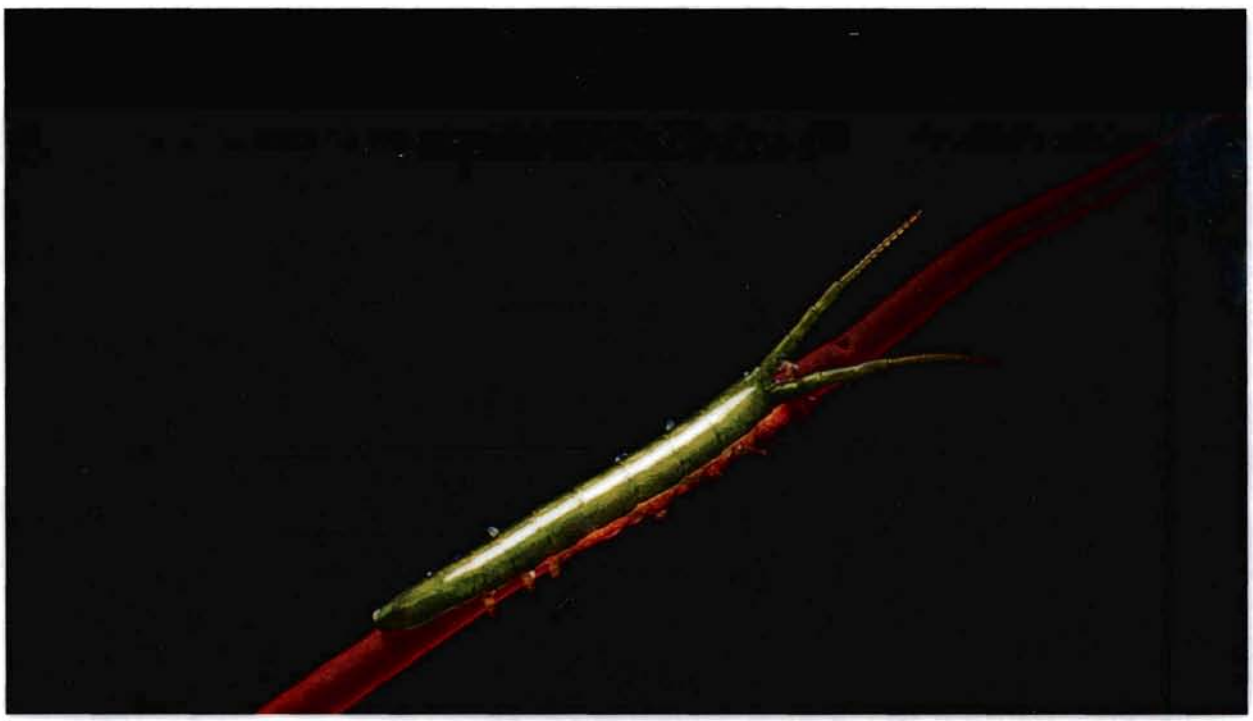
TAXONOMIC ATLAS

OF THE BENTHIC FAUNA OF THE SANTA MARIA BASIN AND WESTERN SANTA BARBARA CHANNEL

Volume 11 — The Crustacea Part 2

The Isopoda, Cumacea and Tanaidacea



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VOLUME 11

The Crustacea Part 2
The Isopoda, Cumacea and Tanaidacea

Edited by

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and
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Taxonomic Atlas of the Benthic Fauna of the Santa Maria Basin and Western Santa Barbara Channel

Volume 11
The Crustacea Part 2 – The Isopoda, Cumacea and Tanaidacea

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Table of Contents

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List of Acronyms

BRA	Refers to a station designation from the MMS Phase I Reconnaissance: Benthic Rocky, transect A/B.
BRC	Refers to a station designation from the MMS Phase I Reconnaissance: Benthic Rocky, transect C/D.
CAS	California Academy of Sciences, Department of Invertebrate Zoology, San Francisco, California, USA.
LACM	Natural History Museum of Los Angeles County, Los Angeles, California, USA.
MMS	United States Minerals Management Service.
SCAMIT	Southern California Association of Marine Invertebrate Taxonomists.
SBMNH	Santa Barbara Museum of Natural History, Santa Barbara, California, USA.
SDNHM	San Diego Natural History Museum, San Diego, California, USA.
USNM	United States National Museum. A historical designation for the National Museum of Natural History (NMNH), Smithsonian Institution, Washington, D.C., USA.

1.0 The Order Isopoda

1.1 Introduction to the Marine Isopoda

by

Regina Wetzer[1], Richard C. Brusca[2]
and George D.F. Wilson[3]

Introduction

The order Isopoda is one of ten orders in the crustacean superorder Peracarida. Peracarids are distinguished from other eumalacostracan superorders (Hoplocarida, Syncarida, Eucarida) by the following combination of characters: absence of caudal rami on the telson; maxillipedal basis typically produced into an anteriorly directed, bladelike endite; mandibles with an articulated accessory process in adults, between the molar and incisor processes (the *lacinia mobilis*); carapace, when present, not fused with posterior pereonites and usually reduced in size; females with unique thoracic coxal endites, called *oostegites*, that form a ventral brood pouch, or marsupium (except in Thermosbaenacea); and, in most groups, young hatching as mancas (a pre-juvenile stage lacking the last pair of thoracopods). All peracarids undergo direct development with brooding, hence true larval forms do not occur in this superorder. About 20,000 species of peracarids have been described.

Although we have tried to keep the amount of terminology in this chapter to a minimum, use of certain standard crustacean terminology is unavoidable. Most of these terms are defined below. An extensive and detailed description of isopod morphology can be found in Brusca and Wilson (1991).

Synonymies are not provided, but they can be found in the key references listed for all taxa. Several general guides to marine isopods of North and middle America have been published. These are: Richardson, 1905 (still a highly valuable reference, although obviously rather out-of-date), Menzies and Frankenberg, 1966, Schultz, 1969 (covers all of North America; many errors - use with caution), Miller, 1975 (good key to common intertidal California species), Brusca, 1980 (keys to Gulf of California fauna), Brusca and Iverson, 1985 (only summary treatment available for the tropical eastern Pacific region), Kensley and Schotte, 1989 (excellent, with keys and figures of Caribbean and many Gulf of Mexico species, supersedes Menzies and Glynn, 1968). Two other general works are also useful. The first is an English translation of Birstein's northwest Pacific deep-water monograph (Birstein, 1973). The second is a three volume compendium on temperate northern hemisphere marine isopods by Kussakin (1979, 1982a, 1988). These latter works are in Russian and compiled entirely from the literature.

The California marine isopod fauna numbers about 176 valid named species, representing 30 families in 8 suborders. The U. S. Department of the Interior, Minerals Management Service (MMS), soft-bottom benthic macroinvertebrate faunal surveys in the Santa Maria Basin and the Western Santa Barbara Channel (hereafter referred to as the "MMS survey") recovered 37 species, 14 of which are undescribed. Where possible, type material was examined and illustrated for the present study (indicated in the figure legends).

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Illustrations were prepared by John Simpson, Frances Runyan, and the authors. This work was accomplished with the assistance of funding from the MMS, and grants to R. C. Brusca and G. D. Wilson from the National Science Foundation.

Summary of Isopod Research in Northeast Pacific Region

The earliest studies on northeast Pacific marine isopods are recorded in the publications of Dana (1853, 1854), Lockington (1876, 1877), Benedict (1897, 1898a-b), and Boone (1918, 1923). However, it was the pioneering 25-year systematic research program of Harriet Richardson that laid the foundation of our modern knowledge regarding this fauna (Richardson, 1897, 1898, 1899a-b, 1900, 1904a-b, 1905a-b, 1906, 1908, 1909). Miller, Schultz, and especially Menzies built on Richardson's foundation through the 1950's, 1960's, and early 1970's (Miller, 1940, 1941, 1968, 1975; Miller and Lee, 1970; Miller and Menzies, 1952; Menzies 1950a-b, 1951a-e, 1952a-b, 1954a-b, 1958, 1961, 1962; Menzies and Barnard, 1951, 1959; Menzies and Bowman, 1956; Menzies and Miller, 1972; Menzies and Mohr, 1952, 1962; Menzies, Mohr, and Wakeman, 1963; Menzies and Waidzunas, 1948; Menzies and Widrig, 1955; Schultz, 1964, 1966, 1972, 1973, 1977; Bowman and Schultz, 1974; Sassaman, Schultz, and Garthwaite, 1984). Research on northeast Pacific isopods by R. Brusca and G. D. Wilson began in the mid-1970's and continues today (Brusca, 1977, 1978a-b, 1980, 1981, 1983a-b, 1984, 1987; Brusca and France, 1992; Brusca and Gilligan, 1983; Brusca and Iverson, 1985; Brusca and Ninos, 1978; Brusca and Wallerstein, 1977, 1979a-b; Brusca and Weinberg, 1987; Brusca and Wilson, 1991; Brusca *et al.*, 1995: Bruce, *et al.*, 1982; Cadien and Brusca, 1993; Delaney and Brusca, 1985; Guzman, *et al.*, 1988; Perry and Brusca, 1989; Stepien and Brusca, 1985; Thun and Brusca, 1980; Wallerstein and Brusca, 1982; Wetzer, *et al.*, 1987; Wilson, 1976, 1982a; Wilson, *et al.*, 1989).

General Isopod Anatomy

The order Isopoda Latreille, 1817, is distinguished from the other eight orders of Peracarida by the following combination of characters (see Figures 1.1 and 1.2):

First thoracomere fused to cephalon, and rarely the second as well. Without a carapace (i.e. with only a cephalic shield). Body usually dorsoventrally depressed, cylindrical (tubular) in some suborders. Antennules and antennae uniramous, but with a minute scale ("squama") in a few taxa. Eyes unstalked but on lobes in some Asellota, Gnathiidea and Valvifera. Mandible usually with a 1- to 3-articulate palp and a multidentate incisor process; left and right lacinia often differ; molar process highly variable. Maxillule and maxilla both without palps. Thoracic appendages uniramous (without exopods). First thoracopods modified as maxillipeds; with a short coxa and usually a short anteriorly-directed lamellar epipod; basis flattened and produced into bladelike anteriorly-directed endite, often with coupling spines; palp of up to 5 articles. Second thoracopods modified as maxillipeds (pylopods) only in Gnathiidea. Pereopodal coxae small and simple, or more-or-less fused with body somites and forming lateral extensions on pereonites (coxal plates); line of dorsal fusion usually demarcated on pereonites II-VII (occasionally pereonite I). Pleon short, in many with various segments fused; telson always fused with last pleonite to form a pleotelson. Pleopods biramous, flattened, specialized for respiration and/or swimming; endopods of second pair typically with stylets in males ("appendix masculinae"). Uropodal rami uniarticulate. Heart located primarily in pleon; usually with 2 pairs of ostia and 5 pairs of lateral arteries. Maxillary glands usually present in adults. Young leave marsupium before appearance of last pair of pereopods (as "manca"). Isopods exhibit biphasic molting.

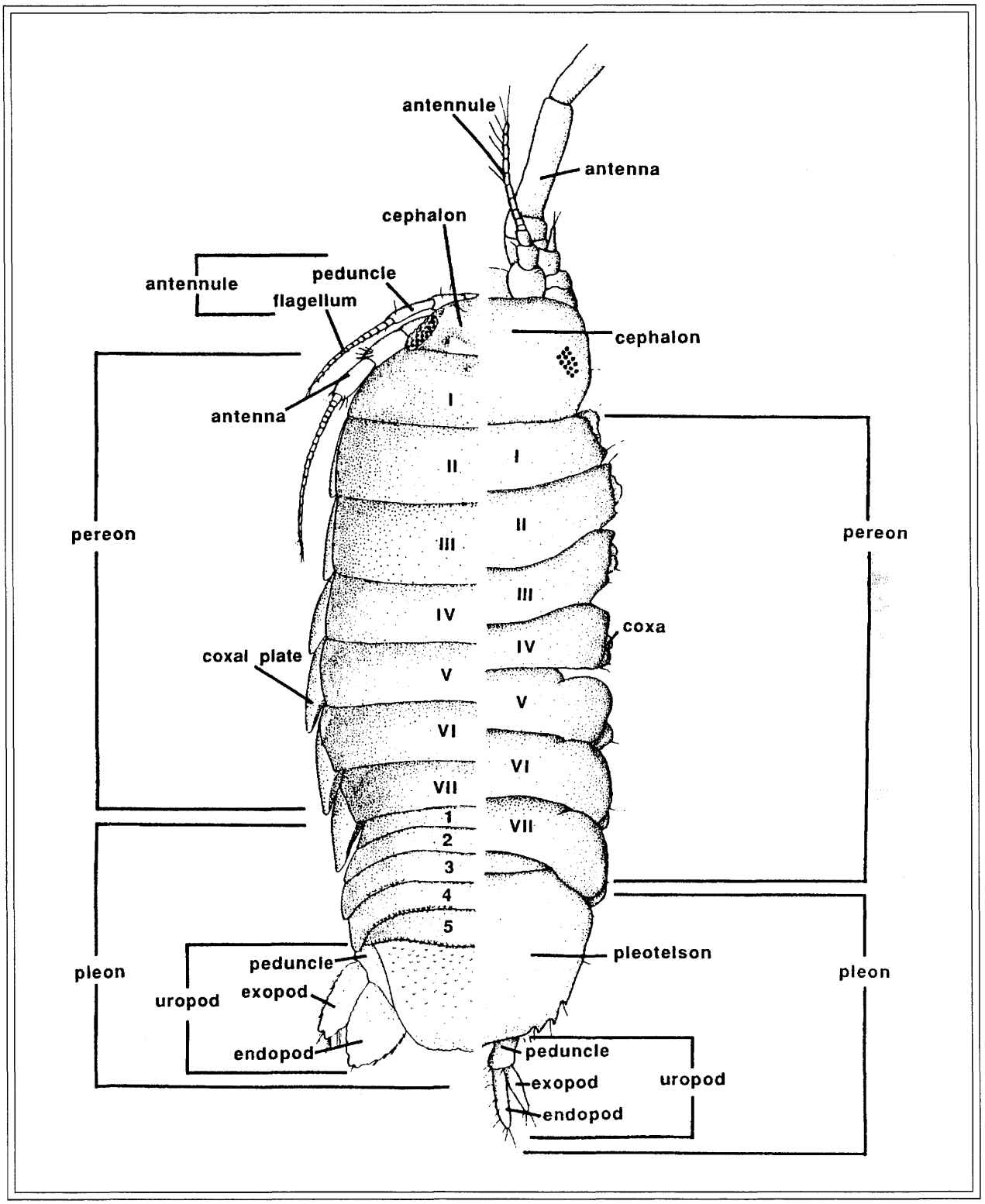

Figure 1.1. Basic isopod morphology. Dorsal aspect of a female *Tridentella glutacantha*, a flabelliferan (left), and *Ianiropsis tridens*, an asellotan (right).

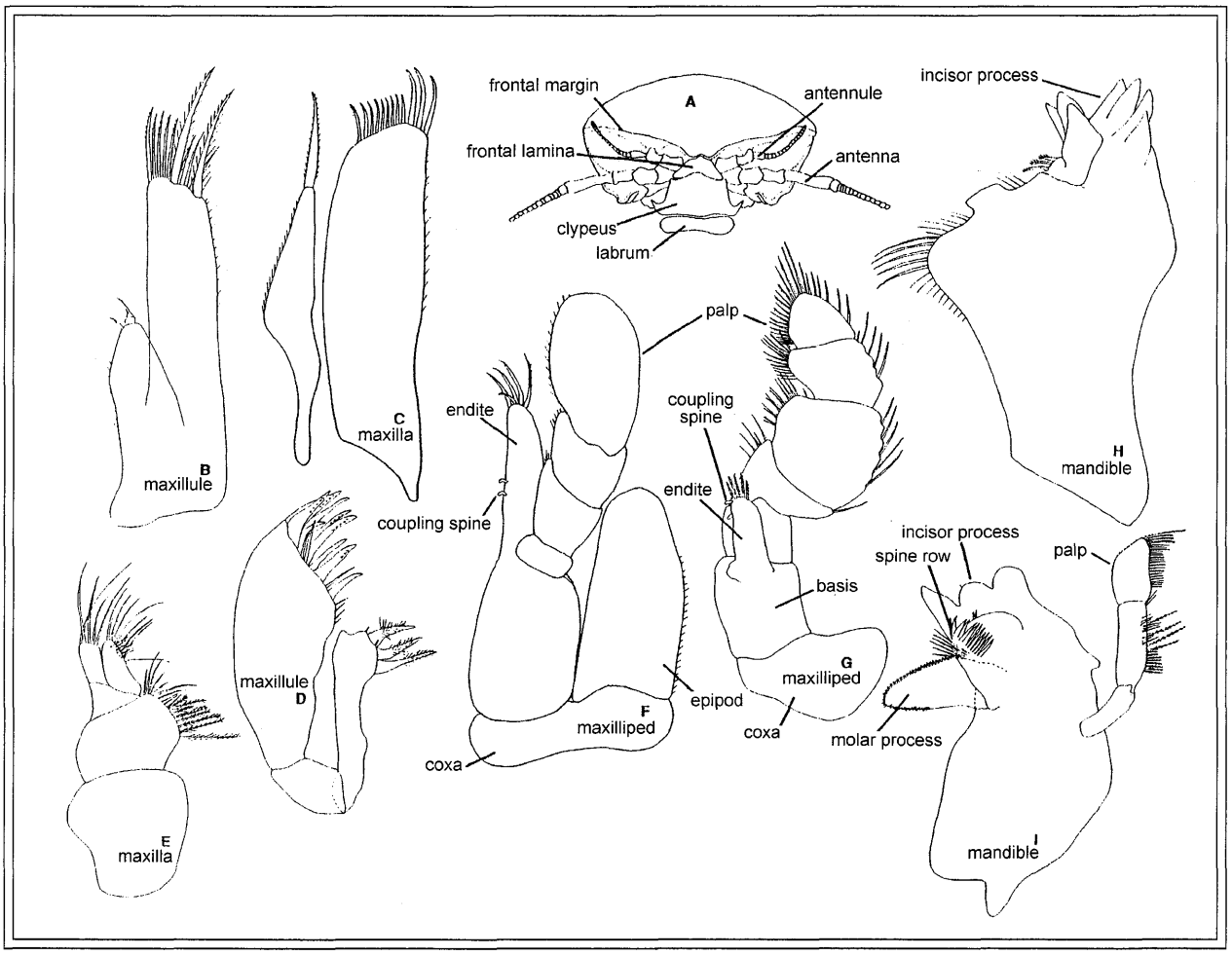

Figure 1.2. Nomenclature of isopod cephalon (A). Examples of isopod mouth appendages: Idoteidae (B, C, F, H); Cirolanidae (D, E, G, I).

Brusca and Wilson (1991) recognize two basic isopod morphologies, "long-tailed" and "short-tailed". Long-tailed isopods have the telsonic region of the pleotelson greatly elongated, thus the anus and origin of the uropods are positioned basally on the pleotelson (Flabellifera, Anthuridea, Gnathiidea, Epicaridea, Valvifera). In the short-tailed isopods, the telsonic region is greatly reduced or vestigial, positioning the anus and uropods terminally or subterminally on the pleotelson (Phreatoicidea, Asellota, Microcerberidea, Oniscidea, Calabozoidea).

Isopods can be sexed in several ways. If oostegites, or marsupium, are present, one is obviously looking at a female. The openings of the oviducts in females (near the base of the legs on the 6th thoracomere) are extremely difficult to observe. If oostegites are absent, males can be distinguished by the presence of paired penes on the sternum of pereonite VII (or pleonite 1) and/or the presence of appendix masculinae on the endopods of the second pleopods. Absence of penes, appendix masculinae, and oostegites indicates the specimen is either a female or a juvenile that has not yet developed secondary sexual features.

Glossary of Technical Terms

aesthetasc. Thin-walled chemosensory seta usually found on antennular flagellum.

antennules. Antennae 1 or first antennae; anteriormost paired appendages of head (= antennula).

antennae. Antennae 2 or second antennae; second paired appendages of head.

appendix masculina. Copulatory stylet arising from medial margin of male pleopod 2 endopod, used for transfer of spermatophores in at least some species. (Pl. appendices masculinae)

biramous. Composed of two rami or branches.

carina. A keel, or acute ridge.

cephalon. Head; strictly speaking the cephalon of an isopod is a cephalothorax, as it is always fused with the first thoracomere (and also with the second thoracomere in the Gnathiidea).

chelate. Having a chela; the propodus and dactylus forming a pincerlike structure wherein the latter articulates submedially on the former to produce a "moveable and fixed finger" arrangement. (True chelae are extremely rare in isopods.)

coupling spine(s). When present, coupling spines (or hooks) occur on the maxillipedal endites and pleopodal peduncles, and serve to lock the opposing appendages together, allowing them to function as a single unit.

coxa. Basal article of an appendage.

coxal plates. Coxae of the pereopods laterally expanded into flattened lamellar structures extending freely (as "plates") to overhang the coxa-basis hinge of the leg.

clypeus. In most (but not all) isopods the labrum consists of two pieces; the anteriormost (proximal) piece is referred to as the clypeus, the posteriormost (distal) piece as the labrum proper.

distal. Situated away from the base or point of origin or attachment.

endite. A lobe on the inner (medial) margin of the protopod of an arthropod limb; enlarged anteriorly directed lobe of the basis of an isopod maxilliped.

endopod. Inner (medial) ramus of an appendage.

exopod. Outer (lateral) ramus of an appendage.

flagellum. Narrow distal part of antenna or antennule, usually multiarticulate, occasionally reduced to one or a few articles, without intrinsic musculature.

frontal margin. Separates the upper surface of the cephalon from the frontal lamina; anterior margin of cephalon.

frontal lamina. A sternal plate arising between the bases of the antennae and probably homologous to the epistome of other arthropods; in many isopods the frontal lamina may extend anteriorly to be visible in the dorsal aspect; in many Valvifera the upper and lower regions of this structure may be separately elevated and visible in the dorsal aspect as two distinct structures (frontal lamina 1 and frontal lamina 2).

frontal process. The lower region of the epistomal plate or sclerite, which in some Valvifera projects outward to become visible in the dorsal aspect as a protuberance lying above the frontal lamina.

gnathopod. A loosely used term usually referring to chelate or subchelate pereopods associated with the head region and used for food handling. This term is rarely used for isopods.

incisor process. Grasping, piercing or slicing structure arising apically on body of mandible.

labium. The posterior border of the buccal field; the "lower lip" (see paragnath).

labrum. Flaplike structure posterior to and borne upon the frontal lamina or clypeus, usually free but occasionally fused to head; the "upper lip" (see clypeus).

lacinia mobilis. Small, usually toothed, process articulating at base of incisor of left or both mandibles; present in most isopod groups.

lamina dentata. Serrate platelike structure on the mandible of anthurideans, presumed to have been formed by the fusion of spines of the spine-row.

manca. Young of most peracarids (including isopods), lacking last (eighth) thoracic appendages at time of release from broodpouch.

mandible. Third pair of head appendages; first (anteriormost) pair of mouthparts functioning as jaws and typically sclerotized.

marsupium. Structure in which eggs and embryos are retained and brooded by female; the broodpouch. Isopod marsupia are typically formed by overlapping medial plates (oostegites) arising from certain pereonal coxae in females; in a few groups the oostegites have been reduced or lost in lieu of internal brooding.

maxillules. Fourth pair of head appendages, functioning as mouthparts, immediately posterior to mandibles (= first maxillae).

maxillae. Fifth pair of head appendages, functioning as mouthparts, immediately posterior to maxillules (= second maxillae).

maxillipeds. Modified first pair of thoracopods, functioning as mouthparts.

molar process. Grinding, or piercing or slicing structure, arising mid-basally on body of mandible; pars molaris.

oostegite. Thin ventromedial plates, born on coxae of some pereopods in female peracarids forming the marsupium, or broodpouch.

palp. Articulated ramus consisting of one to three articles on the mandible, and up to five articles on the maxilliped. (Palps do not occur on the maxillules or maxillae of isopods.)

paragnath. In isopods, the labium is usually produced and cleft into a large bilobed structure, and hence more commonly referred to as the paragnath (= hypostome, metastome, hypopharynx).

peduncle. Enlarged proximal, or basalmost region of an isopod antennule, antenna, pleopod, or uropod; contains intrinsic musculature.

penes. Paired (occasionally fused) submedian processes from vas deferens on sternum of male pereonite VII or pleonite 1. (Sing. penis)

pereon. Those thoracic segments not fused to the cephalon.

pereonite. A segment of the pereon (= pereomere).

pereopods. The paired legs of each pereonite.

pleon. Abdomen.

pleonite. A segment of the pleon (= pleomere).

pleopods. The biramous, paired, lamellar appendages of each pleonite.

pleotelson. In all isopods the sixth pleonite is fused to the telson to form a pleotelson. In anthurideans the line of fusion is often visible as a deep dorsal groove or fold.

praniza. Juvenile, immature stage of gnathiideans.

prehensile. Appendages (usually pereopods) adapted for holding or clinging, the dactyl is as long or longer than the propodus, strongly developed and recurved.

protandrous. In sequential hermaphroditic forms, becoming a functional male (producing spermatozoa) before becoming a functional female (producing eggs).

protogynous. In sequential hermaphroditic forms, becoming a functional female (producing eggs) before becoming a functional male (producing spermatozoa).

proximal. Situated near the base or point of attachment.

pylopods. Second pair of maxillipeds in gnathiids (appendages of the second thoracomere).

rostrum. Anteromedial projection of frontal margin of cephalon.

scale. A small articulate piece occurring on the antennules or antennae in some crustaceans, thought to be a remnant of the second ramus (presumably the exopod). Scales rarely occur in isopods.

spine row. Spinose lobe on the mandible, between the molar and incisor processes.

statocyst. Small saclike sensory organ, usually containing a granule(s), used to indicate to the animal its orientation; present singly or paired on the pleotelson of some anthurideans.

subchelate. Having a subchela; forming a pincerlike structure by the dactylus folding back on the propodus.

tergite. Dorsal sclerite of exoskeleton on arthropods.

uropods. The paired biramous appendages of the isopod pleotelson, representing the appendages of the fused sixth pleonite.

Phyletic Key to the Suborders of Isopod (Adults)

1A. With only 5 pairs of pereopods (thoracomere 2 entirely fused to cephalon, with its appendages [pylopods] functioning as a second pair of maxillipeds; thoracomere 8 reduced, without legs); adult males with mandibles grossly enlarged, forceps-like, projecting in front of head; adult females without mandibles ..... Gnathiidea

1B. With 7 pairs of pereopods (thoracomere 2 not fused to cephalon, with 1 pair of maxillipeds and 7 pairs of pereopods); males without projecting, forceps-like mandibles; females with mandibles 2

2A. Adults obligate parasites on other crustaceans; bilateral symmetry reduced or lost in females; male a small bilaterally symmetrical symbiont living on the body of the female; antennae vestigial; antennules reduced to 3 or fewer articles; without maxillules ..... Epicaridea

2B. Not obligate parasites on other crustaceans; bilateral symmetry retained in both sexes; male not as above; antennae not vestigial; antennules variable; usually with maxillules 3

3A. Body cylindrical or tubular in cross-section, but often appearing laterally compressed (amphipod-like) due to ventrally elongated abdominal pleura; with distinct row of filter setae along medial margin of maxilla; penes located on coxae of male pereopod VII; apex of pleotelson curves dorsally; pleonite 5 elongate, markedly longer than any other pleonites (known only from southern hemisphere and India) ..... Phreatoicidea

3B. Body variable, but not appearing laterally compressed as above; without row of filter setae along medial margin of maxilla; penes on sternum of male pereonite VII (or on sternum of pleonite 1); apex of pleotelson does not curve dorsally; pleonite 5 rarely elongate (markedly longer than other pleonites only in Limnoriidae) 4

4A. Anus and articulating base of uropods positioned terminally (or subterminally) on pleotelson; uropods styliform (in the oniscidean family Tylidae the uropods are modified into flattened ventral plates that cover the anal chamber) 5

4B. Anus and articulating base of uropods positioned at base of pleotelson; uropods flattened 8

5A. With lateral coxal plates; antenna peduncle 5-articulate; antennule reduced to 5 or fewer articles; maxillipeds without coupling spines; penes of male arise from articulation between pereonite VII and pleonite 1; mandible without palp; pleopodal exopods broad and opercular to the thick tumescent endopods; female pleopod 1 present 6

5B. Without lateral coxal plates (pereopodal coxae small); antenna peduncle 6-articulate; antennule reduced or not reduced; maxillipeds with or without coupling spines; penes of male arise on sternum of pereonite VII; mandible with palp; pleopods not as above; female pleopod 1 absent 7

6A. Exoskeleton of pleonites 1 and 2 reduced to only sternal plates; uropodal rami fused to peduncle; blind groundwater animals (known only from ground waters in Venezuela) ..... Calabozoidea

6B. Pleonites 1 and 2 not reduced as above; one or both uropodal rami articulate on peduncle; with or without eyes ..... Oniscidea

7A. Minute, usually less than 3 mm long; long and slender, length about 6 times width; antennal peduncle without a scale; antennule reduced, peduncle indistinguishable from flagellum; maxilliped without coupling spines on endite; female pleopod 2 biramous; male pleopod 2 endopod not geniculate; interstitial ..... Microcerberidea

7B. Rarely minute, usually greater than 4 mm long; body not elongate (length less than 6 times width); antennal peduncle usually with a scale; antennule rarely reduced, peduncle and flagellum distinct; maxilliped almost always with coupling spines on endite; female pleopod 2 uniramous; male pleopod 2 endopod large and geniculate; rarely interstitial ..... Asellota

8A. Body elongate, length usually more than 6 times width; uropodal exopod curving dorsally over pleotelson; coxae of maxillipeds fused to head (i.e. not freely articulating); mandible with unique lamina dentata (in lieu of spine row and lacinia mobilis; lamina dentata, spine row and lacinia mobilis lacking in Paranthuridae); maxillule an elongate stylet with apical hooks or serrate margin; maxilla vestigial and fused with paragnath (or absent) ..... Anthuridea

8B. Body not markedly elongate, length usually less than 4 times width; uropodal exopod not as above; coxae of maxillipeds not fused to head; mandible without lamina dentata; maxillule variable; maxilla well developed, never fused with paragnath 9

9A. Uropods modified as a pair of ventral opercula covering the entire pleopodal chamber; males with penes arising on sternum of pleonite 1, or on articulation between pereonite VII and pleonite 1; mandibular molar process a stout, flattened grinding structure ..... Valvifera

9B. Uropods not modified as ventral opercula covering pleopods; males with penes arising on sternum of pereonite VII; mandibular molar process usually a thin, bladelike, cutting structure, or absent (flattened only in Sphaeromatidae) ..... Flabellifera

1.2 Descriptions of the Species of the Suborders Anthuridea, Epicaridea, Flabellifera, Gnathiidea, and Valvifera

by

Regina Wetzer[4], and Richard C. Brusca[5]

Suborder Anthuridea Leach, 1814

Description. Body long, slender, subcylindrical; circular in cross-section; length 6-15 times width. Antennules short except in males of some species, uniramous (without scale), usually with 3 peduncular articles; some species with only 3 antennular articles, setation suggesting loss of 1 peduncular article as well as most flagellar articles. Antennae short, uniramous (without scale), peduncle 5-articulate, with few flagellar articles. Mandible without distinct lacinia mobilis or spine row, instead usually with a dentate lobe or plate (the "lamina dentata"); palp of 1-3 articles, or absent. Maxillule with inner ramus reduced, outer ramus a slender stylet with terminal spines (spines often reduced to a row of short denticles). Maxillae rudimentary, usually fused with paragnath. Maxillipeds more-or-less fused to head, usually with small endite; without coupling spines; palp of 1-5 articles; apex of palp acute or rounded. Pereonites mostly longer than wide (in contrast to most isopods, in which the reverse is true); dorsum often with distinct ridges, grooves or chromatophore patterns; distinct coxal plates rarely evident. Pereopods I-III (especially pereopod I) tend towards subchelate form; pereopods IV-VII generally ambulatory. Pleonites 1-5 free or fused; pleonite 6 fused with telson, but often demarcated from the telson by a deep dorsal groove or fluting; pleopods 1-5 similar, or pleopod 1 modified as an operculum. Uropods attached laterally at base of pleotelson, but exopods curve dorsally to arch over pleotelson; often with one or two telsonic statocysts.

Remarks. In all isopods the sixth pleonite is fused to the telson to form a pleotelson. In anthurideans the sixth pleonite is often distinctly demarcated by a dorsal groove giving the illusion of an articulation and 6 free pleonites. However, histological studies have so far failed to reveal any anthuridean species in which the telson freely articulates on the 6th pleonite.

Four families of Anthuridea are currently recognized, distinguished primarily by characters of the mouthparts and pleon: Anthuridae Leach, 1814; Paranthuridae Menzies and Glynn, 1968; Hyssuridae Wägele, 1981; and, Antheluridae Poore and Lew Ton, 1988. The family Anthuridae possess 1 or 2 telsonic statocysts (or no statocysts), operculate first pleopods, and broad maxillipedal palps that tend to be operculiform and have a reduced number of articles. The family Paranthuridae has 0 or 1 telsonic statocysts and operculate first pleopods. Species of Hyssuridae have very long bodies (about 15 times longer than wide), no telsonic statocysts, long free pleonites, and lack operculiform pleopods. Antheluridae are defined by the exceptional width of the maxillipedal endite and palp (Wägele 1981). Anthuridae and Paranthuridae have been previously reported from California waters. The MMS project also collected a new species of Hyssuridae.

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Anthurideans appear to be primarily carnivores, feeding on small worms and arthropods of various kinds. Most inhabit littoral or shallow shelf environments, although some deep benthic (and some freshwater) species are also known. Many species are known to be protogynous, and males have not yet been reported for several of these. Fewer than 200 species of anthurideans have been named, but many more remain to be described.

Literature. Richardson, 1905; Miller, 1975; Poore, 1980; Wägele, 1981a-b; Poore and Lew Ton, 1988a-c; Kensley and Schotte, 1989; Cadien and Brusca, 1993.

Key to the Families of Anthuridea Known from California Waters

1A. Mouthparts adapted for piercing and sucking, together forming a conelike structure; mandible usually with an untoothed styliform incisor, but lacking molar process and lamina dentata .... Paranthuridae

1B. Mouthparts adapted for cutting and chewing; mandible usually with a molar process and lamina dentata, incisor usually toothed 2

2A. At most, pereopod I subchelate, with propodus expanded; pleonites generally fused, if free, much shorter than wide; first pleopods operculate; with 0, 1, or 2 telsonic statocysts ..... Anthuridae

2B. Pereopods I-III subchelate, subsimilar; pleonites free, often as long as wide; first pleopods not operculate; never with telsonic statocysts ..... Hyssuridae

Family Anthuridae Leach, 1814

Description. Mandibular palp apically rounded, incisor usually toothed; lamina dentata and molar process usually present. Maxilliped no more than 5-articulate, with palp as broad as basis and last article smaller than preceding articles; palp often broad and somewhat operculiform to other mouthparts. Pereopods I-VII with very few sensory setae, usually only 1 distal spine on carpus and propodus; pereopod I usually subchelate, with propodus inflated; pereopods II and III never subchelate. Pleon short; pleonites free or fused (at least dorsally). Pleopod 1 larger than pleopods 2-5, with operculiform exopod and smaller endopod. Uropodal endopod usually shorter than basis; with a pair of telsonic statocysts, or single medial statocyst, or lacking statocysts. Sexual dimorphism is common and males often have longer pleonites than females.

Remarks. Five species, representing 5 of the 33 described genera of Anthuridae, are known from California waters. The MMS survey recovered 3 of these 5 species; Cadien and Brusca, 1993.

Literature. Menzies, 1951a; Menzies and Barnard, 1959; Schultz, 1977; Wägele, 1979, 1981; Kensley, 1982; Poore and Lew Ton, 1986; Kensley and Schotte, 1989.

Key to the Genera of Anthuridae Collected as Part of the MMS Surveys

1A. Pleopodal endopod 1 with marginal setae 2

1B. Pleopodal endopod 1 without marginal setae ..... *Cyathura*

2A. Pereopods IV-VII with triangular carpus; maxilliped 5-articulate, article 3 wider than long; endite usually reduced or absent; mandibles symmetrical ..... *Amakusanthura*

2B. Pereopods IV-VII with rectangular carpus; maxilliped 4-articulate, article 4 smaller than 3; mandibles asymmetrical, left molar with small tooth which is absent on right molar ..... *Haliophasma*

Genus *Amakusanthura* Nunomura, 1977

Apanthuretta Wägele, 1981.

Description. Dorsum smooth, sometimes pigmented; eyes present, or not visible. Antennular flagellum short, of 3 articles, the last short and bearing 3 aesthethascs. Antennal flagellum short, of 2-4 articles. Mandibles symmetrical, not sexually dimorphic; incisor, lamina dentata and blunt molar process present; palp 3-articulate, article 3 one-third length of article 2 and with 3-4 terminal setae. Maxilliped bearing an acute filamentous endite with a terminal seta; palp of 3 articles, article 1 wider than long; article 2 usually with a row of mesial setae; article 3 oblique, subterminal, much smaller than 2, with 4-5 apical setae. Pereopod 1, propodal palm stepped (sometimes weakly toothed), with stout mesial setae. Pereopods 2 and 3 with propodus only a little more robust than on posterior pereopods. Pereopods 4-7 with triangular-trapeziform carpus, with free anterior margin. Pleon longer than wide; pleonites fused or often pleonites 1-4 separated dorsally by shallow integumental grooves, 4-5 fused dorsally. Uropodal endopod as long as peduncle, its margins setose; exopod narrow and with a sinuous dorsal margin, or with an obscure dorsal lobe.

Males. Male head smaller than in juvenile, with broadened flattened rostrum, antenna 1 flagellum with more than 10 isometric articles each bearing numerous aesthetascs, much longer than head. Male pereopod 1 not grossly modified. Pleotelson narrower, with mid-dorsal longitudinal depression.

Remarks. *Amakusanthura* can be distinguished from the very similar *Apanthura* by a more elongate pleon and by a long male antennal flagellum. For recent reviews of *Amakusanthura* see Poore and Lew Ton (1985 and 1988d). The latter paper provides keys to the Australian species in this and related genera, and reassigns several species from *Apanthura* to *Amakusanthura*, including *Apanthura californiensis* Schultz, 1964.

Literature. Nunomura, 1977; Poore and Lew Ton, 1985, 1988d.

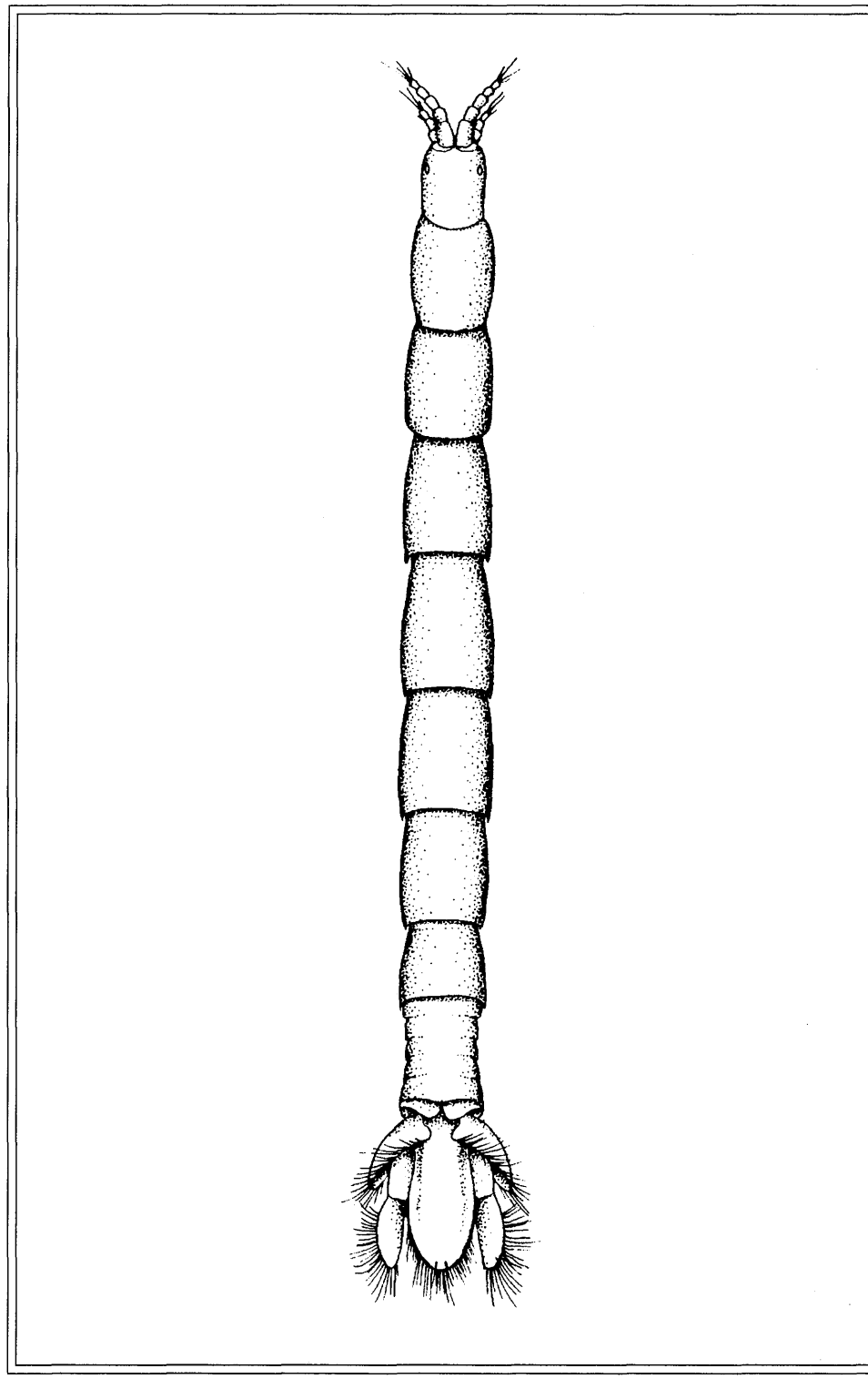

Figure 1.3. *Amakusanthura californiensis* (Schultz, 1964). Holotype LACM 55-35.1 (female). California, Los Angeles Co., off Santa Monica Pier, mud, 73 m., 06 February 1955, coll. R/V *Velero IV*, AHF 2988-55.

Amakusanthura californiensis (Schultz, 1964)

Figure 1.3

Apanthura californiensis Schultz, 1964.

Description. Length to 11 mm. Eyes present, but small. Frontal margin of head forms acute medial projection, but not extending as far forward as anterolateral projections. Antennules and antennae (of males) each 8-articulate. Maxilliped with 5 (4 free) articles; endite broad and lobelike. Pereon without dorsal coloration, pits, or keels. Pereonite VII about half length of pereonite VI; pereopod VII propodus and dactylus with row of short stout spinelike setae along inferior margin; propodus with 1 large spine at distal inferior angle. Pleonites 1-5 distinct laterally, but fused medially. Uropodal endopod longer than pleotelson; pleotelson and both uropodal rami with row of many setae along minutely serrated margins. Appendix masculinum of male arises 1/5 distance from base of endopod.

Remarks. Schultz's (1964) original description had several errors: pleonites 1-5 are fused medially (based on examination of the holotype), the maxillipedal endite is broad and lobelike (not acute), and the apex of the maxillule is truncate (not angular).

Distribution. Known only from type-locality (off Santa Monica, California, 80 m), and from the present study.

Literature. Schultz, 1964.

Genus *Cyathura* Norman and Stebbing, 1886

Description. Dorsum often pigmented. Eyes present or absent. Antennular flagellum 1-3 articulate in females, up to 5-articulate in males. Antennal flagellum short, 1-3 articulate. Mandibles symmetrical; with incisor, lamina dentata, molar process, and 3-articulate palp. Maxilliped of 4 articles (3 free); endite absent or reduced. Pereopod I subchelate, propodus inflated, with a tooth on the palm. Pereopods IV-VII with triangular carpi. Pleon short, about as long as pereonite VII; pleonites 1-5 short, fused; fusion of pleonite 5 to pleonite 6 and to telson often dorsally demarked. Pleopod 1 exopod operculiform, endopod without marginal setae. Pleopods 2-5 with endopods each bearing 1 seta. Uropodal endopod short, more or less square or triangular. Telson with 2 basal statocysts; with long apical setae, but without long dorsal setae.

Remarks. *Cyathura* contains more species than any other New World anthuridean genus. Many *Cyathura* are blind hypogean interstitial species. Of the 8 species now known from the New World, only 2 occur in the Pacific (*C. munda* Menzies, 1951 and *C. guaroensis* Brusca and Iverson, 1985). *C. munda* is known only from California, and *C. guaroensis* is known only from Pacific Costa Rica.

Literature. Richardson, 1905; Wägele, 1979; Kensley, 1982; Brusca and Iverson, 1985; Kensley and Schotte, 1989.

Cyathura munda Menzies, 1951

Figure 1.4

Description. Body length exceeding 9 times width. Most specimens white with scattered patches of black chromatophores. Frontal margin of cephalon produced as short subacute rostrum, projecting forward about same distance as anterolateral angles. Eyes small. Antennular peduncle 3-articulate; male with 4-articulate flagellum with long brushlike setae; female with 2- to 3-articulate flagellum with cluster of apical setae on terminal article; basalmost flagellar article of female minute. Antennal peduncle 5-articulate; flagellum of 2-4 minute setigerous articles. Maxillipedal palp 3-articulate, broad, rounded, middle article longest, apical

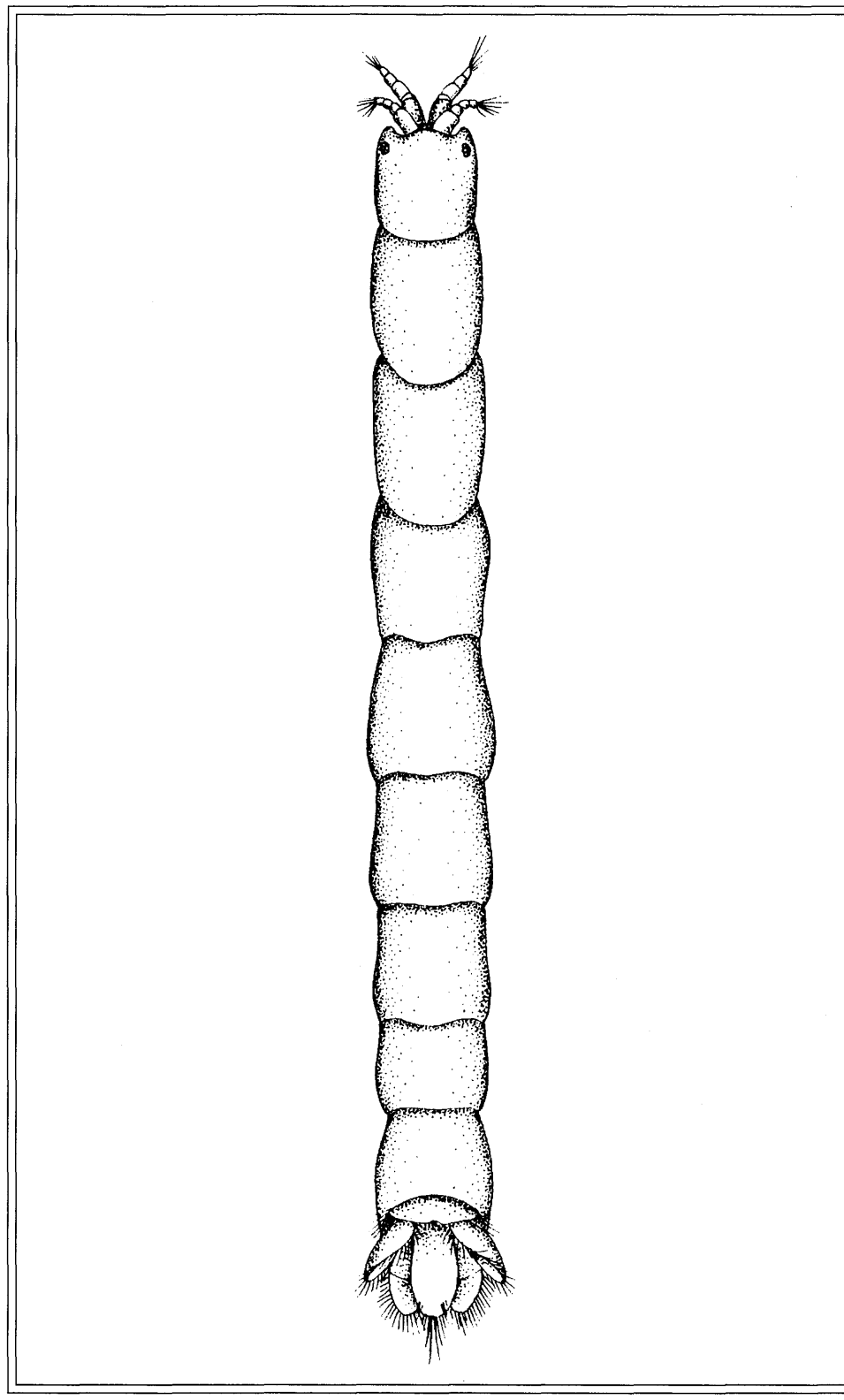

Figure 1.4. *Cyathura munda* Menzies, 1951. Based on Menzies' holotype drawing (male) and paratype material LACM 48-62.3 (mancas). Manca paratype material from California, Marin Co., Tomales Bluff, intertidal, 23 May 1948, coll. R. J. Menzies, AHF 48-621.

article small. Pereonites I-VI similar in length; pereonite VII slightly shorter than pereonite VI; pereonites II and III each with transverse anterior dorsal groove for reception of posterior margin of preceding pereonite. Pleonites 1-5 entirely fused, without obvious lateral incisions; musculature of pleonites visible through cuticle creating illusion of freely articulating pleonites; pleonite 6 with pronounced transverse dorsal ridges demarcating lines of fusion with pleonite 5 and telson. Telson lateral margins smooth, posterior margin slightly concave; paired statocysts present anteriorly.

Remarks. *Cyathura munda* closely resembles *C. guaroensis* (known only from Pacific Costa Rica). The latter can be distinguished by its dorsal pigment pattern, the setal pattern and lack of a tooth on the inferior margin of the propodus of pereopod I, and the possession of large uropodal endopods extending beyond the posterior margin of the pleotelson.

Distribution. Marin County, California to the Mexican border and Gulf of California, intertidal (on *Egregia* and *Laminaria* holdfasts) to 132 m.

Literature. Menzies, 1951a; Menzies and Barnard, 1959; Miller, 1975.

Genus *Haliophasma* Haswell, 1881

Silophasma Schultz, 1977.

Description. Eyes well-developed. Antennule with 3-articulate flagellum, basal flagellar article minute. Antenna with 4- to 7-articulate flagellum. Mandibles asymmetrical, left molar with small tooth which is absent on right molar; palp 3-articulate; palp article 3 with 1 seta, or with transverse or oblique row of 2 to many setae. Maxilliped 4-articulate, article 4 smaller than 3. Pereon with dorsolateral grooves and sometimes additional pitting or sculpture; pereonites IV-VI with dorsal pits. Pereopod I stout, propodus expanded and very broad; pereopods II and III with propodus elongate and subrectangular; pereopods IV-VII with carpi subrectangular and not underriding propodus, carpus about half as long as propodus. Pleonites 1-5 fused at least medially; pleonite 6 demarcated from telson by transverse dorsal ridge. Pleopod 1 exopod more or less indurate, operculiform. Uropodal endopod shorter than telson, exopod folding alongside or over telson. Telson thick, more or less indurate and usually dorsally sculptured; pair of statocysts present (but not always obvious).

Male characterized by more elongate body form, less pronounced dorsal sculpture, antennule with multiarticulate highly setose flagellum, larger eyes, and elongate pereopods, telson and uropods. Appendix masculinum simple.

Remarks. *Haliophasma* is primarily a tropical genus, and only a single species has been reported from North America north of Mexico. Females bearing oostegites have not been reported for this genus.

Literature. Schultz, 1977; Poore 1975; Wägele, 1984; Poore and Lew Ton, 1988b.

Haliophasma geminatum Menzies and Barnard, 1959

Figures 1.5 and 1.6

Silophasma geminatum of Schultz, 1977.

Description of female. Cephalon smooth, slightly longer than wide, rectangular in outline, widest at position of eyes. Rounded rostrum as long as anterolateral lobes. Pereonal tergites rectangular, lateral body walls visible in dorsal aspect. Lateral body margins ornamented with pits and depressions. Bases of pereopods I-VI fit into lateral grooves in body wall; grooves directed posteriorly on pereonite I-III, directed anteriorly on pereonites IV-VI. Pereonite I anterior margin medially scalloped, lateral margins extend anteriorly to acute points, posterior margin straight; anterior margin of pereonites II and III deeply excavated to receive preceding

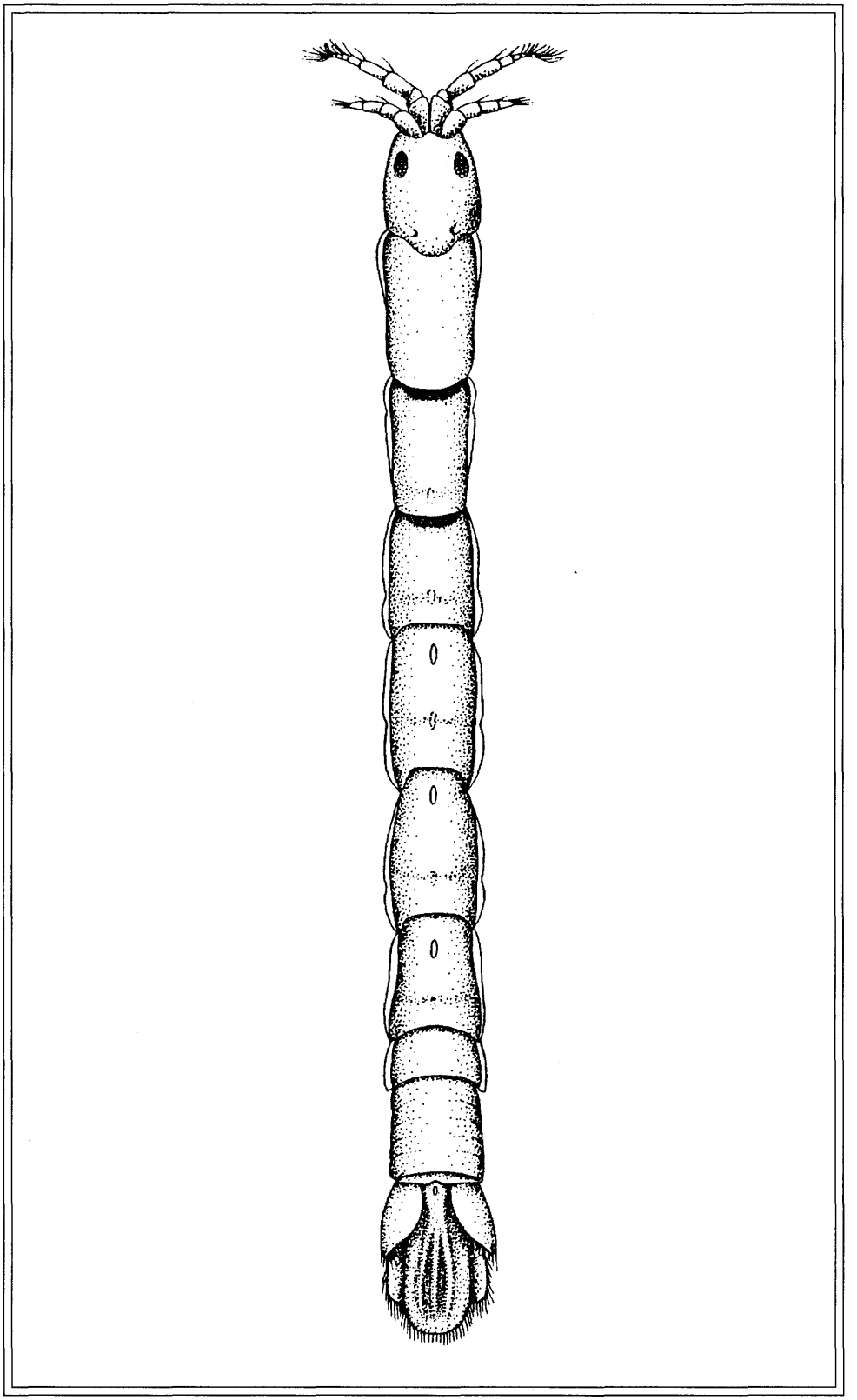

Figure 1.5. *Haliophasma geminatum* Menzies and Barnard, 1959. Female. California, San Diego Co., Oceanside, 20 February 1957, coll. R/V *Velero IV*, AHF 4868-57.

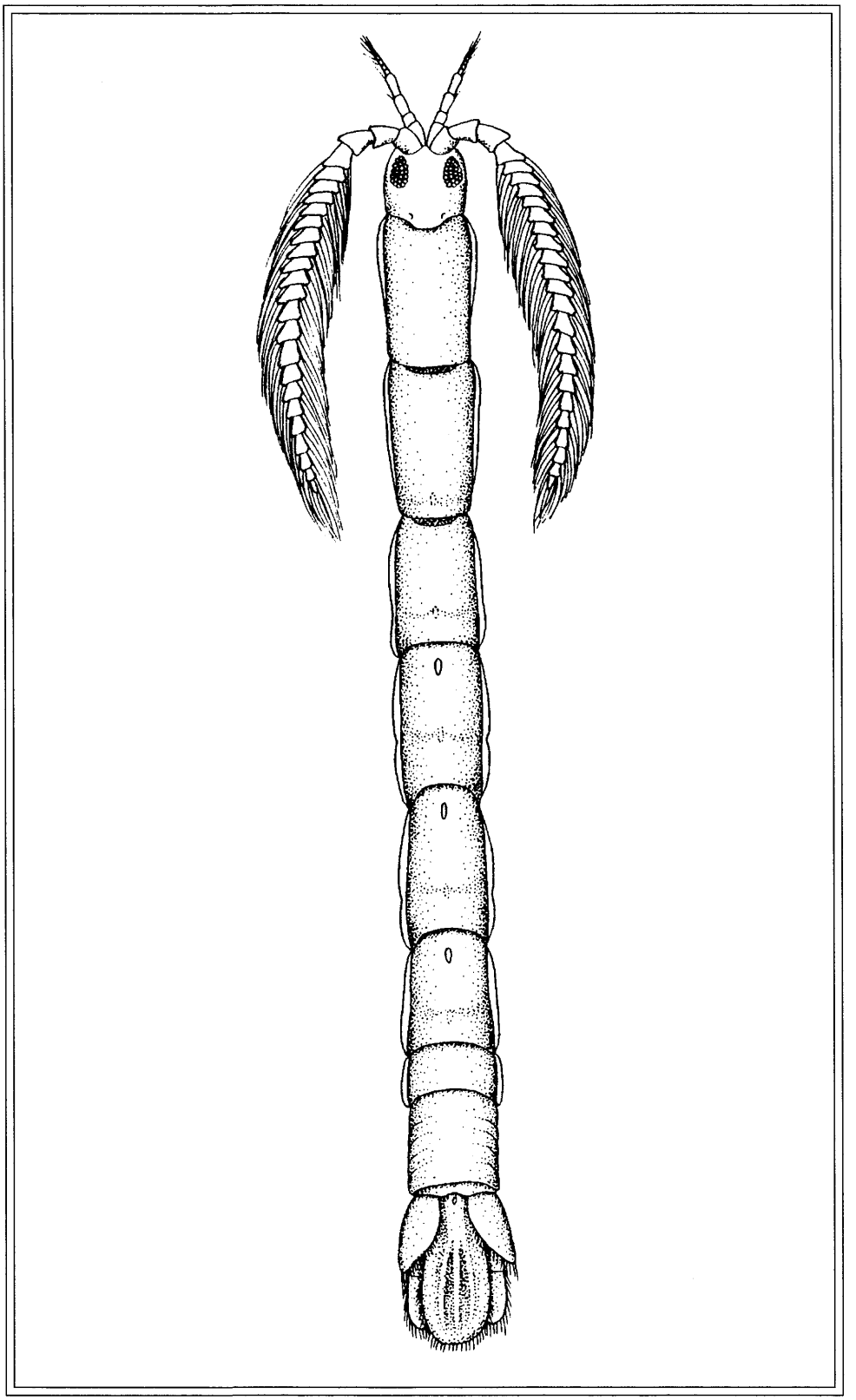

Figure 1.6. *Haliophasma geminatum* Menzies and Barnard, 1959. Male. California, San Diego Co., Oceanside, 20 February 1957, coll. R/V *Velero IV*, AHF 4868-57.

pereonites; pereonites IV-VII weakly excavated; pereonites II-V each with 1 posterior transverse groove containing deep medial pit; depth of transverse groove and medial pit gradually decreases posteriorly; pereonites IV-VII with medial oblong (sometimes keyhole-shaped) pit located on anterior third of pereonite (barely visible on pereonite VII); pereonite VII half as long as pereonite VI. Pleon with 4 lateral sutures, scarcely visible medially, indicating 5 fused segments; short sixth pleonite demarcated dorsally. Pleopod 1 exopod operculiform and pitted. Telson spatulate, sculptured with a long median carina and 2 shorter more pronounced lateral carinae; all 3 carinae fuse to form an elevated plate anteriorly, the anterior margin of which bears a pit that aligns with the posterior notch of pleonite 6. Paired statocysts near base of telson. Uropodal endopod extending nearly to posterior margin of telson and longer than wide, apex blunt, both margins distinctly serrated; exopod pyriform, outer margin sinusoidal, denticulate, slightly shorter than uropodal peduncle.

Description of male. Antennular peduncle 3-articulate; flagellum very setose extending to posterior margin of pereonite II. Antennal peduncle 4-articulate followed by 4 flagellar articles. Median telsonic carina less developed than in females. Appendix masculinum tubular, with simple apex, not extending beyond tip of pleopod 2.

Distribution. Reported from Monterey Bay to central west Baja California, Mexico; coastal shelves, slopes and submarine canyons, 9 to 512 m. MMS survey voucher material from stations R-4 and R-8 was examined.

Literature. Menzies and Barnard, 1959; Menzies, 1962; Iverson, 1974; Poore, 1975; Schultz, 1977; Poore and Lew Ton, 1988b.

Family Hyssuridae Wägele, 1981

Description. Body small and slender. Mouthparts compact, not piercing. Mandibular lamina dentata usually present; molar process forms an acute or blunt spine, or is reduced; palp of 1 or 3 articles. Maxilliped narrow; endite present, short or reaching to second palp article; palp of 5 free articles or single article. Pereopods I-III subchelate; pereopod II as large as or larger than pereopod I, basis linear, carpus produced posterodistally; pereopods IV-VII carpus triangular (rectangular in *Hyssura*), with 0-2 posterior carpal spines and 0-2 posterior propodal spines. Pleonites 1-5 freely articulating, relatively elongate. Pleopods 1-5 of equal length; pleopod 1 not operculiform. Uropodal peduncle short, about one-third total length of uropod; exopod attached basally on peduncle. Telsonic statocysts absent.

Remarks. Hyssuridae contains 6 genera. The MMS survey collected one species which best fits into the genus *Kupellonura*.

Literature. Wägele, 1981ab; Negoescu and Wägele, 1984; Poore and Lew Ton, 1988c; Kensley and Schotte, 1989.

Genus *Kupellonura* Barnard, 1925

Description. Eyes present or absent; enlarged in males. Antennule with brush-like flagellum in male; flagellum 4-articulate, with one aesthetasc on terminal article and occasionally one on 2nd article. Antennal flagellum 8-articulate; peduncle without stout plumose setae. Mouth appendages of the "normal biting type," not piercing or formed into a conelike bundle. Mandibular molar process forms a simple blunt tooth (spine). Maxilliped with endite reaching third palp article; palp 5-articulate. Pereon without dorsolateral keels or dorsal pits. Pereopod 1 with straight palm; ungui short. Pereopods 2 and 3 with 5th article acutely projecting inferiorly; 6th article ovate; palm axial, with marginal spines. Pereopods 4-7 carpus triangular; carpus and propodus each with one posterodistal spine. Pleon elongate, segments distinct. Pleopod 1 not larger than others, and with both rami equally developed. Most or all pleopodal rami with several marginal setae. Pleotelson

shorter than pleonites 1-5, thin, dorsally flat, not indurated, with small statocysts. Uropods not indurate; endopod free, longer than peduncle; exopod large, broad, and with lateral margin widely convex or lobed; exopods hinged transversely, folding dorsally and overlapping broadly over pleotelson. Pleotelson spatulate, about as long as uropods; without statocysts.

Remarks. Synonyms include *Horolanthura* (of Kensley, 1975 in part), *Kensleyanthura* Wägele, 1981, and *Belizanthura* Kensley, 1982. The complex synonymy is described in Kensley (1982), Negoescu and Wägele (1984), and Poore and Lew Ton (1988c). This genus was previously known from the Atlantic, Mediterranean, New Zealand, and Caribbean. Poore and Lew Ton (1988c) list "uropodal exopod with a lateral lobe" as the single synapomorphy for this genus, and we agree that this may be the single unique feature that can be used to unambiguously distinguish it from the closely related genera *Hyssura* Barnard and *Neohyssura* Amar. It is most easily confused with *Hyssura*, from which it can be most quickly distinguished by its wide, lobed uropodal exopods (more narrow, and unlobed in *Hyssura*) and triangular pereopod IV-VII carpus (rectangular in *Hyssura*). Poore and Lew Ton (1988c) also note that the genus is most easily recognized by the uropodal exopods, which are "held obliquely erect in preserved material and usually bear a lateral lobe." About a dozen species are currently recognized.

Literature. Barnard, 1925; Wägele, 1981; Poore and Lew Ton, 1988c.

Kupellonura sp. A

Figure 1.7

Description. Without eyes. Anterolateral lobes of cephalon small, rounded; rostrum not extending beyond anterolateral lobes. Basal peduncular articles of antennule broad and subquadrate, flagellum 4-articulate. Mandibular molar process long and acute, with ridge of large spines. Maxillipedal endite reaches second palp article. Pereonites II-III with anterior depression to receive preceding pereonites I-II, respectively. Dorsum of pereonite V slightly raised. Lateral body walls of pereonites III-VI barely visible in dorsal aspect (lateral body walls slightly exaggerated in Fig. 10.1.7). Pereonite VII with small dorsal posterior ridge. Pereopods IV-VII with triangular carpus. Pleonites 1-5 free. Uropodal exopods subrectangular, with distinct lateral lobe, and overlapping broadly to almost entirely obscure pleotelson; both uropodal rami almost reaching posterior margin of pleotelson. Pleotelson slightly convex dorsally, ornamented with two lateral carinae.

Remarks. This problematic species has features of both *Kupellonura* and *Hyssura*. We assign it to the former genus because of the presence of lobes on the lateral margins of the uropodal exopods, a unique synapomorphy for this genus. It also possess a triangular carpus in pereopods IV-VII, whereas the carpus of *Hyssura* species is rectangular in shape. However, the mouth parts are more characteristic of *Hyssura* in that the mandibular molar process is acute (not blunt, as is characteristic of *Kupellonura*), and the maxillipedal endite is short, reaching only the second palp article (rather than the third article, as is typical of *Kupellonura*). One of the two specimens of this species we examined had a 4-articulate flagellum on the left antenna and an 8-articulate flagellum on the right.

Distribution. The above description is based upon an examination of MMS survey voucher material (USNM specimen no. BRC-14; SBMNH specimen no. BRA-14).

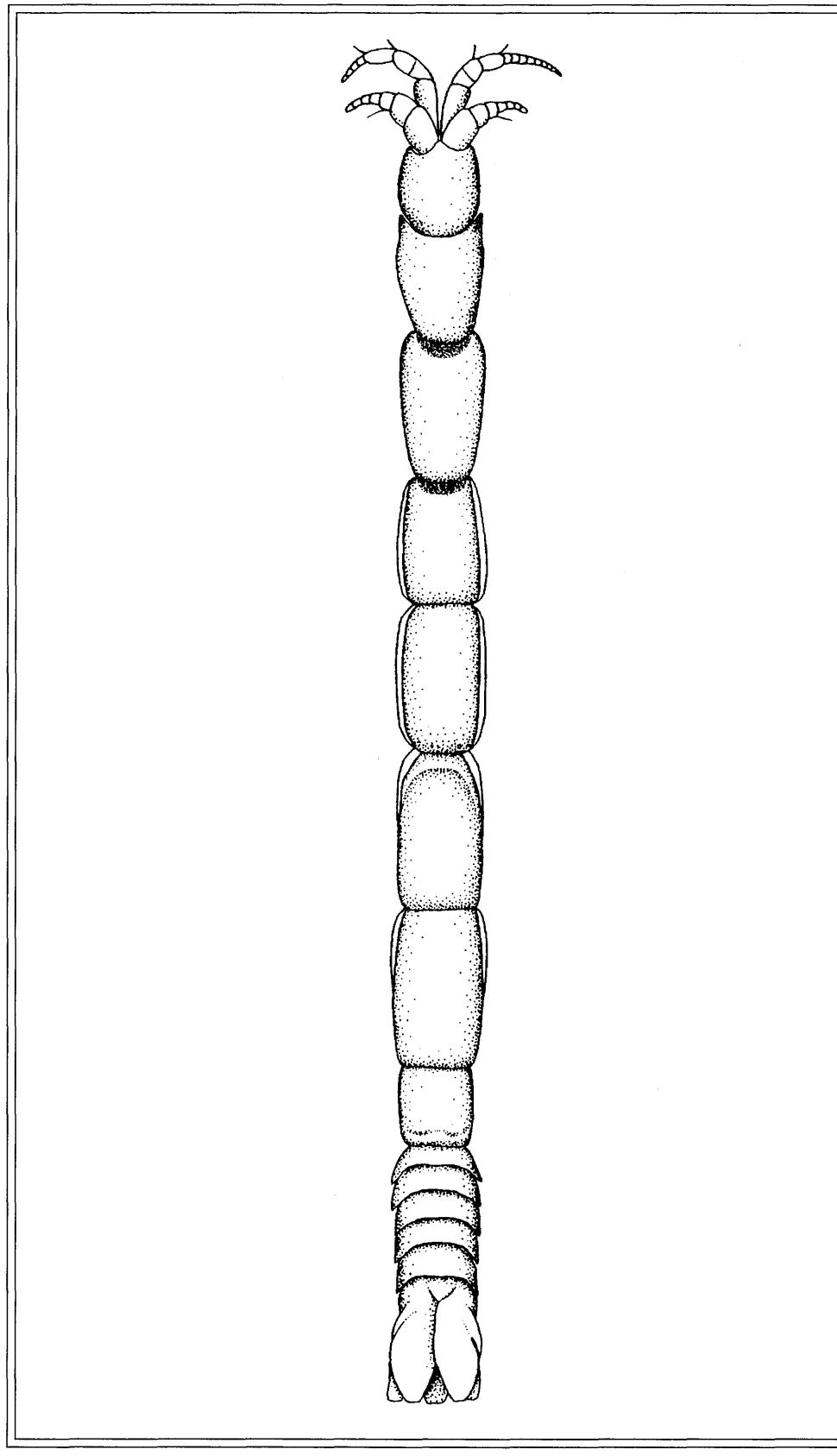

Figure 1.7. *Kupellonura* sp. A. Sta. BRC-14, USNM Phase 1 primary voucher collection.

Family Paranthuridae Menzies and Glynn, 1968

Description. With or without eyes. Mouthparts together form an elongate cone adapted for piercing and sucking. Mandible usually with untoothed, styliform incisor; without a molar process or lamina dentata; palp of 0-3 articles. Maxillules long and slender, with distal barbs or serrations. Maxillae reduced. Maxilliped long and tapering, palp with 0-3 articles, basis long and slender, endite longer than one half palp length, or smaller and reduced. Pereopods with several sensory setae on carpus and propodus; pereopods I, or I-III subchelate. Pleonites 1-6 usually demarcated dorsally (except in *Calathura* and *Pseudanthura*); telson tongue-shaped (except in *Paranthura bellicauda* and related species). Pleopod 1 larger than pleopods 2-5, with large operculiform exopod and small endopod. Pleotelson with 0 or 1 statocyst.

Remarks. Five species of Paranthuridae, representing 3 of the 16 genera of the family, occur in California waters. One of these species was recovered by the MMS survey.

Literature. Poore, 1980, 1984a; Wägele, 1981; Kensley, 1982; Negoescu and Wägele, 1984.

Genus *Paranthura* Bate and Westwood, 1868

Description. Eyes present. Antennular flagellum short, never longer than peduncle, of fewer than 10 articles in female; brushlike in male. Antennal flagellum usually forms a short flat setose plate of fused articles, shorter than peduncle. Mandible with an acute incisor and 3-articulate palp; distal palp article with a comb of about 12 setae. Maxilla forms a sharp, weakly-serrate spine. Maxilliped elongate; endite lacking; palp of 1-2 articles, the terminal article minute if present; palp with a proximal seta, a dorsal seta and 12-13 terminal setae; suture between maxillipedal basis and cephalon distinct. Pereon with feeble ornamentation, otherwise smooth. Pereonites IV-VI without dorsal pits. Pereopod I subchelate, palm axial or moderately oblique, with a mesial cutting edge; pereopods IV-VII carpi rectangular. Pleonites usually separate and distinct; pleonite 6 usually dorsally demarcated from telson; rarely 2-5 fused dorsally. Pleopod 1 exopod operculiform, but only slightly indurate. Uropods with narrow or moderately broad exopods folding over telson; uropodal endopod usually reaching apex of telson. Telson thin, narrow, not indurate, and with long terminal setae; without statocyst.

Remarks. This is the largest of the paranthurid genera. The 50+ species of *Paranthura* are all very similar, distinctions being made on subtle morphological differences in the shape and proportions of the articles of the pereopods, uropods, and telson. Species of *Paranthura* are common in shallow temperate and tropical waters. Two species occur in California waters, *P. elegans* Menzies, 1951 and *P. linearis* Boone, 1923; the status of the latter is uncertain.

Literature. Richardson, 1905; Miller and Menzies, 1952; Poore, 1984a.

Paranthura elegans Menzies, 1951

Figure 1.8

Description. Body length exceeding 9 times width, to 9.5 mm in length (to 15 mm in southernmost part of range); dorsum mostly unornamented; eyes large. Anterolateral angles of cephalon only slightly longer than rostrum. Antennule 8-articulate; article 4 deeply immersed in article 3. Antennal peduncle 5-articulate with first article divided, basal 3 articles partially fused with one another; flagellum composed of a single setigerous, clavate article bearing about 3 small indistinct articles distally; flagellum about one half length of 5th peduncular article. Maxilliped 2-articulate, distal article tapering to very narrow point. Pereonite II slightly longer than pereonite I; pereonites II and III with dorsal anterior depression to receive posterior margin of preceding pereonites; pereonite III slightly wider than long; pereonites IV-V similar in length, roughly one fourth longer than pereonite III; pereonite VI with anterior transverse ridge; pereonite VII one half length of pereonite VI. Pleonites apparently free, but articulations very faint medially; pleonite 5 three times length of pleonite 4; pleonite 6 with sinuate posterior margin and pronounced median cleft. Apex of uropodal endopod extends beyond apex of telson. Telson elongate, with evenly convex setigerous posterior margin and finely serrate posterolateral borders.

Remarks. This is one of the most commonly encountered anthurideans in California waters.

Distribution. Marin County, California to Bahía San Quintin, Baja California, Mexico and into the Gulf of California, intertidal and to 55 m. Found on soft bottom substrates, boat docks, and low rocky intertidal areas with loose sediments.

Literature. Menzies, 1951a; Menzies and Barnard, 1959.

Suborder Epicaridea Latreille, 1831

Description. Ectoparasites of other crustaceans (ostracods, copepods, cirripeds, and malacostracans). Eyes usually present in males, typically reduced or absent in females. Antennules very reduced, usually of 2-3 articles; 3-articulate peduncle generally apparent only in larval stages. Antennae vestigial in adults. Mouthparts reduced, forming a suctorial cone with a pair of piercing stylets formed from the mandibles; mandibular palp absent. Maxillules and maxillae reduced or lost. Females usually greatly distorted but with oostegites retained; body reduced to little more than an unsegmented egg sac in some forms. Males small and not distorted, usually living upon body of female.

Remarks. There are no good references on the Epicaridea as a whole, although Strømberg (1971) reviews the embryology (including several California species), and Jay (1989) cites several other papers containing general information. Overall, the quantity and quality of published work on the Epicaridea lags far behind that of the other isopod suborders. Some authors place the 4 recognized families in 2 superfamilies, Bopyroidea (Bopyridae, Dajidae and Entoniscidae) and Cryptoniscoidea (Cryptoniscidae). The cryptoniscids are parasites on ostracods, cirripeds, mysidaceans, amphipods, cumaceans and other isopods. They are probably all protandrous hermaphrodites. The Dajidae are parasites of pelagic mysidaceans, euphasiaceans, and caridean shrimp. The Entoniscidae are internal parasites of various decapods. Bopyridae parasitize a wide range of decapod crustaceans.

Literature. Richardson, 1905; Nierstrasz and Brender á Brandis, 1923; Strømberg, 1971; Markham, 1975, 1985, 1988; Miller, 1975; Bourdon, 1980; Upton, 1987a-b; Jay 1989; Kensley and Schotte, 1989.

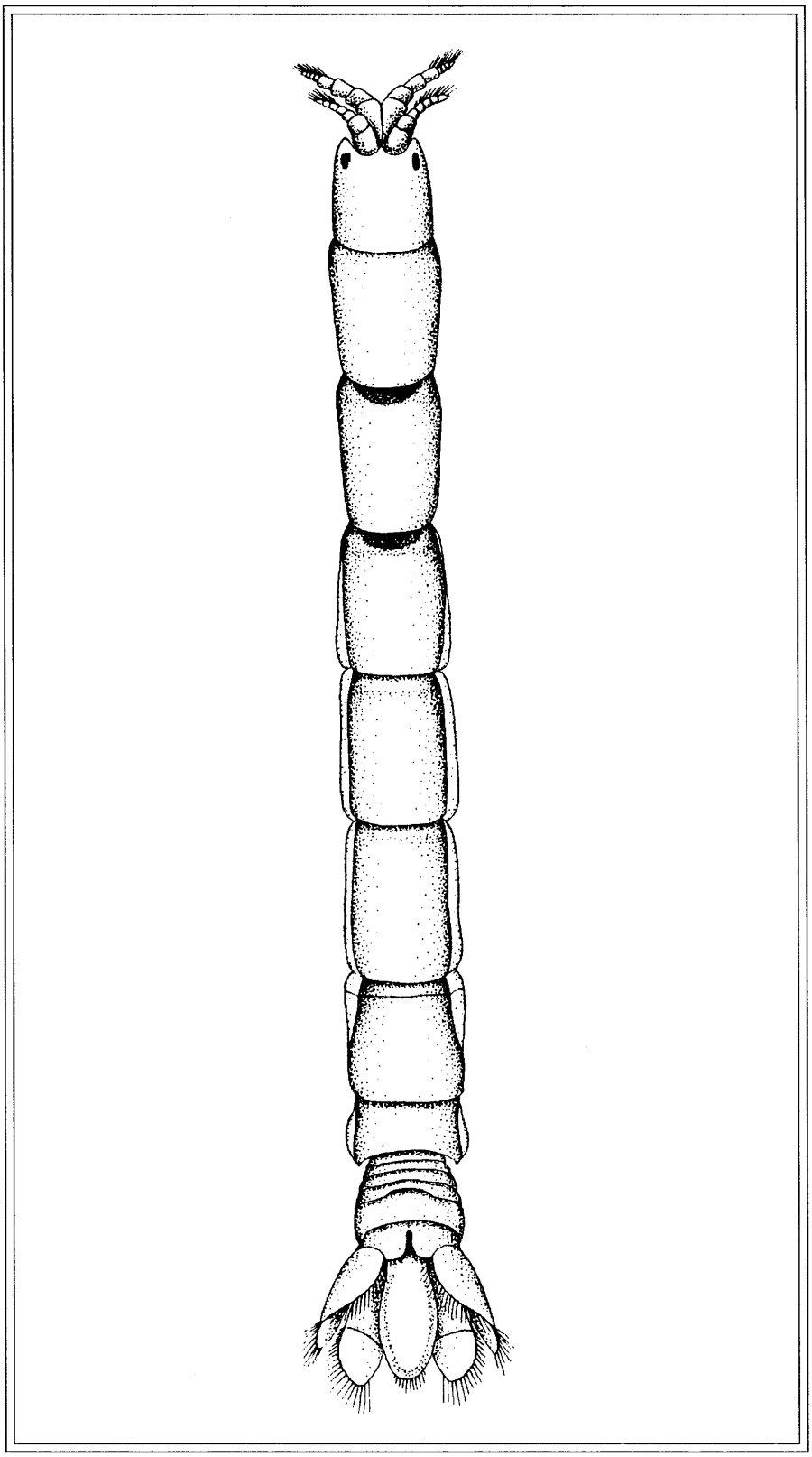

Figure 1.8. *Paranthura elegans* Menzies, 1951. Paratype LACM 48-62.2. California, Marin Co., Tomales Bluff, intertidal, 23 May 1948, coll. R. J. Menzies.

Family Bopyridae Rafinesque, 1815

Description of female. With complete, or at least partial body segmentation. Body slightly to greatly asymmetrical, flattened dorsally. Posteroventral margin of head usually with 1-2 lateral projections on each side. Eyes, if present, are small irregular dorsal pigment spots. Pereon generally with all 7 pereonites distinct, although first (and sometimes second) pereonite occasionally partially fused to cephalon. Pereopods prehensile but reduced, all 7 pairs usually present on at least one side, up to 6 being absent on other side; 5 (rarely 7) pairs of oostegites. Pleon of 2-5 free pleomeres, plus pleotelson; sides of pleomeres often produced as large lateral plates, or epimeres (often resembling pleopodal rami). Pleopods well-developed or rudimentary, but usually present, occasionally absent on posteriormost pleonites. Uropods, when present, uniramous or biramous, often resembling pleopods.

Description of male. Very small, at least twice as long as wide, symmetrical and distinctly segmented. Cephalon rounded anteriorly, occasionally more-or-less fused with first pereonite. Antennae often prominent. Eyes as in females. Pereon of 7 distinct pereonites, each usually with a pair of prehensile pereopods. Pleon of 1-5 pleonites, plus pleotelson (if unsegmented, lacking appendages; if multisegmented, often with uniramous pleopods or at least with ventral tubercles on all but the last pleonite). Uropods, if present, uniramous.

Remarks. Adult bopyrids are parasites either on the abdomen or in the branchial chamber of decapod crustacean hosts. In branchial parasites, the female attaches ventrally to the host's branchiostegite, inducing a bulge in the host's carapace. Males are much smaller and are usually found on the ventral side of the pleon of the female isopod. Females brood many small eggs in an oostegial brood pouch, that hatch as a free-swimming epicaridium stage. The epicaridium attaches to an intermediate host, a calanoid copepod. Once on the copepod, the isopod molts into a microniscus stage, and then into the cryptoniscus stage. The cryptoniscus detaches from the copepod, is free-swimming, and eventually attaches to the definitive host. Bopyrids are sequential hermaphrodites. Upon attachment to the definitive host, the cryptoniscus develops into a female; a second cryptoniscus settles on the host and develops into a male. The family Bopyridae contains nearly 500 described species in 10 subfamilies world-wide, all but one of which are parasites on decapod crustaceans. Thirteen species are known to occur on the Pacific coast of North America north of Mexico.

The cyptoniscus stage of the family Bopyridae possess complex antennules of uncertain homologization. The first article, and often the second, typically bear toothed "gnathobasic margins" that are important in species-level taxonomy. One to 3 lobes may arise from the third article, each invested with bundles of long setae. It is these sensory lobes that Bonnier (1900) and Calman (1909) presumably interpreted as scales, or vestigial rami or flagella. The antennules of adult bopyrids are greatly reduced or their articulation is obscure, and "antennular scales" are absent.

Literature. Richardson, 1905; Markham, 1974, 1975.

Genus *Munidion* Hansen, 1897

Description of female. Body smoothly ovate in outline, with 7 free pereonites and 5 free pleonites (plus the pleotelson); bilateral body axis distortion generally less than 30°. Cephalon subtriangular, medially extending deeply into pereonite I; posterolateral border of cephalon with 2 blunt to sharp processes on each side, and sometimes with small dentate processes near central point of cephalic processes. Maxilliped without palp. All pereonites (or only anterior pereonites) with dorsolateral bosses. Coxal plates distinct. Pereopods similar, slightly larger posteriorly; base produced into blunt carina. Pleonites with distinct epimeres, ranging from narrow pointed projections to leaflike petiolate expansions. Five pairs of biramous pleopods, varying from narrow lanceolate projections to broad foliate structures. Pleotelson forms knoblike or lanceolate process. Uropods similar to pleopods.

Description of male. Cephalon wider than long, occasionally fused with pereonite I. Eyes absent or minute. Body much longer than wide. Antennule and antenna each of 3 articles. Pereonites frequently with midventral tubercle. All pleonites fused into one subtriangular piece; usually without pleopods or uropods.

Remarks. *Munidion* contains 7 species, all of which are parasitic on galatheid crabs of the genera *Munida* and *Pleuroncodes*.

Literature. Hansen, 1897; Richardson, 1905; Markham, 1975.

Munidion pleuroncodis Markham, 1975

Figures 1.9 and 1.10

Description of female. Length to 9.8 mm; bilateral body axis distortion approximately 18°; body shape subpyriform. Without eyes. Cephalon much broader than long, subpentagonal with broad frontal margin; anterior margin slightly convex; posteroventral border of cephalon with 2 lateral digitate processes and a series of dentate processes across the medial margin. Antennules and antennae obscurely 3-articulate, distalmost article minute. Antennae separated by a "frontal plate". Maxilliped subtriangular, obscurely segmented. Coxal plates large, well-developed on all pereonites, extending far beyond edges of pereon and overlapping each other. Pereonites with lobelike dorsolateral tergal projections, increasing in size posteriorly. Pleonites distinct, although pleon obscured by large ovate epimeres and by long biramous lanceolate pleopods. Coxal plates and pleonal epimeres resembling the large thin, leaflike oostegites.

Remarks. The male is typically found attached ventrally to the pleon or posterior oostegites of the female. *M. pleuroncodis* is very similar to *M. princeps* Hansen, 1897, a parasite on *Munida refulgens* Faxon, 1893, which occurs off Cocos Island and the coast of Ecuador. *M. pleuroncodis* can be most easily distinguished by the shape of the pleopodal endopods, which are lanceolate in the former but oval in *M. princeps*, and the coxal plates, which are expanded laterally in the former but pressed against the sides of the pereon in *M. princeps*. The cephalon of *M. pleuroncodis* is fused to the first pereonite in males, but free in *M. princeps*.

Distribution. Central California to (at least) central Mexico, infesting only the pelagic galatheid "red crab" *Pleuroncodis planipes* Stimpson. Markham (1975) described this species from collections made by the Inter-American Tropical Tuna Commission from the R/V *David Starr Jordan* off Baja California, Mexico in 1966, and from specimens washed ashore at Pacific Grove,California in 1973. The host is a member of the tropical west American fauna and records from north of central Baja California presumably correspond to northward extensions of warm coastal waters, such as occur during El Niño events.

Literature. Markham, 1975.

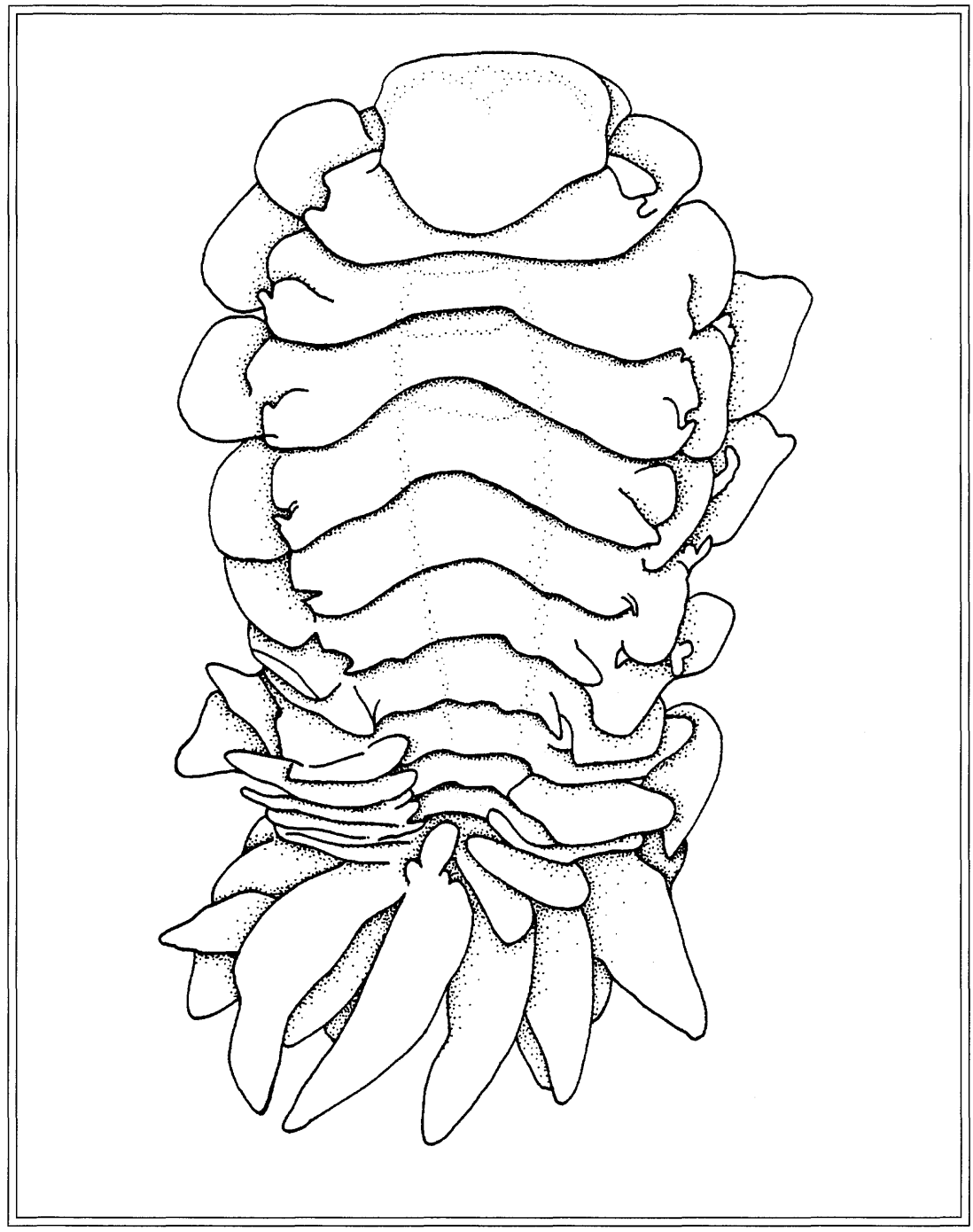

Figure 1.9. *Munidion pleuroncodis* Markham, 1975. Holotype USNM 141597 (female). Mexico, off Baja California, 26°22'N, 115°05'W, 19-21 November 1966, coll. W. C. KIawe, R/V *David Starr Jordan*, Sta. 69.

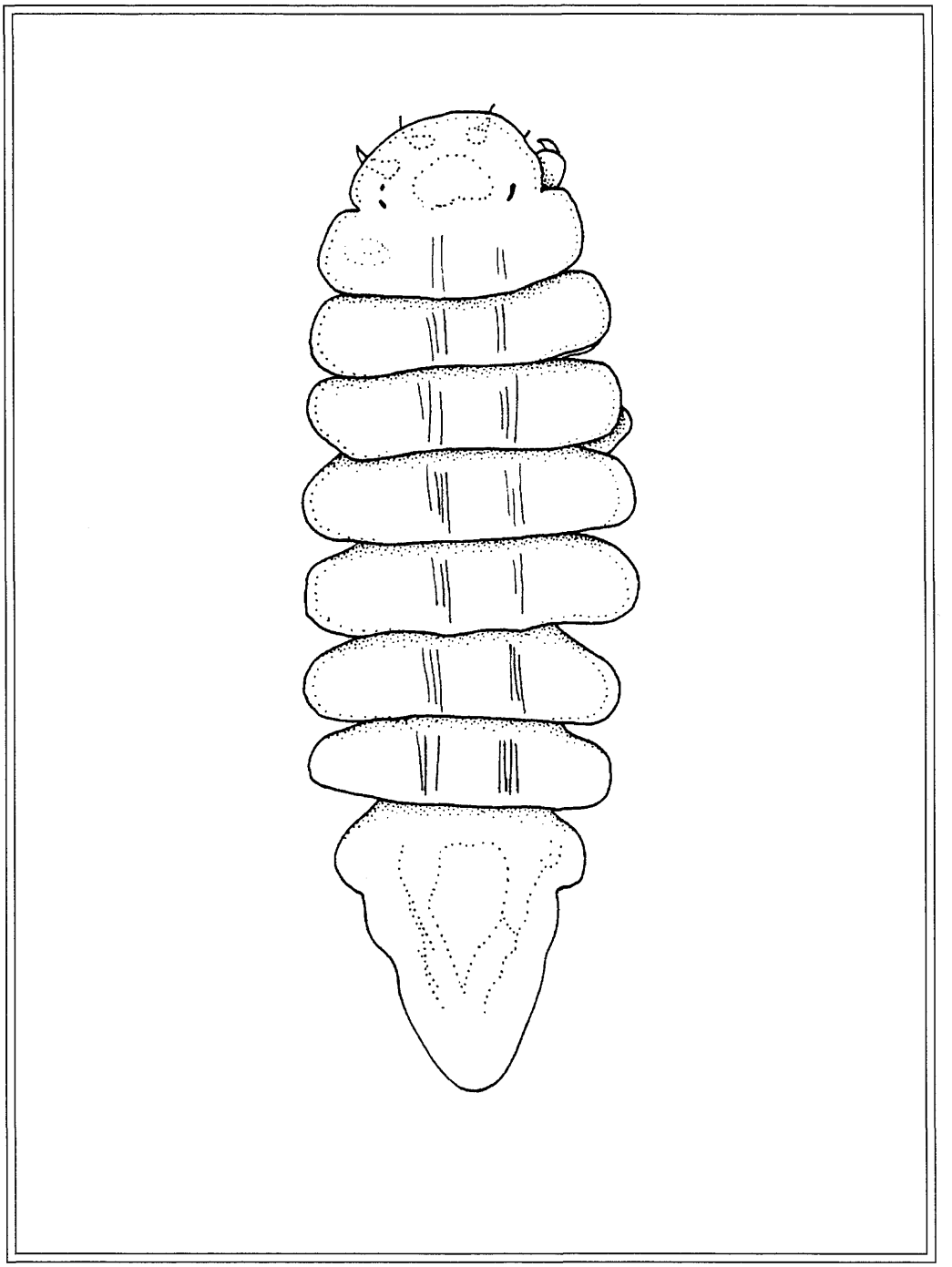

Figure 1.10. *Munidion pleuroncodis* Markham, 1975. Allotype USNM 141598 (male). Mexico, off Baja California, 26°22'N, 115°05'W, 19-21 November 1966, coll. W. C. KIawe, R/V *David Starr Jordan*, Sta. 69.

Suborder Flabellifera G.O. Sars, 1882

Description. Eyes usually well-developed; reduced or absent in cave and deep-sea forms. Antennules usually uniramous, without a scale (except in the cirolanid genus *Bathynomus*), peduncle 3-articulate (4-articulate in Serolidae and Phorotopodidae); antennule reduction occurs in some families. Antennal peduncle commonly 5-articulate, (questionably 6-articulate in some). Frontal lamina, clypeus, and labrum usually well-developed; in groups with the antennae set very close together, the frontal lamina is reduced to a narrow ridge (e.g. Anuropidae, some Aegidae) or a minute plate (e.g. Serolidae). Mandibles usually robust, adapted for cutting and grinding, occasionally for piercing; lacinia mobilis, spine row and molar process usually present, but often reduced or modified in various families; usually with a 3-articulate palp. Maxillule biramous, sometimes adapted for piercing. Maxilla biramous, outer ramus usually consisting of 2 lobes. Pereopods generally ambulatory, sometimes prehensile; pereopods I-II subchelate only in Serolidae, some Sphaeromatidae (Ancininae), and some Cirolanidae; posterior pereopods sometimes secondarily natatory (some cirolanids). Pleon of 0 to 5 free segments, plus pleotelson. Usually 5 pairs of pleopods present. Uropods arise laterally, usually forming a tailfan with pleotelson (except in Anuropidae).

Remarks. The Flabellifera is a diverse and probably non-monophyletic taxon currently containing about 3,000 described species in 180 genera and 15 families. Nearly 60 species, in 9 families, have been reported from California waters. The MMS survey recovered 4 of these species, in 4 families. The largest flabelliferan family, Sphaeromatidae (with about 50 species described from North America north of Mexico), is largely restricted to shallow water and the littoral region.

Literature. Richardson, 1905; Miller, 1975.

Key to the Families of Flabellifera Known from California Waters

1A. Uropods directed ventrally, identical to and functioning with pleopods; body greatly inflated and globular; parasitic on gelatinous zooplankton; antennules greatly modified, 2-articulate, distal artical greatly expanded and scalloped ..... Anuropidae

1B. Uropods unlike pleopods, associated with pleotelson; body not greatly inflated and globular; not parasitic on gelatinous zooplankton; antennules not as described above 2

2A. Uropods greatly reduced, with very small, often clawlike exopod; body less than 4 mm long; burrowing in wood or algal holdfasts ..... Limnoriidae

2B. Uropods not greatly reduced; body rarely less than 3 mm long; rarely burrowing in wood or algae (a few species of Sphaeromatidae burrow into coastal wood structures, but they are large animals) .. 3

3A. Pleon composed of 3 or less dorsally visible free pleonites, plus the pleotelson 4

3B. Pleon composed of 4-5 free dorsally visible pleonites, plus the pleotelson 5

4A. Pleon composed of 3 dorsally visible free (complete) pleonites, plus pleotelson; cephalon fused medially with pereonite I; body strongly depressed and expanded laterally; pereonite VII tergite incomplete or absent; antennae set very close together, frontal lamina reduced to a small triangular plate visible only by pushing aside antennal bases; pleopods 1-3 small and natatory, basis elongated; pleopods 4-5 large, broadly ovate, suboperculiform ..... Serolidae

4B. Pleon composed of 1-2 dorsally visible free (complete) segments, plus pleotelson; cephalon not fused with pereonite I (except in *Ancinus* and *Bathycopea*); body convex dorsally, not strongly depressed; pereonite VII tergite complete; antennae not set close together, frontal lamina large and distinct; pleopods subequal, of modest size, basis not elongated; pleopods 4-5 ovate but not operculiform ... . Sphaeromatidae

5A. All pereopods prehensile (dactyls longer than propodi); antennae reduced, without clear distinction between peduncle and flagellum; maxillipedal palp 2-articulate ..... Cymothoidae

5B. Pereopods IV-VII ambulatory (dactyls shorter than propodi); antennae not as above, with clear distinction between peduncle and flagellum; maxillipedal palp of 2-5 articles 6

6A. Maxillipeds, maxillules, and maxillae with stout, recurved, apical spines; lacinia or molar process of mandible reduced or absent; maxilla reduced to a single slender stylet ..... Aegidae

6B. Maxilliped without stout, recurved spines; mandible with or without lacinia and molar process; maxilla not a slender stylet 7

7A. Mandible with distinct lacinia and large "articulated" bladelike molar process; mandibular incisor generally broad, 3-dentate; maxillule lateral (outer) lobe often with several (10-14) stout spines, never styletlike or falcate; maxillae well-developed; pereopods I-III not prehensile (dactyls not longer than propodi) ..... Cirolanidae

7B. Mandible with lacinia and molar process reduced, vestigial, or absent; mandibular incisor narrow; maxillule lateral (outer) lobe styletlike or falcate; maxillae reduced; pereopods I-III usually prehensile (occasionally ambulatory) 8

8A. Maxillule lateral (outer) lobe slender, styletlike, apex with 3-5 stout, hooked spines, smaller spines subapically; maxilliped with conspicuous endite ..... Tridentellidae

8B. Maxillule not as above, simple and falcate; maxilliped without an endite (the female of at least one species, *Excorallana houstoni* has a small endite) ..... Corallanidae

Family Aegidae Dana, 1853

Description. Body cirolanid-like. Dorsum evenly vaulted or quite depressed; smooth. Eyes, when present, usually large, not uncommonly nearly contiguous (entirely contiguous in a few species). Both antennules and antennae well-developed, division between peduncle and flagellum distinct, flagellum multi-articulate; antennule with 3 peduncular articles; antenna with 5 peduncular articles. Maxillipedal palp of 2, 3 or 5 articles; terminal articles with spines and/or stout setae. Mandible elongate, incisor narrow, with reduced, vestigial, or no lacinia mobilis, spine row and molar process; palp of 3 articles. Coxal plates of pereonites II-VI large and distinct. Pereopods I-III prehensile (i.e. dactyls as long as, or longer than, propodi and strongly recurved); pereopods IV-VII ambulatory (i.e. dactyls shorter than propodi). Pleon with 4-5 free pleonites, plus pleotelson. Uropods flattened, forming a tailfan with pleotelson.

Remarks. The family Aegidae comprises 6 genera. All species are temporary parasites on marine fishes. Adults engorge themselves with blood from their hosts, then dislodge and sit on the bottom to digest their meal. Nine species, in 2 genera, have been reported from Pacific North America north of Mexico, 6 of which inhabit California waters. Only one species was recovered by the MMS survey.

Literature. Richardson, 1905; Miller, 1975; Brusca,1983; Bruce, 1988; Kensley and Schotte, 1989; Brusca and France, 1992.

Genus *Rocinela* Leach, 1815

Description. Body less compact and more depressed than in *Aega*. Eyes well-developed. Anterior margin of cephalon usually extended to form a short rostrum covering all or part of antennular peduncle. Frontal lamina small, narrow, or arrowhead-shaped, indistinctly fused broad flat with clypeus; labrum free. Antennules much shorter than antennae; peduncular articles of antennules not expanded. Mandibles with incisor narrow, not denticulate; palp of 3 articles, middle article subequal or barely longer than first article, which is greatly elongated. Maxilliped with 2- or 3-articulate palp, if 3-articulate the terminal article is very small; endite greatly reduced. Pereopods I-III often with propodi expanded into a spine-bearing lobe.

Remarks. Four species of *Rocinela* occur in California waters: *R. murilloi* Brusca and Iverson,1985, *R. laticauda* Hanson, 1897, *R. angustata* Richardson, 1904, *R. belliceps* (Stimpson, 1864). Only *R. angustata* was collected by the MMS project, but it is highly likely that *R. murilloi* occurs in the area as it is proving to be the most common *Rocinela* in museum collections. There has never been a world-wide monographic treatment of this genus. Species are poorly known and misidentifications are common. The description and key provided below are based on characters different from those traditionally used, and both are based on observations of type material of all known Pacific species.

Literature. Richardson, 1898, 1905; Brusca and Iverson, 1985; Kensley and Schotte, 1989; Brusca and France, 1992.

Key to California Species of *Rocinela*

1A. Medial process of uropodal peduncle extended greater than 50% length of endopod; spines on merus of pereopod I-III blunt; pereopod III merus with 3 spines, on inferior margin; uropodal endopod longer than exopod ..... *Rocinela belliceps*

1B. Medial process of uropodal peduncle extended less than 33% length of endopod; spines on merus of pereopod I-III acute; pereopod III merus with 4-8 spines on inferior margin; uropodal endopod shorter than exopod 2

2A. Propodi of pereopods I-III with 4 stout recurved acute spines; merus of pereopod III with 5-8 acute spines (3-5 distal and 2-3 proximal spines) ..... *Rocinela angustata*

2B. Propodi of pereopods I-III with 4-6 acute spines; merus of pereopod III with 4 acute spines (3 distal and 1 proximal spine) 3

3A. Propodi of pereopods I-III with 5 thin straight acute spines; apical article of maxillipedal palp with thin, nearly straight, acute spines ..... *R. laticauda*

3B. Propodi of pereopods I-III with 4-6 stout, recurved, acute spines; apical article of maxillipedal palp with stout, recurved, acute spines ..... *Rocinela murilloi*

Rocinela angustata Richardson, 1904

Figure 1.11

Description. Body about 2.5 times longer than wide. Cephalon subtriangular, 2.0 to 2.7 times wider than long. Eyes large, separated by about 1 eye-width. Rostrum truncate, extended well beyond bases of antennae. Frontal lamina narrow, not expanded. Antennae extended to, or past, pereonite II. Maxillule styliform tapered to apical tooth. Mandibular palp article 2 more than twice as long as article 3, with 13 spines and 3 setae. Maxilla with setose medial margin; inner lobe fingerlike with 2 stout, recurved spines, 1 apical and 1 subbasal; outer lobe broadly rounded with 2 small, recurved spines on disto-medial edge. Pereonite I longest; pereonite IV or V widest; coxae not visible, or occasionally posteriormost coxae visible, in dorsal aspect. Pereopod I dactyl greatly elongate, as long as carpus and propodus combined; propodus with expanded palm, with 4 stout, acute curved spines (rarely with acute, slender, straight spines); carpus with 1 spine; merus with 3-6 acute spines, 2-5 distal spines set among setae (distalmost spine distinctly longer than others) and 1 proximal spine. Pereopod III merus with 5-8 acute spines, 3-5 distal spines set among setae (2 distalmost spines distinctly longer than others) and 2-3 proximal spines, otherwise as pereopod I. Pereopods IV-VII with short dactyls, much shorter than propodi; ischium, merus, and carpus with fringe of long acute spines on distal margin and acute spines along inferior margin. Pleonite 1 covered by pereonite VII; pleonites 2-4 subequal in length and width; pleonites 1 and 5 narrower than pereonites. Uropods extended slightly beyond posterior margin of pleotelson; inner angle of peduncle extended less than 33% length of endopod; endopod elongate-ovate, terminally truncate, with about 11 spines (7 lateral and 4 on distolateral border); exopod much wider and slightly longer than endopod. Pleotelson broadly rounded, wider than pleonite 5.

Remarks. In 1898 Richardson published a redescription of *Rocinela laticauda* Hansen, based on material collected by the U.S. Fish Commission's *Albatross* expeditions in the north Pacific. Hansen's original description of this species was still in press at the time. Unfortunately, all of the *Albatross* material upon which Richardson based her redescription eventually proved not to be *R. laticauda*. Hansen's type of the latter came from Acapulco, Mexico; Richardson's collections were from Alaska, Canada and California. Recognizing her mistake, Richardson later (1904) established a new species for the *Albatross* material, *R. angustata* (including in the type series one syntype collected in Honshu, Japan).

Rocinela angustata is often misidentified as *R. cornuta*, *R. belliceps* or *R. laticauda* in museum and environmental research collections. It is also extremely similar to the recently described *R. murilloi*. Although the latter species was described from the tropics (Costa Rica) recent work has shown it to be the most common species of *Rocinela* occurring south of 32°N on the Pacific coast of North America.

Distribution. Bering Sea, Alaska south along coast of western North America to Cedros Island, Baja California, Mexico; 30 to 2214 m taken from fishes, or from soft bottom habitats.

Literature. Richardson, 1904, 1905; Birstein, 1973; Brusca and France, 1992.

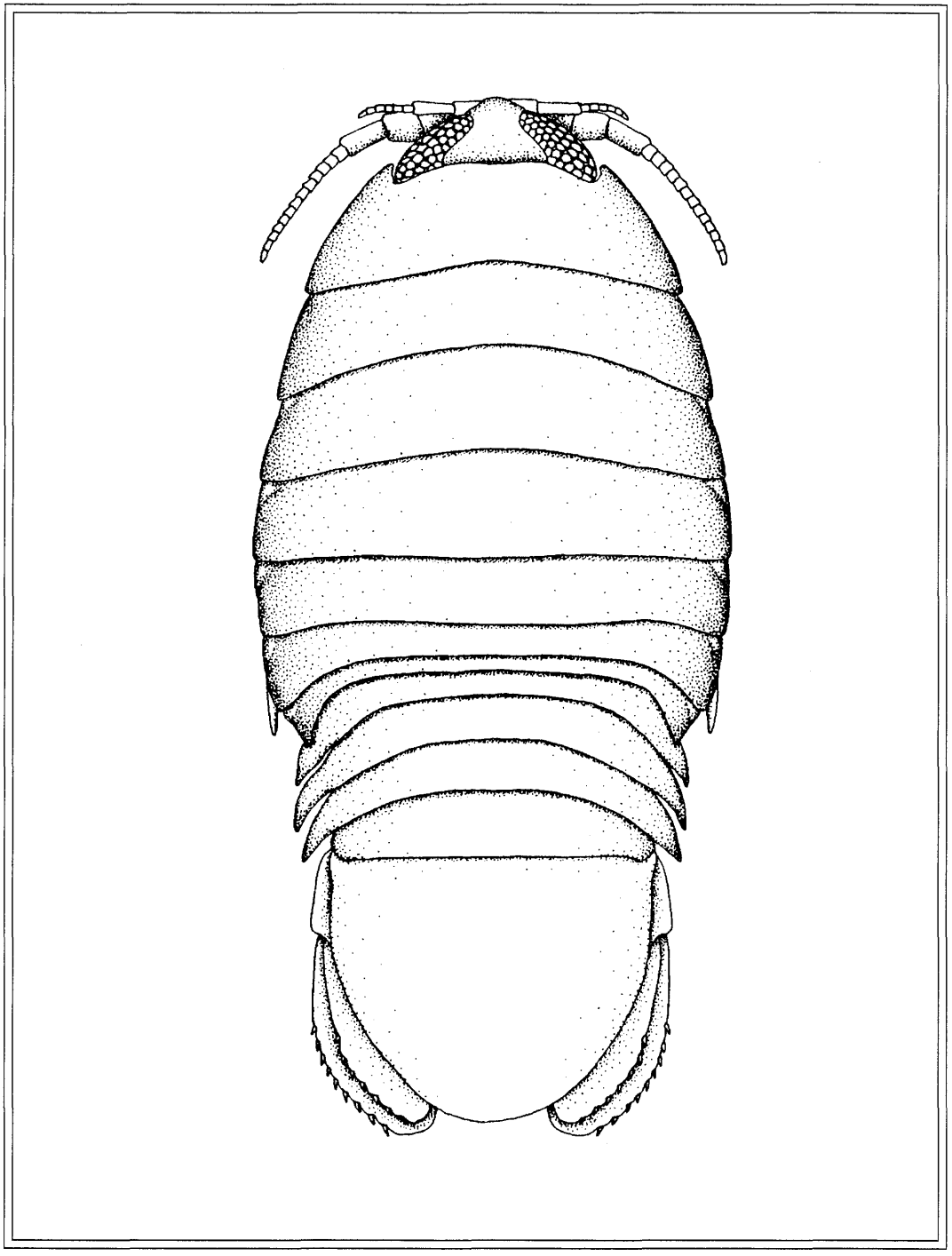

Figure 1.11. *Rocinela angustata* Richardson, 1904. Syntype USNM 22710 (female). Alaska, Bering Sea, N. W. of Unimak Island.

Family Cirolanidae Dana, 1853

Description. Body sleek and symmetrical, 2-6.5 times longer that wide; with well-developed coxal plates on pereonites II-VII, separated from body by distinct sutures. Frontal margin of cephalon evenly convex or produced into short rostrum; distinct frontal lamina present. Antennular peduncle 3-articulate, but occasionally some articles may coalesce to produce 2 free peduncular articles. Antennal peduncle 4- or 5-articulate. Mandible with tridentate incisor, well-developed lobe-like spine row, spinose bladelike "articulated" molar process, and 3-articulate palp. Maxillule outer lobe with 10-14 apical spines; inner lobe with 3-4 apical circumplumose spines. Maxilla setose, bilobed. Maxillipedal palp typically 5-articulate, articles never with hooked or strongly recurved spines; with distinct, minute to large, endite. Pereopods ambulatory; I-III tend towards a grasping form, with dactyls well-developed. Pleon usually with 5 distinct pleonites plus pleotelson, although fusion/ reduction of free pleonites occurs in several genera; pleonite 5 often overlapped laterally by pleonite 4; pleopods membranous; posterior pleopods often lacking PMS on endopods, especially pleopod 5. Uropods usually with both rami well-developed, lamellar, forming a "tail fan" with pleotelson; exopod absent or reduced in some genera.

Remarks. The family Cirolanidae is large, comprising about 52 described genera. Surprisingly, of the 8 species (in 6 genera) of Cirolanidae known from California waters, the MMS soft-bottom survey recovered only one species.

Literature. Richardson, 1905; Miller, 1975; Brusca and Iverson, 1985; Bruce 1986; Brusca *et al.*, 1995.

Genus *Metacirolana* Kussakin, 1979

Description. Cephalon with small to moderate-sized rostral process. Frontal lamina anteriorly dilated, freely projecting, often visible in dorsal aspect; clypeus with ventrally-projecting triangular blade; labrum subequal to clypeus in width, but longer than clypeus. Antennule short, not extended beyond pereonite I; peduncle 3-articulate; basal article not articulating at right angle to others. Mandible with broad tridentate incisor, with small accessory tooth on medial margin of right mandible; molar process and spine row well-developed. Maxilliped slender, endite with 1-2 coupling spines. Pleon with 5 free somites; lateral margins of pleonite 5 not overlapped by pleonite 4. Pleopods 1-2 similar to each other; appendix masculina inserted subbasally (about one-third distance form base) on pleopod 2. Uropods with inner angle of peduncle acutely produced.

Remarks. Species of *Metacirolana* can be most readily distinguished from other, similar genera of Cirolanidae by the freely projecting clypeus, dilated frontal lamina (often visible in dorsal view), pleonal and mouthpart morphology. The genus contains about 2 dozen species, only one of which is currently known from Pacific North America north of Mexico.

Literature. Bruce, 1981, 1986; Botosaneanu, *et al.*, 1986; Brusca et al., 1995.

Metacirolana joanneae (Schultz, 1966)

Figure 1.12

Description. Small, adults 3-5 mm long. Eyes moderate-sized. Antennule extending almost to pereonite II. Antenna extending almost to pereonite IV. Coxal plates well-developed, II-VII visible in dorsal aspect, expanded laterally and with acute posterior angle. Pleomeres 2-5 with large, well-developed epimeres, expanded laterally and with acute posterior angles. Pleotelson with strong, medial, longitudinal ridge; margins of pleotelson and uropodal rami notched. Uropodal exopod about one half width of endopod; both rami subsimilar in length, extending barely beyond posterior margin of pleotelson.

Remarks. The antennular flagellum tends to be slightly longer in males, and males are often more slender than the females.

Distribution. Submarine canyons and basins off central and southern California. The northernmost published record is from 36°41'N, 122°W (off Monterey) at 218 m.

Literature. Schultz, 1966.

Family Serolidae Leach, 1814

Description. Body strongly depressed, broad, with large expanded coxal plates. Cephalon deeply immersed in pereon. Some species quite large (to 80 mm). Eyes present or absent. Antennules with 4 peduncular articles. Antennae with 5 peduncular articles. Mandible with 3-articulate palp; incisor process well-developed, with 2 subterminal movable spines (presumably 1 representing the lacinia mobilis); molar process absent. Maxilliped with 3-articulate palp; without coupling spines on endite. Pereonite I fused dorsally (at least medially) with cephalon and encompassing cephalon laterally; pereonite VII tergite indistinct dorsally, shortened and fused to pereonite VI. Pereopod I of both sexes, and also pereopod II of most adult males, subchelate, with dactyl folding back upon an inflated propodus. Pereopods III-VII ambulatory. Pleon of 3 free pleonites, at least first pleonite narrow, not reaching the lateral margins of the body; pleotelson large (pleonites 4-6 fused with telson). Pleopods 1-3 peduncles elongate, rami subelliptical; exopod of pleopod 4 indurate, operculate, covering endopod and pleopod 5. Uropods small, rami narrow, peduncle and endopod coalesced in some species, in which case the exopod may be greatly reduced.

Remarks. The Serolidae is principally cold-water and southern hemisphere in distribution. Deep-sea species often have reduced eyes, or are blind. Serolids are carnivores, scavengers, or omnivores. They are epibenthic, highly motile animals, capable of shallow burrowing. *Serolis* is the largest of the 21 described genera, and is the only genus represented in the northern hemisphere.

Literature. Richardson, 1905; Nordenstam, 1933; Sheppard, 1933; Menzies and Barnard, 1959; Harrison and Poore, 1984; Brandt, 1988; Wägele, 1994.

Genus *Serolis* Leach, 1818

Description. Maxillule lateral (outer) lobe a flattened blade with large apical spines, medial (inner) lobe a smaller blade with few apical spines. Maxilla lateral (outer) lobe biramous, (medial) inner lobe a flattened blade, both with long apical setae. Pereonites VI and VII often medially shortened; pereonite VII (tergite) medially fused to pereonite VI (also, pereonite VI occasionally fused to pereonite V). Coxal plates well-developed; those of pereonites III-V marked off by distinct sutures. Pereopod II subchelate in males, ambulatory in females. Uropods lateral, lamellar, and usually with articulating rami.

