A systematic study on Amphipoda (Crustacea) of the Caribbean ~~coast~~ Sea of Venezuela.

by Antonio Galan - 1984

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ABSTRACT

The present paper is a taxonomic monograph on the amphipod Crustacea of the Caribbean coast of Venezuela. It is the first such work to be produced for this area. The text comprises forty-four species' descriptions with figures drawn from microscope slide preparations of the original collected material, of which twenty-five are new records for the southern Caribbean. Seven new species and one new genus are reported. Synonymies are presented for all genera and species as well as a synoptic checklist of related taxa worldwide.

Notes on the ecology and biology of the amphipod fauna are included as available. The introduction includes a commentary on historical, zoogeographical and methodological aspects, and a full familial classification of the group is provided. Identification keys are incorporated at all levels. The significance of Amphipoda in understanding the complex zoogeography of the Caribbean is discussed. The paper concludes with a 300-item bibliographic reference.

CONTENTS

INTRODUCTION

PREAMBLE

The benthic fauna of the seas of Venezuela is relatively little known, only the fishes (Cervigon, 1966) and decapods (Rodriguez, 1980) have been monographed to date. Most papers reporting ecological studies in the southern Caribbean give identifications only at generic or even familial levels (Rodriguez, 1959). Nearly 10 per cent of the species described in the first faunal monograph on fishes from the seas of Venezuela were new to science (Cervigon, 1966).

Only four authors have described marine amphipod crustaceans from Venezuela: Stephensen (1948) described a single new species of Talorchestia from Margarita Island and Ruffo (1950 and 1954) reported eleven species in the eight genera, Ampithoe, Ceradocus, Elasmopus, Hyale, Melita, Nototropis, Pontogeneia and Talorchestia, of which three species were new. Myers (1968) recorded a species of Neomegamphopus and described a new species of Amphideutopus. Recently, Galan (1976) recorded a species of Ericthonius from the area for the first time. Thus, at the beginning of the study only fifteen species were known from Venezuelan seas.

From the freshwater fauna, Ruffo (1957) described a new species of Hyalella from subterranean cave waters in the coastal mountains of Venezuela; Stock (1979 and 1981) reported a new species of Bogidiella and Ingolfiella from fresh water of Margarita Island and more recently a new cavernicolous hadziid, Metaniphargus, from Golfo Triste (Stock & Botesaneanu, 1983).

According to Ortiz (1979) a total of about 200 species of Amphipoda have been reported from the Gulf of Mexico, the northern part of the Caribbean sea and adjacent North West Atlantic waters. Given the diversity of coastal habitats in the southern Caribbean around Venezuela it is reasonable to expect an equivalent number of species in this region.

Amphipods are small to medium-sized peracarid crustaceans, many of them between 5-15 mm, that inhabit virtually all permanent waters of the world, including fresh, ground, subterranean, brackish and marine. They range from the intertidal zone to the deepest ocean trenches and from tropical to polar regions, and some have colonized terrestrial habitats that extend to the high coastal rain forest of New Zealand, North America and Eurasia. The majority however inhabit shallow coastal and continental shelf waters. Amphipods are primarily deposit, detritus, or filter feeders, and are important secondary producers in aquatic ecosystems. They represent a significant food source for many bottom-feeding fishes.

Since amphipods are easily cultured in the laboratory, they have been the subject of many biological studies and investigations (Becker, 1971; Ercolini & Scapini, 1974 and 1976; Pinkster, 1972). They may prove particularly useful as indicators of environmental stress in relation to pollution (Barnard, 1958; James & Frame, 1976). Density values for amphipods can be very high: <u>Talorchestia margaritae</u>, for example, reaches 5,000 specimens per square metre on some Venezuelan beaches rich in <u>Thalassia testudinum</u> detritus; and in a mangrove community of a hypersaline sea-lagoon the taxocoenosis of <u>Ericthonius brasiliensis</u> was estimated at 5,000 individuals per square metre (Galan, 1976).

Unfortunately, amphipod identification is a very difficult task for many marine biologists and ecologists, and it was this problem that provided the initial incentive for this study. The south-east sector of the Caribbean Sea, characterized by a system of coastal upwelling, is an area where the demand for taxonomic expertise has increased rapidly through recent years. There is an acute lack of reliable base-line data on the structure and composition of natural ecosystems for research into fisheries, aquaculture and pollution. The recent invasion of the Venezuelan seas by Oil Companies has placed further demands on ecological research.

Tropical ecosystems such as the southern Caribbean are especially demanding from a taxonomic point of view. These systems offer a high species diversity (Margalef, 1974), while at the same time the animals tend to be much smaller. The latter is especially evident amongst the amphipods where the majority have a body length between 2-6 mm. Small size and subtle character differentiation frustrate ecologists and taxonomists alike.

Taxonomic work is urgently needed on the marine communities of southern Caribbean Sea, and amphipods form a conspicuous and important part of the fauna. To date, there have been no keys or handbooks on Venezuelan amphipods. The problem is well illustrated by the present study in which almost 20 per cent of the species identified proved to be new to science.

ACKNOWLEDGEMENTS

I am extremely grateful to my two supervisors: Dr R. Lincoln, Department of Zoology, British Museum (Natural History) and Dr D. Kermack, Imperial College of Science and Technology, for their valuable advice and assistance, and for their patience in attending to my poor English. I also appreciate the collaboration of the following Venezuelan institutions: Instituto Oceanografico and Centro de Acuicultura Isla de Margarita, Orient University; Fundacion Museo del Mar; Fundacion Cientifica Los Roques; Intecmar, Simon Bolivar University; Instituto Zoologia Tropical, Central University of Venezuela and Venezuelan Speleological Society (S.V.E.). As a final word I would like to register my gratitude to Dr J. Barnard, Smithsonian Institution, for providing the original drawing of figure 98.

AREA OF STUDY

Venezuela has tropical seas and a wide range of environmental conditions along its 2,800 km contin:ental coastline (Fig. 1). Between the Orinoco delta in the East and the estuary of Maracaibo lake on the West, there are rocky and sandy shores, typical brackish mangrove lagoons with muddy sediments, beds of turtle-grass, *Thalassia testudinum*, and a chain of coral reef islands with hypersaline mangrove lagoons. Additionally, in the north-east is a wide and relatively shallow continental shelf, less than 100 m in depth and characterized by seasonal upwelling, that supports a large commercial fishery. This region differs markedly from the adjacent tropical waters (Fig. 2).

The north-east continental shelf of Venezuela has a number of special features that result from the seasonal fluctuations of the easterly "Alisios" winds. These include a relatively low temperature, and high productivity. The annual mean surface water temperature is only 24^{o}C in the upwelling region, compared with 28^{o}C for the surrounding tropical sea. The upwelling zone generally has a productivity in excess of 350 g C/m^2, y^{-1}, in contrast with values under 100 g C/m^2, y^{-1} for adjacent tropical waters (Margalef, 1967). From the historical "pearl-oyster" fishery that was started as early as 1498 with the exploitation of *Pinctada radiata*, the area nowadays has the largest commercial fishery in Venezuela for the pilchards, *Sardinella brasiliensis* and *S. aurita*; the annual harvest represents half the total catch of all the Venezuelan fisheries (150,000 tons).

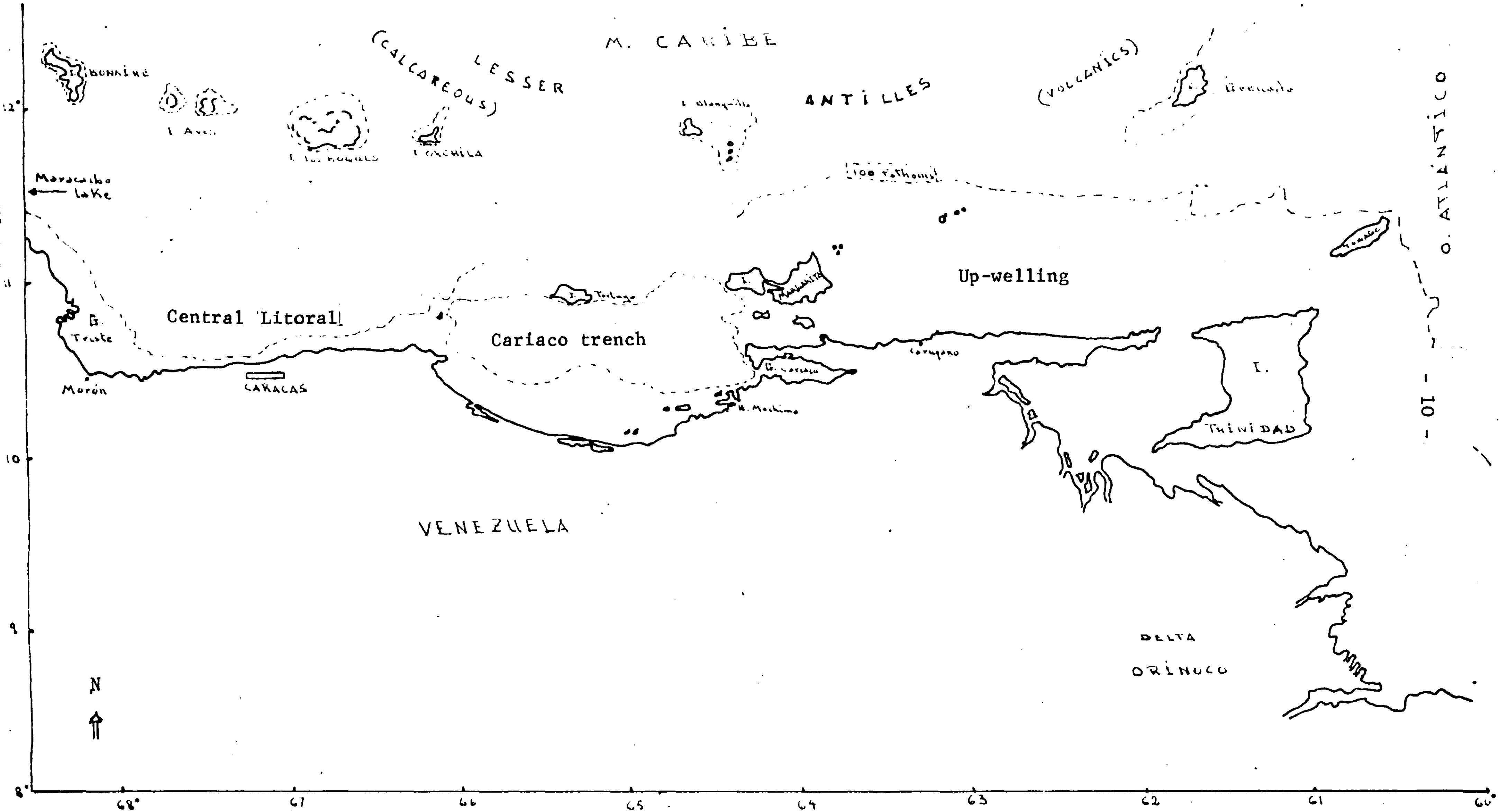
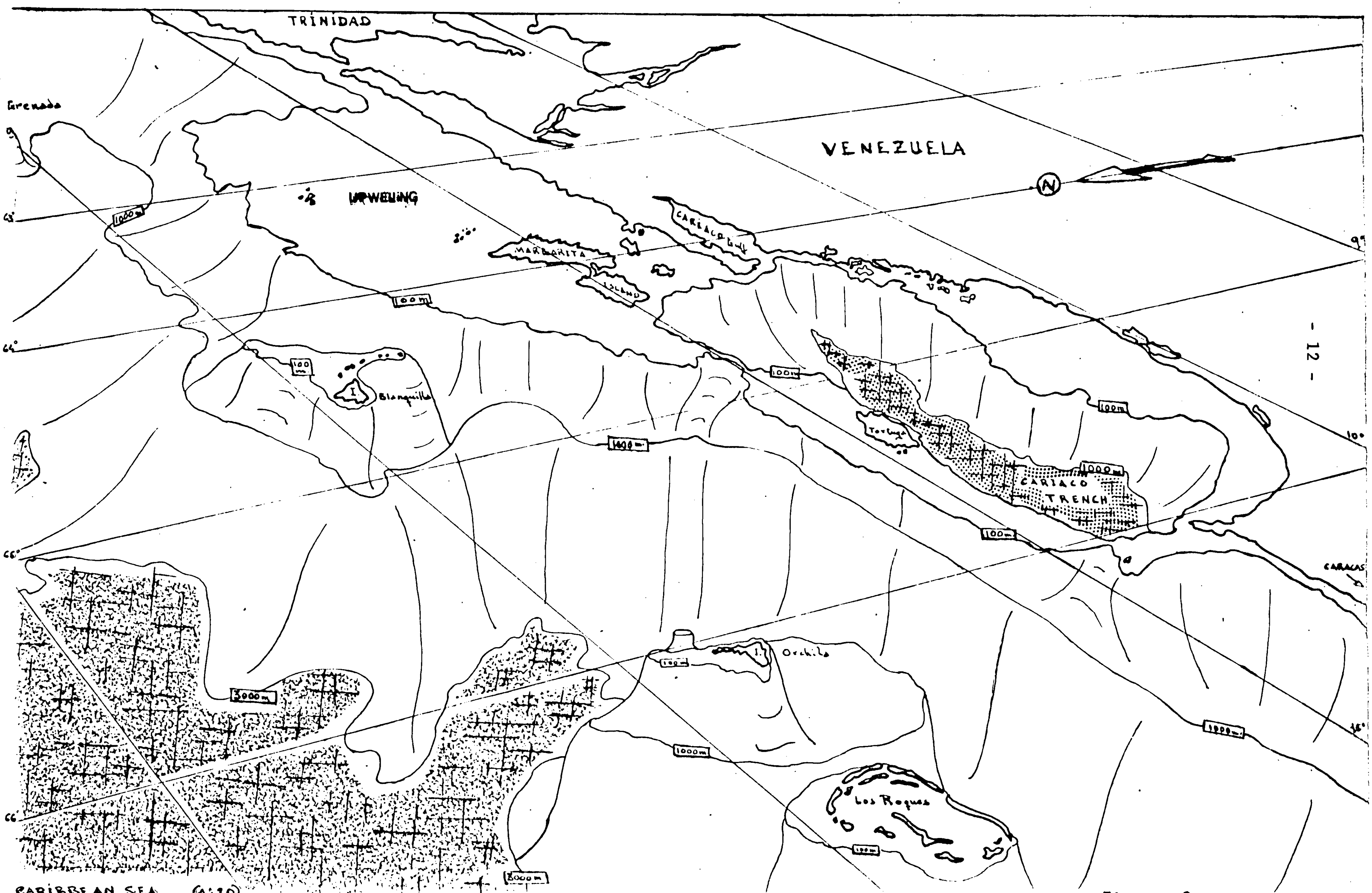


Figure 1. Area of study

Also, the area has the only natural mussel-banks of Perna perna, a species otherwise restricted to more temperate latitudes. A further major feature of the coastline is the Cariaco trench, a 1,500 m deep continental trench adjacent to the shelf. The trench acts like a cess-pit for the adjacent platform, and is anoxic below 400 m. This is a convenient 'sink' for the upwelling area which is subject to annual red tides (Fig. 2).

The upwelling area exhibits a relatively low species richness but has high productivity and the coastal geomorphology provides a wide range of habitats. Ecological differences between tropical Caribbean waters and the upwelling waters provide subtle physico-chemical barriers that might enhance sympatric speciation. Additionally, the upwelling area contains continental islands which were joined to the mainland until the end of the Wurm glaciation about 15,000 years ago (Miro, 1974), when a eustatic rise in sea level separated them from the continent. Today, these islands have some inland endemic species.

Moving east to west from the upwelling area and the Cariaco trench is the region known as the Central Litoral that extends from Codera Cape to the platform of Golfo Triste. This shoreline, bordering the coastal mountain system of Venezuela that reach 2,500 m above sea level, is characterized by an almost total absence of continental shelf. At the midpoint of the Central Litoral, only 2 km offshore, the depth is about 400 m and the slope quickly reaches 3,000 m. These are tropical Caribbean waters similar to the surface waters of the Cariaco trench, having a westward current system parallel to the shore. As in the case of the continental platform to the east, the shallow Golfo Triste shelf is enriched by the nutrients upwelling from deep water, although this insurgence is somehow attenuated.



TRINIDAD
Grenada
VENEZUELA
N
UPWELLING
MARGARITA
ISLAND
CARIACO Gulf
Tortuga
CARIACO
TRENCH
Blanquilla
Orchila
Los Roques
CARACAS
100m
1000m
3000m
CARIBBEAN SEA (1:20)

Figure. 2

To the north, about latitude 12° N there is a row of islands parallel to the continental shore, separated from the mainland by a distance of more than 100 km and waters of abyssal depth. These are the coral islands of the calcareous Lesser Antilles. They differ geologically from Grenada which is of volcanic origin. Las Aves islands and Los Roques archipelago are fine examples of Caribbean coral atolls.

The five major regions of the Venezuelan Caribbean, between the estuarine systems of the Orinoco delta and the Maracaibo lake:

(1) the upwelling zone

(2) Cariaco trench

(3) Central Litoral

(4) Golfo Triste

(5) the chain of coral islands

represent an enormous area of some 200,000 km^2. The present study, using amphipods, is the first to attempt an assessment of the subtle differences in the fauna of these main regions, and should be a contribution to a better understanding of the complex zoogeography of the Caribbean coast of Venezuela.

ZOOGEOGRAPHY

The fossil record of the Amphipoda is limited to only 14 mainly crangonyctid types, none of which is older than Eocene (Palaeogammarus balticus Lucks, 1928). A list is given by Hurley (1973). Most are similar to extant species. The poor fossil record seriously restricts any study of the origin and evolution of the group. However, with the help of zoogeographical studies in the context of plate tectonic theory, a phylogenetic classification is gradually being assembled.

From a zoogeographical point of view the study of Amphipoda, particularly some endemic groups, is proving valuable as a model for general evolutionary theory (Bousfield, 1982). For example, groups such as Hadziidae, confined mainly to Tethyan Sea margins or epicontinental areas, date from the Cretaceous; whilst species of Hyalellidae endemic to Lake Titicaca are no older than the lake basin, about 10 million years.

The Caribbean tectonic plate is one of the most controversial. It comprises oceanic, continental, and a mixture of other structural parts, lacking clear delimitation from other plates especially the South American plate (Edgar et al., 1971). In this context a study of the taxonomy and distribution of Amphipoda in the Caribbean has special relevance.

The complex nature of the Caribbean fauna is well illustrated by the main commercially exploited fish species. It has its own endemic tropical component as for example the snapper, Lutjanus pupureus. In addition, some temperate cosmopolitan species have penetrated into relatively new areas such as the zone of upwelling, for example the tuna, Thunnus thynnus. It is also possible to recognize species from the tropical Pacific fauna, such as the snook, Centropomus pectinatus. The latter appeared, presumably, before the formation of the Panama Isthmus about 5 million years ago. The eastern upwelling area has some elements of the Canary and the Brazilian faunas, the pilchards, Sardinella aurita and S. brasiliensis, respectively, transported westwards by the North Atlantic Tropical Current and the Guyana Current.

This hypothetical multiple origin of the Caribbean fauna illustrated above by selected examples of fish species is given further support by the present study, in which 25 of the amphipod species identified proved to be new distribution records.

In some amphipod groups with freshwater representatives the puzzle has become particularly difficult. Thus bogidiellid amphipods, for example, a group which occurs in Tethyan sea margins, were recently found on the Caribbean island of Margarita (Stock, 1981). Such a distribution can be explained in the light of plate tectonic theory by accepting a Gondwanaland origin for the bogidiellids. The ingolfiellid amphipods, that have a more worldwide distribution, but are also present on Margarita (Stock, 1979), must have a pre-Gondwanaland origin in Pangaea.

According to the dispersal model of Darlington (1957), the Caribbean islands derived their fauna by chance dispersal by the sea from nearby islands or continents. As far as aquatic ecosystems are concerned, crustaceans with planktonic larval stages probably colonized the islands mainly by this way (for example, Macrobrachium, Palaemon, Sesarma). Amphipods are also aquatic but lack larval stages and planktonic dispersion is thus precluded.

The fragmentation model of Rosen (1976) predicts that a proto-antillean arc-archipelago lagged behind when the South and North American plates drifted westward, and that a Mesozoic fauna has evolved since that time. The different freshwater crustacean faunas of the calcareous and volcanic islands can not however be explained by this model.

In the regression model proposed by Stock (1977) a number of the Caribbean islands, mainly the calcareous ones, were submerged during long periods of the late Mesozoic and early Cenozoic when coral limestone was deposited. During regression of the sea mainly in the Oligocene and Miocene, the limestone layers were exposed and several marine littoral species were stranded and became adapted to limnic conditions, as for example, the Tethyan relict hadziid amphipods, that are distributed in subterranean waters of the Mediterranean and Caribbean Seas.

Freshwater gammarids are found on all the continents except South America. The only neotropical stygobiont amphipod is an endemic hyalellid from a coastal mountain of Venezuela. Its presence can best be explained by stranding accompanied by isolation during a long period of glacial drought.

The limnic amphipod taxocoenosis of the Caribbean islands has assumed great significance following recent studies by Stock (1982). The vicariance model (Stock, 1980) encompasses fragmentation and regression to explain a passive mode of speciation, whilst dispersion is an active process. Perhaps a dry model, that is isolation of a population in the groundwaters of a mountain surrounded by sea and desert, may help to explain the origin of species by vicariant evolution. The hyalellids of South America illustrate both active and passive models of evolution within the group.

MATERIAL AND METHODS

A systematic study on Amphipoda from the Caribbean sea of Venezuela has been undertaken, and the ecology of important species examined, with the aim of producing a taxonomic monograph and compiling identification keys. The work is based on the author's original collection and material from two field trips, made during the course of the project in January 1982 and January 1983.

The original collection was presented by colleagues from other institutions, or was obtained from the "Calypso" expedition, that took dredge and grab samples from all major sediment types on the Venezuelan continental shelf during the summer of 1979. The field trips of 1982/3 were made by land-jeep and small boats. Samples were taken from a wide range of habitats including sandy shores, rocky shores, mangroves, corals, mud bottoms, at intertidal and sublittoral levels. Amphipods were collected by hand-sampling, and by scuba diving using small nets, sieve traps and slurp-gun; further details on collecting methods are given by Holme (1964).

In the field, the material was usually fixed in 5 per cent filtered sea-water formalin and subsequently, at the laboratory, transferred to 80 per cent alcohol (Industrial Methylated Spirit) for preservation. A full account of preservation techniques is given by Lincoln & Sheals (1979). The collections were transported to London by hand after separating the amphipods from the mixed samples into labelled vials.

In the laboratory tentative identifications were made at familial or generic levels as a means of rough sorting. Dissections were made under a binocular microscope using fine mounted needles made from small electrolytically sharpened entomological pins set into plastic cocktail sticks. Temporary slides were prepared with glycerine or polyvinyl lactophenol.

The initial sorting programme involving nearly 10,000 specimens produced about 500 individual vials which were cross indexed on file cards. As a tentative estimate the collection comprises 75 amphipod species of which 44 have been worked up so far, and are described in this study. The rest, mainly deeper water species will be worked up later. It is not expected that their exclusion will alter radically the conclusions of this thesis.

Careful dissection is an essential part of any taxonomic study of amphipods, made even more demanding in this instance by the small size of most species. Dissections were carried out in a small (40 x 40 mm) crystallizing dish under a stereo-binocular microscope with the specimen immersed in glycerine. Limbs from one side of the body were removed carefully in turn, and arranged in sequence on a cavity slide in polyvinyl lactophenol. The mouthparts were removed individually, or as a bundle and then teased apart on a slide, and mounted in the same manner. A full explanation of the dissection procedure is given by Barnard (1969). Approximately 200 slides were prepared during the course of the project. All figures are from the original specimens and were prepared initially in pencil, with the aid of a"camera lucida", and later inked.

SYSTEMATICS

The classification of Crustacea is in a state of flux. The scheme set out below is one compromise solution but is likely to remain only temporarily valid as new facts emerge and opinions change as to what constitutes the plesiomorphic versus apomorphic state of any given character. The Crustacea is regarded by some workers as a class (Kaestner, 1970), by others as a superclass (Hessler & Newman, 1975), a subphylum (Barnes, 1981) or a phylum(Manton, 1977; Schram, 1978). Such arguments about major taxonomic ranks do not necessarily affect the internal classification of the group at ordinal and lower levels.

The non-malacostracan classes were formerly grouped as the Entomostraca but this is no longer regarded as a monophyletic group, although it still retains some practical advantages. The lack of agreement on whether the Malacostraca is monophyletic or polyphyletic is evident from the varying opinions expressed in a recent book, "Crustacean Phylogeny" edited by Schram (1983).

The classification of Crustacea that follows is basically similar to that of Moore & McCormick (1969), incorporating numbers of species from Bowman & Abele (1983), but also including two nearly discovered higher taxa, the classes Remipedia (Yager, 1981) and Tantulocarida (Boxshall & Lincoln, 1983; Lincoln & Boxshall, 1983).

Classification of the Recent Crustacea:

Class		Superorder		Order	
Cephalocarida	(9)				
Branchiopoda	(821)				
Ostracoda	(5650)				
Remipedia	(3)				
Tantulocarida	(5)				
Mystacocarida	(9)				
Copepoda	(8405)				
Branchiura	(150)				
Cirripedia	(1025)				
Malacostraca	(22651)	Phyllocarida	(10)	Leptostraca	(10)
		Hoplocarida	(350)	Stomatopoda	(350)
		Syncarida	(115)	Anaspidacea	(15)
				Bathynellacea	(100)
		Eucarida	(10086)	Euphausiacea	(85)
				Amphionidacea	(1)
				Decapoda	(10000)
		Pancarida	(9)	Thermosbaenacea	(9)
		Peracarida	(12081)	Mysidacea	(780)
				Cumacea	(800)
				Spelaeogriphacea	(1)
				Tanaidacea	(500)
				Isopoda	(4000)
				Amphipoda	(6000)

Total number of species (38728)

(Approximate number of species in parenthesis)

There are about 40,000 extant species of crustaceans, and they are the dominant arthropod group in most aquatic communities, both marine and freshwater, as well as having colonized a few terrestrial habitats. Familiar crustacean types include water fleas, tadpole and clam shrimps (Branchiopoda); mussel shrimps (Ostracoda); fish lice (Branchiura); barnacles (Cirripedia); mantis shrimps (Stomatopoda); krill (Euphausiacea); prawns, crabs and lobsters (Decapoda); opossum shrimps (Mysidacea); slaters (Isopoda); and sand hoppers (Amphipoda). The range of forms encompassed by the Crustacea also includes the cave inhabiting Speleonectes, the only known representative of the Remipedia, the Mystacocarida inhabiting interstitial spaces of marine sands and the wholly parasitic groups, Branchiura (parasites of fishes) and Tantulocarida (parasites of deep-sea crustaceans). The smallest adult crustacean is a tantulocarid at about 150 μm, the largest a spider crab, Macrocheira kaempferi, with a leg span of over 3 metres.

Many of these forms are of considerable economic importance both as sources of food and as pests or fouling organisms. Those that are not used as food directly by man, the copepods for example, are often of great ecological significance as they form the first step in the food chain leading from phytoplankton to the commercially important fishes.

The Crustacea encompasses an extremely broad range of morphotypes and as a consequence is not easily defined by unequivocal diagnostic characters. Only two characters appear diagnostic of the group; the presence of two pairs of antennae, and of at least three pairs of postoral mouthparts including gnathobasic mandibles. The body is metamerically segmented and typically comprises three tagmata - head, thorax, and abdomen - bearing jointed limbs that are frequently biramous and may bear gills. A carapace is commonly present covering all or part of thorax. Aspects of the embryology are characteristic of crustaceans, and ontogenetic development usually includes one or more naupliar larval stages.

Within the Crustacea, the class Malacostraca is characterized by a body tagmosis of 5 head, 8 thoracic and 6 (rarely 7) abdominal segments. The head is frequently fused with one or more anterior thoracic segments to form a cephalothorax. All members of this group have the female gonopores on thoracomere 6 and the male genital openings on thoracomere 8, the last segment of the thorax. The thoracic limbs often bear respiratory epipods (gills), and the abdomen may have some of its limbs specialized for swimming and known as natatory pleopods. Seven abdominal segments are found only in leptostracans and lophogastrid mysidaceans.

Of the 6 malacostracan superorders, the Peracarida is traditionally circumscribed by two characters: oostegites and lacinia mobilis. Oostegites are laminar outgrowths from the coxal segment of the thoracopods that overlap medially to form a ventral brood pouch or marsupium for brooding eggs and young. The lacinia mobilis is a dentate articulating process on the mandible immediately proximal to the incisor, probably derived from the distal-most spine of the spine row (Dahl & Hessler, 1982). It may be present on one mandible, or both, but in some apomorphic taxa is secondarily absent. Dahl & Hessler (1982) argue for the occurrence of a lacinia mobilis in groups outside the Peracarida, in which case it no longer qualifies as a peracaridan synapomorphy. Furthermore, the homology of the lacinia mobilis within the Peracarida is also open to doubt.

Amongst the peracaridans the Amphipoda are diagnosed by the following suite of characters: carapace absent; eyes sessile; head fused to one (rarely two) thoracomeres; body typically laterally compressed; thorax bearing 7 pairs of uniramous limbs, the anterior 2 pairs frequently modified as grasping subchelae. The thoracopods are weakly differentiated into 2 groups, limbs 1-4 orientated such that the dactylae are directed backwards, limbs 5-7 orientated with the dactylae pointing forwards. The first three pairs of abdominal limbs are biramous, multiarticulate, and used for swimming (pleopods), the posterior three pairs having only 1 or 2 articles (uropods) and serving for grasping or thrusting against solid substrata. In the ventral nerve chord the 3 posterior ganglia are fused.

The order Amphipoda has 4 subdivisions:

Suborder Hyperiidea Latreille, 1803
Suborder Ingolfiellidea Hansen, 1903
Suborder Caprellidea Leach, 1814
Suborder Gammaridea Latreille, 1803

The suborder Hyperiidea, comprising about 400 species, is typified by a more or less spherical body shape, reduced coxal plates, and enormous eyes that cover the entire head (Fig. 3). A few bathypelagic species are blind and eyeless. Hyperiids

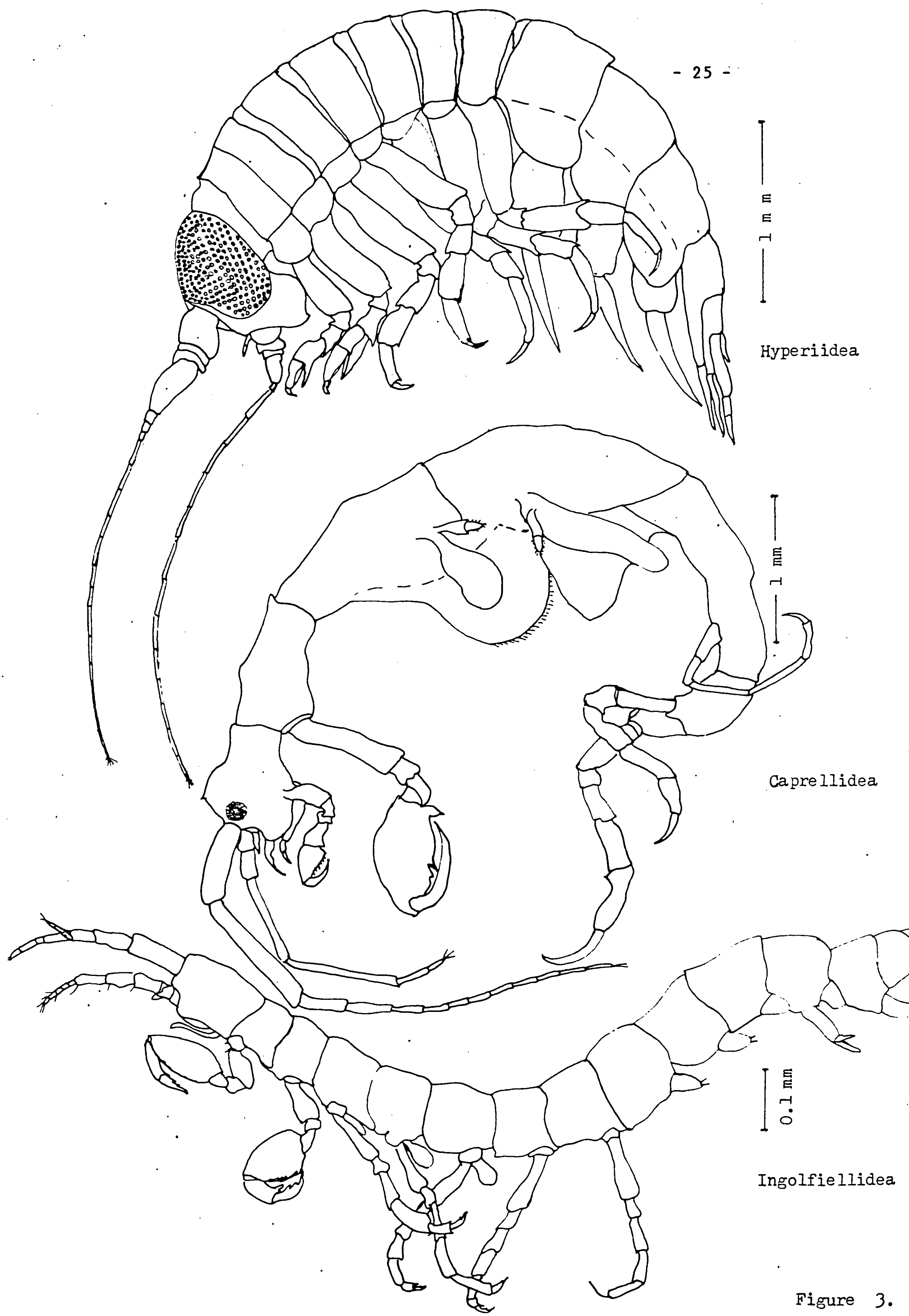


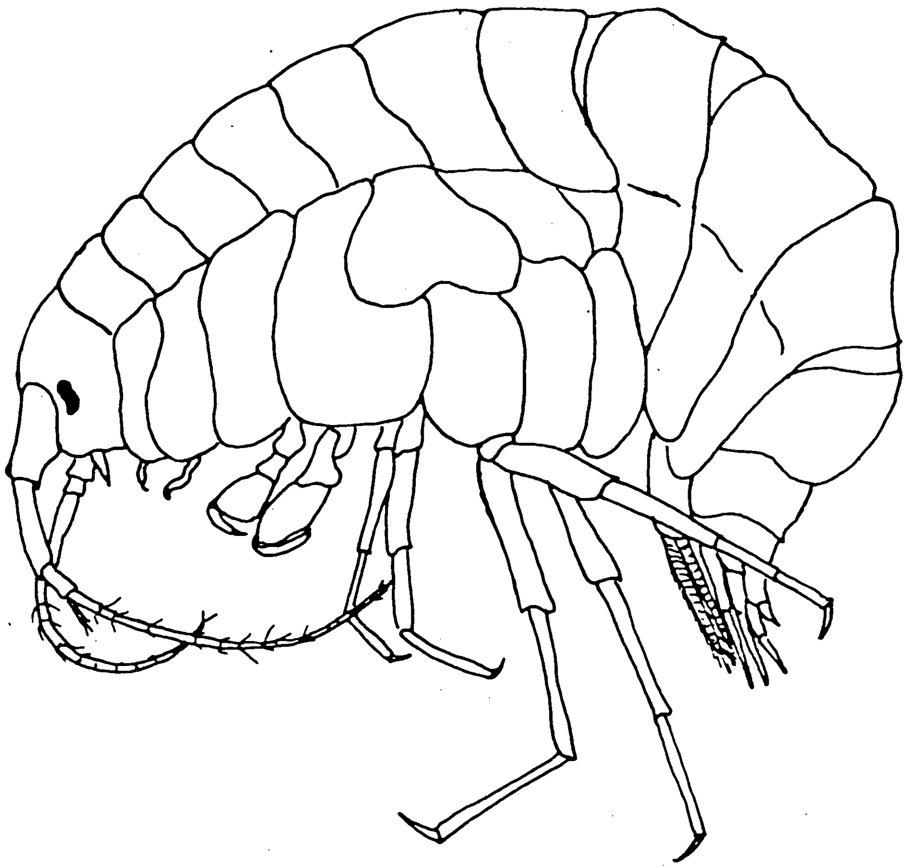
Figure 3.

are specialized for a marine planktonic life, including commensalism with Ctenophora and Thaliacea. They are thought to have evolved early from the Lysianassidae ancestral stock (Bowman & Gruner, 1973).

The suborder Caprellidea contains about 300 species in two subgroups: the caprellids (skeleton shrimps) characterized by an elongate cylindrical body (Fig. 3), and the cyamids (whale lice) that have a short compact flattened form. Caprellideans derived presumably from the specialized corophioidean stock, Podoceridae (Laubitz, 1979). Caprellids are free-living in shallow marine habitats amongst algae and hydroids occasionally penetrating into deep water, whilst cyamids are exclusively ectoparasitic on marine cetaceans - whales and dolphins (McCain, 1968).

The suborder Ingolfiellidea has less than 30 species of elongate slender-bodied amphipods (Fig. 3) which live interstitially in marine bottom sediments (Ruffo, 1969). The group strongly resembles members of the family Bogidiellidae, the most vermiform of the Gammaridea (Barnard & Barnard, 1983). They are preadapted to groudwaters which they have colonized like true freshwater hypogean amphipods (Stock, 1977).

The suborder Gammaridea comprises about 5,270 species, the number increasing rapidly as new faunas are investigated (Barnard, 1972 and 1974; Barnard & Drummond, 1978, 1979 and 1981), amounting to almost 90 per cent of Amphipoda. In general terms the group is morphologically unspecialized compared with other suborders and orders, such as the Isopoda, but despite a conservative body plan (Fig. 4) they are widespread and extremely diverse both in habitat and in habit (Barnard, 1969).



Palaeogammarus balticus Lucks, 1928 EOCENE.

Figure 4. Gammaridea

The 1,000 or so genera are allocated into 100 families, although the number of families is very much dependent upon the authority selected as the source. A great deal of re-arrangement and restructuring of families and superfamilies is being undertaken, or has recently been advocated, by different workers, and the alternative schemes proposed have several major differences that seem irreconcilable at present (Watling, 1983).

Historically, one of the earliest references to amphipods is by Aristoteles (385-322 B.C.) in book IV, cap. 2 and 10, where he mentioned beach-flies that jump and eat the dead fish found on the beach. This probably refers to the amphipod Orchestia gammarellus (Pallas, 1766). Latreille (1802 and 1816) was the first to designate the group Amphipoda and to separate it from the Decapoda.

Amongst the earlier workers Milne-Edwards (1840) was the first to report amphipods from South America (Gammarus ornatus, Orchestia chilensis and Ampithoe gaudichaudi), and Dana (1852) investigated the amphipods from the dredges of the United States Exploration Expedition to South America. A decade later Bate (1862) studied and described South American amphipods in his revision of the collections held in the British Museum and the Musee de Paris.

Stebbing (1888), in a monumental work of more than 1,000 pages, described the amphipod material of the famous Challenger Expedition that circumnavigated the globe during 5 years, 1872-1876. Volume 1 has an excellent annotated bibliography covering all amphipod literature prior to 1888. Stebbing's fine figures are rarely improved upon even today. The first systematic catalogue of Amphipoda was produced by Stebbing in 1906, listing all taxa known at that time and including brief synoptic descriptions. The publications of Della Valle (1893) in the Mediterranean, Sars (1895) in and around Norway, extended north to Spitzbergen and the Arctic Ocean by Stephensen (1942), Schellenberg's German fauna (1942), and Chevreux & Fage's Fauna de France (1925), have since become classical works on the amphipods of the North Atlantic and Mediterranean.

Other valuable contributions to world amphipodology include Gurjanova (1951 and 1962) and Bulycheva (1957) for Asia, Shoemaker (1935 and 1948) and Bousfield (1973) for America, Barnard (1970, 1972 and 1979) for the Pacific Ocean, and Griffiths (1976) for South Africa. Major studies on freshwater and subterranean amphipods have come from Ruffo (1953), Margalef (1953 and 1970), Karaman & Pinkster (1977), Holsinger & Longley (1980), and Barnard & Barnard, (1983).

Barnard's 1958 Index and 1969 Synopsis marked a landmark in amphipod systematics providing up to date synonymies, lists of all taxa, keys, diagnoses and much relevant discussion. Access to literature acted as a stimulus for a renewed interest in the group (Bousfield, 1977; Lincoln, 1979; and Lincoln & Hurley, 1981). Stock (1977, 1979 and 1981) working with freshwater amphipods from Caribbean islands has made a new zoogeographical synthesis based on Plate Tectonic Theory.

Early arrangements of amphipod taxa were semi-phyletic (Sars, 1895 and Stebbing, 1906), although later, Barnard (1958 and 1969) opted for alphabetical arrangements. More recently, Bowman & Gruner (1973), Barnard (1974) and Bousfield (1977, 1978, 1982 and 1983) have proposed new phyletic classification systems that have received at least partial acceptance. Back in 1979 Barnard and Karaman began a joint project to revise the Amphipoda of the world, much in the manner of Stebbing's 1906 monograph, but this gigantean work will probably not see the light of day until the latter part of this decade. Meanwhile, the systematics of the Peracarida and the Malacostraca are under renewed attacks by Watling (1981), Dahl (1983) and Hessler (1983), and others.

The gammaridean superfamilies of Bousfield (1978), with an estimate of species numbers, are as follows:

Phoxocephaloidea	(300)
Lysianassoidea	(600)
Pontoporeioidea	(50)
Gammaroidea	(500)
Crangonyctoidea	(250)
Niphargoidea	(250)
Bogidielloidea	(30)
Eusiroidea	(300)
Oedicerotoidea	(200)
Leucothoidea	(400)
Talitroidea	(385)
Stegocephaloidea	(80)
Synopioidea	(50)
Pardaliscoidea	(60)
Liljeborgioidea	(50)
Dexaminoidea	(80)
Ampeliscoidea	(150)
Melphidippoidea	(40)

Melitoidea	(250)
Corophioidea	(550)

More recently, Bousfield (1982) changed the order of the superfamilies somewhat following a cladistic analysis of the main characters. The new classification has similiarities with the classical schemes of Sars (1895) and Stebbing (1906) but differs substantially from Barnard & Barnard (1983) who monographed all the freshwater Amphipoda of the world and set the Corophioidea at the base of their phylogenetic tree. Bousfield's 1982 superfamilies scheme is set out below:

Eusiroidea

Oedicerotoidea

Leucothoidea

Talitroidea

Crangonyctoidea

Phoxocephaloidea

Lysianassoidea

Synopioidea

Stegocephaloidea

Pardaliscoidea

Liljeborgioidea

Dexaminoidea

Ampeliscoidea

Pontoporeioidea

Gammaroidea

Melphidippoidea

Hadzioidea

Bogidielloidea

Corophioidea

The main changes are: (1) the Eusiroidea, Oedicerotoidea, Leucothoidea and Talitroidea are moved to the head of the list, (2) the Phoxocephaloidea and Lysianassoidea are placed after Crangonyctoidea (which now includes the Niphargoidea), (3) the Pontoporeioidea and Gammaroidea follow after the Ampeliscoidea, (4) the Bogidielloidea are placed after Hadzioidea (=Melitoidea). The main consequence of these changes is the dismissal of the concept that the family Gammaridae is primitive within the Amphipoda.

The Amphipoda may prove to be the largest single ordinal group of malacostracan crustaceans (Bousfield, 1982), although it will have to compete for this honour with the Isopoda which has a rich fauna in the vast habitats of the deep-sea. In the absence of a broadly significant fossil record the origin and evolution of the Amphipoda remains a puzzle. Some progress towards a phylogenetic classification can be made with the help of functional morphology and ultrastructural studies (Lincoln & Hurley, 1981), but until these are completed it is not possible to draw up a convincing phylogenetic scheme.

The 44 species of Venezuelan amphipods described in the taxonomic text are listed below using the updated familial classification of Bousfield (1983).

Gammaridea

Eusiroidea	Pontogeneiidae	*Pontogeneia longleyi* Shoemaker, 1933
Leucothoidea	Leucothoidae	*Leucothoe spinicarpa* (Abildgaard, 1789)
		Leucothoides pottsi Shoemaker, 1933
	Anamixidae	*Anamixis hanseni* Stebbing, 1897
	Stenothoidae	*Stenothoe gallensis* Walker, 1904
Talitroidea	Hyalidae	*Hyale media* (Dana, 1852)
		Hyale pygmaea Ruffo, 1950
		Hyale macrodactyla Stebbing, 1899
		Parhyale hawaiensis (Dana, 1853)
	Hyalellidae	*Hyalella anophthalma* Ruffo, 1957
	Talitridae	*Talorchestia margaritae* Stephensen, 1948
		Talorchestia marcuzzii Ruffo, 1950
		Talorchestia fritzi (Müller, 1864)
		Orchestia aparicioi sp. nov.
Phoxocephaloidea	Platyischnopidae	*Platyischnopus metagracilis* Barnard, 1963

Stegocephaloidea	Stegocephalidae	*Stegocephaloides calypsae* sp. nov.
Dexaminoidea	Atylidae	*Atylus minikoi* (Walker, 1905)
Hadzioidea	Melitidae	*Ceradocus rubromaculatus* (Stimpson, 1855)
		Maera kermackae sp. nov.
		Maeraceradocus reyesi gen. et sp. nov.
		Elasmopus rapax Costa, 1853
		Elasmopus spinidactylus Chevreux, 1907
		Elasmopus bampo Barnard, 1979
		Elasmopus cervigoni sp. nov.
		Elasmopus laughlini sp. nov.
		Elasmopus lincolni sp. nov.
		Dulichiella appendiculata (Say, 1818)
	Hadziidae	*Metaniphargus venezolanus* Stock & Botosaneanu, 1983
Bogidielloidea	Bogidiellidae	*Bogidiella perla* Stock, 1981
Corophioidea	Ampithoidae	*Sunamphithoe pelagica* (Milne-Edwards, 1830)
		Cymadusa filosa Savigny, 1816
		Ampithoe ramondi Audouin, 1826
		Ampithoe marcuzzii (Ruffo, 1954)
	Isaeidae	*Microprotopus shoemakeri* Lowry, 1972

	Neomegamphopidae	_Neomegamphopus_ _rosevelti_ Shoemaker, 1942
		Amphideutopus _dolicocephalus_ Myers, 1968
	Aoridae	_Lembos_ _unifasciatus_ Myers. 1977
	Corophidae	_Corophium_ _rioplatense_ Giambiagi, 1926
	Ischyroceridae	_Ericthonius_ _brasiliensis_ (Dana, 1852)
	Podoceridae	_Podocerus_ _brasiliensis_ (Dana, 1852)
		Podocerus _cristatus_ (Thomson, 1874)
Hyperiidea		
Phronimoidea	Hyperiidae	_Hyperoche_ _martinezii_ (Muller, 1864)
Ingolfiellidea		
Ingolfielloidea	Ingolfiellidae	_Ingolfiella_ _margaritae_ Stock, 1979
Caprellidea		
Caprelloidea	Caprellidae	_Luconacia_ _incerta_ Mayer, 1903

MORPHOLOGY

Body-plan

The body of a generalised amphipod is basically tubular and segmented with three divisions: head, pereon and pleon. It is typically compressed (Fig. 5).

The head or cephalon, strictly termed cephalothorax since it is fused with the first thoracic segment, has 6 pairs of appendages; antenna 1, antenna 2, mandible, maxilla 1, maxilla 2 and maxilliped. Two single plates, the upper and lower lips, together with the mandibles, surround the mouth. The last four pairs of appendages make up the mouthparts (Fig. 6).

The pereon (thorax or mesosome) has seven segments, each bearing a pair of walking legs, the pereopods. The two anterior pairs are known as gnathopods and are after variously modified as subchelae for grasping. The other five pairs form two groups, 3 and 4, and 5-7, that differ structurally one from the other (Fig. 5). The proximal segment of each pereopod is termed the coxa which forms a broad flattened plate, the coxal plate, attached rigidly to the side of the body and contributing to the overall compressed appearance of the amphipod. The inner surface of some coxae (Fig. 6) bear coxal gills (branchiae) and/or oostegites (brood plates), the latter overlapping to form the marsupium (brood pouch).

The pleon (abdomen or metasome) has six segments (Fig. 5); the first three forming the pleosome (metasome in other literature) and the last three, the urosome. The two regions exhibit marked structural and functional differences. The extreme posterior end of the body carries a telson, a fleshy

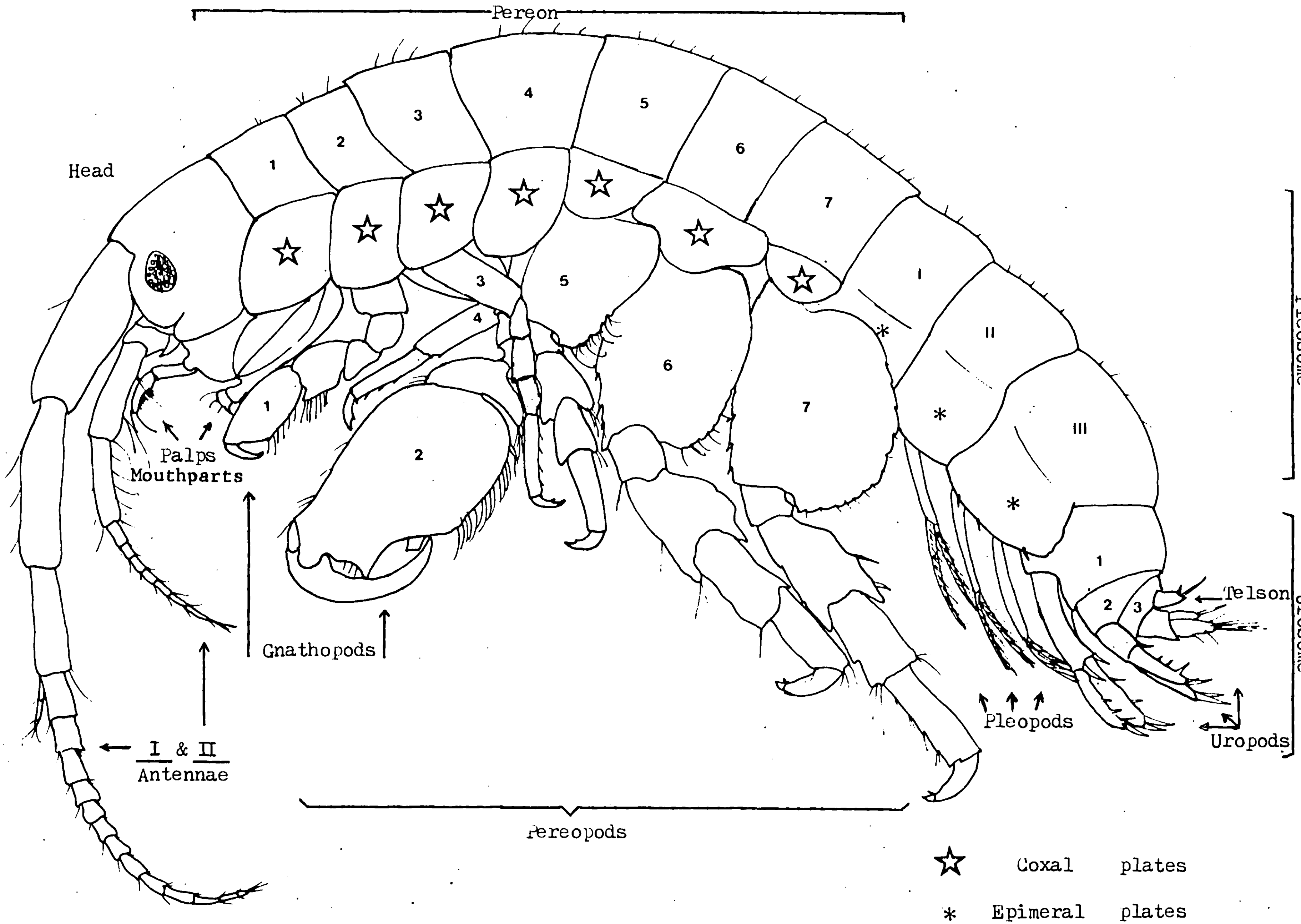


Figure 5. Basic Morphology : *Elasmopus lincolni* ♂ 4 mm.

or laminar structure attached to the posterodorsal margin of the last pleon segment, above the anus. The three pleosomal segments have flat ventrolateral expansions, the epimeral plates (epimera) (Fig. 5), which like the coxal plates also contribute to the compressed appearance of the amphipod. Each pleosomal segment bears a pair of swimming legs known as pleopods, and each urosomal segment a pair of uropods (Fig. 5).

Size and colour

Amphipods range in size from about 1 mm to 150 mm, although the great majority are between 5 and 10 mm. Length is measured from the anterior extremity of the rostrum to the posterior end of the telson. Normally males are bigger than females but the reverse is true in some species. *Alicella gigantea* is an exceptionally large benthic amphipod of 140 mm length, resembling the large bathy pelagic *Thaumatops loveni* abundant in the deep scattering layer of the North Atlantic. Some undescribed species of lysianassid amphipods reaching nearly 300 mm length have recently been photographed from hadal depths (Isaacs & Schwartzlose, 1975).

The colour in life is variable, but many are grey, light brown or colourless. Some sublittoral forms show polychromatism. Benthic species in shallow waters may derive their colour from epibiontic algae exhibiting red, green and yellow vertical bands (*Parhyale*) or spots (*Ampithoe*). Some may change colour with chromatophores and/or by epidermal pigments (*Luconacia*). Mimicry occurs in a few shallow benthic species such as *Caprella*. Pelagic species are mostly transparent and a few are bioluminescent (*Chevreuxiella*). Freshwater and subterranean species appear white

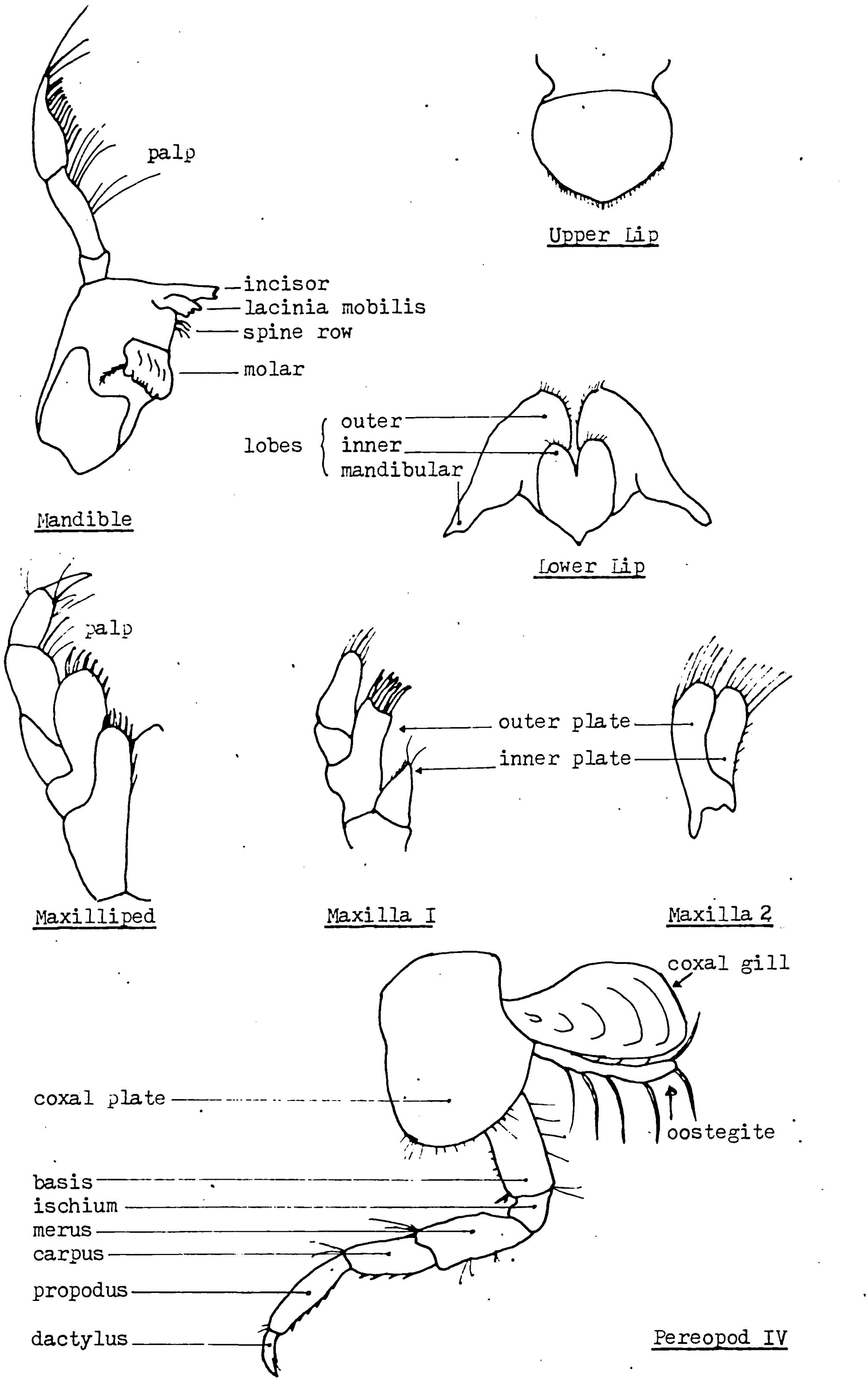


Figure 6. Appendages(Mouthparts)left side:Elasmopus lincolni ♂ 4 mm

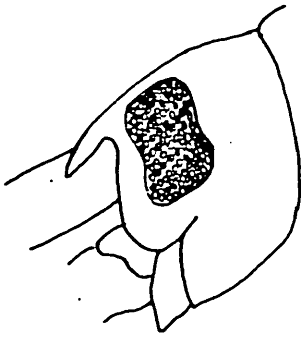
(Hyalella). Amphipods usually turn a pinkish colour when preserved.

Head

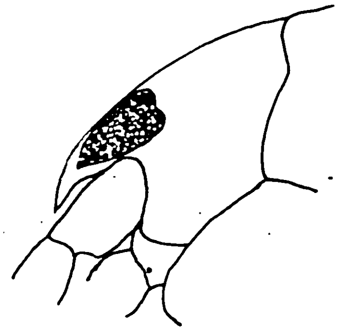
The gammaridean amphipod has a laterally compressed head with a convex dorsal margin, and the mouthparts grouped as a bundle on the ventral surface. The anterodorsal margin may be prolonged to form a rostrum, which can be acute, falcate, decurved or hooded (Fig. 7). The front of the head below the rostrum is termed the epistome. This region is usually simple but may be lobed or acutely projecting. Often, the sides of the head convexly produced at the level of the eyes (lateral lobes, anterior head lobes), and concavely excavated close to the insertion of the second antennae (inferior or post-antennal sinus) (Fig. 7).

Eyes

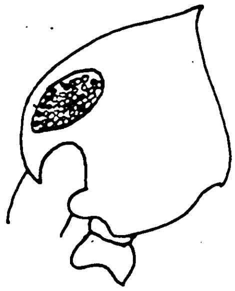
Amphipods usually have paired, sessile, compound, multi-faceted eyes. They come in many shapes and sizes; rounded, oval, reniform, occasionally enlarged and contiguous dorsally. Cuticular lenses are absent, except for the family Ampeliscidae (fig. 7). Eye shape and pigmentation may be a useful guide in the identification of species. The eyes are generally black, brown or red. Cave-living species are typically eyeless (Hyalella anophthalma); in addition some planktonic (Stegocephaloides calypsae), burrowing and interstitial species (Ingolfiella margaritae) also blind. There are species that have blind and eyed populations, associated with darkness and the absence of certain pigment in the habitat. Sexual dimorphism in the size



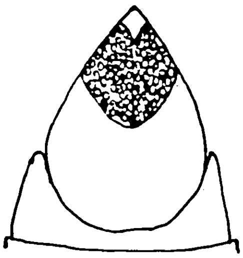
Acute
reniform



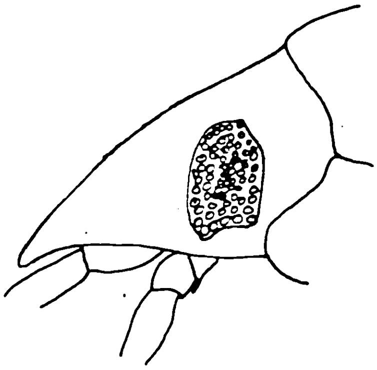
Falcate
rostral



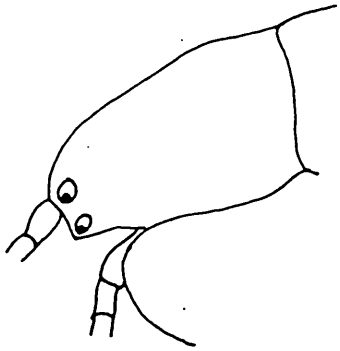
Decurved
oval



Acute
rostral fused



Hooded
lateral



Absent
divided with cuticular lens

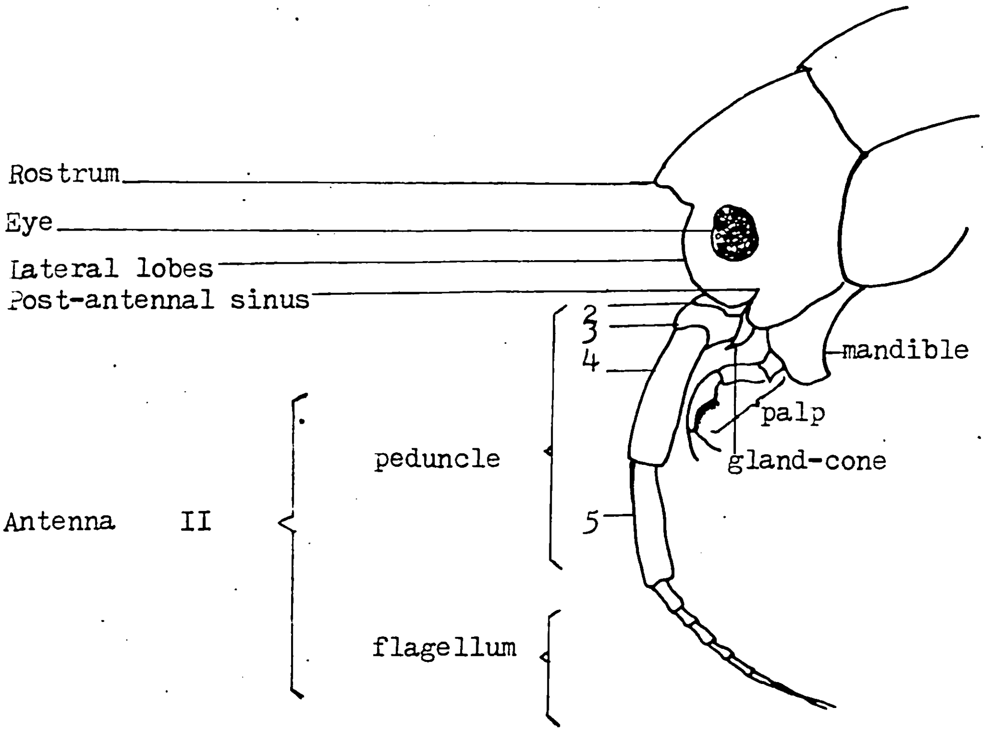


Figure 7. Head : Rostrum and eyes.

of the eye is quite common, with the male usually having a larger eye than the female.

Antennae

Antenna I (first, anterior, or antennule) has a peduncle of three articles and a multiarticulate flagellum. The primitive biramous origin of the antenna is retained in the form of a small accessory flagellum arising from the end of the peduncle (Fig. 8). The accessory flagellum may be multiarticulate, vestigial, or absent, and is an important character in the taxonomy of amphipod families and genera.

Antenna 2 (second, posterior, or antenna) has a peduncle of five articles and a multiarticulate flagellum. Article 1 of the peduncle contains the excretory "antennal gland" that has an osmoregulatory function, and opens to the exterior at the apex of a gland cone on the ventral margin of the second peduncular article (Fig. 7). The gland cone may reach beyond the end of the short article 3. Articles 4 and 5 of the peduncle are typically rather elongate. There are many permutations of antennal shape and size, including that associated with sexual dimorphism. The numbers of articles in the flagellum may vary with age and with body size.

The antennae can be more or less naked, or have a diverse armature of spines and/or setae. Two sensory receptors are associated with amphipod antennae, aesthetascs and calceoli (Fig. 8). Aesthetascs are simple, spatulate, thin-walled receptors found on the flagellar articles of antenna 1. They have a chemosensory function. Calceoli are more complex structures that are unique to certain families of gammaridean

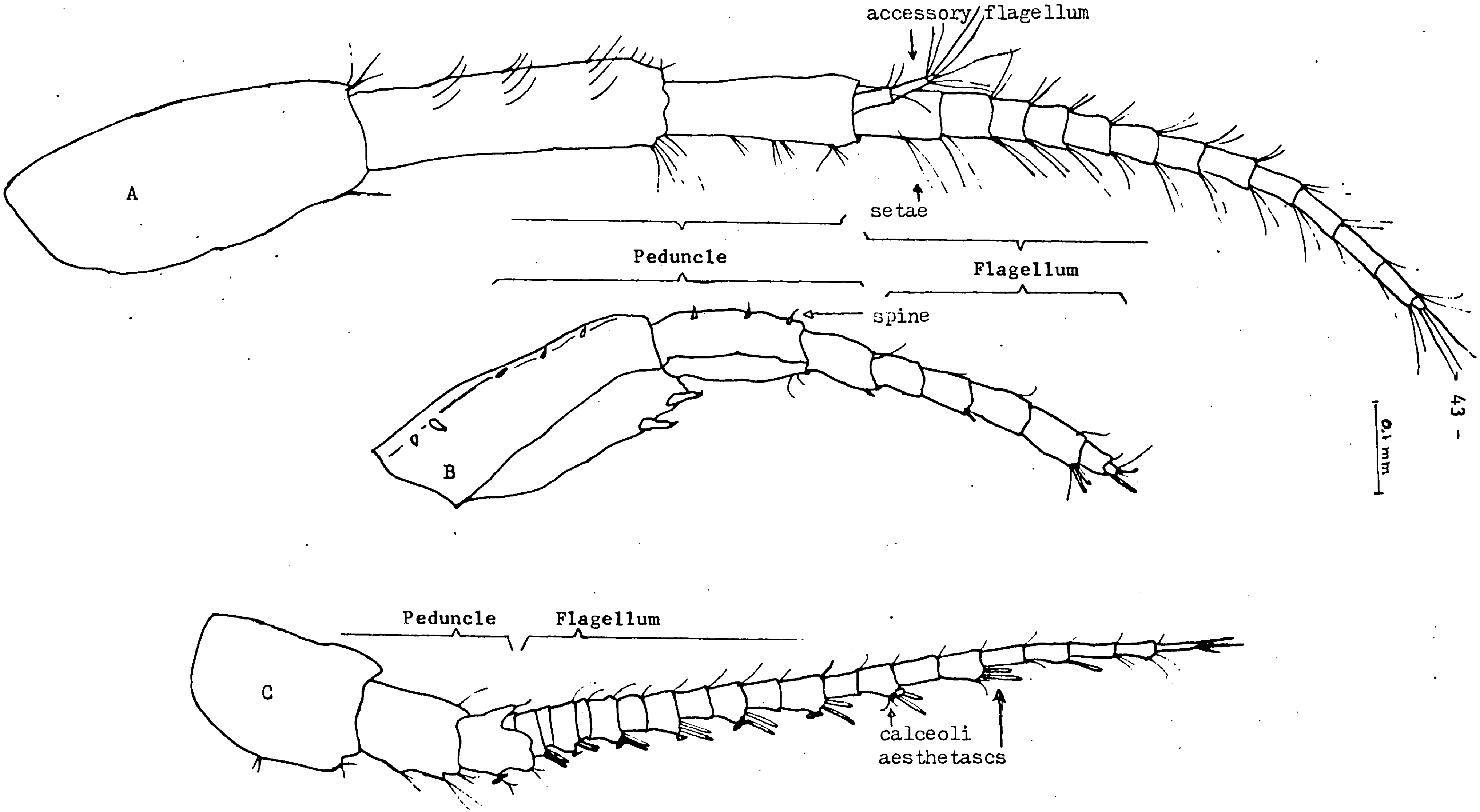


Figure 8. Antenna I of (A) *Elasmopus lincolni* ♂ 4 mm (B) *Corophium rioplatense* ♀ 3 mm (C) *Pontogeneia longleyi* ♂ 3.5 mm

amphipods of the superfamilies: Eusiroidea, Oedicerotoidea, Crangonyctoidea, Phoxocephaloidea, Lysianassoidea, Pontoporeioidea and Gammaroidea (Lincoln & Hurley, 1981). They may occur on the flagellar articles of antenna 1 and 2 in both sexes or may be restricted to the male. They are never found in females only or on antenna 1 alone. They are occasionally found on peduncle articles (Pontogeneia). Each calceolus has a basal stalk supporting a distal element bearing concentric annulations (Fig. 9). The receptors are arranged and orientated in a precise manner along the length of the antenna, and are presumed to be vibration sensitive (phonoreceptors).

Upper lip

Below the epistome, at the anterior margin of the mouth is a simple, flap-like structure, the upper lip. Its distal margin can be rounded, symmetrically or asymmetrically bilobed and is usually finely setulose and/or spinulose (Fig. 6).

Lower lip

The lower lip is situated at the posterior margin of the mouth. It is basically laminar, bilobed, and finely setulose, with the posterolateral angles prolonged as mandibular lobes or processes. Additional inner lobes are often present between the larger outer lobes (Fig. 6).

Mandible

The mandibles (Fig. 6) lie on either side of the mouth, and with the upper and lower lips surround the mouth opening.

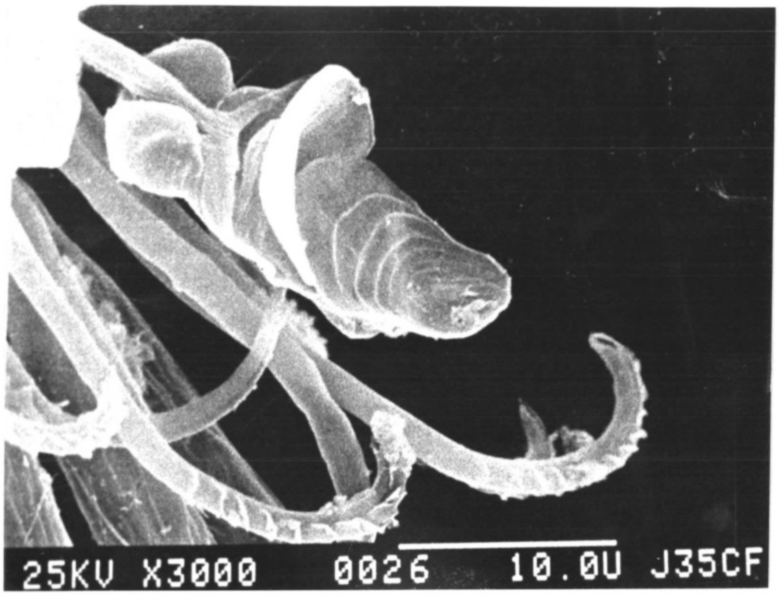


Figure 9. Pontogeneia: Scanning electron microscope photograph of Calceolus.

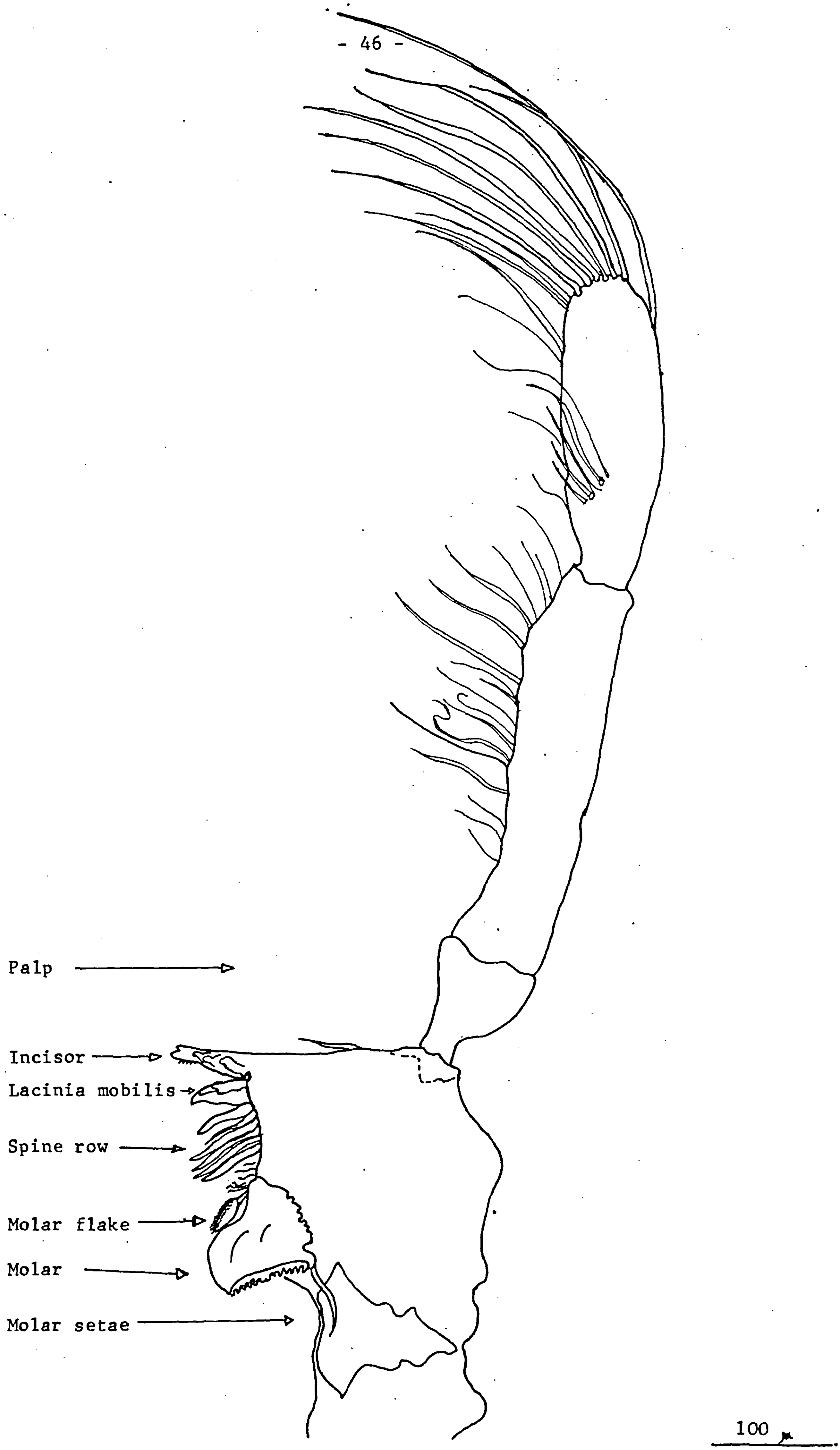


Figure 10. <u>Ericthonius</u> <u>brasiliensis</u> ♂ 5 mm: Right mandible showing molar flake

The basic mandible comprises a toothed distal process, the incisor; a small articulating accessory plate, the lacinia mobilis; a spine row; a large truncated medial process, the molar; and attached to the outer margin a 3-articulate palp. The mandibles are usually weakly dissimilar, the left one being larger than the right. The lacinia mobilis is primitively 5-dentate, but in the derived condition can be multidentate or exhibit a reduced dentition. The molar surface is highly variable in relation to diet and feeding strategies. The familiar triturative (grinding) condition can show ridges, pits, or an array of teeth, and usually has a strongly truncate shape when examined with an optical microscope. The mandible may bear a molar flake between the spine row and the molar, on the right mandible of some families of Dexaminoidea, Hadzioidea, Corophioidea and Caprellidea (Fig. 10). The mandibular palps usually rest between the base of the antennal peduncles and are used to groom the antennae. The palps can be large and falcate, 2-articulate, 1-articulate, vestigial, or absent (Fig. 11).

Maxilla 1

These small appendages are situated immediately posterior to the lower lip. Maxilla 1 (first maxilla, maxillule) consists of an inner plate usually bearing marginal setae, and an outer plate carries a group of robust apical spines and a small biarticulate palp on the outer margin (Fig. 6). The palp may be 1-articulate, vestigial, absent.

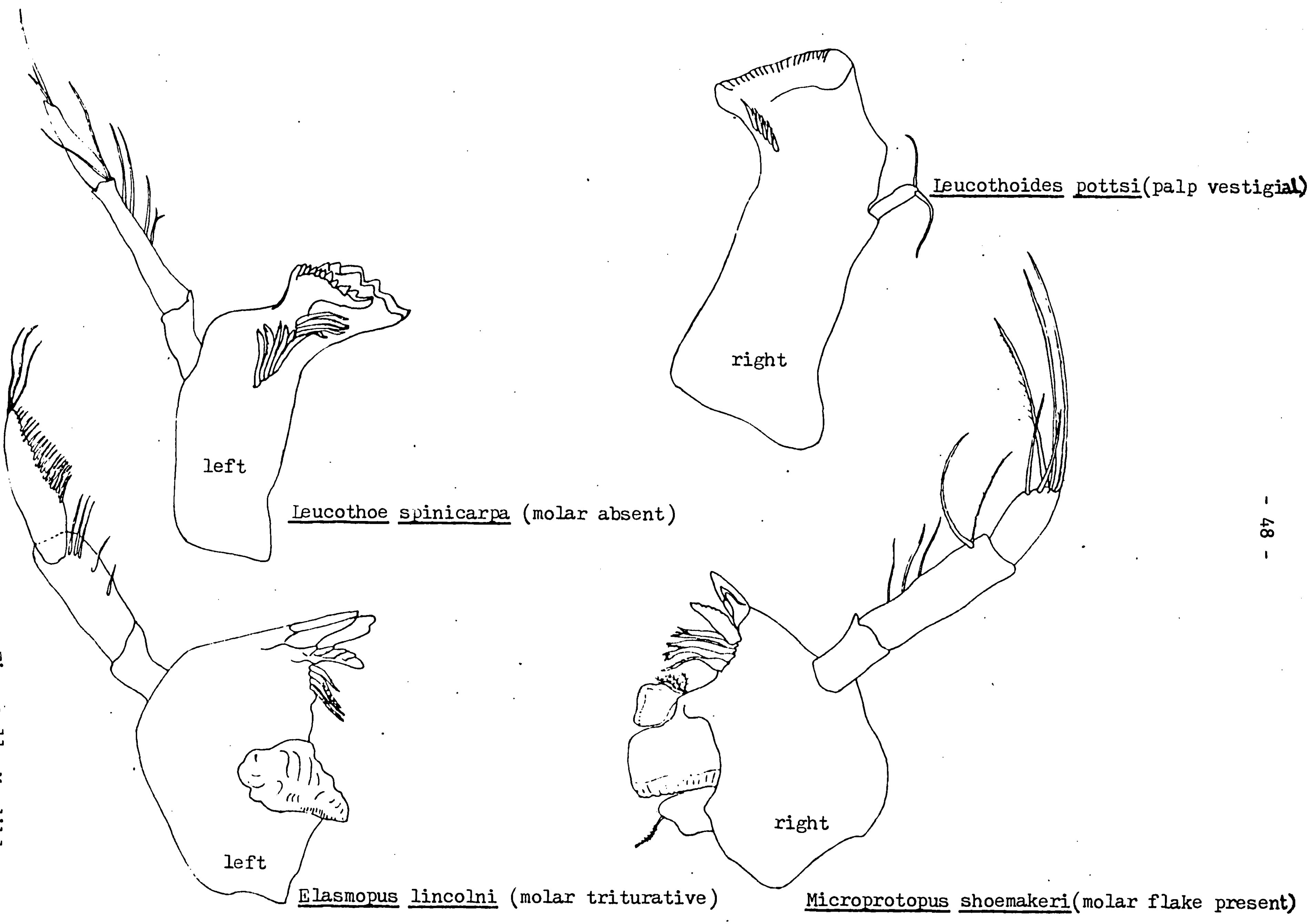


Figure 11. Mandibles

Maxilla 2

The second maxillae (Fig. 6) are the smallest of the mouthparts, situated between the maxilla 1 and the maxilliped. Each comprises a small inner and outer plate fringed with setae, only rarely reduced to a single plate or absent.

Maxilliped

The maxillipeds are the largest of the mouthparts, forming the posterior component of the mouthpart bundle, and are the first to be removed during dissection. These appendages belong to the first true thoracic segment which in amphipods has become fused to the head. The maxillipeds are biramous, comprising an inner and outer plate, and have a well developed 2 to 4-articulate palp on the outer margin. The basal segment is typically fused so that maxillipeds remain together as a pair during dissection. The outer plates bear marginal spines and/or setae, but are occasionally reduced or absent (Fig. 6).