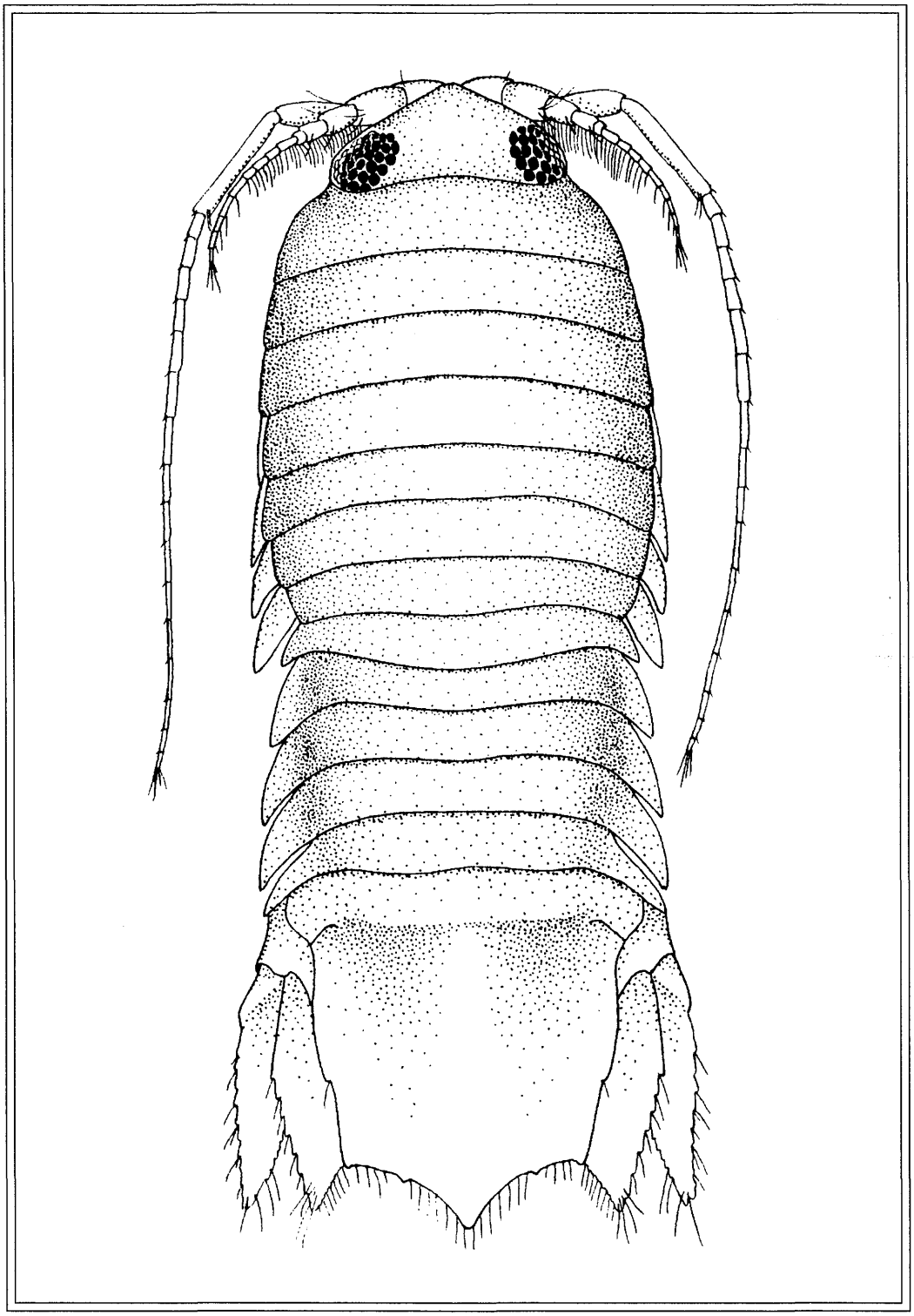

Figure 1.12. *Metacirolana joannae* (Schultz, 1966).

Remarks. See Sheppard (1933) for an excellent review of morphology and taxonomy (including a key to all species known at the time). A single species of *Serolis*, *S. carinata*, is known from Pacific North America north of Mexico.

Literature. Richardson, 1905; Sheppard, 1933; Harrison and Poore, 1984.

Serolis carinata Lockington, 1877

Figure 1.13

Description. Body broadly ovate; males slightly broader than females. Cephalon approximately as broad as long, anterior margin excavated at base of antennules, forming small rostrum. Eyes well-developed, posterolaterally positioned on cephalon, reniform, with black pigment. Cephalon, pereonites, and pleonites all with pronounced mediodorsal carina, forming median keel produced posteriorly on each segment as a short spine. Pleotelson posterior margin with deep medial notch. Uropodal rami subequal in length and width, rounded distally, reaching posterior margin of pleotelson.

Distribution. Southern California to Baja California, Mexico and into the Gulf of California; low intertidal to 98 m from soft bottom habitats. Southern records are usually in deeper water, suggesting these isopods may conform to the latitudinal submersion phenomenon. Specimens collected by the City of San Diego Ocean Monitoring Program at Pt. Loma have extended this species recorded depth range.

Literature. Lockington, 1877; Richardson,1905; Sheppard, 1933; Menzies and Barnard, 1959.

Family Tridentellidae Bruce, 1984

Description. Eyes well-developed. Body often with dorsal spines, tubercles, or carinae (always better developed in the male of the species). Antennular peduncle 3-articulate, basal article not enlarged. Antennal peduncle 5-articulate, articles 4 and 5 elongate. Frontal lamina narrow, pentagonal; clypeus short, broad, inverted V-shaped, lateral angles produced to, or almost to, base of mandibles; labrum small, partly or largely encompassed by clypeus. Mandible with short, acute incisor; molar process vestigial, weakly sclerotized (often lost in dissection); lacinia absent; palp 3-articulate. Maxillule lateral (outer) lobe styliform, slightly curved, tapering toward apex, with 3-5 stout hooked apical spines and smaller subapical spines; medial (inner) lobe simple, greatly reduced. Maxilla uniramous, stout, 2-articulate; distal region of conical second article with small spines and/or scalelike setae. Maxillipedal palp 5-articulate, middle article not elongate; endite elongate, with or without coupling spines. Pereopods I-III subprehensile; pereopods IV-VII ambulatory. Pleopods 1-4 peduncles with 4-6 coupling spines on medial margin; rami lamellar, with plumose marginal setae on all but endopod of pleopod 5. Appendix masculina of male pleopod 2 rodlike, simple, arising from proximal medial margin of endopod.

Remarks. Tridentellidae is a monogeneric family closely related to Corallanidae, Aegidae, Cymothoidae and Cirolanidae. It is most often confused with Corallanidae, but can be most easily recognized by the presence of a large maxillipedal endite (lacking in corallanids).

Literature. Bruce, 1984; Delaney and Brusca, 1985.

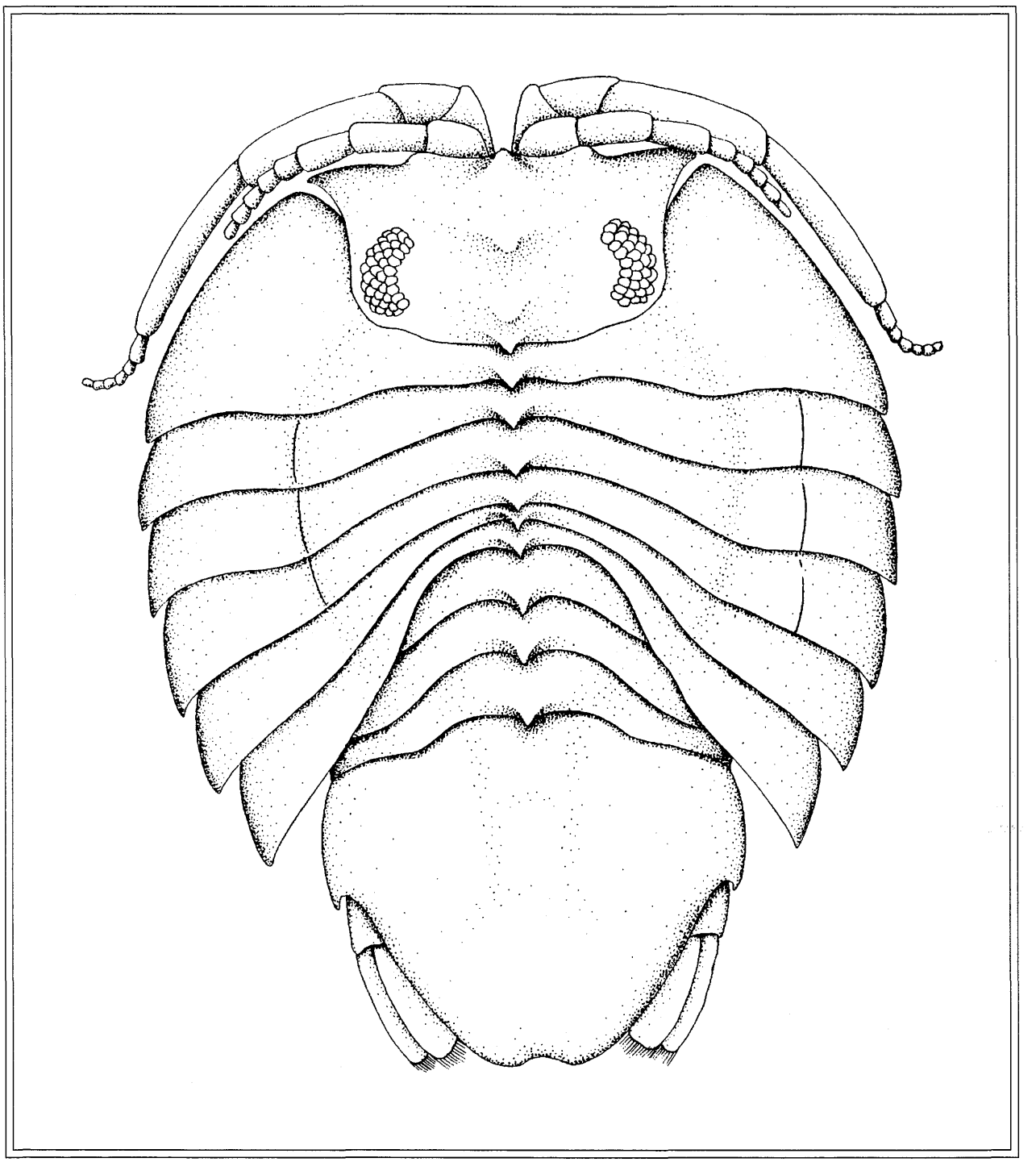

Figure 1.13. *Serolis carinata* Lockington, 1877. California, San Diego Co., Pt. Loma, 47 m, 20 July 1989, coll. Pt. Loma Biology Lab, Sta. A-14, SDNHM A.0014.

Genus *Tridentella* Richardson, 1905

Smicrostoma Hale, 1925.

Description. See family description.

Remarks. *Tridentella* is a cosmopolitan genus reported from shallow (11 m) to bathyal (935 m) depths. It is a small genus of only 14 described species. Most occur in temperate waters, but at least three occur in tropical seas. The bladelike slicing mandibles, and the hooked spines on the maxillules and maxillae, suggest that adults may be predators and/or scavenging carnivores and several species have been reported as "parasites" on various marine fishes. Two species have been reported from California waters, *T. quinicornis* Delaney and Brusca, 1985 and *T. glutacantha* Delaney and Brusca, 1985. Richardson's (1905) record of *T. virginiana* Richardson, 1900 from Santa Barbara Island (*Albatross* Station 4417) almost certainly was based on *T. quinicornis*.

Literature. Richardson, 1905; Menzies, 1962; Schultz, 1969; Kussakin, 1979; Bruce, 1984; Delaney and Brusca, 1985; Delaney, 1990.

Tridentella glutacantha Delaney and Brusca, 1985

Figures 1.14 and 1.15

Description of male. Dorsum highly sculptured. Cephalon with frontal margin produced into large upturned process, and smaller ventrally projecting rostrum that meets the broad frontal lamina. Clypeus short and very broad. Labrum small, partly encompassed by clypeus. Antennular flagellum of 16-17 articles, extending to middle of pereonite I. Antennal flagellum of 25-28 articles, extending to posterior margin of pereonite IV. Maxilliped with large endite, extending to apical palp article and bearing 5-6 coupling spines. Dorsum of pereonite I with 3 large processes; all pereonites with numerous dorsal tubercles, increasing in size posteriorly, becoming spinelike on posterior pereonites and pleon, and extending onto coxae. Pereonites III-VII and all pleonites with row of large tubercles along posterior margin, these also increasing in size posteriorly. Coxal plates large, increasing in size posteriorly and extending beyond posterior margins of their respective pereonites; coxal plates with 2 oblique carinae, increasing in size posteriorly. Large, unfused penes on sternite of pereonite VII, extending nearly to pleonite 2. Pleotelson with longitudinal rows of large spinelike tubercles. Uropods extending barely beyond posterior margin of pleotelson; endopod width about 2 times exopod width; endopod longer than exopod.

Description of female. The female of this species is generally much less spinose than the male, lacks the pronounced large upturned process of the frontal margin and the horns of the cephalon and pereonite I.

Remarks. This species appears to inhabit both rock and mud bottoms. *T. glutacantha* is easily recognized by its 3 large cephalic horns, and 3 large hornlike tubercles on pereonite I. Only the northwest Pacific species *T. cornuta* is similarly horned; however, *T. cornuta* lacks the robust spination of *T. glutacantha*. The MMS primary voucher material includes 1 male, 7, females, 1 manca, and 1 postmanca. The secondary voucher specimen is an intersex individual (but not a mid-molt individual), with a female cephalon and pereonite I, minute penes, well-developed appendix masculina, and typical male pleon. *T. glutacantha* can be quickly distinguished from its California congener *T. quinicornis* by the dorsal cuticular spines (lacking in the latter) and by the dorsal cephalic processes of males (2 posterolateral horns, plus a large rostrum in the former; 5 small cephalic processes in the latter).

Distribution. *T. glutacantha* is known from central California (Farallon Is.) to Los Angeles. Previous known records for *T. glutacantha* were based solely on the type series, which was from near the Farallon Islands (bottom dredge on green mud; 128 to 231 m), near Catalina Island (loose rock bottom; 304 to 310 m), and near the Los Angeles breakwater light (large boulders; 320 to 360 m).

Literature. Delaney and Brusca, 1985.

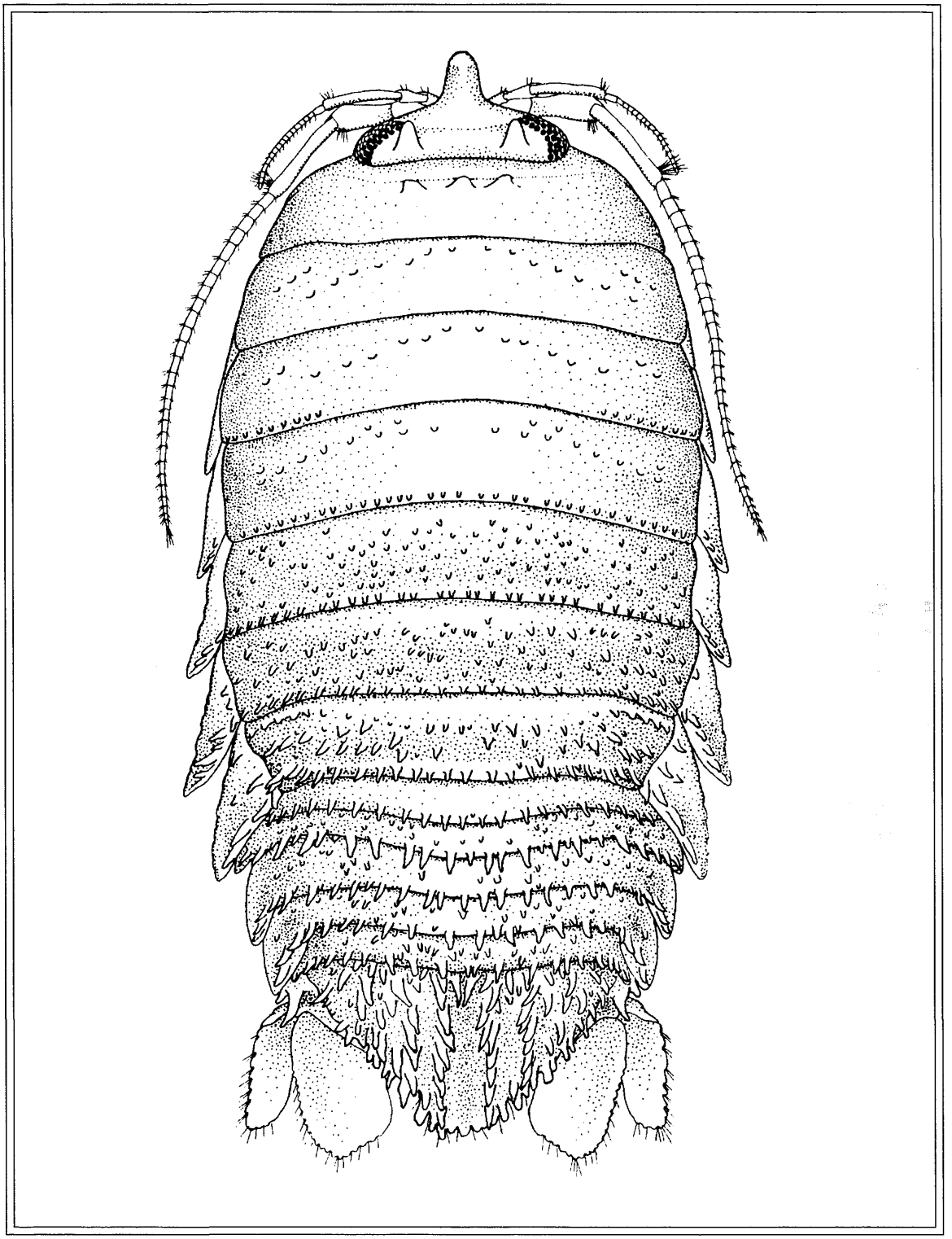

Figure 1.14. *Tridentella glutacantha* Delaney and Brusca, 1985. Holotype CASIZ 025948 (male). California, Los Angeles Co., off Los Angeles breakwater light, loose rock, 320-360 m, 1953, coll. R/V *Velero IV*, Sta. 2413-53.

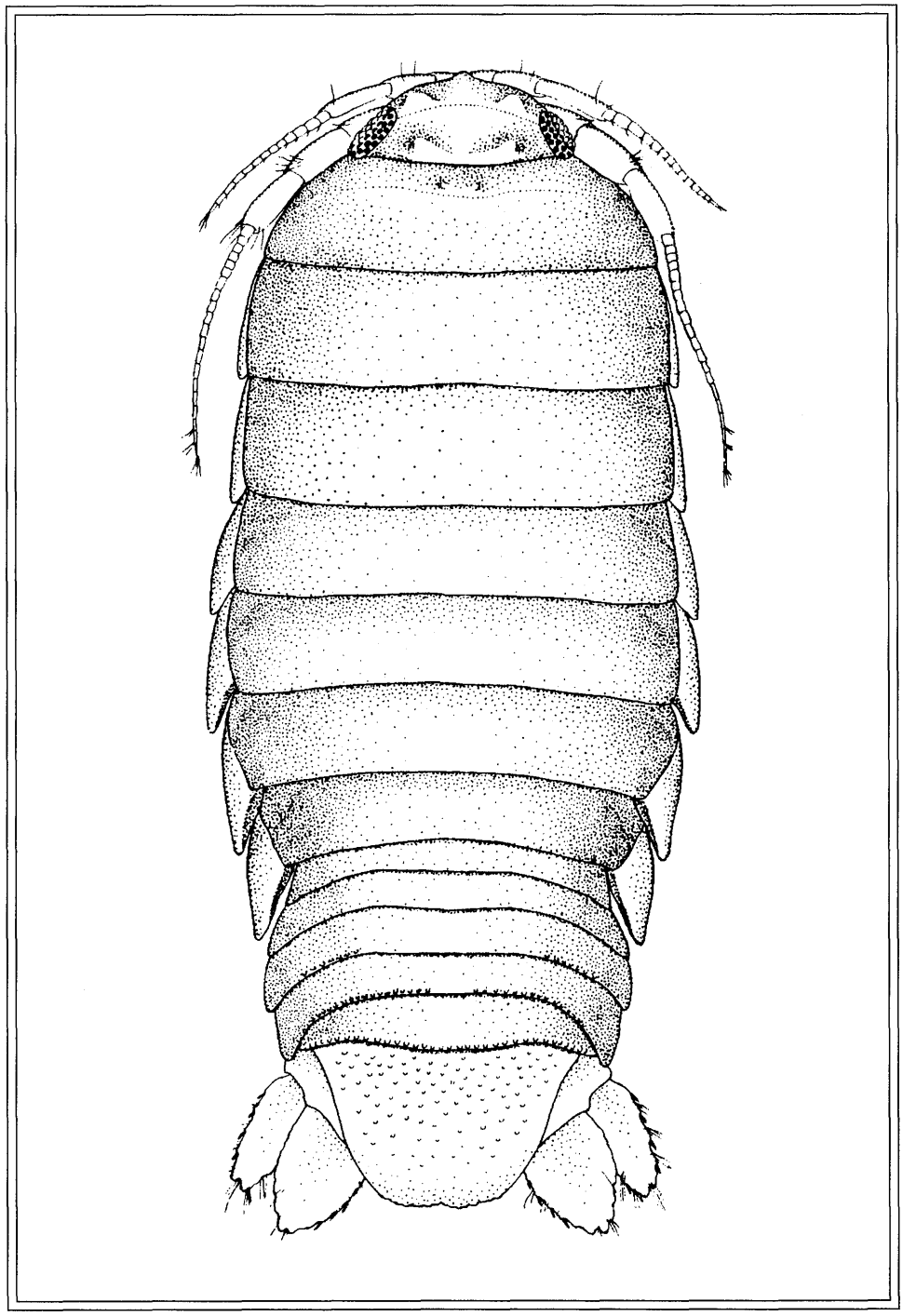

Figure 1.15. *Tridentella glutacantha* Delaney and Brusca, 1985. Allotype LACM 53-113.1 (female). California, Los Angeles Co., Santa Catalina Island, loose rock bottom, 304-310 m, 18 May 1941, coll. R/V *Velero III*, Sta. 1323-41.

Suborder Gnathiidea Leach, 1814

Description. Eyes usually well-developed, in some species on short processes (ocular lobes, or ocular peduncles). Cephalon in males broad and flattened, often with tubercles or bosses; cephalon in females small and narrow. Antennular peduncle 3-articulate, (rarely 2-articulate), usually with well-developed flagellum. Antennal peduncle 5-articulate; both antennules and antennae uniramous, without a scale. Males with rudimentary maxillae and greatly enlarged mandibles (reminiscent of certain ant or termite castes); mandibular palp absent. Females without mandibles or maxillae. Both sexes with only 6 free pereonites and 5 pairs of pereopods. Female pereon large and rotund, with pereonites III-V partly or largely fused. Pereonite I entirely fused with cephalon in males, its pereopods forming a second pair of maxillipeds (the pylopods) that cover the buccal field. Pereonite I only partly incorporated into the cephalon in females, but first pereopods still form a second pair of maxillipeds (pylopods). In both sexes pereonite VII is greatly reduced and lacking pereopods (in males pereonite VII is narrow and the same width as the pleonites, in females pereonite VII is generally not discernible). Pleon abruptly narrower than pereon, with 5 free pleonites plus pleotelson. Pleopods tend to be simple, saclike structures, often without marginal setae, the rami positioned side-by-side (rather than as flattened overlapping plates as in most other isopods). Pleotelson triangular or T-shaped. Uropods biramous and attached laterally to form a "tail fan" in conjunction with pleotelson.

Remarks. The reduced number of pereonites and pereopods, unusual male mandibles (which are not used in feeding), and distinctive pleotelson, quickly distinguish gnathiids. Females incubate their embryos internally, and when gravid nearly the entire body cavity is filled with developing embryos, the internal organs being hardly discernible. Gnathiids occur from the littoral zone to the deep sea, and they are often quite numerous in shallow soft-bottom benthic samples. Adults probably do not feed, and they are often found in association with sponges. Adults are benthic but the juvenile stage (the "praniza") is a temporary parasite on marine fishes, although they are also often collected free-living in benthic samples. Praniza are good swimmers, whereas adults apparently have only limited swimming capabilities. The mouth parts of praniza are styliform, with acute anteriorly-projecting mandibles. Data are not yet available to allow identification of females and juveniles to species, and the taxonomy of this suborder is based entirely on males. About 125 species, in one family, and 10 genera, have been described. Only *Gnathia* is known from California waters.

Literature. Richardson, 1905; Monod, 1926; Menzies and Barnard, 1959; Menzies, 1962; Miller, 1975; Holdich and Harrison, 1980; Juilfs and Wägele, 1987; Wägele, 1987; Camp, 1988.

Genus *Gnathia* Leach, 1814

Description. Gnathiids with male pylopod 2- or 3-articulate, the first article being large and operculate, with the outer (straight) margin much longer than the second article, and the third article (if present) much smaller than the second article.

Remarks. The MMS survey recovered 4 of the 8 species known to occur in California waters. The following key allows for the identification of all known California species.

Literature. See above.

Key to the California Species of *Gnathia* (adult males)

1A. Pleotelson triangular or subtriangular in outline 2

1B. Pleotelson T-shaped 5

2A. Mandible with large, distinct tooth on outer margin; no epimeres visible on pleonites in dorsal aspect 3

2B. Mandible without an outer tooth, or with a minute weakly-developed outer tooth; pleonites with weak or distinct epimeres, either small, truncate, and ventrally directed, or subacute and laterally directed 4

3A. Frontal margin of cephalon with pronounced medial lobe, larger than other frontal lobes; mandible with large outer tooth, and with small scooplike inner region bearing a crenulate margin; dorsum of cephalon not tuberculate; pereon more-or-less straight-sided (pereonites all about same width); eyes may be on ocular lobes ..... *Gnathia steveni*, Menzies, 1962

3B. Frontal margin of cephalon with medial lobe no larger than other lobes; mandible with modest outer tooth, and with broad scooplike inner region with several large marginal cusps; dorsum of cephalon weakly tuberculate; pereon tapering posteriorly (pereonites narrowing posteriorly); eyes never on lobes or stalks ..... *Gnathia tridens*

4A. Without eyes; frontal margin of cephalon trilobed; pleonal epimeres small, truncate, and ventrally-directed ..... *Gnathia coronadoensis*, Schultz, 1966

4B. With eyes; frontal margin of cephalon not lobed, but minutely crenulate; pleonal epimeres subacute, laterally directed ..... *Gnathia crenulatifrons*

5A. Eyes set on distinct ocular peduncles; frontal margin of cephalon 4-lobed; pleonal epimeres in double pairs (a pair of ventrally-directed and a dorsally-directed epimeres on each pleomere) ..... *Gnathia clementensis*, Schultz, 1966

5B. Eyes not on ocular peduncles; frontal margin of cephalon 1 or 3-lobed; pleonal epimeres in single pairs (double pairs may be present in *Gnathia sanctaecrucis*) 6

6A. Pleonal epimeres occur as doublets (2 pairs of epimeres, a dorsal and a ventral, on each pleonite); frontal margin of cephalon produced into a single large lobe; dorsum of cephalon (and entire body) strongly hirsute; pleotelson with a pair of large subapical setae; pleonal epimeres truncate ..... *Gnathia sanctaecrucis*

6B. Pleonal epimeres occur as a single pair on each pleonite; frontal margin of cephalon trilobed; dorsum of cephalon weakly hirsute; pleotelson with or without a pair of subapical setae; pleonal epimeres subacute 7

7A. Mandible outer margin without crenulations or setae; pleotelson without a pair of large apical setae ..... *Gnathia trilobata*, Schultz, 1966

7B. Mandible outer margin with setose crenulations; pleotelson with a pair of large subapical setae (not set side-by-side in transverse line, but off-set from one another) ..... *Gnathia productatridens*

Gnathia crenulatifrons Monod, 1926

Figure 1.16

Description of male. Body about 3.3 to 3.7 times as long as broad; sides parallel. Eyes present, never on lobes or peduncles. Frontal margin of cephalon broad, slightly convex, minutely crenulate, not produced into distinct lobes. Inner margins of mandibles with 3 teeth, sometimes obliterated; tooth on outer margin weakly developed. Pylopods 3-articulate. Body with distinct separation between free pereonites II and III. Pleonal epimeres subacute, laterally directed.

Distribution. Santa Cruz Point, Monterey Bay to Pt. Loma, San Diego County, 9 to 1300 m; coastal shelves, slopes, and submarine canyons. This species has been collected by the City of San Diego Ocean Monitoring Program at Pt. Loma, thereby extending its known range. Specimens have been collected from gray sand, green mud, and green mud with hydrogen sulfide. MMS survey voucher material was examined from PJ-7 and PS-14.

Literature. Monod, 1926; Menzies and Barnard, 1959; Schultz, 1964, 1966; Iverson, 1974.

Gnathia productatridens Menzies and Barnard, 1959

Figure 1.17

Description of male. Body about 3 to 3.5 times as long as broad, sides parallel. Eyes present, never on lobes or peduncles. Dorsum of cephalon tuberculate; frontal margin produced, trilobed. Inner margins of mandibles with 4-5 small teeth; outer margins with a series of 3-5 setose crenulations. Pylopod 3-articulate, distal article minute. Pleon small. Pleotelson with a pair of submedian subapical setae (not set side-by-side in transverse line, but off-set from one another).

Distribution. Until this time, this species had been reported from Point Conception to the Southern California Bight in 20 to 164 m. The type material is from green silt. MMS survey voucher material was examined from station R-5.

Literature. Menzies and Barnard, 1959.

Gnathia sanctaecrucis Schultz, 1972

Figure 1.18

Gnathia hirsuta Schultz, 1966 (not *G. hirsutus* of G.O. Sars, 1870).

Description of male. Body about 3 to 3.75 times as long as broad. Cephalon wider than long, covered with many dorsal tubercles; frontal margin with acutely rounded medial projection and some lateral crenulations. Eyes present, never on ocular peduncles or lobes. Maxilliped with many plumose setae along lateral margin; endite with 2 coupling spines. Pylopod 3-articulate, apical article minute. Mandible acutely pointed with few inner teeth and with smooth, toothless outer margin. Entire body, especially anterior pereonites, covered with long hairlike setae. Each pleonite with 2 pairs of lateral epimeres, a dorsal and a ventral pair on each side; pleonites with stiff, hairlike setae arising from posterior margin. Pleotelson long, with 2 pairs of large submedian setae, one apical pair and one subapical pair. Uropodal rami both with large plumose setae; endopod slightly longer than exopod and just reaching posterior margin of pleotelson.

Remarks. Schultz (1966) originally described this species as *Gnathia hirsuta* (as it also appears in his 1969 handbook). This name, however, was preoccupied (*Gnathia hirsutus* G.O. Sars, 1870), and in 1972 Schultz proposed the new replacement name, *Gnathia sanctaecrucis*, for this species.

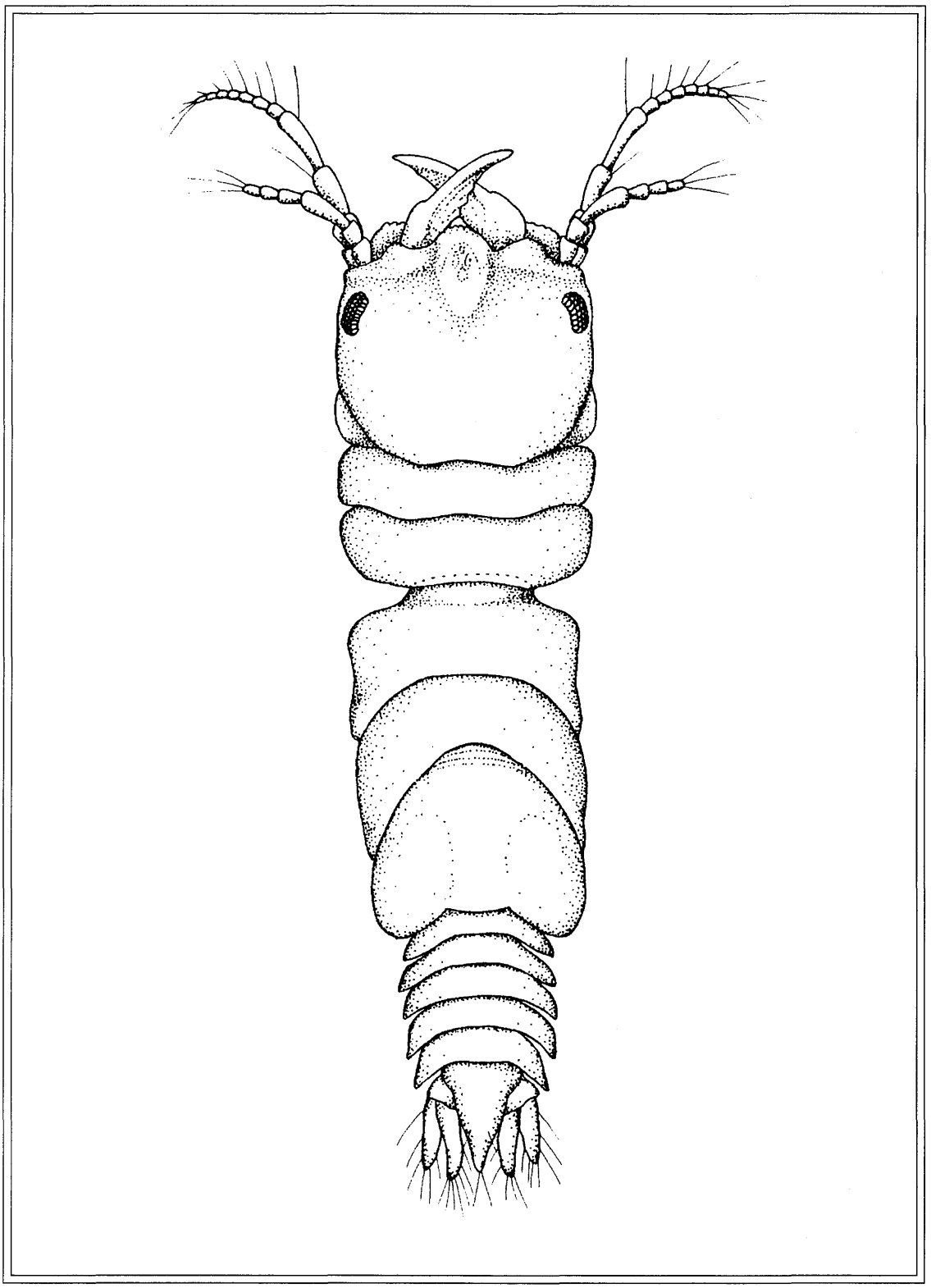

Figure 1.16. *Gnathia crenulatifrons* Monod, 1926. Male. California, San Diego, Co., off Pt. Loma outfall, 05 October 1989, coll. Pt. Loma Biology Lab, Sta. A-5, SDNHM A.0114

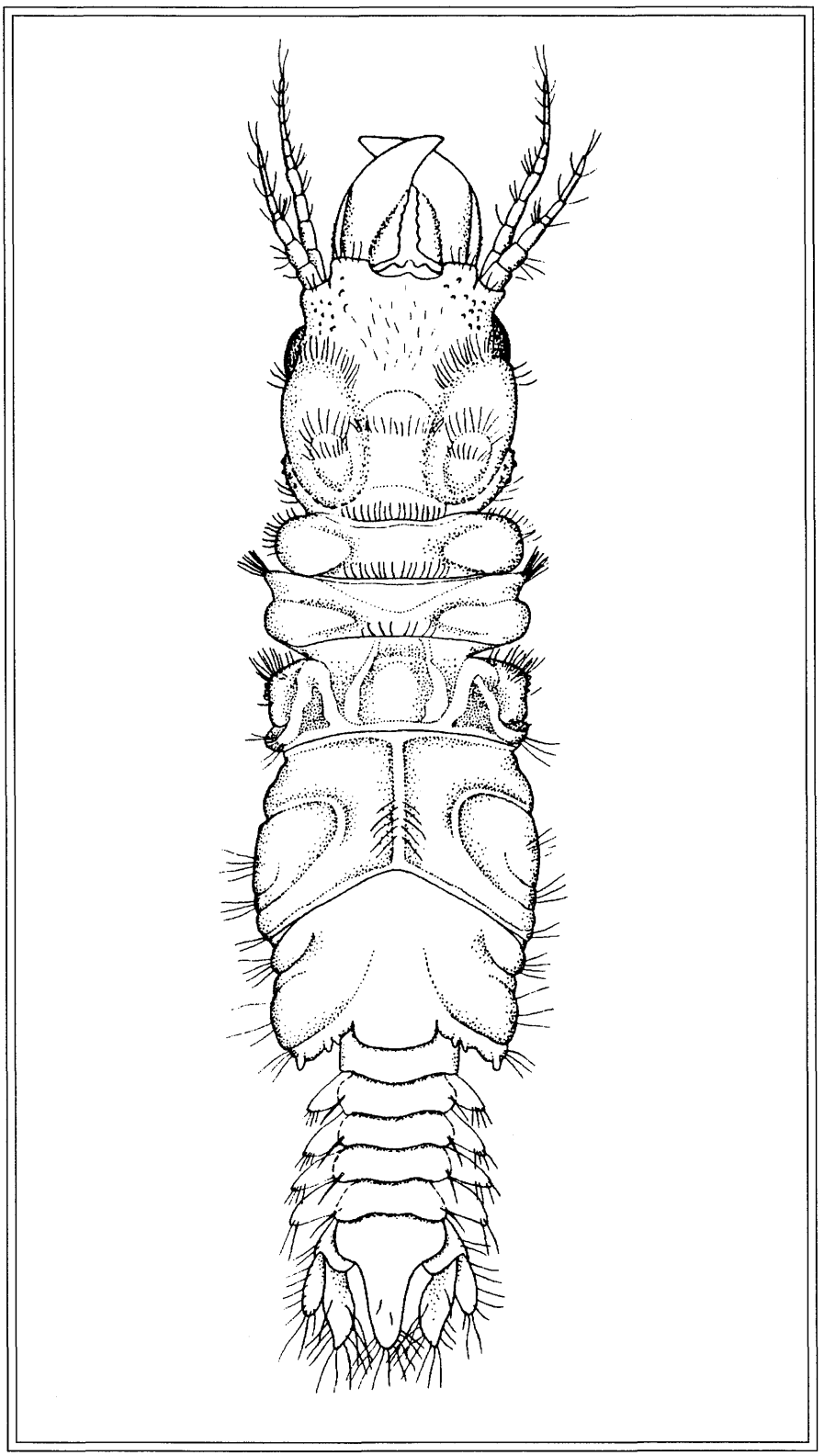

Figure 1.17. *Gnathia productatridens* Menzies and Barnard, 1959. Holotype AHF 5712 (male). California, Santa Barbara Co., off Santa Barbara Pt. Light, green silt, 89 m, 03 July 1957, coll. R/V *Velero IV*, Sta. 5173-57.

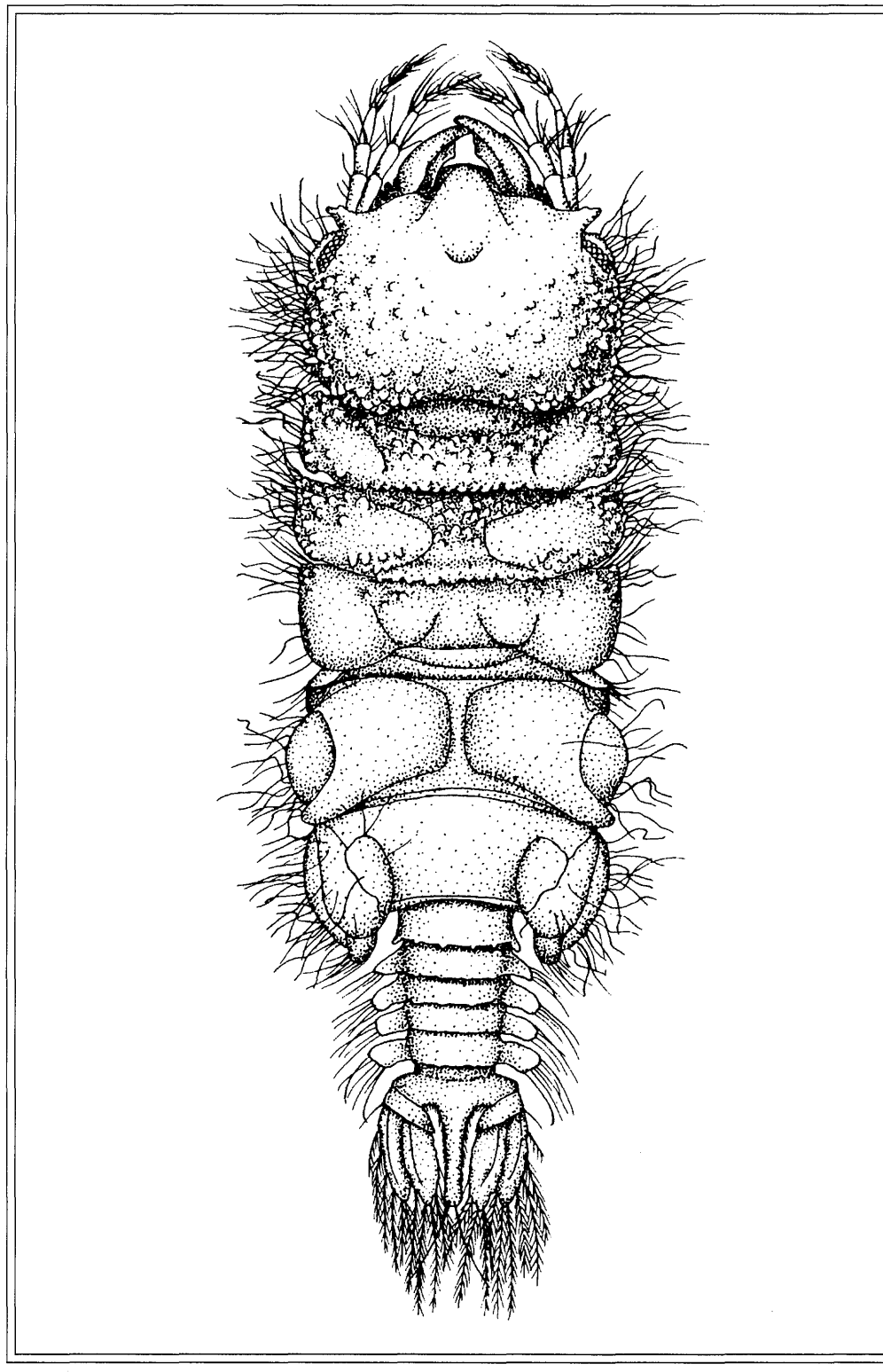

Figure 1.18. *Gnathia sanctaecrucis* Schultz, 1972. Holotype AHF 5927 (male). California, Channel Islands, Santa Cruz Channel, green sand, 201 m, 22 December 1959, coll. R/V *Velero IV*, Sta. 6805-59.

Distribution. Santa Maria Basin to Southern California Bight. The type material is from Santa Cruz Canyon, from a depth of 218 m and a bottom substratum characterized as rocks and green sand.

Literature. Schultz, 1966, 1972.

Gnathia tridens Menzies and Barnard, 1959

Figures 1.19 and 1.20

Description of male. Body about 2.5 to 3.1 times longer than broad, tapering in width posteriorly. Eyes present, never on lobes or peduncles. Mandible outer margin with modest-sized tooth, without crenulations; inner margin with 6-7 small teeth. Pylopod 3-articulate. Dorsum of cephalon weakly tuberculate; frontal margin produced, trilobed. Body separated or not separated between free pereonites II and III. Pleotelson with pair of submedian subapical setae, and pair of submedian apical setae.

Distribution. Specimens of this species have been collected from Point Conception (11 to 27 m) and San Clemente (14 m). The type material was from a benthic sample containing dead kelp fragments and red algae.

Literature. Menzies and Barnard, 1959.

Suborder Valvifera G.O. Sars, 1882

Description. Antennular peduncle 3-articulate, uniramous (without a scale), flagellum reduced to one or a few vestigial articles. Antenna uniramous, peduncle 5-articulate, flagellum multiarticulate or uniarticulate. Frontal lamina, clypeus, and labrum well-developed; mandible with or without 3-articulate palp. Maxillipedal palp of 3-5 articles. Coxal plates prominent. Vas deferens (and penes) of male opening on pleonite 1 or on articulation of pleonite 1 and pereonite VII (rather than on the thorax, as in all other marine isopods). Pleonites variously fused, of 4 or fewer free segments (plus the pleotelson). Uropods biramous or uniramous, attached laterally on pleotelson, but modified as ventral opercular plates covering pleopods.

Remarks. The suborder is composed of 7 families. Valviferans are characterized by the absence of mandibular palps (except in Hognathidae); the presence of penes on pleonite 1; the unique possession of uropods opercular to the pleopods; flagellum of antennule reduced to 1 or a few vestigial articles; pleon of 4 or fewer free somites (plus the pleotelson); uropods biramous or uniramous. Thirty-two species are known to occur in California waters, representing 3 families. The MMS survey recovered 4 species from 2 families.

Literature. Sheppard, 1957; Miller, 1975; Brusca, 1984; Poore, 1985; Poore and Lew Ton, 1990.

Key to the California Families of Valvifera

1A Body cylindrical, often geniculate, flexed between pereonites IV and V; anterior pereopods setose for feeding, posterior pereopods ambulatory; pereonite IV manifestly enlarged or elongated; first pleopods of males with accessory gonopod; cephalon usually fused medially to pereonite I ..... Arcturidae

1B. Body not cylindrical or geniculate; pereopods not as above; pereonite 4 not as above; first pleopods of males without accessory gonopod; cephalon not fused medially to pereonite I ..... Idoteidae

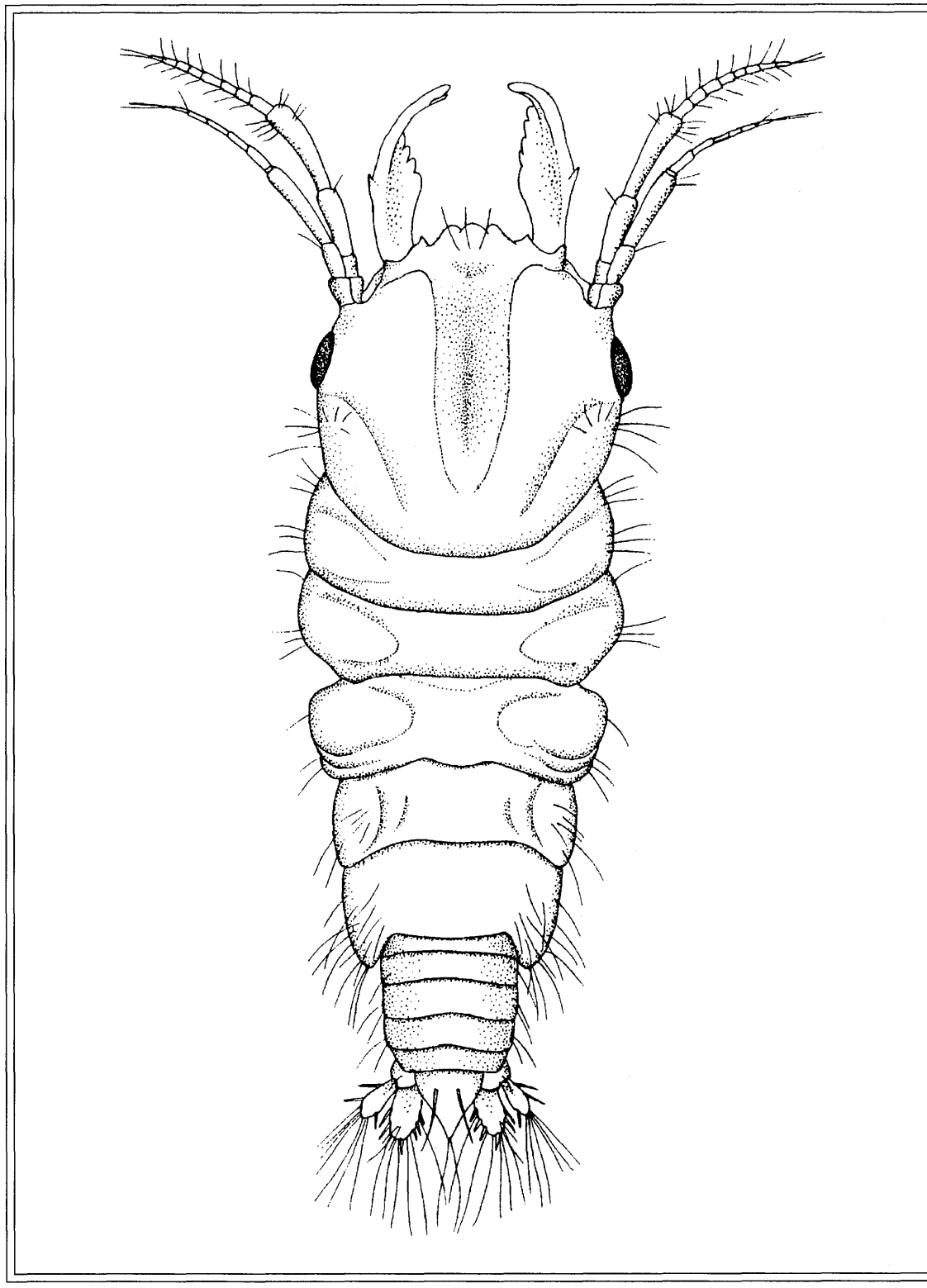

Figure 1.19. *Gnathia tridens* Menzies and Barnard, 1959. Holotype AHF 5711 (male). California, Santa Barbara Co., off Santa Barbara Point Light, 16 m, 17 January 1957, coll. R/V *Velero IV*, Sta. 4822-57.

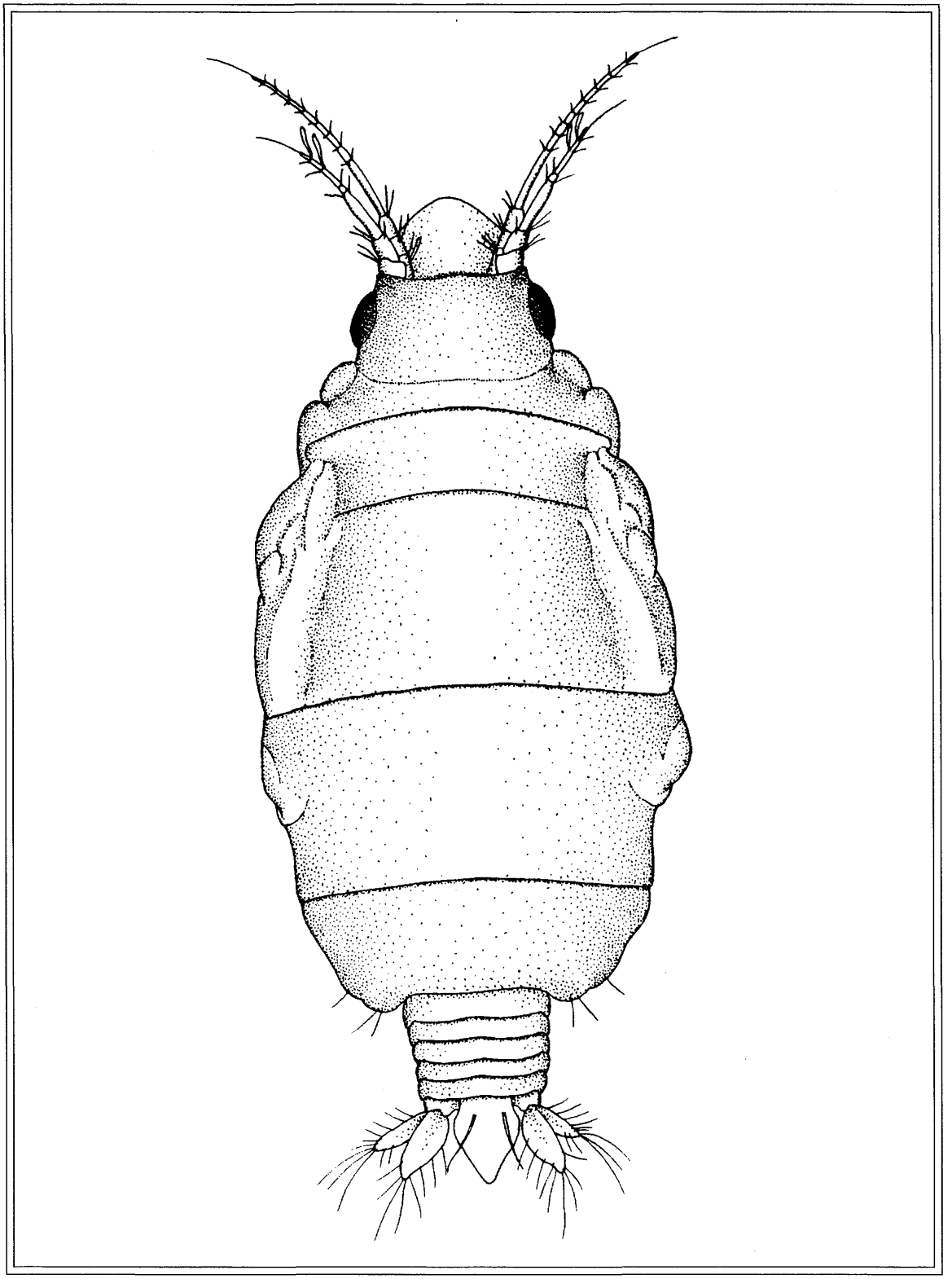

Figure 1.20. *Gnathia tridens* Menzies and Barnard, 1959. Paratype AHF 5711 (female). California, Santa Barbara Co., off Santa Barbara Point Light, 16 m, 17 January 1957, coll. R/V *Velero IV*, Sta. 5164-57.

Family Arcturidae G.O. Sars, 1897

Astacillidae G.O. Sars.

Description. Body cylindrical or tubular, often geniculate (bent between pereonites IV and V, except in *Pleuroprion, Neoarcturus* and *Idarcturus*). Antennal flagellum either 2- to 3-articulate (*Astacilla, Neastacilla, Arcturella, Pleuroprion, Arcturopsis, Arcturina, Neoarcturus, Pseudarcturella* and *Idarcturus*) or of many articles (most other genera). Mandible without palp. Pereonite I either distinct, or completely or incompletely fused with cephalon. Pereonite IV generally manifestly enlarged or elongated. Pereopods I-IV directed anteriorly and setose for feeding; pereopods V-VII directed posteriorly and ambulatory. Male pleopod 1 with elongated peduncle and accessory appendix masculina. Uropods usually biramous, with minute endopod concealed by larger exopod. Sexual dimorphism often marked.

Remarks. Four species, representing three genera of astacillids occur in California waters: *Microarcturus* Nordenstam, 1933, *Neastacilla* Tattersall, 1921, and *Idarcturus* Barnard, 1914. The MMS survey recovered one species.

Literature. G.O. Sars, 1897a; Richardson, 1905; Nordenstam, 1933; Sheppard, 1957; Menzies and Barnard, 1959; Brusca, 1984.

Genus *Idarcturus* Barnard, 1914

Description. Body not geniculate. Cephalon fused with pereonite I, sutures visible laterally. Only distalmost flagellar article of antennule with aesthetascs. Antennal flagellum 2-articulate; flagellum shorter than 5th peduncular article; flagellum often 4-articulate in male. Maxillipedal palp usually 5-articulate. Pereonite IV longer than others. All pleonal segments fused into one piece. Penes fused in male.

Remarks. The original diagnosis of the genus is superficial at best and has not been revised since it was created.

Literature. Barnard, 1914; Nordenstam, 1933; Menzies and Barnard, 1959.

Idarcturus allelomorphus Menzies and Barnard, 1959

Figures 1.21 and 1.22

Description. Eyes lateral and bulging. Antennules not reaching third antennal peduncular article. Cephalon indistinguishably fused with pereonite I, narrow, lateral margins nearly parallel, with two prominent horns located medially just slightly posterior to eyes. Maxilliped with 2 coupling spines; palp 5-articulate. Pereonites II-VII, each with 1 pair of spines set medially on dorsum near posterior margin of each pereonite; pereonites V-VII also with paired lateral spines. Pereopod V dactyl with secondary unguis, in some specimens often badly worn or sometimes completely absent. Pleon with 1 pair of medial spines. Lateral margins of pleotelson with 2 posteriorly directed medium-sized, angulate spines; posterior margin produced, apex blunt.

Remarks. *I. allelomorphus* is easily distinguished from *I. hedgpethi* Menzies, 1951, its only congener in California waters, by its comparatively weakly ornamented dorsum and longer cephalon. *I. hedgpethi* is easily distinguished by the large triangulate anterolateral extensions on pereonites I-VI and large acute posterolateral spines on pereonites IV-VI.

Distribution. Monterey to Pt. Loma (San Diego County), including Cortes and Tanner Banks; 12 to 92 m. A common mud bottom species. MMS survey voucher material was examined from station R-5. This species has been collected by the City of San Diego Ocean Monitoring Program at Pt. Loma, thereby extending its known range.

Literature. Menzies and Barnard, 1959.

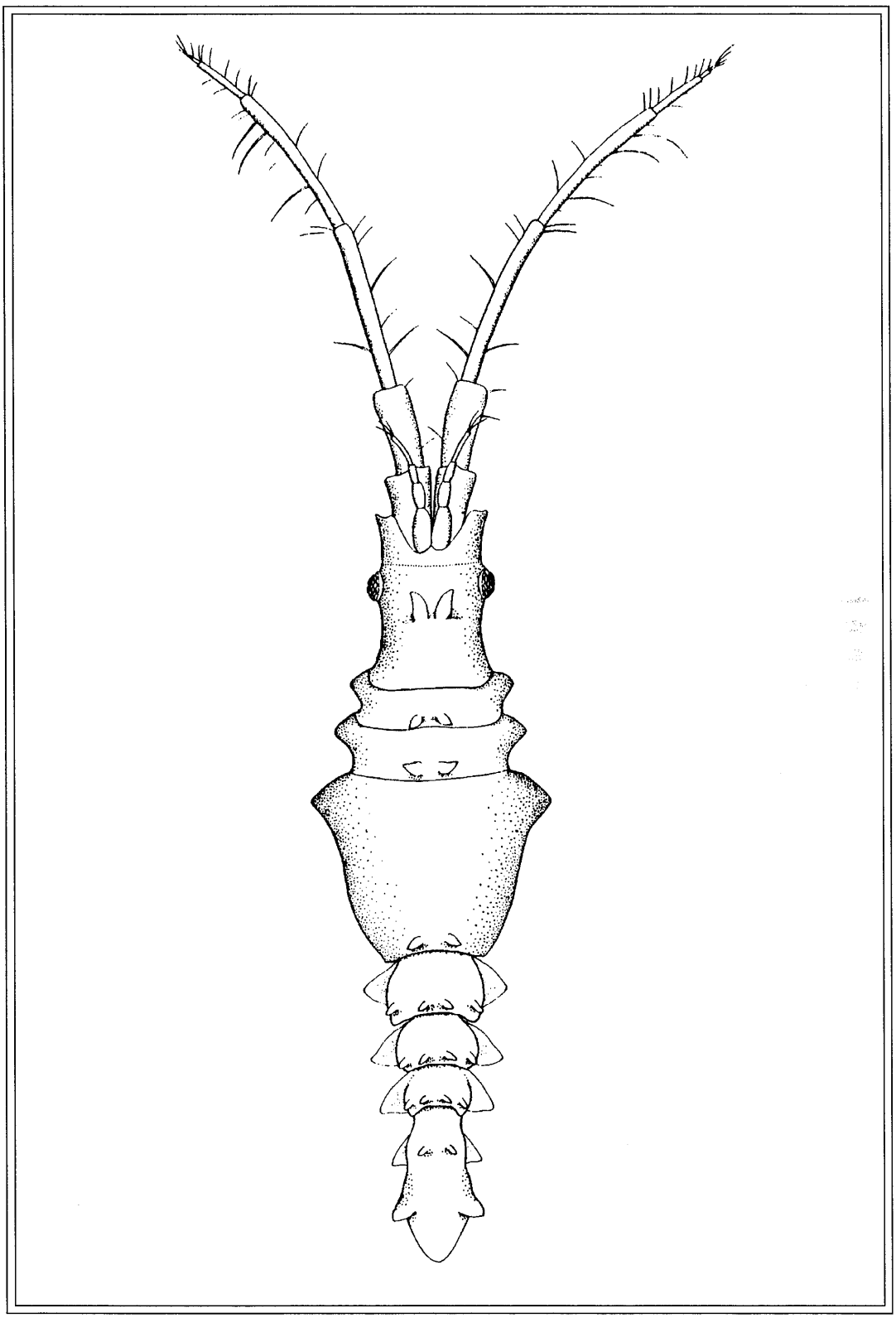

Figure 1.21. *Idarcturus allelomorphus* Menzies and Barnard, 1959. Holotype AHF 5713. California, Santa Barbara Co., off Goleta, medium-coarse gray sand, 17 m, 09 April 1957, coll. R/V *Velero IV*, Sta. 4938-57.

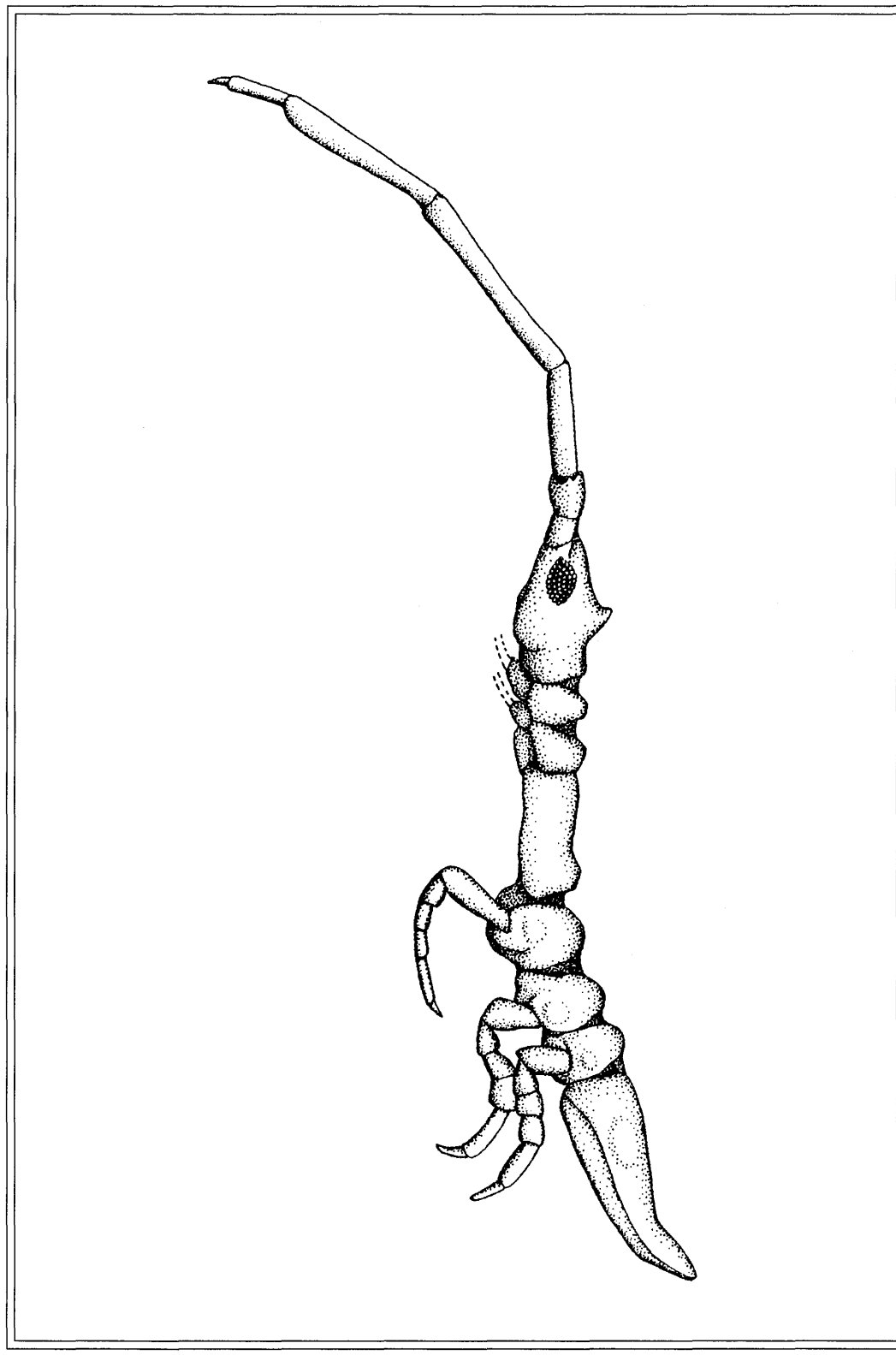

Figure 1.22. *Idarcturus allelomorphus* Menzies and Barnard, 1959. California, San Diego Co., off Bird Rock, 32°49.25'N, 117°19.60'W, sandy silt, 60 m, 19 October 1989, coll. Pt. Loma Biology Lab, Sta. B-5, SDNHM A.0014.

Family Idoteidae Fabricius, 1798

Description. Body slightly to strongly depressed. Cephalon not fused medially to pereonite I. Antennules usually shorter than antenna, and with flagellum reduced to 1-4 minute articles. Antennal flagellum either multiarticulate, reduced to one or a few vestigial articles, or reduced to a large clavate article (occasionally with minute terminal articles). Mandible without palp. Maxillipedal palp of 3-5 articles. Coxal plates usually splayed, ovate, sometimes reduced. Pereopods subequal in length, ambulatory; pereopods I-III more or less anteriorly directed; pereopods IV-VII more or less directed posteriorly. Pleonites tend to fuse; pleon with at most 3 pleonites defined laterally, 2 or fewer articulating or marked dorsally; all pleonites fused in some genera. Pleopods 1 and 2 with short apical plumose marginal setae. Uropods uniramous or biramous. Penes fused basally, or rarely free at base (only in *Idotea* and *Lyidotea*).

Remarks. Idoteids are some of the most common isopods of temperate waters, but they are rare in tropical seas. Most occur in shallow water, and few species are found at depths greater than 30 m. Idoteids usually live somewhat solitary lives. They are omnivores, many feeding primarily on the marine plants to which they cling. Several species which are known to occur on red, green and brown marine plants are capable of undergoing color change when transferred to plants of another color. This phenomenon has been documented for the California species *Idotea resecata* Stimpson, 1857 and *I. montereyensis* Maloney, 1933. Twenty-seven species of idoteids, in 6 of the 26 known genera, have been reported from California waters. Some of those ranging into the Pacific Northwest are included in Kozloff's (1987) key to the idoteids. Three species in 2 genera, were recovered by the MMS survey.

Literature. Richardson, 1905; Menzies, 1950a; Sheppard, 1957; Menzies and Barnard, 1959; Lee, 1966a, b, 1972; Lee and Gilchrist, 1972, 1975; Brusca and Wallerstein, 1979a; Wallerstein and Brusca, 1982; Brusca, 1983, 1984; Kozloff, 1987.

Key to the Genera of Idoteidae Collected as part of the MMS Surveys

1A. Maxillipedal palp 4- or 5-articulate; pleon with 3 discernible pleonites, with lateral sutures present at base of pleotelson ..... *Idotea*

1B. Maxillipedal palp 3-articulate; pleon with all pleonites fused, with 1 distinct pair of anteriorly placed lateral incisions (or lateral incisions barely discernible) ..... *Synidotea*

Genus *Idotea* Fabricius, 1799

Description. Antennal flagellum multi-articulate. Maxillipedal palp composed of 4 or 5 articles. All coxal plates except the coxal plate of pereonite I, distinctly separated from pereonites by deep dorsal groove. Pleon three segmented, with lateral sutures present at base of terminal segment, indicating another partly coaslesced segment.

Remarks. Menzies (1950a) synonymized *Pentidotea* Richardson, 1905 with *Idotea* (reducing the former to a subgenus) because he felt that the single character, 4-articulate (*Idotea*) and 5-articulate (*Pentidotea*) maxillipedal palp did not warrant generic status. Recent unpublished studies by G.C.B. Poore suggest this synonymy may be incorrect, and both genera may once again be recognized.

Literature. Richardson, 1905; Menzies, 1950a; Brusca, 1984.

Idotea (Idotea) rufescens Fee, 1926

Figure 1.23

Description. Anterior margin of cephalon very slightly concave, frontal process apically blunt or notched; frontal lamina 1 semicircular and medially shorter than frontal process; frontal lamina 2 not visible in dorsal view. Eyes large, ovoid. Maxilliped with 1 coupling spine; palp 4-articulate. Posterior pleotelson margin concave in outline.

Remarks. *Idotea rufescens* can be distinguished from the closely related species *I. resecata* by its very slightly concave frontal margin (distinctly concave in *I. resecata*), ovoid rather than pyriform eyes, elongate frontal process (apex blunt rather than acute) and more compressed and ovate maxillipedal palp articles in *I. resecata*. Also, the carpus of pereopod VII is considerably longer in *I. resecata* than in *I. rufescens*, with the largest propodal seta located a considerable distance from the inferior proximal angle (in *I. rufescens* the largest propodal seta occurs at the inferior proximal angle).

Distribution. British Columbia to Central California from shallow-water algal habitats, intertidal to 82 m. Specimens have also been collected at Santa Catalina Island. MMS survey voucher material was examined from station R-5.

Literature. Fee, 1926; Menzies, 1950a; Iverson, 1974; Miller, 1975.

Genus *Synidotea* Harger, 1878

Description. Antennal flagellum multiarticulate. Mandible with molar process. Maxillipedal palp 3-articulate. Pleon with all segments fused; with 1 distinct pair of anteriorly placed lateral incision lines or lateral incisions barely discernible. Uropods uniramous.

Remarks. Species in this genus (approximately 40 species worldwide) occur from the littoral zone to depths of nearly 3000 m. Ten species have been reported from California, 2 of which were collected by the MMS survey. A good key to the eastern Pacific species can be found in Menzies and Miller, 1972.

Literature. Benedict, 1897; Richardson, 1905; Iverson, 1972; Menzies and Miller, 1972; Miller, 1975; Brusca, 1984.

Key to Species of *Synidotea* Collected in the Santa Maria Basin

1A. Dorsal maxillipedal region of cephalon slightly raised; inner anterior cephalic tubercles shorter than posterior cephalic tubercles; coxae of pereonite I entire; pleotelson with several (usually 3 or more) minute posterolateral serrations; pleon without clearly discernible lateral incisions; pleotelson convex, spatulate, evenly rounded, widest medially ..... *Synidotea calcarea*

1B. Dorsal maxillipedal region of cephalon with 1 medial tubercle; inner anterior cephalic tubercles taller than posterior cephalic tubercles; coxae of pereonite I notched; pleon with 1 distinct pair of lateral incisions; pleotelson with only 1 or 2 minute posterolateral serrations, straight-sided or weakly convex, widest anteriorly ..... *Synidotea media*

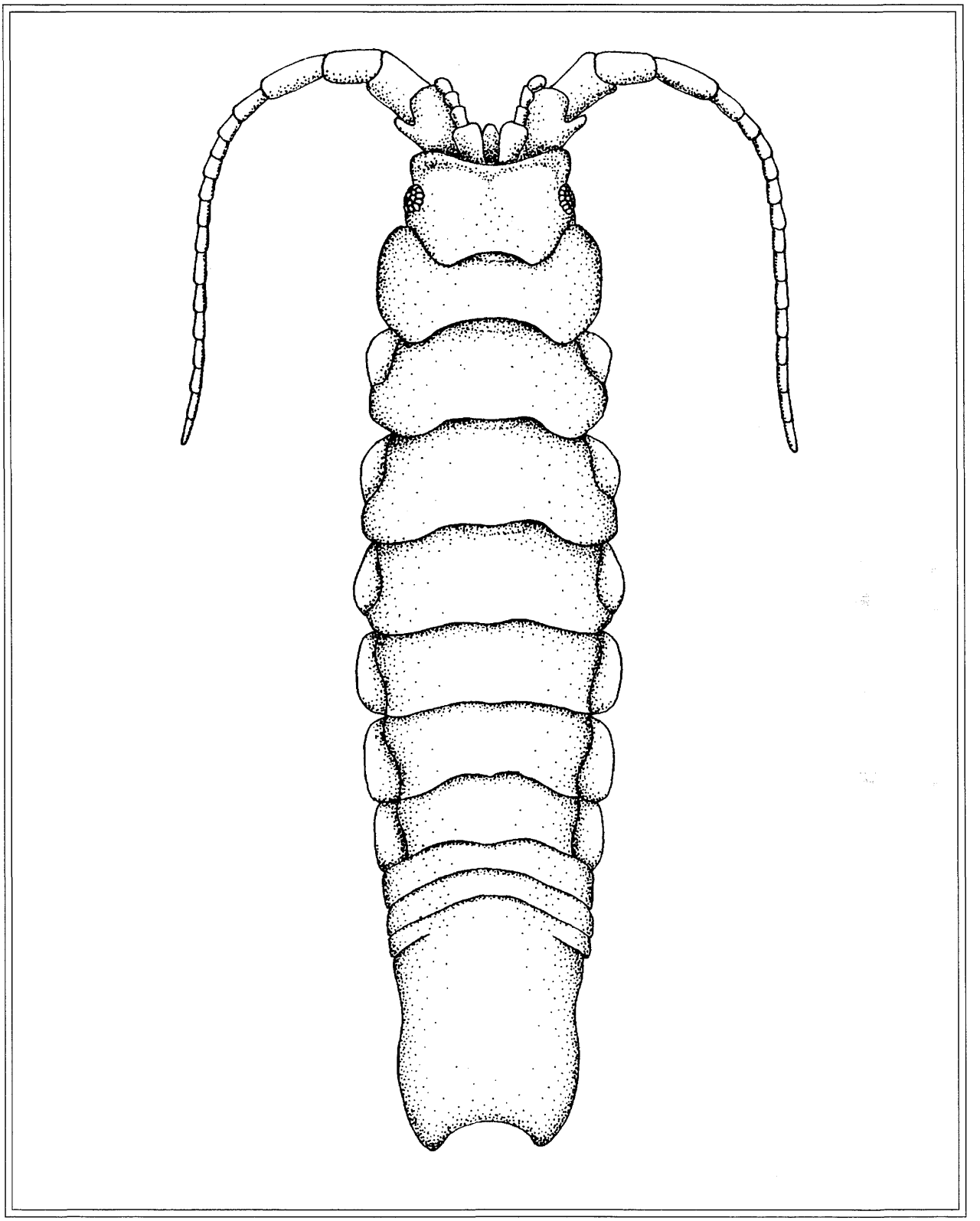

Figure 1.23. *Idotea rufescens* Fee, 1926. Female. Mexico, Baja California, Coronado Is, 08 November 1946, coll. C. C. Hubbs, H46-118, LACM 46-57.1

Synidotea calcarea Schultz, 1966

Figure 1.24

Description. Eyes on very small ocular lobes; lightly pigmented. Cephalon with anterolateral lobes forming shallow, broad, weakly concave frontal margin; each anterolateral lobe with 1 small tubercle near its base; 1 pair of anteriorly-positioned submedian tubercles just behind frontal margin, narrowly rounded, tall; 1 pair of posteriorly-positioned submedian tubercles between eyes, broad and conical. Dorsal maxillipedal region slightly raised. Each pereonite with a tall medial conical tubercle and slightly smaller paired lateral tubercles. Lateral margin of pereonite I coxae entire, not notched. Entire body covered with very fine short setae. Pleon without clearly discernible lateral incisions. Pleotelson convex, widest medially, spatulate, evenly rounded, with several (usually 3 or more) minute posterolateral serrations.

Remarks. *S. calcarea* can be distinguished from the similar appearing *S. magnifica* by its lightly pigmented eyes with few ocelli (eyes darkly pigmented with many ocelli in *S. magnifica*) and the presence of 2 large, conical interocular tubercles on the cephalon (small interocular tubercles in *S. magnifica*).

Distribution. Tanner and Santa Rosa Canyons at depths of 54 to 813 m.

Literature. Schultz, 1966; Iverson, 1972; Menzies and Miller, 1972.

Synidotea media Iverson, 1972

Figure 1.25

Description. Eyes not raised on ocular peduncles or lobes; heavily pigmented. Cephalon with anterolateral lobes forming shallow, broad concave frontal margin; each anterolateral lobe with 1 stout tubercle near its base; 1 pair of anteriorly-positioned submedian tubercles just behind frontal margin, narrowly rounded, tall; 1 pair of posteriorly-positioned submedian tubercles between eyes, large, broad and conical. Dorsal maxillipedal region with 1 medial tubercle. Pereonites I-IV each with 1 anterior and 1 posterior medial tubercle; 1 pair of more laterally-positioned submedian tubercles near posterior margin of pereonite set between lateral concentric ridges and the medial tubercles; pereonites V-VII with less pronounced lateral concentric ridges and 1 medial posteriorly-positioned tubercle. Lateral margin of pereonite I coxa notched. Pleon with 1 distinct pair of anteriorly placed lateral incisions. Pleotelson straight-sided or weakly convex, widest anteriorly; posterolateral margin with 1-2 minute serrations.

Remarks. *S. media* is very similar in appearance to *S. magnifica* and *S. calcarea*; Iverson (1972) provides a table of distinguishing characters.

Distribution. Off Pt. Soberanes, California, 36°25'W to 36°26'N; 183 m. MMS survey voucher material was examined from stations R-4, R-6 and R-8.

Literature. Iverson, 1972; Menzies and Miller, 1972.

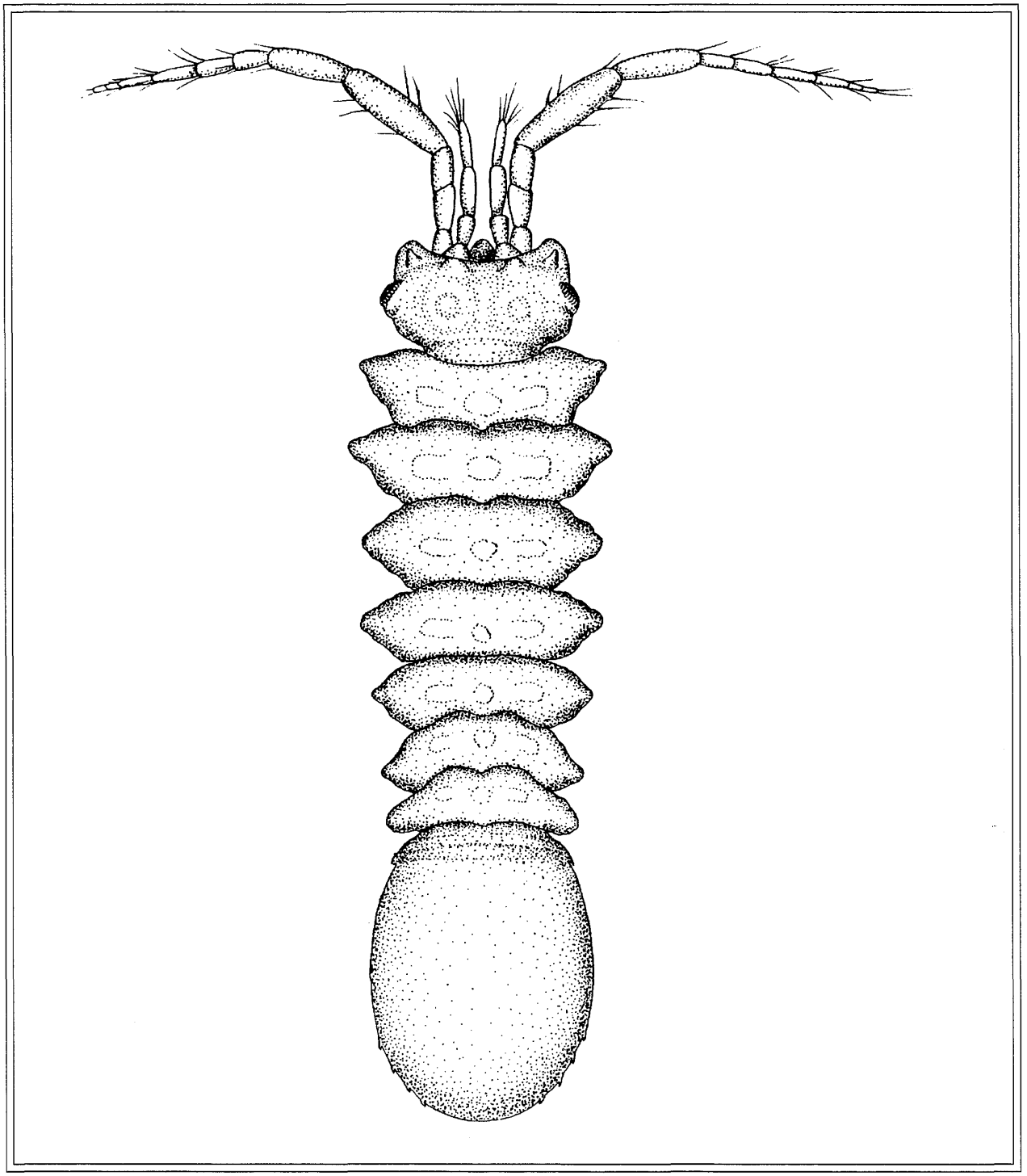

Figure 1.24. *Synidotea calcarea* Schultz, 1966. Holotype AHF 6833-60 (female). California, Channel Islands, Tanner Canyon, San Clemente Island, green muddy sand, 792 m, 19 January 1960, coll. R/V *Velero IV*, Sta. 6833-60.

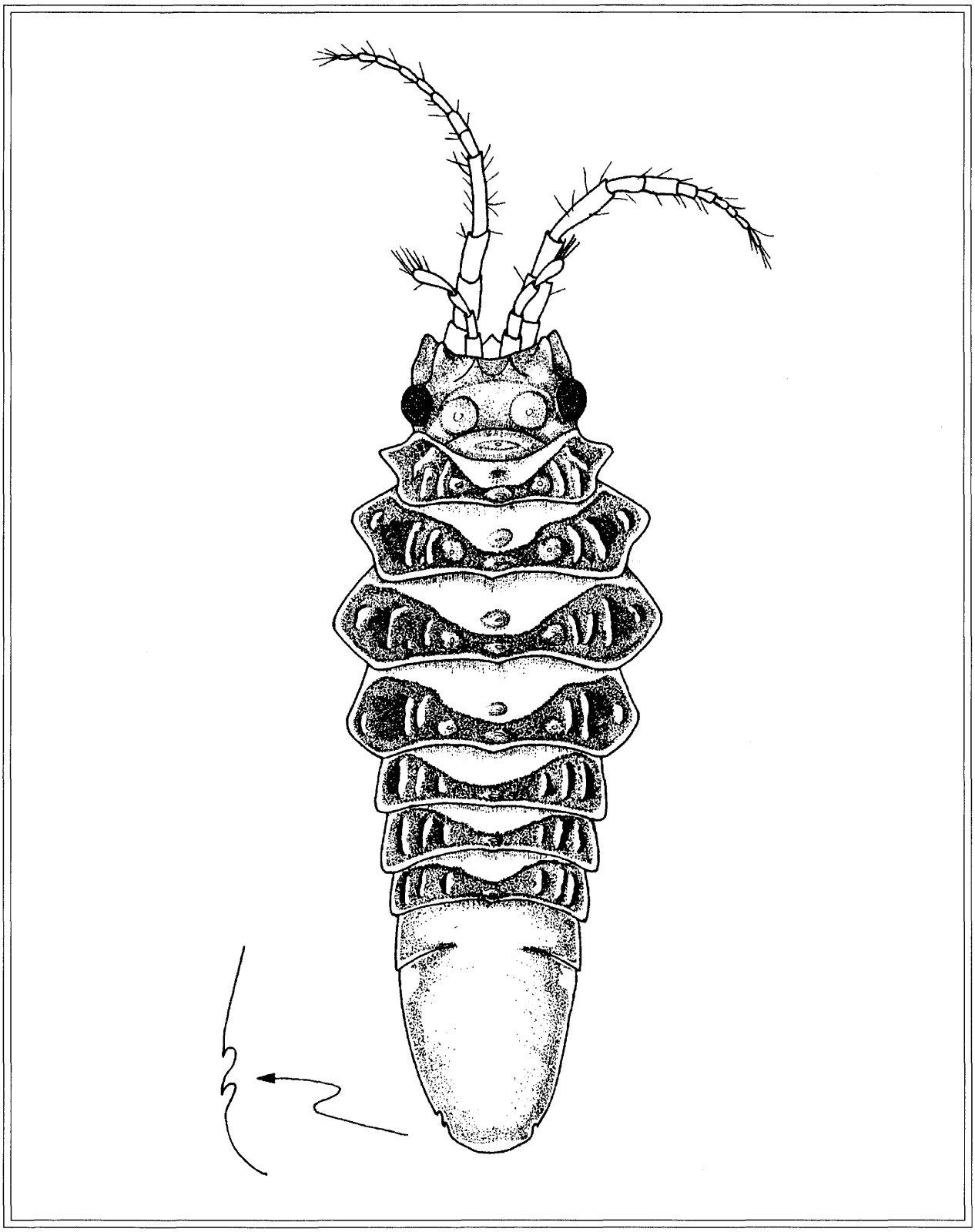

Figure 1.25. *Synidotea media* Iverson, 1972. Holotype CAS 563 (female). California, Monterey Co., off Pt. Soberanes, 183 m, July 1971, coll. R/V *Searcher*.

1.3 The Suborder Asellota

by

George D.F. Wilson[6]

Introduction[7]

The Asellota are the one of the most diverse group of isopod families, comprising approximately 25% of the total. The asellotes have colonized all environments other than the land, which seems to be the domain of the Oniscidea and a few Phreatoicidea. Asellota are, however, most successful and diverse in the deep-sea (Wilson, 1989). This work introduces an interesting assemblage of Asellota from the edge of the deep-sea in the Santa Maria Basin, including depths from the shallow lighted realm down to nearly 1000 meters. As a consequence, species illustrated here have both shallow-water and deep-sea origins.

The Asellota are perhaps the easiest isopods to define owing to their specialized copulatory apparatus. To make it clear what is meant by Asellota, I offer the following list of features as a definition:

1. Pleonites 4-5, and often always pleonite 3, fused to pleotelson, making an enlarged, often wide terminal segment.
2. Pleonites 1-2, and rarely 3, if distinct from pleotelson, are only small rings or cuticular bars visible ventrally.
3. Either pleopods I, II, or III will form a distinct operculum over more posterior branchial pleopods (Asellota never swim with their pleopods).
4. Male pleopods II with specialized copulatory apparatus consisting of an enlarged protopod, a geniculate (knee-like) endopod, and typically well-muscled exopod.
5. Antenna with a distinct basal (precoxal) segment (sometimes fused in advanced groups).
6. Pereopodal coxae, if visible, lack coxal plates but may have coxal epimera or spines, so that the coxae will still be visible if viewed laterally.
7. Uropods generally have narrow rami, and tubular protopods.
8. As far as is known, Asellota have a specialized sperm conduit in the female alternatively named either the cuticular organ or the spermathecal duct. The opening to this duct will either be adjacent to the oopore on pereonite 5 or on the anterolateral or anterodorsal surface of pereonite 5 (Wilson, 1991).

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[7] A Disclaimer. The descriptions included in this work are not complete taxonomic descriptions and should not be used as such. They contain insufficient information to unambiguously identify each species within the context of the global deep-sea asellote fauna. This work is intended to be only an identification guide for the fauna of the Santa Maria Basin, and will be less accurate outside the confines of this geographic area. Because deep-sea asellote species tend to be highly provincial, workers should expect to find different species of each genus in basins other than the Santa Maria Basin. Moreover, not all species from the Santa Maria Basin will be covered in this work, simply because they have not been collected. Most deep-sea Asellota, are rare, and therefore may have a low probability of appearing in samples.

This definition excludes the families Atlantasellidae (living in saltwater caves on islands) and Microcerberidae (living interstitially on beaches). Both families lack the distinctive male copulatory apparatus found in the Asellota (on the male pleopod II: a geniculate endopod and a strong exopod with a copulatory hook). In addition, the pleonites 1-2 are larger and much more distinct in these two families than they are in most Asellota (Stenasellidae can also have large segments). The Atlantasellidae and Microcerberidae should be classified tentatively in the suborder Microcerberidea (Brusca and Wilson, 1991).

General Morphology

See general isopod morphology in this chapter, (Section 1.1 and Figures 1.1 and 1.2). A glossary of more specific to Asellota may be found in Wilson (1989).

Collection and Preservation

Unlike other more robust isopod groups, Asellota are extremely fragile and will be recovered only as fragments if handled harshly during sampling. Some groups, like the Desmosomatidae, are nearly impossible to identify without their anterior legs or uropods. Consequently, it is essential that care be taken to prevent mechanical fragmentation and poor preservation during sample processing. The following suggestions assume that one is sampling soft sediments with a grab or box corer. Other samplers or sediment types may require some adjustments of the procedures, although the principles are the same.

If possible, use a 300μ screen. Many Asellota are around 1 mm long. This means that they will be less than 0.5 mm wide in frontal profile, and will go through a standard 500μ screen. Even in shallow water, small body size seems to be the rule with most Asellota. A 300μ screen will insure that practically all Asellota, including mancas, will be retained.

Subject the specimens to as little washing as possible prior to fixation. Try to wash any benthic sediment samples gently: elutriation or gentle water flows up through screens. Do not use a strong water spray on the screen! If you try to force the sediment through the screen, you will also force the animals through, too. A gentle flow either from above or below the screen is sufficient. For quantitative box corer samples, don't wash the top water and top 1 cm of the samples until after the material has been in fixative for a while. Put the upper parts of the sample directly into buffered 4% formaldehyde solution. Don't screen the upper sections of the sample until you transfer the material to alcohol. Most of the animals will be in the upper few centimeters of the sample. For shallower water, they may occur deeper, although these sediments will also be much oozier. A good rule of thumb is that if the sediment is liquified, it will have the highest percentage of animals, and should be fixed without washing. The bulk parts of a sample can be washed in an elutriation kettle or gently on screens, depending on the mechanical characteristics of the sample.

Fix the specimens as soon as possible after sampling. As soon as samples are brought to the surface, many animals will be dead or dying, mostly due to thermal shock. Once they are dead, the animals' own enzymes will start to degrade their bodies; the end result is that the specimens will literally fall to pieces. Therefore, the sooner you get the specimens in fixative, the better. The formaldehyde will crosslink the proteins and make the specimens much tougher and able to hang together during washing and manipulation. Do not let a sample sit in the sun while deploying the next lowering. If manpower restraints prevent you from dealing with a sample immediately after recovery, then put the sample in a cold room at less than 4°C. This will slow the degradation of the specimens. The formaldehyde fixative should be well buffered to prevent dissolution of the calcium carbonate in the isopod exoskeleton. Some workers use sodium borate which achieves a pH of around 8, while others prefer sodium bicarbonate which makes a solution just above neutral. In all cases, the solution be mixed with sea water.

Transfer the specimens to ethanol in such a way as to avoid salt precipitates or osmotic distortion. This is a dual problem, because (1) insoluble salt crystals precipitate on your specimens if you simply dump sea water covered specimens into 70-80% ethanol, and (2) if the specimens are left in fresh water too long, they will blow up like little balloons and pop off their legs, heads, etc. Both of these effects make the Asellota specimens difficult to identify. This procedure seems to work reasonably well: first wash away excess sediment with gentle screening in sea water. Then, briefly wash the sample with fresh water. Next, give the sample a wash of 25% ethanol. Finally, wash the sample into bottles using 70-80% ethanol. This achieves a slow transfer from sea-water to ethanol without a prolonged exposure to pure fresh water. The timings will depend on the bulk of the sample: bulky samples will require more time, top water samples can be processed in less than a minute.

Laboratory Methods

Although there are as many different ways to sort benthic samples as there are laboratories in this business, a few comments are in order. The fragility of the Asellota should also be taken into account when it comes time to handle them in the laboratory. Hard forceps may damage or break the specimens, especially if one is rushed to finish a job. If possible, pick them up with wide mouth pipettes, Erwin loops (the meiofauna specialists know about them), or spring forceps which deform under very weak pressures. Pipettes are best, though. Do not squash the specimens with large folded labels (as were many of the voucher specimens used in this study). Trying to identify asellote pizza is not fun! If you cannot double vial the specimens (who has the time for that?), use small labels that are not in contact with the top and the bottom and do not have sharp edges. If you still must use large folded labels, at least put the label in the vial *first*, push it all the way to the bottom, and then put in the specimens. Rolling the labels doesn't work because the label will expand to the inner circumference of the vial, and then by Murphy's Law, the specimens will get between the label and vial wall. More pizza! The ideal label is one that has a rounded points at either end, is narrower than the diameter of the vial, and is shorter than its interior length.

Despite your most careful processing efforts, some specimens will be fragmented. Save these fragments because they may be identifiable. This is especially true for small quantitative samples, where most species will be represented by only one or two specimens. For example, Ischnomesidae practically always lose their legs and antennae, but my experience has been that different species of ischnomesids in an area may have decidedly different cuticular textures. So match up the fragmented bits by texture and size, and *voila*, you may be able to reassemble your fragmented specimens. If you are reasonably cautious about your assignments, you can make the identification process much easier. Also if you or anyone else plans to make taxonomic descriptions of the Asellota, these parts will be invaluable.

Glossary and Terminology

A detailed glossary specific for janiroidean Asellota (but largely applicable to most isopods) can be found in Wilson (1989). The terminological notes below touch on a few points that the reader might find different between this section and the others in this chapter.

Setae and Spines. Setal morphology, although not a central part of the taxonomy in this Atlas, may be more important in isopod systematics once detailed comparative studies are done. A difficulty observed in most isopod works is the confusion of the terms "seta" and "spine." Oshel and Steele (1988) argue that the use of "spine" to indicate setae confounds the ontogenetic and phylogenetic origins of both structures. Poore (1991) has a similar opinion. Often sensillate setae are found in a morphological series on the same animal that start at hair-like structure and terminate in robust toothed spine-like setae. Often, authors will call the

former "a seta" and the latter "the spine," even though one can easily find intermediate forms. Even worse, some authors will call the same structure something "a seta" at one magnification and "a spine" at a higher magnification. To avoid this confusion, "spine" will be used *only* for simple epidermal outgrowths, and "seta" will refer to a complex epidermal organ that consists of a proximally articulated shaft at the cuticular surface and a variety of distal terminations, mostly pointed. Most setae have nerve extensions and are sensory in at least one modality. Spines, on the other hand, have only mechanical functions.

Numbering of Body Parts. This work follows previous isopod authors (Wolff, 1962; Hessler, 1970; Kussakin, 1979; 1982b; 1988; Wilson, 1989) in numbering body or limb segments with Arabic Numerals and limbs themselves with Roman numerals. The primary purpose of this convention is to avoid confusion segments and limbs in descriptions. The convention also has the advantage that one can abbreviate a reference to the carpus of the first pereopod as PerI5.

Key to the Families of the Asellota and the Species Collected in the Santa Maria Basin

For the purposes of completeness, I here provide a key to all families of the Asellota. The classification follows Brusca and Wilson (1991) in excluding the Atlantasellidae and the Microcerberidae from the Asellota and putting them instead in the Microcerberidea (see diagnosis of Asellota). In addition, it uses new data from Just and Poore (1992) for completeness. Although only 21 species are listed in this work, the asellote fauna off California, including the deep sea, could exceed 100 species with representatives in all marine families. Most of the isopod diversity will be in the janiroidean families. With the addition of shallow water animals and fresh water contaminants, any family below could be represented in a collection. Although my goal was to divide the key on the basis of external characters alone, in some cases it will be necessary to dissect off the mandible (see above). For the first few couplets, it may also be necessary to carefully dissect off the male pleopods I and II to determine the morphology and organization of the sperm transfer apparatus. If this is to be done, first note how many distinct pleonites are present in ventral and dorsal view. Some families, such as the Janiridae, are extremely diverse and not well defined, so it was necessary to make several entries into the key for these families. I would be grateful if anyone using this key could contact me on encountering difficulties in keying out families. This key should be regarded as preliminary, and will be updated as time goes on. This key also includes the species, either in the main part where only one species of a family has been found, or toward the end where confamilial species are separated.

1A. Pleopods I-II may be opercular (completely covering more posterior pleopods) in males, pleopod II fused and practically always opercular in the female 5

1B. Pleopods III are opercular in both sexes, pleopods I-II small and non-opercular 2

2A. Pleopods I in male and pleopods II in female completely separate 3

2B. Pleopods I in male and pleopods II in female fused at least basally into single unit 4

3A. Endopod of male pleopod II fused into a single unit with a bulbous tip; pleonites 1-2 short, indistinct ..... Asellidae [fresh-water habitats only]

3B. Endopod of male pleopod II distinctly biarticulate separate with an often complex coiled tip; pleonites 1-2 large, easily seen dorsally ..... Stenasellidae [fresh-water habitats only, generally in caves]

4A. Male pleopods I with protopods separate from rami ..... Stenetriidae [cosmopolitan marine]: *Stenetrium* sp. A

4B. Male pleopods I with protopods fused to rami ..... Pseudojaniridae [southern hemisphere marine]

5A. Male pleopod II exopods with two distinct segments 6

5B. Male pleopod II exopods fused into a single hook-like or curved segment 7

6A. Male pleopods I protopods completely fused to distal rami; endopod of male pleopod II pointed, sometimes curved, with either a sperm groove or sperm tube ..... Protojaniridae [fresh water, cavernicolous habitats]

6B. Male pleopods I protopod distinct from distal rami; endopod of male pleopod II either complex or blunt, but lacking distinct sperm tub ..... Gnathostenetroididae [interstitial and cryptic marine habitats]

7A. Male pleopods I with median sperm tube closed ventrally; male penes apparently well separated from pereopod VII coxa ..... [Janiroidea *sensu* stricto] 9

7B. Male pleopods I with median sperm groove open ventrally; penes clearly associated with medial process from the pereopod VII coxa or on coxa (interstitially-living asellotes with small, largely non-opercular pleopods) 8

8A. Uropodal exopod inserts subdistally, separate from endopod; pleonite 3 not visible ventrally, completely fused to pleotelson; pleotelson as long as or longer than posterior pereonites .... "Microparasellidae" [partial, including only genera *Angeliera*, *Paracharon*, and *Microcharon*]

8B. Uropodal exopod inserts distally, adjacent to endopod; pleonite 3 present ventrally, separate from pleotelson; pleotelson shorter than posterior pereonites ..... Vermeciadidae [southern hemisphere on isolated subantarctic island beaches]

9A. Pereopod I distinctly subchelate with dactylus and propodus opposing each other; eyes, if present, often on stalks; antennulae with short flagellae, always with less than 14 articles total 10

9B. Pereopod I often leg-like but if subchelate, with propodus and carpus opposing each other and dactylus short; eyes, if present, may protrude laterally but are never found on elongate stalks; antennulae may be long or short 13

10A. Anus always terminal, without terminal projections of pleotelson; if visible, female spermathecal duct opening on ventral surface of pereonite 5 and closely associated with oopore (to see this special preparation may be required); eyes, if present, sometimes large with many ommatidia 11

10B. Anus never terminal, with distinct, often pointed, terminal projections of pleotelson; female spermathecal duct opening on dorsal surface of pereonite 5; eyes, if present, with few ommatidia, never large and distinct 12

11A. Body compact, pleotelson often held at angle to rest of body; protopod of uropod absent or tiny; mandibular palp generally large ..... Munnidae: *Munna* sp. A [primarily cosmopolitan shallow water with a few deep-sea taxa; a few brackish water taxa]

11B. Body more normal, sometimes elongate, pleotelson typically held in line with rest of body; protopod of uropod distinct, often elongate; mandibular palp absent ..... Santiidae [cryptic habitats, cosmopolitan shallow water]

12A Protopod of uropod distinct, often elongate; antennal article 3 always short but may have a large anteromedial setose projection ..... Pleurocopidae [cryptic habitats, tropical to temperate shallow water]

12B. Protopod of uropod absent or tiny; antennal article 3 enlarged, and generally much longer than other basal articles ..... Paramunnidae [cosmopolitan shallow water, with moderate number of deep-sea taxa] 44

13A. Posterior part of body arranged as a distinctive natasome, consisting of partially or completely fused pereonites 5-7 and pleotelson in most groups; pereopods V-VII with enlarged, paddle-like carpi and propodi that have articulated plumose setae on their margins; most dactyli with specialized paired terminal claws that enclose the distal sensillae ..... Munnopsididae [blind deep-sea cosmopolitan family with emergent shallow water taxa; contains several subfamilies including the Eurycopinae and the Ilyarachninae] 33

13B. Posterior part of body never with a distinct natasome; pereopods V-VII carpi and propodi rarely expanded and natatory (except in some Desmosomatidae, e.g. *Eugerda*) and never with articulated plumose setae; pereopodal dactyli various, but never with specialized paired terminal claws that enclose the distal sensillae 14

14A. Uropods with elongate protopod, often longer than pleotelson; if uropods missing, uropodal socket on pleotelson large and projecting 15

14B. Uropodal protopod not elongate; uropodal socket not obvious if uropods missing 20

15A. Anterior pereonites compressed into heavy fossorial unit; body never with dorsal or lateral spines; anterior pereopods fossorial (strong, with many heavy setae), projecting laterally ..... Macrostylidae Hansen, 1916 [blind, deep-sea cosmopolitan; some emergent taxa]

15B. Anterior pereonites distinctly separate; body may be dorsally or laterally spiny; pereopods ambulatory, never fossorial, generally projecting ventrally 16

16A. Body moderately narrow to very narrow and elongate; pereonites often distinctly set apart laterally; mandibular molar distally broad and truncate 17

16B. Body broad, somewhat flattened; cephalon and pereonites often with laterally projecting tergal processes or lappets; mandibular molar may be narrow and finger-like 19

17A. Pereonites 4 and 5 distinctly elongate 23

17B. Pereonites 4 and 5 near length of other pereonites 18

18A. Body stiff and thick, never attenuated and spider-like; pleotelson never reflexed dorsally; uropodal rami tiny or absent, protopod inserting laterally ..... Echinothambematidae [blind, rare deep-sea endemic group]

18B. Body sometimes attenuated and spider-like; pleotelson often reflexed dorsally; uropodal rami large, generally biramous, protopod inserting dorsolaterally on pleotelson ..... Dendrotiidae [rare shallow-water taxa with small eyes to blind deep-sea cosmopolitan]

19A. Maxillipedal palp with 4 articles; pereopod I setochelate (using seta on propodus as fixed finger) .. Katianiridae [blind, deep-sea cosmopolitan]

19B. Maxillipedal palp with 5 articles; pereopod I not setochelate ..... Acanthaspidiidae [some with eyes, shallow-water to deep-sea]

20A. Pereopodal dactyli with 3 distinct claws: two large distal claws and one large subdistal accessory claw 21

20B. Pereopodal dactyli with 1 or 2 distinct claws, third accessory claw tiny or absent 22

21A. Uropods short with thick protopod and button-like rami; uropods inserting posteromedially, almost touching; cephalon with distinctive rounded rostrum inserting in concave frontal margin; antennae compact, geniculate ..... Joeropsididae [primarily shallow-water group, eyes well-developed to absent] 37

21B. Uropods various, but protopod generally narrow, not substantially larger than rami; uropods separated by well-defined anal region; rostrum, if present, elongate and not inserting in concave frontal margin; antennae generally straight, elongate ..... Janiridae [not monophyletic - taxonomy in poor state; primarily shallow-water with some deep-sea genera; eyes well-developed to absent] 38

22A. Narrow elongate, sometimes flattened bodies 23

22B. Broad, thick bodies 28

23A. Cephalon well set into and generally fused with pereonite 1; pereonites 4 and 5 elongate; uropods uniramous ..... Ischnomesidae [blind, deep-sea cosmopolitan; some emergent taxa]

23B. Cephalon separate from pereonite 1; pereonites 4 and 5 approximately same length as other pereonites; uropods biramous 24

24A. Mandible with small, triangular, setose molar 25

24B. Mandible with truncate molar 27

25A. Anus inside pleopodal cavity; uropods terminal and adjacent ..... Microparasellidae [*sensu stricto*, Genus *Microparasellus*; blind, shallow-water interstitial]

25B. Anus separate from pleopodal cavity; uropods separated by well-defined anal area 26

26A. Major anterolateral seta on pereonites 2-4 on the coxa, not the tergite ..... Desmosomatidae [blind, deep-sea cosmopolitan; some emergent taxa] 42

26B. Major anterolateral seta on pereonites 2-4 on the tergite, not the coxa .... Nannoniscidae [blind, deep-sea cosmopolitan; some emergent taxa]: *Nannonisconus latipleonus*

27A. Body extremely long and thin; pereonal ventral surface often broadly "V" shaped .... Thambematidae [blind, deep-sea cosmopolitan]

27B. Body more normal; ventral surface rounded 28

28A. Cephalon may have eyes; penes not elongate; pleotelson flattened, pleonite 1 generally distinct 21B

28B. Cephalon without eyes; penes fused; pleonite 1 elongate; pleotelson dorsally and laterally ovoid 32B

29A. Tergal surfaces with no dorsal or lateral spination; anus clearly external to pleopodal chamber; bodies often capable of enrolling or folding .... Haploniscidae [blind, deep-sea cosmopolitan; some emergent taxa]

29B. Tergal surfaces often tuberculate or spiny with lateral lappets or spines; anus generally covered by pleopods; bodies not capable of enrolling or folding 30

30A. Body without large lateral projections or lappets, spines only; body always deep, never flattened ... . Haplomunnidae [blind, deep-sea cosmopolitan]

30B. Body with large lateral projections or lappets; body broad, somewhat flattened to narrow 31

31A. Lateral projections or lappets on cephalon; male penes short .... Janirellidae [blind, deep-sea cosmopolitan]

31B. Cephalon rounded laterally, lacking projections or lappets; male penes elongate 32

32A. Spiny body; pleotelson with lateral projections ..... Mesosignidae [blind, deep-sea cosmopolitan]

32B. Relatively smooth body; pleotelson without lateral projections .... Mictosomatidae [blind, rare deep-sea]

33A. Cephalon with rostrum projecting anteriorly between antennulae 34

33B. Cephalon without rostrum or anterior projections 35

34A. Cephalic rostrum narrow, roundly pointed, not bilobed; natasome robust and deep; pereonite 7 larger than pereonites 5 or 6 (except in manca stages 1 and 2); uropodal exopod greater than half length of endopod, easy to see ..... *Eurycope californiensis*

34B. Cephalic rostrum broad, distinctly bilobed; natasome flattened, tapering; pereonite 7 smaller than pereonites 5 or 6; uropod exopod tiny, difficult to see ..... *Belonectes* sp. A

35A. Natasome not triangular, with flexible somites, pleotelson inflated; pereonite 7 near size of pereonites 5 and 6; uropodal protopod small, tubular 36

35B. Natasome triangular and only stiffly articulating somites; pereonite 7 distinctly narrower than pereonites 5 and 6; uropodal protopod large, flattened ..... *Ilyarachna acarina*

36A. Small species, body length of adults less than 2mm; cephalon as broad as pereonite 1, vaulted posteriorly, with flattened frons; dorsal mandibular muscle insertions in cephalon few and large ..... *Munnopsurus* sp. A

36B. Large species, body length of adults reaching 7mm; cephalon huge, distinctly broader than pereonite 1, dorsal mandibular muscle insertions in cephalon many and small ..... *Munnopsurus* sp. B

37A. Cephalon with distinct indentation on lateral margin below eyes; cephalic lateral margin not produced, into lateral plate, with only small denticulae; ventral midline of pereon with distinct ridges; body narrow, with few setae and devoid of pigment ..... *Joeropsis concava*

37B. Cephalon lateral margin not indented, with large anteriorly curved spines, substantially produced laterally forming large plate; ventral midline of pereon without distinct ridges; body broad, devoid of pigment, but with numerous fine setae ..... *Joeropsis* sp. A

38A. Anterior pereonites 2 and 3 with paired lappets of varying sizes; pereopod I propodus with proximoventral denticles ..... [Genus *Janiralata*] .. 39

38B. Anterior pereonites 2 and 3 with or without paired lappets of varying sizes; pereopod I propodus without proximoventral denticles ..... Other Janiridae not included here [likely genera include *Ianiropsis*, *Iais*].

39A. Cephalon with distinct rostrum; lappets on pereonites 2 and 3 large; pleotelson with distolateral spines 40

39B. Cephalon without distinct rostrum; lappets on pereonites 2 and 3 small or indistinct; pleotelson without distolateral spines 41

40A. Body with diffuse pigmented anastomosing chromatophores, with pigment anterior to eyes on cephalon; obtuse rostral point of cephalon not extending anteriorly beyond anterior spines on lateral margin .. .. *Janiralata* sp. A

40B. Body completely devoid of pigment; cephalon of adults with pointed rostrum extending well beyond anterior limits of pointed lateral margins ..... *Janiralata* sp. B

41A. Broad body completely devoid of pigment; lateral margins of cephalon broad, not near bulging eyes; pleotelson distinctly trilobed posteriorly ..... *Janiralata* sp. C

41B. Narrow body with dense pigmented chromatophores on most dorsal parts of the body; lateral margins of cephalon narrow, near large bulging eyes; pletotelson posteriorly rounded, without lateral lobes ..... *Janiralata* sp. D

42A. Pereonite 1 distinctly larger than pereonite 2 (synapomorphy of Eugerdellatinae), with large ventral median spine. Pereonites 3 and 7 with posteriorly curving ventral median spines. Pereopod I with robust setochelate carpus ..... *Prochelator* sp. A

42B. Pereonite 1 subequal or smaller than pereonite 2, without ventral median spines on any pereonites. Pereopod I carpus not robust, not setochelate 43

43A. Pereonite 1 subequal to pereonite 2; cephalon with anterolateral spines; uropodal exopod present... ..... *Momedossa symmetrica*

43B. Pereonite 1 smaller than pereonite 2; cephalon lacking anterolateral spines; uropodal exopod absent ..... *Desmosoma* sp. A

44A. Cephalon with small eyes below the antennulae; coxae rounded, only slightly visible in dorsal view ..... *Austrosignum tillerae*

44B. Cephalon with no trace of eyes; coxae with long spines clearly visible in dorsal view 45

45A. Antennula article 1 lacking denticulate distal lateral lobe ..... *Pleurogonium californiense*

45B. Antennula article 1 with denticulate distal lateral lobe ..... *Pleurogonium* sp. A

Description of Asellotan Species

Family Stenetriidae Hansen, 1905

Genus *Stenetrium* Haswell, 1881

Description (modified from Serov and Wilson, 1994). Head with large, reniform anterolateral eyes; frontal margin with both lateral and antennal spines; lateral spines generally extending past antennal spines. Body lateral margins angular or quadrate with coxal extensions visible in dorsal view; pereonite 1 longer than remaining pereonites. Antennal article 1 with acutely pointed lateral spine. Male pereopod I robust with blades or teeth on propodal palm and without denticulate setae or large terminal seta; dactylus subequal to or longer than propodal palm width. Male pleopod I evenly rounded on lateral margins. Male pleopod II protopod distal tip produced, length subequal to exopod; endopod and exopod positioned on distomedial margin. Male pleopod II appendix masculina with one or more distal spines. Pleotelson with prominent posterolateral spines and 2 free pleonites.

Stenetrium sp. A

Figure 1.26

Material Examined. California, Santa Maria Basin, off Purisima Point, Sta. BRA-20, 90-130.5 m, copulatory male (illustrated), early preparatory female.

Description. Body elongate, unpigmented; all lateral margins with long simple setae; dorsal surface lacking long setae. Cephalon distinctly broader than long, without projecting rostrum; frontal area with arched supraclypeal ridge; clypeus semicircular in dorsal view; weakly convex with subtriangular anterolateral points. Eyes on cephalon lightly pigmented, not on lateral margin, situated just behind insertions of antennae. Pereonite 1 with fused pointed coxa in male and preadult female. Pereonite 2 with thin pointed anterior lappet. Pereonites 3-4 with both anterior and posterior small lappets separated by broad gap exposing coxae. Pereonites 4-5 shortest along medial axis than other pereonites. Pleonites 1-2 distinct dorsally and ventrally. Pleonite 3 visible as distinct plate ventrally. Pleotelson shield-like, widest anteriorly, lateral margins slightly convex and curving down to small posterolateral spines; distomedial margin rounded, projecting posteriorly between uropodal insertions. Antennula of male with around 12 articles, article 3 longer than articles 1-2. Antennal scale with elongate setae, some exceeding length of article 1 of antennula. Pereopod I of male strongly subchelate with subquadrate projection on propodus opposing dactylar teeth; many elongate simple setae on the following parts: proximomedial side of dactylus, distoventral margin of propodus, proximoventral margin of propodus, ventral margin of carpus, distoventral and distodorsal margins of merus; merus with elongate dorsal spine extending well beyond distal margin of carpus; dorsal margin of ischium also projecting distally somewhat, with several short teeth and elongate setae. Coxae II-VI visible and distinctly bilobed in dorsal view between pereonal lappets. Male pleopod II endopod article 2 longer than medial margin of protopod, distal tip broader than proximal part, grooved and setose, with small spine-bearing finger-like projection curving dorsolaterally from distal tip; exopod with distinct suture demarcating two articles on ventral side only. Uropodal rami with many distally curved thin setae; exopod subequal to protopod length; endopod longer than protopod.

Biology. As usual, little is known about stenetriids. The male copulatory apparatus is rather different from most Asellota, in that the exopod of pleopod II is not endowed with large fan-like muscles, suggesting that the form of copulation in this group may also be different than assumed for most Asellota (Wilson, 1991).

Remarks. This species of *Stenetrium* can be separated easily from all others by the distinct thick projection on pereopod I of the male and the presence of many elongate thin setae on the male pereopod I segments 4-7. Pereonal lappets are better developed in this species than in most stenetriids, and the distal finger-like projection on the appendix masculina is somewhat unusual. The body of this species, however, is generally similar to other stenetriids collected from deep and cold waters. Although it is typically not illustrated or noted by other authors, readers should be alert to the fact that this species has visible ventral sutures for pleonite 3, whereas other species have lost this plesiomorphic feature (e.g. see *Stenetrium dagama* pleotelson illustration in Wilson, 1987).

Type Locality and Type Specimens. None. This species is undescribed.

Distribution. Santa Maria Basin, 90-130.5 m.

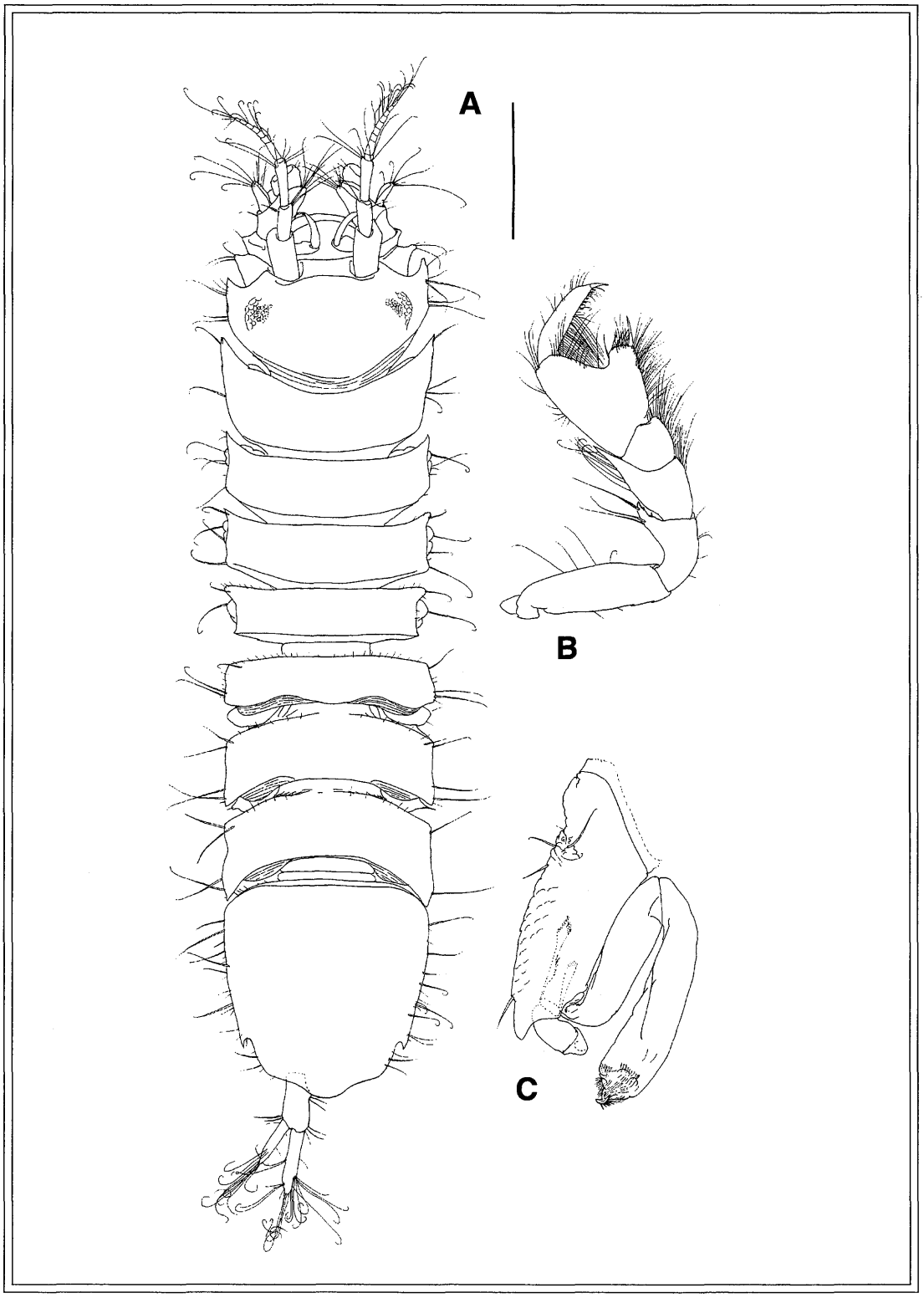

Figure 1.26. *Stenetrium* sp. A. Copulatory male from Phase I Sta BRA-20. A, dorsal view, scale bar = 1mm. B, right pereopod I. C, right pleopod II.

Family Munnidae Sars, 1897

Genus *Munna* Krøyer, 1839

Description (modified from Poore, 1984b). Munnidae with numerous dorsal setae often with setae on head, pleon and opercular pleopods. Antennula distal article minute, distal two articles with single aesthetasc. Mandibular molar strong and subcylindrical, distally truncate, bearing accessory setae; palp extending beyond incisor process, normally armed with second article bearing 1-2 serrate setae. Maxillipedal epipod apex acute. Pereopod I sexually dimorphic, enlarged in male, sometimes carposubchelate. Pereopods II-VII not substantially dimorphic; dactyli with two claws, anterior claw largest. Pleopod I of male with acute lateral lobes. Pleopod III with broad second article distinctly longer than endopod.

Munna sp. A

Figure 1.27

Material Examined. California, Santa Maria Basin, off Purisima Point, Sta. BRC-14, 105-117 m, 1 brooding female, illustrated; off Point Arguello, Sta. BRA-04, 168-237 m, 5 individuals, illustrated male pleopod;

Description (generic features modified from Poore, 1984b). Munnidae with large well-developed rounded eyes, projecting laterally as far as width of pereonite 2. All dorsal surfaces covered with fine simple setae. Frontal margin of cephalon forming smooth quadrate arc in dorsal view. Pereonites axially compressed, medial pereon length subequal to pleotelson length. Pereonites projecting radially from body centre, so that pereonite 1 extends anteriorly under cephalon and pereonite 7 extends posteriorly under pleotelson. Pereonite 1 shorter and narrower than pereonite 2 in both sexes. Pleotelson with enlarged posterior subanal projection no wider than anus, not extending under uropods. Antennula with tiny distal article and two aesthetascs. Mandible with normal, functional palp, extending beyond incisor process with curved distal article having cleaning setae. Pereopods II-VII longer than body, lengthening posteriorly so that pereopod VII nearly 3 body lengths. Male pleopods I-II not opercular, not covering exopod of pleopod III; female pleopod II opercular. Male pleopod I distally flared and truncate with pointed laterally projecting lateral lobes. Pleopod III endopod broad and elongate, extending well beyond endopod, forming operculum for pleopods IV and V in the male. Uropodal protopod absent; exopod tiny with only one large simple seta; endopod tapering distally with around 5 penicillate setae and several simple setae; endopodal distal tip lacking claws, spines, or large denticles.

Biology. Munnids are small, agile janiroideans that seem to favor hard substrates, especially in the long legged forms such as described here, but can be found in many different micro habitats. Not much is known of their life history, other than some behavioral information in Hessler and Strømberg (1989). Large males are known to sequester manca 3 females in a lengthy precopula (*ibid*).

Remarks. The best entry into the literature on munnids is Poore (1984b), which places most described species in the genera *Munna* and *Uromunna* (a few exceptions could not be placed). Of the Northeastern Pacific species of *Munna*, this species can be distinguished from *M. stephenseni* by no large lateral spine-like sensillate setae on the pleotelson and no spines on the uropodal endopod; from *M. chromatocephala* by a more compact body and no spines on the uropodal endopod; from *M. halei* by a subanal shelf that does not extend under the uropods; from *M. spinifrons* by no large robust sensillate setae on the cephalon frons and coxae; from *M. fernaldi* by no large sensillate setae on the pleopods I and II and by much longer legs and a more compact body. Of these, *Munna* sp. A is most similar to *M. fernaldi*.

Type Locality and Type Specimens. None. This species is not formally described.

Distribution. Santa Maria Basin, hard substrates, 105-237 m.

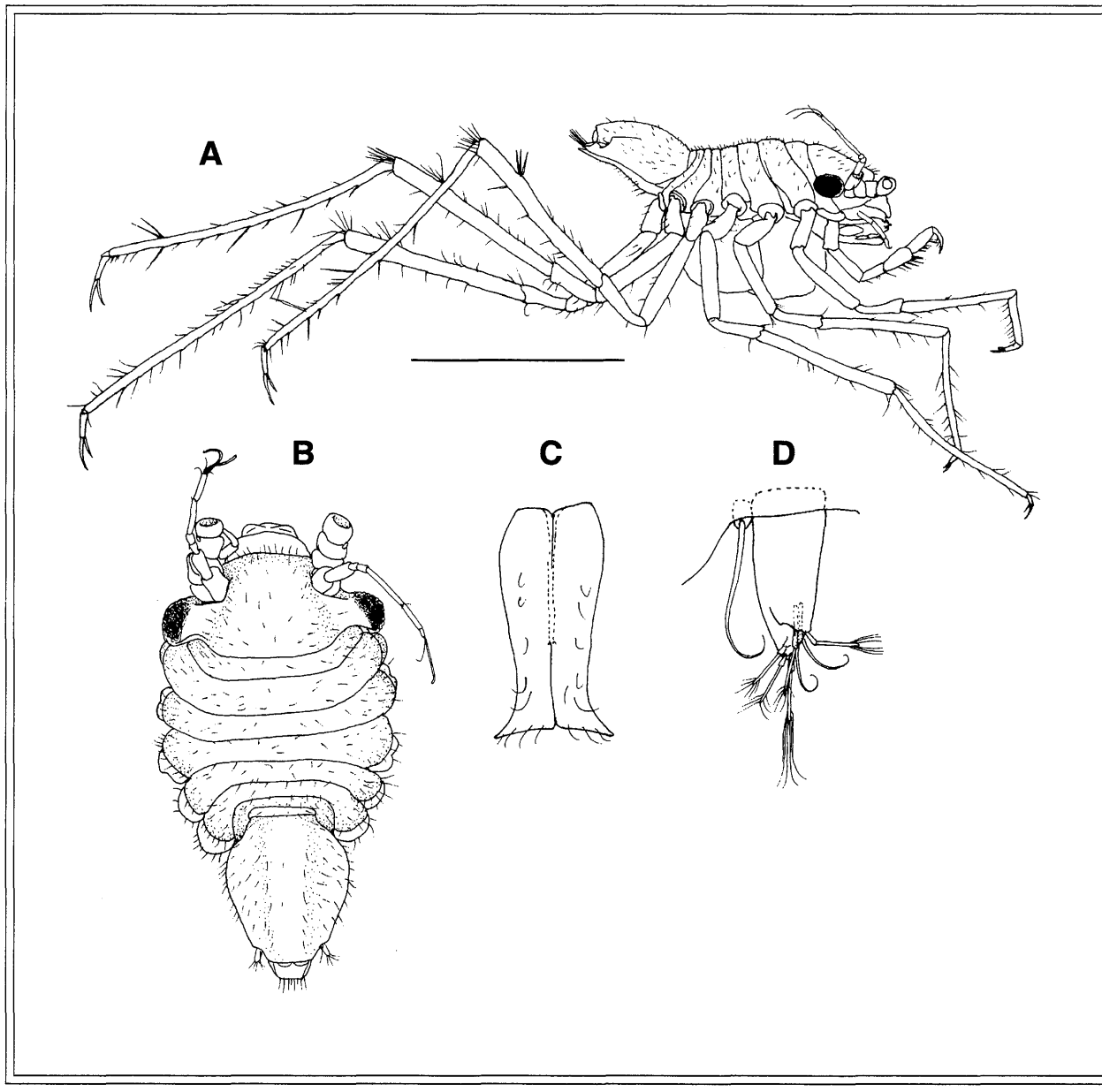

Figure 1.27. *Munna* sp. A. A-B, brooding female from Phase I Sta. BRC-14, lateral and dorsal views, scale bar = 1 mm. C, right uropod, lateral view, brooding female. D, pleopod I, ventral view, male from Sta. BRA-4.

Family Paramunnidae Vanhöffen, 1914

Genus *Munnogonium* George and Strömberg, 1968

Description. Head partially recessed into first pereonite; eyes, if present, with few ocelli, placed below antennulae on small lateral bumps. Body ovate, without laterally projecting tergal spines or plates, coxae II-VII visible in dorsal view lacking spines. Females with dorsal spermathecal duct on pereonite 5 well separated from articular membrane between pereonites. Pleotelson lenticular, distally pointed; pleonite one large, length subequal to pereonite 7. Antennulae short, with six articles and with one terminal aesthetasc. Antennae short, never longer than body, strongly geniculate: articles 1-3 projecting medially, article 4 dorsolaterally and remaining articles laterally; article 3 distinctly longer than articles 1,2, or 4, without large spines or projections. Mandibular molar process distally broad and quadrate, palp absent. Pereopod I prehensile with major hinges between dactylus and propodus; carpus narrow, longer than broad, participating in grasping by robust sensillate setae and spines. Pereopods II-VII ambulatory, paucisetose. Male pleopod I sagittate distally, smooth ventrally with tufts of small setae on lateral corners; vas deferens entering pleopodal medial sperm duct internally. Uropods tiny, biramous; protopod absent. Anus ventral, covered by opercular pleopods, anal cavity confluent with pleopodal cavity.

Munnogonium cf. *tillerae* (Menzies and Barnard, 1959)

Figure 1.28

Synonymy (assuming *M. tillerae* = *M. erratum*).

Austrosignum tillerae Menzies and Barnard, 1959:8-9.

Austrosignum erratum Schultz, 1966:307,309-310.

Munnogonium tillerae Bowman and Schultz, 1974:270; Wetzer *et al.*, 1991:15-16.

Munnogonium erratum Bowman and Schultz, 1974:270; Wetzer *et al.*, 1991:15.

Material Examined. MMS Collections: California, Santa Maria Basin, off Point Estero, Sta. 1, from rock, 98 m (1); off Morro Bay, Sta. 6, 109 m (2); Sta. BRA-27, 96-126 m (1); off Point Sal, Sta. PJ-17, 158 m (2); off Purisima Point, Sta. R-4, 92 m (20, 17); off Point Arguello, Sta.BRA-6, 54-63m (22).—Other collections: LACM cat. no. 56-26.2: R/V *Velero IV* station 4753 (type locality), *M. tillerae* brooding female paratype, illustrated pereopod I, (Holotype missing, see Type data). LACM cat. no. 57-132.2: *M. tillerae*, paratype male from off Pt. Conception, dissected parts only. LACM cat. no. 57-228.2: *M. tillerae*, paratype brooding female from Pt. Santa Barbara, decalcified. LACM cat. no. 57-22.2: *M. tillerae*, paratype from Pt. Arguello, nothing in vial, perhaps dissected by Bowman and Schultz. LACM cat. no. 58-166.1: R/V *Velero IV* station 6003, *M. erratum*, holotype male, apparently dissected by previous authors, only a few limbs in vial.

Description. Body broad, ovate. Cephalon somewhat recessed into first pereonite. Eyes situated on short bumps ventral to antennulae, small, with few ocelli. Pleotelson lenticular, distally pointed. Anus ventral, covered by opercular pleopods, anal cavity confluent with pleopodal cavity. Antennulae short, with six articles and one terminal aesthetasc. Antennae shorter than body length; article 3 distinctly longer that articles 1,2, or 4; antenna strongly geniculate: articles 1-3 projecting medially, article 4 dorsolaterally and remaining articles laterally. Mandibular palp absent; molar process distally broad and quadrate. Pereopodal coxae laterally rounded, only slightly visible in dorsal view. Pereopod I prehensile with major hinges between dactylus and propodus; carpus also participating in grasping with robust sensillate setae. Pereopod II of mature male with robust subtriangular projection on basis distoventral corner and proximal projection on ischium; juveniles and females lacking such lobes on proximal articles of pereopod II. Pereopods II-VII ambulatory, paucisetose. Male pleopod I always sagittate distally, smooth ventrally with tufts of small setae on lateral corners. Uropods tiny, biramous, protopod absent.

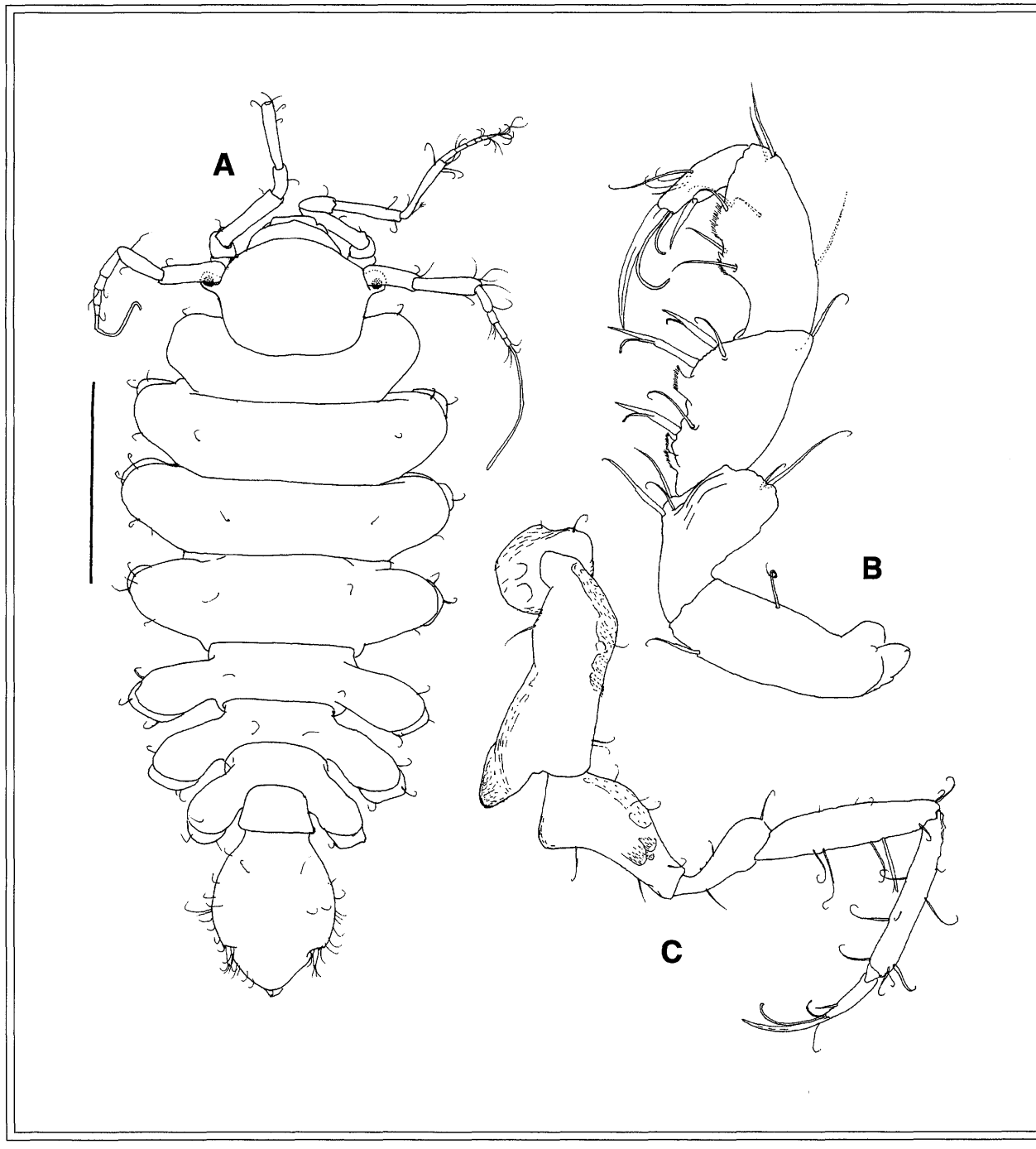

Figure 1.28. *Munnogonium* cf. *tillerae*. A and C, male (from Phase II, Sta. R-4). A, dorsal view, scale bar = 0.5 mm. B, left pereopod I, brooding female (LACM cat. no. 56-26.2). C, right pereopod II.

Biology. Like most janiroideans, species of *Munnogonium* appear to be epibenthic detritivores. I have observed *M. waldronense* alive at Friday Harbor Labs in the San Juan Archipelago. When alive, this species appears to be a small ball of detritus with legs, owing to its habit of sticking material from the bottom on the dorsal surface. This species seems to be clumsy and slow, perhaps relying on its camouflage for protection from predators instead of nimbleness (like *Munna*). The various populations of *M. tillerae*, however, are much less covered with detritus in the samples, so perhaps their methods of defence are different. The males of the Northern California sites have a unique enlargements on the basis and ischium of pereopod II. These lobes may be used in precopula, of which *M. waldronense* is known to practice a passive form (Wilson, 1991).

Remarks. Bowman and Schultz (1974), in addition to combining *Munnogonium waldronense* with *Austrosignum tillerae*, assert that the following *Austrosignum* species should be assigned to *Munnogonium* owing to an absent mandibular palp: *grande*, *erratum*, *tillerae*, *globifrons*, *maltinii*. The problem here is that *grande* (=*glaciale*) is the type for *Austrosignum*, and that it probably *does* have a mandibular palp, since the female *glaciale* has the palp. Hodgson (1910) never said the palp of *grande* was absent - he only said it was "not observed." Moreover, in the pleopod part of his descriptions, Hodgson (1910) describes male pleopods for *grande* and female pleopods for *glaciale* (some crustacean taxonomists at the turn of the century didn't understand the sexual dimorphism in asellote pleopods). The length of the eye stalks might make a good character for separating *Austrosignum* and *Munnogonium*. Concerning the composition of *Munnogonium*, Hooker (1985) adds another species, *M. wilsoni,* to *Munnogonium*, and gives a key to the species of the genus in which he also includes a Kensley species *subtilis*. Both *wilsoni* and *maltini* probably should be transferred to *Metamunna* Tattersall, 1905 (which should be removed from *Paramunna*) because of their overall resemblance to *M. typica* (the type specimens, unfortunately, are probably lost (R. Lincoln, pers. comm.). Other species that possibly should be included in *Metamunna* are *subtilis* Kensley, 1976, *Paramunna simplex* Menzies, *P. kerguelensis* Vanhöffen, *Munnogonium polynesiensis* Müller, 1989, possibly *Austrimunna serrata* Richardson, possibly *P. dubia* Hale, and possibly *Heterosignum mutsuensis* Gamo, 1976. An undescribed species of *Metamunna* also was found in the La Jolla area by Eric Vetter, Scripps Institution of Oceanography.

The following species can be definitely assigned to *Munnogonium*: *erratum*, *tillerae*, *globifrons*, and *waldronense*. I am not sufficiently convinced that *M. waldronense* should be synonymised into *tillerae* as proposed by Bowman and Schultz (1974) because they did not discuss specimens from the San Juan Archipelago. *M. erratum* is not distinct from the Northern California form of *M. tillerae*. Much of the confusion in the *Munnogonium* species *tillerae*, *waldronense*, and *erratum* arises from the distinct elongation of males over two to three adult (copulatory) molts from the more compact female form. Furthermore, if the specimens are exposed to fresh water during fixations, the segments are telescoped, giving a strong separation of the posterior segments. Schultz's (1966) specimen of *M. erratum* clearly shows everted articular membranes along the margins of the pereonites, suggesting his holotype is damaged in this way. Therefore, the elongation and separation of the lateral pereonites is *not* a useful character for defining species in this genus. Bowman and Schultz (1974) indicated that this was the primary character separating *M. tillerae* from *M. erratum*. Consequently, we must consider the two species identical for the purposes of this Atlas. Additional species-specific characters were not found by previous authors, probably because these species are so tiny. This problem will require complete redescriptions of material from near the type localities of all three species. Unfortunately, the type material has been so badly depleted by previous descriptions that the types will not provide sufficient information. Male types of both *M.tillerae* and *M. erratum* are lost or are thoroughly dissected, many parts of which are missing. The eyes of the northern California population of *M. tillerae* may have larger and darker ocelli than those of the San Diego specimens. The two populations may differ in the size of the antennulae, as well. Because quantitative data are not yet available, I have no choice but to provisionally synonymize *M. erratum* with *M. tillerae*. If sufficient evidence is found to separate the northern and southern populations at the species level, then the northern population will be called *M. erratum*, and the southern population will be called *M. tillerae*.

Type Locality and Type Specimens. Holotype lost (note in vial left by Bowman and Schultz; see also Wetzer *et al.*, 1991:16). Brooding female paratype, 1.0 mm, LACM cat. no. 56-26.2: R/V *Velero* IV station 4753, 8 December 1956: 5.2 miles at 294° True from Pt. Loma Light, San Diego Co., California, 32°41.8'N, 117°20.4'W, 101 m, sediment green mud (data from LACM label). Other paratypes listed by Menzies and Barnard (1959) and Bowman and Schultz (1974) should not be considered representative of the holotype because they are not from the San Diego type locality. Unfortunately the latter authors do not identify the source of the paratype illustrations in their paper.

Distribution. Waters off San Diego County to central California (provisional), 18-135 m.

Genus *Pleurogonium* Sars, 1883

Description. Head partially recessed into first pereonite; eyes always absent. Body ovate, sometimes with laterally projecting spines; coxae II-VII visible in dorsal view with lateral spines. Females with dorsal spermathecal duct on pereonite 5 well separated from articular membrane between pereonites. Pleotelson lenticular, distally pointed; pleonite one large, distinct, ring-like. Antennulae short, with six articles and with one terminal aesthetasc. Antennae short, never longer than body, strongly geniculate: articles 1-3 projecting medially, article 4 dorsolaterally and remaining articles laterally; article 3 distinctly longer that articles 1,2, or 4, without large spines or projections. Mandibular molar process distally narrow with 1-2 spines and 1-2 curved setulate setae; palp absent. Pereopod I prehensile with major hinges between dactylus and propodus; carpus enlarged, as broad or broader than long, participating in grasping with robust sensillate setae and short spines. Pereopods II-VII ambulatory, paucisetose. Male pleopod I sagittate distally, smooth ventrally with tufts of small setae on lateral corners; vas deferens entering pleopodal medial sperm duct internally. Uropods tiny, biramous; protopod absent. Anus ventral, covered by opercular pleopods, anal cavity confluent with pleopodal cavity.

Pleurogonium californiense Menzies, 1951

Figure 1.29

Pleurogonium californiense Menzies, 1951a:139, figs. 25-26; Menzies and Barnard, 1959:14, fig. 8; Kussakin, 1962:99; Schultz, 1966:12; Schultz, 1969:291.

Material Examined. California, Santa Maria Basin, off Port San Luis, Sta. R-1, 91 m (15); off Purisima Point, Sta. 42, 100 m (7); off Purisima Point, Sta. R-4, 92 m (17); Sta R-5, 154 m (1).—Western Santa Barbara Channel, off Point Conception, Sta. 79, 98 m (4).

Description. Body broad, ovate. Cephalon somewhat recessed into first pereonite. Cephalon without eyes or eye stalks. Pereon and pleotelson with rounded lateral margins lacking large teeth or serrations. Pereonite 1 of males (not intersexes) distinctly longer and more robust than that of females. Cuticle on body and limbs smooth to lightly scaled. Antennulae without anterior projection on distal margin. Mandible lacking palp; molar process thin, finger-like, with rounded distal tip having only one distal spine and one seta. Pereonal coxae visible in dorsal view with single projecting spines; spine on coxa VII reduced or absent. Uropods biramous, positioned dorsolaterally on pleotelson, protopod absent.

Biology. Populations of this benthic species often may be protogynous hermaphrodites. Fully hermaphroditic populations will exhibit small primary males, and larger secondary males that were females in a previous moult. The large secondary males (approximately the size of a brooding female) are broad and have a highly depressed lateral profile and a concave ventral surface, probably retained from the brooding condition. The smaller primary males have a more normal, convex ventral surface. Preparatory and brooding

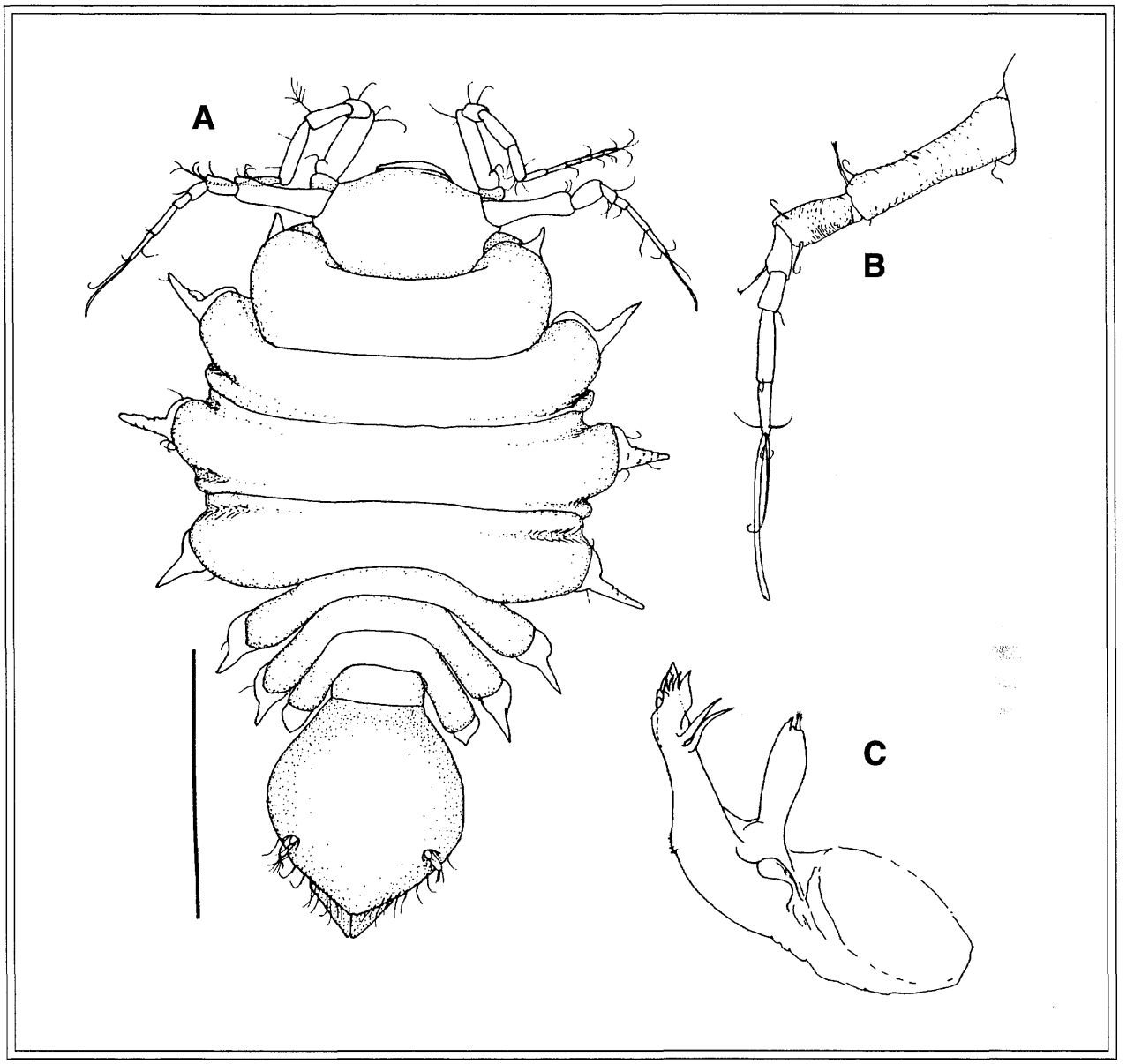

Figure 1.29. *Pleurogonium californiense* Menzies, 1951. A, Dorsal view of hermaphroditic brooding female, Phase II Sta. R-4, scale bar = 0.5 mm. B, left antennula. C, left mandible, dorsal view.

females generally have either developing or fully mature male pleopods. Currently, it is unknown whether the testes are active in these transitional females. Surprisingly, some populations (e.g. those in the MMS Phase I Sta. 42) seems to lack hermaphrodites, indicating that this feature of their sexual biology may be facultative.

Pleurogonium sp. A could also be a different morphotype of *P. californiense*. Such a hypothesis, however, must accommodate the presence of these differing morphotypes at all life stages as well as the differences in the antennules, cuticle, and mandibular molar. These types of differences have not been encountered before in one species, so at the moment they are classified as separate species.

Both species may be relatively recent siblings judging from their overall morphological similarity. If this is so, their sympatry is all the more interesting. If they are indeed separate species, then the unusual protuberance (not seen in any other *Pleurogonium*) on the antennule of *Pleurogonium* sp. A may provide an effective signal to prevent interspecific matings and concomitant gamete wastage.

Remarks. *Pleurogonium californiense* co-occurs with *Pleurogonium* sp. A., so the two similar species must be carefully differentiated. *P. californiense* lacks large projections on the first antennular article, thereby providing an easy identification character for separation from *P.* sp. A. *Pleurogonium californiense* can be further verified by noting its smoother cuticle, its shorter antennulae, and (if dissections are made) the lack of a second short spine on mandibular molar process. The original description of *P. californiense* shows a male with a much longer antennular article 2 than seen in the current collection. This suggests that the populations of this species North of San Francisco may be somewhat differentiated from those to the South. A comparison of the type material with the Santa Maria Basin material seems necessary to verify this feature.

Type Locality and Type Specimens. "Holotype (U.S.N.M. no. 87412), allotype (U.S.N.M. no. 87413), and 1 male paratype (U.S.N.M. no. 87414), collected at type locality, 3 miles west of mouth of Russian River, Sonoma County., Calif., July 13, 1947, by R.J. Waidzunas and Paul B. Quyle; found in fine mud with the sea-star *Luidia foliata* Grube ..." (Menzies, 1951a:143).

Distribution. Off northern and central California, 90-154 m.

Pleurogonium sp. A

Figure 1.30

Material Examined. California, Santa Maria Basin, off Purisima Point, Sta. 42, 100 m (1); off Purisima Point, Sta. R-4, 92 m (13); Sta. R-5, 154 m (1).—Western Santa Barbara Channel, off Point Conception, Sta. 79, 98 m (6);

Description. Body broad, ovate. Cephalon somewhat recessed into first pereonite. Cephalon without eyes or eye stalks. Pereon and pleotelson with rounded lateral margins lacking large teeth or serrations. Pereonite 1 of males (not intersexes) distinctly longer and more robust than that of females. Cuticle on body and limbs rough with apparent microscales on all surfaces. Antennulae with large curved anterolateral projection on distal margin. Mandible lacking palp; molar process thin, finger-like, with rounded distal tip having two distal spines and one seta. Pereonal coxae visible in dorsal view each with single projecting spines; spine on coxa VII large. Uropods biramous, positioned dorsolaterally on pleotelson, protopod absent.

Biology. Populations of this benthic species may contain protogynous hermaphrodites. See remarks above under *Pleurogonium californiense*.

Remarks. *Pleurogonium* n.sp. A. co-occurs with *Pleurogonium californiense*, so the two similar species must be carefully differentiated. *P. californiense* lacks large projections on the first antennular article found in this species, thereby providing an easy identification character for separation of the two species. *P.* n.sp. A. can be further verified by noting its rougher cuticle, its longer antennulae, and (if dissections are made) the presence of a second short spine on mandibular molar process.

Type Locality and Type Specimens. None. This species is undescribed.

Distribution. Santa Maria Basin and western Santa Barbara Channel, 90-154 m.

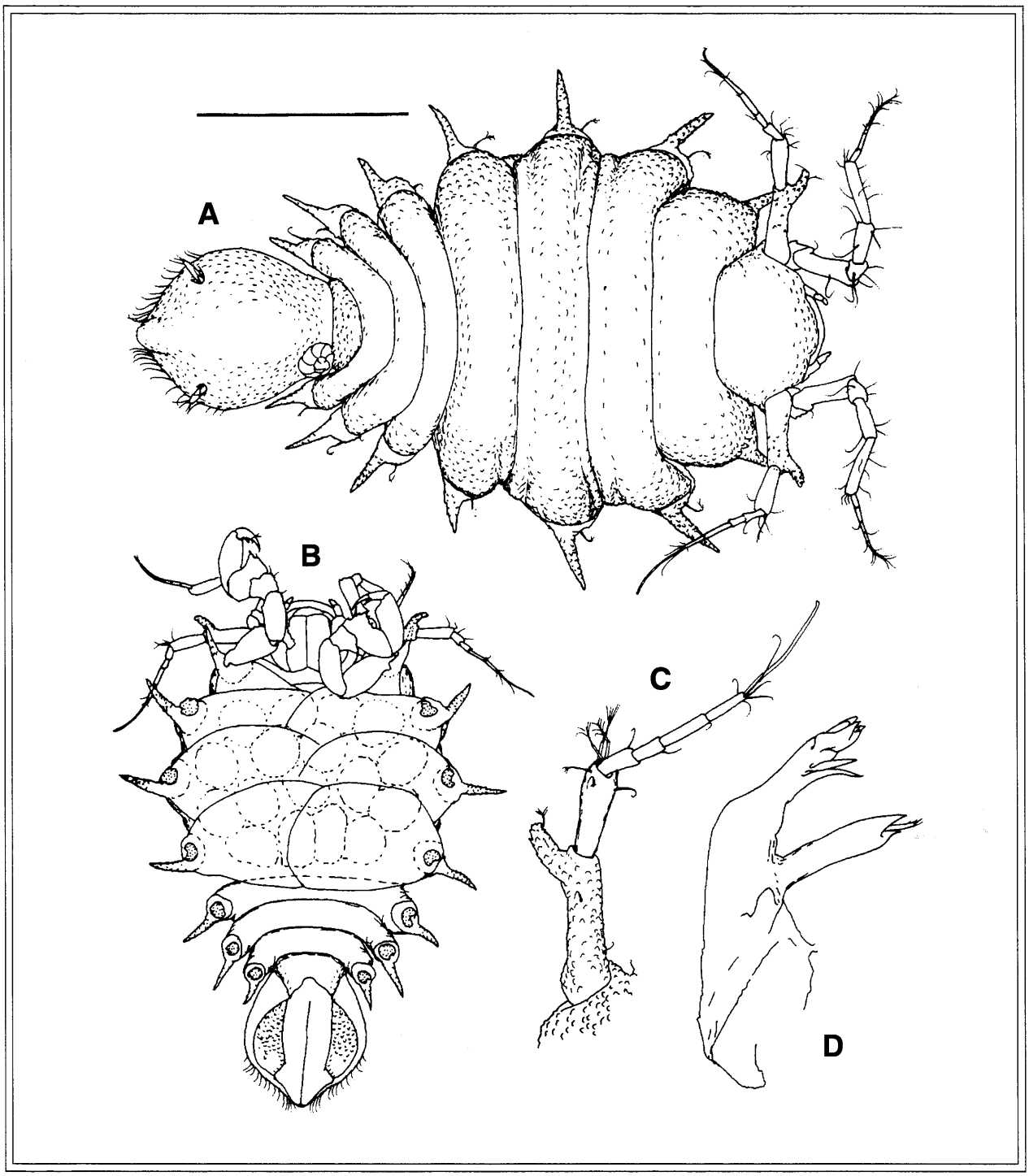

Figure 1.30. *Pleurogonium* sp. A. A-B, Dorsal view of hermaphroditic brooding female, Phase II Sta. R-4, scale bar = 0.5 mm. C, left antennula. D, left mandible, dorsal view.

Family Janiridae Sars, 1897

Genus *Janiralata* Menzies, 1951b

Description (modified from Wilson and Wägele, 1994). Head with dorsal eyes; lateral margins straight, with anterolateral points or spines; vertex obtusely pointed to rostrate. Body broad and flattened. Lateral margins of pereonites 2-3 divided into 2 lobes by deep cleft or broad niche, coxae visible on dorsal view; pereonite 1 with coxal lappet dorsally visible on anterolateral border. Pleonite 1 short, visible dorsally, much narrower than pereonite 7 or pleotelson. Pleotelson near width of pereonite 7. Antennulae multiarticulate, with approximately 12-20 flagellar articles; antennal article 1 longer than wide. Antenna article 3 with conspicuous scale (exopod); basal article 1-4 subequal; articles 5-6 long, distinctly longer than basal articles 1-4; flagellum multiarticulate, with more than 20 articles; basal articles of flagellum wider than long but not conjoint. Mandibular molar process truncate; palp long, article 3 elongate, curved and setose. Maxillipedal endite longer than wide, width subequal to palp; palp articles 4-5 narrow, straight sided, distinctly narrower than broad articles 1-3, palp article 3 distally broad, setose, not tapering, near width of article 2. Pereopod I carposubchelate, dactylus short, with 2 claws; propodus on proximal inferior border serrated, carpus with 2 rows of short spine-like setae on ventral margin. Pereopod II-VII dactylus with two subequal claws, with subdistal accessory seta enlarged into third claw. Male pleopod I distal tips laterally expanded, with projecting subtriangular lateral lobes, and broad setose medial lobes merging smoothly into lateral lobes. Male pleopod II distal tip of protopod blunt, setiferous; basal article of endopod only somewhat wider than maximum width of stylet, but not inflated; stylet elongate, curved, longer than sympod. Female pleopod II broad, ovate, with distal median concavity. Pleopod III endopod with 3 plumose setae having distinct gap between medial seta and two lateral setae; exopod narrower and longer than endopod; exopod with 2 segments, with distal plumose setae. Uropods biramous, rami subequal; exopod inserting apically; protopod subequal to rami.

Janiralata sp. A

Figure 1.31

Material Examined. California, Santa Maria Basin, off Point Sal, Sta. BRA-17, 160.6-168 m (1 preparatory female).

Description. Body broad and flattened, with large dark-pigmented diffuse chromatophores on all dorsal surfaces, including cephalon anterior to eyes. Dorsal surfaces with many fine setae. Cephalon with large dorsal eyes, well separated from lateral margins; lateral margins convexly curved, with triangular anterolateral points; anterior margin with obtuse rostral point not extending anteriorly beyond lateral points. Lateral margins of pereonites 2-3 divided into 2 lappets with broad notches bearing coxae, anterior lappets approximately 2 times length of associated coxal lobes in dorsal view. Pereonite 1 bearing only posterior lappet shorter than associated coxa; pereonites 4-7 bearing anterior lappets, with that of pereonite 4 being relatively narrow and that of pereonites 5-7 being broad and laterally rounded; lappets of pereonites 6-7 with distinct posterolateral projections. Tergite 5 distinctly shorter medially than other tergites. Pleotelson with semicircular lateral margins, posterolateral medially curving spines, and posterior margin being obtusely rounded; margin between posterolateral spines and distal tip slightly convex, not concave; tip of pleotelson extending beyond posterior limits of posterolateral spines. Antennula article 3 distinctly longer than wide; flagellum with around 12 articles, distal article tiny. Antenna with conspicuous pointed scale. Mandibular article 3 elongate, longer than palp article 1. Articles 1-3 of maxillipedal palp expanded. Pereopod I carposubchelate; dactylus short, with 2 claws; propodus with 9 denticles on proximoventral border, carpus with 2 rows of short spine-like sensillate setae on ventral margin and fine fringe of cuticular comb-like spinules. Coxa I bluntly pointed, large, longer than pereonal lappet. Coxae II-V laterally bilobed in dorsal

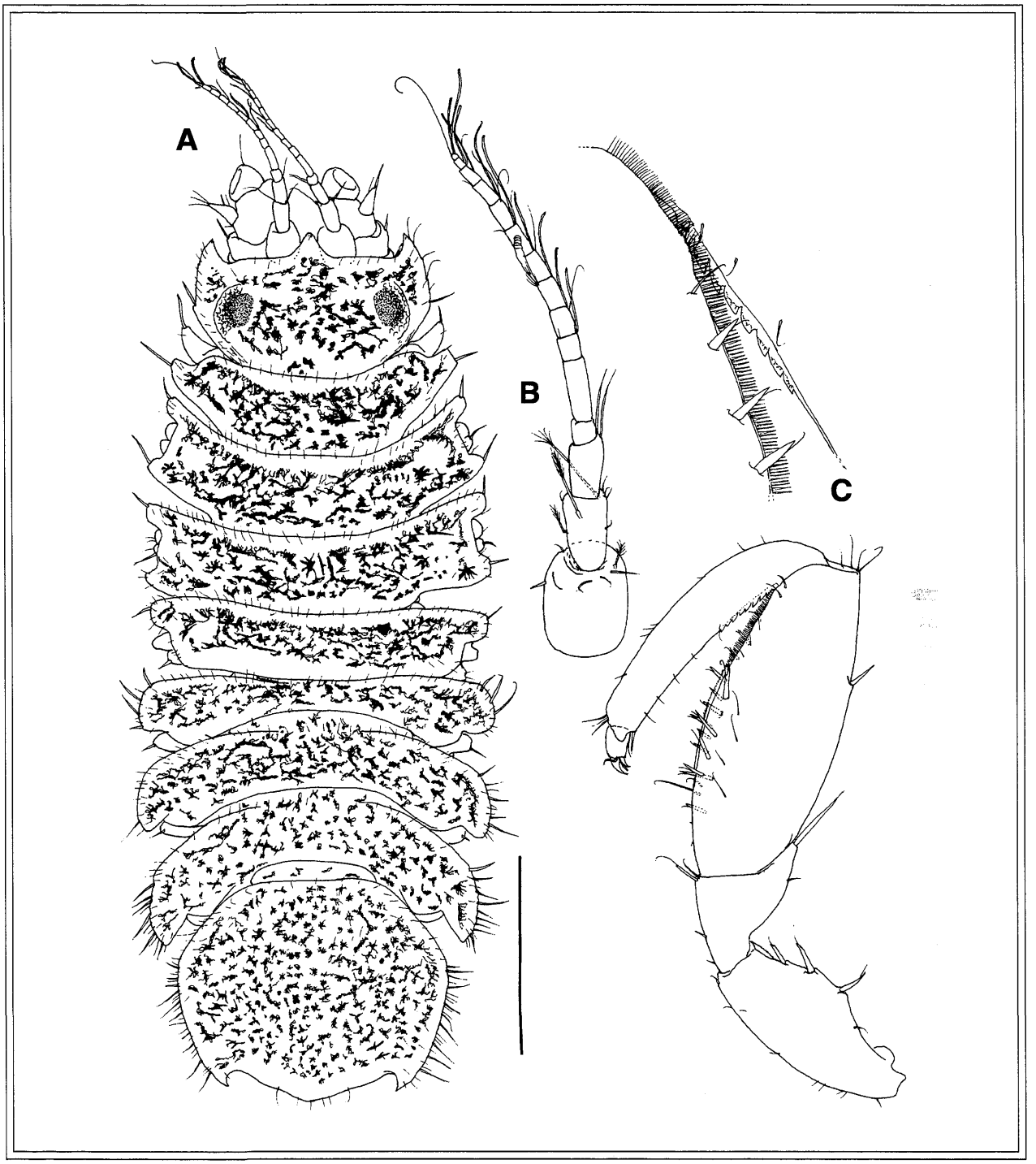

Figure 1.31. *Janiralata* sp. A., preparatory female, MMS Phase I Sta. BRA-17. A, dorsal body view, scale bar = 1 mm. B, left antennula. C, left pereopod I, with enlargement of opposing margins of propodus and carpus.

view, length of both lobes coxae II-III subequal. Female operculum broad ovate, distally with median concavity. Male pleopods I-II unknown. Uropods (unknown in this species) probably biramous with branches of subsimilar length, sympod about as long as rami.

Biology. Little is known about the biology of *Janiralata* species in general, although they seem to favor hard substrates and are quite agile. *Janiralata occidentalis* is especially quick: it is difficult to capture with forceps from a petri dish during live sorting because it easily avoids the forceps tips by scampering under debris and clinging tightly. *J. solasteri* is found as a commensal in the ambulacral groove of the asteroid, *Solaster* species, where it typically co-habits with other commensals like polynoid scale worms. The dense gut contents of the specimen examined here suggests that, like most janiroideans, this species is a detritivore.

Remarks. This species is very similar to *Janiralata occidentalis* (Walker, 1898). Specimens of *J. occidentalis* from the San Juan Archipelago (Menzies, 1951a), and some fresh specimens from the same general locality collected by the author suggest that the two species can easily be separated by their pigmentation. *J. occidentalis* has dense, non-anastomosing chromatophores that are absent from the region anterior to the eyes, while *J.* sp. A has diffuse anastomosing chromatophores that extend into the region anterior to the eyes. *J.* sp. A also has a thinner, more elongate antennula. Readers should be aware, however, that the two species are nearly identical in most other features, including the rostrum. The rostrum of *J. occidentalis* is shown much less prominent in (Menzies, 1951a) than it actually is, possibly because Menzies illustrated the specimen with the cephalon angling down anteriorly. Additionally *J.* sp. A has fewer proximoventral denticles on propodus of pereopod I.

Type Locality and Type Specimens. None. This species is undescribed.

Distribution. Santa Maria Basin, 160-168 m.

Janiralata sp. B

Figure 1.32

Material Examined. California, Santa Maria Basin, off Point Arguello, Sta. BRA-4, 168-237 m, 1 brooding female, 2 juvenile females, 1 manca.

Description. Brooding female only. Body broad and flattened, with no pigment on any dorsal surface. Dorsal surfaces with many fine setae. Cephalon with rostrum extending well beyond anterior limits of pointed lateral margins; anterior margin with lateral medially-curving flattened spines adjacent to distinct concave indentations; eyes large, bulging but not near lateral margin except in early juveniles and mancas. Lateral margins of pereonites 2-3 divided into 2 lappets with broad notches bearing coxae, anterior lappets approximately 2 times length of associated coxal lobes in dorsal view. Pereonite 1 bearing only posterior lappet shorter than associated coxa; pereonites 4-7 bearing anterior lappets, with that of pereonite 4 being relatively narrow and that of pereonites 5-7 being broad and laterally rounded; lappets of pereonites 6-7 with distinct posterolateral projections. Tergite 5 distinctly shorter medially than other tergites. Pleotelson with nearly straight lateral margins, with posterolateral medially curving spines, and with posterior margin being obtusely rounded; margin between posterolateral spines and distal tip slightly convex, not concave; tip of pleotelson extending beyond posterior limits of posterolateral spines. Antennula article 3 distinctly longer than wide; flagellum with around 12 articles, distal article tiny. Antenna with conspicuous pointed scale. Mandibular article 3 elongate, longer than palp article 1. Articles 1-3 of maxillipedal palp expanded. Pereopod I carposubchelate; dactylus short, with 2 claws; propodus with 17 denticles on proximoventral border, carpus with 2 rows of short spine-like sensillate setae on ventral margin and fine fringe of cuticular comb-like spinules. Coxa I bluntly pointed, large, longer than pereonal lappet. Coxae II-V laterally bilobed in dorsal view, length of both lobes of coxae II-III subequal. Female operculum broad, ovate, distally with median concavity. Male pleopods I-II unknown. Uropods (known only in early juvenile) biramous with branches of subsimilar length, sympod about as long as rami.

Biology. See remarks under *Janiralata* sp. A.

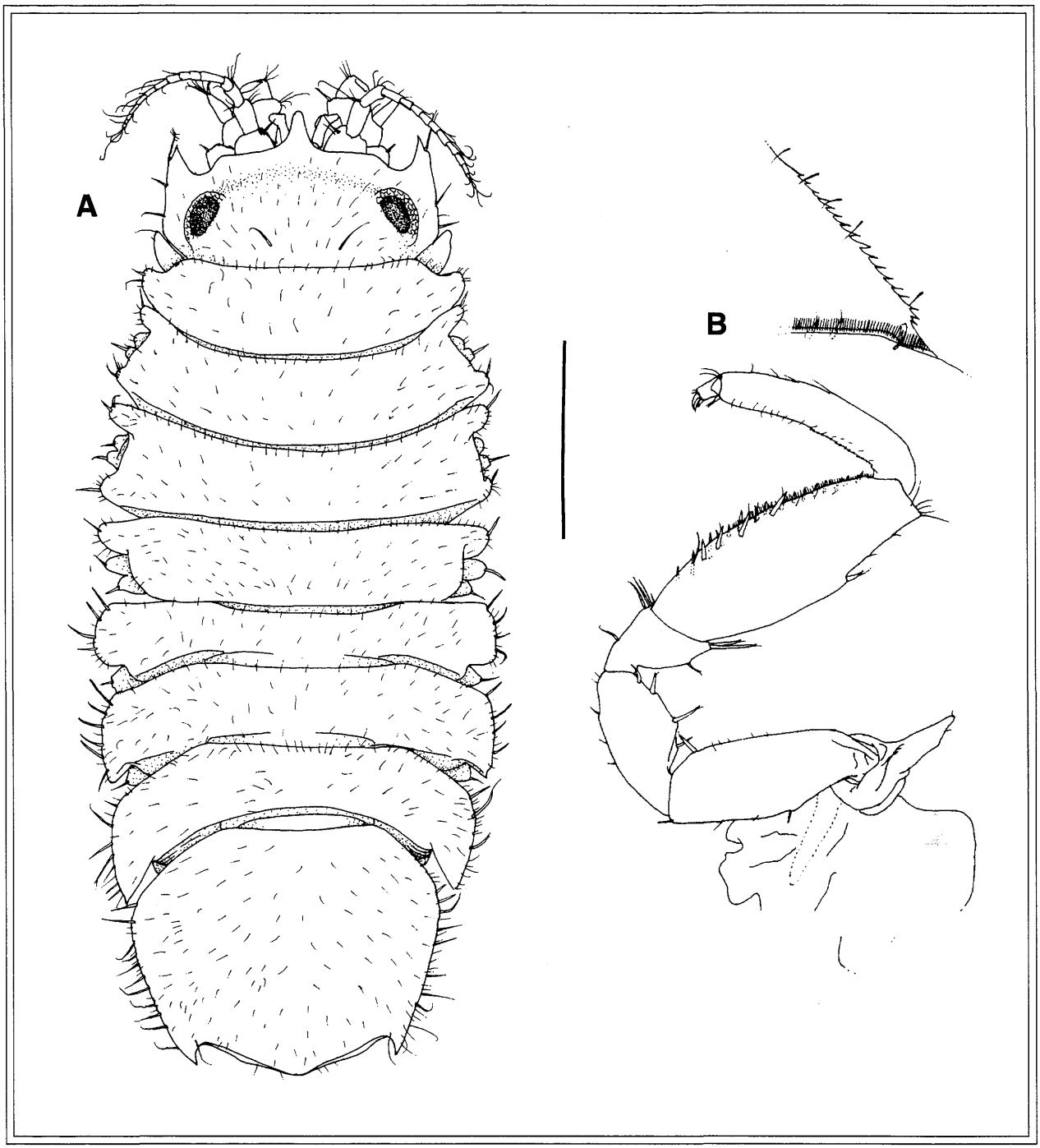

Figure 1.32. *Janiralata* sp. B, brooding female, MMS Phase I Sta. BRA-4. A, dorsal view, scale bar = 1 mm. B, pereopod II with enlargement of proximoventral denticles on propodus.

Remarks. *Janiralata* sp. B is most similar to *J.* sp. A, *J. occidentalis* and *J. solasteri*, but has a different combination of features. Unlike *J.* sp. A and *J. occidentalis*, this species lacks pigment and has a decidedly longer rostrum in the adult. Juveniles, however, have much shorter rostra than in adults and could be confused with other species on this character alone. *J.* spp. A and B have nearly identical antennulae, so readers can consult the plate for the former species for the antennular form of the latter. *J.* sp B. differs from *J. solasteri* in having different lengths of coxal projections on pereopods II and III, the relative lengths of antennular articles 2-3, the terminal extension of the pleotelson beyond the posterior limits of the posterolateral spines, and the number of proximoventral denticles on propodus I in the adult.

Type Locality and Type Specimens. None. This species is undescribed.

Distribution. Santa Maria Basin, 168-237

Janiralata sp. C

Figure 1.33

Material Examined. California, Santa Maria Basin, off, Purisima Point, Sta. BRA-16, 91.5-123 m, 1 preparatory female, illustrated, and another 9 individuals, parts of 1 male illustrated.

Description. Body broad and flattened, with no pigment on any dorsal surface. Dorsal surfaces with many fine setae. Cephalon with no rostrum, anterior margin smoothly convex or with slight medial rounded point, margin posterior to limits of anterolateral angles; anterolateral margin broad flattened angle, not spine-like; lateral margin only slightly curved; eyes large, bulging, but not near lateral margins. Lateral margins of pereonites 2-3 with 2 short lappets, posterior lappets indistinct, separated by broad indentations only slightly exposing coxae in dorsal view. Pereonite 1 with no posterior lappet; pereonites 5-7 laterally broad and rounded, with no obvious anterior lappets. Pereonite 4 with short, broad anterior lappet. Tergite 5 distinctly shorter medially than other tergites. Pleotelson broad with smoothly rounded margins, with no posterolateral spines, and with indistinctly trilobed posterior margin; margin between posterolateral lobes and rounded distal tip concave; tip of pleotelson extending only slightly beyond posterior limits of posterolateral lobes. Antennula article 3 distinctly longer than wide; flagellum with around 6 articles, distal article small, but easily seen. Antenna with conspicuous pointed scale. Mandibular article 3 elongate, longer than palp article 1. Articles 1-3 of maxillipedal palp expanded. Pereopod I carposubchelate; dactylus short, with 2 claws; propodus with 6 denticles on proximoventral border, carpus with 2 rows of short spine-like sensillate setae on ventral margin (3 on lateral side and 10 on medial side) and fine fringe of cuticular comb-like spinules. Coxa I bluntly pointed, large. Coxae II-V not obviously bilobed, barely visible in dorsal view. Female operculum broad, ovate, distally with median concavity. Male pleopod I with elongate laterally-pointed copulatory horns and broad truncate medial lobes. Male pleopod II with short stylet not exceeding length of protopod. Uropods unknown, probably biramous with branches of similar length and sympod about as long as rami.

Biology. See remarks under *Janiralata* sp. A.

Remarks. *Janiralata* sp. C is most similar to *J. koreaensis* Jang, 1991 although this new species lacks pigment, has a broader pleotelson, has fewer articles in the antennula, and has much smaller lappets on pereonites 1-4. In this last regard, *J.* sp C is similar to *J. rajata* Menzies, 1951, although the width of the body immediately separates the two species. In Menzies' (1951a) key, this species will key out to *J. erostrata*, although again pereonal lappets and coxal projections immediately distinguish the two species.

Type Locality and Type Specimens. None. This species is undescribed.

Distribution. Santa Maria Basin, 91.5-123 m.

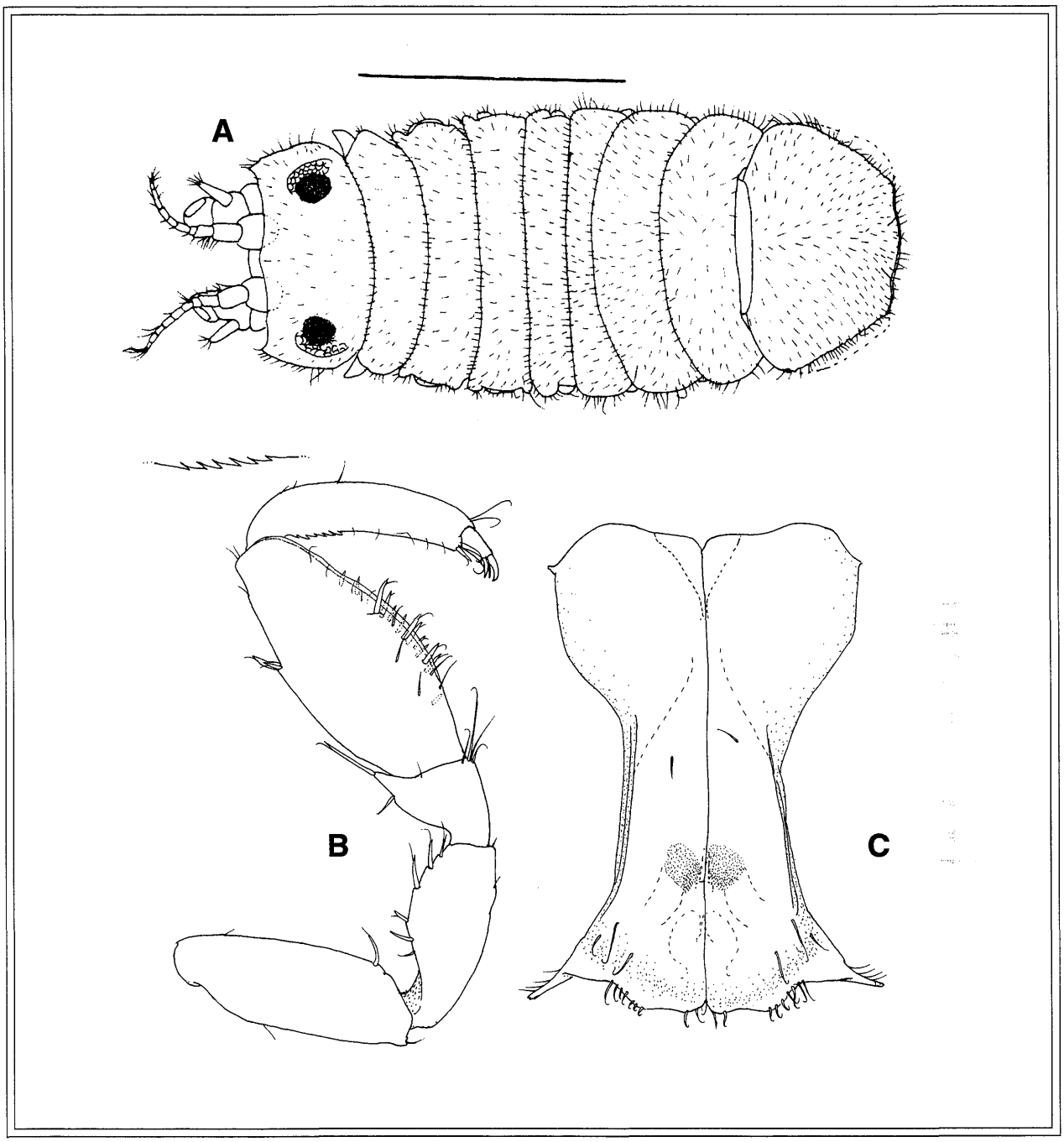

Figure 1.33. *Janiralata* sp. C. A, dorsal view, preparatory female (MMS Phase I Sta. BRA-16), pleotelson slightly damaged, scale bar = 1 mm. B-D, copulatory male (MMS Phase I Sta. BRA-16). B, right pereopod I, with enlargement of proximoventral spines on propodus. D, pleopod I.

Janiralata sp. D (cf. *rajata*)

Figure 1.34

Material Examined. California, Santa Maria Basin, off Purisima Point, Sta. BRA-16, 91.5-123 m, 1 preparatory female body length 3.7 mm.

Description. Body narrow, with numerous dark-pigmented chromatophores on dorsal surfaces. Dorsal surfaces with few fine setae. Cephalon with no rostrum, anterior margin with slight medial rounded point; anterolateral margins rounded, not spine-like, not projecting anteriorly, with single sensillate seta; lateral margin narrow, only slightly curved, with single sensillate seta adjacent to eyes; eyes large, bulging, extending to lateral margins. Lateral margins of pereonites 2-3 with very short lappets, posterior lappets indistinct, separated by broad indentations only slightly exposing coxae in dorsal view. Pereonite 1 with no posterior lappet; pereonites 5-7 laterally broad and rounded, with no obvious anterior lappets. Pereonite 4 with short, narrow anterior lappet. Tergite 5 only slightly shorter medially than other tergites. Pleotelson with smoothly rounded margins, lacking posterolateral spines or lobes; posteromedial tip rounded, most posterior part of body. Antennula article 3 distinctly longer than wide; with 12-13 articles, distal article small, but easily seen. Antenna with conspicuous pointed scale. Mandibular article 3 elongate, longer than palp article 1. Articles 1-3 of maxillipedal palp expanded. Pereopod I carposubchelate; dactylus short, with 2 claws; propodus with 18 denticles on proximoventral border, carpus with 2 rows of short spine-like sensillate setae on ventral margin (5 on lateral side and 18 on medial side) and fine fringe of cuticular comb-like spinules. Coxa I triangular, pointed. Coxae II-V weakly bilobed, barely visible in dorsal view. Female operculum broad, ovate, with median concavity distally. Male pleopods I-II unknown. Uropods unknown, probably biramous with branches of similar length and sympod about as long as rami.

Biology. See remarks under *Janiralata* sp. A

Remarks. This species is very similar to *Janiralata rajata* Menzies, 1951a, especially in body form. *J.* sp. D differs from *J. rajata* in the following: the eyes are smaller, the body has numerous dense chromatophores, the antennula is longer, and the propodus of pereopod I has more proximoventral denticles (18 instead of 12 or 13). Nevertheless, this new specimen and the male holotype of *J. rajata* are near the same size. Males from the Santa Maria Basin population must be collected to establish more differences.

Type Locality and Type Specimens. None. This species is undescribed.

Distribution. Santa Maria Basin, 91.5-123m.

Family Joeropsididae Nordenstam, 1933
(originally Jaeropsini)

Genus *Joeropsis* Koehler, 1885

Description (derived from data of Wilson, 1994). Body broad; pereonal tergites laterally rounded, coxae not visible in dorsal view. Head wider than long; frons wide with distinct vertex, rostrum projecting anteriorly between antennulae. Pleotelson with posterolateral spines; pleonite 1 fused to pleotelson. Antennular first article length greater than width, with spines on distolateral margin, flagellum with less than 5 articles. Antennal flagellum with more than 12 articles but proximal articles conjoint; articles 5-6 longer than 1-4, article 5 with broad lateral flange; article 3 not especially enlarged compared to articles 1-2 and 4, scale absent. Mandibular molar thin, elongate, distally tapering. Maxillipedal palp slender, endite extremely broad, more than twice as broad as palp. Pereopod I ambulatory, not subchelate, carpus and propodus with few setae. Pereopods II-VII dactyli with 2 subequal claws, accessory seta claw-like. Penes situated medially on

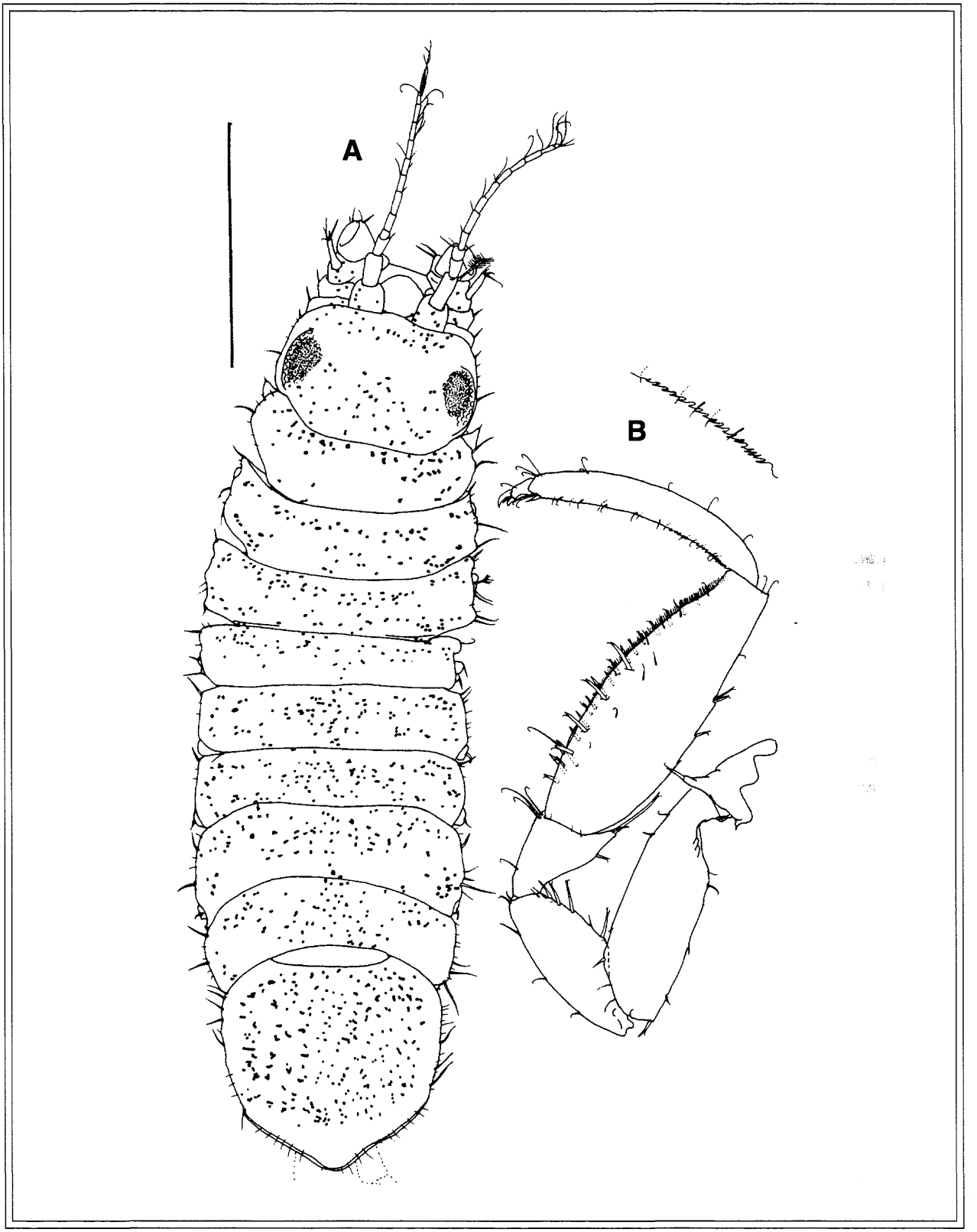

Figure 1.34. *Janiralata* sp. D (cf. *rajata*), MMS Phase I Sta. BRA-16, preparatory female. A, dorsal view of body, scale bar = 1 mm. B, right pereopod I with enlargement of proximoventral denticles on propodus, lateral view.

pereonite 7 sternum. Pleopod III endopod with 3 plumose setae; exopod narrower and longer than endopod, lacking plumose setae, with 2 free articles. Uropods squat, inserting terminally on pleotelson, rami distinctly shorter than protopod, exopod shorter than endopod; enlarged protopod with distinctive medial claw.

Joeropsis concava (Schultz, 1966)

Figure 1.35

Material Examined. California, Santa Maria Basin, off Purisima Point, Sta. BRA-16, 91.5-123 m (5).—Western Santa Barbara Channel, Sta. BRC-2, 120-123 m (3).

Description. Body devoid of pigment, but covered with numerous fine simple setae. Body elongate and parallel-sided; all segments width subequal, body length exceeding 4 times body width. All lateral margins with small denticulae, and pleotelson with 7 large posteriorly curved spines. Cephalic lateral margin with distinct indentation below eyes; eyes small, with fewer than 10 ocelli. Antennula with 5 distinct articles (Schultz, 1966, reports 6 - see remarks below) article 1 with large distolateral projection bearing around 6 sharp, flat spines curving toward article 2; article 2 distinctly longer than wide. Male pleopod II with distinctly separate medial and lateral lobes; medial lobes longest, with medially converging sides. Uropodal protopod with distinct distomedial spine; rami with short setae no longer than protopod.

Biology. Living joeropsidids look like slow-moving little tanks. They are relatively well calcified compared to other more speedy shallow-water janiroideans, such as *Ianiropsis*. Shallow-water species are usually well pigmented although this deep-water form seems to lack any pigment.

Remarks. Several species of *Joeropsis* are substantially similar to *J. concava* in many details, especially *J. brevicornis* Koehler, *J. dubia* Menzies, 1951, and *J. paucispinis* Menzies, 1951 (varieties and subspecies of previous authors should be considered separate species unless clear evidence for their conspecific nature is given). *J. concava* differs from all of these species by having a more elongate body, no pigment, and a distinctive indentation in the cephalic margin below the eyes.

The specimens illustrated here from the Santa Maria Basin conform with Schultz's (1966) description of *Joeropsis concava* in practically all points, but their identification must be considered tentative because the antennulae do not match. Schultz (1966) illustrates a 6 articled antennula with the terminal sixth article being elongate and pointed, while these specimens clearly have 5-articled antennulae, with the presumptive sixth article being fused to the 5 article. Some joeropsidids may have a free sixth article, but it is always tiny and truncate, never elongate and pointed. Other species illustrated in Schultz (1966) are sometimes inaccurate on details of this scale, so the illustration and his description may be erroneous. Alternatively, the type specimen could be simply a deviation from the common joeropsidid form. The types of this species must be examined to settle this problem.

The ventral surface of this species showed distinctive ridges on the ventral midline, that were not present in *J.* sp. A (see next description). Formal descriptions of joeropsidid species nearly always ignore the ventral surface of the body, so these features could not be included here. For the future, however, taxonomists of this morphologically conservative group should be aware that important characters may be obtained from the lateral and ventral sides of the body.

Type Locality and Type Specimens. Holotype male, 3.1 mm long, R/V *Velero IV* station 6806: 33°56.1'N, 118°52.28'W, Santa Cruz Canyon, 221 m, 22 December 1959, rocks and coarse green sand (from Schultz, 1966).

Distribution. Central to southern California, 60-221m. Additional specimens of this species have been collected by the City of San Diego Ocean Monitoring Program at Station B5 (32°49.25'N, 117°19.60'W, 60m).

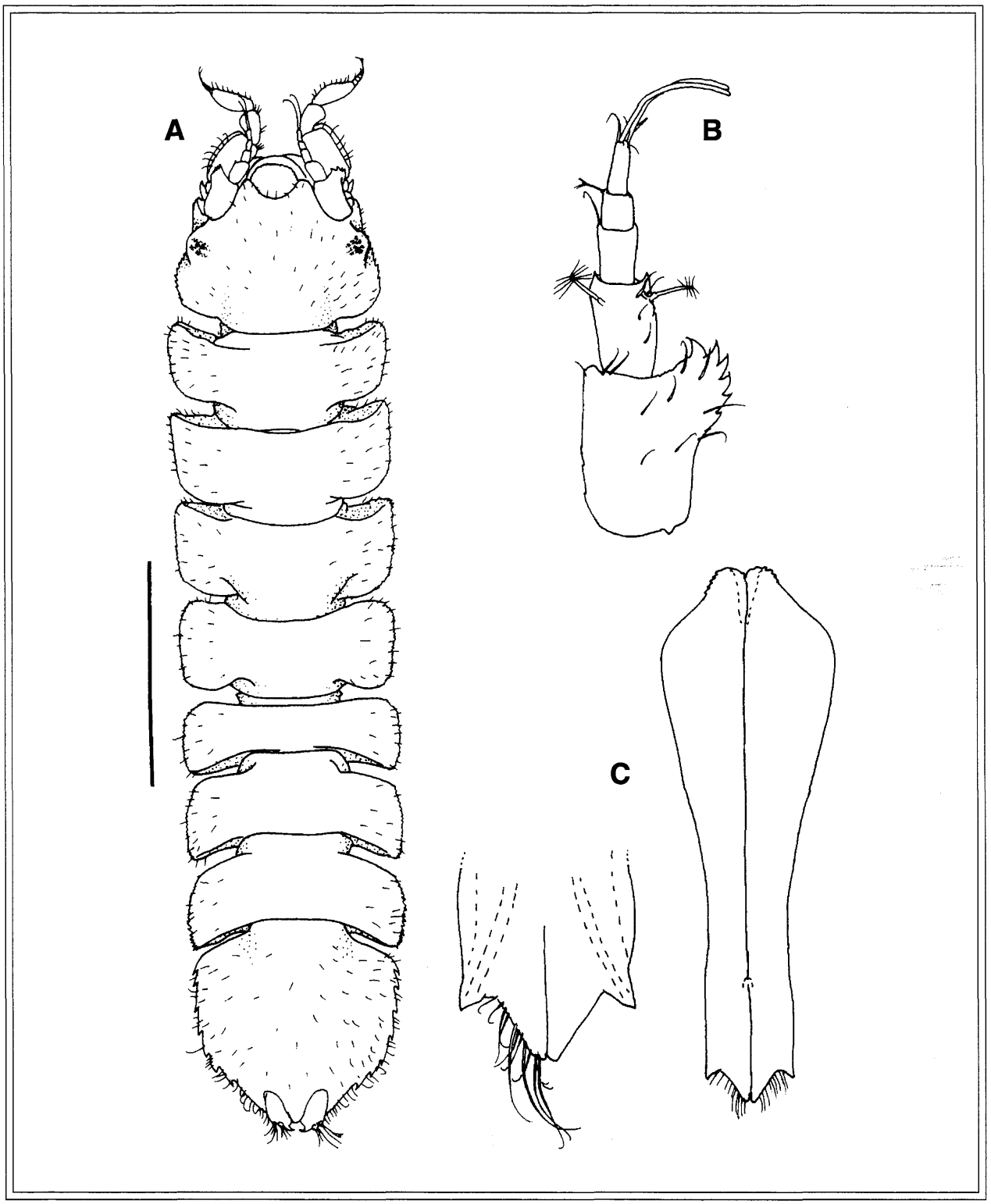

Figure 1.35. *Joeropsis concava* Schultz, 1966, male from Phase I Sta. BRA-16. A, body dorsal view, scale bar = 1 mm. B, antennula. C, male pleopod I with enlargement of distal tip.

Joeropsis sp. A

Figure 1.36

Material Examined. California, Santa Maria Basin, off Purisima Point, 90-130.5 m, Sta. BRA-20, 90-130.5 m (1); off Point Arguello, 54-63 m, Sta. BRA-6, 4 individuals, illustrated brooding female and copulatory male.

Description. Body devoid of pigment, but covered with numerous fine and some longer simple setae. Body broad and laterally curved; pereonites 3 and 4 widest, body length between 2.5 and 3 times body width; all pereonites with tergites extending much further than ventral insertions of pereopods. All lateral margins with small denticulae, pleotelson with 8 large posteriorly curved spines. Cephalic lateral margin with large anteriorly curved spines, substantially produced laterally forming large lateral plate; eyes small, with approximately 10 ocelli. Antennula with 5 distinct articles; article 1 with small distolateral projection bearing several laterally curving flat spines; article 1 with small medial projection with several denticulae; article 2 distinctly longer than wide. Male pleopod II with distinctly separate medial and lateral lobes; medial lobes longest, with medially converging, straight sides; medial margin of lateral lobe distinctly arc-like. Uropodal protopod with distinct distomedial spine; rami with elongate setae longer than protopod.

Biology. See general remarks above, *J. concava.*

Remarks. This new species is most like *Joeropsis lata* Kussakin, but differs in the following respects (*J. lata* in parentheses): the antennulae have large distinct denticulae (only tiny denticulae) and article 2 is much longer than broad (length and width approximately equal); male pleopod I medial lobe on the distal tip straight sided (not curved). This species of *Joeropsis* is also similar to *J. setosa* George and Strömberg, although the latter is largely denticle-free on all margins, and seems to have more obvious dorsal setae. George and Strömberg (1968) provide a useful key to species of *Joeropsis*, although it is out of date now that the number of species in the genus has nearly doubled.

Type Locality and Type Specimens. None. This species is undescribed.

Distribution. Santa Maria Basin, 54-130.5 m.

Family Munnopsidae Sars, 1869

Subfamily Eurycopinae Hansen, 1916

Genus *Eurycope* G.O. Sars, 1864

Description (from Wilson, 1982b). Eurycopinae with deep, vaulted and rounded natasome; venter with no enlarged or recessed area; body without dorsal or lateral spines. Tergal articulations of pereonites 5-7 distinct; pereonite 7 subequal to or longer than pereonites 5 and 6. Rostrum and frons distinct; clypeus narrow, striplike; labrum longer than clypeus. Pleotelson posterolateral margin parallel to pleotelson longitudinal axis or angled downward in lateral view. Antennular first article broad, with well-developed medial lobe. Mandibular molar triturating surface broad, oval, with tiny denticles and small setae on posterior edge; ventral edge flattened into angular blade. Mandibular palp well-developed and functional; flattened distal article strongly curled laterally. Bases of pereopods I-IV subequal to body depth. Bases of pereopods V-VII subequal, short, and robust. Uropods short, biramous; protopod broad or tubular, not leaflike; exopod subequal to or shorter than endopod.

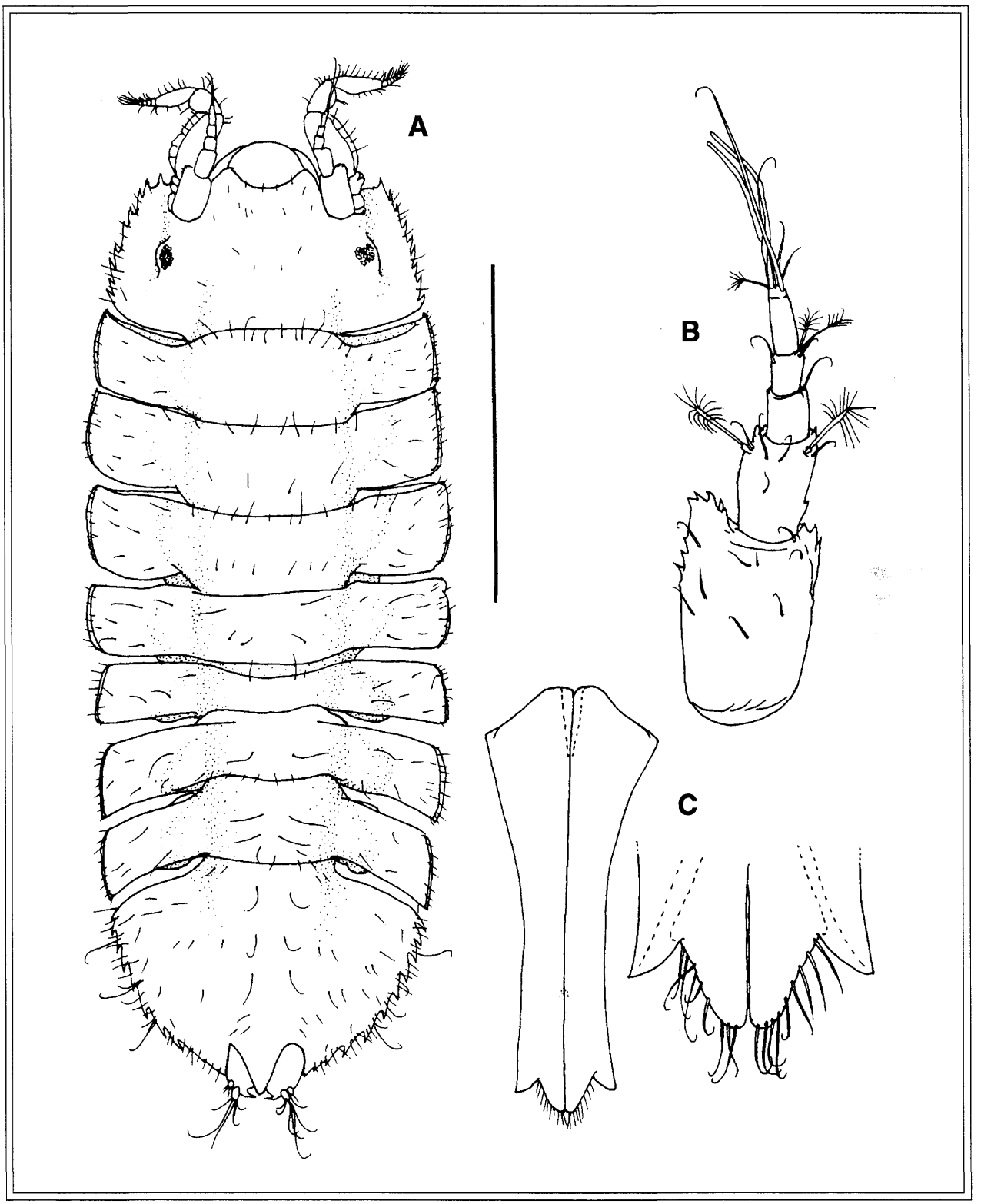

Figure 1.36. *Joeropsis* sp. A. A-B, brooding female from Phase I Sta. BRA-6. A, body dorsal view, scale bar = 1 mm. B, antennula. C, male pleopod I with enlargement of distal tip, male specimen from same station.

Eurycope californiensis Schultz, 1966

Figure 1.37

Eurycope californiensis: Schultz, 1966:4, 8, 28-29.

Material Examined. California, Santa Maria Basin, off Point Sal, Sta. R-7, 565 m (1 female, illustrated; another female); off Purisima Point, Sta. 50, 591 m, (3, illustrated male); off Point Arguello, Sta. 63, 930 m, (1 female).

Description. *Eurycope* (Eurycopinae) with deep, vaulted, and rounded natasome. Venter of natasome with no enlarged or recessed areas; tergal articulations dorsally distinct. Pereonite 7 medially longer than pereonites 5-6; bullae on the ventrolateral surface of pereonite 7 indistinct. Pleotelson posterolateral margin only slightly angled downward compared in lateral view to anterolateral margin. Rostrum of cephalon broadly acute, anteriorly rounded, only slightly overhanging frons, lacking setae, spines, or lateral keels. Body without dorsal or lateral spines. Antennular first article broad, medial lobe with around 4 sensillate setae, lateral lobe with short, conical setae. Mandible with narrow molar process having numerous distal denticles surrounding triturating surface. Mandibular palp large, well-developed, with distal article strongly curled laterally. Maxilliped with normal 5 articled palp. Pereopod I-IV bases subequal and elongate, lengths longer than axial length of cephalon and pereonites 1-4. Pereopod V-VII bases robust, short and subequal, basis VII with only one small seta. Male pleopod II protopod lateral fields only slightly recurved ventrally; distal tip with short narrow projection. Uropods robust and biramous; protopod with modest medial lobe and distoventral fringe of sensillate setae, length subequal width; exopod longer than half length of endopod; both rami with distal tufts of sensillate setae; endopod with several penicillate setae.

Biology. Genera and species of the Eurycopinae are strongly swimming, epibenthic animals, usually found on soft deep-water substrates. Hessler and Strömberg (1989) review most of what is known about their behavior. Compared to other asellotes, members of the genus *Eurycope* are often large, with much higher biomass concentrations than other more abundant but smaller species. Analyses of their population biology (Wilson, 1981, 1983a-b) suggests that some abyssal members of *Eurycope* may grow rapidly to an adult size (as evidenced by the rarity of intermediate life stages) and reproduce multiple times as adults (shown by various sizes of copulatory adults as well as a strong and broad modal distribution of adults).

Remarks. *Eurycope californiensis* resembles members of the *Eurycope complanata* complex (see Wilson, 1983a). However, it differs from that group in the following features: rostrum distally rounded, lacking a distinct anterior notch; no distinct bullae on the ventrolateral surface of pereonite 7; lateral fields of pleopods II not strongly recurved; and uropodal protopod not broader than long. Schultz (1966) described this species with a reduced palp. Actually, the palp is quite normal but is often broken off during collection and processing. The specimens that lack the palp can be seen to have a distinct socket where the palp was prior to breaking off.

Type Locality and Type Specimens. Holotype female, body length 3.5mm. R/V *Velero IV* station 7032. Newport Canyon, 33°31.29'N, 117°54.95'W, 478m. Collected with green mud and gray sand, some very coarse.

Distribution. Newport Canyon to Santa Maria Basin, upper and middle slope depths, 478 to 930m.

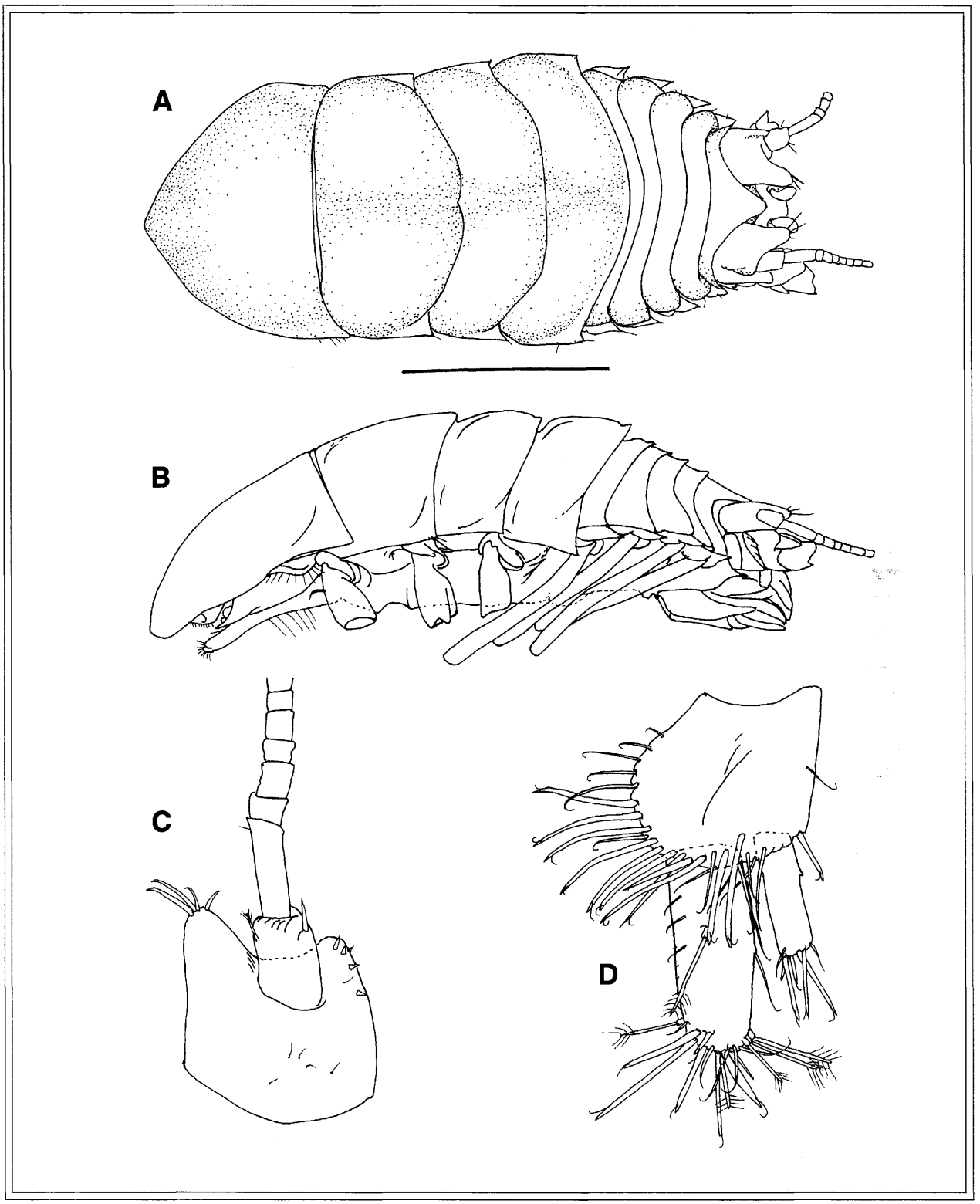

Figure 1.37. *Eurycope californiensis* Schultz, 1966. A-C, copulatory male (Phase I Sta. 50), dorsal lateral views of body (scale bar = 1 mm), and enlargement of antennular basal article. D, preparatory female (Phase II Cruise 3-4, Sta. R7), left uropod, ventral view.

Genus *Belonectes* Wilson and Hessler, 1981

Description (from Wilson and Hessler, 1981). Eurycopinae with elongate, streamlined natasome; venter with pronounced medial bump at posterior margin of pereonite 5, becoming abruptly recessed dorsally posterior to bump. Pereonite 4 with distinct ventromedial bump. Pereonites 5 and 6 fused dorsally, pereonite 7 smaller and narrower than combined pereonites 5 and 6. Rostrum of cephalon broad, quadrate, sloping directly into low frons; clypeus dorsally prominent, approximately half length of labrum. Pleon posterolateral margin angles distinctly upward in lateral view. Antennular first article trapezoidal, lacking medial lobe. Mandibular molar thin, obliquely truncate distally; ventral margin flattened into angular blade; posterior margin with tiny denticles and small setae. Mandibular condyle shorter than molar process. Mandibular palp distal article somewhat reduced, curled approximately 90° laterally. Bases of pereopods I-IV elongate and subequal; bases of natatory pereopods differing from one another; pereopod V basis shortest and widest, pereopod VI longest but intermediate in width, pereopod VII basis thinnest but intermediate in length. Uropods short, biramous protopod, tubular; exopod tiny; endopod more than twice length of protopod.

Belonectes sp. A

Figure 1.38

Material Examined. California, Santa Maria Basin, off Point Arguello, Sta. 72, 401 m (1 preparatory female, illustrated).

Description. *Belonectes* (Eurycopinae) with elongate, streamlined natasome, distinctly narrowing at pereonite 7. Rostrum of cephalon broad, sloping medially to low frons but with laterally flaring anterior lobes with thin fringes. Clypeus of cephalon prominent in dorsal view. Ventromedial surface of pereonite 5 with distinct bump, becoming recessed posterior to bump. Pereonites 5 and 6 fused dorsally, pereonite 7 smaller and narrower than pereonites 5 and 6. Pleotelson posterolateral margin angling distinctly upward in lateral view. Pleonal preanal ridge not enlarged and prominent. Antennular first article oval, wider proximally than distally. Bases of pereopods I-IV elongated and subequal. Pereopod bases V-VII differing in length and width: basis V shortest and widest, basis VI longest, basis VII thinnest. Uropods short, biramous; protopod parallel sided; exopod very small; endopod less than twice length of protopod.

Biology. See remarks under *Eurycope californiensis*. *Belonectes* tend to be much smaller both in body size and in population size than *Eurycope*, and therefore comprise a much smaller part of the benthic biomass.

Remarks. Unlike any of the known species or undescribed species of *Belonectes* from the Atlantic (see Wilson and Hessler, 1981), this species has a distinctive broad and laterally flaring rostral area of the cephalon. Unfortunately the only specimen examined had a damaged pleotelson, so the illustrated shape should not be trusted for accuracy. Within the Santa Maria Basin, this eurycopine species is distinctive with broad indented and laterally flaring rostrum, waisted pereonite 7 and narrow uropods with tiny exopods.

Type Locality and Type Specimens. No type locality - this species is undescribed.

Distribution. Santa Maria Basin, 401 m.

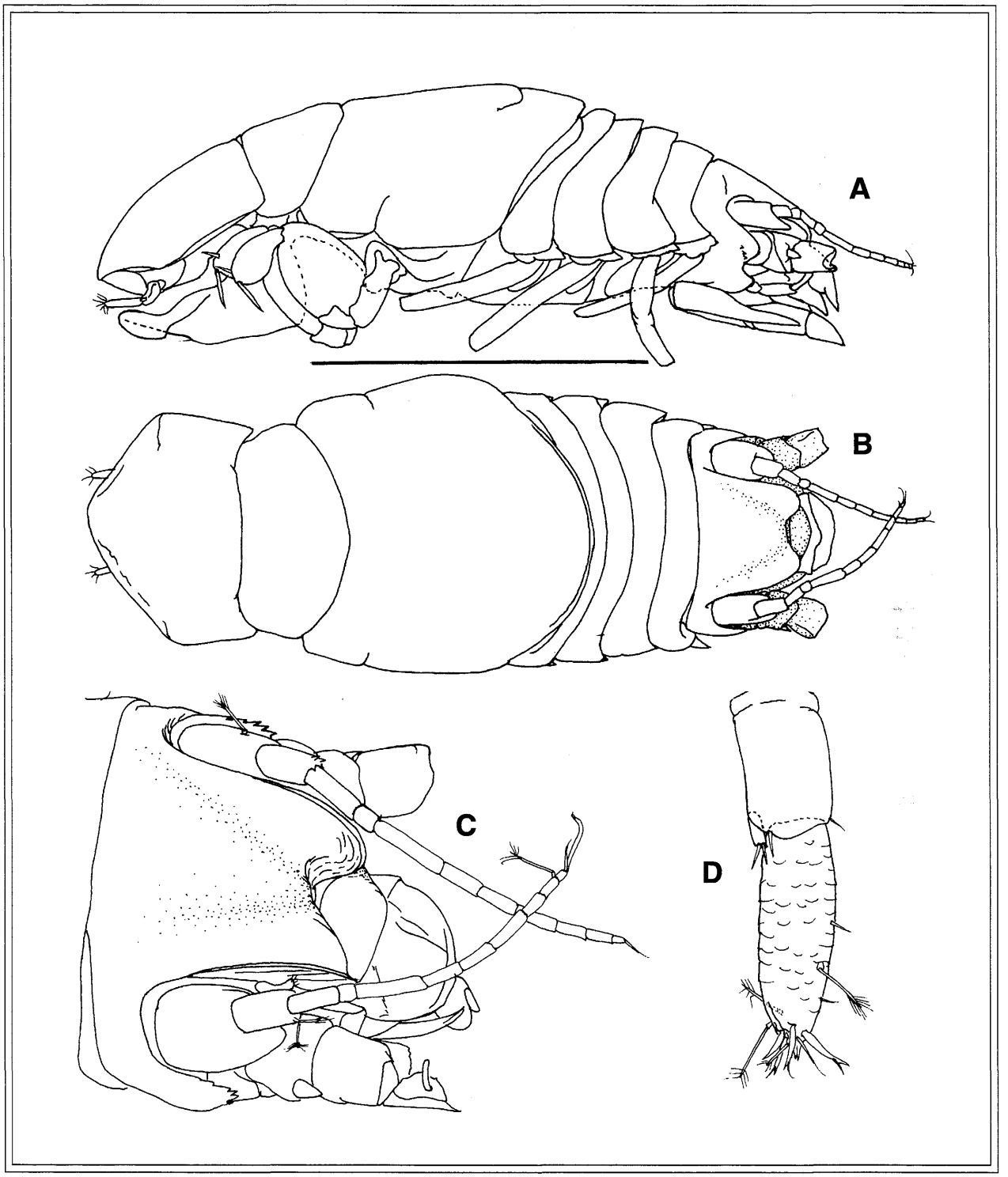

Figure 1.38. *Belonectes* sp. A, preparatory female, Phase I Sta. 072. A-B, body, dorsal and lateral views, scale bar = 1 mm. C, cephalon, lateral oblique view. D, right uropod, ventral view.

Subfamily Ilyarachninae Hansen, 1916

Genus *Ilyarachna* Sars, 1870

Description. Head much broader than long, with flattened frons, lacking rostal projections, antennulae medially adjacent; clypeus and labrum reduced, much narrower than head. Body with distinct natasome, natasome without stout dorsal setae. Pleonite 1 distinct dorsally. Pleotelson dorsally subtriangular. Antennulae with multiarticulate flagellum. Mandibular incisor process robust, teeth broad rounded; molar process reduced, distally tapering and setose; dorsal condyle elongate, curving; palp shorter than mandibular body, with 3 articles. Pereopods I-II length subequal, both prehensile. Pereopods III-IV extremely long, ambulatory, bases short and robust, lengths nearly as short as wide. Pereopods V-VI carpus-propodus paddle-like, fringed with plumose setae. Pereopod VII carpus-propodus narrow, but fringed with plumose setae. Uropodal protopod flattened and foliacious, longer than rami; exopod tiny or absent.

Ilyarachna acarina Menzies and Barnard, 1959

Figure 1.39

Ilyarachna acarina: Menzies and Barnard, 1959:9-10; Menzies, 1962:136; Wolff, 1962:96-97; Schultz, 1964:310; Schultz, 1966:9; Hessler and Thistle, 1975:157; Thistle, 1979:382-384.

Material Examined. Off Purisima Point, Sta. R-5, 154 m (14, illustrated 1 large female with most legs intact; 10 from another replicate; 3 damaged specimens from another sample).—Western Santa Barbara Channel, Sta. 87, 299 m (2 damaged specimens).

Description. Head short and broad, with decidedly projecting lateral cheeks bearing mandibular articulations; cephalic dorsal vertex with 10-15 stout setae in adult. Pereonites 1-4 freely articulated, with 11-16 large pedestal setae on anterior dorsal margins; pereonite 4 with distinct anterolateral projection with several setae. Pereonites 5-7 with visible sutures, narrowing posteriorly. Tergites 5-7 and pleotelson with scattered fine setae dorsally. Pereonal sternum lacking spines. Pleotelson subtriangular in dorsal view, with uropods projecting posteriorly. Antennula article 1 with several setae; article 2 length subequal article 3. Antenna basal article with lateral projection having 3-4 setae. Mandible heavily sclerotized, incisor process massive, molar process reduced to small setose flap; mandibular palp present but reduced; distal article not curled, paucisetose. Pereopods I-II short, somewhat prehensile, pereopods III-IV extremely elongate with bases only slightly longer than wide. Pereopod I coxal plate with 2-3 setae; pereopod II coxal plate with 1-2 setae. Pereopod II basis fringed by long setae on anterior and posterior surfaces. Pereopods V-VII decreasingly natatory toward the posterior end of the body, with pereopod VII nearly completely ambulatory. Female operculum with setose median keel. Male pleopod I elongate, tapering to narrow distal tip with narrow projecting lateral lobes and non-projecting medial lobes with 6-7 setae. Uropodal protopod broad, flattened, leaf-like; exopod completely fused to protopod and reduced to two setae on protopod.

Biology. Ilyarachnines are interesting because they are known to burrow despite their munnopsid abilities of swimming (Hessler and Strömberg, 1989). They walk on soft substrates with on elongate pereopods III and IV, probing with the anterior 2 pairs of pereopods. They can burrow into the mud posteriorly, pushing sediment with their "natatory" pereopods, and are often found at rest with their entire body in the mud with only their long antennae and pereopods III-IV protruding radially from surface. If sufficiently disturbed, they will take to the water with short spasmodic strokes. This, however, does not last for long and they will settle to the bottom and either walk away or burrow into the sediment. Like *Munnopsurus*, their powerful jaws suggest that they can feed on shelly or hard food items. Males seem to be much smaller than females in this species: the illustrated preparatory female was 3.9mm long, while a fully adult male was only 2.0mm long.

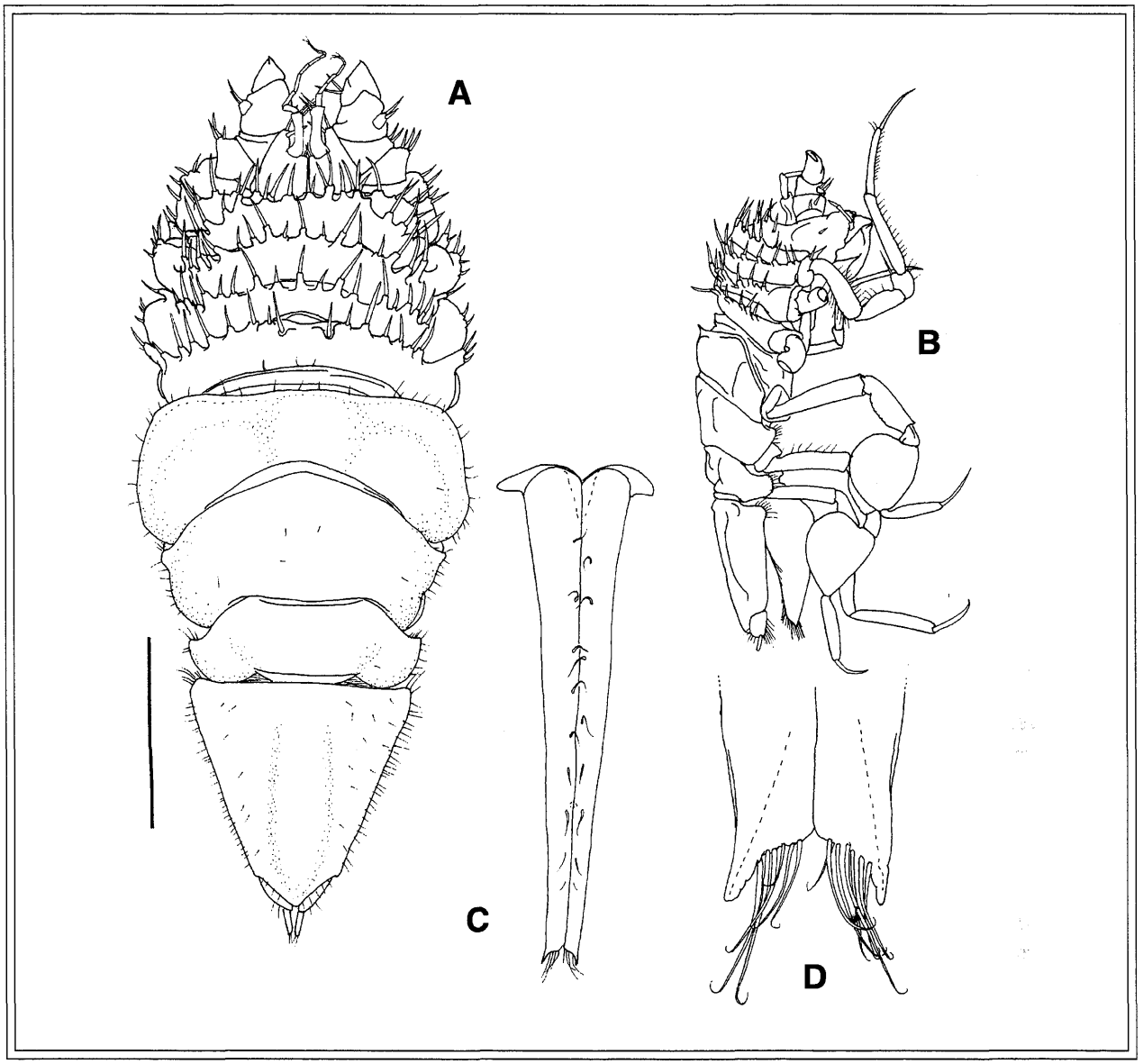

Figure 1.39. *Ilyarachna acarina* Menzies and Barnard, 1959. A-B, body lateral and dorsal views, scale bar = 1 mm, preparatory female from MMS Phase II, Cruise 3-4, Sta. R-5. C-D, male pleopod II ventral view and distal tip, male from same station.

Remarks. Thistle (1979) provides sufficient information to separate *Ilyarachna acarina* from *I. profunda* Schultz, 1966, both found in Californian waters. The best character that allows distinguishing both two species is the large pedestal setae on the anterior margin of pereonites 1-4 in *I. acarina*; *I. profunda.* has much smaller non-pedestal setae on anterior pereonite margins. Menzies and Barnard (1959) thought their species was similar to *I. denticulata* Sars, 1897b, although *I. acarina* has considerably larger pedestal setae on the anterior margins, and has distinct anterolateral projections on pereonite 4. Mancas of *I. acarina*, however, lack pedestal setae or have few of them, so one should check the developmental stage of specimens before arriving at an identification.

Type Locality and Type Specimens. Holotype brooding female, 4.3mm long, Allan Hancock Foundation collection number 578. Off coast of California, R/V *Velero* Sta. 4980, 34°15.8'N, 119°34.5'W, 92m.

Distribution. Off Southern California from Santa Maria Basin to off Pt. Loma, 73-1118m.

Subfamily *incertae sedis*

Genus *Munnopsurus* Richardson, 1912

Description. Head broad, vaulted, frons flattened with heavily cuticularized frontal arch; clypeus angled sharply dorsally, subtriangular in anterior view, laterally extending near lateral margins of head; vertex distinctly separating antennular insertions dorsally. Pereonites 1-4 freely articulated. Body with distinct natasome, natasomal somites free, including pleonite 1. Pleotelson broad, rounded, often inflated. Antennular article 1 flattened, longer than wide, lacking distinct medial lobe. Mandibular incisor molar process broad, heavily cuticularized, wider than long; dorsal condyle elongate, curving. Pereopod I slender, not prehensile. Pereopods II-IV elongate, thin, paucisetose, subequal; bases many times longer than wide. Pereopods V-VII carpus-propodus paddle-like, fringed with plumose setae. Uropod small, biramous; protopod tubular, shorter than rami.

Munnopsurus sp. A

Figure 1.40

Material Examined. California, Santa Maria Basin, off Point Buchon, Sta. 15, 393 m (1 preparatory female); off Point Sal, Sta. R-9, 410 m (3, including 2 males, 1 with Per IV, and 1 female; second sample with 3 individuals: 1 male, 1 mashed female, and 1 manca stage 3); Sta. R-7, 565 m (1 brooding female); off Point Arguello, Sta. 62, 582 m (1, brooding female).

Description (generic characters modified from Wolff, 1962). Small body size, adults with body length around 1.8 mm. Head as broad as pereonite 1, vaulted posteriorly, with flattened frons; frontal arch strongly calcified, semicircular; labrum and clypeus triangular. Dorsal surfaces of body with scattered fine simple setae. Pereonites 1-4 free and loosely articulated. Pereonites 5-7 lengths subequal and freely articulated. Pleotelson rounded in dorsal view, somewhat inflated. Antennula with no medial projection, distally flattened; flagellum in both sexes short with few articles, antennular article count 15 or less; article 2 with no medial projection, inserting around quarter length of article 1 from distal tip. Molar process of mandible broad and simple, but distinctly projecting; mandibular palp article 3 fully functional, curved and setose. Maxillipedal second article with strongly oblique anterior margin. Pereopod I not prehensile, elongate and thin. Pereopods II-IV long and slender, more than twice body length. Pereopods V-VII short, with carpi no longer than depth of body. Male pleopod I elongate and narrow, distinctly waisted proximally and broadening distally; lateral lobe on distal tip broadly recurved, projecting distally approximately half distance of medial. Male pleopod II with endopod and exopod reduced, placed distally in last fifth of protopod. Uropods short, biramous, somewhat inflated; exopod distinctly longer than protopod.

Biology. Little is known about the biology of species of *Munnopsurus*. Their somewhat reduced natapods suggests a reduction in the swimming lifestyle, while their elongate legs (typical in munnopsids) is in line with a soft bottom, deep-water habitat. The distinctive feature of the genus, the powerful mouthparts, suggests an adaptation for crushing large hard objects, such as foraminifera (as suggested for *Amuletta*; see Wilson and Thistle, 1985). This species has more eurycopine-like mouthparts and therefore is probably somewhat more of a generalist.

Remarks. *Munnopsurus* sp. A is most similar to *M. minutus* Gurjanova, 1933, although it differs by being distinctly smaller with body lengths around 2 mm (a 7mm deep-sea asellote isopod is not *minute*, so one wonders why Gurjanova gave it this name), by the lack of dorsal tubercles on pereonites 5-7, by having a somewhat inflated and rounded pleotelson, and in having somewhat more articles in the antennula. *M. minutus* Gurjanova, *M. atlanticus* Beddard, and *M.* sp. A are some what different from the remainder of *Munnopsurus*

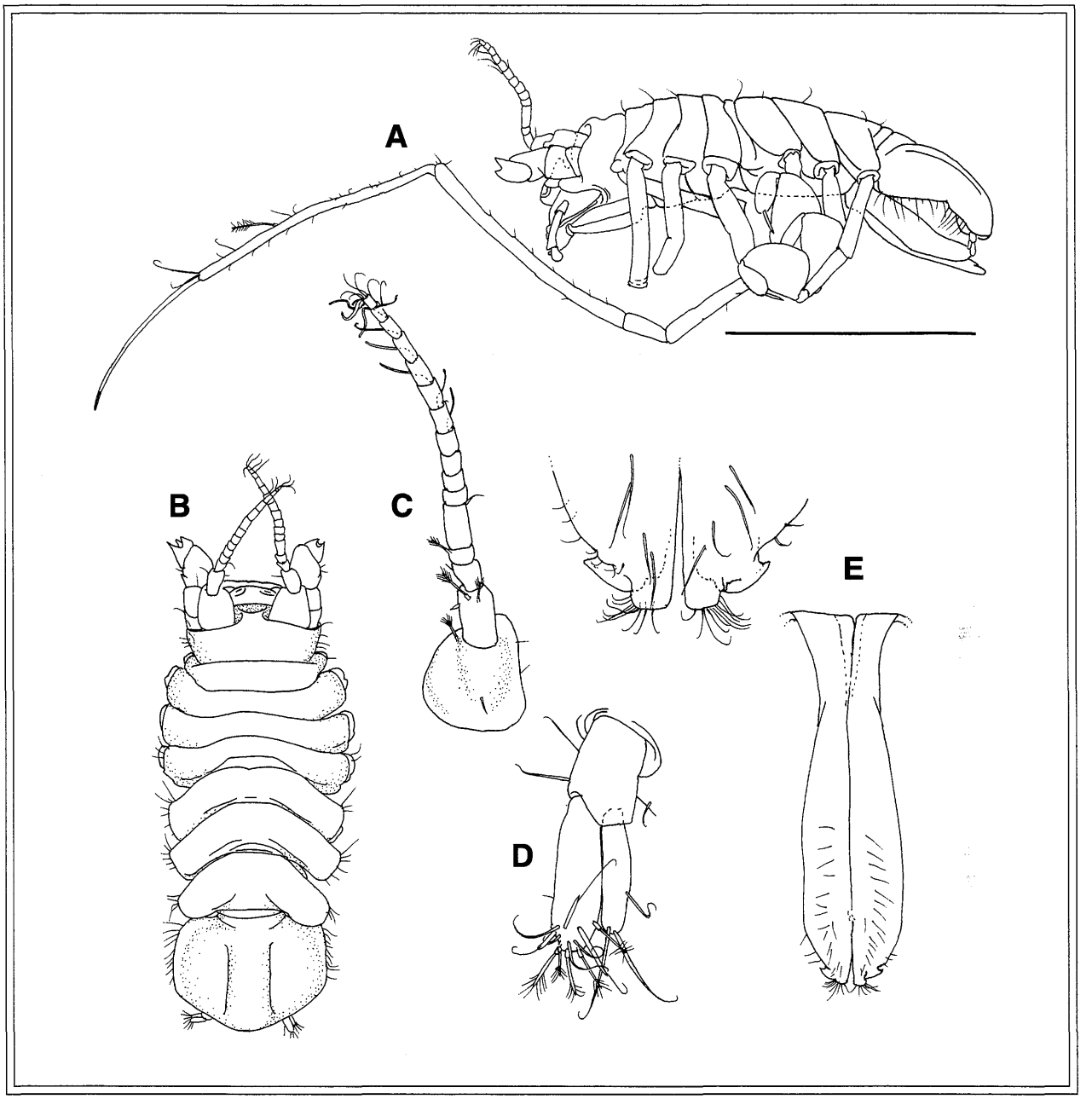

Figure 1.40. *Munnopsurus* sp. A. A-B, body dorsal and lateral views, scale bar = 1 mm, copulatory male, Phase II, Cruise 1-2, Sta. R-9. C, right antennula. D-E, male pleopod I, ventral view with enlargement of distal tip. F, left uropod, ventral view.

species in having a more plesiomorphic eurycopine-like mandible with a functional mandibular palp and a strengthened but not massive mandibular molar and incisor. See remarks under *Munnopsurus* sp. B for separating the two congeners within the Santa Maria Basin.

Type Locality and Type Specimens. None. This species is not described.

Distribution. Santa Maria Basin, 393-582m.

Munnopsurus sp. B

Figure 1.41

Material Examined. California, Santa Maria Basin, off Point Arguello, Sta. 63, 930 m (2, adult male, juvenile female, both specimens squashed by labels in vial).

Description (generic characters modified from Wolff, 1962)**.** Large body size, adults with body length around 7 mm. Head huge, distinctly broader than pereonite 1, vaulted posteriorly, with flattened frons; frontal arch heavily calcified, semicircular, distinctly projecting; labrum and clypeus triangular. Dorsal surfaces of body smooth, with few simple setae. Pereonites 1-4 free and loosely articulated. Pereonites 5-7 lengths subequal and freely articulated. Pleotelson rounded in dorsal view, somewhat inflated. Antennula with no medial projection, distally flattened; flagellum in both sexes elongate, antennular article count much more than 15 (around 45 in male); flagellar articles of male conjoint proximally, intermediate articles wider than long; article 2 with small medial projection, inserting around half length of article 1 from distal tip. Mandible huge, heavily cuticularized; incisor process blunt; molar process broad and simple, not projecting; mandibular palp article 3 thin, reduced, not curved or setose. Maxillipedal second article with strongly oblique anterior margin; basis with 6 coupling hooks. Pereopod I not prehensile, elongate and thin. Pereopods II-IV long and slender. Male pleopod I elongate and narrow, more or less parallel-sided; lateral lobe on distal tip laterally straight, not recurved, projecting distally as far as medial lobe. Male pleopod II with endopod and exopod reduced, placed distally in last fifth of protopod. Uropods thin, biramous; exopod approximately same length as protopod.

Biology. See remarks on the biology of *Munnopsurus* sp. A. The huge jaws of this species indicates they can crush fairly heavy things.

Remarks. *Munnopsurus* sp. B is somewhat similar to *M. longipes* (Tattersall, 1905), although the male pleopods are different. Unlike *Munnopsurus giganteus* (Sars, 1879) or *M. ochotensis* (Gurjanova, 1933), *M.* sp. B has a larger and wider cephalon (Both the first two taxa are considered by most authors to be subspecies of *M. giganteus* (Sars), although there is no evidence for their being conspecific. Therefore, they should be thought of as distinct species.). The huge mouth parts of *M.* sp. B makes this species a member of *Munnopsurus* sensu stricto. Although not listed in the description, the dorsal mandibular muscle insertions attachments provide an easy way to separate cephalon fragments of *M.* sp. A and *M.* sp. B: if they are few and large, the fragment is sp. A, and if they are many and small, it is sp. B. This sorting character will work only within this basin where these two species may appear in the same series of samples. Outside of the Santa Maria Basin, other species may have similar patterns of dorsal mandibular muscle insertions.

Type Locality and Type Specimens. None. This species is not formally described.

Distribution. Santa Maria Basin, 930 m.

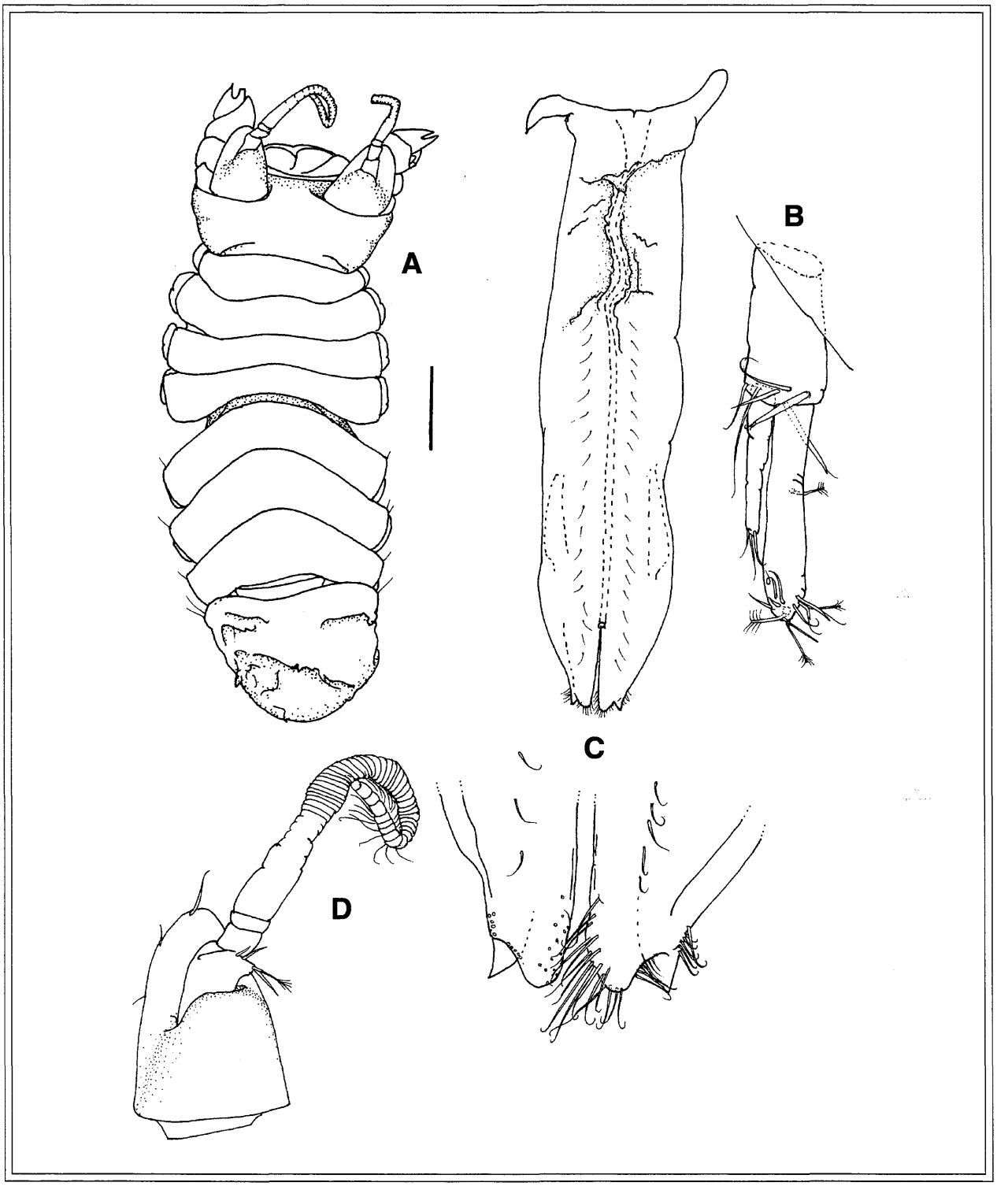

Figure 1.41. *Munnopsurus* sp. B. A, copulatory male (Phase I, Sta. 63), dorsal view, pleotelson damaged, scale bar = 1 mm. B, left antennula. C, male pleopod I, ventral side, and enlargement of distal tip. D, right uropod, ventral view.

Family Nannoniscidae Hansen, 1916

Genus *Nannonisconus* Schultz, 1966

Description. (from Schultz, 1966, 1969 and Siebenaller and Hessler, 1981) Antennula extending only slightly anterior of cephalon; 5-segmented, with bulbous distal article. Cephalon without anterolateral lobes. Pereonite 7 fused with pleon. Pleon of single somite and at widest point wider than cephalon or pereon. Lateral outline of body concave. Male pleopods I not apically pointed; proximal part much narrower than the medial or distal part. Uropods biramous.

Nannonisconus latipleonus Schultz, 1966

Figure 1.42

Nannonisconus latipleonus: Schultz, 1966:3, 11, 35; Siebenaller and Hessler, 1981:248-249.

Material Examined. California, Western Santa Barbara Channel, off Point Conception, Sta. 81, 294 m (1 manca stage 3 individual).