Coxal plates

The coxal plate (side plate) is the first article of the pereopod (Fig. 6). It is usually a rectangular or rounded plate attached to the ventrolateral margins of the pereonal segment, thereby increasing the effective lateral compression of the body. As an overlapping series they provide a large ventral channel for respiratory and other water currents, as well as affording protection to the gills and oostegites. Coxal plates 1-4 are usually large with the anterior margin overlapping the plate in front. Plates 5-7 tend to be much smaller, and are more or less bilobed, allowing for lateral extension of the posterior pereopods (Fig. 5). The configuration of the coxal plates is a valuable taxonomic guide for distinguishing amphipod taxa at all levels. Coxal plates tend to be reduced in domicolous and inquilinous amphipods, such as corophioideans.

Coxal gills

The coxal gills or branchiae arise as epipodites from the inner base of coxa of pereopods 2 to 7, sometimes absent from 2-3 (usually only in females but also in both sexes, Ischyroceridae) and from 7 (Podoceridae). Accessory coxal gills, and sternal gills derived from ventral surface of some pereonal segments are often present in some freshwater species (Crangonyctidae, Hyalellidae). The gills tend to be very large in some semi-terrestrial species (Talitridae). In addition, respiratory surfaces may be increased by feather-like gills (Atylidae).

Oostegites

The oostegites (brood-plates) are foliaceous or linear epipodites arising from the inner bases of coxal plates 2-5, that overlap or interlock to form the ventral surface of the marsupium (brood-pouch). Exceptionally they can be absent on pereopod 5 (Podoceridae). The oostegites are fully formed only at the maturation moult, the moult preceding mating and egg-laying, and are usually lost at the moult which follows the release of the young. Oostegite margins are usually setose but may be naked.

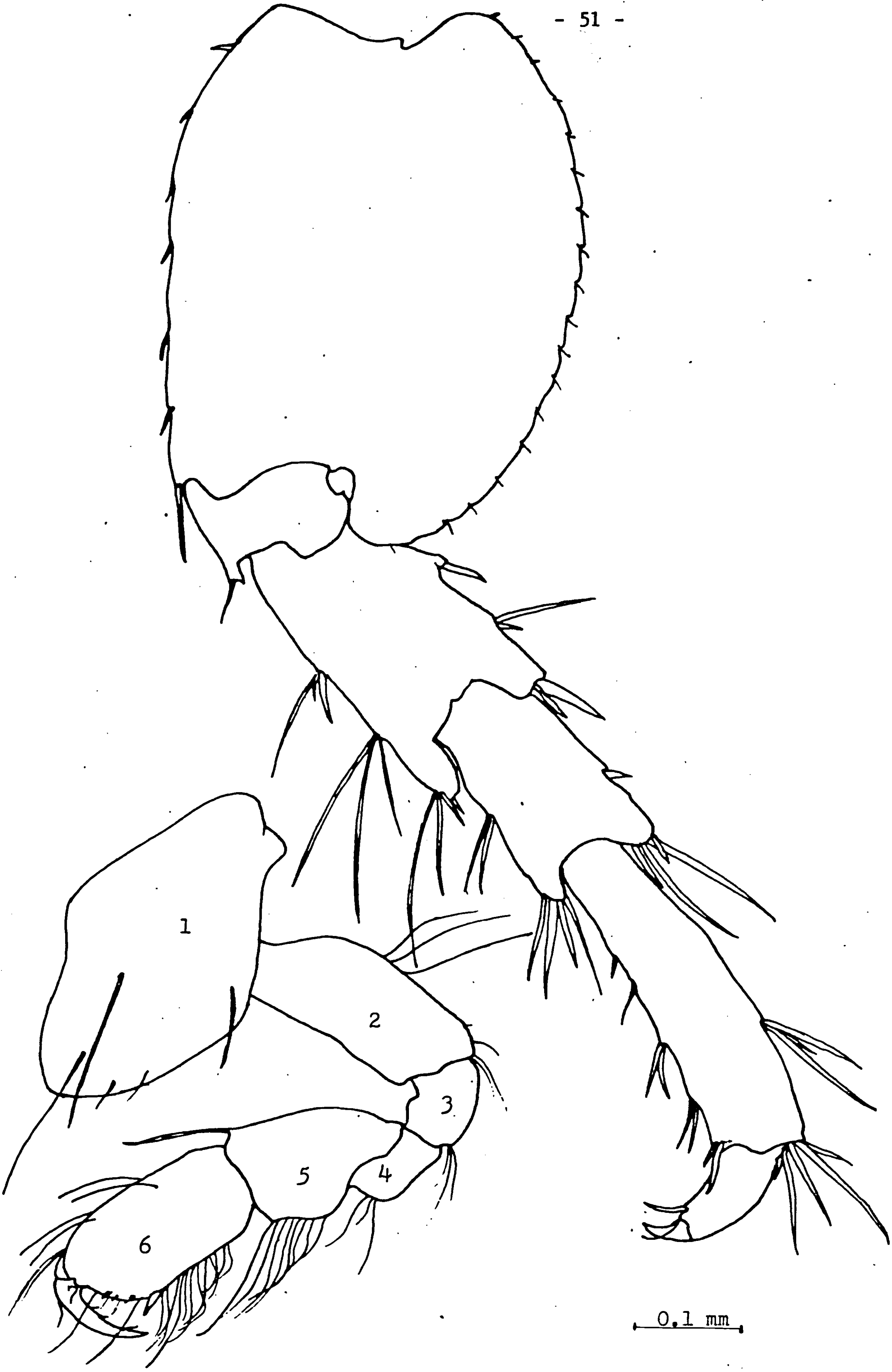


Figure 12. Elasmopus lincolni ♂ 4 mm: Gnathopod 1 & Pereopod 7 (left)

Pereopods

The pereon has 7 pairs of uniramous appendages named gnathopods 1 and 2, and pereopods 3-7. The first two pereopods (gnathopods) are structurally and functionally different from pereopods 3-7. Some authors number the pereon appendages, gnathopods 1-2, pereopods 1-5. Each limb is constructed of seven articles which may be referred to by name or number (1) coxal plate, (2) basis, (3) ischium, (4) merus, (5) carpus, (6) propodus and (7) dactylus (Figs 6 and 12).

A typical gnathopod has a broad coxal plate, an elongate slender basis, a short ischium and merus forming a joint for flexion, a triangular carpus, a large robust propodus, and a slender finger-like dactylus closing against the posterior margin of the propodus. The configuration of propodus and dactylus is referred to as subchelate, and the differentiated posterior margin of the propodus covered by the dactylus is termed the palm. The shape and form of the gnathopods are most important taxonomically, particular emphasis being placed on gnathopod 2 of the male (Fig. 13). The second gnathopods are frequently sexually dimorphic. Gnathopod design can be simple, non-subchelate (Stegocephalidae); filiform (Synopiidae); minutely subchelate (Talitridae); weakly subchelate (Hadziidae); powerfully subchelate (Melitidae);complexly subchelate (Ischyroceridae); carpochelate (Leucothoidae); minutely chelate (Lysianassidae); or chelate (Anamixidae, Platyschnopidae) (Fig. 14). Gnathopods 1 and 2 may be subsimilar or more or less markedly dimorphic; frequently they show greater differences in males than in females. The size of gnathopod 2 may become exaggerated in the "terminal or supermale" condition as a result of pronounced allometric growth

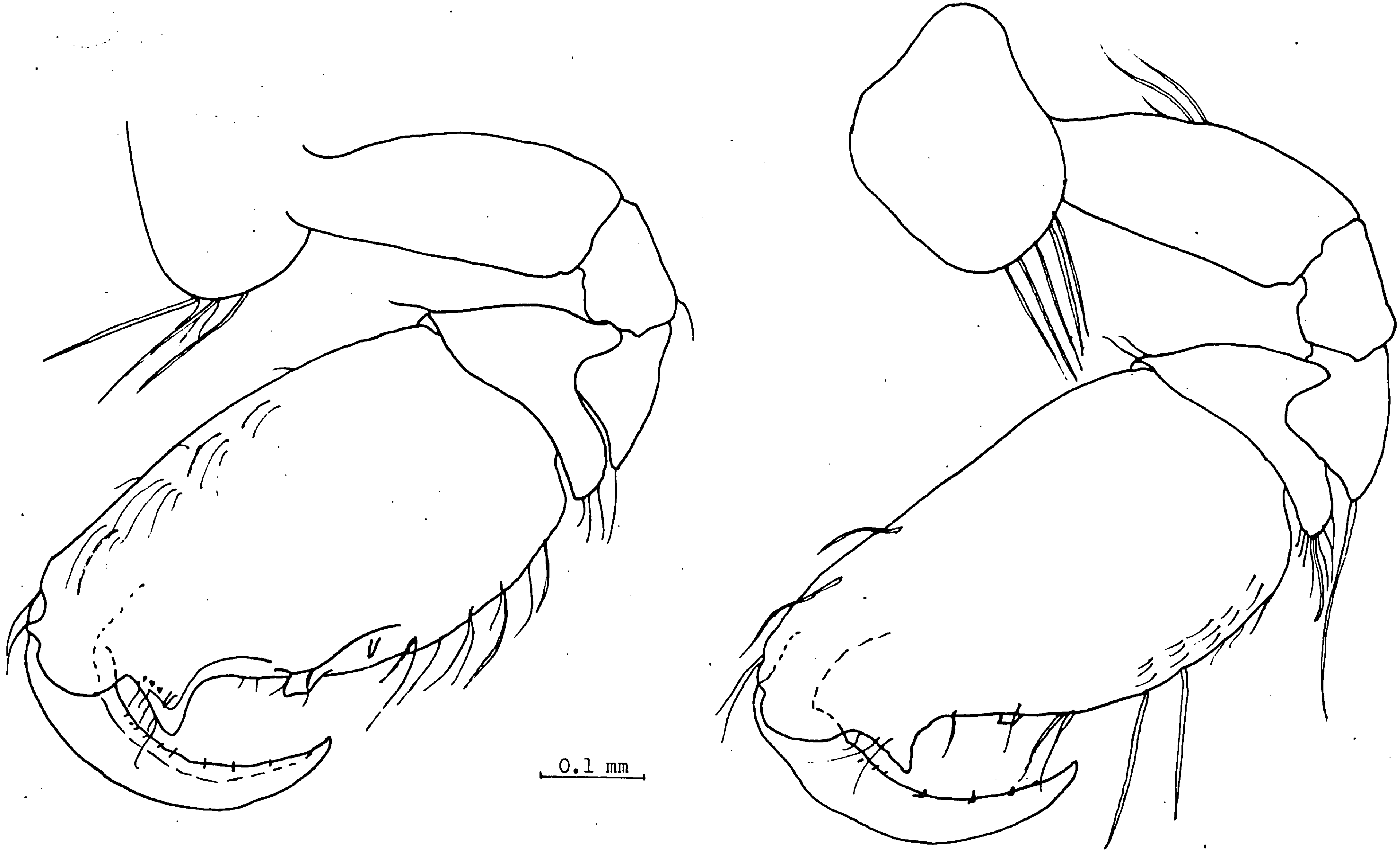


Figure 13. Elasmopus lincolni ♂ 4 mm; Gnathopod 2 (left) internal and external view.

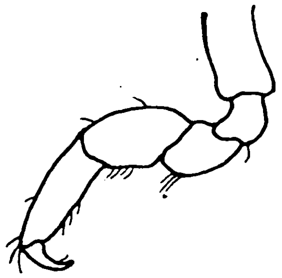
(Anamixis hanseni). Exceptionally, dissymmetry of the second male gnathopod is shown by an enormous super male gnathopod on one side, and a reduced gynomorphic one on the other side (Dulichiella appendiculata). Occasionally, distinctive phenotypic stages in the development of gnathopods have been used to name as separate species, sexes and age populations of the same one (Cymadusa filosa). In addition, females and immature males of closely allied species are so very similar that they cannot always be reliably separated (Elasmopus spp.). From a functional standpoint gnathopods are involved in feeding, burrowing, tube-construction, grooming and hygiene, and reproductive behaviour (precopula).

Pereopods 3 and 4 are frequently small and slender (Fig. 6). They have a role in cleaning and grooming other appendages, and in domicolous and related families are involved in the construction of tubes, nests or burrows, having glutiniferous glands situated in the basal or carpal articles opening to the exterior through a small pore near the tip of the dactylus.

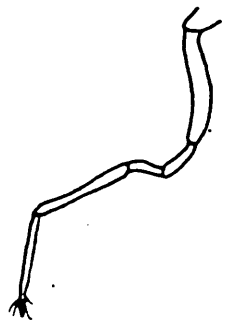
Pereopods 5-7 are frequently robust and elongate, the basis often having an expanded posterior lobe (Fig. 12). They can be subequal in size, but more often increase in length substantially from 5 to 7. The posterior 3 pairs of pereopods have a variable armament of setae and/or spines, and are especially stout and spinose in some of the burrowing (fossorial) species.

Pleosome

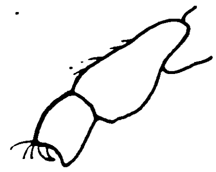
This term refers to the three anterior segments of the pleon (abdomen), occasionally termed metasome in other literature, that bear biramous swimming (natatory) pleopods. The dorsal margin of



Simple

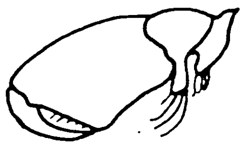


Filiform

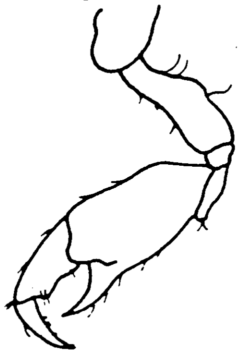


Minutely subchelate

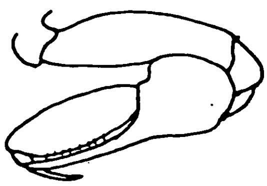
Weakly subchelate



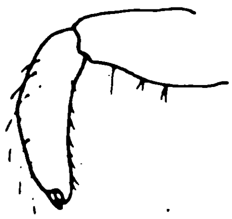
Powerfully subchelate



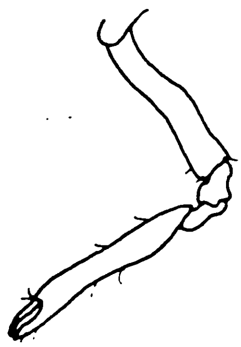
Complexly subchelate



Carpochelate



Minutely chelate



Chelate

Figure 14. Gnathopods

the pleosome segments may be simple or keeled (mucronate, carinate) naked or sparsely setose.

Epimeral plates

These are laminar outgrowths of the pleosomal segments which form an overlapping lateral shield partially enclosing the pleopods (Fig. 5). The shape of the epimera, especially plate 3, can be an important species-level character. The posterodistal angle may be quadrate, rounded, sinous toothed, or mucronate.

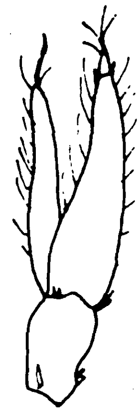
Pleopods

These are paired biramous natatory appendages of the three pleosome segments. Each limb comprises a basal article termed peduncle and two multiarticulate rami bearing long lateral setae. The internal margin of the peduncle bears one or more minute coupling hooks which unite the pleopod pair and assist in the metachronal movements associated with swimming. Pleopod activity also directs ventilatory water currents towards the gills and in females to the marsupium. It may aid in the transport of sperm during copulation.

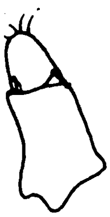
Urosome

The three posterior segments of the pleon form the urosome. The segments are usually free but can have 1-2 fused (some species of Phliantidae, Isaeidae and Corophidae), 2-3 fused (Atylidae), or 1-3 fused (some species of Cheluridae and Podoceridae). The dorsal margin may be simple, carinate, bicarinate, toothed, naked or spinose.

Rami with hook spines



Rami foliaceous

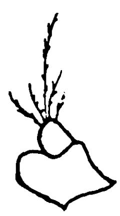


Vestigial inner ramus

Ramus uncinate

Ramus spatulate

Ramus styliform



Peduncle medially lobate

Figure 15. Uropod 3

Uropods

The uropods are appendages associated with the three segments of the urosome, typically biramous, occasionally uniramous, rarely absent. Each uropod comprises a single basal article or peduncle and a pair of 1-articulate rami (a second article to the outer ramus of uropod 3 is present in a few species). Uropods 1 and 2 can have falciform rami, or they may be lanceolate, foliaceous, with or without spines. They are used to provide the amphipod a purchase on the substratum, for scudding movements, and also to assist in swimming, jumping, burrowing, and tube dwelling manoeuvres. Uropod 3 is generally more freely articulated than 1-2 with the ramus or rami styliform, spatulate or uncinate (Fig. 15). Not infrequently there is some sexual dimorphism in size or armature of uropod 3 (Fig. 16). It is thought to function as a rudder in swimming forms or as an anchor in tubiculous species.

Telson

The telson is essentially a flap-like structure attached to the posterior margin of the pleon above the anus. It can be laminar or fleshy, cleft or entire, setose, spinose or naked, but is never absent (Fig. 16).

Penes

The male penes are a pair of muscular ectodermal ejaculatory ducts which open behind two papillae, at the posterior ventral margin of the seventh pereonal segment. In some species lacking sexual dimorphism the presence of penes may be the only external structure with which to identify males.

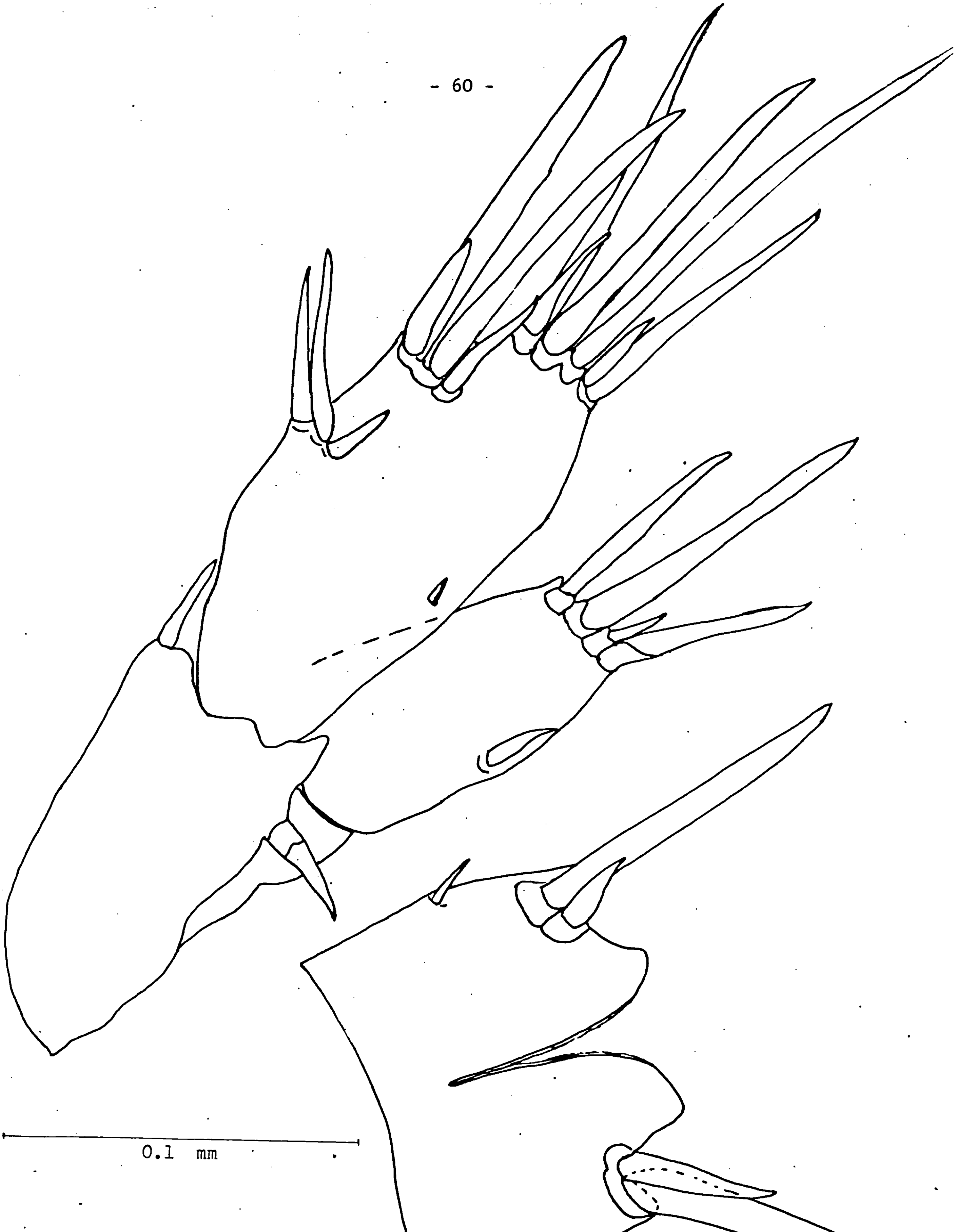


Figure 16. Elasmopus lincolni ♂ 4 mm; Uropod 3 and Telson.

LIST OF ABBREVIATIONS TO FIGURES

A 1	Antenna 1	b	Basis
A 2	Antenna 2	is	Ischium
a f	Accessory flagellum	m	Merus
L	Upper lip	c	Carpus
l	Lower lip	pr	Propodus
M	Mandible	d	Dactylus
m	Molar	p	Palm
f	Molar flake	g	Coxal gill
s	Spine row	o	Oostegites
l m	Lacinia mobilis	G 1	Gnathopod 1
i	Incisor	G 2	Gnathopod 2
pl	Palp	P 3-7	Pereopods 3-7
S 1	Maxilla 1	E	Epimeral plate
S 2	Maxilla 2	U 1-3	Uropods 1-3
X	Maxilliped	T	Telson
C	Coxal plate	r	Right side

All studied material has been deposited in the collections of the British Museum Natural History

TAXONOMY

KEY TO SUBORDERS OF AMPHIPODA

1	Two pairs of oostegites. Pleon vestigial, without conspicuous pleopods or uropods (vestiges of 1 or 2 pairs may be present). Pereonite 1 fused with head.	Caprellidea
-	Three or more pairs of oostegites. Pleon well developed with three pairs of pleopods and three pairs of uropods. Pereonite 1 free.	2
2	Maxilliped without palp. Eyes typically enormous, covering entire head.	Hyperiidea
-	Maxilliped palp present. Eyes not covering entire head.	3
3	Coxal and epimeral plates absent. Pleopods absent or reduced. Finger of gnathopods 1-2 formed by fusion of articles 6-7 (propodus-dactylus).	Ingolfiellidea
-	Coxal and epimeral plates present. Pleopods biramous. Finger of gnathopods 1-2 formed only of article 7 (dactylus).	Gammaridea

GAMMARIDEA

Key to the 9 Venezuelan Superfamilies

1	Body smooth, shallow or depressed; coxal plates small, plate 4 not excavate. Rostrum weak or absent. Eyes small or medium, on lateral lobes. Mouthparts basic; molar flake present. Pereopods 3-4 glandular. Telson entire. (Domicolous amphipods).	Corophioidea
-	Body moderately to strongly compressed; coxal plates deep, plate 4 usually excavate posteriorly. Rostrum variable. Eyes medium or large, lateral. Mouthparts variable. Pereopods 3-4 simple, not glandular. Telson variable. (Free-living amphipods).	2
2	Urosome segments 2-3 fused. Pereopods 5-7 with dactylus turned backwards; coxal gills Feather-like.	Dexaminoidea
-	Urosome segments 2-3 separate. Pereopods 5-7 with dactylus turned forwards; coxal gills variable.	3
3	Body fusiform. Head projecting with large hooded rostrum. Mandible molar very weak. Gnathopods feeble. Pereopods spinose, specialized for burrowing.	Phoxocephaloidea
-	These characters not combined.	4

4	Body sturdy; coxal plates forming large lateral shield, plate 1 not concealed by 2. Mandible without palp or molar. Gnathopods feeble.	Stegocephaloidea
-	These characters not combined.	5
5	Body usually small; coxal plate 1 partly or entirely concealed by plate 2, plates 2-4 typically large and shield-like. Accessory flagellum absent. Mouthparts specialised; molar vestigial or absent. Telson entire.	Leucothoidea
-	These characters not combined.	6
6	Antennae armed with calceoli and aesthetascs. Eyes large, subrectangular. Lower lip without inner lobes. Pereopods short.	Eusiroidea
-	These characters not combined.	7
7	Antenna 1 reduced, shorter than 2; accessory flagellum absent. Mandibular palp absent. Uropod 3 uniramous.	Talitroidea
-	Antenna 1 well developed, usually longer than 2; accessory flagellum present. Mandibular palp present. Uropod 3 biramous.	8
8	Body compressed and slender; coxal plates moderately deep, plates 1-4 overlapping, plates 5-7 anterolobate. Gnathopod 2 larger than 1. Telson cleft.	Hadzioidea

- Body elongate and vermiform; coxal plates very small, simple, not overlapping. Gnathopods subsimilar. Telson entire. Bogidielloidea

Superfamily EUSIROIDEA

Body smooth or variously carinate and toothed; pereonal segments short; pleonal segments large, pleosome especially robust; coxal plates moderately deep, coxa 4 excavate, coxae 5-7 posteriorly lobate. Head with rostrum. Antennae bearing calceoli; accessory flagellum small, vestigial or lacking. Eyes large and subrectangular. Mouthparts basic, but lower lip inner lobes vestigial. Gnathopods 1 and 2 generally weakly dimorphic and weakly subchelate. Pereopods basic, subsimilar. Pleopods well developed and often powerful. Uropods lanceolate; rami of uropod 3 foliaceous, outer ramus 1-articulate. Telson entire or lobes narrowly separated distally. Sexual dimorphism pronounced.

The superfamily Eusiroidea Bousfield (1978) comprises 7 families of amphipods distributed mainly in the North Pacific and antiboreal regions, in coastal or shelf epibenthic marine habitats, but also including some freshwater species. Most exhibit a generalised amphipod morphology. The eusiroid families are: Eusiridae, Pontogeneiidae, Bateidae, Gammarellidae, Calliopiidae, Paramphithoidae and Amathillopsidae.

Pontogeneia longleyi Shoemaker is the only record of the family Pontogeneiidae from the Caribbean.

Family PONTOGENEIIDAE

Body smooth, occasionally carinate dorsally with strong pleon. Coxal plates moderately deep and rounded. Head with rostrum moderately developed; eyes medium to large; antennae with peduncle articles short, accessory flagellum absent or as minute scale; calceoli usually present. Upper lip without marginal notch; lower lip with inner lobes absent or weakly developed; mandibles with molar and palp well developed; inner plates of maxillae marginally setose; maxilliped well developed, palp 4-articulate. Gnathopods subsimilar, weakly sexually dimorphic, subchelate; generally small and with shallow carpal lobe. Coxal gills simple, present on pereopods 2-7; sternal gills occasionally present; brood plates large and broad. Pereopods rather short. Pleopods powerful. Uropods 1-2 spinose; uropod 3 spinose and setose. Telson short, deeply cleft.

The family Pontogeneiidae Stebbing, 1906 contains 26 genera and about 100 species. The family is most diverse in epibenthic habitats of the Pacific and Antarctic oceans. Only Pontogeneia is known from the Caribbean fauna.

Pontogeneia Boeck

Pontogeneia Boeck, 1870: 193; Sars, 1895: 451; Stebbing, 1906: 359.

Body smooth or weakly toothed dorsally with large pleosome; coxal plates not large. Head with rostrum ranging from moderate to strong. Eyes large, subrectangular, nearly contiguous dorsally in males. Antennae slender, without accessory flagellum; calceoliferous in males. Gnathopods small, subchelate; subequal and similar; not sexually dimorphic. Pereopods 5-7 basis expanded posteriorly. Uropods 1-2 outer ramus shorter than inner; uropod 3 with rami subequal and lanceolate. Telson narrow and laminar, deeply cleft, lobes only slightly separate.

A cosmopolitan genus which comprises about 25 mainly benthic littoral species, of which only *Pontogeneia longleyi* Shoemaker has been collected from the Venezuelan coast.

Pontogeneia longleyi Shoemaker

(Figs 17, 18)

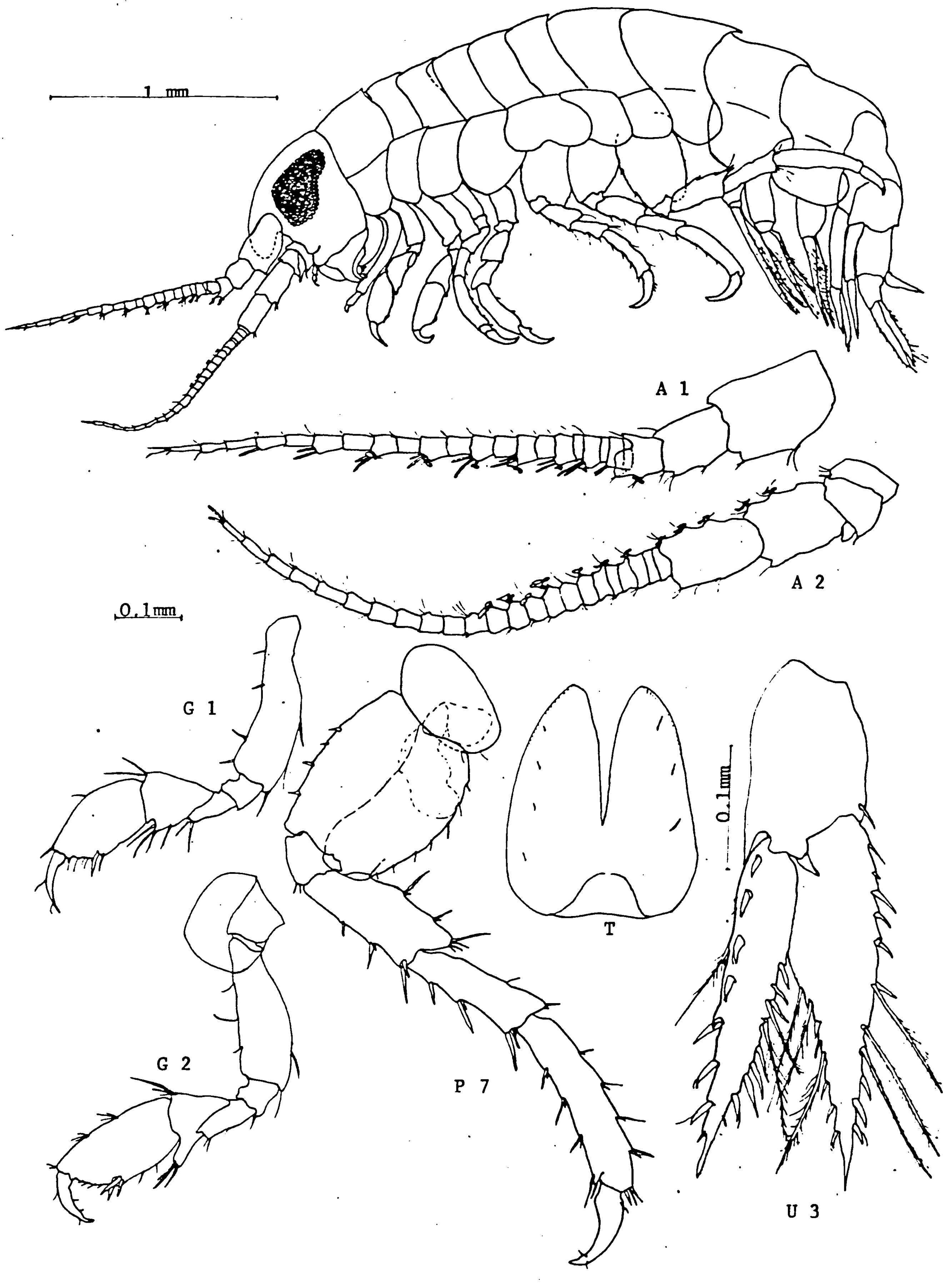
Pontogeneia longleyi Shoemaker, 1933: 253.

Material examined:

1 ♂, 1 ♀ from Patánemo Bay, Venezuela, 26 June 1981.

Description:

Length 3.5 mm, colour pale yellowish, body smooth, pereon short, pleosome powerful. Eyes large, especially in males, subrectangular and densely pigmented; colour blackish but dark-red inferiorly. Rostrum prominent, curving downwards with rounded apex. Antennae less than half body length, peduncle short, flagellum slender. Antenna 1 with setae, aesthetascs and calceoli posteriorly; flagellum 21-articulate in the male; article 3 of peduncle with posterodistal toothed process in males. Antenna 2 slightly longer than 1, with setae, and calceoli anteriorly; flagellum 24-articulate in male. The calceoli are disposed alternately along the flagellar articles, but occur sparsely on the peduncles. Upper lip symmetrically rounded; lower lip without inner lobes. Mandibles basic, palp 3-articulate. Maxilla 1 with stout biarticulate palp, eleven spines on outer plate and three setae on inner plate. Maxilla 2 well developed. Maxilliped basic, palp 4-articulate. Coxal plates overlapping and moderately deep. Gnathopods weak, basic. Coxal gills pedunculate, present on coxae 2-7, with accessory gills on coxae 5-7. Pereopods short with dactylus stout. Epimeral plates subrounded; epimeral plate 3 blunt and not produced posterodistally.



Fipure 17. Pontogeneia longleyi ♂ 3.5 mm

Pleopods powerful. Uropod 1 extending beyond 2, and 3 beyond 1; uropods 1-2 with outer ramus shorter than inner; uropod 3 rami subequal, laminar bearing spines and setae. Telson longer than broad, cleft to two-thirds length, laminar, unarmed, with bluntly rounded lobes.

Female similar to male but eyes smaller and more rounded (less rectangular and reniform); antennae less sculptured, antenna 1 flagellum 20-articulate, antenna 2 flagellum 26-articulate. The oostegites are large, oval to lanceolate, with setose margins. Body length of female subequal to male at about 3.5 mm.

Ecology:

Collected in small numbers from shallow waters of Patanemo Bay together with specimens of Apherusa sp. (Calliopiidae). This bay is near the frontier between the Central Littoral and Golfo Triste regions off the Venezuelan coast.

Distribution:

Pontogeneia longleyi is known by a single female from Tortugas, Florida, Gulf of Mexico. Ruffo (1950: 50) mentioned 2 females from Margarita Island in the upwelling area of the Caribbean, and a small male from Maiquetia, in the Central Littoral. This species presence has now been confirmed for the Caribbean and recorded further west along the Venezuelan coast.

Remarks:

Pontogeneia longleyi was described briefly by Shoemaker, 1933 from a single female specimen. The material studied fits precisely with Shoemaker's description. The male of this species is described for the first time, and the known range of distribution extended.

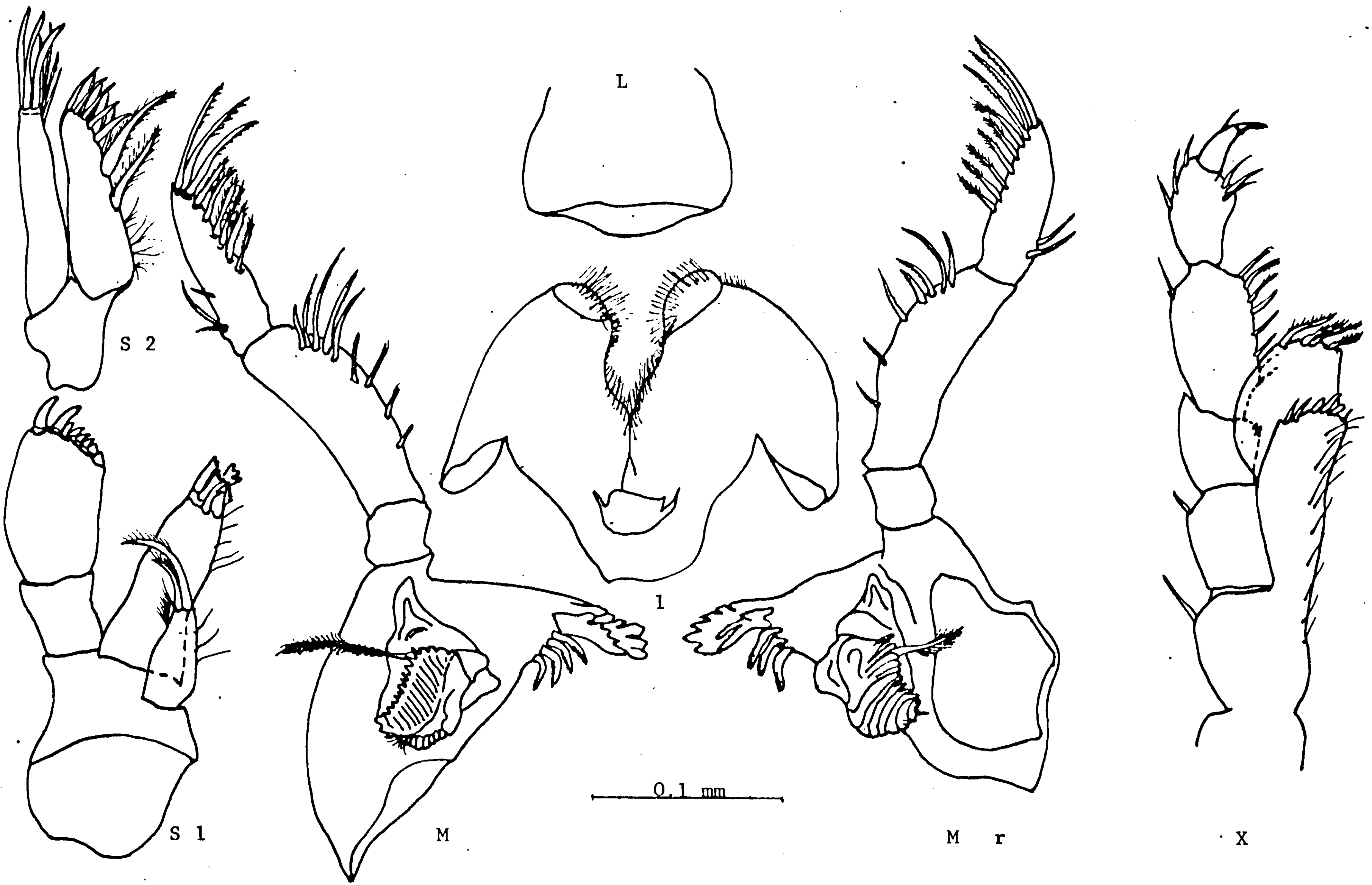


Figure 18. Pontogeneia longleyi ♂ 3.5 mm : Mouthparts.

Superfamily LEUCOTHOIDEA

Body smooth, occasionally weakly carinate or toothed; usually small body size; urosome segments occasionally fused; coxal plates deep. Head with small to well developed rostrum. Eyes medium sized, rounded. Antennae short, without calceoli; accessory flagellum absent or vestigial. Mouthparts specialised, upper lip asymmetrical; mandibles with molar vestigial or lacking; maxillae small; maxilliped with strong dactylate palp. Gnathopods variable, well developed. Pereopods slender. Uropods biramous. Telson usually entire and simple.

The superfamily Leucothoidea was proposed by Bousfield (1978) for 13 families of small mostly benthic and commensal amphipods that live on various sessile invertebrates such as sponges and ascidians.

On the Caribbean coast of Venezuela the families Leucothoidae and Anamixidae form part of an inquilinous taxocenosis inhabiting sponges and colonial ascidians. The Anamixidae is a group of peculiar amphipods that lacks all mouthparts except for the maxilliped palp. *Leucothoe spinicarpa* and *Anamixis hanseni* have been found on mangrove roots in the upwelling area. *Leucothoides pottsi*, *Anamixis hanseni* and a diminutive variety or population of *Leucothoe spinicarpa* have been found as symbionts in colonial invertebrates on coral atolls of the offshore chain of islands. *Leucothoides pottsi* may be a synonym of *Anamixis hanseni*, the two forms being distinctive developmental stages of the same species. A similar ontogenetic transformation may take place in other species of *Anamixis* and the family Anamixidae may eventually have to be sunk within the Leucothoidae.

The relationship between the small variety of <u>Leucothoe spinicarpa</u> and <u>Leucothoides</u> or <u>Anamixis</u> remains unknown but could be a rewarding avenue for investigation.

The family Stenothoidae is also represented on the epibiosis and fouling communities of littoral habitats in Venezuela.

<u>Key to the Venezuelan families of Leucothoidea</u>

1	Coxal plates 2-4 shield-like, subsimilar. Antenna 1 longer than 2. Gnathopod 1 carpochelate. Uropod 3 biramous.	2
-	Coxal plates 2-4 shield-like but plate 4 very large. Antenna 1 shorter than 2. Gnathopod 1 subchelate. Uropod 3 uniramous.	Stenothoidae
2	Head with hood-like rostrum. Mouthparts absent except the maxilliped palp. Gnathopod 1, distally slender and fragile.	Anamixidae
-	Head with small rostrum, never hood-like. Mouthparts present. Gnathopod 1 distally robust.	Leucothoidae

Family LEUCOTHOIDAE

Body slender and smooth. Head small with short rostrum and subrounded eyes of medium size. Antennae relatively short, subequal or antenna 2 shorter than 1; accessory flagellum vestigial or absent. Mouthparts modified, epistome produced; upper lip markedly asymmetrical, lower lip with vestigial lobes; mandible without molar; maxilla 1-2 basic; maxilliped with large strongly dactylate palp, inner plates fused, outer plates vestigial. Coxal plates moderately deep, overlapping. Gnathopods large, unequal, very weakly sexually dimorphic; gnathopod 1 carpochelate; gnathopod 2 larger than 1 and subchelate with produced carpal process and robust propodus. Pereopods slender. Pleopods basic to weak. Uropods biramous, uropod 2 shorter than 1, rami of uropod 3 styliform. Telson entire, unarmed.

The family Leucothoidae Leach, 1814, comprises only 5 genera of mainly small shallow water amphipods that live as commensals on Porifera and Tunicata. Two genera have been found in the southern Caribbean sea.

Key to the Venezuelan Genera of Leucothoidae

1 Coxal plate 1 not hidden by 2. Eyes composed of many small facets. Gnathopod 2 palm oblique. <u>Leucothoe</u>

\- Coxal plate 1 mostly hidden by 2. Eyes composed of few big facets. Gnathopod 2 palm transverse. <u>Leucothoides</u>

Leucothoe Leach

Leucothoe Leach, 1814: 403; Stebbing, 1906: 163; Lincoln, 1979: 172.

Body smooth, subcompressed to cylindrical; coxal plates 1-4 rounded, moderately deep and broad. Head short with very small obtuse rostrum from which a vertical lamella descends between the antennae to the epistome which forms a conical projection anterodistally. Antenna 1 slightly longer than 2, both peduncles longer than flagella; accessory flagellum very small or absent. Upper lip asymmetrically bilobed; lower lip lacking inner lobe. Mandible without molar; maxilliped outer plate vestigial. Gnathopod 1 carpochelate, rather slender and elongated with propodus and dactylus freely articulated. Gnathopod 2 robustly subchelate, propodus powerful, carpus with prolonged setose posterior lobe; dactylus strong and curved. Pereopods 3-4 slender; pereopods 5-7 subequal with expanded basis. Uropods biramous, uropod 2 the shortest. Telson entire, triangular, long and unarmed.

A large cosmopolitan genus comprising about 30 species found mainly on sponges and tunicates typically in shallow littoral habitats, only exceptionally in deep water. *Leucothoe spinicarpa* is recorded for the first time from Caribbean islands of Venezuela.

Leucothoe spinicarpa (Abildgaard)

(Figs 19-20)

Gammarus spinicarpus Abildgaard, 1789: 66.

Leucothoe articulosa Leach, 1814: 403; Sars, 1895: pl. 100.

Leucothoe spinicarpa; Sars, 1895: 283; Krapp-Schickel, 1975: 95.

Material examined:

4, 6 and 1 specimens from La Restinga, Isla de Margarita, Venezuela, 15 February 1975, 20 June 1975 and 16 February 1976, respectively.

8, 4, 20 and 24 specimens from Los Roques archipelago, Venezuela, 28 April, 30 April, 23 June and 25 June 1980, respectively.

Description:

Length up to 8 mm, body slender, broadly rounded dorsally, colour pinkish, sometimes greenish. Head subequal to length of first pereonal segment; rostrum very short; anteroventral angles subrounded; carinate lamella below rostrum; epistome acute and produced anteriorly. Eyes oval, of moderate size and composed of many small facets; colour bright red. Antennae unequal, slender and short. Antenna 1 less than one-third body length; peduncle longer than flagellum; peduncle article 1 robust and produced posterodistally as an acute angle; peduncle article 2 as long as 1 but narrower; peduncle article 3 small; flagellum about 10-articulate. Antenna 2 little shorter than 1 and more slender; peduncle longer than flagellum which is very small. Upper lip with vestigial left lobe; lower lip without inner lobes, lateral angles narrowly rounded.

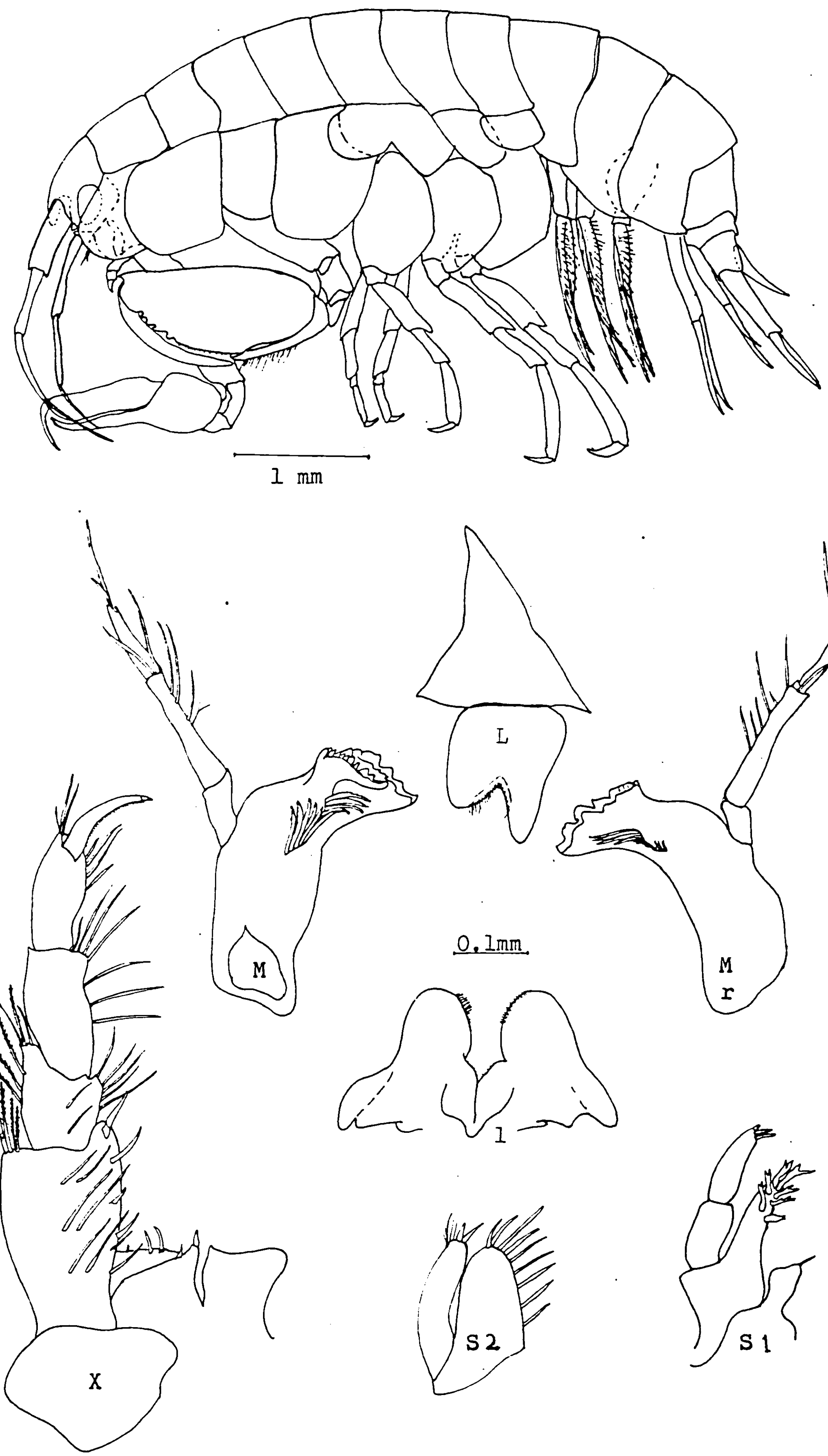


Figure 19. Leucothoe spinicarpa ♀ 8 mm ; Mouthparts.

Mandibles without molar; well developed palp with article 3 smaller than 2; incisor dentate; spine row present; lacinia mobilis multidentate on the left mandible, absent on the right one. Maxilla 1, palp biarticulate, outer plate with spines, inner plate very small with one seta. Maxilla 2, inner plate broader than outer. Maxilliped without outer plates, inner plates small, partly coalesced, large palp with long terminal article as claw. Coxal plates as deep as body, the first expanded anteriorly and transversely truncated; the second broader than deep and subquadrangular; the third narrow and obliquely truncated at the tip; the fourth the largest, blunt anteriorly and excavate posteriorly with projection obtusely pointed; the fifth broader than deep and bilobed; coxal plates 6-7 small. Epimeral plates slightly produced posterodistally: the first nearly rectangular; the second slightly curved and the third with minute blunt tooth in specimens above 4 mm length, subquadrate in specimens below that size.

Gnathopods unequal and slightly sexually dimorphic. Gnathopod 1 carpus globular proximally and produced distally as very narrow carpal process, spiniform and quite smooth, ending in upturned acuminate apex; propodus with sharp posterior edge, finely serrulate, and with a row of small curved setae; dactylus slender, less than half propodus length, weakly curved. Gnathopod 2 very large, subchelate, carpus cup-shaped with setose process, somewhat laminar at the apex with minutely serrulate terminal edge; propodus massive, ovoid, and produced anterodistally above dactylus as triangular tooth; palm with unevenly serrate distal margin; dactylus large and robust reaching almost to carpal process.

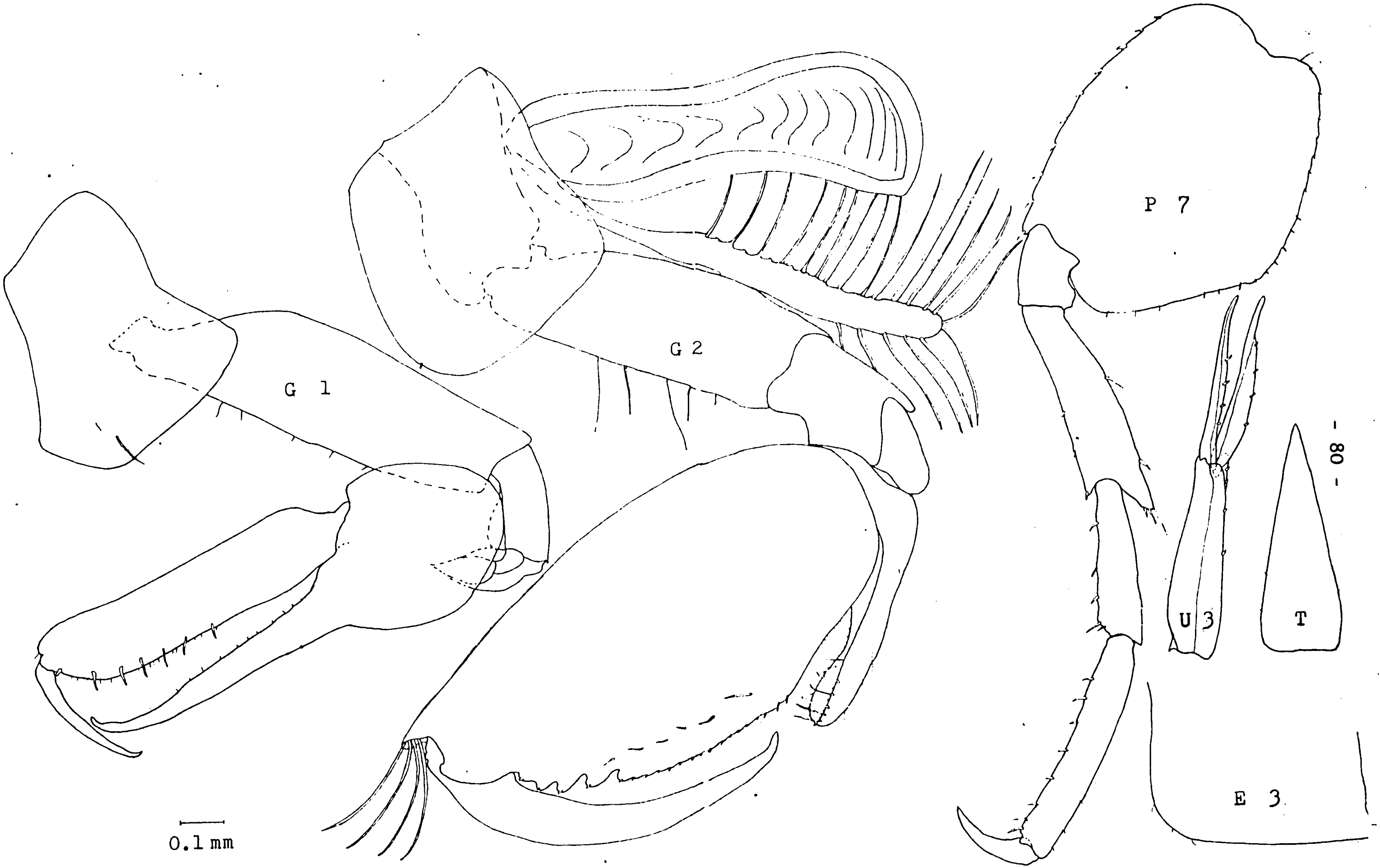


Figure 20. Leucothoe spinicarpa ♀ 8 mm

Pereopods subequal bearing short spines and small dactylae; basis of pereopod 7 the largest, oval with posterior edge serrate and strongly convex in the middle. Pleopods of moderated size. Urosome small with segment 3 produced postero-distally at lateral corners. Uropod 3 peduncle slightly longer than ramus. Telson entire, elongate triangular; three times longer than broad at base and gradually narrowing to an acuminate apex.

Female similar to the male but propodus of gnathopod 2 slightly shorter. Oostegites present on pereopods 2-5, slender, elongate and setose. Gravid females with many small eggs of greenish colour.

Ecology:

Leucothoe spinicarpa has been found free-living on mangrove roots in an island of the upwelling area, the specimens having a relatively large size, exceeding 4 mm. It was also found associated with sponges and ascidians on shells of *Strombus gigas* and *S. costatus* in beds of *Thalassia testudinum*, *Syringodium filiforme*, *Halimeda opuntia* and *H. discoidea* at 5 m depth in offshore coral islands. These specimens were smaller, not reaching 4 mm, and coexisted with *Leucothoides pottsi* and *Anamixis hanseni*.

Distribution:

Leucothoe spinicarpa has a wide distribution in the North Atlantic, from Greenland to the Mediterranean, and also occurs in the Indian and Pacific Oceans. This is the first record from Venezuela.

Remarks:

The material fits precisely the descriptions of Leucothoe spinicarpa. The two ecological populations mentioned above can also be separated by the shape of the posterodistal margin of epimeral plate 3 which forms a minute blunt tooth in specimens above 4 mm in length, and is subquadrate in specimens below this size.

Leucothoides Shoemaker

Leucothoides Shoemaker, 1933: 244.

Body smooth, of small size. Head with short rostrum, anteroventral corner subquadrate. Eyes large, lateral. Antenna 1 less than half body length, antenna 2 smaller than 1. Mandibles without molar, palp reduced, 1-articulate; maxilla 1 palp well developed; maxilla 2 basic; maxilliped outer plate vestigial, inner plates not coalesced. Coxal plates relatively deep, coxal plate 1 greatly reduced and hidden by 2. Gnathopod 1 carpochelate, chela serrate on opposing margins, dactylus reduced, spine-like. Gnathopod 2 subchelate with carpal process not reaching subtransverse palm. Uropod 3 extending beyond 1 and 2. Telson short, apex broadly rounded.

Since the discovery of the type species *Leucothoides pottsi* Shoemaker, in Florida, another 3 species have been described from Pacific islands: *Leucothoides pacifica* Barnard, 1955; *L. torrida* Barnard, 1974 and *L. yarrega* Barnard, 1974, and the type species has been further recorded from Pacific islands (Barnard, 1965: 492). Barnard (1974) discusses the original description retaining the holotype of *pottsi* with only a brief diagnosis but excluding the drawings which he regards as belonging to a separate species.

Amongst the material of *Leucothoides pottsi* studied for the first time from the Southern Caribbean Sea, one pre-moult specimen exhibited the *Anamixis hanseni* morphology. Pending further work on the life history of this group, the *Leucothoides pottsi* morph is described as a valid species.

The validity of Leucothoides is however very much open to question. Recently, Thomas & Barnard (1983) first witnessed the remarkable single-moult transformation of a 'Leucothoides pottsi' specimen into Anamixis hanseni, of which it appears to represent simply a late developmental stage.

Leucothoides pottsi Shoemaker

(Figs 21-22)

Leucothoides pottsi Shoemaker, 1933: 244; Barnard, 1974: 105.

Material examined:

3 specimens	from	Los Roques	Archipelago,	Venezuela,		28 April 1980
33	"	"	"	"	"	30 April 1980
7	"	"	"	"	"	23 June 1980
5	"	"	"	"	"	25 June 1980

Description:

Length up to 2.5 mm, colour pale whitish to yellowish. Head small with subrounded anteroventral angles which may be partially covered by anterodistal expansion of coxal plate 2. Eyes medium to large, composed of few large facets of light brown colour; may also be partially covered by coxal plate 2. Antenna 1, flagellum subequal in length to peduncle, 8-articulate; antenna 1 with normal anterior position; antenna 2 with a more posteroventral insertion. Antenna 2 flagellum shorter than last peduncle article, 4-articulate. Mandible reduced, bearing only weak incisor, vestigial palp and spine row. Maxilla 1 basic but inner plate vestigial. Maxilla 2 very small. Maxilliped palp very large, outer plate vestigial, inner plate very short. Upper and lower lip inconspicuous. Coxal plate 1 much reduced and hidden by 2; anterodistal corner narrowly produced. Coxal plate 2 expanded anterodistally; plate 3 deeper than broad; plate 4 deep and broad, slightly excavate posteriorly. Coxal plates 5-7 smaller, basic.

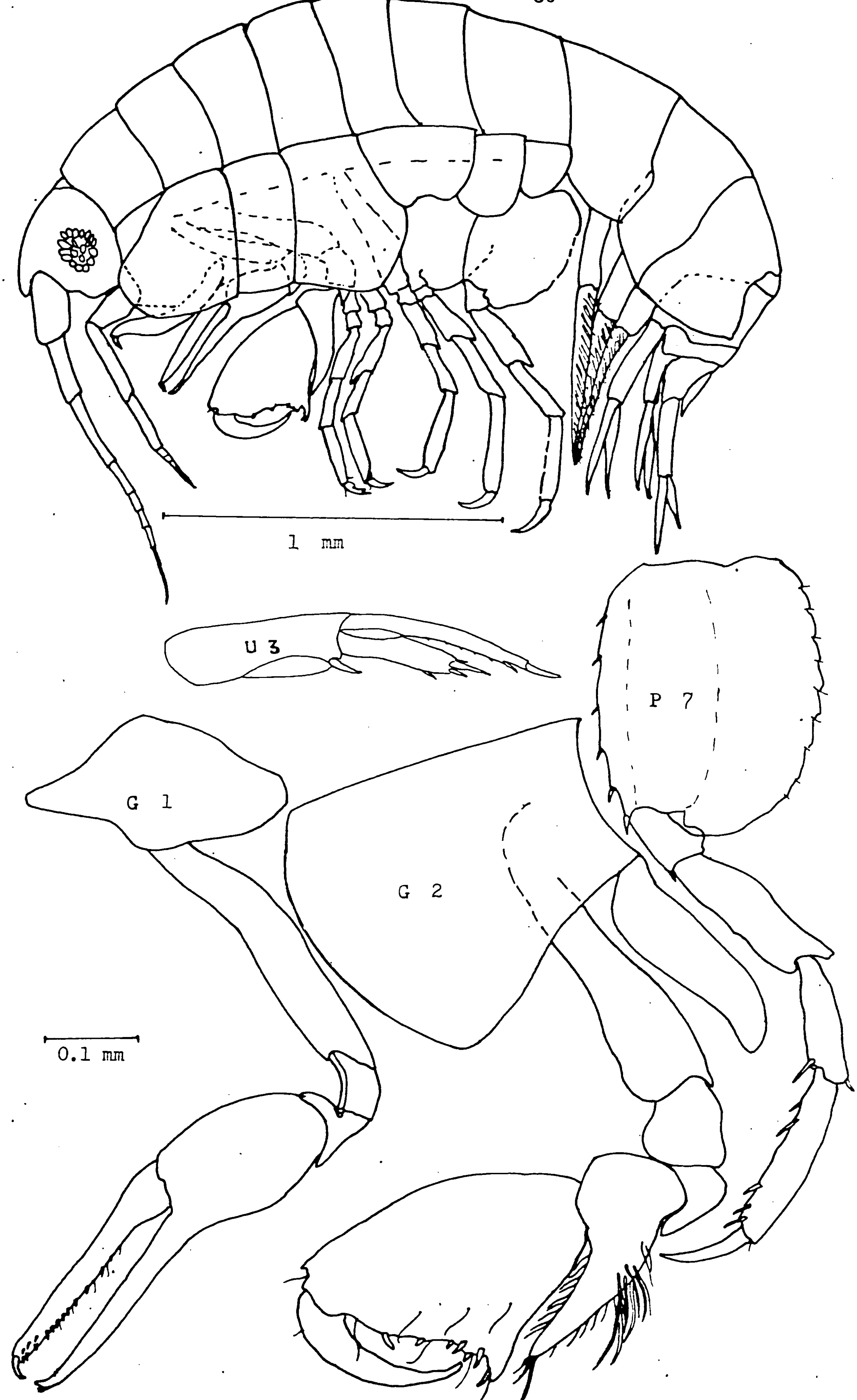


Figure 21. Leucothoides pottsi ♂ 2.5 mm.

Gnathopod 1 carpochelate; carpus expanded proximally and produced distally into elongate narrow carpal process having serrate anterior margin; propodus slender, elongate, spinose along posterior margin; dactylus very small, curved, spine-like. Gnathopod 2 subchelate; carpus setose, expanded proximally, and produced distally as elongate process reaching two-thirds length posterior margin of propodus; propodus distally expanded, palm oblique, spinose and defined from posterior margin by large tooth bearing single spine; dactylus strongly curved, closing against palm. Pereopods 3-4 subequal; pereopods 5-7 basis expanded; pereopod 7 the longest. Epimeral plate 3 subquadrate posterodistally. Uropod 1 rami subequal, as long as peduncle; uropod 2 with subequal rami longer than peduncle; uropod 3 elongate, peduncle slightly longer than the unequal rami. Telson oval, entire, longer than broad.

Female unknown.

Ecology:

The material was collected on sponges and colonial ascidians which were epibiontic on Strombus gigas and S. costatus in beds of Thalassia testudinum, Syringodium filiforme, Halimeda opuntia and H. discoidea between 4 and 6 m depth in tropical Caribbean open waters surrounding coral atolls. These amphipods were always found together with the small-size populations of Leucothoe spinicarpa and Anamixis hanseni. The collection comprised 56 specimens of Leucothoe spinicarpa, length up to 4 mm; 48 specimens of Leucothoides pottsi, length up to 2.5 mm; and 22 specimens of Anamixis hanseni, length between 2 and 4 mm. Females, with small eggs, were only present for Leucothoe spinicarpa.

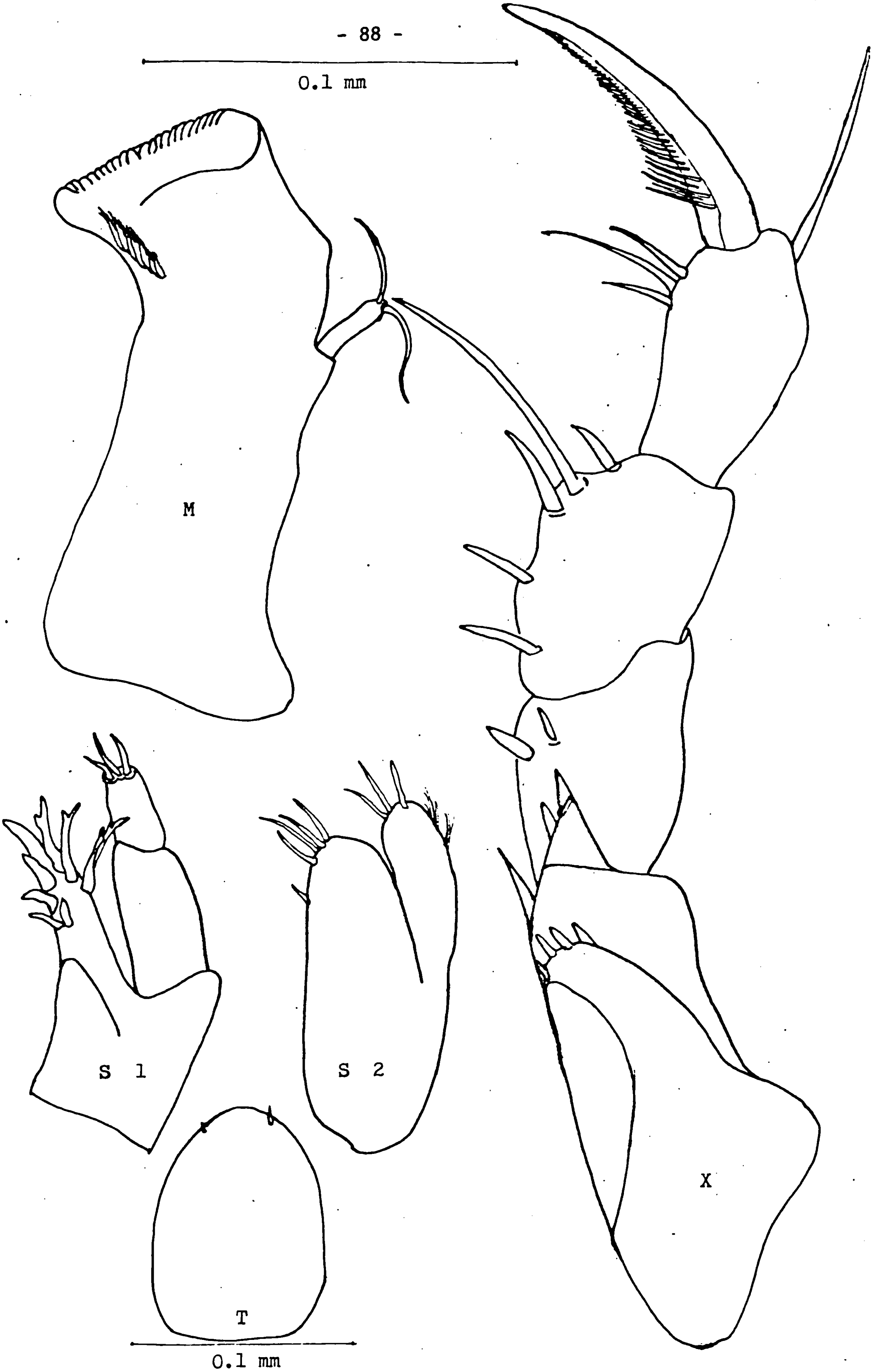


Figure 22. Leucothoides pottsi ♂ 2.5 mm: Mouthparts (r) & Telson

Distribution:

Leucothoides pottsi, described originally from the Gulf of Mexico (Tortugas, Florida) is now recorded from Los Roques, Venezuelan islands of the south-east Caribbean Sea.

Remarks:

Within Leucothoides pottsi there is some variability in the extent to which the anteroventral corner of head is covered by the expansion of the second coxal plates. Most of the specimens were about 1 mm body length.

The material described as Leucothoides pottsi is probably a developmental stage of Anamixis hanseni, and should therefore be relegated to the status of a junior synonym. However, such a synonymy could have generic and familial repercussions which are outside the scope of this study, and is not pursued at this time.

Family ANAMIXIDAE

Body smooth, coxal plates 2-4 large and deep, shield-like. Head with strong hood-like rostrum. Eyes small to medium, rounded. Antennae 1 longer than 2; antenna 2 insertion well separated from 1; accessory flagellum absent. Mouthparts aberrant, only elongate palp of maxilliped present. Gnathopods unequal; gnathopod 1 absent or carpochelate. Gnathopod 2 subchelate. Pereopods slender. Pleopods small. Uropods biramous, uropod 2 the shortest. Telson entire.

The family Anamixidae Stebbing, 1897 comprises 2 genera of small amphipods found in shallow tropical waters of the Pacific and West Indies, living as inquilines or parasites on colonial invertebrates. The genus Anamixis is reported for the first time from the southern Caribbean sea. It appears to be a terminal male or super male of a species belonging to the family Leucothoidae. If the transformation reported by Thomas & Barnard (1983) is confirmed for other members, the two families will have to be synonymized.

Anamixis Stebbing

Anamixis Stebbing, 1897: 36; Barnard, 1969: 146.

Body smooth and slender. Coxal plate 1 very small and hidden by the shield-like coxae 2-4. Head with rostrum produced anteriorly. Eyes medium to small, subrounded and composed of few small facets. Antenna 1 slightly less than half body length, antenna 2 smaller than 1 and with its origin well separated from 1. Mandibles, lips and maxillae absent; buccal region with a ventrally projected keel. Maxilliped with very long dactylate palp, outer plates absent, inner plates small, fused. Gnathopod 1 delicately carpochelate; gnathopod 2 immense, partially hidden by the coxal shields. Pereopods 5-7 basis expanded. Uropod 3 styliform, rami subequal, nearly as long as the elongate peduncle. Telson small, entire, subrounded.

A small genus comprising the following four species:
Anamixis hanseni Stebbing, 1897: 36; West Indies.
Anamixis stebbing Walker, 1904: 259; Ceylon and Caroline Islands.
Anamixis linsleyi Barnard, 1955: 28; California.
Anamixis falarika Barnard, 1965: 485; Caroline Islands.
These amphipods are inquilinous in sponges on climax communities of tropical corals. They are a good example of the complex biological interrelationships of this ecosystem. Anamixis hanseni is reported for the first time in the southern Caribbean sea.

Anamixis hanseni Stebbing

(Figs 23-24)

Anamixis hanseni Stebbing, 1897: 36; Stebbing, 1906: 172.

Material examined:

1 specimen from Laguna Grande, Gulf of Cariaco, Venezuela, 12 January 1980

2	specimens	from	Los	Roques	Archipelago,	Venezuela,	28 April 1980
9	"	"	"	"	"	"	30 April 1980
7	"	"	"	"	"	"	23 June 1980
4	"	"	"	"	"	"	25 June 1980

Description:

Length between 2 and 4 mm, colour yellowish. Head distally narrow, produced into a rounded rostrum; without cephalic lobes and covered anteroventrally by coxal plates 1-2. Eyes lateral, small and rounded with few small facets, colour bright red. Antennae placed ventrally; antenna 1 below apex of head, peduncle elongate, flagellum 10- articulate; antenna 2 at the base of the head with flagellum 4-articulate. Ventral surface of head with keel projecting between second antennae. Mouthparts absent, except for very long maxilliped palps.

Coxal plate 1 small, subtriangular and hidden by the second; coxal plates 2-4 large and deep, coxal plate 2 the largest, coxal plate 3 deeper than broad; coxal plate 4 slightly excavated behind; coxal plates 5-7 smaller, basic. Gnathopod 1 hidden by 2; carpus wider and slightly longer than basis, carpal process long, slender and curved, tipped with a needle-like spine; propodus tapering distally; dactylus very small and slender.

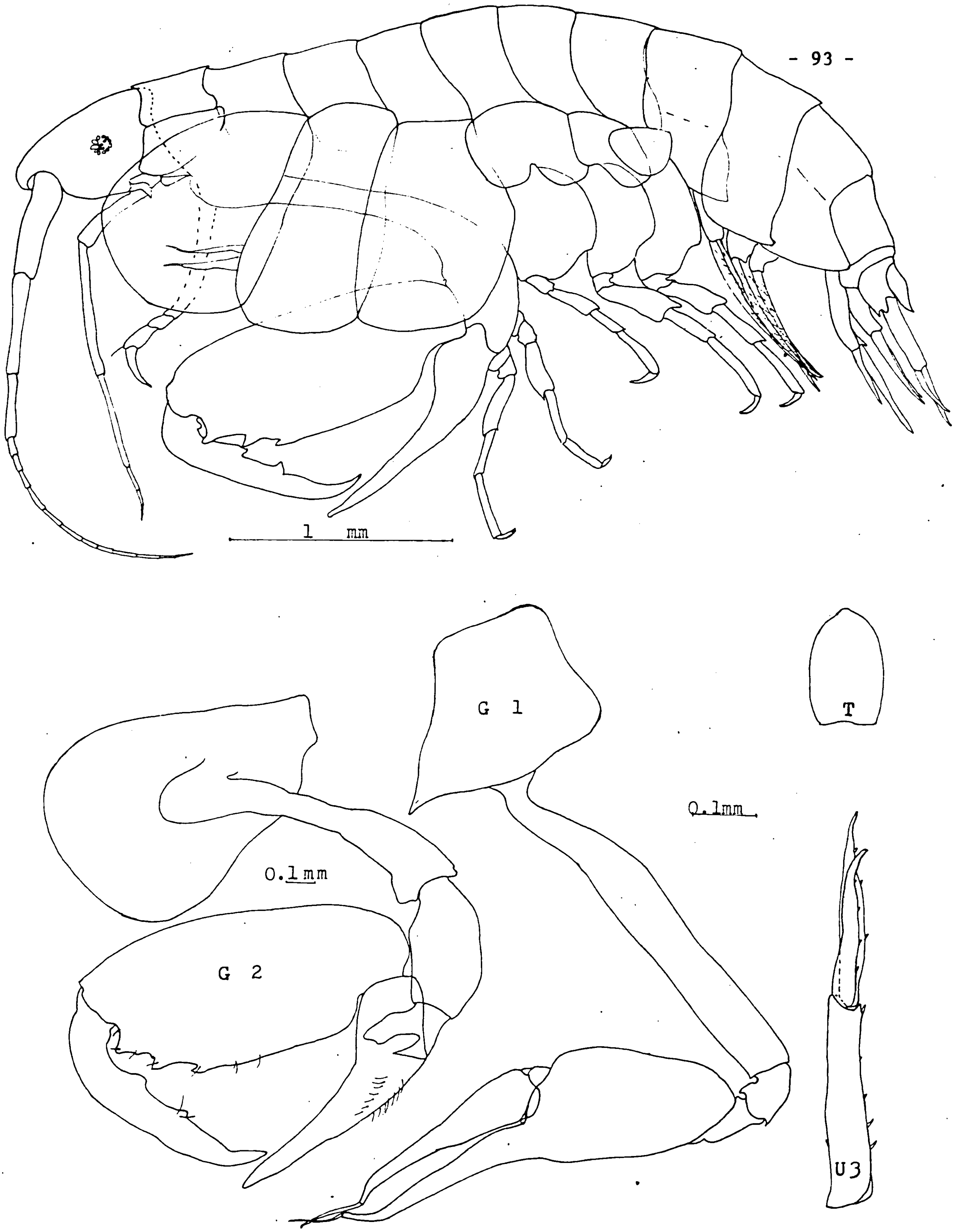


Figure 23. Anamixis hanseni ♂ 4 mm.

Gnathopod 2 massive, partially hidden by coxal plates 2-4, complexly subchelate; propodus and dactylus robust, forming a false chela against the large carpal process; palm oblique, 3-dentate. Pereopods 3-4 slender; pereopods 5-7 basis expanded, oval, posterior margin angular. Pleopod rami shorter than peduncle. Epimeral plate 3 blunt posterodistally. Urosome segment 2 very short. Uropods slender, styliform rami unequal. Telson entire, little longer than broad, apex rounded.

Female unknown.

Ecology:

One specimen was collected from a mangrove root community with *Leucothoe spinicarpa*. Twenty two specimens were collected in colonial sponges and ascidians epibiontic *Strombus* shells in beds of sea turtle grass surrounding coral atolls in Caribbean open waters. *Anamixis hanseni* was always sampled together with *Leucothoides pottsi* and the small-size population of *Leucothoe spinicarpa*.

Distribution:

The species was originally described from West Indies and is here recorded from Laguna Grande, Cariaco Gulf in the upwelling area, and from Los Roques, a coral archipelago in the Caribbean waters of Venezuela.

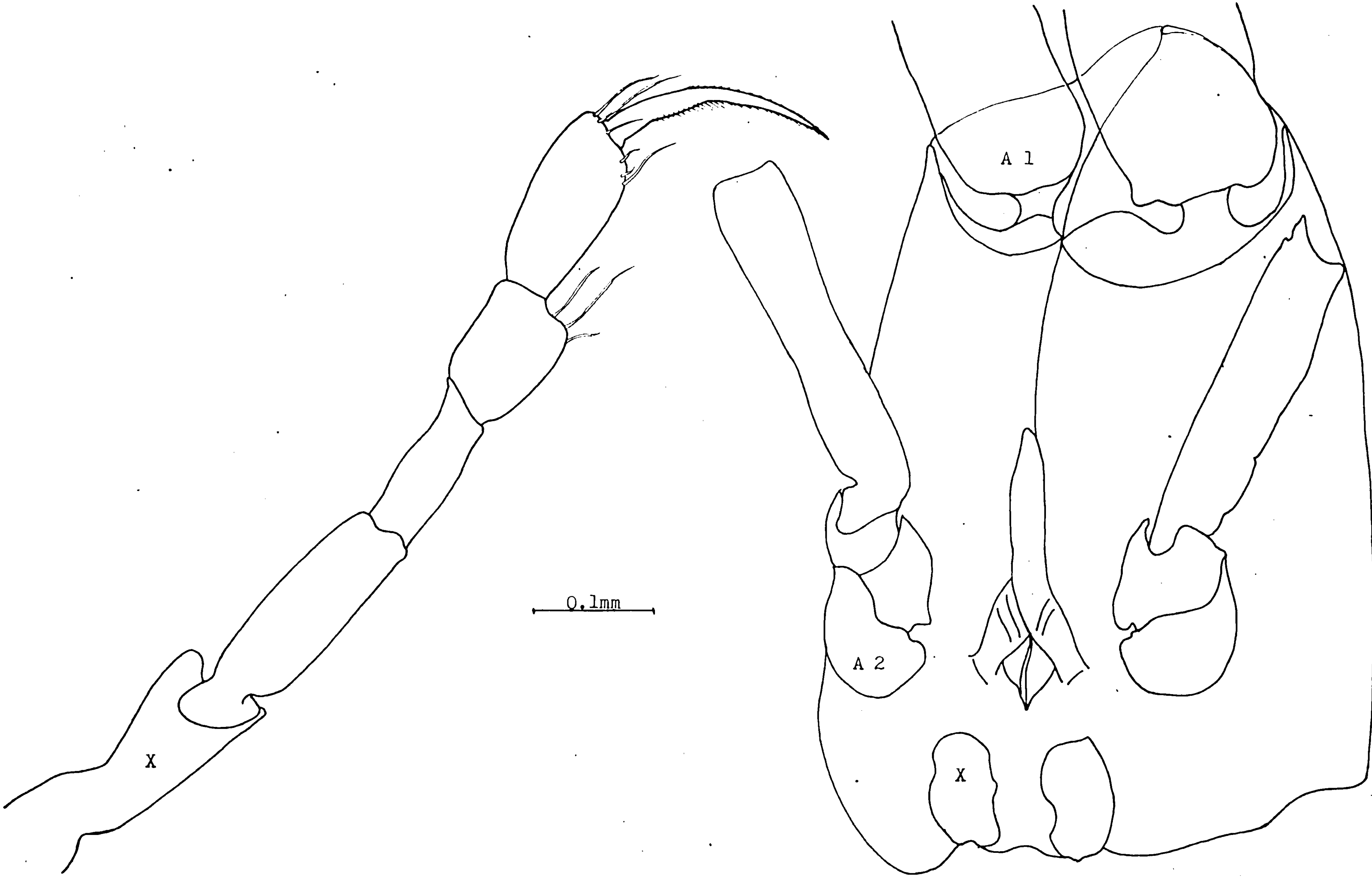


Figure 24. Anamixis hanseni ♂ 4 mm : Mouthparts.

Family STENOTHOIDAE

Body compressed, subrounded and smooth. Coxal plate 1 small and concealed by plate 2; plates 2-4 large; plate 4 very large and shield like. Head with small rostrum; eyes medium size and rounded. Antennae subequal in length, medium size, with accessory flagellum vestigial or absent. Mouthparts modified; mandible, molar reduced, palp small or absent; maxilla 1 palp 1 or 2-articulate; maxilla 2 reduced; maxilliped slender, outer plate vestigial. Gnathopods subchelate and sexually dimorphic; gnathopod 1 small; gnathopod 2 powerful. Pereopods short; pereopod 5 with slender basis; pereopods 6-7 basis usually expanded. Uropods 1-2 biramous; uropod 3 uniramous, ramus 2-articulate. Telson entire. Coxal gills present on pereopods 2-6 moderately developed; oostegites on pereopods 2-5.