Description. Broad-bodied Nannoniscidae with pereonite 6-7 and pleotelson fused medially. Rostrum distinct with small lateral keels. Lateral flanges on margins of pereonites and pleotelson. Pleotelson with distinct posterolateral spines, somewhat confluent with lateral flanges; anal region distinctly projecting from remainder of pleotelson. Venter of pereonites without large spines, although pereonite 6 may have small spine projecting from anterior margin. Pleon at widest point wider than cephalon or pereon. Lateral outline of body concave in dorsal view. First antenna with 5 articles, distal article bulbous. Female pleopod large, covering almost entire ventral surface of pleotelson. Uropodal exopod more than two thirds length of endopod.

Biology. Typical for all nannoniscids, *Nannonisconus latipleonus* is likely to be a generalized detritivore that lives on soft bottoms or perhaps is associated with biogenic substrates (Levin *et al.*, 1986). Sexual dimorphism is common in the family, and although the manca stage 3 specimen illustrated here is largely similar to the male specimen illustrated by Schultz (1966), a fully mature male may have broader lateral flanges on the pereonites and pleotelson. Although detailed quantitative surveys have not been made at the localities described herein, the rarity of specimens (2 to date) suggests that this species is not a dominant component of the benthic community.

Remarks. *Nannonisconus carinatus* Mezhov, 1986 may be conspecific with *N. latipleonus*. Schultz (1966) does not appear to have described a fully mature male because the appendix masculina on the pleopod II, as illustrated in his plate 6, is short and blunt. The appendix masculina should be long and distally thin in a fully mature male as in *N. carinatus*. All apparent differences between the two species, such as broader lateral flanges on the body, could be explained by ontogenetic changes taking place during the maturation to the male moult. Neither type has been examined at this point so it is not possible to demonstrate this with certainty, although the reader should be aware of this problem when making identifications. If the two names are indeed conspecific, then the total distribution extends from Southern California to Alaska Bay.

Type Locality and Type Specimens. Holotype male, 2.8 mm long, R/V *Velero IV* station 2793: 33°48.0'N, 118°32.0'W, Redondo Canyon, 465 m, 22 May 1954, blue-gray mud and large rocks (from Schultz, 1966).

Distribution. Shallow bathyal slopes of Southern and Central California (but see remarks above), collected at only 2 stations 190 km apart.

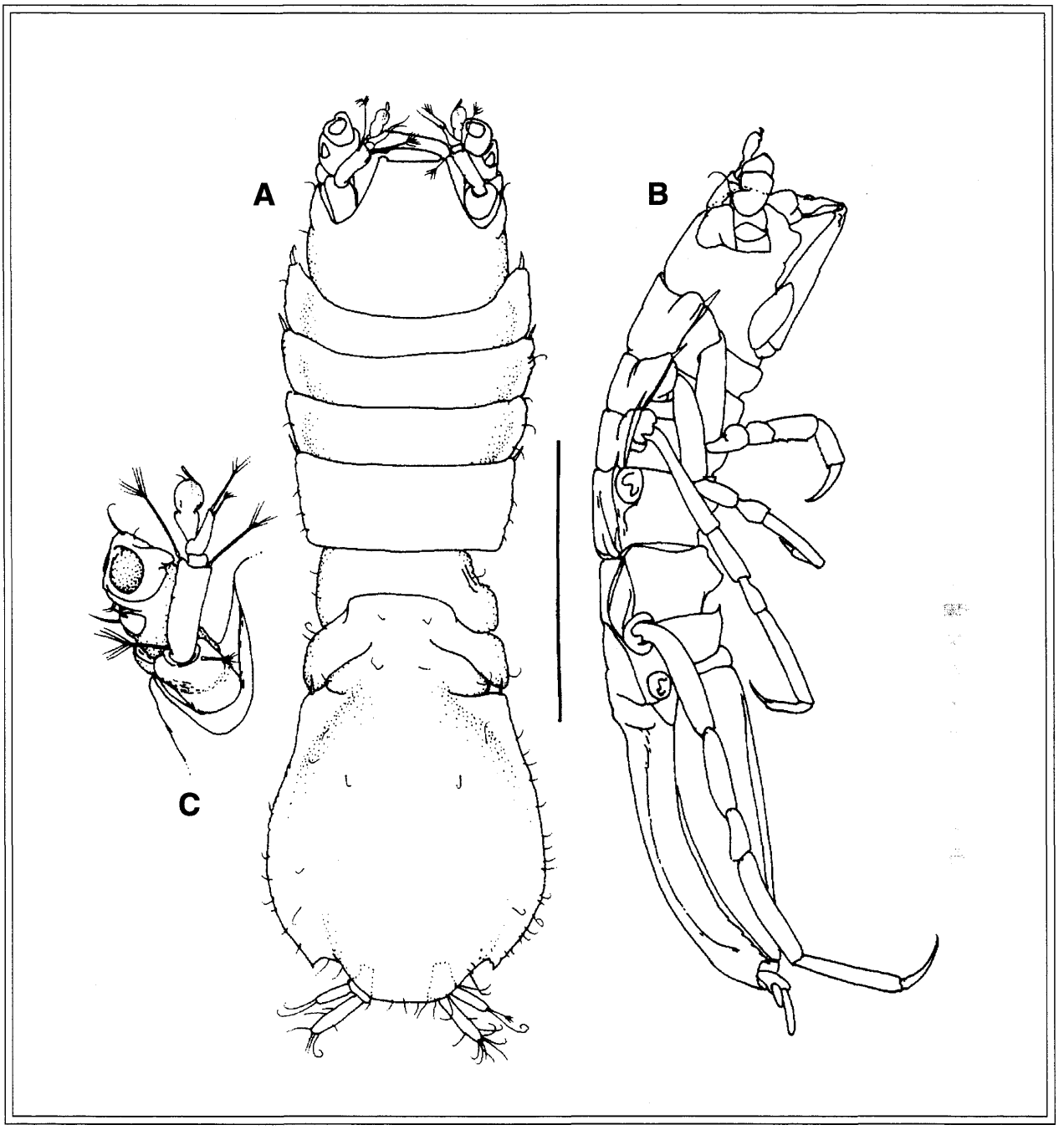

Figure 1.42. *Nannonisconus latipleonus* Schultz, 1966. Manca stage 3 specimen, Phase I Sta. 81, body length 1.5 mm, scale bar = 0.5 mm. A, body, dorsal view. B, body, lateral view. C, enlargement of antennula and base of antenna, in situ on head.

Family Desmosomatidae Sars, 1897

Genus *Momedossa* Hessler, 1970

Description. (from Hessler, 1970) Pleotelson with posterolateral spines, in female widest anteriorly. Uropod biramous. Cuticle of body well sclerotized. Pereonites 1 and 2 subequal in size. Pereopods long. Pereopod I moderately reduced; carpus and propodus somewhat attenuated; propodus without major setae; carpus with row of major setae only ventrally. Coxae of pereopods I-IV in female only moderately produced. Sexual dimorphism modest; in known copulatory males (*M. profunda, M. symmetrica*) coxae of pereopods I-IV somewhat more strongly produced and pleotelson widest at posterolateral spines.

Momedossa symmetrica (Schultz, 1966)

Figure 1.43

Desmosoma symmetrica: Schultz, 1966:3, 5, 7, 26-27.

Momedossa symmetrica: Hessler, 1970:62, 77.

Material Examined. California, off San Francisco, Gulf of the Farallones, numerous specimens collected Aug 1990, R/V *Farnella*, by J.A. Blake, as part of U.S. Navy 103 survey of proposed deep-water disposal site: Sta. S-19, 37°38.41'N, 123°24.36'W, 2580m, 13 Aug 90; Sta. I-19, 37°38.38'N, 123°27.77'W, 2835m, 13 Aug 90; Sta. E-19, 37°38.40'N, 123°29.21'W, 2955m, 14 Aug 90; Sta. K-15, 37°39.38'N, 123°27.23'W, 2830m, 14 Aug 90; Sta. E-07, 37°41.64'N, 123°29.16'W, 2462m, 15 Aug 90.

Description. Head with spines projecting lateral to antennulae and antennae; dorsal surface of head without longitudinal furrows. Pleotelson with posterolateral spines; pleotelson sexually dimorphic: broadest anteriorly in female, posterolateral spines larger and more distinct in male, and pleotelson more vaulted in male. Cuticle of body well sclerotized. Pereonites 1 and 2 subequal in width and length. Pereonite 5 laterally convex in dorsal view. Coxae of pereopods I-IV with distinct anterior spines, larger in male. Pereopod lengths distinctly greater than half body length. Pereopod I only moderately reduced but distinctly smaller than pereopod II, propodus without major setae; carpus with ventral row of major sensillate setae only, most distal sensillate seta longer than adjacent penultimate sensillate seta (synapomorphies of the Desmosomatinae). Pereopods II-III similar, propodi and carpi somewhat broadened with rows of both dorsal and ventral sensillate setae. Ventral margins of meri and ischia I-III with no more than 3 sensillate setae. Pereopods V-VII carpi and propodi with distinctly fewer than 10 setae. Uropod biramous, exopod tiny compared to long thin endopod.

Biology. Desmosomatids are epibenthic or shallow burrowing detritivores (Thistle and Wilson, 1987; Hessler and Strömberg, 1989), a pattern expected for *Momedossa symmetrica*. The anterior limbs may be used for burrowing in the sediment, because they are held laterally and have many lateral facing setae. This species is abundant compared to other deep water Janiroidea, and may be a dominant benthic taxon in the Santa Maria Basin. Sexual dimorphism is apparent in this species, resulting in the female being larger than the male, a typical pattern for many skinny desmosomatids.

Remarks. Although this species does not appear in the voucher collection for the Santa Maria Basin, it is included to prevent further misidentifications of the species. The male illustrated here adds to the female illustrated by Schultz (1966). Desmosomatids should be viewed on the lateral side, especially examining the head where useful characters are typically found, such as the cephalic spines. These cephalic spines are the chief feature to identify this species from most other desmosomatines, as well as from *Momodossa profunda* Hessler, 1970. Other features separating *M. symmetrica* from *M. profunda* are the convex lateral margins of pereonite 5 in dorsal view, the generally fewer setae on the pereopods and the longer posterolateral spines on

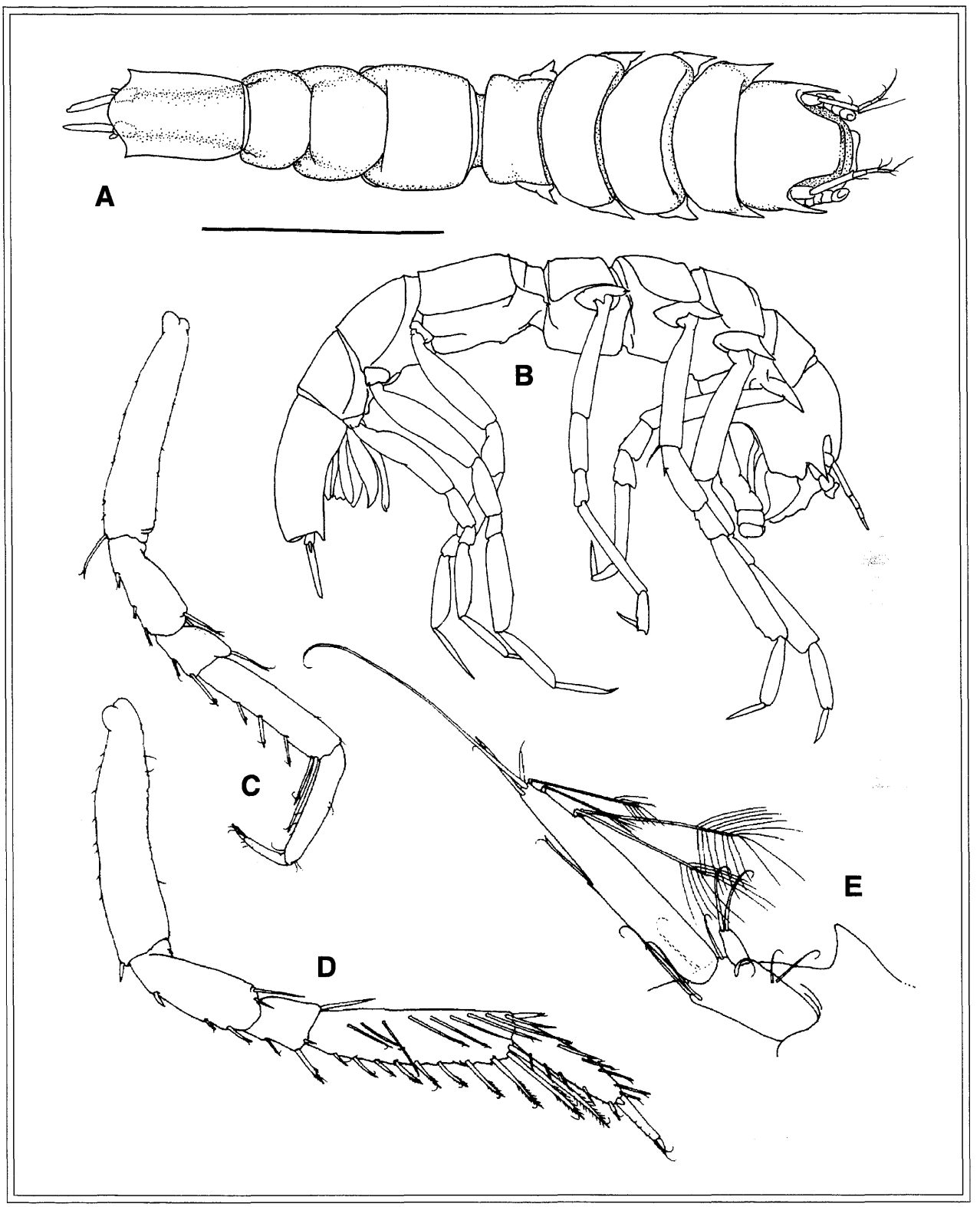

Figure 1.43. *Momedossa symmetrica* (Schultz, 1966), copulatory male (Navy 103 station). A-B, body, dorsal and lateral views, scale bar = 1 mm. C-D, pereopods I and II, right, lateral view. E, uropod, right, ventral view.

the pleotelson. The uropodal exopods, however, are similar. Biologists new to identifying Desmosomatidae should also know that this species appears to be similar to *Eugerdella cornuta* Hessler, 1970, primarily due to the cephalic and pleotelsonic spines, as well as the fewer setae on the pereopods (compared to *M. profunda*). The features of the first pereopod, such as its size and its setation that separate the Desmosomatinae from the Eugerdellatinae apply here quite clearly: the pereopod I is smaller than pereopod II and the pereopod I carpus has a distal ventral seta that is larger than the penultimate seta. The opposite situations apply for *Eugerdella cornuta*. Another desmosomatid found in the Santa Maria Basin (*Desmosoma* sp. A), is easily separated from this species by the lack of the uropodal exopods and the cephalic spines.

Type Locality and Type Specimens. Holotype brooding female, body length 3.2 mm (no paratypes). Tanner Canyon, R/V *Velero IV* station 2793: 32°36'N, 119°05.3'W, 469m, 29 January 1960, green mud with shale fragments (Schultz, 1966).

Distribution. California continental slope and submarine canyons, 469-2955 m.

Genus *Desmosoma* G.O. Sars, 1864

Description. (from Hessler, 1970) Pleotelson without posterolateral spines, broadest anteriorly. Uropod uniramous; protopod may or may not be abundantly setose. Pereonite 1 moderately to much smaller than pereonite 2. Pereopod I moderately reduced; carpus and propodus moderately attenuated; propodus devoid of major setae; carpus without major dorsal setae, but usually with ventral row of slender setae. Carpus of pereopod II broad, abundantly setose. Sexual dimorphism moderate to slight; in copulatory males pereonites 5-7 and pleotelson may be broader; coxae of pereopods I-IV may be moderately more strongly produced. In female, coxae of pereopods I-IV only modestly produced.

Desmosoma sp. A

Figure 1.44

Material Examined. California, Santa Maria Basin, off Point Estero, Sta. 3, 291 m (preparatory female, brooding female); off Point Buchon, Sta. 14, Phase I Sta. 14, 299 m (3 brooding females).

Description. (All specimens in poor condition). Body long, attenuated, with thin cuticle. Frons sloping, mouth parts somewhat prognathous, without large frons-clypeal furrow (feature of the Desmosomatinae). Pereonite 1 distinctly shorter than pereonite 2. Pleotelson without posterolateral spines, at least in female. Pereopods I-IV with triangular coxae in dorsal view, basis of pereopod I subequal in length and size to basis II. Bases V-VII enlarged, muscular. Uropod elongate and uniramous, with many penicillate setae on endopod and approximately 8-10 long coil-tip setae on lateral margin; uropod length greater than half pleotelson length.

Biology. Too little material of this species was available to comment here, other than to refer the reader to the general remarks under *Momedossa symmetrica* above.

Remarks. These specimens were originally classified in the Santa Maria voucher collection as *Momedossa symmetrica*, but are easily separated from that species by the lack in *Desmosoma* spp. of the uropodal exopod and the lack of the cephalic spines seen in *M. symmetrica*. Although no specimens had pereopods, the specimens are provisionally classified in *Desmosoma* for the following reasons: (1) pereonite 1 is much smaller than pereonite 2, suggesting that the associated pereopod is at least somewhat attenuated; (2) the uropod is uniramous; and (3) the bases of pereopods V-VII are large suggesting that this species has enlarged natatory posterior pereopods, common among species of *Desmosoma*. This species, however, is unlike any other described species in *Desmosoma*, primarily because of its unusual setation of the uropod. Biologists studying this area should be aware that several undescribed species of *Desmosoma sensu stricto*

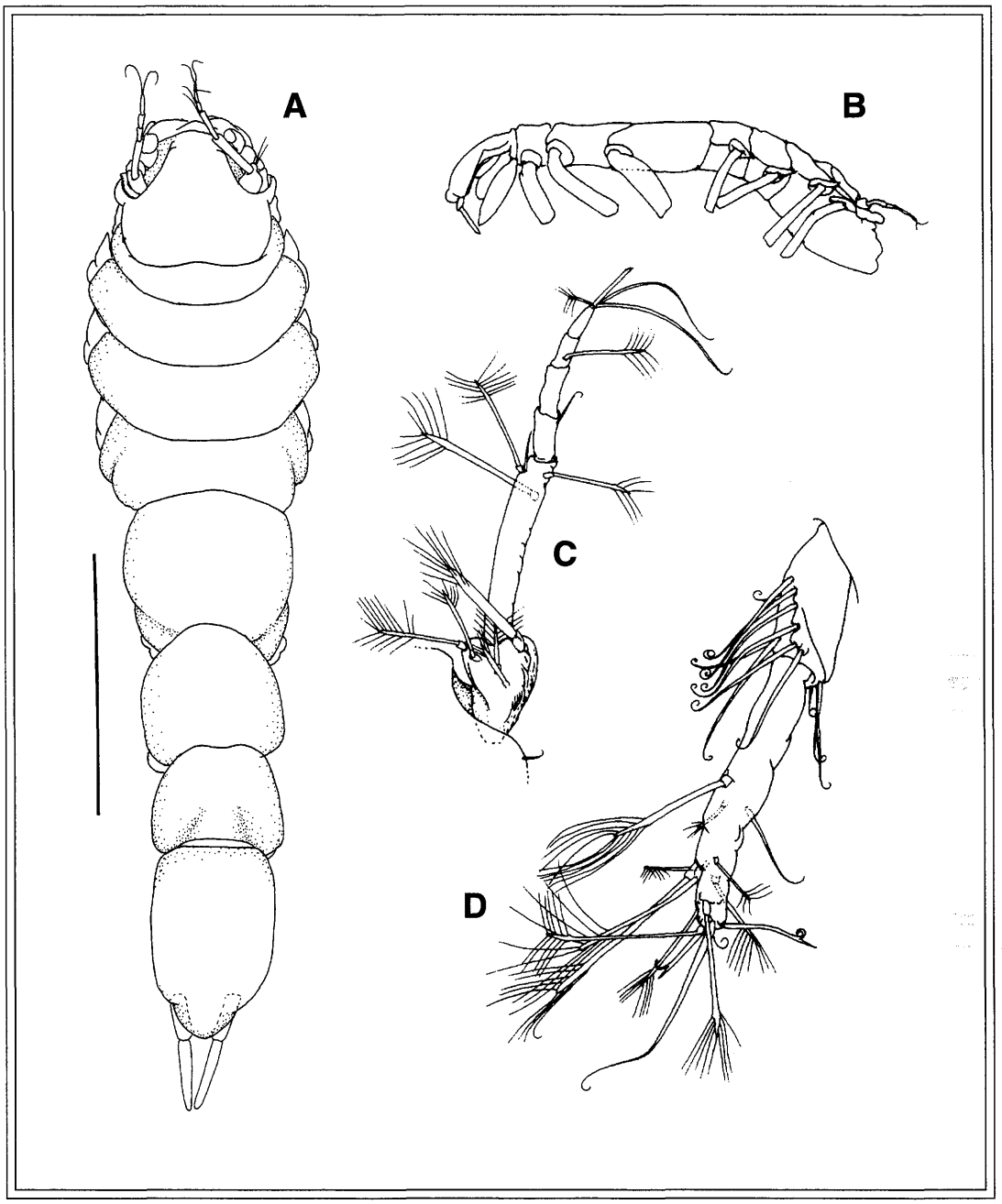

Figure 1.44. *Desmosoma* sp. A, Brooding female, dorsal view, composite illustration of several specimens (Phase I Sta. 14), scale bar = 1 mm. B, brooding female, lateral view, brood plates and mouth part detail omitted. C, right antennula, dorsal view. D, right uropod, ventral view.

are present in the California Continental Borderland. This species can be separated from another species known to this author by a setose lateral margin of the uropod, a smaller and narrower body, and a smaller pereonite 1 in comparison with pereonite 2.

Type Locality and Type Specimens. This species is not formally described.

Distribution. Currently known only from the Santa Maria Basin, ca. 290 m.

Genus *Prochelator* Hessler, 1970

Description. (from Hessler, 1970) First pereopod large, chelate; dactylus and enlarged, specialized propodus together comprising movable finger which acts in opposition to immovable claw formed by large seta on distal end of ventral margin of enlarged carpus. Carpus usually not produced at base of claw. Ventral margin of carpus with two accessory setae: a short, stout, unequally bifid seta located midway along margin and somewhat longer, more slender seta located at base of fixed claw, just proximal to it. Pereonite 1 as large as or larger than pereonite 2. Pleotelson with posterolateral spines, sometimes obscure. Uropods nearly always biramous. Most dorsal tooth on lacinia mobilis reduced or absent; next tooth in line considerably enlarged. Joints surrounding palp segment 1 of maxilliped nearly straight; segment 3 with long lateral margin. Coxae of pereopods I-IV anterolaterally angular, but not produced. Head with transverse ridge on frons and with frons-clypeal furrow.

***Prochelator* sp. A**

Figure 1.45

Material Examined. California, off San Francisco, Gulf of the Farallones, numerous specimens collected Aug 1990, R/V *Farnella*, by J.A. Blake, as part of survey of proposed U.S. Navy 103 deep-water disposal site: Sta. S-19, 37°38.41'N, 123°24.36'W, 2580m, 13 Aug 90 (10); Sta. I-19, 37°38.38'N, 123°27.77'W, 2835m, 13 Aug 90 (3); Sta. E-19, 37°38.40'N, 123°29.21'W, 2955m, 14 Aug 90 (1); Sta. F-17, 37°38.96'N, 123°28.83'W, 2945m, 14 Aug 90 (2); Sta. K-15, 37°39.38'N, 123°27.23'W, 2830m, 14 Aug 90 (2); Sta. L-17, 37°38.94'N, 123°26.85'W, 2855m, 14 Aug 90 (61); Sta. E-07, 37°41.64'N, 123°29.16'W, 2462m, 15 Aug 90 (29); Sta. J-13, 37°40.01'N, 123°27.45'W, 2770m, 15 Aug 90 (1); Sta. N-13, 37°40.01'N, 123°26.06'W, 2623m, 15 Aug 90 (10).—Santa Maria Basin, off Point Estero, Sta. 2, 200 m (2, female and male); off Port San Luis, Sta. 22, (2 brooding females, illustrated 1 specimen); off Purisima Point, Sta. R-5, 154 m (74; plus 1 male from another sample, illustrated).

Description. Head with pointed spines lateral to antennae; frons clypeal ridge and clypeal furrow small but present. Pereonite 1 distinctly larger than pereonite 2 (feature of Eugerdellatinae), with large ventral spine. Pereonites 3 and 7 with posteriorly curving spines. Pereonite 5 of male with anterolateral posteriorly curving spine. Pereonite 5 of female distinctly convex, lacking a recurved spine. Pleotelson posteriorly rounded, with large subdistal ventrolateral spines. Pereopod I with robust setochelate carpus not produced at base of distal seta (feature of *Prochelator*), with penultimate accessory seta adjacent to elongate strong sensillate seta on distoventral corner of carpus (synapomorphy of Eugerdellatinae); shorter sensillate seta in middle of carpus ventral margin. Pereopod II robust with 4 elongate distally fringed sensillate setae on ventral margin, and 2 simple setae on dorsal margin of carpus. Male pleopod II with distinct laterally recurved spine on distal tip. Uropod biramous, exopod approximately third length of endopod with seta longer than uropod on exopod tip.

Biology. Although members of this species are tiny, they are among the most abundant of the Asellota studied from the Santa Maria Basin. Their rather more powerful anterior pereopods and anteriorly blunt faces suggest they are strongly burrowing forms. See also general remarks under *Momedossa symmetrica*.

Remarks. This undescribed species of *Prochelator* is most like *P. uncatus* Hessler, 1970, but has several distinctive features that separate the two species. Most important, sexual dimorphism is evident in the species, while *P. uncatus* is nearly monomorphic. Other features of this species not seen in *P. uncatus* include: ventral midline spines on pereonites 1, 3, and 7; recurved lateral spines on the distal tip of male pleopod I; and a convex lateral margin of pereonite 5 in dorsal view of the female. The recurved lateral spine on pereonite 5 includes a large amount of variability, both sexual and ontogenetic. The spine is distinct in males, and largely absent in females. Juvenile males may show a gradation from the absent (female) condition to distinct and

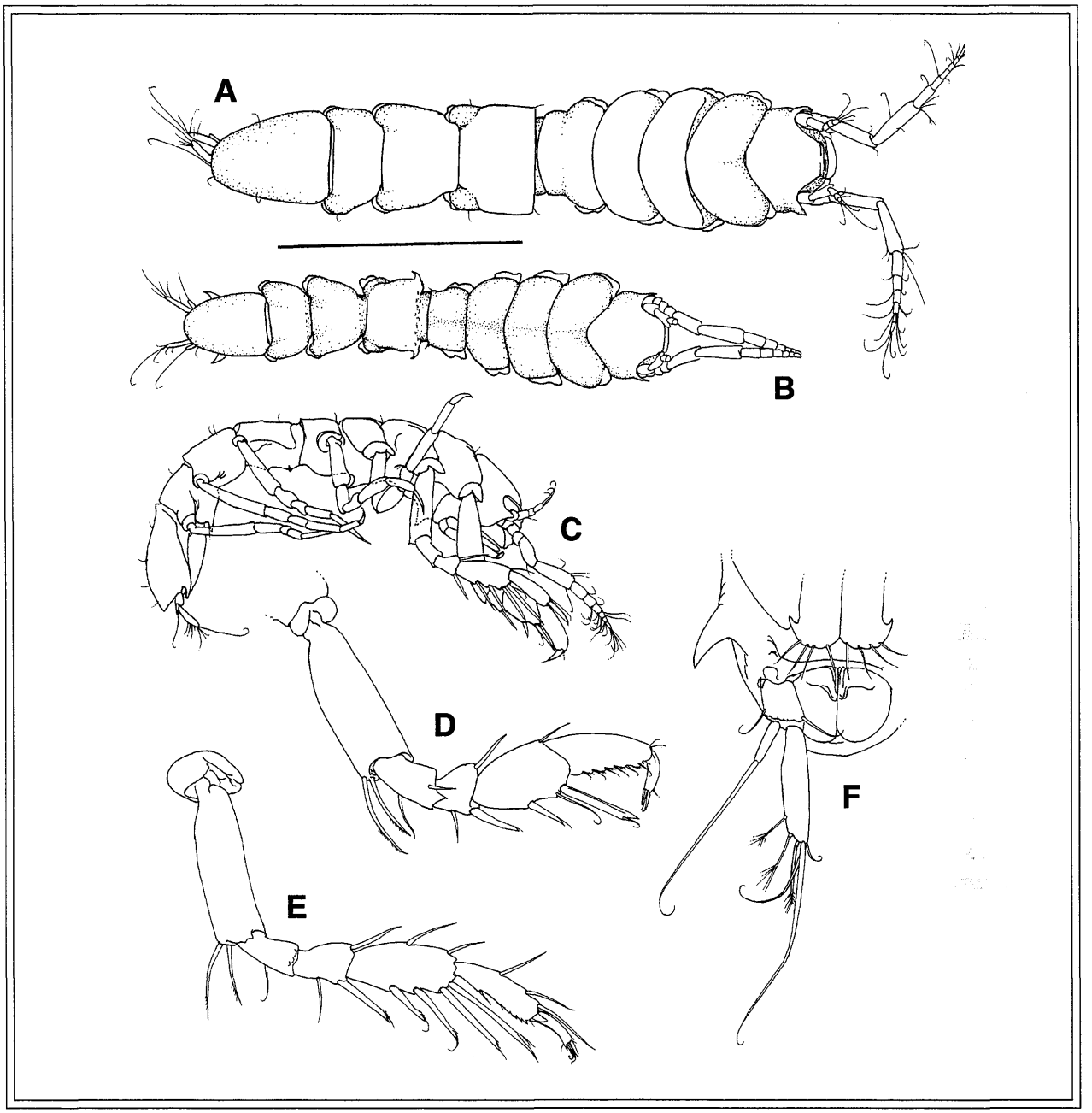

Figure 1.45. *Prochelator* sp. A. A, brooding female (Phase I Sta. 22), body dorsal view, scale bar = 1 mm. B-C, copulatory male, body lateral and dorsal view. D-E, pereopods I-II, right, copulatory male (Phase II, Cruise 3-4 Sta. R-5). F, uropod, tip of pleopod I and right pleotelson posterolateral spine, copulatory male.

large. Biologists sorting samples from this area should be aware that another rare and undescribed species of *Prochelator* was found at the Navy103 site. This second species is easy to distinguish because it lacks the recurved spine on pereonite 5, has pointed coxal spines on pereopods 1-3, and has a uniramous uropod.

Type Locality and Type Specimens. None. This species is undescribed.

Distribution. Santa Maria Basin to off San Francisco, 99-2955 m.

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2. CUMACEA

by

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Introduction

Cumaceans are small crustaceans, generally ranging in size from 1 mm to 1 cm; however, a few species, such as *Diastylis goodsiri*, may be 3 cm or more in length. The Order Cumacea currently contains more than 1200 species worldwide. This is a sizable increase over the 770 species listed by Jones (1969). Of these, and including those described herein, 49 species are known from the Pacific coast of the United States. Many of the habitats where cumaceans are likely to be found, such as estuaries, shallow embayments, beaches, tidal flats, and the inner continental shelf, have not yet had their cumacean fauna documented. In contrast, the far less diverse cumacean fauna of the northeastern United States is completely known (Watling 1979).

Cumaceans are malacostracans, considered by many to be an order in the Superorder Peracarida, but considered by Watling (1983) and Schram (1986) to be a member of the Superorder Brachycarida. They are distinguished by the following combination of features: the carapace covers the first three or four, or rarely six, thoracic somites; the anterior margin of the carapace is extended in front of the head as pseudorostral lobes; the telson may be present, reduced, or incorporated into the last abdominal somite (pleonite); the eyes are confluent dorsally in all but a very few genera; the second antennae lack an exopod; and pleopods are absent in females (with the exception of one deep-sea species) and often reduced in number or absent in males (Fig 2.1).

Cumacean Morphology

The cumacean body is externally divided into carapace, thorax, and abdominal regions (Fig. 2.2). The carapace covers three, four, or rarely six, thoracic somites. Externally the body can then be seen to be divided into three regions, the carapace, the pereon (reduced thorax), and the abdomen or pleon. The pereon usually consists of five body somites, but fewer may be visible depending on the extent of the carapace. The abdomen always contains six body somites, of which pleonite 5 is usually the longest. An articulated telson may or may not be present terminally.

The carapace is expanded ventrally and laterally to form a branchial chamber. Each side of the carapace is produced anteriorly in the form of pseudorostral lobes which meet, but are not fused, in front of the head, forming a pseudorostrum (Fig. 2.2). Reaching to the end of, or projecting beyond, the pseudorostrum are the tips of the branchial epipods of the first maxilliped, which together form the branchial siphon, or exhalant canal, for the respiratory current. The pseudorostrum may be directed anteriorly at various angles, or be completely reflexed such that the branchial opening is dorsal. The lower margin of the pseudorostrum is incised to form a notch for the first antenna. Below this notch the carapace bears an anteroventral corner, which may be broadly rounded or produced into one or more teeth. Laterally and dorsally, the carapace may

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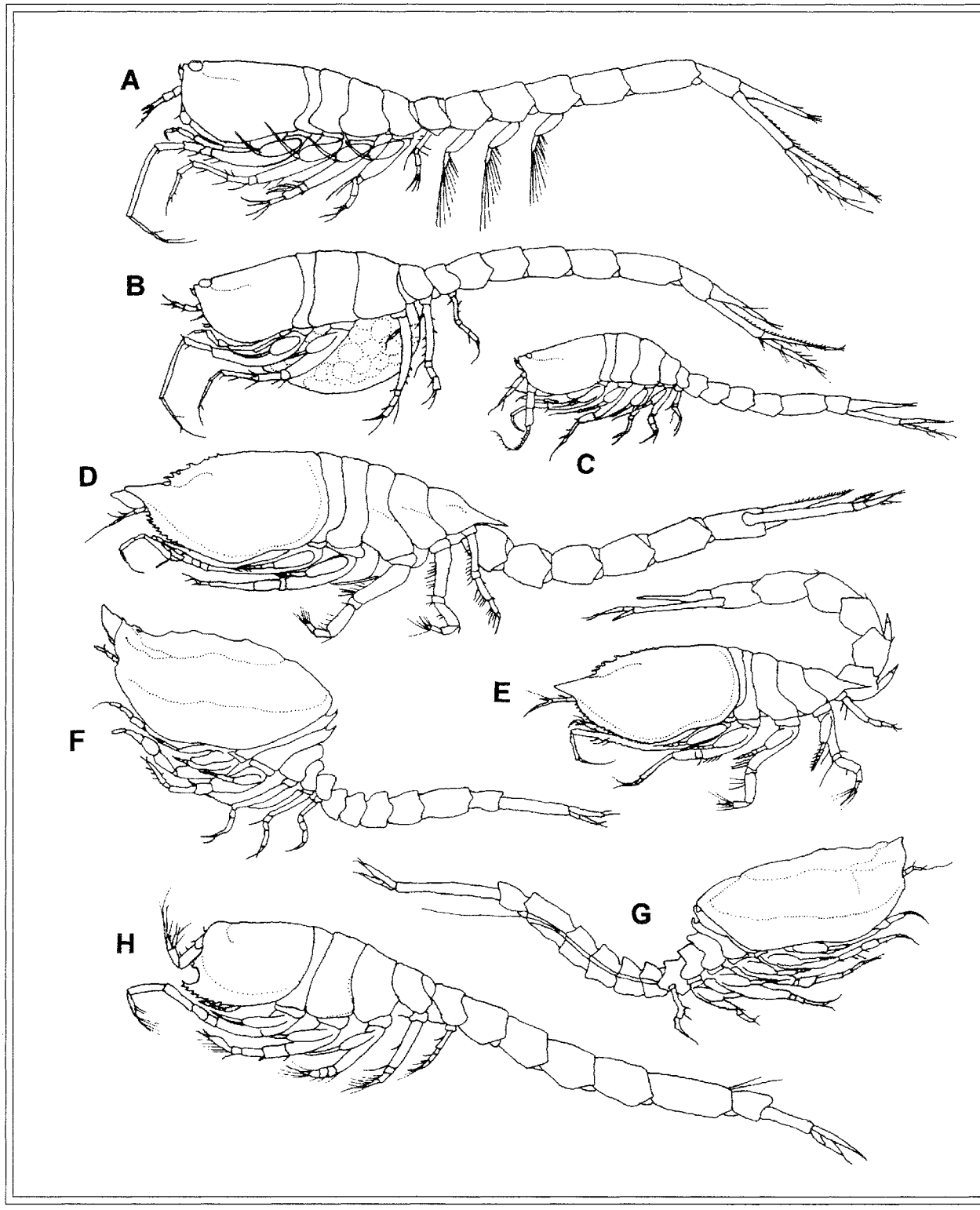

Figure 2.1. Representative cumaceans from various families likely to be encountered in the Santa Maria Basin Region: A, Lampropidae, mature male with elongate antenna 2; B, Lampropidae, female with eggs in brood pouch; C, Lampropidae, mature male with grasping antenna 2; D, Diastylidae, subadult female; E, Diastylidae, subadult male; F, Nannastacidae, subadult female; G, Nannastacidae, mature male; H, Leuconidae, subadult female.

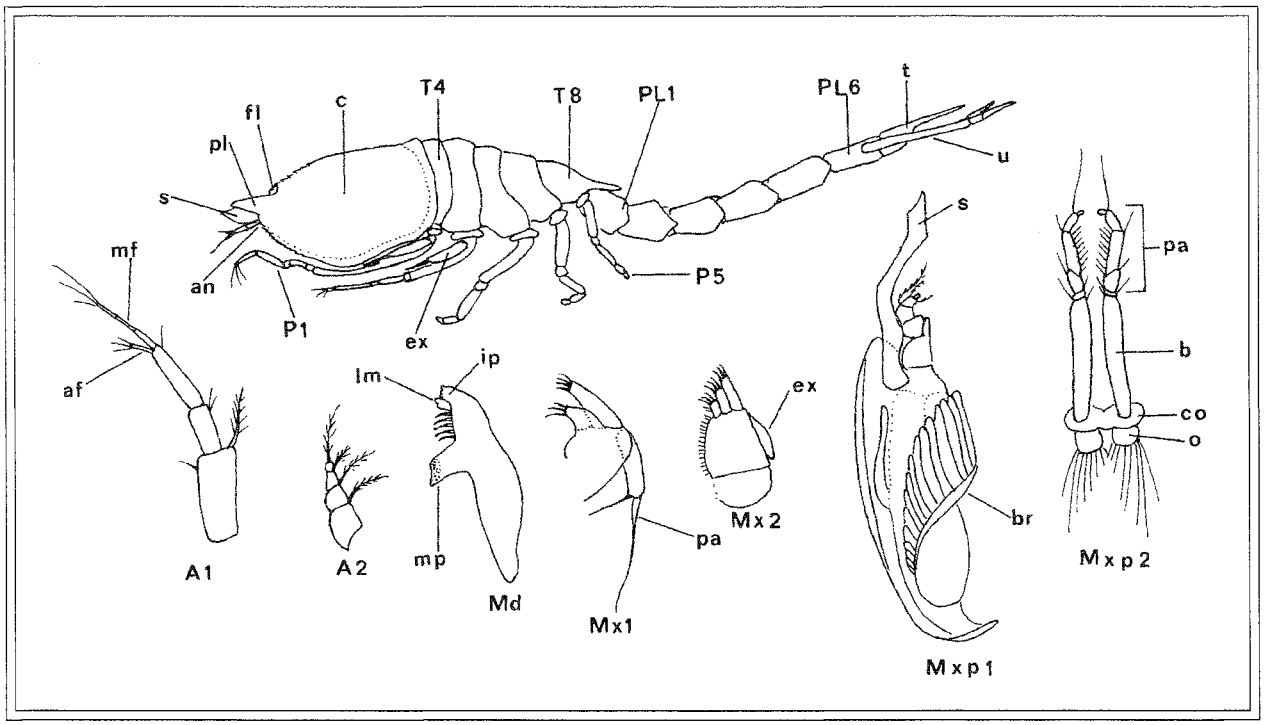

Figure 2.2. Side view of the cumacean body with details of the seven anterior head and thoracic appendages. A1, antenna 1; A2, antenna 2; Md, mandible; Mx1, maxilla 1 (maxillule); Mx2, maxilla 2 (maxilla); Mxp1, maxilliped 1; Mxp2, maxilliped 2; P1, pereopod 1; P5, pereopod 5; PL1, pleonite 1; PL6, pleonite 6; T4, thoracic somite 4 (=pereonite 1); T8, thoracic somite 8 (=pereonite 5); af, accessory flagellum; an, antennal notch; b, basis; br, branchial apparatus; c, carapace; co, coxa; ex, exopod; fl, frontal lobe; ip, incisor process; lm, lacinia mobilis; mf, main flagellum; mp, molar process; o, oostegite; pa, palp; pl, pseudorostral lobe; s, siphon; t, telson; u, uropod (from Watling, 1979).

be ornamented with tubercles, spines, ridges, or any combination of these. The side of the carapace may be depressed to form a sulcus (Fig. 2.1F, G). The ventral margin may be smooth or produced into a series of teeth or serrations. In males, the ventral margin is extended some additional distance ventrally to house the enlarged peduncle of antenna 2 (Fig. 2.1E).

Behind the pseudorostrum is the anterior-most part of the head, known as the frontal lobe (Fig. 2.2). The anterior part of the frontal lobe contains the eyelobe, which may be present even when eyes are absent. In some cases, especially in deep-sea species, the eyelobe may range in shape from extremely elongate to being completely absent. The frontal lobe ranges in shape from triangular to broadly rounded. It houses the brain and optic ganglia (when eyes are present) and provides the point of attachment for the first and second antennae. As in all crustaceans the head bears five pairs of appendages, viz., the first and second pairs of antennae, mandibles, and first and second pairs of maxillae.

The first antenna (Fig. 2.2, 2.3A,B) consists of a three-articulate peduncle, the distal-most of which bears two rami, a main flagellum of 2 to 6 articles, and an accessory flagellum (when present) of 1 to 4 articles. In several families, the accessory flagellum consists of a single article ranging in size from minute to nearly as long as the main flagellum. Occasionally, both flagellae are very small and their exact structure is difficult to determine using light microscopy. The main flagellum is often festooned with long sensory setae, especially in males of the genus *Leptostylis* (Fig. 2.3D).

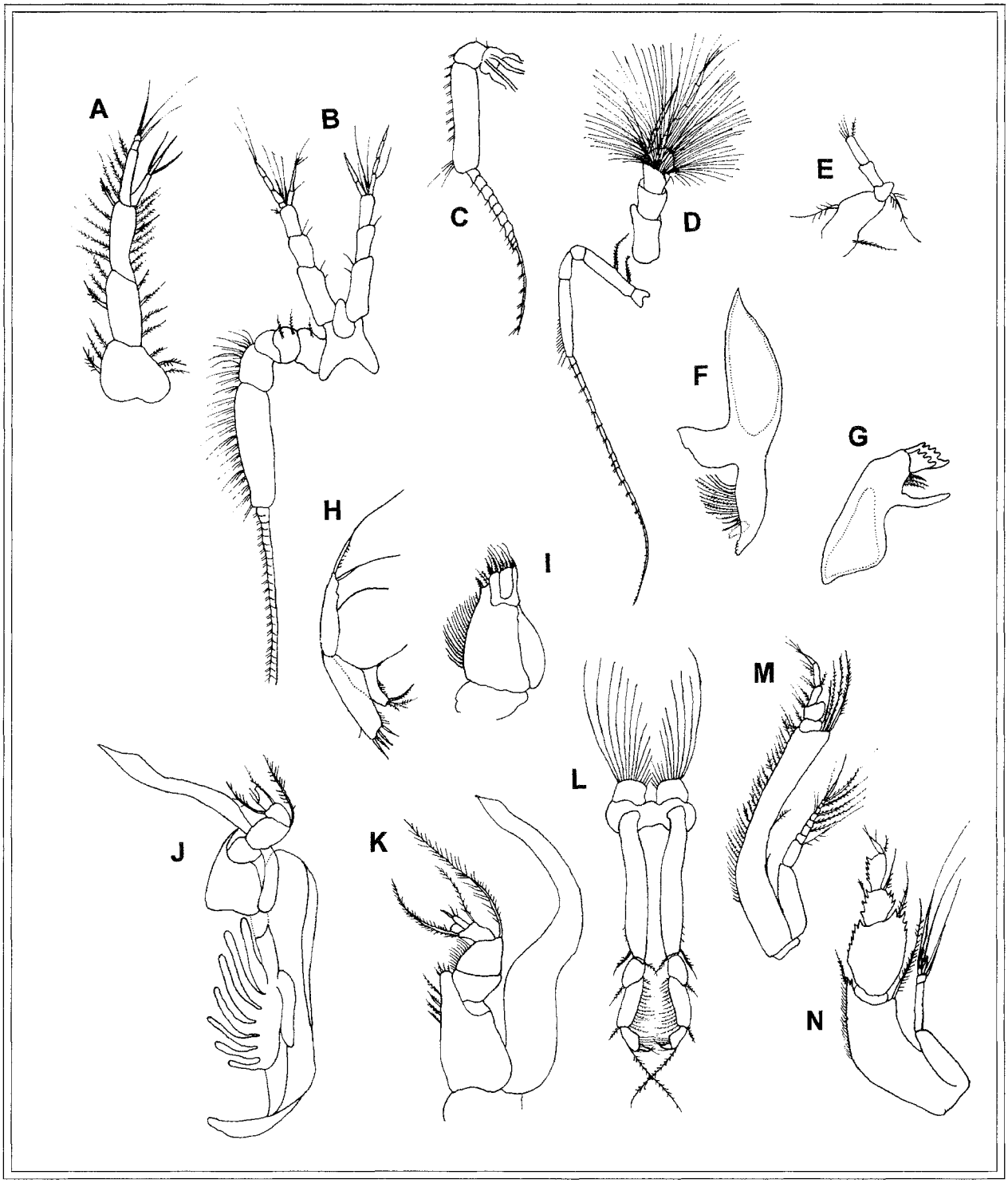

Figure 2.3. Detailed views of selected cumacean head and anterior thoracic appendages. A, antenna 1 from female Leuconidae; B, antennae 1 and 2 from mature male Diastylidae (note enlarged peduncle article 5 and large setal brush on antenna 2); C, antenna 2 modified for grasping, from male of Lampropidae; D, antennae 1 and 2 from mature male of *Leptostylis* (note enlarged antenna 1 and setal brush on peduncle article 3); E, antenna 2 of female Diastylidae; F, mandible typical of most families; G, mandible from *Campylaspis*; H, a typical maxilla 1; I, a typical maxilla 2; J, maxilliped 1 with details of gill lobules from *Eudorella*; K, endopod of maxilliped 1; L, maxilliped 2 of *Diastylis*; M, maxilliped 3 of *Diastylis*; N, maxilliped 3 of *Campylaspis*.

The second antenna (Fig. 2.2) is generally rudimentary in the female (Fig. 2.3E) but may consist of as many as five articles. In the male, the structure of the second antenna changes with age and its final form is determined by the use to which it is going to be put. In the most typical form it consists of a five-articulate peduncle bearing a very long multi-articulate flagellum, peduncle articles four and five bear a strong brush of sensory setae, and peduncle article five is much longer than article four (Fig. 2.3B). In the immature male, the setal brush and elongate flagellum are not present; instead the second antenna is shaped like an elongate club. There are various modifications to this pattern, most of which appear to be related to the antenna functioning as a grasping device (Fig. 2.3C). In this case, the antenna is shortened, the setal brush is lost or reduced, and the smaller number of flagellar articles bear specialized setae on their anterior margin. Little is known about the sensory functions of the setae arming the second antenna, so the exact uses of this appendage cannot be predicted from its structure.

The mouth field is defined by the upper lip (labrum), paired mandibles, lower lip (labium), and paired first and second maxillae. In contrast to other small crustaceans, such as the amphipods, the upper and lower lip are of no taxonomic significance in cumaceans.

The cumacean mandible is a simple structure (Fig. 2. 2). In its basic form it consists of an elongate mandible body, a columnar molar process, an incisor process, and a row of setae with distal lacinia mobilis between the molar and incisor (Fig. 2. 3F). A palp is never present. The paired mandibles are connected by a transverse mandibular tendon to which the mandibular adductor and abductor muscles are anchored. Those mandibles having the elongate body are referred to as "boat-shaped." In some families the mandibular body is reduced, with that portion dorsal to the molar being lost. In this case, the mandible is referred to as truncate. Cumacean mandibles usually have strongly columnar molars, used for crushing the material to be ingested. The Nannastacidae genus, *Campylaspis,* and allies have a recurved, stylet-like molar thought to be an aid to predation on foraminifers (Fig. 2.3G). Very few examinations of food habits have been made for cumaceans; consequently strong relationships between the structure of the molar and food sources cannot yet be made.

The first maxilla (maxillule) consists of a three-articulate protopod, the first and third articles of which bear terminally setose lobes (endites) (Fig. 2.2, 2.3H). There is a backwardly-directed palp of one article which bears either one or two setae. The palp extends into the anterior part of the branchial chamber, but its exact role is unknown.

The second maxilla (maxillula) consists of a three-articulate protopod, of which only the third is produced into an endite (Fig. 2.2, 2.3I). On the outer side of the appendage is a thin, flattened plate, considered to be the reduced exopod.

In cumaceans, the carapace generally covers the three most anterior thoracic somites. Only the first of these is thought to be fused with (or incorporated into) the head. However, the appendages of all three somites are modified and are termed maxillipeds. As with most crustacean thoracic legs, in cumaceans the basic form consists of a coxa immediately adjacent to the body, the basis, and five articles making up the endopod. The coxa may bear an epipod of varying size and the basis an exopod of no more than two articles (in those forms where the exopod bears long swimming setae, the second article is multi-annulate, not multi-articulate, as can be seen by examining the musculature). The basis is often elongated, with the exopod attached proximally and the endopod distally. The endopod is the most developed part of the limb and its articles are named ischium, merus, carpus, propodus, and dactylus, in consecutive order distally.

The first maxilliped, which is, in fact, the first thoracic appendage, is very highly modified (Fig. 2.2, 2.3J,K). The epipod is elaborated into a large branchial structure. Its posterior portion is composed of branchial lobules (gills) on a supporting lappet and its anterior part is extended to form, with its pair, the branchial siphon. The endopod normally comprises five articles and extends forward to aid in the manipulation of food near the mouth.

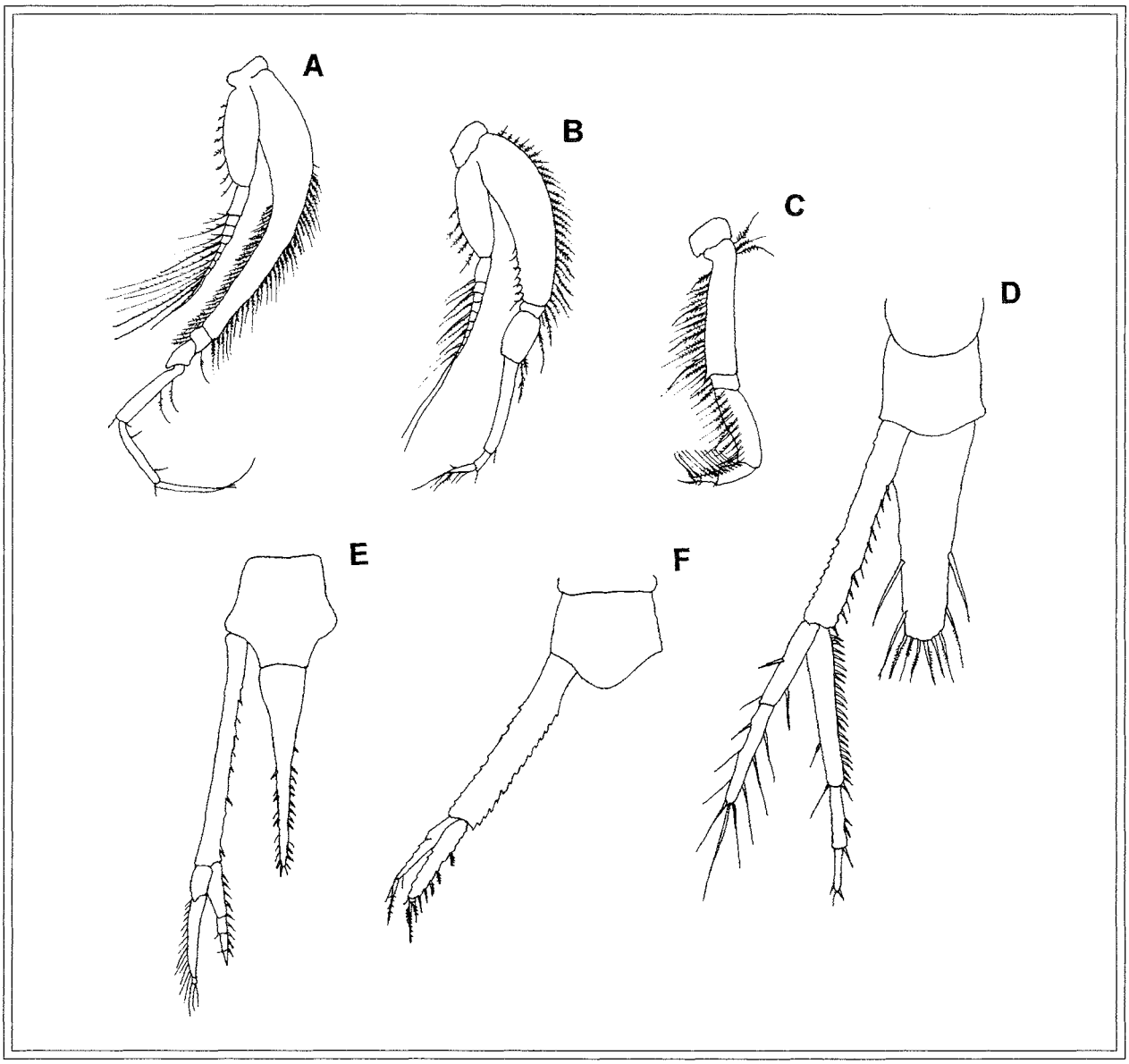

Figure 2.4. Detailed views of pereopods, uropods, and telons. A, pereopod 1 from Diastylidae; B, pereopod 2 from Diastylidae; C, pereopod 3 from Diastylidae; D, uropod and telson from Lampropidae; E, uropod and telson from Diastylidae; F, uropod from Nannastacidae (telson fused to pleonite 6).

The endopod of the second maxilliped is more elongate than in the previous appendage (Fig. 2.2, Fig. 2.3L). The epipod and exopod are both absent. In mature females a small pair of posteriorly-directed oostegites may be present.

The third maxilliped is even more leg-like than the second maxilliped (Fig. 2.3M,N). It consists of an elongate basis and five-articulate endopod, and often possesses an exopod. The shape of this appendage ranges from very elongate to broad and operculate. Whether truly opercular or not, the third maxilliped usually covers the ventral aspect of the mouth field.

Pereopod 1 is the first true ambulatory appendage, but is, in fact the fourth thoracic appendage (Fig. 2.4A). Its structure is much the same as for the third maxilliped, but the endopod is generally more elongate. An exopod is usually present. The remaining pereopods decrease in length and robustness posteriorly (Fig. 2.4B, C); exopods may or may not be present on pereopods 2 to 4. An exopod is never present on pereopod 5.

The appendages of abdominal somites 1 to 5 are known as pleopods, and are present (with a single exception in a deep-sea species) only in males. Depending on the family, there may be one to five pairs of pleopods, or they may be absent altogether.

The last pair of abdominal appendages are the uropods. They consist of a uniarticulate peduncle bearing two rami, the endopod and exopod (Fig. 2.4D-F). The exopod is always two-articulate, but the endopod may consist of one to three articles.

The cumacean body terminates with a telson, on the ventral side of which is located the anus and anal valves. In the Bodotriidae, Leuconidae, and Nannastacidae, the telson is very short and is fused to the sixth pleonite (Fig. 2.4F). Freely articulated telsons of varying length can be found in the other families (Fig. 2.4D,E).

Classification

Family Bodotriidae
Subfamily Bodotriinae*
Subfamily Vaunthompsoniinae
Subfamily Mancocuminae
Family Leuconidae*
Family Nannastacidae*
Family Lampropidae*
Family Pseudocumatidae
Family Diastylidae*
Family Gynodiastylidae
Family Ceratocumatidae

The Order Cumacea is divided into 8 families. Those families and subfamilies dealt with in this atlas are marked with an asterisk.

Attachment I is a list of names that have changed between the original identifications as part of the MMS studies, and the present treatment.

Key to the Families of Cumacea with Species in the Santa Maria Basin Region

1A. With freely articulated telson 2

1B. Without freely articulated telson 3

2A. Telson with 0 or 2 terminal setae ..... Diastylidae

2B. Telson with 3 or more terminal setae ..... Lampropidae

3A. Uropod endopod uniarticulate ..... Nannastacidae

3B. Uropod endopod 2-articulate 4

4A. Male with 0 or 2 pairs of pleopods, females with exopods on pereopods 1 to 3 ..... Leuconidae

4B. Male with 5 pairs of pleopods; females with exopods only on pereopod 1 or on pereopods 1-4 ..... Bodotriidae

Family Diastylidae

Diagnosis (as emended by Day, 1980). Mandible normally boat-shaped but rarely truncate. First maxilliped branchial filament with numerous leaflets. Exopods present on maxilliped 3 (except in *Paradiastylis*), and in females on pereopods 1 and 2, absent or rudimentary on pereopods 3 and 4, in males present on pereopods 1-4. Telson variable, usually large, often with long post-anal part, sometimes short and poorly armed, usually with 1 pair of terminal setae, occasionally with none. Uropods usually long and slender, endopod with 1-3 articles. Male antenna 2 with long flagellum, reaching at least to posterior margin of thorax. Males with 2 pairs of pleopods; no outer process on inner ramus.

Remarks. The Diastylidae are a family of predominantly cold-water favoring cumaceans. On a global basis, by far the greatest number of species are found at latitudes exceeding 30°N and S (Day, 1980). From Point Conception northwards to British Columbia (the Oregonian Province), 12 species are known to date. Most of these were described, or redescribed, by Calman (1912) and Zimmer (1926, 1936, 1943), with single additional species added by Hart (1930) and Lie (1971). In contrast, more than 40 species of diastylids are known from the North Atlantic, suggesting that the fauna from the boreal eastern Pacific is vastly under-represented. The present study has produced an additional 12 new species with sufficient material to provide adequate diagnoses, and another 7 probable new species represented by single specimens.

Key to the Diastylidae from the Santa Maria Basin Region

1A. Telson elongate, with 1 pair of lateral setae; male antenna 1 with club-shaped article 3 bearing many sensory setae ..... *Leptostylis* 2

1B. Telson short, with 2 or more pairs of lateral setae; male antenna 1 elongate, with sensory setae on distal articles ..... *Diastylis* 3

2A. Uropod exopod and endopod subequal in length ..... *Leptostylis calva*

2B. Uropod exopod reaching only halfway along endopod terminal article ..... *Leptostylis abditis*

3A. Carapace with spines, but no ridges 4

3B. Carapace with ridges, but no spines 5

4A. Carapace with 4 horizontal rows of spines; pereonite 1 not completely visible in lateral view ..... *Diastylis sentosa*

4B. Carapace with 1 row of horizontal spines; pereonite 1 completely visible in lateral view ..... *Diastylis paraspinulosa* Zimmer (not in text)

5A. Carapace with serrate or crenellate ridges ..... *Diastylis crenellata*

5B. Carapace ridges smooth, not serrate 6

6A. Carapace with 2 oblique lateral ridges ..... *Diastylis pellucida*

6B. Carapace with more than 2 lateral ridges 7

7A. Carapace with 3 lateral ridges, the area in front of the dorsal-most ridge slightly depressed; telson not reaching end of uropod peduncle ..... *Diastylis californica*

7B. Carapace with 4 distinct lateral ridges and no horizontal ridges; telson reaching end of uropod peduncle *Diastylis quadriplicata*

7C. Carapace with 4 oblique ridges of different lengths and a few horizontal ridges; telson not reaching to end of uropod peduncle ..... *Diastylis santamariensis*

Genus *Diastylis* Say, 1818

Type Species. *Cuma rathkei* (Krøyer, 1841).

Diagnosis (after Sars, 1900 and Day, 1980). Carapace large, tumid, often armed with spiniform projections, sometimes also with lateral folds or ridges, but never with dorsal crest. Male antenna 1 article 3 not expanded distally, with sensory setae distally. Male antenna 2 flagellum extends to end of or beyond pleon. Third and fourth pereonites not coalesced. Basis of pereopods not widened in male and pereopods 2 and 3 not widely separated in ovigerous female. Pereopods 3 and 4 with rudimentary exopods or exopods absent in female. Male with 2 pairs of pleopods. Post-anal part of telson longer than pre-anal part. Uropod endopod 2- or 3-articulate.

Remarks. This is the oldest of all cumacean genera. It is represented in all cold and cold temperate seas of the world. Including those described below, 8 species are known from the Oregonian Province. A complete list can be found in Attachment II.

Diastylis sentosa Watling and McCann, new species

Figure 2.5

Material Examined. Santa Maria Basin, Phase I stations 66, 201 m and 70, 200 m, 10 Nov 1983, and the following Phase II stations: Cruise 1-1, Nov 1986, Stas. R-2 (2), R-5 (4); Cruise 1-2, Jan 1987, Stas. R-2 (5), R-5 (31), PJ-1 (2); Cruise 1-3, May 1987, Stas. R-2 (7), R-5 (17); Cruise 2-3, Oct 1987, Stas. R-2 (2), R-5 (2), R-6 (1); Cruise 2-4, Jan 1988, Stas. R-2 (1), R-5 (33), R-6 (1), PJ-1 (3); Cruise 2-5, May 1988, Stas. R-2 (1), R-5 (15), PJ-1 (1); Cruise 3-1, Sep 1988, Stas. R-5 (2), PJ-1 (1); Cruise 3-4, May 1989, Stas. R-2 (2), R-4 (1), R-5 (23), R-6 (17), PJ-1 (2).

Description. Adult female and immature male, 6.5 mm. Carapace 2 times length of thoracic somites, posterior two-thirds broadly rounded, lobes separated dorsally by mid-dorsal furrow; ornamentation of thorn-like spines arranged in 4 rows running approximately horizontally and a fifth row paralleling posterior carapace margin; amongst large spines many short spines scattered over carapace; dorsolateral spine row continues anteriorly onto dorsolateral margin of pseudorostral lobes; eyelobe broad, bearing 2 spines; ventral margin serrate throughout length. Pereonite 1 not visible ventrally; with group of spines dorsolaterally. Pereonites 2-5 with pair of large dorsolateral spines; spines may also be present on lateral and ventral margins. Pleonites with lateral spines; pleonite 5 with lateral spines terminally and additional pair midway along segment length. Pereopod 1 elongate, extending well beyond pseudorostral lobes. Telson extending slightly beyond uropod peduncles; post-anal part about equal in length to pre-anal part; lateral margins with 3-6 setae. Uropod peduncle with few setae on medial margin; rami subequal in length; endopod of 2 subequal articles, with strong setae equally spaced along medial margin, terminal seta partially fused to distal article; exopod with 3 terminal setae, lateral margin with 3-5 evenly spaced setae. Adult male, 7.0 mm. Similar to female but carapace spines less pronounced, anterolateral corner below eyelobe with twin anteriorly directed spines. Pereonite 5 posteriorly produced, with 1 or 2 spines.

Remarks. This species belongs to a small group of northern and Arctic species characterized by the presence of a spiny carapace: *D. paraspinulosa* Zimmer, *D. spinulosa* Heller, *D. echinata* Bate, and *D. ornata* Lomakina. Of these, only *D. paraspinulosa*, originally described from the Bering Sea, has been recorded from Californian waters (Zimmer, 1943). *Diastylis sentosa* differs from *D. paraspinulosa* most noticeably in the following features: pereonite 1 is not completely visible in lateral view, there are at least four horizontal and one vertical row of spines on the carapace, and the telson bears only 4-5 pairs of lateral setae. It is quite likely that *D. paraspinulosa* has been mis-identified from southern California waters or has been only occasionally carried into these waters by the California Current. None of the specimens collected during this study are *D. paraspinulosa*.

Type Locality and Type Specimens. California, Santa Maria Basin, off Purisima Point, Sta. R-5 34°42.69'N, 120°50.83'W, 154 m, holotype USNM 273595, paratypes USNM 273596 and LACM 95-84.1.

Etymology. From Latin, *sentus*, = thorny, referring to the shape and arrangement of the spines on the carapace.

Distribution. Known from the Santa Maria Basin region to off Pt.Loma, San Diego; depth range, 92-410 m.

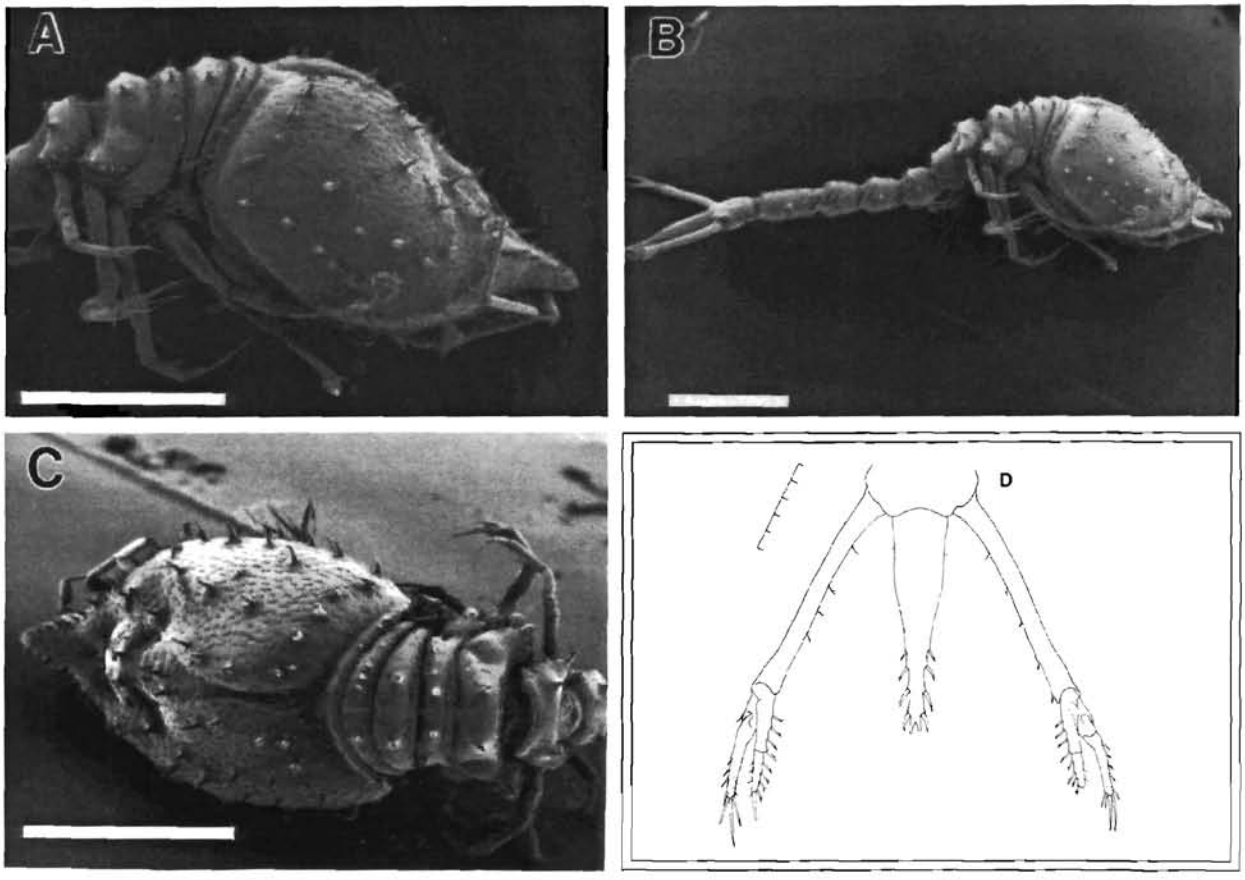

Figure 2.5. ***Diastylis sentosa*** **Watling and McCann, new species.** Female: A, carapace and pereonites, lateral view; B, body, lateral view; C, carapace and pereonites, dorsal view; D, telson and uropods. Scale, A-C = 1 mm, D = 0.5 mm.

Diastylis crenellata Watling and McCann, new species

Figure 2.6

Material Examined. Santa Maria Basin, Phase II, Cruise 1-1, Nov 1986, Stas. R-1 (3), R-4 (43), R-5 (21), PJ-1 (7); Cruise 1-2, Jan 1987, Stas. R-4 (7), R-5 (39), PJ-1 (2); Cruise 1-3, May 1987, Stas. R-2 (1), R-4 (22), R-5 (29), R-8 (1), PJ-1 (21); Cruise 2-3, Oct 1987, Stas. R-1 (2), R-2 (3), R-4 (13), R-5 (36), R-9 (1), PJ-1 (10); Cruise 2-4 Jan 1988, Stas. R-1 (4), R-4 (11), R-5 (47), R-8 (3), PJ-1 (26); Cruise 2-5, May 1988, Stas. R-1 (3), R-2 (4), R-4 (44), R-5 (14), R-8 (4), R-9 (1), PJ-1 (14); Cruise 3-1, Oct 1988, Stas. R-1 (5), R-4 (61), R-5 (48), PJ-1 (21); Cruise 3-4, May 1989, Stas. R-1 (13), R-4 (51), R-5 (18), R-8 (29), PJ-1 (24).

Description. Adult female and immature male, 2.5 mm. Carapace twice length of pereonites 1-5; posterior margin extended strongly laterally to cover pereonites 1 and 2 ventrally; with three major serrate ridges, anteriormost originates middorsally behind frontal lobe, crosses onto pseudorostrum, eventually joining anterior horizontal extension of posterior ridge, latter originates dorsolaterally near anterior ridge, extends posteriorly, then descends laterally in wide sweeping arc toward anterior, ending near antennal angle, third ridge runs ventrally from anterior extension of posterior ridge to ventral margin; region of carapace behind posterior ridge covered with dirt and debris, creating roughened look; eyelobe and frontal lobe each with pair of small spines; ventral margin finely toothed. Pereonites 1-5 without spines; pereonite 5 with subacute

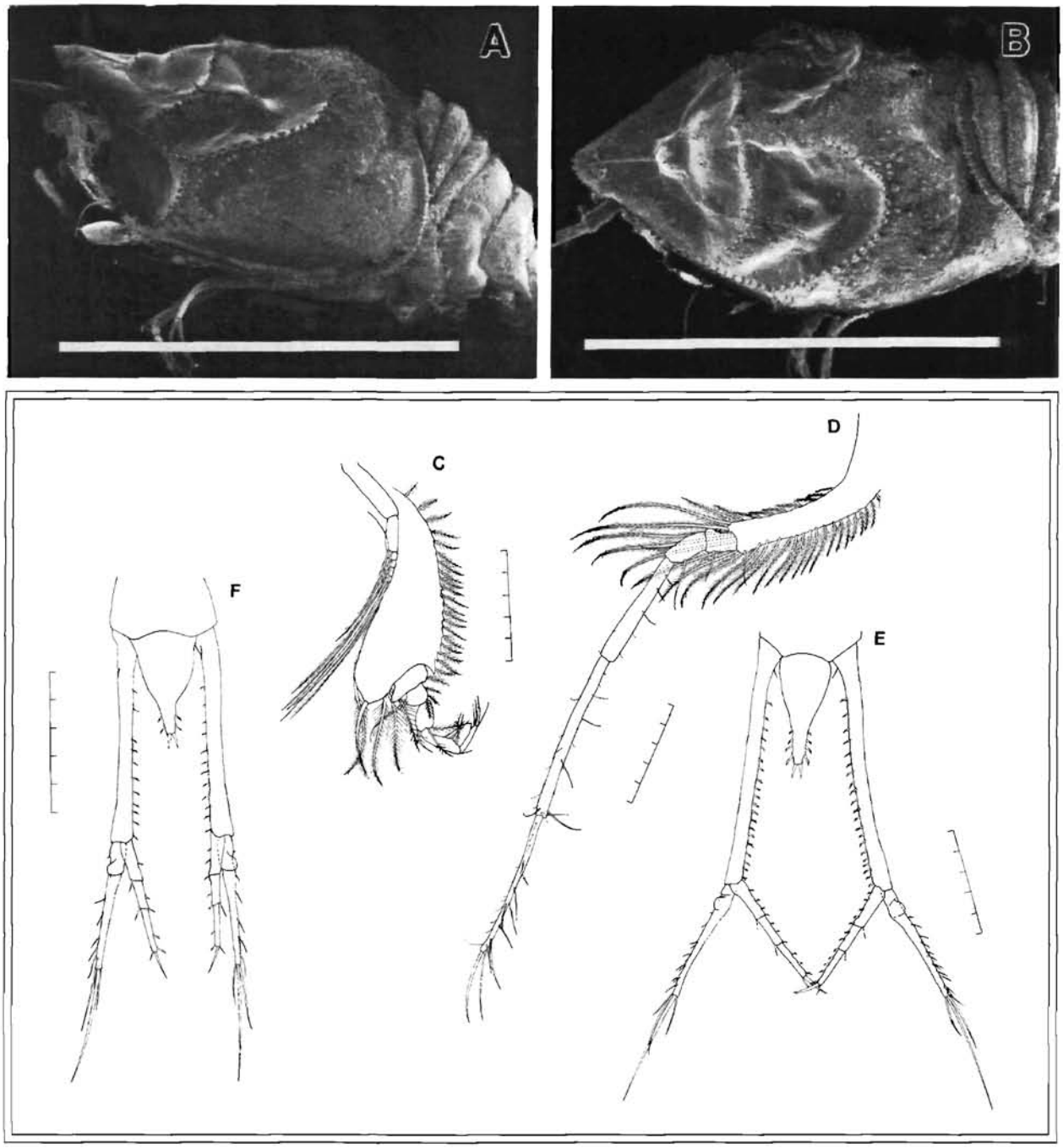

Figure 2.6. ***Diastylis crenellata*** **Watling and McCann, new species.** Female: A, carapace and pereonites, lateral view; B, same, dorsal view; C, maxilliped 3; D, pereopod 1; E, telson and uropods. Juvenile: F, telson and uropods. Scale, A,B = 1 mm, C-F = 0.5 mm.

posterior corners. Maxilliped 3 basis distal margin exceptionally broad, forming opercular-like cover to mouth field; distal margin with few long, very finely plumose setae; medial margin with thick row of short plumose setae; endopod articles small, together less than half length of basis. Pereopod 1 long and slender; basis slender, heavily armed with finely plumose setae; articles 6 and 7 subequal in length, together equal in length to rest of limb, with covering of simple setae throughout. Telson short, about 1.5 times length of pleonite 6; post-anal part slightly shorter than pre-anal part; lateral margins with 3-5 setae. Uropod peduncles more than twice length of telson; inner margins lined with closely spaced setae; exopod longer than endopod, outer margin with many short setae, armed terminally with 4 setae; endopod of 3 articles, subequal in length, with continuation of setal part from peduncle on inner margin, distal article armed terminally with single strong seta.

Remarks. This species is very close to *D. californica* Zimmer, but differs from it in the following features: while the ridge pattern is deceptively similar, *D. californica* does not have a ridge crossing the frontal lobe, the ridges are not serrate, and the posterior margin of the carapace covers pereonites 1 and 2 laterally whereas in *D. californica* it extends over only part of pereonite 1. The juveniles of this species have only a single pair of lateral telson setae, located subterminally, and have been identified in early benthic surveys from this region as *Leptostylis* sp. E. A second pair of lateral setae does not appear on the telson until at least the third juvenile stage.

Type Locality and Type Specimens. California, Santa Maria Basin, off Purisima Point, Sta. R-5 34°42.69'N, 120°50.83'W, 154 m, holotype USNM 273591, paratypes USNM 273592 and LACM 95-82.1.

Etymology. From Latin, *crenellus*, = embrasure, battlement, referring to the notches found at the top of the battlement, the pattern of which is seen on the carapace ridges.

Distribution. Known from the Santa Maria Basin region to off Pt. Loma, San Diego, depth range, 47-160 m, one record at 410 m.

Diastylis quadriplicata Watling and McCann, new species

Figure 2.7

Material Examined. Off Point Arguello Phase I station 071, 306 m; off Point Conception, 075, 293 m.

Description. Adult female and immature male, 4.5 mm Carapace about half again as long as pereonites 1-5; pseudorostrum broadly triangular; major ornamentation consists of 4 folds or ridges, three of which are parallel and run dorsoventrally from vicinity of paired dorsolateral ridges; fourth dorsoventral ridge originates at junction of pseudorostral lobe with carapace; eyelobe small, without spines. Pereonite 1 nearly completely covered by posterior carapace margin. Pereonites 1-5 dorsal surfaces free of spines; posterior corner of pereonite 5 broadly triangular. Pereopod 1 articles 5-7 subequal in length. Telson very slightly shorter than uropod peduncles; post-anal part slightly longer than pre-anal part; lateral margins with 5-8 setae. Uropod peduncle about 20% longer than rami; endopod slightly longer than exopod, 3-articulate, basal article longer than distal, armed terminally with a single seta; exopod with two setae on medial margin, outer margin with several setae, armed terminally with 3 setae. Mature male unknown.

Remarks. This species belongs to a group of diastylids found predominantly in the northern cold waters of the Atlantic and Pacific, with some connection through the low Arctic. These species all have a series of parallel dorsoventral ridges on the carapace. The northern Atlantic species, *D. scorpioides* (Lepechin), *D. edwardsi* (Krøyer) and *D. lepechini* Zimmer, all have four ridges running the full dorsoventral distance and have serrate ridges on the frontal lobe and pseudorostrum. Four multi-ridged species are thus far known from the colder Pacific waters: *D. bidentata* Calman, *D. dalli* Calman, *D. alaskensis* Calman, and *D. pellucida* Hart. *Diastylis alaskensis* has six ridges that run nearly vertically dorsoventral rather than obliquely

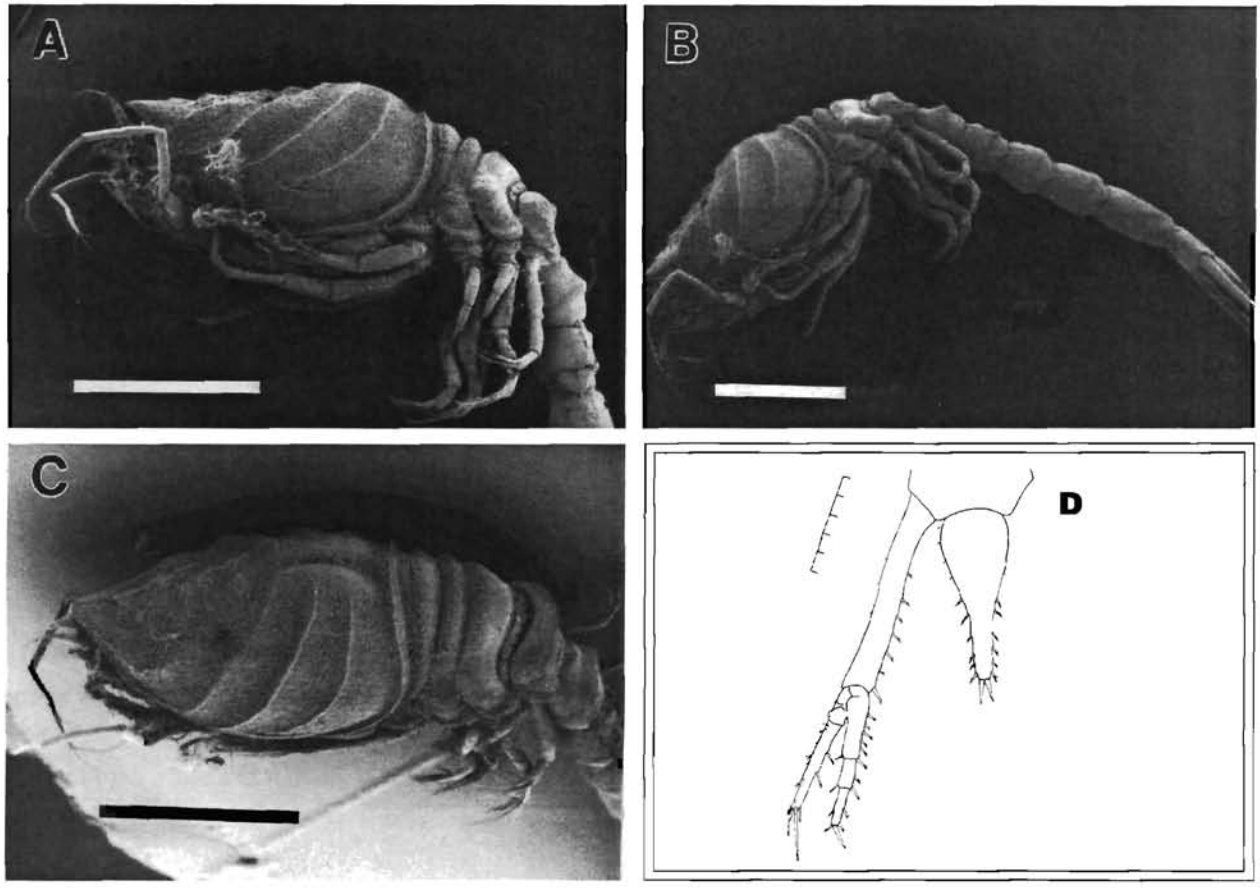

Figure 2.7. ***Diastylis quadriplicata*** **Watling and McCann, new species.** Subadult male: A,carapace and pereonites, lateral view; B, body, lateral view; C, carapace and pereonites, dorsal view; D, telson and uropod. Scale, A-C = 1 mm, D = 0.5 mm.

as in this species. Also, in *D. alaskensis* the telson is much shorter than the uropod peduncles. In *D. bidentata* and *D. dalli*, the carapace folds are oblique and the telson is more nearly equal in length to the uropod peduncle; however, in these two species the basal article of the uropod endopod is longer than the two distal articles combined, which is clearly not the case in *D. quadriplicata*.

Type Locality and Type Specimens. California, Santa Barbara Co., off Pt. Arguello, Sta. 71, 34°29.04'N, 120°44.01'W, 306 m, holotype USNM 273593, paratypes USNM 273594 and LACM 95-83.1.

Etymology. From Latin, *quadros* = four, and *plicatus* = fold or ridge, referring to the four ridges ornamenting the carapace.

Distribution. Known only from the Santa Maria Basin Region, approximately 290-310 m.

Diastylis santamariensis Watling and McCann, new species

Figure 2.8

Material Examined. Santa Maria Basin, Phase II, Cruise 1-1, Nov 1986, Sta. R-5 (4), PJ-1 (1); Cruise 1-2, Jan 1987, Sta. R-5 (3); Cruise 1-3, May 1987, Stas. R-4 (3), R-5 (3), R-8 (22); Cruise 2-3, Oct 1987, Stas. R-2 (2), R-5 (5), PJ-1 (3); Cruise 2-4, Jan 1988, Stas. R-1 (3), R-5 (5), PJ-1 (1); Cruise 2-5, May 1988, Stas. R-5 (1), R-8 (4); Cruise 3-1, Oct 1988, Stas. R-1 (2), R-4 (3), R-5 (2), PJ-1 (3); Cruise 3-4, May 1989, Stas. R-1 (39), R-4 (2), R-5 (16), R-8 (1).

Description. Adult female and subadult male. Carapace twice length of pereonites 1-5; surface with general overall wrinkled look; with 4 dorsoventral ridges, the two posteriormost originating dorsally at dorsolateral ridge and running to ventral margin, anteriormost extending across frontal lobe but not reaching ventral margin, behind that a short ridge extending from psudorostral cut toward but not reaching ventral margin; eyelobe smooth and globular, lenses not visible in SEM view. Pereonite 1 concealed ventrally in subadult male but not in young female. Pereonite 5 posterior corner bluntly rounded. Telson pre-anal part shorter than pleonite 6, post-anal part longer than pre-anal, with 4-5 setae on lateral margins. Uropod peduncle slightly longer than telson; endopod longer than exopod, 3 articles of endopod subequal in length, distal article with single terminal seta; exopod with several setae on outer margin, armed with 3 setae terminally.

Remarks. On the basis of its carapace ornamentation, this species is closely allied to *D. alaskensis* Calman and *D. paralaskensis* Vassilenko and Tzareva. *Diastylis santamariensis* has fewer dorsoventral ridges than either of the other two. In addition, its telson is more nearly equal in length to the uropod peduncles (versus much shorter in both *D. alaskensis* and *D. paralaskensis*) and the basal uropod endopod article is not much longer than either of the distal two articles (versus much longer in *D. alaskensis*).

Type Locality and Type Specimens. California, Santa Maria Basin, off Point Sal, Sta.PJ-3 34°56.26'N, 120°49.58'W, 138 m, holotype USNM 273589, paratypes USNM 273590 and LACM 95-81.1.

Etymology. Name derived from sample locations in the Santa Maria Basin region.

Distribution. Known from the Santa Maria Basin region, depth range, 90-161 m., and Puget Sound, Washington, as shallow as 10 m.

Diastylis californica Zimmer, 1936

Figure 2.9

Material Examined. Off Point Conception, Phase I, Sta. 079, 98 m.S.

Description. Adult size, female 9 mm, male 12 mm. Carapace with elevated ridges or keels, lateral ridges terminating in paired elevated teeth, 1 pair dorsolaterally above and behind frontal lobe and 1 pair to side of frontal lobe; from dorsal tooth ridge runs posteriorly then ventrally meeting ventrally-directed ridge originating at lateral tooth. Antenna 1 very slender, peduncle article 2 reaching end of pseudorostrum, peduncle article 3 equal in length to first 2 articles. Maxilliped 3 basis broadly expanded, upturned somewhat laterally, and forming opercular-like covering of mouth field. Uropod peduncle more than twice length of telson; endopod 3-articulate, all articles subequal in length; exopod longer than endopod.

Remarks. This species is very distinct with respect to carapace sculpturing. The species to which it is most closely related is *Diastylis crenellata* sp. n., described above. While the latter is a species of the Oregonian Province, *D. californica* is probably restricted to the shelf of the San Diego Province, reaching its northern limit in the immediate vicinity of Point Conception.

Type Locality and Type Specimens. Between Balboa and Corona Del Mar, California, holotype USNM no. 71440.

Distribution. Off Southern California, San Diego to Point Conception, 19 - 127 m.

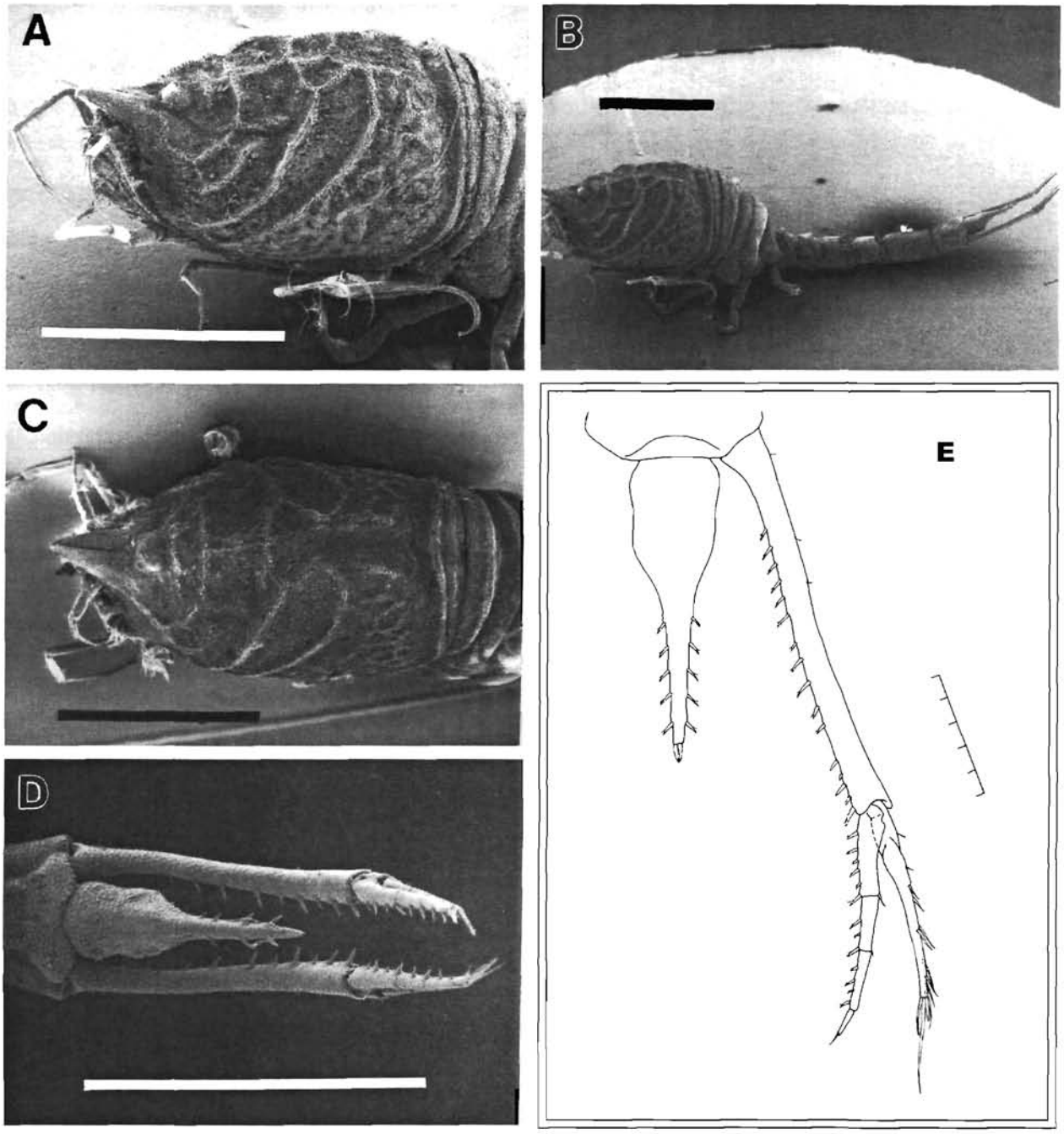

Figure 2.8. ***Diastylis santamariensis*** **Watling and McCann, new species.** Female: A, carapace, lateral view; B, body, lateral view; C, carapace and pereonites 1-2, dorsal view; D, E, telson and uropods. Scale, A-D = 1 mm, E = 0.5 mm.

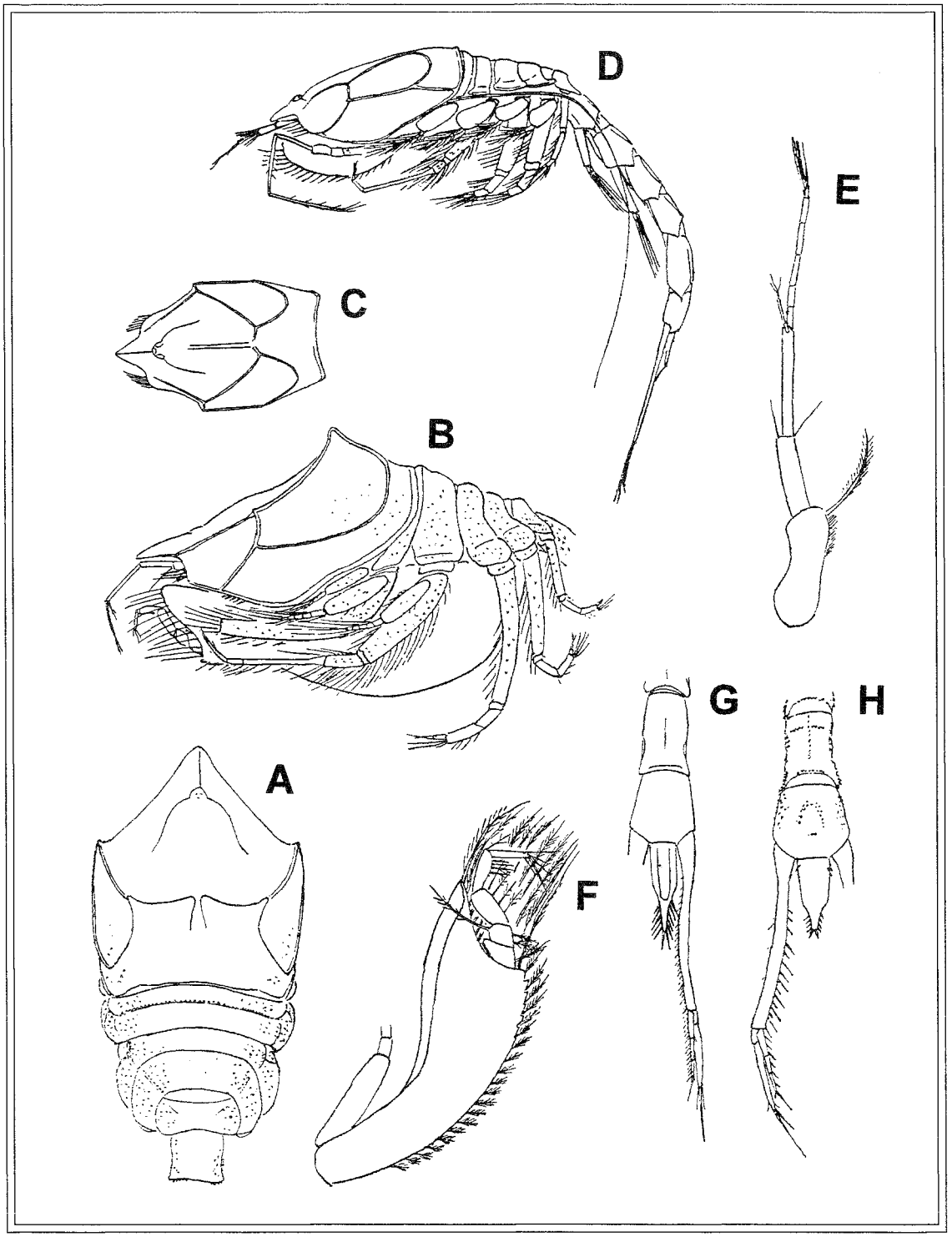

Figure 2.9. *Diastylis californica* Zimmer 1936. Female: A, carapace and pereonites, dorsal view; B, same, lateral view; E, antenna 1; F, maxilliped 3; H, telson and uropods. Juvenile: C, carapace, dorsal view. Male: D, body, lateral view; G, telson and uropod. From Zimmer (1936); no scale provided.

Diastylis pellucida Hart, 1930

Figure 2.10

Material Examined. Cruise 1-1 (November, 1986), Sta. R-2 (81), R-3 (2), R-5 (1), PJ-1 (9); Cruise 1-2 (January, 1987), Sta. R-2 (43), R-3 (3), R-5 (1), R-6 (3), R-9 (2), PJ-1 (20); Cruise 1-3 (May, 1987), Sta. R-2 (61), R-3 (20), R-5 (2), R-6 (4), R-9 (10), PJ-1 (1); Cruise 2-3 (October, 1987), R-1 (1), R-2 (14), R-6 (1), R-9 (11); Cruise 2-4 (January, 1988), Sta. R-2 (89), R-3 (5), R-5 (6), R-9 (10), PJ-1 (16); Cruise 2-5 (May, 1988), Sta. R-2 (42), R-3 (2), R-5 (1), R-6 (7), R-8 (2), R-9 (27); Cruise 3-1 (October, 1988), Sta. R-2 (5), R-3 (2), R-5 (1), R-6 (3), R-9 (8), PJ-1 (1); Cruise 3-4 (May, 1989), Sta. R-2 (24), R-3 (9), R-4 (1), R-5 (3), R-6 (7), R-9 (66), PJ-1 (5).

Description. Adult size, female 8 mm, male 9 mm. Carapace longer than free pereonites; surface smooth except for two oblique, minutely crenulate ridges running from mid dorsal ridge to ventral margin; a third very slight circumcinct ridge occurs posterior to frontal lobe. Pereonite 1 visible ventrally; pereonite 5 posterior corners subacute. Antenna 1 peduncle article 2 extending near to end of pseudorostrum. Telson slightly more than half length of uropod peduncle; lateral margin with 5-8 setae. Uropod exopod longer than 3-articulate endopod.

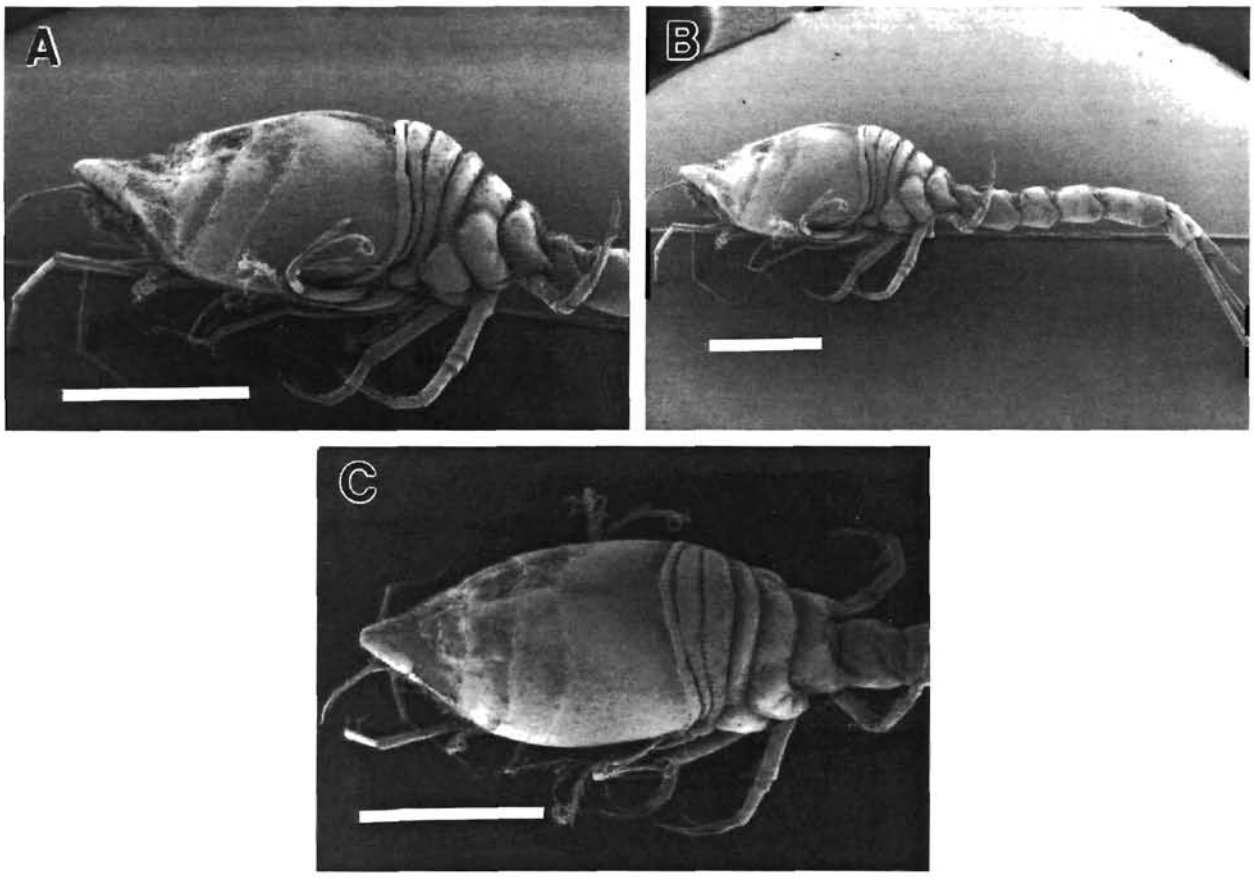

Figure 2.10. *Diastylis pellucida,* Hart 1930. Male: A, carapace and pereonites, lateral view; B, body, lateral view; C, carapace and pereonites, dorsal view. Scale = 1 mm.

Remarks. This species is the only diastylid in this region with just two lateral oblique ridges. It also has a relatively thin integument, so the ridges in newly moulted individuals are not readily visible except in transmitted light.

Type Locality and Type Specimens. Deep Cove, Vancouver Island, British Columbia, 120 m. Type in British Columbia Provincial Museum. Holotypes on slides are in very bad condition.

Distribution. Southern California to British Columbia, Canada (Oregonian Province), 50 - 410 m.

Genus *Leptostylis* G. O. Sars, 1869

Type Species. *Diastylis longimana* Sars, 1865.

Diagnosis. (modified from Day, 1980) Carapace usually tumescent posteriorly. Pereonites 3 and 4 may be coalesced or not; fifth pereonite not produced posteriorly. Male antenna 1 with club-shaped article 3, with dense array of sensory setae distally. Male antenna 2 not extending beyond pereonite 5. Basis of pereopods in male not widened and pereopods 2 and 3 not widely separated in ovigerous female. Pereopods 3 and 4 with rudimentary exopods or exopods absent in female, fully developed in male. Male with 2 pairs of pleopods. Post-anal part of telson shorter than pre-anal; with single pair of lateral setae sub-terminally. Uropod endopod 3-articulate.

Remarks. The short telson and form of the male antenna 1 characterize this genus. It is widespread throughout the colder waters of the world's oceans but not as diverse as *Diastylis*. One species, *Leptostylis villosa*, has previously been recorded from the Oregonian Province, but it is likely this record is in error, at least from Puget Sound south.

Leptostylis calva Watling and McCann, new species

Figure 2.11

Material Examined. Santa Maria Basin, Cruise 1-1 (November, 1986), Sta. R-1 (64); Cruise 1-2 (January, 1987), Sta. R-1 (90); Cruise 2-3 (October, 1987), Sta. R-8 (49); Cruise 2-5 (May, 1988), Sta. R-1 (89), R-4 (56), R-8 (82); Cruise 3-1 (October, 1988), Sta. R-1 (39), R-4 (40), R-5 (4), R-8 (30); Cruise 3-4 (May, 1989), Sta. R-1 (64), R-8 (54).

Description. Adult size, 2.5 mm. Carapace slightly swollen posteriorly; triangular in dorsal view; very slight ridge present lateral to frontal lobe; surface of carapace smooth, with few setae; posterolateral margins extended posteriorly partially covering pereonite 1. Pereonites 1 and 2 of normal width dorsally but narrowed ventrolaterally; pereonites 3 and 4 coalesced dorsally. Pereopods 3 and 4 with rudimentary exopods in female. Telson about half as long as uropod peduncles in male and female; with single pair of subterminal lateral setae. Female uropod peduncle setose along distal two-thirds of medial margin; rami subequal; endopod articles subequal; male uropods similar but more elongate.

Remarks. This species is unusual in the extent to which the carapace extends posterolaterally. It is very similar to the following species, *L. abditis*, being most easily distinguished from the latter by its subequal uropod rami.

Type Locality and Type specimens. California, Santa Maria Basin, off Point San Luis, Sta.R-1 35°05.83'N, 120°49.16'W, 91 m, holotype USNM 273587, paratypes USNM 273588 and LACM 95-80.1.

Etymology. From Latin, *calvus*, = bald, bare, indicating the lack of setae on the carapace.

Distribution. Known so far only from the Santa Maria Basin region, primarily at depths near 90 m. It is probably an abundant member of the shallow shelf fauna.

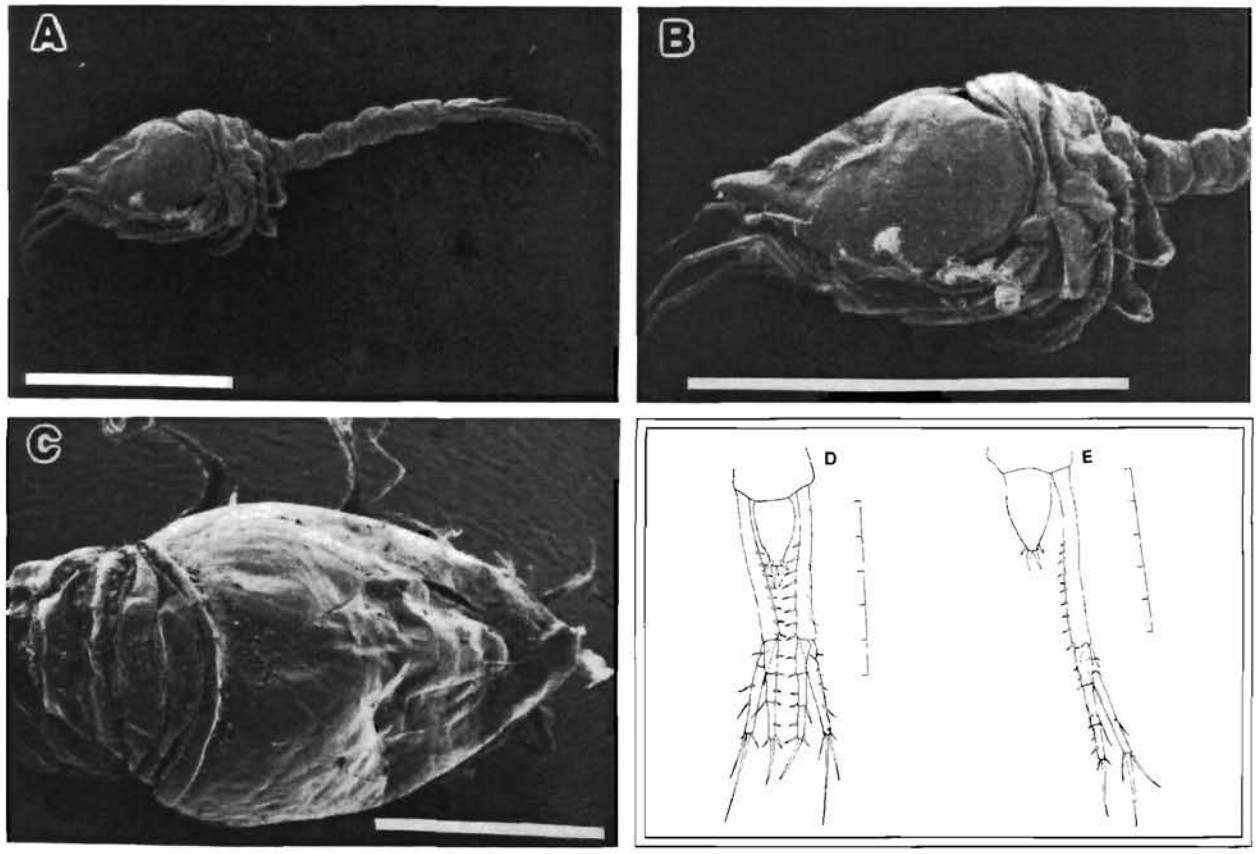

Figure 2.11. ***Leptostylis calva*** **Watling and McCann, new species.** Female: A, body, lateral view; B, carapace and pereonites, lateral view; C, same, dorsal view; D, teslon and uropods. Male: E, telson and uropods. Scale, A-C = 1 mm, D,E = 0.5 mm.

Leptostylis abditis Watling and McCann, new species

Figure 2.12

Material Examined. Santa Maria Basin, PhaseII, Cruise 1-1 (November, 1986), Sta. R-5 (25); Cruise 1-2 (January, 1987), Sta. R-5 (13); Cruise 2-3 (October, 1987), Sta. R-5 (14), PJ-1 (18); Cruise 2-4 (February, 1988), Sta. PJ-1 (6); Cruise 2-5 (May, 1988), Sta. R-3 (1), R-4 (2), R-5 (6), PJ-1 (1); Cruise 3-1 (October, 1988), Sta. PJ-1 (1); Cruise 3-4 (May, 1989), Sta. R-1 (1), R-4 (6), R-5 (18), PJ-1 (15).

Description. Adult size, 3.5 mm. Carapace swollen posteriorly into tumescent lobes; anteroventral margin below antennal sinus with coarse serrations; surface of carapace smooth, with few setae; posterolateral margins extended posteriorly to cover pereonite 1 laterally. Pereonites 1 and 2 of normal width dorsally but narrowed ventrolaterally; pereonites 3 and 4 weakly coalesced dorsally. Pereopods 3 and 4 without rudimentary exopods in female. Telson less than half length of uropod peduncle. Uropod exopod shorter than endopod, reaching just beyond end of endopod second article; endopod terminal article longer than second. Male uropod similar but more elongate.

Remarks. This species is superficially similar to *L. calva*, especially in general aspects of the carapace and body shape. However, the unequal rami of the uropods and the lack of rudimentary exopods on pereopods 3 and 4 of the female serve to readily distinguish it from *L. calva*.

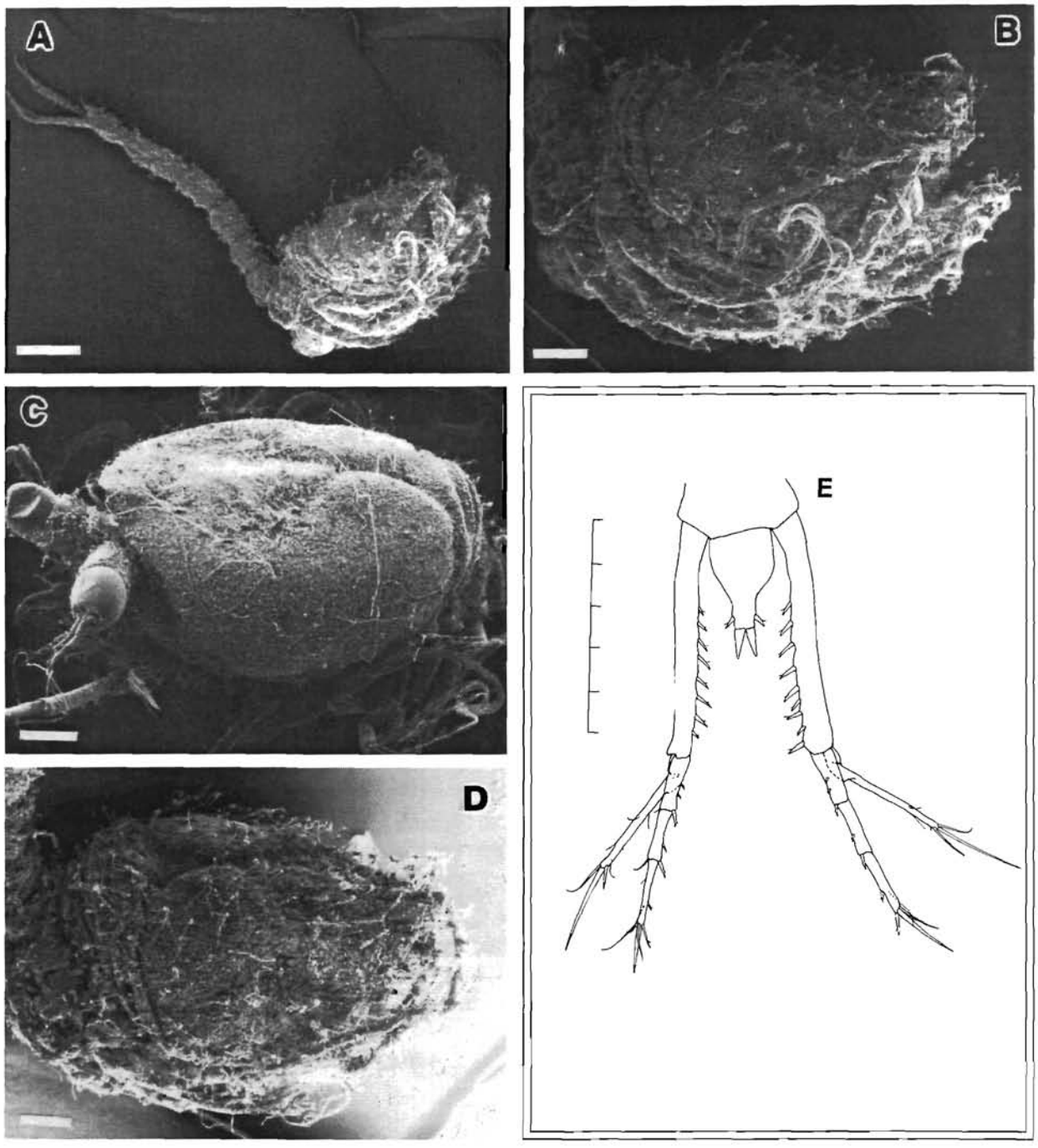

Figure 2.12. ***Leptostylis abditis*** **Watling and McCann, new species.** Female: A, body, lateral view; B, carapace and anterior pereonites, lateral view; D, carapace and pereonites, dorsal view; E, telson and uropods. Male: C, carapace and antenna 1, dorsal view. Scale, A = 0.5 mm, B-D = 0.2 mm, E = 0.5 mm.

Type Locality and Type Specimens. California, Santa Maria Basin, off Purisima Point, Sta. R-5 34°42.69'N, 120°50.83'W, 154 m, holotype USNM 273585, paratypes USNM 273586 and LACM 95-79.1.

Etymology. From Latin, *abditus* = hidden, concealed, referring to the initial difficulty in separating this species from *L. calva*.

Distribution. A somewhat rare species of shelf and slope, known from the Santa Maria Basin region, primarily at depths of 145-410 m., to off Pt. Loma, San Diego as shallow as 47m.

Family Lampropidae

Diagnosis (from Day, 1978). Mandibles naviculoid. Maxilla 1 palp absent or bearing 1 or 2 setae. Exopods present on maxilliped 3 and pereopod 1 in both sexes; in female present or rudimentary on pereopods 2-4 or absent from all three; in male exopods present on pereopods 2-4. Pleopods absent or 1-3 pairs in male, with outer process on inner ramus. Telson moderate to large, with post-anal part longer than pre-anal, with 3 to 8 terminal and subterminal setae.

Remarks. Lampropids are most easily distinguished on the basis of possessing at least three terminal setae on the telson. The family presently comprises 10 genera and is well represented in the cold waters of the world's oceans, from shallow depths to the abyss. The taxonomic history of this family has been quite clear, with the exception of Stebbing's (1912) division of the group into five families on the basis of male pleopod number. Given (1964) followed Stebbing's example and created the family Mesolampropidae for species where the male possessed two pairs of pleopods. This arrangement of the lampropids has not been followed by any other workers and is not accepted here.

Genus *Hemilamprops* Sars, 1883

Type Species. *Vaunthompsonia rosea* Norman, 1863.

Diagnosis (From Day, 1978). Carapace not strongly dorsoventrally flattened. Eye present or absent. Pseudorostrum short. Antenna 1 flagella well developed. Maxilla 1 palp with 2 terminal setae. Exopods on pereopods 3 and 4 rudimentary in female. Male with 3 pairs of pleopods. Telson usually with 3 terminal and often 2 subterminal setae.

Remarks. *Hemilamprops* Sars, *Mesolamprops* Given, and *Lamprops* Sars are very closely related genera. The only definitive method of distinguishing these genera at the present time is on the basis of the number of pleopod pairs in the male, viz., *Hemilamprops* has three, *Mesolamprops* has two, and *Lamprops* none.

Hemilamprops californicus Zimmer, 1936

Figure 2.13

Hemilamprops (?) californica Zimmer, 1936.

Lampropoides californicus, Harada, 1959.

Hemilamprops californiensis, Lie, 1969 (*lapsus calami*).

Material Examined. Santa Maria Basin, Phase II, Cruise 1-1 (November, 1986), Sta. R-1 (1); Cruise 1-2 (January, 1987), Sta. R-1 (3), R-4 (23), R-8 (61); Cruise 1-3 (May, 1987), Sta. R-1 (2), R-3 (43), R-4 (4), R-8 (111); Cruise 2-3 (October, 1987), Sta. R-1 (1), R-8 (18); Cruise 2-4 (February, 1988), Sta. R-4 (15), R-8 (3); Cruise 2-5 (May, 1988), Sta. R-4 (1), R-8 (4); Cruise 3-1 (October, 1988), Sta. R-1 (24), R-4 (8), R-8 (33); Cruise 3-4 (May, 1989), Sta. R-4 (7), R-8 (12).

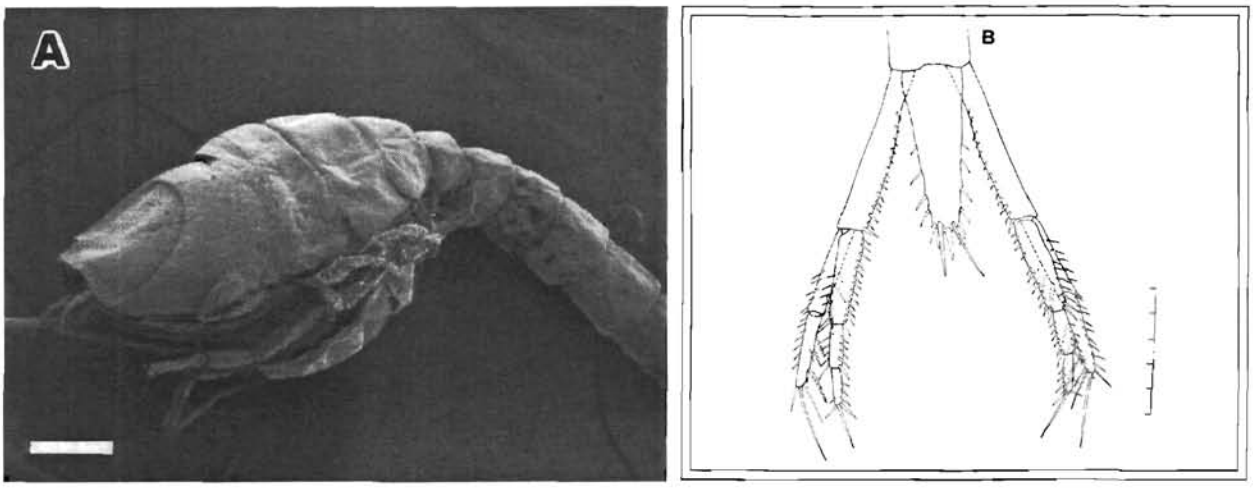

Figure 2.13. *Hemilamprops californicus* Zimmer 1936. Female: A, carapace and pereonites, lateral view; B, telson and uropods. Scale, A = 1 mm, B = 0.5 mm.

Description. Adult size, female, 5.5 to 8 mm, male 6 mm. Carapace as long as first 4 pereonites; broadly truncate anteriorly; with single ridge running from pseudorostral margin upward and backward to median carina on frontal lobe; ocular lobe distinct, large, with 7 lenses; pseudorostral lobes extend only short distance in front of ocular lobe. All 5 pereonites visible in lateral view; pereonites 2 and 3 subequal in length. Telson as long as uropod peduncles, with 3 apical and 2 dorsal subapical setae. Uropod endopod longer than exopod, proximal article longer than distal 2 combined, distal article the shortest; exopod reaching to midpoint of endopod distal article, 2 articles subequal in length, external margin with heavier setae than on inner margin.

Remarks. Zimmer did not have a male in his collection when he described the species, but assigned it questionably to *Hemilamprops* on the basis of general features. Given (1964) noted that the specimens he identified as *H. californicus* had three pairs of pleopods, as did the specimens identified as this species by Harada (1959) and Gamô (1962). Harada (1959) created the new genus *Lampropoides* to accommodate several new species wherein the male possessed three pairs of pleopods and a recurved fold on the carapace. He included Zimmer's *Hemilamprops (?) californica* in this new genus. Gamô (1962) dismissed the genus as not being sufficiently distinguishable from *Hemilamprops*. Currently, the closely related genera *Hemilamprops*, *Lamprops*, and *Mesolamprops* are defined on the basis of the number of pleopods present on the male. Therefore, on the basis of male pleopod number, this species belongs in the genus *Hemilamprops*. However, Gladfelter (1975) described a new species, *Mesolamprops dillonensis*, in which the male possessed two pairs of pleopods, but the female is virtually indistinguishable from *H. californicus*. In the material at hand, there is also a male with two pairs of pleopods accompanying two ovigerous females that also fit well the description of *H. californicus*. There is thus a major problem in need of solution. Are there two closely related species assignable to two different genera (on the basis of male pleopod number), or is it possible for one species to have two male morphologies? Perhaps Harada's *Lampropoides* concept needs to be given a more thorough examination, and all species redefined on other characters. For the present time, this species will be left in the genus *Hemilamprops*, in order to avoid needless cluttering of the synonymy until the necessary studies are completed.

Type Locality and Type Specimens. Between Balboa and Corona Del Mar, California. Holotype USNM 71439.

Distribution. Puget Sound, Washington to Southern California, Japan, 13-60 m.

Family Leuconidae

Diagnosis (modified from Jones, 1963). Mandible truncate, molar usually present and columnar. Maxilla 1 palp bears single seta. Exopods present on maxilliped 3 and pereopods 1-3 (occasionally on pereopods 1-2) in both sexes, additional exopod on pereopod 4 on most males. Pleopods absent, rudimentary, or 2 pairs in male, without external process on inner ramus. Telson absent. Eye generally absent; if present may be either fully developed or rudimentary.

Remarks. The Leuconidae is one of the oldest cumacean families, having been established by Sars (1878). Until Watling's (1991a) revision, it had consisted of only eight genera, all but one of which were proposed by 1907. The latest revision expanded the family so that it now comprises 12 genera, and five subgenera in the genus *Leucon*. The present material adds one new genus, a new subgenus, and 4 new species.

Key to the Leuconidae of the Santa Maria Basin Region

1A. Efferent orifice anterior or anterodorsal 2

1B. Efferent orifice distinctly dorsal, pseudorostral lappets bent posteriad and directed dorsally 6

2A. Male antenna 1 short, not reaching posterior margin of carapace; male without pleopods .... *Alloeoleucon santamariensis*

2B. Male antenna long, extending well past carapace posterior margin; male with 2 pairs of pleopods . ..... *Leucon* 3

3A. Branchial siphon longer than pseudorostral lobes; male pleopods reduced (Subgenus *Diaphonoleucon*) *Leucon (D.) declivis*

3B. Branchial siphon normal, barely extending beyond pseudorostrum; male pleopods normal .... (Subgenus *Leucon*) 4

4A. Carapace with forwardly curving ventrally directed lateral ridge ..... *Leucon (L.) falcicosta*

4B. Sides of carapace without ridge 5

5A. Pseudorostral lobes short, bluntly truncate anteriorly ..... *Leucon (L.) armatus*

5B. Pseudorostral lobes elongate, subacute anteriorly, slightly upturned .... *Leucon (L.) magnadentatus*

6A. Antenna 1 geniculate between peduncle articles 1 and 2; carapace with 2 lateral, strongly curving ridges.... ..... *Eudorellopsis longirostris*

6B. Antenna 1 geniculate between peduncle articles 2 and 3; carapace without lateral ridges .... *Eudorella* 7

7A. Antenna 1 main flagellum with setae only at distal end; uropod peduncles with long marginal setae; pereopod 5 absent ..... *Eudorella redacticruris*

7B. Antenna 1 main flagellum with setae along whole margin; pereopod 5 normal in male and female 8

8A. Uropod exopod reaching only to end of endopod basal article; carapace ventral margin bent, posterior section smooth, anterior section with serrations ..... *Eudorella pacifica*

8B. Uropod exopod extending beyond end of endopod basal article; carapace ventral margin continuously curved, anterior section with fine serrations ..... *Eudorella truncatula*

Alloeoleucon, new genus

Type Species. *Alloeoleucon santamariensis* Watling and McCann, new species

Diagnosis. Pseudorostrum projecting anteriorly. Antenna 1 not geniculate. Male antenna 2 extending only to posterior margin of carapace; peduncle articles 4 and 5 without setal brush; flagellum not modified for grasping. Exopods on pereopods 1-3 in female and 1-4 in male. Pereopod 2 article 3 very short. Uropod endopod 2-articulate. Male without pleopods.

Remarks. This peculiar genus resembles *Hemileucon*, *Austroleucon*, *Heteroleucon*, and *Nippoleucon* in its lack of pleopods and shortened antenna 2 of the male. However, it differs from most of this group by having neither a strong setal brush on the antennal peduncle nor a flagellum modified for grasping. In this latter respect it is closest to *Heteroleucon*, but the latter is additionally modified in possessing exopods only on pereopods 1 and 2 in both sexes.

Etymology. From Greek, *alloios*, of another kind, different, + *leucon*, the stem genus, referring to the unusual collection of features characterizing this genus.

Alloeoleucon santamariensis Watling and McCann, new species

Figure 2.14

Material Examined. Santa Maria Basin, PhaseII, Cruise 1-1 (November, 1986), Sta. R-3 (12); Cruise 1-2 (January, 1987), R-3 (8), R-4 (4); Cruise 1-3 (May, 1987), R-3 (2), R-6 (1); Cruise 2-3 (October, 1987), R-3 (6); Cruise 2-4 (February, 1988), R-3 (4); Cruise 2-5 (May, 1988), R-3 (2); Cruise 3-1 (October, 1988), R-3 (2); Cruise 3-4 (May, 1989), R-3 (5), R-9 (1).

Description. Adult size, 2 mm, male and female. Carapace in both sexes slightly longer than pereonites; median carina sparsely, coarsely, serrate; pseudorostral lobes bluntly truncate; eyelobe not distinguishable from frontal lobe. Antenna 1 not geniculate; accessory flagellum minute. Male antenna 2, flagellum short, not extending beyond pereonites; peduncle articles 4 and 5 without brush of sensory setae, article 5 with 4 long proximal setae. Maxilliped 3 leg-like, distal articles slender, basis not strongly expanded distally, bearing only four setae. Pereopod 1 articles 5 and 6 subequal in length; basis armed with single, long, plumose seta distally. Pereopod 2 with short article 3. Uropod similar in male and female; endopod longer than exopod, 2-articulate, articles subequal in length; exopod with 1-2 subterminal setae on inner margin.

Type Locality and Type Specimens. California, Santa Maria Basin, off Point San Luis, Sta R-3, 35°05.30'N, 121°00.90'W, 409 m, holotype USNM 273583, paratypes USNM 273584 and LACM 95-78.1.

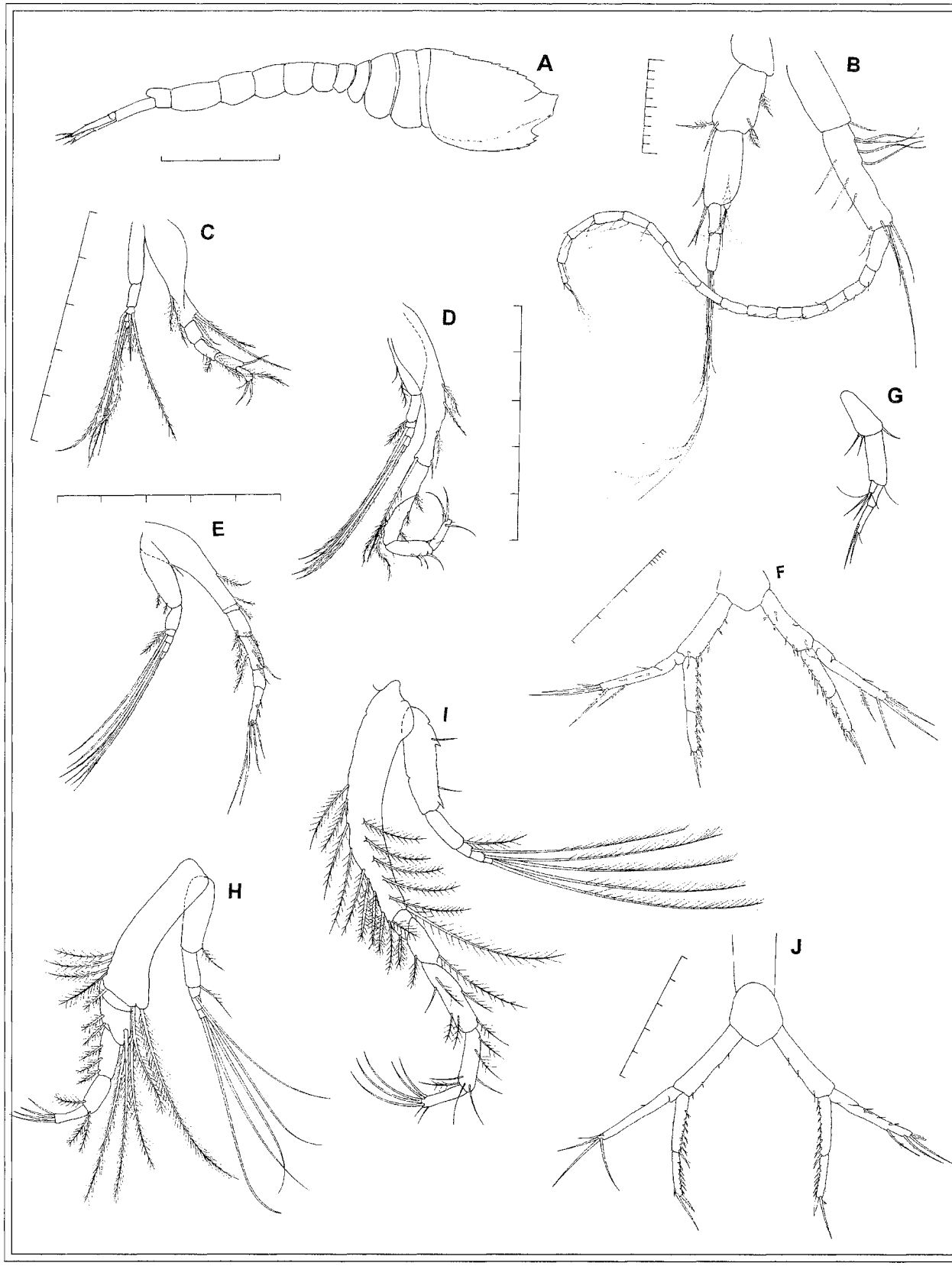

Figure 2.14. ***Alloeoleucon santamariensis*** **Watling and McCann, new species.** Male: A, body, lateral view; B, antennae 1 and 2; C, maxilliped 3; D, pereopod 1; E, pereopod 2; F, uropods. Female: G, antenna 1; H, maxilliped 3; I, pereopod 1; J, uropods. Scale, A, C-J = 0.5 mm, B = 0.1 mm.

Remarks. This is the smallest leuconid found in Californian waters. The species is readily distinguishable from the other leuconids found in the Santa Maria Basin area by the truncate pseudorostral lobes and the very similar appearance of the male and female.

Etymology. This species is named for its principal place of occurrence, the Santa Maria Basin of southern California.

Distribution. Known thus far only from the Santa Maria basin area, depth range, 409-410 m, with one record at 92 m.

Genus *Leucon* Krøyer, 1846

Type Species. *Cuma nasica* Krøyer, 1841.

Diagnosis (from Watling, 1991a). Pseudorostrum projecting anteriorly, usually slightly shorter in male; antenna 1 not geniculate; male antenna 2 with brush of setae on anterior margin of peduncle articles 4 and 5; male antenna 2 flagellum extending well along pleon; female with exopods on pereopods 1-3; male with exopods on pereopods 1-4; pereopod 2 article 3 very short or lacking; uropod endopod 2-articulate; male with 2 pairs of pleopods.

Remarks. This genus was subdivided by Watling (1991a) into 5 subgenera, using as criteria the relative length of the branchial siphon, the length of the antennule accessory flagellum, the presence of ventral hooks on pereonite 5, and the degree of fusion of the uropod endopod terminal seta. A new subgenus is described below which has a new combination of the above characters, but as well, shows extreme reduction of the pleopods in the male.

***Diaphonoleucon*, new subgenus**

Type Species. *Leucon (Diaphonoleucon) declivis* Watling and McCann, new species

Diagnosis. Branchial siphon elongate, longer than pseudorostral lobes; antenna 1 accessory flagellum minute; pereonite 5 without ventral teeth; uropod endopod terminal seta not fused with distal article; pleopods of male reduced to short peduncle bearing nub-like rami.

Remarks. The combination of elongate branchial siphon and minute antennule accessory flagellum, is sufficient to distinguish this subgenus from the others recently established by Watling (1991a). The presence of reduced pleopods is not unique to this subgenus, having also been seen in *L. serrulirostris* Ledoyer, which was assigned to the subgenus *Crymoleucon* on the basis of its short branchial siphon and long antennule accessory flagellum.

Etymology. From Greek, *diaphonos*, dissonant + *leucon*, the stem genus, referring to the strongly different form of the male.

***Leucon (Diaphonoleucon) declivis* Watling and McCann, new species**

Figure 2.15

Material Examined. Santa Maria Basin, Phase II. Cruise 1-1 (November, 1986), Sta. R-7 (5); Cruise 1-2 (January, 1987), R-7 (1); Cruise 1-3 (May, 1987), R-7 (8); Cruise 2-3 (October, 1987), R-7 (7); Cruise 2-4 (February, 1988), R-7 (2); Cruise 3-1 (October, 1988), R-7 (1); Cruise 3-4 (May, 1989), R-7 (10).

Description. Size of adult female, 9.0 mm, male, 9.5 mm. Carapace pseudorostral lobes upturned, about one-fifth total carapace length; dorsal crest serrate only along anterior half, serrations conspicuous on frontal lobe and on posterior extension of frontal lobe, often with middorsal gap; antennal notch narrow,

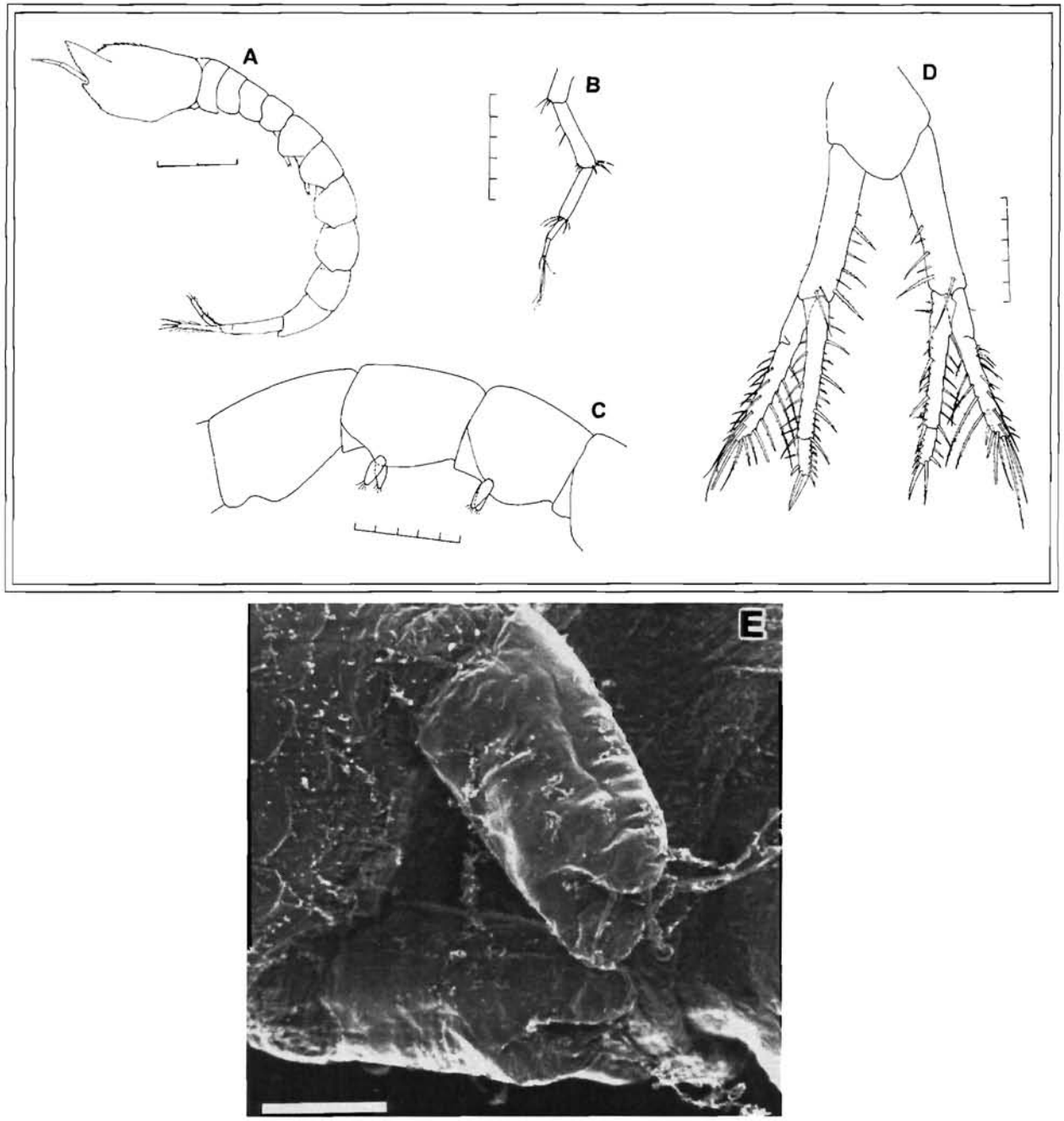

Figure 2.15. ***Leucon (Diaphonoleucon) declivis*** **Watling and McCann, new species.** Subadult male: A, body, lateral view; B, antenna 1; C, pleonites 1 and 2 with reduced pleopods; D, uropods; E, first pleopod pair. Scale, A = 1.0 mm, B-D = 0.5 mm, E = 50 μm.

toothed along ventral margin of pseudorostral lobe; anteroventral corner acute. Branchial siphon much longer than pseudorostral lobes. Antennule elongate, thin, extending beyond end of pseudorostrum, accessory flagellum minute. Pereopod 1 article 5 longer than article 6. Pereopod 2 article 3 nearly as long as wide. Uropod rami longer than peduncle; endopod longer than exopod, distal article one-fourth length of basal article, both articles setose along both inner and outer margin; exopod strongly setose along both margins. Male pleopods reduced, 2 pairs, each consisting of shortened peduncles bearing nub-like ramal remnants. Antenna 2 of final male stage unknown, but sub-adult shows many compressed articles forming within old cuticle.

Remarks. This is one of the largest leuconid cumaceans known. It appears to be confined to the very soft, low oxygen mud habitat at the upper reaches of the oxygen minimum zone. None of the specimens collected were fully mature, so it is possible that the reduced pleopods of the male will eventually be found to develop small rami since there is an indication of a biramous condition which can be seen under the old cuticle of the one specimen that appears ready to undergo its final molt. There is no indication, however, that these pleopods will be fully formed as is the case in the genus generally.

Type Locality and Type Specimens. California, Santa Maria Basin, off Point Sal, Sta R-7, 34°52.90'N, 121°10.30'W, 565 m, holotype USNM 273581, paratypes USNM 273582 and LACM 95-77.1.

Etymology. From Latin, *declivis* = downhill, sloping, referring to the slope habitat in which this species lives.

Distribution. Known only from the deeper waters of the Santa Maria Basin, at least 565 m.

Subgenus *Crymoleucon* Watling, 1991a

Diagnosis. Branchial siphon normal; antenna 1 accessory flagellum extending at least to midlength of main flagellum first article; pereonite 5 without ventral teeth; uropod terminal seta not fused to distal article.

Remarks. Most of the species assigned to this subgenus are found in the deeper or colder polar waters of the world ocean. Otherwise, it is a rather heterogeneous assemblage of species united by the unusually large accessory flagellum.

Leucon (Crymoleucon) bishopi Bacescu, 1988

Figure 2.16

Epileucon pacifica Jones, 1969

Epileucon pacifica, Bishop, 1981

Leucon (Epileucon) bishopi Bacescu, 1988

Material Examined. Santa Maria Basin, Phase I, Sta. 63, (1);Phase II, Cruise 1-2 (January, 1987), Sta. R-7 (2); Cruise 1-3 (May, 1987), R-7 (2); Cruise 2-4 (February, 1988), R-7 (1); Cruise 3-1 (October, 1988), R-7 (2); Cruise 3-4 (May, 1989), R-7 (2).

Description. Size of adult female, 6 mm. Carapace pseudorostral lobes directed anteriorly, less than one-fifth total carapace length; dorsal crest without serrations in female and male; anteroventral corner slighting projecting, with several teeth below antennal notch. Branchial siphon not projecting beyond end of pseudorostrum. Antenna 1 short, peduncle articles 2 and 3 subequal in length; accessory flagellum extending slightly beyond mid-length of main flagellum basal article. Pereopod 1 article 5 slightly shorter than article 6. Pereopod 2 article 3 shorter than wide. Uropod peduncle as long as endopod basal article; exopod basal article long, about half length of distal article; exopod extends at least to end of endopod basal article;

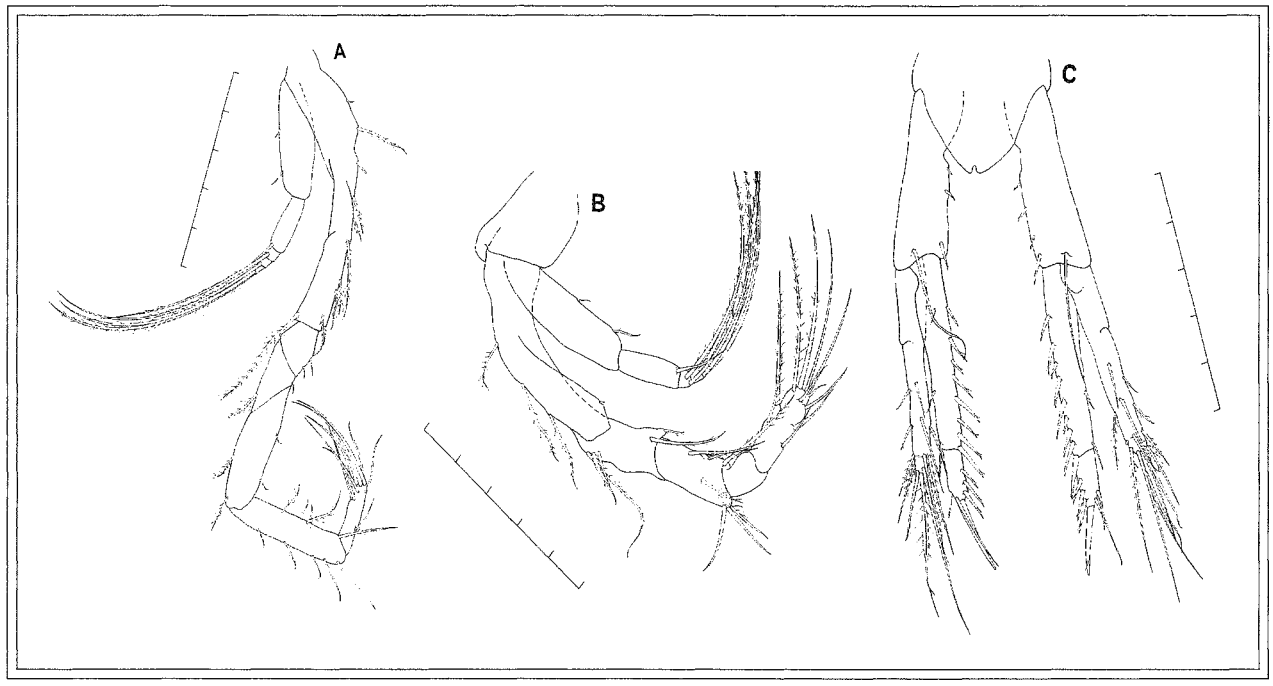

Figure 2.16. *Leucon (Crymoleucon) bishopi* Bacescu, 1988. Subadult male: A, pereopod 1; B, pereopod 2; C, uropods. Scale, A-C = 0.5 mm.

endopod armed medially with continuous series of narrowly spaced setae, 3 on distal article.

Remarks. This species was assigned to the genus *Epileucon* Jones, 1969, because it lacked serrations on the dorsal crest in the female. Bacescu (1988) and Watling (1991a) relegated *Epileucon* to subgeneric status because the constituent species could not be characterized by any feature other than the presence of ventral teeth on pereonite 5. Bishop (1981) noted that *E. pacifica* did not possess these ventral teeth and subsequently Bacescu (1988) moved *E. pacifica* into *Leucon (Epileucon)*. Since the species *L. pacifica* was an occupied name, Bacescu proposed *L. (E.) bishopi* for Jones' *E. pacifica*.

Type Locality and Type Specimens. Galathea station 745, 7° 15' N, 79° 25' W (Gulf of Panama), 915 m, T 5°C; holotype in British Museum.

Distribution. Previously known only from the type locality; the present specimens extend the range of the species to the north and further up the slope. *L. (C.) bishopi* seems to be characteristic of the upper reaches of sediments in contact with low oxygen content water.

Subgenus *Leucon* Krøyer, 1846

Diagnosis. Branchial siphon normal; antenna 1 accessory flagellum rudimentary; pereonite 5 without ventral teeth; uropod endopod terminal seta not fused to terminal article.

Remarks. This is the most wide-spread of the subgenera and embodies most of the northern Atlantic and sub-Arctic species included in the monograph of Sars (1900) from Norway.

Leucon (Leucon) falcicosta Watling and McCann, new species

Figure 2.17

Material Examined. Santa Maria Basin, Phase II. Cruise 1-1 (November, 1986), Sta. R-2 (18), R-4 (3), R-5 (3), R-6 (1), PJ-1 (77); Cruise 1-2 (January, 1987), R-1 (1), R-2 (15), R-5 (3), PJ-1 (19); Cruise 1-3 (May, 1987), R-1 (2), R-2 (52), R-4 (6), R-5 (9), R-8 (5), PJ-1 (41); Cruise 2-3 (October, 1987), R-1 (3), R-2 (15), R-8 (4), PJ-1 (29); Cruise 2-4 (February, 1988), R-2 (28), R-4 (14), R-5 (10), R-8 (3), PJ-1 (36); Cruise 2-5 (May, 1988), R-1 (4), R-2 (25), R-4 (8), R-5 (9), R-8 (9), PJ-1 (12); Cruise 3-1 (October, 1988), R-1 (4), R-2 (10), R-5 (4), R-8 (1), PJ-1 (14); Cruise 3-4 (May, 1989), R-1 (9), R-2 (14), R-4 (10), R-5 (10), R-8 (11), PJ-1 (52).

Description. Adult size, female and male, 3 mm. Carapace pseudorostral lobes subtriangular distally, less than one-fifth length of carapace; dorsal crest serrate anterior two-thirds, with approximately 15 serrations; with single anteriorly-directed curved ridge extending from posterior of dorsal serrations ventrally to region behind pseudorostral cut; antennal notch deep, anteroventral corner blunt. Antennule accessory flagellum nearly half length of basal article of main flagellum; peduncle third article 1.25 times length of article 2. Maxilliped basis distal margin not strongly extended laterally and bearing only 3 long plumose setae; ischium with additional long plumose seta. Pereopod 1 article 5 longer than article 6; exopod articles as long as basis. Pereopod 2 article 3 present, about half as long as wide; merus and carpus subequal in length. Uropod exopod slightly longer than endopod, inner margin armed with few (4-6), long, sparsely setulose setae; endopod distal article three-fourths length of basal article, inner margin of both articles armed with short, stiff setae.

Remarks. This species is superficially similar to *L. armatus* Given, but differs from the latter in the strength of the dorsolateral curved ridge, which is noticeable as a very sharp line in *L. falcicosta*, but only as a low, raised feature in *L. armatus*. The shape of the pseudorostral lobes and the uropod armature also differ in the two species. The only other species of *Leucon* possessing a curved ridge on the carapace is *L. (L.) kobjakovae* Lomakina, 1955. It differs from *L. (L.) falcicosta* by having a more blunt pseudorostrum in the male, fewer setae along the inner margin of the uropod, and simple rather than plumose setae on pereopods 1 and 2.

Type Locality and Type Specimens. California, Santa Maria Basin, off Point San Luis, Sta. R-1, 35°05.83'N, 120°49.16'W, 91 m, holotype USNM 273579, paratype USNM 273580 and LACM 95-76.1.

Etymology. From Latin, *falcis* = sickle, and *costa* = ridge, signifying the sickle-shaped nature of the dorsolateral ridge on the carapace.

Distribution. Known from the Santa Maria Basin region, 90-161 m (with a single record from 410 m), and off Pt. Loma, San Diego, from one specimen taken at 116 m.

Leucon (Leucon) armatus Given, 1961

Figure 2.18

Material Examined. California: Santa Maria Basin, Phase II, Sta. PJ-1.

Description. Adult size, female, 5.5 mm. Carapace pseudorostral lobes subquadrate distally; dorsomedian crest serrate nearly throughout entire length; dorsolateral depression extends from dorsomedian crest anteroventrally to just behind origin of pseudorostral lobe; slight dorsolateral depression also present posteriorly. Pereopod 1 article 5 longer than 6. Pereopod 2 article 3 absent. Uropod endopod stout and broadened, as long as or longer than exopod with dense array of setae along inner margin.

Remarks. This species is the only member of the genus *Leucon* present in California waters to have subquadrate pseudorostral lobes. As yet, an adult male has not been described, so the exact affinities of the species remain slightly in doubt.

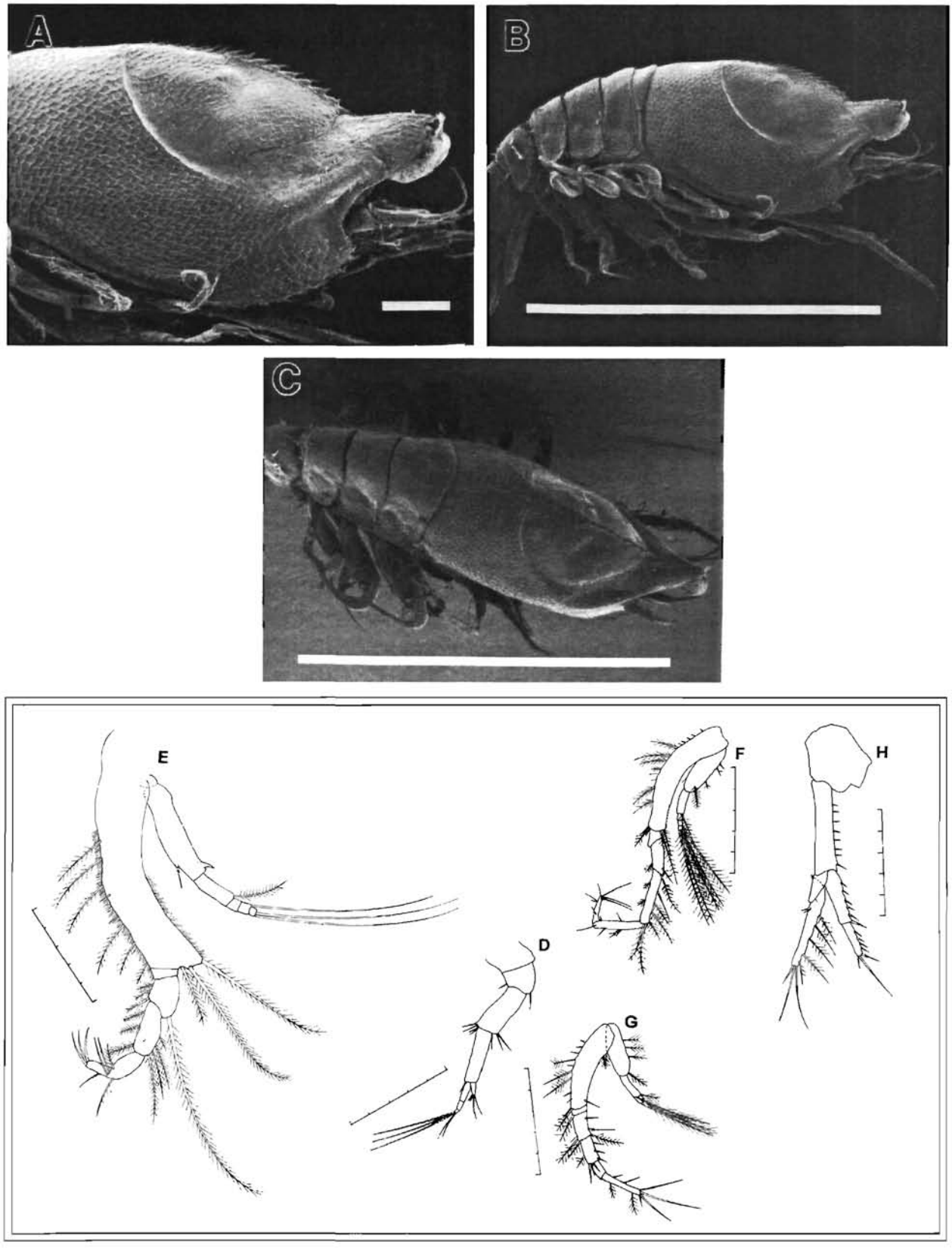

Figure 2.17. ***Leucon (Leucon) falcicosta*** **Watling and McCann, new species.** Male: A, carapace, lateral view; B, body, lateral view; C, carapace and pereonites, dorsal view. Female: D, antenna 1; E, maxilliped 3; F, pereopod 1; G, pereopod 2; H, uropod. Scale, A = 0.1 mm, B-C = 1 mm, D,E = 0.25 mm, F-H, 0.5 mm.

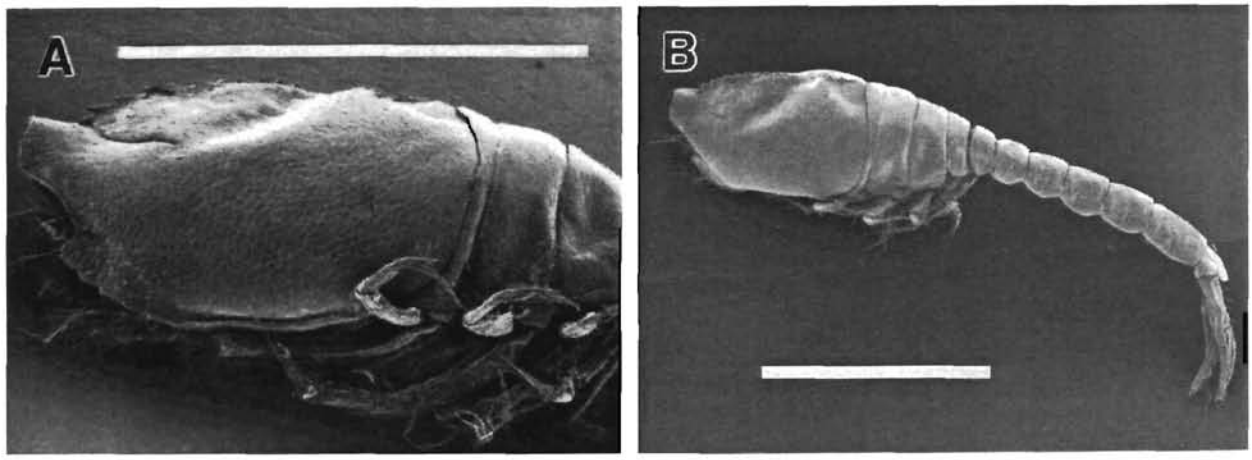

Figure 2.18. *Leucon (Leucon) armatus* Given, 1961. Female: A, carapace and pereonites 1-3, lateral view; B, body, lateral view. Scale = 1 mm.

Type Locality and Type Specimens. Velero IV sta. 4851-57, Mugu Canyon, 7.75 miles from Port Hueneme Light, 172 m; holotype AHF 5726, in Los Angeles County Museum.

Distribution. Southern California, in sandy silt, 145-187 m.

Leucon (Leucon) magnadentata Given, 1961

Figure 2.19

Material Examined. Santa Maria Basin, Phase II. Cruise 1-1 (November, 1986), Sta. R-3 (87), R-6 (4); Cruise 1-2 (January, 1987), R-3 (66), R-5 (1), R-6 (1), R-9 (12); Cruise 1-3 (May, 1989), R-3 (135), R-6 (3), R-9 (23); Cruise 2-3 (October, 1987), R-3 (144), R-6 (2), R-9 (26); Cruise 2-4 (February, 1988), R-3 (118), R-6 (3), R-9 (26); Cruise 2-5 (May, 1988), R-3 (41), R-6 (1), R-9 (44); Cruise 3-1 (October, 1988), R-3 (137), R-6 (2), R-9 (20); Cruise 3-4 (May, 1989), R-3 (195), R-6 (11), R-9 (41).

Description. Size of adult female 5.5 mm, male 6.0 mm. Carapace longer than pereonites; pseudorostral lobes acute distally, slightly upturned; dorsomedian crest with 7-10 large serrations; anteroventral margin below antennal notch with large teeth. Pereopod 1 basis with large serrations; article 5 longer than article 6. Pereopod 2 article 3 absent. Uropod endopod 2-articulate, basal article the longer; endopod shorter than exopod. In mature male, carapace pseudorostral lobes more truncate than in female, serrations on dorsal crest reduced; pereonites 4 and 5 with exaggerated pleurites; uropod exopod and endopod with additional medial setae.

Remarks. Until this study, this species was known only from four specimens, all of which were juveniles. The species is distinguished by the very large serrations, both dorsally and ventrally, on the carapace of the juveniles and immature females and males.

Type Locality and Type Specimens. R/V *Velero IV* Sta. 5762-58, 8.6 miles 310.5° true from Point Loma light (near San Diego, California), 575 ft (208 m). Holotype AHF 585 (now in Los Angeles County Natural History Museum).

Distribution. Southern California including San Diego and southern part of Oregonian Provinces, 200-410 m.

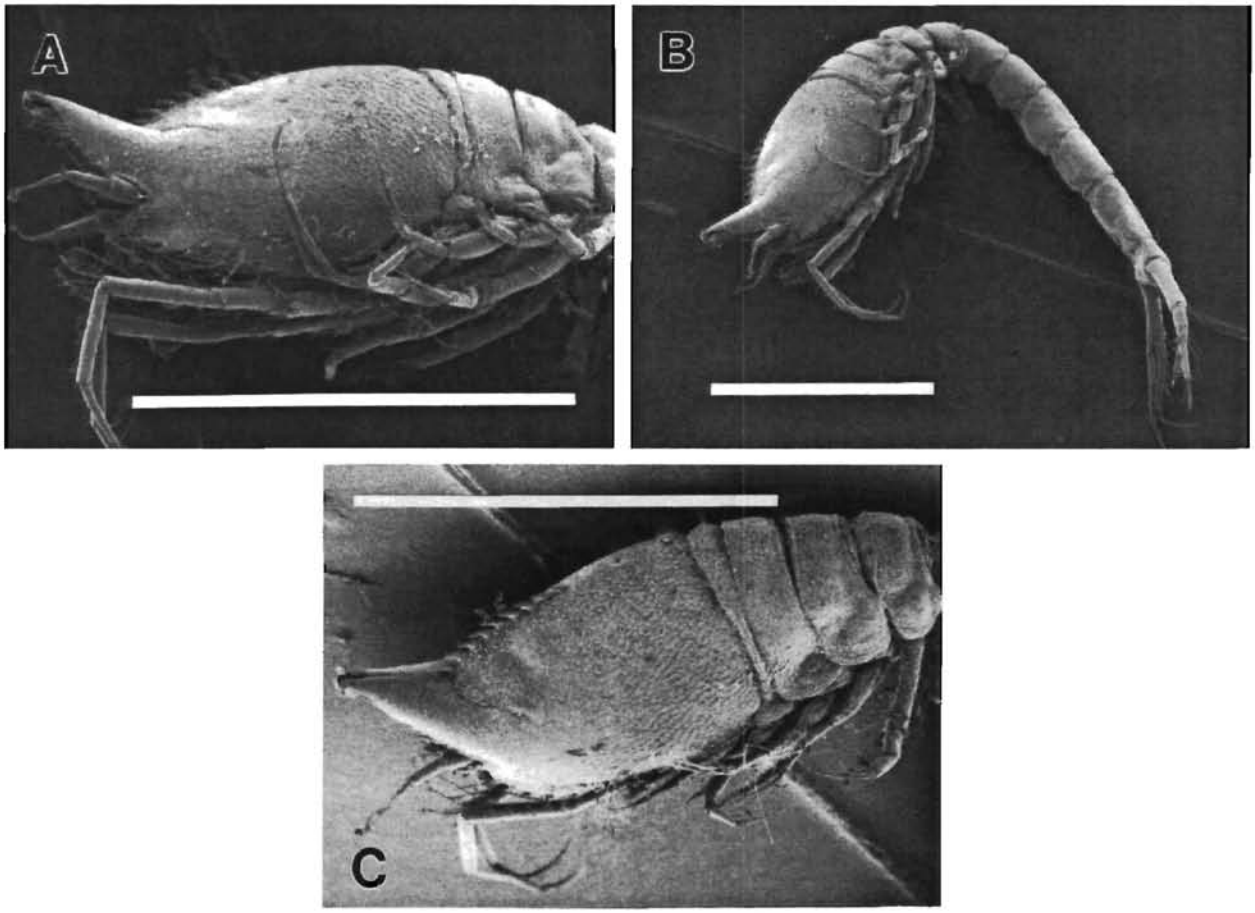

Figure 2.19. *Leucon (Leucon) magnadentata* Given, 1961. Female: A, carapace and anterior pereonites, lateral view; B, body, lateral view; C, carapace and anterior pereonites, dorsolateral view. Scale = 1 mm.

Genus *Eudorella* Norman, 1867

Type Species. *Eudora truncatula* Bate, 1856.

Diagnosis (from Watling, 1991a). Pseudorostrum directed dorsally in both male and female; antenna 1 geniculate between peduncle articles 2 and 3; male antenna 2 with brush of setae on anterior margin of peduncle articles 4 and 5; male antenna 2 flagellum extending nearly to end of pleon; female with exopods on pereopods 1-3; male with exopods on pereopods 1-4; pereopod 2 article 3 lost; uropod endopod 2-articulate; male with 2 pairs of pleopods.

Remarks. This is a cold-water genus represented by approximately 27 known species. The genus has a very conservative body plan, consequently, species are often differentiated on the basis of a narrow suite of features and correct identification of species may be difficult. If the specimen at hand does not fit the species described here, the key to the known species of the world (Watling, 1991a) should be consulted. Any species taken south of the immediate area encompassed by this Atlas are likely to be new to science.

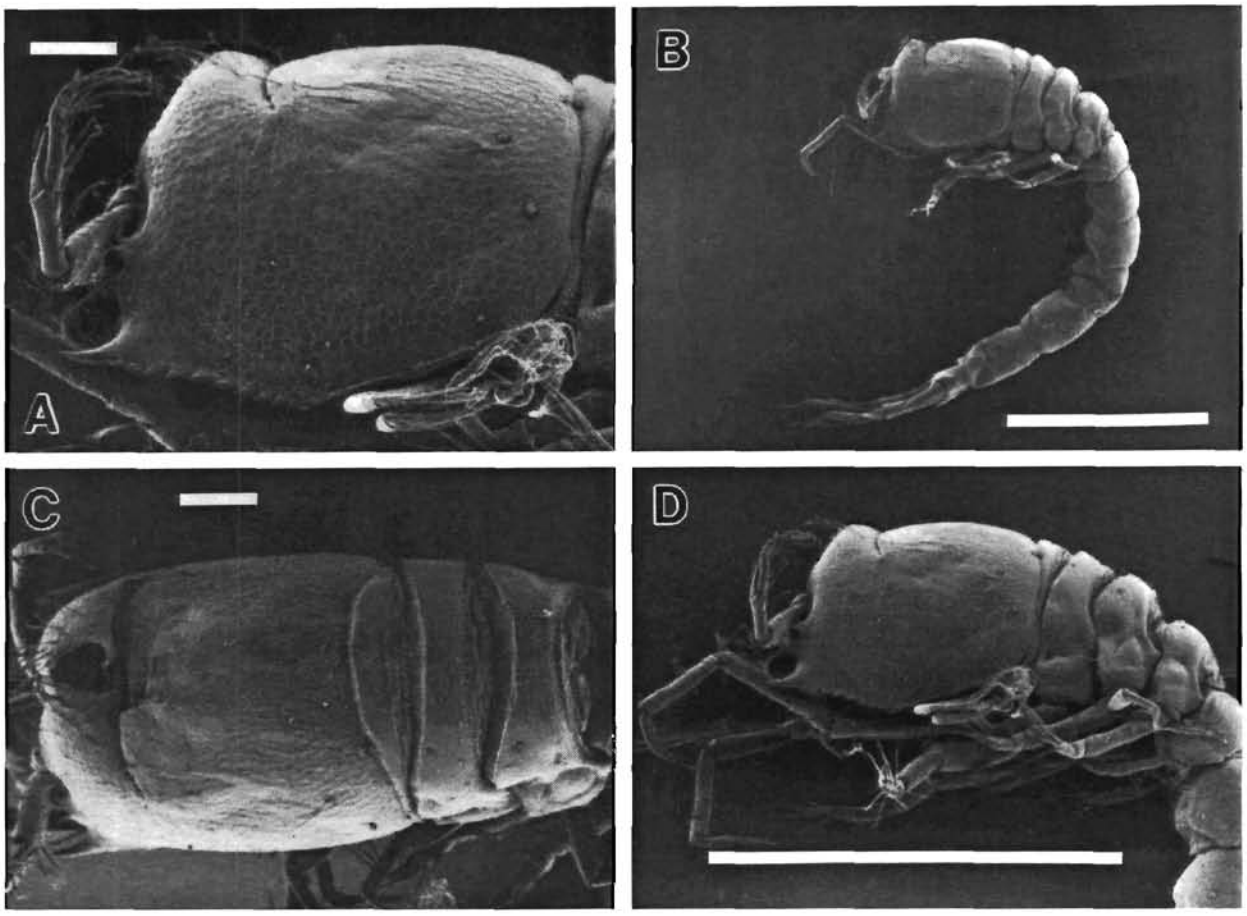

Figure 2.20. *Eudorella pacifica* Hart, 1930. Female: A, carapace, lateral view; B, body, lateral view; C, carapace and anterior pereonites, dorsal view; D, carapace and pereonites, lateral view. Scale A, C = 1 mm, B, D = 1 mm.

Eudorella pacifica Hart, 1930

Figure 2.20

Eudorella tridentata Hart, 1930.

Material Examined. Santa Maria Basin, Phase II. Cruise 1-1 (November, 1986), Sta. R-1 (14), R-2 (33), R-3 (24), R-4 (79), R-5 (53), R-6 (1), PJ-1 (45); Cruise 1-2 (January, 1987), R-1 (14), R-2 (35), R-3 (15), R-4 (46), R-5 (54), R-9 (12), PJ-1 (18); Cruise 1-3 (May, 1987), R-1 (21), R-2 (30), R-4 (84), R-5 (62), R-6 (2), PJ-1 (31); Cruise 2-3 (October, 1987), R-1 (28), R-2 (20), R-3 (33), R-4 (153), R-5 (117), R-8 (1), PJ-1 (36); Cruise 2-4 (February, 1988), R-1 (34), R-2 (28), R-3 (20), R-4 (168), R-5 (159), R-8 (1), PJ-1 (43); Cruise 2-5 (May, 1988), R-1 (30), R-2 (38), R-3 (10), R-4 (138), R-5 (120), R-8 (8), R-9 (61), PJ-1 (23); Cruise 3-1 (October, 1988), R-1 (51), R-2 (22), R-3 (67), R-4 (208), R-5 (36), R-8 (12), PJ-1 (30); Cruise 3-4 (May, 1989), R-1 (61), R-2 (32), R-3 (66), R-4 (156), R-5 (64), R-6 (2), R-8 (21), PJ-1 (35).

Description. Female 4.5 mm, male 6 mm. Antennule peduncle articles 2 and 3 subequal in length; main flagellum basal article with setae along inner margin; accessory flagellum as long as main flagellum basal article. Pereopod 1 article 5 shorter than article 6. Pereopod 2 article 5 about 1.5 times length of article 4. Uropod exopod much shorter than endopod, only as long as endopod basal article.

Remarks. This species shows considerable variation, especially with respect to the teeth in the vicinity of the anteroventral corner and associated notch (Barnard and Given, 1960). Additionally, variation in the length of appendage articles and degree of setation has also been seen, both of which undoubtedly led Hart to create the new species *E. tridentata*. In the Santa Maria Basin area *E. pacifica* is very common and exhibits varying degrees of calcification as well as size of adults.

Type Locality and Type Specimens. Deep Cove, Vancouver Island, British Columbia; holotype in British Columbia Provincial Museum.

Distribution. Very common throughout San Diego and Oregonian Provinces, 20-410 m.

Eudorella redacticruris Watling and McCann, new species

Figure 2.21

Material examined. *Pac Baroness* wreck (34°21.43'N, 120°38.29'W, 410-436 m) and control (34°25.01'N, 120°41.51'W, 432 m) sites, off Point Conception, 135 specimens.

Description. Size of adult female and male, 3.5-4.0 mm. Carapace in both male and female longer than free pereonites; anteroventral angle marked with strong tooth; antennal notch broad and shallow, with only a single tooth marking dorsal boundary in female, no tooth in male. Pereonite 1 visible dorsally, submerged laterally; pereonites 4 and 5 with lateral pleural extension in male. Antennule peduncle articles 2 and 3 subequal in length; accessory flagellum two-thirds length of main flagellum basal article, outer margin of latter with two setae distally. Pereopod 1 articles 5 and 6 subequal in length. Pereopod 2 article 3 absent; article 4 one-half the length of article 5. Pereopod 5 absent in both sexes; male with strongly developed penial lobes. Uropod exopod nearly as long as endopod; terminal seta not fused to endopod distal article; endopod basal article armed with long setae proximally and short, microsetulate setae distally.

Remarks. This species is unique in the genus in having lost the fifth pereopod; however, since the animal otherwise is indistinguishable from *Eudorella*, the erection of a new genus for this aberrant form seems unwarranted. The presence of penial lobes is also quite rare in the Cumacea. Two other species with penial lobes are known, *Campylaspis rowei*, for which the new genus, *Campylaspenis*, was originally erected by Bacescu & Muradian (1974) and *Archaeocuma peruanum*, used to establish the new family Archaeocumatidae by Bacescu (1972). Ledoyer (1988) was not convinced that *Campylaspenis*, with the exception of the penial lobes, was sufficiently different from the remaining *Campylaspis* species to warrant the erection of a new genus; and Day (1988) noted that *Archaeocuma* possessed many of the characters of the Lampropidae. In general, single character differences, even though they seem significant, have not resulted in the erection of new genera, but this view may change as more of these aberrant forms are discovered.

Type Locality and Type Specimens. California, Santa Barbara Co., off Pt. Conception, 34°21.43'N, 120°38.29'W,430m, holotype USNM 273577, and paratypes USNM 273578 and LACM 95-75.1.

Etymology. From Latin, *redactus* = edited, abridged, and *cruris* = leg, referring to the highly reduced form of the fifth leg.

Distribution. Known only from the type locality.

Eudorella truncatula Bate, 1856

Figure 2.22

Material examined. Santa Maria Basin, Phase II. Cruise 1-1 (November, 1986), Sta. R-7 (7); Cruise 1-2 (January, 1987), R-7 (1); Cruise 1-3 (May, 1987), R-7 (2), R-9 (40); Cruise 2-3 (October, 1987), R-7 (1), R-9 (22); Cruise 2-4 (February, 1988), R-7 (3), R-9 (60); Cruise 3-1 (October, 1988), R-7 (4), R-9 (35); Cruise 3-4 (May, 1989), R-6 (2), R-7 (1), R-9 (58).

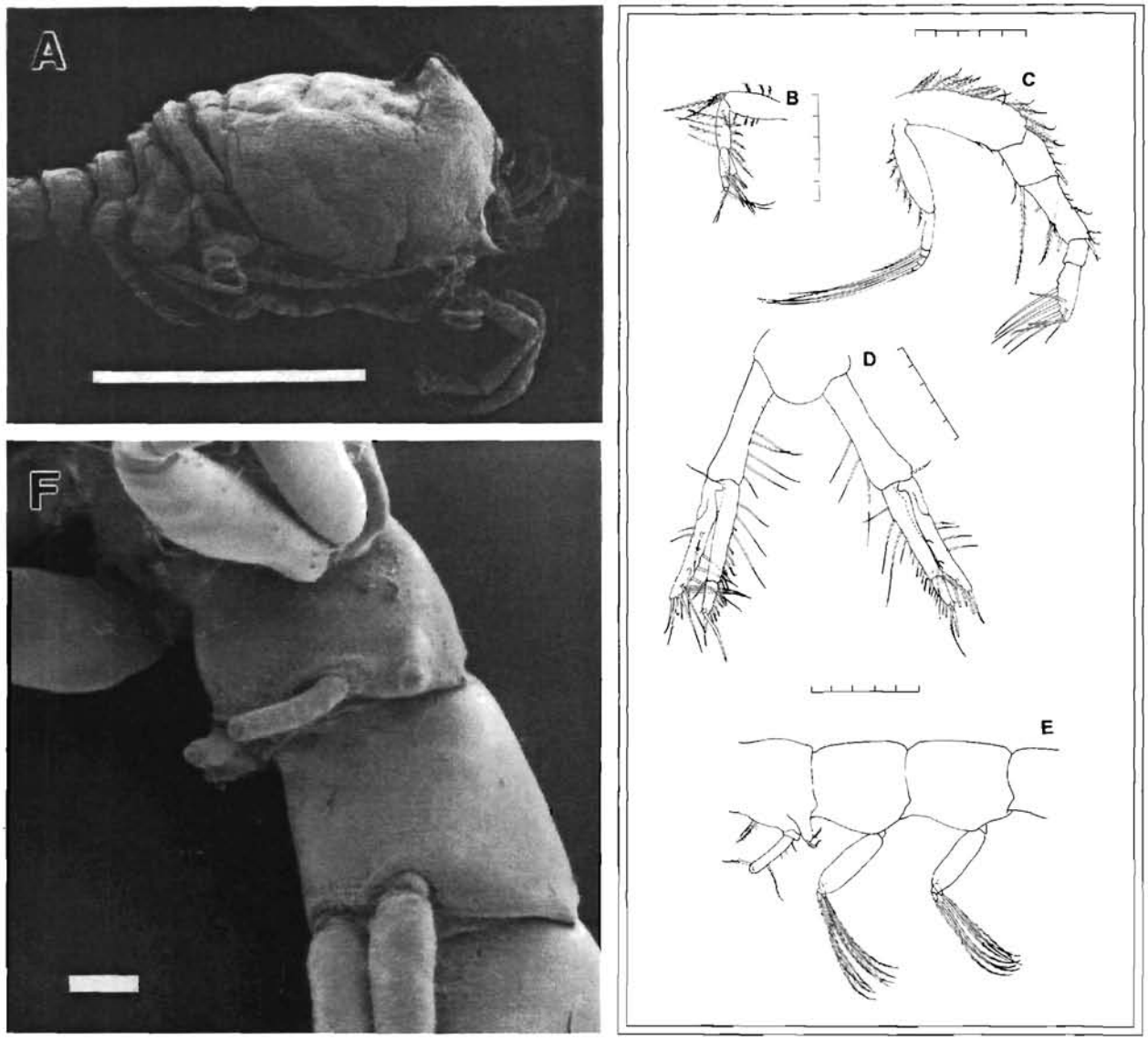

Figure 2.21. ***Eudorella redacticruris* Watling and McCann, new species.** Female: A, carapace and pereonites, lateral view; B, antenna 1; C, pereopod 2; D, uropods. Male: E, pereonite 5 with penial lobes and pleonites 1 and 2 with appendages; F, ventral view of penial lobes. Scale, A = 1 mm, B-E = 0.5 mm, F=0.1mm.

Description. Adult size, female and male, 5 mm. Antennule peduncle articles 2 and 3 subequal in length; main flagellum basal article with setae on outer margin; accessory flagellum three-fourths length of main flagellum basal article. Pereopod 1 article 5 shorter than article 6. Pereopod 2 articles 4 and 5 subequal in length. Uropod exopod longer than endopod basal article; endopod terminal seta fused to distal article.

Remarks. This is a widespread northern cold-water species which seems to exhibit a significant amount of variation. At least four species have been described from the eastern North Atlantic and Mediterranean which may be variants of *E. truncatula*. This species has hitherto not been recorded from the U.S. west coast; however, since it is known to occur in boreal waters, it is possible that it will be found at outer shelf depths from California to Alaska.

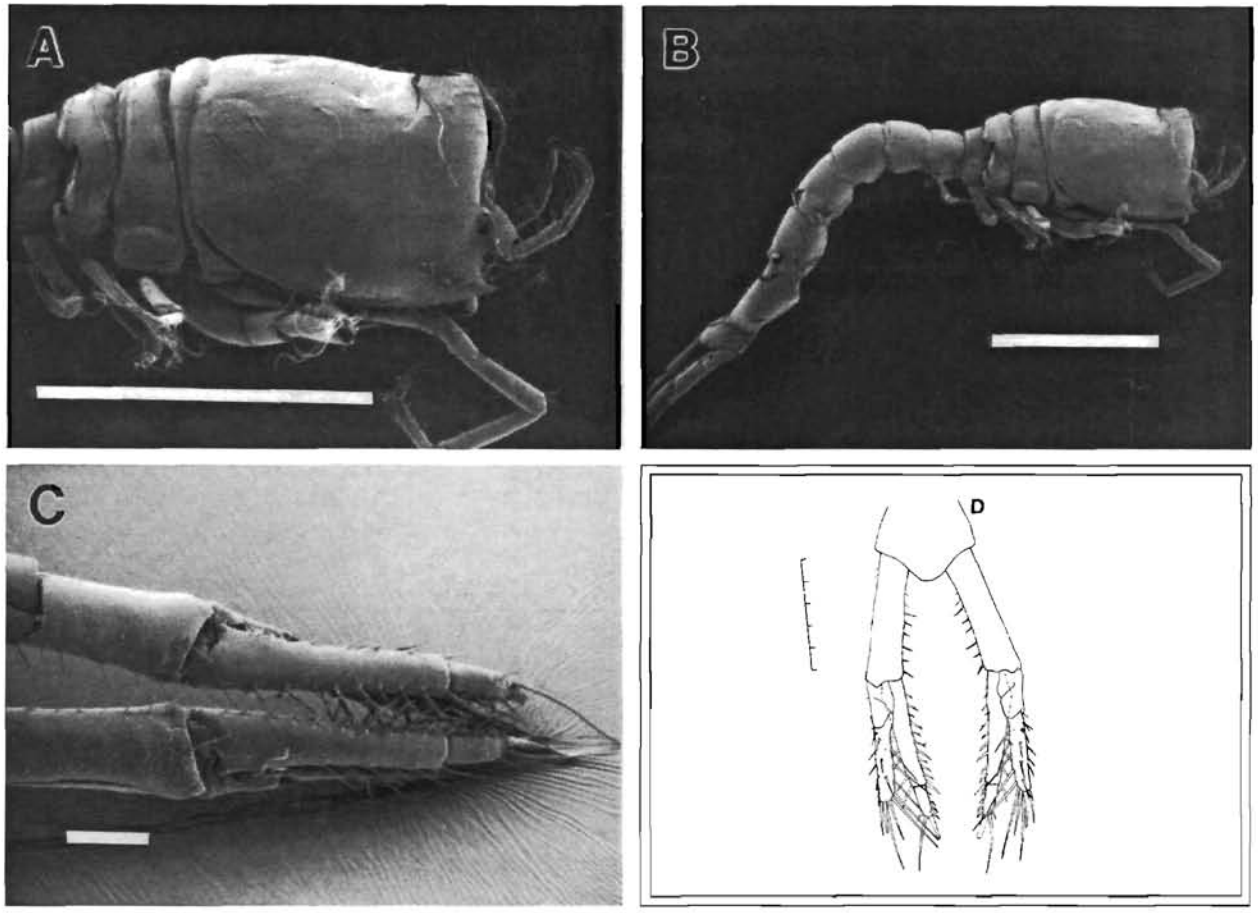

Figure 2.22. *Eudorella truncatula* Bate, 1856. Female: A, carapace and pereonites 1-4, lateral view; B, body, lateral view; C, D, uropods. Scale, A, B = 1 mm, scale C = 0.1 mm, D = 0.5 mm.

Type Locality and Type Specimen. British Isles; holotype in Natural History Museum, London.

Distribution. Boreal N.E. and N.W. Atlantic, Mediterranean, and boreal N.E. Pacific, shallow shelf to deep bathyal. Record from New Zealand is doubtful.

Genus *Eudorellopsis* Sars, 1883

Type Species. *Leucon deformis* Krøyer, 1846.

Diagnosis (from Watling, 1991a). Pseudorostrum directed dorsally in both male and female; antenna 1 geniculate between peduncle articles 1 and 2; male antenna 2 with brush of setae on anterior margin of peduncle articles 4 and 5; male antenna 2 flagellum extending well along pleon; female with exopods on pereopods 1-3; male with exopods on pereopods 1-4; pereopod 2 article 3 lost; uropod endopod peduncle 2-articulate; male with 2 pairs of pleopods.

Remarks. Species in this genus have been found, with one exception (New Zealand), in the North Atlantic and North Pacific.

Eudorellopsis longirostris Given, 1961

Figure 2.23

Material Examined. Santa Maria Basin, Phase II. Cruise 1-1 (November, 1986), Sta. R-4 (6); Cruise 1-2 (January, 1987), R-4 (2); Cruise 1-3 (May, 1989), R-4 (14); Cruise 2-3 (October, 1987), R-4 (4); Cruise 2-4 (February, 1988), R-4 (4), R-5 (1); Cruise 2-5 (May, 1988), R-4 (12), R-5 (3); Cruise 3-1 (October, 1988), R-4 (5), R-5 (2); Cruise 3-4 (May, 1989), R-4 (17), R-5 (2).

Description. Size of adult female, 4 mm. Carapace with 2 oblique, curving, lateral ridges, uppermost terminating anteriorly in small horn; pseudorostral lobes with covering of fine setae; anteroventral margin finely serrate. Uropod endopod nearly as long as exopod; endopod basal article strongly armed with medial setae; distal article about one-third length of proximal article, terminal seta slender, not approaching fusion with distal article.

Remarks. The only other species with anterolateral horns, *E. ushakovi* Lomakina, also has one or more dorsomedial horns on the carapace, and the anteroventral margin of the carapace is coarsely serrate.

Type Locality and Type Specimens. R/V *Velero IV* Sta. 5828-58, 10 miles 231.5° true from Ventura Pier light, depth 186 m; holotype AHF 584 (now in Los Angeles County Natural History Museum).

Distribution. Southern California, in sandy sediments, 43-183 m.

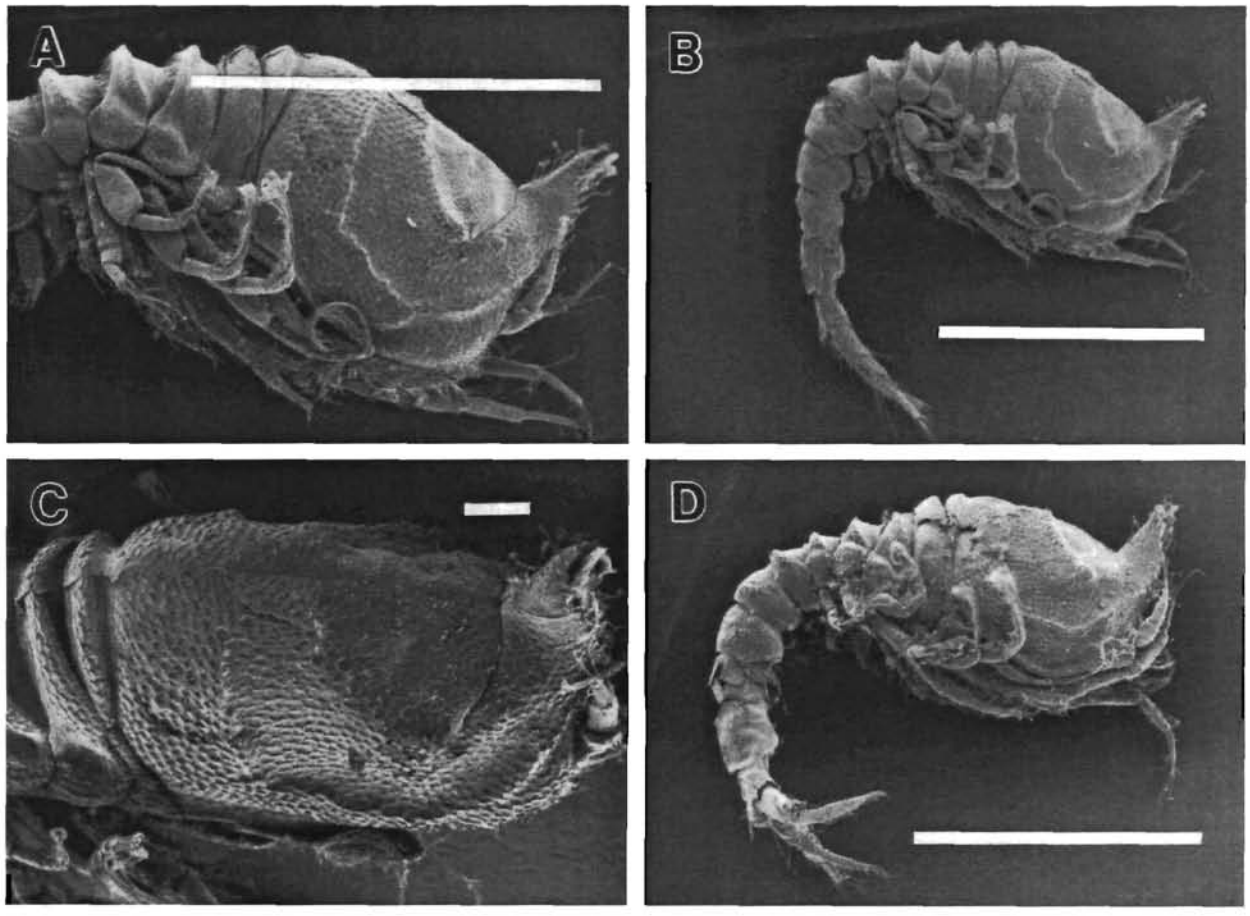

Figure 2.23. *Eudorellopsis longirostris* Given, 1961. Subadult male: A, carapace and pereonites, lateral view; B, body, lateral view; C, carapace, dorsal view. Subadult female: D, body, lateral view. Scale A, B, D = 1 mm, C = 0.1 mm.

Family Nannastacidae

Diagnosis (emended from Jones, 1963). Mandibles naviculoid with columnar molar or truncate with styliform molar. Maxilla 1 palp with 1 or 2 setae. Exopods present on maxilliped 3 and pereopods 1-4, occasionally absent from pereopods 3 and/or 4, in male, and in female on maxilliped 3 and pereopods 1 and 2, occasionally absent from maxilliped 3 while occurring on pereopods 1 and 2, or absent from all appendages. Pleopods absent in male. Telson absent. Uropod endopod uniarticulate.

Remarks. The Nannastacidae are often difficult to distinguish from specific members of the Bodotriidae, especially those where the male is unknown, or where, as in some members of the Mancocuminae, the male lacks pleopods. In the Santa Maria Basin region, the family is represented only by the genera *Campylaspis, Procampylaspis*, and *Cumella*, all of which have a characteristic carapace shape, and so are easily recognizable.

Key to the Nannastacidae of the Santa Maria Basin

1A. Carapace basically smooth, may be covered with fine sediment, lateral sulcus may be present 2

1B. Carapace with tubercles, ridges, spines covering large areas of the carapace or otherwise conspicuous 6

2A. Carapace covered with fine detritus, 3 or 4 spines occasionally visible, maxilliped 2 dactyl with recurved teeth ..... *Procampylaspis caenosa*

2B. Carapace features visible, not covered excessively with detritus 3

3A. Pereonites 4 and 5, pleonites 1-3 with dorsolateral spikes ..... *Campylaspis blakei*

3B. Pereonites and pleonites without dorsolateral spikes 4

4A. Carapace without lateral sulcus ..... *Campylaspis rufa*

4B. Carapace with lateral sulcus 5

5A. Carapace lateral sulcus narrow; uropod exopod without setae on outside margin ..... *Campylaspis canaliculata*

5B. Carapace lateral sulcus wide; uropod exopod with setae on outside margin *Campylaspis biplicata*

6A. Carapace with conspicuous middorsal ridge or spines 7

6B. Carapace ornamentation primarily dorsolateral 8

7A. Carapace with middorsal row of large curved spines ..... *Cumella californica*

7B. Carapace with middorsal ridge ..... *Cumella morion*

8A. Carapace with lateral ridges, without tubercles ..... *Campylaspis hartae*

8B. Carapace with tubercles or tuberculate ridges 9

9A. Uropod peduncle and endopod with many evenly-spaced medial setae ..... *Campylaspis rubromaculata*

9B. Uropod peduncle devoid of medial setae, endopod with 1-3 medial setae ..... *Campylaspis maculinodulosa*

Genus *Campylaspis* Sars, 1865

Type Species. *Cuma rubicunda* Lilljeborg, 1855

Diagnosis (after Jones, 1974). Carapace strongly elevated posteriorly in females, often covering anterior pereonites; anteroventral corner little or not produced; ocular lobe single, middorsal, often rudimentary. Mandible molar styliform. Maxilla reduced to simple plate without movable endites. Antenna 1 peduncle article 2 without process, subequal to or longer than article 3. First maxilliped reduced, with only three articles, terminal article very small. Second maxilliped with propodus articulated at near right-angle to carpus and ending in broad seta, dactyl short and ending in 2 or more distal diverging spines. Female maxilliped 3, pereopods 1 and 2 with exopods; male maxilliped 3 and pereopods 1-4 with exopods. Pereopod 1 with ischium not specially elongated. Uropod peduncle usually as long as or longer than pleonite 6; exopod basal article short, not submerged in peduncle; exopod longer than its terminal seta.

Remarks. The genus *Campylaspis* belongs to a group of genera (including *Procampylaspis*, *Camylaspides*, *Paracampylaspis*) within the Nannastacidae characterized by the carapace being elevated posterodorsally. In this group the primary generic characters are associated with head or anterior thoracic appendages. For example, in *Procampylaspis*, the dactyl of maxilliped 2 is clawed, rake-like, in *Campylaspides*, it is in the form of a trident, and in *Paracampylaspis*, while the dactyl of maxilliped 2 is highly reduced, the carpus of maxilliped 3 is greatly expanded.

Campylaspis canaliculata Zimmer, 1936

Figure 2.24

Material Examined. Santa Maria Basin, Phase II. Cruise 1-2 (January, 1987), Sta. R-1 (2), R-3 (1), R-4 (1), R-6 (1), R-8 (2), R-9 (1); Cruise 1-3 (May, 1987), R-1 (1); Cruise 2-3 (October, 1987), R-1 (1), R-3 (1), R-4 (1), R-9 (2); Cruise 2-4 (February, 1988), R-1 (4), R-4 (5), R-8 (1), PJ-1 (2); Cruise 2-5 (May, 1988), R-1 (1), R-4 (1), R-5 (1); Cruise 3-1 (October, 1988), R-1 (4), R-4 (1), R-8 (2), R-9 (1); Cruise 3-4 (May, 1989), R-4 (5), R-9 (2).

Description. Female, 4 mm. Carapace smoothly rounded, elevated posteriorly, with small, lateral, upwardly curving sulcus extending from ventral margin of pseudorostral lobe to middle of carapace side; in dorsal view, carapace moderately pointed anteriorly; pseudorostral lobes of normal short length; eyelobe with 3 lenses. Pereonites 1 and 2 with mid-dorsal projections (lappets) which fit into posteromedian depression on carapace. Pereopod 2 article 7 as long as article 5, not distally tapering. Uropod peduncle about twice length of endopod, and slightly longer than last 2 pleonites, armed medially with 2-7 heavy setae; endopod with 2-7 heavy setae; exopod shorter and more slender than endopod, with single subterminal median seta. Male, 4 mm. Carapace more elongate and less arched than that of female; lenses of eyelobe enlarged; lateral sulcus not present. Pereonites 1 and 2 with middorsal projections; pereonite 1 mostly obscured by dorsal margin of carapace; remaining pereonites and pleonites with paired dorsolateral ridges. Uropod peduncles much longer than those of female, about as long as last 4 pleonites; medial margin of endopod and peduncle armed continuously with finely serrate setae; exopod as in female.

Remarks. Previously known from 2 specimens, both females. This is the only smooth carapace form in this region with a narrow lateral sulcus.

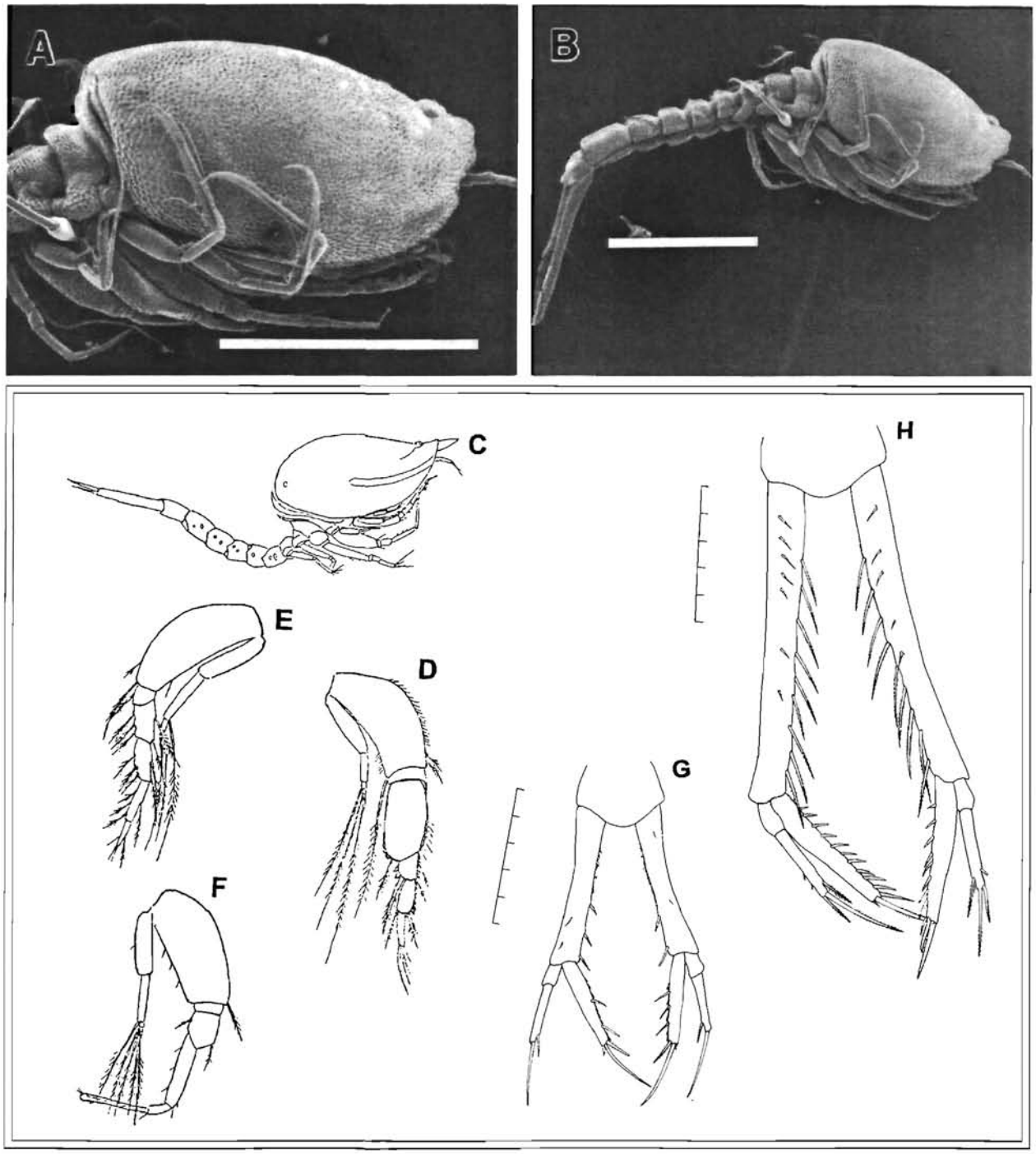

Figure 2.24. *Campylaspis canaliculata* Zimmer, 1936. Male: A, carapace and pereonites 1-2, lateral view; B, body, lateral view; H, uropods. Female: C, body, lateral view; D, maxilliped 3; E, pereopod 1; F, pereopod 2; G, uropods. Scale A, B = 1 mm, G, H = 0.5 mm (C-F from Zimmer, 1936; no scale provided).

Type Locality and Type Specimens. Between Corona Del Mar and Balboa, California, holotype USNM 7148.

Distribution. Southern California including San Diego and southern Oregonian Provinces, 14-410 m.

Campylaspis rufa Hart, 1930

Figure 2.25

Material Examined. Santa Maria Basin region, Phase II. Cruise 1-1 (November, 1986), Sta. R-3 (2); Cruise 1-2 (January, 1987), R-7 (4).

Description. Female, 3.5 mm. Carapace large, smooth, comprising more than half total length of body, extending dorsally over pereonites 1-3; antennal notch obsolescent; eyelobe broadened, without lenses. Pereopod 2 articles 5 and 7 subequal in length. Uropod peduncles twice length of endopod and approximately equal in length to last 2 pleonites combined; medial margin of peduncle armed with large scales giving coarsely serrate appearance; endopod with about 7 medial setae. Color dark reddish-brown to orange, with large dark red chromatophores scattered over body.

Remarks. The very small adult body size and smooth, reddish brown carapace serves to distinguish this species from all others in the Santa Maria Basin region. *Campylaspis rufa* has never been found in even moderate abundance; its occurrence here extends its range throughout the Oregonian Province.

Type Locality and Type Specimens. Mitlenatch, Vancouver Island, British Columbia, 200 m.; type in British Columbia Provincial Museum.

Distribution. Vancouver Island to Point Conception, 200 - 565 m.

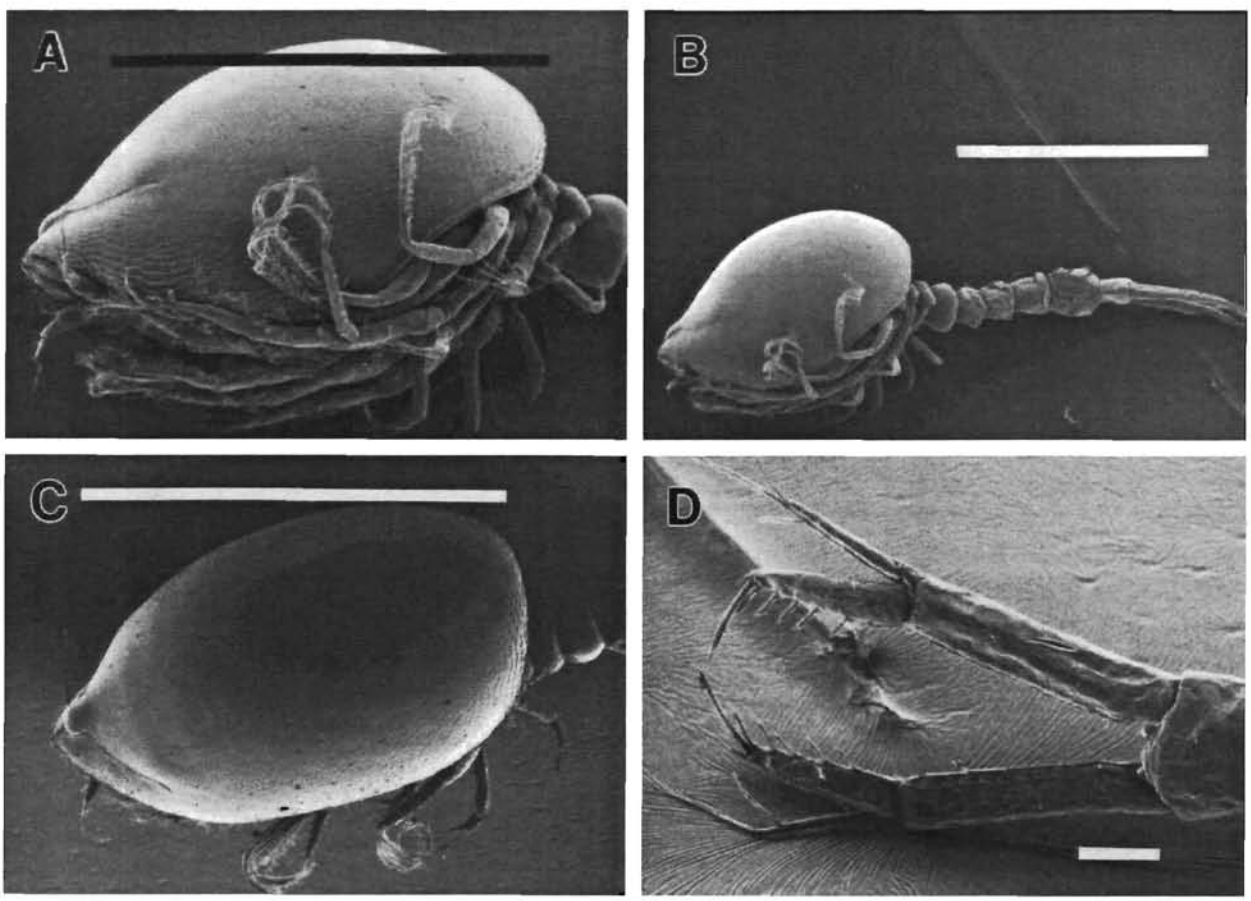

Figure 2.25. *Campylaspis rufa* Hart, 1930. Female: A, carapace and pereonites, lateral view; B, body, lateral view; C, carapace, dorsal view; D, uropods. Scale A-C = 1mm, D = 0.1 mm.

Campylaspis rubromaculata Lie, 1971

Figure 2.26

Campylaspis nodulosa Lie, 1969 (*non* Sars, 1887)

Material Examined. Santa Maria Basin, Phase II, Cruise 1-1 (November, 1986), Sta. R-4 (1), R-5 (14), R-7 (8), PJ-1 (15); Cruise 1-2 (January, 1987), R-1 (3), R-2 (1), R-4 (1), R-5 (4), PJ-1 (10); Cruise 1-3 (May, 1987), R-1 (3), R-8 (3), PJ-1 (9); Cruise 2-3 (October, 1987), R-5 (3), PJ-1 (6); Cruise 2-4 (January, 1988), R-1 (2), R-8 (2), PJ-1 (16); Cruise 2-5 (May, 1988), R-1 (1), PJ-1 (2); Cruise 3-1 (October, 1988), PJ-1 (1); Cruise 3-4 (May, 1989), R-1 (3), R-8 (1), PJ-1 (9).

Description. Female, 4 mm. Carapace elevated posteriorly, covered with low tubercles in middorsal region, laterally forming dorsal border to sulcus, with single ridge of low tubercles forming ventral border to sulcus and short row of 3 tubercles extending into sulcus dorsally; pseudorostral lobes without tubercles dorsally, slightly elongate; eyelobe enlarged, without noticeable lenses. Pereonites 1 and 2 with middorsal projections, pereonite 1 visible in lateral view; pereonites 3-5 with strong ridge along posterior border. Pereopod 2 article 7 nearly 1.5 times length article 5; articles 4 and 5 armed with plumose setae. Uropod peduncle as long as last 2 pleonites combined and more than twice length of endopod; latter terminally quadrate, armed with 3-5 setae medially and 1 short and 1 long setae terminally; exopod shorter than endopod, with single subterminal seta medially. Color in life, orange with red pigment chromatophores.

Remarks. This species was originally described by Lie (1969), but the proposed name, *Campylaspis nodulosa,* was occupied as Sars (1887) had described a species from the North Atlantic with that name. *Campylaspis rubromaculata* bears considerable resemblance to *C. sagamiensis* Gamô and *C. maculinodulosa* Watling and McCann, which is described below. See remarks under that species for characters which can be used for their separation.

Type Locality and Type Specimens. Puget Sound, Seattle, Washington, Holotype female, USNM 125081, 23 m.

Distribution. Southern California to Washington, 22-565 meters.

Campylaspis maculinodulosa Watling and McCann, new species

Figure 2.27

Material Examined. Santa Maria Basin, Phase II, Cruise 1-1 (November, 1986), Sta. R-1 (19), R-4 (5), PJ-1 (5); Cruise 1-2 (January, 1987), R-1 (3), R-4 (4), R-8 (2), PJ-1 (2); Cruise 1-3(May, 1987), R-1 (16), R-4 (1), R-5 (1), R-8 (3), PJ-1 (2); Cruise 2-3 (October, 1987), R-1 (12), R-4 (4), R-5 (2), R-8 (4), PJ-1 (2); Cruise 2-4 (January, 1988), R-1 (3), R-4 (3); Cruise 2-5 (May, 1988), R-1 (20), R-4 (6), R-8 (16); Cruise 3-1 (October, 1988), R-1 (12), R-4 (5), R-8 (2); Cruise 3-4 (May, 1989), R-1 (24), R-8 (11).

Description. Adult size, female and male, 2.0 mm. Carapace slightly elevated posteriorly, with covering of non-contiguous low tubercles dorsally; lateral sulcus bordered with lightly tuberculate ridge dorsally and row of widely spaced tubercles ventrally; pseudorostral lobes longer than normal for the genus, with row of 3 tubercles extending anteriorly from lateral carapace ridge; eyelobe distinct, without noticeable lenses. Pereonites 1 and 2 with middorsal projections; pereonites 3 and 4 with low dorsolateral tubercles. Pereopod 2 article 3 present; article 7 only slightly longer than article 5. Uropod peduncle as long as last 2 pleonites combined and nearly twice length of endopod; rami subequal in length; peduncle unarmed medially and endopod with 1 or 2 medial setae. Color in life translucent white with spots on tubercles. Male carapace lower and more elongate, only 2 lateral tubercles at posterior end of sulcus; uropod longer than in female, with about 10 evenly spaced setae on peduncle medial margin, endopod with 4-5 medial setae.

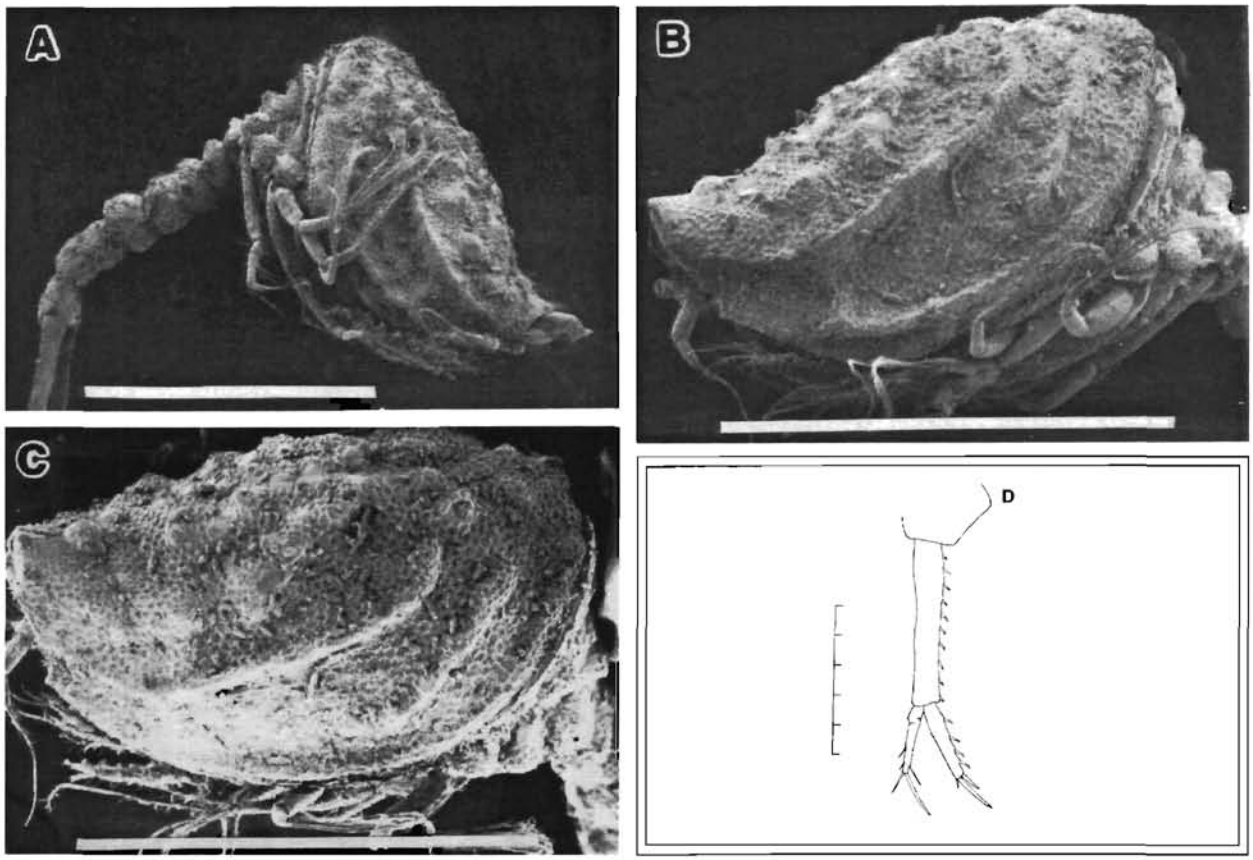

Figure 2.26. *Campylaspis rubromaculata* Lie, 1971. Subadult female: A, body, lateral view; B, carapace and anterior pereonites, lateral view; C, carapace, dorsal view; E, uropod. Scale, A-C, 1.0 mm, D = 0.5 mm.

Remarks. This species is very similar in general form to *C. rubromaculata*, but differs from the latter in the presence of tubercles rather than a short ridge at the posterior end of the carapace lateral sulcus, and in the lack of setae on the medial margin of the female uropod peduncle. *Campylaspis sagamiensis* Gamô exhibits a very similar arrangement of tubercles on the carapace, but differs from *C. maculinodulosa* in having the tubercles more widely separated such that a continuous ridge is not formed above the sulcus, and in its weakly setose male uropod peduncle.

Type Locality and Type Specimens. California, Santa Maria Basin, off Point San Luis, Sta.R-1 35°05.83'N, 120°49.16'W, 91 m, holotype USNM 273575, paratypes USNM 273567 and LACM 95-74.1.

Etymology. From Latin, *maculosus*, = spotted, and L., *nodulus*, = knob, referring to the chromatophores that are associated primarily with the tubercles on the carapace.

Distribution. Known only from the Santa Maria Basin region, 90-154 m.

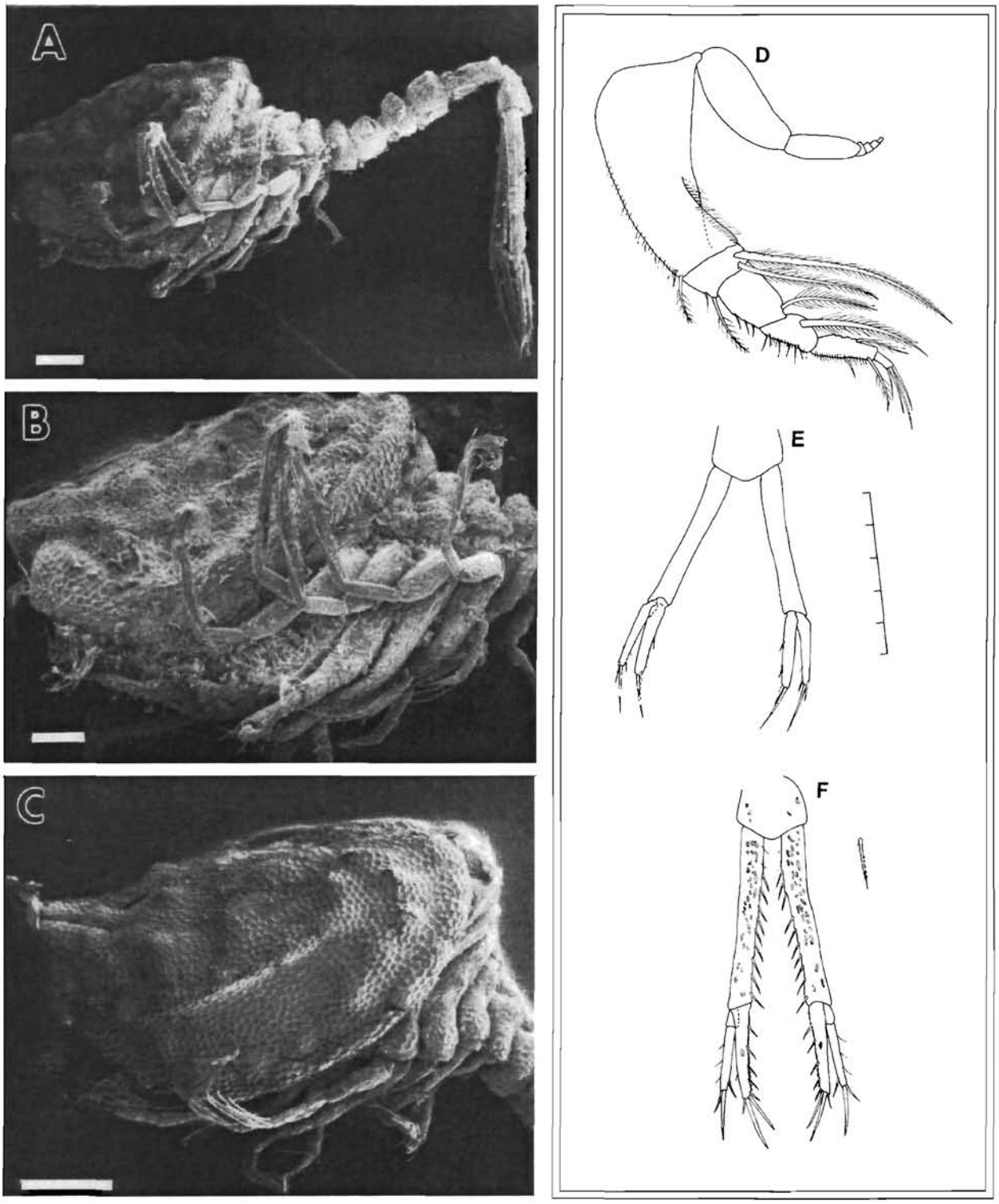

Figure 2.27. ***Campylaspis maculinodulosa*** **Watling and McCann, new species.** Male: A, body, lateral view; B, carapace and pereonites, lateral view; F, uropods. Female: C, carapace and pereonites, lateral view; D, maxilliped 3; E, uropods. Scale, A= 0.1 mm, B,C = 0.2 mm, E = 0.5 mm.

Campylaspis hartae Lie, 1969

Figure 2.28

Material Examined. Santa Maria Basin, Phase II, Cruise 1-2 (January, 1987), Sta. R-5 (3), PJ-1 (3); Cruise 1-3 (May, 1987), R-1 (7), R-5 (8); Cruise 2-3 (October, 1987), R-5 (17), R-8 (4); Cruise 2-4 (January, 1988), R-5 (5); Cruise 2-5 (May, 1988), R-5 (8); Cruise 3-1 (October, 1988), R-4 (4), R-5 (4), R-8 (1); Cruise 3-4 (May, 1988), R-4 (2), R-5 (3).

Description. Adult female, 3.5 mm. Carapace strongly elevated posteriorly, with several series of strong ridges bordering deep sulci, 3 of which transverse, with first crossing frontal lobe and joining lateral ventral ridges anteriorly, second passing obliquely posteriorly to middorsal region, and posteriormost running from ventrolateral ridge to middorsal ridge, 2 of which are horizontal and border lateral sulcus. Eyelobe enlarged but without distinct lenses. Pereonite 1 only with strong middorsal projection. Pereopod 2 article 3 distinct, article 7 short and wide but longer than article 5, armed with several lateral setae. Uropod peduncle nearly equal in length to last 2 pleonites and 2 to 2.5 times length of endopod; peduncle unarmed medially, but heavily scaled, endopod with 3 medial setae. Immature male very similar to female; uropod endopod with more medial setae, but peduncle remains without medial setae.

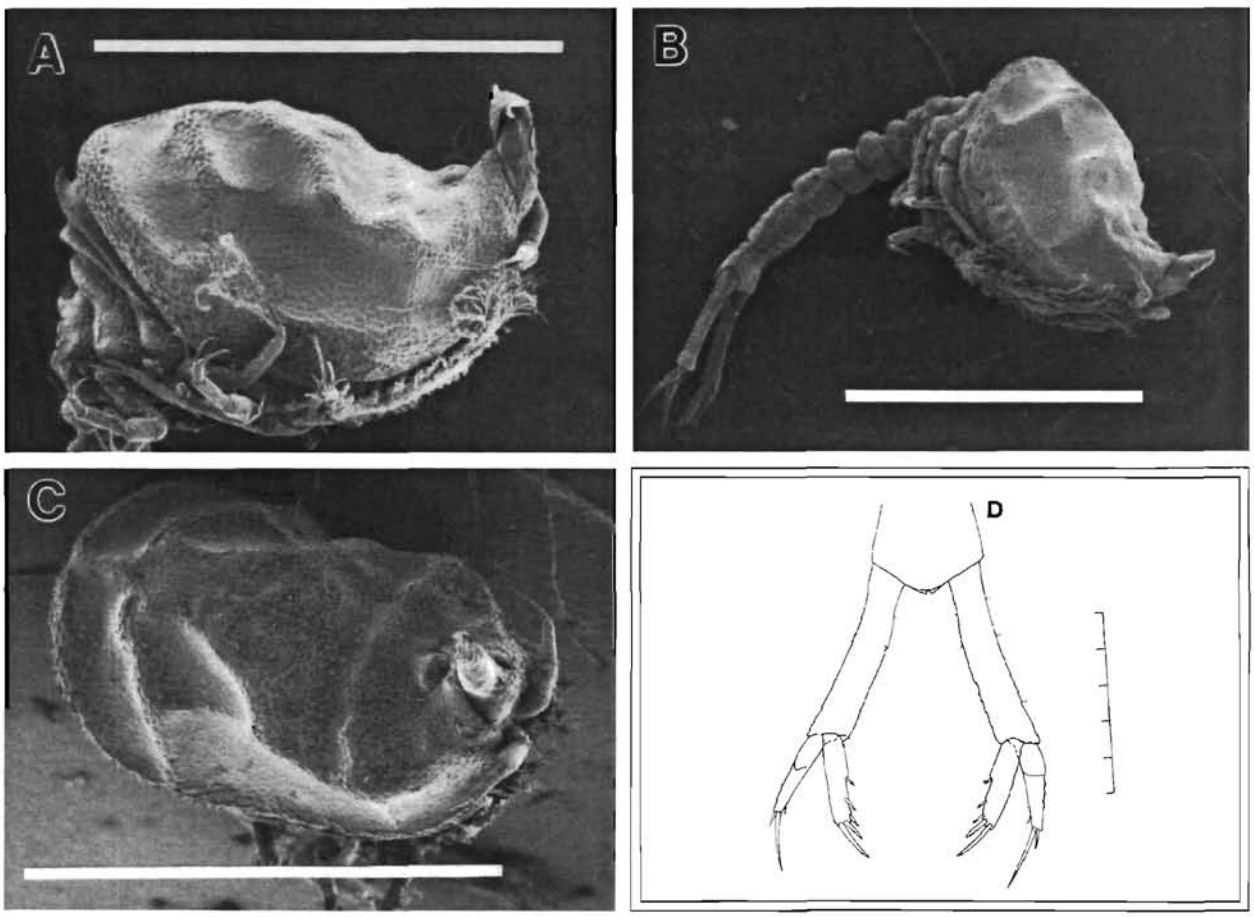

Figure 2.28. *Campylaspis hartae* Lie, 1969. Female: A, carapace and pereonites, lateral view; B, body, lateral view; C, carapace, dorsal view; D, uropods. Scale, A-C = 1 mm, D = 0.5 mm.

Remarks. This species can be distinguished from all others in this region by the very deep depressions between the ridges combined with the absence of tubercles on the carapace. Of the 69 specimens examined in this study only a single individual was a male. Lie did not record a male from the type locality. While mature males of campylaspids are always rare, they are usually encountered at some time during the year.

Type Locality and Type Specimens. Puget Sound, off Seattle, 22-23 m, sediment >80% sand, mean particle size 0.113-0.235 mm. Holotype, USNM 125077.

Distribution. Probably distributed throughout San Diego and the Oregonian Provinces, a species of the shallow shelf, known thus far from depths of 22-154 m.

Campylaspis blakei Watling and McCann, new species

Figure 2.29

Material Examined. Santa Maria Basin, Phase II, Cruise 1-1 (November, 1986), Sta. R-4 (1), R-5 (6); Cruise 1-2 (January, 1987), R-2 (1), PJ-1 (2); Cruise 1-3 (May, 1987), R-5 (5); Cruise 2-3 (October, 1987), R-2 (1), PJ-1 (3); Cruise 2-4 (January, 1988), PJ-1 (1); Cruise 2-5 (May, 1988), R-2 (1), R-5 (2), PJ-1 (1); Cruise 3-1 (October. 1988), R-4 (1), R-5 (1), PJ-1 (7); Cruise 3-4 (May, 1989), PJ-1 (2).

Description. Female, 3 mm. Carapace strongly elevated posterodistally, broadly rounded, with gently sloping lateral sulcus not bounded by ridges; with paired set of 3 small spines dorsolaterally near posterior margin; eyelobe small, distinct; pseudorostral lobes ordinary. Pereonites 1 and 2 with middorsal projections; pereonite 4 with dorsally projecting lateral spines; pereonite 5 with both dorsolateral and lateral dorsally projecting spines. Similar spines also on pleonites 1-4. Pereopod 2 article 3 distinct; article 7 as long as article 5. Uropod peduncle as long as last 3 pleonites combined and about 2.5 times length of endopod; peduncle slightly flared terminally. Endopod and distal half of peduncle armed with 4 to 6 and 4 setae respectively. Color in life, white to gray, translucent. Male unknown.

Remarks. This species is unique among members of this genus which have a smooth carapace in possessing blunt, dorsally projecting spines on the pereonites and pleonites.

Type Locality and Type Specimens. California, Santa Maria basin, off Purisima Point, Sta. R-5, 34°42.69'N, 120°50.83'W, 154 m, holotype USNM 273548, paratypes USNM 273549 and LACM 95-73.1.

Etymology. The species is named in honor of my friend and colleague, the lead scientist of the Santa Maria Basin macrobenthic sampling program, and senior editor of this Atlas project, in recognition of his many contributions to our knowledge of the benthic fauna of the Southern California continental shelf.

Distribution. Known from the Santa Maria Basin area and off Pt. Loma, San Diego, 92-161 m.

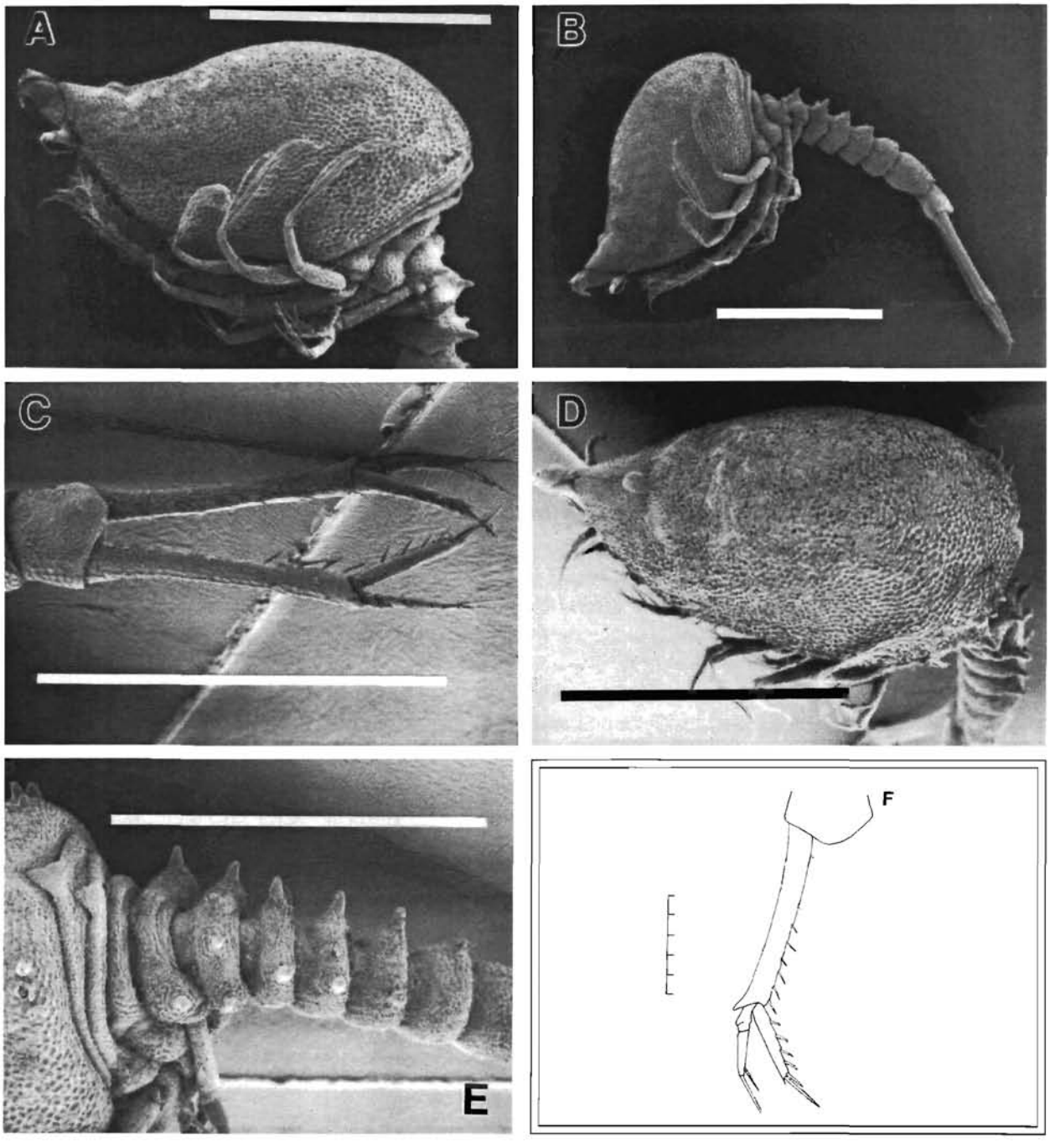

Figure 2.29. ***Campylaspis blakei* Watling and McCann, new species.** Female: A, carapace and pereonites, lateral view; B, body, lateral view; C, uropods; D, carapace, dorsal view ; E, pereonites 1-5 and pleonites 1-4, dorsal view; F, uropod. Scale, A-E = 1 mm, F = 0.5 mm.

Campylaspis biplicata Watling and McCann, new species

Figure 2.30a, b

Material Examined. Santa Maria Basin Region, Phase II, Cruise 1-1 (November, 1986), Sta. R-6 (17), PJ-1 (3); Cruise 1-2 (January, 1987), R-1 (1), R-3 (6), R-5 (11), R-6 (1); Cruise 1-3 (May, 1987), R-3 (9), R-5 (7), R-6 (9), R-9 (10), PJ-1 (2); Cruise 2-3 (October, 1987), R-2 (1), R-3 (18), R-5 (4), R-6 (11), R-9 (4), PJ-1 (3); Cruise 2-4 (January, 1988), R-3 (11), R-5 (20), R-6 (10), R-9 (5), PJ-1 (2); Cruise 2-5 (May, 1988), R-3 (1), R-5 (14), R-6 (12), R-9 (2), PJ-1 (1); Cruise 3-1 (October, 1988), R-1 (2), R-3 (15), R-5 (20), R-6 (14), R-9 (7), PJ-1 (3); Cruise 3-4 (May, 1989), R-3 (3), R-4 (1), R-5 (24), R-6 (11), R-9 (3), PJ-1 (8).

Description. Adult size, female and male, 2.0 mm. Carapace extended strongly posteriorly, appearing flattened dorsally; with lateral, nearly horizontal sulcus becoming wider from posterior to anterior, bounded above and below by soft ridges ornamented with pigment spots; eyelobe small, pseudorostral lobes slightly enlarged, branchial siphons about twice length of pseudorostrum. Pereonites 1 and 2 with middorsal projections; pleonite 4 pleurae extending back along peronite 5. Pereopod 2 article 3 distinct, article 7 longer than article 5, with terminal seta as long as article in length. Uropod peduncle as long as last 3 pleonites combined and twice length of endopod, with only a few weak setae; exopod basal article half length of distal article; endopod with 3-5 medial setae. Male uropod endopod somewhat more robust than in female.

Remarks. The presence of two, three, or four subparallel lateral ridges on the carapace occurs in several species, many of which have been found in the deep Atlantic (e.g., *C. arcuata* Jones, *C. plicata* Jones, *C. valleculata* Jones, *C. exarata* Jones, *C. bicarinata* Jones, *C. crispa* Lomakina, *C. johnstoni* Hale, *C. macrophthalma* Sars, *C. sinuosa* Gamô, *C. umbensis* Gurwitchi, *C. undata* Sars). The appendage morphology of *C. biplicata* is somewhat similar to that seen in *C. crispa* and *C. umbensis*, however, both of these species have three ridges that are more vertical (relative to the ventral margin). In the form of the ridges *C. plicata* resembles most closely the Atlantic species of Jones and Sars, but differs from them in the form of the appendages, especially the uropod.

Type Locality and Type Specimens. California, Santa Maria Basin, off Point Sal, Sta. R-9, 34°53.68'N, 120°59.12'W, 410 m, holotype USNM 273546, paratypes USNM 273547 and LACM 95-72.1.

Etymology. From Latin, *bis* = two, and L. *plicatus* = fold, referring to the two lateral ridges on the carapace.

Distribution. Known from Puget Sound to San Diego, including the Santa Maria Basin Region, 47-410 m, with most specimens found at 145-410 m.

Genus *Procampylaspis* Bonnier, 1896

Type Species. *Procampylaspis echinata* Bonnier, 1896.

Diagnosis. Carapace strongly elevated in female, occasionally covering part of first pereonite; anterolateral corner not produced in females, weakly produced in males; ocular lobe single, middorsal, often rudimentary. Mandible molar elongate, weakly triturative distally. Maxilla with movable endites. Antenna 1 peduncle article 2 without process, longer than article 3. First maxilliped 6-articulate, dactyl minute. Maxilliped 2 dactyl with recurved processes, claw-like. Female maxilliped 3, pereopods 1 and 2 with exopods; male maxilliped 3 and pereopods 1-4 with exopods. Pereopod 1 article 3 (ischium) subequal to or longer than article 4. Uropod peduncle usually as long as or longer than pleonite 6; exopod basal article short, not submerged in peduncle; exopod longer than its terminal seta.

Remarks. This genus is distinguished from other members of the family by the shape of the dactyl on maxilliped 2 and the elongate ischium on pereopod 1.

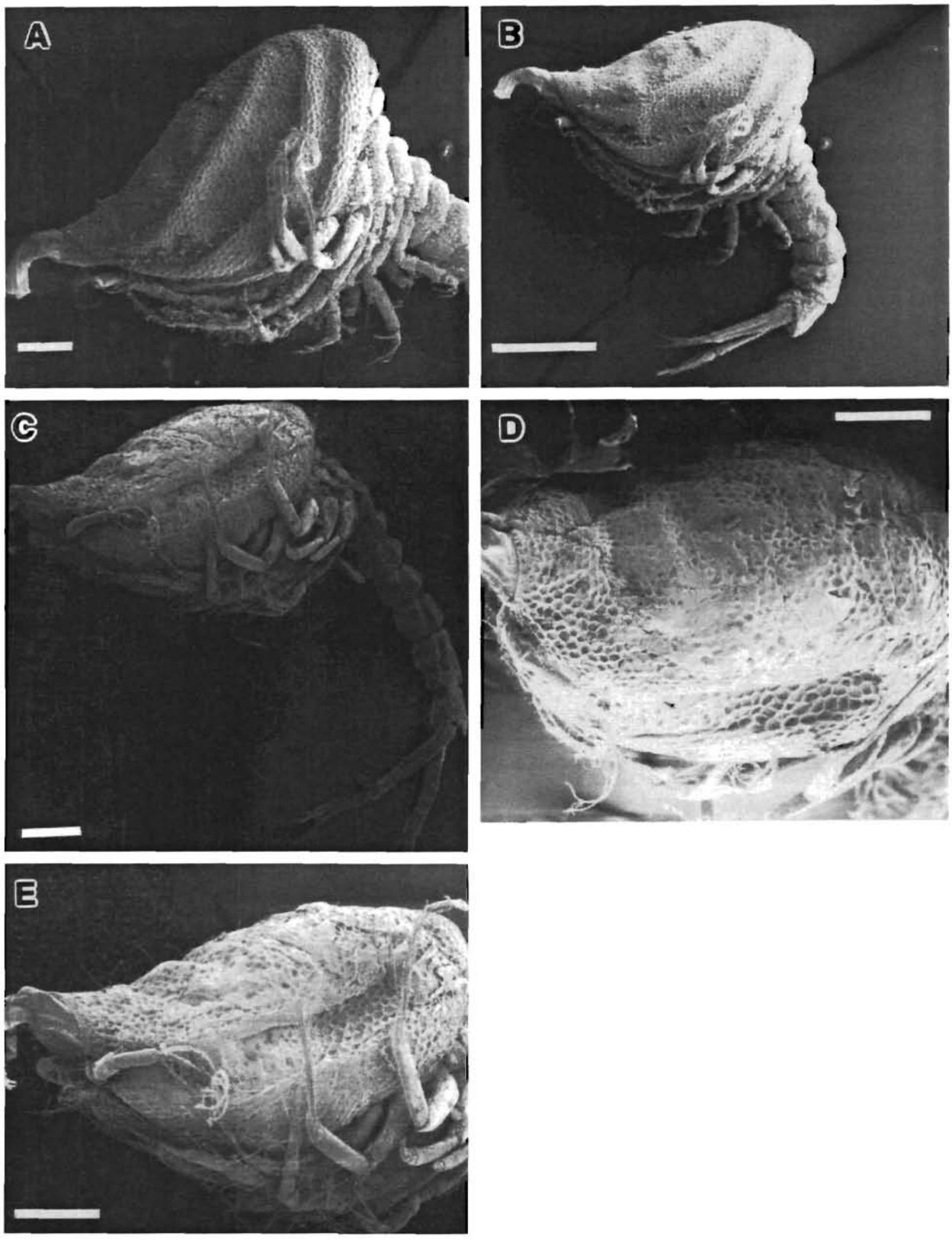

Figure 2.30a. ***Campylaspis biplicata*** **Watling and McCann, new species.** Female: A, carapace and pereonites, lateral view; B, body, lateral view. Male: C, body, lateral view; D, carapace, dorsal view; E, same, lateral view. Scale, A = 0.2 mm, C-E = 0.3 mm, B = 0.5 mm.