The family Stenothoidae Boeck, 1870 is a very large one comprising about 18 genera and more than 200 species. The distribution is cosmopolitan. Stenothoids typically occupy littoral habitats, and are represented in the south Caribbean sea by the common genus, Stenothoe.

Stenothoe Dana

Stenothoe Dana, 1852: 311; Sars, 1895: 235; Stebbing, 1906: 192; Chevreux & Fage, 1925: 450; Barnard, 1969: 450; Lincoln, 1979: 194.

Probolium Costa, 1853: 170.

Body very small and smooth. Coxal plates shield-like; plate 1 reduced, plates 2-4 very large, especially the 4th. Head with small rostrum; eyes small or medium size, rounded. Antennae moderately developed, subequal and without accessory flagellum. Mouthparts modified. Mandible without palp or molar. Maxilla 1 palp 2-articulate; maxilla 2 reduced. Maxilliped with vestigial outer plates; inner plates separated; palp well developed. Gnathopods subchelate; gnathopod 2 larger than 1 especially in male. Pereopod 5 basis slender; pereopods 6-7 basis broadly expanded. Uropod 3 ramus biarticulate. Telson tongue-like. Coxal gills sack-like, small to moderately developed. Oostegites well developed.

A large cosmopolitan genus comprising about 35 recognised species. All are of small size and live mainly as epibionts on littoral hydroids and bryozoans. A cosmopolitan species, *Stenothoe gallensis* Walker is recorded for the first time from the upwelling region in the southern Caribbean Sea.

Stenothoe gallensis Walker

(Fig. 25)

Stenothoe gallensis Walker, 1904: 261; Barnard, 1955: 3.

Stenothoe cattai Stebbing, 1906: 195; Lincoln, 1979: 202.

Stenothoe crenulata Chevreux, 1907: 412; Shoemaker, 1935: 237.

Material examined:

Approximately 50 specimens from Turpialito, Gulf of Cariaco, August 1974; 7 specimens from Turpialito, Gulf of Cariaco, October 1974; 18 specimens from La Restinga lagoon, Isle of Margarita, 15 February 1975. Approximately 50 specimens from La Restinga, Isle of Margarita, 28 January 1976. Approximately 100 specimens from La Restinga, Isle of Margarita, 26 February 1976.

Description:

Length up to 4 mm, colour whitish. Coxal plate 1 very small, hidden by 2; coxal plates 2-4 very large; plate 3 anterior and posterior margins almost parallel. Head with lateral lobes subrounded; eyes of moderate size, rounded, bright red. Antennae about half body length, subequal; antenna 1, flagellum about 23-articulate; antenna 2, peduncle moderately robust in male, flagellum robust and 23-articulate. Mandible without molar and palp; maxilla 1 palp robust, biarticulate; maxilliped inner plates reduced but separated. Gnathopod 1 small, merus rounded distally, propodus oval, palm convex delimited by small spines, dactylus slightly overlapping palm. Gnathopod 2 very large in male, basis long and slender with anterodistal lobe, propodus very elongate, palm densely setose and with one large and one small rounded process close

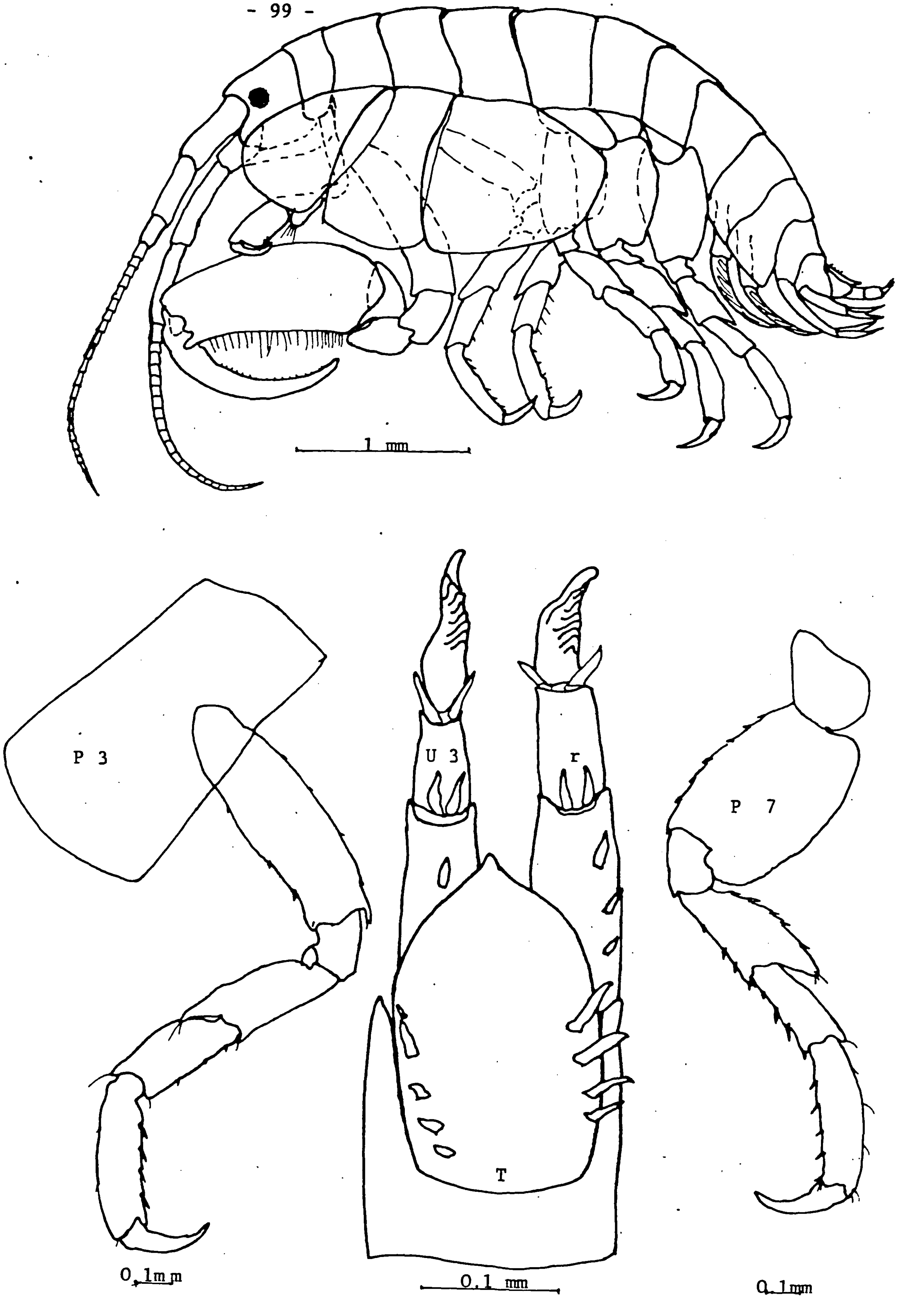


Figure 25. Stenothoe gallensis ♂ 4 mm.

to base of dactylus; dactylus long and slender with inner margin sparsely setulose, slightly overlapping palm. Pereopods robust, dactylus short, merus only weakly expanded; pereopod 7 merus with posterodistal angle reaching half the length of carpus. Epimeral plate 3 subquadrate. Uropods 1-2 rami subequal, spinose. Uropod 3 sexually dimorphic; in male peduncle spinose about equal to length of ramus; ramus articles about equal length, distal article geniculate and crenulate. In female, distal article of uropod 3 ramus styliform, smooth. Telson broadly oval, apex subacute, with 4-5 pairs of dorsolateral spines.

Ecology:

Stenothoe gallensis inhabits mangrove roots in shallow waters of the upwelling area living on hydroids and bryozoans. It is also a common member of the fouling community, having its maximum densities towards February at the minimum annual water temperature.

Distribution:

Indian, Pacific and Atlantic oceans; also in the Mediterranean and Caribbean seas (Porto Rico). Stenothoe gallensis is recorded for the first time from the south Caribbean upwelling area.

Remarks:

The material fits precisely the original description of Stenothoe gallensis. Barnard (1955) explained its differences from other allied species and gives a full synonymy (Barnard, 1958).

Superfamily TALITROIDEA

Body smooth, very occasionally setose, with shortened urosome and sexual dimorphism conspicuous mainly in gnathopod 2. Coxal plates usually with posterior process, plate 4 excavate posteriorly. Head lacking rostrum. Eyes lateral, medium to large size and rounded (rarely absent). Antenna 1 usually short, without accessory flagellum. Mandible with strong triturative molar, palp absent. Upper lip rounded. Lower lip without inner lobe. Maxilla 1 palp reduced or vestigial. Maxilla 2 inner plate strongly setose. Maxilliped, inner plate with three apical teeth. Gnathopods usually subchelate. Uropod 3 small, uniramous, occasionally minutely biramous. Telson short with cleft or fused lobes. Coxal gills present on pereonites 2-6. Oostegites lamellate.

An extensive revision of this large group of amphipods was published by Bulycheva (1957). More than 300 species are recognized. The three main families, which are represented in Venezuela, offer a convenient ecological grouping; the Talitridae containing truly terrestrial amphipods, the Hyalellidae comprising mainly freshwater amphipods, and the Hyalidae with exclusively marine amphipods.

From a study of systematic morphology in relation to distribution and species diversity, it can be deduced that the freshwater South American Hyalellidae and the worldwide temperate terrestrial Talitridae of the shingly and sandy beaches arose from a plesiomorphic Hyalidae stock of Mesozoic origin in the North Pacific.

Key to the Venezuelan families of Talitroidea

1	Antenna 1 longer than peduncle of antenna 2.	2
-	Antenna 1 shorter than peduncle of antenna 2.	Talitridae
2	Telson entire; accessory sternal gills present; freshwater.	Hyalellidae
-	Telson notched; sternal gills absent; marine.	Hyalidae

Family HYALIDAE

Body basic gammaridean, talitroidean type, smooth or carinate. Coxal plates 1-4 deep, plates 1-2 dissimilar, with posterior process weak or lacking. Antenna 1 shorter than 2 but longer than peduncle of antenna 2, with flagellum usually longer than peduncle. Maxilliped palp 4-articulate and dactylate. Gnathopods with marked sexual dimorphism, subchelate. Pereopods robust, non-fossorial. Uropods similar to Talitridae but occasionally uropod 3 with inner ramus small. Telson bilobed or with small notch. Sternal gills absent. Oostegites large and fringed with hooked setae.

The Hyalidae Bulycheva, 1957 is a family of marine intertidal and shallow subtidal amphipods. It comprises about 75 species grouped in 7 genera mainly from tropical and warm temperate regions but with a rich North Pacific diversity and some biboreal forms.
From a study of plesiomorphic characters in relation to ecology and species diversity, it can be deduced that the Hyalidae have a North Pacific origin with the Parallorchestes complex, which retain both the 2-articulate palp on maxilla 1 and the vestigial inner ramus of uropod 3. This gave rise to the tropical Parhyale and temperate worldwide Hyale, and finally the apomorphic biboreal Allorchestes which has a uniramous uropod 3, a vestigial palp on maxilla 1 and a neotenic male gnathopod 2 that retains article 5 extending between articles 4 and 6.

Eight species of Hyalidae in 3 genera have been recorded from Venezuelan Caribbean seas: Parhyale inyacka by Stephensen (1948); Parhyale hawaiensis and P. fascigera by Shoemaker (1956); Hyale hawaiensis, H. media and H. pygmaea by Ruffo (1950); Hyale macrodactyla by Ruffo (1954); and Allorchestes chelonites by Oliveira (1951).

The present study recognises only three Venezuelan species in two genera, Parhyale and Hyale. According to Shoemaker (1956), Parhyale inyacka and Hyale hawaiensis are both synonyms of Parhyale hawaiensis.

Shoemaker (1956) included Venezuela as a locality for Parhyale fascigera but this record is considered dubious since P. fascigera, characterized by an absence of spines on the propodus of pereopods 6-7, was not found in the abundant Venezuelan Parhyale material examined.

Hyale media and H. pygmaea were both present in the study collections.

Hyale macrodactyla was reported by Ruffo (1954) from a solitary small specimen from Orchila Island. In view of marked phenotypic variation of this species in relation to size its occurrence in Venezuela is also considered doubtful.

Allorchestes chelonites was described by Oliveira (1951) from Brazil, and Venezuelan material from Golfo Triste was regarded as conspecific. This species correctly belongs to Parhyale and and not to Allorchestes since it has a vestigial ramus on uropod 3 and the carpus in the male is masked between the merus and propodus of gnathopod 2. Further, the Venezuelan material is identical with Parhyale hawaiensis.

In conclusion, the family Hyalidae is represented in Venezuela by 3 species: Parhyale hawaiensis (Dana, 1853), Hyale media (Dana, 1852) and Hyale pygmaea Ruffo, 1950.
See map for distribution (Fig. 26).

Key to the Venezuelan genera of Hyalidae

1 Uropod 3 inner ramus vestigial. Maxilla 1 palp vestigial. .... Parhyale

- Uropod 3 without inner ramus. Maxilla 1 palp small, 1 or 2-articulate. .... Hyale

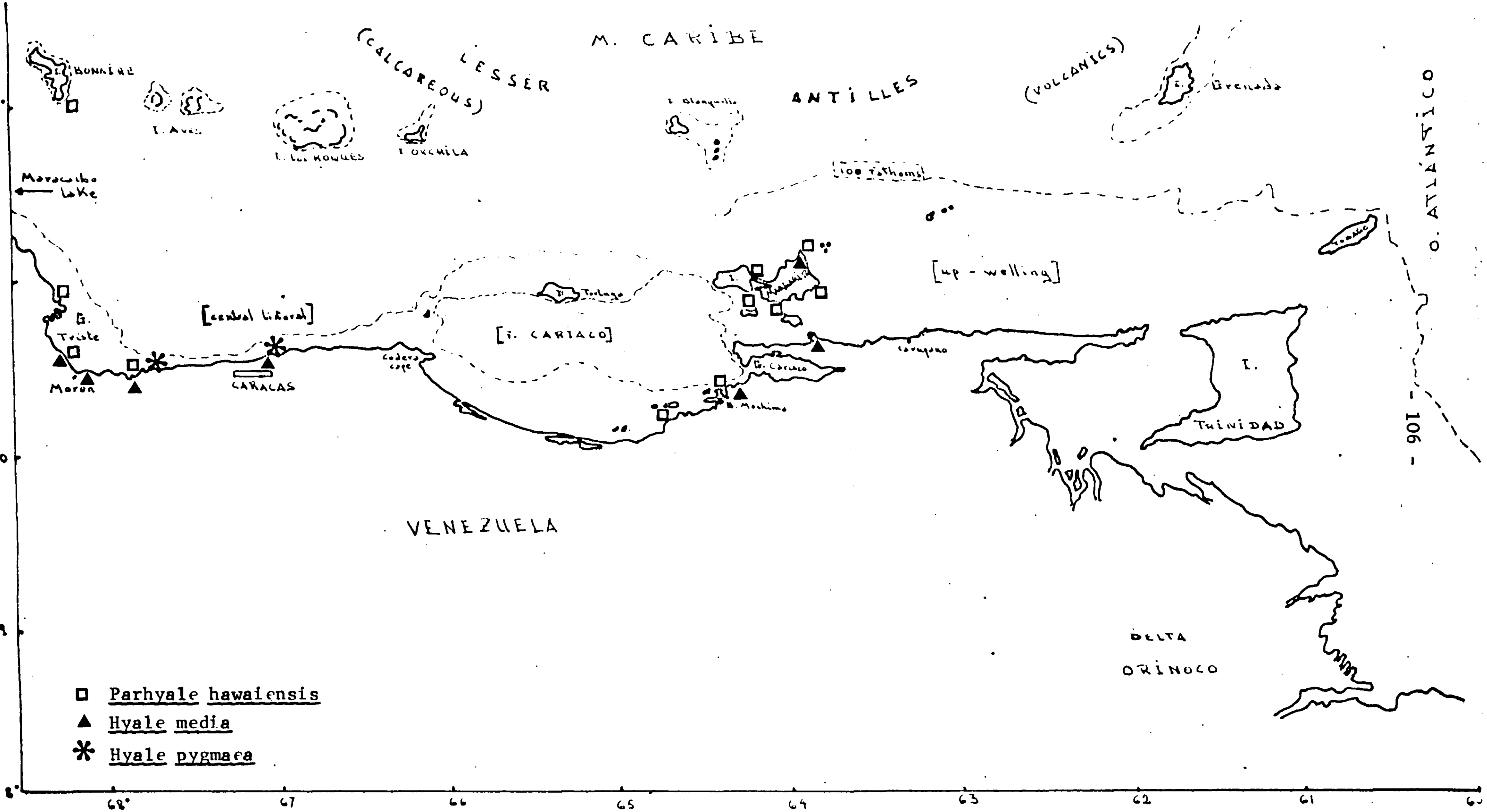


Figure 26. Map of the distribution of Hyalidae

Hyale Rathke

Hyale Rathke, 1837: 377.

Body robust, compressed, smooth. Coxal plates moderately broad and long, plate 4 deeper than 5. Antenna 1 longer than peduncle of antenna 2; antenna 2 about half body length. Maxilla 1 palp 1 or 2-articulate. Maxilliped basic hyalid; palp article 3 without dense brush of setae, article 4 broad. Gnathopods basic hyalid; subequal in females. Uropod 1 with stout inter-ramal spine. Telson deeply cleft.

A very large genus, mostly intertidal or shallow subtidal. Although the group has a cosmopolitan distribution a great many of the species occur in tropical regions. The 53 species currently referred to *Hyale* are listed below; of these, only two species have been recorded for Venezuelan seas.

Key to the Venezuelan species of Hyale

1 Eyes subrounded with posterior concavity. Antenna 2 with dense posterior setae. Male gnathopod 2, propodus with posterior margin longer than palm. *Hyale media*

\- Eyes suboval. Antenna 2 without dense posterior setae. Male gnathopod 2, propodus with posterior margin shorter than palm. *Hyale pygmaea*

Conspectus of *Hyale* species with synonymy and geographical distribution.

Hyale affinis Chevreux, 1907: 415.

Hawaii.

Hyale anceps (Barnard) / *Allorchestes anceps* Barnard, 1969: 130 / *Hyale anceps*; Barnard, 1974: 42.

California.

Hyale antores Oliveira, 1953: 340.

Brazil.

Hyale ayeli Barnard, 1955: 14.

Hawaii.

Hyale bishopae Barnard, 1955: 16.

Hawaii.

Hyale californica (Barnard) / *Hyale grandicornis californica* Barnard, 1969: 133 / *Hyale californica*; Barnard, 1979: 116.

Gulf of California and California.

Hyale campbellica (Filhol) / Allorchestes campbellica Filhol, 1885: 466 / *Hyale campbellica*; Stebbing, 1906: 562.

Campbell Island, South Pacific.

Hyale camptonix (Heller) / *Nicea camptonix* Heller, 1866: 10 / *Hyale camptonix*; Stebbing, 1906: 570.

Mediterranean Sea.

Hyale canalina Barnard, 1979: 102.

Baja California.

Hyale carinata (Bate) / *Allorchestes carinatus* Bate, 1862: 37 / *Hyale carinata*; Stebbing, 1906: 561.

Mediterranean Sea.

Hyale changi Chen, 1948: 117.

China.

Hyale chevreuxi Barnard, 1916: 235.

Seychelles, Chagos Archipelago and Gilbert Islands.

Hyale crassicornis (Haswell) / Allorchestes crassicornis Haswell, 1879: 252 / Hyale crassicornis; Stebbing, 1906: 568.

New South Wales.

Hyale darwini Barnard, 1979: 99.

Galapagos and Panama.

Hyale dentifera Chevreux, 1907: 414.

Gambier Island, Pacific.

Hyale diplodactyla Stebbing, 1906: 562.

St. Croix, Caribe.

Hyale dollfusi Chevreux, 1910: 238.

Guetaria, Atlantic; Alexandria, Mediterranean.

Hyale frequens (Stout) / Allorchestes frequens Stout, 1913: 650 / Hyale frequens; Shoemaker, 1941: 187.

California.

Hyale galateae Stebbing, 1899: 402.

Pacific and Sargasso Sea.

Hyale goetschi Schellenberg, 1935: 227.

Chile.

Hyale graminea (Dana) / Allorchestes graminea Dana, 1852: 208 / Hyale graminea; Stebbing, 1906: 564.

Rio de Janeiro.

Hyale grandicornis (Kroyer) / Orchestia grandicornis Kroyer, 1848: 292 / Hyale grandicornis; Stebbing, 1906: 566.

South Pacific.

Hyale grenfelli Chilton, 1916: 362.

New Zealand.

Hyale grimaldii Chevreux, 1891: 257.

North Atlantic and Mediterranean Sea, on Thalassochelys and on floating objects.

Hyale gussave Barnard, 1979: 111.

Baja California.

Hyale hirtipalma (Dana) / Allorchestes hirtipalma Dana, 1852: 205 / Hyale hirtipalma; Stebbing, 1906: 564.

South Pacific and Indian Ocean.

Hyale honoluluensis Schellenberg, 1937: 69.

Hawaii.

Hyale humboldti Barnard, 1979: 116.

Galapagos.

Hyale incerta Chevreux, 1913: 21.

Zanzibar.

Hyale iwasai Shoemaker, 1956: 356 / Hyale gracilis Iwasa, 1939: 282.

West Pacific.

Hyale janneli Chevreux, 1913: 16.

Zanzibar, brackish water caves.

Hyale macrodactyla Stebbing, 1899: 404.

St. Thomas, Rio de Janeiro, Congo Belge, Senegal.

Hyale maroubrae Stebbing, 1899: 405.

Australia.

Hyale media (Dana) / Allorchestes medius Dana, 1852: 898 / Hyale media; Stebbing, 1906: 569.

St. Thomas, Venezuela, Brazil, Tenerife, Congo Belge, Cape Verde.

Hyale milloti Ruffo, 1958: 47.

Comores, freshwater caves.

Hyale nigra (Haswell) / Allorchestes niger Haswell, 1879: 319 / Hyale nigra; Stebbing, 1906: 571.

Indian Ocean.

Hyale nilssoni (Rathke) / Amphithoe nilssoni Rathke, 1843: 264 / Hyale nilssoni; Sars, 1895: 40.

Atlantic and Meditterranean Sea.

Hyale perieri (Lucas) / Orchestia perieri Lucas, 1846: 52 / Hyale perieri; Stebbing, 1906: 570.

Atlantic and Mediterranean Sea.

Hyale plumulosa (Stimpson) / Amphithoe plumulosa Stimpson, 1853: 44 / Hyale plumulosa; Thorsteinson, 1941: 55.

Atlantic and Pacific.

Hyale pontica Rathke, 1837: 378.

Atlantic and Mediterranean Sea.

Hyale prevosti (Milne-Edwards) / Amphithoe prevosti Milne-Edwards, 1830: 378 / Hyale prevosti; Schellenberg, 1936: 16.

Atlantic and Mediterranean Sea.

Hyale pugettensis (Dana) / Allorchestes pugettensis Dana, 1852: 901 / Hyale pugettensis; Stebbing, 1906: 573.

North West Atlantic.

Hyale pusilla Chevreux, 1907: 506.

Gambier Island.

Hyale pygmaea Ruffo, 1950: 62.

Venezuela.

Hyale ramalhoi Reid, 1939: 29.

Madeira.

Hyale rubra (Thompson) / Nicea rubra Thompson, 1879: 236 / Hyale rubra; Stebbing, 1888: 500.

New Zealand.

Hyale saldanha Chilton, 1912: 509.

South Africa.

Hyale schmidti (Heller) / *Nicea schmidti* Heller, 1866: 11 /

Hyale schmidti; Stebbing, 1906: 571.

Atlantic, Mediterranean Sea, Red Sea, Japan.

Hyale spinidactyla Chevreux, 1925: 366.

Dakar, Canary Islands, Cape Verde.

Hyale spinidactyloides Schellenberg, 1939: 131.

Congo.

Hyale wolffi Reid, 1951: 245.

Azores.

Hyale yaqui Barnard, 1979: 104.

Gulf of California.

Hyale zuaque Barnard, 1979: 108.

Gulf of California, Galapagos, Ecuador.

<u>Hyale</u> <u>media</u> (Dana)

(Figs 27-28)

<u>Allorchestes</u> <u>medius</u> Dana, 1852: 898

<u>Hyale</u> <u>media</u>; Stebbing, 1906: 569

<u>Material examined</u>:

1 ♂, 3 ♀♀ and 5 juveniles, Cayo Rincon del Pirata, Golfo Triste, 2 June 1978. 1 ♀ Boca de Aroa, Golfo Triste, 30 January 1981. Several specimens from Patanemo, Central Litoral, 5 June 1981. 4 ♂♂ Patanemo, Central Litoral, 26 June 1981. Several specimens from Bahia de Mochima, 9 April 1978. 4 ♀♀ Chacopata, Araya, 28 November 1976. Several specimens from Playa El Agua, Isla de Margarita, 14 January 1982.

<u>Description</u>:

Body typical hyalid. Length up to 10 mm. Colour variable due to presence of epibiontic algae. Eyes subrounded with unique posterior concavity, colour brown with transparent periphery. Antenna 1 peduncle short, flagellum small, about 12-articulate. Antenna 2 half body length or less, densely setose posteriorly on peduncle and flagellum; flagellum 15-articulate. Mouthparts talitroidean type. Maxilla 1, palp 1-articulate. Maxilliped palp with broad dactylate article 4. Male gnathopod 1 basis narrow proximally, antero-distally expanded; carpus with rounded lobe fringed with setae, not produced along propodus; propodus oblong, margins parallel; dactylus scarcely overlapping oblique palm.

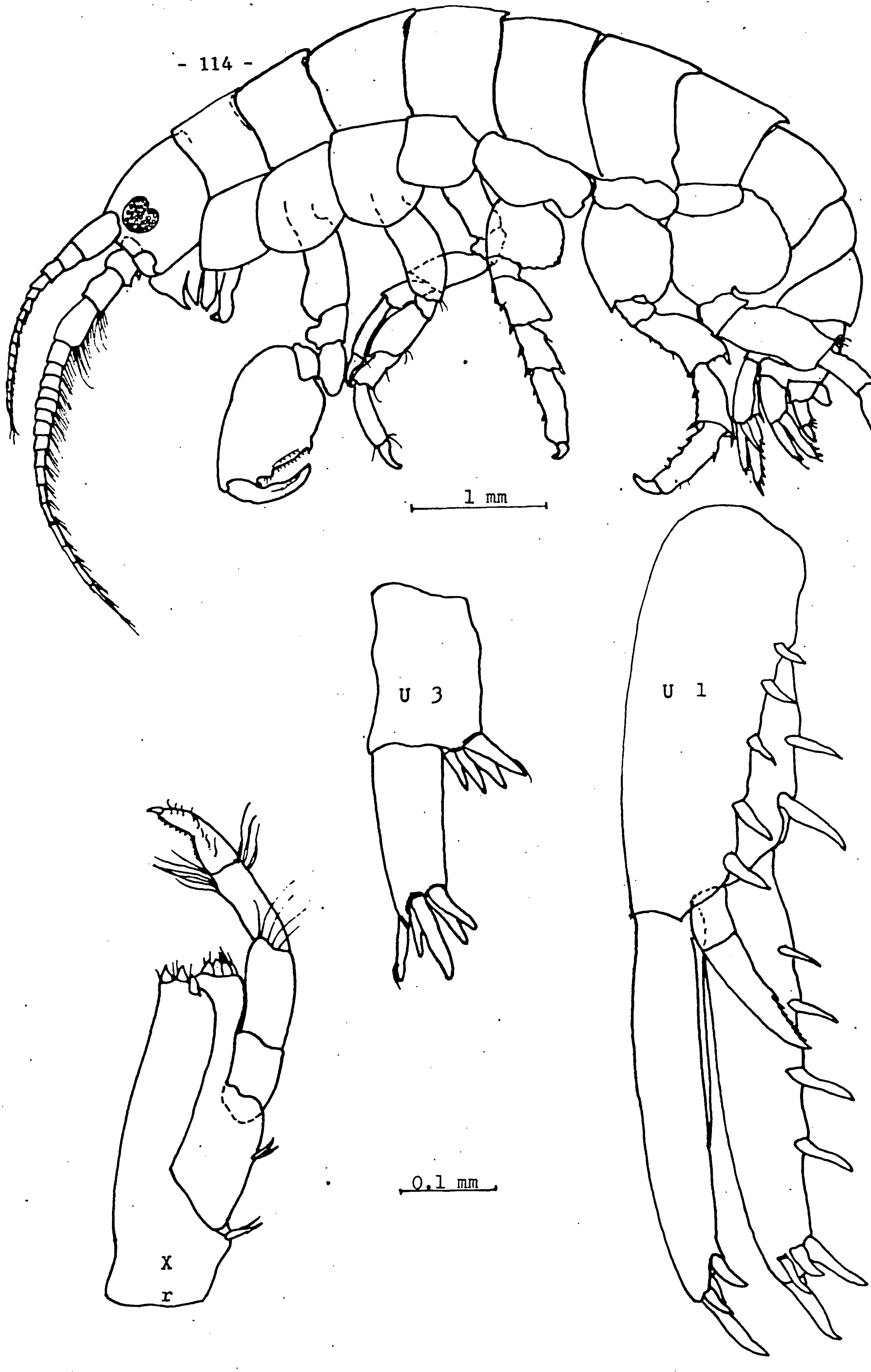


Figure 27. Hyale media ♂ 8 mm.

Male gnathopod 2, basis distally expanded; ischium with anterior lobe; propodus suboval with posterior margin as long or longer than palm which is well defined proximally by two conspicuous spines; dactylus robust, with inner spinules and rounded apex, closely fitting the palm. Pereopods robust with curved dactylus bearing spine. Uropod 1 rami subequal, about same length as peduncle, interramal spine about half outer ramus length, outer ramus without marginal spines. Uropod 3 small, ramus as long as peduncle. Telson bilobed, lobes subtriangular.

Female similar to male except gnathopods 1-2 subsimilar; gnathopod 2 longer than 1, propodus elongate with small notch; dactylus overlapping palm.

Ecology:

Found in intertidal pools, and in shallow subtidal waters.

Distribution:

Hyale media has been reported from St. Thomas, Rio de Janeiro, Cape Verde, Tenerife and Congo. Ruffo (1950) recorded it from Maiquetia, in the Venezuelan central littoral.

Remarks:

This is the common *Hyale* species of Venezuelan coasts.

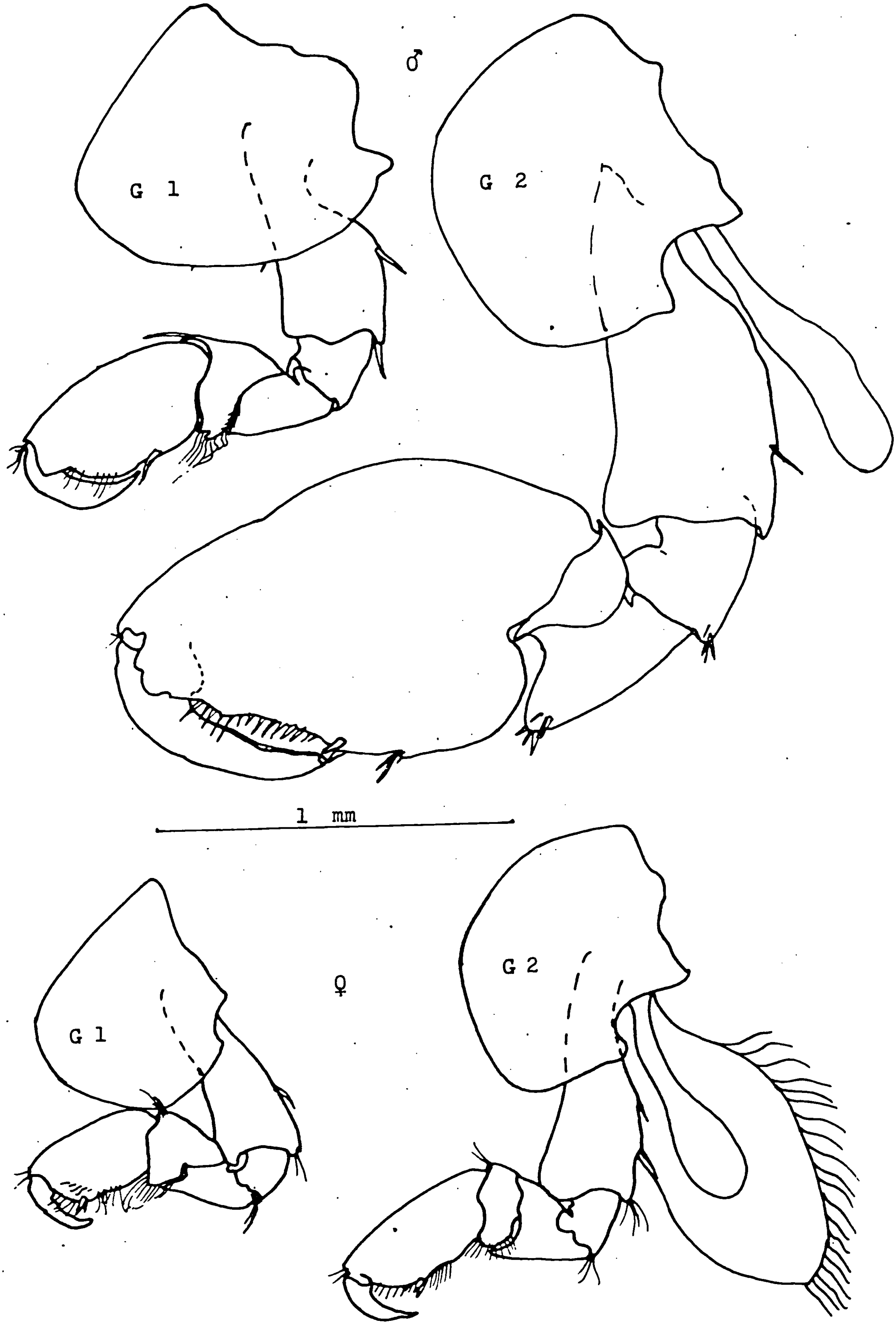


Figure 28. <u>Hyale media</u> ♂ 8 mm & ♀ 7 mm: Gnathopods.

Hyale pygmaea Ruffo

(Fig. 29)

Hyale pygmaea Ruffo, 1950: 62.

Material examined:

Several specimens from Patanemo, Central Litoral, 20 June 1980.
3 ♂♂, 6 ♀♀, 5 juveniles, Patanemo, Central Litoral, 26 May 1981.
Several specimens from Patanemo, Central Litoral, 26 June 1981.

Description:

Body hyalid type. Length up to 6 mm. Colour brownish. Eyes suboval, colour brown. Antenna 1 half length of antenna 2; peduncle article 1 longer than 2, subequal to 3; flagellum about 15-articulate. Antenna 2 less than half body length; peduncle article 4 half length of article 5; flagellum 24-articulate. Mouthparts talitroidean type. Maxilla 1 palp 1-articulate. Maxilliped palp with article 4 broad and dactylate. Male gnathopod 1 basis narrow proximally and very wide distally; ischium with anterior lobe; carpus with setose posterior lobe; propodus subquadrangular, palm weakly oblique, delimited posteriorly by 2 spines. Male gnathopod 2 basis distally expanded; ischium with anterior lobe; propodus suboval with palm strongly oblique and longer than posterior margin; dactylus robust with inner spinules, and acute apex fitting the palm. Pereopods robust, dactylus armed with single spine. Uropod 1 rami subequal, about same length or longer than peduncle; interramal spine nearly half length of outer ramus; outer ramus with small marginal spines. Uropod 3 small, ramus as long as peduncle. Telson with subtriangular lobes.

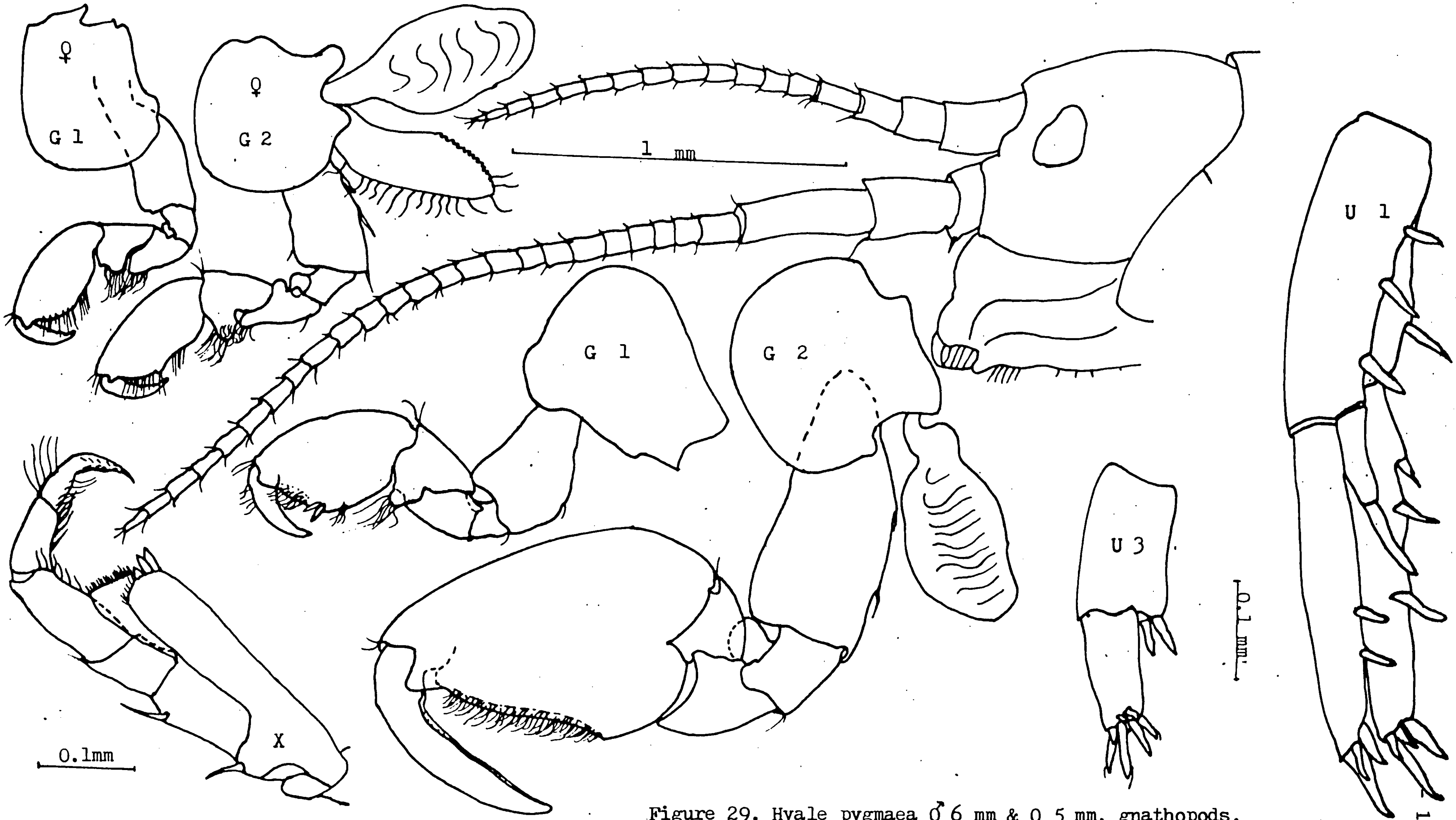


Figure 29. Hyale pygmaea ♂ 6 mm & ♀ 5 mm, gnathopods.

Female differs from male in gnathopods which are subequal and smaller. Female gnathopod 1 with subrectangular propodus and palm shorter than sinuous posterior margin. Female gnathopod 2 basis broad; ischium with anterodistal lobe; carpus with posterior setose lobe extending between merus and propodus; propodus elongate subrectangular, palm shorter than concave posterior margin.

Ecology:

A shallow subtidal species.

Distribution:

Hyale pygmaea was known previously only from the type locality, Maiquetia, Central Littoral of Venezuela. It has now been recorded from a more westerly locality in Patanemo Bay, together with *Hyale media*.

Remarks:

This small species occasionally occurs together with *Hyale media* in the Venezuelan northern littoral.

Parhyale Stebbing

Parhyale Stebbing, 1897: 27.

Body robust, hyalid type. Antenna 1 longer than peduncle of antenna 2; antenna 2 greater than half body length. Maxilla 1 with a vestigial 1-articulate palp. Maxilliped with a dense brush of setae at the apex of the third article of the palp. Gnathopods of hyalid type; male gnathopod 2 with the carpus masked between merus and propodus (except in some juveniles). Uropod 1 with interramal spine. Uropod 3 with vestigial inner ramus. Telson cleft to base, lobes separate.

A small genus found in subtidal and intertidal warm temperate waters comprising the following 6 species:

Parhyale aquilina (Costa) / *Amphithoe aquilina* Costa, 1854: 174 / *Parhyale aquilina*; Krapp-Schickel, 1974: 326.
Mediterranean Sea and Canary Islands.

Parhyale eburnea Krapp-Schickel, 1974: 327.
Mediterranean Sea.

Parhyale plumicornis (Heller) / *Nicea plumicornis* Heller, 1867: 5 / *Parhyale plumicornis*; Krapp-Schickel, 1974: 326.
Mediterranean Sea.

Parhyale fascigera Stebbing, 1906: 556.
Pacific: Tropical Mexico, Galapagos and Juan Fernandez Islands and Perú.
Atlantic: Gulf of Mexico, Florida and Caribbean Sea.

<u>Parhyale hawaiensis</u> (Dana) / <u>Allorchestes hawaiensis</u> Dana, 1853: 900 / <u>Parhyale hawaiensis</u>; Shoemaker, 1956: 351.
Pantropical.

<u>Parhyale penicillata</u> (Shoemaker) / <u>Parhyale fascigera penicillata</u> Shoemaker, 1956: 350 / <u>Parhyale penicillata</u>; Barnard, 1979: 123.
Gulf of California.

Relatively abundant <u>Parhyale</u> material from Venezuelan seas fits closely the description of <u>Parhyale hawaiensis</u> (Dana). A revision of the Pacific and African South Atlantic material of this species is called for.

Parhyale hawaiensis (Dana)

(Figs 30-31)

Amphithoe hawaiensis Dana, 1853: 900.

Hyale inyacka Barnard, 1916: 233.

Parhyale inyacka; Stephensen, 1948: 6.

Hyale hawaiensis; Ruffo, 1956: 57.

Parhyale hawaiensis; Shoemaker, 1956: 351.

Material examined:

Several specimens, San Juan de los Cayos, Golfo Triste, 23 April 1981. 3 ♂♂, 4 ♀♀ Tucacas, Golfo Triste, 22 April 1981. 1 ♂ Patanemo, Central Litoral, 5 June 1981. Several specimens, Patanemo, Central Litoral, 11 February 1981 and 26 March 1981. 4 ♂♂, 6 ♀♀ Patanemo, Central Litoral, 12 June 1980. 3 ♂♂, 2 ♀♀ Morro de Lecherias, Puerto La Cruz, 9 August 1977. 2 ♂♂, 2 ♀♀, 4 juveniles, Playa Maritas, Bahia de Mochima, 7 March 1976. 1 ♂, Ensenada de Reyes, Bahia de Mochima, 30 June 1977. 6 ♂♂, 14 ♀♀, 10 juveniles, Pta Piedras, Isla de Margarita, 3 February 1976. 2 ♂♂, 1 ♀♀, Playa El Agua, Isla de Margarita, 14 January 1982. Several specimens, Ensenada El Saco, Isla de Margarita, 22 September 1982. Several specimens, Bahia de Charagato, Isla de Cubagua, 11 November 1982.

Description:

Body similar to Hyale. Length up to 12 mm, colour whitish, but variable due to presence of epibiontic algae, commonly banded pale green and white, or dark green and white.

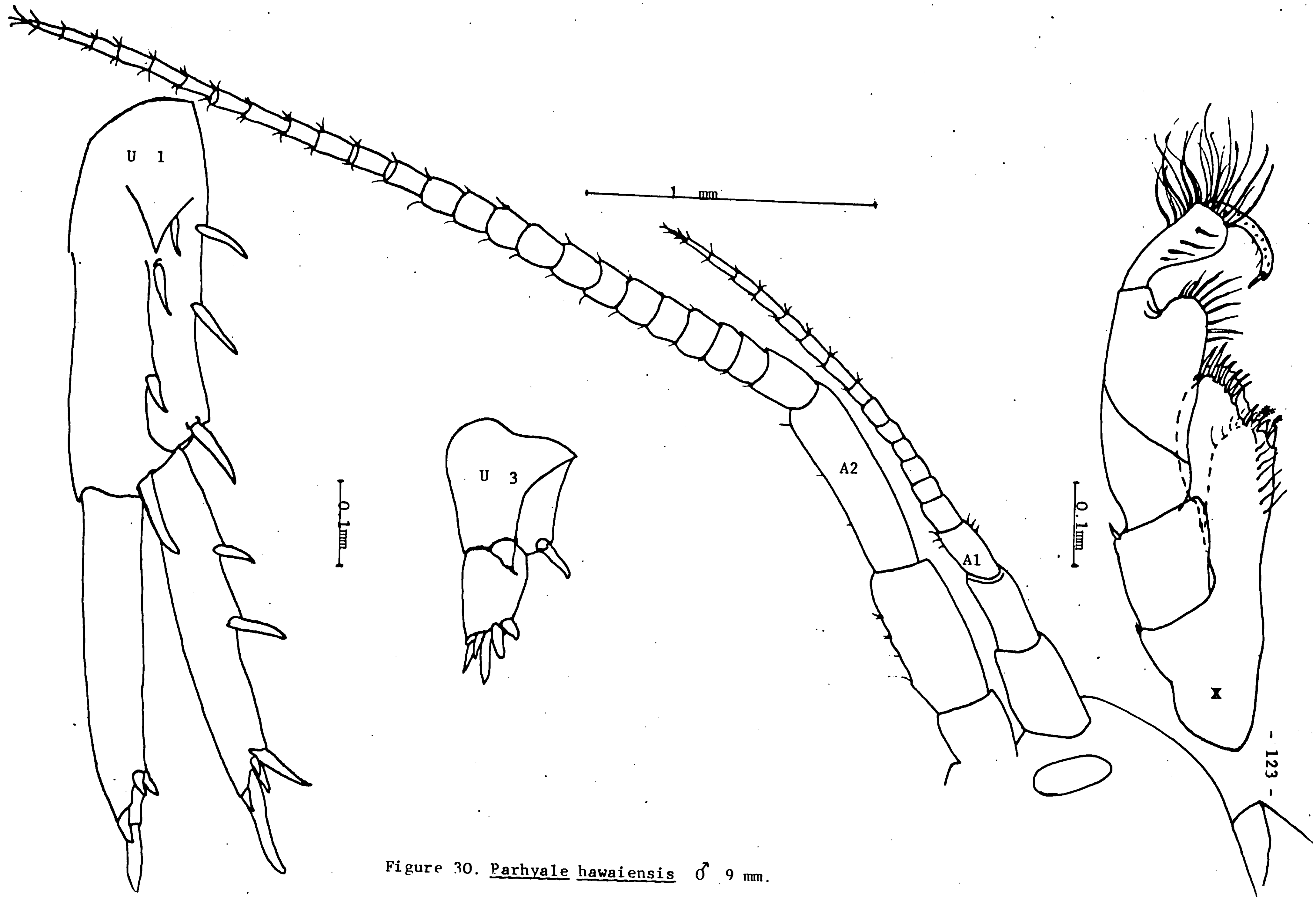


Figure 30. Parhyale hawaiensis ♂ 9 mm.

Eyes pyriform, colour brown. Coxal plates with weak posterior process. Epimeral plates with posterodistal angle quadrate or acute. Gills simple. Antenna 1, flagellum 15-articulate; antenna 2, flagellum 25-articulate. Mouthparts of talitroidean type; maxilla 1, palp small 1-articulate, not reaching end of outer plate and bearing one apical setae; maxilliped palp with slender dactylate article 4 concealed by very dense brush of setae on article 3. Gnathopods hyalid type. Male gnathopod 1, basis slightly expanded; carpus with a rounded posterior lobe bordered by long setae; propodus elongate, subtriangular, palm oblique with spines and setae; dactylus sharply curved fitting palm. Male gnathopod 2, basis anterodistally expanded as a lobe; carpus masked between merus and propodus (only produced in juveniles); propodus trapezoidal, posterodistal margin as long as palm, palm oblique with two rows of small spines and slightly concave surface fitting curvature of dactylus, proximal surface grooved to accommodate apex of dactylus; dactylus strongly bearing posteriorly two rows of minute spinules. Pereopods spinose but non-fossorial with dactylus short and almost straight except for the curved spine; pereopods 6-7 minutely spinose on carpus and propodus. Uropod 1 peduncle little longer than the subequal rami, with at least 6 marginal spines and one stout terminal spine; rami with marginal and terminal group of spines. Uropod 2 shorter than 1. Uropod 3 shorter than 2, peduncle reaching end of telson with terminal spine and vestigial inner ramus similar to the spine but bearing an apical spinule; ramus short with terminal spines. Telson bilobed, subtriangular, lobes widely divergent.

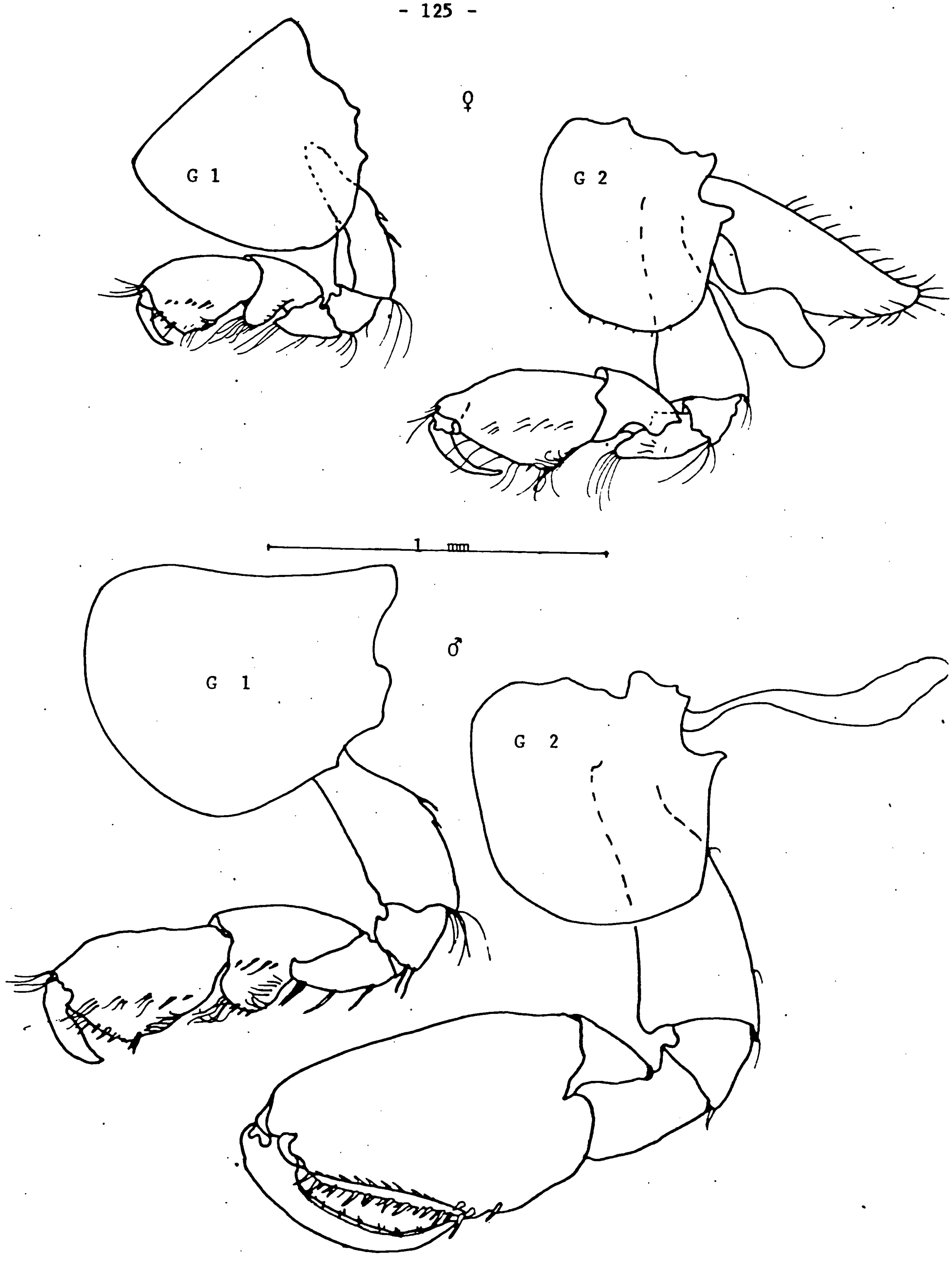


Figure 31. Parhyale hawaiensis ♂ 9 mm & ♀ 8 mm: Gnathopods

Female similar to male except in the gnathopods; gnathopod 1 more slender than in male, basis expanded, carpus with posterior lobe protruding and with long posterior setae; propodus subtriangular, not elongate, palm less oblique than in male. Gnathopod 2 similar to 1, little stouter; basis anterodistally expanded as a lobe pointing more downwards than in male; carpus produced between merus and propodus; propodus with palm oblique; dactylus bearing some minute posterior spinules. Oostegites with narrow apex fringed with short setae.

Ecology:

This species is a shallow water browser that lives in coarse sediments of small shingle. It has the ability to move shingle particles up to ten times its body size. Fresh moults are eaten within an hour or so by a small group of individuals. Amplexus lasts for eight days. Heart rate is about 200 beats per minute.

Distribution:

Pantropical: in Venezuela common on all Caribbean shores. See map of Hyalidae distribution.

Remarks:

This species is in need of revision using Caribbean, Pacific and African-Atlantic material, to clarify the nature and extent of geographical variation.

Family HYALELLIDAE

Body smooth or mucronate. Coxal plate 1-4 deep and lacking posterior process. Antenna 1 longer than peduncle of antenna 2, subequal, or longer than antenna 2. Antenna 2 gland cone prominent. Maxilliped 4-articulate strongly dactylate. Gnathopods usually similar, gnathopod 2 in males usually strongly subchelate. Pereopods slender, non-fossorial. Uropods similar to Talitridae. Telson entire and weakly armed. Coxal gills and accessory gills present on pereonal segments 2-7. Oostegites large and triangular with short hooked setae.

The Hyalellidae Bulycheva, 1957 is a family of amphipods comprising freshwater species, in the main part, and having a largely South American distribution. The family contains about 50 species grouped in 5 genera, most belonging to Hyalella Smith which has been recorded from Venezuela.

Hyalella Smith

Hyalella Smith, 1874: 645.

Body smooth, spinose or mucronate. Coxal plates 1-4 deeper than long. Antenna 1 half length of antenna 2. Antenna 2 peduncle slender with prominent gland cone. Gnathopods 1-2 subchelate, similar in female, gnathopod 2 much larger than 1 in male. Pereopods slender. Urosome reduced; telson entire, naked or with two small marginal spines. Coxal gills sack-like.

A very large genus of freshwater amphipods distributed throughout South America with a high level of endemism. Exceptionally diverse in Lake Titicaca and neighbouring lakes of altiplano (Lincoln, pers. comm.).
Of about 40 described species only one, *Hyalella azteca*, extends into North America. The most widespread species in South America is *H. curvispina*. This genus includes the only stygobiont amphipod known from South America where it occurs in Venezuelan caves.

Hyalella anophthalma Ruffo

(Fig. 32)

Hyalella anophthalma Ruffo, 1957: 363.

Material examined:

23 specimens, Cuevas del Rio Hueque, Edo. Falcon, 9 April 1971.
14 specimens, Cuevas del Rio Hueque, Edo. Falcon, 20 May 1971.
Type locality: Cuevas del Rio Hueque, Sierra S. Luis formation, Oligocene, 11° 11' 27" N, 69° 33' 29" W; 800 m alt. and 7 km N.E. from Cabure, Dto. Petit, Edo. Falcon, Venezuela.
Notes: The samples are from pools up to 0.5 m depth, 100 m into the cave in still waters at 19°C. (air temperature 20°C.) of a freshwater subterranean river near to the type locality: (type series: 3 ♂♂, 4 ♀♀, 12 September 1956, Museo Civico di Storia Naturale di Verona.

Description:

Length up to 7 mm, colour whitish, unpigmented. Eyes absent, antennal gland very large. Coxal plates 1-3 deeper than the corresponding pereonal segment, plate 4 deeply excavate posteriorly. Accessory gills and sternal gills present on the ventral surface of pereonal segments 2-7. Oostegites elongate, distally truncate. Brood of 6 large eggs in females of 7 mm length, only 3 in animals with 4.6 mm. Epimeral plates 1-3 with acutely prolonged posterodistal angle. Antenna 1 from half to two-thirds length of antenna 2; peduncle articles subequal, flagellum 10-articulate, longer than peduncle. Antenna 2 nearly half body length, flagellum 14-articulate.

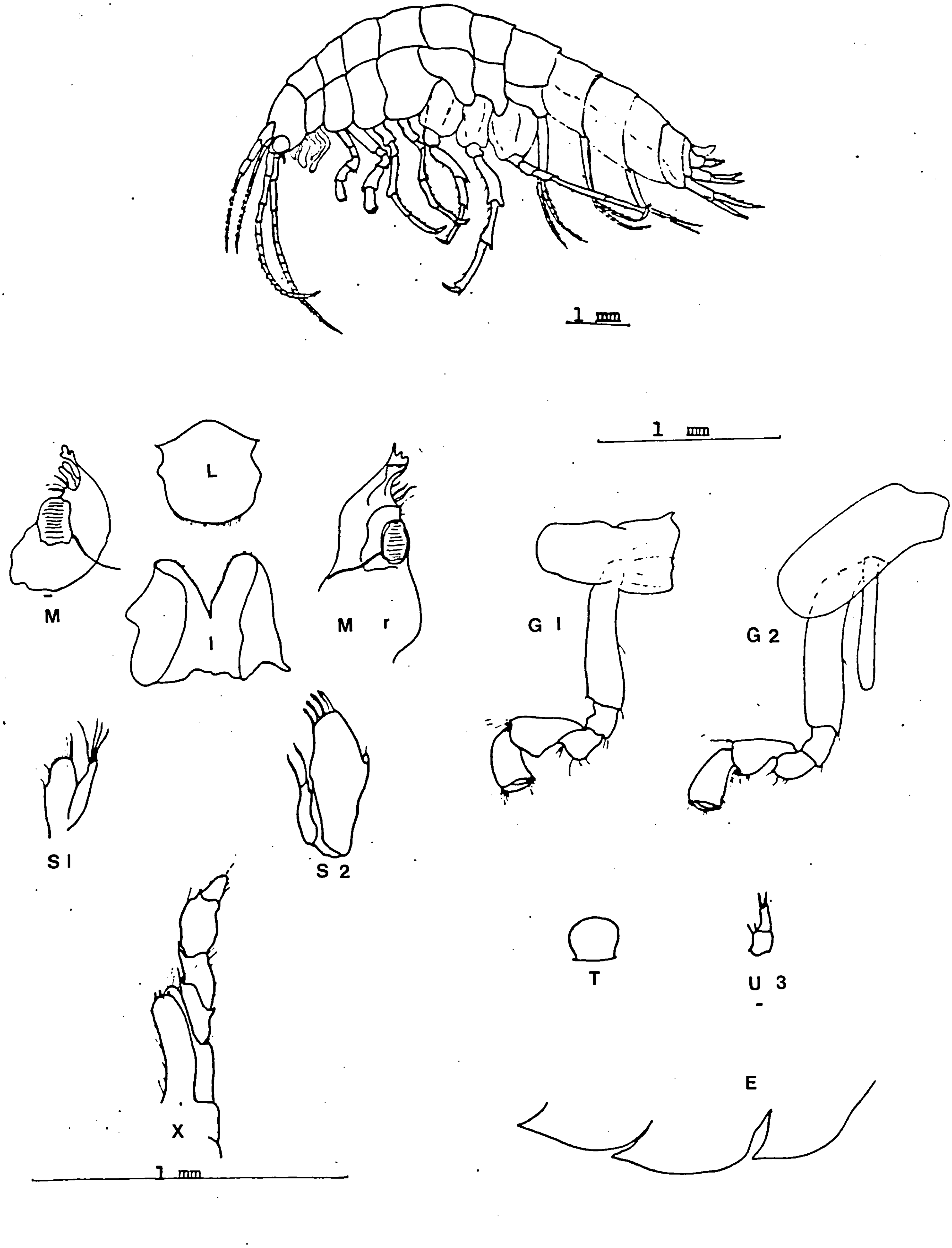


Figure 32. Hyalella anophthalma ♀ 7 mm.

Mouthparts basic; mandible without palp, molar triturative with long plumose seta; left mandible with 2-toothed lacinia mobilis, right with multitoothed lacinia; maxilla 1 palp vestigial. Gnathopod 1-2 subequal in female, subchelate, where gnathopod 2 male larger than 1 with suboval propodus. Pereopods 3-4 subequal, dactylus elongate; pereopods 5-7 spinose, dactylus elongate, 6 longer than 5 and 7, and basis suboval; pereopod 7 basis oval. Pleopods basic. Uropods 1-2 rami subequal, spinose; uropod 3 uniramus, short, apical spines on peduncle and ramus. Telson entire, more or less rounded.

Ecology:

Benthic in still subterranean freshwaters.
The absence of eyes and lack of body pigmentation are considered stygobiontic adaptations; the enlargement of the antennal gland and development of accessory gills are considered adaptations to still freshwater. The small brood size and large eggs are indicative of a "k" reproductive strategy, typical of a stygobiontic life-history.

Distribution:

Hyalella anophthalma is the only stygobiont amphipod known from the South American continent, and has only been found in a cave at the type locality. It has been reported on three separate occasions, but has not been found since 1971 during many other expeditions to this cave, and to other neighbouring caves in the Sierra S. Luis. An English expedition to the Sierra during the spring of 1973 failed to find amphipods but recorded Hyalella ? meinerti (identified by J. Stock) from the deep dry shelf "Sima Haiton del Guarataro" (Chapman, 1980). An investigation of these caves by the author in September and December 1981 discovered troglobitic isopods and Collembola but no amphipods.

Hyalella anophthalma is an endemic of Sierra S. Luis, a range of limestone mountains up to an altitude of 1500 m surrounded by xerophytic lowland and the Caribbean Sea. This stygobiontic species is a relict of earlier amphipod taxocoenosis. It undergoes population fluctuations correlated with seasonal and annual changes in rainfall.

Remarks:

The family Gammaridae contains the majority of stygobiontic freshwater amphipods across the world with the exception of South America where the Hyalellidae is the common freshwater family. The only exception is the bitypic genus *Falklandella* from the continental Falkland Islands. In South America *Hyalella* has undergone a species explosion in Lake Titicaca with abundant restricted and endemic species. This pattern parallels somewhat the evolution of *Gammarus* in the asiatic Lake Baikal.

Many of the species of *Hyalella* are difficult to differentiate morphologically. However, *H. curvispina* Shoemaker is relatively easy to recognize by the long curved spine of the outer ramus of uropod 1. It is widespread from Cochabamba, Ecuador, to Tierra del Fuego, and from sea level in Montevideo to 4000 m in the Andean lakes. *Hyalella anophthalma* is quite similar to *H. meinerti* Stebbing from the Amazon basin and to *H. pteropus* Schellenberg from Peru, but is unique amongst hyalellids for the total absence of eyes and lack of body pigmentation.

Family TALITRIDAE

Body robust and smooth. Coxal plates of moderate size with posterior process. Coxal plate 1 reduced. Eyes large, nearly contiguous. Antenna 1 shorter than peduncle of antenna 2. Antenna 2 gland cone absent. Lacinia of left mandible 4-5 toothed. Maxilliped 3-articulate, article 4 vestigial or absent. Gnathopods variable, simple, subchelate or mitten-type. Pereopods similar; occasionally fossorial. Uropod 3 small and uniramus. Telson small, fleshy, entire or apically notched. Coxal gills sack-like; sternal gills absent. Oostegites lamellate.

The Talitridae Costa, 1857 is the only family of amphipods with fully terrestrial species, usually associated with sandy or shingly beaches, and exhibits characteristic orientation behaviour in relation to the height and angle of the sun (Ercolini & Scapini, 1972).

The family comprises more than 200 warm-temperate species grouped in 13 genera (Bousfield, 1982). Two genera have been recorded from the Venezuelan littoral: _Orchestia_ (beach flea), a non-substrate modifier and _Talorchestia_ (sand hopper), a substrate modifier. Both genera have a large number of species but still retain a somewhat artificial taxonomic distinction. The only valid character separating _Orchestia_ and _Talorchestia_ is the form of gnathopod 1 in the females, which is subchelate and simple respectively. There are however intermediate states as exemplified by the case of _Talorchestia fritzi_. _Talorchestia tucurauna_ was described by Fritz Müller in 1864 from Brazil. Stebbing described as _Talorchestia fritzi_ similar material from Costa Rica in 1903, and transferred _T. tucurauna_ to

Orchestia tucurauna in 1906. In 1938, Schellenberg described material from Brazil as T. fritzi but this could equally well be assigned to O. tucurauna as the author explained. Finally in the revision of Talitridae by Bousfield (1982) the species is referred to as a beach flea, Orchestia fritzi (page 69) and as a sand-hopper, Platorchestia fritzi (page 73).

Key to the Venezuelan genera of Talitridae

1 Gnathopod 1 in female subchelate, but palm very short. Orchestia

\- Gnathopod 1 in female simple. Talorchestia

Talorchestia Dana

Talorchestia Dana, 1852: 310; Stebbing, 1906: 543;
Barnard, 1969: 472.

Body very robust and smooth. Coxal plates moderately large and rounded. Antenna 1 not reaching beyond peduncle article 4 of antenna 2; antenna 2 robust about half body length. Maxilliped palp article 4 vestigial or absent. Gnathopod 1 in male subchelate; gnathopod 1 in female simple. Gnathopod 2 in male subchelate and robust; gnathopod 2 in female weak, mitten-type. Pereopods 6-7 robust and spinose. Uropods 1-2 biramous. Uropod 3 small and uniramus. Telson entire or weakly notched.

A very large genus, widely distributed, mostly circumtropical, terrestrial, and usually associated with sandy beaches. Most are modifiers of the substrate and are known as sand-hoppers. The 44 species currently referred to *Talorchestia* are:

Talorchestia ancheidos Barnard, 1916: 221.
South Africa.

Talorchestia antennulata Chevreux, 1915: 4.
New Caledonia.

Talorchestia australis Barnard, 1916: 220.
South Africa.

Talorchestia brito Stebbing, 1891: 324.
North Atlantic and Mediterranean Sea.

Talorchestia capensis (Dana) / *Orchestia capensis* Dana, 1853: 866 / *Talorchestia capensis*; Barnard, 1940: 470.
South Africa.

Talorchestia chathamensis Hurley, 1956: 365.

Chatham Islands.

Talorchestia cooki Filhol, 1885: 459; Hurley, 1956: 365.

Cook Strait.

Talorchestia darwini (Muller) / Orchestia darwini Fritz Muller, 1864: 16 / Talorchestia darwini; Stebbing, 1906: 545.

Brazil.

Talorchestia dentata (Filhol) / Orchestia dentata Filhol, 1885: 462 / Talorchestia dentata; Hurley, 1956: 385.

Kapiti Islands.

Talorchestia deshayesii (Audouin) / Orchestia deshayesii Audouin, 1826: 93 / Talorchestia deshayesii; Chevreux, 1873: 127.

North Atlantic and Mediterranean Sea.

Talorchestia diemenensis Haswell, 1879: 248.

Tasmania.

Talorchestia franchetti Maccagno, 1936: 179.

Red Sea.

Talorchestia frisiae Klein, 1969: 179.

Frisian Islands.

Talorchestia fritzi Stebbing, 1903: 925; Schellenberg, 1938: 211 and in part Talorchestia tucurauna (Fritz Muller), 1864: 54.

Brazil and Costa Rica.

Talorchestia gracilis (Dana) / Talitrus gracilis Dana, 1852: 201 / Talorchestia gracilis Stebbing, 1906: 551.

South-east Asia.

Talorchestia inaequalipes Barnard, 1951: 705.

South Africa.

Talorchestia kempi Tattersall, 1914: 449.

Assam.

<u>Talorchestia</u> <u>kirki</u> Hurley, 1956: 371.

Chatham Islands.

<u>Talorchestia</u> <u>landanae</u> Schellenberg, 1925: 160.

West Africa.

<u>Talorchestia</u> <u>limicola</u> Haswell, 1880: 98.

South Pacific: Queensland.

<u>Talorchestia</u> <u>longicornis</u> (Say) / <u>Talitrus</u> <u>longicornis</u> Say, 1818: 384 / <u>Talorchestia</u> <u>longicornis</u> Stebbing, 1906: 549.

Cape Cod to New Jersey.

<u>Talorchestia</u> <u>marcuzzi</u> Ruffo, 1950: 50.

Central Litoral, Venezuela.

<u>Talorchestia</u> <u>margaritae</u> Stephensen, 1948: 7.

Margarita Island, Venezuela.

<u>Talorchestia</u> <u>martensii</u> (Weber) / <u>Orchestia</u> <u>martensii</u> Weber, 1892: 564 / <u>Talorchestia</u> <u>martensii</u> Stebbing, 1906: 553.

Flores Sea, East Indies.

<u>Talorchestia</u> <u>nipponensis</u> Morino, 1972: 53.

Japan.

<u>Talorchestia</u> <u>novaehollandiae</u> Stebbing, 1899: 399.

East Australia.

<u>Talorchestia</u> <u>pachypus</u> Derjavin, 1938: 109.

Japan Sea.

<u>Talorchestia</u> <u>patersoni</u> Stephensen, 1938: 247.

Stewart Island.

<u>Talorchestia</u> <u>pollicifera</u> (Stimpson) / <u>Orchestia</u> <u>pollicifera</u> Stimpson, 1855: 383 / <u>Talorchestia</u> <u>pollicifera</u> Stebbing, 1906; 550.

North Pacific.

<u>Talorchestia</u> <u>pravidactyla</u> Haswell, 1880: 100.

Tasmania.

Talorchestia quadrimana (Dana) / Orchestia quadrimana Dana, 1852: 204 / Talorchestia quadrimana; Stebbing, 1906: 584.

Australia.

Talorchestia quadrispinosa Barnard, 1916: 204.

South Africa, Cape Peninsula.

Talorchestia quoyana (Milne-Edwards) / Orchestia quoyana Milne-Edwards, 1840: 15 / Talorchestia quoyana; Chilton, 1917: 294.

New Zealand.

Talorchestia rectimana (Dana) / Orchestia rectimana Dana, 1852: 203 / Talorchestia rectimana; Stephensen, 1935: 143.

Society Islands (500 m alt.).

Talorchestia sinensis Chilton, 1925: 283.

China.

Talorchestia skoogi Stebbing, 1922: 8.

Angola.

Talorchestia spadix Hurley, 1956: 383.

New Zealand.

Talorchestia spinipalma (Dana) / Orchestia spinipalma Dana, 1852: 203 / Talorchestia spinipalma; Stebbing, 1906: 552.

Tropical Pacific.

Talorchestia spinifera (Mateus) / Orchestia spinifera Mateus, 1962: 9 / Talorchestia spinifera; Amanieu & Salvat, 1963: 1.

South-west Europe.

Talorchestia telluris (Bate) / Orchestia telluris Bate, 1862: 20 / Talorchestia telluris Chilton, 1917: 299.

New Zealand.

Talorchestia tricornuta Shoemaker, 1920: 373.

Congo and Angola.

Talorchestia _tridentata_ Stebbing, 1899: 398.

California.

Talorchestia _tumida_ Thompson, 1895: 577.

New Zealand.

Talorchestia _zachsi_ Derjavin, 1938: 108.

Japan.

Five of these species are from the American Atlantic: _Talorchestia_ _longicornis_ has a wide northern distribution from Cape Cod to New Jersey (Stephensen, 1948). _T_. _fritzi_ has been reported twice from Costa Rica and Brazil, and is herein recorded from Venezuela. _T_. _darwini_ has been reported only from Brazil. _T_. _margaritae_ and _T_. _marcuzzii_ are Venezuelan species, the former abundant, the latter less common.

<u>Key to the American Atlantic species of Talorchestia</u>

1	Male gnathopod 2 palm with proximal process.	2
-	Male gnathopod 2 palm without proximal process.	4
2	Palmar process in male gnathopod 2 enormous and bifid.	<u>darwini</u>
-	Palmar process in male gnathopod 2 not bifid.	3
3	Gnathopod 2 male palmar process prolonged with one conspicuous spine; dactylus simple with marginal spinules.	<u>margaritae</u>
-	Gnathopod 2 male palmar process unprolonged; dactylus with a posteroproximal tooth and marginal spinules.	<u>marcuzzii</u>
4	Uropod 1 outer ramus with 10 spines.	<u>longicornis</u>
-	Uropod 1 outer ramus without marginal spines.	<u>fritzi</u>

Of these, <u>Talorchestia</u> <u>margaritae</u>, <u>T</u>. <u>marcuzzii</u> and <u>T</u>. <u>fritzi</u> are redescribed from Venezuela. For their distribution see map on figure 33.

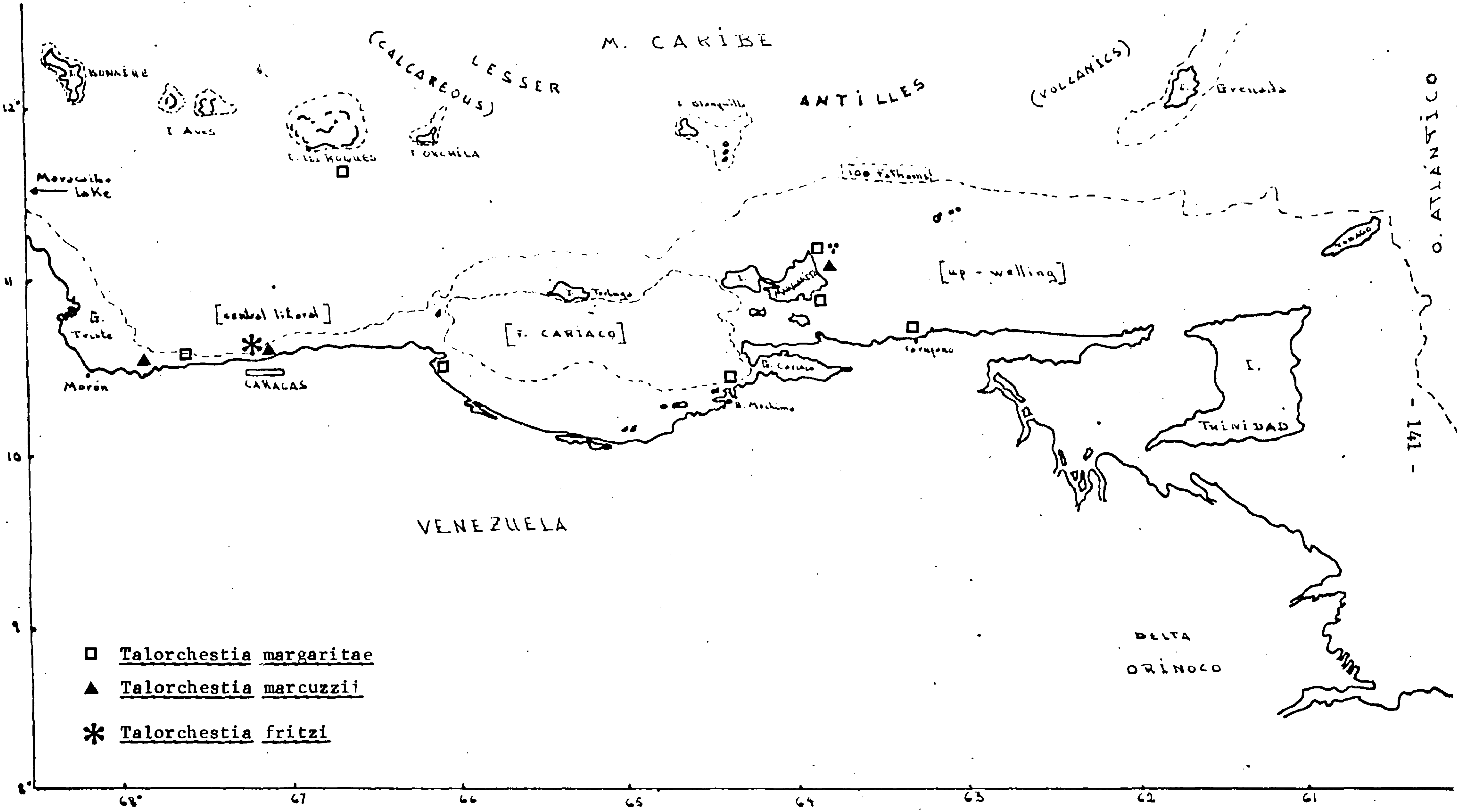


Figure 33. Map of the distribution of the species of Talorchestia.

<u>Talorchestia</u> <u>margaritae</u> Stephensen

(Figs 34-35)

<u>Talorchestia</u> <u>margaritae</u> Stephensen, 1948: 7; Ruffo, 1950: 50.

<u>Material examined</u>:

19 ♂♂, 12 ♀♀ and 12 juveniles, Playa El Agua, Isla de Margarita, 14 January 1982. Several specimens from Cumana, Golfo de Cariaco, 3 November 1975 and 2 September 1977. Several specimens from Los Totumos, Cabo Codera, 7 May 1980. Several specimens from Patanemo, Central Litoral, 26 March, 5 and 25 June 1981.

<u>Description</u>:

Length up to 12 mm, median size 9 mm, colour pale greyish white. Eyes black, large and almost contiguous. Coxal plates spinose distally and posteriorly with tooth on posterodistal margin of plates 1-4. Coxal gills conspicuous. Epimeral plates with some serrations and spines on posterodistal margin angle. Head shorter than the first two pereonal segments. Antenna 1 short, not reaching mid-point of peduncle article 4 of antenna 2, flagellum 3-articulate. Antenna 2 over half body length; peduncle article 4-5 subequal; flagellum 18-articulate.
Male gnathopod 1 subchelate, carpus and propodus with postero-distal lobes, dactylus longer than palm. Male gnathopod 2 propodus extremely robust, subtriangular; palm medially convex, spinose, with large proximal process supporting apical spine; dactylus strong and curved; posterior margin of propodus shorter than palm. Pereopod 4 little shorter than 3; pereopods 6-7 similar and longer than 5; basis of pereopod 7 broader than 6.

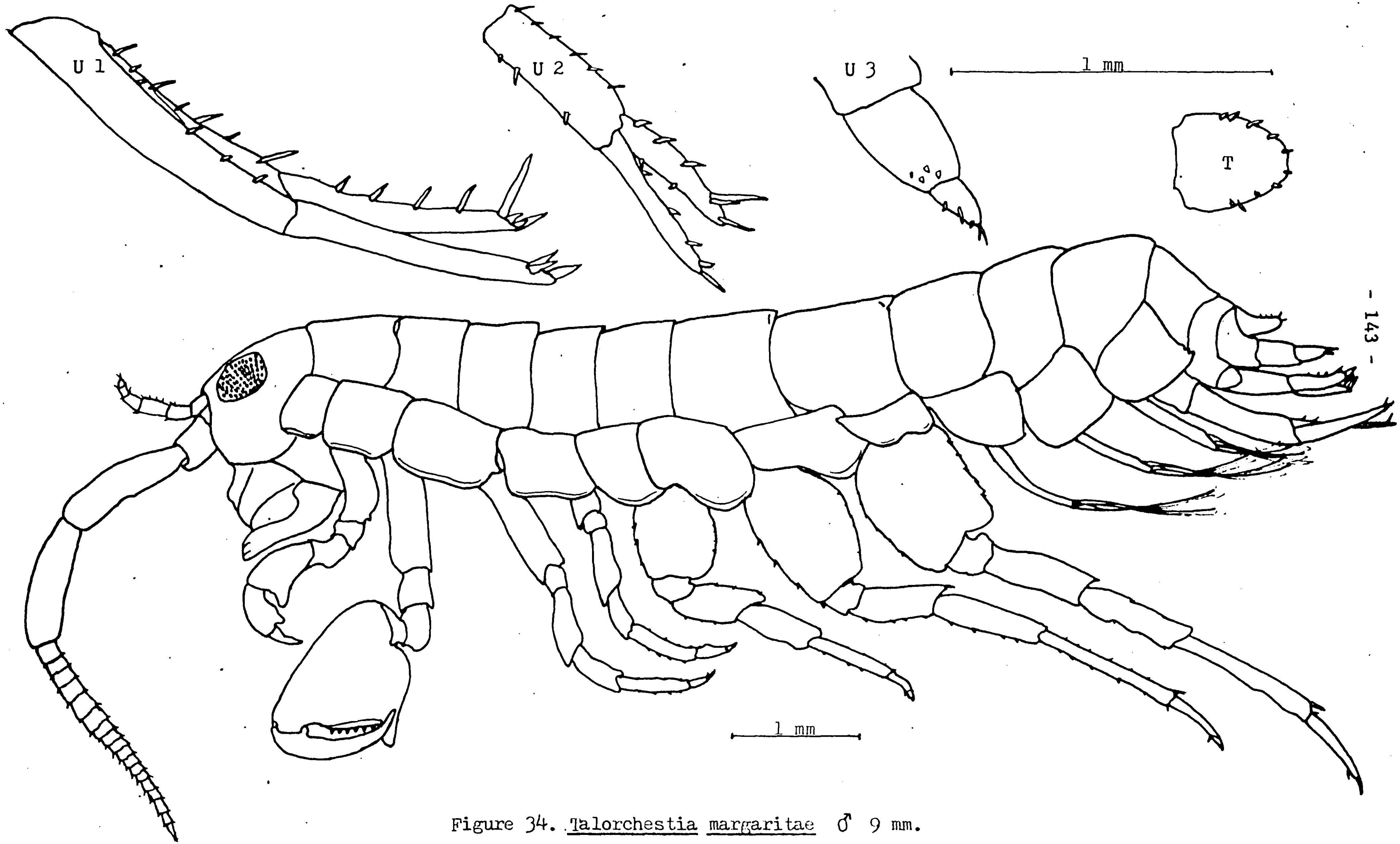


Figure 34. Talorchestia margaritae ♂ 9 mm.