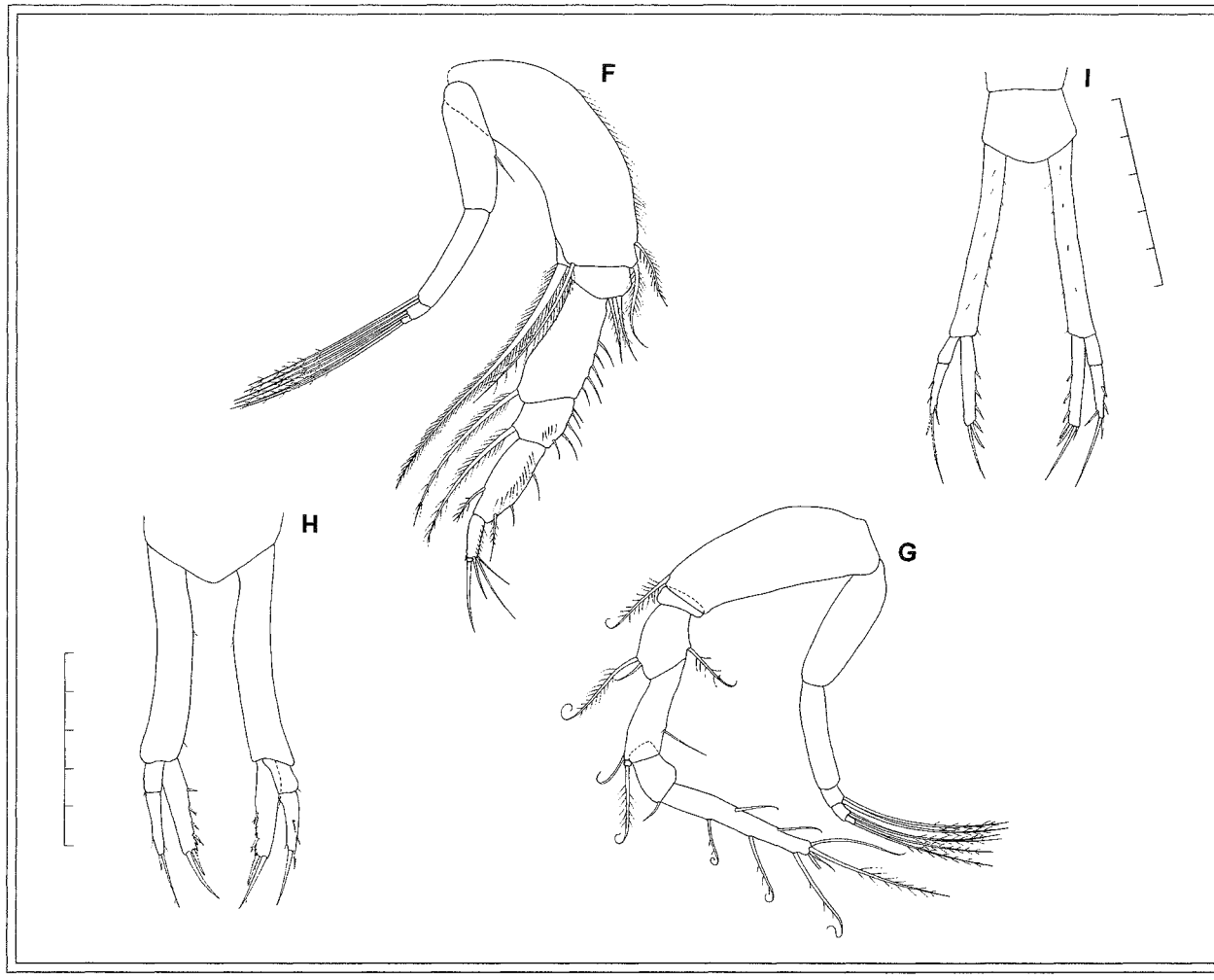

Figure 2.30b. ***Campylaspis biplicata*** **Watling and McCann, new species.** Female: F, maxilliped 3; G, pereopod 2; H, uropod. Male: I, uropod. Scale H, I = 0.5 mm.

Procampylaspis caenosa Watling and McCann, new species

Figure 2.31

Material Examined. Santa Maria Basin Region, Phase II, Cruise 1-1 (November, 1986), Sta. R-1 (3), R-2 (3), PJ-1 (8); Cruise 1-2 (January, 1987), R-1 (6), R-2 (4), R-4 (5), R-5 (7), PJ-1 (3); Cruise 1-3 May, 1987), R-1 (6), R-2 (3), R-4 (1), R-5 (8), PJ-1 (9); Cruise 2-3 (October, 1987), R-1 (6), R-2 (6), R-4 (11), R-8 (6), PJ-1 (6); Cruise 2-4 (January, 1988), R-1 (4), R-4 (15), R-5 (3), R-8 (2), PJ-1 (1); Cruise 2-5 (May, 1988), R-1 (5), R-4 (10), R-5 (3), R-8 (4); Cruise 3-1 (October, 1988), R-1 (6), R-4 (3), R-5 (1), R-8 (2), PJ-1 (6); Cruise 3-4 (May, 1989), R-1 (3), R-4 (10), R-8 (3), PJ-1 (4).

Description. Female, 3.0 mm. Carapace slightly elevated dorsally; covered with dense coating of sediment through which shallow lateral sulcus visible, bordered above and below by low ridges, upper of which may bear 3-5 large conical spines; pseudorostral lobes enlarged, directed somewhat upward; eyelobe not distinct. Pereonites 1 and 2 without middorsal projections. Pleonites 1-5 with paired dorsolateral spines. Maxilliped 2, articles 6 and 7 subequal in length; terminal article with 4 large recurved claw-like teeth, and 1

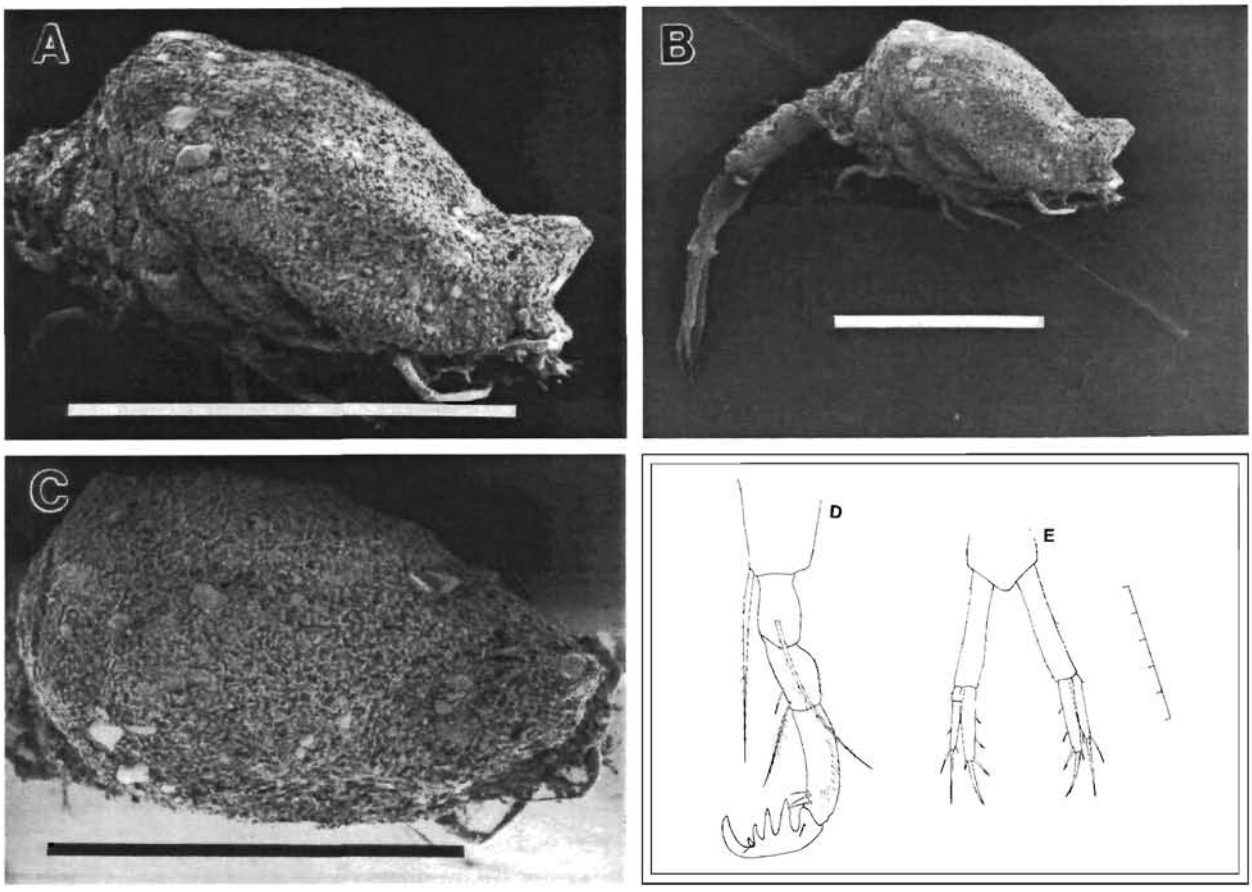

Figure 2.31. ***Procampylaspis caenosa*** **Watling and McCann, new species.** Female: A, Carapace and anterior pereonites, lateral view; B, body, lateral view; C, carapace, dorsal view; D, maxilliped 2; E, uropods. Scale, A-C = 1 mm, E = 0.5 mm.

smaller tooth nestled between penultimate and last claw. Uropod peduncle 1.5 times length of endopod; medial margin of peduncle unarmed, of endopod with 2 setae; exopod with very long terminal seta, extending to end of endopod terminal seta. Male, similar to female but carapace and uropod peduncles more elongate.

Remarks. The combination of conical carapace spines and broad lateral sulcus, along with the details of the maxilliped 2 dactyl, help to distinguish this sediment-covered species. Of the 26 known species of *Procampylaspis*, only 5 have been found at shallow shelf depths.

Type Locality and Type Specimens. California, Santa Maria Basin, off Purisima Point, Sta. R-4, 34°43.01'N, 120°47.39'W, 92 m, holotype USNM 273542, paratype USNM 273543 and LACM 95-71.2.

Distribution. Known from the Santa Maria Basin region and off Pt. Loma, San Diego, 47-161 m.

Etymology. From Latin, *caenosus*, = muddy, dirty, referring to the covering of sediment particles on the carapace surface.

Genus *Cumella* Sars, 1865

Type Species. *Cumella pygmaea* Sars, 1865

Diagnosis (from Watling, 1991b). Carapace anteroventral corner acute to slightly rounded, not strongly projecting; ocular lobe single, middorsal; siphons united medially, occasionally slightly separated; pseudorostral lobes of varying length, usually slightly to strongly upturned, meeting in front of eyelobe. Mandible molar columnar. Maxilla with movable endites. Antenna 1 peduncle article 2 with or without process, subequal to or longer than article 3. Maxilliped 1 of normal length. Female maxilliped 3, pereopods 1 and 2 with exopods; male maxilliped 3 and pereopods 1-4 with exopods. Uropod peduncle usually as long as or longer than pleonite 6; exopod basal article short, not submerged in peduncle; exopod much longer than its terminal seta.

Remarks. Following the lead of Bacescu (1971) who erected the first subgenus in this very large genus, Watling (1991b) added three additional subgenera in an attempt to define some pattern among the species. For diagnoses of the subgenera, see Watling (1991b).

Cumella (Cumella) morion Watling and McCann, new species

Figure 2.32

Material Examined. Santa Maria Basin Region, Phase II, Cruise 1-1 (November, 1986), Sta. R-4 (17); Cruise 1-2 (January, 1987), R-1 (8), R-4 (5), R-8 (11); Cruise 1-3 (May, 1987), R-1 (13), R-4 (39), R-8 (4); Cruise 2-3 (October, 1987), R-1 (1), R-4 (24), R-8 (14); Cruise 2-4 (January, 1988), R-1 (4), R-4 (21), R-5 (1), R-8 (8), PJ-1 (1); Cruise 2-5 (May, 1988), R-1 (2), R-4 (107), R-8 (5); Cruise 3-1 (October, 1988), R-1 (4), R-4 (31), R-8 (16); Cruise 3-4 (May, 1989), R-1 (1), R-4 (110), R-8 (4).

Description. Female, 1.5 mm. Carapace with flared ridge along posterodorsal margin, dorsally joining large middorsal crest which originates on frontal lobe; eyelobe without obvious lenses; pseudorostral lobe with short, curved horizontal ridge extending onto carapace frontal lobe. Pereonites 1 and 2 with thickened posterior margin; pereonite 3 with slight middorsal process. Body compressed laterally. Pleonites 1 -4 with dorsally-directed middorsal processes. Uropod peduncle and endopod subequal in length, about as long as last 2 pleonites combined; endopod with 2 medial setae and 2 terminal setae.

Remarks. This species is quite similar in carapace shape and appendage morphology to *C. (C.) rigida* Gamô and *C. (C.) sadoensis* Gamô, but differs from both in not possessing a dorsolateral vertical ridge midway along the carapace and in bearing vertical processes on pleonites 1 - 3.

Type Locality and Type Specimens. California, Santa Maria Basin, off Purisima Point, Sta. R-4, 34°43.01'N, 120°47.39'W, 92 m, holotype USNM 273544, paratype USNM 273545 and LACM 95-71.1.

Etymology. A morion is a visor-less helmet with a high crest worn by some 16th century soldiers, for example, the Spanish conquistadors who frequented the Californian shores, and to which the carapace of this species bears some resemblance.

Distribution. Known only from the Santa Maria Basin region, most abundant at the 90 m stations, but occasionally found to 154 m.

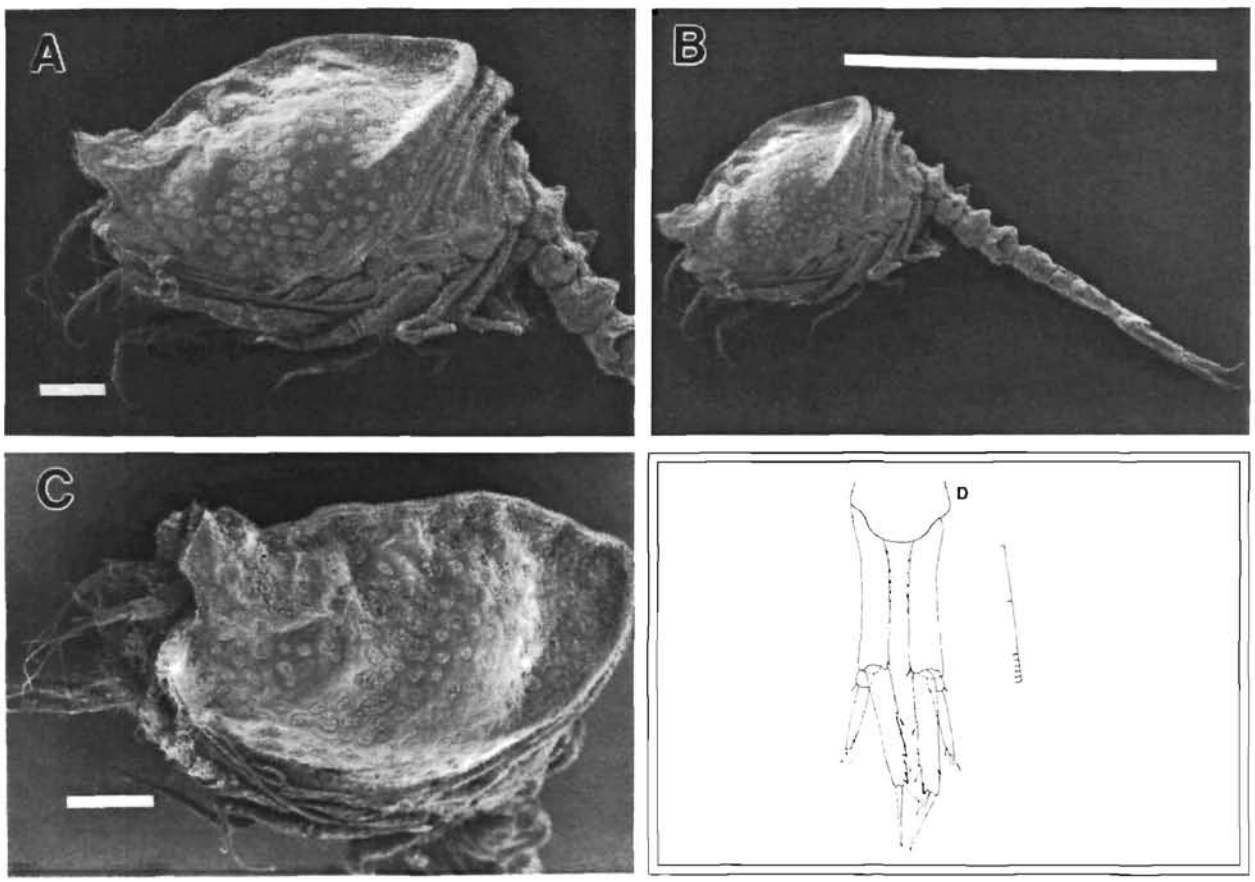

Figure 2.32. ***Cumella (Cumella) morion*** **Watling and McCann, new species.** Female: A, carapace, pereonites, and anterior pleonites, lateral view; B, body, lateral view; C, carapace, anterodorsal view; D, uropods. Scale, A,C, D = 0.2 mm, B = 1 mm.

Cumella (Cumella) californica Watling and McCann, new species

Figure 2.33

Material Examined. Santa Maria Basin Region, Phase II, Cruise 1-1 (November, 1986), Sta. R-4 (2), PJ-1 (1); Cruise 1-2 (January, 1987), R-4 (4), R-5 (1), R-8 (2), PJ-1 (1); Cruise 1-3 (May, 1989), R-4 (1), R-5 (5), R-8 (1), PJ-1 (6); Cruise 2-3 (October, 1987), R-4 (24), R-5 (3), R-8 (4), PJ-1 (1); Cruise 2-4 (January, 1988), R-4 (7), R-5 (1), R-8 (6), PJ-1 (4); Cruise 2-5 (May, 1988), R-4 (2), R-5 (1), R-8 (13), PJ-1 (2); Cruise 3-1 (October, 1988), R-4 (9), R-5 (2), R-8 (20), PJ-1 (3); Cruise 3-4 (May, 1989), R-4 (23), R-8 (3), PJ-1 (15).

Description. Female, 2 mm. Carapace with swollen ridge parallel to posterior margin, giving appearance of elevated submarginal region dorsally; 4-5 spines in middorsal row beginning on frontal lobe; eyelobe small; pseudorostral lobes directed forward, subacute. Pereonites with flared lateral margins, becoming nearly horizontal. Uropod peduncle as long as last pleonite; endopod as long as peduncle, with elongate, partially fused terminal seta; exopod distal article as long as terminal seta.

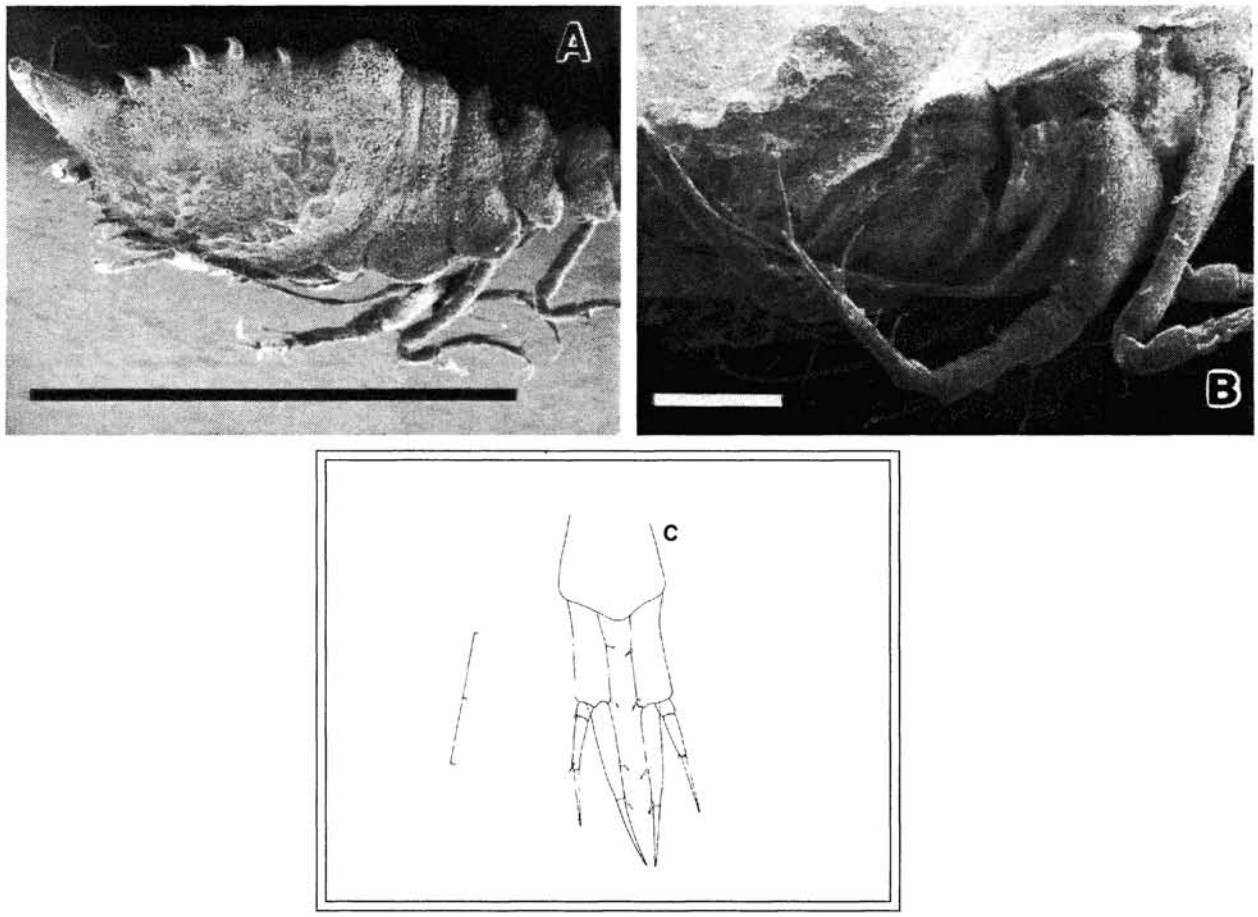

Figure 2.33. ***Cumella (Cumella) californica*** **Watling and McCann, new species.** Female: A, carapace and pereonites, dorsolateral view; B, pereonites and pereopods 1-3; C, uropods. Scale, A = 1 mm, B,C = 0.2 mm.

Remarks. In addition to the new species described here, three *Cumella (Cumella)* species are known to have coarse spines along the middorsal crest of the carapace, viz., *C. (C.) arguta* Gamô, *C. (C.) meridionalis* Jones, and *C. (C.) quadrispinosa* Gamô. None have the broadly flaring pleurites nor the short uropod peduncles seen in *C. (C.) californica*.

Type Locality and Type Specimens. California, Santa Maria Basin, off Purisima Point, Sta. R-4, 34°43.01'N, 120°47.39'W, 92 m, holotype USNM 273540, paratype USNM 273541 and LACM 95-70.1.

Distribution. Known from the Santa Maria Basin Region and off Pt. Loma, San Diego, 45-154 m.

Acknowledgements

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Attachment I

Phase I and II manuscript names with formal equivalents

Family Diastylidae

Diastylis paraspinulosa = ***D. sentosa* new species**

Diastylis sp. 1 = *Diastylis pellucida* Hart, 1930

Diastylis sp. 2 = ***Diastylis sentosa* new species**

Diastylis sp. 5 = ***Diastylis santamariensis* new species**

Diastylis sp. A = ***Diastylis crenellata* new species***

Diastylis sp. E = ***Diastylis quadriplicata* new species**

Leptostylis longimana = ***Leptostylis calva* new species**

Leptostylis villosa = *Leptostylis* ? (specimens too damaged, but are definitely not *L. villosa*).

Leptostylis sp. 1 = ***Leptostylis abditis* new species**

Leptostylis sp. A = ***Leptostylis calva* new species**

Leptostylis sp. E = ***Diastylis crenellata* new species***

Family Leuconidae

Hemileucon sp. 1 = ***Alloeoleucon santamariensis* new species**

Leucon sp. H = ***Leucon (Diaphonoleucon) declivis*, new species**

Leucon sp. A = *Leucon* (*Leucon*) *falcicosta*, new species

Leucon (? *Epileucon*) sp. B = *Leucon* (*Crymoleucon*) *bishopi* Bacescu, 1988

Eudorella sp. 2 = *Eudorella redacticruris* new species

Eudorella sp. 1 = *Eudorella truncatula* Bate, 1856

Family Nannastacidae

Campylaspis sp. N = manca, probably of *C. rubromaculata*

Campylaspspis sp 6 = *Campylaspis rufa* Hart, 1930

Campylaspis sp.1 = ***Campylaspis maculinodulosa*, new species**

Campylaspis sp. 10, *Campylaspis* sp. 12 = *Campylaspis hartae* Lie, 1969

Campylaspis sp. E = ***Campylaspis blakei*, new species**

Campylaspis sp. B, sp. 7, sp. 8, sp. 9, and *Campylaspis* nr. *crispa* = ***Campylaspis biplicata*, new species**

Campylaspis sp. 4 = ***Procampylaspis caenosa*, new species**

Cumella sp. 1 = ***Cumella* (*Cumella*) *morion*, new species**

Cumella sp. 2 = ***Cumella* (*Cumella*) *californica*, new species**

*Note that *Diastylis crenellata* is correctly listed twice on the checklist.

Attachment II

List of cumaceans previously found in the Oregonian Province

Family Diastylidae

- *Anchicolurus occidentalis* (Calman, 1912) as *Colurostylis* (?)
- *Diastylis abbotti* Gladfelter, 1975
- *Diastylis californica* Zimmer 1936
- *Diastylis paraspinulosa* Zimmer, 1926
- *Diastylis pellucida* Hart, 1930
- *Diastylis umatillensis* Lie, 1969
- *Diastylopsis dawsoni* Smith, 1880
- *Leptostylis villosa* Sars, 1869 (doubtful record of Hart, 1930)

Family Lampropidae

- *Hemilamprops californica* Zimmer, 1936
- *Hemilamprops gracilis* Hart, 1930
- *Lamprops carinata* Hart, 1930
- *Lamprops quadriplicata* Smith, 1879
- *Lamprops serrata* Hart, 1930
- *Lamprops tomalesi* Gladfelter, 1975
- *Lamprops triserrata* Gladfelter, 1975
- *Lamprops krasheninnikovi* Derzhavin, 1926
- *Lamprops obfuscata* (Gladfelter, 1975)
- *Mesolamprops bispinosa* Given, 1964
- *Mesolamprops dillonensis* Gladfelter, 1975

Family Leuconidae

- *Eudorella pacifica* Hart, 1930 (includes *Eudorella tridentata* Hart, 1930)
- *Eudorellopsis biplicata* Calman, 1912
- *Eudorellopsis integra* Smith, 1879
- *Eudorellopsis longirostris* Given, 1961
- *Leucon armatus* Given, 1961
- *Leucon magnadentata* Given, 1961
- *Leucon subnasica* Given, 1961

Family Nannastacidae

- *Campylaspis canaliculata* Zimmer, 1936
- *Campylaspis hartae* Lie, 1969
- *Campylaspis rubromaculata* Lie, 1969
- *Campylaspis rufa* Hart, 1930
- *Cumella vulgaris* Hart, 1930

Family Bodotriidae

- *Cyclaspis nubila* Zimmer, 1936

3. The Tanaidacea

by

Masahiro Dojiri[1] and Jürgen Sieg[2]

Introduction

The Tanaidacea is an order of free-living and exclusively benthic malacostracans belonging to the Peracarida, which also includes the orders Mysidacea, Amphipoda, Cumacea, Isopoda, Spelaeogriphacea, and Mictacea. Presently, the tanaids include three recent suborders (i.e., Apseudomorpha, Neotanaidomorpha, and Tanaidomorpha) and one extinct suborder (i.e., Anthracocaridomorpha), 21 families, and about 700 extant species. Most species are exclusively marine, but a few are known to occur in fresh or brackish water. Species that have been reported from fresh water are typically marine, euryhaline species. There are no strictly fresh water Tanaidacea. This order is most closely related to the Isopoda (see Siewing, 1953; Fryer, 1964; Sieg, 1983a), although Watling (1981) considered it a sister taxon to the Cumacea.

Taxonomic History

The first tanaidacean ever described is probably "*Gammarus heteroclitus*" recorded by Viviani (1805) from Genoa, Italy. The published illustrations are reminiscent of members of the genus *Leptochelia*, but the species cannot be identified with any certainty. For this reason, it was listed as *incertae sedis* under the family Paratanaidae (now Leptocheliidae) by Sieg (1983b). Prior to the discovery of Viviani's work, "*Cancer Gammarus Talpa,*" now attributed to *Apseudes talpa* and described by Montagu (1808), was considered the first known tanaidacean. In both cases, the incorrect identifications indicate that the authors thought that these organisms belonged to the Gammaridea (Amphipoda). Although Latreille (1831) had transferred these species to the isopodan group "Heteropa" (= Heteropoda), their supposed amphipod affiliation could still be found in Gerstaecker (1883).

These tanaid species then were taxonomically grouped with the Isopoda for quite some time. Milne-Edwards (1840) thought that the known species should be included in the "Idoteides", while White (1847, 1850) placed them in the "Asellita." Dana (1852) introduced the name "Anisopoda" which indicated that this group of miscellaneous species represented a very unusual group among the isopods. This prompted Bate and Westwood (1868) to place them in the "Tribus Vagantia" of their "Isopoda Aberrantia" which contained anthurid and gnathiid isopods among others. G. O. Sars (1882) named them "Isopoda chelifera."

Finally, Claus (1888) elevated the Anisopoda to the ordinal level, a taxonomic position equal to that of the Isopoda. Hansen (1895) introduced the name Tanaidacea, which is now the commonly accepted name for the order.

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The systematics of some tanaidacean groups is still in a state of flux. Many new species remain to be described, and the diversity within this order is only now being recognized. So far about 700 species have been described, but the estimated number of tanaidacean species calculated from deep-sea samples could raise this number well over 3,000 species.

Tanaidaceans have a relatively well-known fossil record that dates back to the Lower Carboniferous (Schram, 1974; Sieg, 1983a, 1984a) and shows the first radiation in the Jurassic (Schram *et al.*, 1986). Even some Eocene specimens are known (Sieg, unpublished data).

Since G. O. Sars (1882), only two families, Tanaidae and Apseudidae, were recognized until Lang (1949) published his first paper on the Tanaidacea; this paper marks the starting point for a more complex, but better foundation for the systematics of this order. In the following years, Lang (1956a, 1956b, 1970, 1971, 1973) published a series of papers not only describing a few new families, but also dividing the order into two suborders Monokonophora and Dikonophora. Subsequently, the classification was further revised by Sieg (1973, 1976, 1980a, 1984a) who included the fossil record in his analysis.

Four suborders are presently recognized. The first suborder, Anthracocaridomorpha, contains exclusively Carboniferous and Permian species. The second suborder, Apseudomorpha, consists of fossil species from the Jurassic (Schram *et al.*, 1986) as well as all the extant taxa formerly united in the Monokonophora. The third suborder, Neotanaidomorpha, is a group of exclusively deep-sea species (Gardiner, 1975) which have no known fossil record. The final suborder, Tanaidomorpha, includes one fossil (Jurassic) species and all remaining taxa formerly grouped under the suborder Dikonophora.

External Morphology

Because the tanaidacean fauna collected for this study belongs predominantly to the suborder Tanaidomorpha, much of the general discussion on morphology presented here focuses on this suborder. Additionally, however, morphological features of the Apseudomorpha, specifically the Apseudidae, that differ from those of the Tanaidomorpha are discussed. Much of the information provided here is taken from the compilation published by Sieg (1984a).

Body Shape

The general habitus of the tanaidomorphans is characterized by its cylindrical body shape, while that of the apseudomorphans is dorsoventrally depressed. Terminology for the descriptions of the surfaces of body **somites** and appendages follow that of Lang (1968): **tergal** and **sternal** are synonymous with dorsal and ventral, respectively; **rostral** and **caudal** are synonyms of anterior and posterior, respectively (Figure 3.1).

The body (Figure 3.1), ranging in total length from 1 to 37 mm, always consists of three tagmata of which the first one, the **cephalothorax**, is formed by the fusion of the **cephalon** and the first two **thoracomeres**. A small **carapace** encloses the **branchial chamber**. Eight appendages, seven of which are paired, are found attached to this region: antenna 1 (**antennule**), antenna 2 (**antenna**), **labrum** (unpaired), **mandibles**, maxilla 1 (**maxillules**), maxilla 2 (**maxilla**), **maxilliped** (thoracopod 1), and **cheliped** (thoracopod 2).

The remaining six free thoracomeres are called **pereonites** (or pereomeres), each bearing one pair of **uniramous** walking legs, the **pereopods**, and collectively forming the second tagma referred to as the **pereon**. Only the first pair of pereopods bear **exopodites**. The last tagma, the **abdomen** or **pleon**, is predominantly six-segmented and composed of five **pleonites** and a **pleotelson**. Sometimes the pleonites are reduced in number or totally fused with the pleotelson. Typically, each pleonite bears one pair of **biramous pleopods**. Pleopods may be present or absent. Usually only the last abdominal somite is fused with the **telson**, forming the pleotelson. The appendages of the pleotelson, the **uropods**, are filiform or styliform, and uni- or biramous, but may be reduced in some tanaidomorphan families.

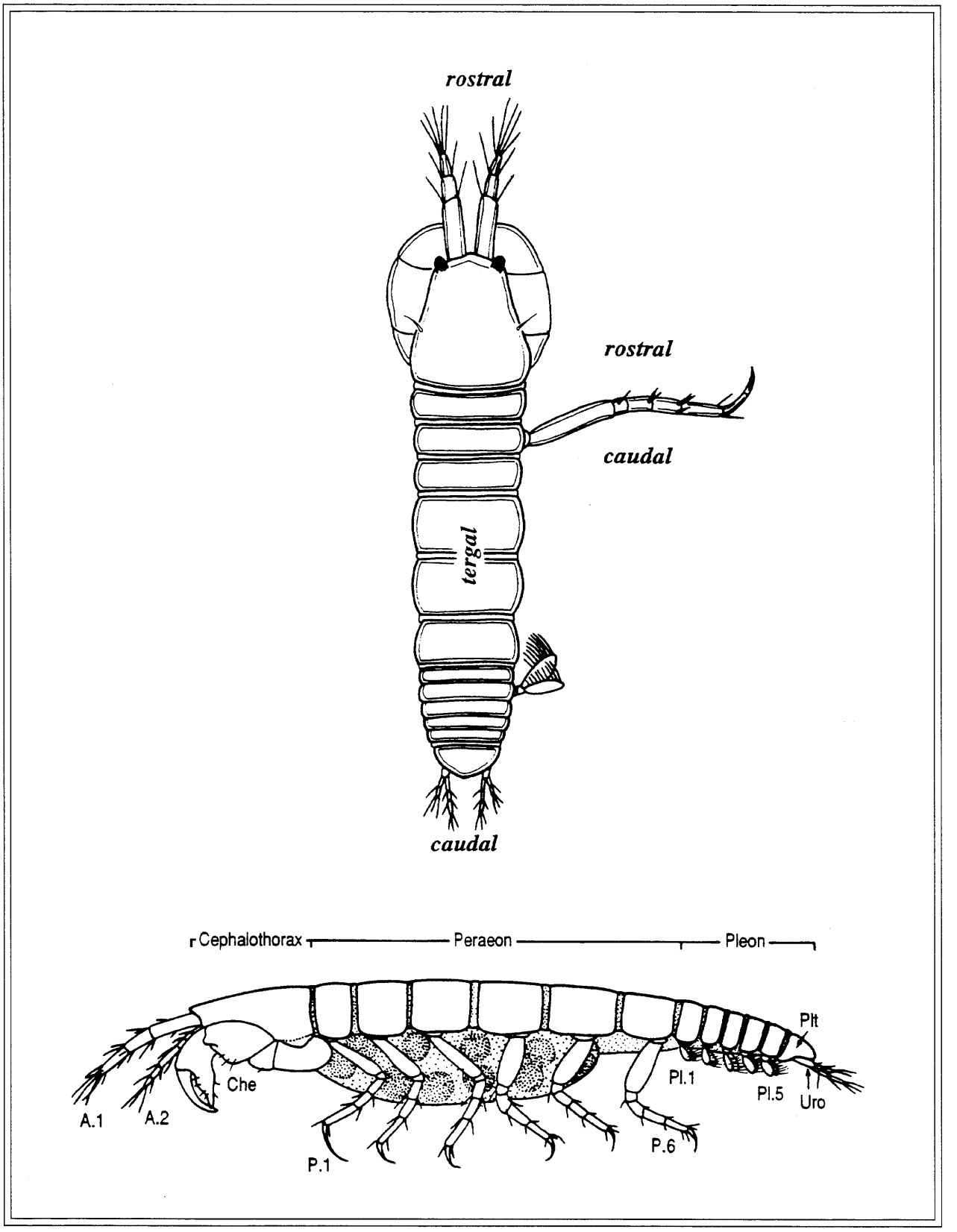

Figure 3.1. Generalized habitus of a tanaidomorphan: top, dorsal view; bottom, lateral view.

Genital openings are found on the **coxae** of the fourth pair of pereopods (thoracopod 6) in the female. In the male, these openings are centered on a cone located on the **sternite** of the last pereonite (thoracomere 8). Some species of tanaidaceans have one slender, elongate "genital cone" having one common outlet for both **testes** ("Monokonophora" *sensu* Lang), but others have two cones, each with an outlet for one testis ("Dikonophora" *sensu* Lang). Various intermediate stages exist between these two extremes: a single genital cone can be relatively broad and bear two openings, or the cone may be deeply incised resulting in a dicondyl (bilobed) type of genital cone.

Hooks, referred to as **hyposphaenia**, are located on the sternites of some of the pereonites in apseudids and occasionally in tanaidomorphans. Ridges may occur on the sternal area of the pleonites (e.g., *Scoloura*).

Females of some tanaidacean species lack pleopods, while females of other species have a reduced number of pleonal somites.

The reduction in the number of pleonal segments is a more or less common feature within the Tanaidae in which the pleon is composed of up to five pleonites of which only three are fully developed. Each of the three distinct pleonites bear one pair of pleopods. The evolutionary fate of the posterior two pleonites differs among the various genera of this family. For example, in phylogenetically primitive genera of the Tanaidae, the last two pleonites remain separate, but are distinctly smaller and never have pleopods. In more derived genera (e.g., *Zeuxo*) the last two pleonites are represented by two small **tergites** dorsally, but by only a single sclerite ventrally. Furthermore, in some genera, one or both of the pleonites may be absent, resulting in a four-segmented (e.g., *Tanais*) or three-segmented (e.g., *Pancolus*) pleon.

Typically, the pleonites are as wide as the pereonites. In contrast, within the subfamily Anarthrurinae, the pleonites of the females are usually narrower than the pereonites. This is also the case in some species of the Akanthophoreinae.

Sexual dimorphism is commonly observed in the general habitus of most tanaidacean groups with the exception of the Tanaidae. Males often look quite different from the females. For example, the "**swimming males**", found in such families as the Paratanaidae, Anarthruridae, Typhlotanaidae, Pseudotanaidae, among others, have a much more strongly developed pleon than the female and bears well-developed pleopods. Even in those taxa in which the females lack the pleopods, these appendages are still present in the corresponding males. In taxa that have an abbreviated post-marsupial development in the male, the **subadult males** may look quite similar to the females, but can be distinguished by a stouter antenna 1 and somewhat more strongly developed pleon.

Antenna 1

In most tanaidacean species, antenna 1 (Figure 3.2) is uniramous and uniform in structure. Major differences occur only between sexes.

Antenna 1 in the female typically is three- or four-segmented. The four-segmented condition is most likely plesiomorphic, and, apparently, the three-segmented state is the result of the fusion of the two proximal segments. This proposed transformation series is supported by the presence of one or two long setae at the midlength of the first segment; these setae are thought to mark the original segmental suture of the plesiomorphic segments. The last segment typically bears one single distal **aesthetasc**.

Antenna 1 of the male is always seven-segmented in those groups that have "swimming males" (e.g., Anarthruridae, Pseudotanaidae, among others). In these taxa, there is a three-segmented **peduncle** and a four-segmented **flagellum**. Each segment of the flagellum bears a large group of aesthetascs. Some long setae typically occur on the terminal segment.

Males of the Leptocheliidae are characterized by an antennal flagellum consisting of three or more segments. Each flagellar segment is not annular as in the "swimming males" of the other families but more elongate, and morphologically similar to a normal segment. Typically, they bear a group of at least 3-5 aesthetascs.

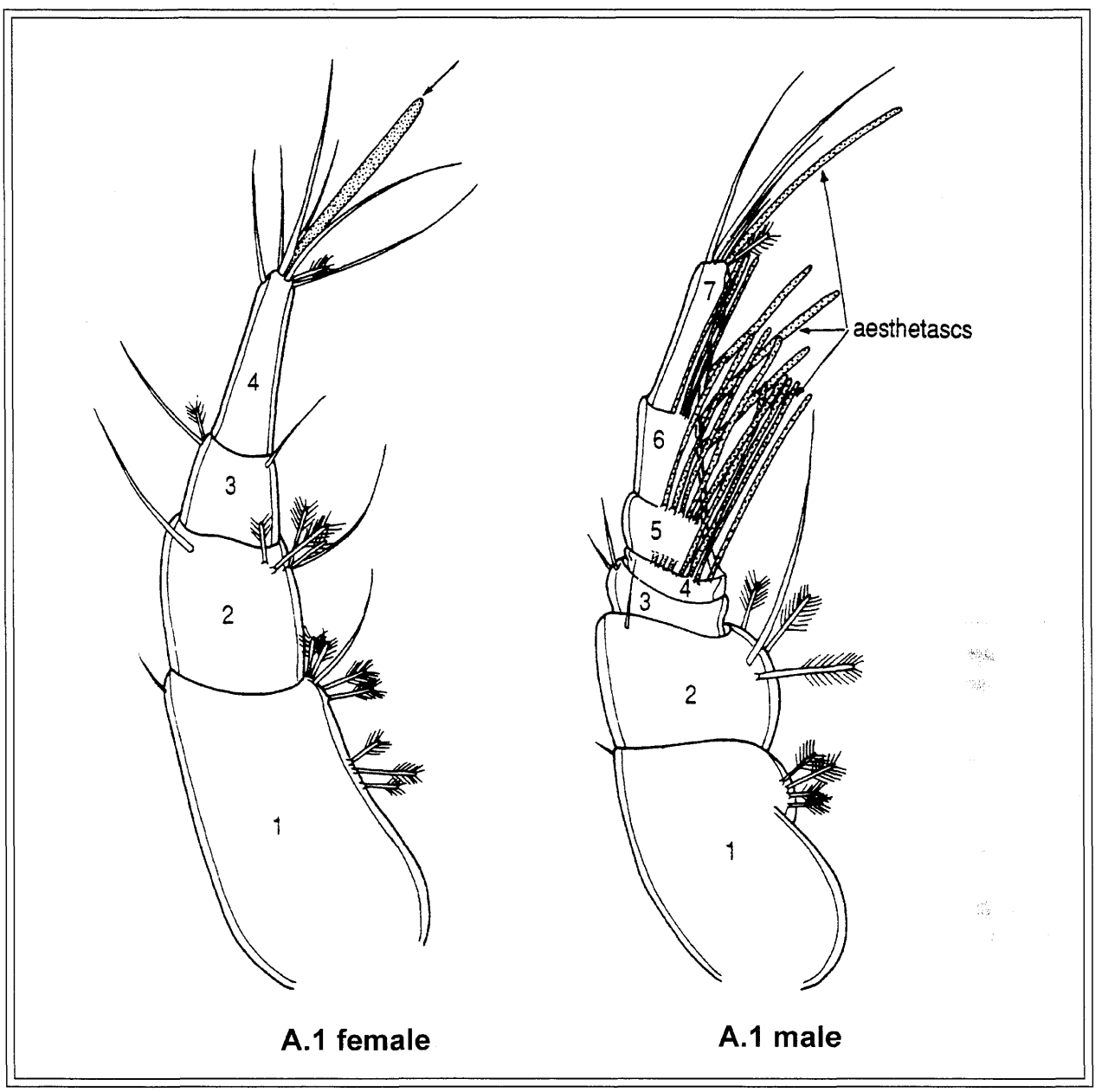

Figure 3.2. Generalized first antenna of female and male tanaidomorphan.

In the Tanaidae, in which sexual dimorphism is weakly expressed, antenna 1 of the male is only somewhat more elongate than in the female, but otherwise is similar.

Antenna 2

Antenna 2 (Figure 3.3) typically is six-segmented and does not show any great morphological variability.

The first segment is small and in most cases semicircular in cross-section. Unfortunately, it is quite often overlooked, resulting in an incorrect count of segments. The second and third segments are distinct and each typically bears a distal seta on its outer border. Segment four is elongate and always bent ventrally. The distinctly 7-segmented antenna 2 of the members of the genus *Heterotanoides* Sieg, 1973

(Kudinova-Pasternak, 1977; Sieg, 1973, 1977b, 1986a) and the possible remnant of the segmental suture still present in many Akanthophoreinae species suggest that the fourth segment may be the result of the fusion of two segments. Segment five is similar in length and shape to the fourth, while the sixth is always tiny and conical in the Tanaidomorpha. In some genera the sixth segment appears to be fused to the fifth, resulting in a "five-segmented" antenna 2.

The antenna 2 of apseudids differ from that just presented for tanaidomorphans.

Mouthparts

Sexual dimorphism within the mouthparts is one of the characteristic features of the suborder Tanaidomorpha. The only exception to this general rule is the Tanaidae in which males and females have morphologically identical mouthparts. In all other tanaidomorphan families, adult males have strongly reduced mouthparts (Sieg, 1984a).

Morphological reduction does not occur in the **palpus** of maxilla 1 and the **epignath** in tanaidomorphan species. Both are generally found to be functionally active in the respiratory chamber. In some species, i.e., *Siphonolabrum fastigatum* Sieg, 1986, the maxilla 2 and remnants of the maxilla 1 **endite** may also be present (Sieg, 1986a). In other species, mostly in "swimming males," only the maxilliped remains, while the other mouthparts are fused to the labrum forming a conspicuous "**epistome.**" Leptocheliidae do not have a functional maxilliped, but instead have two small lamellae occasionally bearing some setae.

Labrum

The labrum is always hood-shaped (a convex flap) and morphologically uniform throughout the entire suborder Tanaidomorpha (Figure 3.3), except in *Siphonolabrum* Lang, 1973 (Figure 3.12).

Mandible

The detailed morphology of the mandible (Figure 3.3) of tanaidomorphans is an important diagnostic character in distinguishing genera and species. For this reason, illustrations of this appendage is mandatory in taxonomic descriptions. Unfortunately, some structures, e.g., the **lacinia mobilis** or the **pars molaris**, may look quite different depending upon the viewing angle.

In all tanaidomorphan genera, each one of the mandibular pair is different (asymmetric) from the other member and generally lacks a palpus. Each consists of the mandibular body (corpus mandibularis), a mandibular projection (pars molaris), an articulated "cutting blade" (lacinia mobilis), and a fixed distal "cutting blade" (pars incisiva). Some setae located near the lacinia mobilis are present in members of the family Tanaidae; these setae are probably the remnants of the much better developed spine-row found in the Apseudoidea.

The asymmetry of the mandibles generally is expressed in the reduction of the lacinia mobilis of the right mandible. Within the Tanaidomorpha, the lacinia mobilis of the right mandible is freely articulated only in members of the Tanaidae, but is fused to the pars incisiva in the remaining families. This fusion results in a "two-pointed" pars incisiva.

Within the Leptocheliidae and Typhlotanaidae these structures are not good generic or specific discriminants because all species within a particular family seem to have nearly identical mandibles.

On the other hand, the lacinia mobilis of the right mandible in the members of the Tanaidae shows various degrees of morphological reduction and, therefore, is a valuable character in species identification (Sieg, 1980b).

In other families, e.g., Anarthruridae and Pseudotanaidae, the morphology of the pars molaris is one of the most important taxonomic characters at the generic and specific levels. As first shown for *Pseudotanais*, species that otherwise resemble each other in body shape and armature of appendages can easily be distinguished by the shape of the pars molaris (Sieg, 1977a). For many anarthruridean genera, the general shape of the pars molaris is characteristic; species can be distinguished from each other by small morphological

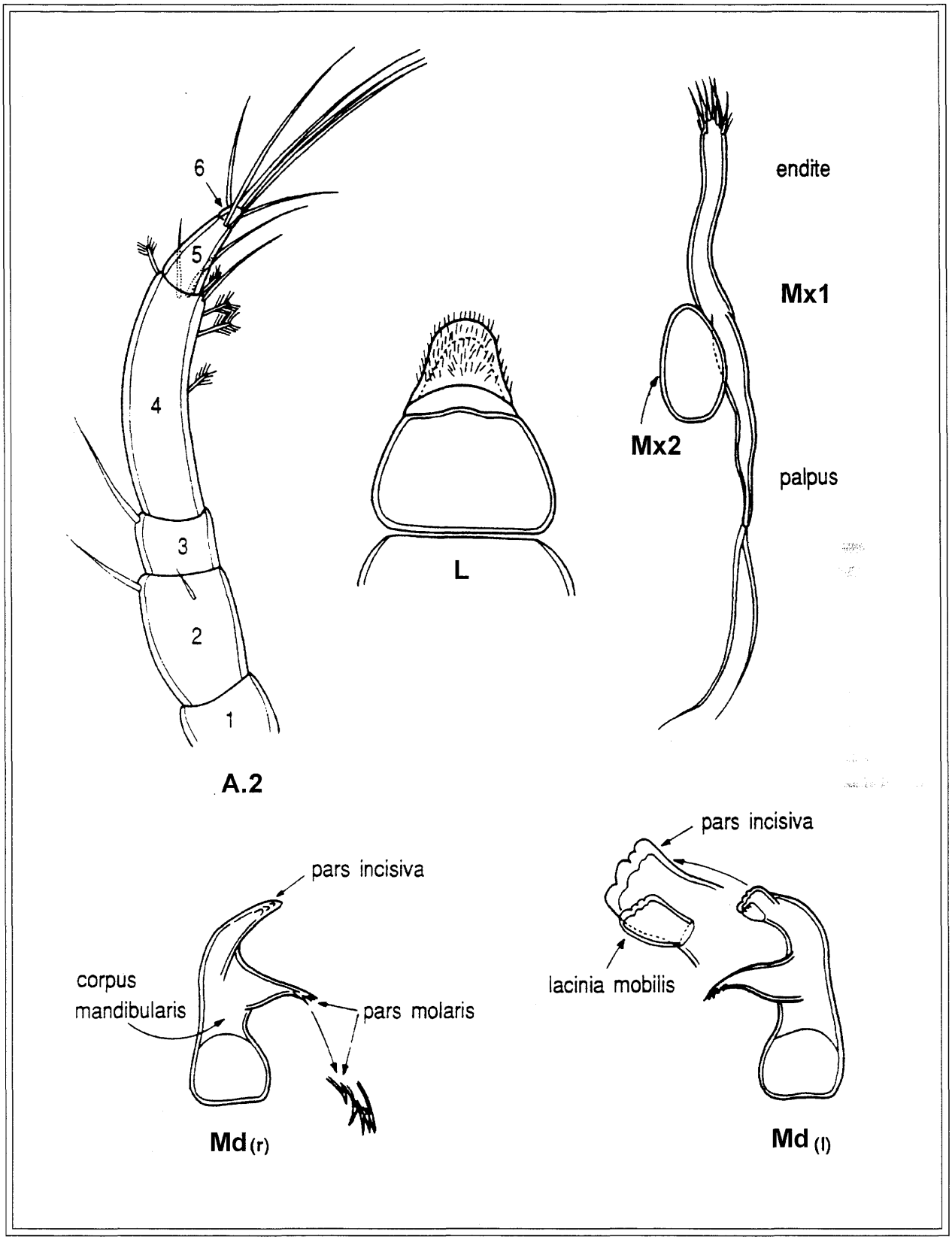

Figure 3.3. Generalized tanaidomorphan second antenna, labrum, right and left mandible, first maxilla, and second maxilla.

differences at the apex of this structure. Within certain groups, e.g., *Araphura* Bird and Holdich, 1984, a thin, multi-pointed pars molaris is typical; the number and shape (blunt versus pointed) of the processes (tips) on the apex are important specific discriminants (Sieg and Dojiri, 1989).

Finally, within many genera of the subfamily Leptognathiinae and Anarthrurinae the pars molaris is more or less reduced and represented only by a thin weak lobe (e.g., *Tanaopsis* G. O. Sars, 1882) or is totally reduced as in *Siphonolabrum* Lang, 1971.

First and Second Maxillae

Maxilla 1 (Figure 3.3) exhibts only slight variation among the various tanaidomorphan taxa. It consists of a single endite and a one-segmented palpus. The number of spines on the endite is constant for all species within a specific genus, but may vary among the genera (Lang, 1967). So far the lowest number of observed spines is five and the highest twelve. The palpus typically bears two long terminal setae, except in the family Tanaidae in which a greater number of setae is present in the majority of species.

Maxilla 2 (Figure 3.3) is oval in shape throughout the Tanaidomorpha and occasionally bears one or two setae.

Paragnath (= Labium or Hypopharynx)

The labium (Figure 3.4) consists of two lobes that are medially fused in the proximal third. It consists of an inner and outer lobe with the outer lobe bearing a small one-segmented palpus distally in the plesiomorphic family Tanaidae. In all other tanaidomorphan families the palpus is absent and the outer lobe has undergone further reduction. In most species of the families Anarthruridae and Typhlotanaidae, the outer lobe is represented by a convex protrusion, while it is totally missing in the Pseudotanaidae.

Thoracopods

As in all malacostracans, the Tanaidacea have eight thoracic somites of which two, without exception, are fused to the cephalon forming a cephalothorax. The first pair of thoracopods, the maxilliped, is specialized and serves as an additional pair of mouthparts. The second pair has been modified into a cheliped. Therefore, out of the ancestral eight thoracopods, only six pairs of walking legs or pereopods are present.

Maxilliped and Epignath

The maxilliped (Figure 3.4) is the posteriormost appendage of the mouthparts. The coxa, if present, is small and situated at the base of the appendage. The **basis** is the largest segment and may be partly or completely fused to the other member of the pair. The distal portion of the basis carries a pair of protrusions or lobes referred to as the maxillipedal endites. The endopod consists of four segments and articulates with the basis. A free **ischium** is invariably absent and is probably integrated into the basis. The remaining endopodal segments, collectively known as the palpus, are the **merus**, **carpus**, **propodus**, and **dactylus**. An exopodite is never present throughout the entire order.

Within the Tanaidomorpha, the progressive fusion of the basal region of this appendage is of some taxonomic value. The most plesiomorphic character state is represented by the Tanaidae. In this family, the coxa is still present and the medial borders of the basis, as well as the maxillipedal endite, are not fused. In all other families, the coxa is absent. In the Leptocheliidae, the basis remains unfused as in the Tanaidae, but the coxa is missing. One of the more derived character states is represented by the subfamily Pseudotanainae in which the bases and the endites are completely fused, forming a plate-like structure and enclosing the posterior portion of the mouth chamber. Anarthruridae and Typhlotanaidae exhibit various degrees of fusion along the medial margins of the basis and occasionally of the endite.

The distal margin of each endite usually bears one or two setae and some translucent hemispherical protrusions. In some taxa, the presence or absence and the spatial arrangement of these structures may be of taxonomic importance.

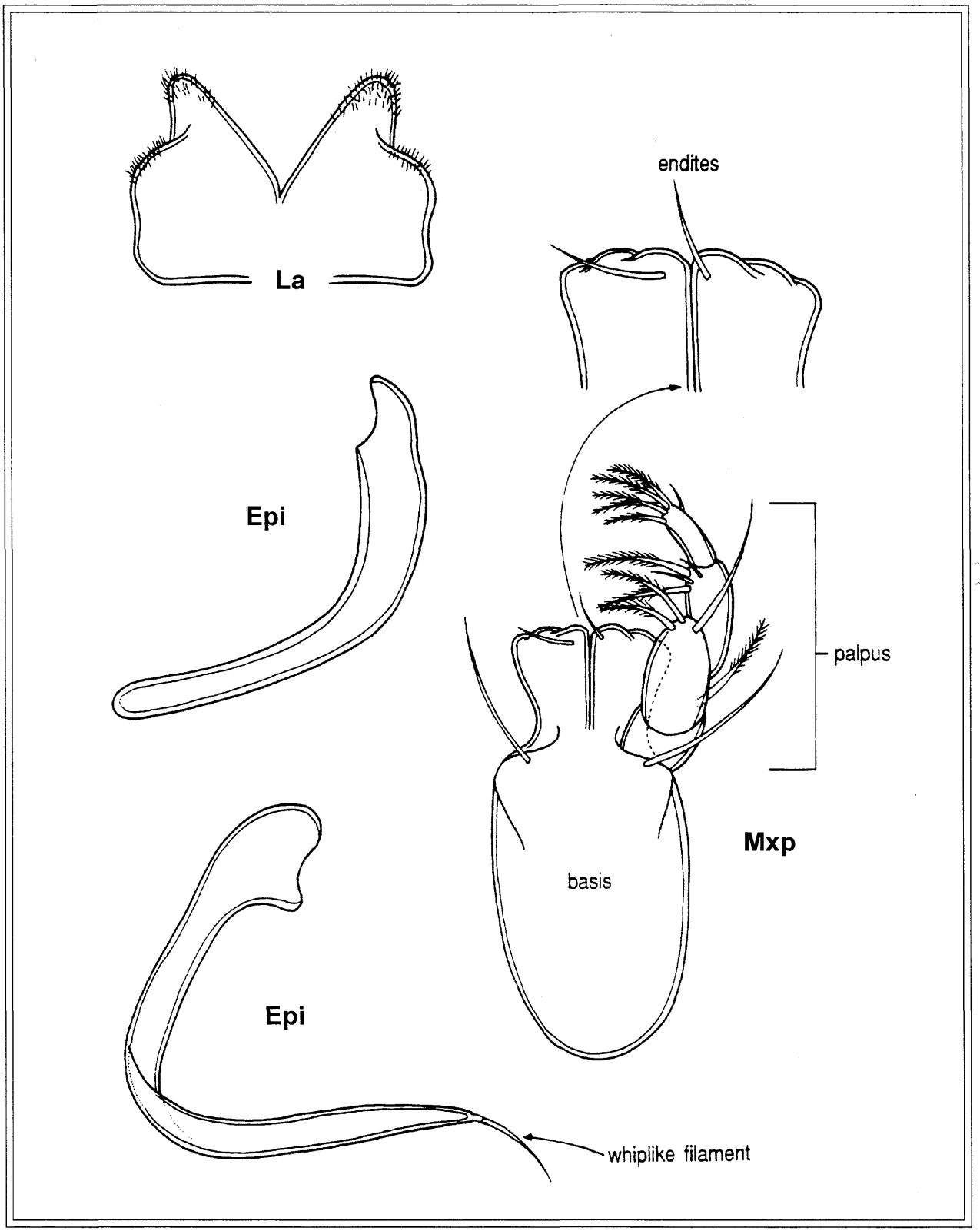

Figure 3.4. Generalized tanaidomorphan labium, maxilliped, and epignath.

The basis always bears at least one seta close to the articulation of the palpus. The number of setae on the palpus may play an important taxonomic role in distinguishing genera, especially within the family Leptocheliidae in which some taxa have been described as having up to eight.

So far, the available information on the setation of different palpal segments is not reliable enough to draw any definitive conclusions. The merus (first segment) usually does not bear any setae. The carpus (second segment) usually is equipped with an outer seta which appears spiniform in some species. The inner margin of this segment bears several elements, variable in number as well as in structure: some are setiform, while others are highly sclerotized and spiniform, and sometimes barbed. The number and the combination of spines and setae on this segment might be uniform within the genus or subfamily. The same holds true for the propodus (third segment), but this segment never bears an outer seta. The terminal (fourth) segment, the dactylus, is digitiform and typically bears one small outer seta and a group of inner setae variable in number and size.

Sexual dimorphism in the maxillipeds is common except in the Tanaidae. Even in families in which the males lack mouthparts, remnants of the maxilliped and a normally developed epignath are present. Typically, however, the maxilliped in the male is well-developed. Differences between the two sexes in these taxa are found in the setation and shape of the segments. In contrast, the maxilliped is almost completely reduced in the males of Leptocheliidae. Typically, it is only represented by a small plate-like structure that bears one or two setae. In some leptocheliid males, the remnants of the palpus are represented by knoblike projections.

Articulated to the maxilliped of all Tanaidomorpha is a posteriorly-directed **epipodite**, known as the epignath. In the Tanaidae it is a broad, kidney-shaped structure, while in all other families it is small and elongate (sausage-like). Sometimes the tip is elongate and resembles a whiplike filament.

Cheliped

The general structure of the tanaidomorphan cheliped (Figure 3.5), especially the presence or absence of a coxa, has been a subject of controversy (Lang, 1971; Lauterbach, 1970; Sieg, 1980a, 1984a) and can only be discussed in conjunction with the carapace.

Tanaidomorphan taxa all have a well-developed dorsal carapace which curves ventrally to form a ventral chitinous plate that houses the branchial chamber into which the palpus of maxilla 1 extends and the epignath is located.

Lang (1971) stated that there exist some taxa that have a coxa and others that lack this segment. On the other hand, Lauterbach (1970) in his paper on the cephalothorax of *Tanais cavolinii* Milne-Edwards, 1840 [= *T. dulongii* (Audouin, 1826)] believed the coxa to be absent and used the term **side-piece** ("Seitenstück") in alluding to this structure. This side-piece, or plate, that lies near the insertion of the cheliped is probably a remnant of the sternite of the second thoracic segment and not the chelipedal coxa as suggested by some authors. These sclerotized plates were referred to as the "coxa" by Lang (1971) and "**pseudo-coxa**" by Sieg (1980b, 1984a); the latter author confirmed Lauterbach's opinion that a chelipedal coxa is absent in all tanaidomorphan families.

The morphology of the cheliped is uniform throughout the Tanaidomorpha. The cheliped always consists of a well-developed basis which is articulated to the cephalothorax along its proximal margin or at a point slightly removed from this margin and indicated by a conspicuous projection. The ischium is generally thought to be absent, except in the Neotanaidomorpha (Gardiner, 1975). The merus is small and more or less triangular having the carpal articulation along the tergal margin. The carpus is a very large segment bearing two setae on the tergal border, usually one on the proximal and another on the distal areas; the sternal border usually bears some longer setae. The propodus and dactylus together form the **chela**. The sternal part of the propodus is greatly expanded and is called the "**fixed finger.**" The tergal margin of the fixed finger may be characteristically denticulated, while the sternal margin usually bears three setae. The

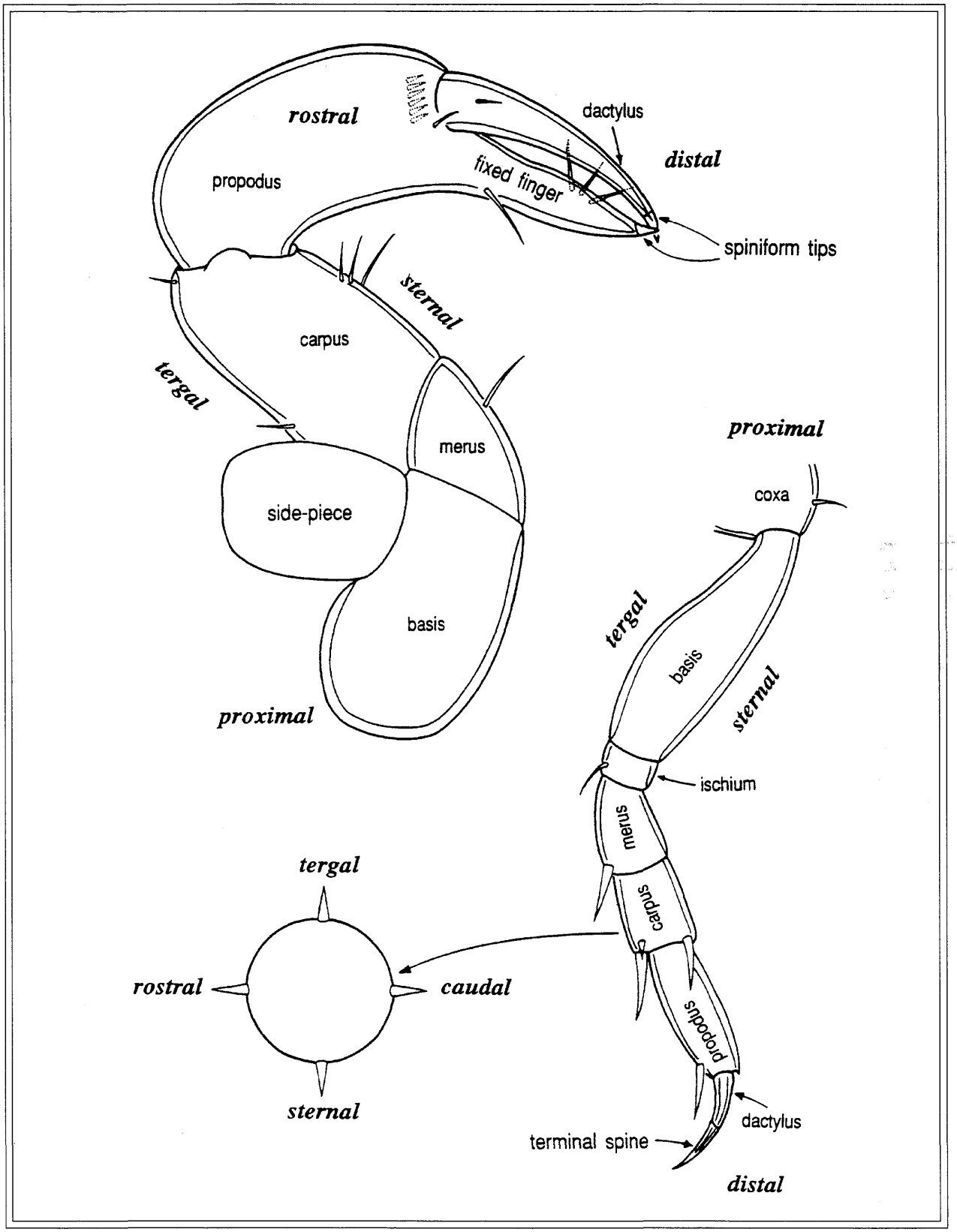

Figure 3.5. Generalized tanaidomorphan cheliped and pereopod.

fixed finger and dactylus have strongly sclerotized tips. Typically, there is a row of smaller setae, often referred to as the "comb," located on the rostral side near the articulation of the dactylus.

Sexual dimorphism in the Tanaidomorpha is often primarily expressed in chelipedal differences. This is a common feature, especially in the Leptocheliidae in which up to four different kinds of chelipeds can be distinguished in one species [e.g., *Heterotanais oerstedti* (Krøyer, 1842); see Bückle-Ramirez, 1965; Sieg, 1984a]. Fortunately, none of the genera in this atlas has such a complicated post-marsupial development. On the other hand, "swimming males", which exhibit a general habitus different from that of their corresponding females, possess chelipeds morphologically similar to that of the female.

Pereopods

The remaining six pairs of thoracopods are called pereopods 1-6 (Figure 3.5). The cheliped has been referred to as the first pereopod by some authors; this misnomer results in seven pairs of pereopods. However, since "pereopod" refers to a "walking leg" and Bate (1856) clearly restricted the term to the appendages of "free" thoracic somites, we prefer the terminology used herein. This point has been discussed in the past to some extent (Wolff, 1956; Lang, 1957; Sieg, 1980b; Messing, 1981).

All pereopods are styliform. Morphological adaptations of the pereopods to different kinds of sediments or habitats, observed in the Apseudoidea, are not found in the Tanaidomorpha. Typically, each pereopod consists of a coxa, basis, ischium, merus, carpus, propodus, and dactylus which bears a strong terminal spine. An exopodite is never developed in the Tanaidomorpha. Within the family Tanaidae, the ischium is absent and is most probably fused with the basis.

The six pairs of pereopods can be separated into two functional groups. Females develop **oostegites** on pereopods 1-4, or exclusively on pereopod 4.

Pereopods 1 to 3. The first three pairs of pereopods are attached to the anteroventral corner of the pereonites, are directed anteriorly, always have free coxae, and are used for spinning the silk tube. The coxa always has a bicondyle-type articulation which lies in a longitudinal (anterior-posterior) direction. The basis also exhibits this type of articulation, but lateral in orientation. This "cardanic" articulation allows the animal to move the leg in all directions. The terminal spine of these pereopods is never fused to the dactylus. Its morphological independence appears to be correlated with the special function of spinning a silk tube which is produced by the **thoracic glands**,

The armature of each segment is important for distinguishing genera and identifying species. In plesiomorphic taxa, pereopods 1-3 bear only setae on each segment. In more derived taxa, especially in the Anarthruridae, spines have secondarily developed on the merus and carpus, the number and position of these spines are taxonomically useful characters.

In most taxa, pereopod 1 is more slender than the next two pairs of pereopods and usually does not have spines on the merus and/or carpus.

Pereopods 4 to 6. The last three pairs of pereopods are attached to the posteroventral corner of the pereonite, are directed laterally, have a coxa fused with the sternite of the pereonite, and are used for clinging to the tube.

The dactylus and terminal spine are often fused to form a **claw**. The fusion produces a large, functionally strong prehensile structure that is used to grasp the inner surface of the tube. This structure is very characteristic for some taxa (e.g., Tanaidae). In the Anarthruridae the dactylus is uniquely modified: the sternal border of the elongate dactylus is concave and the two resulting ridges are lined with setules (hairs). The basis can be quite massive in many Typhlotanaidae.

The fourth and fifth pair of pereopods are quite similar in appearance and armature. However, the propodus of pereopod 6 bears some additional distal setae or spines on the sternal border in most taxa. The armature of each segment of these pereopods is as taxonomically important as in the preceding three pairs.

Marsupium

Three different types of **marsupia** or **brood pouches** exist within the Tanaidomorpha.

The "normal- (= *Heterotanais*-) type" is represented by all families except Tanaidae and Pseudotanaidae. This type of marsupium is formed by four pairs of oostegites on pereopods 1-4. Each oostegite develops from the coxa as a bilamellar sheet, containing some epithelial tissue within the interlamellar space. After the animal moults, the oostegites start to grow. Each sheet of the oostegite becomes much thinner and most of the epithelial tissue is lost or resorbed. The eggs lie between the oostegites and the ventral surface of the body wall.

The "*Pseudotanais*-type" is quite similar to the normal-type. However, only one pair of oostegites are present; they occur exclusively on pereopod 4, and cover the genital opening.

The "*Tanais*-type" is unique. Although it also consists of only one pair of oostegites on pereopod 4 as in the *Pseudotanais*-type, the morphology of the oostegite is very different. During the early developmental stages, these oostegites are not sheet-like but more or less sac-like and filled with tissue. Later in the adult, the eggs are laid or placed inside the oostegites, resulting in **brood sacs** or "**ovisacs**" (Lang, 1960). How the eggs get inside the oostegites and how they get fertilized is still unknown. The nutrition of the developing embryos was recently studied by Johnson and Attramadal (1982).

Pleopods

The pleopods (Figure 3.6) are morphologically very uniform throughout all tanaidomorphan families. The basis articulates with a one-segmented **exopodite** and a one-segmented **endopodite**. The outer border of the exopodite bears a row of many, long, pinnate setae, while the entire inner border remains unarmed (naked). The outer border of the endopodite is similar to that of the exopodite. The inner border bears at least one distal seta, but it may have several setae in some species of the Tanaidae.

Variation in setation is quite common and may be taxonomically valuable. Very often the outer margin of the exopodite bears a proximal "specialized" seta spatially separated by a distinct gap from the other setae (Figure 3.6). This seta typically is slightly stouter than the others and is not pinnate, but pilose. Reduction in the number of setae is very common and, therefore, both pleopodal rami may bear only a few distal setae. Frequently, these setae may not have pinnae, consequently, are naked.

In the adults of some species, pleopodal setation is absent, but much more common is the complete loss of the pleopods. Since **manca-stages** and **juveniles** of several species also lack pleopods, this character has to be used with caution, since the juveniles of one species could be confused with the adults of other species.

Sexual dimorphism is observed in all those species in which "swimming males" have been reported. Often the females lack pleopods while the corresponding males have very large ones [e.g., *Pseudotanais forcipatus* (Lilljeborg, 1864)].

Uropods

The uropods (Figure 3.6), which articulate on the pleotelson, are the last pair of appendages. They are typically biramous structures consisting of a one-segmented basis, a short exopodite, and a longer endopodite. In contrast to the Apseudoidea, the uropods within the Tanaidomorpha are not filiform, but are styliform. The only tanaidomorphan species that have uropods morphologically similar to those of the Apseudoidea are some species of the Tanaidae.

Reductions in the number of exopodal and endopodal segments is a common feature and has great taxonomic relevance. Generally, the plesiomorphic families (e.g., Tanaidae and Leptocheliidae) typically have more than two endopodal segments, while the more derived ones (e.g., Anarthruridae, Pseudotanaidae, and Typhlotanaidae) never have more than two.

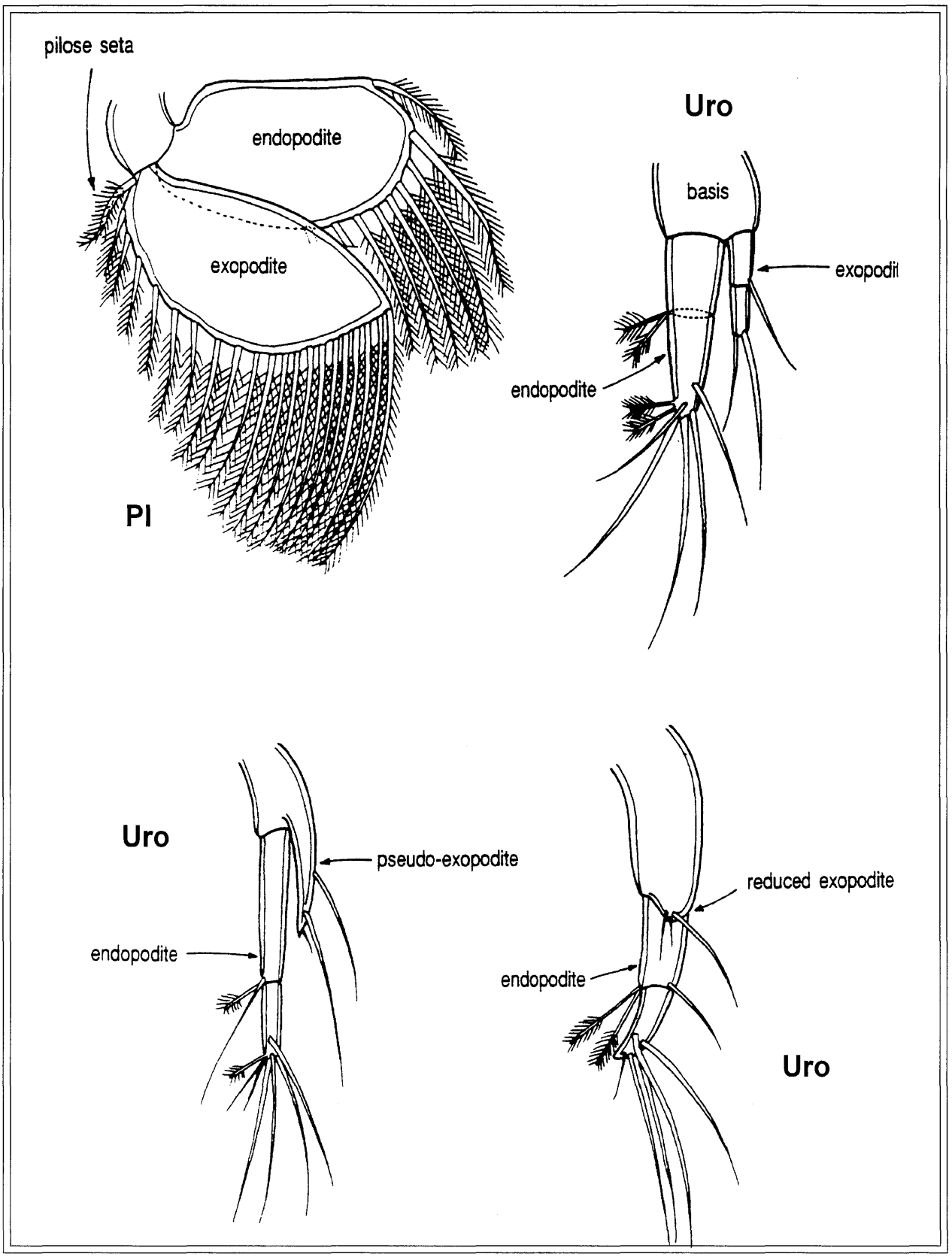

Figure 3.6. Generalized tanaidomorphan pleopod and representative examples of uropods.

The exopodite also has undergone some morphological changes. In some taxa, e.g., the entire family Tanaidae, the exopodite is absent. A much more common modification is the fusion of an exopodal remnant with the basis, a feature found in some genera of the anarthruran subfamily Akanthophoreinae.

The uropod may be sexually dimorphic is some taxa. The uropod in the female of *Siphonolabrum fastigatum* Sieg, 1986 has the exopodite fused to the basis and the endopodite is two-segmented. The male, in contrast, has a small but free exopodite and the endopodite seems to be three-segmented (Figure 3.13).

Internal Anatomy

The internal morphology of tanaids is still poorly known, especially that of the Tanaidomorpha. For detailed light-microscopical studies of the internal anatomy of tanaids, the reader is directed to Siewing (1953) and Lauterbach (1970). Only a brief account is provided herein.

The nervous system consists of a brain, a subesophageal mass, and a ventral chain. The eyes are sessile, if present, and may or may not have visual elements. The **alimentary tract** consists of a ventral mouth, a stomach (part of the **foregut**) which is divided into a filter and a masticatory chamber, a syncytial midgut, and a terminal anus. There are two pairs of **hepatopancreases**, and one pair of **maxillary glands** for excretion. The gonads are paired; the **ovaries** are connected to the **oviducts** which open laterally at the base of the sixth pair of thoracic legs; the testes are connected to one or two **genital cones** on the last thoracic segments via the **vas deferentia**.

Development

Sexual dimorphism is common, but present only when accompanied by **hermaphroditism**, **protogyny**, and possibly **protandry**. Females produce several broods. Development of eggs takes place inside a marsupium. The post-marsupial development of the order is only partly understood. In all cases, development is direct and there is no planktonic larval stage. After hatching, the embryo, still contained within the broodpouch, changes (without a molt) to the first post- embryonic stage (manca-I); the last pair of pereopods and all pleopods have not yet developed. In the second stage (manca-II), the rudiments (anlage) of these appendages are present. In addition to these differences, both manca stages can be distinguished from the adult by the proportionately smaller pereonites. The next stage is termed "**neuter**" and represents the preparatory female/male which is followed by the adult. Post-embryonic instars and adult females resemble each other closely, but usually differ markedly from the males, which often do not feed, having reduced mouthparts, and a sealed anus.

Apseudomorphans are probably all primarily **gonochoristic** (Sieg, 1984a) and follow the post-embryonic development of *Pagurapseudes largoensis* reported by Messing (1979). Sexual dimorphism among members of this suborder is only weakly developed, and is reflected in the first antenna and cheliped.

On the other hand, members of the Tanaidomorpha exhibit a great variety of post-marsupial developmental pathways. A gonochoristic type of development similar to that of the Apseudomorpha is found in the plesiomorphic tanaidomorphan taxa (e.g., Tanaidae). Reduction of the mouthparts in the male phase sometimes leads to a highly complicated post-marsupial development expressed by up to four different types of males (e.g., Leptocheliidae). Mainly, the secondary males may show strongly developed dimorphism resulting in huge and striking chelipeds as well as totally different first antenna. More apomorphic families (e.g., Anarthruridae, Pseudotanaidae, and others) are also gonochoristic, but the sole primary male is adapted for the search of the female ("swimming male"). However, since males have not yet been discovered for many taxa, parthenogenesis may be the means of reproduction in these genera. Sexual dimorphism and protogyny are common in this suborder.

Ecology and Biology

Tanaids normally build tubes by spinning silk produced by glands having their outlet on the dactylar tips of the first to third pereopods. During construction, feces and detritus are added to the silk. These tubes can be found in the sediment or among algae, hydroids, and sponges. The presence of these tubes in fine sediment may reduce erosion, thus resulting in a more stable sandy bottom. When building a new tube, juveniles bore through the wall of the "mother tube" and build their own nearby (Bückle-Ramirez, 1965). Therefore, tanaidaceans have patchy distribution with high population densities. High population densities on the magnitude of 10^4 to 10^5 / m^{-2} can be observed in shallow waters. Consequently, they are an important part of the food web within marine ecosystems: tanaids serve as food for polychaetes, amphipods, decapods, fishes, and some water birds.

Analyses of the stomach and gut contents indicate that tanaids are usually scavengers or detritivores, although some may be raptorial carnivores. Their food normally consists of detritus or small algae, mainly diatoms. They may occasionally feed on nematodes and harpacticoids (Feller, 1978). Only the kalliapseudids are filter feeders (Lang, 1956a) as indicated by the setal structure on their maxilliped and cheliped (Sieg, 1984a).

Very little is known concerning habitat preference. Within the suborder Tanaidomorpha, there are some indications that several families occur in more or less regularly distinct habitats. For example, Tanaidae are common in algal mats. If there is also plenty of sediment between these algal filaments, members of the family Paratanaidae are also found in this habitat, although they are more typical of sandy bottoms. If the sand is less coarse or if the percentage of mud increases, members of the Leptognathiinae and Pseudotanaidae would replace members of these other families.

Zoogeographic Distribution

Tanaids have a worldwide distribution, inhabiting the intertidal zone down to the hadal zone (nearly 8,000 m depth). This order is not well known from tropical waters and in the deep sea, simply because the group has not been extensively studied from these regions. It does, however, appear to be well represented in the deep sea (e.g., Holdich and Bird, 1985; Sieg, 1983a, 1984a). Even though tanaids are not very diverse in shallow waters, the few species that are present in a specific locality may be very abundant there (Barnard, 1970). As in other peracarids, tanaids also show an increase in species diversity with increasing depth (Hessler *et al.*, 1979). According to Wolff (1977), tanaids may comprise as much as 19% (by number) of the benthic macrofauna at 5,000 m depth, and quite often the order is found to be the second most abundant peracarid group, next to amphipods, in ecological studies of the deep sea.

The zoogeography, and even the descriptive distributional patterns, of the Tanaidacea have been so far largely ignored by biologists. This is mainly a result of the difficulty in accumulating and analyzing the information (data) contained in the scattered literature. Recent monographic revisions (Gardiner, 1975; Sieg, 1977a, 1980b) and a bibliographic index listing all known literature pertaining to this order (Sieg, 1983b) have helped in the compilation of the published literature. In an attempt to help analyze distributional patterns, an EDP-database was established at the Universität Osnabruck, Abteilung Vechta (Sieg, 1984). Initial use of this database aided in the recognition and understanding of the distributional patterns of a few families (Sieg, 1980b, 1983b) and species composition within a given area (Sieg and Heard, 1983). The most comprehensive use of this database involved all the available information on the Tanaidacea and allowed the study of worldwide distributional patterns of this order (Sieg, 1986b).

Data has revealed that the shallow water regions of the southern hemisphere, specifically around Antarctica, may have been the "evolutionary center" for this order (Sieg, 1986b). A large number of tanaid families and genera, along with a very high degree of endemism, supports this contention.

The tanaid composition between the temperate North Atlantic and the temperate North Pacific regions are very different. The North Atlantic has been studied more in relation to tanaids than the North Pacific, which may account, in part, for the huge difference between these two areas: the great dissimilarity between these areas may be more apparent than real. Since our tanaidacean fauna of the southern temperate region is still only poorly known, especially in the southern part of South America and in the New Zealand area, comparisons among it and other zoogeographic areas may be preliminary at best. Our scanty information suggests that the northern temperate waters of the Pacific and the Atlantic Oceans share a more similar tanaid composition with the tropical warm waters of these oceans than with the southern temperate regions of these bodies of water.

The tropical warm water areas of the Atlantic, Indian, Indo-West Pacific, and Pacific zoogeographic subregions are more diverse than the northern or southern temperate zones and are different from each other, i.e., characterized by independent species compositions. In contrast to isopods and amphipods, tanaids may have their greatest number of species within the tropics. The Atlantic tropical subregion appears to have a more diverse tanaidacean fauna than the Pacific tropical subregion, but, as in the temperate waters, this may be an artifact of our past preference for studying the Atlantic Ocean. The tanaid fauna of the tropical Atlantic region, which includes the Caribbean Sea, Gulf of Mexico, and Mediterranean Sea, seems to have a closer relationship to that of the tropical Pacific than to the Indian Ocean. The Indo-West Pacific fauna shares some species with both the tropical Pacific and Indian Oceans, a result consistent with its intermediate geographic position between these two oceans.

Depth Distribution

The distribution of tanaids in relation to the depth has been summarized (Sieg, 1983a, 1986b). Several generalities concerning the tanaid families have been noted. For example, the Apseudidae appears to have a large bathymetric range, extending from shallow water (0-200 m) to nearly 6,000 m.

The Neotanaidae (not treated in this atlas), the lone family within the suborder Neotanaidomorpha, is typically deep sea. The depth-distribution of this family has been discussed by Wolff (1956) and Gardiner (1975).

Finally, the depth-distribution of the Tanaidomorpha has been reviewed by Sieg (1983a, 1986b). The plesiomorphic families (i.e., Tanaidae, Leptocheliidae, and Paratanaidae) are, with some exceptions, shallow-water taxa. The more derived families (i.e., Anarthruridae, Typhlotanaidae, and Pseudotanaidae) occur throughout a broad depth range from shallow water to hadal depths (below 6,000 m). The Leptognathiinae, a subfamily of the Anarthruridae, exhibit a high species diversity at bathyal depths (200-2,000 m), which gradually decreases in abyssal (2,000-6,000 m) and hadal depths.

In general, a relatively large number of tanaid species, contrary to most other crustaceans, appear to have broad depth ranges, ranging from shallow water to the deep sea. However, as the taxonomy of the Tanaidacea becomes better known, this perception may be modified.

Materials and Methods

The specimens examined were part of an extensive voucher collection of Crustacea collected for the MMS/Santa Maria Basin and Western Santa Barbara Channel Study and Atlas, supplemental MMS material from the bulk collection obtained from Battelle, a collection of Tanaidacea housed at the Los Angeles County Museum of Natural History, and specimens collected by the Biology Laboratory, Environmental Monitoring Division, Bureau of Sanitation, Department of Public Works of the City of Los

Angeles. Selected specimens were measured and dissected in glycerol. The appendages were mounted on slides according to the procedure described by Sieg (1973).

All type and non-type specimens have been deposited in the National Museum of Natural History and Santa Barbara Museum of Natural History and the National Museum of Natural History (Smithsonian Institution), except those on loan from the Los Angeles County Museum of Natural History.

Acknowledgements

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Abbreviations Used in Keys and Figures

A.1 = first antenna

A.2 = second antenna

L = labrum

Md(r) = right mandible

Md(l) = left mandible

Mx.1 = first maxilla

Mx.2 = second maxilla

La = labium

Mxp = maxilliped

Epi = epignath

Che = cheliped

P.1-P.6 = pereopods 1-6

Pl.1-Pl.5 = pleopods 1-5

Plt = pleotelson

Uro = uropod

Glossary

The following terms are defined with respect to their application to the Tanaidacea.

Abdomen: See pleon.

Aesthetasc: A setiform element, thin-walled (not sclerotized), cylindrical throughout entire length, with blunt tip, probably chemosensory, and occurring exclusively on flagellum of antenna 1.

Antenna: Second pair of cephalic appendages (Antenna 2).

Antennule: First pair of cephalic appendages (Antenna 1).

Alimentary tract: Tubular structure between mouth and anus, consisting of foregut, midgut, and hindgut, and associated with hepatopancreas.

Basis: Second segment (article) of thoracic and abdominal appendages; **sympodal** segment immediately distal to coxa and carrying the rami.

Biramous: A term used to describe an appendage having two rami (branches), an exopodite and endopodite.

Branchial chamber: Cavity between carapace and body wall into which the maxillular palp and the epignath extend; synonymous with respiratory chamber.

Brood pouch: See marsupium.

Brood sac: Specialized marsupium of the family Tanaidae; each sac-like oostegite ("ovisac" sensu Lang, 1960) houses eggs within its cavity.

Carapace: Outgrowth of the maxillary segment which is fused with tergites of first and second thoracomere; it is curved ventrally, covered on its inner surface with a respiratory epithelium, and encloses respiratory chamber.

Carpus: Fifth segment (article) of thoracic appendages.

Caudal: Term introduced by Lang (1968) to describe a specific surface or border of body somite or appendage; synonymous with posterior.

Cephalon: Anteriormost part of body, bearing eyes (when present), mouth, two pairs of antennae and mouthparts, excluding maxilliped.

Cephalothorax: Anterior tagma resulting from fusion of cephalon and first two thoracomeres.

Chela: Distal end of cheliped formed by propodus and dactylus.

Cheliped: Second pair of thoracic appendages, adjacent and posterior to maxilliped.

Claw: Fusion of dactylus and terminal spine in pereopods.

Coxa: First segment (article) of thoracic and abdominal appendages; sympodal segment proximal to basis.

Dactylus: Seventh segment (article) of thoracic appendages.

Endite: Medially-directed projection of coxa or basis.

Endopodite (endopod): Inner ramus of thoracic and abdominal appendages.

Epignath: Epipodite of maxilliped.

Epipodite: Exite of coxa with branchial function; exclusively found on maxilliped.

Epistome: Portion of cephalothorax of male, posterior to labrum and consisting of fused remnants of mouthparts.

Exopodite (exopod): Outer ramus of thoracic and abdominal appendages.

Flagellum: Multisegmented distal portion (ramus) of antenna 1 or 2.

Fixed finger: Distally-directed projection of chelipedal propodus.

Foregut: Anterior part of alimentary tract, consisting of esophagus and stomach.

Genital cones: Conical projection on sternite of sixth pereonite of male; this projection bears one or two gonopores.

Gonochoristic: Sexes separate; condition in which individuals remain the same sex throughout their entire life cycle.

Grinding area: Flat distal end of processus molaris which typically is surrounded by a slightly crenulated wall; often reduced or lacking.

Hepatopancreas: Caeca located at border of fore- and hindgut and mostly directed posteriorly; occasionally one pair is directed anteriorly.

Hermaphroditism: Condition in which individuals develop functional male and female genital organs - either simultaneously or sequentially.

Hypopharynx: See labium.

Hyposphaenium (pl. hyposphaenia): Process (hook) on sternite of pereonite or pleonite.

Incisor process: See pars incisiva.

Ischium: Third segment (article) of thoracic appendages.

Juveniles: Post-embryonic stages that show neither sexually defined morphological structure nor have developed functional gonads.

Labium: Flat, bilobed structure situated posterior to mouth, with or without a one-segmented distal palp; not homologous with a segmental appendage; lower lip.

Labrum: Bulbous, hood-like structure situated anterior to mouth; upper lip.

Lacinia mobilis: Articulated "cutting blade" of mandible;developed mainly on left mandible, very often absent on right mandible.

Lower lip: See labium.

Manca(-stage): Post-embryonic developmental stage, lacking sixth pereopod and pleopods (Manca-I) or having rudiments of these appendages (Manca-II).

Mandibles: Pair of appendages immediately posterior to labrum; functions in masticating food.

Marsupium: Ventral chamber in female formed by oostegites in which eggs and embryos are brooded.

Maxillae: Third pair of mouthparts (maxilla 2).

Maxillary gland: Excretory organ situated in maxillary somite with its opening on maxilla.

Maxilliped: First pair of thoracic appendages; specialized for feeding.

Maxillules: Second pair of mouthparts (maxilla 1).

Merus: Fourth segment (article) of thoracic appendages.

Molar process: See pars molaris.

Neuter: Post-embryonic stage with full set of pereopods and pleopods, but without developed gonads ("juveniles").

Ocellus: A simple eye or pigment spot functioning as light receptor.

Oostegite: Normally thin, flat plates arising from inner margin of coxae of pereopods 1 - 4 or only 4.

Ovary: Female gonad.

Oviduct: Tube in female for passage of ova from ovary to gonopores.

Ovisacs: Marsupium of Tanaidae; saclike structure within which eggs are brooded.

Palpus (or palp): Segmented or unsegmented structures of different origin in mandible, maxilla 1, labium, and maxilliped.

Paragnath: See labium.

Pars incisiva: Fixed (non-articulated) distal "cutting blade" of mandible; synonymous with incisor process.

Pars molaris: Medial projection of mandible originally used for grinding; synonymous with molar process.

Peduncle: First three segments of antenna 1 and first five segments of antenna 2.

Pereon: Free thoracomeres 3-8; anterior portion of trunk, excluding maxillipedal and chelipedal somites.

Pereonite: Somite belonging to the pereon.

Pereopod: Walking leg; appendage belonging to one of six free thoracomeres (3-8).

Pleon: Posteriormost body tagma, consisting of pleonites and pleotelson.

Pleonite: Somite belonging to pleon.

Pleopod: Appendage of pleonite, often natatory.

Pleotelson: Structure resulting from fusion of at least sixth pleomere (abdominal somite) and telson.

Propodus: Sixth segment (article) of thoracic appendages.

Protandry (adj. protandrous): Hermaphroditism in which functional male phase precedes female phase.

Protopodite (protopod): First two segments (coxa and basis) of thoracic or abdominal appendages; synonymous with sympodite (adj. sympodal).

Protogyny (adj. protogynous): Hermaphroditism in which functional female phase precedes male phase.

Pseudobiramous: Condition in which two rami are present in uropods, but one is fused to proximal segment (basis).

Pseudo-coxa: Posterior part of cephalothorax to which cheliped articulates.

Rostral: Synonymous with anterior (Lang, 1968); see caudal.

Side-piece: Sclerite articulated on one side to carapace and on other side to area posterior to a distal projection of chelipedal basis; formerly called coxa.

Somite: Body segment, usually covered with sclerotized tergite and sternite.

Sternal: Term introduced by Lang (1968) to describe a specific surface of body somite or appendage; synonymous with ventral.

Sternite: Ventral sclerotized surface of body.

Subadult males: Second juvenile stage of males that are sexually mature.

Swimming male: Highly transformed male having a large pleon with well-developed pleopods and a small pereon; mouthparts reduced, except maxilliped.

Sympodite (adj. sympodal): First two segments (coxa and basis) of thoracic or abdominal appendages; synonymous with protopod(ite).

Telson: Posteriormost part of body, bearing anus; in Recent tanaidaceans always fused to sixth pleonite to form pleotelson.

Tergal: Synonymous with dorsal (Lang, 1968); see sternal.

Tergite: Sclerotized dorsal surface of body.

Testes: Male gonads.

Thoracic glands: Compound glands lying in first three pereonites and secreting silk-like substances that are transported via a channel to end of dactylus and used for constructing tubes; restricted to Tanaidomorpha.

Thoracomere: Thoracic somite; in tanaidaceans first and second thoracomeres are fused with cephalon and bear specialized appendages, maxilliped and cheliped, respectively.

Uniramous: A term used to describe an appendage having only one ramus (branch), an exopodite or endopodite.

Upper lip: See labrum.

Uropods: Styliform abdominal appendages of the pleotelson; usually biramous, but often uniramous or pseudobiramous.

Vas deferentia: Tubes in male for passage of sperm from testes to gonopores.

List of Species

Suborder Apseudomorpha Sieg, 1980
- Family Apseudidae Leach, 1814
  - Genus *Carpoapseudes* Lang, 1968
    - ***Carpoapseudes caraspinosus* Dojiri and Sieg, new species**

Suborder Tanaidomorpha Sieg, 1980
- Family Tanaidae Dana, 1849
  - Genus *Zeuxo* Templeton, 1840
    - *Zeuxo maledivensis* Sieg, 1980
- Family Leptocheliidae Lang, 1973
  - Genus *Leptochelia* Dana, 1849
    - *Leptochelia dubia* (Krøyer, 1814)
- Family Paratanaidae Lang, 1949
  - Genus *Paratanais* Dana, 1849
    - ***Paratanais intermedius* Dojiri and Sieg, new species**
- Family Anarthruridae Lang, 1971
  - Subfamily Anarthrurinae Lang, 1971
  - Genus *Siphonolabrum* Lang, 1972
    - ***Siphonolabrum californiensis* Dojiri and Sieg, new species**
  - Subfamily Akanthophoreinae Sieg, 1986
  - Genus *Paraleptognathia* Kudinova-Pasternak, 1981
    - *Paraleptognathia* cf. *gracilis* (Krøyer, 1842)
    - ***Paraleptognathia bisetulosa* Dojiri and Sieg, new species**
  - Genus *Scoloura* Sieg and Dojiri, 1991
    - *Scoloura phillipsi* Sieg and Dojiri, 1991
  - Genus ***Chauliopleona* Dojiri and Sieg, new genus**
    - ***Chauliopleona dentata* Dojiri and Sieg, new species**
  - Genus *Araphura* Bird and Holdich, 1984
    - ***Araphura breviaria* Dojiri and Sieg, new species**
    - ***Araphura cuspirostris* Dojiri and Sieg, new species**
  - Genus *Tanaella* Norman and Stebbing, 1886
    - ***Tanaella propinquus* Dojiri and Sieg, new species**
  - Genus *Incertae Sedis*
    - Male species 1
    - Male species 2
    - Male species 3
  - Subfamily Leptognathiinae Sieg, 1973
  - Genus *Leptognathia* G.O. Sars, 1882
    - *Leptognathia* cf. *breviremis* (Lilljeborg, 1864)
  - Genus *Tanaopsis* G.O. Sars, 1896
    - *Tanaopsis cadieni* Sieg and Dojiri, 1991
- Family Typhlotanaidae Sieg, 1984
  - Genus *Typhlotanais* G.O. Sars, 1882
    - ***Typhlotanais williamsae* Dojiri and Sieg, new species**
    - ***Typhlotanais crassus* Dojiri and Sieg, new species**
- Family Pseudotanaidae Sieg, 1973
  - Genus *Pseudotanais* G.O. Sars, 1882
    - ***Pseudotanais makrothrix* Dojiri and Sieg, new species**
    - ***Pseudotanais californiensis* Dojiri and Sieg, new species**

Key to Families

1A. A.1 biramous; Md with palp (suborder Apseudomorpha) ..... *Carpoapseudes caraspinosus*

1B. A.1 uniramous; Md without palp (suborder Tanaidomorpha) 2

2A. Mouthparts (except maxillipeds in some families) reduced to lobiform structures (generally males) . 9

2B. Mouthparts not reduced (females and some males) 3

3A. P.1 - P.6 without ischium; Uro uniramous; Mxp with coxa and with basis not fused medially; last 2 pleonites smaller than 3 preceding ones (occasionally with only 3 or 4 pleonites), with 3 pairs of pleopods ..... Tanaidae

3B. P.1 - P.6 with ischium; Uro typically biramous, sometimes pseudobiramous; Mxp without coxa, basis fused or unfused medially; typically with 5 pleonites of equal size 4

4A. Endopodite of Uro at most with 2 segments 5

4B Endopodite of Uro with more than 2 segments (Mxp not fused medially; with eyes) .... Leptocheliidae

5A. Endite of Mxp enlarged and laterally expanded ..... Paratanaidae

5B. Endite of Mxp not enlarged nor laterally expanded 6

6A. Merus of P.1 with 1 tergal spine; dactylus of characteristic shape (elongate, semicircular in cross-section, and both margins covered with fine setules), not fused with terminal spine .... Anarthruridae (subfamily Akanthophoreinae and subfamily Anarthrurinae)

6B. Merus of P.1 with setae only; dactylus of typical shape (not elongate), usually fused to terminal spine 7

7A. Pars molaris of Md broad, grinding area surrounded by crenulated wall ..... Typhlotanaidae

7B. Pars molaris of Md reduced, small, grinding area without crenulated wall, and terminating as an attenuate process or several points, or bearing several spiniform elements 8

8A. Carpus of P.2 with 1 tergal spine; pereonites 1 and 2 extremely small, about 5-7× broader than long; marsupium formed by only 1 pair of oostegites ..... Pseudotanaidae

8B Carpus of P.2 with only setae; pereonites 1 and 2 of typical shape, mostly about 3-4× broader than long; marsupium formed by 4 pairs of oostegites ..... Anarthruridae (subfamily Leptognathiinae)

9A. With eyes 10

9B Without eyes 11

10A. Mxp reduced to lobiform structure, lacking palpus; A.1 with more than 7 segments; Che much larger than and different in shape from that of female ..... Leptocheliidae (males)

10B. Mxp not reduced to lobiform structure, but modified from that of female, palpus always present; A.1 with 7 (?) segments, first 2 segments distinctly broader than remaining ones; Che of similar size and shape to that of female ..... Paratanaidae (males)

11A. Che articulated to cephalothorax along proximal margin of basis ..... Anarthruridae (males - subfamily Anarthrurinae)

11B. Che articulated to cephalothorax by a "side-piece" along distal lateral margin of basis 12

12A. Merus of P.1 with tergal spine ..... Anarthruridae (males - subfamily Akanthophoreinae)

12B. Merus of P.1 with only setae 13

13A. Last 3 segments of A.1 of similar length ..... Typhlotanaidae (males)

13B. Last 2 segments of A.1 of similar length ..... Pseudotanaidae (males) and Anarthruridae (males - subfamily Leptognathiinae)

Key to Genera and Species

Note: Genera enclosed within brackets are those that have been reported from California, but were not represented in the present study. Species enclosed within brackets indicate males that were not collected.

1A. With eyes 2

1B. Without eyes 12

2A. P.1 - P.6 without ischium 3

2B. P.1 - P.6 with ischium 7

3A. Pleon with more than 3 pleonites 4

3B. Pleon with 3 pleonites ..... [*Pancolus*]

4A. Uro long and slender, each segment more than twice as long as broad ..... [*Synaptotanais*]

4B. Uro short, each segment twice as long as broad 5

5A. Pleon with 4 pleonites ..... [*Sinelobus*]

5B. Pleon with 5 pleonites (last 2 pleonites distinctly smaller than preceding ones) 6

6A. First segment of A.1 twice as long as second segment ..... [*Anatanais*]

6B. First segment of A.1 2.5× (nearly 3x) longer than second segment (genus *Zeuxo*) ..... *Zeuxo maledivensis*

7A. A.1 with more than 3 segments 8

7B. A.1 with 3 segments 11

8A. A.1 with more than 4 segments (exclusively males) 9

8B. A.1 4-segmented (genus *Paratanais*) ..... *Paratanais intermedius*

9A. A.1 with more than 7 segments; all mouthparts reduced to lobiform structures; Uro endopodite with more than 2 segments (genus *Leptochelia*) ..... [*Leptochelia dubia*, male]

9B. A.1 with 6-7 segments; mouthparts except Mxp reduced to lobiform structures; Uro endopodite with 2 segments 10

10A. A.1 7-segmented (genus *Pseudotanais*, in part) ..... [*Pseudotanais makrothrix*, male]

10B A.1 6-segmented (genus *Paratanais*) ..... [*Paratanais intermedius*, male]

11A. Endopodite of Uro with more than 2 segments; basis of Mxp not fused medially (genus *Leptochelia*) ..... *Leptochelia dubia*

11B. Endopodite of Uro 2-segmented; basis of Mxp fused medially (genus *Pseudotanais*) ..... *Pseudotanais makrothrix*

12A. A.1 7-segmented, first and second segments laterally compressed, flagellar segments with many aesthetascs; mouthparts, except Mxp, reduced to lobiform structures (exclusively males) 26

12B. A.1 3- to 5-segmented, first and second segments cylindrical, only 1 terminal aesthetasc; mouthparts not reduced 13

13A. A.1 3- or 4-segmented 14

13B. A.1 5-segmented (exclusively subadult males of *Chauliopleona*, *Paraleptognathia*, and possibly *Scoloura*) 19

14A. A.1 4-segmented 15

14B. A.1 3-segmented 24

15A. Che articulated to cephalothorax by a "side-piece" along distal lateral margin of basis 16

15B. Che articulated to cephalothorax along proximal margin of basis (genus *Siphonolabrum*) ..... *Siphonolabrum californiensis*

16A. Uro with exopodite fused to basis (pseudobiramous) 17

16B. Uro with exopodite not fused to basis (biramous) 19

17A. Exopodite of Uro represented by a well-developed projection, occasionally reaching length of first endopodal segment (genus *Araphura*) 18

17B. Exopodite of Uro only represented by a tiny, knoblike projection on basis (genus *Tanaella*) ..... *Tanaella propinquus*

18A. Pleotelson short, with lateral borders relatively straight, and without knoblike process on posterior margin ..... *Araphura breviaria*

18B. Pleotelson long, subquadrate, with slightly concave lateral borders, and with knoblike process on posterior margin ..... *Araphura cuspirostris*

19A. Pleotelson with large, ventrolateral, triangular process (genus *Scoloura*) ..... *Scoloura phillipsi*

19B. Pleotelson without such a process 20

20A. Last pleonite with a large, midventral, caudally-directed spiniform process that reaches more than half the length of the pleotelson (genus *Chauliopleona*) ..... *Chauliopleona dentata*

20B. Last pleonite without such a process 21

21A. Merus of P.1 with exclusively setae or unarmed 22

21B. Merus of P.1 with a tergal spine ..... *Paraleptognathia* cf. *gracilis*

22A. Merus of P.1 with 2 long, strong setae, both as long as carpus ..... *Paraleptognathia bisetulosa*

22B. Merus of P.1 unarmed or with only short setae, never as long as carpus 23

23A. Coxa of P.1 with well-developed, rostrally-directed, triangular process; merus of P.1 unarmed (genus *Tanaopsis*) ..... *Tanaopsis cadieni*

23B. Coxa of P.1 without such a process; merus of P.1 with 1 seta (genus *Leptognathia*) ..... *Leptognathia* cf. *breviremis*

24A. Pereonites 1 and 2 extremely small, typically both pereonites together as long as third pereonite; pars molaris reduced to various degrees (genus *Pseudotanais* G.O. Sars, 1882) ..... *Pseudotanais californiensis*

24B. Pereonites 1 and 2 of normal size, both pereonites together longer than pereonite 3; pars molaris not reduced, with broad grinding area surrounded by a crenulated wall (genus *Typhlotanais*) 25

25A. Lateral borders of pereonites nearly parallel; Uro with exopodite and endopodite indistinctly 2-segmented; exopodite only slightly longer than first endopodal segment; sternal border of propodus in P.2 with 2 setae of equal size ..... *Typhlotanais williamsae*

25B. Lateral borders of pereonites convex; Uro with endo- and exopodite 1-segmented, exopodite slender, reaching about 2/3 endopodal length; sternal border of propodus in P.2 with 1 short and 1 long setae (exceeding combined length of dactylus and terminal spine) ..... *Typhlotanais crassus*

26A. Che articulated to cephalothorax by a "side-piece" along distal lateral margin of basis; Mxp endite with short distal seta 27

26B. Che articulated to cephalothorax along proximal margin of basis; Mxp endite with long distal seta (genus *Siphonolabrum*) ..... [*Siphonolabrum californiensis*, male]

27A. Merus of P.1 exclusively with seta(e) or unarmed 30

27B. Merus of P.1 with at least 1 tergal spine (subfamily Akanthophoreinae) 28

28A. Uro with endopodite 3-segmented; caudo-distal part of chelipedal carpus not expanded; P.1 - P.3 with tergal spines of merus and carpus short, reaching only 1/3 length of following segment 29

28B. Uro with endopodite 2-segmented; caudo-distal part of chelipedal carpus expanded; P.1 - P.3 with tergal spines of merus and carpus long, reaching about midlength of following segment (probably genus *Chauliopleona*) ..... male species 1

29A. Ischium of P.6 with 2 small setae; cephalothorax with anterior part distinctly smaller than posterior part; Pl with outer margin of exopodite denticulated ..... male species 3

29B. Ischium of P.6 with 1 spine and 1 small seta; cephalothorax with anterior part not distinctly smaller than posterior part; Pl lacking denticles on outer margin of exopodite ..... male species 2

30A. A.1 with segment 3 about twice as long as broad (genus *Pseudotanais*) .....
..... [*Pseudotanais californiensis*, male]

30B. A.1 with segment 3 annular (much shorter than long) (genus *Tanaopsis*)
.....[*Tanaopsis cadieni*, male]

Descriptions of Species

Suborder Apseudomorpha Sieg, 1980

Family Apseudidae Leach, 1814

Genus *Carpoapseudes* Lang, 1968

Carpoapseudes caraspinosus Dojiri and Sieg, new species

Figure 3.7

Type Material. Specimen (holotype, with P.1 and Che missing; USNM 284720) from cruise 3-4, Sta. R-7 (rep. 2), 34°52.90'N 121°10.30'W, 565 m, off Purisima Point, Santa Maria Basin, California, originally identified as *Apseudes gracilis*; specimen (paratype, dissected; SBMNH 144122) from Sta. BSR-28, 35°04.22'N 121°19.65'W, 603 m, southwest of Pt. San Luis, Santa Maria Basin, California, originally identified as *Apseudes gracilis*.

Description. (Figure 3.7). Body, 5.5 mm, about 5× longer than broad, and with 5 pairs of oostegites (cheliped with 1 pair of reduced oostegites). Cephalothorax trapezoid in general outline; midlaterally separated by indentation and 1 small thorn; anterior half also equally rounded; rostrum large, spear-shaped; eyelobes large, pointed, without visual elements. Pereonites 1 and 2 lacking spines (very often with well-developed coxal spines of P.1 and P.2 mistaken for pereonal spines), 3.5-4.0× broader than long; pereonites 4-6 with posteriorly expanded protrusions at insertion of pereopods; coxa with small thorn (often mistaken for pereonal spines); pereonite 3 about 1.5× broader than long, with long anteriorly, slightly curved thorns; pereonites 4 and 5 about 1.25× longer than broad, with laterally-directed thorns; pereonite 6 also 1.5× broader than long, laterally-directed thorn small. All 5 pleonites of equal size, with well-developed pleurites, 2.5× broader than long.

First antenna with 4-segmented peduncle, 8-segmented inner flagellum, and about 20-segmented outer flagellum; peduncle 1 about twice as long as remaining peduncular segments combined; outer flagellum with about 5 aesthetascs.

Mouthparts of typical apseudoidean shape. Maxillipeds not fused; coxa short, no seta; basis with lateral margin expanded, no setae; palpus 4-segmented, with inner palpal margin with 1 long strong seta, outer margin with 1 short, but strong seta; segments 2-4 bearing typical setation; endite with specialized spine well developed.

Cheliped slender; ischium absent; semicircular coxa of adult females with reduced oostegite; basis 2.5× longer than broad, exopodite well developed, 3-segmented, bearing 4 long pinnate setae terminally, and group of distal setae on sternal margin; merus bent tergally, with sternal margin covered with setae; carpus 2.5× longer than broad, with 2 short distal setae on tergal margin and 3 long and 4 short setae along sternal margin; propodus combined with fixed finger about twice as long as broad, bearing 6 setae sternally, spiniform element at its tip, 1 row of membranous structures (chemoreceptors?) along tergal margin, and 2 caudal setae near articulation of dactylus; dactylus with spine curved caudally, carrying 2 long and 1 short setae.

Pereopod 1 slender, non-fossorial; coxa with large anteriorly-directed projection; basis 4.8× as long as broad, no setae; exopodite 2-segmented, with 6 pinnate setae; ischium small; merus as long as carpus or slightly longer, 2.5× longer than broad, with 3 distal setae on tergal border, 1 row of setae along sternal margin, and 1 distal pinnate spine; carpus 3.7× longer than broad, with 1 row of setae along sternal and tergal margins and 2 pinnate spines distally; propodus short, 1.4× longer than broad, with row of setae along sternal and tergal margins, 1 row of 5 pinnate spines distally, 1 short specialized spine near articulation of dactylus; dactylus half as long as propodus, bearing sternal row of setae (each setal loci consisting of 2 setae) and 3 tergal setae; short terminal (dactylar) spine not fused to dactylus; terminal spine with 2 small setae at base on sternal margin.

Pleopods 1-5 of similar shape, biramous; coxa fused with sternite; basis elongate; exo- and endopodite 1-segmented; inner and outer margins covered with pinnate setae.

Pleotelson long, 2.6× longer than broad.

Uropods only partially known; basis 2.75× longer than broad, with inner margin equipped with several terminal setae; endopodite missing; exopodite 15- to 17-segmented, with 3 long setae and 1 short seta.

Remarks. *Carpoapseudes caraspinosus* represents the only species of the suborder Apseudomorpha Sieg, 1980 collected during the MMS Soft-Bottom Benthic Fauna of the Santa Maria Basin and Western Santa Barbara Channel study.

Carpoapseudes and *Leviapseudes*, both belonging to the subfamily Leviapseudinae within the Whitelegiidae, are closely related to each other. However, both genera are easily separated by the shape of the pleonites. In *Carpoapseudes* the pleonites are broader than long, while those of *Leviapseudes* are triangular and typically longer than broad. Additionally, in *Carpoapseudes* the pleonites show well-developed pleurites, while these are small in *Leviapseudes*. In *Carpoapseudes* the carpus is about 2.5× longer than broad, but in *Leviapseudes* it is almost 4.5× longer than broad.

Carpoapseudes caraspinosus may be distinguished from all its congeners by a combination of characters. So far, all known members of *Carpoapseudes* lack a lateral thorn anterior to the carapace chamber, which is characteristic for species of the genus *Leviapseudes*, while the new species is the only species within its genus that possesses such a small thorn. *Carpoapseudes auritocheles* Kudinova-Pasternak, 1975 and *C. caraspinosus* have anterolateral thorns on pereonite 6. But, these species may be distinguished by the shape of pereonite 2: *C. caraspinosus* lacks anterolateral thorns, while *C. auritocheles* has well-developed ones.

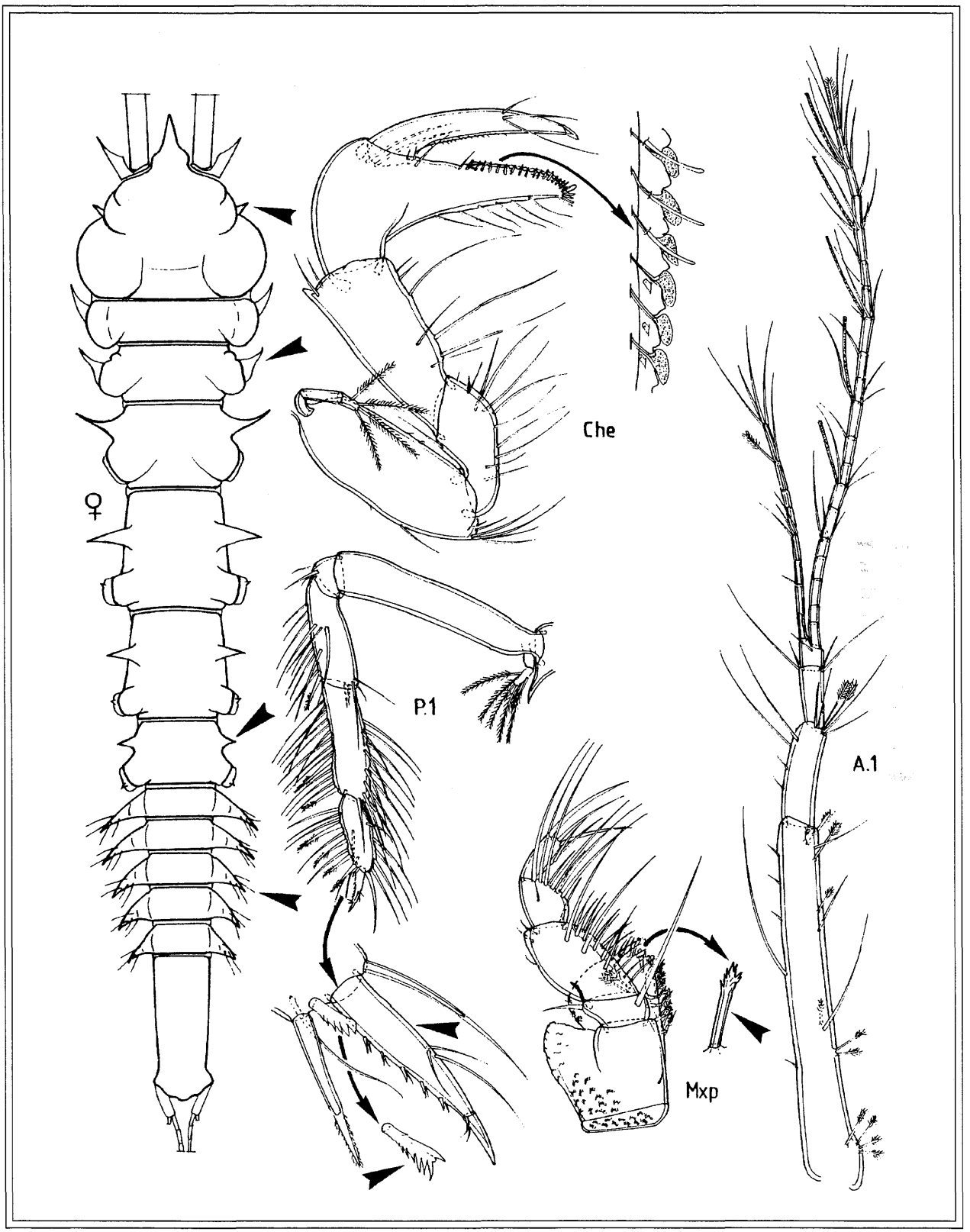

Figure 3.7. ***Carpoapseudes caraspinosus*** **Dojiri and Sieg, new species**, female: ♀, general habitus of female; A.1, first antenna; Mxp, maxilliped; Che, cheliped; P.1, pereopod 1.

Finally, the shape of the specialized propodal spine close to the articulation of the dactylus on P.1 may be characteristic. However, as in many other cases, morphological details are not always examined and reported. Because of these shortcomings, the present taxonomic value of these morphological characters is reduced and do not allow detailed morphological comparisons to be made among the species of this genus.

Etymology. The specific name *caraspinosus* is a combination of the Greek words *cara*, meaning head or top, and *spinosus*, thorny, and alludes to all the spines on the head and body.

Type Locality and Type Specimens. Santa Maria Basin, California. Types deposited in the National Museum of Natural History (USNM 284720) and the Santa Barbara Museum of Natural History (SBMNH 144122); see "Type Material."

Distribution. This species is so far known only from its type locality.

Suborder Tanaidomorpha Sieg, 1980

Family Tanaidae Dana, 1849

Genus *Zeuxo* Templeton, 1840

Zeuxo maledivensis Sieg, 1980

Figure 3.8

Material Examined. 1 neuter (dissected) from Sta. 53, 34°37.96'N 120°50.38'W, 196 m, northwest of Pt. Arguello, Santa Maria Basin, California; 2 neuters from Sta.56, 34°30.32'N 121°01.02'W, 900 m, southwest of Pt. Arguello, Santa Maria Basin, California; 1 male (dissected) from Sta. BRA-6, 35°20.88'N 120°59.62'W, 109 m, between Pt. Estero and Pt. Buchon, Santa Maria Basin, California.