Pleopods elongate, basic. Uropod 1 outer ramus without marginal spines. Uropod 2 outer ramus with 4 marginal spines. Uropod 3 ramus half peduncle length with small spines. Telson fleshy, subrounded, apex weakly excavate with about 10 spines.

Female similar to male except gnathopod 1 simple, basis narrower, carpus with smaller lobe, propodus without palm, dactylus longer than in male. Gnathopod 2 mitten-type, smaller than in male. Oostegites setose. Ovigerous female with 7 eggs.

Ecology:

Talorchestia margaritae is the common sand-hopper on the beaches of Venezuela. Occurrence is correlated with the accumulation of dry turtle grass, *Thalassia testudinum*, with densities exceeding 5000 amphipods per square metre on some sandy beaches where they live under the grass during the day, leaving at night. The amphipods can jump in excess of 1 metre. A small red ectoparasitic mite was found on the ventral pereon of some specimens.

Distribution:

Venezuela: Isla de Margarita (type locality); Carupano; Golfo de Cariaco; Cabo Codera; Central Litoral; Islas Los Roques (see map).

Remarks:

The species was described by Stephensen (1948) and later recorded by Ruffo (1950) from the type locality and surrounding area. The present material corresponds closely with the type description.

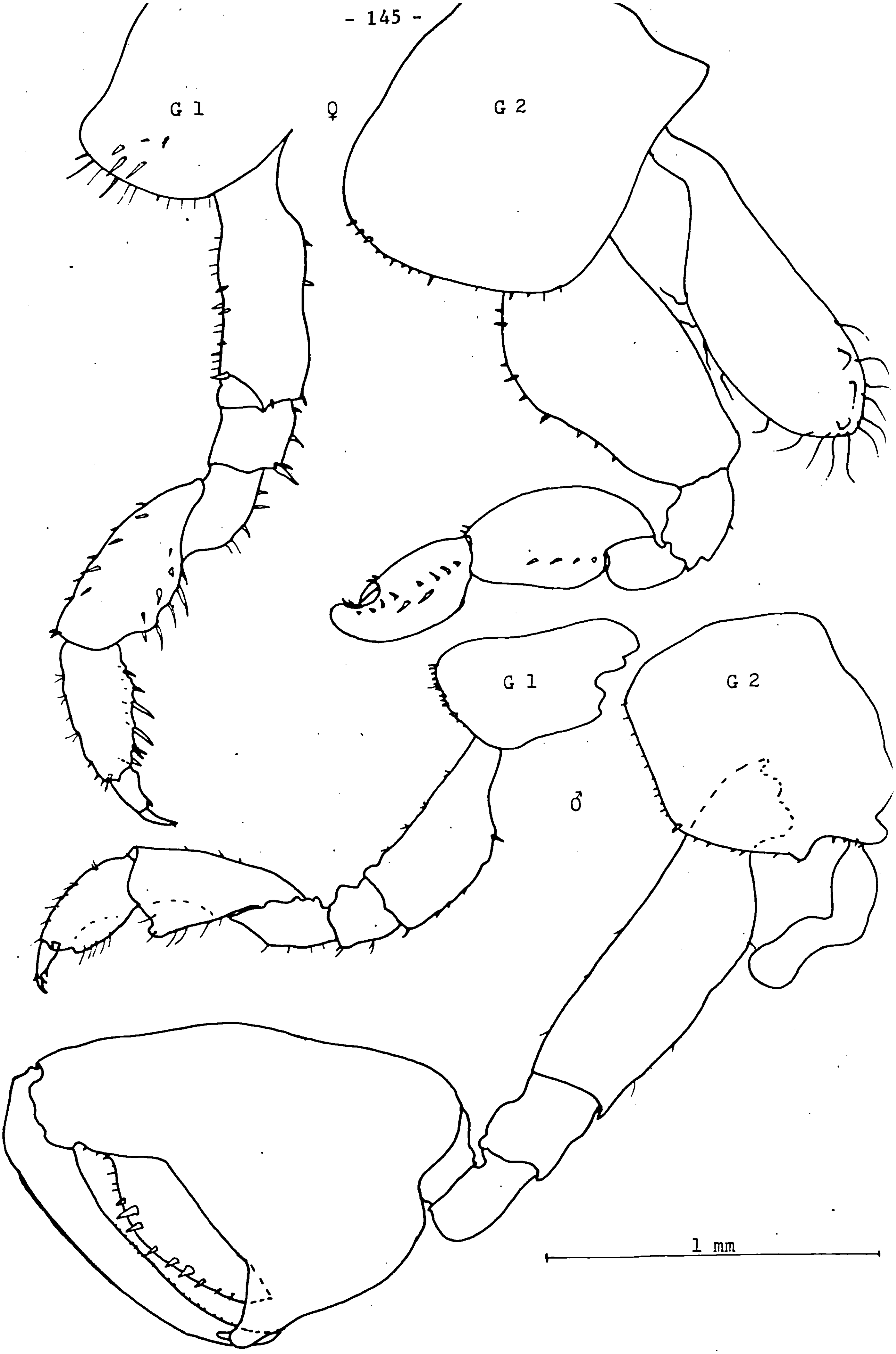


Figure 35. Talorchestia margaritae ♂ 9 mm & ♀ 9 mm: Gnathopods.

<u>Talorchestia marcuzzii</u> Ruffo

(Figs 36-37)

<u>Talorchestia marcuzzii</u> Ruffo, 1950: 52.

<u>Material examined</u>:

3 ♂♂, 5 ♀♀, Playa Quisandal, Puerto Cabello, Golfo Triste, 27 December 1965.

<u>Description</u>:

Length up to 10 mm, colour whitish. Eyes black, large and almost contiguous. Coxal plates, coxal gills and the epimeral plates more or less as in <u>T. margaritae</u>. Head about as long as the first pereonal segment. Antenna 1 short, reaching about mid-point of peduncle article 4 of antenna 2; flagellum 4-articulate. Antenna 2 more than half body length; flagellum longer than peduncle; peduncle article 4 shorter than 5; flagellum 22-articulate, the first two articles fused, articles 11-18 with a conical posterodistal prolongation, especially prominent on article 17; articles of flagellum also spinose; the conical processes only appear in adult males over 8 mm in length. Male gnathopod 1 subchelate as in <u>T. margaritae</u>. Male gnathopod 2 propodus extremely robust, subrectangular; palm medially convex, spinose, with large proximal process and distal concavity; dactylus robust, more strongly curved than in <u>T. margaritae</u> and with a rounded inner marginal tooth close to the base; posterior margin of propodus longer than palm and with few spines. Pereopods and pleopods similar to <u>T. margaritae</u>. Uropods 1-2 outer ramus without marginal spines. Uropod 3 similar to <u>T. margaritae</u>. Telson fleshy, suboval, with weakly

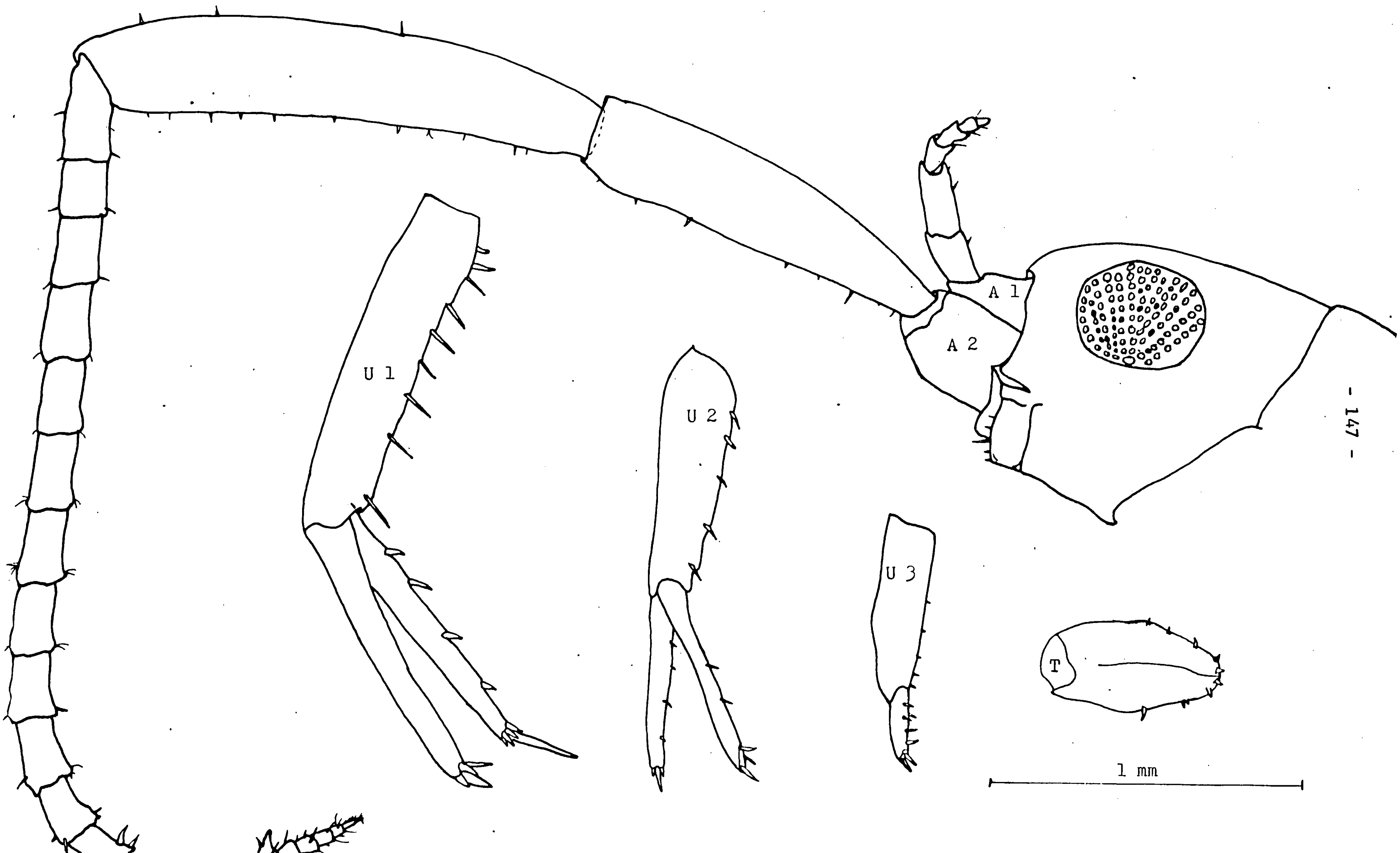


Figure 36. Talorchestia marcuzzii ♂ 9 mm.

notched apex, margin bearing about 10 spines.

Female similar to male and similar to the female of _T._ _margaritae_, except the first gnathopod intermediate between simple and subchelate. Gnathopod 2 mitten-type, smaller than in male. Oostegites setose.

Ecology:

Talorchestia _marcuzzii_ is less common and slightly smaller than the preceding species, but with the same general features. Its abundance is probably limited by competition with _T._ _margaritae_.

Distribution:

Venezuela: Maiquetia, Central Litoral; Puerto Fermin, Isla de Margarita; Puerto Cabello, Golfo Triste (see map).

Remarks:

The species was described by Ruffo (1950) from the Central Litoral. Material from Golfo Triste corresponds precisely with the type, extending the known distribution westward. Ruffo (1950) mentioned juveniles in the north-east part of Isla de Margarita, but during recent collecting in this area only _T._ _margaritae_ was found.

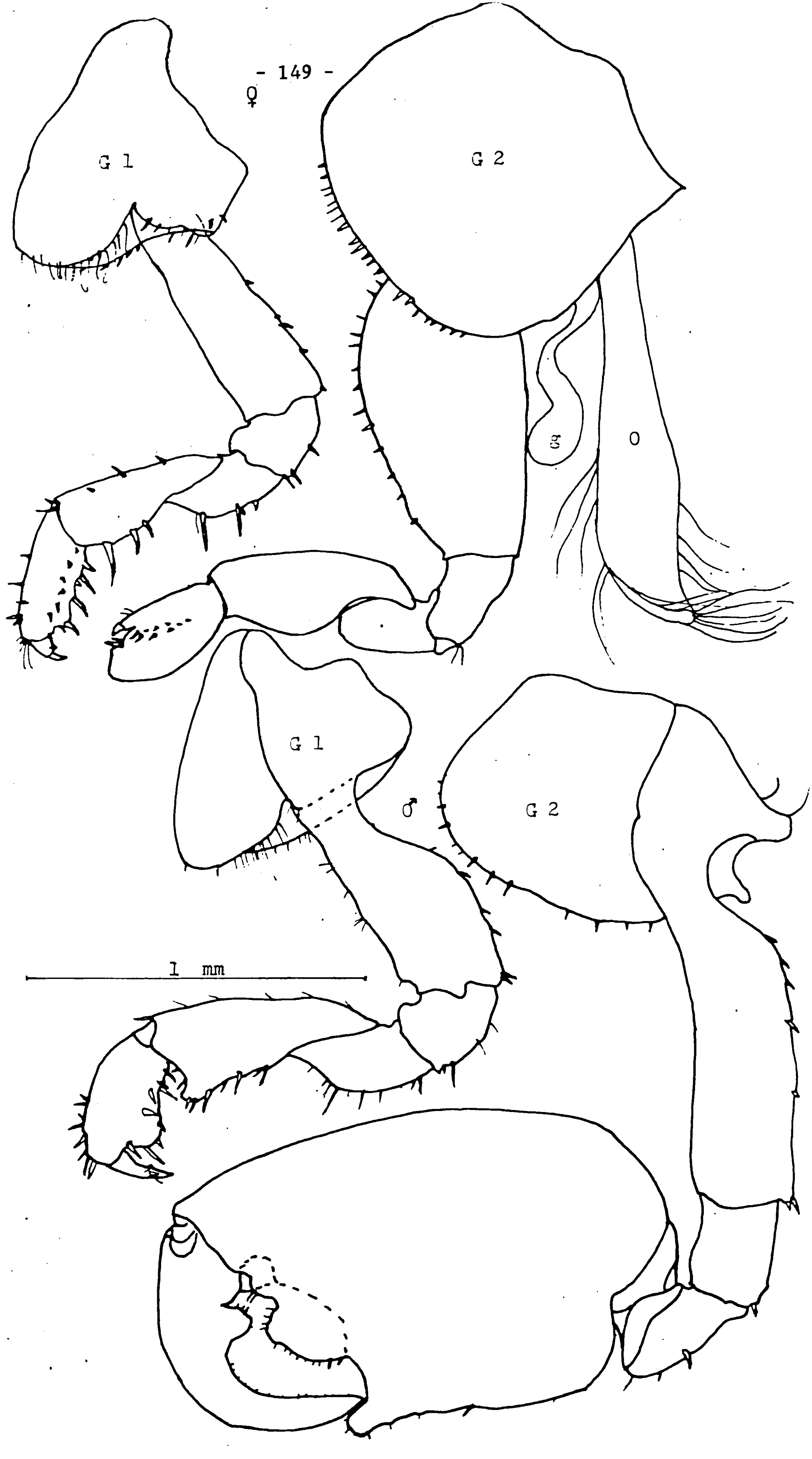


Figure 37. Talorchestia marcuzzii ♂ 9 mm & ♀ 9 mm: Gnathopods.

Talorchestia fritzi (Müller)

(Figs 38-39)

Talorchestia tucurauna Fritz Müller, 1864: 54.

Talorchestia fritzi Stebbing, 1903: 925; Schellenberg, 1938: 211.

Material examined:

7 ♂♂, 9 ♀♀, Puerto Cruz, Central Litoral, 2 August 1966.

Description:

Length up to 11 mm, body smooth, colour whitish. Eyes large and nearly contiguous, blackish. Coxal plates, gills and epimeral plates similar to T. margaritae. Head little longer than first pereonal segment. Antenna sexually dimorphic. Antenna 1 in male almost reaching the mid-point of article 4 of antenna 2; peduncle articles subequal and longer than 4-articulate flagellum. Male antenna 2 less than half body length, peduncle massive, subequal in length with 15-articulate flagellum. Gnathopods sexually dimorphic. Male gnathopod 1 subchelate, carpus and propodus with posterodistal lobes, propodus as long as broad, with palm longer than dactylus. Male gnathopod 2 propodus extremely robust, subrectangular; palm convex and spinose with distal concavity; dactylus robust and curved with inner marginal tooth close to the hinge. Pereopods 5-7 longer than 3-4; pereopod 4 distinctly cuspidactylate. Uropod 1, rami subequal, as long as peduncle, outer ramus without marginal spines. Uropod 2 shorter than 1, outer ramus with two marginal spines. Uropod 3 small, uniramous. Telson intermediate between T. margaritae and T. marcuzzii.

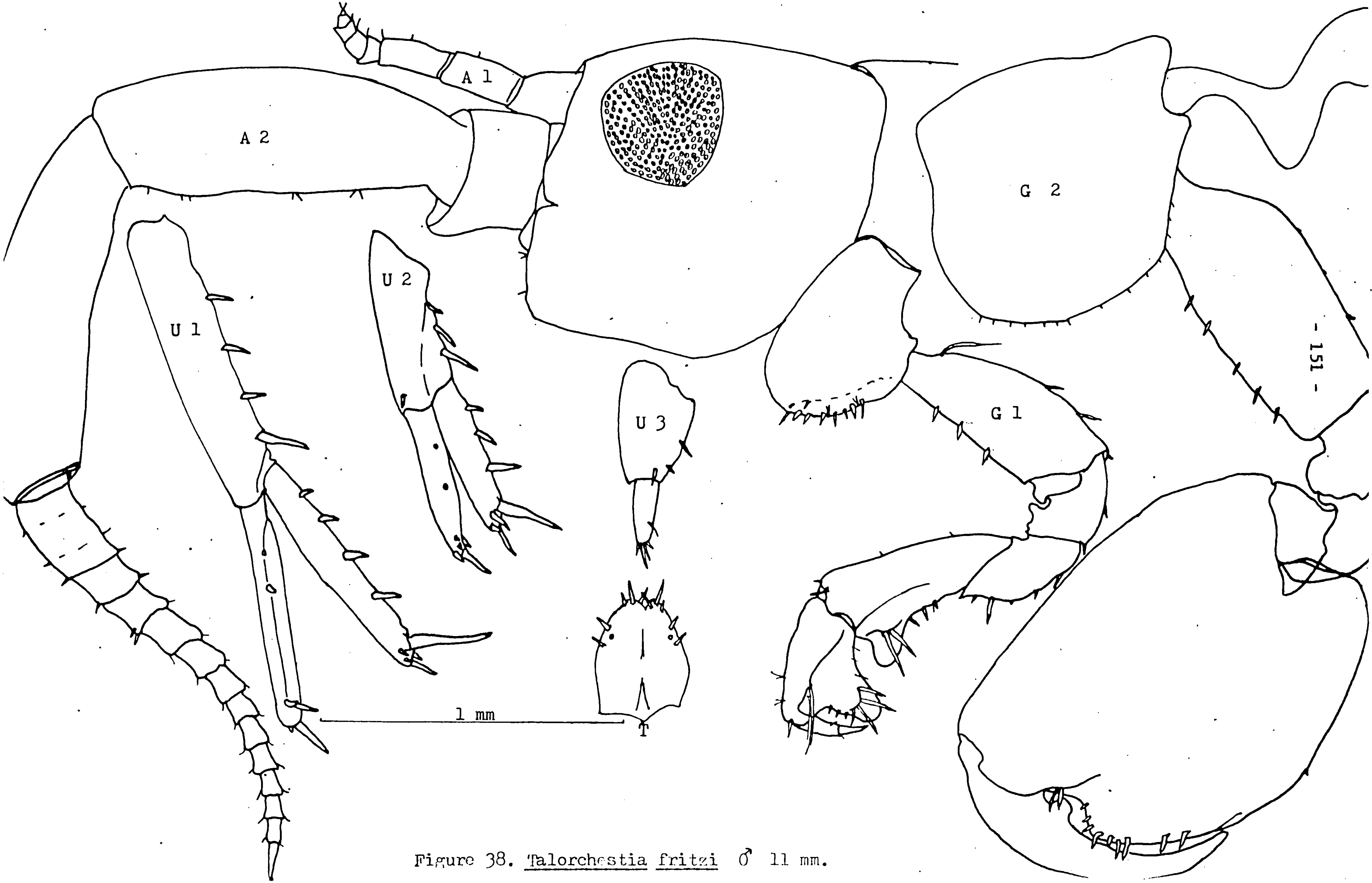


Figure 38. Talorchestia fritzi ♂ 11 mm.

Female generally similar to male, length up to 9 mm, antenna 1, flagellum 3-articulate; antenna 2 not massive, about half body length. Gnathopod 1 simple. Gnathopod 2 subchelate, mitten-type.

Ecology:

Talorchestia fritzi is a rare sand-hopper reported only once on a Venezuelan sandy beach.

Distribution:

Costa Rica; Isla de Cocos; Brazil: widespread distribution. Herein recorded for the first time from Venezuela.

Remarks:

The present material agrees closely with the type description (Müller, 1864) and subsequent descriptions (Stebbing, 1903; Schellenberg, 1938).

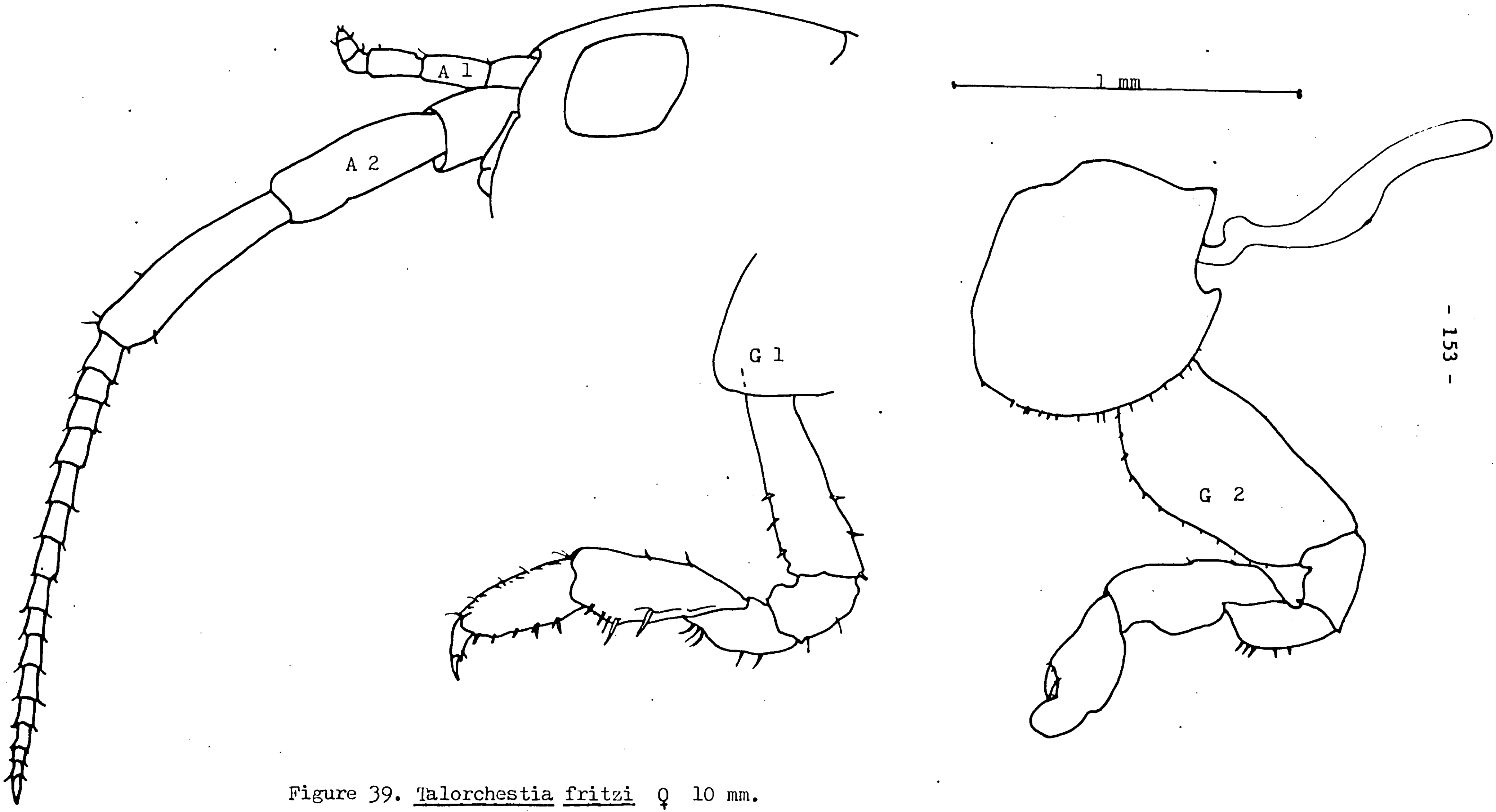


Figure 39. <u>Talorchestia</u> <u>fritzi</u> ♀ 10 mm.

Orchestia Leach

Orchestia Leach, 1814: 402; Stebbing, 1906: 530; Bousfield, 1982: 22.

Body basic gammaridean, robust and smooth. Coxal plates of moderate size. Head with deep antennal sinus. Antenna 1 shorter than peduncle of antenna 2. Buccal mass prognathous. Lacinia 4-dentate, rarely with vestigial fifth tooth. Maxilliped palp 3-segmented, segment 2 broad, lobose. Gnathopod 1 in male subchelate, dactylus shorter than palm. Gnathopod 1 in female subchelate, dactylus longer than palm. Gnathopod 2 in male subchelate, propodus powerful, dactylus sinuous. Gnathopod 2 in female weak, mitten-type. Pereopods 3-7 cuspidactylate; pereopod 4 distinctly pinched. Uropods as in *Talorchestia*. Telson weakly notched.

Formerly a very large genus, recently revised and subdivided by Bousfield (1982) to comprise mainly the Atlantic and Mediterranean species close to the type species of the genus, *Oniscus gammarellus* Pallas, 1766. The genus has about fifteen recognized terrestrial species; usually associated with shingle beaches. These amphipods are regarded as non-modifiers of the substrate and are locally referred to as beach-fleas.

<u>Orchestia aparicioi</u> new species

(Figs 40-41)

<u>Material examined</u>:

Holotype ♂, 15 mm, Boca de Rio, Macanao, Isla de Margarita (south-west), 3 January 1983.

Paratypes: 1 ♂, 10 mm; and many additional specimens also from type locality.

<u>Etymology</u>: The species is named after a colleague, Mr J. Aparicio.

<u>Description</u>:

Length up to 15 mm, colour pale brownish white. Eyes black, lateral not enlarged. Coxal plates similar to <u>Talorchestia</u>. Coxal gills 3-5 reduced. Epimeral plates weakly serrated and spinose posterodistally. Head basic talitrid, antennal sinus deep. Antenna 1 short, scarcely reaching end of peduncle article 4 of antenna 2; flagellum about 5-articulate. Antenna 2 less than half body length; peduncle not distinctly robust in male; flagellum about 21-articulate. Mouthparts prognathous. Lacinia of left mandible 5-dentate but fifth tooth vestigial. Maxilliped palp article 4 absent; article 2 broad with inner marginal lobe. Male gnathopod 1 subchelate with tumescent process on postero-distal margin of carpus and propodus; dactylus shorter than palm. Male gnathopod 2 subchelate; propodus powerful, subrounded, palm medially convex, as long as posterior margin of propodus and spinose; dactylus robust, curved, sinuous. Pereopods non-fossorial, slender, weakly spinose, cuspidactylate, but with pereopod 4 distinctly pinched. Pleopods basic. Uropod 1 outer ramus without marginal spines. Uropod 2 outer ramus with about three marginal spines. Uropod 3 ramus scarcely shorter than peduncle. Telson weakly notched with distal and dorsomarginal spines.

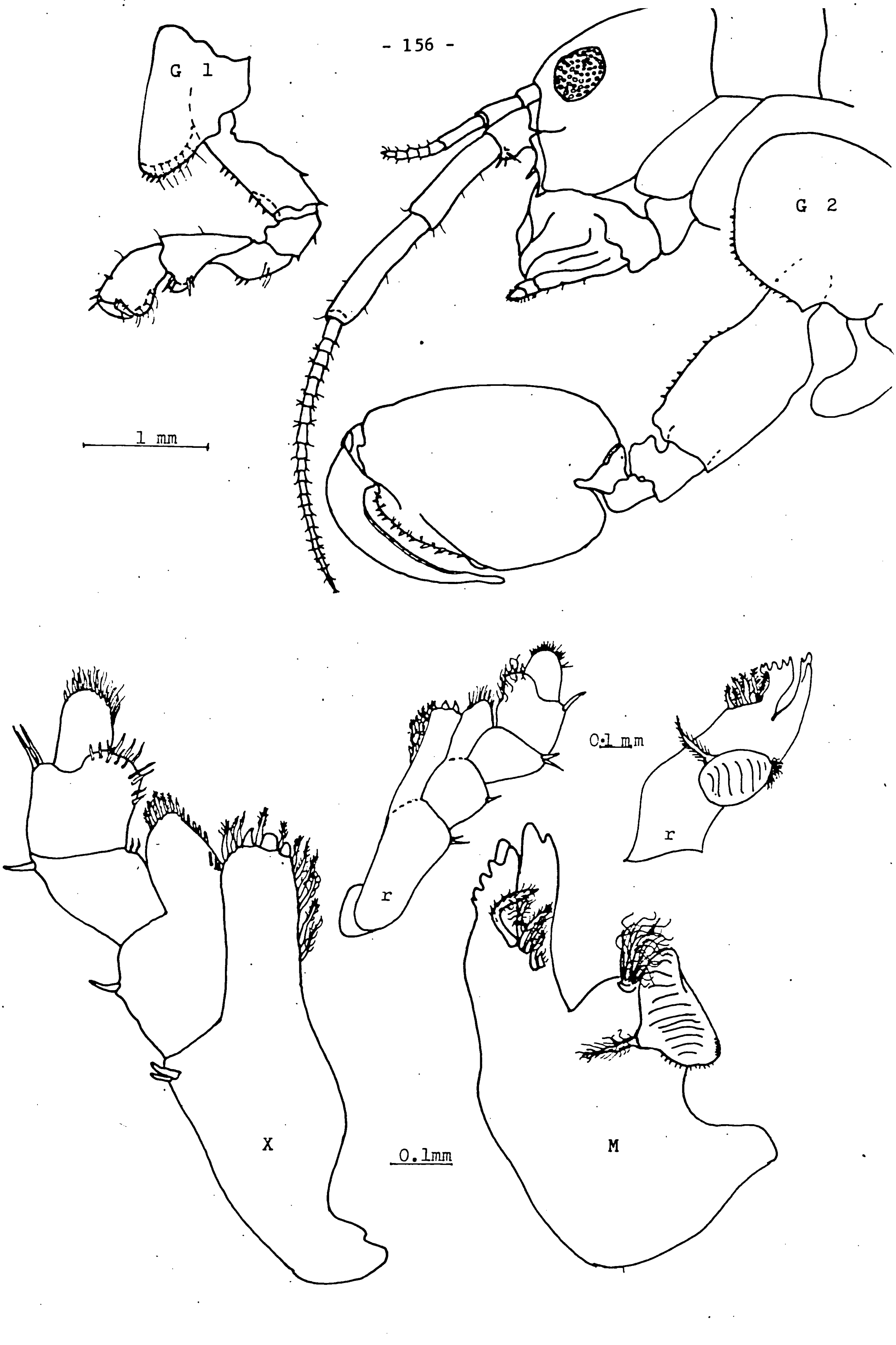


Figure 40. Orchestia aparicioi ♂ 15 mm.

Female similar to male except gnathopod 1 subchelate, dactylus exceeding palm; gnathopod 2 subchelate, mitten-type with basis expanded anteriorly. Oostegites elongate with small setae.

Ecology:

Orchestia aparicioi is a common beach-flea on shingly beaches that have an accumulation of seaweed and turtle grass, *Thallassia testudinum*, occurring in densities exceeding 5000 amphipods per square metre. They live under the grass and within the shingle during the day, emerging to jump around at night. A small, white, ectoparasitic mite was found on the ventral pereonal surface of some specimens.

Distribution:

Known only from the vicinity of the type locality in Venezuela.

Remarks:

The species fits well within the new concept of the genus proposed by Bousfield (1982). It can be distinguished from all known species by the slender form of male antenna 2, the slender nature of pereopod 7 in large males, and the presence of a small fifth tooth on the lacinia of the mandible.

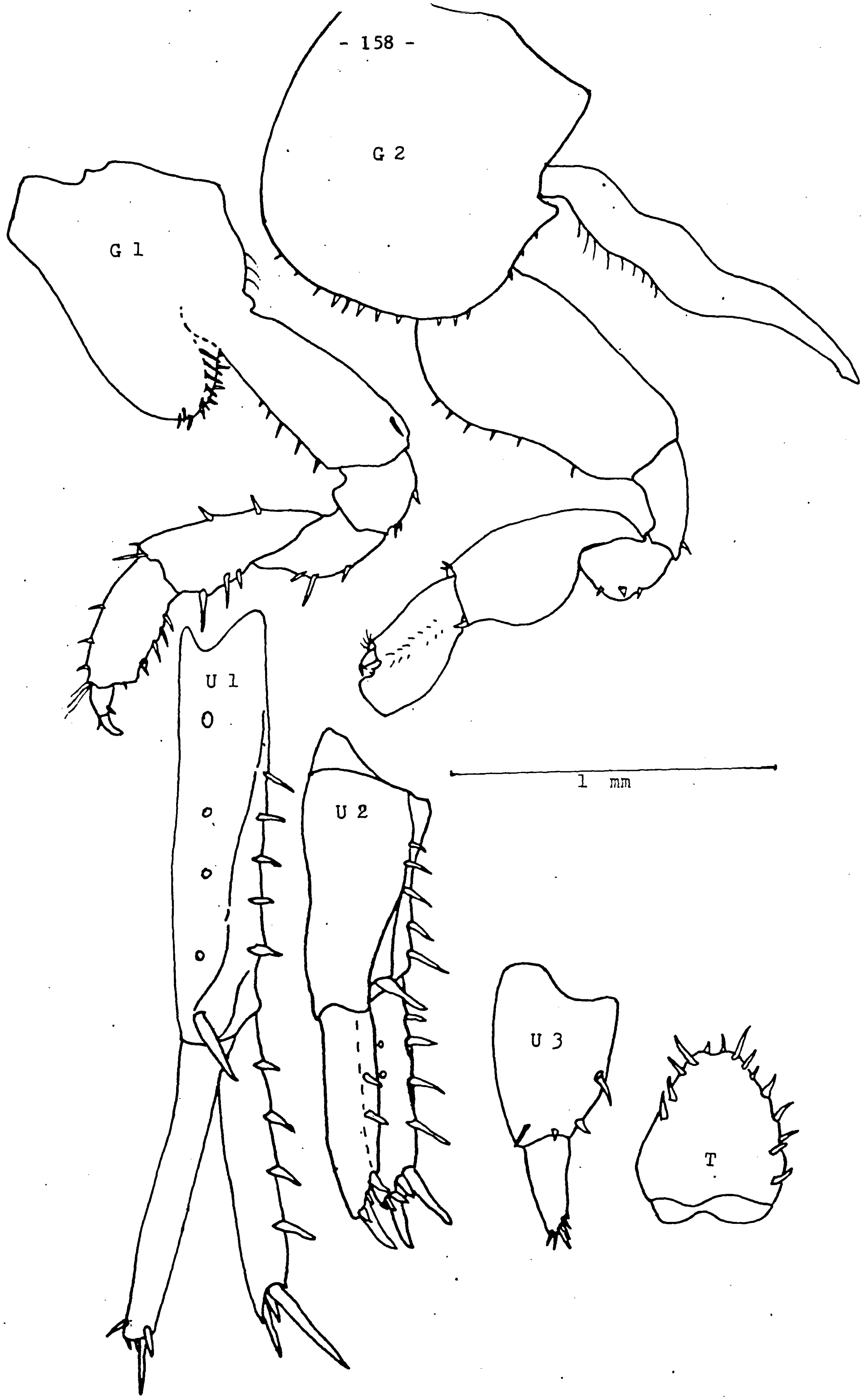


Figure 41. Orchestia aparicioi. ♂ 15 mm & ♀ 10 mm: Gnathopods.

Superfamily PHOXOCEPHALOIDEA

Body smooth, with fossorial adaptations, antennae and appendages, spinose and setose. Sexual dimorphism restricted mainly to the antennae, terminal male antennae bearing calceoli. Accessory flagellum multiarticulate. Rostrum present or absent, hood-like or cylindrical. Mandibular molar generally weak, palp 3-articulate. Coxal plates deep and overlapping. Gnathopods weak, subsimilar, not sexually dimorphic, variously chelate or subchelate. Pereopods 3-4 spinose and fossorial, pereopods 5-7 distally elongated, dactylus spinose. Pleopods strong. Uropods strong. Uropod 3 outer ramus dominant, 2-articulate. Telson lamelliform, cleft.

The superfamily Phoxocephaloidea was proposed by Bousfield (1978) to encompass the families Phoxocephalidae, Urothoidae and Platyischnopidae. In addition to their ecologial unity as sand burrowers, they share the same type of calceolus (Lincoln & Hurley, 1981). The Phoxocephalopsidae, recently designated by Barnard & Clark (1982), has been encompassed within the Urothoidae by Bousfield (1983). This study reports the Platyischnopidae from the Caribbean for the first time.

Family PLATYISCHNOPIDAE

Body slender, anterior pereon segments compressed. Head elongate, produced into cylindrical rostrum. Mandibular molar weakly triturative; maxillipeds dactylate. Gnathopods chelate. Pereopods fossorial. Uropod 3 outer ramus elongate, 2-articulate; inner ramus short. Telson short, entire or cleft.

The fossorial family Platyischnopidae Barnard & Drummond, 1979 (p. 2) comprises 5 genera, _Platyischnopus_ Stebbing, 1888 and the recently designated _Tomituka_, _Yurrokus_, _Tittakunara_ and _Indischnopus_ (Barnard & Drummond, 1978). Further new genera are anticipated from American species of _Platyischnopus_ (Barnard & Drummond, 1979). The unity of the family is based on the unique large hooded rostrum. However, it resembles Phoxocephalidae and Urothoidae in possessing a simple type-8 calceolus (Lincoln & Hurley, 1981). The genus _Platyischnopus_ is recorded for the first time from the Caribbean.

Platyischnopus Stebbing

Platyischnopus Stebbing, 1888: 830; Stebbing, 1906: 122.

Body moderately robust, pereon small, head long with "shark nose" rostrum. Mandible with elongate incisor; lacinia mobilis linguiform; spine row reduced. Maxilla 1 reduced, inner plate naked or bearing single seta; maxilla 2 plates rather conical with setae mainly medial. Maxilliped palp 4-articulate. Coxal plates rounded, subquadrate below. Gnathopods strongly chelate. Pereopods dactylate; article 2 of pereopods 6 and 7 expanded. Uropods 3 immensely elongate (outer ramus); inner ramus short, scale-like; outer ramus thick and strongly spinose. Telson lacking dorsal spines.

A littoral genus formerly of 9 species of which the Indian ones have been removed to Indischnopus by Barnard (1979) and the American ones to Endevenopus Thomas & Barnard (1983). In the latter the carpus of the gnathopods is smaller than the propodus. Since these changes have yet to become generally accepted, the former concept of Platyischnopus is retained for the present study. The nine recognized species are:

Platyischnopus capensis Barnard, 1925 p.338
South Africa

Platyischnopus capuciatus (Oliveira, 1955) / Phoxocephalus capuciatus Oliveira, 1955: 313 / Platyischnopus capuciatus; Barnard, 1963: 224.
Brazil.

Platyischnopus gracilipes Schellenberg, 1931: 63.
Valparaiso and Rio de Janeiro.

Platyischnopus herdmani Walker, 1904: 247.

Sri Lanka.

Platyischnopus mam Barnard & Drummond, 1979: 11.

East Australia.

Platyischnopus metagracilis Barnard, 1963: 225.

Baja California.

Platyischnopus mirabilis Stebbing, 1888: 830.

East Australia and tropical Atlantic.

Platyischnopus neozelanicus Chilton, 1897: 1

New Zealand.

Platyischnopus viscana Barnard, 1963: 226.

Baja California.

<u>Platyischnopus</u> <u>metagracilis</u> Barnard

(Figs 42-44)

<u>Platyischnopus</u> <u>metagracilis</u> Barnard, 1963: 225.

<u>Material examined</u>:

3 ♂♂, 8 ♀♀, Los Roques archipelago, Venezuela, 28 April 1980.

1 ♀, Golfo Triste continental shelf, Venezuela, 8 September 1979.

<u>Description</u>:

Length up to 3 mm, pereon short, colour yellowish. Head elongate about 20 per cent of body length. Eyes large, contiguous dorsally, ommatidia distinct, but may be obscured with black pigment. Antenna 1 short; accessory flagellum 3-articulate, half or more length of primary flagellum. Antenna 2 about equal to body length; flagellum multiarticulate, extremely elongate and narrow, calceoli present. Mandible with weak triturative molar; incisor simple with cornified side ridge; lacinia mobilis liguiform; three small spines in spine row; palp 3-articulate, elongate and slender, article 1 short and naked, article 2 with distal short spine, article 3 slender with oblique apex and 4 setal spines. Maxilla 1, inner plate small, outer plate with 7 spines, palp 1-articulate reaching apex of outer plate, thin and setose. Maxilla 2 basic and small. Upper lip fused to epistome; lower lip with inner lobes. Maxillipeds short, inner plate small and weak, outer plate thin, palp 4-articulate and dactylate. Coxal plates deep and overlapping; coxal plate 4 quadrate with posterior lobe very wide. Gills present on coxae 3-7. Gnathopods chelate, 2 slightly bigger than 1; article 5 of gnathopods shorter than 6, dactylus with crenulate outer margin. Pereopods

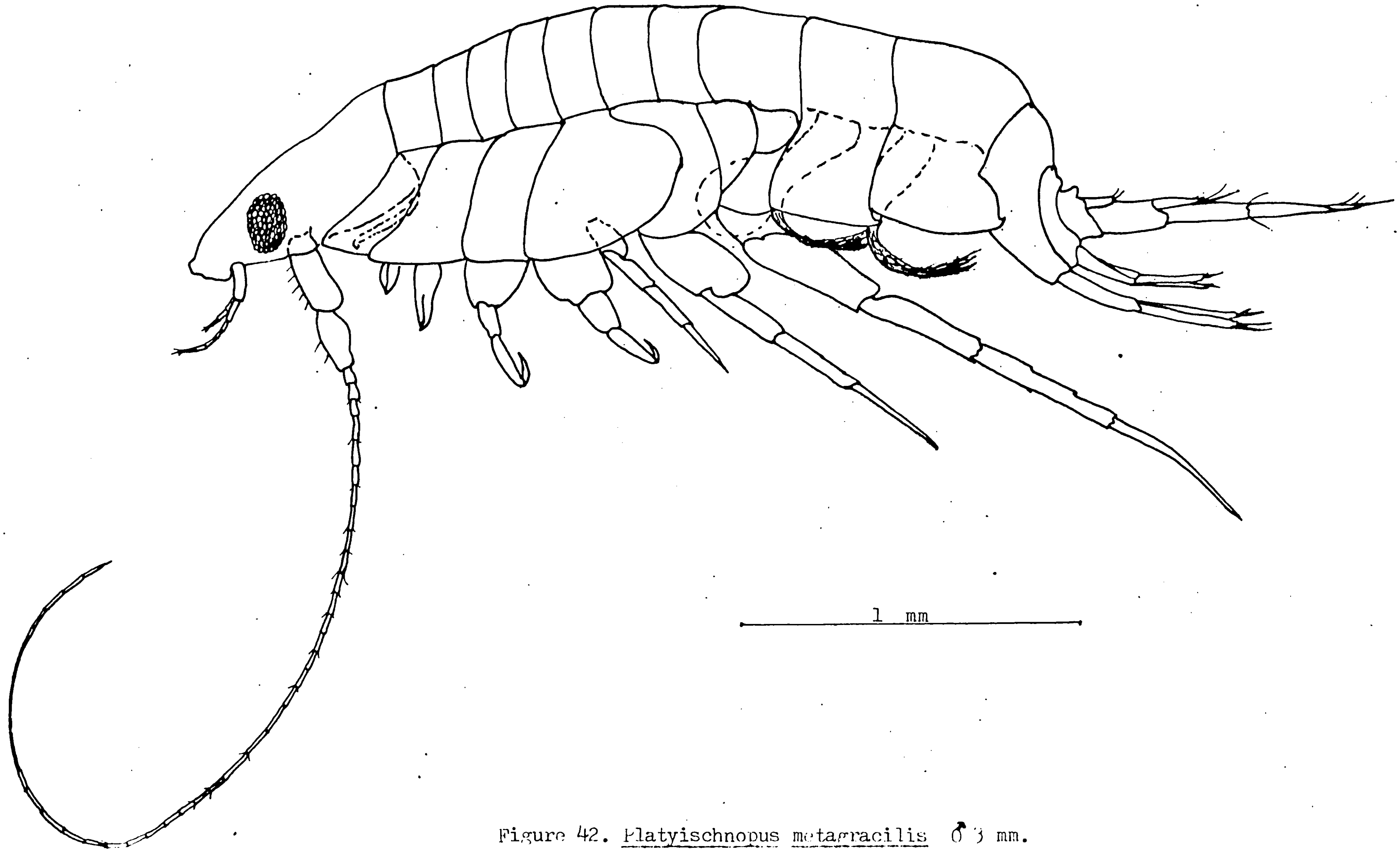


Figure 42. *Platyischnopus metagracilis* ♂ 3 mm.

3-4 similar with reflexed dactylus closing between spines of propodus, carpus with stout spines, merus with long setae, ischius small, basis with two long posterior setae. Pereopods 5-7 spinose with spiniform elongate dactylus as long as propodus. Pereopod 7 with article as wide as long bearing an incision on posterodistal angle, dactylus as long or longer than propodus. Pleosome large, segment 3 dorsally smooth; epimeral plate 2 with small tooth on posterodistal angle; epimeral plate 3 with recurved tooth posterodistally; pleopods strong. Urosome small; segment 1 bearing scarcely evident dorsal saddle; urosomite 2 weakly protuberant dorsally; urosomite 3 strongly protuberant dorsally. Peduncle of uropod 1 with thin posterodistal spine and two strong curved apical spines; rami with posterodistal spines. Uropod 2 smaller than 1. Uropod 3 elongate, spiniform and setose; peduncle bearing leaf-like inner ramus and biarticulate outer ramus with plumose setae and spines, ending in acute and elongate apex with spine. Telson laminar cleft, lobes divergent, each lobe with an apical incision bearing two spines and two apicolateral setae.

Female similar to male except antenna 2 short, just reaching beyond antenna 1, flagellum simple 3-articulate. Oostegites elongate and very narrow, bearing 6, 7 or 8 very long setae, present only on pereopods 3-5. Gravid females with about 5 eggs.

Ecology:

Platyischnopus metagracilis was collected on Halichondria opuntia at 4 m depth near a coral and mangrove "cayo" of Los Roques atoll.

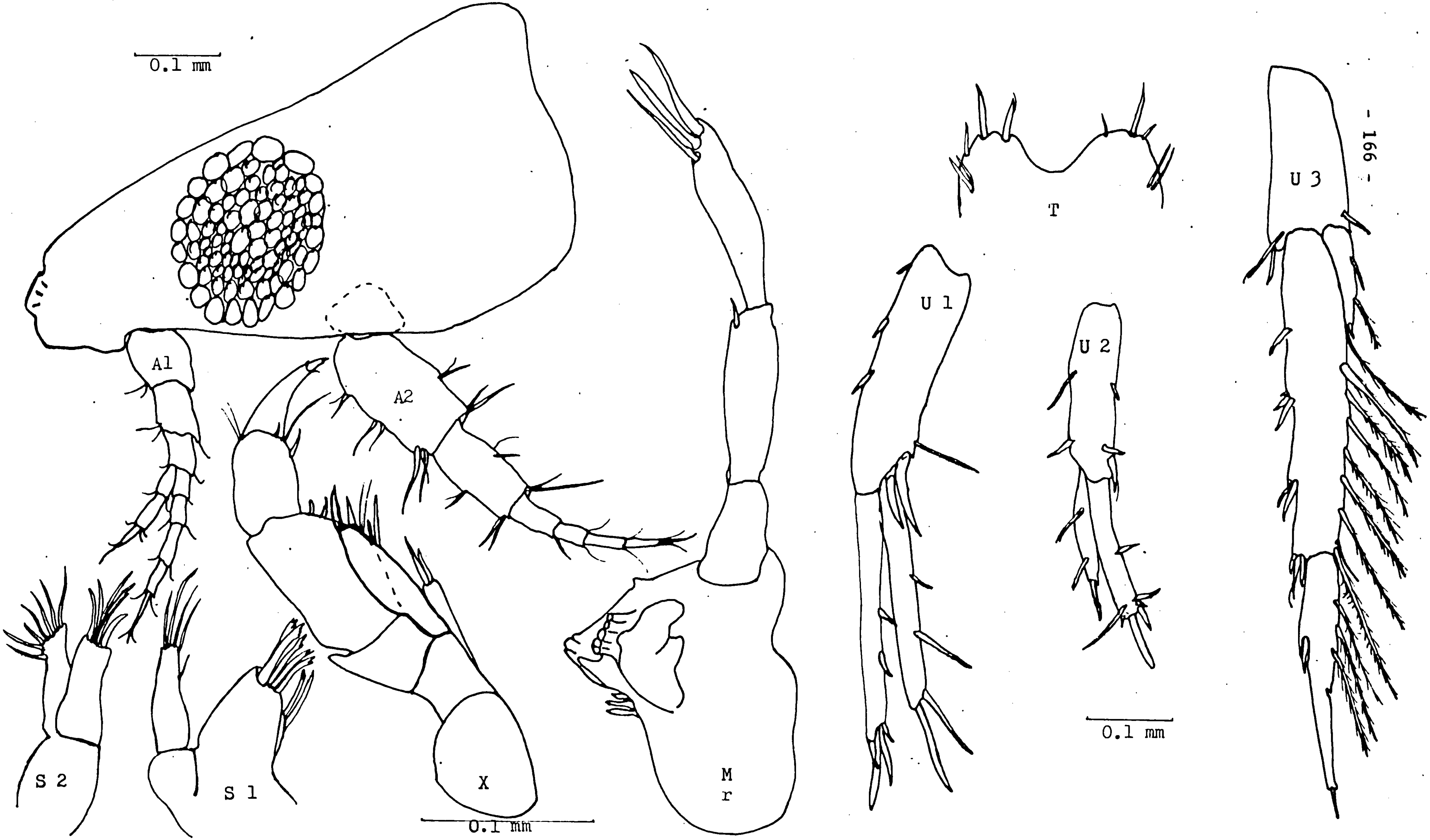


Figure 43. Platyischnopus metagracilis ♀ 2.5 mm.

Distribution:

The species has been reported previously only from Baja California.

Remarks:

Platyischnopus metagracilis differs from *P. gracilipes* and *P. viscana* mainly in the long dactylus of pereopods 6 and 7, the large and quadrate coxal plate 4, and the short cleft telson. The material examined fits precisely Barnard's description except for the eyes which are obscured by pigment, a character that may vary according to the nature of preservation.

This species is a further example of a faunal element shared by the Pacific Ocean and the Caribbean Sea, presumably predating the appearance of the Panama Isthmus about 4 to 5 million years BP.

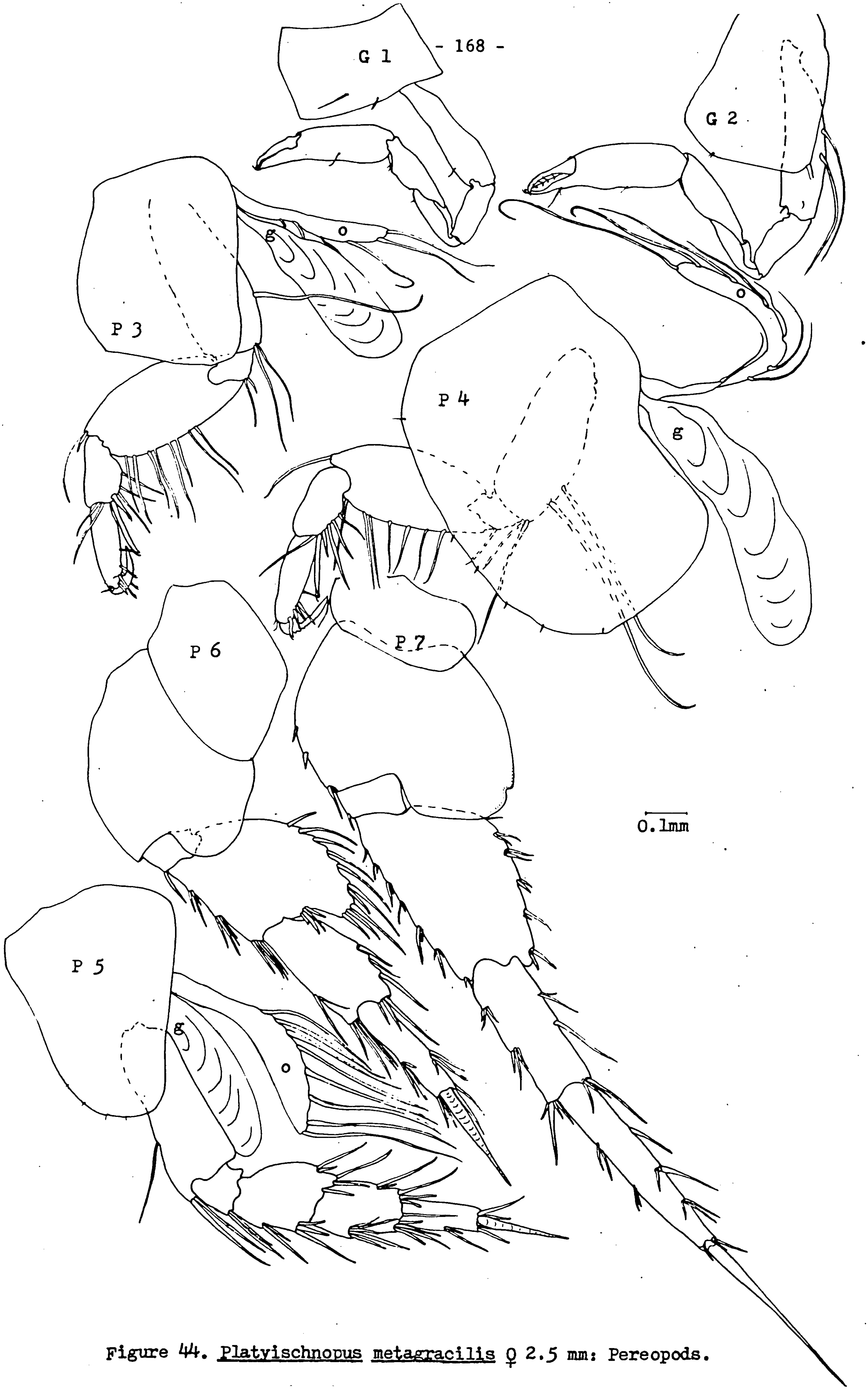


Figure 44. Platyischnopus metagracilis ♀ 2.5 mm: Pereopods.

Superfamily STEGOCEPHALOIDEA

Body compressed; head with rostrum; antenna 1, peduncle article 1 may be enlarged with small accessory flagellum and scarce brush setae. Mouthparts modified; buccal mass cone-like (suctorial or piercing); upper lip distinctly notched distally; lower lip tall, lacking inner lobes; mandibular molar and palp vestigial or lacking; maxillipeds with inner cutting edge. Coxal plates 1-4 deep, coxal plate 4 strongly excavated posteriorly. Gnathopods slender, not sexually dimorphic. Pereopods 3-4 similar; pereopods 5-7 similar, not elongated, with basis expanded or not. Telson lobes usually separated distally.

The superfamily Stegocephaloidea was proposed by Bousfield (1978) to encompass the families: Stegocephalidae, Acanthonotozomatidae, Ochlesidae and Lafystiidae; members of which are mostly pelagic, abyssopelagic, epibenthic or benthic and occur typically in colder fully marine waters of the Northern and Southern Hemispheres. The family Stegocephalidae is reported for first time from the Caribbean Sea.

Family STEGOCEPHALIDAE

Body short and robust. Head short and deep, almost withdrawn within the first pereonal segment. Antennae short. Buccal mass greatly projecting. Mandible simple, without palp, molar and spine row; maxillae large; maxilliped with slender palp and expanded lobes. Coxal plates 1-4 very deep and shield-like, plate 4 the largest; plates 5-7 shallow and small. Pleosome strong with well developed epimeral plates. Urosome short and stout.

The family Stegocephalidae Dana, 1852: 310 comprises 17 genera and 45 species, typically associated with deep waters. Most are burrowers, scavengers or predators that inhabit mainly arctic-boreal and subantarctic regions. This is a very distinctive family recorded for the first time from Caribbean bathyal waters.

Stegocephaloides Sars

Stegocephaloides Sars, 1895: 201; Stebbing, 1906: 91.

Body compact and rounded, dorsum strongly curved. Coxal plates very deep, plate 4 enormous with distal margin angular. Eyes absent. Antennae short, subequal length, but antenna 1 the strongest with flattened peduncle. Mouthparts typical of family. Gnathopods subequal, without sexual dimorphism, generally weak and hidden. Pereopods 3 and 4 subsimilar, slender distal to basis. Pereopods 5 and 6 similar, basis narrow, linear, never laminarly expanded. Pereopod 7 shorter than 5 and 6 having the basis large and laminar with deflexed angular posterodistal lobe. Pleopods powerful, decreasing in size from 1 to 3. Uropods biramous, successively decreasing in length from 1 to 3. Telson triangular, unarmed, cleft.

A genus containing 7 species found in moderate to deep waters of the North and South Atlantic, but with the recent discovery of a deep-water species in Baja California. The following species are presently assigned to the genus.

Stegocephaloides attinges Barnard, 1916: 131.

South Africa.

Stegocephaloides auratus Sars, 1895: 203.

Norway.

Stegocephaloides australis Barnard, 1916: 129.

South Africa.

Stegocephaloides canoti Barnard, 1967: 148.

Cedros Trench, California.

Stegocephaloides christianiensis Sars, 1895: 202.

North Atlantic: from Arctic Ocean to western Mediterranean.

Stegocephaloides katalia Barnard, 1962: 40.

South Africa.

Stegocephaloides vanhoffeni Schellenberg, 1926: 299.

Antarctic Ocean.

Stegocephaloides vegae Oldevig, 1959: 25.

Arctic Ocean.

The genus is now recorded for the first time from Caribbean bathyal waters with a new species, _Stegocephaloides calypsae_.

Stegocephaloides calypsae new species

(Figs 45-47)

Material examined:

Holotype ♂, 3 mm, Cariaco Trench, Venezuela. Type locality: Station West Cariaco Trench, 10°38'N 65°32'W, water depth 1400m, Calypso expedition, night catch at 300-350 m, 6 October 1979.

Samples of	4 ♂♂	from same locality	350 - 300 m	depth	horizon
"	4 ♂♂	"	300 - 250 m	"	"
"	5 ♂♂	"	250 - 200 m	"	"
"	2 ♂♂	"	200 - 100 m	"	"
"	2 ♂♂, 1 ♀	"	100 - 75 m	"	"

Station East Cariaco Trench, 10°31'N 64°45'W, water depth 1300 m, Calypso expedition, night catches from the above depth horizons with 4 ♂♂, 4 ♂♂, 2 ♂♂, 4 ♂♂, 1♂ and 1 ♀, respectively, 5 October 1979.

Etymology:

The species is named after the French oceanographic vessel "Calypso" that took part in a scientific expedition to the Caribbean Sea - Calypso, 79.

Description:

Length up to about 4 mm; body globose with broadly vaulted back, strongly arched anteriorly; colour dark greenish brown, mottled over a whitish background, semitransparent and with white spots. Coxal plates 1-4 forming continuous rigid shield. Head deep and narrow, mostly concealed by first pereonal segment and first coxal plates; rostrum small; lateral lobes

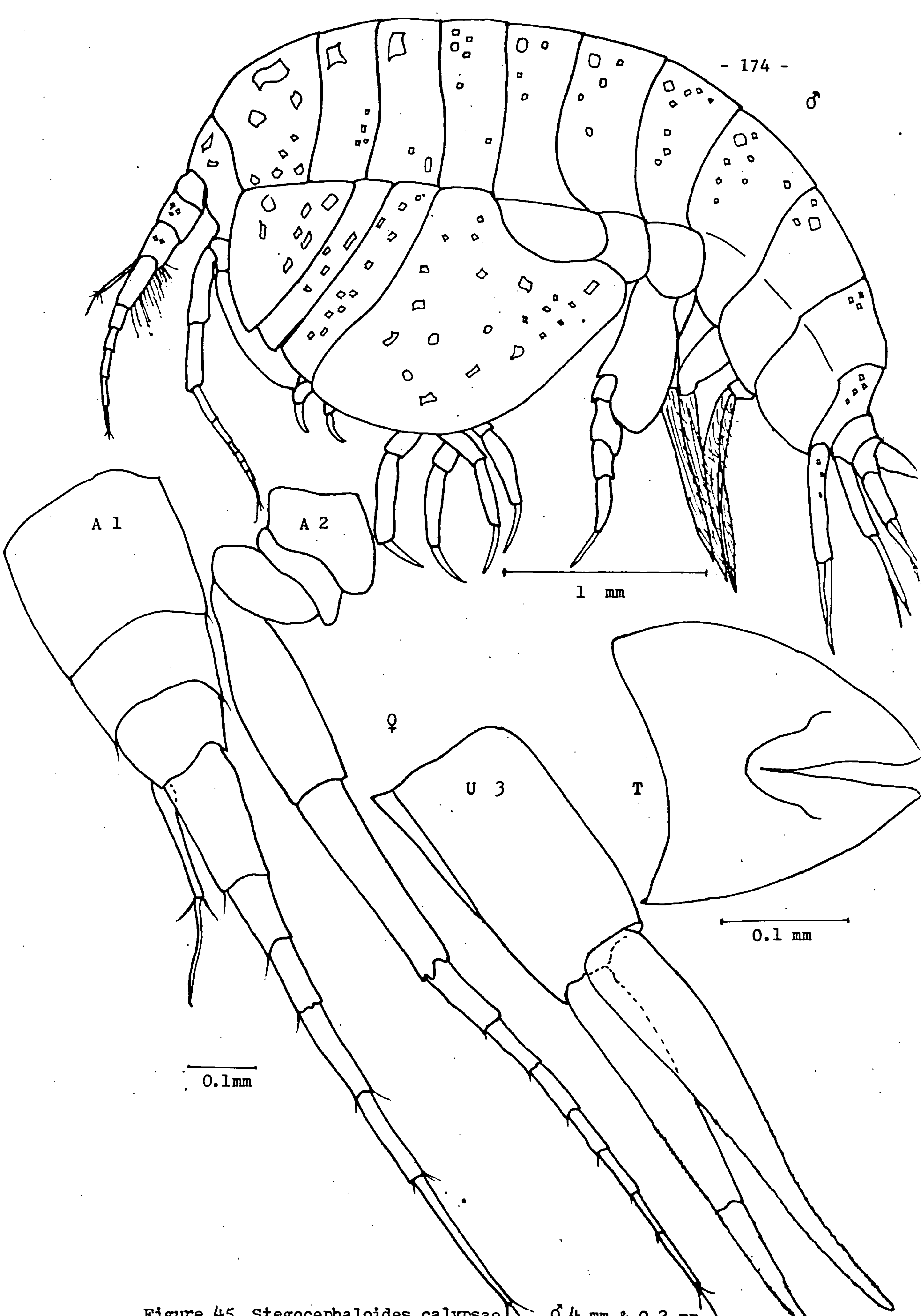


Figure 45. Stegocephaloides calypsae ♂ 4 mm & ♀ 3 mm.

small and triangular. Eyes absent, anterior part of head occupied by two large muscular masses for the first antennae. Antenna 1 peduncle half length of flagellum; peduncle articles flattened, decreasing in length from 1 to 3; flagellum 6 or 7-articulate, article 1 setose and about equal to 2-3 combined, other articles successively elongated, distal article spiniform; accessory flagellum 1-articulate and about equal in length to the first primary flagellar article. Antenna 2 slender, peduncle articles 4 and 5 about equal size, flagellum 6 or 7-articulate. Mouthparts deeply projecting. Upper lip laminar and asymmetrically bilobed. Lower lip with lobes broadly separated, apex of lobes with bidigitate processes. Mandibles with toothed incisor; lacinia mobilis vestigial with a finely serrated edge; lacinia present on left mandible only; right mandible lacking all parts except the incisor. Maxilla 1 palp uniarticulate not reaching base of spines on outer plate. Maxilla 2, outer plate elongate geniculated, inner plate broadly oval. Maxilliped inner plate half length of outer, distally concave; outer plate broad and large, weakly serrate on the inner edge, distally concave; palp 4-articulate, slender. Coxal plate 1 triangular, 2 and 3 very deep, 4 enormous, 5-7 partly hidden by plate 4. Coxal gills present on coxal plates 2-7, sack-like and becoming progressively smaller towards posterior; gill on coxa 7 very small. Gnathopods simple and alike with propodus slender, longer than carpus, palm not delimited, dectylus short. Pereopods 3-6 basis slender. Pereopod 7 considerably shorter than 6; basis expanded posteriorly but not as broad as in other species of the genus, the lobe distally subrounded scarcely reaching proximal joint of article 5; anterior margin of basis relatively short,

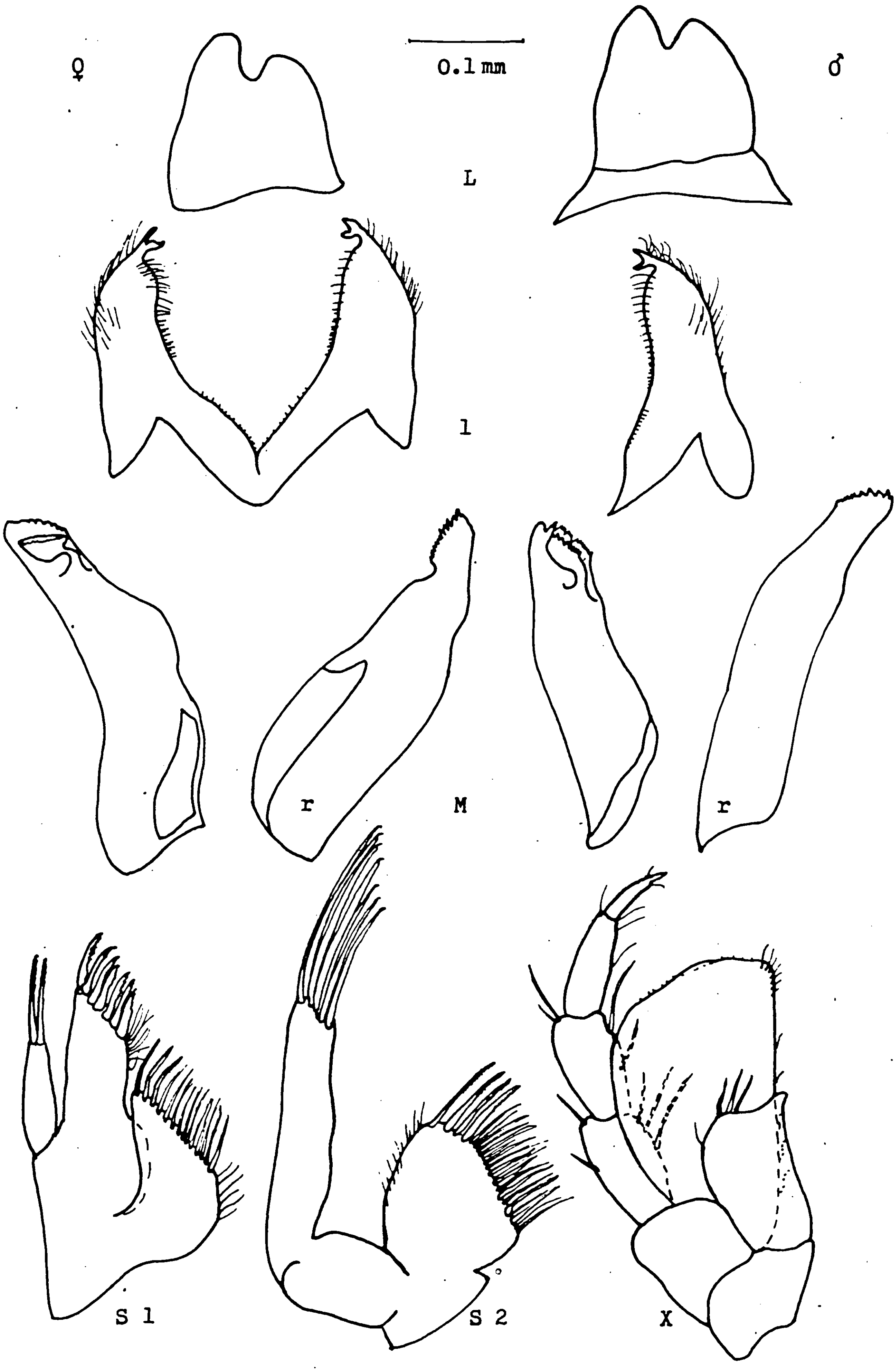


Figure 46. Stegocephaloides calypsae ♂ & ♀ 3 mm: Mouthparts.

shorter than the remaining articles combined; the penes, as paired papillae, projecting ventromedially from the sternum of pereon 7, lateral in position and attached to the interior part of the coxal plate 7 above the gill. Pleopods powerful with short, broad peduncle. Epimeral plate 1 posterodistal angle subrounded, plate 2 subquadrate, plate 3 slightly projecting. Uropod 1, laterally spinose, outer ramus shorter than inner; uropod 2 rami subequal; uropod 3 rami short, outer slightly longer than inner which is biarticulate. Telson laminar, unarmed, and cleft to half length.

Female similar to male, lacking sexual dimorphism in antennae or gnathopods but distinguished by broad oostegites on coxal plates 2-5, and by epimeral plate 3 having 3 distal setae. In addition, gnathopod 2 much less setose and spinose than in male. In the material examined the two females were ovigerous each carrying a single large egg.

Ecology:

On board the oceanographic vessel Hayes that was visiting the Cariaco trench in summer, 1978, the author had the opportunity to observe this species in huge quantities during daytime, in plankton samples taken from a 400 m depth horizon. The material described above was collected in short hauls at night from the same locality, between 200 and 300 m depth, a year later. Thus, Stegocephaloides calypsae may have a daily vertical migration, but not exceeding 400 m because in the Cariaco trench this is the horizon at which the oxygen concentration rapidly falls to zero. The only females of the samples, came from the upper horizon.

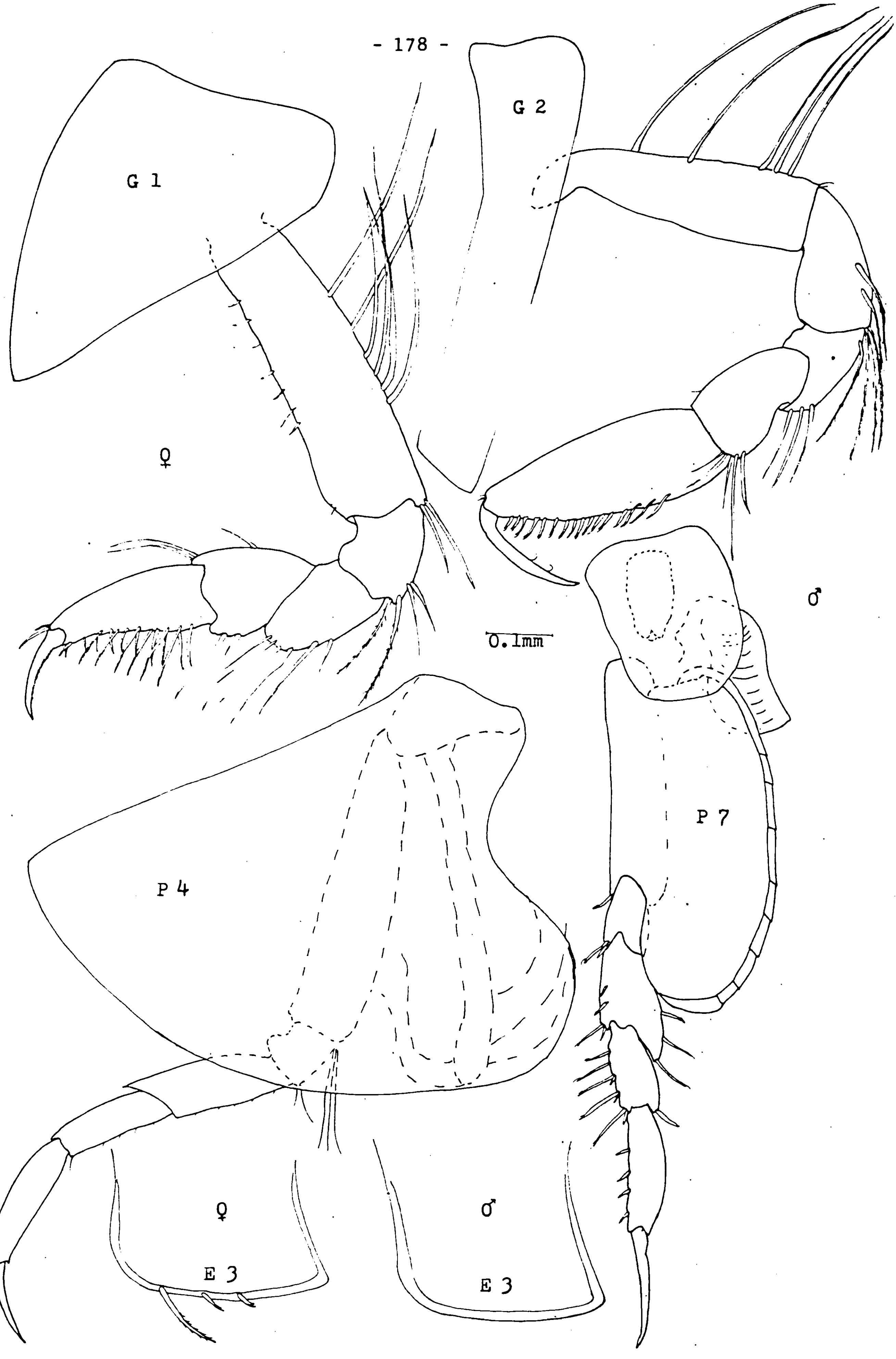


Figure 47. Stegocephaloides calypsae ♂ & ♀ 3 mm: Pereopods & E 3.

Stegocephaloides calypsae is an unusual bathypelagic gammaridean in that it lacks eyes but has well marked pigmentation. It is not in the list of bioluminescent amphipods given by Herring (1978). Perhaps the brownish pigment has something to do with the excretory isolation of metabolites, since iron crystals have been reported in the gut caeca of other species of Stegocephaloides (Moore, 1979), although their function is unknown.

Distribution:

The bathypelagic Stegocephaloides calypsae is the first species of this genus to be found in fully tropical waters where it is so far only known from the type locality in the continental Cariaco trench. The only other species from near tropical latitudes, S. canoti Barnard, also occurs in a deep continental trench, in the latter case the Cedros trench in the Pacific off Mexico.

Remarks:

Stegocephaloides calypsae differs from all other species of in the absence of a strongly tapering pointed posteroventral lobe on the basis of pereopod 7. It has its closest affinities with the bathypelagic S. canoti Barnard, 1967 from the Cedros trench, but can be distinguished by the following features: calypsae has the lobes of the lower lip bifid instead of ragged; the telson half cleft rather than two-thirds; epimeral plate 3 subquadrate instead of toothed; the biarticulate inner ramus of uropod 3 shorter than outer ramus, not the reverse.

Superfamily DEXAMINOIDEA

Body compressed, pleon carinate. Head rostrate; eyes lateral, reniform or rounded. Antenna 1 peduncle usually bearing brush setae; accessory flagellum absent or vestigial; antenna 2 peduncle elongate; calceoli absent. Upper lip somewhat incised; lower lip inner lobes developed. Mandible basic, right molar may bear molar flake. Maxillae with inner plates weakly setose. Maxilliped palp reduced. Coxal plates medium to deep, plate 4 excavate. Gnathopods subequal and subchelate. Coxal gills pleated or foliaceous. Brood plates moderately broad. Pleopods basic. Urosome with the last two segments coalesced. Uropods lanceolate; uropod 3 foliaceous. Telson deeply cleft with lobes narrowly separated; apices with spine. Sexual dimorphism slight.

The superfamily Dexaminoidea Leach, 1814 as defined by Bousfield (1978) comprises 5 families and has a world-wide distribution; Atylidae Lilljeborg, 1865, Anatylidae Bulycheva, 1955, Lepechinellidae Schellenberg, 1926, Dexaminidae Leach, 1814, and Prophliantidae Nicholls, 1940. Most of the species are marine coastal, typically fossorial or nestling, but some are abyssal. Amongst the dexaminoids only the family Atylidae is represented in the Venezuelan collections.

Family ATYLIDAE

Body robust and compressed, pleon with some segments carinate or toothed dorsally, urosome segments 2 and 3 fused. Head with slender rostrum, without post-antennal sinus. Eyes lateral and well developed. Antennae well developed, setose; antenna 2 longer than 1; accessory flagellum absent or vestigial. Mouthparts basic, mandible with well developed molar and slender palp; maxilliped palp small to medium. Gnathopods subequal, subchelate and small. Coxal gills from simple to branched and pleated. Uropods biramous. Telson well developed, bilobed.

A small monogeneric cosmopolitan family, revised by Barnard (1969: 163), and comprising about 20 mainly shallow-water species. The genus *Atylus* Leach is represented in the Caribbean coast of Venezuela by the cosmopolitan species, *A. minikoi* (Walker).

Atylus Leach

Atylus Leach, 1815: 21; Barnard, 1956: 38.

Nototropis Costa, 1853: 170.

Paratylus Sars, 1895: 462.

Body strongly compressed with short pereon and robust pleon. Urosome segment 1 with dorsal, toothed carina; urosome segments 2 and 3 coalesced. Coxal plates 1-4 deep. Head with small rostrum and lateral lobes. Eyes large, subrounded, lateral. Antennae slender, well developed, sexually dimorphic; antenna 2 longer than 1. Mouthparts basic; mandible with molar flake on right molar. Coxal gills on plates 2-7, simple to pleated. Oostegites large, oval, densely setose, setae long. Gnathopods subequal, subchelate, small and slender. Pereopods slender, spinose and setose; pereopods 3 and 4 sexually dimorphic; pereopods 5-7 basis expanded. Uropods spinose and setose; uropod 2 the shortest; uropod 3 rami subequal with sexually dimorphic armature. Telson moderately large, deeply cleft.

A cosmopolitan genus of 22 mainly marine littoral species with preference for sandy bottoms. The genus exhibits wide variation in gill morphology: the arctic and antarctic species have simple gills or gills with few folds, cold-water species have some of the gills strongly pleated, and tropical species have a large number of feather-like gills. The Indo-Pacific species *Atylus minikoi* (Walker) has been described with some variation from the Atlantic (Schellenberg, 1938) and has been reported from the Isle of Margarita. In the present western Venezuelan material a number of additional variations have been found.

Atylus minikoi (Walker)

(Figs 48-50)

Paratylus minikoi Walker, 1905: 925.

Nototropis minikoi Chilton, 1922: 9; Schellenberg, 1938: 206; Ruffo, 1950: 49.

Atylus minikoi Barnard, 1959: 30.

Material examined:

1 ♂, Tucacas beach, Golfo Triste, Venezuela, 23 July, 1980.

62 specimens from Tucacas, Golfo Triste, Venezuela, 4 December, 1980.

17 specimens from Moron, Golfo Triste, Venezuela, December, 1981.

Description:

Length up to 7 mm. Urosome carinate. Head as long as the first two pereonal segments, with well developed slender rostrum; eyes reniform, consisting of many small facets with blackish centre and brownish periphery. Antenna 1 shorter than 2, peduncle small, flagellum 28-articulate bearing aesthetascs in males; accessory flagellum vestigial 1-articulate. Antenna 2 about half body length, peduncle elongate, flagellum about 21-articulate. Mouthparts basic atylid with right molar flake present. Coxal plates 1-4 almost twice as deep as wide, coxal plate 1 the narrowest, fourth the largest and weakly excavate posteriorly; coxal plates 5-7 decreasing in size, wider than deep. Coxal gills on pereopods 2-7; coxal gills 2-5 deeply pleated; coxal gill 6 sack-like, simple and elongate; coxal gill 7 short, sack-like and bilobed. Gnathopods subequal, weakly subchelate, basis relatively robust, propodus longer than carpus. Pereopods 3 and 4 subequal and slender, 3 usually more setose in males than females; pereopod

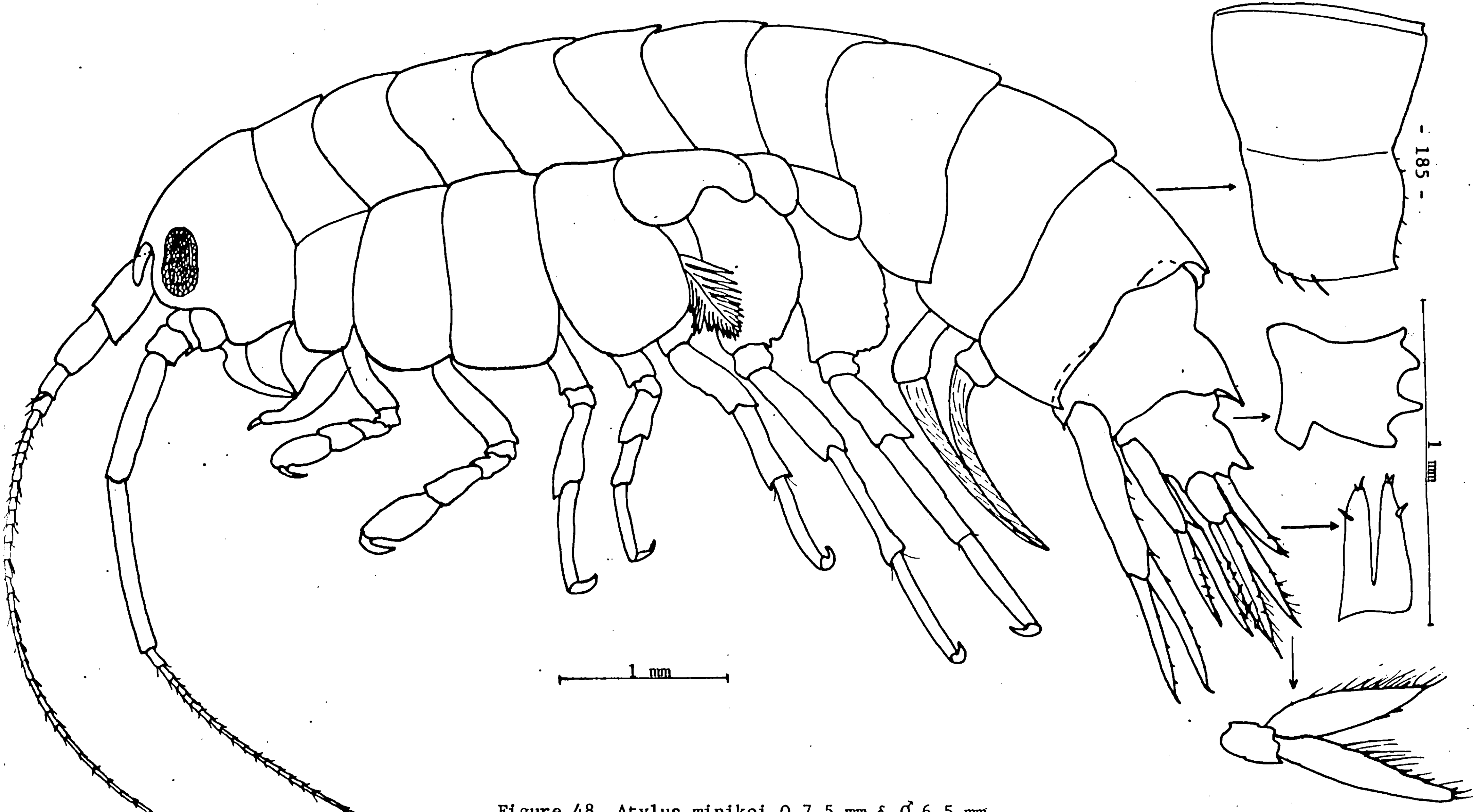


Figure 48. <u>Atylus</u> <u>minikoi</u> ♀ 7.5 mm & ♂ 6.5 mm.

5 smaller than 6 and 7, basis expanded proximally, narrow distally; pereopod 6 subequal to 7; pereopod 7 basis expanded distally, posterior margin coarsely serrulated with distal angle subrounded. Pleosome untoothed; epimeral plate 3 with posterior margin convex and excavate above the slightly upturned posterodistal angle. Urosome segment 1 dorsal margin convex anteriorly, with medial transverse dorsal depression and elevated posterior pointed carina; urosome segments 2 and 3 fused, similar in dorsal profile to segment 1, but bearing smaller carina. Uropod 3 rami three times length of peduncle, rami with spines which are longer in females than males, and setae which are longer in males than females. Telson about twice as long as wide, deeply cleft, lobes slightly overlapping medially, each with an apical, a submarginal, and a dorsolateral spine.

Females with large, oval, densely setose, oostegites on coxal plates 2-5; oostegites on coxal plate 5 small. Brood comprising about 10 eggs.

Ecology:

The samples were collected from sandy bottoms in shallow water.

Distribution:

Atylus minikoi was first described from Laccadive Islands and Australia/New Zealand. It has since been recorded from the Western Atlantic, including Isla de Margarita. The present material is from Golfo Triste on the western Caribbean coast of Venezuela.

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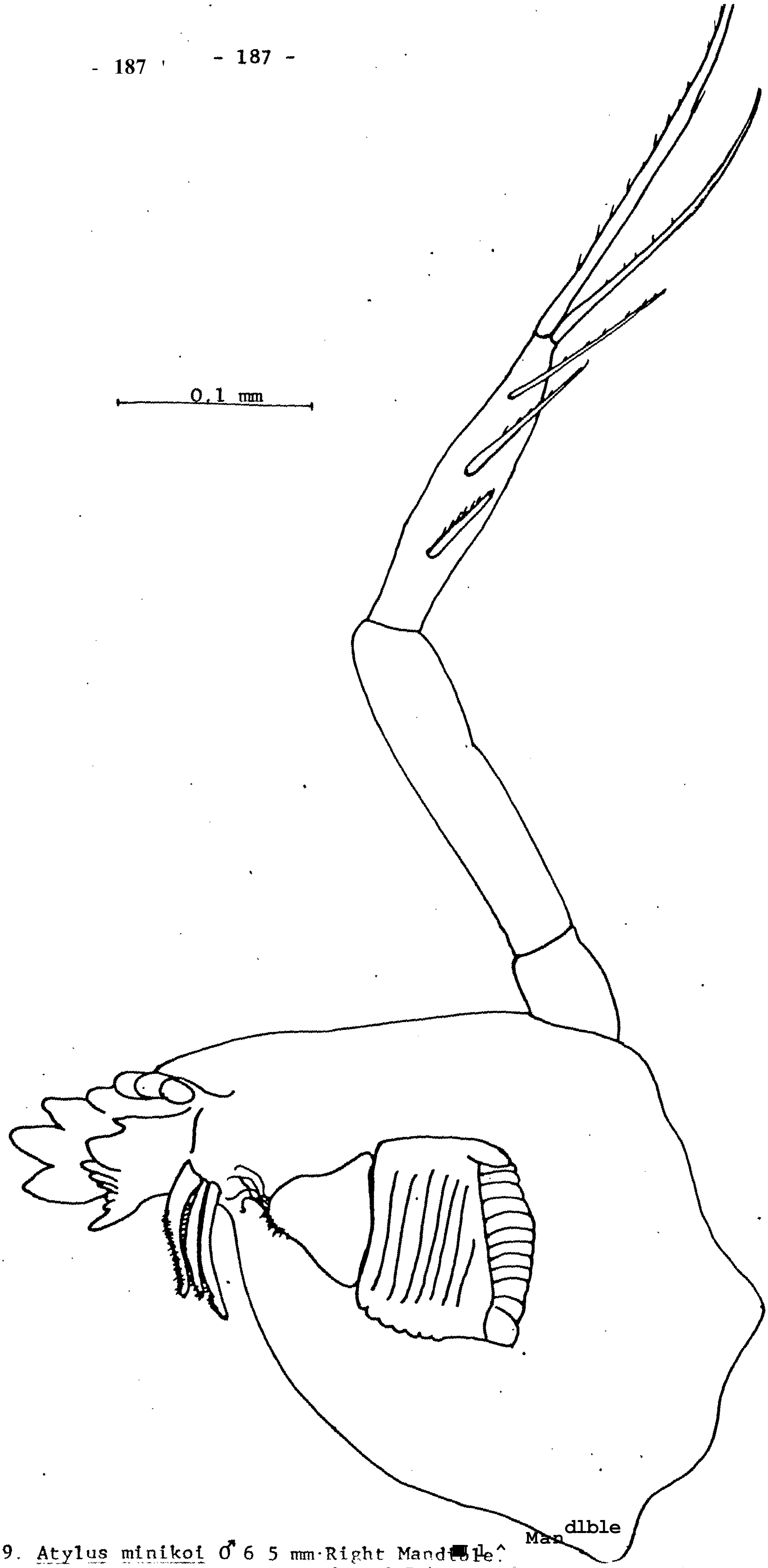

Man dlble

Figure 49. Atylus minikoi ♂ 6 5 mm·Right Mandible.

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Remarks:

Walker's original description was expanded by Chilton (1922). Schellenberg described *Atylus minikoi* from Brazil giving details of the gill structure and mentioning also the presence of two pairs of dorsolateral spines on the telson. Ruffo (1950) recorded the species from Margarita island. The Venezuelan material differs in many characters from the original Walker material, but in view of the apparent cosmopolitan distribution of *A. minikoi*, these discrepancies are not pursued at this time.

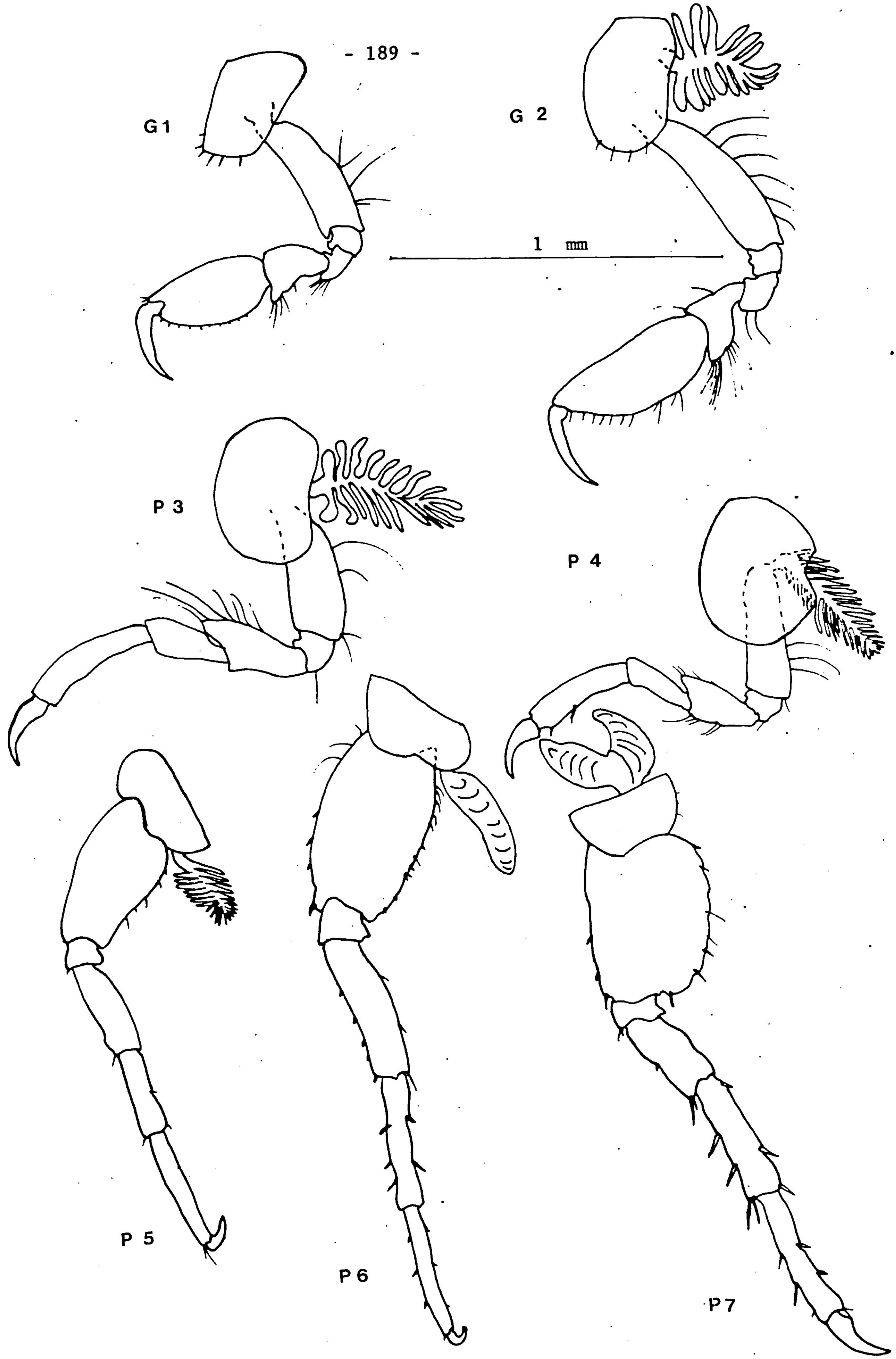


Figure 50. Atylus minikoi ♂ 6.5 mm: Pereopods.

Superfamily HADZIOIDEA

Body slender, medium size, sexually dimorphic. Head shallow with very small rostrum. Antennae well developed; antenna 1 usually the longest. Mouthparts basic. Coxal plates 1-4 contiguous or overlapping; short to moderately deep, plate 4 weakly excavate posteriorly; plates 5-7 usually anterolobate. Coxal gills simple, sac -like, pedunculate; often reduced and lacking on plate 7. Oostegites simple, linear, with sparse marginal setae. Gnathopods subchelate; gnathopod 2 larger than 1 and usually powerful in male. Pereopods 3-4 slender, similar; pereopod 5 usually smaller than 6-7; pereopods 6-7 basis subequal, variably expanded. Epimeral plates more or less deep, posterodistal angle acuminate. Pleopods basic. Uropods 1-2 not elongate, rami linear, spinose; peduncle with basofacial spine. Uropod 3 rami variable; outer ramus 1 or 2-segmented. Telson cleft, lobes separate or partly fused; apices with notch and spines.

The superfamily group Melitoidea was proposed and defined by Bousfield (1977; 1978 and 1982) although the name was subsequently changed to Hadzioidea by Holsinger & Langley (1980: 4) for reasons of priority. The superfamily contains about 260 species and more than 50 genera in the following 3 families: Hadziidae Karaman, 1943; Melitidae Bousfield, 1973; Carangaliopsidae Bousfield, 1977.

The hadziids inhabit tropical and temperate regions, worldwide. Most are hypogean in warm-temperate fresh and brackish groundwaters of former marine embayments of the tethyan sea area. The melitids are cosmopolitan mostly in shallow littoral coastal marine and brackish waters of warm and temperate latitudes. Both families are well represented in Venezuela.

Key to the families of Hadzioidea in Venezuela

Antennae stout and setose; eyes present; lower lip, inner lobes well developed; telson lobes divergent.	Melitidae
Antennae slender and weakly setose; eyes absent; lower lip, inner lobes weakly or not developed; telson lobes more or less fused.	Hadziidae

Family MELITIDAE

Body elongate and compressed; pereon without dorsal processes; pleon smooth or toothed. Coxal plate contiguous, generally short. Head without rostrum; postantennal sinus notched or not. Eyes typically small and subrounded. Antennae well developed; calceoli absent; antenna 1 longer than 2; accessory flagellum present. Mandible with molar triturative, molar flake occasionally present, palp elongated, 3-articulate. Maxilla 1 palp 2-articulate, inner plate small. Maxilla 2 basic. Maxilliped well developed, palp 3 or 4-articulate. Gnathopods subchelate, 2 robust and very much larger than 1, especially in male. Uropods spinose, biramous; uropod 3 rami sub or unequal. Telson cleft, lobes usually divergent, spinose. Sexual dimorphism of gnathopod 2 marked, also evident in antennae and pereopods.

Classically this group was placed in the family Gammaridae. Bousfield proposed its separation as a family and later redefined it (Bousfield, 1973; 1977). The family comprises about 30 marine genera as a well defined cluster within the 200 or so mainly freshwater genera of the old "Gammaridae". Nine species are recorded from the Venezuelan Caribbean Sea: *Dulichiella appendiculata* (Say); *Elasmopus rapax* Costa, *E. bampo* Barnard, *E. cervigoni* sp. nov., *E. laughlini* sp. nov., *E. lincolni* sp. nov.; *Ceradocus rubromaculatus* (Stimpson); *Maera kermackae* sp. nov. and *Maeraceradocus reyesi* gen. *et* sp. nov.

Key to the Venezuelan Genera of Melitidae

1 Uropod 3 rami subequal. 3

- Uropod 3 inner ramus half or less length of outer. 2

2 Uropod 3 outer ramus 2-articulate; left and right male gnathopod 2 dissymmetrical. Dulichiella

- Uropod 3 outer ramus 1-articulate; left and right male gnathopod 2 symmetrical. Melita

3 Uropod 3 rami short and broad, about equal to length of peduncle, not or slightly reaching beyond uropod 1. Mandibular palp article 3 falciform. Elasmopus

- Uropod 3 rami elongate, much longer than peduncle, reaching well beyond uropod 1. Mandibular palp article 3 linear. 4

4 Maxilla 1 inner plate densely setose medially; maxilla 2 inner plate with facial row of setae. Ceradocus

- Maxilla 1 inner plate only few apical setae; maxilla 2 inner plate without facial setae. 5

5 Mandibular palp article 3 subequal to 2. Epimeral plate 3 posterior margin smooth. Urosomites smooth. Maera

- Mandibular palp article 3, two-thirds length of article 2. Epimeral plate 3 posterior margin serrate. Urosomites dorsally toothed. Maeraceradocus

Ceradocus Costa

Ceradocus Costa, 1853: 170; Stebbing, 1906: 430; Sheard, 1939: 275; Fox, 1973: 147.

Megamoera Bate, 1862: 224; Bate & Westwood, 1862: 400.

Body basic to slender, coxal plates short, pleonites toothed or denticulate. Antenna 1 much longer than 2 and more robust; accessory flagellum multiarticulate. Upper lip rounded, lower lip with inner lobes. Mandibular palp article 3 linear and less than half the length of article 2. Maxillae densely setose medially. Inner plate of maxilla 1 subtriangular with marginal row of setae. Inner plate of maxilla 2 with facial row of setae. Maxilliped setose, palp 4-articulate. Gnathopods sexually dimorphic, subchelate, 2 larger than 1; male gnathopod 2 larger than in female. Pereopods 5-7 basis more or less expanded. Uropods 1-2 rami subequal in size and shape; uropod 3 extended, reaching beyond 1, rami elongate. Telson deeply cleft.

A circumtropical, littoral and sublittoral genus comprising 24 species. Only one species has previously been recorded from Venezuelan waters, *Ceradocus rubromaculatus* (Stimpson).

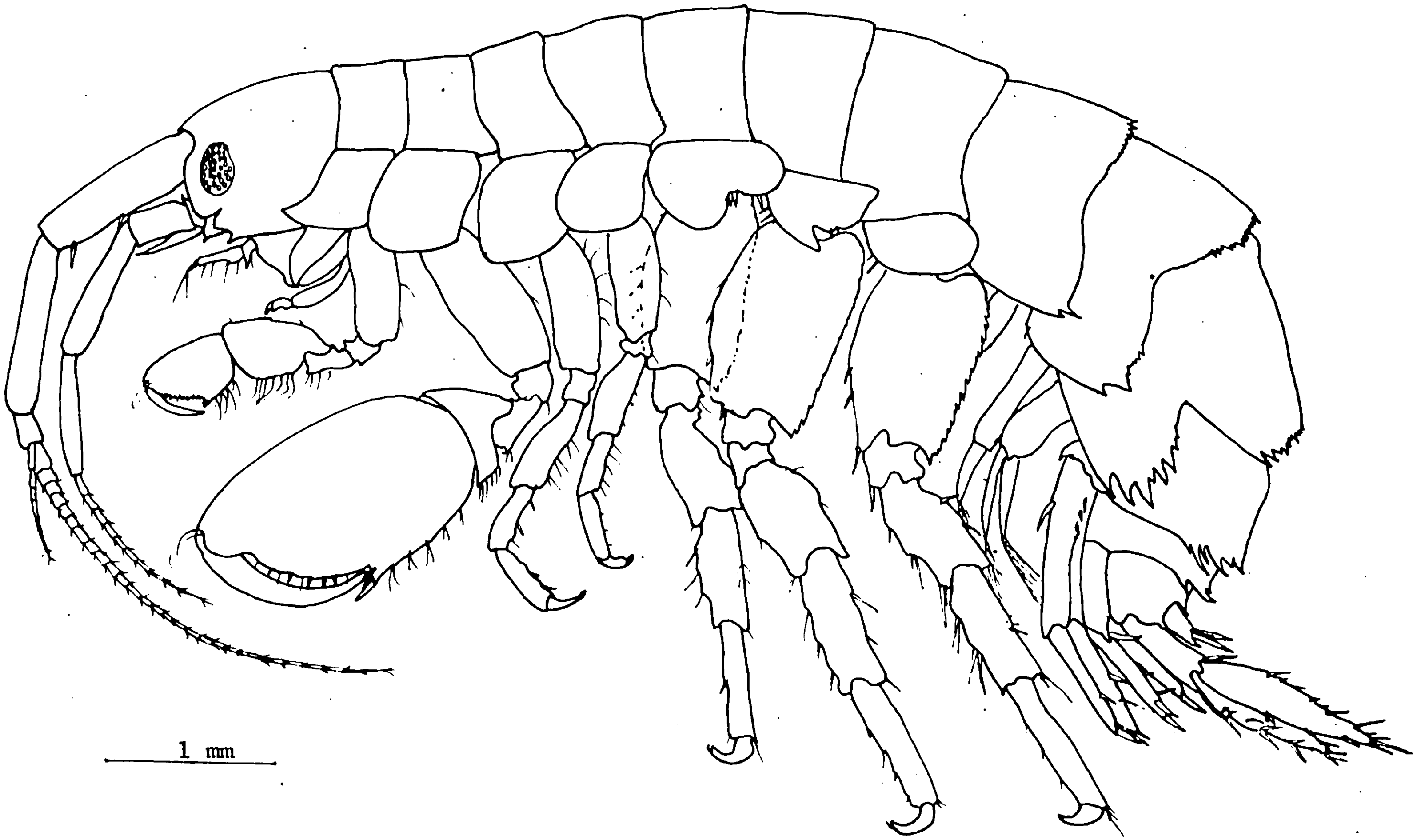


Figure 51. Ceradocus rubromaculatus ♂ 8 mm.

Cerodocus rubromaculatus (Stimpson)

(Figs 51-53)

Gammarus rubromaculatus Stimpson, 1855: 394.

Moera rubromaculata; Haswell, 1880: 267.

Ceradocus rubromaculatus; Stebbing, 1906: 430; Ruffo, 1954: 118.

Material examined:

30 specimens from Archipielago Los Roques, 30 April, 1980.

Description:

Length up to about 8 mm, body robust, colour whitish. Eyes oval, narrowing dorsally, colour dark brown. Lateral cephalic lobes subrounded; postantennal sinus deep with notch; postero-distal angle acute with small sharp tooth. Antenna 1 less than half body length, article 1 of peduncle with three ventral spines, flagellum 25-articulate, accessory flagellum 6-articulate; peduncle of antenna 2 reaching beyond peduncle of antenna 1, flagellum 10-articulate, gland cone just exceeding apex of article 3. Mandibular palp article 1 distally toothed; articles 1 and 3 subequal. Inner plate of maxilla 1 trapezoidal, wider than deep with row of more than 20 setae. Inner plate of maxilla 2 with apical, marginal, and oblique facial row of setae. Coxal plate 1 anterodistal angle produced, acute. Coxal gills sack-like, present on coxal plates 2-6. Gnathopods 1-2 subchelate, 2 larger than 1, and larger in male than female; merus with prolonged posterodistal angle; palm oblique, convex and spinose with two or three stronger spines on tooth defining palm from setose posterior margin. Pereopods 5-7, basis produced posterodistally, posterior margin serrate.

Figure 52. Ceradocus rubromaculatus ♂ 8 mm: Mouthparts

Pleosomites 1-2 evenly serrate dorsally; pleosomite 3 and urosomites 1-2 dorsally serrate with some lateral teeth enlarged; urosomite 3 with only a median dorsal tooth. Epimeral plates 1-2 with two or three posterodistal serrations. Epimeral plate 3 with some spines distally, coarsely serrate posteriorly and with posterodistally angle produced as tooth. Telson lobes prolonged apically, each lobe with two elongate and two smaller spines, plus one distal and two lateral plumose setae.

Female similar to male except gnathopod 2 slightly smaller and palm more evenly convex and spinose. Oostegites slender and elongate.

Ecology:

Ceradocus rubromaculatus is a large amphipod, common in the Thallassia testudinum communities around coral atolls.

Distribution:

Widespread in the Indo-Pacific region, from the Red Sea and South Africa to Australia and New Zealand including the Tuamotu islands. Ceradocus rubromaculatus was first reported in Venezuela by Ruffo (1954), from the same locality as the present material, but with fewer specimens.

Remarks:

Ceradocus rubromaculatus has been recorded by various authors as exhibiting some geographical variability. Following this tradition of accepting the species as polymorphic (see Ruffo, 1954), the Venezuelan material fits adequately within the description of the species.

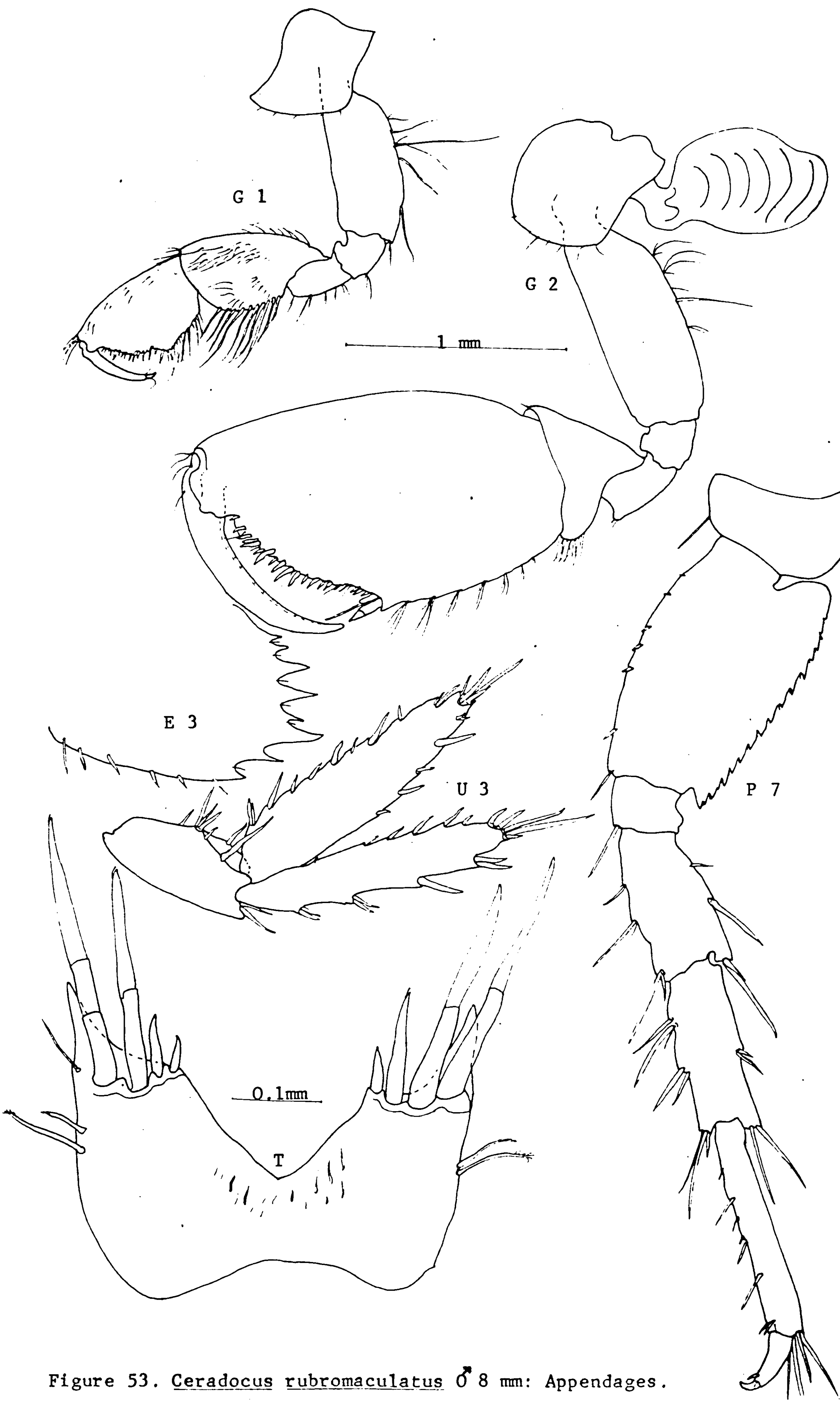


Figure 53. Ceradocus rubromaculatus ♂ 8 mm: Appendages.

Maera Leach

Maera Leach, 1814: 403; Stebbing, 1906: 433; Karaman & Ruffo, 1971: 113; Barnard, 1979: 83.

Leptothoe Stimpson, 1853: 46.

Linguimaera Pirlot, 1936: 309.

Body slender, coxal plates short and weakly overlapping, pleonites smooth. Antennae elongate and slender; antenna 1 much longer than 2, accessory flagellum well developed, multiarticulate; antenna 2 flagellum short. Upper lip rounded; lower lip with inner lobes. Mandible with large molar, palp article 3 linear, not falcate, subequal to 2. Maxillae poorly setose medially; inner plate of maxilla 1 ovate, with few apical setae; inner plate of maxilla 2 without facial setae. Maxilliped well developed, palp 4-articulate. Gnathopods sexually dimorphic, subchelate, 2 larger than 1; male gnathopod 2 slightly longer and more strongly sculptured than in female; left and right gnathopods may be dissymmetrical. Pereopods 5-7 basis weakly expanded. Uropods 1-2 rami subequal length; uropod 3 extended or not, rami subequal, lanceolate. Telson deeply cleft.

A large cosmopolitan genus, mostly from tropical littoral waters. The genus comprises 60 species and is probably polyphyletic, derived from Ceradocus, Mallacota, perhaps also Elasmopus. The genus Maera differs from Ceradocus in having only a few apical setae on the inner plates of maxilla 1 and 2, from Mallacota in having non-carinate pleonites, and from Elasmopus in the non-falciform palp article 3 of the mandible.

Of the 60 species in the genus *Maera* there are ten that share a subquadrate propodus of gnathopod 2 and the differences between them are subtle. They are mainly tropical and from the Pacific Ocean. These ten species can be referred to as the *Maera inaequipes* complex and are: *Maera inaequipes* (Costa, 1851); *M. chinarra* Barnard, 1979; *M. incerta* Chilton, 1883; *M. kaiulani* Barnard, 1970; *M. pacifica* Schellenberg, 1938; *M. quadrimana* (Dana, 1852); *M. rathbunae* Pearse, 1908; *M. reishi* Barnard, 1979; *M. serrata* Schellenberg, 1938 and *M. viridis* Haswell, 1879. Some species having a Pacific distribution have been found recently in the Caribbean Sea; as for example *Elasmopus bampo* Barnard, and *Maera inaequipes* (Shoemaker, 1921: 100). The *Maera* material collected in Venezuela exhibits one unique character, the mandibular palp article 3 is as long as or longer than article 2, and is described below as a new species.

Maera kermackae new species

(Figs 54-56)

Material examined:

Holotype ♂, 5.5 mm, from Los Roques islands, Venezuela.
Type locality: Archipielago Los Roques, Isla Mosquises, coral atoll, shallow water, depth 5 m, in Thalassia testudinum community surrounding mangroves and coral reefs.
50 specimens from the same locality, 30 April, 1980.

Etymology:

This species is named in honour of my University supervisor, Dr D. Kermack.

Description:

Length up to 5.5 mm, colour whitish. Eyes oval, colour black. Lateral cephalic lobes subrounded; postantennal sinus deep without cephalic notch; posterodistal angle produced as a tooth. Antenna 1 about half body length; flagellum 20-articulate; accessory flagellum 9-articulate. Antenna 2 peduncle article 4 longer than 5; flagellum 9-articulate; gland cone just reaching peduncle article 4. Mandibular palp article 1 weakly produced distally, without distal tooth; article 3 slightly longer than 2. Maxilla 1 inner plate ovate with three apical setae; maxilla 2 inner plate without oblique row of facial setae. Coxal plate 1 anterodistal angle acute, produced anteriorly. Coxal gills ovate present on plates 2-6. Gnathopod 1 smaller than 2; propodus shorter than carpus, subovate, longer than broad; palm oblique; dactylus slender with anterior setae. Left and right gnathopod 2 sometimes dissymetrical, one side of male form, the other

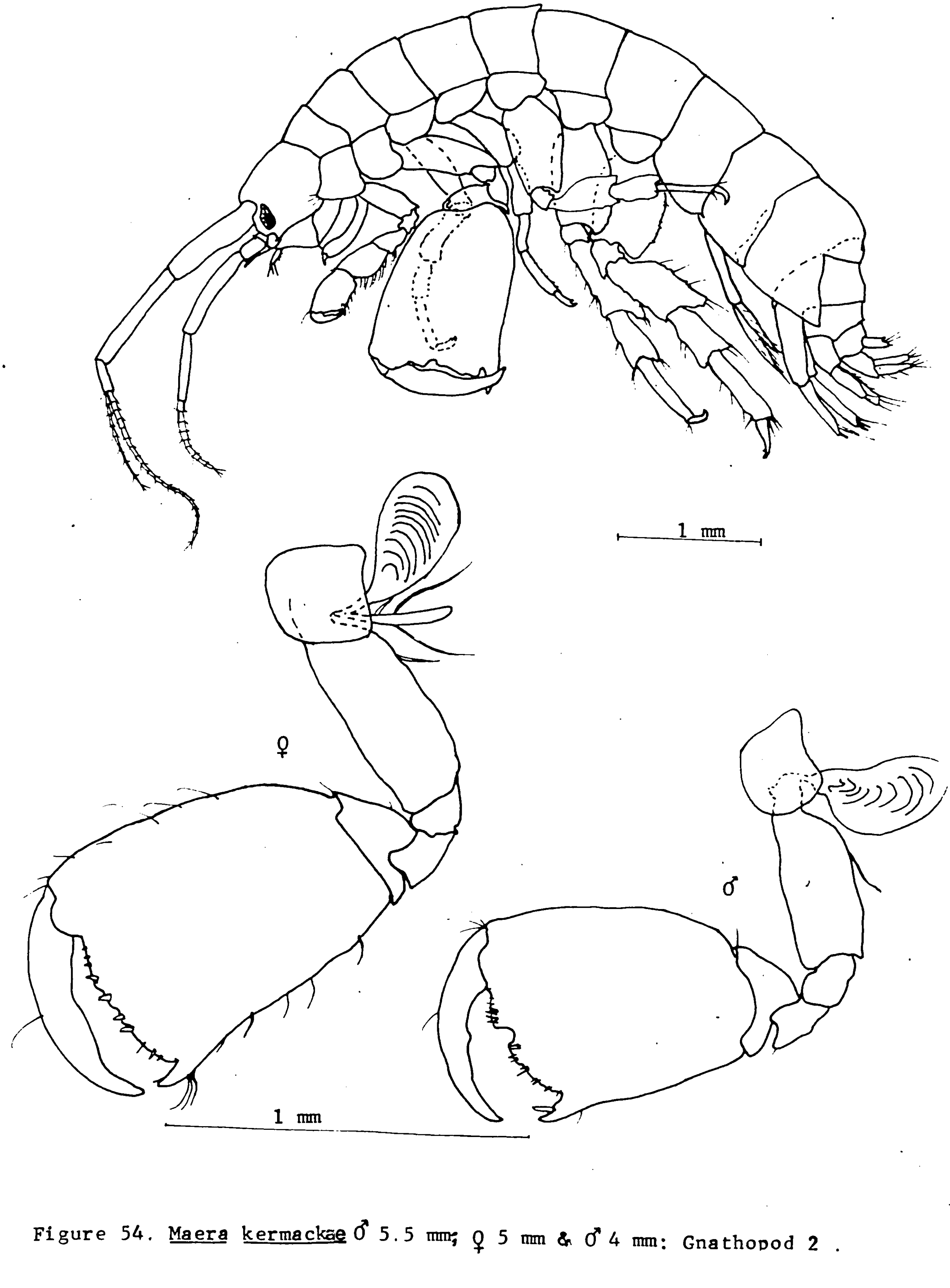


Figure 54. Maera kermackae ♂ 5.5 mm; ♀ 5 mm & ♂ 4 mm: Gnathopod 2 .

female; carpus short, propodus very large, poorly setose, subrectangular, palm transverse. Palm of male gnathopod 2 with medial excavation; large male with small sinus below excavation; palm defined from posterior margin of hand by strong tooth bearing spine; dactylus strong, as long as or slightly longer than palm with blunt tooth on posterior margin matching palmar excavation, and setae on anterior margin. Pereopods 3-7 dactylus with accessory tooth and bifurcate unguis. Pereopods 3-4 poorly setose, dactylus short. Pereopods 5-7 stout and short; basis oval with convex, more or less serrate, posterior margin, and posterodistal lobe. Epimeral plates 1-3 with posterodistal angle subacute; distal and posterior margin smooth. Epimeral plate 3 with six distolateral spines. Uropods 1-2 stout with inner ramus slightly longer than outer. Uropod 3 short but reaching beyond 1-2, rami subequal, outer ramus slightly longer than inner. Telson short and cleft; telsonic lobes entire with four distal spines of unequal length and 2 lateral setae.

Female generally similar to male, gnathopod 2 of similar size or slightly shorter, propodus subquadrate, longer than broad, palm without excavation, evenly spinose, and dactylus without blunt tooth on posterior margin, but swollen at midpoint. Oostegites slender.

Ecology:

This species of Maera was collected in a sample containing Ceradocus and Maeraceradocus. It represents a small-size amphipod population in this Thalassia taxocoenosis.

Figure 55. Maera kermackae ♂ 5.5 mm: Mouthparts.

Distribution:

Known only from the type locality: Archipielago Los Roques, Venezuela.

Remarks:

This new species of *Maera* is characterized by the configuration of the mandibular palp articles. It differs from the *Maera inaequipes* complex also in the structure of the telson.

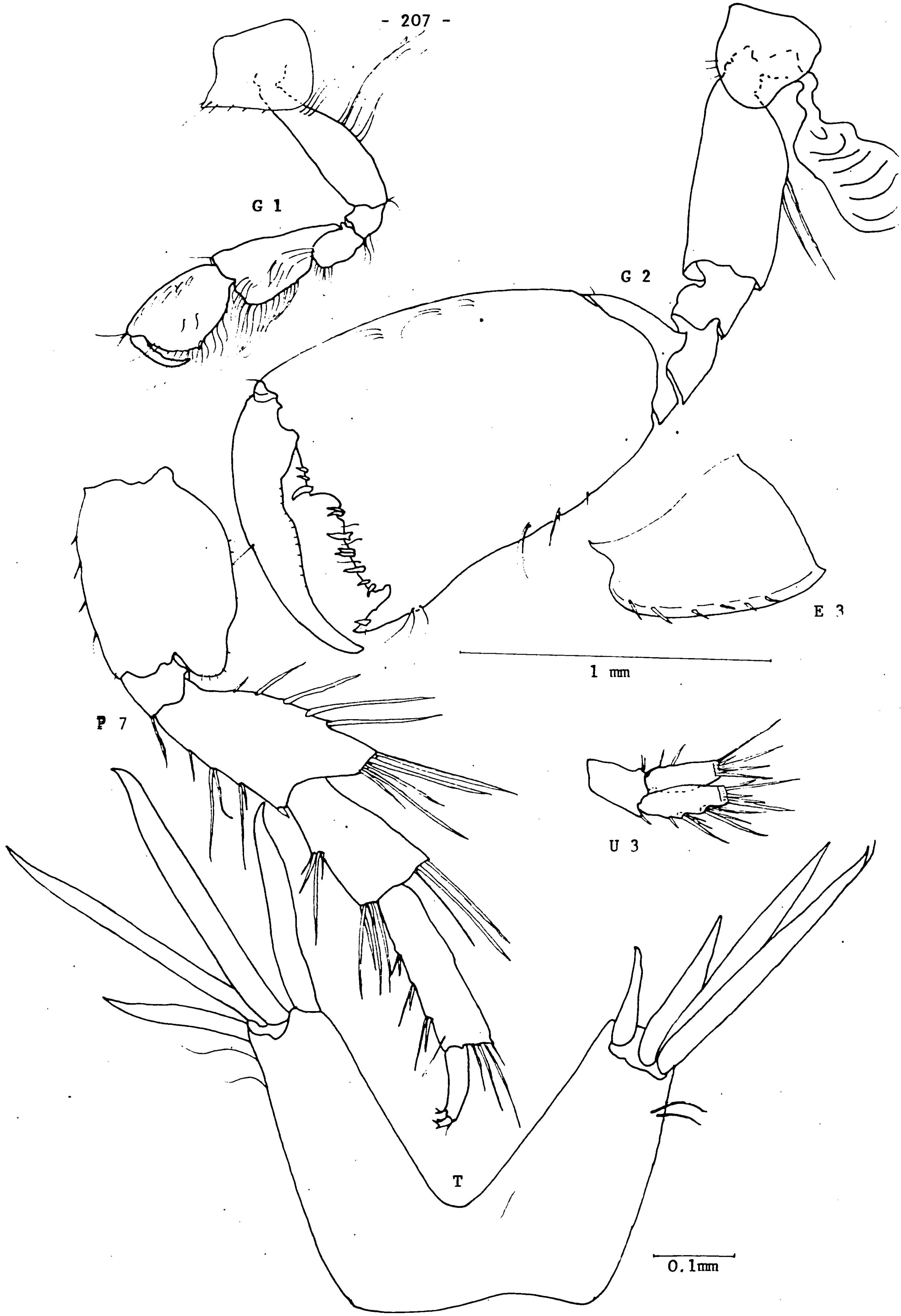


Figure 56. Maera kermackae ♂ 5.5 mm: Appendages.

Maeraceradocus new genus

Etymology:

Derived by combination of the genera *Maera* and *Ceradocus*.

Description:

Body size intermediate between that of *Ceradocus rubromaculatus* (8 mm length) and *Maera kermackae* (5.5 mm length); the anterior body resembling the latter, the posterior body resembling the former; urosomites transversely and dorsally toothed; colour whitish. Antenna 1 about half body length, peduncle article 1 with posterior spines, accessory flagellum multiarticulate, well developed. Antenna 2 smaller than 1 but reaching well beyond the peduncle, flagellum short. Mandibular palp article 3, two-thirds the length of 2; other mouthparts similar to Maera. Gnathopods subchelate, 2 larger than 1 and sexually dimorphic, of subequal size in the two sexes but showing dissimilar sculpturing. Pereopods resembling *Ceradocus*, but dactylus with bifid unguis. Uropods 1-2 extending to same point; uropod 3 reaching beyond 1-2. Telson cleft, each lobe with apical concavity armed with two spines.

Remarks:

A tropical genus from shallow littoral waters of coral atolls with a morphology intermediate between *Ceradocus* and *Maera*. Separation is based on the same characters used to define *Ceradomaera* Ledoyer, 1973. *Maeraceradocus* differs from *Maera* in that the urosomites are denticulate, epimeral plate 3 is serrate and left and right gnathopod 2 is not dissymetrical. It separates from *Ceradocus* in having only a few apical setae on the inner plates of maxilla 1 and 2, and from <u>Ceradomaera</u> in the length of mandibular palp article 3 and the structure of the telson.

Maeraceradocus reyesi new species

(Figs 57-59)

Material examined:

Holotype ♂, 7 mm, from Los Roques islands, Venezuela.
Type locality: Archipielago Los Roques, Isla Mosquises, coral atoll, shallow water, 5 m depth, in *Thalassia testudinum* community surrounding mangroves and coral reefs.
40 specimens from the same locality, 30 April, 1980.

Etymology:

The species is named after Dr G. Reyes.

Description:

Length up to 7 mm, colour whitish. Eyes oval, colour very dark brown with yellow surround. Lateral cephalic lobes rounded. Postantennal sinus deep with notch; posterodistal angle acute and protruding. Antenna 1 peduncle article 1 with 3 posterior spines; flagellum 20-articulate; accessory flagellum 9-articulate. Antenna 2 gland cone reaching well beyond peduncle article 3; flagellum 8-articulate. Mouthparts as for *Maera inaequipes*. Inner plate of maxilla 1 ovate with three apical setae; inner plate of maxilla 2 with apical row of setae but without oblique facial group. Coxal plate 1 anterodistal angle acutely produced. Coxal gills oval, present on plates 2-6. Gnathopod 1 small with oblique palm. Male gnathopod 2 as in *Maera inaequipes*, but basis with two spines posteriorly; carpus short; propodus very large, subquadrate, weakly setose, palm transverse, sculptured, with medial excavation; dactylus strong with blunt tooth posteriorly and seta anteriorly. Pereopods 3-7, dactylus with accessory

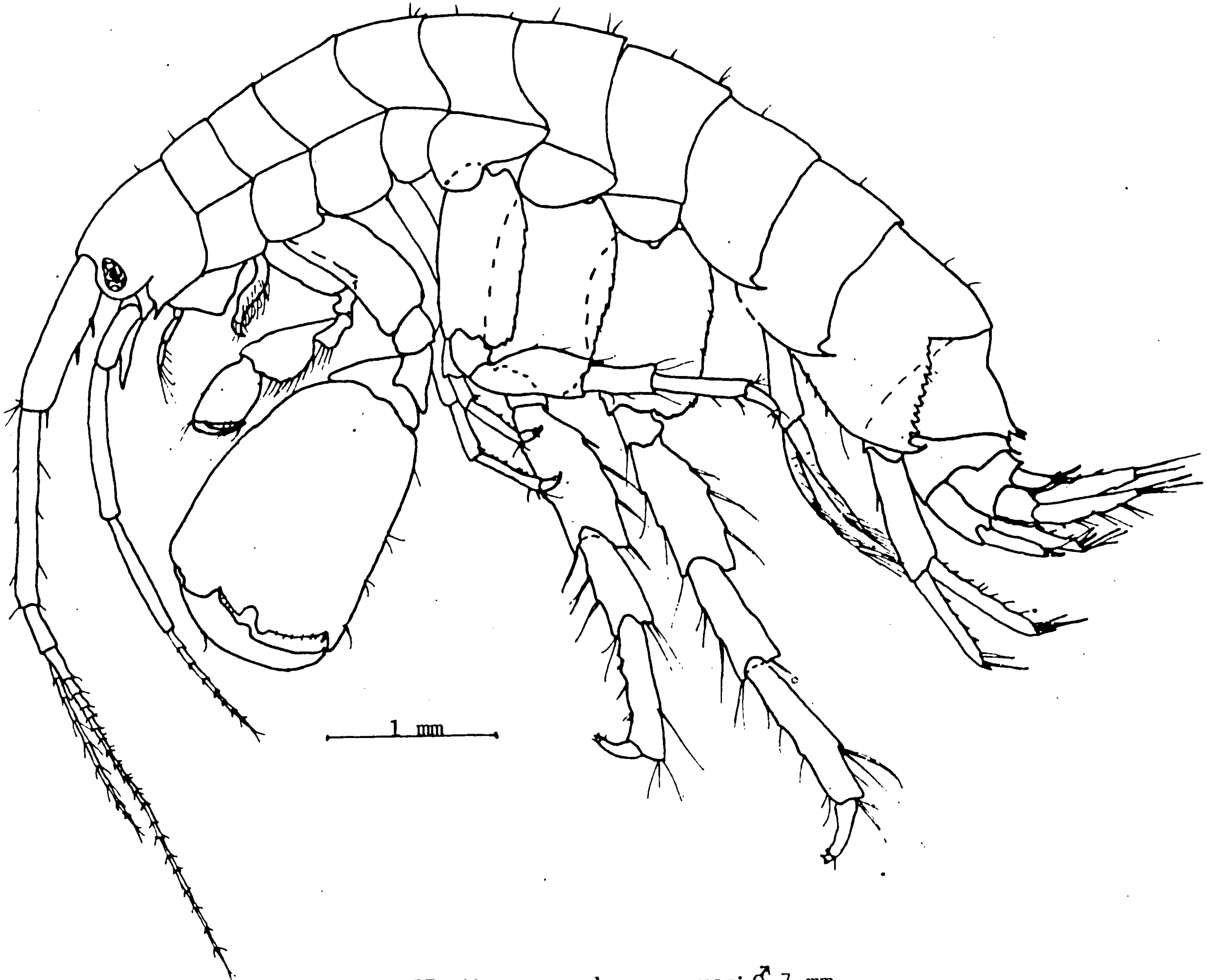


Figure 57. *Maeraceradocus reyesi* ♂ 7 mm.

tooth, unguis bifid with three setules. Pereopods 5-7 basis serrate and slightly lobate posteriorly. Epimeral plates 1-2 posterodistal angle toothed with sinus above and few spines on ventral surface. Epimeral plate 3 posterodistal angle toothed, with sinus above, eight posterior serrations and four ventral marginal spines. Pleon with scarce dorsal setae. Urosomite 1 with three dorsomedial teeth. Urosomite 2 with one dorsomedial tooth. Urosomite 3 lateral tooth. Uropods 1-2 rami reaching to almost same point; uropod 3 extending beyond 1-2. Uropod 3 peduncle scarcely elongate, rami subequal. Telson cleft, each lobe with apical concavity armed by two long spines, one apical and two lateral setae.

Female generally similar to male, gnathopod 2 resembling _Maera_ _inaequipes_ - evenly spinose without concavity on the palm, and with dactylus untoothed. Gnathopod 2 subequal or slightly smaller in female than male. Oostegites elongate and slender.

Ecology:

Maeraceradocus _reyes_ represents the intermediate-size population of the taxocoenosis collected together with _Maera_ and _Ceradocus_ on beds of turtle grass (_Thalassia_ _testudinum_).

Distribution:

Known only from the type locality: Los Roques Archipielago, Venezuela.

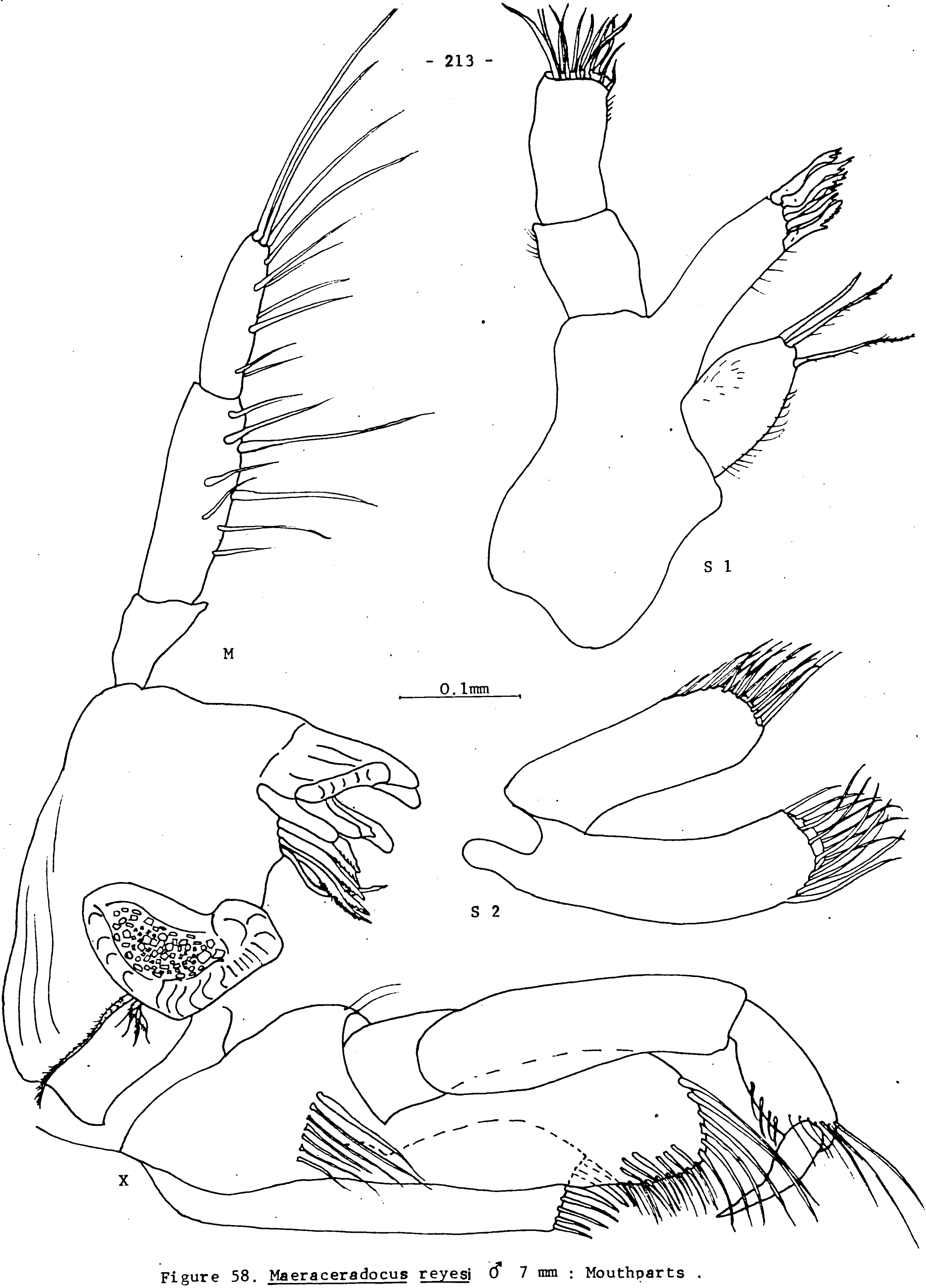


Figure 58. Maeraceradocus reyesi ♂ 7 mm : Mouthparts .

Remarks:

Maeraceradocus reyesi is closely similar to Maera inaequipes and shares some characters with the monotypic Ceradomaera. It appears intermediate between Maera kermackae and Ceradocus rubromaculatus.

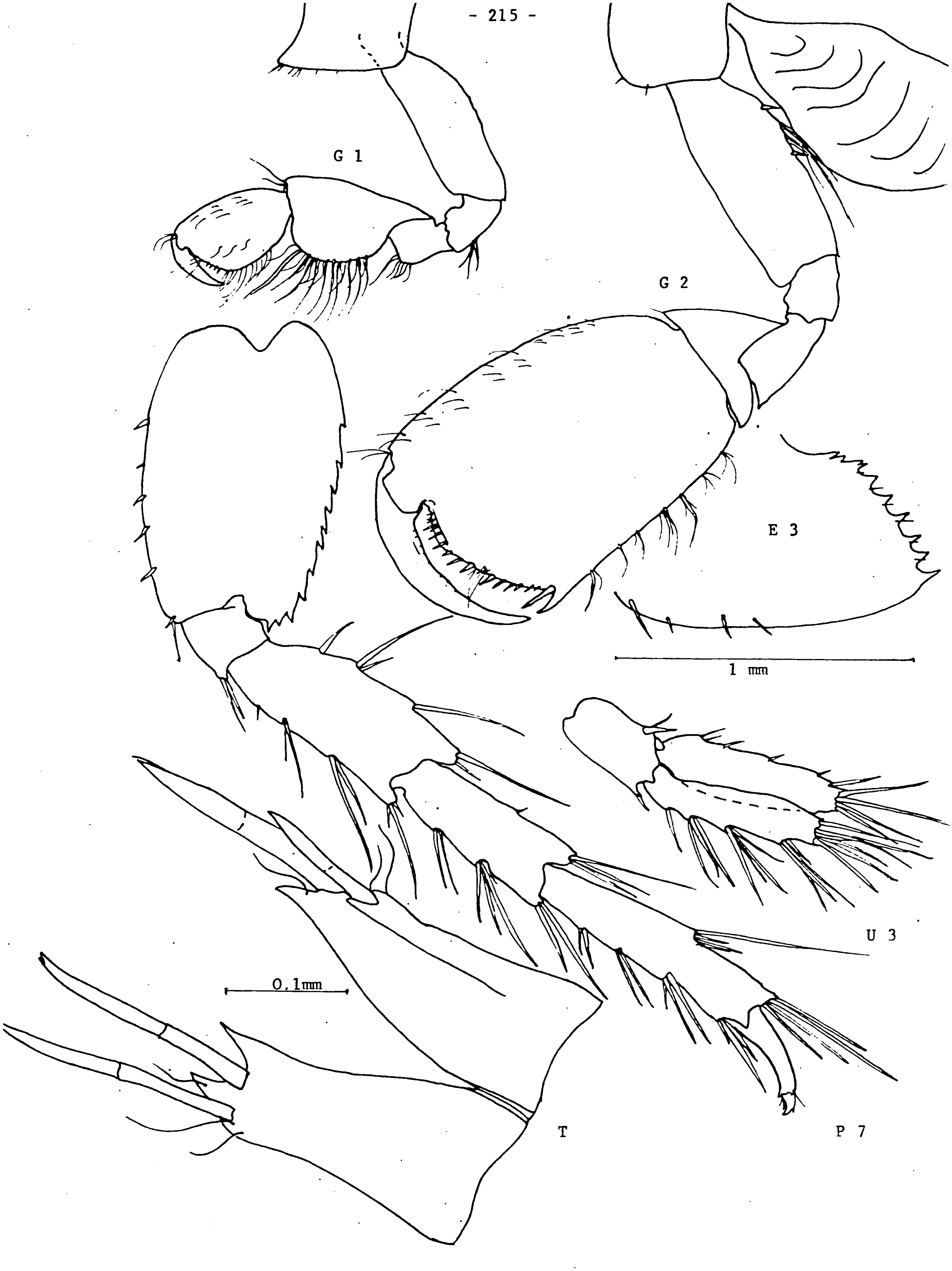


Figure 59. Maeraceradocus reyesi ♀ 7 mm : Appendages.

Elasmopus Costa

Elasmopus Costa, 1853: 170; Sars, 1895: 520; Stebbing, 1906: 441; Chevreux & Fage, 1925: 244; Barnard, 1979: 57.

Body compressed, robust and smooth. Coxal plates moderately large. Head without rostrum, lateral lobes rounded. Antenna 1 longer than 2; accessory flagellum small and usually multiarticulate. Lower lip with inner lobes. Maxilla 1 and 2 inner plates with apical setae only. Mandible with palp article 3 robust and falciform. Maxilliped well developed. Gnathopods powerfully subchelate, especially gnathopod 2 in males. Coxal gills present on pereopods 2-6. Oostegites slender. Pereopods robust, pereopods 5-7 basis broad. Uropods spinose; peduncle of uropod 1 with basofacial spine; uropod 3 usually short, rami broad, subequal length. Telson deeply cleft and apically spinose.

A large cosmopolitan genus of about 60 recognized species only one of which, Elasmopus rapax Costa (1853), is recorded as very widespread with wide phenotypic variations which in tropical waters is regarded as a mark of speciation. Most of the species are tropical. The species described to date are:

Elasmopus affinis Della Valle, 1893: 734.

East Atlantic and Mediterranean Sea.

Elasmopus antennatus (Stout) / Neogammaropsis antennatus Stout, 1912: 645 / Elasmopus antennatus; Shoemaker, 1941: 187; Barnard, 1969: 115.

California.

Elasmopus atolgidus Barnard, 1965: 498.

Caroline Islands.

Elasmopus bampo Barnard, 1979: 61.

Hawaii and California.

Elasmopus besnardi Oliveira, 1951: 13.

Trinidad.

Elasmopus bollonsi Chilton, 1915: 328.

New Zealand.

Elasmopus brasiliensis (Dana) / Gammarus brasiliensis Dana, 1853: 956 / Elasmopus brasiliensis; Stebbing, 1906: 443 (part); Oliveira, 1951: 4.

Rio de Janeiro.

Elasmopus buchneri Spandl, 1924: 54; Ruffo, 1939: 163.

Red Sea.

Elasmopus calliactis Edmondson, 1951: 189.

Hawaii.

Elasmopus caprai Maccagno, 1936: 184.

Red Sea.

Elasmopus chevreuxi Cecchini, 1928: 390 / Elasmopus brasiliensis; Schellenberg, 1938: 38.

Mediterranean Sea.

Elasmopus delaplata Stebbing, 1888: 1025.

Montevideo (deep sea).

Elasmopus dentiferus Schellenberg, 1938: 54.

Fiji and Gilbert Islands.

Elasmopus diemenensis (Haswell) / Megamoera diemenensis Haswell, 1879: 266 / Elasmopus diemenensis Stebbing, 1906: 442.

Tasmanian Sea.

Elasmopus diplonyx Schellenberg, 1938: 54.

Marshall Islands.

Elasmopus dubius Walker, 1904: 276.

Sri Lanka.

Elasmopus ecuadoriensis Schellenberg, 1936: 153; Barnard, 1979: 64.

Hawaii and Galapagos Islands.

Elasmopus erythraeus (Kossman) / Moera erythraea Kossman, 1880: 132 / Elasmopus erythraeus; Stebbing, 1888: 516.

Red Sea.

Elasmopus excavatus Schellenberg, 1938: 58.

Micronesia and Pacific islands.

Elasmopus fusimanus Oliveira, 1951: 10.

Ilha Grande, Brazil.

Elasmopus gracilis Schellenberg, 1938: 59.

Indo-Pacific.

Elasmopus hawaiensis (Schellenberg) / Elasmopus ecuadoriensis hawaiensis Schellenberg, 1938: 54 / Elasmopus hawaiensis Barnard, 1979: 67.

Hawaii.

Elasmopus holgurus Barnard, 1962: 91.

California.

Elasmopus hooheno Barnard, 1970: 121.

Hawaii.

Elasmopus japonicus Stephensen, 1932: 490.

Indo-Pacific.

Elasmopus latibtachium Walker, 1905: 928.

Minikoi and Hulule, Indian islands.

Elasmopus levis (Smith) / Moera levis Smith, 1873: 559 / Elasmopus levis; Bousfield, 1973: 63.

North West Atlantic.

Elasmopus magnispinatus Kunkel, 1910: 54.

Bermuda.

Elasmopus mayo Barnard, 1979: 67.

Galapagos Islands, Ecuador and Gulf of California.

Elasmopus menurte Barnard, 1974: 21.

South-west Australia.

Elasmopus minimus Chevreux, 1907: 483.

Gambier Archipelago.

Elasmopus molokai Barnard, 1970: 483.

Hawaii.

Elasmopus mutatus Barnard, 1979: 60 / Elasmopus rapax mutatus Barnard, 1962: 96.

California.

Elasmopus neglectus Chilton, 1915: 326.

New Zealand.

Elasmopus ocoroni Barnard, 1979: 68.

Galapagos Islands.

Elasmopus pectinicrus (Bate) / Moera pectinicrus Bate, 1862: 192 / Elasmopus brasiliensis; Stebbing, 1906: 443 (part) / Elasmopus pectinicrus; Reid, 1951: 237; Oliveira, 1951: 3.

Brazil and West Africa.

Elasmopus perditus Reid, 1951: 237.

East Atlantic.

Elasmopus piikoi Barnard, 1970: 127.

Hawaii.

Elasmopus pocillimanus (Bate) / Moera pocillimanus Bate, 1862: 191 / Elasmopus pocillimanus; Della Valle, 1893: 733.

North Atlantic and Mediterranean Sea.

Elasmopus podotrichius Ruffo, 1969: 31.

Red Sea.

Elasmopus pseudaffinis Schellenberg, 1938: 53.

Indo- Pacific.

Elasmopus rapax Costa, 1853: 175; Sars, 1895: 521; Chevreux & Fage, 1925: 244; Barnard, 1979: 69.

Cosmopolitan.

Elasmopus serricatus Barnard, 1979: 73 / Elasmopus rapax serricatus Barnard, 1969: 121.

California, Panama, Ecuador and Galapagos Islands.

Elasmopus smirnovi Bulycheva, 1952: 190.

Japan Sea.

Elasmopus sokotrae Walker & Scott, 1903: 223.

Abd-el-Kuri.

Elasmopus spinibasus Sivaprakasam, 1976: 45.

Sri Lanka.

Elasmopus spinidactylum Chevreux, 1907: 413; Schellenberg, 1937: 55.

Cosmopolitan.

Elasmopus spinimanus Walker, 1904: 277.

Indo-Pacific.

Elasmopus steinitzi Ruffo, 1959: 22.

Red Sea.

Elasmopus suensis (Haswell) / Megamoera suensis Haswell, 1879: 335 / Elasmopus suensis; Stebbing, 1906: 442.

Torres Strait, North Australia.

Elasmopus temori Barnard, 1979: 75.

Galapagos Islands.

Elasmopus tiburoni Barnard, 1979: 77.

California and Galapagos Islands.

Elasmopus tubar Barnard, 1979: 79.

California and Galapagos Islands.

Elasmopus vachoni Mateus, 1966: 181.

Sao Tome and Principe.

Elasmopus wahine Barnard, 1972: 103.

New Zealand.

Elasmopus yunde Barnard, 1974: 23.

West Australia.

Elasmopus zoanthidea Barnard, 1979: 79.

Galapagos Islands.

In Venezuela Elasmopus spinidactylus, described originally from the Pacific Ocean, is the only species of Elasmopus which has been recorded to date. It was collected by Ruffo in 1954, from a coral and mangrove open-sea island "Orchila". During the present study 5 more species have been found: E. rapax, a cosmopolitan species collected from open waters of the upwelling area; E. bampo also of Pacific origin and widely recorded from coastal mangrove lagoons in the upwelling area; E. cervigoni, a new species sympatric with the preceding one; E. laughlini and E. lincolni both new species from coral and mangrove atolls of open Caribbean waters, the former abundant, the latter sympatric but smaller and less common. The cosmopolitan species, E. rapax must have invaded the upwelling continental shelf area relatively recently because the platform has been submerged for only some 15,000 years. The 3 new species are thought to have evolved from a form close to E. bampo from the Pacific by sympatric speciation within the coral and mangrove ecosystems. The Panama isthmus dates back to the Pliocene; most of the coral and mangrove islands are of Pleistocene origin.

See map for distribution of species (Fig. 60).

The main taxonomic characters used to separate the species of Elasmopus are confined to the palm of male gnathopod 2. To a lesser extent, epimeral plate 3, telson and mandibular palp, and occasionally antennae, eyes and pereopods are also included. Unfortunately, these characters often exhibit subtle variations within and between species. The genus poses a major problem for zoologists. A good example to illustrate this point is the treatment of Elasmopus rapax by Barnard (1979). He treats (pages 59-60) the North Atlantic E. rapax as a variety of the

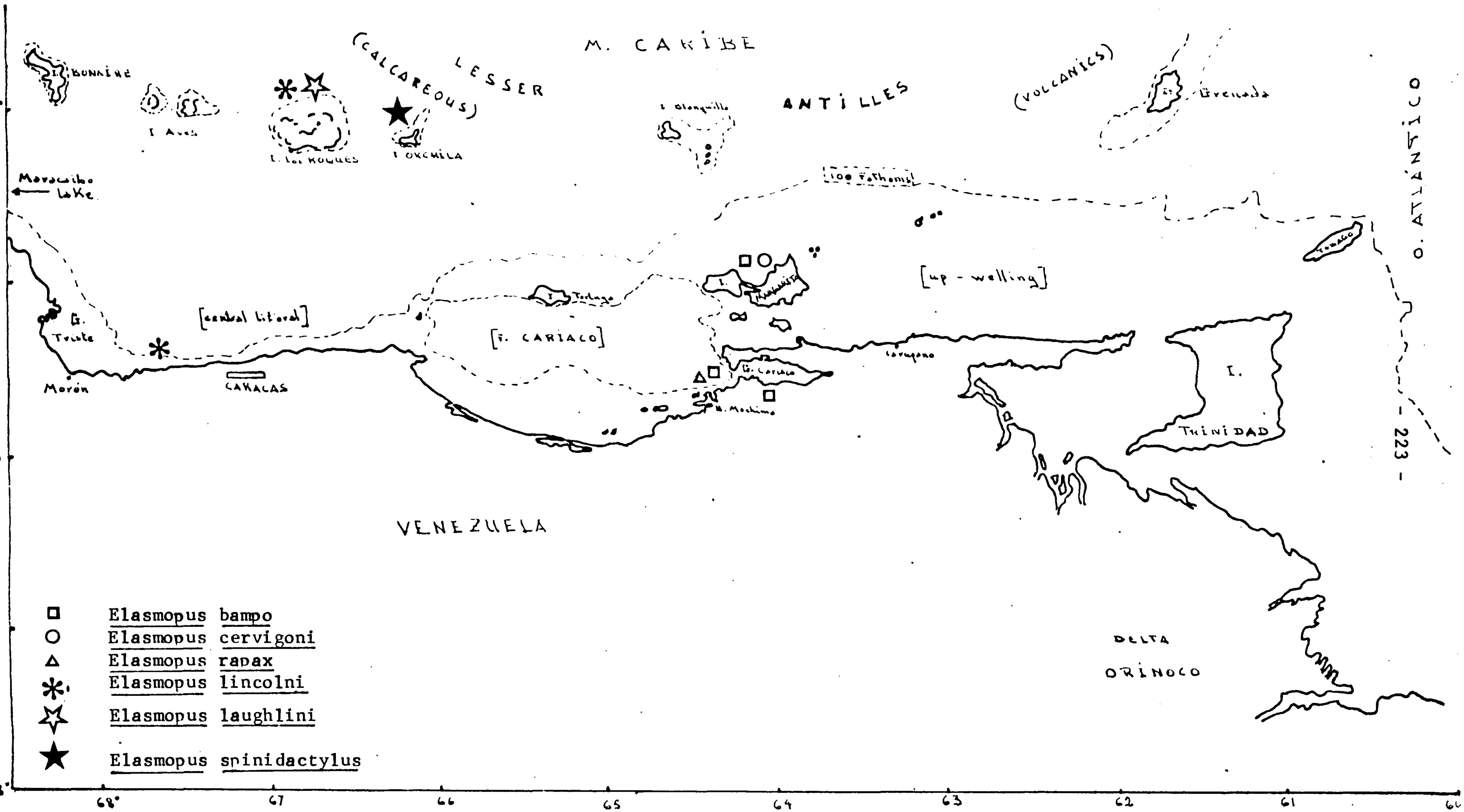


Figure 60. The distribution of the species of Elasmopus in Venezuela

one designated by him as Mediterranean E. rapax from the type locality (after Sars, 1895 and Chevreux & Fage, 1925, respectively). He notes differences in the setae and spines on epimeral plate 3, telson and pereopods. Perhaps Barnard was unaware the the Norwegian material on which Sars based his description was collected from the French Mediterranean. Sars on page 522 wrote " I have never myself met with this form, but Boeck states its occurrence in the Christianiafjord. The figures here given are from French specimens kindly sent to me by M. Chevreux". Thus Barnard detected slight differences in European E. rapax in the drawings of Sars and Chevreux & Fage based on material from the same locality. Additionally he called his material (page 69) Eastern Pacific E. ? rapax. The same variation can be found between Pacific and Caribbean material and European material. For the purposes of this study Elasmopus rapax is treated as a cosmopolitan pending a revision of material throughout the geographic range of the species. The separation of females and juveniles remains extremely problematical in the abundant Caribbean material in which several species occurring together in the same sample. In the following keys and descriptions the references apply primarily to males.

<u>Key to the Venezuelan species of Elasmopus</u>

1	Palm of male gnathopod 2 with 4 processes.	<u>bampo</u>
-	Palm of male gnathopod 2 with 3 or less processes.	2
2	Palm of male gnathopod 2 with 3 processes.	3
-	Palm of male gnathopod 2 with or less processes.	4
3	Accessory flagellum 2-articulate.	<u>rapax</u>
-	Accessory flagellum 3-articulate.	<u>lincolni</u>
4	Palm of male gnathopod 2 with 2 processes. Accessory flagellum 1-articulate.	<u>cervigoni</u>
-	Palm of male gnathopod 2 with 1 process, or without process.	5
5	Palm of male gnathopod 2 with 1 process; accessory flagellum 2-articulate.	<u>spinidactylus</u>
-	Palm of male gnathopod 2 without process; accessory flagellum 3-articulate.	<u>laughlini</u>

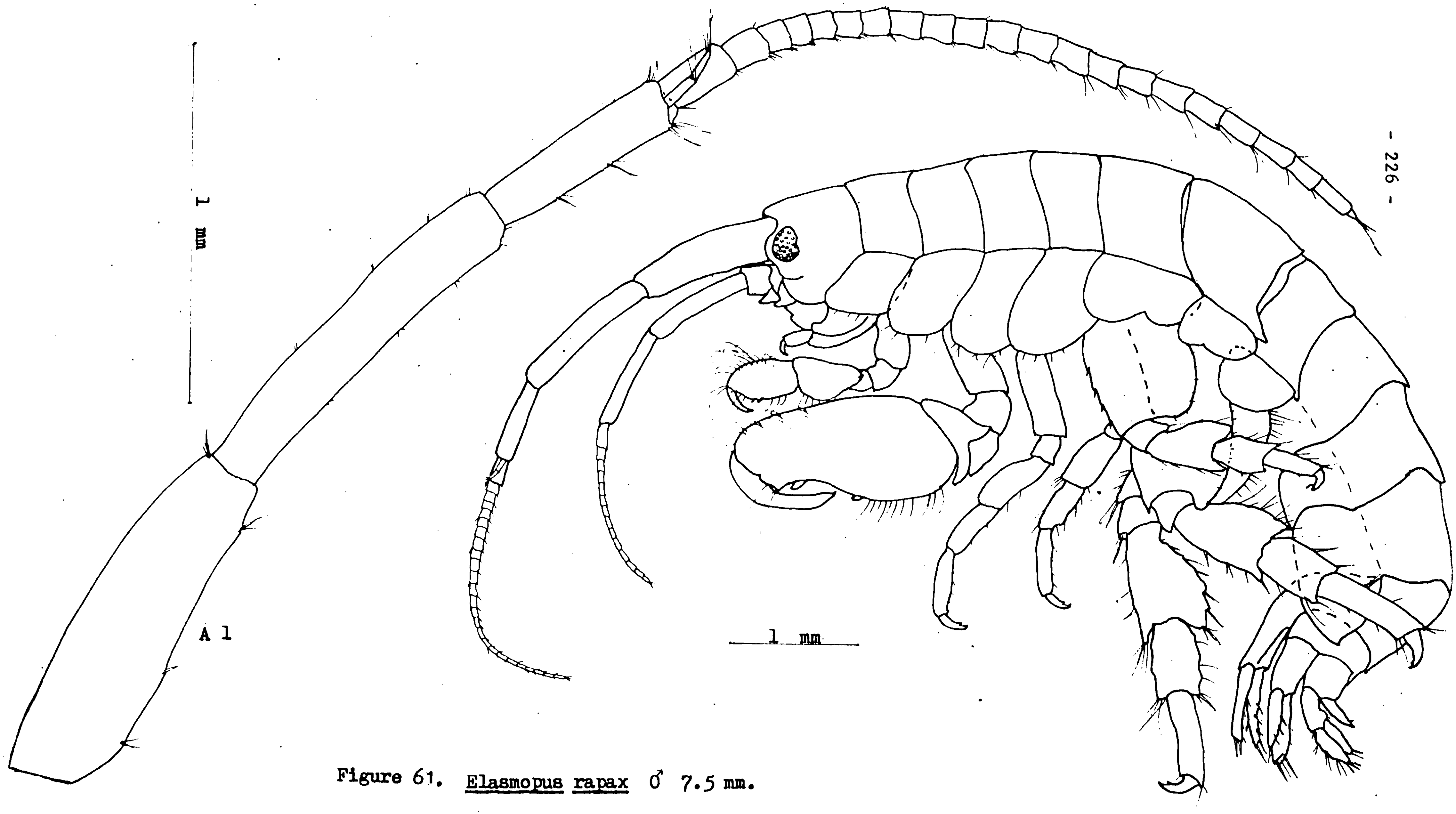


Figure 61. Elasmopus rapax ♂ 7.5 mm.

<u>Elasmopus</u> <u>rapax</u> Costa

(Figs 61-64)

<u>Elasmopus</u> <u>rapax</u> Costa, 1853: 175; Sars, 1895: 521; Chevreux & Fage, 1925: 244; Lincoln, 1979: 278.

<u>Megamoera</u> <u>brevicaudata</u>; Bate, 1862: 228.

<u>Elasmopus</u> ? <u>rapax</u> Costa; Barnard, 1979: 69, from Eastern Pacific.

<u>Material examined</u>:

12 ♂♂, 16 ♀♀, 11 juveniles from Playa La Gabarra, Bahia de Mochima, 9 April 1978.

<u>Description</u>:

Length up to about 10 mm, colour yellowish. Body robust, almost smooth. Head with lateral lobes broadly rounded; eyes large, oval, red-brown. Antenna 1 robust, half or more body length; flagellum subequal with peduncle, more than 20-articulate; peduncle articles 1 and 2 subequal length, article 3 half length of 2; accessory flagellum small, 2-articulate. Antenna 2 shorter than 1, slender, peduncle articles 4 and 5 subequal; flagellum shorter than peduncle. Mandibular palp article 3 falcate, apically with 3 setae, comb comprising 32 setae; article 2 apically with row of 4 setae; molar triturative with bifurcate setae; incisor bifurcate; lacinia mobilis bearing 5-dentate, a 4-spine row plus setae. Male gnathopod 1 propodus and carpus strongly setose; palm oblique, convex, delimited by 2 small spines. Palm of male gnathopod 2 with 3 distinct processes, a spinose hump near dactylar hinge, an acute proximal tooth, and the palmar margin with a tapering medial tooth. Palm and posterior margin

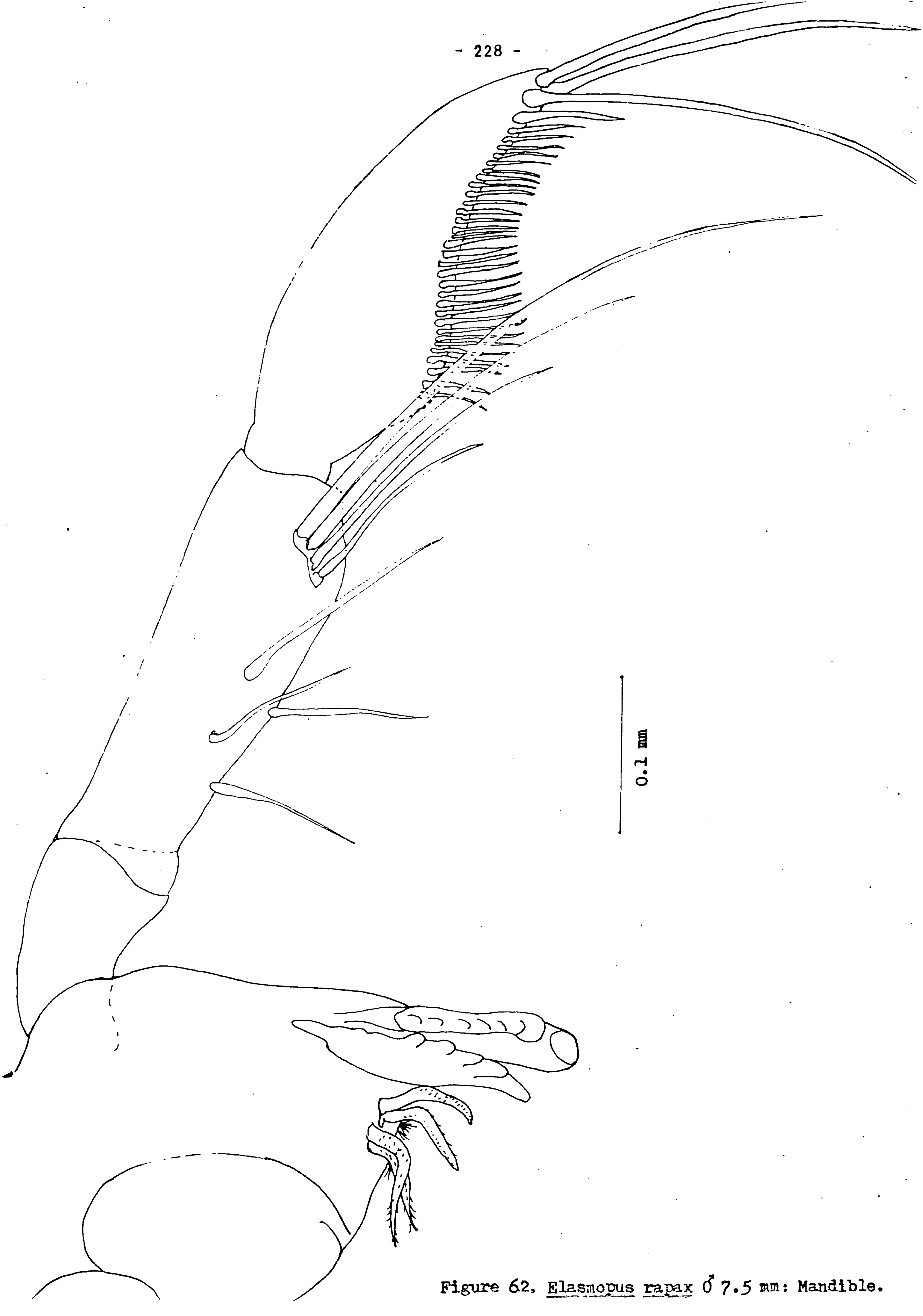


Figure 62. Elasmopus rapax ♂ 7.5 mm: Mandible.

of propodus evenly and sparsely setose. Dactylus strong, short, and minutely spinulose posteriorly. Coxal plates moderately large, plates 1-4 sparsely setose distally; gills rounded and moderately large. Pereopods 5-7 basis long posterior setae. Propodus of pereopod 7 with spines and long setae. Epimeral plates 1-3 with short spines and long setae. Epimeral plate 3 with weakly S-shaped posterior margin bearing setular notches and two conspicuous posterodistal invaginations; ventral margin with spines and setae, formula 3 : 3 : 1 : 3 : 1. Uropods 1-2 spinose; uropod 3 rami broad, truncated distally, spinose; rami of subequal length or outer ramus slightly longer than inner. Telson lobes apically rounded with small lateral sinus, each lobe with pair of distolateral spines and 2 setules.