Description (male) (Figure 3.8). Body 3.8× longer than broad. Cephalothorax about as long as broad, tapered at anterior end. Pereonite 1 shortest of pereonal segments; pereonites 1-5 similar in width; pereonites 4 and 5 longest and pereonite 6 narrowest of all pereonites. Pleonites 1-5 divisible into 2 groups: first group consists of pleonites 1-3, with each pleonite about 4× broader than long, bearing pleopod; second group composed of pleonites 4 and 5, with each pleonite about 10× broader than long, lacking pleopod.

First antenna 3-segmented, bearing numerous aesthetascs terminally.

Mandible with broad, flat, crushing pars molaris; 8 hairs (setules) situated at insertion of lacinia mobilis.

Maxilliped with small coxa, each bearing 1 naked seta; basis not fused to opposite member, each bearing single distal seta. Distal margin of each endite with specialized seta, scattered setules, and several curved rows of tiny spinules. Palpus 4-segmented; first segment with lateral seta and a few rows of minute spinules; second segment with approximately 8 medial and 1 lateral setae; third segment with numerous medial setae, many pinnate at tips; inner margin of fourth segment with 7 setae (5 pinnate, 2 naked); outer margin with 2 pinnate setae terminally, 1 naked seta medially.

Cheliped with sternal protuberance articulating with side-piece. Merus small, with small protuberance on sternal distal margin, bearing 2 sternal setae. Carpus stout, about as long as broad, expanded at tergal proximal corner, bearing 1 tergal seta at midlength, 2 distal tergal setae, small rounded sternal protuberance, and 4 sternal setae. Fixed finger broad and bluntly rounded terminally, tipped with small stout spine; tergal and sternal borders with numerous setae. Dactylus with subterminal seta and numerous small, stout spinules on inner (sternal) margin.

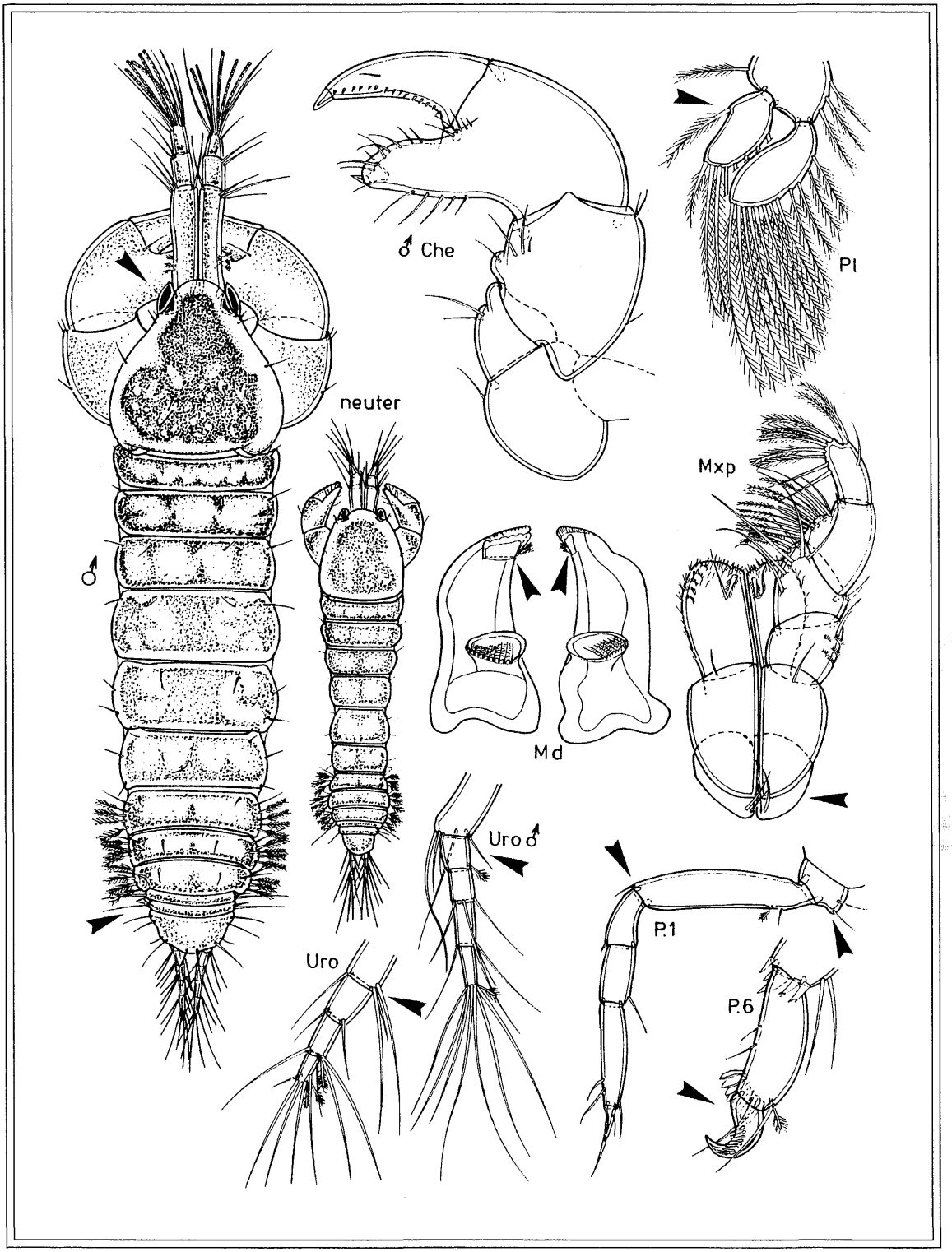

Figure 3.8. *Zeuxo maledivensis* Sieg, 1980 male: ♂, general habitus of male; Md, mandible; Mxp, maxilliped; ♂ Che, cheliped; P.1, pereopod 1; P.6, pereopod 6; Pl, pleopod; Uro ♂, uropod of male; neuter, general habitus of neuter; Uro, uropod of neuter.

Pereopod 1 with coxa bearing a slight protuberance on sternal distal corner near 2 naked setae; basis with proximal hair and setae and sternal distal seta; ischium absent; merus with small tergal distal seta; carpus with 1 long sternal seta; propodus with 4 setae; dactylus slender, with 1 setule; terminal spine not fused to dactylus. Pereopod 6 with carpus bearing 2 naked setae, 3 stout bifid spines, and 2 stout spines; propodus with 2 sternal setae, 3 terminal setae, 1 terminal hair, and several spatulate spines; dactylus clawlike, armed with row of translucent spinules on each side.

Pleopods 1-3 with basis carrying 3 outer pinnate setae and 1 inner pinnate seta; exopodite with numerous outer pinnate setae; endopodite with several outer pinnate setae and 1 inner pinnate seta.

Pleotelson, 2.3× broader than long, with irregular border.

Uropod uniramous; basis with 5 setae. Exopodite absent. Endopodite 4-segmented; first segment with 1 feathered hair; second segment with 3 setae; third segment with 3 setae; fourth segment with 7 setae and 1 feathered hair.

Description (neuter) (Figure 3.8). Body about 4× longer than broad. Cephalothorax about as long as broad. Pereonites tapering posteriorly. Pleonites 1-3 expanded slightly relative to preceding pereonites 5 and 6.

Uropod with endopod only 3-segmented.

Remarks. *Zeuxo maledivensis* Sieg, 1980 is recorded for the first time in California waters. It had previously been recorded only from the Maldives, Japan, and Florida, but it's occurrence in California was predicted by Sieg and Winn (1981:341). So far, a total of eight species belonging to the family Tanaidae have been recorded from the California coast: *Synaptotanais notabilis* Sieg and Winn, 1981, *Sinelobus stanfordi* (Richardson, 1901), *Pancolus californiensis* Richardson, 1905, *Anatanais pseudonormani* Sieg and Winn, 1981, *Zeuxo normani* (Richardson, 1901), *Z. paranormani* Sieg, 1980, and now *Z. maledivensis* Sieg, 1980.

Sinelobus stanfordi and *Pancolus californiensis* are easily recognized by having 4 and 3 pleonites, respectively. *Synaptotanais notabilis* also has 5 pleonites visible dorsally. But, this species differs from *Zeuxo* in having the two reduced pleonites still free and not fused sternally to the pleotelson. Finally, the totally different shape of the uropodal segments makes the distinction between *Synaptotanais notabilis* and *Zeuxo* species quite easy. *Anatanais pseudonormani* may be recognized by the relatively elongate cephalothorax and the large triangular protrusion of the coxa in pereopod 1.

Within *Zeuxo*, the newly recorded species *Z. maledivensis* is characterized by having a slightly reduced lacinia mobilis on the right mandible. This is also true for *Z. normani* and *Z. paranormani*, but *Z. maledivensis* can be distinguished from these two congeners by the pleopodal endopodite which bears only 1 seta, instead of 2 or 3, on the inner border. Finally, the coxal protrusion on pereopod 1 in *Z. maledivensis* is only slightly developed, while it is distinctly larger in *Z. normani* and *Z. paranormani*.

Juveniles (neuters) of *Z. maledivensis* have only 4-segmented uropods, as does *Z. coralensis* Sieg, 1980, another species predicted by Sieg and Winn (1981) to inhabit California waters. It can be distinguished from adults of this species (juveniles of *Z. coralensis* have a 3-segmented uropod) by the shape of the coxal protrusion in pereopod 1 and additionally by the armament of the second segment of the maxillipedal palpus. In *Z. maledivensis* there are only 2 relatively long setae, while adults of *Z. coralensis* have mostly 4 (seldomly 3) setae in addition to the 3 pilose spines.

Type Locality and Type Specimens. Holotype and paratypes deposited in Senckenberg Museum/ Frankfurt (SMF 8690 and SMF 8691), Zoologisches Museum Berlin (ZMB 15951) and National Museum of Natural History (USNM).

Distribution. *Zeuxo maledivensis* Sieg, 1980 is known from scattered records from the Maldives, Japan, Florida, and the Santa Maria Basin, California.

Family Leptocheliidae Lang, 1973

Genus *Leptochelia* Dana, 1849

***Leptochelia dubia* (Krøyer, 1842)**

Figures 3.9, 3.10

Material Examined. Santa Maria Basin, phase I: 1 male from Sta. 6, 35°20.88'N 120°59.62'W, 190 m, between Pt. Estero and Pt. Buchon, October 1984; 1 female from Sta. BRA-16, 35°12.23'N 121°16.29'W, 591 m, off Pt. Buchon, March 1985; 1 female and 1 neuter from Sta.-73, 34°28.21'N 120°36.80'W, 98 m, between Pt. Conception and Pt. Arguello, February 1985. Santa Maria Basin, phase II: 1 neuter from cruise 1-3, Sta. R-4 (rep. 1), 34°43.01'N 120°47.39'W, 93 m, off Purisima Pt., May 1987; 1 neuter from cruise 3-4, Sta. R-4 (rep. 3), 34°43.01'N 120°47.39'W, 93 m, off Purisima Pt., May 1989; 1 manca-I from cruise 2-4, Sta. R-4 (rep. 2), 34°43.01'N 120°47.39'W, 93 m, off Purisima Pt.; 1 female from cruise 3-4, Sta. R-4 (rep. 2), 34°43.01'N 120°47.39'W, 93 m, off Purisima Pt., May 1989; 1 female from cruise 1-3, Sta. R-8 (rep. 1), 34°55.30'N 120°45.87'W, 90 m, off Pt. Sal, May 1987.

From Santa Monica Bay, California, collected by Biology Laboratory, Environmental Monitoring Division, City of Los Angeles: 10 females, 1 neuter from Sta. B8, 33°53'48"N 118°28'27"W, 45 m, 11 January 1990; 7 females from Sta. D4, 33°51'07"N 118°31'30"W, 80 m, 11 January 1990; 1 female and 1 male from Sta. C4(2), 33°58'17"N 118°34'00"W, 60 m, 12 July 1990; 3 females and 1 male from Sta. B3, 34°00'25"N 118°35'46"W, 45 m, 09 July 1990; 4 females, 1 male, and 8 neuters (1 neuter dissected) from Sta. D2, 33°53'40"N 118°35'20"W, 79 m, 08 January 1990; 1 male from Sta. 4C, 33°50'40"N 118°26'22"W, 77 m, 24 July 1986; 3 females and 1 male from Sta. C1(2), 33°59'49"N 118°42'50"W, 60 m, 09 July 1990; five females and 3 males (1 female and 1 male dissected) from Sta. B8, 33°53'48"N 118°28'27"W, 45 m, 19 July 1990; 4 females and 2 males from Sta. D4, 33°51'07"N 118°31'30"W, 80 m, 03 September 1987.

From Los Angeles County Museum of Natural History: 3 females, 1 male, and 2 neuters (LACM 59-147), 205 m, rocks, 2.45 mi, 249.5° T (true north) from Gull Island, Santa Cruz Channel, Santa Barbara County, California, 33°56.10'N 119°52.28'W, R/V *Velero IV* (AHF 6806-59), 22 December 1959; 3 females (LACM 59-147), 205 m, rocks, 2.45 mi, 249.5° T from Gull Island, Santa Cruz Channel, Santa Barbara County, California, 33°56.10'N 119°52.28'W, R/V *Velero IV* (AHF 6806-59), 22 December 1959; 6 females (LACM 59-149), 201 m, rocks, 2.3 mi, 246.5° T from Gull Island, Santa Cruz Channel, off south side of Santa Cruz Island, California Channel Islands, California, 33°56.05'N 119°52.05'W, R/V *Velero IV* (AHF 6805-59), 22 December 1959; 1 female (LACM 59-161), 86 m, sand, 2.4 mi, 248° T from Kinton Point, Santa Cruz Island, California Channel Islands, California, 33°59.53'N 119°55.92'W, R/V *Velero IV* (AHF 6803-59), 22 December 1959; 1 female and 1 neuter (LACM 55-35), 73 m, mud, 9.9 mi, 203° T from Santa Monica Pier Light, Los Angeles County, California, 33°51.37'N 118°34.7'W, R/V *Velero IV* (AHF 2998-55), 06 February 1955; 1 female (LACM 58-60), 35 m, green mud, 2.1 mi, 231° T from Santa Monica Pier Light, Los Angeles County, California, 33°59.2'N 118°32.0'W, R/V *Velero IV* (AHF 5732-58), 15 May 1958; 2 females (LACM 55-67), 119 m, sand and mud, 7.4 mi, 229° T from end of El Segundo Pier, Los Angeles County, California, 33°50.00'N 118°32.38'W, R/V *Velero IV* (AHF 3385-55), 23 August 1955; 1 female (LACM 53-125), 229 m, sand, 6.4 mi, 239° T, end of Redondo Beach Pier, Los Angeles County, California, 33°47.05'N 118°30.12'W, R/V *Velero IV* (AHF 2789-53), 08 July 1953; 2 females (LACM 54-38), 11 m, mud with stones, 4.1 mi, 331° T from Palos Verdes Point, Los Angeles County, California, 33°50.00'N 118°28.00'W, R/V *Velero IV* (AHF 2725-54), 08 May 1954; 1 female (LACM 53-128), 183 m, sand, 3.4 mi 301° T from Pt. Vicente Light, Los Angeles County, California, 33°44.13'N 118°25.80'W, R/V *Velero IV* (AHF 2357-53), 08 July 1953; 1 female and 1 male (LACM 57-102), 20 m, coarse black sand, 3.35 mi, 112° T from Pt. Vicente Light, Los Angeles County, California, 33°43.30'N 118°20.88'W, R/V

Velero IV (AHF 5102-57), 24 May 1957; 2 females (LACM 60-100), 219 m, 4.7 mi, 349.5° T from Pt. Fermin Light to midpoint, Los Angeles County, California, 33°37.80'N 118°16.73'W, R/V *Velero IV* (AHF 7161-60), 08 October 1960; 1 male (LACM 60-101), 214 m, mud, 3.8 mi, 163.5° T from Pt. Fermin Light, Los Angeles County, California, 33°38.60'N 118°16.27'W, R/V *Velero IV* (AHF 7174-60), 09 October 1960; 2 females and 1 male (LACM 53-126), 75 m, sand, 6.3 mi, 184° T from L.A. Breakwater Lighthouse, Los Angeles County, California, 33°36.23'N 118°15.50'W, R/V *Velero IV* (AHF 2355-53), 11 July 1953; 8 females and 1 fragment (LACM 52-51), 88 m, 9.2 mi, 156.5° T from L.A. Lighthouse, Los Angeles County, California, 33°34.08'N 118°10.68'W, R/V *Velero IV* (AHF 2126-52), 25 June 1952; 1 female (LACM 60-108), 16 m, silt, 0.2 mi, 254.5° T from base of Newport Pier, Newport Canyon, Orange County, California, 33°36.40'N 117°55.90'W, R/V *Velero IV* (AHF 7031-60), 05 May 1960; 1 female (LACM 60-184), 139 m, sand, 45 mi, 037.5° T from Point La Jolla, San Diego County, California, 32°52.38'N 117°15.5'W, R/V *Velero IV* (AHF 7043-60), 07 May 1960; 2 females and 1 male (LACM 60-185), 84 m, sand, 1.4 mi, 027.5° T from Point La Jolla, San Diego County, California, 32°52.35'N 117°15.45'W, R/V *Velero IV* (AHF 7044-60), 07 May 1960.

Description (female) (Figure 3.9). Body, 3-5 mm long, about 7× longer than broad. Cephalothorax, 1.4× longer than broad, with curved lateral borders and tapered anterior end. Pereonite 1 shortest of pereonites; pereonites 2-6 quadrangular with relatively straight, parallel, lateral borders; pereonite 4 longest; pereonite 5 almost as long as broad. Pleonites 1 and 5 narrowest of pleonites and pleonites 2-4 broadest; each pleonite about 5× broader than long.

First antenna 3-segmented; first segment long and slender, 3.5× longer than broad; third segment with 2 subterminal setae and slight constriction giving appearance of a fourth segment; formula for armature: 4 setae + 7 feathered hairs, 2 setae + 1 feathered hair, 4 setae + 1 aesthetasc.

Second antenna 6-segmented with armature formula as follows: 1 small seta, 2 stout spines, 1 stout spine, 3 setae + 3 feathered hairs, 2 setae, and 5 setae.

Mandible with pars molaris broad; crushing area well-developed; 1/3 of surrounding wall denticulated.

Maxilliped without coxae; basis not fused medially and bearing 5 setae near insertion of palpus. Endites each lobiform with 3 hyaline bulbs and 1 seta. Palpus 4-segmented; distal margin of first segment slanting toward inner border, unarmed; second segment trapezoidal, inner border longer than outer, outer border with 1 seta, inner border with 4 setae and row of small setules; third segment longest, with 7 pinnate setae and 2 naked setae; fourth segment with 9 pinnate setae and 1 naked seta.

Cheliped carpus slender, 2.5× longer than broad, with 2 tergal setae and 3 sternal setae. Palm comb with 3 small pinnate setae and 1 naked seta; 3 rows of minute spinules situated near comb. Fixed finger with spiniform tip and 5 indentations; tergal border with 3 setae and 1 seta (dotted seta in figure) near insertion of dactylus; sternal border with 4 setae. Dactylus with 1 proximal seta.

Pereopod 1 with merus bearing 2 tergal setae and 1 sternal seta; carpus with 5 setae; propodus with 1 tergal and 3 sternal setae; dactylus and terminal spine longer than propodus; dactylus with 1 seta. Pereopod 6 with carpus bearing 2 setae and 2 spines; propodus with 2 tergal spines and 1 long and 4 shorter pinnate setae; dactylus and terminal spine forming a stout curved claw.

Pleotelson, 2.5× broader than long, with protuberant posteromedian area.

Uropod biramous. Exopodite 1-segmented, 2.8× longer than broad, with 3 setae. Endopodite 5-segmented; first segment 1.5× longer than broad, with 1 small distal seta; second segment 2.8× longer than broad, with 1 feathered hair; third segment 3× longer than broad, with 1 distal seta; fourth segment 4× longer than broad with 1 long seta and 1 feathered hair; fifth segment about 5.7× longer than broad, with 1 subterminal and 4 long terminal setae.

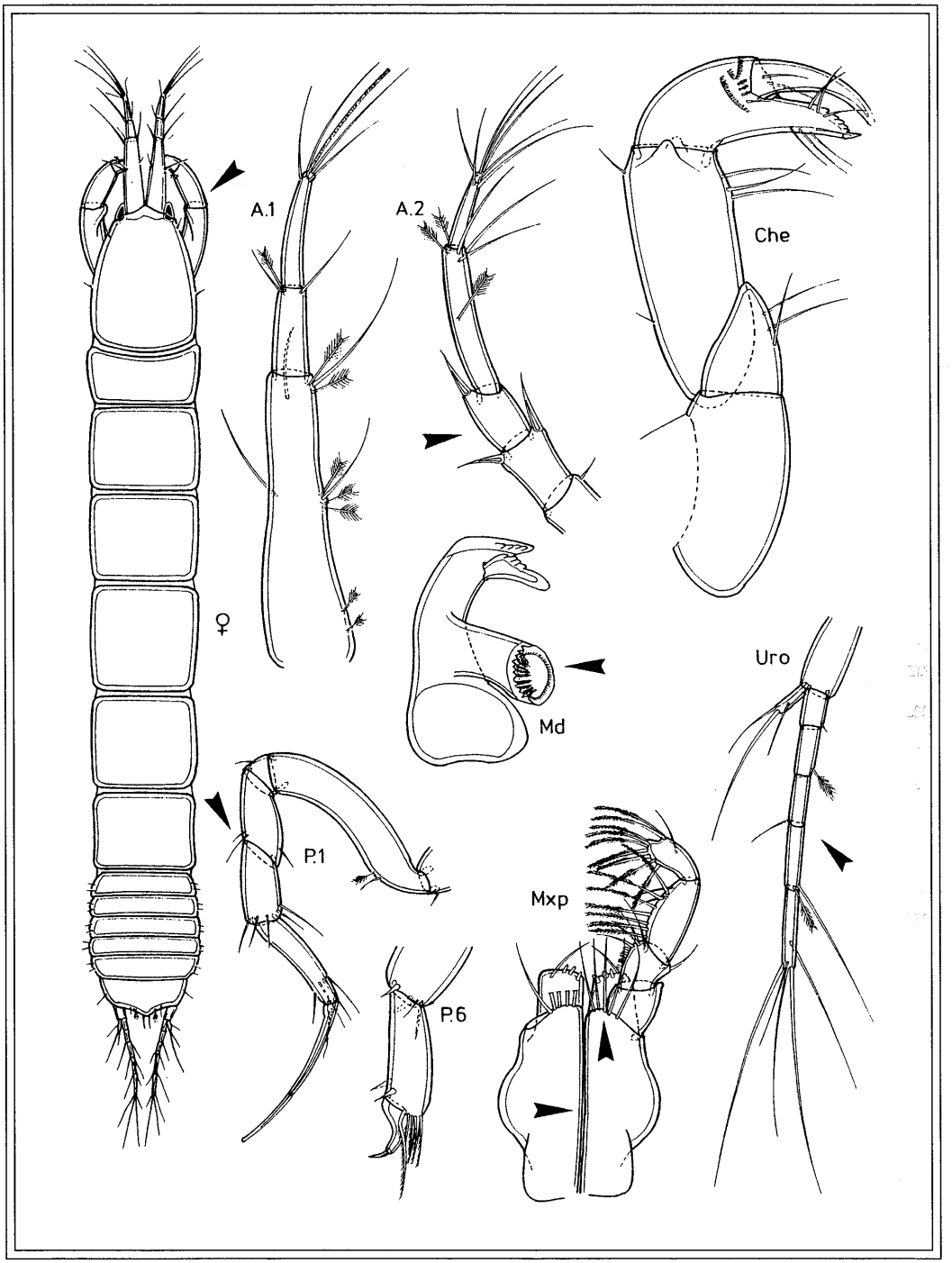

Figure 3.9. *Leptochelia dubia* (Krøyer, 1842) female: ♀, general habitus of female; A.1, first antenna; A.2, second antenna; Md, mandible; Mxp, maxilliped; Che, cheliped; P.1, pereopod 1; P.6, pereopod 6; Uro, uropod.

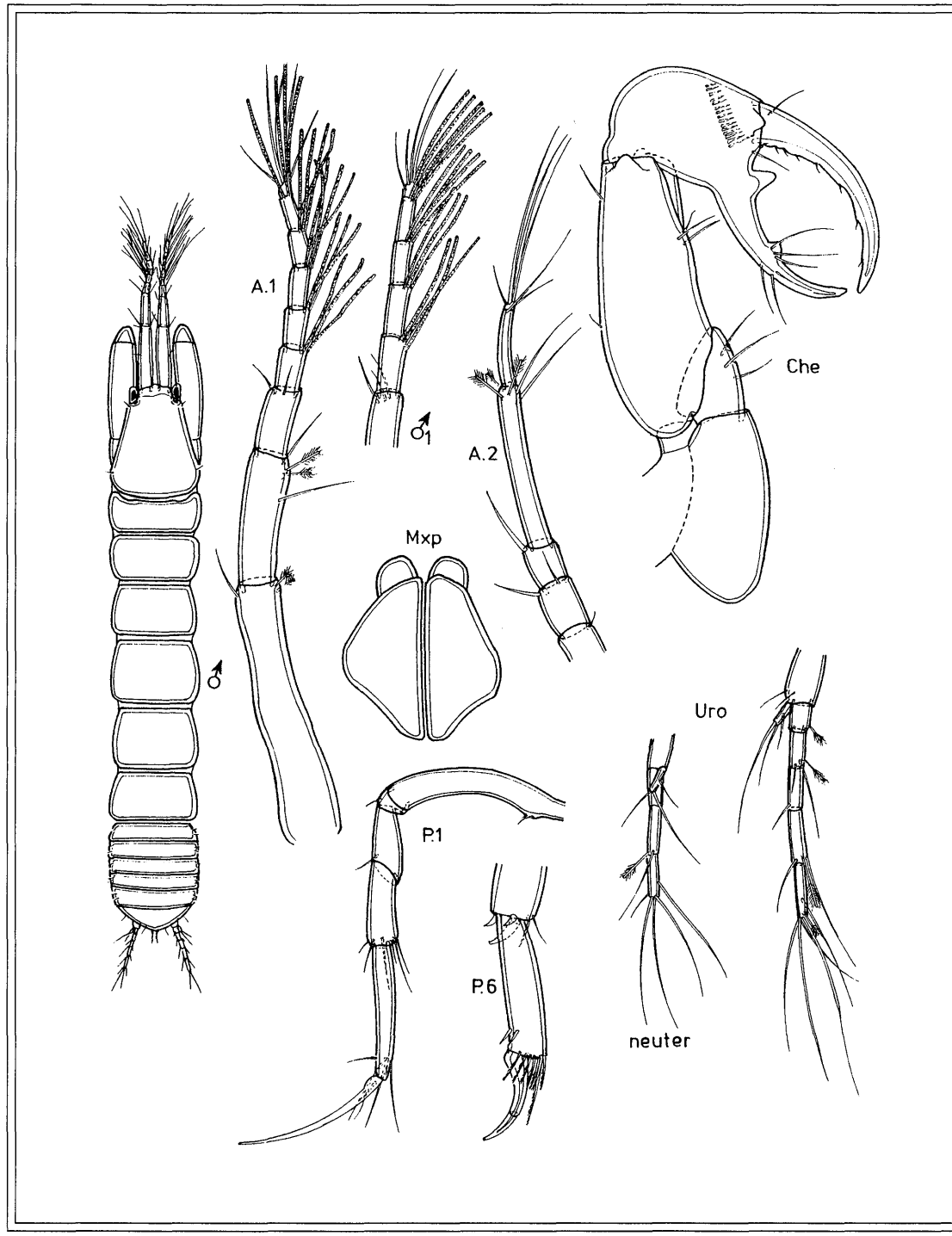

Figure 3.10. *Leptochelia dubia* (Krøyer, 1842) male: ♂, general habitus of male; A.1, first antenna; ♂1, flagellar segments of first antenna (variant); A.2, second antenna; Mxp, maxilliped; Che, cheliped; P.1, pereopod 1; P.6, pereopod 6; Uro, uropod.

Description (male) (Figure 3.10). Body, 2 - 3.5 mm long, 6× longer than broad. Cephalothorax 1.3× longer than broad, with narrow anterior end and broad posterior end. Pereonite 1 shortest of pereonites and pereonite 4 longest; all pereonites similar in width. Pleonites 1-5 slightly broader than pereonites, each about 5-5.5× broader than long.

First antenna with 3-segmented peduncle and 5- or 6-segmented flagellum; first segment long, slender, about 4.5× longer than broad; second segment 3.2× longer than broad; third segment 2× longer than broad; remaining segments comparatively short; last one considerably smaller than preceding ones. Formula for armature as follows: 1 seta + 2 feathered hairs, 2 setae + 2 feathered hairs, 2 setae, 3 aesthetascs, 3 aesthetascs, 4 aesthetascs, 4 aesthetascs, 3 aesthetascs, 4 setae + 1 aesthetasc.

Second antenna 6-segmented; first segment semicircular in cross-section; second and third segments short, about as long as broad; segment 4 long and slender, 6.7× longer than broad; segment 5 about 5.7× longer than broad; segment 6 minute, as long as broad. Armature formula as follows: 1 seta, 1 seta + 1 spine, 1 spine, 2 setae + 3 feathered hairs, 1 seta (?), and 5 setae (?).

Maxilliped sexually dimorphic; basis reduced to unarmed plates; palpus reduced to rounded lobes without setae.

Cheliped carpus slender, 2.4× longer than broad. Palm comb with numerous spinules. Fixed finger curved with 1 proximal tergal process and 1 tergal process near midlength; 1 tergal seta located between proximal process and insertion of dactylus and 3 setae near process at midlength; sternal border with 3 setae. Dactylus slender, curved, with 1 proximal tergal seta and several setules along sternal margin.

Pereopod 1 more slender than in female; merus with 1 tergal seta; carpus with 6 setae; propodus with 5 setae; dactylus and terminal spine as long as propodus; dactylus with 1 seta. Pereopod 6 carpus with stout spines and 2 sternal setae; propodus with 2 tergal spines and 1 long and 7 shorter pinnate setae.

Pleotelson about 2.2× broader than long.

Uropod biramous with basis bearing 2 setae. Exopodite 1-segmented, 3× longer than broad, with 3 setae. Endopodite 5-segmented, with armature as follows: 1 feathered hair + 1 setule, 2 setae + 1 feathered hair, 1 seta, 2 setae + 1 feathered hair, 5 setae + 1 feathered hair.

Remarks. This species can be distinguished from all other southern California tanaidaceans by the 5-segmented endopodite of the uropods in both the adult female and male. The endopodite of the neuter of this species is 3-segmented (Figure 3.10). Several characters in combination also are helpful in the diagnosis of *L. dubia*: (1) the spines on the second and third segments of the second antenna of the female, (2) the structure of the pars molaris of the mandible, (3) the unfused maxillipedal basis, (4) 3-5 setae on the distal end of the maxillipedal basis, (5) the armature of the maxillipedal endite, and (6) 2 setae on the merus of pereopod 1. The males can be distinguished from the females by the large chelipeds and the handcuff-like propodus/dactylus combination. Some males with a different number of flagellar segments (Figure 3.10, ♂1) were present in the collection.

This species inhabits a wide range of substrates from rocks and sand to mud and silt.

Type Locality and Type Species. See Krøyer (1842).

Distribution. *Leptochelia dubia* occurs in tropical and subtropical shallow waters throughout the world; it is known from Santa Maria Basin, California south to La Jolla, San Diego County, California.

Family Paratanaidae Lang, 1949

Genus *Paratanais* Dana, 1849

Paratanais intermedius Dojiri and Sieg, new species

Figure 3.11

Type Material. 1 female holotype (USNM 284721) from Sta. BRA-20, 35°15.72'N 121°04.68'W, 396 m, off Pt. Buchon, Santa Maria Basin, California, June 1985, originally identified as Paratanaidae sp. A; 1 female paratype (SBMNH 144121)(dissected) from Sta. BRC-1, 35°27.86'N 121°05.33'W, 98 m, off Pt. Estero, Santa Maria Basin, California, June 1985, originally identified as Paratanaidae sp. A.; 1 manca-II (paratype; SBMNH 144130) from Sta. BRA-16, 35°12.23'N 121°16.29'W, 591 m, southwest of Pt. Buchon, Santa Maria Basin, California, originally identified as Tanaidacea sp. A; 1 manca-II (paratype; SBMNH 144131) from Sta. 6, 35°20.88'N 120°59.62'W, 109 m, between Pt. Estero and Pt. Buchon, Santa Maria Basin, California, October 1984, originally identified as Tanaidacea sp. A.

Description (female) (Figure 3.11). Body, 2.16 mm long, about 6× longer than broad. Cephalothorax, 1.2× longer than broad, with posterior margin broader than anterior. Pereonites 1 and 6 similar in length; pereonite 1 broadest; pereonite 4 longest; all pereonites with convex lateral borders. Pleonites 1-5 similar lengths and widths; 4.4× broader than long.

First antenna 4-segmented; first segment about 2.5× longer than broad; second segment as long as broad; third segment smallest, annular; fourth segment 2.6× longer than broad; formula for armature: 1 seta + 5 feathered hairs, 1 seta + 4 feathered hairs, 1 seta, and 4 setae + 1 aesthetasc + 1 feathered hair.

Second antenna 6-segmented; segment 1 small and unarmed; armature formula of segments 2-6 as follows: 2 setae, 1 stout spine, 1 seta + 5 feathered hairs, 1 seta, and 5 setae.

Mandible with broad pars molaris; crushing area well-developed with serrations.

Maxilliped without coxae; basis fused to about midlength, bearing 1 distal seta near insertion of palpus. Endites each with 2 hyaline bulbs and 1 medial seta. Palpus 4-segmented; first segment stout and unarmed; second segment with 1 naked seta on outer border and 1 naked seta, 1 pinnate stout seta, and 1 denticulated spine on inner border; third segment with 3 pinnate setae and 1 naked seta; and fourth segment with 5 pinnate setae and 1 naked seta.

Cheliped carpus stout, 1.3× longer than broad (length measured along tergal margin), with 2 small tergal setae (1 proximal, another distal) and 2 sternal setae. Fixed finger with spiniform tip and bilobed protuberance (indicated by arrow in figure); tergal border with 3 setae and 1 seta (dotted seta in figure) near insertion of dactylus; sternal border with 1 seta. Dactylus stout with 1 small tergal seta and 1 sternal spiniform element.

Pereopod 1 with merus almost as long as carpus, bearing 1 tergal seta; carpus with 1 tergal seta and 2 sternal setae; propodus with 3 sternal setae; dactylus and terminal spine longer than propodus; dactylus with 1 seta. Pereopod 6 with carpus bearing 2 stout tergal spines, 1 small sternal seta, and 1 large clawlike spine; propodus with 2 stout tergal spines, 3 sternal pinnate spines, and 1 sternal feathered hair; dactylus with 2 minute sternal setules, and several curved rows of minute spinules; terminal spine relatively stout and curved.

Pleotelson, 2.5× broader than long, with rounded posterior margin.

Uropod biramous. Exopodite 1-segmented, 3.7× longer than broad, with 1 subterminal and 2 terminal setae. Endopodite 1-segmented with constriction at about midlength, approximately 2.4× longer than broad, and bearing 2 feathered hairs near constriction, and 5 setae at tip.

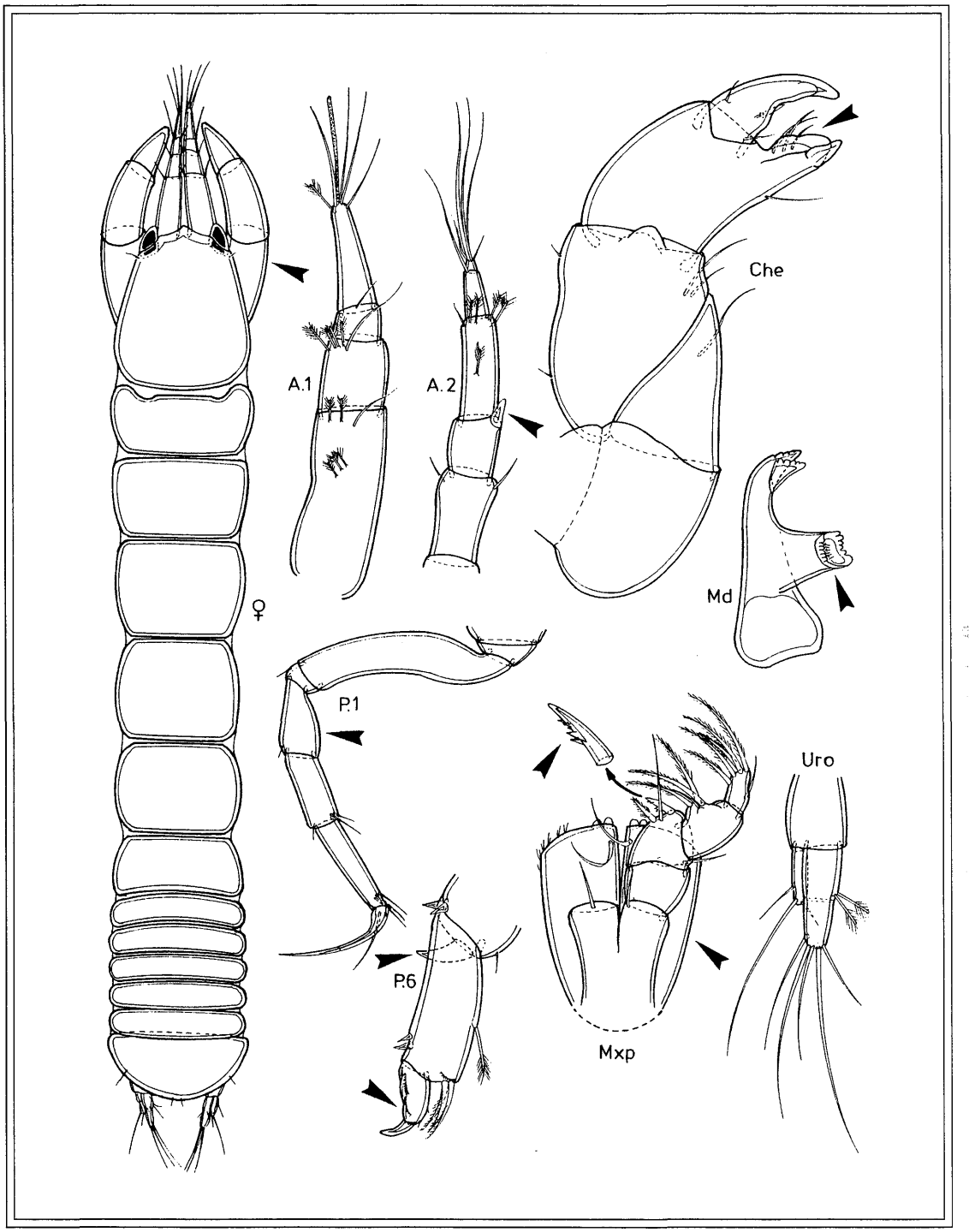

Figure 3.11. ***Paratanais intermedius*** **Dojiri and Sieg, new species**, female: ♀, general habitus of female; A.1, first antenna; A.2, second antenna; Md, mandible; Mxp, maxilliped; Che, cheliped; P.1, pereopod 1; P.6, pereopod 6; Uro, uropod.

Remarks. The genus *Paratanais* is readily identified by a combination of the following characters: a broad pars molaris, a pair of eyes, strong spine on the third segment of the second antenna, and a 2-segmented uropodal endopodite.

Paratanais intermedius appears to be morphologically related to *P. impressus* Kussakin and Tzareva and *P. spinanotandus* Sieg, but can be distinguished from these two species by the length of the merus relative to the carpus (about equal in length in *P. intermedius*) and by the serrated stout spine on the second palpal segment of the maxilliped.

This species was identified as Paratanaidae sp. A and Tanaidacea sp. A in the MMS voucher collection.

Etymology. The specific name *intermedius* alludes to the species morphological similarities to two species, *Paratanais impressus* and *P. spinanotandus*.

Type Locality and Type Specimens. Santa Maria Basin, California. Types deposited in the National Museum of Natural History (USNM 284721) and the Santa Barbara Museum of Natural History (SBMNH 144121, 144130, 144131); see "Type Material."

Distribution. So far known only from its type locality, Santa Maria Basin, California.

Family Anarthruridae Lang, 1971

Subfamily Anarthrurinae Lang, 1971

Genus *Siphonolabrum* Lang, 1972

***Siphonolabrum californiensis* Dojiri and Sieg, new species**

Figures 3.12, 3.13

Type Material. 1 female (holotype; USNM 284722), 2 paratypes (1 female; 1 dissected; SBMNH 144129), and 1male (dissected) from Sta. BSR-79, 34°24.12'N 120°28.32'W, 98 m, off Pt. Conception, Western Santa Barbara Channel, California, originally identified as *Leptognathia* sp. F.

Material Examined. Santa Maria Basin and Western Santa Barbara Channel, phase I: 1 male from Sta. 79, 34°24.12'N 120°28.32'W, 98 m, off Pt. Conception, 09 November 1983, originally identified as *Cryptocope* sp. D; 2 neuters and 2 fragments from Sta. 39, 34°49.53'N 120°56.85'W, 294 m, off Pt. Sal, October 1984, originally identified as *Leptognathia* sp. F; 1 neuter from Sta. 59, 34°33.65'N 120°47.18'W, 216 m, off Pt. Arguello, October 1984, originally identified as *Leptognathia* sp. D. Santa Maria Basin, phase II: 4 neuters and 1 fragment from cruise 1-1, Sta. PJ-17 (rep.2), 34°56.56'N 120°48.98'W, 126 m, originally identified as *Araphura* sp. C; 4 neuters from cruise 2-3, Sta. R-4 (rep.1), 34°43.01'N 120°47.39'W, 92 m, off Purisima Pt., originally identified as *Araphura* sp. C; 7 neuters and 1 fragment from cruise 2-4, Sta. R-2 (rep. 1), 35°05.50'N 120°53.40'W, 161 m, off Pt. San Luis; 5 females from cruise 1-2, Sta. PJ-23 (rep.1), 34°56.33'N 120°49.90'W, 143 m, originally identified as *Araphura* sp. C; 6 females, 1 neuter, and 1 manca-II from cruise 1-1, Sta. PJ-7 (rep. 1), 34°55.79'N 120°48.60'W, 123 m, originally identified as *Leptognathia* sp. F; 11 females and 2 manca-II from cruise 1-1, Sta. PJ-1 (rep. 1), 34°55.79'N 120°49.91'W, 145 m, originally identified as *Leptognathia* sp. F; 11 females and 3 manca-III from cruise 1-1, Sta. R-2 (rep. 3), 35°05.30'N 121°00.90'W, 409 m, off Pt. San Luis, originally identified as *Leptognathia* sp. F; 4 females and 1 manca-II from cruise 1-1, Sta. PJ-2 (rep. 2), originally identified as *Leptognathia* sp. F; 9 females, 1 neuter, and 1 manca-II from cruise 1-3, Sta. PJ-8 (rep. 3), 34°56.87'N 120°49.91'W, 142 m, originally identified as *Araphura* sp. C; 8 females from cruise 1-3, Sta. R-4 (rep. 2), 34°43.01'N 120°47.39'W,

92 m, off Purisima Pt., originally identified as *Araphura* sp. C; 7 females and 2 neuters from cruise 1-3, Sta. PJ-7 (rep. 3), 34°55.79'N 120°48.60'W, 123 m, originally identified as *Araphura* sp. C; 5 females and 3 manca-II from cruise 1-1, Sta. R-6 (rep. 3), 34°41.40'N 120°57.90'W, 410 m, off Purisima Pt., originally identified as *Leptognathia* sp. F; 9 females and 3 neuters from cruise 1-3, Sta. PJ-1 (rep. 2), 34°55.79'N 120°49.91'W, 145 m, originally identified as *Araphura* sp. C; 10 females from cruise 1-3, Sta. R-1 (rep. 3), 35°05.83'N 120°49.16'W, 91 m, off Pt. San Luis, originally identified as *Araphura* sp. C; 6 females, 1 neuter, and 3 manca-II from cruise 1-3, Sta. PJ-23 (rep. 2), 34°56.33'N 120°49.90'W, 143 m, *Araphura* sp. C.

From Santa Monica Bay, California, collected by Biology Laboratory, Environmental Monitoring Division, City of Los Angeles: 1 fragment (neuter) from Sta. E2, 33°58'39"N 118°39'16"W, 150 m, 05 January 1989.

Description (female) (Figure 3.12). Body, 1.74-2.32 mm long, about 7× longer than broad. Cephalothorax, 1.2× longer than broad, with lateral margins convex. Pereonite 1 shortest of pereonal segments; all pereonites similar in width. Pleonites 1-5 similar in lengths and widths, approximately 3-3.7× wider than long.

First antenna 4-segmented; first segment about 2.4× longer than broad; second segment 1.3× longer than broad; third segment smallest, as long as broad; fourth segment 3.3× longer than broad; formula for armature: 1 seta + 4 feathered hairs, 2 setae + 3 feathered hairs, 2 setae, and 6 setae + 1 aesthetasc + 1 feathered hair.

Labrum with large patch of setules.

Mandible without pars molaris; pars incisiva tipped with several teeth.

Maxilliped without coxa; basis fused. Distal margin of endites each with 1 long seta. Palpus 4-segmented; first segment stout and unarmed; second segment with 3 medial setae; third segment with 4 setae; fourth segment with 4 inner and 1 small outer setae.

Cheliped with basis lacking enlarged protuberance (projection); proximal basal margin articulating with ventral surface of cephalothorax. Merus slightly enlarged and bearing protuberance on sternal surface immediately distal to single seta. Carpus stout, about 1.3× longer than broad, bearing 1 proximal tergal seta, 1 distal tergal seta, and 2 proximal sternal setae. Fixed finger with spiniform tip, bicuspid tooth (indicated by arrow in figure) near tip, and 1 single tooth near midlength of finger; tergal border with 3 setae near midlength and 6 setae near insertion of dactylus; sternal border with 1 seta. Dactylus with 1 large seta near midlength.

Pereopod 1 with merus about as long as carpus and bearing no setae or spines; carpus with 3 setae; propodus with 1 seta; dactylus with long whiplike seta. Pereopod 6 with carpus bearing 3 stout plumose spines and 1 sternal setule; propodus with 2 plumose tergal spines and 1 plumose sternal spine on distal margin; dactylus slender.

Pleotelson, 1.6× broader than long, with convex posterior margin.

Uropod "pseudobiramous." Exopodite fused to basis with 1 subterminal and 2 long setae and 1 terminal feathered hair. Endopodite 2-segmented; first segment 2.5× longer than broad and carrying 1 seta and 2 feathered hairs; second segment 1.9× longer than broad and bearing 5 setae and 1 feathered hair.

Description (male) (Figure 3.13). Body 4.8× longer than broad. Cephalothorax 1.5× broader than long, broadest in posterior half. Pereonites 1, 2, and 6 similar in length and width, 3.3-3.5× broader than long; pereonites 3-5 similar, 2.2-2.5× broader than long. Pleonites 1-5 approximately 3× broader than long.

First antenna with 2-segmented peduncle and 4- or 5-segmented flagellum. Formula for armature as follows: 1 seta + 3 feathered hairs, 2 setae + 2 feathered hairs, 2 setae + 1 feathered hair, numerous (~10) aesthetascs, numerous (~10) aesthetascs, 5 setae + 1 aesthetasc.

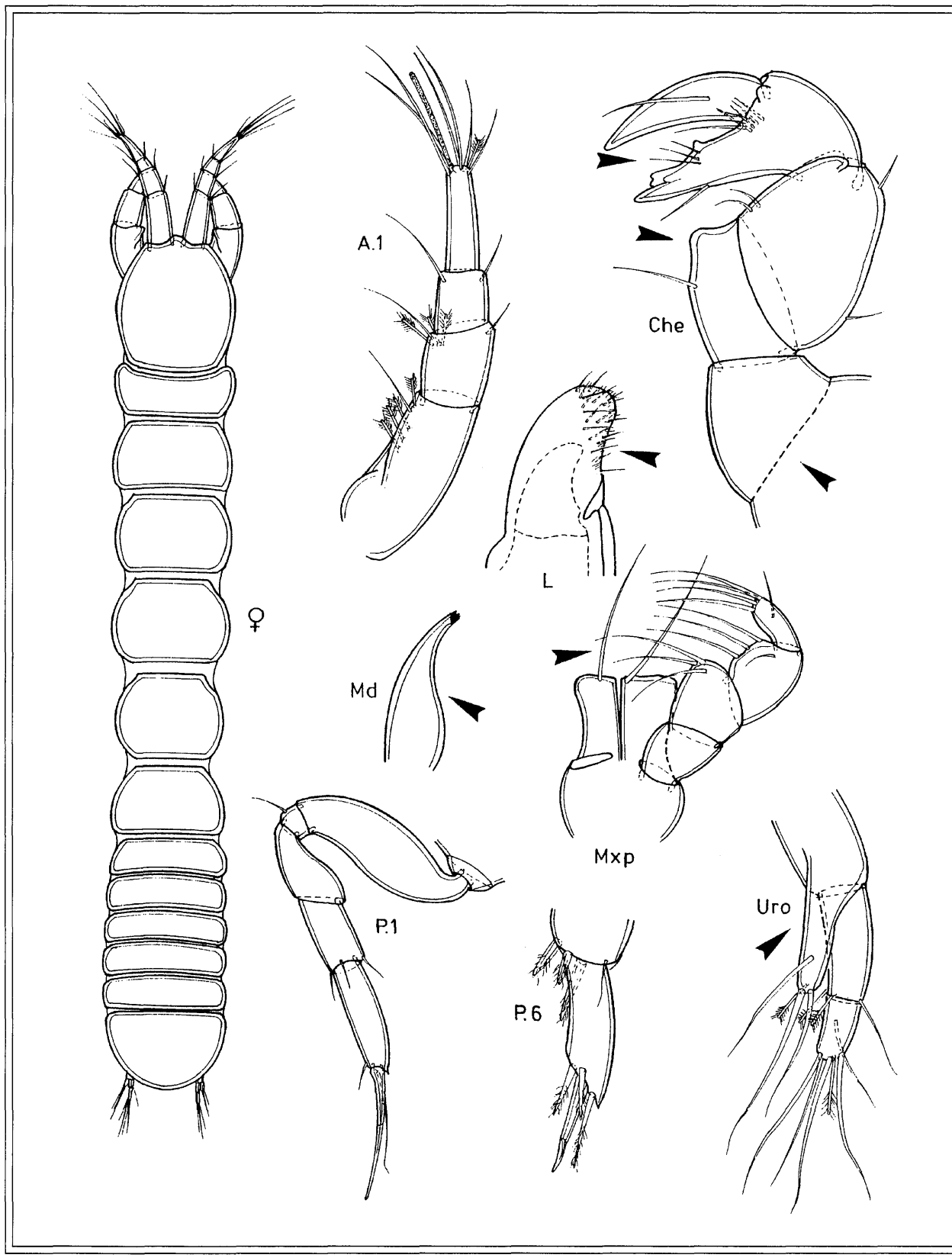

Figure 3.12. ***Siphonolabrum californiensis*** **Dojiri and Sieg, new species**, female: ♀, general habitus of female; A.1, first antenna; L, labrum; Md, mandible; Mxp, maxilliped; Che, cheliped; P.1, pereopod 1; P.6 pereopod 6; Uro, uropod.

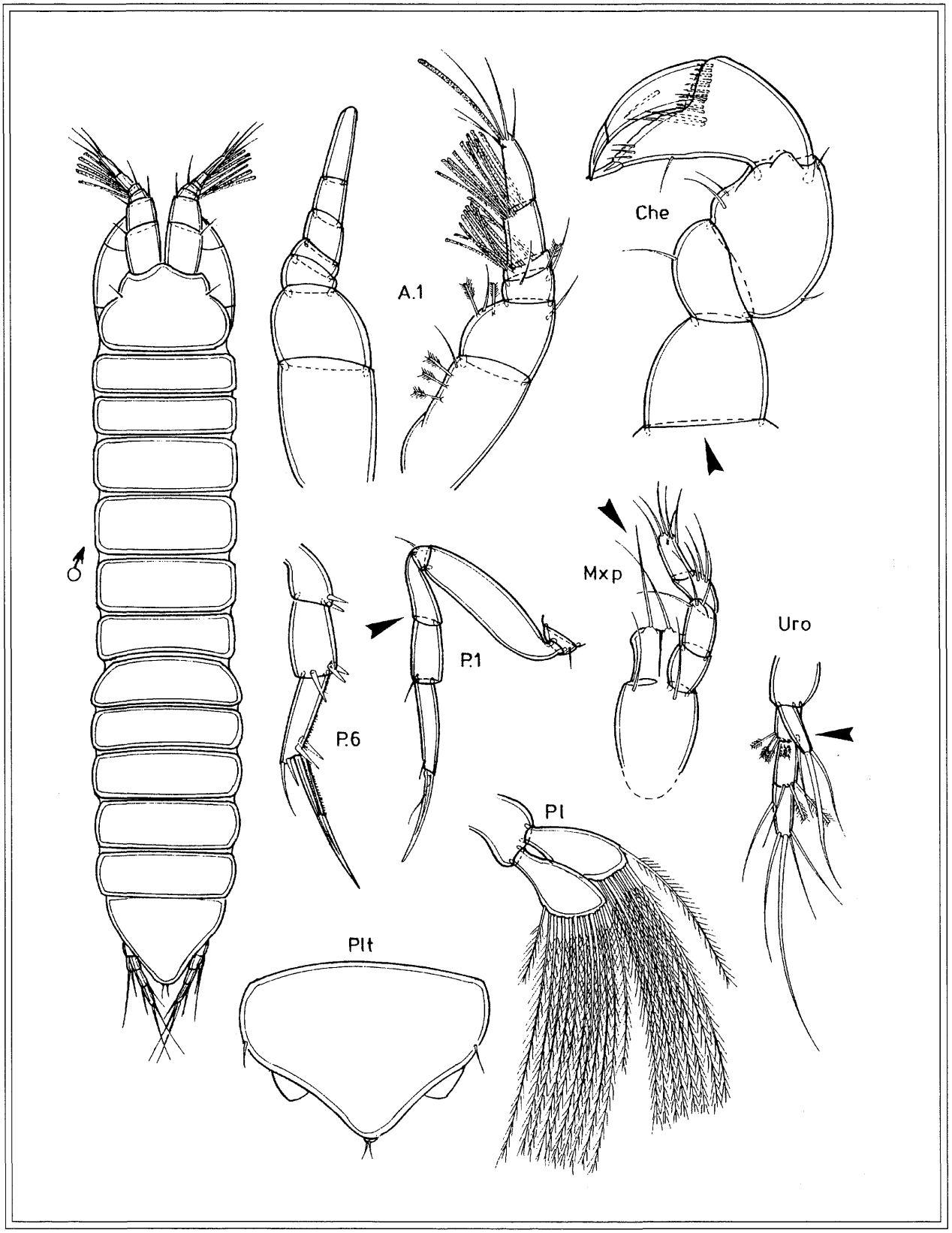

Figure 3.13. ***Siphonolabrum californiensis*** **Dojiri and Sieg, new species**,, male: ♂, general habitus of male; A.1, first antenna; Mxp, maxilliped; Che, cheliped; P.1, pereopod 1; P.6, pereopod 6; Pl, pleopod; Plt, pleotelson; Uro, uropod.

Maxilliped basis fused medially and bearing 1 seta near insertion of each palpus. Endites each with 1 seta. Palpus 4-segmented; first segment unarmed; second segment with 3 distal setae; third segment with 3 setae; and fourth segment with 6 setae.

Cheliped basis as in female. Merus with 1 sternal seta at about midlength. Carpus about 1.3× longer than broad, bearing 1 proximal tergal seta and 1 distal tergal seta and 2 sternal setae. Propodus with 1 rostral seta, 2 longer caudal setae, and comb consisting of several (about 10) setae. Fixed finger with rugose (irregular) tergal margin and bearing 3 setae near spiniform tip; sternal margin with 1 seta at about midlength. Dactylus with 1 large caudal seta near midlength.

Pereopod 1 more slender than in female; merus unarmed; carpus with 1 distal tergal seta; propodus with small distal tergal seta; dactylus with 1 seta. Pereopod 6 merus with 2 stout tergal spines; carpus with 3 stout spines; propodus with 3 spines and 1 seta; propodus and dactylus with row of spinules (or denticulations).

Pleopod biramous; exopodite and endopodite about 2× longer than broad and bearing numerous pinnate setae.

Pleotelson about 1.4× broader than long, with protuberant posteromedial margin; tip of posteromedial protuberance with 2 small setae.

Uropod biramous. Exopodite 1-segmented, 3× longer than broad, with 3 (?) setae. Endopodite 3-segmented, with armature as follows: 5 feathered hairs, 1 seta + 2 feathered hairs, and 5 setae.

Remarks. The genus *Siphonolabrum* can be easily recognized from the other tanaid genera inhabiting the Santa Maria Basin and Western Santa Barbara Channel by the proximal margin of the chelipedal basis articulating directly with the cephalothorax; in other genera the cheliped articulates with the cephalothorax via a sclerotized plate known as the "side-piece."

The large patch of setules on the labrum, the absence of the pars molaris, the presence of long setae on the maxillipedal endites, the humplike process on the sternal surface of the chelipedal merus of the female, and the bicuspid tooth on the tergal border of the fixed finger of the cheliped of the female distinguishes this species from all known taxa.

Etymology. The specific name alludes to the state from which the new species was collected.

Type Locality and Type Specimens. Santa Maria Basin and Western Santa Barbara Channel, California. Types deposited in the National Museum of Natural History (USNM 284722) and the Santa Barbara Museum of Natural History (SBMNH 144129); see "Type Material."

Distribution. Reported from its type locality, Santa Maria Basin and Western Santa Barbara Channel, California south to Santa Monica Bay and San Pedro, California.

Subfamily Akanthophoreinae Sieg, 1986

Genus *Paraleptognathia* Kudinova-Pasternak, 1981

Paraleptognathia cf. *gracilis* (Krøyer, 1842)

Figure 3.14

Material Examined. 1 neuter (dissected on slides) from phase II, cruise 1-1, Sta. PJ-2 (rep. 1), 34°55.30'N 120°45.90'W, Santa Maria Basin, California.

Description (neuter) (Figure 3.14). Body, 1.5 mm long, about 6× longer than broad. Cephalothorax, approximately 1.3× longer than broad, with convex lateral margins. Pereonites with convex lateral borders, and decreasing in width posteriorly with pereonite 1 broadest and pereonite 5 narrowest; pereonite 6 shortest

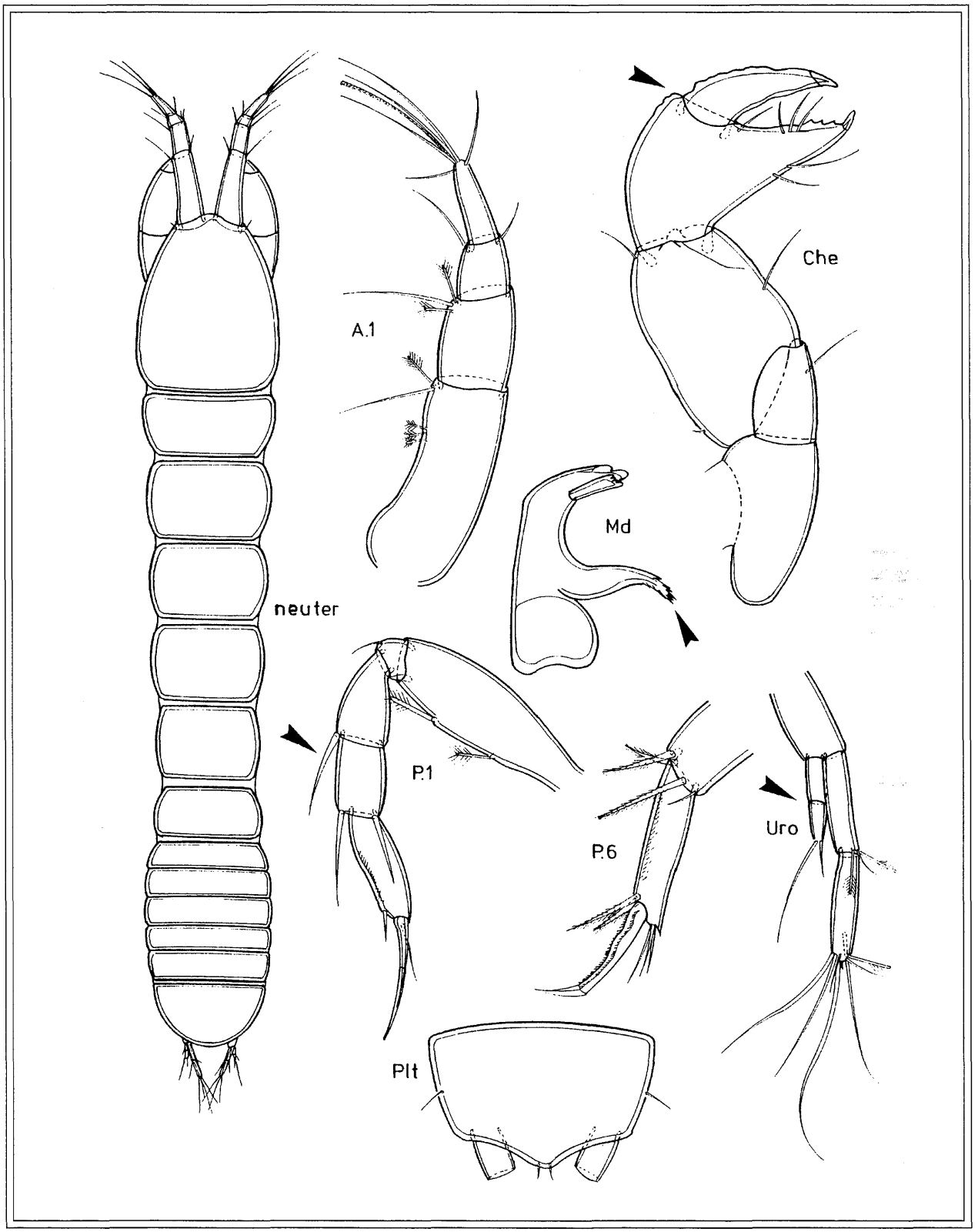

Figure 3.14. *Paraleptognathia* cf. *gracilis* (Krøyer, 1842), neuter: neuter, general habitus of neuter; A.1, first antenna; Md, mandible; Che, cheliped; P.1, pereopod 1; P.6, pereopod 6; Plt, pleotelson; Uro, uropod.

and slightly broader than pereonite 5. Pleonites 2-5 similar in size, each about 4-5× broader than long; pleonite 3 widest of pleonites.

First antenna 4-segmented with armature as follows: 1 seta + 4 feathered hairs, 1 seta + 2 feathered hairs, 2 setae, and 5 setae + 1 aesthetasc, respectively.

Mandible with pars molaris bearing several (9?) pointed processes at tip.

Cheliped carpus moderately stout, about 1.5× longer than broad (length measured along tergal border); tergal border without pointed protrusion proximally; sternal border without platelike projection. Propodus with crenulations on distal end of tergal margin near insertion of dactylus. Fixed finger with 3 spiniform processes ("teeth") and sclerotized tip; tergal border with 3 setae and 1 seta near articulation of dactylus; sternal border with 2 setae. Dactylus with crenulations along tergal border.

Pereopod 1 with merus bearing 1 large spine; carpus with 1 tergal and 1 sternal spines; propodus with row of minute setules along tergal border and tergal spine at tip; dactylus with 1 seta. Pereopod 6 with carpus equipped with 3 pilose spines and 1 small naked seta; propodus with row of minute setules, 2 tergal pilose spines and 3 sternal naked setae.

Pleotelson, 1.5× broader than long, with slightly convex lateral borders, each with 1 seta at about midlength; posterior margin with protuberant median area bearing 2 small setae.

Uropods biramous. Exopodite 2-segmented, slightly shorter than first endopodal segment; first segment, about 2× longer than broad, naked; second segment, with proportion similar to that of first segment, having 2 setae at tip. Endopodite 2-segmented; first segment, 3.8× longer than broad, with 2 feathered hairs and 1 seta; second segment, 4× longer than broad, with 1 feathered hair, 1 subterminal seta, and 2 small and 3 long terminal setae.

Remarks. This single specimen was originally identified as *Leptognathia* sp. C. The original description of *Leptognathia gracilis* by Krøyer (1842) is not adequate for comparative purposes. This specimen may represent a new species, but should be carefully compared to specimens positively identified as *Paraleptognathia gracilis* (Krøyer, 1842) before a final decision on its taxonomic status is made.

This species can be distinguished from *Paraleptognathia bisetulosa* new species, described below, by the shape of the cephalothorax, the presence of crenulations on the tergal border of the propodus of the cheliped, and the number of setae on the merus of pereopod 1.

Distribution. In addition to its type locality, this species has so far only been collected from the Santa Maria Basin at Sta. PJ-2, California.

Paraleptognathia bisetulosa Dojiri and Sieg, new species

Figure 3.15

Type Material. 1 female holotype (on slides; USNM 284723) from cruise 1-3, Sta. R-6 (rep. 1), 34°41.40'N 120°57.90'W, 410 m, off Purisima Pt., Santa Maria Basin, California, May 1987, collected by Battelle.

Description (female) (Figure 3.15). Body, 2 mm long, about 6× longer than broad. Cephalothorax, slightly longer than broad, with nearly straight parallel borders, and markedly tapered at anterior end. Pereonites 2-4 with convex lateral borders; pereonite 6 narrowest of pereonites, with concave lateral borders. Pleonites 1-5 similar in length and width to each other, and about as broad as pereonites 2-4.

First antenna 4-segmented with armature as follows: 2 setae + 4 feathered hairs, 2 setae + 4 feathered hairs, 2 setae, and 4 long and 1 short setae + 1 feathered hair + 1 aesthetasc.

Mandible with pars molaris bearing several pointed processes at tip.

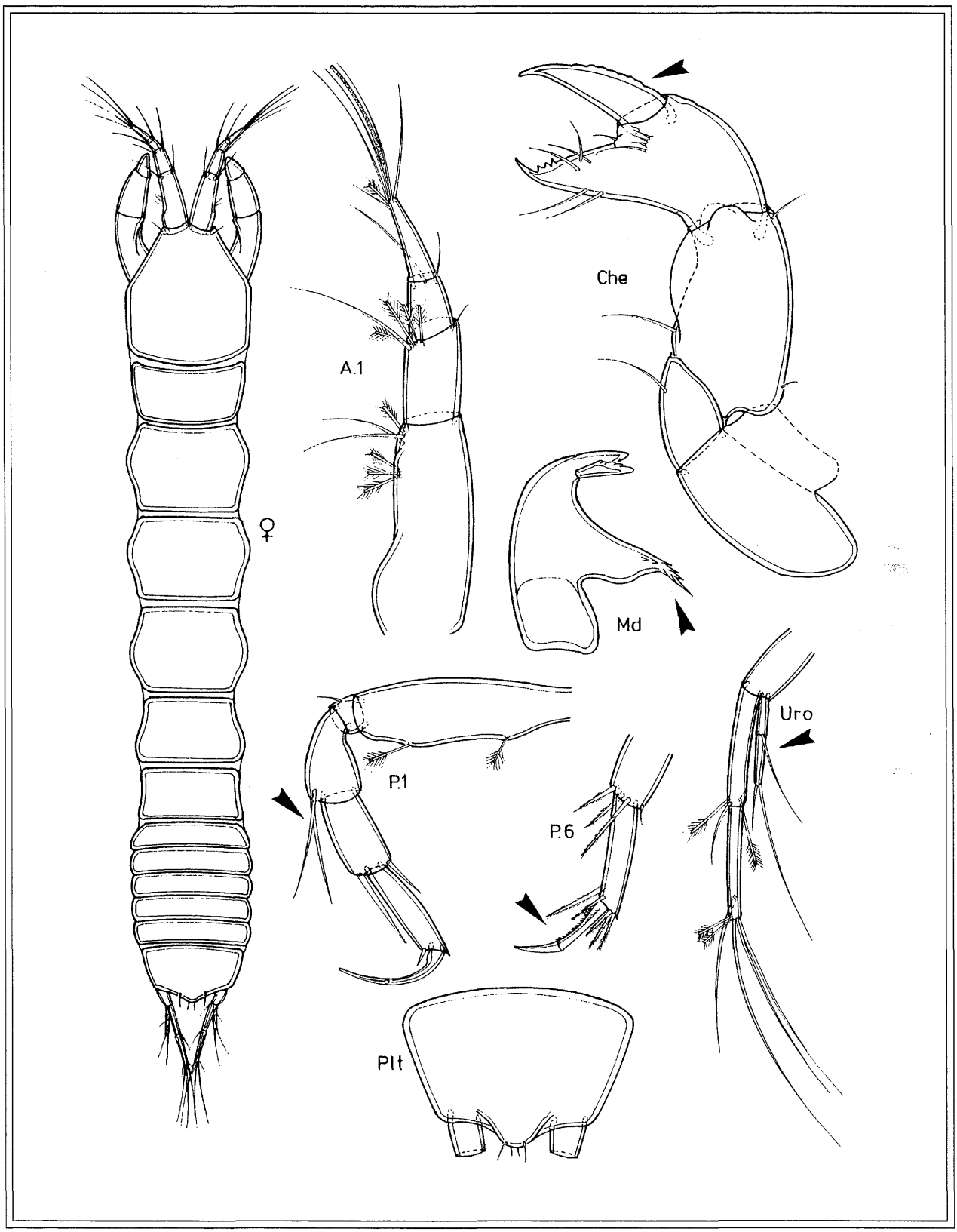

Figure 3.15. ***Paraleptognathia bisetulosa*** **Dojiri and Sieg, new species**, female: ♀, general habitus of female; A.1, first antenna; Md, mandible; Che, cheliped; P.1, pereopod 1; P.6, pereopod 6; Plt, pleotelson; Uro, uropod.

Cheliped carpus about 1.8× longer than broad (length measured along tergal border), with small platelike projection on sternal border; tergal border without pointed protrusion proximally; palm bearing comb with 1 long and 3 short setae on caudal surface. Fixed finger with slender spiniform tip and 3 smaller "teeth;" tergal border with 1 seta near insertion of dactylus and 3 setae near midlength; sternal border with 2 long setae. Distal part of propodus and dactylus with slight crenulations along tergal border.

Pereopod 1 with merus bearing 2 long, strong setae instead of spines; carpus with 1 tergal and 1 sternal setae; propodus with spiniform sternal corner and 1 tergal spine. Pereopod 6 with carpus carrying 3 pilose setae and 1 small sternal seta; propodus with 2 tergal pilose setae and 3 sternal pilose setae.

Pleotelson, 1.5× broader than long; posterior margin with protuberant median area bearing 4 minute setae.

Uropods biramous. Exopodite 2-segmented and slightly shorter than first endopodal segment; first segment, about 3× longer than broad, with 1 long slender seta; second segment longer than first, about 4.5× longer than broad, bearing 1 long and 1 short setae. Endopodite 2-segmented; first segment 6× longer than broad, and having 1 seta and 2 feathered hairs; second segment 8× longer than broad, as long as first segment, but more slender, and carrying 1 subterminal and 3 long slender setae and 2 feathered hairs.

Remarks. This species can be distinguished from *Paraleptognathia* cf. *gracilis* by the characters outlined above in the Remarks section for the former species. The presence of two setae on the merus of pereopod 1 distinguishes *P. bisetulosa* from its congeners. In addition, the single seta on the first exopodal segment of the uropod helps to separate this species from *P.* cf. *gracilis*.

Etymology. The specific name refers to the two setae on the merus of pereopod 1.

Type Locality and Type Specimen. Santa Maria Basin, California. Types deposited in the National Museum of Natural History (USNM 284723) and the Santa Barbara Museum of Natural History (SBMNH); see "Type Material."

Distribution. This species is so far known only from its type locality, Santa Maria Basin, California.

Genus *Scoloura* Sieg and Dojiri, 1991

Scoloura phillipsi Sieg and Dojiri, 1991

Figure 3.16

Scoloura phillipsi Sieg and Dojiri, 1991: 1495-1501, figs. 1-4.

Material Examined. Phase I: 4 females from Sta. 50, 34°37'48'N 121°01'40"W, 591 m, off Purisima Pt; 1 neuter from Sta. 79, 34°24'07"N 120°28'19"W, 98 m, off Pt. Conception, Western Santa Barbara Channel; 1 female from Sta. 73, 34°28'13"N 120°36'48"W, 98 m, between Pt. Conception and Pt. Arguello; 1 fragment from Sta. 3, 35°27.07'N 121°10.20'W, 291 m, off Pt. Estero, Santa Maria Basin, California.

From Santa Monica Bay, California, collected by Biology Laboratory, Environmental Monitoring Division, City of Los Angeles: 1 female from Sta. 7B, 33°54'45"N 118°35'25"W, 138 m, 18 January 1977; 1 female from Sta. 7B, 33°54'45"N 118°35'25"W, 180 m, 12 July 1984; 1 female from Sta. 8C, 33°58'47"N 118°36'17"W, 125 m, 19 January 1977; 1 female from Sta. E2, 33°58'39"N 118°39'16"W, 150 m, 05 January 1989; 2 females from Sta. 8C, 33°58'47"N 118°36'17"W, 120 m, 22 July 1977; 2 females from Sta. 4C, 33°50'40"N 118°26'22"W, 77 m, 24 July 1986; 1 female from Sta. 4C, 33°50'40"N 118°26'22"W, 08 January 1987; 1 female from Sta. 7B, 33°54'45"N 118°35'25"W, 172 m, 29 July 1985; 3 females (1 dissected) from Sta. 4C, 33°50'40"N 118°26'22"W, 76 m, 13 January 1977; 1 female from Sta. 7B, 33°54'45"N 118°35'25"W, 11 July 1985; 1 female from Sta. 7B, 33°54'45"N 118°35'25"W, 190 m, 09 July 1982.

From Los Angeles County Museum of Natural History: 5 females and 1 neuter (LACM 54-54) 7.8 mi 298° T (true north) from Palos Verdes Pt., 33°49'59"N 118°34'06"W, 165 m, sandy blue-gray mud, R/V *Velero IV* (AHF 2789-54), 22 May 1954; 2 females (LACM 60-100) 4.7 mi 349.5° T from Pt. Fermin Light to midpoint, 33°37'48"N 188°16'44"W, 219 m, R/V *Velero IV* (AHF 7161-60), 08 October 1960; 1 female (LACM 55-67) 7.4 mi 229° T from end of El Segundo Pier, 33°50'00"N 118°32'23"W, 119 m, sand and mud, R/V *Velero IV* (AHF 3385-55), 23 August 1955; 2 females and 1 fragment (LACM 53-126) from 6.3 mi 184° T from L.A. Breakwater Lighthouse, 33°36'14"N 118°15'30"W, 75 m, sand, R/V *Velero IV* (AHF 2355-53), 11 July 1953; 1 neuter (LACM 52-51) 9.2 mi 156.5° T from L.A. Lighthouse, 33°34'05"N 118°10'41"W, 88 m, R/V *Velero IV* (AHF 2126-52), 25 June 1952; 2 females (LACM 54-40) 6.4 mi 304° T from Palos Verdes Pt., 33°50'00"N 118°32'00"W, 121 m, green sticky mud, R/V *Velero IV* (AHF 2727-54), 08 May 1954; 2 females and 2 neuters (LACM 54-38) 4.1 mi 331° T from Palos Verdes Pt., 33°50'00"N 118°28'00"W, 11 m, mud with stones, R/V *Velero IV* (AHF 2725-54), 08 May 1954; 1 female (LACM 53-125) 6.4 mi 239° T, end of Redondo Beach Pier, 33°47'03"N 118°30'07"W, 229 m, sand, R/V *Velero IV* (AHF 2789-53), 08 July 1953; 1 neuter (LACM 60-83), 172 m, sandy mud, Coronado Canyon, 3.7 mi 013° T from N. Coronado Id., San Diego County, California, 32°30.27'N 117°16.80'W, R/V *Velero IV* (AHF 6845-60), 01 February 1960, EX_AHF [60-83].

Description (female) (Figure 3.16). Body, 3.60-5.00 mm long, about 7× longer than broad. Cephalothorax 1.3× longer than broad; anterior 1/3 narrowed, posterior 2/3 with parallel borders; posterolateral corners with a pair of rounded dorsal lobes. Pereonites 1, 5, and 6 quadrangular; pereonites 2-4 hexagonal with lateral margins noticeably convex in dorsal view. First pereonite 1.9× broader than long and narrowed posteriorly. Pereonite 2 about 1.2× broader than long with broadest area in anterior third. Pereonites 3 and 4 about as long as broad, and broadest at about midlength of each somite. Pereonite 5, narrowest of pereonal somites, subrectangular, about as long as broad, and widest in posterior region. Pereonite 6 short, 1.8× broader than long, widest across posterior margin. Pleonites with 5 tergites visible dorsally; sternites with keel-like mid-longitudinal ridge; all somites of similar size, broader than pereonites and each about 4.5× broader than long.

First antenna 4-segmented with armature of segments as follows: 1 seta + 4 feathered hairs; 2 setae + 2 feathered hairs; 2 setae + 1 feathered hair; and 7 setae + 1 aesthetasc, respectively.

Mandible with pars molaris terminating in 9-10 pointed processes.

Cheliped palm bearing row of crenulations along tergal border and caudal surface with comb consisting of 5 setae. Fixed finger with strongly sclerotized tip; tergal border with 3-4 setae, 3 pointed teeth, and 1 seta near articulation of dactylus; sternal border with 2 setae; rostral surface of fixed finger with row of blunt protuberances. Dactylus curved, bearing a sclerotized tip; tergal border crenulated.

Merus of pereopod 1 subtriangular, wider in distal region, and bearing 1 spine and 1 seta distally. Dactylus of pereopods 4-6 elongate, with longitudinal groove lined with 2 rows of minute setules.

Pleotelson bearing pair of large, ventrolateral, triangular-shaped processes; caudal point protuberant and bent ventrally.

Uropod biramous with very slender rami; exopodite 2-segmented and extending about 1/2 length of first endopodal segment; endopodite also 2-segmented.

Description (neuter) (Figure 3.16). Total length less than that of adult female. Pereonites with lateral margins not as convex and pleonites not as expanded as those of female.

Remarks. This species was described by Sieg and Dojiri (1991) as a new genus and species based on specimens obtained from this study and from the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT) who identified these specimens originally as *Leptognathia* sp. C. It can be distinguished from all known species by the presence of a pair of ventrolateral triangular-shaped processes on the pleotelson.

This species appears to inhabit substrates consisting of sandy mud and sandy silt.

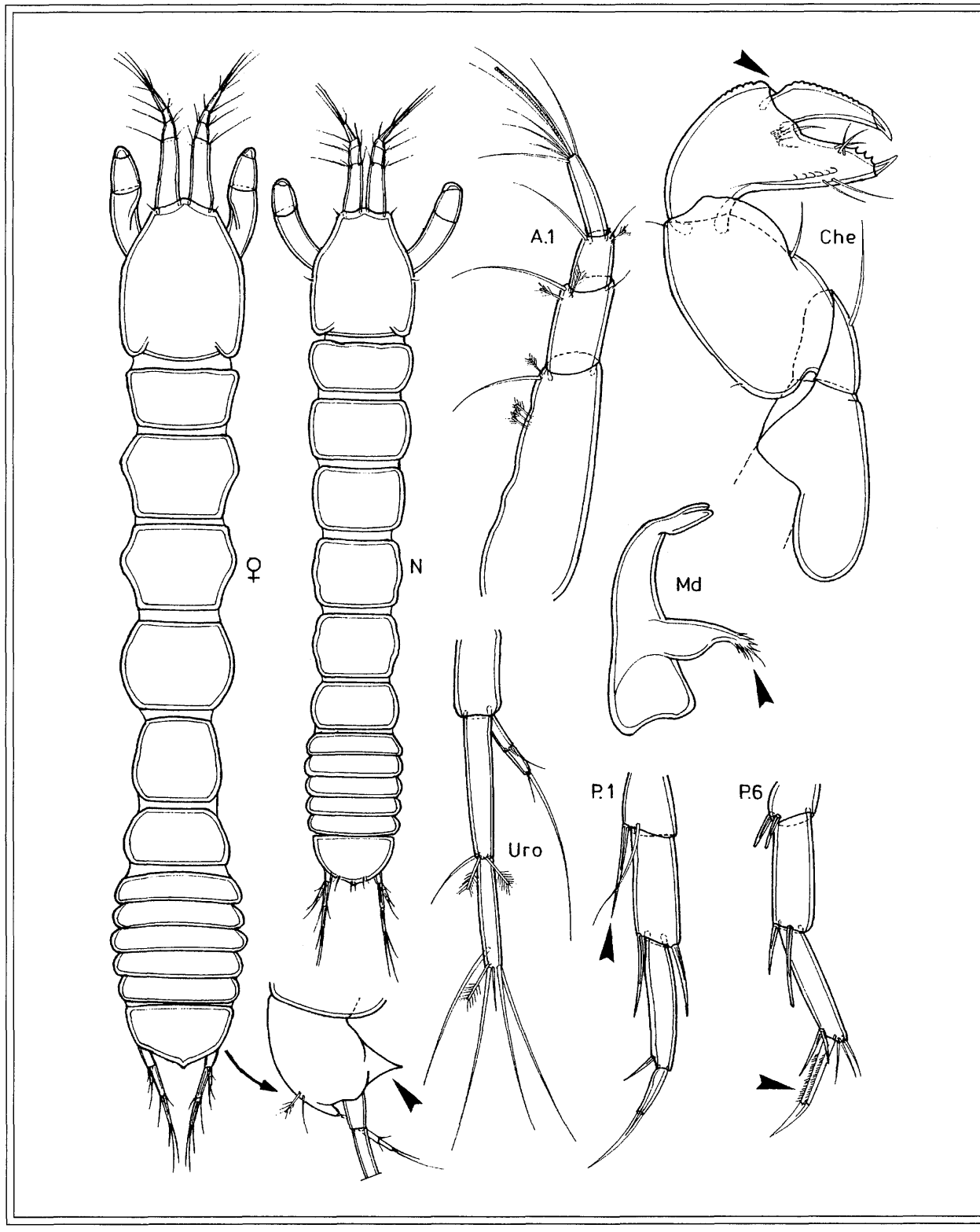

Figure 3.16. *Scoloura phillipsi* Sieg and Dojiri, 1991, female: ♀, general habitus of female; A.1, first antenna; Md, mandible; Che, cheliped; P.1, pereopod 1; P.6, pereopod 6; Uro, uropod. Neuter: N, general habitus of neuter.

Type Locality and Type Specimens. Holotype female (LACM 81-134.1) and 4 female paratypes (LACM 81-134.2; 1 dissected) from Sta. 4C, 33°50'40"N, 118°26'22"W, 89 m, sandy silt, Santa Monica Bay, California, collected by the Biology Laboratory, Hyperion Treatment Plant, 22 July 1981, deposited in the Natural History Museum of Los Angeles County.

Distribution. Pt. Sal (Santa Maria Basin) to Coronado Island (Mexico), 11-519 m (Sieg and Dojiri, 1991).

Genus *Chauliopleona* Dojiri and Sieg, new genus

Type species (here designated): *Chauliopleona dentata* Dojiri and Sieg, new species.

Diagnosis. Pleonite 5 with prominent, posteriorly-directed, sternal spiniform process.

Remarks. *Leptognathia armata*, *L. hastata*, *L. amdrupii*, and the new species described below are morphologically related, but generic transfer of the three *Leptognathia* species into this new genus is postponed until detailed redescriptions are done for these species. A generic diagnosis can only be determined after a detailed study is completed.

Etymology. The generic name is a combination of the Greek words *chaulios*, meaning prominent, and *pleo*, meaning swim, and alludes to the prominent tooth on the pleon.

Chauliopleona dentata Dojiri and Sieg, new species

Figure 3.17

Type Material. 1 female holotype (USNM 284724) and 6 paratypes (SBMNH 144123; 5 females, 1 subadult male; 1 female and 1 subadult male dissected) from Sta. 4C, 33°50'40"N 118°26'22"W, 76 m, Santa Monica Bay, California, collected by Biology Laboratory, Environmental Monitoring Division, 08 January 1987.

Material Examined. Phase I: 1 female and 1 subadult male from Sta. 42, 34°48.04'N 120°47.50'W, 100 m, off Purisima Pt., Santa Maria Basin, California, 09 January 1984; 2 females and 2 neuters from Sta. 79, 34°24.12'N 120°28.32'W, 98 m, off Pt. Conception, Western Santa Barbara Channel, California. Phase II: 2 females, 1 subadult male, and 4 neuters from cruise 1-2, Sta. R-4 (rep. 3), 34°43.01'N 120°47.39'W, 92 m, off Purisima Pt., Santa Maria Basin, California, collected by Battelle in January 1987 on board M/V *Aloha*; 8 females, 4 neuters, and 1 manca-II (dissected) from cruise 2-3, Sta. R-4 (rep. 1), 34°43.01'N 120°47.39'W, 92 m, off Purisima Pt., Santa Maria Basin, California, collected by Battelle in January 1988 on board M/V *Aloha*; 5 females and 2 neuters from cruise 1-3, Sta. R-4 (rep. 3), 34°43.01'N 120°47.39'W, 92 m, off Purisima Pt., Santa Maria Basin, California, collected by Battelle on May 1987 on board M/V *Aloha*.

From Santa Monica Bay, California, collected by Biology Laboratory, Environmental Monitoring Division, City of Los Angeles: 1 female and 1 subadult male from Sta. 4C, 33°50'40"N 118°26'22"W, 76 m, sandy silt, 13 January 1977; 5 females from Sta. 4C, 33°50'40"N 118°26'22"W, approximately 76 m, 24 July 1986; 1 female from Sta. 6B, 33°52'27"N 118°34'12"W, 75 m, 30 July 1986; 1 subadult male from Sta. 6B, 33°52'27"N 118°34'12"W, 79 m, 07 February 1986; 3 females, 1 subadult male, and 1 neuter from Sta. D2, 33°53'40"N 118°35'20"W, 80 m, 08 January 1990; 2 females from Sta. D4, 33°51'07"N 118°31'30"W, 80 m, 11 January 1990; 1 female from Sta. D3, 33°51'47"N 118°35'15"W, 80 m, 17 July 1989; 1 female from Sta. 4C, 33°50'40"N 118°26'22"W, 76 m, 08 January 1987; 2 females from Sta. D2, 33°53'40"N 118°35'20"W, 80 m, 03 September 1987; 1 female from Sta. D4, 33°51'07"N 118°31'30"W, 81 m, 20 July 1990; 2 females from Sta. D4, 33°51'07"N 118°31'30"W, 80 m, 03 September 1987; 1 female from Sta. 6B, 33°52'27"N 118°34'12"W, 79 m, 21 January 1987; 2 females from Sta. D4, 33°51'07"N 118°31'30"W, 80 m, 26 July 1990.

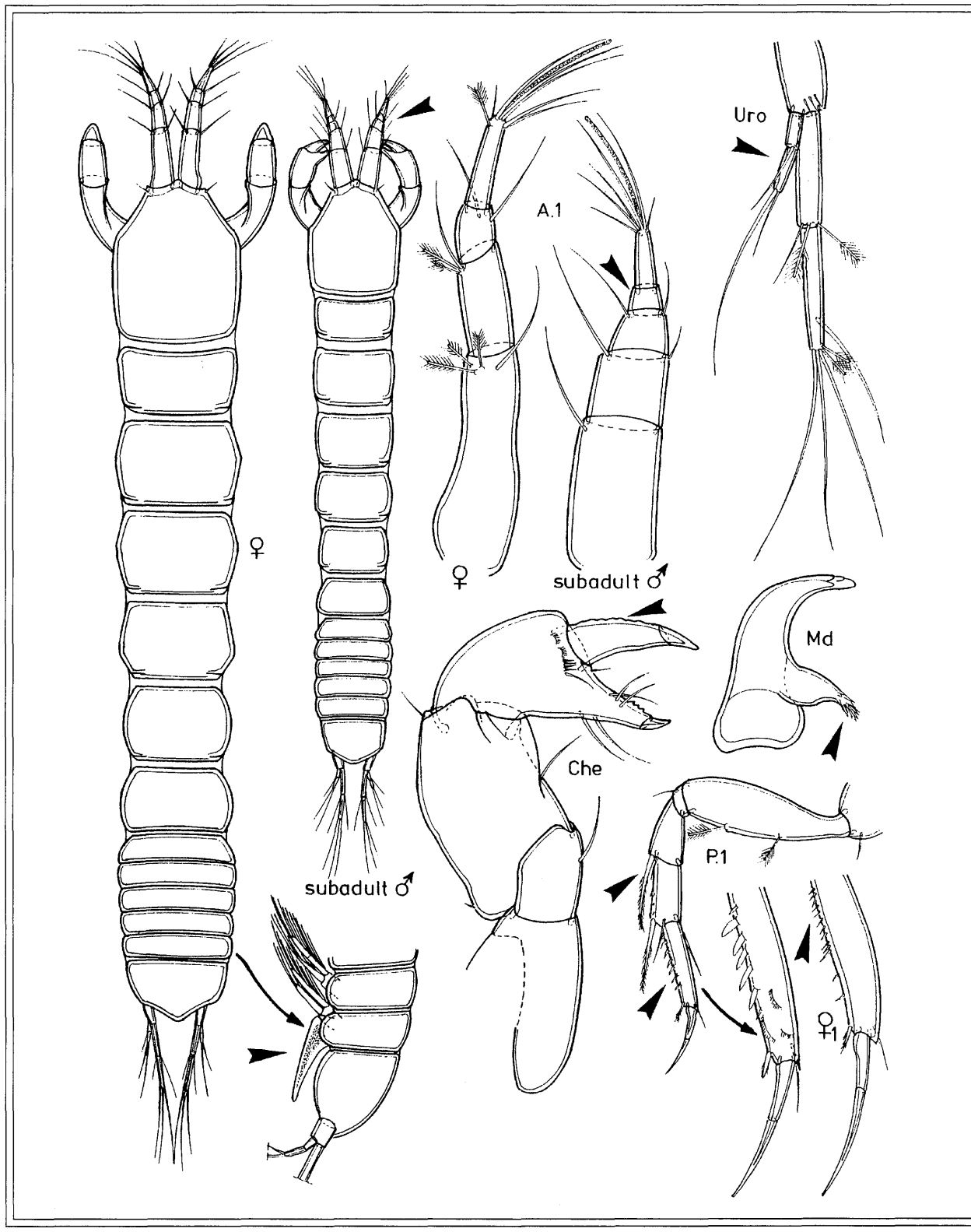

Figure 3.17. ***Chauliopleona dentata*** **Dojiri and Sieg, new species**, female: ♀, general habitus of female; ♀ A.1, first antenna of female; Md, mandible; Che, cheliped; P.1, pereopod 1; ♀ 1, terminal segment of pereopod 1 of neuters and some variant females; Uro, uropod. Subadult ♂, general habitus of subadult male; subadult ♂ A.1, first antenna of subadult male.

From Los Angeles County Museum of Natural History: 1 female (LACM 59-147), 205 m, rocks, 2.45 mi, 249.5° T from Gull Island, Santa Cruz Channel, Santa Barbara County, California, 33°56.10'N 119°52.28'W, R/V *Velero IV* (AHF 6806-59), 22 December 1959; 1 neuter (LACM 55-46), 53 m, 4.25 mi, 273° T from base of El Segundo Pier, Los Angeles County, California, 33°53.00'N 115°30.63'W, R/V *Velero IV* (AHF 2994-55), 05 February 1955; 1 female (LACM 55-67), 119 m, sand and mud, 7.4 mi, 229° T from end of El Segundo Pier, Los Angeles County, California, 33°50.00'N 118°32.38'W, R/V *Velero IV* (AHF 3385-55), 23 August 1955; 1 female (LACM 54-38), 11 m, mud with stones, 4.1 mi, 331° T from Palos Verdes Pt., Los Angeles County, California, 33°50.00'N 118°28.00'W, R/V/*Velero IV* (AHF 2725-54); 1 female (LACM 54-54), 165 m, sandy blue-gray mud, 7.8 mi, 298° T from Palos Verdes Pt., Los Angeles County California, 33°49.98'N 118°34.10'W, R/V *Velero IV* (AHF 2789-54), 22 May 1954; 2 females (LACM 60-100), 219 m, 4.7 mi, 349.5° T from Pt. Fermin Light to midpoint, Los Angeles County, California, 33°37.80'N 118°16.73'W, R/V *Velero IV* (AHF 7161-60), 08 October 1960; 1 female (LACM 60-86), 949 m, mud over sand, 14.95 mi, 264° T from Pt. La Jolla, San Diego County, California, 32°49.62'N 117°35.20'W, R/V *Velero IV* (AHF 7049-60), 07 May 1960; 1 female and 1 neuter (LACM 60-110), 585 m, mud, 31.5 mi, 254° T from China Point Light, Tanner Canyon, San Clemente Island, California Channel Islands, California, 32°39.55'N 119°01.40'W, R/V *Velero IV* (AHF 6834-60), 29 January 1960; 1 female (LACM 60-84), 225 m, mud, 34.1 mi, 246° T from China Point Light, San Clemente Island, Tanner Bank, California Channel Islands, California, 32°34.47'N 119°02.70'W, R/V *Velero IV* (AHF 6837-60), 29 January 1960; 1 female (LACM 60-183), 108 m, muddy sand, 3.85 mi, 024° T from Coronado Norte, Islas de Los Coronados, Baja California, Mexico, 32°30.30'N 117°16.07'W, R/V *Velero IV* (AHF 6846-60), 01 February 1960.

Description (female) (Figure 3.17). Body, 2-4 mm long, about 6.7× longer than broad. Cephalothorax, 1.3× longer than broad, with relatively straight parallel lateral margins, abruptly tapered anteriorly. Pereonites 1-4 similar in width; pereonite 5 narrowest; pereonite 6 shortest. Pleonites 1-5 similar in size, 4-5× broader than long; pleonite 5 with large, posteriorly-directed, sternal, spiniform process.

First antenna 4-segmented with armature as follows: 1 seta + 3 feathered hairs, 1 seta + 2 feathered hairs, 2 setae, and 6 setae + 1 feathered hair + 1 aesthetasc.

Mandible with pars molaris bearing approximately 10 pointed processes at tip.

Cheliped carpus about 1.7× longer than broad; palm with comb bearing 2 small rows of spinules, 4 short setae, and 1 longer seta. Fixed finger with sclerotized tip and 3 small teeth; tergal border with 3 long and 1 shorter setae near articulation of dactylus; sternal border with 2 setae. Dactylus with crenulations along tergal margin.

Pereopod 1 with merus bearing 1 pinnate spine; carpus with tergal row of spinules, 1 tergal spine, and 2 setae; propodus with 1 tergal row of hyaline spatulate spinules in females with marsupia, other females and neuters with attenuate spinules (see female 1 in figure), curved rows of minute setules, 1 stout pinnate spine, and 1 slender seta.

Pleotelson, 1.7× broader than long, with protuberant posteromedian area.

Uropods biramous. Basis with 3 small setae near insertion of endopodite. Exopodite 2-segmented, distinctly shorter than first endopodal segment; first segment about 2.7× longer than broad, with 1 distal seta; second segment 4× longer than broad, and bearing 1 long and 1 short setae at tip. Endopodite 2-segmented; first segment 4.5× longer than broad, and equipped with 1 seta and 2 feathered hairs; second segment 6.5× longer than broad, with 1 subterminal and 3 long setae and 2 feathered hairs terminally.

Description (subadult male) (Figure 3.17). Body smaller than that of adult female, but proportions of body somites similar. Cephalothorax similar in shape, about 1.25× longer than broad.

First antenna 5-segmented with armature formula as follows: 1 seta, 2 setae, 2 setae, 0, 6 setae + 1 aesthetasc.

Remarks. The posteriorly-directed spiniform process on the ventral (sternal) surface of the last pleonite helps distinguish *Chauliopleona dentata* from all other tanaidacean species collected in the Santa Maria Basin and Western Santa Barbara Channel. This species appears to be closely related to *Leptognathia armata*, *L. hastata*, and *L. amdrupii*, which may eventually be transferred to *Chauliopleona* (see generic "Remarks" section above). Unfortunately, the descriptions of these three species are not adequate for a detailed comparison with *C. dentata*. The crenulation along the chelipedal dactylus helps distinguish *C. dentata* from the above three species.

Specimens collected by the Environmental Monitoring Division were previously identified as "*Leptognathia* sp. E" of SCAMIT.

Etymology. The specific name refers to the numerous spatulate spinules on the propodus of pereopod 1 in females with marsupia.

Type Locality and Type Specimens. Santa Monica Bay, California. Types deposited in the National Museum of Natural History (USNM 284724) and the Santa Barbara Museum of Natural History (SBMNH 144123); see "Type Material."

Distribution. This species has been collected from Santa Maria Basin south to Coronado Norte, Islas de Los Coronados, Baja California, Mexico.

Genus *Araphura* Bird and Holdich, 1984

***Araphura breviaria* Dojiri and Sieg, new species**

Figure 3.18

Type Material. 1 female holotype (USNM 284725) and 3 paratypes (1 female, 2 neuters; SBMNH 144132) from Sta. 4C, 33°50'40"N 118°26'22"W, 76 m, Santa Monica Bay, California, 08 January 1987.

Material Examined. Santa Maria Basin, California, phase I: 2 females from Sta. 54, 34°36'34"N 120°52'01"W, 396 m, between Pt. Arguello and Purisima Pt., November 1984; 2 females from Sta. 61, 34°33'01"N 120°48'53"W, 345 m, off Pt. Arguello, November 1984. Phase II: 20 neuters, 3 manca-I, 4 manca-II, and 6 fragments from cruise 2-4, Sta. R-4 (rep. 2), 34°43'01"N 120°47'23"W, off Purisima Pt.; 14 neuters, 4 manca-II, and 1 manca-I from cruise 1-3, Sta. R-4 (rep. 3), 34°43'01"N 120°47'23"W, off Purisima Pt.

From Santa Monica Bay, California, collected by Biology Laboratory, Environmental Monitoring Division, City of Los Angeles: 2 females from Sta. E1, 33°59'03"N 118°42'50"W, 150 m, 09 July 1990; 1 female and 1 neuter from Sta. B5, 33°58'00"N 118°31'45"W, 45 m, 11 August 1987; 2 females from Sta. 2B, 33°56'25"N 118°29'14"W, 37 m, silt; 1 female from Sta. 4C, 33°50'40"N 118°26'22"W, 76 m, sandy silt;3 females (2 dissected) from Sta. 3B, 33°54'45"N 118°28'29"W, 40 m, silt with organic debris; 2 females from Sta. OC, 34°01'17"N 118°36'00"W, 29 m, clay silt.

From LACM: 3 females and 1 neuter (LACM 55-35), 9.9 mi, 203° T from Santa Monica Pier Light, Los Angeles County, California, 33°51'22"N 118°34'42"W, 73 m, mud, R/V *Velero IV* (AHF 2998-55), 06 February 1955; 2 females (LACM 55-36) 14.3 mi., 345° T from Aero Beacon, San Nicolas Island, Ventura County, California, 33°28'04"N 119°34'41"W, 732 m, rock, sand, and mud, R/V *Velero IV* (AHF 3031-55), 07 May 1955; 1 female (LACM 52-51) 9.2 mi., 156.5° T from L.A. Lighthouse, Los Angeles County, California, 33°34'05"N 118°10'41"W, 88 m, R/V *Velero IV* (AHF 2126-52), 25 June 1952.

Description (female) (Figure 3.18). Body, 2.45-3.64 mm long, about 7× longer than broad. Cephalothorax, stout, 1.1× longer than broad, anterior half narrowed, posterior half with parallel sides. Pereonites subquadrangular; pereonites 2-5 with irregular, slightly convex lateral borders. First pereonite 1.6× broader than long and tapered posteriorly. Pereonite 2 about 1.2× broader than long. Pereonites 3-5

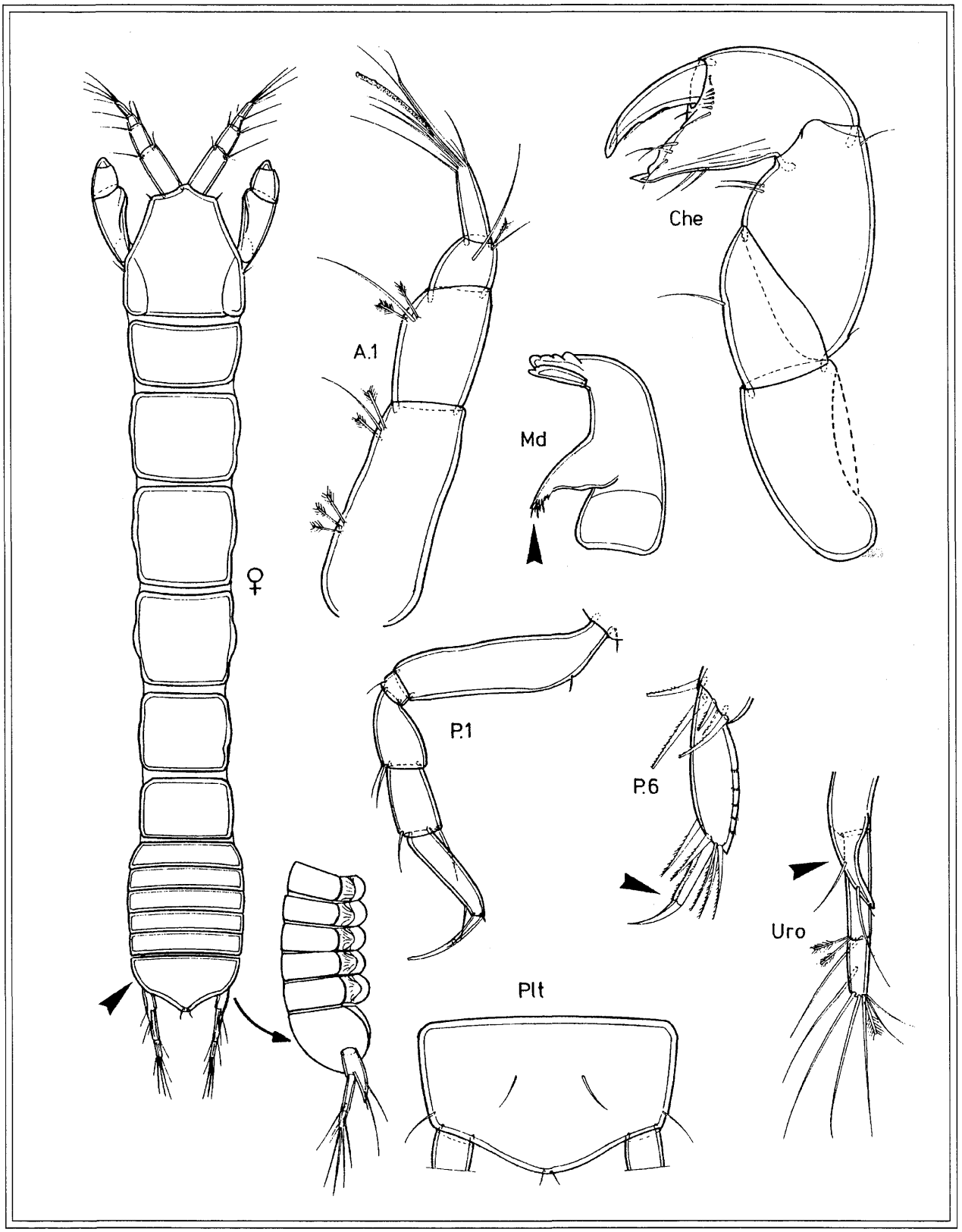

Figure 3.18. ***Araphura breviaria*** **Dojiri and Sieg, new species**, female: ♀, general habitus of female; Md, mandible; Che, cheliped; P.1, pereopod 1; P.6, pereopod 6; Plt, pleotelson; Uro, uropod.

about as long as broad. Pereonite 6 shortest of pereonal somites, 1.4× broader than long. Pleonites 1-5 similar in size, about as broad as pereonites 1 and 2, and each about 5.6× broader than long.

First antenna 4-segmented with armature as follows: 1 seta + 5 feathered hairs; 1 seta + 2 feathered hairs; 2 setae + 1 feathered hair; and 8 setae + 1 aesthetasc, respectively.

Mandible with pars molaris terminating in 7 pointed processes.

Cheliped palm bearing comb of 5 short setae and 1 longer seta on caudal surface. Fixed finger with strongly sclerotized tip; tergal border with 3 setae and 1 seta near articulation of dactylus; sternal border with 2 setae. Dactylus with 1 sternal (or 2 sternal ?) setae.

Pereopod 1 with merus bearing 1 seta and 1 spiniform seta tergally; carpus with 1 tergal spiniform seta and 1-2 sternal setae; propodus with 1 tergal seta. Pereopod 6 with carpus bearing 2 barbed spines tergally and 2 barbed spines and 1 seta sternally; propodus having several rows of minute spinules along sternal border and bearing 2 barbed spines tergally and 3 barbed spines sternally; dactylus with longitudinal groove lined with 2 rows of minute setules.

Pleotelson short, 1.6× broader than long, with relatively straight lateral borders.

Uropod "pseudobiramous;" exopodite fused with basis. Fused exopodite reaching beyond midlength of first endopodal segment and bearing 2 long lateral setae and 1 short subterminal seta. Endopodite 2-segmented; first segment 4.3× longer than broad, with 1 long seta and 2 feathered hairs; second segment about 1/2 length of first, 2.5× longer than broad, and bearing 1 long subterminal seta and 1 feathered hair, 2 short setae, and 3 long setae at tip.

Remarks. *Araphura breviaria* is described from MMS specimens and from specimens in the SCAMIT collections. These specimens were originally identified as "*Araphura* sp. A" and "*Leptognathia* sp. A". It can be distinguished from *A. cuspirostris* new species by the short pleotelson, straight lateral borders of the pleotelson, and absence of the conical knob on the posterior border of the pleotelson.

This species has been collected from various types of sediments (e.g., sandy silt, silt, and silty clay) ranging in depth from 29-732 m.

Etymology. The specific name is from Latin meaning abridged or shortened and alludes to the short pleotelson of this species.

Type Locality and Type Specimens. Santa Monica Bay, California. Types deposited in the National Museum of Natural History (USNM 284725) and the Santa Barbara Museum of Natural History (SBMNH 144132); see "Type Material."

Distribution. Santa Maria Basin south to Los Angeles Light, Los Angeles County.

Araphura cuspirostris Dojiri and Sieg, new species

Figure 3.19

Type Material. 1 female holotype (USNM 284726) , 13 female paratypes (2 females dissected on slides; SBMNH 144127) from Sta. 55, 34°33'40"N 120°56'19"W, 590 m, west of Pt. Arguello, Santa Maria Basin, California, September 1984.

Material Examined. Santa Maria Basin, phase I: 4 females, 7 neuters from Sta. 59, 34°33'39"N 120°47'11"W, 216 m, southwest of Pt. Arguello, October 1984. Phase II: 7 neuters, 1 manca-I from cruise 1-3, Sta. R-4 (rep. 3), 34°43'01"N 120°47'23"W, 92 m, southwest of Purisima Point; 8 females, 4 neuters, 3 manca-I, 3 manca-II, 3 fragments from cruise 2-4, Sta. R-4 (rep. 2), 34°43'01"N 120°47'23"W, southwest of Purisima Point; 2 neuters from cruise 1-3, Sta. R-4 (rep. 3), 34°43'01"N 120°47'23"W, 92 m, southwest of Purisima Point.

From Santa Monica Bay, California, collected by Biology Laboratory, Environmental Monitoring Division, City of Los Angeles: 1 female from Sta. E3, 33°58'21"N 118°36'44"W, 149 m, 10 July 1989.

From LACM: 1 female (LACM 59-264) 8.75 mi., 235° T from Santa Monica Pier Light, Los Angeles County, California, 33°55'29"N 118°38'32"W, 457 m, sand, R/V *Velero IV* (AHF 6779-59), 19 December 1959; 3 females and 3 neuters (LACM 55-96) 7.1 mi., 226° T from Santa Monica Pier Light, Los Angeles County, California, 33°55'30"N 118°35'55"W, 293 m, mud and silt, R/V *Velero IV* (AHF 3180-55), 05 July 1955; 2 females (LACM 54-55) 5.5 mi., 287.5° T from Palos Verdes Point, Los Angeles County, California, 33°48'00"N 118°32'00"W, 459 m, blue-grey mud, R/V *Velero IV* (AHF 2793-54), 22 May 1954; 1 female (LACM 53-127) 8.45 mi., 184° T from L.A. Breakwater Lighthouse, Los Angeles County, California, 33°34'07"N 118°15'44"W, 366 m, clay, R/V *Velero IV* (AHF 2354-53), 02 July 1953; 1 female (LACM 60-101) 3.8 mi., 163.5° T from Pt. Fermin Light, Los Angeles County, California, 33°38'36"N 118°16'16"W, 214 m, mud, R/V *Velero IV* (AHF 7174-60), 09 October 1960; 1 female (LACM 55-101) 11.7 mi., 257° T from end of El Segundo Pier, Los Angeles County, California, 33°52'08"N 118°39'18"W, 457 m, mud, R/V *Velero IV* (AHF 3399-55), 23 August 1955; 1 female (LACM 60-108) 0.2 mi., 254.5° T from base of Newport Pier, Newport Canyon, Orange County, California, 33°36'24"N 117°55'54"W, 16 m, silt, R/V *Velero IV* (AHF 7031-60), 05 May 1960; 1 female (LACM 60-124) 4.8 mi., 019° T from Port Hueneme Light, Ventura County, California, approximately 34°03'55"N 119°13'W, 428 m, mud, sand, and pebbles, R/V *Velero IV* (AHF 6899-60), 11 March 1960; 4 females and 1 neuter (LACM 53-128) 3.4 mi., 301° T from Pt. Vicente Light, Los Angeles County, California, 33°44'08"N 118°25'48"W, 183 m, sand, R/V *Velero IV* (AHF 2357-53), 08 July 1953; 1 female (LACM 53-125) 6.4 mi., 239° T end of Redondo Beach Pier, Los Angeles County, California, 33°47'03"N 118°30'07"W, 229 m, sand, R/V *Velero IV* (AHF 2789-53), 08 July 1953; 1 female (LACM 60-86) 14.95 mi., 264° T from Pt. La Jolla, San Diego County, California, 32°49'37"N 117°35'12"W, 949 m, mud over sand, R/V *Velero IV* (AHF 7049-60), 07 May 1960; 1 female (LACM 59-147) 2.45 mi., 249.5° T from Gull Island, Santa Cruz Channel, Santa Barbara County, California, 33°56'06"N 119°52'17"W, 205 m, rocks, R/V *Velero IV* (AHF 6806-59), 22 December 1959.

Description (female) (Figure 3.19). Body, 2.73-3.49 mm long, about 9.2× longer than broad. Cephalothorax, slender, 1.4× longer than broad, and tapered anteriorly. Pereonites subquadrangular; pereonites 1 and 6 similar in length and width, about 1.2× broader than long. Pereonites 2-5 similar in length, but pereonites 4 and 5 narrower than preceding somites. Pleonites 1-5 similar in size, each about 4× broader than long.

First antenna 4-segmented with armature as follows: 1 seta + 4 feathered hairs; 1 seta + 4 feathered hairs; 2 setae; and 6 setae + 1 aesthetasc, respectively.

Mandible with pars molaris bearing 6 pointed processes at tip.

Cheliped palm bearing comb of 3 short and 1 long setae on caudal surface. Fixed finger with strongly sclerotized tip; tergal border with 3 long and 1 shorter setae near articulation of dactylus; sternal border with 2 long setae. Dactylus with 1 caudal seta and 1 sternal seta.

Pereopod 1 with merus bearing 1 seta and 1 spiniform seta tergally; carpus with 1 tergal spiniform seta and 1-2 sternal setae; propodus with 3 setae. Pereopod 6 with carpus bearing 2 barbed spines tergally and 2 barbed spines and 1 seta sternally; propodus having several rows of minute spinules on sternal border and bearing 2 barbed spines tergally and 3 barbed spines sternally; dactylus with longitudinal groove lined with 2 rows of minute setules.

Pleotelson subquadrate, 1.2× broader than long, with slightly concave lateral borders, and bearing small conical or digitiform process on posterior border.

Uropod "pseudobiramous." Fused exopodite reaching about 3/4 length of proximal endopodal segment and carrying 3 setae. Endopodite 2-segmented; first segment slender, 5.3× longer than broad, with 1 long seta and 1 feathered hair distally; second segment about 1/2 length of first, with 1 long subterminal seta, 1 feathered hair, 2 short setae, and 3 long setae at tip.

Description (neuter). Total length less than that of adult female; habitus as in figure. Lateral borders of pleotelson slightly concave.

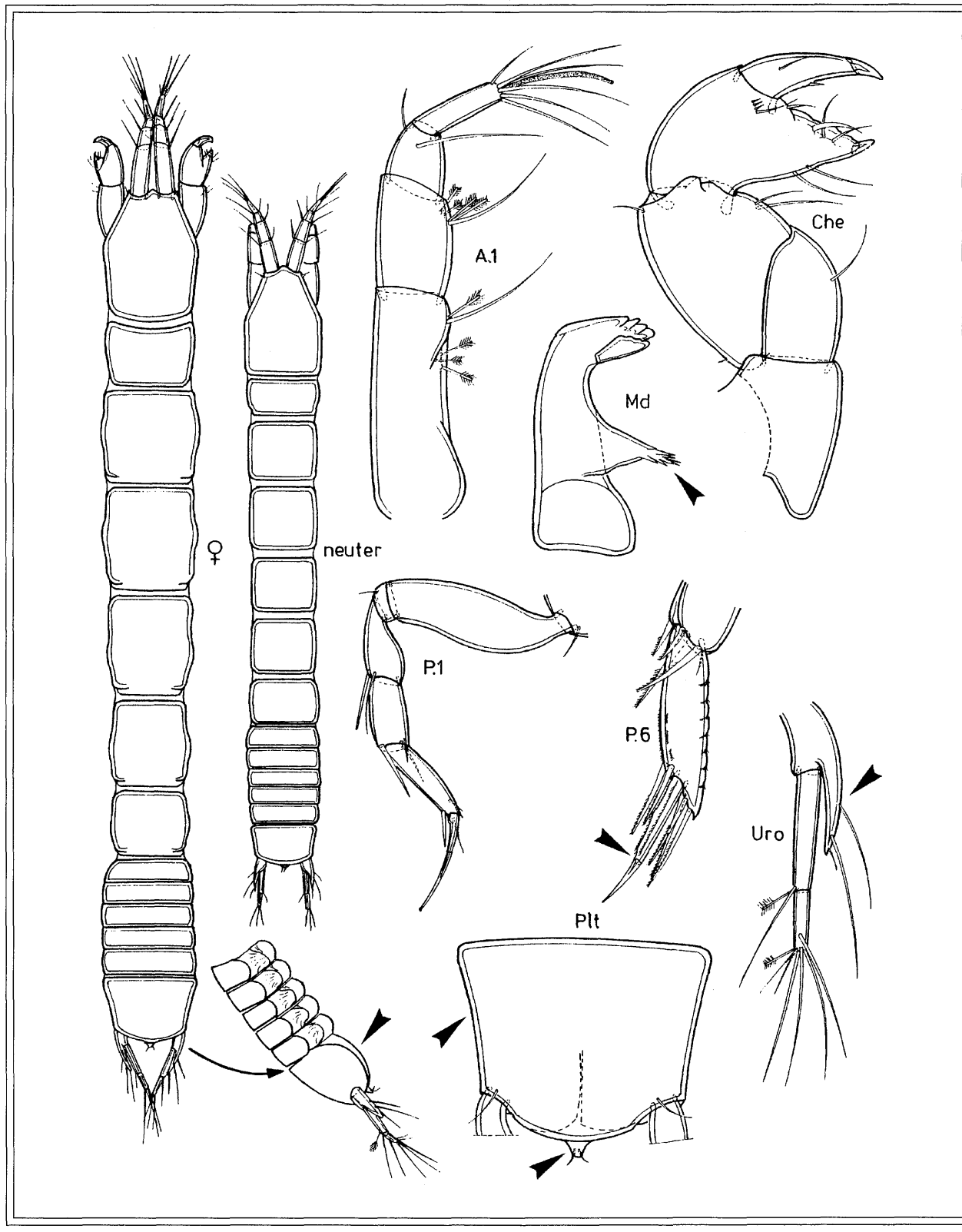

Figure 3.19. ***Araphura cuspirostris*** **Dojiri and Sieg, new species**, female: ♀, general habitus of female; A.1, first antenna; Md, mandible; Che, cheliped; P.1, pereopod 1; P.6, pereopod 6; Plt, pleotelson; Uro, uropod. Neuter, general habitus of neuter.

Remarks. *Araphura cuspirostris* is described from specimens originally obtained for MMS and from specimens belonging to SCAMIT. These specimens were originally identified as *Araphura* sp. B and *Leptognathia* sp. D. It can be distinguished from *A. breviaria* by the general shape (subquadrate) of the pleotelson, the slightly concave lateral borders of the pleotelson, and the presence of the conical or digitiform process on the posterior border of the pleotelson.

Araphura cuspirostris has been collected from a wide variety of sediments including rocks, pebbles, sand, mud, muddy silt, and silt.

Etymology. The specific name is a combination of the Latin words *cuspis*, meaning point, and *rostrum*, meaning beak, and alludes to the small conical process on the pleotelson.

Type Locality and Type Specimens. Santa Maria Basin, California. Types deposited in the National Museum of Natural History (USNM 284726) and the Santa Barbara Museum of Natural History (SBMNH 144127); see "Type Material."

Distribution. Santa Maria Basin south to Pt. La Jolla (San Diego County).

Genus *Tanaella* Norman and Stebbing, 1886

Tanaella propinquus Dojiri and Sieg, new species

Figure 3.20

Type Material. 1 female holotype (USNM 284727) and 4 paratypes (SBMNH 144124; 3 females and 1 neuter) from Sta. E7, 33°54'44"N 118°34'17"W, 150 m, Santa Monica Bay, California, collected by Biology Laboratory, Environmental Monitoring Division, 16 July 1990.

Material Examined. Santa Maria Basin and Western Santa Barbara Channel, phase I: 1 female and 7 neuters from Sta. 84, 34°13'32"N 120°31'11"W, 394 m, south of Pt. Conception, Western Santa Barbara Channel, California, February 1985; 2 females from Sta. 73, 34°28'13"N 120°36'48"W, 98 m, between Pt. Conception and Pt. Arguello, Santa Maria Basin, California, January 1985. Phase II: 7 females, 6 neuters, and 21 manca-I from cruise 3-1, Sta. R-4 (rep. 3), 34°43'01"N 120°47'23"W, 92 m, off Purisima Pt., Santa Maria Basin, California; 7 females, 4 neuters, 4 fragments, and 58 manca-I from cruise 2-3, Sta. R-4 (rep. 1), 34°43'01"N 120°47'23"W, 92 m, off Purisima Pt., Santa Maria Basin, California.

From Santa Monica Bay, California, collected by Biology Laboratory, Environmental Monitoring Division, City of Los Angeles: 2 females from Sta. E2, 33°58'39"N 118°39'16"W, 150 m, 04 January 1989; 2 females from Sta. E3, 33°58'21"N 118°36'44"W, 149 m, 10 July 1989; 1 female from Sta. 7B, 33°54'45"N 118°35'25"W, 168 m, 11 February 1986; 2 females from Sta. 7B, 33°54'45"N 118°35'25"W, 21 January 1987; 1 female from Sta. E8, 33°54'32"N 118°35'49"W, 150 m, 17 January 1989; 2 females and 1 manca-I from Sta. E8, 33°54'32"N 118°35'49"W, 150 m, 20 August 1987; 1 female from Sta. E7, 33°54'44"N 118°34'17"W, 148 m, 17 July 1989; 1 female from Sta. E8, 33°54'32"N 118°35'49"W, 149 m, 17 July 1989; 2 females from Sta. E3, 33°58'21"N 118°36'44"W, 150 m, 11 August 1987; 1 specimen from Sta. E8, 33°54'32"N 118°35'49"W, 150 m, 08 January 1990; 1 female from Sta. E8, 33°54'32"N 118°35'49"W, 151 m, 25 January 1988; 4 females from Sta. E7, 33°54'44"N 118°34'17"W, 150 m, 14 July 1988; 3 specimens from Sta. 8C, 33°58'47"N 118°36'17"W, 116 m, 08 January 1987; 1 female from Sta. C7(2), 33°53'35"N 118°32'15"W, 59 m, 16 July 1990; 1 female from Sta. E2, 33°58'39"N 118°39'16"W, 152 m, 28 January 1988; 4 females from Sta. E1, 33°59'03"N 118°42'50"W, 150 m, 09 July 1990.

From LACM: 4 females (LACM 55-67) 7.4 mi, 229° T (true north) from end of El Segundo Pier, 33°50'00"N 118°32'23"W, 119 m, sand and mud, R/V *Velero IV* (AHF 3385-55), 23 August 1955; 1 female (LACM 54-40) 6.4 mi, 304° T from Palos Verdes Pt., 33°50'00"N 118°32'00"W, 121 m, green sticky mud, R/V *Velero IV* (AHF 2727-54), 08 May 1954; 2 females (LACM 53-78) 1.55 mi, 002° T from Long Pt. Light, Santa Catalina Island, California Channel Islands, 33°25'57"N 118°21'54"W, 320 m, clay mixed

with broken shell sand, R/V *Velero IV* (AHF 2423-53), 29 September 1953; 9 females and 3 neuters (LACM 54-54) 7.8 mi, 298° T from Palos Verdes Pt., 33°49'59"N 118°34'06"W, 165 m, sandy blue gray mud, R/V *Velero IV* (AHF 2789-54), 22 May 1954; 3 females and 1 neuter (LACM 55-96) 7.1 mi, 226° T from Santa Monica Pier Light, 33°55'30"N 118°35'55"W, 293 m, mud and silt, R/V *Velero IV* (AHF 3180-55), 05 July 1955; 4 females and 5 neuters (LACM 53-125) 6.4 mi, 239° T from end of Redondo Beach Pier, 33°47'03"N 118°30'07"W, 229 m, sand and mud, R/V *Velero IV* (AHF 2361-53), 08 July 1953; 13 females and 4 neuters (LACM 60-101), 3.8 mi, 163.5° T from Pt. Fermin Light, 33°38'36"N 118°16'16"W, 214 m, mud, R/V *Velero IV* (AHF 2361-53), 08 July 1953. From San Diego County: 3 females (LACM 60-83) 3.7 mi, 013° T from N. Coronado Island, 32°30'16"N 117°16'48"W, 172 m, sandy mud, R/V *Velero IV* (AHF 6845-60), 01 February 1960. From Mexico: 3 females (LACM 60-183) 3.85 mi, 024° T from Coronado Norte, Islas de Los Coronados, Baja California, 32°30'18"N 117°16'04"W, 108 m, muddy sand, R/V *Velero IV* (AHF 6846-60), 01 February 1960.

Description (female) (Figure 3.20). Body, 2.78-3.31 mm long, about 7.9× longer than broad. Cephalothorax, 1.4× longer than broad, narrowed anteriorly. Pereonites with convex lateral borders; pereonites 1, 2, and 3 similar in width; pereonite 3 longest and broadest of pereonites; pereonite 6 shortest, with small ventrally-directed spiniform process on sternite; pereonites 5 and 6 similar in width and narrowest of pereonites. Pleonites 1-5 similar in size, each about 5× broader than long, and bearing ventral hyaline keel along its length .

First antenna 4-segmented with armature as follows: 1 seta + 4 feathered hairs; 1 seta + 2 feathered hairs; 2 setae; and 6 setae + 1 aesthetasc, respectively.

Mandible with pars molaris bearing several pointed processes at tip.

Cheliped carpus relatively slender; palm bearing comb of 4 short and 1 long pinnate setae on caudal surface. Fixed finger with strongly sclerotized tip; tergal border with 3 long and 1 shorter setae near articulation of dactylus; sternal border with 2 long setae. Dactylus with 1 caudal seta and 1 sternal seta.

Pereopod 1 with merus bearing 1 seta and 1 barbed spine; carpus with 1 seta and 2 barbed spines; propodus slender, with 2 setae and 1 barbed spine. Pereopod 6 with propodus bearing several rows of minute spinules and 4 spiniform setae; dactylus with longitudinal groove lined with 2 rows of minute setules.

Pleotelson, 1.7× broader than long, with convex lateral borders; posterior margin concave on either side of very slightly protuberant median area which bears 2 small setae; posterior margin with posteriorly-directed spiniform process.

Uropods curved inwards, giving "bow-legged" appearance; 4.4× longer than broad. Exopodite presumably represented by 3 naked setae at distal end of basis. Endopodite 2-segmented; first segment 1.9× longer than broad, with 1 seta and 2 feathered hairs; second segment 2.2× longer than broad and bearing 1 short and 4 long setae.

Remarks. *Tanaella propinquus* is described from specimens originally obtained for MMS, SCAMIT, and the Los Angeles County Museum of Natural History. SCAMIT specimens were identified as *Leptognathia* sp. B and later simply as *Tanaella* sp. It can be distinguished from all other tanaidaceans from the MMS survey by the "bow-legged" appearance of the paired uropods. This species has been collected from a variety of substrates (e.g., sandy mud, clay mixed with broken-shell sand, silty mud, and mud).

Etymology. The specific name is from the Latin word meaning "near" and alludes to its morphological similarity to other species of its genus.

Type Locality and Type Specimens. Santa Monica Bay, California. Types deposited in the National Museum of Natural History (USNM 284727) and the Santa Barbara Museum of Natural History (SBMNH 144124); see "Type Material."

Distribution. This species has so far been collected from Santa Maria Basin south to Coronado Norte, Islas de Los Coronados (Baja California).

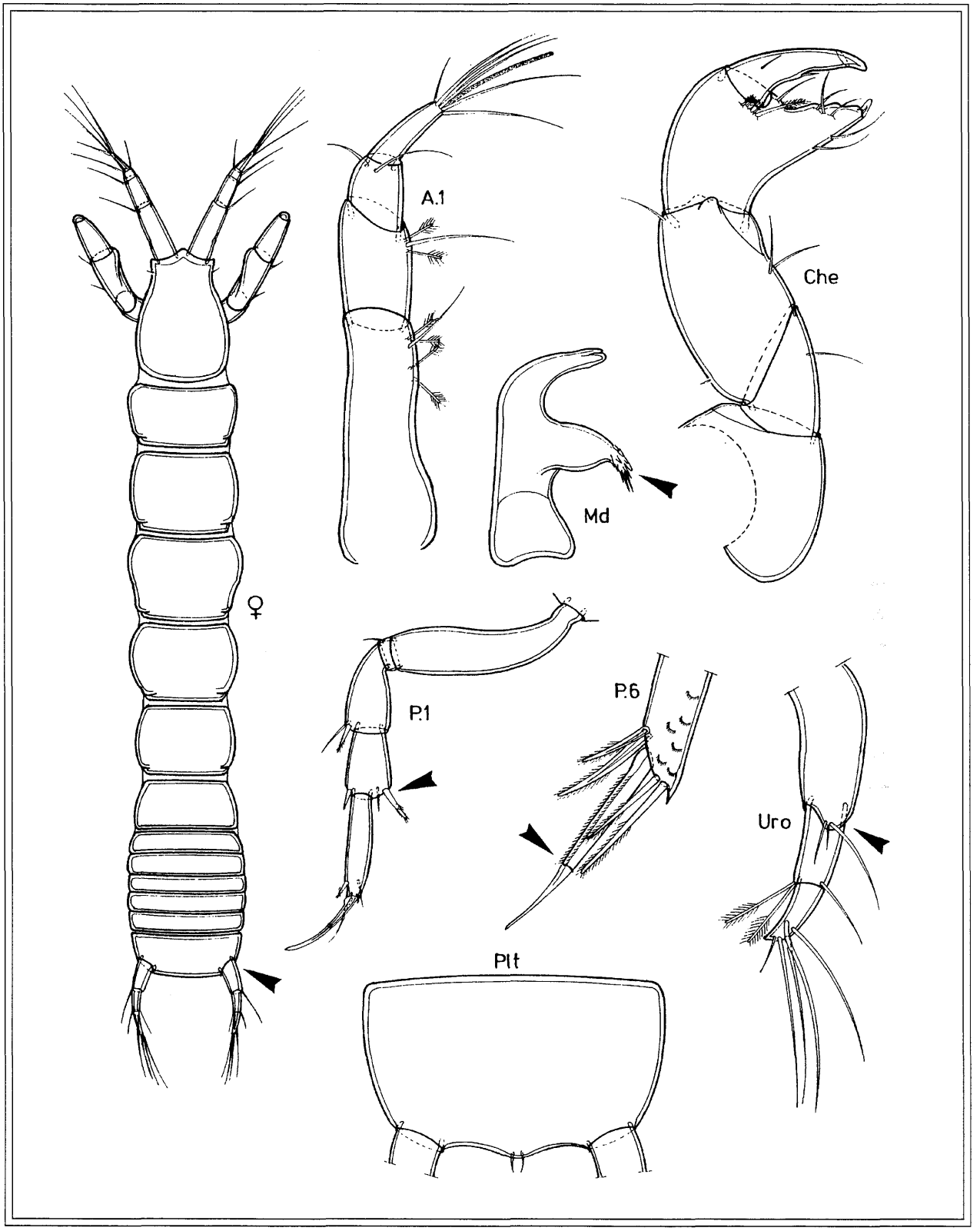

Figure 3.20. ***Tanaella propinquus* Dojiri and Sieg, new species**, female: ♀, general habitus of female; A.1, first antenna; Md, mandible; Che, cheliped; P.1, pereopod 1; P.6, pereopod 6; Plt, pleotelson; Uro, uropod.

Genus *incertae sedis*

Male species 1

Figure 3.21

Material Examined. 1 male from, Sta. 42 (phase I), 34°48.04'N 120°47.50'W, 100 m, west of Purisima Pt., Santa Maria Basin, California, 06 January 1984, originally identified as *Cryptocope* sp. C.

Description (male) (Figure 3.21). Body about 4× longer than broad. Cephalothorax, about as long as broad, narrowed anteriorly. Pereonites 1-3 about 4-5.5× broader than long; pereonites 4 and 6 approximately 3× broader than long; pereonite 5 longest of pereonites, 2.5× broader than long. Pleonites 3-3.5× broader than long, except pleonite 4 about 2.6x.

First antenna 7-segmented with numerous aesthetascs on segments 4-6; terminal segment with 5 setae and 1 aesthetasc.

Maxilliped with fused basis bearing 1 distal seta near insertion of palpus. Endites each with 1 distal seta. Palpus 4-segmented; first segment unarmed; second segment with 2 setae; third segment with 4 setae; and fourth segment bearing 6 setae.

Chelipedal carpus robust, about 1.6× longer than broad, distally inflated (segmental margin indicated by dotted line and arrow in figure; area above dotted line depicts inflated portion), and bearing 1 tergal and 1 sternal setae. Fixed finger with spiniform tip; tergal border with 3 setae; area near insertion of dactylus with 1 small seta; comb with 3 relatively long setae (or spines) and a row of several spines; sternal margin with 2 setae.

Pereopod 1 with merus bearing 1 spine and 1 seta; carpus with 2 spines and 1 seta; propodus with several rows of minute spinules. Tergal spines of merus and carpus of pereopods 1-3 long, reaching to about midlength of following segment. Pereopod 6 with long slender dactylus bearing long rows of spinules.

Pleopods without serrations along outer margin of exopodite.

Pleotelson, 1.2× broader than long, somewhat triangular in outline.

Uropod biramous. Exopodite 2-segmented; first segment, 2.3× longer than broad, bearing 1 long seta; second segment 3.6× longer than broad, carrying 1 long and 1 shorter setae. Endopodite 2-segmented; first segment longer than entire exopodite, about 4× longer than broad, and bearing 1 seta and feathered hairs; second segment, 4.3× longer than broad, with 1 subterminal and 4 terminal setae and 1 feathered hair.

Remarks. Male species 1 differs from the other two unidentified males (species 2 and 3) by having 2-segmented rami of the uropod (exopodite 1-segmented and endopodite 3-segmented in species 2 and 3), an inflated distal margin of the chelipedal carpus, and tergal spines of the merus and carpus of pereopods 1-3 reaching to about midlength of following segment. This male may belong to the new genus *Chauliopleona*.

Distribution. Santa Maria Basin, California.

Male species 2

Figure 3.22

Material Examined. 1 male from Sta. 42 (phase I), 34°48.04'N 120°47.50'W, 100 m, west of Purisima Pt., Santa Maria Basin, California, October 1984, originally identified as *Cryptocope* sp. C.

Description (male) (Figure 3.22). Body about 4× longer than broad. Cephalothorax, 1.3× broader than long, constricted at about midlength, anterior portion narrower than posterior. Pereonites 1-6 similar in length/width ratios, ranging from 3.5× to 4.1× broader than long. Pleonites 1-5 similar to each other.

First antenna 7-segmented with numerous aesthetascs on segments 4-6; terminal segment with 5 setae and a feathered hair.

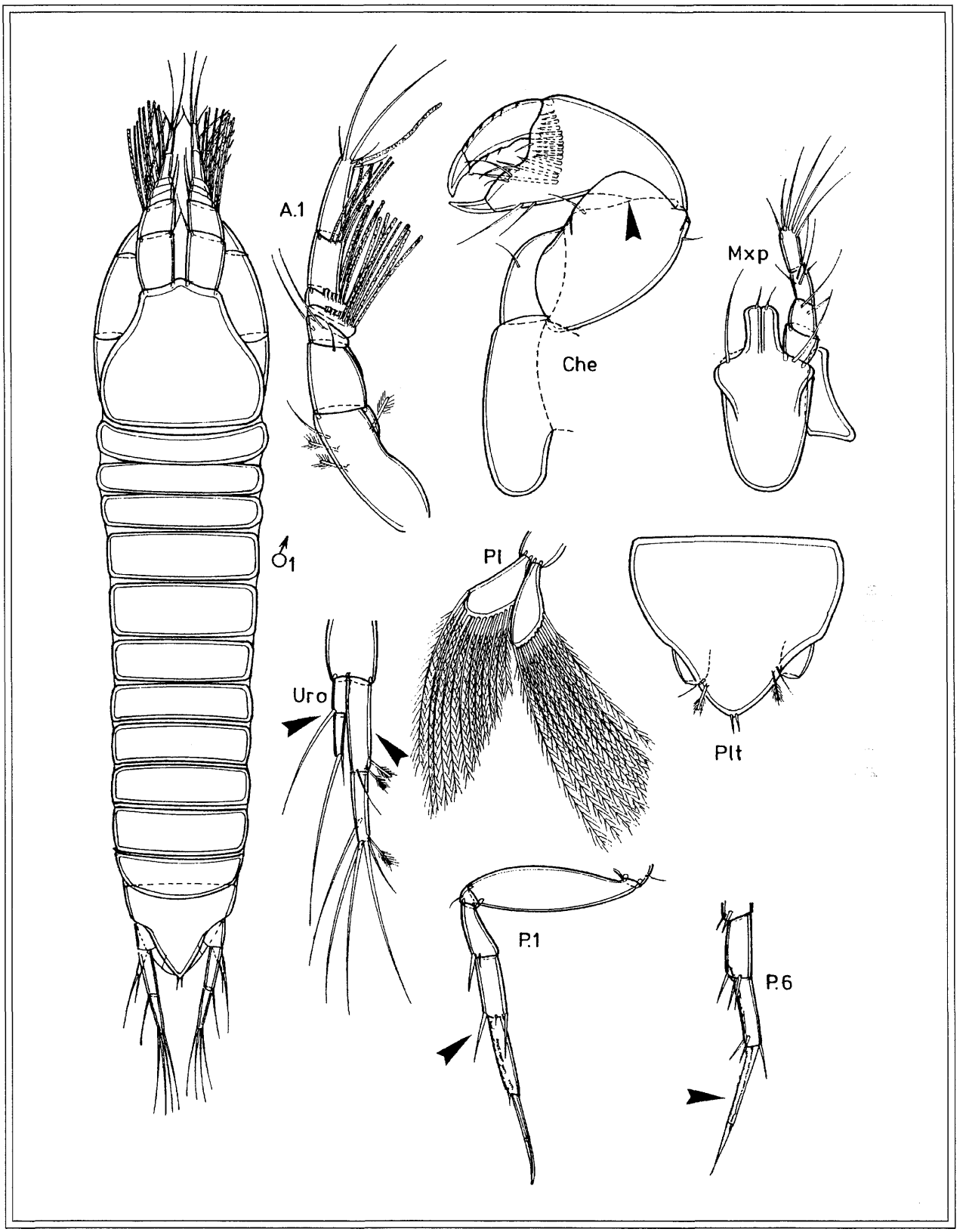

Figure 3.21. Genus *incertae sedis*, male species 1: ♂1, general habitus of male; A.1, first antenna; Mxp, maxilliped; Che, cheliped; P.1, pereopod 1; P.6, pereopod 6; Pl, pleopod; Plt, pleotelson; Uro, uropod.

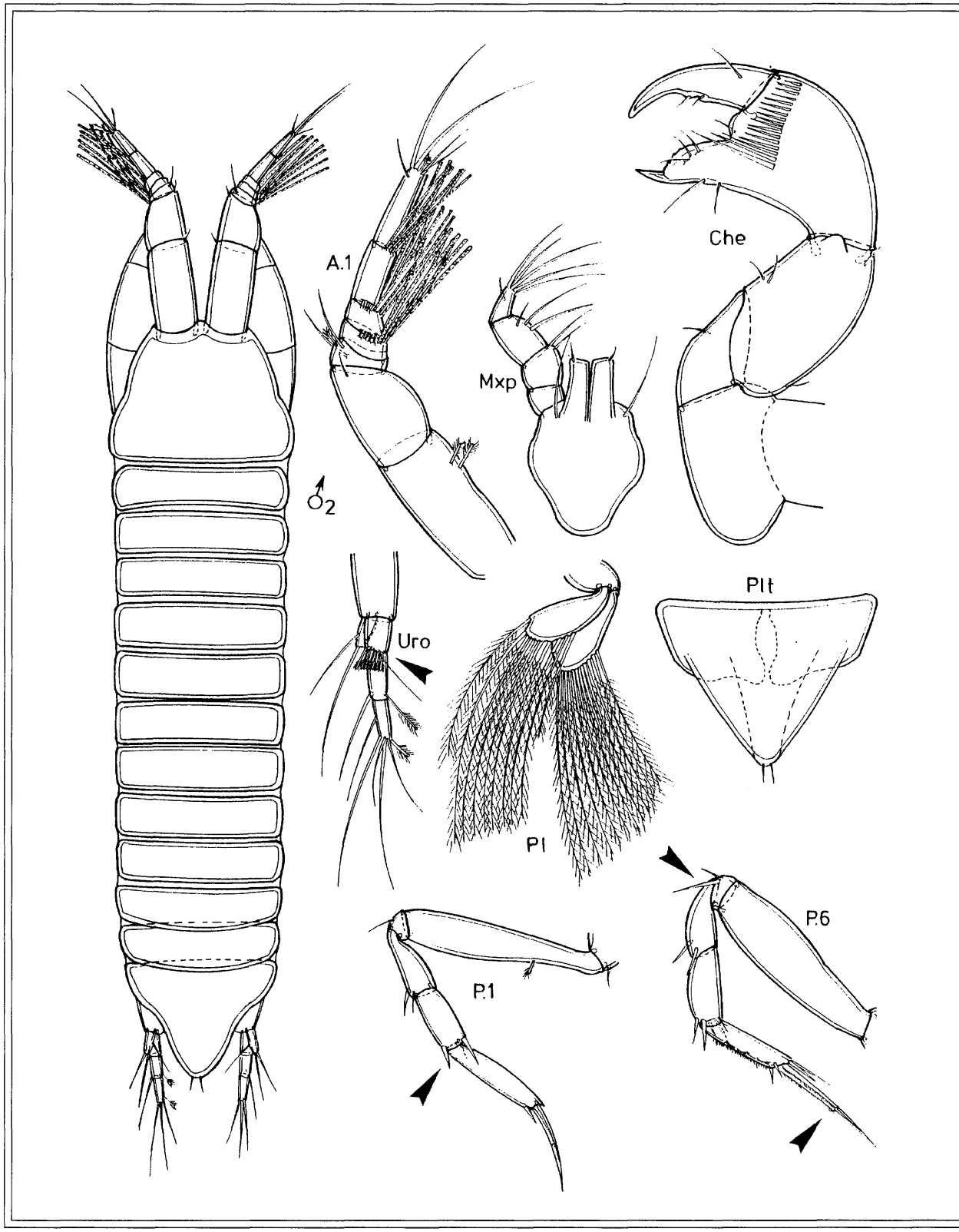

Figure 3.22. Genus *incertae sedis*, male species 2: ♂2, general habitus of male; A.1, first antenna; Mxp, maxilliped; Che, cheliped; P.1, pereopod 1; P.6, pereopod 6; Pl, pleopod; Plt, pleotelson; Uro, uropod.

Maxilliped similar to that of male species 1; palpus with third segment bearing 3 setae.

Cheliped as in male species 1 except inflated area on distal margin of carpus lacking.

Pereopods 1-3 with tergal spines on merus and carpus short, not reaching to midlength of following segment. Pereopod 6 with 1 spine and 1 seta on ischium and rows of spinules along length of dactylus.

Pleopods as in male species 1.

Pleotelson 1.4× broader than long, with posterior portion triangular in outline.

Uropod biramous. Exopodite 1-segmented, 2.3× longer than broad, and bearing 3 setae. Endopodite 3-segmented; first segment 1.3× longer than broad, with several feathered hairs; second segment 2.5× longer than broad, with 1 seta and a feathered hair; third segment 3× longer than broad, with 1 subterminal seta, 4 terminal setae, and feathered hair.

Remarks. Male species 2 can be distinguished from male species 1 by the 1-segmented exopodite and 3-segmented endopodite of the uropod and from male species 3 by the shape of the cephalothorax and pleotelson, the absence of denticles on the outer margin of the pleopodal exopodite, and the presence of 1 spine and 1 seta on the ischium of pereopod 6.

Distribution. Santa Maria Basin, California.

Male species 3

Figure 3.23

Material Examined. 1 male from Sta. 42 (phase I), 34°48.04'N 120°47.50'W, 100 m, west of Purisima Pt., Santa Maria Basin, California, 06 January 1984, originally identified as *Cryptocope* sp. C.

Description (male) (Figure 3.23). Body about 3.8× longer than broad. Cephalothorax, 1.2× broader than long, with distinctly narrower anterior portion. Pereonite 1 with concave rostral (anterior) margin; pereonites 2-4 about 5× broader than long; pereonites 5 and 6 about 3.7× broader than long. Pleonites approximately 4× broader than long, except pleonite 5 about 3.2× broader than long.

First antenna 7-segmented with numerous aesthetascs on segments 4-6; terminal segment with 3 setae.

Maxilliped similar to those of male species 1 and 2; palpus with second segment bearing 3 setae, third segment with 4 setae, and fourth segment with 1 subterminal and 4 terminal setae.

Cheliped similar to male species 2 with carpus about 1.6× broader than long.

Pereopods 1-3 similar to those in male species 2: tergal spines on merus and carpus short. Pereopod 6 with rows of spinules along length of dactylus.

Pleopods with exopodite serrated along outer margin.

Pleotelson 1.2× broader than long; posterior projection triangular in outline.

Uropod biramous. Exopodite 1-segmented, 3.2× longer than broad, and bearing 3 setae. Endopodite 3-segmented; first segment 2× longer than broad with several feathered hairs; second segment 2.7× longer than broad, with 1 seta and a feathered hair; third segment 2.7× longer than broad, with 5 setae and a feathered hair.

Remarks. Male species 3 can be distinguished from male species 1 by the 1-segmented exopodite and 3-segmented endopodite of the uropod. Male species 3 differs from both male species 1 and 2 by the narrow anterior portion of the cephalothorax, the attenuate posterior projection of the pleotelson, and the serrate outer margin of the pleopodal exopodite.

Distribution. Santa Maria Basin, California.

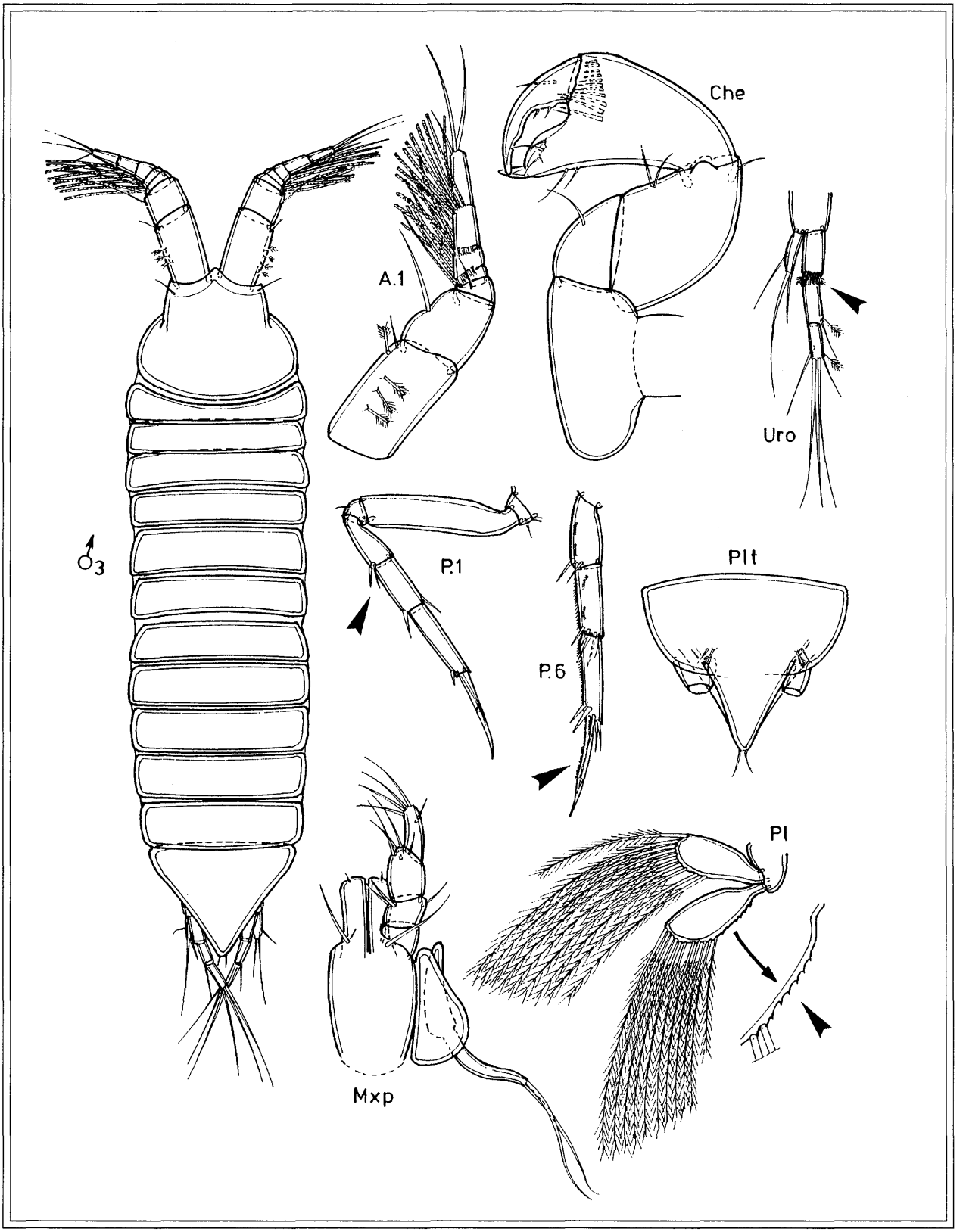

Figure 3.23. Genus *incertae sedis*, male species 3: ♂3, general habitus of male; A.1, first antenna; Mxp, maxilliped; Che, cheliped; P.1, pereopod 1; P.6, pereopod 6; Pl, pleopod; Plt, pleotelson; Uro, uropod.

Subfamily Leptognathiinae Sieg, 1973

Genus *Leptognathia* G.O. Sars, 1882

Leptognathia cf. *breviremis* (Lilljeborg, 1864)

Figure 3.24

Material Examined. Santa Maria Basin, 2 neuters from phase II, cruise 1-3, Sta. PJ-1, (rep. 3), 34°55.79'N 120°49.91'W, 145 m, off Point Sal; 7 females from cruise 2-4, Sta. R-2 (rep. 1) 35°05.50'N 120°53.40'W, 161 m, southwest of Pt. San Luis, Santa Maria Basin, California; 1 female from cruise 2-4, Sta. R-4 (rep. 2), 34°43.01'N 120°47.39'W, 93 m, off Purisima Point, Santa Maria Basin, California.

Description (female) (Figure 3.24). Body, 0.84 - 0.90 mm long, about 4.3× longer than broad. Cephalothorax, 1.2× broader than long, with convex lateral margins. Pereonites 1-3 similar in length and width, 2.6× broader than long; pereonites 4-6 about 2.4× broader than long. Pleonite 1 longest, about 4.3× broader than long; pleonite 2 broadest, 6.3× broader than long; pleonites 3 and 4 about 5.8× broader than long; pleonite 5 narrowest, 4.8× broader than long.

First antenna 4-segmented; first segment 1.4× longer than broad; second segment about as long as broad; third segment 2.4× broader than long; fourth segment 1.8× longer than broad; formula for armature: 1 seta + 3 feathered hairs, 1 seta + 2 feathered hairs, 2 setae, and 5 setae + 1 aesthetasc.

Mandible with attenuate pars molaris with bifid tip.

Chelipedal carpus 1.9× longer than broad, with 2 small tergal setae (1 proximal, another distal) and 2 sternal setae. Palm comb consisting of 2 small setae with 1 additional larger seta. Fixed finger with spiniform tip and several denticles; tergal border with 3 setae; sternal border with 1 long seta. Dactylus curved and stout.

Pereopod 1 with merus bearing 1 tergal seta; carpus with 1 spiniform tergal seta, with 1 long spiniform seta and 1 small seta on sternal margin; propodus with 1 tergal spiniform seta and 2 sternal setae; dactylus and terminal spine about as long as propodus. Pereopod 6 with carpus bearing 3 spines and 1 seta; propodus with 2 tergal and 3 sternal spines; dactylus and terminal spine shorter than propodus.

Pleotelson, 1.4× broader than long; posterior margin with protuberant median area bearing 2 pairs of setae.

Uropod biramous. Exopodite 1-segmented, 1.8× longer than broad, with 2 terminal setae. Endopodite 2-segmented; first segment 1.3× longer than broad, naked; second segment 1.9× longer than broad, bearing 5 setae and 1 feathered hair.

Remarks. The two specimens of *Leptognathia* in the MMS voucher collection are both neuters and are in poor condition. Both specimens appear to be related to *L. breviremis* (Lilljeborg, 1864), but, without additional material, a positive identification and detailed description are not possible. We have retained the original identification of the material as *Leptognathia* cf. *breviremis*.

This species can be distinguished from the other MMS/Santa Maria Basin and Western Santa Barbara Channel tanaidaceans by the combination of a stout body, stout 4-segmented first antenna, attenuate pars molaris of the mandible, one long and one short sternal setae on carpus of pereopod 1, and an unarmed stout first endopodal segment of the uropod.

Type Locality and Type Specimens. Type material was collected in Norway.

Distribution. The specimens described here were collected from the Santa Maria Basin, California.

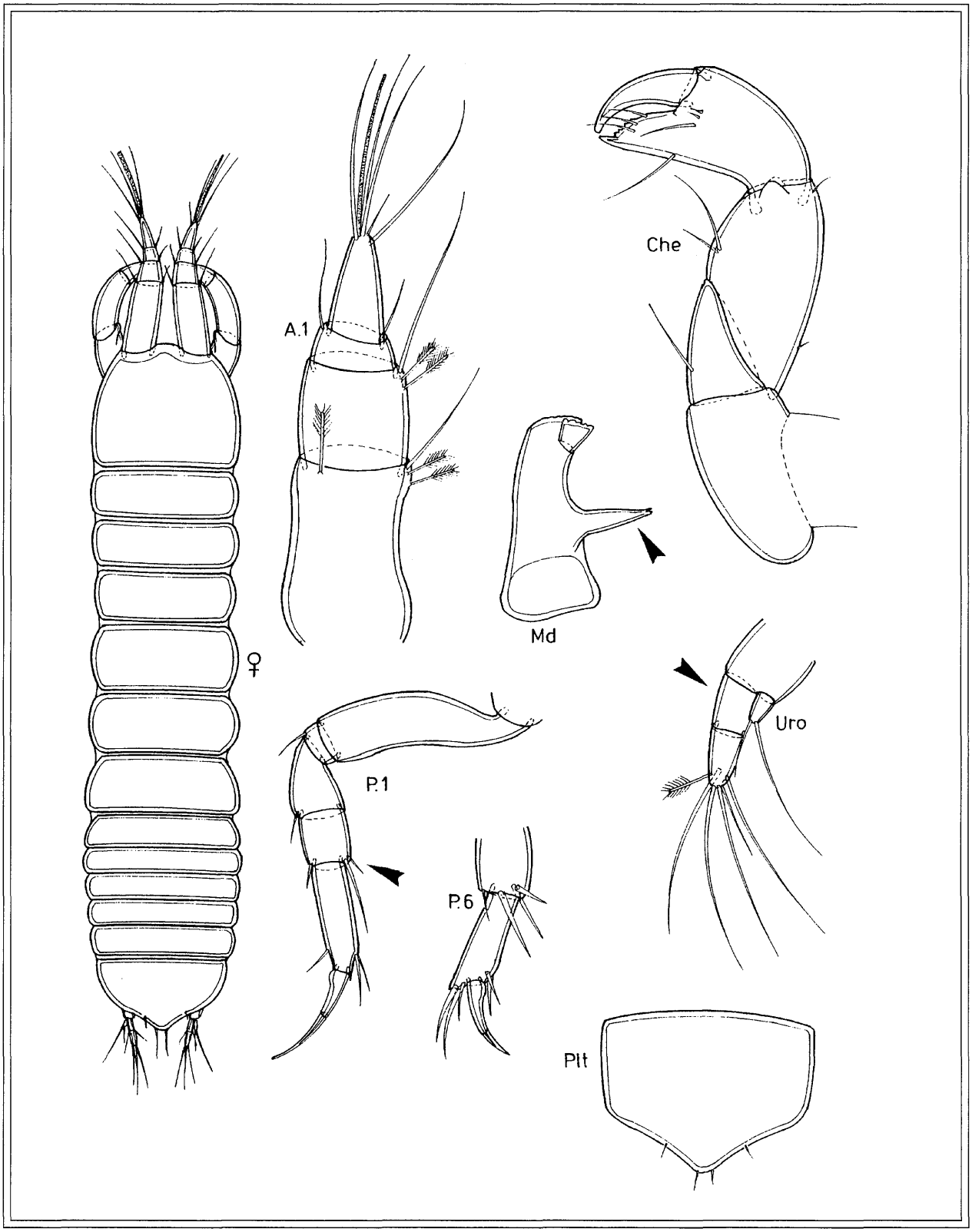

Figure 3.24. *Leptognathia* cf. *breviremis* (Lilljeborg, 1864), female: ♀, general habitus of female; A.1, first antenna; Md, mandible; Che, cheliped; P.1, pereopod 1; P.6, pereopod 6; Plt, pleotelson; Uro, uropod.

Genus *Tanaopsis* G.O. Sars, 1896

Tanaopsis cadieni Sieg and Dojiri, 1991

Figures 3.25, 3.26

Tanaopsis cadieni Sieg and Dojiri, 1991: 1501-1511, figs. 5-10.

Material Examined. From Santa Maria Basin and Western Santa Barbara Channel, phase I: 9 females, 1 male, 6 neuters, 3 manca-II, 2 fragments from Sta. 67, 34°30'17'N 120°45'30"W, 282 m, off Pt. Arguello; 1 manca-II from Sta. 73, 34°28'13"N 120°36'48"W, 98 m, between Pt. Conception and Pt. Arguello; 2 neuters, 1 manca-II from Sta. 59, 34°33'39"N 120°47'11"W, 216 m, off Pt. Arguello; 5 females from Sta. 71, 34°29'02"N 120°44'01"W, 306 m, southwest of Pt. Arguello. Phase II: 3 neuters, 9 manca-I from cruise 1-3, Sta. PJ-7 (rep. 3), 34°55'48"N 120°48'36"W, 123 m, May 1987; 2 neuters, 1 manca-I from cruise 1-1, Sta. PJ-13 (rep. 2), 34°56'01"N 120°49'55"W, 144 m, October 1986; 1 manca-I from cruise 2-3, Sta. R-8 (rep.2), 34°55'18"N 120°45'52"W, 90 m, west of Pt. Sal, January 1988.

From Santa Monica Bay, California, collected by Biology Laboratory, Environmental Monitoring Division, City of Los Angeles: 1 male from Sta. B5, 33°58'00"N 118°31'45"W, 45 m, 11 August 1987; 6 females from Sta. E7, 33°54'44"N 118°34'17"W, 150 m, 16 July 1990.

From LACM: 1 female (LACM 53-125) 6.4 mi., 239° T end of Redondo Beach Pier, 33°47'30"N 118°30'07"W, 229 m, sand and mud, R/V *Velero IV* (AHF 2361-53), 08 July 1953. From Orange County, California: 1 female from B44, 33°34'34"N 118°05'22"W, 242 m, Newport Canyon, off Huntington Beach, collected by County Sanitation Districts of Orange County, 23 September 1983; 3 females and 1 male (1 female and 1 male dissected on slide) from Sta. B39, 33°33'18"N 117°58'27"W, 200 m, Newport Canyon, off Newport Beach, collected by County Sanitation Districts of Orange County, 18 July 1983; 2 manca-I from Sta. 32, 33°34'43"N 117°57'42"W, 59 m, Newport Beach, collected by County Sanitation Districts of Orange County, 21 July 1982; 2 females from Sta. B24, 33°33'36"N 118°01'03"W, 200 m, off Huntington Beach, collected by Sanitation Districts of Orange County, 03 August 1984; 1 female from Sta. B44, 33°34'30"N 118°05'22"W, 242 m, Newport Canyon off Huntington Beach, collected by County Sanitation Districts of Orange County, 23 September 1983; 1 neuter (LACM 62-172) 73 mi 192.5° T from Dana Point, 33°20'30"N 117°44'52"W, 719 m, mud, R/V *Velero IV* (AHF 7728-62), 10 April 1962. From San Diego County, California: 1 female (LACM 60-85) 1.6 mi, 354.5° T from Pt. La Jolla, 32°52'48"N 117°16'32"W, 104 m, muddy silt, R/V *Velero IV* (AHF 7038-60), 06 May 1960.

Description (female) (Figure 3.25). Body, 3.01-3.97 mm long, about 5.5× longer than broad. Cephalothorax about as long as broad; widest in posterior region; posterior border curved. Lateral margins of all pereonites rounded. First pereonite 3.8× broader than long, with rostral border concave. Pereonite 2 about 2.6× broader than long. Pereonites 2 and 6 about 1.6× broader than long, similar in shape. Pereonites 4 and 5 about 1.3× broader than long. All pereonites similar in width. Pleonites all of similar size, similar in width to pereonites.

First antenna 4-segmented with armature of segments as follows: 2 setae + 7 feathered hairs; 2 setae + 4 feathered hairs; 2 setae + 1 feathered hair; 6 setae, 1 feathered hair, 1 aesthetasc.

Mandible with pars molaris an unornamented spiniform process.

First maxilla with strongly curved endite equipped with 3 short rows of minute setules and tipped with 6 spines.

Cheliped palm with comb consisting of 1 long and 3 shorter setae. Fixed finger with usual seta near base of dactylus, terminating in bifid spiniform process; tergal border with 3 setae and 1 spiniform process having a small accessory process at its base; sternal border with 2 setae; rostral surface with longitudinal ridge extending from articulation point of dactylus to near base of spiniform process. Dactylus crenulated along tergal margin, bearing 1 proximal seta, and terminating in heavily sclerotized spine.

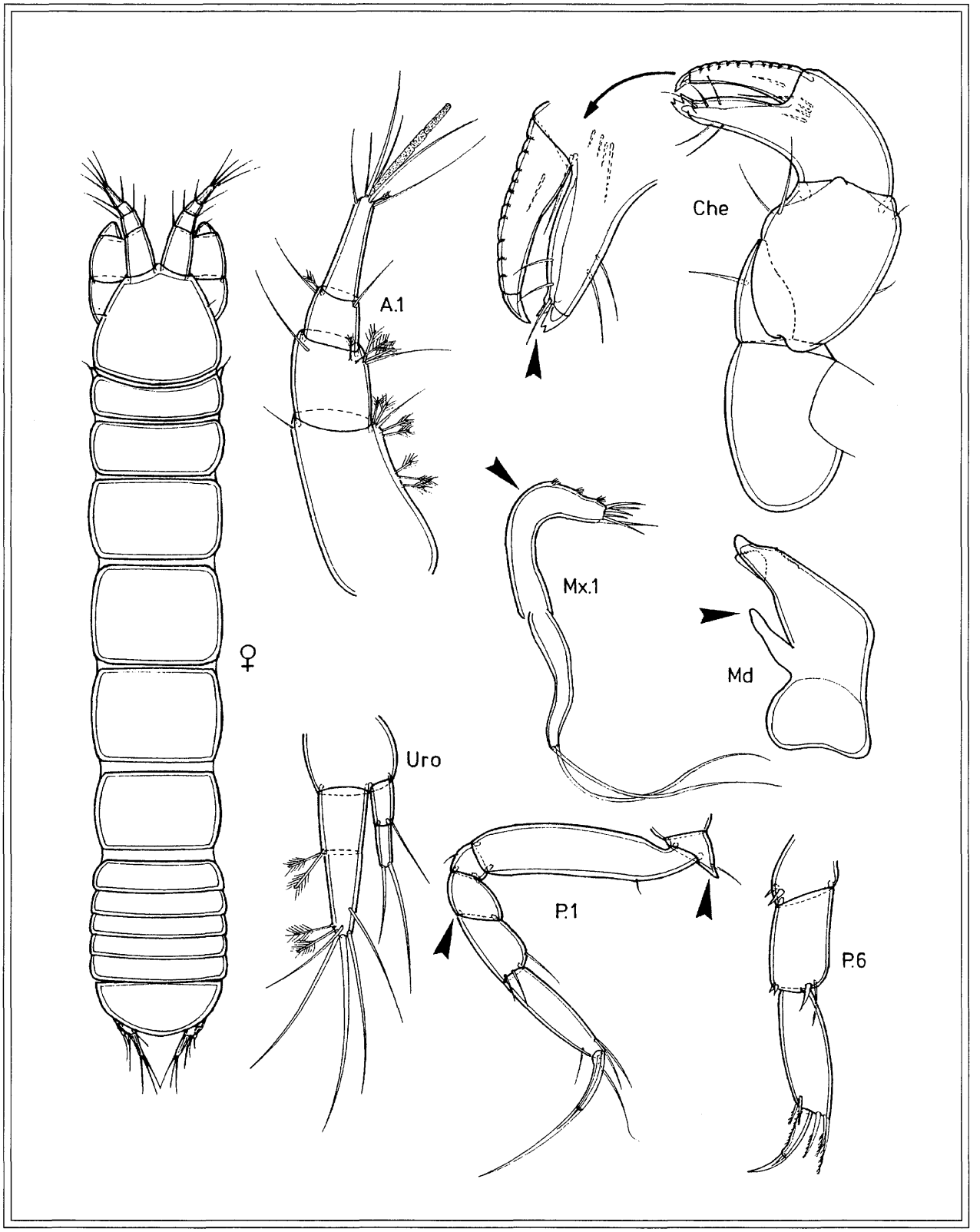

Figure 3.25. *Tanaopsis cadieni* Sieg and Dojiri, 1991, female: ♀, general habitus of female; A.1, first antenna; Md, mandible; Mx.1, first maxilla; Che, cheliped; P.1, pereopod 1; P.6, pereopod 6; Uro, uropod.

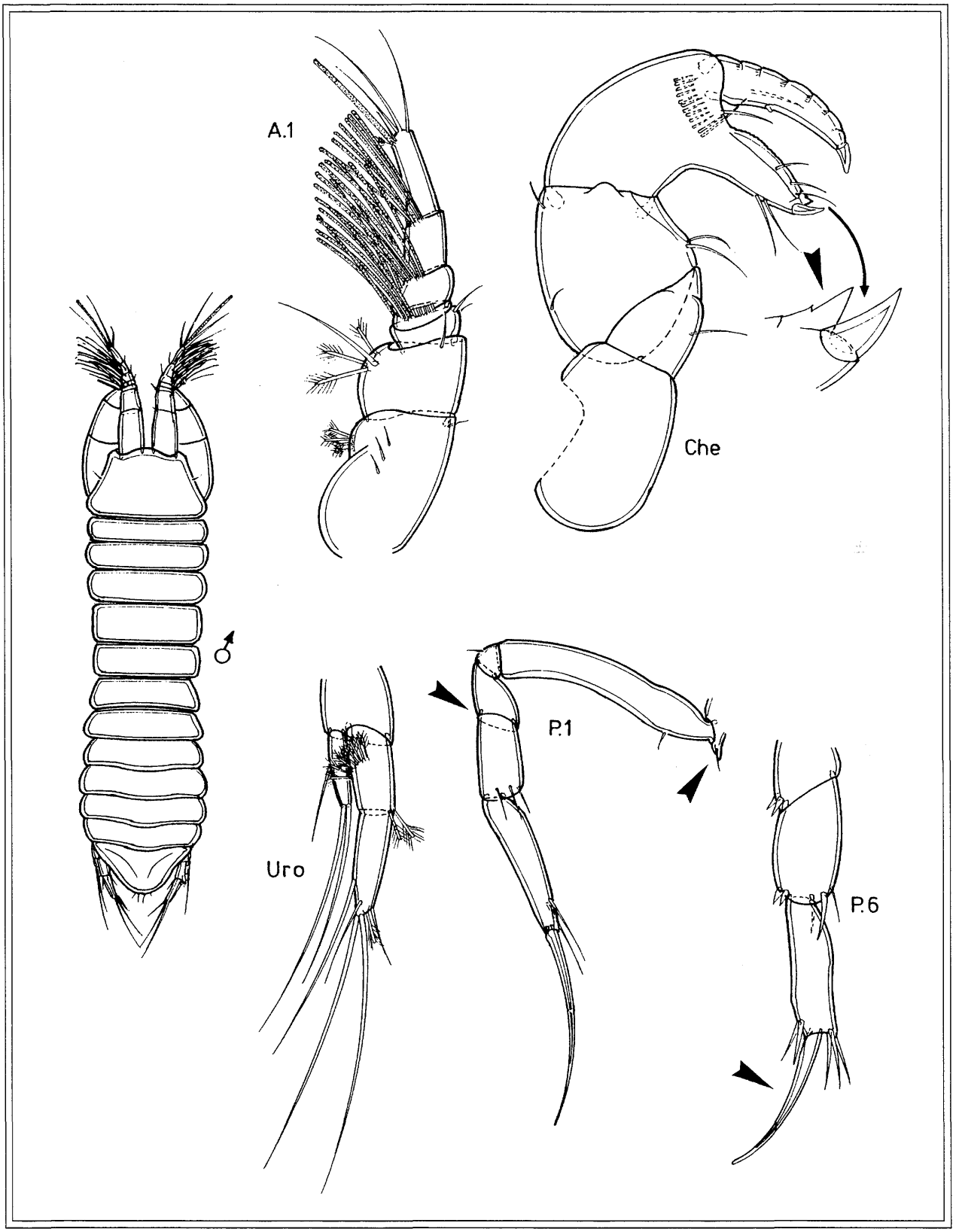

Figure 3.26. *Tanaopsis cadieni* Sieg and Dojiri, 1991, male: ♂, general habitus of male; A.1, first antenna; Che, cheliped; P.1, pereopod 1; P.6, pereopod 6; Uro, uropod.

Pereopod 1 with coxa bearing rostrally-directed triangular process; merus unarmed; propodus elongate, about 3.7× longer than broad with 1 tergal and 2 sternal setae; dactylus armed with 1 long seta and not fused to terminal spine. Dactylus and terminal spine of pereopods 1-3 longer than propodus. Pereopods 4-6 with dactylus and terminal spine combined shorter than propodus. Dactylus without long proximal seta.

Pleotelson, 1.5× broader than long, with 1 pair of setae at caudal corners, 1 pair subapically, and 2 pairs (1 long, 1 short) apically.

Uropod biramous with stout rami. Exopodite 2-segmented and extending slightly beyond midlength of endopodite. Endopodite 1-segmented, but with constriction (segmental suture ?) at midlength, 3× longer than broad.

Description (male) (Figure 3.26). Body, 1.49-2.18 mm long, stout. Cephalothorax 1.5× broader than long, with relatively straight posterior margin. Pereonites and pleonites similar in appearance; pereonites 3-6 slightly longer and a bit narrower than remaining body somites.

First antenna 6-segmented with curved rows of numerous aesthetascs on segments 4 and 5; terminal segment with 4 setae, 1 feathered hair, and 1 aesthetasc.

Mandible as in female.

Cheliped palm with comb composed of 11 stiff setae (spines ?) and 2 longer setae. Fixed finger terminating in simple spine; tergal border serrate. Dactylus with 2 small spines on sternal border.

Pereopod 1 with propodus missing 1 tergal seta; long seta on dactylus absent. Pereopod 6 with dactylus and terminal spine combined as long as propodus.

Pleotelson as in female, except caudal point more slender and 1 pair of feathered hairs.

Uropod as in female, except curved row of feathered hairs near base of endopodite.

Remarks. This species was described by Sieg and Dojiri (1991) based on specimens collected for the present study and from the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT). The specimens had been previously identified by MMS as *Cryptocope* spp. A and B and by SCAMIT as *"Leptognathia* sp. B" and later as *Tanaopsis* sp. A. This species can be distinguished from all other known California tanaidaceans by its stout body shape, short uropod, and by the detailed morphology of the mandible, first maxilla, cheliped, triangular process on the coxa of pereopod 1, and absence of elements (spines and/or setae) on the merus of pereopod 1.

This species appears to inhabit substrates consisting of mud and muddy silt.

Type Locality and Type Specimens. Female holotype (LACM 60-173.2) and 13 female paratypes (LACM 60-173.3) 2.25 mi 156.5°T (true north) from Catalina Head, Santa Catalina Island, California Channel Islands, 33°23'12"N, 118°29'38"W, 86 m, mud, R/V *Velero IV* (AHF 6823-60), 27 January 1960. Types deposited in the Natural History Museum of Los Angeles County.

Distribution. Santa Maria Basin to La Jolla (San Diego), California, 45-719 m (Sieg and Dojiri, 1991).

Family Typhlotanaidae Sieg, 1984

Genus *Typhlotanais* G.O. Sars, 1882

***Typhlotanais williamsae* Dojiri and Sieg, new species**

Figure 3.27

Type Material. 1 female holotype (USNM 284728) and 34 paratypes (SBMNH 144126; 20 females [4 ovigerous], 7 neuters, 4 fragments, and 3 manca-I) from cruise 1-1, Sta. PJ-15 (rep. 1), 34°55.80'N 120°50.60'W, 155 m, M/V *Aloha*, October 1986;

Material Examined. Santa Maria Basin, phase I: 2 neuters from Sta. 73, 34°28.21'N 120°36.80'W, 98 m, originally identified as *Leptognathia* sp. H; 1 neuter from Sta. 58, 34°34.35'N 120°45.18'W, 99 m, November 1984; 1 female (ovigerous) from Sta. 71, 34°29.04'N 120°44.01'W, 306 m, originally identified as *Leptognathia* sp. H; 2 neuters from Sta. 42, 34°48.40'N 120°47.50'W, 100 m; 2 females and 1 neuter from Sta. 54, 34°36.57'N 120°52.02'W, 396 m, originally identified as *Leptognathia* sp. H, March 1985; vial with label reporting 2 females from Sta. 42, 34°48.04'N 120°47.50'W, 100 m, with 1 dried specimen. Santa Maria Basin, phase II: 42 neuters, 3 mancas, and 8 fragments from cruise 1-3, Sta. R-4 (rep. 3), 34°43.00'N 120°47.40'W, 92 m, M/V *Aloha*, May 1987; 32 females and 6 neuters from cruise 1-2, Sta. PJ-7 (rep. 2), 34°55.79'N 120°48.60'W, 123 m, originally identified as *Typhlotanais* sp.; 96 females, 4 neuters, 4 manca-II, and 1 manca-I from cruise 1-2, Sta. PJ-7 (rep. 3), 34°55.79'N 120°48.60'W, 123 m, originally identified as *Typhlotanais* sp.; 25 females and 2 neuters from cruise 1-1, Sta. PJ-4 (rep. 2), originally identified as *Leptognathia* sp. H; 16 females, 1 neuter, and 1 manca-I from cruise 1-1, Sta. PJ-6 (rep. 1), 34°54.71'N 120°49.91'W, 148 m, originally identified as *Leptognathia* sp. H; 14 females, 1 neuter, 1 manca-II, and 4 manca-I from cruise 1-1, Sta. PJ-8 (rep. 2), 34°56.80'N 120°49.91'W, 142 m, originally identified as *Leptognathia* sp. H; 27 females and 2 neuters from cruise 1-1, Sta. PJ-2 (rep. 3), originally identified as *Leptognathia* sp. H; 54 females, 3 neuters, and 1 manca-I from cruise 1-2, Sta. PJ-23 (rep. 2), 34°56.33'N 120°49.90'W, 143 m, originally identified as *Typhlotanais* sp.; 28 females, 1 neuter, and 7 manca-I from cruise 1-2, Sta. PJ-6 (rep. 3), 34°41.40'N 120°57.90'W, 410 m, originally identified as *Typhlotanais* sp.; 28 females, 20 neuters, and 1 manca-I from cruise 1-1, Sta. PJ-8 (rep. 1), 34°56.87'N 120°49.91'W, 142 m, originally identified as *Leptognathia* sp. H; 26 females from cruise 1-1, Sta. PJ-4 (rep. 3), originally identified as *Leptognathia* sp. H; 32 females and 7 neuters from cruise 1-2, Sta. PJ22 (rep. 3), 34°55.25'N 120°49.93'W, 143 m, originally identified as *Typhlotanais* sp.

From LACM: 1 female (LACM 54-94), 457 m, gravel and mud, 13.1 mi, 301° T from North Light, Santa Barbara Island, Channel Islands, California, 33°35.98'N 119°15.18'W, R/V *Velero IV* (AHF 2969-54), 31 October 1954; 1 female and 1 neuter (LACM 55-35), 73 m, mud, 9.9 mi, 203° T from Santa Monica Pier Light, Los Angeles County, California, 33°51.37'N 118°34.70'W, R/V *Velero IV* (AHF 2998-55), 06 February 1955; 1 female (LACM 55-36), 732 m, rock, sand, and mud, 14.3 mi, 345° T from Aero Beacon, San Nicolas Island, Ventura County, California, 33°28.07'N 119°34.68'W, R/V *Velero IV* (AHF 3031-55), 07 May 1955; 3 females (LACM 60-77), 415 m, coarse muddy sand, Tanner Canyon, 35.3 mi, 249°T from China Point Light, San Clemente Island, California Channel Islands, California, 32°35.80'N 119°04.92'W, R/V *Velero IV* (AHF 6836-60); 1 neuter (LACM 60-84), 225 m, mud, 34.1 mi, 246° T from China Pt. Light, San Clemente Island, Tanner Bank, California Channel Islands, California, 32°34.47'N 119°02.70'W, R/V *Velero IV* (AHF 6837-60), 29 January 1960; 1 neuter (LACM 60-186), 814 m, mud, 265 mi, 204°T from Ribbon Rock, Santa Catalina Island, California Channel Islands, California, 33°22.78'N 118°36.20'W, R/V *Velero IV* (AHF 6829-60), 28 January 1960.

Description (female) (Figure 3.27). Body, 1.40-1.62 mm long, about 7× longer than broad. Cephalothorax, 1.3× longer than broad, with lateral margins nearly parallel (only slightly convex). Pereonites 1-6 subquadrangular; pereonites 1 and 6 with similar length/width ratio: 1.8× broader than long; pereonites 2, 3, and 5 about 1.3× as wide as long; pereonite 4 as long as broad. Pleonites 1-5 about 4-5× broader than long.

First antenna 3-segmented; first segment about 2.5× longer than broad; second segment smallest, as long as broad; third segment more than 3× longer than broad; formula for armature: 1 seta + 8 feathered hairs, 2 setae, and 5 setae + 1 aesthetasc + 1 feathered hair.

Mandible with truncate pars molaris; crushing area with crenulated wall.

Maxilliped with basis fused and bearing 1 distal seta each near insertion of palpus. Endites each with 2 distal setae and 2 bulbs. Palpus 4-segmented; first segment unarmed; second segment with 1 lateral and 3 medial setae (2 of them spiniform); third segment with 3 medial setae; fourth segment with 1 medial and 5 terminal inner setae.

Chelipedal carpus slender, about 3× longer than broad (length measured along tergal margin), with 2 small tergal setae (1 proximal, another distal), and 3 sternal setae. Fixed finger with spiniform tip; tergal border with 3 setae; area near insertion of dactylus comb with 1 small seta and row of spinules; sternal margin with 2 setae.

Pereopod 1 with merus longer than carpus and bearing 2 tergal setae; carpus with 2 tergal and 1 sternal setae; propodus with 3 sternal setae. Pereopod 6 merus with 2 stout tergal spines; carpus with hooklike protuberance (indicated by arrow in figure) and 1 sternal seta; propodus with 2 stout tergal spines, a few setules along sternal margin, and 3 long sternal spiniform setae at distal end; dactylus with rows of spinules along tergal margin, fused with terminal spine.

Pleopods 1-5 similar. Exopodite with proximal pilose seta (indicated by arrow in figure) on outer margin. Endopodite with 1 distal seta (indicated by arrow in figure) on inner border.

Pleotelson, 1.8× wider than long, with rounded protuberance on posterior margin.

Uropod biramous. Exopodite indistinctly 2-segmented, 2.6× longer than broad, 1 seta at midlength, and 1 large and 1 small setae terminally. Endopodite indistinctly 2-segmented; first segment, about 2× longer than broad, bearing 1 distal seta; second segment about 3× longer than broad, with 1 subterminal seta and 4 setae and 1 feathered hair terminally.

Remarks. *Typhlotanais williamsae* can be distinguished from other Santa Maria Basin and Western Santa Barbara Channel tanaid species by the presence of a 3-segmented first antenna in the female, a broad crushing area of the pars molaris surrounded by a crenulated wall, a slender cheliped, and normal-sized pereonites 1 and 2 (combined longer than pereonite 3). *Typhlotanais williamsae* differs from *T. crassus* by the characters listed in the Remarks section for the latter species.

Etymology. This species is named in honor of Ms. Isabelle "Izzie" Williams, Woods Hole, MA, who assisted in putting the finishing touches on this chapter and who critically reviewed the entire manuscript. Without her efforts, this manuscript would not have been completed.

Type Locality and Type Specimens. Santa Maria Basin, California. Types deposited in the National Museum of Natural History (USNM 284728) and the Santa Barbara Museum of Natural History (SBMNH 144126); see "Type Material."

Distribution. Santa Maria Basin, California to San Clemente Island, California.

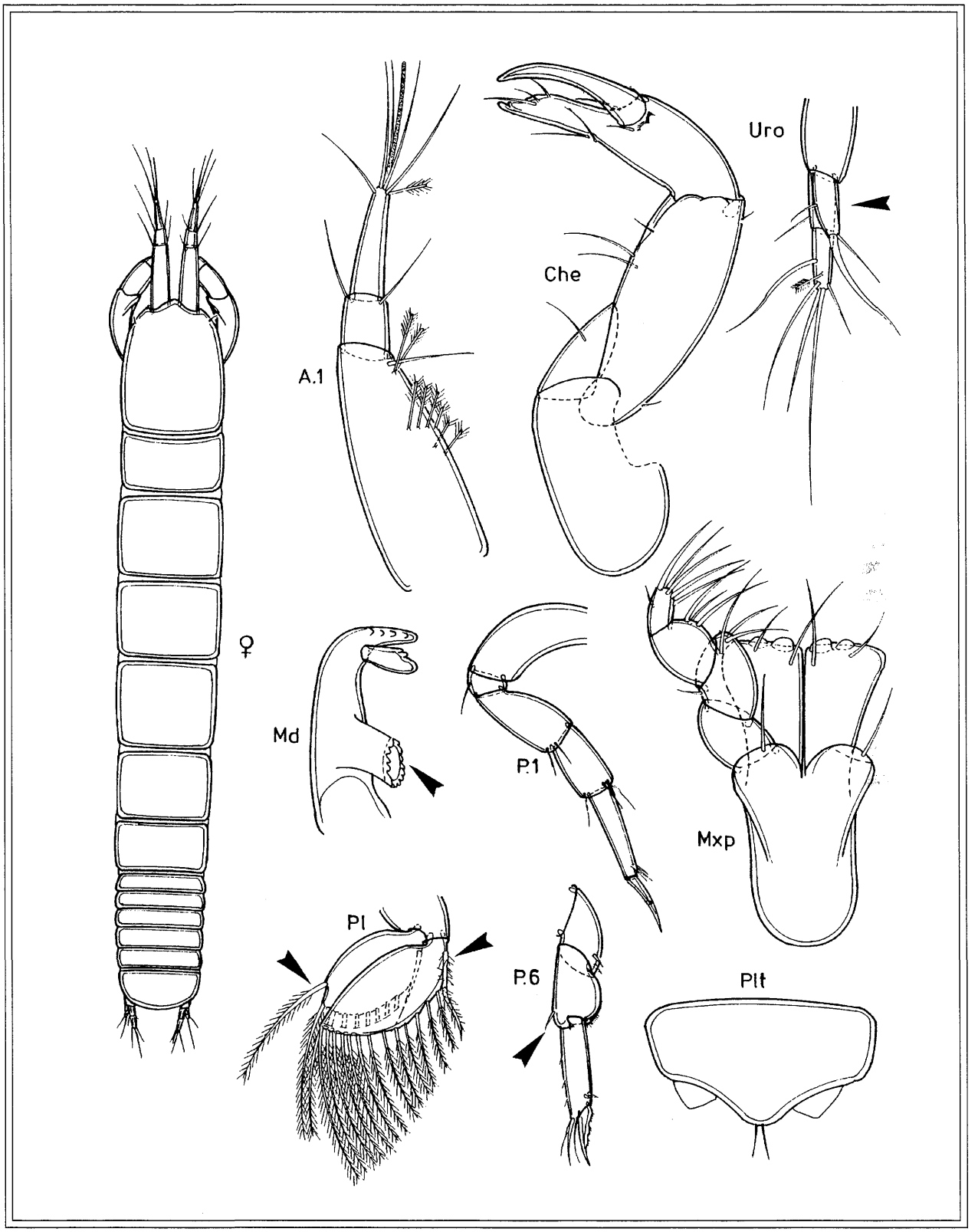

Figure 3.27. ***Typhlotanais williamsae*** **Dojiri and Sieg, new species**, female: ♀, general habitus of female; A.1, first antenna; Md, mandible; Mxp, maxilliped; Che, cheliped; P.1, pereopod 1; P.6, pereopod 6; Pl, pleopod; Plt, pleotelson; Uro, uropod.

Typhlotanais crassus Dojiri and Sieg, new species

Figure 3.28

Type Material. 1 neuter holotype (USNM 284729) and 3 paratypes (neuters; SBMNH 144133) from Sta. D3, 33°52'47"N 118°35'15"W, 80 m, Santa Monica Bay, California, collected by Biology Laboratory, Environmental Monitoring Division, City of Los Angeles, 14 July 1988.

Material Examined. From Santa Monica Bay, California, collected by Biology Laboratory, Environmental Monitoring Division, City of Los Angeles: 4 females and 1 neuter from Sta. D3, 33°52'47"N 118°35'15"W, 79 m, 16 January 1992; 3 females and 2 neuters from Sta. D3, 33°52'47"N 118°35'15"W, 80 m, 23 January 1993; 1 female from Sta. D3, 33°52'47"N 118°35'15"W, 77 m, 18 July 1991.

Description (neuter) (Figure 3.28). Body, 1.20-1.32 mm long, about 5× longer than broad. Cephalothorax about as long as broad, with anterior 2/3 tapered. Pereonites 1-6 with convex lateral margins; pereonite 1 about 8.3× broader than long; pereonite 4 longest of pereonites and 1.6× broader than long. Pleonites 1-5 about 5-6× broader than long.

First antenna 3-segmented; first segment about 2.4× longer than broad; second segment shortest, about as long as broad; third segment almost 4× longer than broad; formula for armature: 6 setae + 5 feathered hairs, 2 setae + 1 feathered hair, and 5 setae + 1 aesthetasc.

Mandible with truncate pars molaris; crushing area with crenulate wall and spiniform processes.

Maxilliped with basis fused and bearing 1 distal seta near insertion of each palpus. Endites each with 2 distal setae. Palpus 4-segmented; first segment unarmed; second segment with 1 lateral and 3 medial setae (2 of them spiniform); third segment with 4 medial setae; fourth segment with 1 lateral and 5 terminal inner setae.

Cheliped with sternal protuberance, articulating with side-piece. Merus small, with distal margin bearing 1 sternal seta. Carpus slender, about 2.2× longer than broad (length measured along tergal margin), with 2 small tergal setae (1 proximal, another distal), and 2 sternal setae. Fixed finger with spiniform tip; tergal border with 3 setae; sternal margin with 2 setae. Dactylus as long as fixed finger and lacking seta.

Pereopod 1 with basis bearing several (about 4) setae along sternal border; merus about as long as carpus and bearing 2 setae; carpus with 1 tergal and 3 sternal setae; propodus with 3 setae. Pereopod 6 merus with stout, pinnate, tergal seta, 1 tergal naked seta (indicated by dotted lines in figure) and several rows of minute spinules; carpus with several rows of minute spinules, a hooklike protuberance, and 1 sternal seta; propodus with 2 stout tergal spines, a few setules along sternal margin, and 3 distal spiniform setae; dactylus and terminal spine fused; dactylus with minute spinules; terminal spine serrated along tergal margin.

Pleopods 1-5 similar. Exopodite with proximal pilose seta (indicated by arrow in figure) on outer margin. Endopodite with distal pilose seta (indicated by arrow in figure) on inner border.

Pleotelson, 1.9× broader than long, with conical protuberance on posterior margin.

Uropod biramous. Exopodite 1-segmented, 4.5× longer than broad, with 1 seta at about midlength and 1 small and 1 long setae terminally. Endopodite 1-segmented, about 3.8× longer than broad, bearing 5 distal setae and 4 feathered hairs.

Remarks. *Typhlotanais crassus* differs from *T. williamsae* by the combination of several characters: (1) cephalothorax with anterior 2/3 tapered (nearly parallel lateral margins in *T. williamsae*); (2) convex lateral borders of the pereonites (relatively straight in *T. williamsae*); (3) exopodite and endopodite of uropod 1-segmented (indistinctly 2-segmented in *T. williamsae*); (4) exopodite reaching about 2/3 length of endopodite (only slightly longer than midlength of endopodite in *T. williamsae*); and (5) two setae on sternal border of propodus of leg 2 unequal in size (these two setae equal in size in *T. williamsae*). These specimens were previously identified by SCAMIT as "*Leptognathia* sp. H" and later as "*Typhlotanais* sp. A."

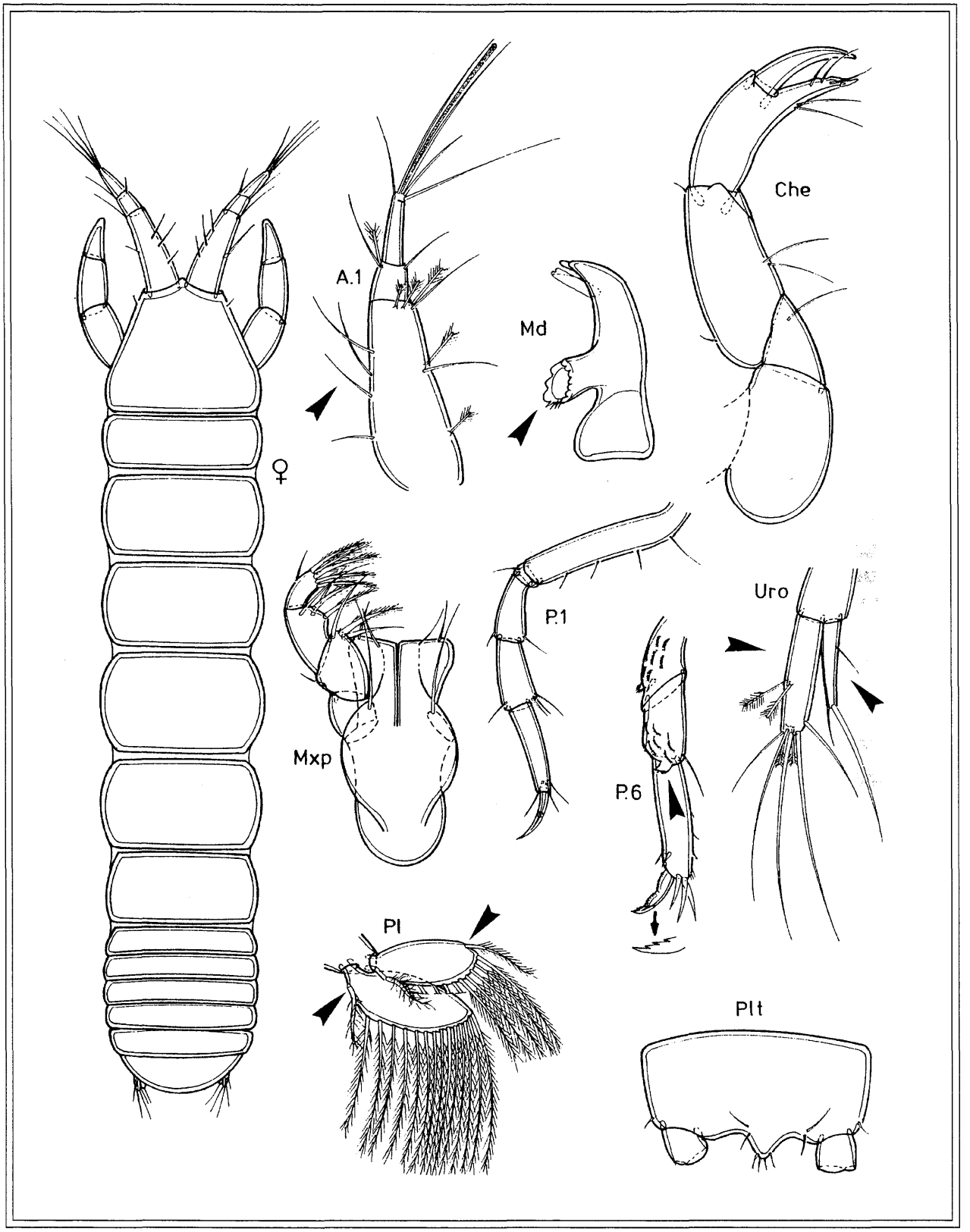

Figure 3.28. ***Typhlotanais crassus* Dojiri and Sieg, new species**, female: ♀, general habitus of female; A.1, first antenna; Md, mandible; Mxp, maxilliped; Che, cheliped; P.1, pereopod 1; P.6, pereopod 6; Pl, pleopod; Plt, pleotelson; Uro, uropod.

Etymology. The specific name *crassus* is Latin meaning "fat" and alludes to the stout body of this species.

Type Locality and Type Specimens. Santa Monica Bay, California. Types deposited in the National Museum of Natural History (USNM 284729) and the Santa Barbara Museum of Natural History (SBMNH 144133); see "Type Material."

Distribution. Presently, this species has been reported only from Santa Monica Bay, California, but may be expected to inhabit the Santa Maria Basin and Western Santa Barbara Channel.

Family Pseudotanaidae Sieg, 1973

Genus *Pseudotanais* G.O. Sars, 1882

Pseudotanais makrothrix Dojiri and Sieg, new species

Figure 3.29

Type Material. 1 female holotype (USNM 284730) and 1 paratype (SBMNH 144128; dissected female) from Sta. 4, 35°26.56'N 121°14.93'W, 393 m, off Pt. Estero, Santa Maria Basin, California, March 1985, originally identified as Tanaidacea sp. B

Material Examined. 1 female from Sta. BRC-1, 35°27.86'N 121°05.33'W, 98 m, off Pt. Estero, Santa Maria Basin, California, March 1985, originally identified as Tanaidacea sp. B.

Description (female) (Figure 3.29). Body about 3.6× longer than broad. Cephalothorax, 1.2× broader than long, broadest at posterior end, and bearing a pair of eyes. Pereonites 1 and 2 combined shorter than pereonite 3; pereonites 4 and 5 longest of pereonites and about 2× broader than long; pereonite 6 with curved posterior margin. Pleonite 1 longest of pleonites, 3.6× broader than long; pleonites 2-5 approximately 4-5× broader than long.

First antenna 3-segmented; first segment long and slender, about 5× longer than broad; second segment shortest of 3 segments, 2× longer than broad; third segment 4.4× longer than broad; formula for armature: 2 setae, 2 setae + 1 feathered hair, and 5 setae + 1 aesthetasc.

Mandible with pars molaris whiplike; pars incisiva and lacinia mobilis denticulate.

Maxilliped with basis fused medially and carrying 1 seta near insertion of each palpus. Endites fused and bearing a pair of short distal setae and a few setules. Palpus 4-segmented; first segment stout and unarmed; second segment with 1 spiniform seta and 1 long seta; third segment with 3 spiniform setae and 1 short seta; terminal segment with 1 outer seta near midlength and 5 distal spiniform setae.

Cheliped of typical shape. Merus triangular and bearing sternal seta. Carpus about 1.5× longer than broad, with 1 proximal tergal seta, 1 distal tergal seta, and 2 sternal setae. Propodus with 1 seta near insertion of dactylus and comb consisting of about 5 setae. Fixed finger elongate, with 3 distal tergal setae and 1 sternal seta. Dactylus with 1 proximal seta and fused terminal spine.

Pereopod 2 with ischium bearing 1 feathered hair; merus with 2 distal tergal setae; carpus with 1 large spine and 1 large seta on distal tergal margin; propodus with 1 distal tergal seta. Pereopod 6 carpus with 3 large spines and 1 small, distal, sternal seta. Propodus with 2 terminal spiniform setae, with 1 long terminal spine and 1 shorter spiniform seta.

Pleopods with exopodite and endopodite about 2.4× longer than broad; exopodite with 9 pinnate setae; endopodite with 7 pinnate setae.

Pleotelson about 2.4× broader than long, with protuberant median posterior margin.

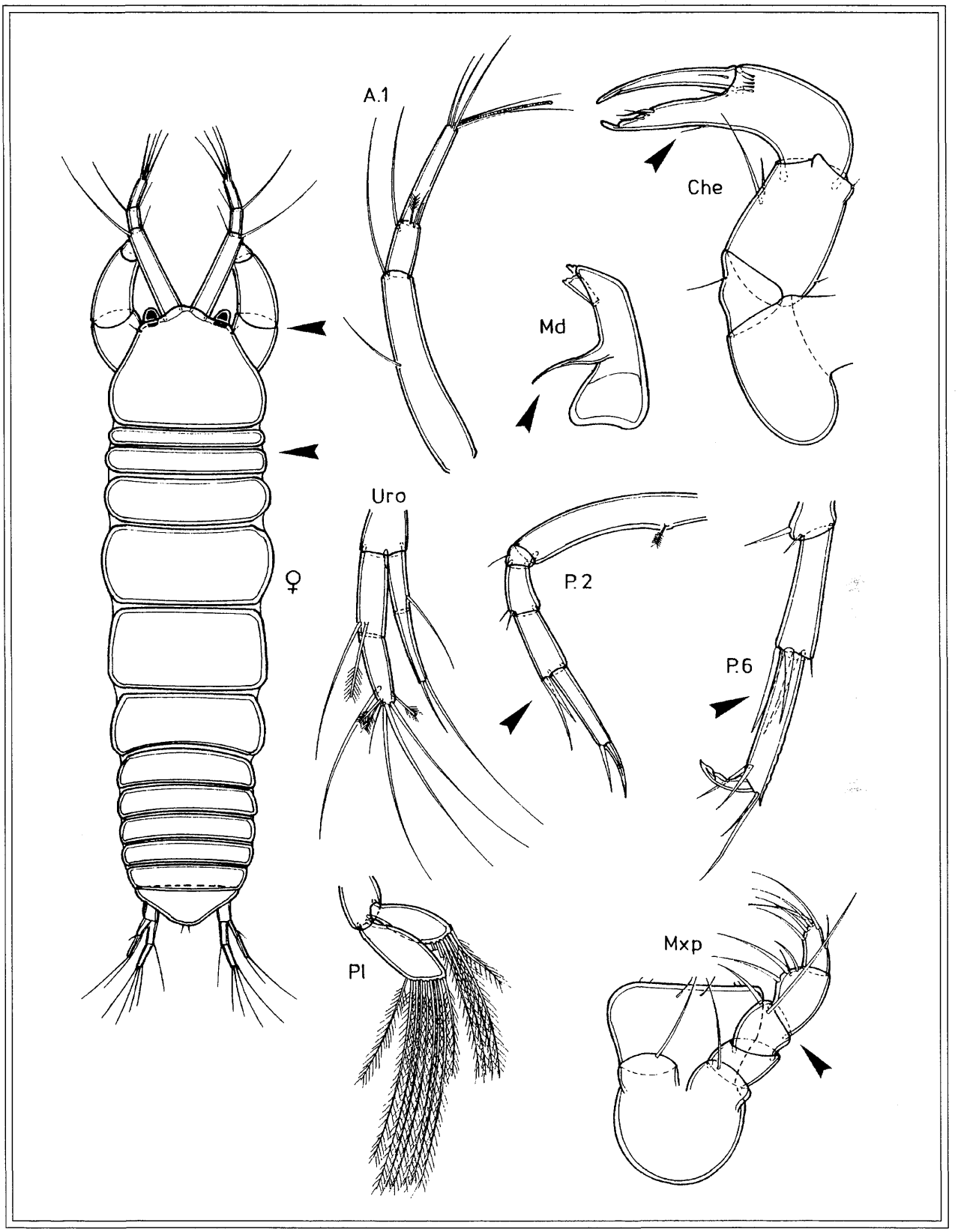

Figure 3.29. ***Pseudotanais makrothrix* Dojiri and Sieg, new species**, female: ♀, general habitus of female; A.1, first antenna; Md, mandible; Mxp, maxilliped; Che, cheliped; P.2, pereopod 2; P.6, pereopod 6; Pl, pleopod; Uro, uropod.

Uropods biramous. Exopodite indistinctly 2-segmented; first segment with 1 distal seta; second segment with 2 distal setae. Endopodite indistinctly 2-segmented; first segment with 1 seta and 1 feathered hair; second segment with 4 large setae, 1 smaller seta, and 3 feathered hairs.

Remarks. *Pseudotanais makrothrix* is characterized by possessing a pair of eyes, typical (not modified to bladelike elements) carpal spines on pereopods 2-6, and a whiplike pars molaris of the mandible. Additionally, the merus of pereopod 4 has two spines of unequal size and the second segment of the maxillipedal palpus bears a very long seta on the inner margin. This latter character is shared with the subantarctic species *P. guillei* Shiino, 1978 which was redescribed by Sieg (1986a). However, *P. makrothrix* may be distinguished from this species by its slender and longer propodal spines, most noticeable on pereopod 6: in *P. makrothrix* these spines are more than half as long as the propodus, but in *P. guillei* they are less than half the propodal length. Also, in *P. guillei* the third spine (sternal spine) is conspicuously smaller than the other two, while in *P. makrothrix* all three spines are similar in size.

Etymology. The specific name is a combination of the Greek words *makros*, meaning long or large, and *trichos* (=thrix), meaning hair, and alludes to the long and slender propodal spines, most noticeable on pereopod 6.

Type Locality and Type Specimens. Off Pt. Estero, Santa Maria Basin, California. Type deposited in the National Museum of Natural History (USNM 284730) and the Santa Barbara Museum of Natural History (SBMNH 144128); see "Type Material."

Distribution. Off Pt. Estero in the Santa Maria Basin, California.

Pseudotanais californiensis Dojiri and Sieg, new species

Figure 3.30, 3.31

Type Material. 1 female holotype (USNM 284731) and 31 paratypes (SBMNH 144125; 16 females, 1 male and 14 neuters; 1 female and 1 male dissected) from cruise 2-3, Sta. R-5, 34°42.70'N 120°50.80'W, 154 m, southwest of Purisima Pt., Santa Maria Basin, California, M/V *Aloha*, October 1987, originally identified as *Pseudotanais* sp. A by J. Toal.

Material Examined. Santa Maria Basin, phase I: 4 females, 1 neuter, and 1 fragment from Sta. 3, 35°27.07'N 121°10.20'W, 291 m, originally identified as *Cryptocope* sp. A. Santa Maria Basin, phase II: 4 females and 1 neuter from cruise 1-1, Sta. PJ 15 (rep. 1), 34°55.80'N 120°50.60'W, 155 m, M/V *Aloha*, October 1986, originally identified as *Pseudotanais* sp. A by G. Gillingham; 17 females, 4 neuters, 1 fragment, and 1 male (poor condition) from cruise 2-3, Sta. R-8 (rep. 1), 34°55.30'N 120°45.90'W, 90 m, M/V *Aloha*, January 1988, originally identified as *Pseudotanais* sp. A by J. Toal; 39 females and 9 neuters from cruise 2-4, Sta. R-4 (rep. 3), 34°43.01'N 120°47.39'W, 93 m, off Purisima Point, Santa Maria Basin, California; 16 females from cruise 2-4, Sta. R-4 (rep. 1), 34°43.01'N 120°47.30'W, 92 m, off Purisima Point, Santa Maria Basin, California; 32 females from cruise 2-4, Sta. R-5 (rep. 3), 34°42.69'N 120°50.83'W, 154 m, off Purisima Point, Santa Maria Basin, California; 26 females from cruise 2-4, Sta. R-5 (rep. 2), 34°42.69'N 120°50.83'W, 154 m, off Purisima Point, Santa Maria Basin, California; 1 female from cruise 1-1, Sta. PJ-4 (rep. 3); 32 females and 7 neuters from cruise 2-4, Sta. R-4 (rep. 2), 34°43.01'N 120°47.39'W, 92 m, off Purisima Point, Santa Maria Basin, California.

Description (female) (Figure 3.30). Body, 0.90-1.10 mm long, 3.8× longer than broad. Cephalothorax, about as long as broad, with tapered anterior end. Pereonites 1 and 2 short, 7.2× and 5.5× broader than long, respectively; pereonites 3 and 6 about 3× broader than long; pereonites 4 and 5 about 1.5× broader than long. Pleonites 1-5 approximately 6-7× broader than long.

First antenna 3-segmented; first segment long and slender, 5× longer than broad; second segment 2× longer than broad; third segment about 3× longer than broad; formula for armature: 2 setae + 2 feathered hairs, 1 seta + 2 feathered hairs, and 6 setae (2 have dendriform tips) + 1 aesthetasc.

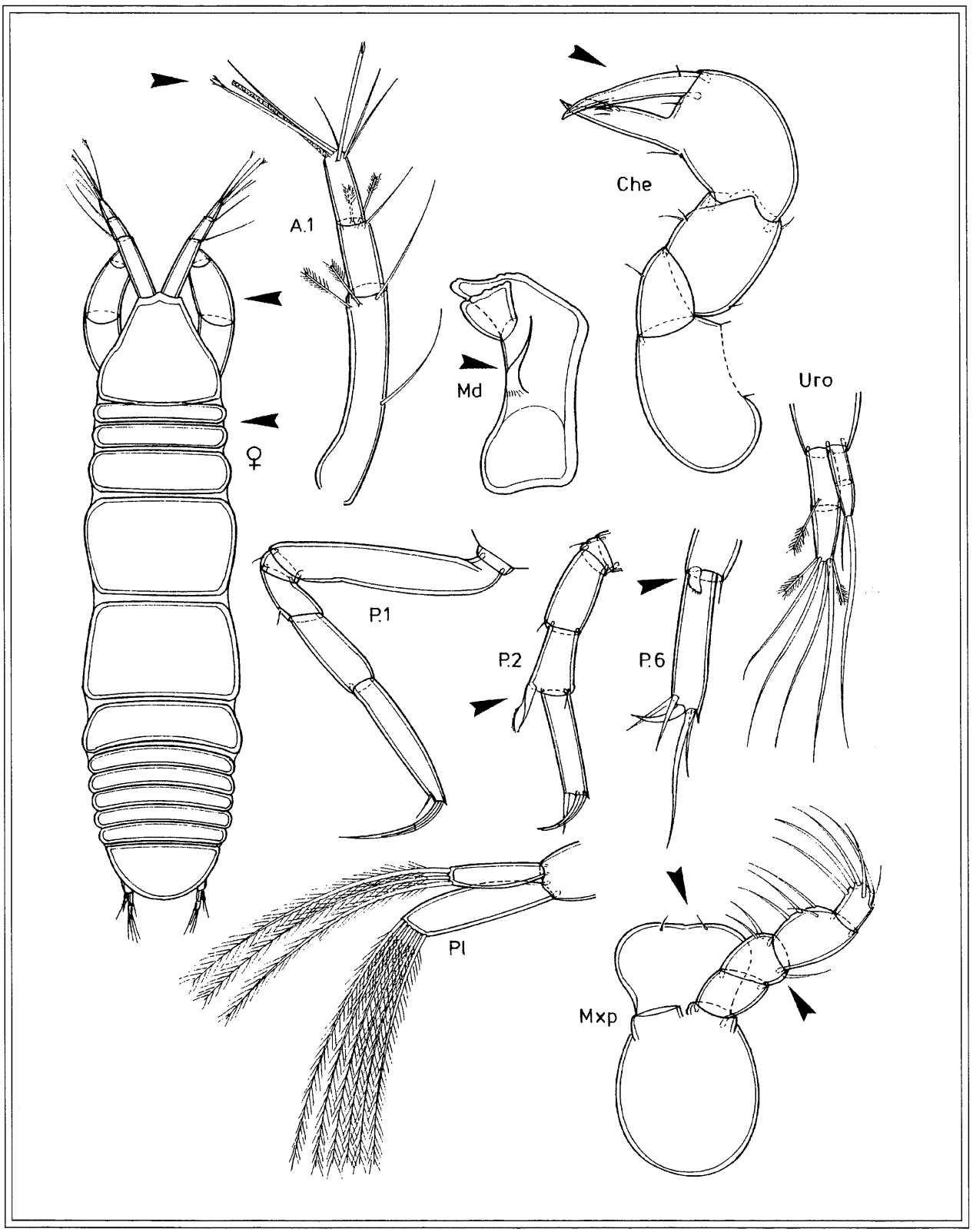

Figure 3.30. ***Pseudotanais californiensis*** **Dojiri and Sieg, new species**, female: ♀, general habitus of female; A.1, first antenna; Md, mandible; Mxp, maxilliped; Che, cheliped; P.1, pereopod 1; P.2, pereopod 2; P.6, pereopod 6; Pl, pleopod; Uro, uropod.

Mandible with pars molaris whiplike.

Maxilliped with basis and endites fused, bearing 1 pair of small distal setae. Palpus 4-segmented; first segment unarmed; second segment with 1 outer distal seta and 2 inner distal setae; third segment with 3 long setae and 1 small seta; terminal segment with 5 long inner setae and 1 smaller outer seta.

Cheliped basis with protuberance. Merus triangular and carrying 1 sternal seta. Carpus about 1.3× longer than broad with 1 proximal tergal seta, 1 distal tergal seta, and 2 sternal setae. Chela having distinct gap between fixed finger and dactylus. Propodus with 1 sternal seta and 1 seta near insertion of dactylus. Fixed finger with 3 tergal setae. Dactylus with 1 small tergal seta.

Pereopods 2-6 with modified (bladelike) spine on carpus.

Pleopods with exopodite about 2/3 length of endopodite and bearing 3 terminal pinnate setae; endopodite with 6 pinnate setae.

Pleotelson 2× broader than long, with rounded posterior margin.

Uropod with exopodite indistinctly 2-segmented; first segment unarmed; second segment with 2 terminal setae. Endopodite indistinctly 2-segmented; first segment with feathered hair; second segment bearing 4 setae and 2 feathered hairs.

Description (male) (Figure 3.31). Body 4.3× longer than broad. Cephalothorax about as long as broad, broadest in posterior half. Pereonites 1 and 2 similar, 6× broader than long; pereonites 3 and 6 about 3.6× broader than long; pereonites 4 and 5 about 1.8-1.9× broader than long. Pleonites 1-4 about 4× broader than long; pleonite 5 narrowest of all pleonites, about 3.6× broader than long.

First antenna 7-segmented, bearing numerous aesthetascs on segments 4-6, and carrying 5 setae and 1 aesthetasc at tip of terminal segment.

Maxilliped with basis and endites completely fused; basis partially fused to cephalothorax.

Cheliped, with rounded protuberance, articulating with side-piece. Merus with sternal seta at about midlength. Carpus, about 1.3× longer than broad, bearing 1 proximal and 1 distal tergal seta and 1 long sternal seta. Propodus with 1 distal tergal seta near comblike row of spinules. Fixed finger with 1 proximal seta and 3 tergal setae. Dactylus slightly expanded proximally and attenuate distally.

Pereopod 1 with unarmed merus; carpus with small distal seta. Pereopod 2 with distal seta on merus; carpus with 1 seta and 1 spine distally. Pereopod 6 ischium with conspicuous spine.

Pleopod with unarmed basis; exopodite and endopodite with several pinnate setae.

Pleotelson triangular, 1.3× broader than long.

Uropod biramous. Exopodite 2-segmented; first segment with 1 seta; second segment with 2 terminal setae. Endopodite 2-segmented; first segment with 1 seta and 2 pinnate setules; second segment with 4 setae and 1 pinnate setule.

Remarks. The transformed bladelike carpal spines on pereopods 2-6 places this species in the subgenus *Pseudotanais* (*Pseudotanais*) sensu stricto. Additional important characters are the absence of eyes, the structure of the pleopods, and the pointed whiplike pars molaris of the mandible. The gap between the fixed finger and the articulation of the dactylus in the cheliped indicate that *P. californiensis* is morphologically similar to *P. jonesi* Sieg, 1977 and *P. abyssi* Hansen, 1913. All three species also share the dendritic (or split) setal tips on the third antennal segment. *Pseudotanais californiensis* can be distinguished from these two congeners by the strong distal tergal spine on the propodus of pereopods 2 and 3.

The general outline of this male provides additional evidence that determination of the swimming male-type specimens may be quite difficult, but not impossible under certain conditions. Firstly, only a detailed examination of all apendages will allow the assignment of the specimens under study to the appropriate family. Secondly, if the male is accompanied by only one species of females of the same genus, as in the present case of *P. californiensis*, it is even possible to identify the specimens to species.

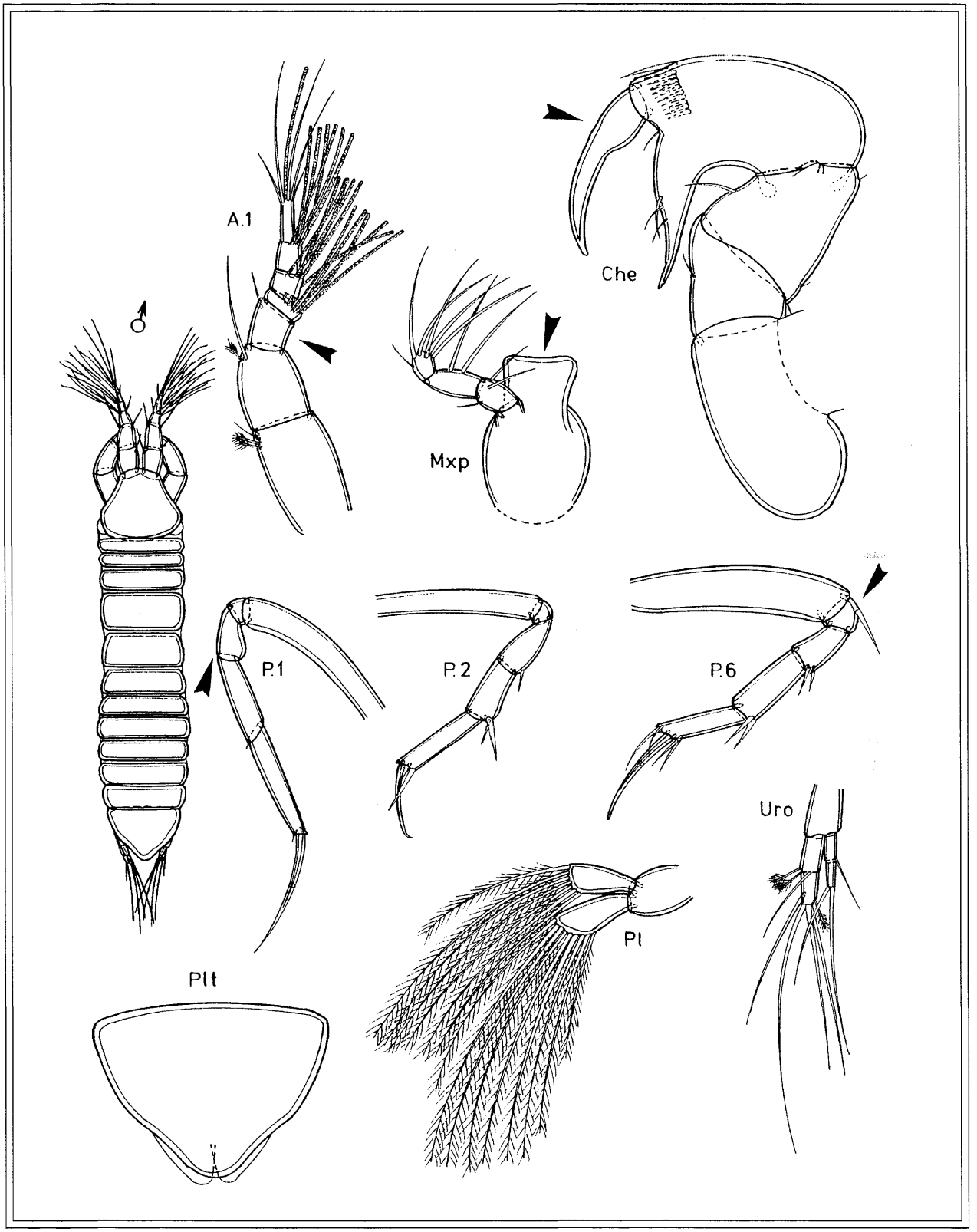

Figure 3.31. ***Pseudotanais californiensis*** **Dojiri and Sieg, new species**, male: ♂, general habitus of male; A.1, first antenna; Mxp, maxilliped; Che, cheliped; P.1, pereopod 1; P.2, pereopod 2; P.6, pereopod 6; Pl, pleopod; Plt, pleotelson; Uro, uropod.

The present male does not differ from the general habitus of "swimming males." The second antenna, pereopods, pleopods, and uropods provide no special information since they are very similar within the Anarthruridae, Pseudotanaidae, and Typhlotanaidae. But, the elongate third segment in the 7-segmented first antenna, as well as the totally fused maxillipedal endites are characteristic of the Pseudotanaidae. Since the cheliped is articulated with the cephalothorax via a side-piece and the chela shows the typical "pseudotanaid" shape, there is no doubt that the specimen represents a species of *Pseudotanais*. Finally, the male corresponds to the accompanying *Pseudotanais* females by lacking eyes and having a gap between the fixed finger and the dactylus of the cheliped. Therefore, the specimen is identified herein as the male of the new species *P. californiensis*.

In the case of *P. californiensis*, the armament of the pereopods is misleading. Pereopod 1 fits the general scheme by having no meral spines. However, pereopods 2-6 are misleading. The carpus of these appendages do not bear the expected transformed spine. All pereopodal segments exclusively bear strong spines. Only looking at the pereopods and not knowing the female, the male would have been placed within the subgenus *Akanthinotanais* and not *Pseudotanais* sensu stricto. This shows once more that in "swimming males" quite often anchestral characters may "reappear" (as the re-segmentation of the uropodal endopodite or the 3-segmented uropodal endopodite in some anarthrurid species).

Finally, the ischium of pereopod 6 bears a spine similar to that of the akanthophoreid male-type 2 (see above). But taking into account the details mentioned above, distinguishing the two species should not be difficult.

Etymology. The specific name alludes to the state where the specimens were collected.

Type Locality and Type Specimens. Off Purisima Pt., Santa Maria Basin, California. Types deposited in the National Museum of Natural History (USNM 284731) and the Santa Barbara Museum of Natural History (SBMNH 144125); see "Type Material."

Distribution. Off Pt. Estero, Purisima Pt., Pt. Sal, Santa Maria Basin, California.

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Appendix

Lists and Maps of Stations

Table A.1. Position of soft-substrate stations taken during the Phase I Reconnaissance.

Station	Latitude	Longitude	Depth (m)
1	35°27.86'N	121°05.33'W	98
2	35°27.70'N	121°06.52'W	200
3	35°27.07'N	121°10.20'W	291
4	35°26.56'N	121°14.93'W	393
5	35°25.77'N	121°21.69'W	585
6	35°20.88'N	120°59.62'W	109
7	35°20.65'N	121°02.57'W	197
8	35°20.00'N	121°06.58'W	308
9	35°19.48'N	121°10.06'W	398
10	35°18.28'N	121°18.65'W	591
11	35°17.80'N	121°22.13'W	690
12	35°15.03'N	120°57.31'W	98
13	35°14.54'N	120°59.77'W	197
14	35°14.15'N	121°02.04'W	299
15	35°13.98'N	121°04.54'W	393
16	35°12.23'N	121°16.29'W	591
17	35°11.61'N	121°22.55'W	654
18	35°09.08'N	120°56.55'W	197
19	35°08.93'N	120°59.66'W	296
20	35°15.72'N	121°04.68'W	396
21	35°06.11'N	120°44.82'W	49
22	35°05.85'N	120°50.23'W	99
23	35°05.60'N	120°55.18'W	195
25	35°05.07'N	121°00.75'W	390
26	35°04.38'N	121°15.99'W	590
27	35°04.30'N	121°19.27'W	611
28	35°04.22'N	121°19.65'W	603
30	34°54.19'N	120°47.07'W	98
31	34°53.76'N	120°52.96'W	200
32	34°53.56'N	120°56.81'W	297
33	34°53.43'N	120°59.66'W	396
34	34°53.15'N	121°04.40'W	492
35	34°52.96'N	121°10.30'W	548
36	34°52.77'N	121°15.37'W	492
38	34°49.81'N	120°52.66'W	197
39	34°49.53'N	120°56.85'W	294
40	34°49.24'N	121°00.81'W	392
41	34°48.35'N	121°19.14'W	495
42	34°48.04'N	120°47.50'W	100
43	34°46.59'N	120°52.92'W	197
45	34°44.91'N	120°59.59'W	395
46	34°41.22'N	121°13.56'W	597
47	34°41.99'N	121°10.81'W	378
48	34°45.11'N	120°52.85'W	196
49	34°45.03'N	120°56.31'W	290
50	34°37.80'N	121°01.66'W	591
52	34°39.56'N	120°47.64'W	98
53	34°37.69'N	120°50.38'W	196
54	34°36.57'N	120°52.02'W	396
55	34°33.66'N	120°56.31'W	590
56	34°30.32'N	121°01.02'W	900

Table A.1 (Continued)

Station	Latitude	Longitude	Depth (m)
58	34°34.35'N	120°45.18'W	99
59	34°33.65'N	120°47.18'W	216
60	34°33.25'N	120°48.34'W	275
61	34°33.01'N	120°48.89'W	345
62	34°30.46'N	120°52.13'W	582
63	34°26.29'N	120°58.08'W	930
64	34°33.15'N	120°40.90'W	59
65	34°31.27'N	120°43.27'W	107
66	34°30.46'N	120°44.55'W	201
67	34°30.29'N	120°45.50'W	282
68	34°29.24'N	120°45.99'W	390
69	34°22.88'N	120°54.20'W	927
70	34°29.67'N	120°43.70'W	200
71	34°29.04'N	120°44.01'W	306
72	34°28.41'N	120°44.76'W	401
73	34°28.21'N	120°36.80'W	98
74	34°26.84'N	120°38.61'W	201
75	34°26.08'N	120°39.65'W	293
76	34°25.59'N	120°40.98'W	387
77	34°22.62'N	120°44.02'W	578
78	34°18.78'N	120°49.30'W	762
79	34°24.12'N	120°28.32'W	98
80	34°22.86'N	120°28.34'W	196
81	34°21.26'N	120°28.83'W	294
82	34°18.71'N	120°29.55'W	394
83	34°17.20'N	120°30.20'W	444
84	34°13.54'N	120°31.19'W	394
85	34°25.88'N	120°16.31'W	113
86	34°24.45'N	120°17.02'W	197
87	34°21.60'N	120°17.11'W	299
88	34°17.89'N	120°16.86'W	393
89	34°13.79'N	120°16.56'W	471
90	34°09.44'N	120°16.30'W	375
91	34°11.73'N	120°07.43'W	540
92	34°08.70'N	120°07.50'W	444
93	34°07.63'N	120°07.51'W	357
96	34°22.91'N	120°05.42'W	296
94	34°24.54'N	120°05.47'W	96
95	34°23.70'N	120°05.47'W	198
97	34°22.28'N	120°05.49'W	393
98	34°12.87'N	120°05.59'W	561
99	34°11.22'N	120°05.86'W	540
100	34°08.67'N	120°05.50'W	443
101	34°07.51'N	120°05.65'W	357
102	34°59.71'N	120°48.22'W	99
103	34°59.63'N	120°53.56'W	197
104	34°59.45'N	120°56.49'W	294
105	34°59.23'N	120°59.60'W	392
106	34°58.95'N	121°04.42'W	492
107	34°58.65'N	121°15.08'W	573
108	34°58.21'N	121°17.88'W	492

Note: Sample labels from the Soft-substrate stations have several identification codes which include a station number, sample type, replicate number, and analysis type. These are as follows: 001 to 200 = the range of station numbers; BSS = Benthic Sediment Single (i.e., a non-replicated station); BSR = Benthic Sediment Replicate (three replicates taken at this station); BSV = Benthic Sediment Variance (subsamples); 01-09 = replicate numbers; TX = a taxonomy sample. Sample labels having the designation BRA, represents a sample from rocks taken as part of the hard bottom survey.

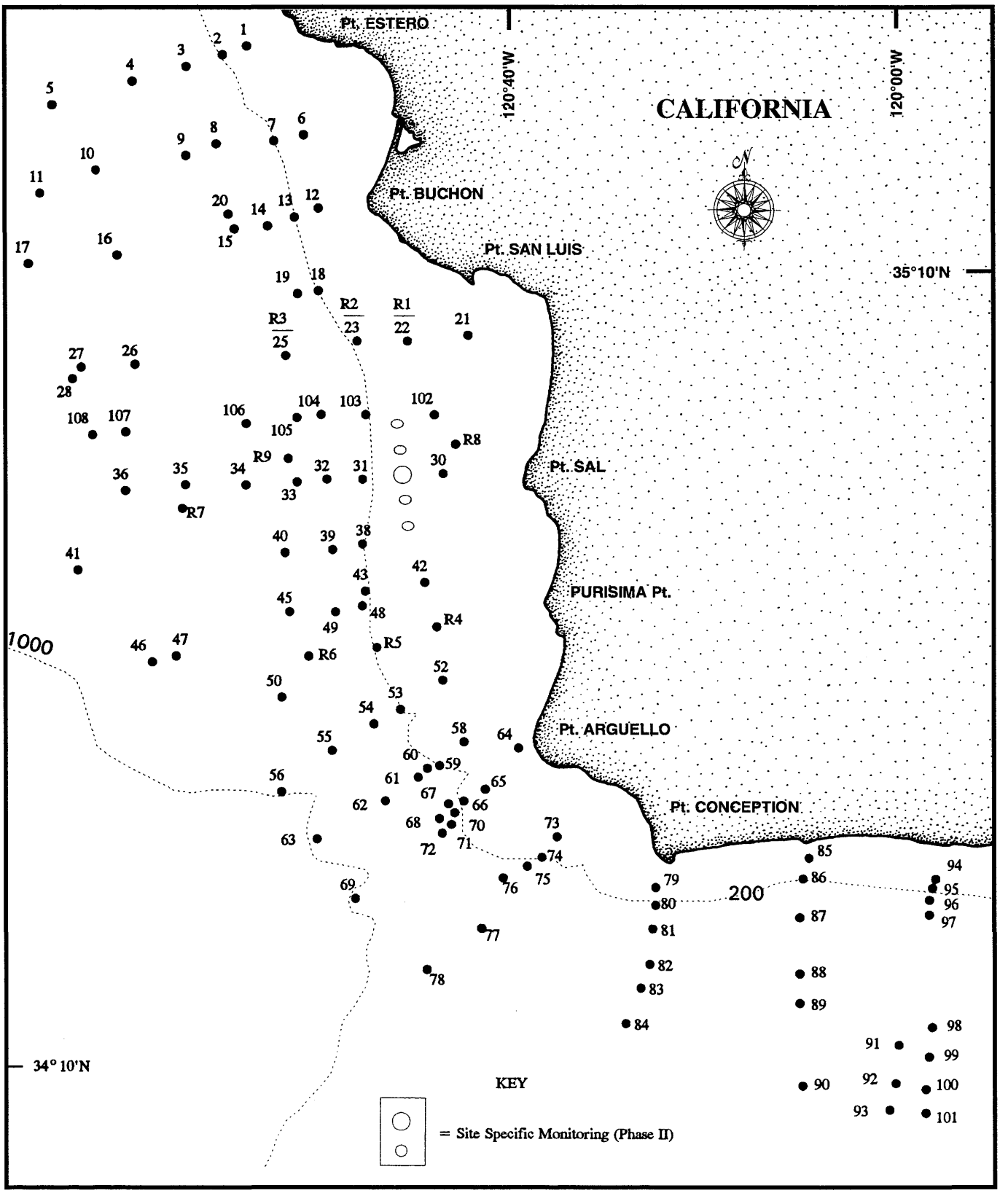

Figure 1.1. Map showing location of soft-substrate stations from the Phase I Reconnaissance and Phase II Monitoring Programs.

Table A.2. Location of soft-substrate stations taken during the Phase II Monitoring Program.

Station	Latitude	Longitude	Depth (m)
R-1	35°05.83'N	120°49.16'W	91
R-2	35°05.50'N	120°53.40'W	161
R-3	35°05.30'N	121°00.90'W	409
R-4	34°43.01'N	120°47.39'W	92
R-5	34°42.69'N	120°50.83'W	154
R-6	34°41.40'N	120°57.90'W	410
R-7	34°52.90'N	121°10.30'W	565
R-8	34°55.30'N	120°45.87'W	90
R-9	34°53.68'N	120°59.12'W	410
PJ-1	34°55.79'N	120°49.91'W	145
PJ-2	34°55.32'N	120°49.59'W	142
PJ-3	34°56.26'N	120°49.58'W	138
PJ-4	34°56.26'N	120°50.24'W	150
PJ-5	34°55.32'N	120°50.24'W	152
PJ-6	34°54.71'N	120°49.91'W	148
PJ-7	34°55.79'N	120°48.60'W	123
PJ-8	34°56.87'N	120°49.91'W	142
PJ-9	34°55.79'N	120°51.23'W	169
PJ-10	34°53.63'N	120°49.91'W	147
PJ-11	34°57.95'N	120°49.91'W	136
PJ-12	34°55.58'N	120°49.91'W	145
PJ-13	34°56.01'N	120°49.91'W	144
PJ-14	34°55.79'N	120°49.26'W	134
PJ-15	34°55.79'N	120°50.57'W	155
PJ-16	34°55.03'N	120°48.99'W	130
PJ-17	34°56.56'N	120°48.98'W	126
PJ-18	34°56.56'N	120°50.84'W	158
PJ-19	34°55.03'N	120°50.84'W	167
PJ-20	34°50.38'N	120°49.91'W	148
PJ-21	35°01.23'N	120°51.15'W	143
PJ-22	34°55.25'N	120°49.93'W	143
PJ-23	34°56.33'N	120°49.90'W	143

Table A.3. Sampling dates of MMS Phase II Monitoring Program.

Cruise	Date
1-1	October 1986
1-2	January 1987
1-3	May 1987
2-1	July 1987
2-3	October 1987
2-4	January 1988
2-5	May 1988
3-1	October 1988
3-4	May 1989

Table A.4. MMS Phase I - Locations of hard-substrate transects.

Station	Beginning Latitude	Longitude	End Latitude	Longitude	Depth (m)
1 A/B	34°24.454'N	120°01.876'W	34°24.464'N	120°00.878'W	69-73.5
1 C/D	34°24.076'N	120°00.443'W	34°24.184'N	120°01.480'W	73.5-78
2 A/B	34°11.377'N	120°29.318'W	34°11.289'N	120°28.774'W	110-126
2 C/D	34°10.984'N	120°28.094'W	34°10.780'N	120°27.554'W	120-123
4 A/B	34°27.539'N	120°40.364'W	34°28.162'N	120°40.189'W	168-237
6 A/B	34°30.246'N	120°35.555'W	— —.—	— —.—	54-63
6 C/D	— —.—	— —.—	34°30.421'N	120°34.315'W	54-63
13 A/B	34°42.570'N	120°47.899'W	34°42.107'N	120°48.253'W	92-100
13 C/D	34°42.556'N	120°48.147'W	34°42.974'N	120°47.424'W	88.5-100.5
14 A/B	34°43.589'N	120°49.093'W	34°42.826'N	120°48.370'W	96-105
14 C/D	34°43.244'N	120°49.406'W	34°42.893'N	120°48.822'W	105-117
16 A/B	34°46.544'N	120°50.197'W	34°45.912'N	120°49.726'W	91.5-123
17 A/B	34°49.382'N	120°50.768'W	34°49.600'N	120°50.688'W	160.5-168
19 A/B	34°47.833'N	120°51.425'W	34°47.097'N	120°50.793'W	148.5-177
20 A/B	34°46.470'N	120°50.289'W	34°46.140'N	120°49.885'W	90-130.5
21 A/B	34°47.335'N	120°45.903'W	34°47.548'N	120°46.123'W	75-90
22 A/B	34°50.365'N	120°48.221'W	34°50.990'N	120°48.365'W	114-115.5
23 A/B	34°49.868'N	120°47.393'W	34°50.003'N	120°47.480'W	93-102
25 A/B	35°05.662'N	120°47.562'W	35°06.036'N	120°47.652'W	64.5-72
26 C/D	35°11.586'N	120°55.556'W	35°11.555'N	120°55.233'W	108-111
27 A/B	35°20.906'N	120°59.657'W	35°21.035'N	120°59.603'W	96-126
28 A/B	35°21.539'N	120°59.641'W	35°21.867'N	120°59.299'W	96-105
29 A/B	35°27.864'N	121°05.331'W	35°27.805'N	121°05.277'W	102-106.5

Table A.5. MMS Phase II - Locations of hard-substrate photosurvey stations.

Station	Latitude	Longitude	Depth (m)
PH-E	34°30.26'N	120°42.76'W	119
PH-F	34°30.81'N	120°42.36'W	105
PH-I	34°29.96'N	120°41.68'W	107
PH-J	34°29.82'N	120°41.82'W	117
PH-K	34°29.37'N	120°42.26'W	160
PH-N	34°29.21'N	120°42.05'W	166
PH-R	34°29.11'N	120°42.67'W	213
PH-U	34°31.48'N	120°43.51'W	113
PH-W	34°31.52'N	120°45.86'W	195

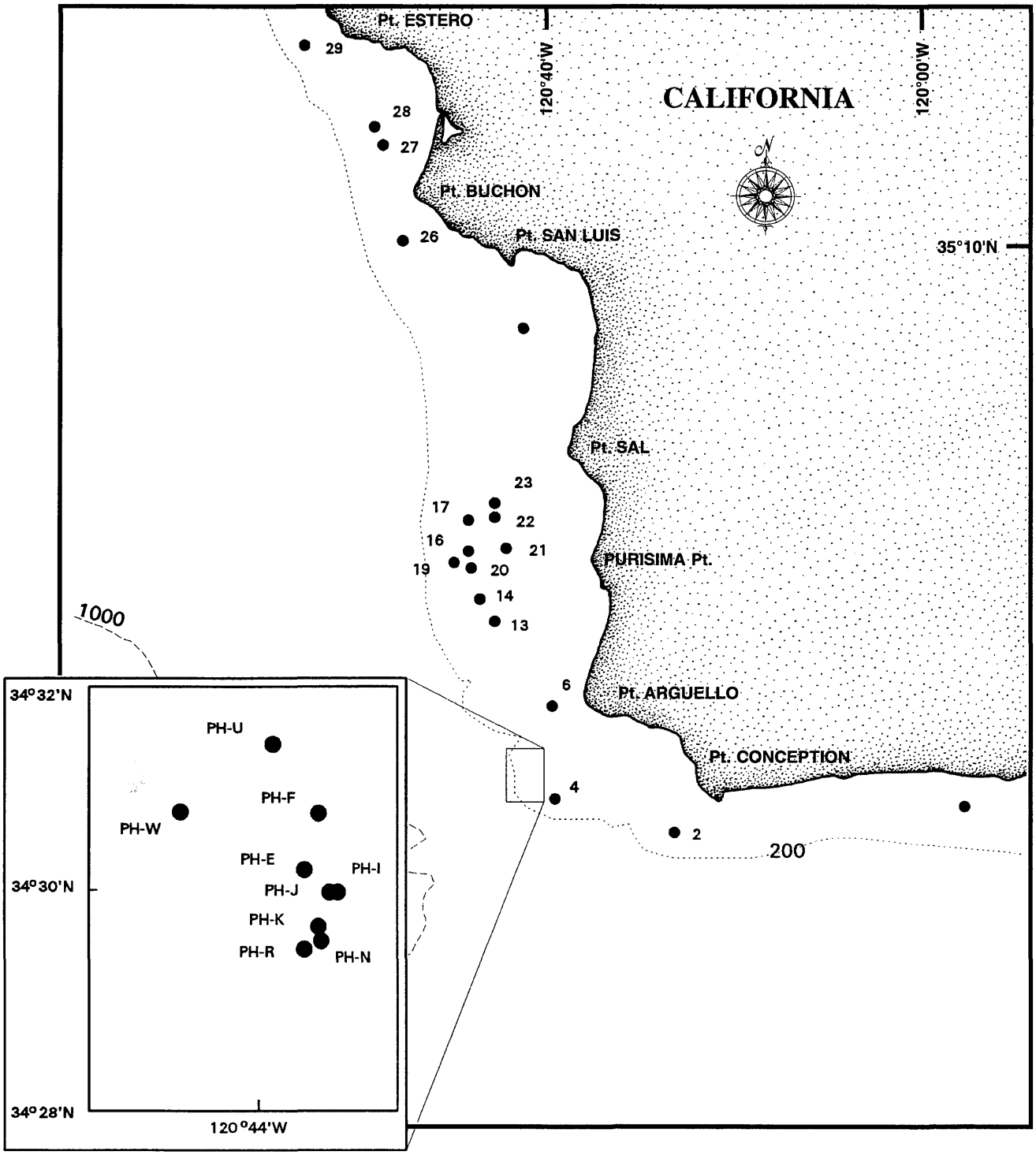

Figure 1.2. Map showing location of hard-substrate stations from the Phase I Reconnaissance and

Index

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

Z

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