Female similar to male except gnathopod 2 smaller and devoid of palmar processes, spines usually longer, and setae less dense.

Ecology:

Elasmopus rapax was collected from the upwelling area in the open clear waters of Mochima Bay, in contact with Cariaco trench waters. It is abundant amongst algae in shallow subtidal habitats. Elasmopus bampo was collected from the same locality but at the bottom of the bay.

Distribution:

Very widespread in Atlantic, Pacific and Indian oceans. Depth range about 0-100 m; often shallow subtidal.

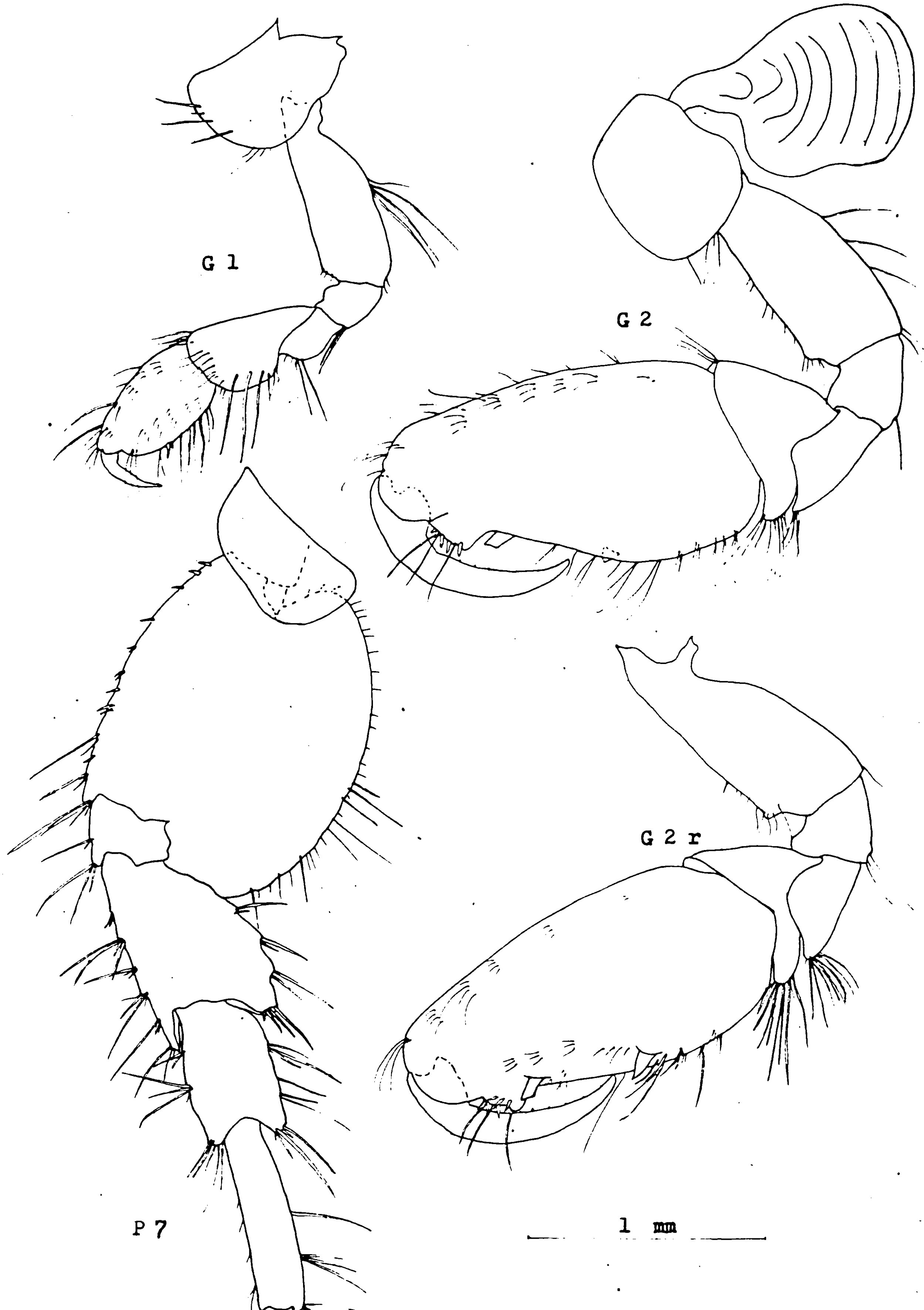


Figure 63. Elasmopus rapax ♂ 7.5 mm : Pereopods.

Remarks:

The Venezuelan *E. rapax* shares with the American Pacific and the European forms the main characters of the taxon but differs in having two posterodistal invaginations on epimeral plate 3. The Gulf of California material has only one such invagination, and in the North Atlantic and Mediterranean material, the margin is smooth. The cosmopolitan concept of *E. rapax* is retained for the present study despite the wide phenotypic variation that in other instances may have been used to designate two or more different species.

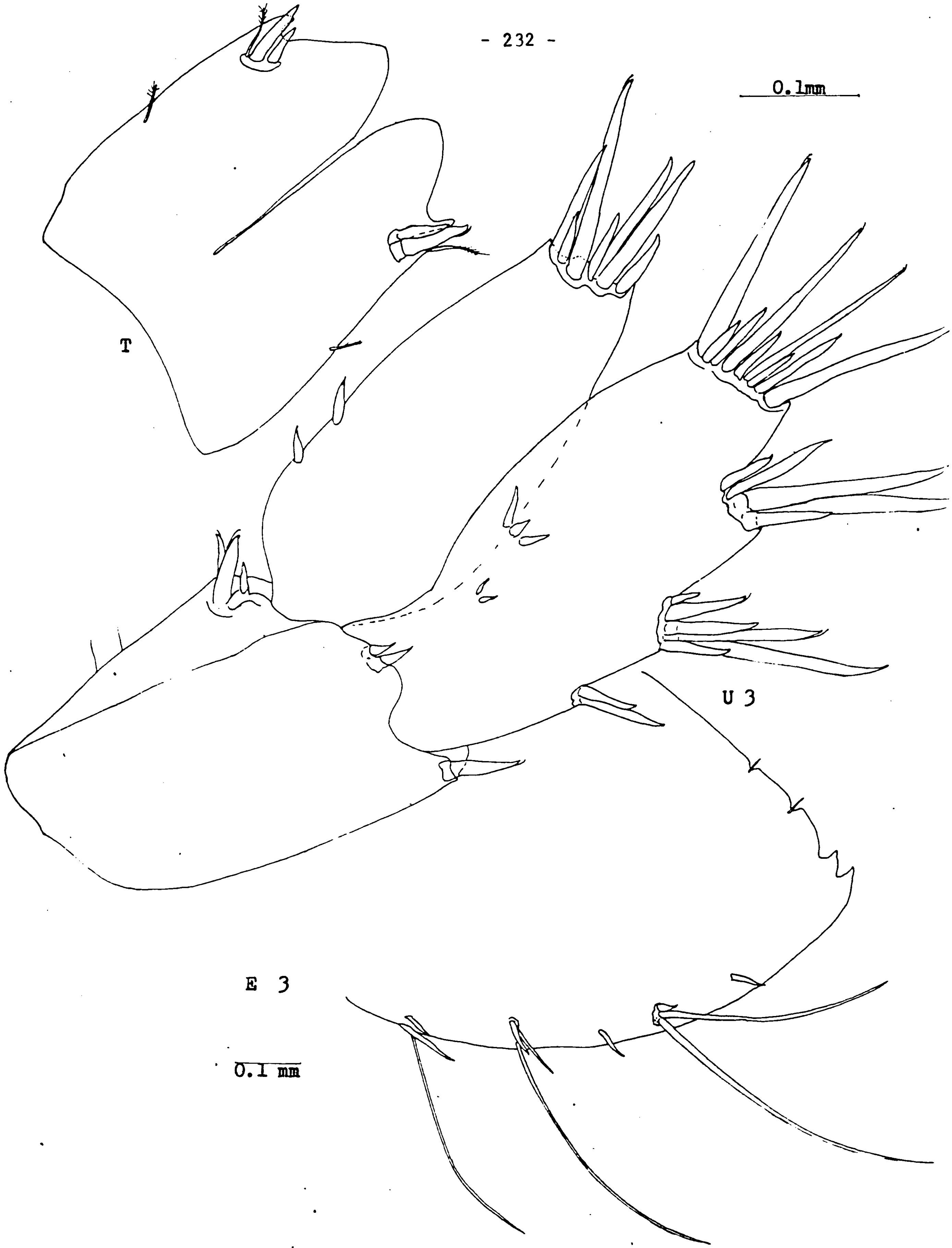


Figure 64. Elasmopus rapax ♂ 7.5 mm: Epimeral plate, uropod and telson.

Elasmopus bampo Barnard

(Figs 65-67)

Elasmopus bampo Barnard, 1979: 61.

Elasmopus rapax; Barnard, 1970: 131.

Material examined:

Several specimens from Mochima Bay, 18 February 1967. 1 ♂, 3 ♀♀, from Gulf of Cariaco, 7 March 1974. Several specimens from Gulf of Cariaco, August 1974 and from Isla de Margarita, 15 February 1975, 18 July 1975 and 26 February 1976.

Description:

Length up to about 10 mm, colour variable, often yellowish. Body robust and smooth. Eyes large, oval, dark-red. Antennae of E. rapax type but flagellum of antenna 1 more than 25-articulate and accessory flagellum 3-articulate. Mouthparts as in E. rapax except mandibular palp article 3 deeply falcate with comb of 50 setae; article 2 with row of 6 apical setae. Male gnathopod 1, propodus and carpus setose, palm spinose. Palm of male gnathopod 2 with 4 distinct processes, a simple spinose hump near dactylar hinge, a triangular naked tooth, an acute proximal tooth, and the palm defined by tapering medial tooth. Palm and posterior margin of hand evenly and sparsely setose. Coxal plates and gills similar to E. rapax. Article 2 of pereopods 5-7 with long posterior setae; propodus of pereopod 7 with spines and short setae. Epimeral plates 1-3 with short spines and long setae. Epimeral plate 3 with almost straight posterior margin bearing setular notches and a small

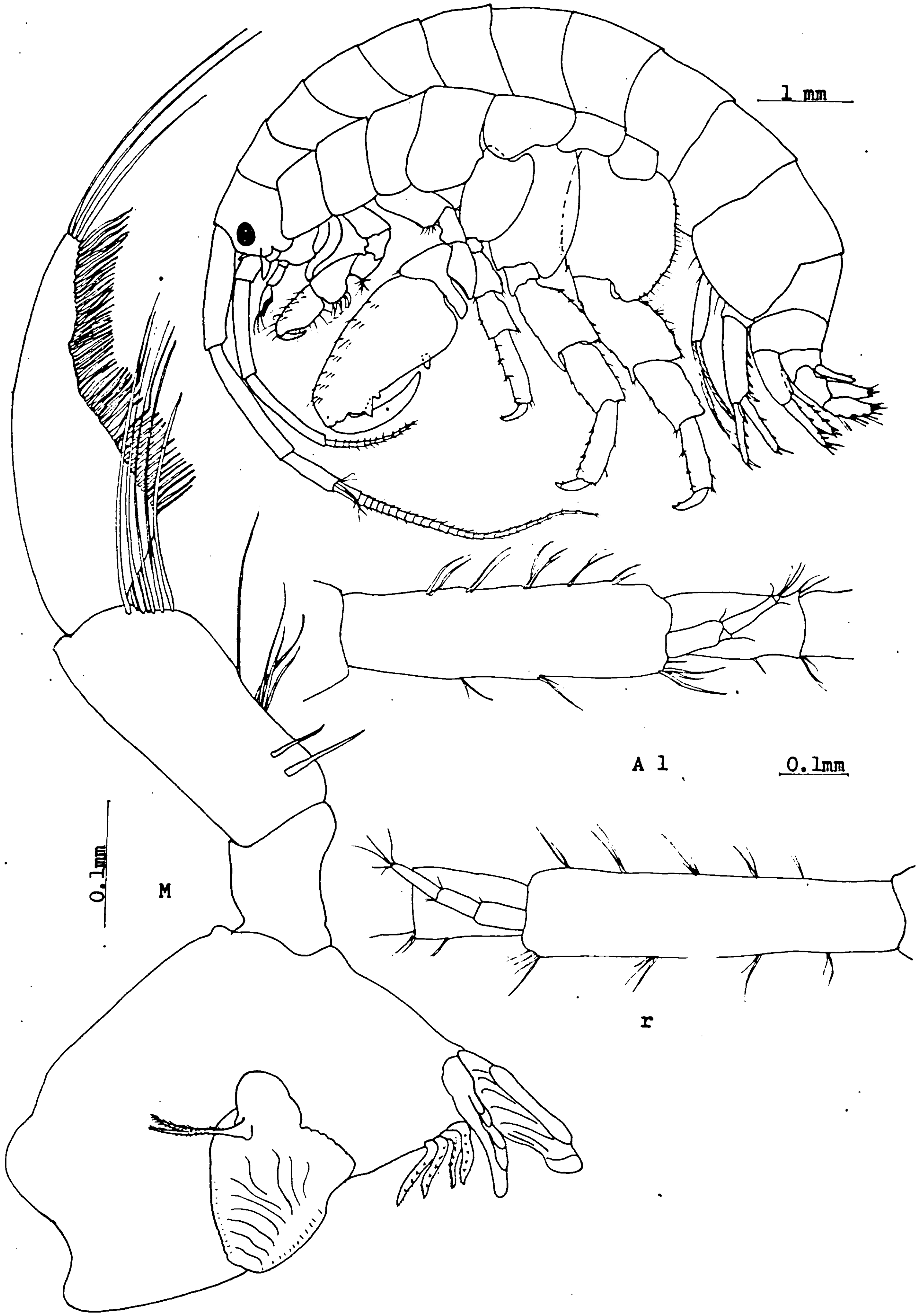


Figure 65. Elasmopus bampo ♂ 9 mm.

posterodistal sinus; ventral margin with spines and setae, formula 2 : 3 : 1 : 2 : 1 : 2 : 2. Uropods spinose; uropod 3 rami subequal, truncate distally. Telson lobes rounded, naked, with small lateral sinus; each lobe with pair of short spines and a seta.

Females closely similar to females of Elasmopus rapax.

Ecology:

Very common locally in the subtidal mangrove communities of the upwelling area of the Venezuelan seas together with Elasmopus rapax and E. cervigoni.

Distribution:

Venezuelan Caribbean seas: Bahia de Mochima; Golfo de Cariaco; and Isla de Margarita, Laguna de la Restinga.
Hawaii and Gulf of California.

Remarks:

Elasmopus bampo and E. spinidactylus are typical tropical Pacific species that have been recorded for the first time in Venezuelan Caribbean seas inhabiting coral and mangrove communities. They probably reached this area before the appearance of the Panama isthmus about 5 million years ago. Since the cosmopolitan Elasmopus rapax is confined to one part of the upwelling area only, the more widespread Elasmopus bampo probably gave rise to the other species of the Venezuelan Caribbean by a process of sympatric speciation not uncommon in tropical ecosystems.

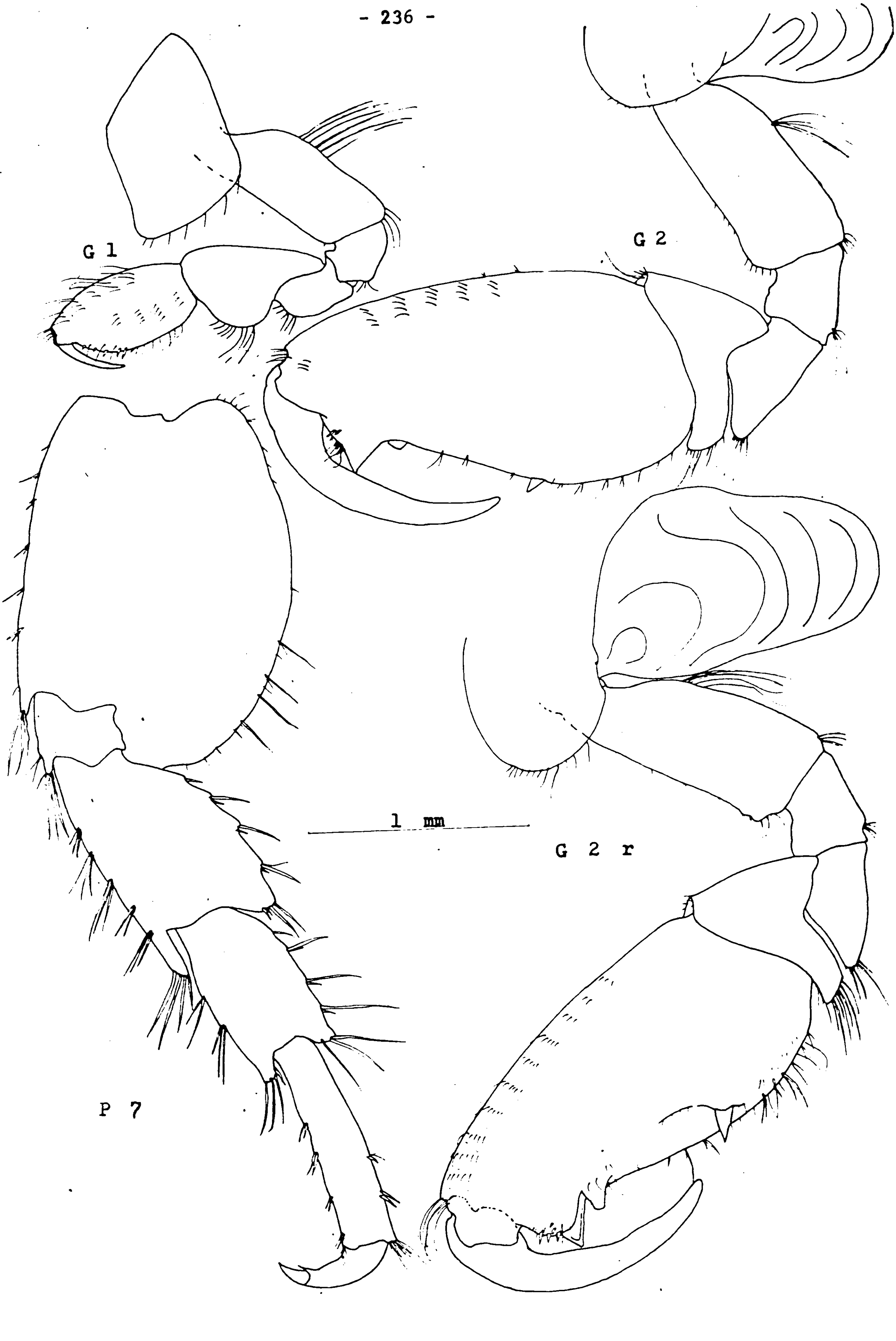


Figure 66. Elasmopus bampo ♂ 9 mm : Pereopods .

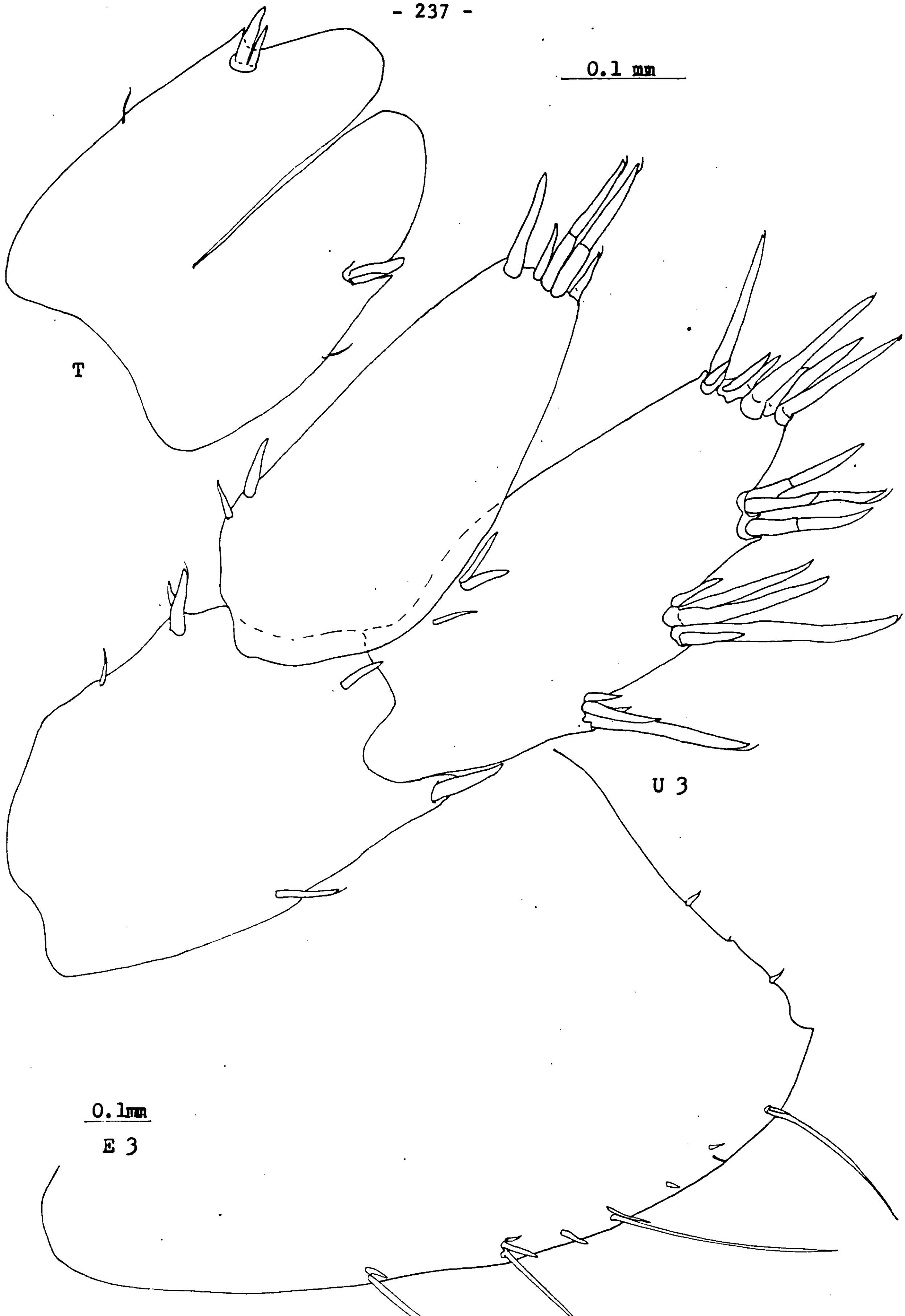


Figure 67. Elasmopus bampo ♂ 9 mm: Epimeral plate, uropod and telson.

<u>Elasmopus</u> <u>cervigoni</u> new species

(Figs 68-70)

<u>Material examined</u>:

Holotype ♂, 9 mm, Laguna de la Restinga, Isla de Margarita, Venezuela, 15 February 1975.

Type locality: Hypersaline mangrove lagoon "Restinga", Isla de Margarita, shallow sublittoral waters, on mangrove roots; samples with several specimens, 15 February 1975, 21 November 1975 and 26 February 1976.

<u>Etymology</u>:

The species is named after Dr F. Cervigon.

<u>Description</u>:

Length up to 9 mm, colour variable, yellowish. Generally similar to <u>Elasmopus</u> <u>rapax</u>. Body smooth; eyes basic but smaller than rapax and post-antennal sinus oblique. Antenna 1 short, half body length or less; flagellum subequal in length to peduncle, about 20-articulate; accessory flagellum 1-articulate, shorter than first article of primary flagellum, apically truncate and setose. Antenna 2 flagellum usually of six articles occasionally few more. Mouthparts as for <u>E</u>. <u>rapax</u> except mandibular palp deeply falcate with different setal pattern; apically with six or seven setae and a comb of thirty-six setae on article 3; article 2 apically with a row of eight setae plus two; left lacinia mobilis 5-dentate, right 6-dentate; spine row with 4 spines plus setae; molar bearing bifurcate setae. Gnathopod 1 subchelate, carpus and propodus with long setae. Male gnathopod 2 powerful, subchelate; merus, carpus and propodus densely

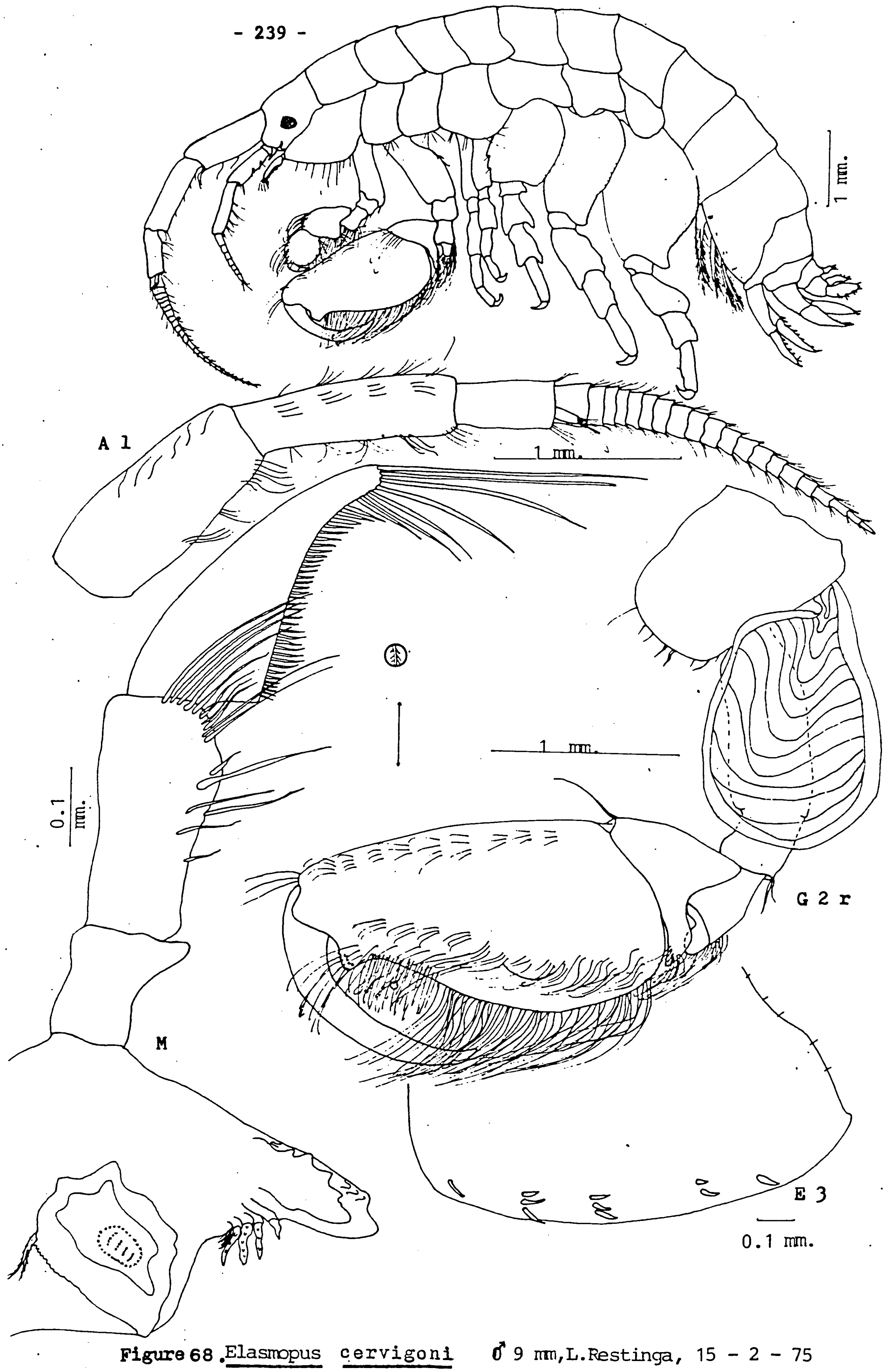


Figure 68. <u>Elasmopus</u> <u>cervigoni</u> ♂ 9 mm, L. Restinga, 15 - 2 - 75

setose posteriorly, mainly with long setae; palm of male gnathopod 2 with hump and ridge-hump only; hump near dactylar hinge bearing small spines internally; medial face of palm with sympodial setae; ridge-hump hidden by row of setae internally on hand level with apex of dactylus; no tooth delimiting palm from posterior margin; palm and posterior margin of propodus heavily setose; apex of hand without anterodistal stridulation ridges. Coxal plates 1-4 with few distal setae. Article 2 of pereopods lacking long setae; article 2 of pereopods 6-7 with posterodistal margin serrate and castellate. Epimeral plate 3 with spines, lacking long setae, posterodistal margin weakly S-shaped; epimeral plate 3 ventral margin with spine formula 1 : 3 : 3 : 2 : 1. Uropod 3 bearing strong stout spines; outer ramus of uropod 3 longer than inner. Telson with truncate and excavate apices, each armed with seven or eight spines, three of the spines always elongate.

Female similar to male except gnathopod 2 smaller and without palmar humps.

Ecology:

Elasmopus cervigoni was found with E. bampo in the hypersaline mangrove lagoon "Restinga" on an island in the upwelling area, from November to February - the period of minimum annual temperature for these waters.

Distribution:

Known only from the type locality, Laguna de la Restinga, Isla de Margarita.

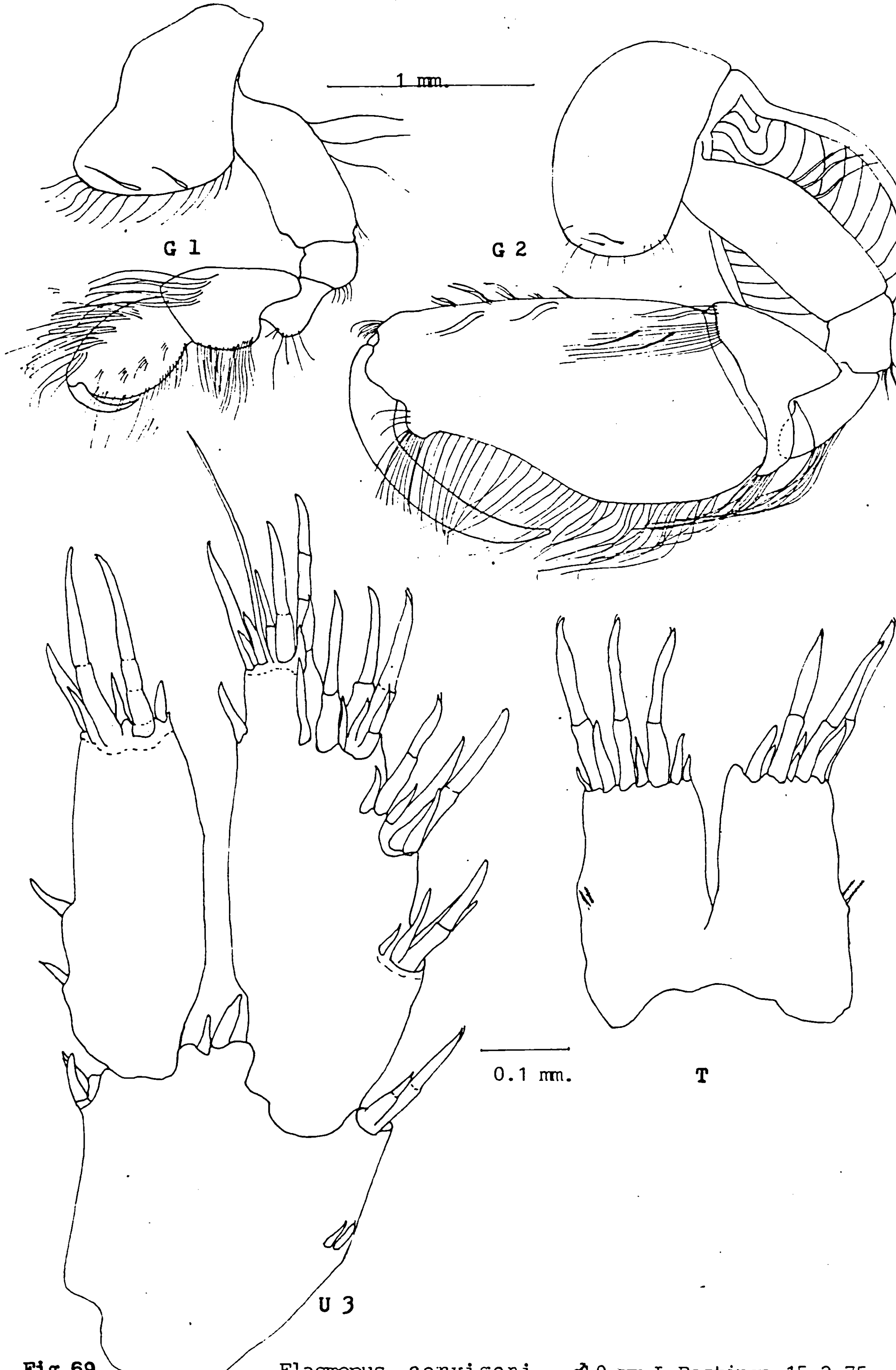
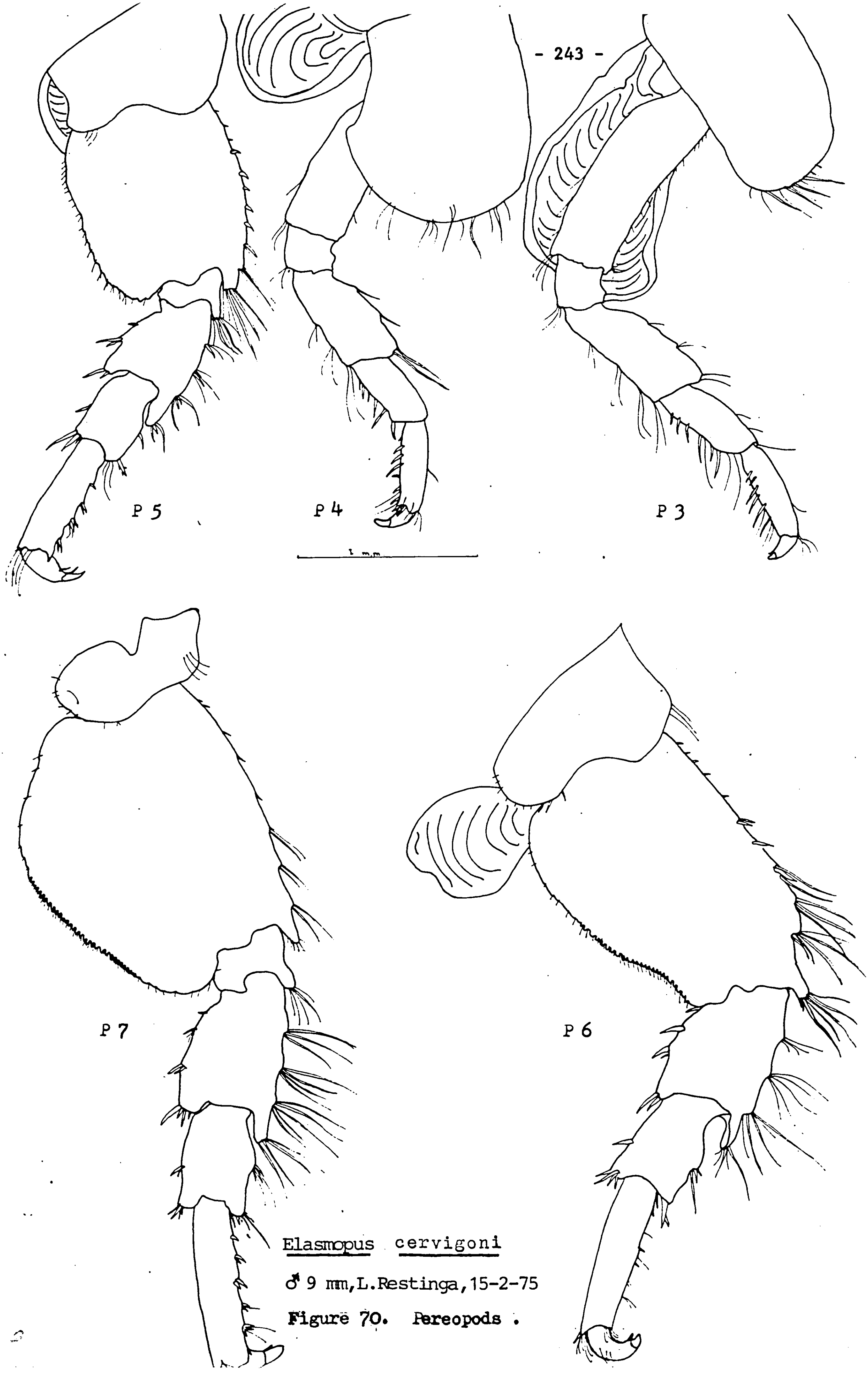


Fig.69. <u>Elasmopus cervigoni</u> ♂ 9 mm, L. Restinga, 15-2-75

Remarks:

Elasmopus cervigoni is a new species from Isla de Margarita living in the same taxocoenosis as *E. bampo* which extends throughout the upwelling area of the southern Caribbean Sea.



Elasmopus cervigoni

♂ 9 mm, L.Restinga, 15-2-75

Figure 70. Pereopods .

<u>Elasmopus</u> <u>laughlini</u> new species

(Figs 71-72)

<u>Material examined</u>:

Holotype ♂, 8 mm, from Los Roques islands, Venezuela, 30 April 1980. Type locality: Coral atoll with mangrove communities, Isla Mosquises, Archipielago Los Roques, shallow subtidal to 5 m depth; samples with several specimens, 27 April 1980, 30 April 1980 and 23 June 1980.

<u>Etymology</u>:

The species is named after Dr R. Laughlin.

<u>Description</u>:

Length up to 8 mm, body smooth, colour yellowish; generally similar to Elasmopus rapax; eyes basic, colour dark brown. Antenna 1 half body length; flagellum subequal to peduncle, up to 20-articulate; accessory flagellum small but 3-articulate. Antenna 2 with flagellum shorter than peduncle, up to 10-articulate. Mouthparts of <u>E</u>. <u>rapax</u> type; mandibular palp article 3 weakly falcate, apically with 3-4 setae and comb of 38 setae; article 2 apically with a row of 3 setae. Male gnathopod 1, propodus and carpus strongly setose; palm oblique, convex and spinose; 4 strong spines between proximal part of palm and distal part of posterior margin. Male gnathopod 2 palm without process; carpus and propodus posteriorly setose; palm oblique, convex and armed with small spines on distal half. Coxal plates and gills basic for genus. Pereopods 5-7 basis with long posterior setae. Epimeral plates 1-3 with distal spines, posterodistal angle acute. Epimeral plate 3 posterior margin without setular notches; ventral margin spine formula 1 : 2 : 3 : 2 : 2 : 1 : 1; postero-

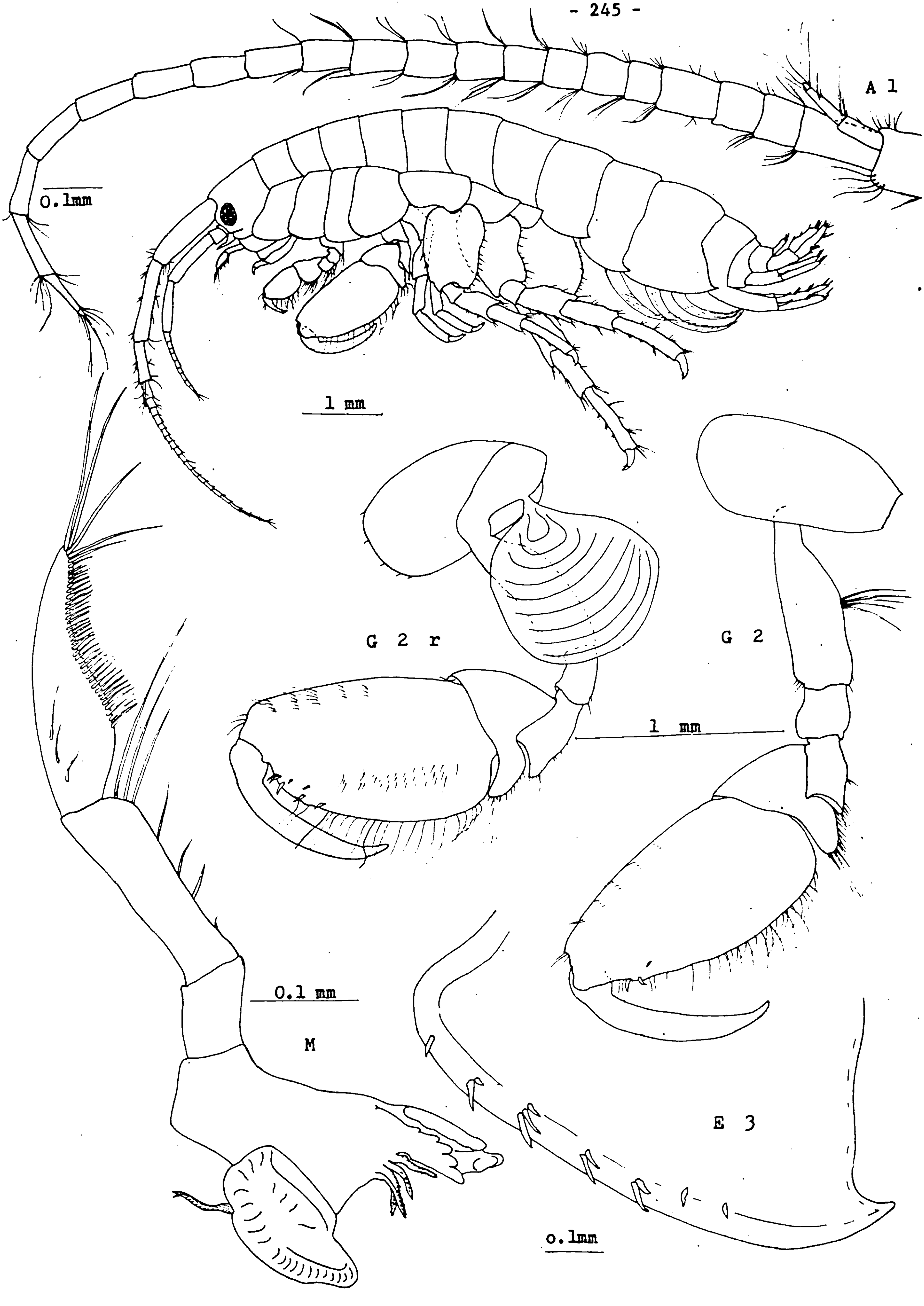


Figure 71. Elasmopus laughlini ♂ 8 mm.

distal angle strongly produced as tooth-like process. Uropods basic, spinose; uropod 3 inner ramus shorter than outer. Telson lobes with apical sinus bearing one short and one long dorsal spine.

Females difficult to separate from other females of the genus.

Ecology:

Elasmopus laughlini is a large and abundant species in the shallow subtidal waters of coral atolls. It was collected with *E. lincolni*.

Distribution:

The species is known only from the type locality, Archipielago Los Roques, a coral atoll in the open Caribbean waters.

Remarks:

Elasmopus laughlini is the most common species of *Elasmopus* in the atolls. The absence of any process on the palm of the male gnathopod 2 makes for easy recognition of this species.

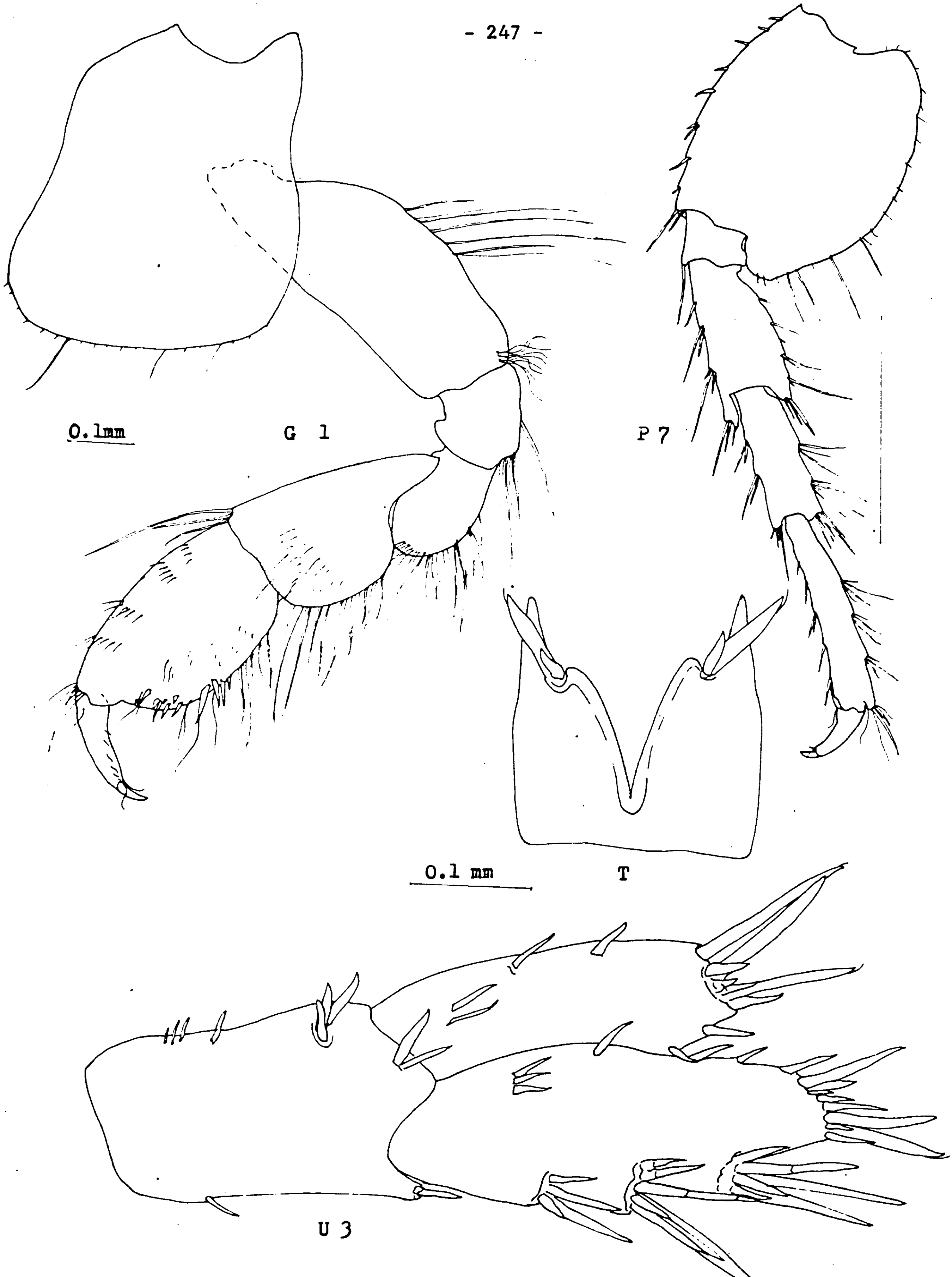


Figure 72. Elasmopus laughlini ♂ 8 mm: Appendages.

Elasmopus lincolni new species

(Figs 73-74)

Material examined:

Holotype ♂, 5 mm, from Islas Los Roques, Venezuela, 30 April 1980. Type locality: Coral atoll with mangrove communities, Isla Mosquises, Archipielago Los Roques, shallow subtidal to 5 m depth; sample with 10 ♂♂, 30 April 1980.

2 ♂♂, from Patanemo Bay, Central Litoral, Venezuela, 26 June 1981.

Etymology:

This species is named after my BM(NH) supervisor, Dr Roger Lincoln.

Description:

Length up to 5 mm, colour yellowish; body robust with minute setae dorsally on pereon and pleon. Head basic, eyes red-brown. Antenna 1 robust, half body length, flagellum subequal to peduncle, 12 to 15-articulate; accessory flagellum small and 3-articulate. Antenna 2 small with flagellum shorter than peduncle, 9-articulate. Mouthparts of Elasmopus rapax type; mandibular palp article 3 falcate with 3 apical setae and comb of 20 setae, article 2 with 3 apical setae. Male gnathopod 1, merus, carpus and propodus with long setae posteriorly; palm oblique with conspicuous spine proximally and 3-4 small spines medially; dactylus bearing setules. Palm of male gnathopod 2 with three distinct processes: a spinose hump near dactylar hinge; a proximal spine; and a tapering medial tooth also proximally situated; carpus and propodus sparsely setose; dactylus with flat setulose posterior surface. Coxal plates and gills typical of the genus. Pereopods 5-7 without long setae posteriorly but bearing serrations with setules on the

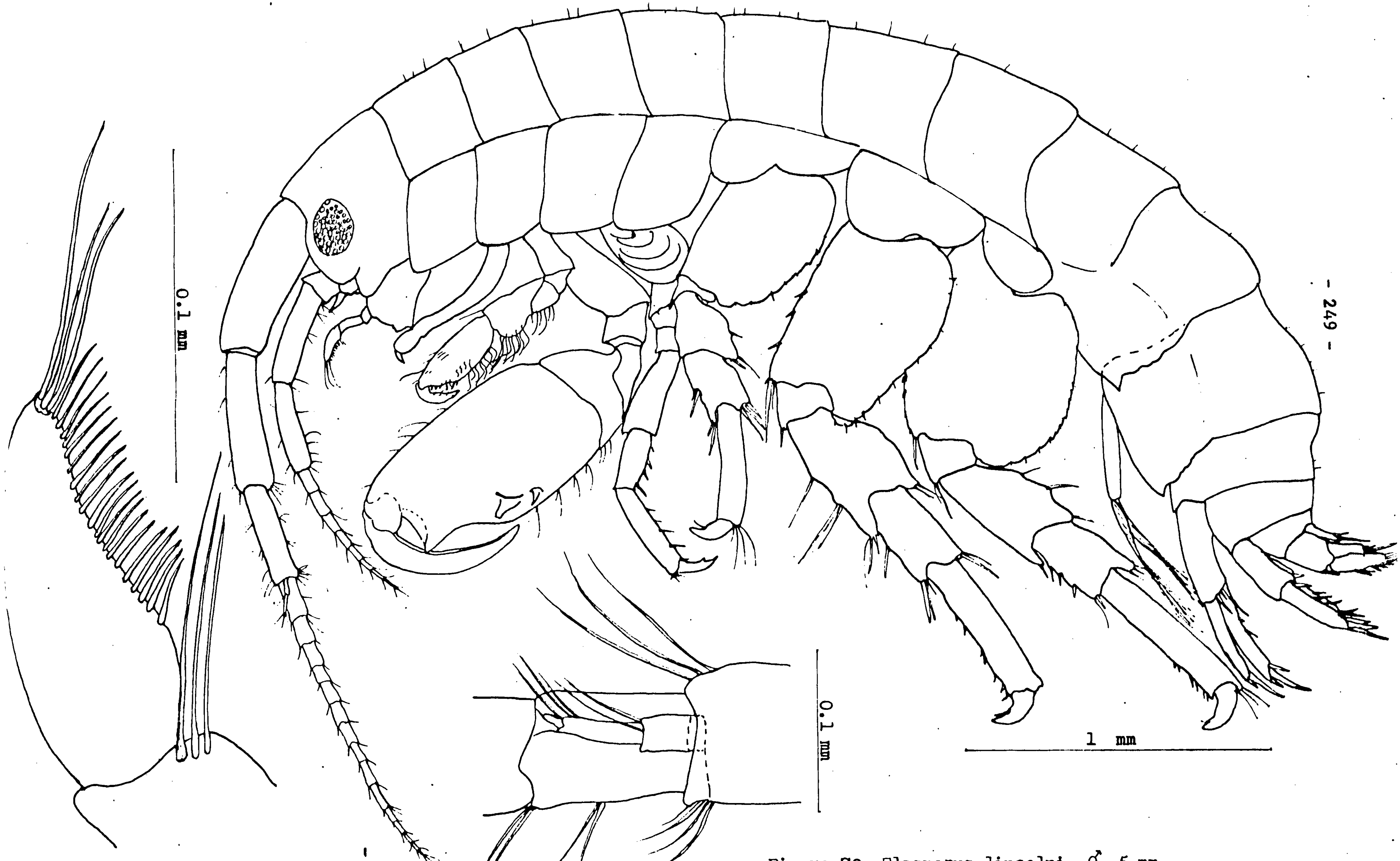


Figure 73. Elasmopus lincolni ♂ 5 mm.

basis, in general strongly spinose. Epimeral plates 1-3 lacking setae, with posterodistal sinus. Epimeral plate 3 weakly S-shaped posteriorly with small spines; posterodistal angle slightly produced as toothed process below small sinus; ventral margin with spine formula 1 : 1 : 1. Uropods spinose. Uropod 3 inner ramus shorter than outer. Telson lobes with apicolateral sinus bearing one short and one long spine.

Female unknown.

Ecology:

A small, rare species of Elasmopus found amongst samples of E. laughlini from shallow subtidal waters of coral atolls.

Distribution:

Known only from the type locality andthe clear tropical waters of the Venezuelan Central Litoral.

Remarks:

This species probably evolved by sympatric speciation in the mature tropical coral and mangrove ecosystems of the Venezuelan Caribbean. This is a further example of a small, relatively rare species accompanying a larger more abundant species in the same taxocoenosis. Elasmopus lincolni is difficult to recognize except for the unique process on the palm of male gnathopod 2.

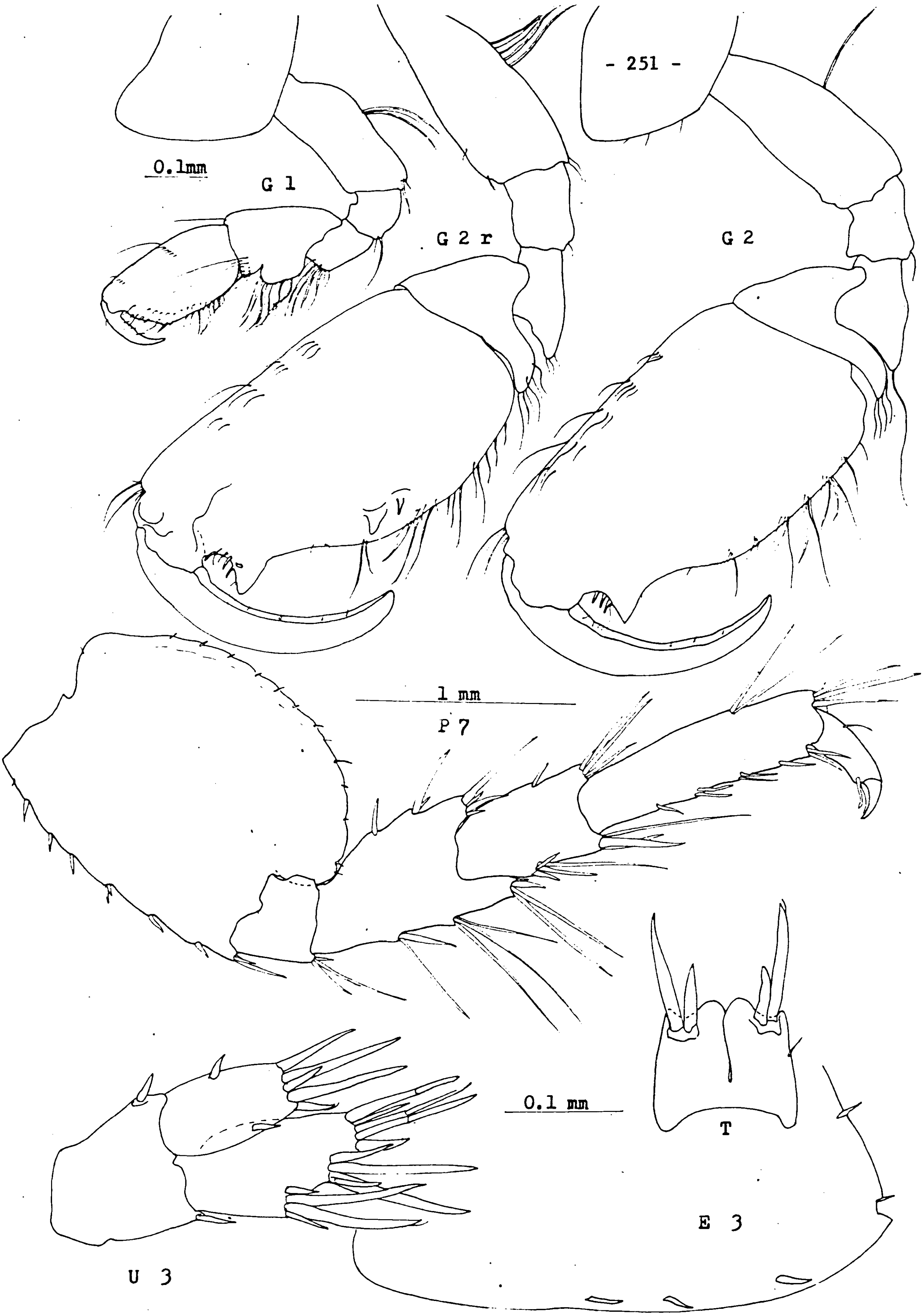


Figure 74. Elasmopus lincolni ♂ 5 mm : Appendages

Dulichiella Stout

Dulichiella Stout, 1912: 140; Karaman, 1981: 31.

Body with pleonal segments toothed and with spines; coxal plates of moderate size. Rostrum absent. Antenna 1 longer than antenna 2, longer than half body length; accessory flagellum present. Upper lip emarginate; lower lip with inner lobes. Mandible well developed, molar flake present, incisor and lacinia mobilis toothed, palp 3-segmented. Maxilla 1 inner lobe conical carrying distally only 1-2 strong plumose setae. Maxilla 2 inner lobe with oblique row of facial setae. Maxillipeds well developed, palp 4-articulate. Gnathopods subchelate, sexually dimorphic, left and right male gnathopod 2 markedly unequal in size and shape (dissymmetric), one remains small resembling the female condition, the other enormously enlarged. Uropods biramous; uropod 3 inner ramus scale-like, outer ramus elongate, 2-segmented. Telson cleft to the base.

A cosmopolitan genus found in shallow tropical waters. Stout's description of *Dulichiella* was based on the mistaken idea that uropod 3 lacked rami (in fact, they were broken off) and was thus to be compared to *Dulichia*. Nevertheless, the genus remained as a synonym of *Melita* until Karaman & Barnard (1979) again separated them. Recently, Karaman (1981) separated off a third genus from *Melita*, namely *Abludomelita*. *Dulichiella* differs from *Melita* in the form of the dimorphic male gnathopod 2; in having a conical inner lobe to maxilla 1 bearing only 1-2 plumose setae; in the oblique row of setae on the inner lobe of maxilla 2; and in having a 2-segmented outer ramus on uropod 3. *Dulichiella* differs from *Abludomelita* in the form of the dimorphic male gnathopod 2, and in the conical inner lobe of maxilla 1 with 1-2 plumose setae.

Dulichiella comprises the following 5 species: *Dulichiella appendiculata* (Say, 1818), *D. australis* (Haswell, 1874), *D. exilii* (Muller, 1864), *D. grandimana* (Chevreux, 1908) and *D. spinosa* (Stout, 1912).

Dulichiella anisochir (Kroyer, 1845), *D. cotesi* (Giles, 1890), *D. fresnelli* (Audouin, 1826), *D. pilosus* (Dana, 1852), *D. setipes* (Dana, 1852) and *D. validus* (Dana, 1852) are all regarded as synonyms of *D. appendiculata* (Say). Descriptions of these species are poor, often lacking illustrations, and the validity of this synonymy must remain open to doubt.

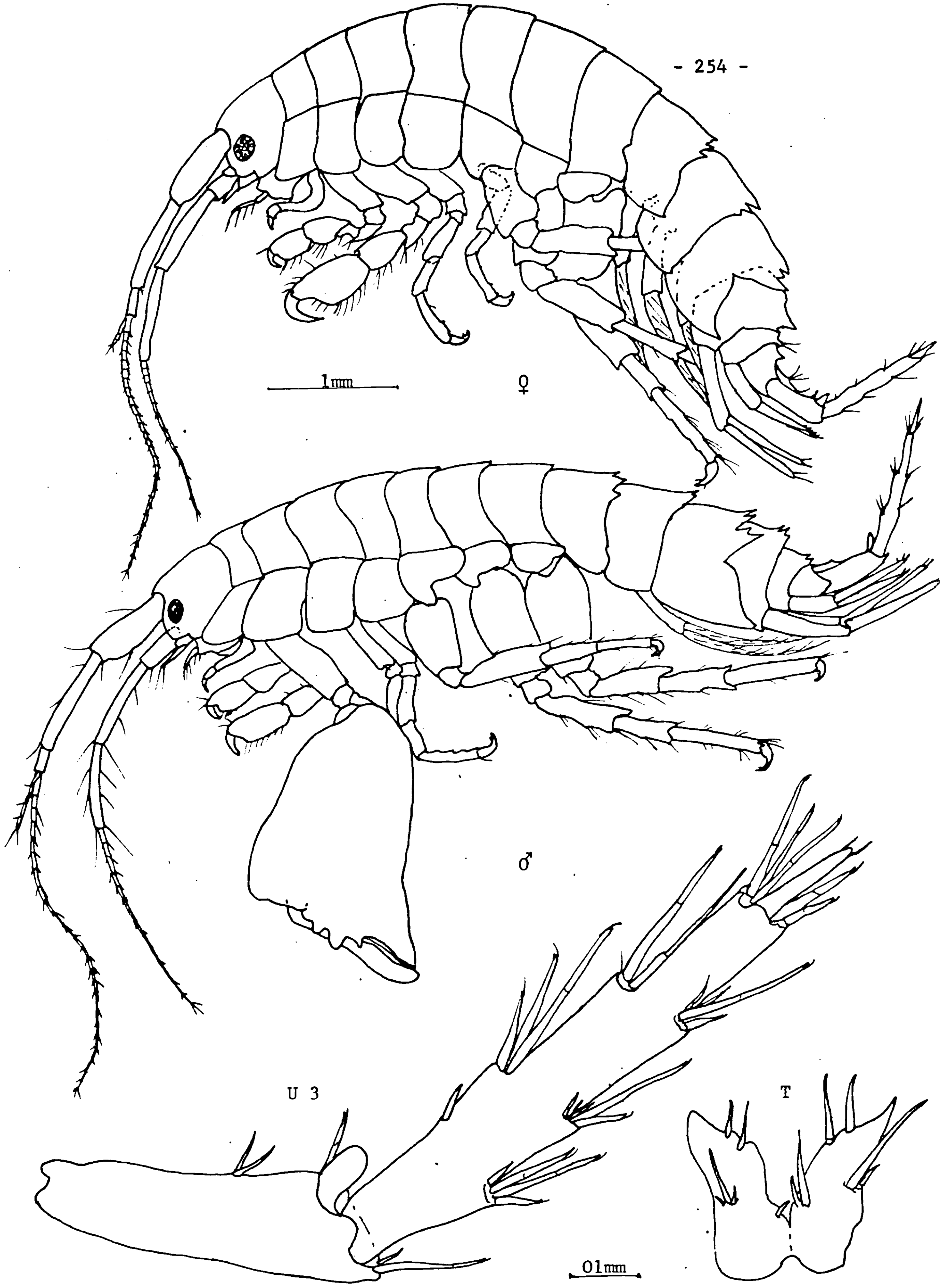


Figure 75. Dulichiella appendiculata ♀ & ♂ 6 mm.

Dulichiella appendiculata (Say)

(Figs 75-77)

Gammarus appendiculatus Say, 1818: 377.

Dulichiella appendiculata; Karaman & Barnard, 1979: 153.

Material examined:

36 ♂♂, 24 ♀♀, from Laguna Restinga, Isla de Margarita, 15 February 1975. 18 ♂♂, 17 ♀♀, from the same locality, 19 April 1975. 28 ♂♂, 23 ♀♀, from the same locality, 28 December 1975.

Description:

Body slender, length up to 6 mm, colour cream to yellowish. Posterior margin of pleonites toothed. Eyes subrounded, dark red. Lateral cephalic lobes subquadrate. Antennae setose. Antenna 1 longer than 2, surpassing half body length, flagellum about 26-articulate, accessory flagellum 4-articulate. Antenna 2 flagellum about 12-articulate. Right mandible with molar flake. Mandibular palp article 3 weakly clavate. Upper lip weakly bilobed. Lower lip with inner lobes developed, fleshy. Inner plate of maxilla 1 long, narrow, and tapering, armed with 2 strong apical plumose setae and 12 medial marginal setae; outer plate with 9 spines; palp biarticulate with 11 apical spines. Inner plate of maxilla 2 with row of oblique facial setae. Maxillipeds with weak dactylar palps terminating in a spine. Coxal plates of medium size, 4 scarsely longer than 5. Gills rounded, present on coxae 2-6. Gnathopod 1 Melita type with carpus longer than propodus. Gnathopod 2 in female and on one side of male slightly larger than 1, propodus longer than carpus. Male gnathopod 2 on the other side always immensely

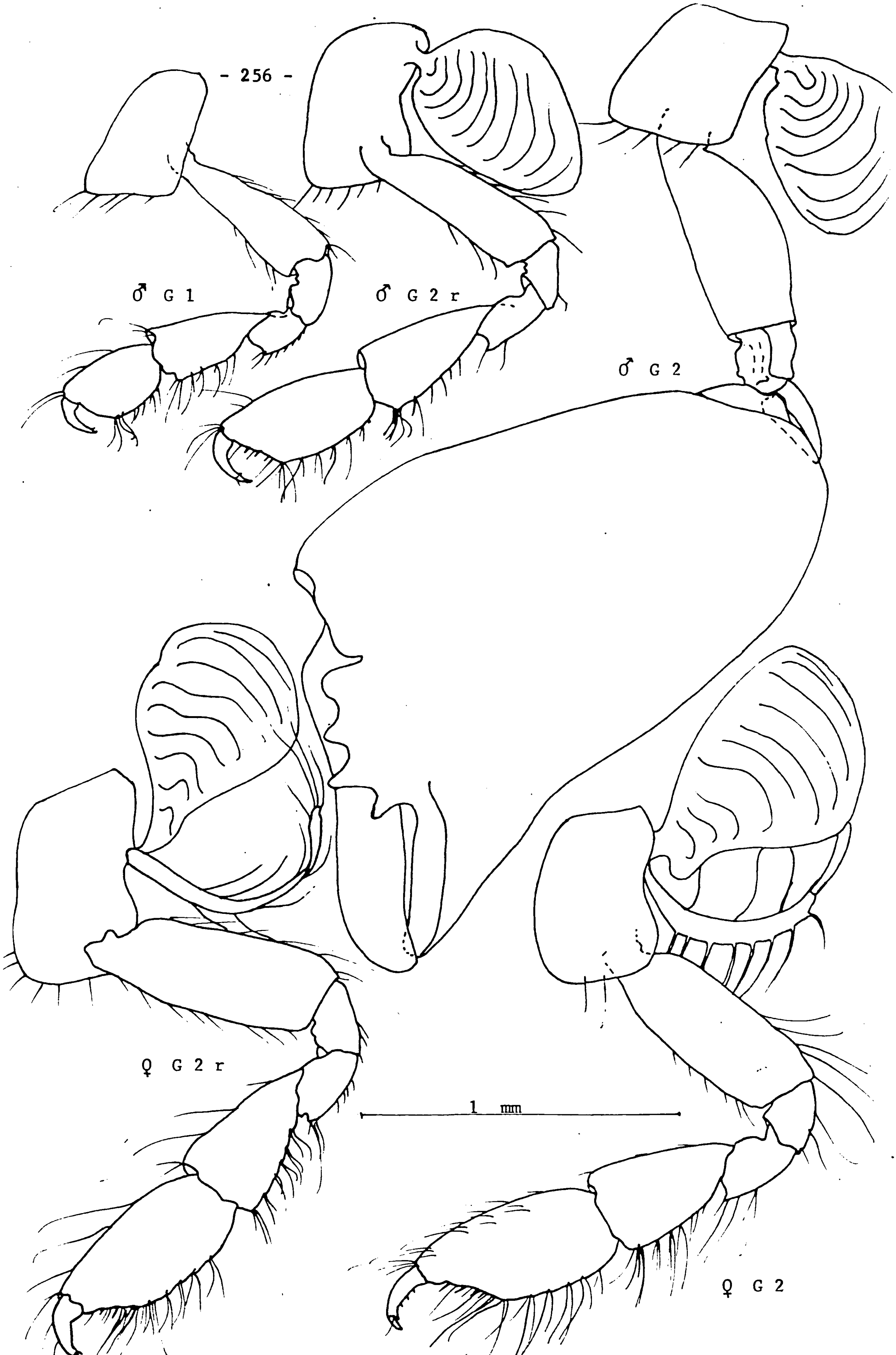


Figure 76. Dulichiella appendiculata ♂ & ♀ 6 mm: Gnathopods.

enlarged and chelate resembling crab claw (of 82 males examined, 46 developed an enlarged right gnathopod, 36 an enlarged left one); articles 3-5 very small; propodus almost half body size with giant chela; dactylus very thick, closing on to the extended transverse palm bearing three or four teeth. Pereopods slender, article 2 of pereopods 5-7 scarsely expanded, sublobate. Pleopods normal or elongated. Epimeral plates with toothed posterodistal angles. Epimeral plate 3 posterodistal angle with large tooth. Uropods 1-2 rami spinose, subequal. Uropod 3, inner ramus vestigial, outer ramus elongate, spinose with short article 2, reaching well beyond uropod 1. Telson bilobed, spinose distolaterally.

Female with left and right gnathopod 2 similar; oostegites slender with long setae, present on coxal plates 2-5; marsupium bearing 22 eggs.

Ecology:

From 146 individuals collected in shallow water around mangrove roots, 82 were males and 64 females of which 44 carried eggs. The dissymmetric male gnathopod 2 is a feature reminiscent of fiddler crabs and other hole-living crustaceans but is a paradox in this free-living species.

Distribution:

A circumtropical species recorded from Venezuela in sea mangrove lagoon at Restinga on Isla de Margarita.

Remarks:

The Venezuelan material fits precisely the Barnard & Karaman (1979) description of Dulichiella appendiculata.

Figure 77. Dulichiella appendiculata ♂ 6 mm: Mouthparts.

Family HADZIIDAE

Body very slender, lacking pigmentation, pleon segments usually very weakly spinulose; coxal plates 1-4 deep and plates 5-7 occasionally posterolobate. Head without or with very small rostrum; eyes absent. Antennae slender, sparsely setose; accessory flagellum vestigial or absent. Mouthparts basic; lower lip, inner lobes weakly or not developed. Gnathopods weakly subchelate and weakly sexually dimorphic; carpus usually elongate without posterior lobe. Pereopods slender and elongate. Uropod 3, rami often broad, lanceolate or weakly foliaceous; outer ramus with reduced terminal segment. Telson entire, or lobes more or less fused.

Hadziids were discovered almost simultaneously in the Mediterranean region by S. Karaman in 1932 (p. 214) who described Hadzia fragilis and (p. 220) H. gjorgjevici; and in the Caribbean region by Stephensen (1933: 426) with Metaniphargus curasavicus. The latter was recorded again by the same author later that year (1933: 441) and subsequently redescribed by Stephensen (1948: 4). Karaman (1943: 206) first recognized the family Hadziidae; since then there has been a series of papers, for instance, Ruffo (1953: 16), Bousfield (1977: 297), Stock (1977: 3), Zimmerman & Barnard (1977: 566) and Holsinger & Longley (1980: 7); but still the family is in a state of flux and confusion, Barnard (1977: 286) amalgamated Hadzia and Metaniphargus, mentioning Hadzia curasavica (Stephensen) 1933, and later with Karaman (1982: 177) also synonymized the genus Liagoceradocus. Barnard (1983: 639) revised the hadziids recognizing the following clusters, Paraweckelliids, Hadziids and Weckelliids, and drawing attention to the need for further study. For the moment the generic composition of the family Hadziidae is as follows:

Allotexiweckelia Holsinger, 1980: 26.

Texas - 1 species.

Alloweckelia Holsinger & Peck, 1968: 250.

Puerto Rico - 1 species.

Dulzura Barnard, 1969: 114.

Galapagos, Hawaii and California - 4 species.

Hadzia Karaman, 1932: 214.

Yugoslavia - 3 species.

Holsingerius Karaman & Barnard, 1982: 180.

Texas - 1 species.

Liagoceradocus Barnard, 1965: 504.

Hawaii, Caroline and Canary islands - 3 species.

Mayaweckelia Holsinger, 1977: 15.

Yucatan - 2 species.

Metahadzia Stock, 1977: 32.

Portugal to Greece - 4 species.

Metaniphargus Stephensen, 1933: 426.

Caribbean - 14 species.

Mexiweckelia Holsinger & Minckley, 1971: 426.

Mexico - 2 species.

Paramexiweckelia Holsinger, 1981.

Mexico - 1 species.

Paraweckelia Shoemaker, 1959: 279.

Cuba - 1 species.

Protohadzia Zimmerman & Barnard, 1977: 569.

Bimini and Puerto Rico - 1 species.

Psammoniphargus Ruffo, 1956: 89.

Reunion islands - 1 species.

Saliweckelia Stock, 1977: 70.

Bonaire, Curaçao and Tortuga - 1 species.

Texiweckelia Holsinger, 1980: 7.

Texas - 1 species.

Texiweckeliopsis Karaman & Barnard, 1982: 179.

Texas - 1 species.

Weckelia Shoemaker, 1942: 11.

Cuba - 1 species.

Zhadia Lowry & Fenwick, 1983: 243.

Auckland Islands - 1 species.

The family Hadziidae comprises about 44 species in 19 genera. Most are small, fragile, colourless, translucent, blind hypogean amphipods of phreatic groundwaters, brackish wells and coastal marine seeps. Most records fall within former Tethyan areas of the Caribbean and Mediterranean, but further explorations may show that the group has a cosmopolitan circumtropical distribution. Metaniphargus venezolanus Stock was recently discovered from a freshwater cave pool in a seashore sandstone area of the Caribbean coast of Venezuela. It represents the second stygobiont amphipod (after Hyalella anophthalma Ruffo) for Venezuela and for the South American continent.

Metaniphargus Stephensen

Metaniphargus Stephensen, 1933: 426.

Body smooth and slender; colourless. Head without rostrum; eyes absent; lateral cephalic lobes rounded. Antenna 1 much longer than antenna 2; accessory flagellum vestigial; flagellum longer than peduncle. Antenna 2 peduncle elongate, longer than flagellum. Mouthparts basic; lower lip, inner lobes absent. Coxal plates basic, plate 4 not lobed; coxal gills on plates 2-6, large and ovate. Oostegites narrow. Gnathopods subchelate and weakly sexually dimorphic; gnathopod 2 larger than 1. Gnathopods 1-2 carpus elongate and lacking posterior lobe. Pereopods 3-4 subequal. Pereopods 5-7 subequal, basis weakly expanded. Pleopods basic or modified in males. Uropods 1-2 rami subequal; uropod 3 reaching beyond the others, inner ramus shorter than outer, with rudimentary apical segment. Telson cleft and short, apically spinose.

A Caribbean genus comprising interstitial and troglobitic species that inhabit warm brackish and freshwater areas near the sea. The genus contains 12 species and 2 subspecies as follows:

Metaniphargus anchihalinus Stock, 1983: 279.

Jamaica.

Metaniphargus beattyi Shoemaker, 1942: 24.

St. Croix.

Metaniphargus bousfieldi Stock, 1977: 53.

Puerto Rico.

Metaniphargus bullipos Stock, 1980: 414.

Marie-Galante.

Metaniphargus craterensis Stock, 1983: 269.

Jamaica.

Metaniphargus curasavicus curasavicus Stephensen, 1933: 426.

Curaçao.

Metaniphargus curasavicus orientis Stock, 1977: 43.

Curaçao.

Metaniphargus hyporheicus Stock, 1983: 273.

Jamaica.

Metaniphargus jamaicae Holsinger, 1974: 648.

Jamaica.

Metaniphargus longipes longipes Stock, 1977: 56.

Aruba.

Metaniphargus longipes christophorensis Stock, 1977: 60.

Curaçao.

Metaniphargus nicholsoni Shoemaker, 1959: 276.

Barbuda.

Metaniphargus palpator Stock, 1977: 49.

St. Martin and Anguilla.

Metaniphargus venezolanus Stock, 1983: 159.

Venezuela.

The genus was established by Stephensen with records from Curaçao (1933: 423) and from Bonaire (1933; 441), and was later redescribed by the same author (1948: 4). The type species is Metaniphargus curasavicus from Aruba, Curaçao, Bonaire and St. Croix. Recently Stock (1977) divided M. curasavicus into three species and 5 subspecies from Aruba, Curaçao and St. Croix, plus a species in a new genus Saliweckelia holsingeri from Bonaire, regarding this group as a vicariant of the Mediterranean *Hadzia*, together representing a relict Tethyan family. Recently, Ruffo (1982) demoted *Metaniphargus* to a subgenus of *Hadzia*. Barnard & Karaman (1982) consider the group as part of the Gammaridae stock.

Another viewpoint, supported by the discovery of recent hadziid species in the young volcanic Canary Islands, as well as in California, Hawaii, Caroline Islands and Reunion is presented by Bousfield (1977 and 1983) and Holsinger & Longley (1980) who consider the Hadzoidea a separate group of Amphipoda and the Hadziidae a family having interstitial adaptations evolving from the sea through brackish groundwaters to fresh-water habitats.

Metaniphargus venezolanus Stock

(Figs 78-79)

Metaniphargus venezolanus Stock & Botosaneanu, 1983 p. 159.

Material examined:

2 ♀♀ (paratypes deposited in Z. M. A. 107577 c), from Cueva Sima del Agua Dulce (Urbani,1967), Venezuela, March 1982.

Description:

Length up to 5.25 mm, colourless. Head without rostrum; eyes absent; cephalic lobes subrounded. Antenna 1 equal to body length, flagellum up to 37-articulate; accessory flagellum small, article 1 as long as article 1 of primary flagellum, article 2 rudimentary. Antenna 2 half length of antenna 1; flagellum subequal to length of peduncle, up to 17-articulate. Mouthparts as for type-species M. curasavicus Stephensen. Coxal gills large and sack-like, present on plate 2-6; oostegites linear present on plates 2-5. Gnathopod 1 basis broad, carpus elongate with 5 tufts of setae; propodus two-thirds as long as carpus, palm transverse; dactylus equal to the length of palm. Gnathopod 2 larger than 1; in male carpus forming an isosceles triangle, propodus elongate, palm oblique; in female, carpus more elongate and propodus shorter than in male; dactylus fitting palm. Pereopods 3-4 similar. Pereopods 5-7 elongate and spinose; pereopod 5 basis elongate and weakly expanded, dactylus very slender, elongate, almost straight in specimens over 5 mm in length; pereopods 6-7 elongate, basis weakly expanded, serrate posteriorly with spines; pereopod 6 longer than 7. Epimeral plates with

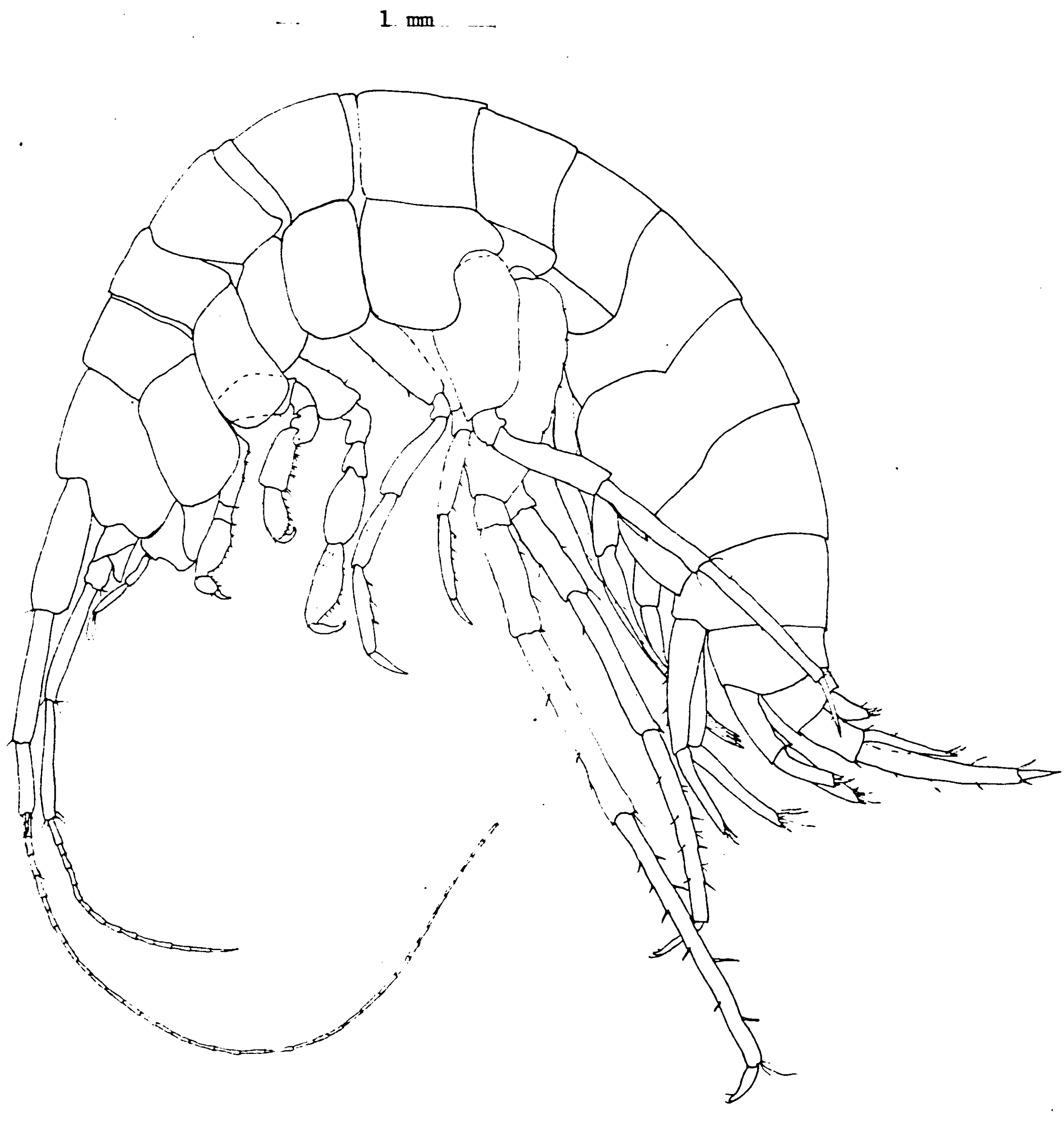


Figure 78. Metaniphargus venezolanus ♀ 5.25 mm.

posterodistal angle weakly acute. Uropods spinose; uropods 1-2 inner ramus longer than outer and subequal to peduncle; uropod 3 inner ramus slightly longer than peduncle, outer ramus twice length of inner and with short apical article. Telson as long as peduncle of uropod 3, cleft to base, each lobe with 5 or 6 spines.

Ecology:

Metaniphargus venezolanus is abundant in a freshwater pool within a permanently dark cave 15 metres above sea-level on the calcareous seashore peninsula of Chichiriviche, Golfo Triste, Venezuela. *M. venezolanus* exhibits troglobitic adaptations as such anophthalmia and depigmentation, but not freshwater adaptations such as enlarged antennal glands and the presence of sternal and/or accessory gills.

Distribution:

Metaniphargus is an endemic interstitial Caribbean genus for which *M. venezolanus* sets the southerly distribution limit. The sandstone area of the Chichiriviche Peninsula is similar to that of the islands Aruba, Curaçao and Bonaire at the margin of the Caribbean and South American tectonic plates. *M. venezolanus* is the first record of the genus from the South American plate.

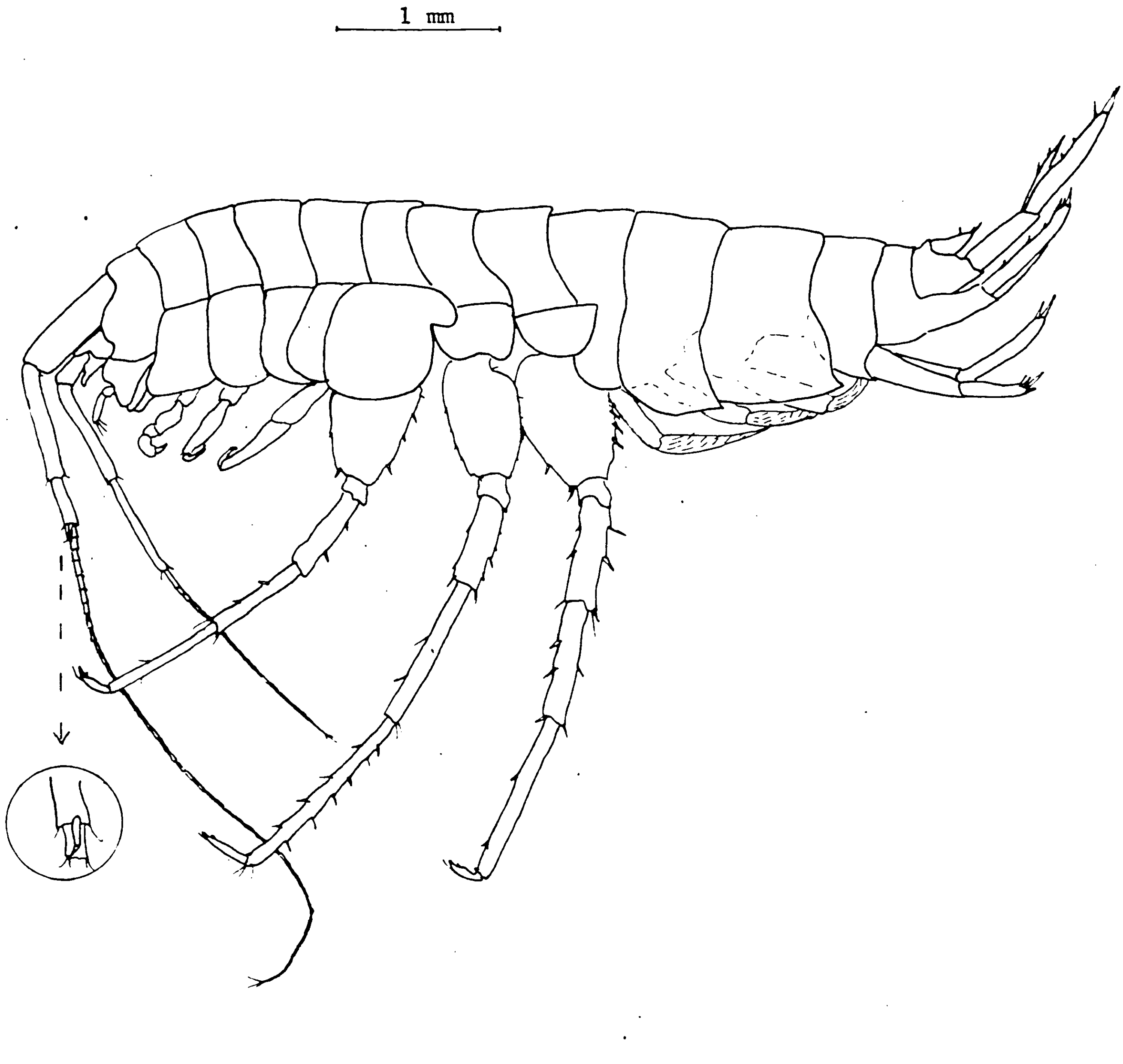


Figure 79. Metaniphargus venezolanus ♀ 5 mm.

Remarks:

Metaniphargus venezolanus is closely allied to M. longipes longipes and M. longipes christophorensis Stock (1977) which were formerly described as M. curasavicus by Stephensen (1933 & 1948) from Aruba and West Curaçao (partly). The Venezuelan material fits closely the description of Stock, but there is some variation between specimens of 5.25 mm length and those measuring 5 mm in length. The former have 15 articles in the flagellum of the antenna 2 whilst the latter have 17 articles and a shorter dactylus on pereopod 5. Lieshout (1983) recently found new material of Saliweckelia from La Tortuga (Venezuelan island) which is intermediate between S. emarginata and S. holsingeri Stock (1977) from Bonaire and eastern Curaçao, which were part of Stephensen's material of M. curasavicus from Bonaire - indicating perhaps the existence of only one variable species in this area. Lieshout (1983) pointed to the need for hybridization experiments to sort out the Saliweckelia problem, and a similar approach could be employed to investigate the relationships of Metaniphargus venezolanus and the two subspecies of M. longipes.

Superfamily BOGIDIELLOIDEA

Body elongate, subvermiform, more or less smooth. Head without rostrum, eyes absent. Antenna short, slender, without calceoli; aesthetascs present on antenna 1. Mandible with strong palp. Maxilliped with large palp bearing dactyl. Coxal plates typically small. Coxal gills small, pedunculate, om pereonites 2-6. Gnathopods subsimilar in size and shape, or gnathopod 1 larger than 2; occasionally weakly sexually dimorphic. Pereopods slender. Pleopods small with reduced rami. Uropods 1-2 short, uropod 3 with strong subequal rami. Telson entire or with shallow notch.

The superfamily Bogidielloidea Hertzog, 1936 (new status Bousfield, 1977) comprises about 50 mostly interstitial species in warm-temperate and tropical freshwaters around the world (Stock, 1981). Following the recent discovery of the dubious _Spelaeogammarus bahiensis_ Silva, 1975 and _Artesia subterranea_ Holsinger, 1980, Bousfield (1982) established the family Artesiidae to separate these species with short deep bodies and coxae from the vermiform Bogidiellidae which frequently occur in hypogean warm freshwaters together with species of the suborder Ingolfiellidea.

Family BOGIDIELLIDAE

Body slender, elongate and vermiform. Eyes absent. Antennae short. Coxal plates very shallow and discontinuous. Gnathopods almost subsimilar in size and shape, subchelate. Pereopods 3-4 subsimilar; pereopods 5-7 becoming successively more elongate, basis not expanded. Pleopods with rami much reduced. Uropods 1-2 small and similar; uropod 3 well developed, rami linear and spinose. Telson lobes totally fused or slightly excavate apically. Oostegites present on pereopods 2-5 or 3-5. Lenticular organs or Hertzog's organs present on the basis of the pereopods.

The family Bogidiellidae Hertzog, 1933 encompasses 50 species in 11 genera (Stock, 1981). After the recent separation of the two stygobiont taxa, the family is well unified with mostly interstitial, tropical freshwater species derived from marine pre-tethyan ancestors (Ruffo, 1973).

<u>Bogidiella</u> Hertzog

<u>Bogidiella</u> Hertzog, 1933: 226; Ruffo, 1973: 49.

<u>Jugocrangonix</u>; Karaman, 1933: 45.

Body small and vermiform. Rostrum obsolescent. Lateral cephalic lobes subrounded. Eyes absent. Antennae slender; accessory flagellum present, small, 1 to 3-articulate. Coxal plates very short, broader than long and poorly setose; discontiguous; coxal plate 4 simple. Coxal gills present on pereopods 4-6, articulated. Oostegites present on coxae 2-5 or 3-5. Gnathopods medium to large size; gnathopod 1 often slightly larger than 2. Pereopod basis often with lenticular organs. Pleopods practically uniramous. Uropod 3 extended. Telson short and broad, entire or weakly cleft.

A large genus of about 36 species having a Palaearctic and Neotropical distribution (Stock, 1981). Most are interstitial in limnic waters close to the sea. Stock (1981) described the first Venezuelan species from Isla de Margarita.

Bogidiella perla Stock

(Fig. 80)

Bogidiella perla Stock, 1981: 362.

Material examined:

Holotype ♂, from La Plaza well, Isla de Margarita, Venezuela, 1 June 1978, deposited in the Zoological Museum, Amsterdam.

Description:

Length up to 2.5 mm, body vermiform. Head without rostrum and eyes. Antenna 1 longer than 2, with robust peduncle which has the first article armed with a pair of spines; accessory flagellum 2-articulate and primary flagellum 10-articulate with aesthetascs on articles 1-9. Mandible triturative with distinct lacinia mobilis on both left and right sides; mandible palp 3-articulate, swollen and short. Maxilla 1 palp biarticulate. Maxilla 2 of usual bogidiellid type. Maxilliped palp 4-articulate and robust. Coxal plates 1-7 wider than long. Coxal gills elliptical, on pereopods 4-6. Gnathopod 1 slightly larger than 2; propodus with concave oblique palm bearing six spines on the palmar angle. Gnathopod 2 propodus with nearly straight palm bearing three spines on palmar angle. Pereopods 3-4 similar; pereopod 5 same length as 4; pereopod 6 longer than 5; pereopod 7 the longest. Basis of pereopods bearing circular lenticular organs, elliptical on pereopod 7. Pleopods small with 1-articulate endopodite and 3-articulate exopodite; peduncle slender on pleopod 1 and robust on 2-3. Telson entire, trapezoidal, slightly concave bearing single distolateral and lateral spine with pair of

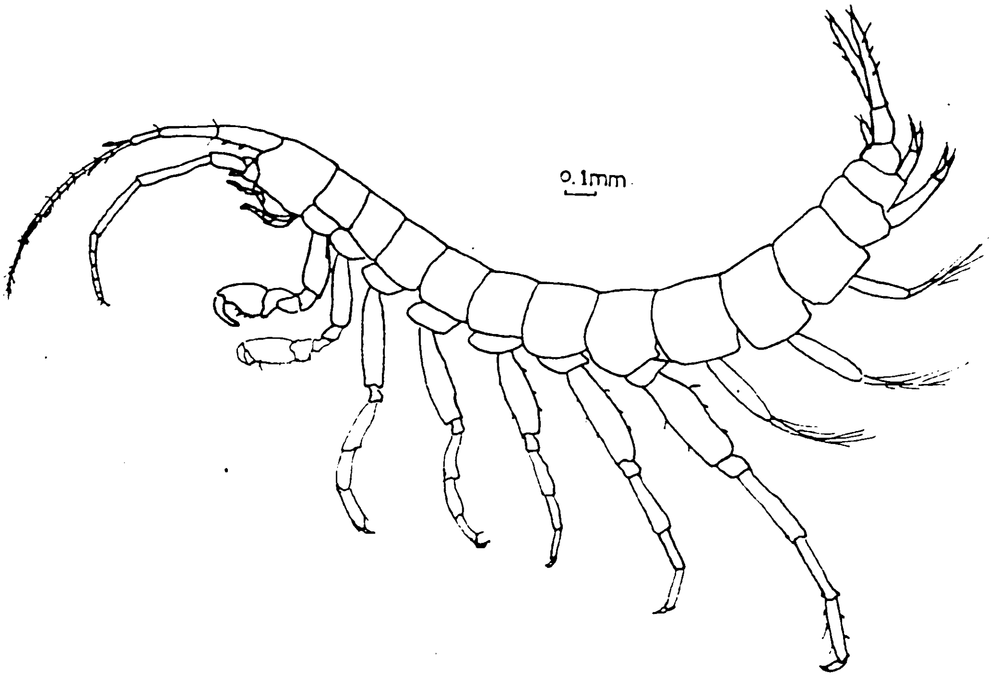


Figure 80. Bogidiella perla ♂ 2.5 mm.

setae between.

Female unknown.

Ecology:

The species was recently discovered in a sample of sediment from La Plaza well, a freshwater reservoir on Margarita island, together with *Ingolfiella margaritae* Stock (1979).

Distribution:

Bogidiella perla Stock (1981) is known only from a single male from the type locality.

Remarks:

This species is unique in the disposition of the lenticular organs. Generally, the species of this genus have a high level of endemicity on the Caribbean islands, as in the Mediterranean region, probably having a marine Mesozoic origin, isolated by the double processes of continental fragmentation and Cenozoic marine transgressions.

Superfamily COROPHIOIDEA

Body of medium size, generally smooth and slender, somewhat depressed or cylindrical; urosome segments occasionally fused. Head with small rostrum. Antennae strongly developed and setose; sexually dimorphic. Mouthparts basic; right mandible usually bearing a molar flake. Coxal plates variable, plate 4 not excavate posteriorly, 6 and 7 anteriorly lobate. Gnathopods subchelate, unequal and strongly sexually dimorphic. Pereopods 3 and 4, basis typically extended containing cement glands that open through the simple dactylus; pereopods 5-7 dissimilar, dactylate. Epimeral plates often separated. Pleopods variable. Uropods 1 and 2 short with rami often reduced and unequal; uropod 3 rami very short and linear, or absent, often with hooked spines distally. Telson short, thick and fleshy, lobes fused or having a small apical notch. Coxal gills simple, reduced in number in one or both sexes; oostegites usually broad with simple setae.

The Corophioidea Dana, 1849 was elevated to superfamily status by Barnard (1973: 9), revised and emended by Bousfield (1978) and Myers (1981), and comprises approximately 670 species and 104 genera in the following 9 families: Ampithoidae, Biancolinidae, Isaeidae (+ Photidae), Neomegamphopidae, Aoridae, Corophiidae, Ischyroceridae, Cheluridae and Podoceridae. Most species are domicolous in coastal marine or estuarine habitats of tropical and temperate regions, and construct open-minded tubes or nests of bottom debris and sediment which are fixed horizontally on the substratum, or are portable. Some tube-dwelling species occurring in colonies are important components of marine fouling (and boring: Cheluridae) communities.

Key to the Venezuelan families of Corophioidea

1	Body depressed (especially urosome) and broad. Antenna 2 longer and more powerful than 1.	Corophiidae
-	Antenna 2 subequal to antenna 1.	2
2	Pereon broad. Urosome segment 1 more than twice as long as urosome segment 2 (including 3). Uropod 3 vestigial or absent. Pereopods not glandular and subequal.	Podoceridae
-	Pereon slender. Urosome segment 1 not more than one and a half times as long as urosome segment 2. Uropod 3 present. Pereopods glandular and dissimilar.	3
3	Uropod 3 rami shorter than peduncle; outer ramus with pair of hooked spines distally.	4
-	Uropod 3 rami as long as, or longer than peduncle; outer ramus without hooks.	5
4	Head anterior lobe acute, bearing eye. Antenna 1 peduncle article 3 more than half length of 2. Coxal gills absent on plate 2.	Ischyroceridae
-	Head anterior lobe blunt, eye at its base. Antenna 1 peduncle article 3 less than half length of 2. Coxal gills present on plate 2.	Ampithoidae
5	Gnathopod 1 smaller than 2. Molar flake present on both mandibles.	Isaeidae

-	Gnathopod 1 larger than 2. Molar flake only present on right mandible or vestigial.	6
6	Antenna 2 inserted on anterior margin of head. Molar flake present on right mandible only; mandibular palp slender.	Aoridae
-	Antenna 2 inserted on ventral margin of head. Molar flake absent or vestigial on right mandible; mandibular palp distally truncate.	Neomegamphopidae

Family AMPITHOIDAE

Body of medium size, weakly compressed, smooth. Head without rostrum; eyes subrounded, often small, lateral. Antenna 1 usually longer than 2 or equal, sometimes shorter; peduncle article 3 very small; accessory flagellum absent, microscopic or vestigial. Upper lip subrounded; lower lip with produced outer lobes. Mandible palp variable or absent; molar flake absent. Maxillae basic. Maxilliped well developed. Coxal plates 1-5 well developed; coxal plate 5 the largest, bilobed. Gnathopods dissimilar, sexually dimorphic, strong and subchelate; gnathopod 2 larger than 1. Pereopods 3-4 glandular with expanded basis. Pereopod 5 shorter than 6-7. Uropods biramous, basic; uropod 3 peduncle robust, rami much shorter than peduncle, inner ramus apically setose, outer ramus with 1-3 large hooked apical spines. Telson short, entire, fleshy, sometimes with small apical cusps or hooks.

The family Ampithoidae Stebbing, 1899 comprises about 13 genera (Conlan, 1982) although only one genus, Ampithoe has a substantial number of species. The ampithoids are cosmopolitan, benthic, sedentary, domicolous, often colonial mainly in shallow tropical and temperate regions. They construct tubes of detritus cemented together by a secretion from the glandular pereopods. Only one species has been reported previously from the Caribbean. Three genera and four species are recorded in the present study from the southern Caribbean waters (Fig. 81).

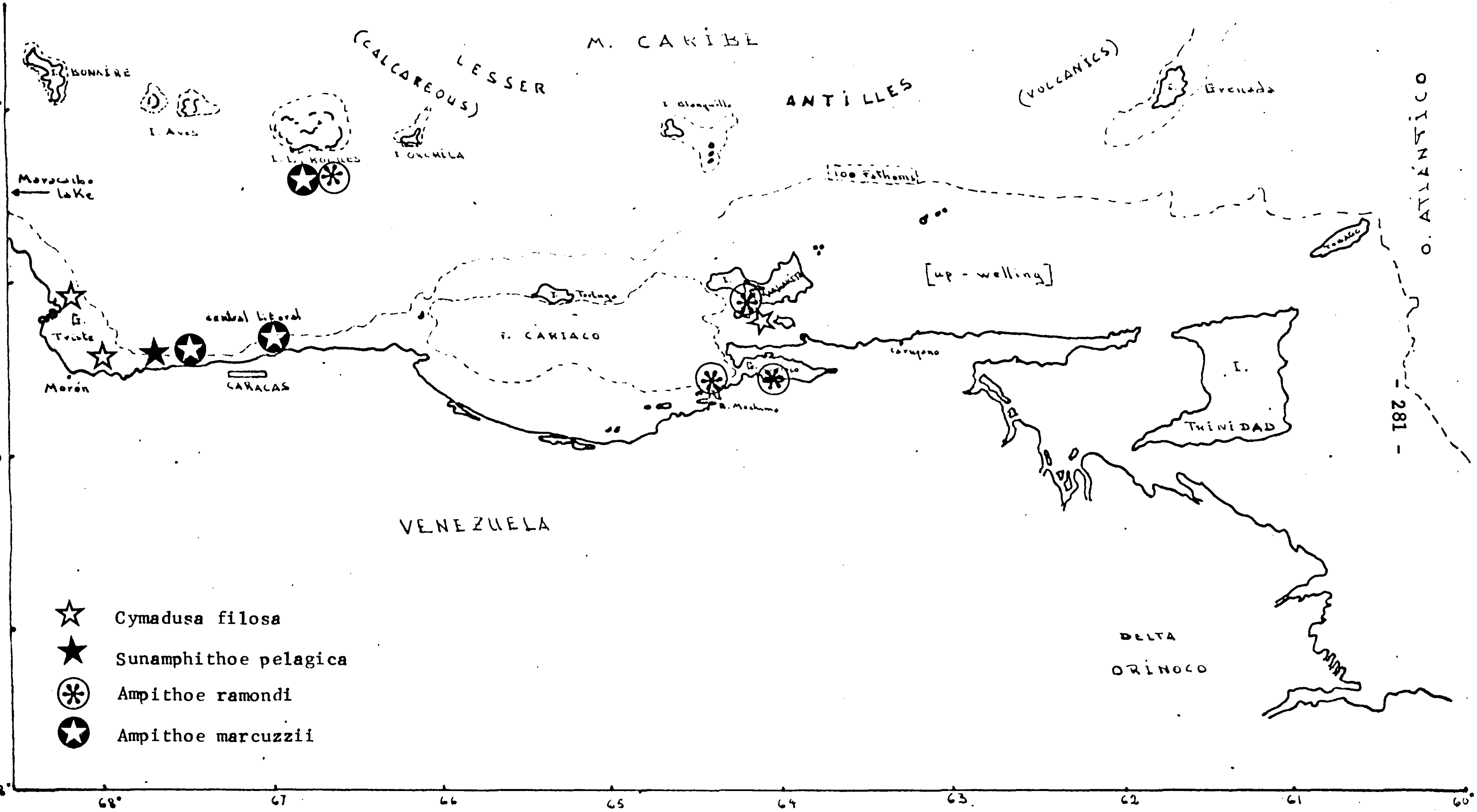


Figure 81. Distribution of species of the family Ampithoidae in Venezuela

Key to the Venezuelan genera of Ampithoidae

1 Antenna 1 equal to 2 or shorter. Mandibles without palps. Telson tipped by cornified knobs. Sunamphitoe

- Antenna 1 longer than 2. Mandibular palps well developed. Telson tipped with setae. 2

2 Accessory flagellum small, biarticulate. Uropod 1 with a spinose peduncular process projecting distally below rami. Uropod 3, outer ramus distinctly shorter than inner. Cymadusa

- Accessory flagellum absent or microscopic. Uropod 1 peduncular process absent. Uropod 3 outer ramus about equal to, or longer than inner ramus. Ampithoe

Sunamphitoe Bate

Sunamphitoe Bate, 1856: 59; Stebbing, 1906: 645;
Lincoln, 1979: 466.
Sunamphithoe Bate, 1862: 250; Sars, 1895: 584.

Body smooth, moderately compressed. Coxal plates 1-5 broad, plate 5 with anterior lobe as long as plate 4. Antenna 1 equal to 2 or slightly shorter. Mouthparts basic ampithoid; mandible with small molar, palp absent. Maxillae inner plate with only one apical setae. Gnathopods sexually dimorphic, propodus larger then carpus; gnathopod 2 very large in male and larger than 1; gnathopods subequal in female. Pereopods 5-7, propodus expanded distally and armed with spines; pereopod 5 basis broadly expanded. Uropod 1 with peduncular spinose process projecting distally below rami. Uropod 3 with small subequal rami, two hooked apical spines on outer ramus. Telson entire, fleshy, short, tipped by a small cornified knob with small spine and setae each side of the apex.

A small genus of only two recognized species, one of which, Sunamphitoe plumosa Stephensen (1944), is densely setose and has a Pacific distribution; and the other one, S. pelagica is widespread from the North Atlantic, American and European coasts, ranging from the Sargasso Sea to Norway. The latter is recorded for the first time from the Caribbean Sea.

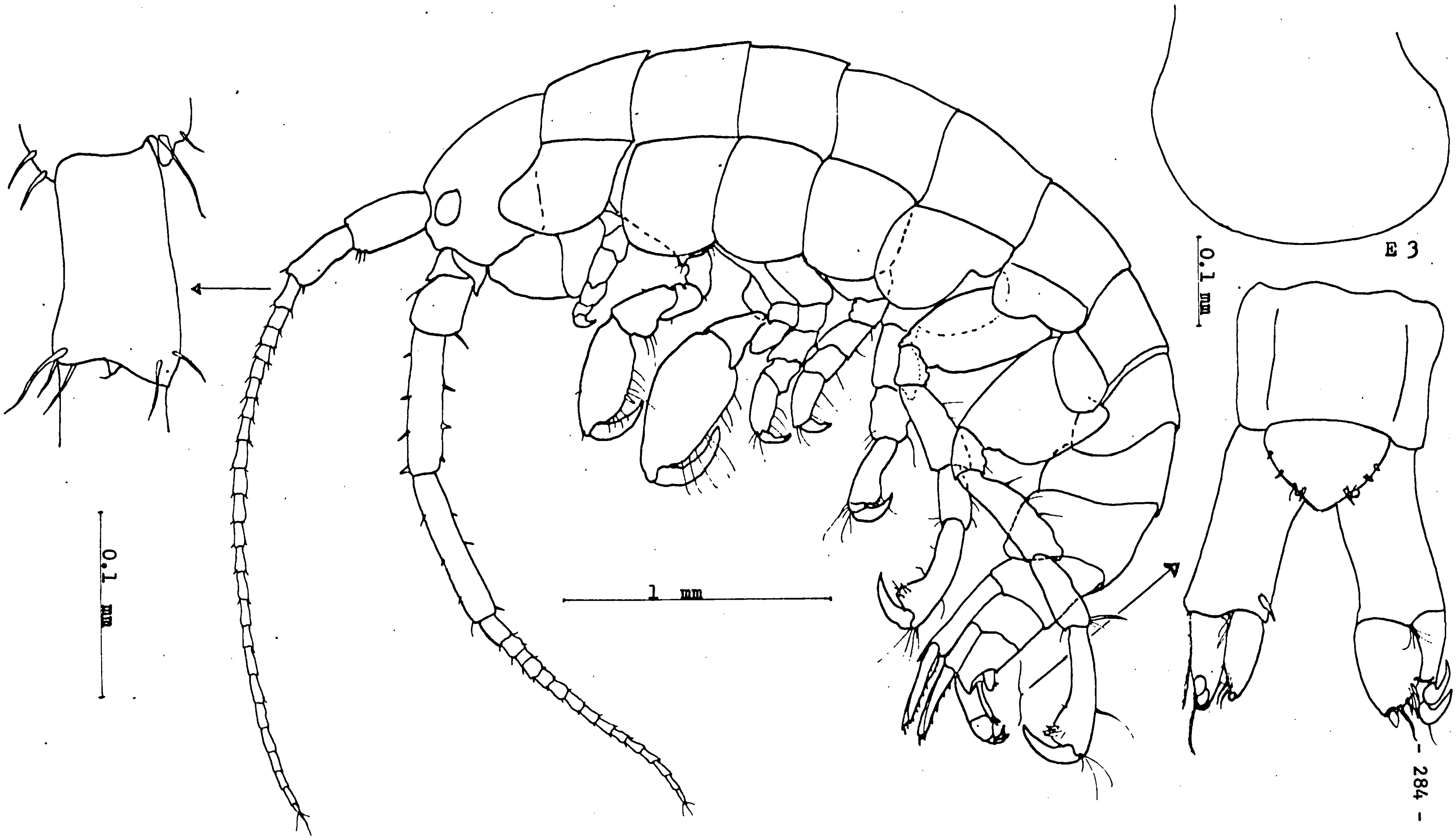


Figure 82. Sunamphithoe pelagica ♂ 4 mm.

Sunamphitoe pelagica (Milne-Edwards)

(Figs 82-84)

Amphithoe pelagica Milne-Edwards, 1830: 378.

Sunamphitoe conformatus Bate, 1856: 59.

Sunamphithoe conformata; Sars, 1895: 585.

Sunamphitoe pelagica; Stebbing, 1906: 645.

Material examined:

6 ♂♂, 15 ♀♀ from Patanemo Bay, Venezuela, 26 May 1981.

Description:

Length up to 10 mm, colour yellowish. Body smooth and compressed; coxal plates subrounded with few long setae, epimeral plates subrounded. Head without rostrum and postantennal sinus, eyes close to the lateral lobes, medium size and subrounded; red in colour. Antenna 1 and 2 subequal length, peduncle article 3 slightly less than half length of 2, flagellum 30-articulate. Antenna 2 peduncle articles 4 and 5 subequal, flagellum short, up to 17-articulate. Upper lip basic ampithoid; lower lip bilobed outer lobes produced, mandibular processes well developed, inner lobes strong. Mandible molar small, spine row of 5 elements, palp absent. Maxillae and maxilliped basic ampithoid. Gnathopod 1 basis with small anterodistal lobe; propodus rectangular, palm transverse, convex and defined by spine; dactylus longer than palm. Gnathopod 2 ♀ similar to 1 but larger and with carpal lobe slender. Gnathopod 2 ♂ large; basis with produced antero-distal lobe; carpus short; propodus elongate, palm extending entire posterior margin and with tubercle close to base of dactylus in males longer than 5 mm, dactylus powerful.

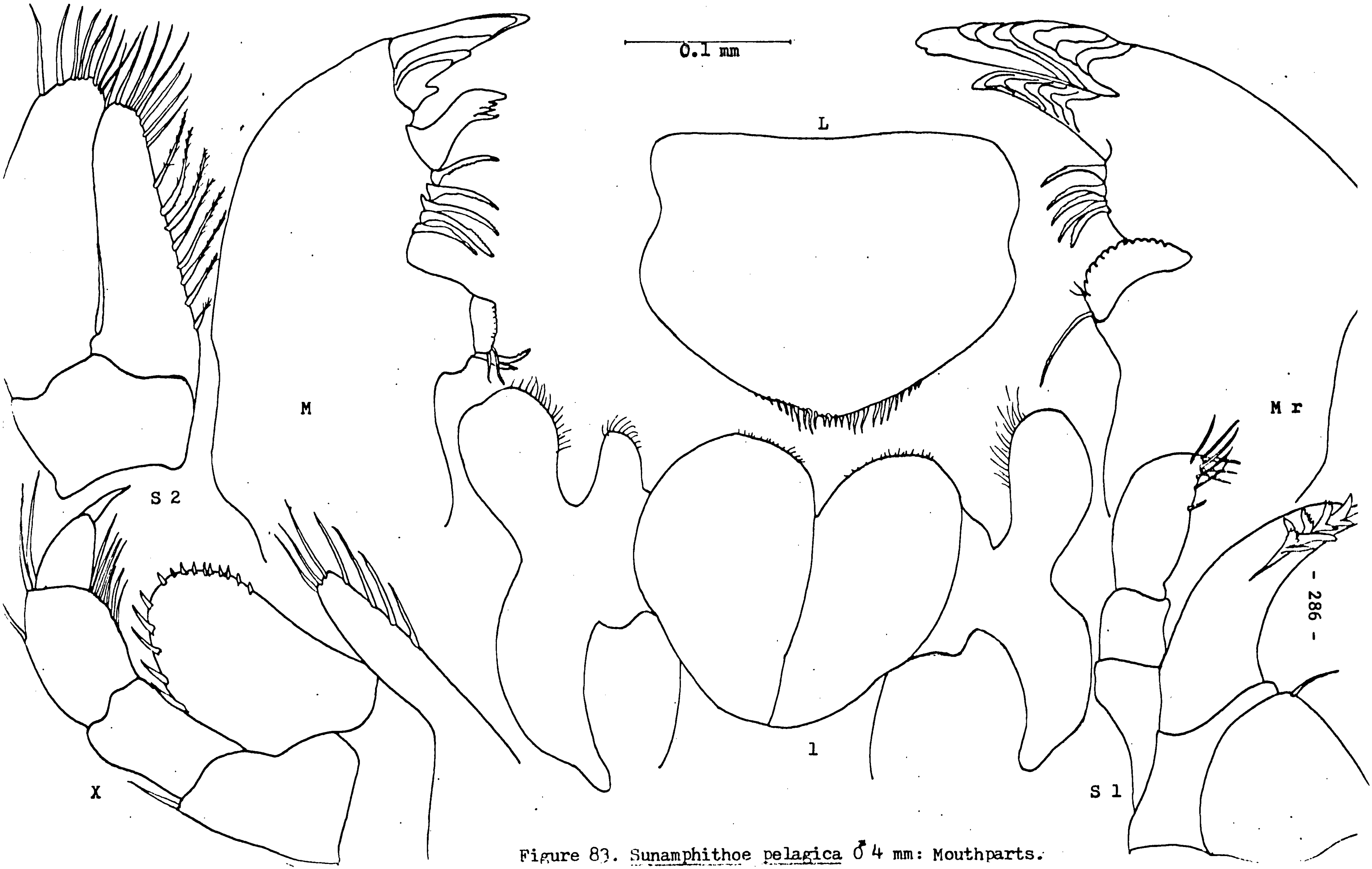


Figure 83. Sunamphithoe pelagica ♂ 4 mm: Mouthparts.

Pereopods 3 and 4 merus expanded; pereopod 5 basis broadly expanded; pereopod 6 basis with posterior lobe; pereopod 7 basis with posteroproximal angle. Pereopods 5-7 propodus expanded distally bearing 4 spines. Uropods 1 and 2 spinose; uropod 3 peduncle twice length than rami. Telson short, broad, apex truncated between lateral cusps and with two pairs of small spines laterally. Coxal gills present on coxal plates 2-6; oostegites of corophioid type present on plates 2-5.

Ecology:

Sunamphitoe pelagica had been described as epipelagic since it is often cast up with *Sargassum* spp. along western Atlantic shores, and is intertidal on algae along eastern Atlantic shores. In the Caribbean coast of Venezuela it has been found in shallow subtidal waters of Patanemo Bay which is the frontier area between the Gulf Triste and the Central Litoral regions.

Distribution:

S. pelagica is known from the North Atlantic and the Mediterranean Sea, and is recorded for the first time from the Caribbean Sea.

Remarks:

The material described above comprised specimens up to 4 mm length fitting closely the description of *Sunamphitoe pelagica*, but showing the typically small body size of tropical populations compared with those from more northerly temperate latitude, that may have a body length up to 10 mm.

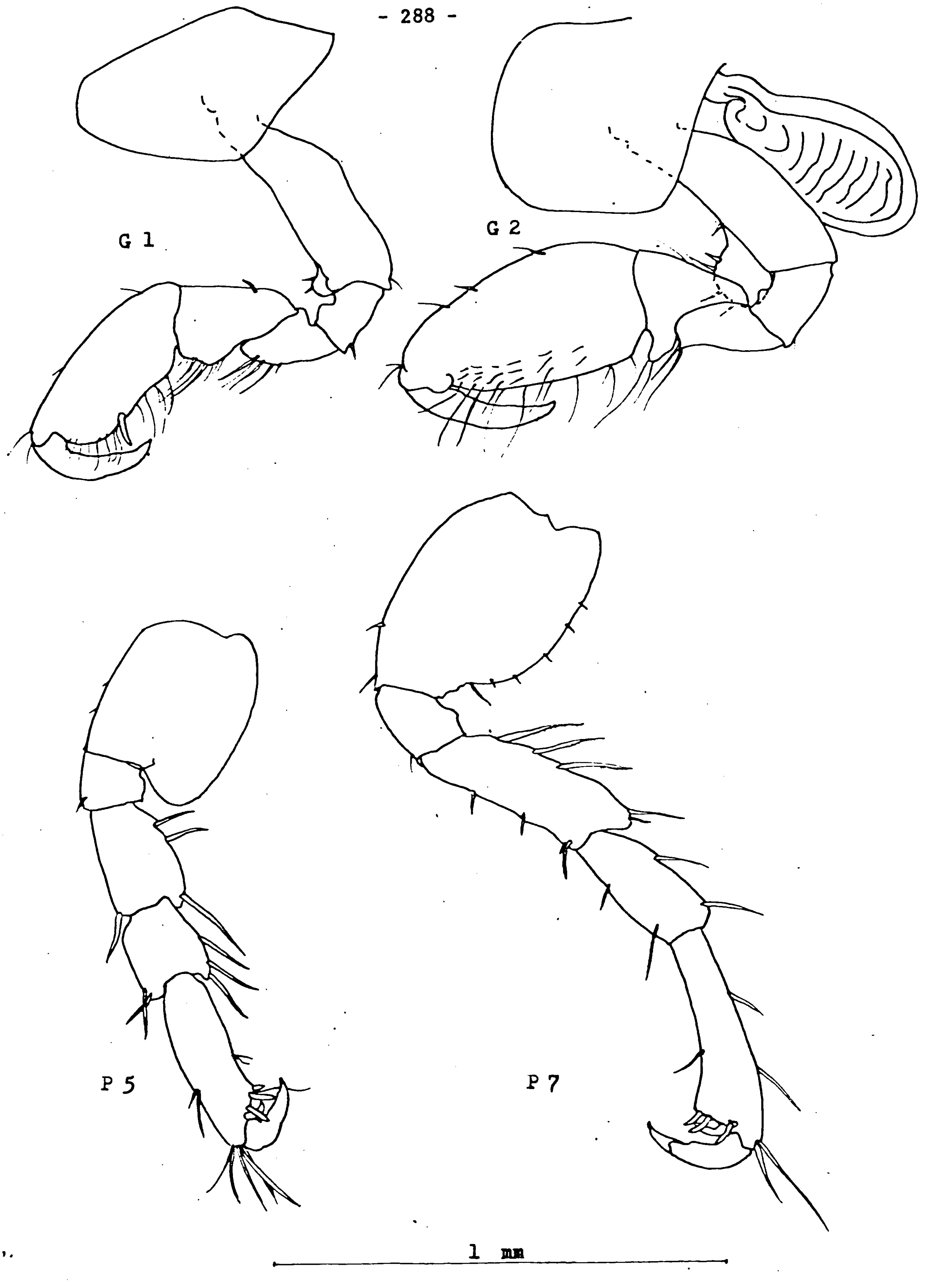


Figure 84. Sunamphithoe pelagica ♂ 4 mm: Pereopods.

Cymadusa Savigny

Cymadusa Savigny, 1816: 109; Barnard, 1959: 26.

Grubia Czerniavski, 1868: 103.

Acanthogrubia Stout, 1912: 143.

Body robust and smooth. Coxal plates basic ampithoid, plate 1 expanded anteriorly. Antenna 1 longer than 2, accessory flagellum present; antenna 2 sexually dimorphic. Head with lateral eyes of medium size. Mouthparts basic ampithoid; mandible with molar and palp well developed; maxilla 1 inner plate with several marginal setae. Gnathopods subchelate, powerful, and subequal especially in males. Pereopods 3-4 basis slightly expanded anteriorly; pereopod 5 basis as wide as long; pereopods 6-7 propodus not expanded distally. Uropod 1 peduncle with spinose process projecting distally below rami; uropod 3 inner ramus distinctly longer than outer ramus which is tipped by two hooks. Telson entire, fleshy and short bearing long setae.

A warm or tropical shallow water genus comprising 9 species (Barnard, 1969) of which *Cymadusa filosa* Savigny is widespread from the Red Sea to the American Atlantic coast. This species exhibits some variation and in the past has been treated as three different species. It is recorded for the first time from the southern Caribbean.

Cymadusa filosa Savigny

(Figs 85-87)

Cymadusa filosa Savigny, 1816: 51; Pirlot, 1939: 64;
Ruffo, 1947: 169.

Amphithoe brasiliensis Dana, 1853: 943.

Amphithoe filicornis Dana, 1853: 944.

Grubia filosa; Shoemaker, 1935: 245.

Grubia hirsuta Chevreux & Fage, 1925: 339.

Grubia sardenata Oliveira, 1953: 365.

Material examined:

7 ♂♂, 9 ♀♀ from N.E. Cubagua Island, Venezuela, 2 August 1962.

1 ♂, 2 ♀♀ from Key Animas, Venezuela, 30 January 1980.

2 ♀♀ from Tucacas beach, Venezuela, 23 July 1980.

Description:

Length up to 15 mm, colour yellowish-green with dark patches. Eyes suboval, red to black in colour. Antenna 1 equal to body length, peduncle article 3 one-third length of 2, flagellum extremely elongate, up to 47-articulate; accessory flagellum small but biarticulate with article 1 almost as long as the first article of the flagellum, article 2 vestigial. Antenna 2 sexually dimorphic, peduncle setose and slightly shorter than 1; peduncle with densely plumose setae in male; flagellum up to 33-articulate. Upper lip broad; lower lip with inner lobes and mandibular process well developed; mandibles with triturative molar, spine row of several elements, palp 3-articulate with apical setae only; maxilla 1 inner plate with marginal setae.

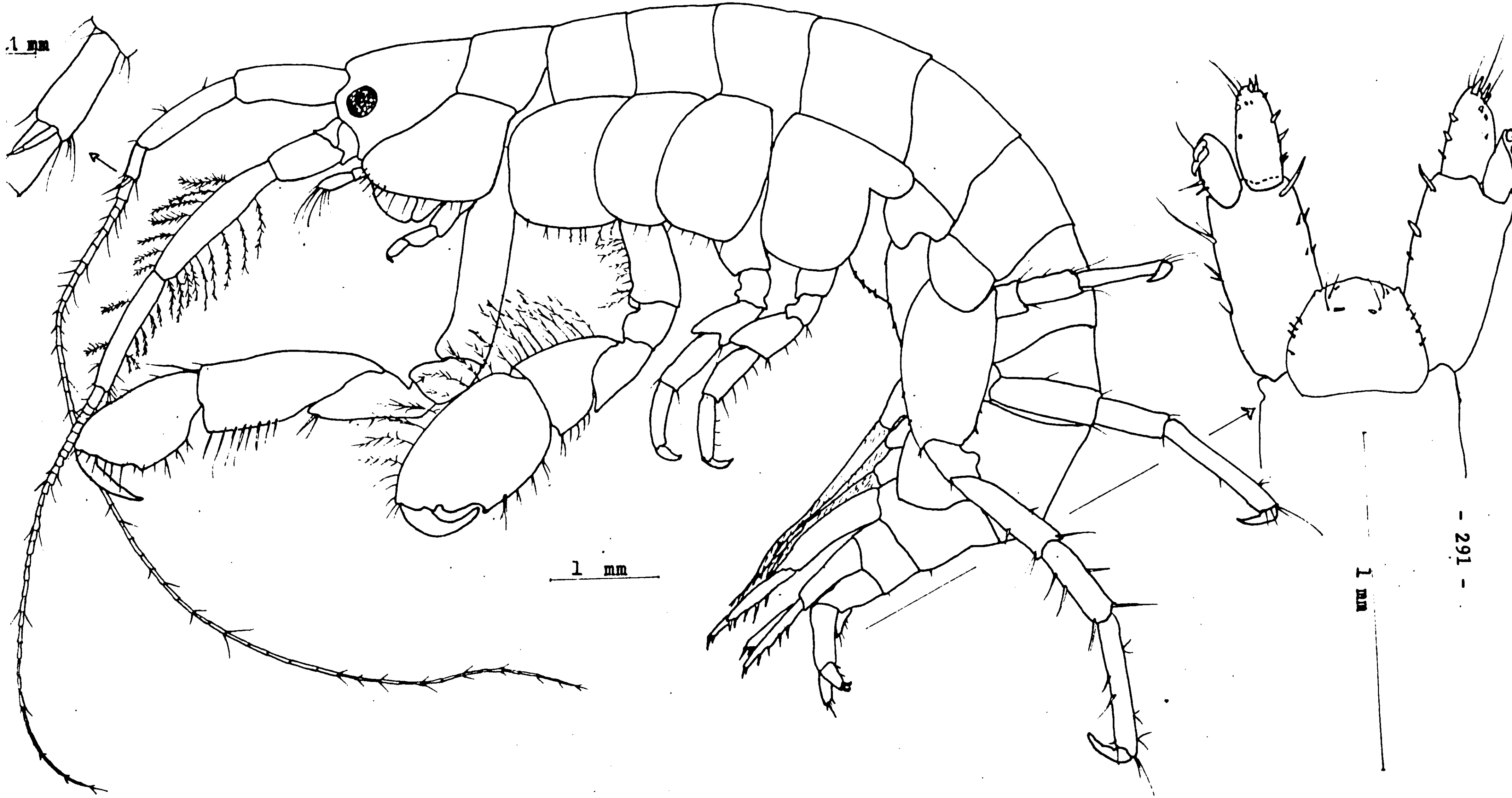


Figure 85. Cymadusa filosa ♂ 11 mm

Coxal plates subrounded, ampithoid type; plate 1 expanded anterodistally; plates 1-5 with long setae distally, plumose setae in terminal male; epimeral plates with subrounded margins; epimeral plate 3 convex posteriorly with slightly produced corner. Gnathopod 1 longer but more slender than 2, much longer in terminal male; basis long and slender with anterodistal lobe produced; carpus rectangular, longer than propodus and with broad posterior lobe; propodus subtriangular with oblique palm defined by spine; dactylus overlapping palm. Gnathopod 2 powerful, with dense plumose setae anteriorly on basis, carpus and propodus; basis with anterodistal angle produced into a lobe; merus with posterodistal corner produced into a blunt angular lobe; carpus shorter than propodus with posterior margin produced into a broad and setose lobe; propodus with oblique palm defined by a blunt tooth and bearing near the hinge of dactylus a low flat topped tooth, which almost reaches end of palm, and is only present in terminal male. Pereopods 3-4 basis with plumose setae anteriorly. Pereopods 6-7 basis slender, propodus not expanded distally. Pereopod 7 basis posteriorly slightly expanded with upper corner angular. Uropod 3 outer ramus shorter than inner, tipped by two hooks and setae; inner ramus spinose, tipped by setae. Telson fleshy, with two pairs of setae dorsally and tipped by two small protuberances postero-laterally and some small setae on the lateral margins.

Female similar to male except for the absence of plumose setae of antenna 2, gnathopod 2 and coxae, and the smaller gnathopods, the second slightly larger than the first; coxal gills on coxal plates 2-6 and oostegites on plates 2-5 of corophioid type. Some gravid females were carrying over one hundred eggs.

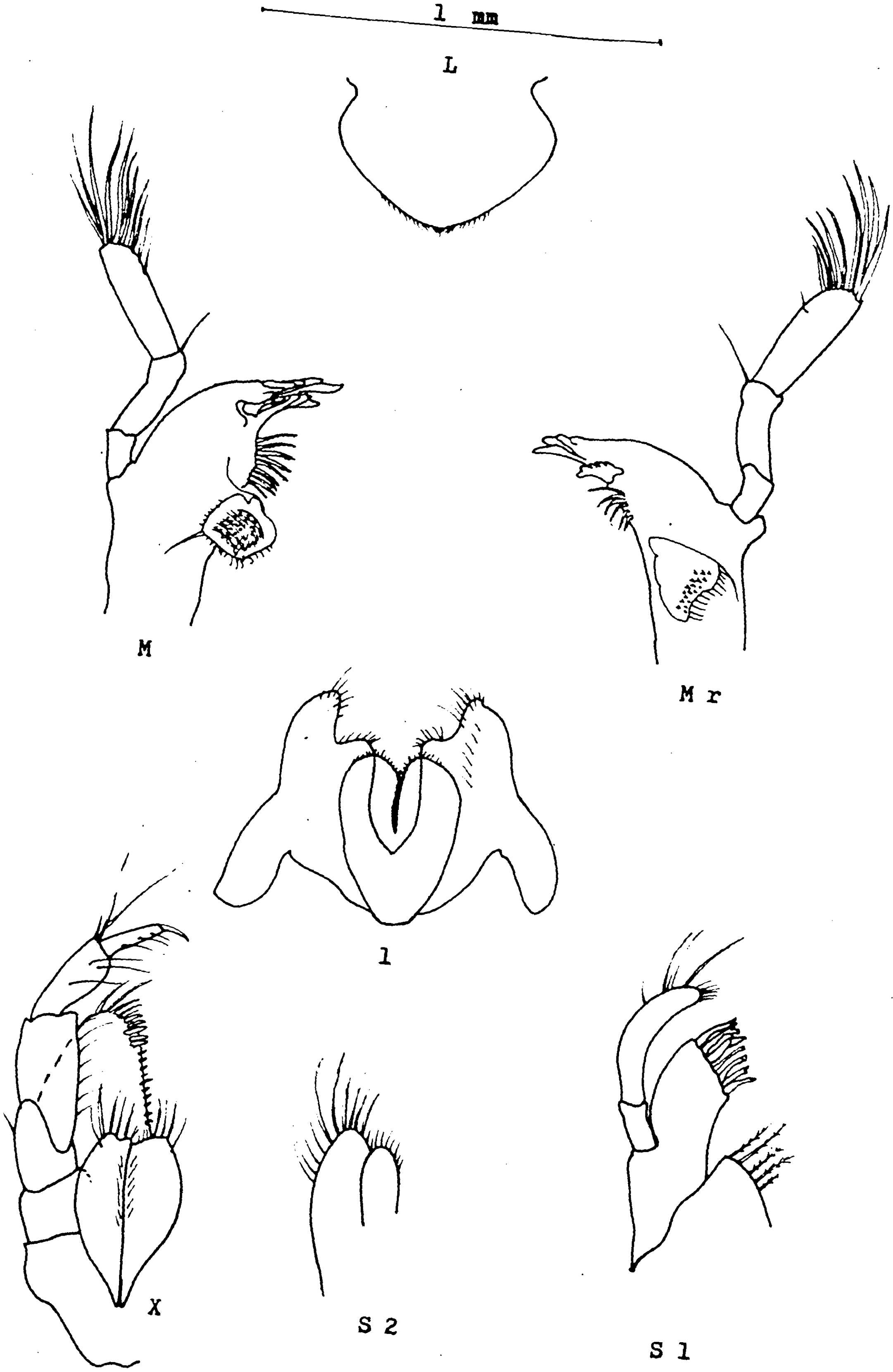


Figure 86. Cymadusa filosa ♂ 11 mm: Mouthparts.

Ecology:

Cymadusa filosa occurs in shallow waters on north-east coasts of Cubagua Island, Tucacas and Animas Keys.

Distribution:

A cosmopolitan tropical-water species: Red Sea. Mediterranean Sea, Atlantic Ocean and Caribbean Sea.

Remarks:

The Venezuelan material agrees well with the original description of Cymadusa filosa Savigny and subsequent revisions by Pirlot (1939) and Ruffo (1947). The wide morphological variation, most notably in the size of the gnathopods in relation to sex and body length, is illustrated by the following historical note: Oliveira (1953) described Grubia sardenata as a new species for Brazil, which was later shown to be the large terminal male of Cymadusa filosa, and also recorded Amphithoe brasiliensis (p. 358) and A. filicornis (p. 364), which proved to be the male and female respectively of average size C. filosa (after Pirlot, 1939).

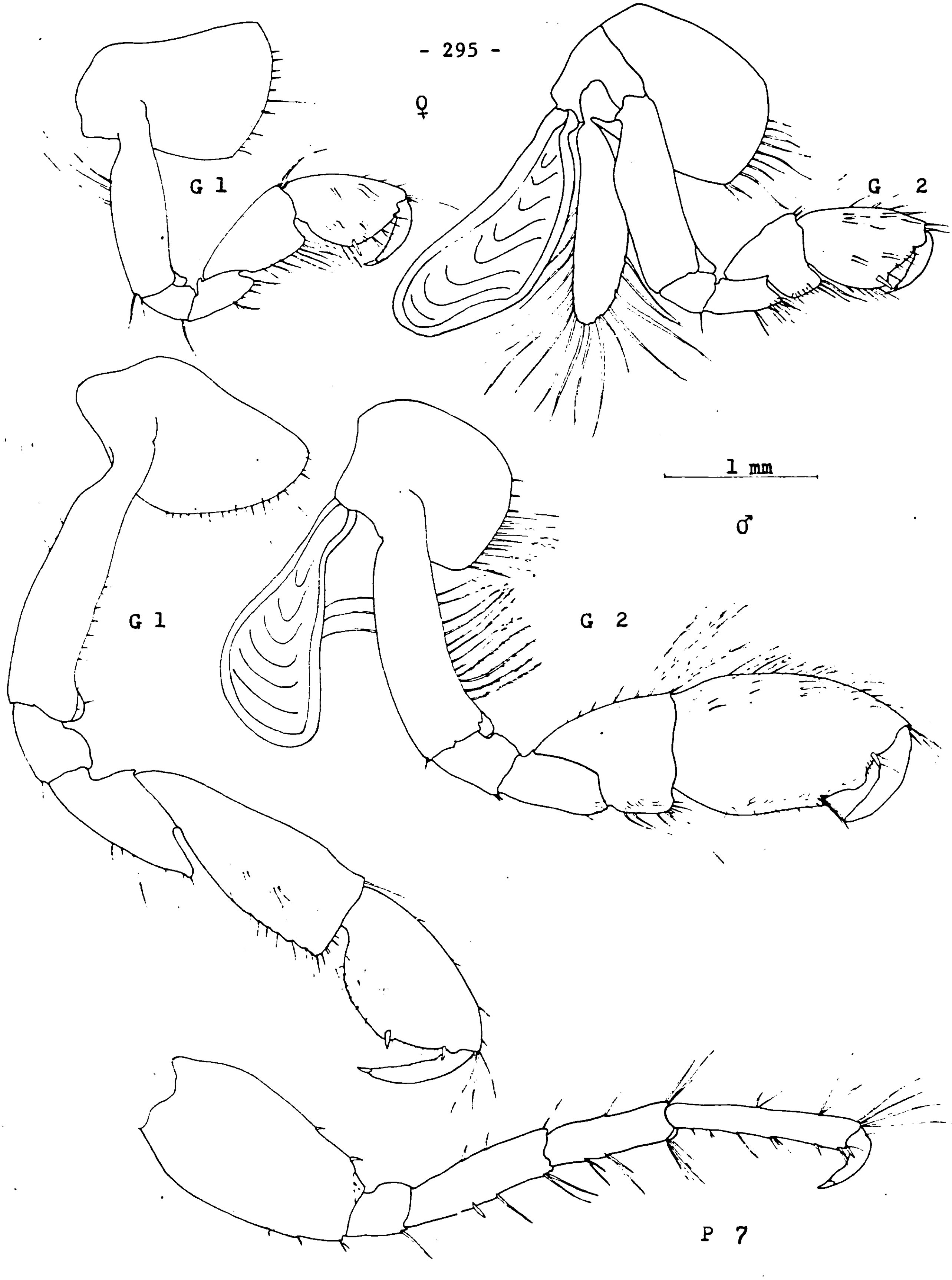


Figure 87. <u>Cymadusa</u> <u>filosa</u> ♀ & ♂ 11 mm: Pereopods.

Ampithoe Leach

Ampithoe Leach, 1814: 403; Stebbing, 1906: 631; Lincoln, 1979: 458.

Amphithoe Latreille, 1816: 470; Sars, 1895: 578.

Body moderately compressed and smooth; coxal plates 1-5 broad, plate 1 anteriorly expanded, plate 5 with large anterior lobe and small posterior one; epimeral plates subrounded distally and convex posteriorly. Head ampithoid type; antenna 1 longer than 2, accessory flagellum absent or microscopic. Mouthparts basic; mandible with triturative molar, palp 3-articulate; maxilliped with large outer plate and palp well developed. Gnathopods ampithoid type; gnathopod 2 larger than 1, especially in male, in female subsimilar to 1. Pereopods glandular, pereopods 3-4 basis broad; pereopods 5-7 with slightly expanded propodus distally. Uropod 3 with small subequal rami, outer ramus with two hooked spines, inner ramus tipped by setae. Telson entire, fleshy and short tipped by some setae or small spines.

A large genus of about 37 species having cosmopolitan distribution in shallow subtidal waters. The cosmopolitan *Ampithoe ramondi* Audouin, is recorded for the first time from the southern Caribbean Sea, together with the local species, *A. marcuzzii* which was found in the coral atolls of Venezuela extending its known range to the Central Litoral region of the Venezuelan Caribbean coast.

Key to the Venezuelan species of _Ampithoe_

Gnathopods 1-2 male and gnathopod 2 female, ischium with large inner distal lobe. Gnathopods 1-2 male with elongate suboval propodus. Gnathopod 2 male with concave palm. Eyes moderately large.

ramondi

Gnathopods 1-2 male and gnathopod 2 female, ischium without distal lobe. Gnathopods 1-2 male with very long rectangular propodus. Gnathopod 2 male with convex palm. Eyes moderately medium size.

marcuzzii

Ampithoe ramondi Audouin

(Figs 88-89)

Ampithoe ramondi Audouin, 1826: 93; Pirlot, 1938: 346;

Amphithoe ramondi; Moore, 1984: 375.

Ampithoe vaillanti; Stebbing, 1906: 639.

Amphithoe vaillanti; Chevreux & Fage, 1925: 333.

Material examined:

6 ♂♂, 24 ♀♀ from Turpialito, Cariaco Gulf, October 1974.

5 ♂♂, 9 ♀♀ from La Restinga, Margarita Island, 15 February 1975.

1 ♂, 33 ♀♀ from " " " 23 May 1976.

2 ♂♂, 9 ♀♀ from " " " 21 November 1976.

6 ♂♂, 31 ♀♀ from " " " 28 December 1975.

22 ♂♂, 53 ♀♀ from " " " 15 February 1976.

5 ♂♂ from " " " 26 February 1976.

1 ♀ from Playa Blanca, Mochima Bay, 23 October 1976.

7 ♂♂, 16 ♀♀ from Guatacaral, Mochima Bay, 18 February 1967.

14 ♂♂, 75 ♀♀ from Los Roques Archipelago, 23 June 1980.

8 ♂♂, 31 ♀♀ from " " 25 June 1980.

Description:

Length up to about 8 mm, colour reddish brown with light spots. Eyes reddish in colour. Antennae about half body length; antenna 1 peduncle article 3 about one-third length of 2, flagellum elongate and slender; antenna 2 shorter than 1,peduncle strong, flagellum short. Mandibular palp 3-articulate. Coxal plates ampithoid type with minute spines on edges; coxal gills on plates 2-6. Gnathopods densely setose, basis with very large anterodistal lobe, ischium also with large inner distal lobe;

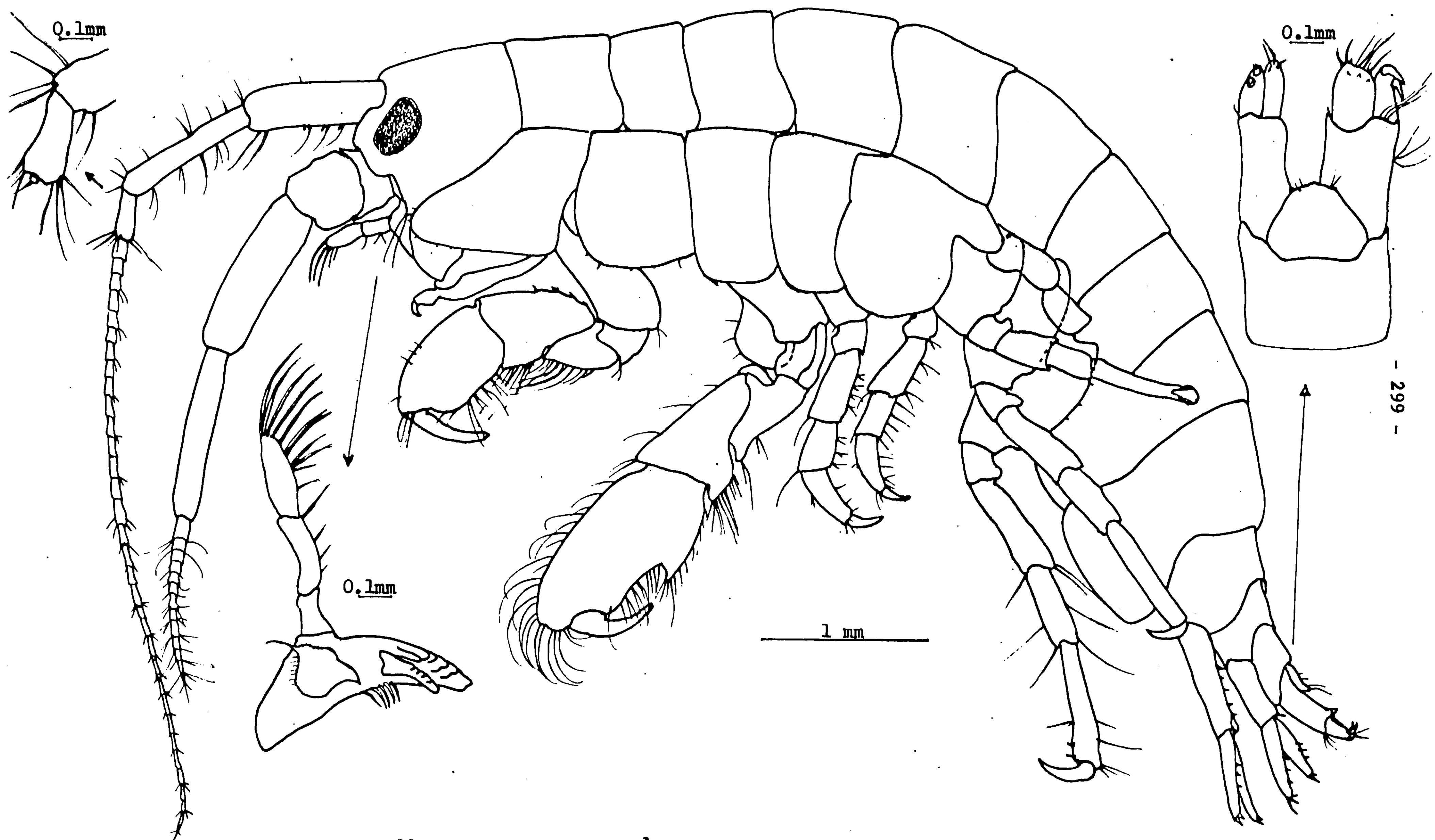


Figure 88. Ampithoe ramondi ♂ 7.5 mm

gnathopod 1 carpus powerful with up to 4 spines on anterior margin and laminar posterior one, propodus suboval with convex palm delimited by spine, dactylus long and overlapping palm; gnathopod 2 larger than 1 with powerful propodus, propodus broadly suboval with anterodistal margin produced and palm deeply concave, very densely setose, dactylus fitting into palm. Pereopods 3-4 short, basis moderately expanded. Pereopods 5-7 basis moderately lobate posteriorly and propodus slightly expanded distally. Epimeral plate 3 curved posteriorly with subrounded posterodistal angle. Uropod 3 outer ramus with two strong hooks, inner ramus with three small spines and few long setae. Telson broad at base, apex convex between small lateral cusps and few small setae.

Female similar to male with weaker gnathopods, palm of gnathopod 2 sinuous; oostegites present on coxal plates 2-5 carrying numerous small eggs and sometimes egg-mimicking ectoparasitic Copepoda - (Nicothoidae) Sphaeronella spp.

Ecology:

This cosmopolitan tubicolous species is very common all year round in the shallow waters of the eastern upwelling region of Venezuela. Generally about one-third of the populations were males; and one-third of the females found were carrying oostegites.

Distribution:

Ampithoe ramondi is a cosmopolitan species of the temperate regions in the Atlantic, Indian and Pacific oceans; usually shallow subtidal amongst algae and recorded herein for the upwelling Caribbean area, and the offshore islands of Los Roques.

Remarks:

The Caribbean populations have a body length up to 8 mm, in higher latitudes this increases to about 12 mm, an effect noticed already in other cosmopolitan species (in addition to other geographical variations) which is probably in relation with temperature.

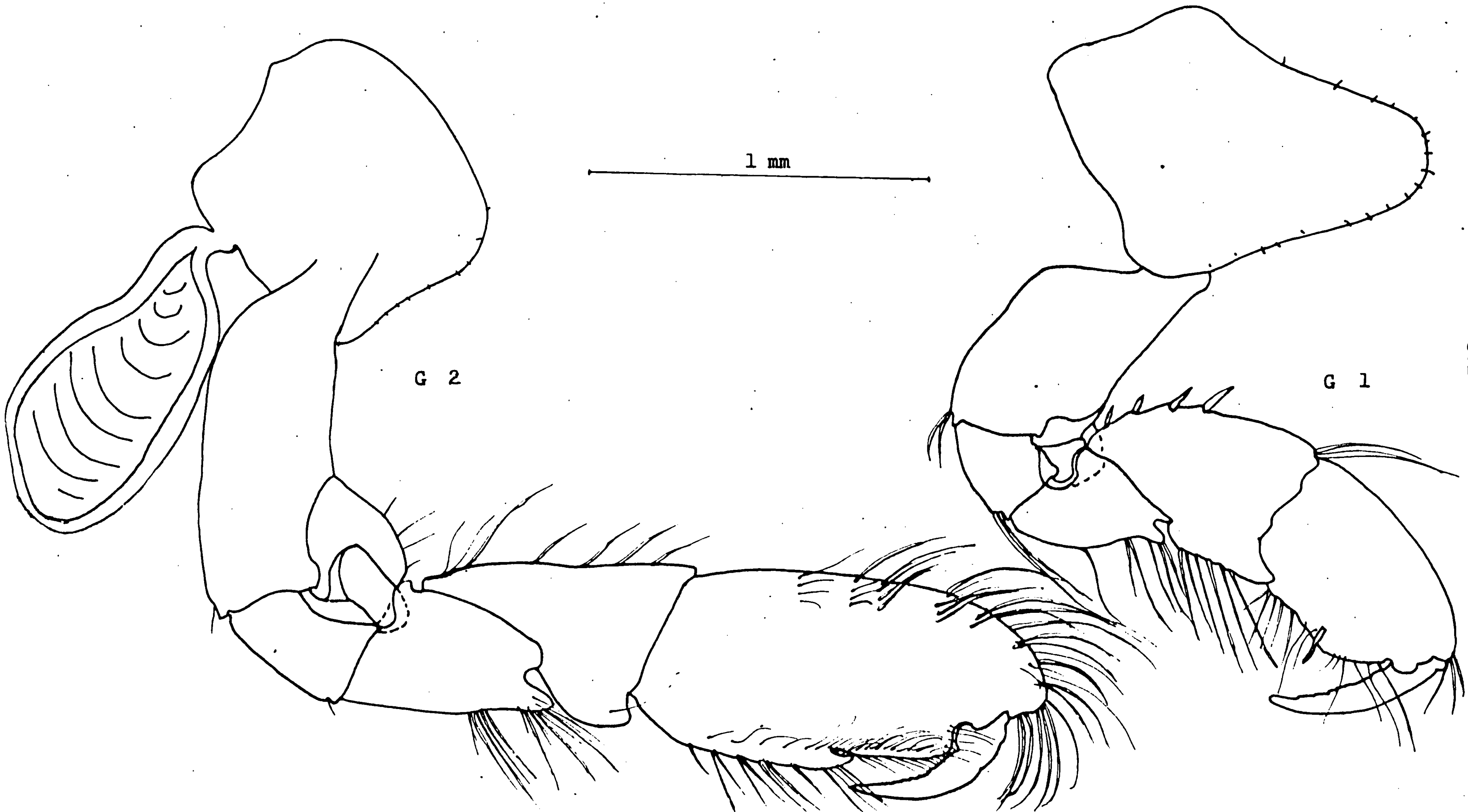


Figure 89. Ampithoe ramondi ♂ 7.5 mm : Gnathopods

Ampithoe marcuzzii Ruffo

(Figs 90-91)

Amphithoe marcuzzii Ruffo, 1954: 120.

Material examined:

1 ♂, 3 ♀♀ from Las Salinas, Distrito Federal, Central Litoral, Venezuela, November 1980.

2 ♂♂, 5 ♀♀ from Patanemo Beach, Venezuela, 26 June 1981.

Description:

Length up to 11 mm, colour yellowish. Eyes lateral, medium size, suboval. Antennae about half body length; antenna 1 peduncle article 3 less than one-third length of 2, flagellum very long and slender, 44-articulate; antenna 2 slightly shorter than 1, peduncle articles 4 and 5 subequal in length, flagellum 24-articulate. Mandible palp 3-articulate. Coxal plates with few minute spines distally; coxal gills on plates 2-6. Gnathopod 1 male, basis with anterodistal lobe, carpus subtriangular and distinctly shorter than propodus, with broad and setose posterior lobe; propodus subrectangular, very elongate, palm oblique, concave, with protuberance and delimited by spine; dactylus robust with serrate posterior margin, overlapping palm. Gnathopod 2 male, basis with very large anterodistal lobe, carpus subtriangular and distinctly shorter than propodus, with narrow setose posterior lobe; propodus subrectangular, elongate, robust, palm oblique and convex with proximal concavity and defined by blunt angle; dactylus robust, curved, short, closing into palm. Pereopods 3-4 robust, short, basis moderately expanded for genus.

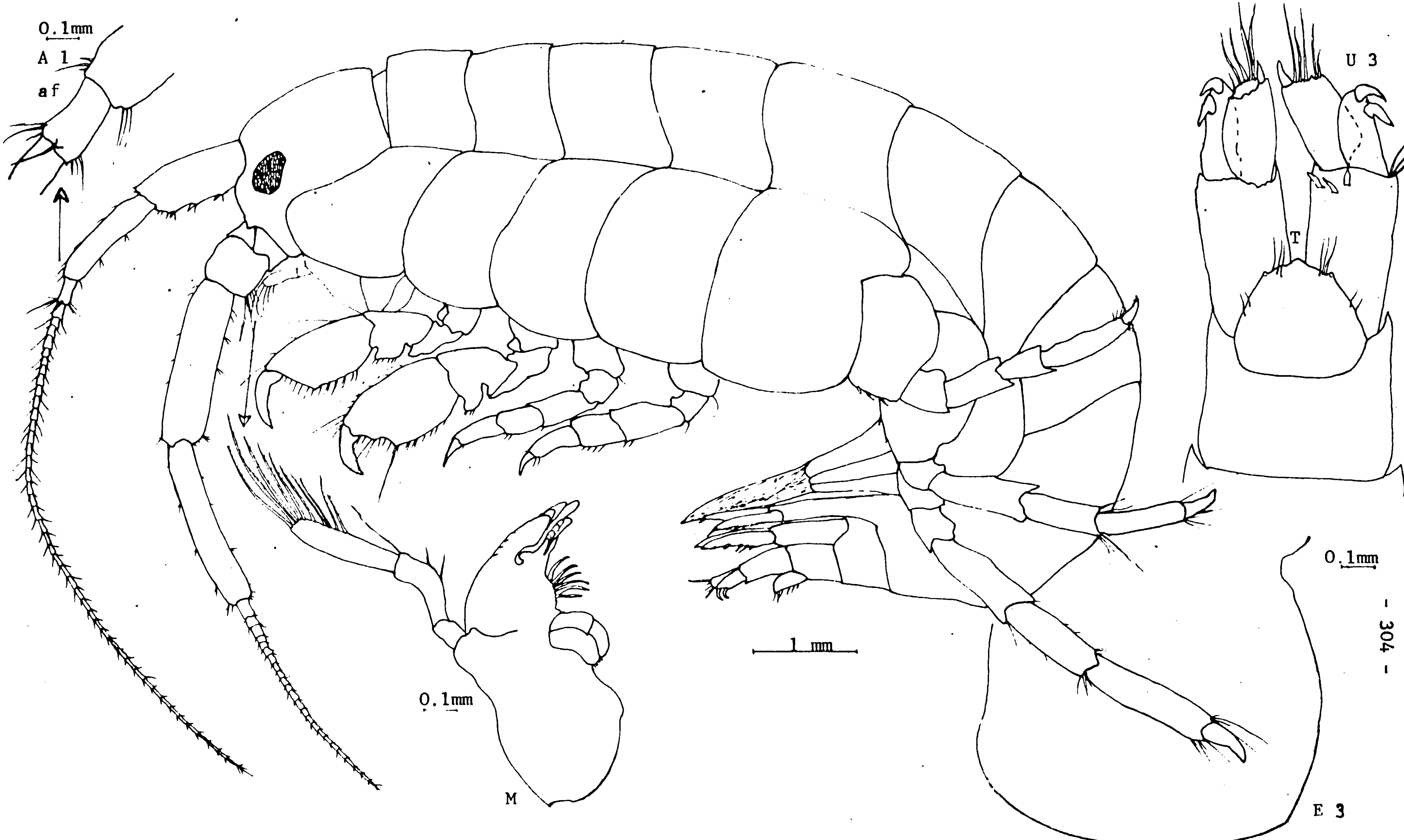


Figure 90. Ampithoe marcuzzii ♀ 11 mm

Pereopods 5-7 basis moderately lobate posteriorly, propodus slightly expanded distally. Epimeral plate 3 convex posteriorly with subrounded posterodistal angle. Uropod 3 outer ramus with two strong hooks, inner ramus with one large spine, three small spines and few long setae. Telson broad at base, apex convex between small lateral cusps and few long setae.

Female with oostegites on coxal plates 2-5; male with a carina between penes on posterior sternal surface of pereonite 7. Female similar to male but gnathopod 1 carpus robust, not much shorter than propodus which is suboval with oblique palm; gnathopod 2 suboval, propodus with sinous, oblique palm.

Ecology:

Ampithoe marcuzzii is a shallow subtidal species from the Central Litoral of Venezuela, found North to Los Roques where it lives with *A. ramondi*, although in more open waters, and West to Patanemo Bay where it coexists with *Sunamphitoe pelagica*.

Distribution:

Ampithoe marcuzzii is a Caribbean species, Ruffo (1950) mentioned *Ampithoe* sp. from Central Litoral of Venezuela but this was based only on 2 females. Ruffo (1954) described the species with a male and a female from Los Roques. The material studied herein is from these same two localities, as well as to the west of Patanemo Bay at the boundary between the Central Litoral and the Gulf Triste shelf.

Remarks:

The material studied agrees precisely with Ruffo's original description and is easily recognized by the elongate gnathopods. Its distribution is extended westerly.

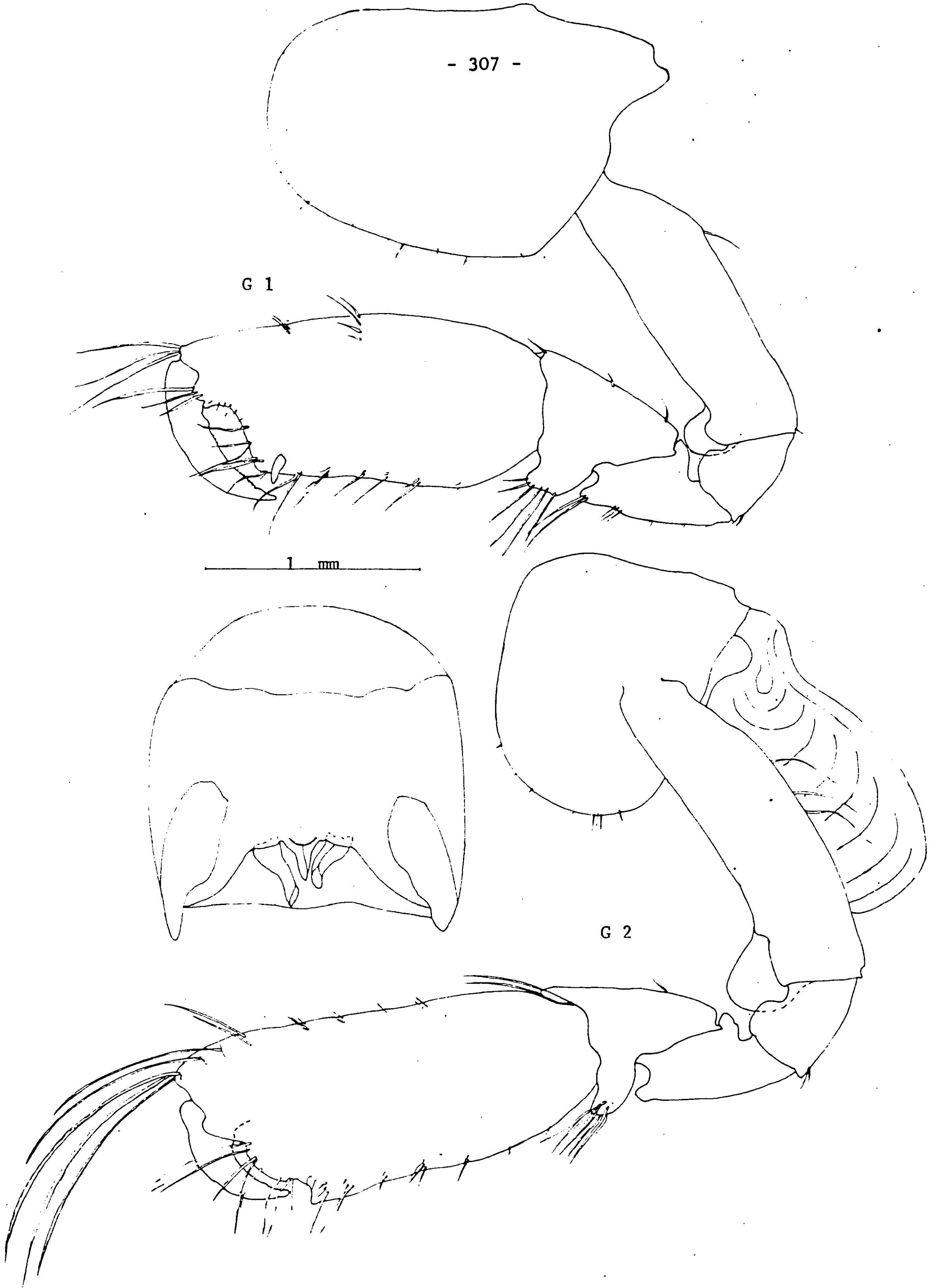


Figure 91. <u>Ampithoe</u> <u>marcuzzii</u> ♂ 11 mm: Gnathopods and ventral pereonite 7 showing penes and carina .

Family ISAEIDAE

Body compressed or weakly depressed and smooth. Coxal plates deep; plate 4 not excavate behind; plate 5 with anterior lobe. Head without rostrum; antennae subequal with accessory flagellum variable. Mouthparts basic; epistome produced, upper lip notched; lower lip with inner lobes and mandibular processes developed; mandible with strong molar, molar flake usually present on both mandibles. Gnathopods subchelate, gnathopod 2 larger than 1 and sexually dimorphic. Pereopods successively longer from 5 to 7. Uropods 1 and 2 slender and biramous; uropod 3 reduced, or with absent inner ramus. Telson entire, fleshy, thick and short. Coxal gills present on pereopods 2-6, oostegites on pereopods 2-5; oostegite 5 the smallest.

The family Isaeidae Dana, 1853 (p. 913) has been recently revised by Conlan (1983: 3). It comprises 26 genera, mostly of small species, that inhabit intertidal or shallow subtidal coastal marine and brackish waters, worldwide. A few species inhabit deep-water and some are commensal on Decapoda. The family is recorded for the first time from the southern Caribbean Sea.

Microprotopus Norman

Microprotopus Norman, 1867: 197; Sars, 1895: 566; Stebbing, 1906: 604; Lincoln, 1979: 512.

Body of small size; coxal plates deep, plate 5 as deep as plate 4. Head with lateral cephalic lobes produced. Antennae short and subequal; antenna 1, article 3 of peduncle much shorter than 1; accessory flagellum present and small. Mouthparts basic; mandible with slender 3-articulate palp. Gnathopods subchelate, gnathopod 1 smaller than 2, gnathopod 2 in male extremely large; gnathopod 1 propodus shorter than carpus; gnathopod 2 carpus with narrow posterior lobe, shorter than propodus. Pereopods 3-4 short and broad with dilated merus and carpus. Pereopods 5-7 successively longer, basis broad and expanded to subrounded lobe. Uropods 1-2 biramous, spinose with peduncle not prolonged distally, rami subequal. Uropod 3 uniramous and 1-articulate. Telson small, entire, fleshy, distally truncate.

A small genus of 4 North Atlantic species of which *Microprotopus shoemakeri* is recorded for the southern Caribbean Sea. The genus previously comprised two European and Mediterranean species and two American ones. *M. shoemakeri* is first record from the Caribbean coast of Venezuela.

<u>Microprotopus</u> <u>shoemakeri</u> Lowry

(Figs 92-94)

<u>Microprotopus</u> <u>shoemakeri</u> Lowry, 1972: 282; Bousfield, 1973: 188.

<u>Material examined</u>:

23 ♂♂, 25 ♀♀ from Tucacas beach, Golfo Triste, 23 July 1980.

11 ♂♂, 17 ♀♀ " " " " " 4 December 1980.

1 ♂, 1 ♀ " " " " " 22 April 1981.

<u>Description</u>:

Length up to 3 mm, colour yellowish. Head without rostrum. Eyes lateral, small and subrounded, brownish colour. Antenna 2 nearly half body length and about one and a half times longer than antenna 1. Antenna 1 peduncle article 1 the longest and stoutest, flagellum subequal to length of peduncle, 10-articulate; accessory flagellum small, 4-articulate. Antenna 2 peduncle longer than flagellum, 10-articulate. Mouthparts basic; mandible with strong molar, palp slender, 3-articulate; molar flake present on both mandibles. Maxilla 1 palp well developed; maxilla 2 well developed; maxilliped palp 4-articulate. Coxal plates 1-5 deep, densely setose distally with plumose setae; plates 6-7 very shallow. Coxal gills on plates 2-6, sack-like. Gnathopod 1 subchelate, propodus subequal or shorter than elongate carpus, densely setose posteriorly; palm oblique defined by strong spine; dactylus slightly overlapping palm. Gnathopod 2 enormous, especially in male; carpus compressed and lobate; propodus massive, twice as long as broad, palm defined by hooked tooth, with 2 teeth distally; dactylus powerful, curved, swollen

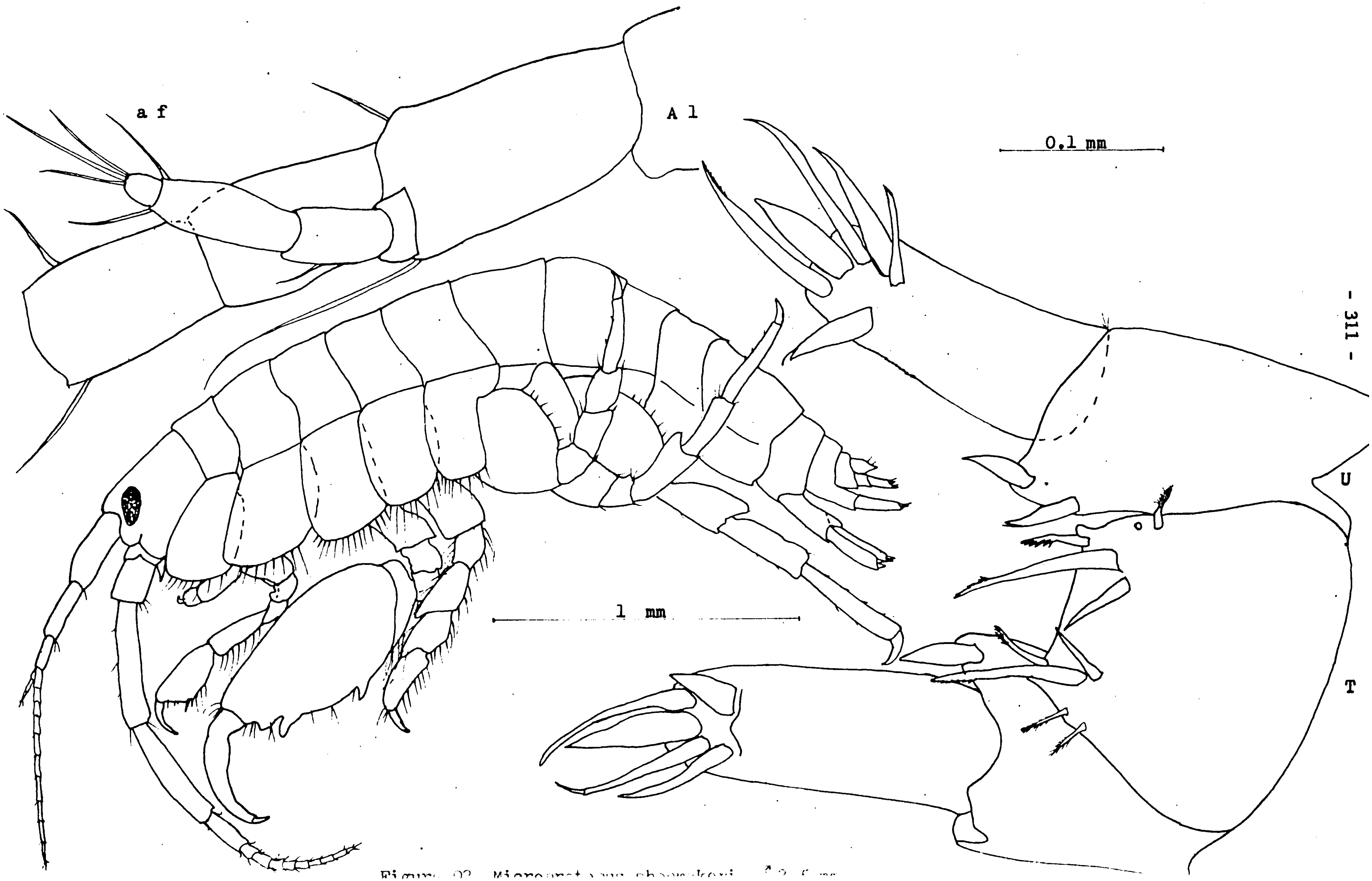


Figure 92. Microprotopus shoemakeri ♂ 2.6 mm

proximally, the dactylus fitting precisely against the palm at margin. Pereopods 3-4 subsimilar in size and shape, with dense plumose setae; basis, merus and carpus expanded. Pereopods 5-7 successively elongate, basis rounded with some setae and spines posteriorly. Uropods 1-2 biramous, spinose, with peduncle slightly shorter than rami. Uropod 3 uniramous, ramus subequal in length to peduncle and bearing 5 apical spines. Telson entire, fleshy, short and broad, apically truncate with produced posterolateral corners bearing pair of large setae and a number of smaller ones.

Female similar to male but gnathopod 2 less powerful and palm less strongly sculptured, propodus with oblique palm bearing spines; antenna 2 slightly shorter than in male; pereopods 3-4 less setose. Oostegites present on pereopods 2-5, large, slender and laminar. Males bearing penis two-thirds length of sternal surface of pereonal segment 7.

Ecology:

Microprotopus shoemakeri is abundant in shallow waters of Tucacas beach together with *Cymadusa filosa*.

Distribution:

The species was recently described by Lowry (1972) from Florida, who records its range as Cape Hatteras to the Gulf of Mexico. The new material extends the known distribution to the southern Caribbean coast of Venezuela.

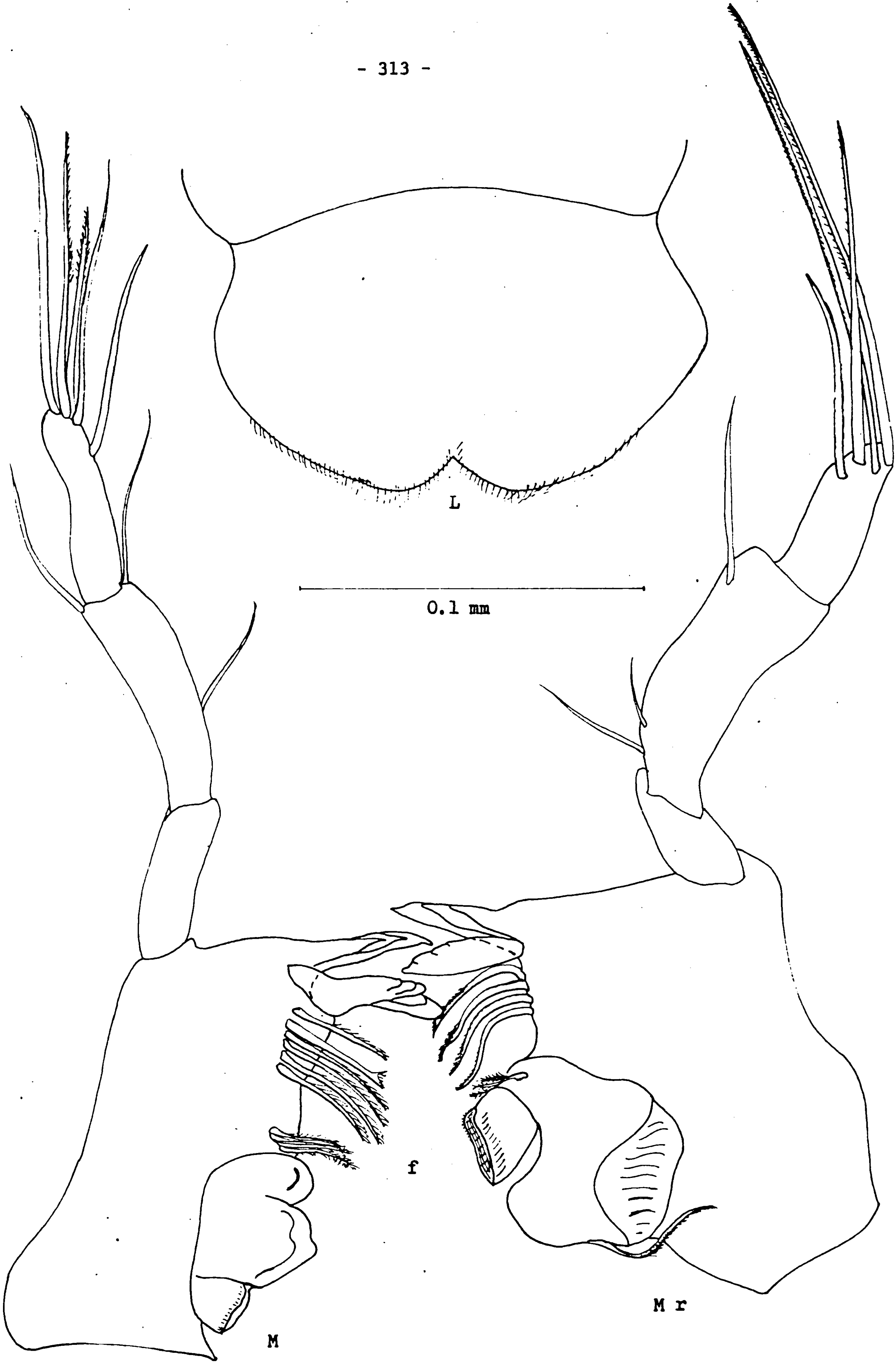


Figure 93. Microprotopus shoemakeri ♂ 2.5 mm: Mouthparts

Remarks:

The material studied herein fits closely the original description of Microprotopus shoemakeri Lowry (1972). This species differs from others in the genus in having antenna 2 longer than antenna 1; the accessory flagellum 4-articulate; strongly plumose setae on pereopods 3-4; and a novel armature on the propodus of gnathopod 2 in the males. The presence of a molar flake on both the left and right mandible is an interesting feature of this genus that merits investigation in allied genera and families. To date, this structure has been largely ignored by taxonomists but may prove to be a valuable apomorphy in phylogenetic discussions.

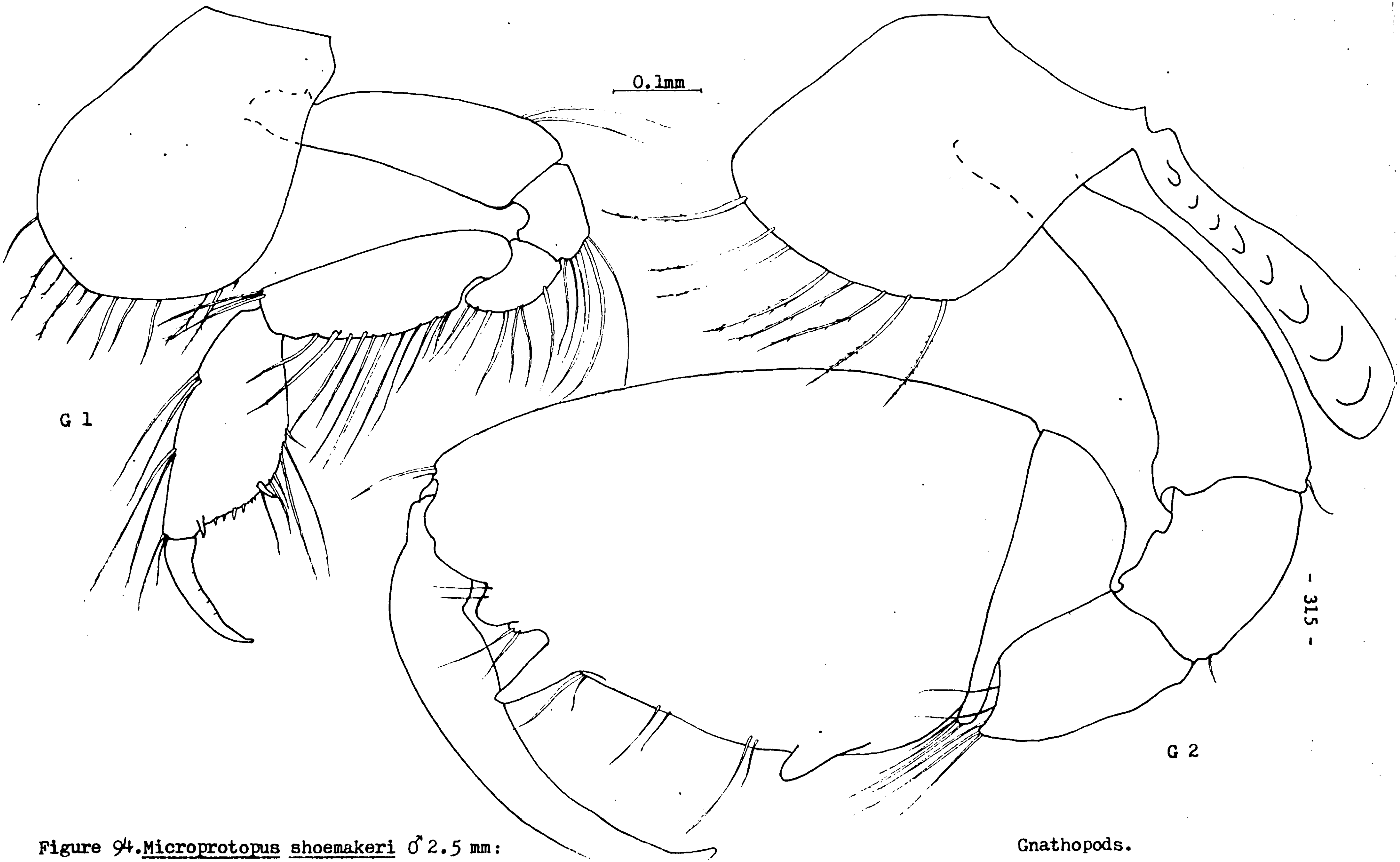


Figure 94. Microprotopus shoemakeri ♂ 2.5 mm: Gnathopods.

Family NEOMEGAMPHOPIDAE

Body compressed and smooth. Coxal plates moderately deep; plate 4 not excavate posteriorly; plate 5 with anterior lobe well developed. Head elongate, strongly recessed below ocular lobes; eyes subrounded, situated well forward on lateral lobes. Antenna 1 accessory flagellum small. Antenna 2 inserted half way back along ventral margin of head. Mouthparts of basic corophioidean type; mandible with strong molar without molar flake or flake vestigial on right mandible; palp distally truncate. Coxal gills sack-like, present on pereopods 2-6; oostegites present on plates 2-5, large and laminar; oostegite 5 the smallest. Gnathopods subchelate; gnathopod 1 larger than 2, often complexly subchelate in male; gnathopod 2 slender. Pereopods 3-4 glandular, basis not expanded; pereopods 5-7 successively elongated. Uropods 1-2 slender, biramous, rami subequal; uropod 3 sometimes projecting beyond uropods 1 and 2. Telson entire, fleshy and short.

The family Neomegamphopidae was erected by Myers (1981: 8) to include a small group of genera with an apparent mixture of Isaeidae and Aoridae characters. It has closest affinity to the Isaeidae but shows the dominant gnathopod 1 of the Aoridae (Conlan & Bousfield, 1982: 96).
The type genus for the family is Neomegamphopus Shoemaker, from the tropical sublittoral East Pacific; also recorded from the Indian Ocean and present in the Venezuelan Caribbean. It is very similar to Amphideutopus Barnard, but differs in having an indistinct palm on gnathopod 2.

Neomegamphopus Shoemaker

Neomegamphopus Shoemaker, 1942: 35; Myers, 1973: 263.

Body slender. Head with prolonged lateral lobes bearing the eyes. Antennae slender; antenna 1 the shortest, accessory flagellum small, 2-articulate; antenna 2 inserted ventrally on the head. Mouthparts basic; lower lip with inner lobes well developed; mandibular palp stout, article 3 shorter than 2 and distally truncate. Gnathopod 1 in male complexly chelate; carpus enormous and produced posterodistally into a tooth; propodus and dactylus slender. Gnathopod 2 long and slender in male; propodus shorter than carpus, palm poorly defined. Gnathopods in female subsimilar to male gnathopod 2. Coxal plate 4 not excavate posteriorly, plate 5 with anterior lobe well developed. Pereopods 5-7 basis equally expanded; pereopod 7 the longest. Uropod 3 rami subequal, slightly longer than peduncle. Telson entire, fleshy and short.

The genus Neomegamphopus was erected for the type-species N. roosevelti by Shoemaker (1942) from sandy bottom at 30 m, in Baja California; placed originally in the family Photidae. Myers (1968) recorded it from a sandy bottom at 40 m on Coche Island and placed it in the family Aoridae. A second species, N. kunduchii Myers (1973), from a sandy mud bottom at 22 m in Tanzania, was described and the genus placed in the family Isaeidae. Finally, this genus and 4 others were moved to the newly erected family Neomegamphopidae Myers (1981) and Bousfield (1983).

Neomegamphopus roosevelti Shoemaker

(Figs 95-96)

Neomegamphopus roosevelti Shoemaker, 1942: 36; Myers, 1968: 127.

Material examined:

2 ♂♂, 2 ♀♀, from Hancock Atlantic Expedition, 3 miles north of Coche Island, Venezuela, 1939, deposited in BM(NH) reg. nos 1966.9.28.1-4.

Description:

Length up to 4 mm, body slender and smooth; coxal plates moderately deep, plates 1 and 2 the largest, plate 4 not excavate posteriorly, plate 5 anterior lobe well developed, plates 6 and 7 shallow. Head as long as the first two pereonal segments; lateral lobes strongly produced, bearing oval eyes; head ventrally recessed below lateral lobes for insertion of antenna 2. Antenna 1 slightly shorter than 2, less than half body length; peduncle article 2 the longest; flagellum shorter than peduncle; accessory flagellum short, 2-articulate. Antenna 2 flagellum subequal in length to peduncle, about 10-articulate. Mandible with strong molar, molar flake absent, or vestigial on right mandible only; mandibular palp stout, article 2 longest, article 3 distally truncate bearing long setae. Coxal gills sack-like on pereopods 2-6. Gnathopod 1 powerful, complexly subchelate; basis long and slender; carpus produced forward into a strong and slightly curved posterodistal tooth; propodus slender, convex anteriorly and concave posteriorly. Gnathopod 2 slender, elongate; carpus longer than propodus, palm inconspicuous; dactylus slender and slightly curved with fine

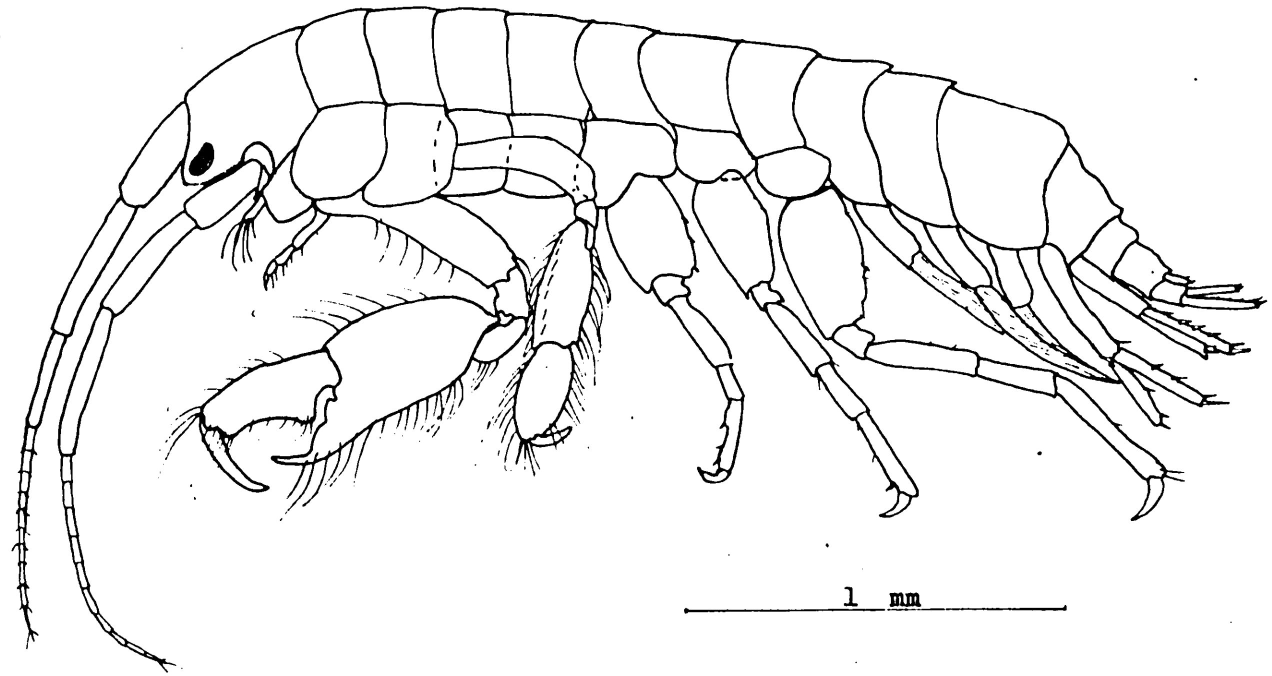


Figure 95. Neomegamphopus roosevelti ♂ 3 mm.

serrations and setae. Pereopods 5-7 basis moderately expanded; pereopod 7 the longest. Uropods biramous; uropod 1 peduncle with posteroventral toothed process; uropod 3 rami subequal, outer ramus about as long as the peduncle, inner slightly longer. Telson entire, fleshy and short, bearing distolaterally a small spine and couple of setae.

Female similar to male except gnathopods which resemble gnathopod 2 of male. Oostegites present on plates 2-5.

Ecology:

The species has been collected on a sandy and weedy bottom, at 30 m, near San Lucas Cape, Baja California, 18 July 1938 and on a sandy, shelly bottom at 40 m, near Coche Island, Venezuela, 15 April 1939 (44 ♂♂, 66 ♀♀).

Distribution:

Neomegamphopus roosevelti has been recorded from the tropical Pacific, and Caribbean continental shelf waters.

Remarks:

Neomegamphopus roosevelti is another example of a species shared between the tropical Pacific fauna and the Caribbean fauna, and also illustrates the familiar change in body size with latitude - the Caribbean material being significantly smaller (4 mm) than the Californian one (5 mm).

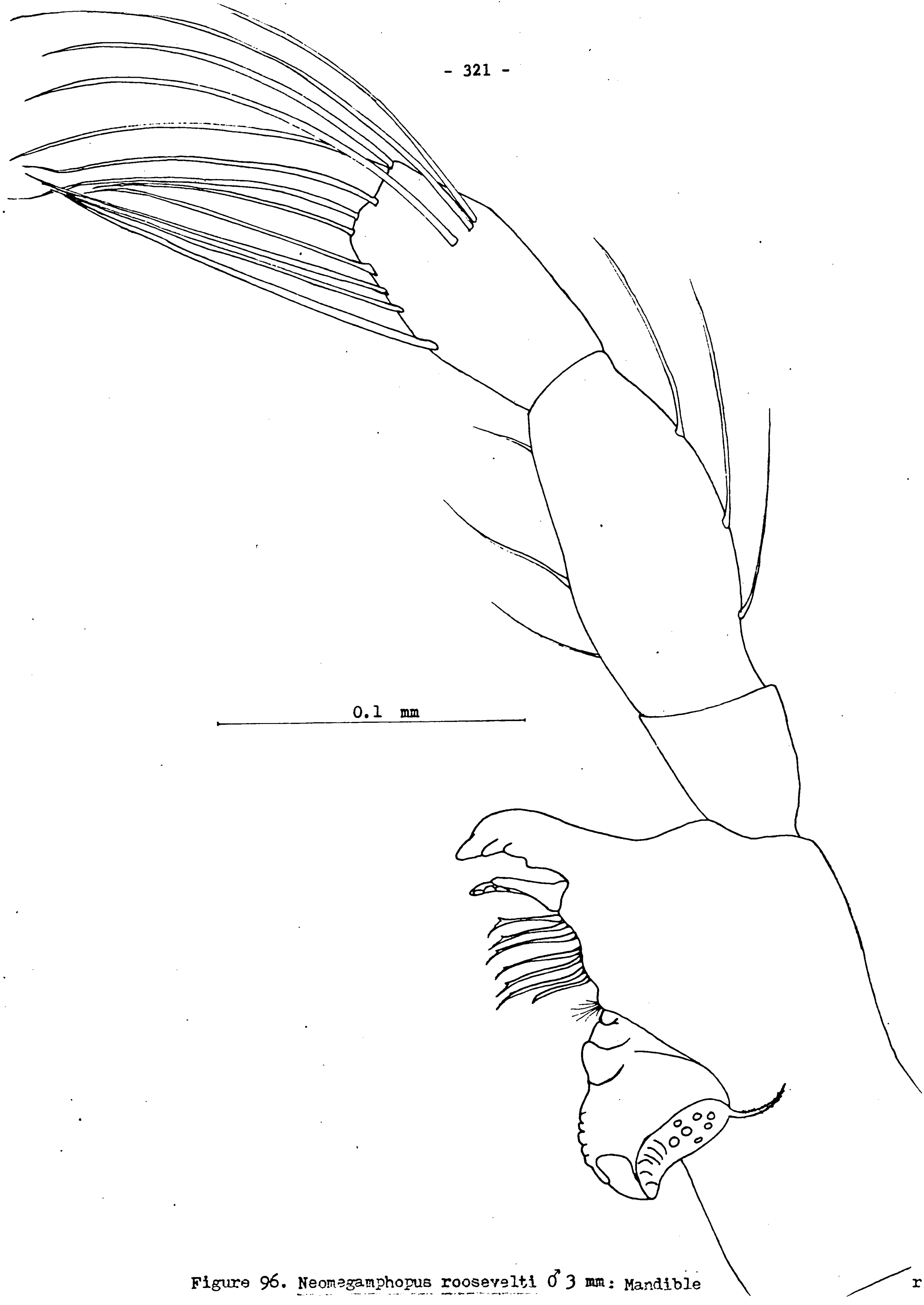


Figure 96. Neomegamphopus roosevelti ♂ 3 mm: Mandible

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Amphideutopus Barnard

Amphideutopus Barnard, 1959: 34; Barnard, 1961: 181.

Body slender. Head with projecting lateral lobes bearing oval eyes; ventral margin of head incised for the insertion of the second antenna. Antenna slender; antenna 1 the shortest, accessory flagellum small, 2-articulate. Mouthparts basic; lower lip with inner lobes well developed; mandibular palp stout, article 3 shorter than 2 and distally truncate. Gnathopod 1 larger than 2 in male and complexly chelate; carpus enormous, produced posterodistally into a tooth; propodus stout and short, dactylus curved and short. Gnathopod 2 slightly smaller than in male, subchelate with well-defined palm. Gnathopods in female as in Neomegamphopus. Coxal plate 4 not excavate posteriorly and 5 with anterior lobe well developed. Pereopods slender, pereopod 7 the longest. Uropod 3 rami subequal, about twice as long as peduncle. Telson entire, fleshy and short.

The genus Amphideutopus was described with the type-species, A. oculatus, from sandy littoral bottoms in California by Barnard (1959), and redescribed from open sea material by the same author in 1961. Barnard placed it in the family Photidae. A new species, A. dolicocephalus was described by Myers (1968) from a sandy bottom at 40 m depth, north of Margarita Island in the Caribbean, and placed in the family Aoridae. Later, Myers (1981) erected the new family Neomegamphopidae but placed Amphideutopus in the Isaeidae. Barnard (1973) and others prefer to submerge the families Isaeidae, Photidae and Aoridae into an expanded concept of the Corophiidae. Conlan & Bousfield (1982) assigned Amphideutopus to the family Aoridae. The genus Amphideutopus resembles Neomegamphopus quite closely, differs only in the well developed palm of male gnathopod 2 and the much longer rami of uropod 3. Neomegamphopus and Amphideutopus are distinct from Isaeidae in having the first gnathopod dominant, and from Aoridae in the posterior insertion of antenna 2, the strongly projecting lateral lobes, the presence of a vestigial molar flake, and the truncate mandibular palp. The Venezuelan material of Amphideutopus has to be placed together with Neomegamphopus as the only means of separating the family Neomegamphopidae from the Isaeidae and the Aoridae.

Amphideutopus dolicocephalus Myers

(Figs 97-98)

Amphideutopus dolicocephalus Myers, 1968: 128.

Description:

Length up to 7 mm, body robust. Head very elongate with the lateral lobes produced, rounded, and bearing oval eyes. Antenna 1 shorter than 2, almost half body length; peduncle article 2 the longest; accessory flagellum short, 2-articulate; primary flagellum 16-articulate, subequal in length to the peduncle. Antenna 2 inserted on ventral emargination of head; flagellum longer than peduncle, about 22-articulate. Gnathopod 1 powerful, complexly subchelate; basis strong; merus acute posterodistally, carpus with series of ventral teeth; propodus short and stout, posterior margin convex; dactylus curved, shorter than propodus. Gnathopod 2 nearly as large as 1; basis swollen; merus with prolonged posterodistal angle; carpus very broad, larger than propodus with broad transverse palm, posterodistal angle produced; dactylus short, fitting palm. Pereopods 6-7 long and slender. Uropod 3 rami subequal; more than twice as long as peduncle. Telson entire, fleshy and short, bearing distolaterally a pair of spines and a long seta.

Female unknown.

Ecology & Distribution:

Amphideutopus dolicocephalus is only known from two male specimens (7 mm, 6 mm) dredged at 40 m on a sandy bottom 5 miles north-west of Margarita Island, by the Alan Hancock Expedition, 21 April 1939, deposited in the USNM, reg. nos 113586-7.

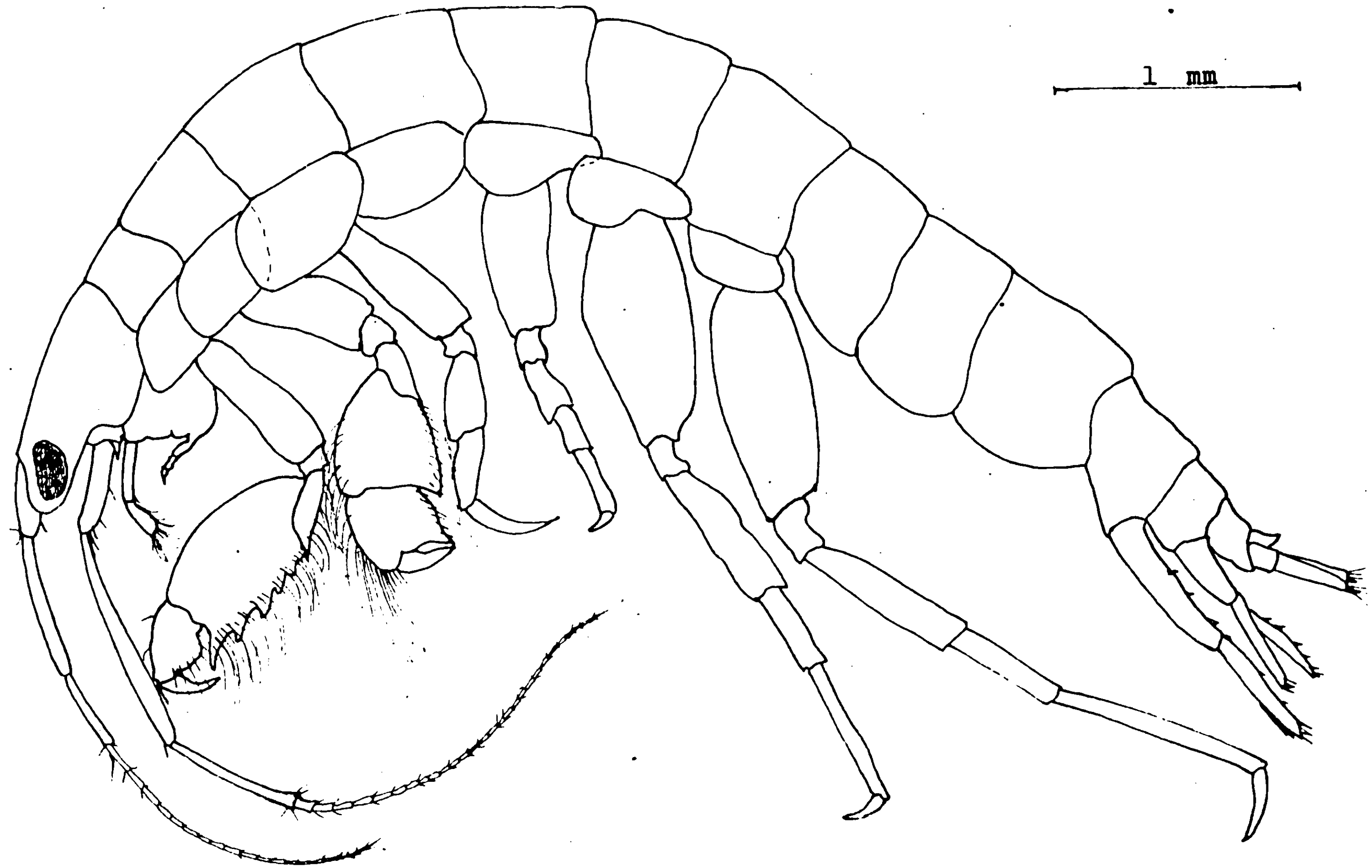


Figure 97. Amphideutopus dolicocephalus ♂ 6 mm.

Remarks:

Amphideutopus dolicocephalus most closely resembles *A. oculatus*, but can be distinguished by the series of teeth on the posterior carpal margin of male gnathopod 1 and the fine tooth on the posterodistal angle of the merus.

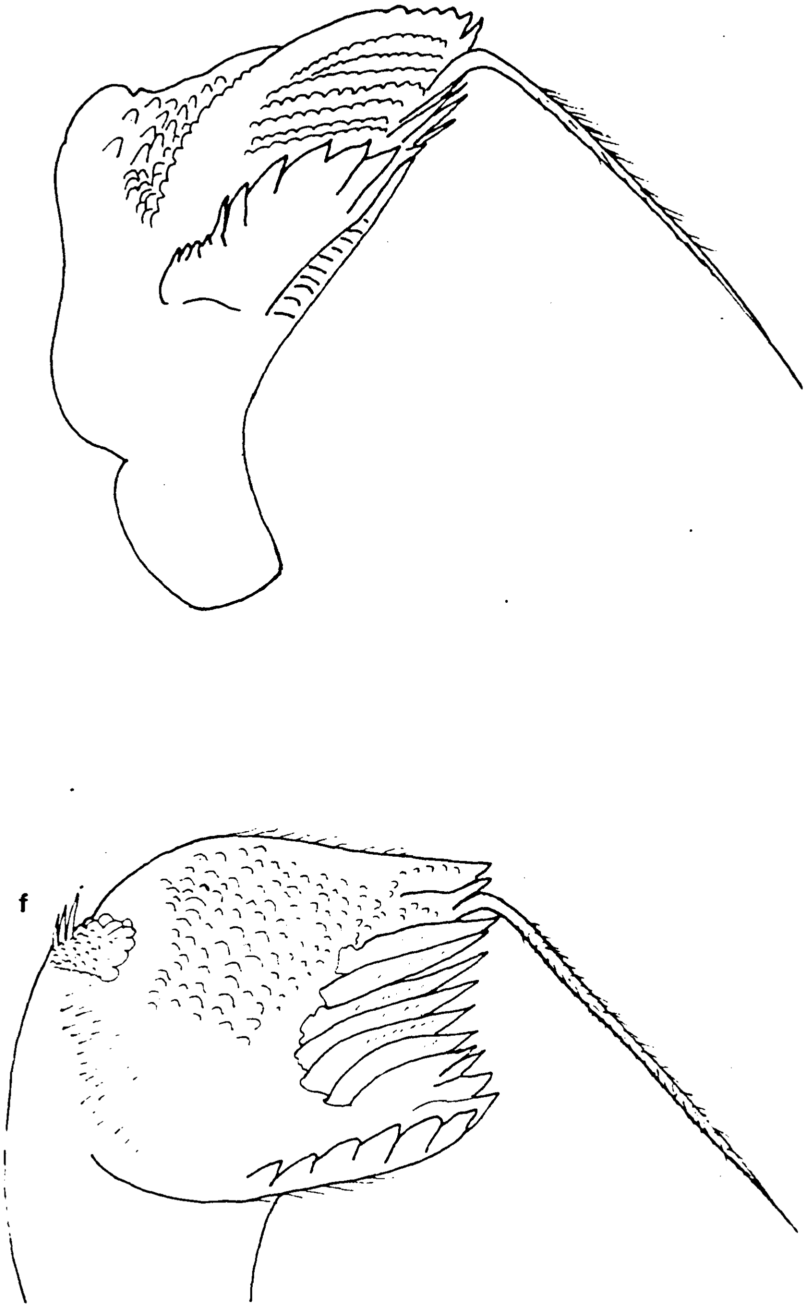


Figure 98. <u>Amphideutopus</u> <u>dolicocephalus</u> ♂ 6 mm : Right molar from two different angles showing the remains of a molar flake. (After Barnard)

Family AORIDAE

Body smooth, slender, often weakly depressed; coxal plates shallow, weakly contiguous; plate 1 generally largest, plate 4 not excavate posteriorly, plate 5 often with deep anterior lobe. Pereonal segments in male often with midventral sternal processes. Pleon segments rarely coalesced. Head with rostrum very short or absent; eyes small and subrounded. Antenna 1 slender, longer than 2; accessory flagellum usually present, well developed. Mouthparts basic. Upper lip entire, lower lip with inner lobes; mandible with slender palp and strong molar, molar flake sometimes present on right mandible. Gnathopods subchelate; gnathopod 1 larger than 2, often complexly subchelate in male; gnathopod 2 slender. Pereopods 3-4 basis not expanded, dactylus with gland ducts; pereopods 5-7 slender, usually successively elongated. Epimeral plates shallow. Uropods 1-2 biramous, slender, peduncle often with spine-like distal process; uropod 3 quite short. Telson short, fleshy and entire. Coxal gills sack-like, present on plates 2-6; oostegites present on plates 2-5, large and laminar; oostegite 5 the smallest.

The family Aoridae Stebbing (1899: 211) now contains nearly 180 species in more than 30 genera. Most species inhabit shallow marine and brackish waters in tropical and warm-temperate regions, and are tube builders among sponges or are inquilinous upon tubes or shells of other organisms. The genus Lembos Bate is recorded for the first time from the southern Caribbean Sea.

Lembos Bate

Lembos Bate, 1857: 142; Myers, 1981: 10.

Body slender, weakly depressed; colour pattern characteristically disruptive. Head shallow, eyes small, lateral lobes obtuse. Antenna 1 slender, accessory flagellum multiarticulate; antenna 2 stout. Mandibule palp 3-articulate, article 3 narrow distally and setose; molar flake present on right mandible. Coxal plates moderately developed. Gnathopods subchelate; gnathopod 1 larger than 2, especially large in male, carpus and propodus robust and setose, carpus not toothed, propodus larger than carpus and bearing teeth in male; gnathopod 2 moderately robust, carpus subequal to propodus. Uropod 3 biramous.

A large cosmopolitan genus of more than 30 species presenting many problems in identification, the females being especially difficult to separate. Also, intraspecific geographical variation has been little studied. Most are tubicolous and inquilinous, and are common in tropical littoral habitats. Lembos unifasciatus Myers (1977: 117) is herein recorded from Los Roques coral atolls where the males appear to exhibit three varieties of gnathopod morphology.

Lembos unifasciatus Myers

(Figs 99-100)

Lembos unifasciatus Myers, 1977: 117; Myers, 1979: 244.

Material examined:

5 ♂♂, 7 ♀♀	from Los	Roques	Archipelago,	Venezuela,	28 April 1980.
13 ♂♂, 7 ♀♀	"	"	"	"	30 April 1980.
4 ♂♂, 7 ♀♀	"	"	"	"	23 June 1980.
2 ♂♂, 1 ♀	"	"	"	"	25 June 1980.

Description:

Length up to 4 mm, colour variable; yellowish disrupted with brown spots. Head without rostrum; eyes lateral, small and subrounded, colour dark-brown. Antenna 1 about three-quarters body length, flagellum slender, longer than peduncle, 14-articulate; accessory flagellum up to 7-articulate, terminal article vestigial. Antenna 2 about half body length, flagellum short, up to 7-articulate. Mandibule palp terminal article falcate and setose; molar flake present on right mandible; left incisor 6 teeth; lacinia mobilis 3 teeth. Pereonal segments 2-4 with midventral sternal processes in male. Coxal plates moderately shallow for genus; coxal gills present on plates 2-6, sack-like. Gnathopod 1 powerful, basis robust; carpus reduced, cup-shaped; propodus enormous, subrectangular to ovoid, posterior margin stepped at insertion of setal bundles and usually bearing spine distally near the tooth which defined the palm, palmar margin angular; dactylus curved, overlapping palm. Gnathopod 2 slender, smaller than 1; basis robust with anterior margin concave and posterior margin convex;

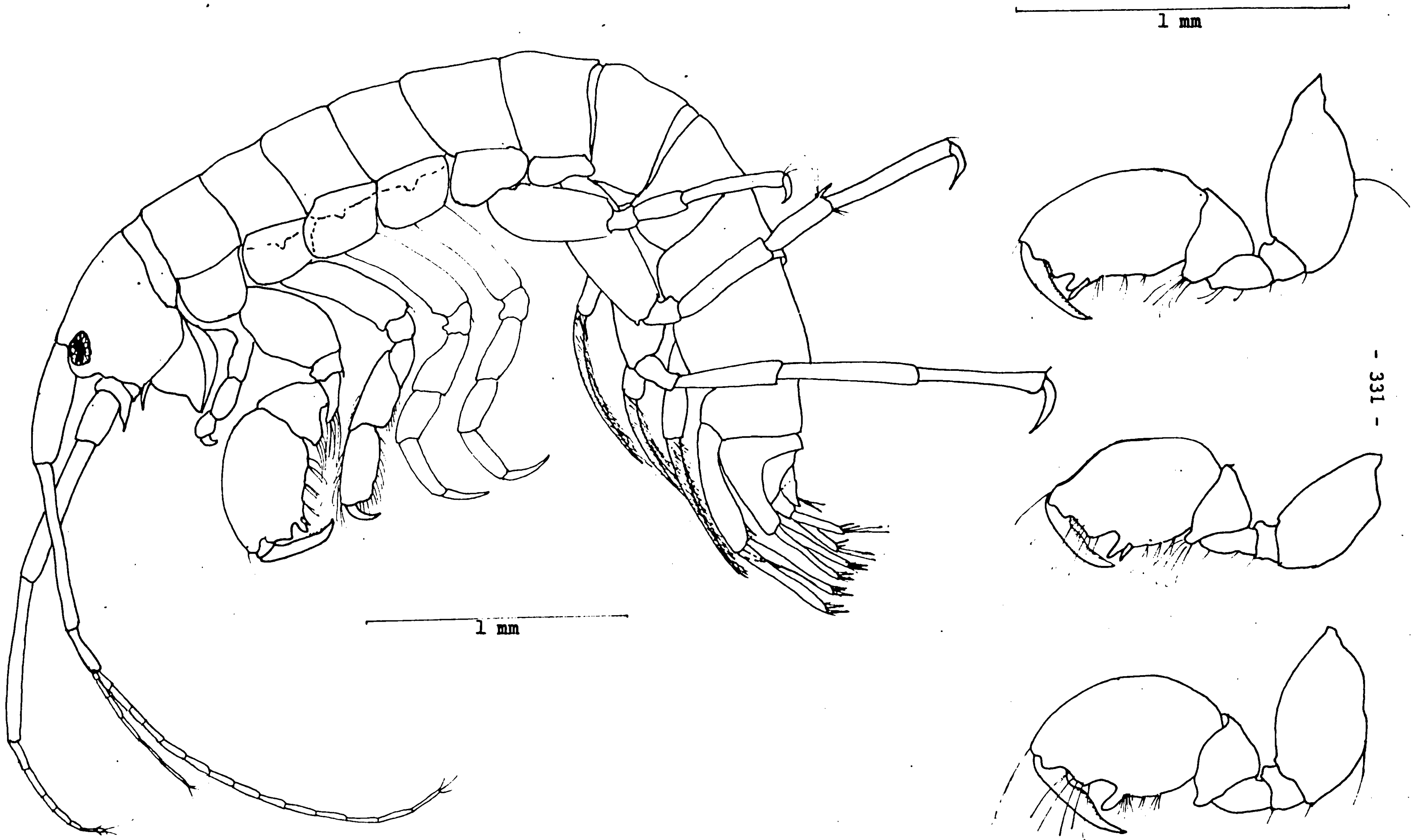


Figure 99. Lembos unifasciatus ♂ 4 mm, plus gnathopod 1 of other three males: 3 mm.

carpus elongate, slightly longer than propodus; propodus slender with sinuous palm; dactylus slightly overlapping palm. Pereopods 3-4 slender, subequal; dactylus about half length of propodus. Pereopods 5-7 successively elongated; pereopod 7 carpus and propodus very slender. Uropod 1, peduncle with stout, spine-like distal process about one-quarter length of peduncle; rami subsimilar and about subequal. Uropod 2, peduncle with distal spinose process. Uropod 3 rami subequal in length and longer than peduncle. Telson simple,. fleshy, entire, bearing a pair of long subapical setae.

Female similar to male except gnathopod 1 propodus elongate with oblique palm, dactylus slightly overlapping palm. Oostegites laminar, very large on pereopods 2-4 and small on 5.

Ecology:

Lembos unifasciatus has been collected from the fouling community on shells (about 200 mm in length) of *Strombus gigas* living in beds of *Thalassia testudinum* and *Halimeda opuntia* at about 5 m depth around the coral atolls of Los Roques Archipelago.

Distribution:

Lembos unifasciatus has been described from Florida, Bahamas and Puerto Rico and is now reported for the first time from Venezuelan islands in the southern Caribbean Sea.

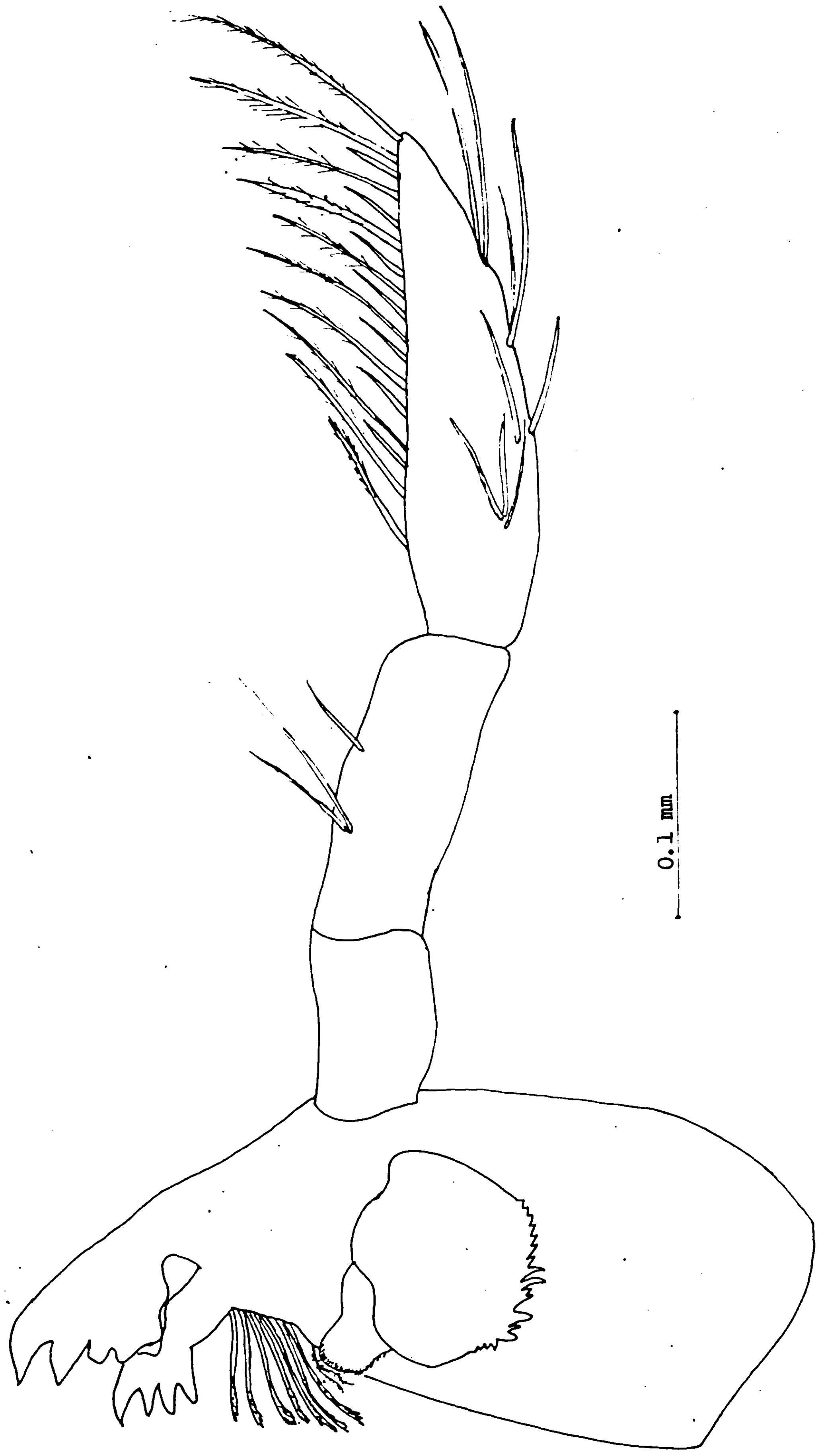


Figure 100. Lembos unifasciatus ♂ 4 mm: Right mandible with molar flake.

Remarks:

The material studied herein agrees well with the original description of Lembos unifasciatus by Myers (1977 and 1979). Three varieties of males of similar body size have been collected in the same sample.

1. Male with gnathopod 2 propodus ovoid, palmar margin bearing U-shaped excavation and a spine on the tooth delimiting the palm; uropod 1 spinose process one-third length of peduncle.
2. Male with gnathopod 2 propodus subrectangular, palmar margin with V-shaped excavation, and a spine on the tooth delimiting the palm; uropod 1 spinose process one-fifth length of peduncle.
3. Male with gnathopod 2 propodus ovoid, palmar margin bearing U-shaped excavation, without spine on the tooth delimiting the palm, dactylus swollen; uropod 1 spinose process one-third length of peduncle.

Only culture and hybridization experiments will solve the problem of whether these represent distinct species or subspecies or are simply different growth stages.

Family COROPHIIDAE

Body smooth, strongly depressed with urosome tending to fusion. Coxal plates very shallow, separate, plate 4 not excavate posteriorly. Head with small rostrum or rostrum absent; eyes small or absent. Antennae short and robust, without accessory flagellum, sexually dimorphic especially antenna 2. Mouthparts basic; mandibular palp slender; molar flake present on right mandible; maxilliped outer plate large. Gnathopods simple or subchelate, subequal or gnathopod 2 enlarged. Pereopods glandular; pereopod 5 the shortest, pereopod 7 the longest. Uropods 1-2 basic, spinose; uropod usually reduced. Telson entire, fleshy and short. Coxal gills sack-like, present on plates 3-6. Oostegites present on plates 2-5; oostegites on plate 2 reduced, oostegites on plates 4-5 large.

The family Corophiidae Dana (1849: 139) comprises about 70 described species in 7 genera; they are generally small and they are amongst the most specialized of the tube building amphipods. Most are found in shallow-littoral, estuarine and brackish water habitats in tropical and temperate seas around the world. Many species are gregarious, often abundant. Some belong to familiar fouling communities. The family also includes some freshwater forms.

<u>Corophium</u> Latreille

<u>Corophium</u> Latreille, 1806: 58; Stebbing, 1906: 685.

<u>Audouinia</u> Costa, 1851: 24.

Body strongly depressed; urosome segments free or tending to fusion. Coxal plates very shallow, separate. Head with small rostrum or rostrum absent; eyes small, situated on prominent lateral lobes. Antenna 1 weaker than 2, markedly sexually dimorphic; antenna 2 robust, peduncle powerful, flagellum very short. Mandible with small palp, molar flake on right molar. Gnathopods small, densely setose; gnathopod 1 slender; gnathopod 2 carpus and propodus elongate. Pereopods 3-4 robust; pereopods 5-6 weak; pereopod 7 elongate and setose. Uropods 1-2 biramous, rami short; uropod 3 uniramous with flattened peduncle and ramus. Telson entire, fleshy and short.

A large cosmopolitan genus containing more than 50 species, mostly occurring in tropical and temperate littoral marine habitats but also found in brackish and fresh waters. <u>Corophium</u> species are gregarious inhabiting tubes of mud or sand, either within the substratum or attached to other organisms or objects. <u>Corophium</u> <u>rioplatense</u> Giambiagi is recorded here from Venezuela.

Corophium rioplatense Giambiagi

(Figs 101-103)

Corophium rioplatense Giambiagi, 1926: 138; Crawford, 1937: 605.

Corophium sp. Shoemaker, 1947: 49.

Material examined:

1 ♂ (2 mm in length), 1 ♀ (3 mm in length) from San Francisco de los Guayos, Orinoco delta, Venezuela, 1984, deposited in BM(NH) reg. no. 1984.169.

Description:

Length up to 3 mm, colour brownish; body strongly depressed, pereonal segment 1 short, urosome segments separate. Coxal plates shallow and separate; plate 1 anterodistally produced with four long setae. Head without rostrum, wider than long and as long as the first pereonal segments combined; eyes small and dark; lateral lobes short and subrounded. Antenna 1 about one-third body length; peduncle article 1 equal to length of 2 and 3 combined and bearing at least 1 posterodistal spine; flagellum slightly shorter than peduncle, 6-articulate. Antenna 2 very robust, markedly sexually dimorphic; flagellum short, 3-articulate with 2 distal hooks; peduncle extremely robust. Male peduncle article 4 and 5 of antenna 2 more elongate than in female; article 4 produced posterodistally into a curved tooth with accessory tooth above, article 5 with posteroproximal blunt tooth; both articles with tufts of very long setae posteriorly. Female peduncle article 4 with laminar expansion posteriorly, bearing 4 short marginal spines; article 5 with lobe bearing single spine. Mandibular palp biarticulate, the

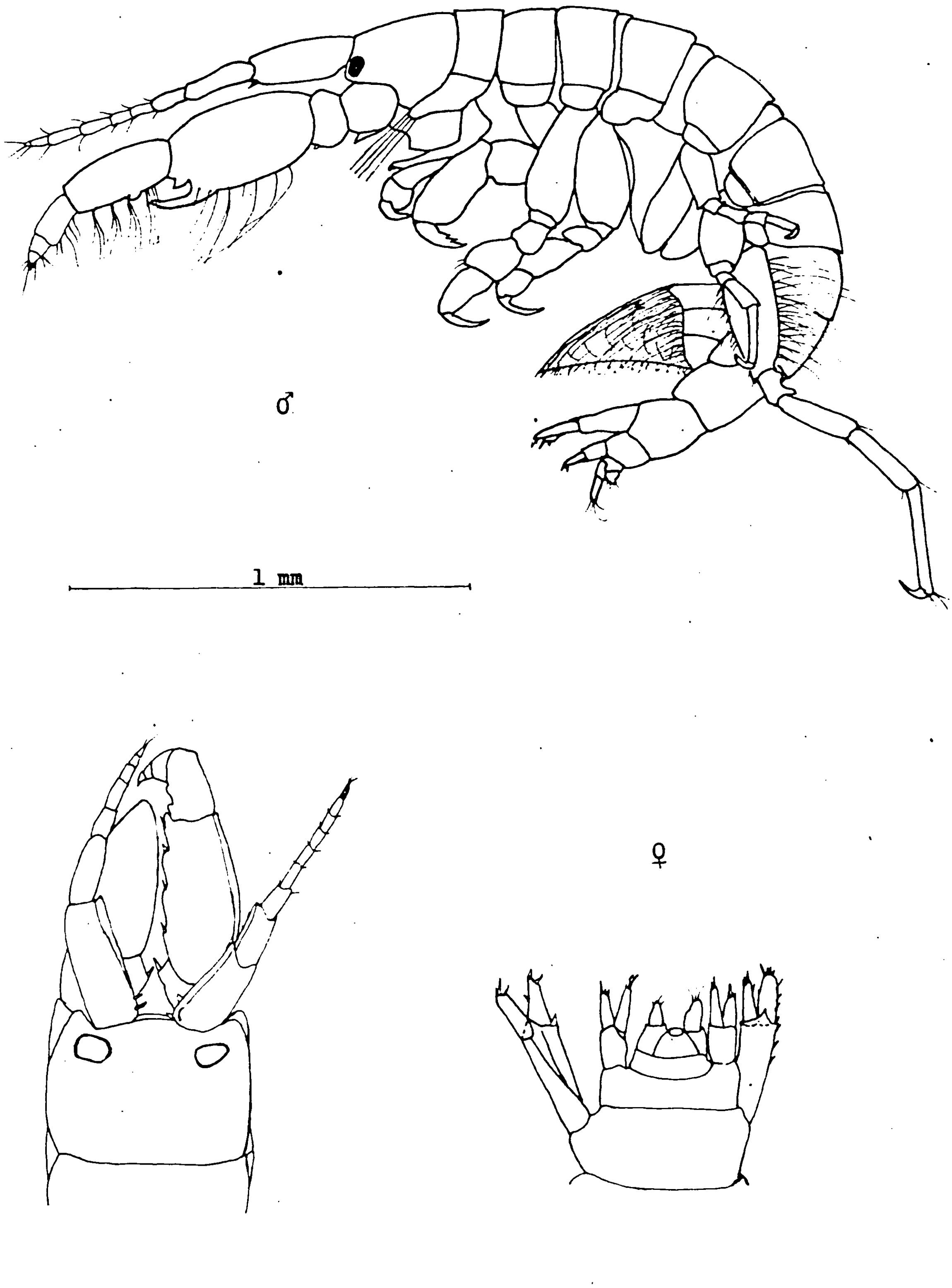


Figure 101. <u>Corophium</u> <u>rioplatense</u> ♂ 2 mm & ♀ 3 mm .

first article bearing a plumose seta distally, the second longer article, bearing a plumose seta in female and an additional small seta in male. Right molar bearing molar flake. Gnathopod 1 propodus as long as carpus, with convex palm bearing spines, dactylus overlapping palm. Gnathopod 2 propodus longer than carpus, dactylus strong with two teeth on posterior margin. Pereopods 3-4 subequal and strong; pereopod 7 the largest, extended beyond posterior extremity of the body; basis expanded slightly, bearing dense plumose setae on both margins; other articles slender, margins parallel. Uropod 1 biramous with short rami, peduncle expanded distally with subtriangular process. Uropod 2 biramous, shorter than 1, peduncle without spines. Uropod 3 uniramous, sexually dimorphic; male uropod 3 ramus longer than peduncle; female uropod 3 ramus equal in length to peduncle. Telson wider than long, apex rounded.

Ecology:

Corophium rioplatense is a tube-dwelling species found intertidally on shells of freshwater Mollusca of the family Unionidae in the type locality. In Venezuela it has been collected about mangrove roots in brackish waters from the two main estuarine systems - the delta of the Orinoco river and Maracaibo lake.

Distribution:

Only known from the type locality of Rio de la Plata and from the Orinoco Delta and Sinamaica lagoon in Maracaibo.

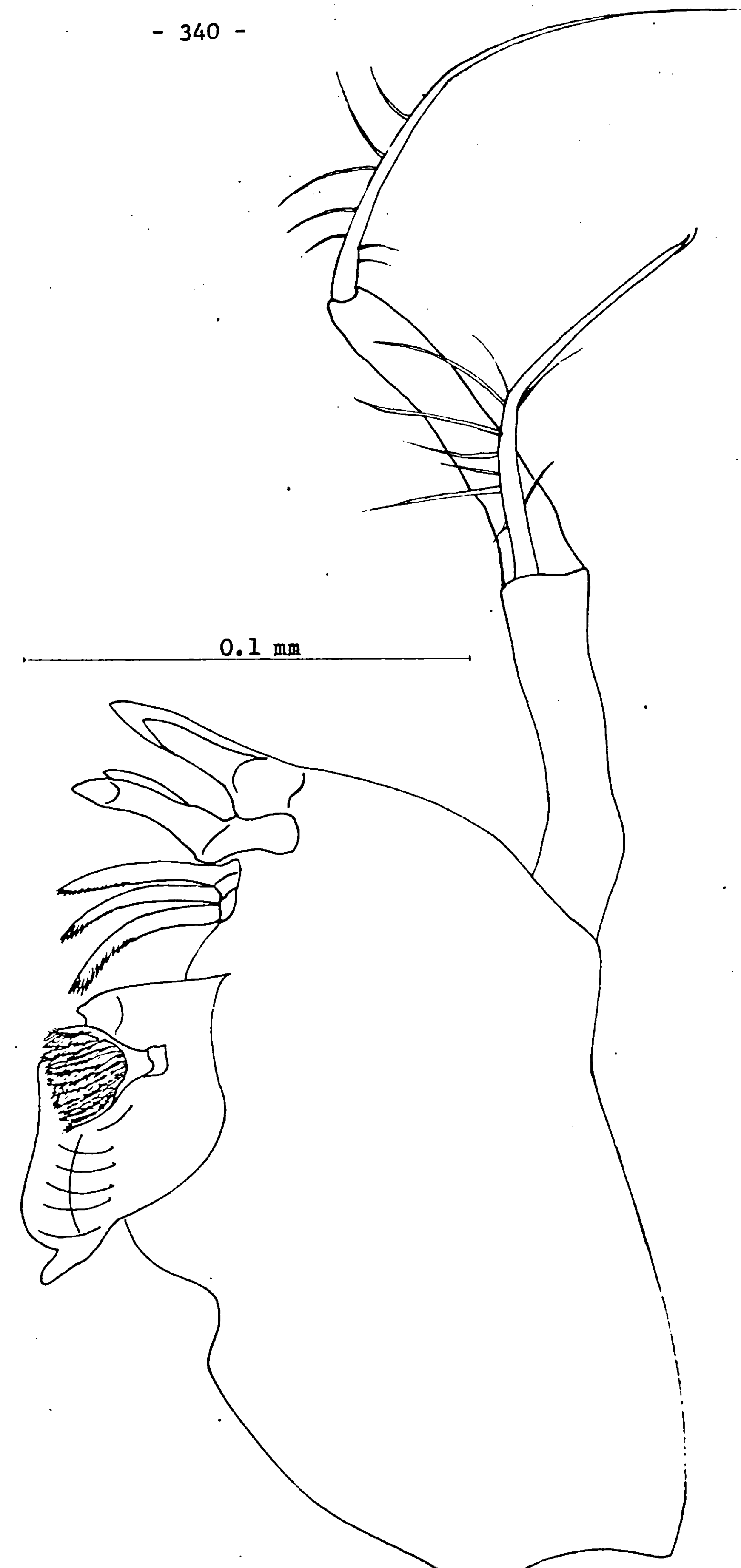


Figure 102. Corophium rioplatense ♀ 3 mm: Right mandible.

Remarks:

The Venezuelan material agrees well with the original description of *Corophium rioplatense* although the specimens are a little bit smaller (length up to 3 mm, compared with 4 mm for the South Atlantic material). There are some differences in the number of spines on the antennae but such variation is common in species of *Corophium*. The true status of the Caribbean species will only be ascertained by studying a comprehensive series of specimens with a full range of body size.

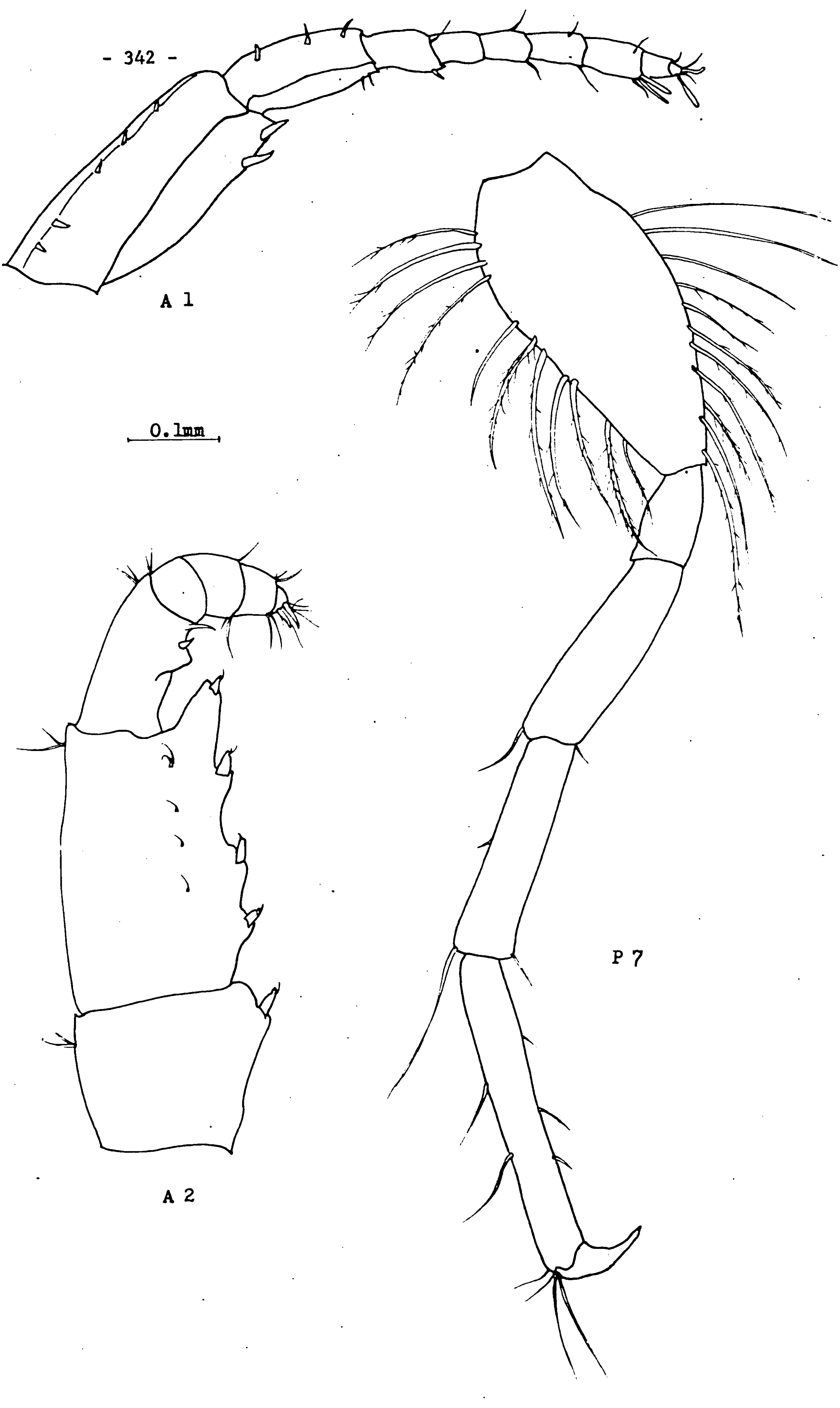


Figure 103. Corophium rioplatense ♀ 3 mm: Appendages.

Family ISCHYROCERIDAE

Body shallow, often of small size, sexually dimorphic. Eyes small. Antenna 1-2 peduncle elongate, strong and setose, flagellum short, accessory flagellum absent. Mouthparts basic; mandible with molar flake on the right molar; mandibular palp with apical article short, broad and setose. Gnathopods subchelate, gnathopod 2 the largest, in male often enormous and toothed. Pereopods 3-4 basic, swollen with cement glands. Pereopods 5-7 dissimilar. Pleopods basic. Uropod 3 rami very short, inner ramus may be absent, outer uncinate bearing hooked spines. Coxal gills present on plates 2-6; gills may be absent on plate 2 in females. Oostegites present on plates 2-5.

The family Ischyroceridae Stebbing, 1899: 211 comprises about 60 species in 13 genera, widespread in shallow marine or brackish waters, mainly in the northern hemisphere. Most are small tube-dwelling species, but may become cemented together to form extensive fouling mats on submerged surfaces.

Ericthonius Milne-Edwards

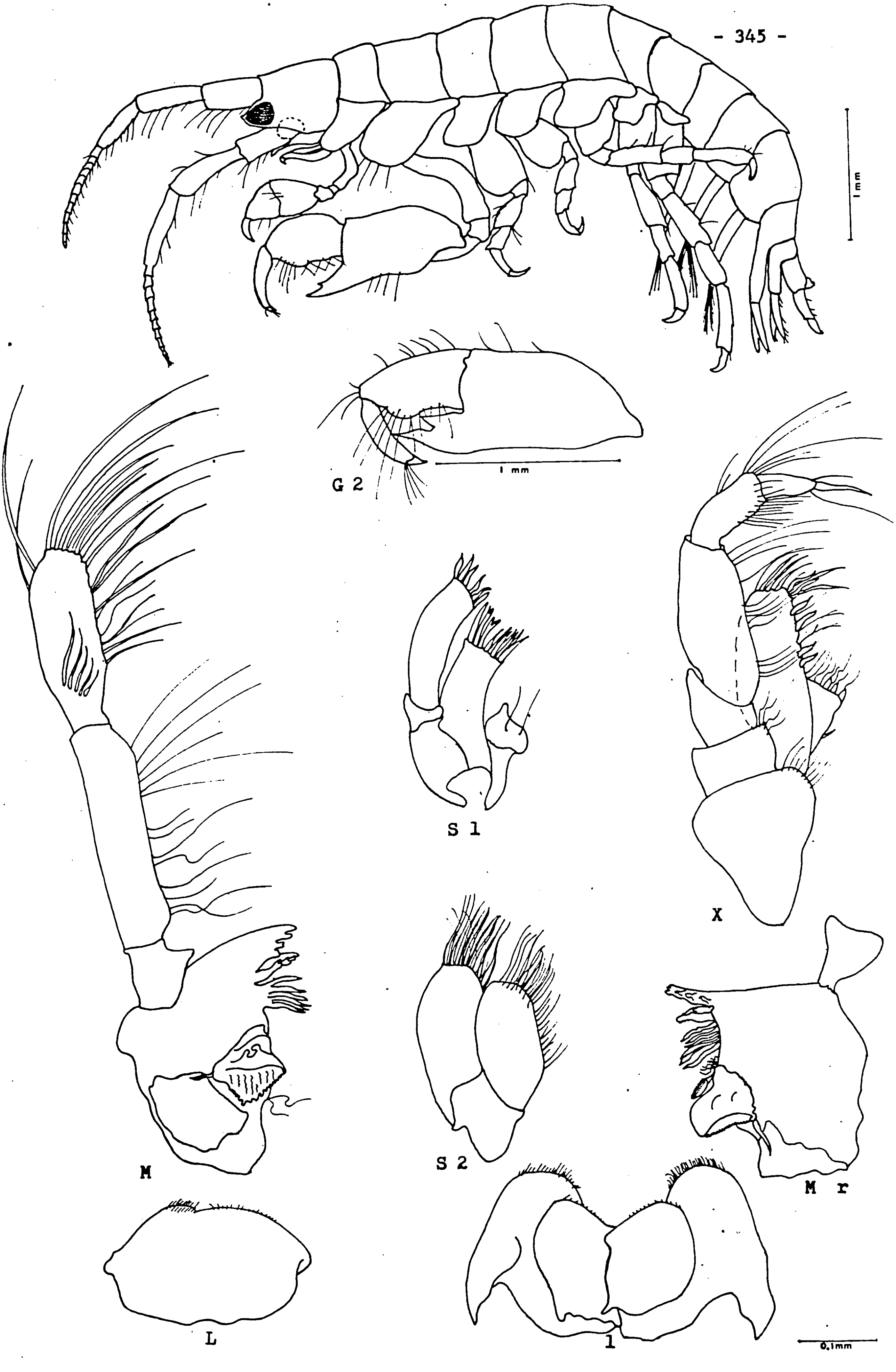
Ericthonius Milne-Edwards, 1830: 382.

Pyctilus Dana, 1852: 218.

Erichthonius Sars, 1895: 601; Bousfield, 1973: 193.

Body depressed, especially in male. Coxal plates short and scarcely contiguous; plates 2 and 5 longer than rest. Head elongate, lateral lobes very large and prolonged, apically acute. Mouthparts basic; upper lip entire, lower lip with inner lobes well developed; mandible with large triturative molar, palp robust, distal article broad, setose; maxillae 1-2 basic; maxilliped inner and outer plates well developed, palp slender. Antennae subequal, slender, accessory flagellum absent. Gnathopod 1 in male and 1 and 2 in female subchelate; gnathopod 2 in male very large, complexly carpochelate. Pereopods 3-4 basis broadly oval. Uropods 1-2 biramous, spinose; uropod 3 uniramous, ramus much shorter than peduncle, apex with minute reverted denticles. Telson broad, bilobed, surface minutely spinulose.

A circumtropical and northern temperate genus of about 10 tube-dwelling species, typically found in littoral habitats. Species separation is based mainly on the structure of the male second gnathopod, but it must be emphasized that the male second gnathopod exhibits marked intraspecific variation according to the size and age of the individual. Developmental changes in gnathopod 2 morphology have been inadequately described for most species.



Ericthonius brasiliensis, ♂ 5 mm, G.Cariaco, Aug. 1974

Figure 104.

Ericthonius brasiliensis (Dana)

(Figs 104-107)

Pyctilus brasiliensis Dana, 1852: 976.

Cerapus abditus; Bate, 1862: 263.

Ericthonius abditus; Sars, 1895: 602.

Cerapus brasiliensis; Bate, 1862: 267.

Erichthonius brasiliensis; Chevreux & Fage, 1925; Galan, 1976.

Ericthonius brasiliensis; Stebbing, 1906; Bousfield, 1973: 195.

Material examined:

1 ♂ from Turpialito, Golfo de Cariaco, August 1974; monthly samples with many specimens from Golfo de Cariaco through 1974; monthly samples with many specimens from Laguna de la Restinga, Isla de Margarita, 1975; several specimens from Bahia de Mochima, 7 March 1976; several specimens from Moron, Golfo Triste, March 1981.

Description:

Length up to 7.2 mm (median size 5 mm), colour brown mottled with darker pigment including pair of symmetrical spots on telson; eyes red. Coxal plates contiguous, plate 2 in male with distal margin rounded; coxal gills absent on coxal plates 2-3 in both sexes. Epimeral plate 3 distal margin rounded, minutely crenulate. Head, lateral lobes apically acute; eyes very large, anterior, protruding and rounded. Antennae subequal, little over half body length, peduncle articles elongate, setose; antenna 1 flagellum up to 13-articulate (in 30% of specimens the number of articles differs between the left and right antenna, the right antenna always having the greater number) antenna 2 flagellum up to 11-articulate, peduncle articles 4 and 5 subequal, or 5 little longer than 4. Right mandible with molar flake (Fig. 104). Gnathopod 1 propodus smaller than carpus, both triangular, setose, palm oblique delimited by obtuse angle. Gnathopod 2 ♀ carpus with narrow setose posterior lobe, propodus oval, palm convex. Gnathopod 2 ♂ very variable, merus very small, carpus very large and robust, posterodistal angle with long acute process, and small accessory tooth on inner margin, propodus much smaller with low distal tubercle, dactylus broad. Pereopods 3-4 basis broadly rounded; pereopods 5-7 basis moderately expanded. Uropods 1-2 rami subequal, weakly spinose, margins minutely serrate; uropod 3 peduncle elongate, ramus very short and curved. Telson small, bilobed and spinulose.

Ecology:

Depth range from intertidal to 171 m (Barnard, 1979). This species is a benthic tube-dweller, constructing a small tube of sand consolidated by mucus. The tubes are usually clustered together amongst algae, hydroids, polychaete-tubes, bryozoans and colonial ascidians (Fig. 105), and may be occupied by inquilinous Stenothoe species. Locally E. brasiliensis is very common in shallow waters reaching densities of up to 5000 per square metre (at least 50 animals were found on one side of submerged plates of 100 cm^2 during weekly counting of specimens and tubes throughout a two year period). It feeds largely on detritus, and is preyed upon by Gobiosoma zebrella and Lupinnoblenius dispar; an analysis of 50 stomachs of Gobiidae and Blenniidae yielded 1 to 4 amphipods, isopods or tanaids and up to 50 harpacticoids per gut content.

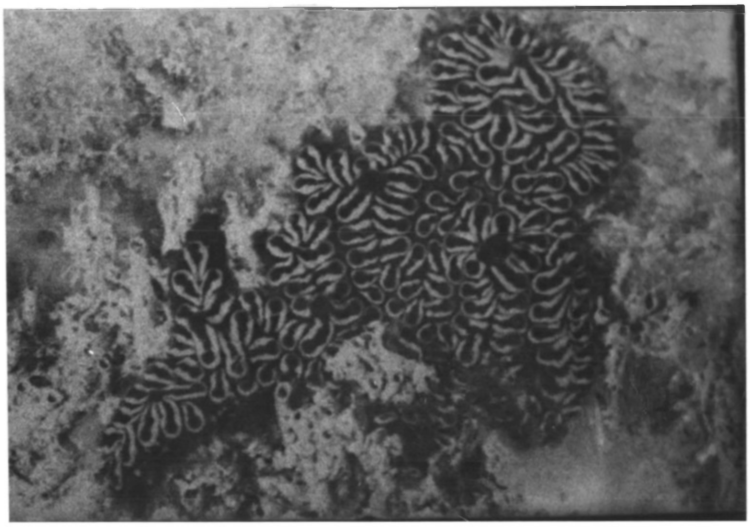


Figure 105. The tubes of *Ericthonius brasiliensis* around a colonial ascidian, *Botrylloides sp.*

In the tropical waters of the southern Caribbean Sea, E. brasiliensis has a short life cycle and a relatively small body size; 12 mm for North Atlantic material (Stebbing, 1906) compared with a maximum size of 7.2 mm for Caribbean material (found by the author after measuring 80 adult specimens from a total of 3093 adults studied). This species can settle on a virgin substrate and build a tube within the first 24 hours of submersion on the substrate (Galan, 1976; 1978). Juveniles were found throughout the year in a monthly sampling survey in the Gulf of Cariaco during 1974 and in a mangrove lagoon of Isla Margarita during 1975, with maximum numbers from May to September (Fig. 106). The incidence of males expressed as percentage of the total adult population through a year was 38.86 per cent; and that of females with a brood pouch as a percentage of the total adult females was 39.15 per cent (from 1815 adults examined). The relation between length (mm) and the number of eggs ($n^{\underline{o}}$) in females with brood pouch was, approximately, $n^{\underline{o}} : 1/4 \times mm^3$ between a range from 3.2 mm and 5 eggs to 6.4 mm and 68 eggs. For an estimation of age, from adult increase in body length and number of articles in first antenna, see fig. 107. Still to be ascertained is the duration between moults and the total number of moults from egg to adult. This is a dominant species in the peracaridan taxocoenosis of shallow waters near harbours, and is useful as an indicator of high levels of organic matter. It is tolerant of wide fluctuations in environmental factors (42% salinity, $30^{\underline{o}}$ C. and 2 ml/lt. dissolved O_2; see Galan, 1976) and also inhabits hypersaline lagoons.

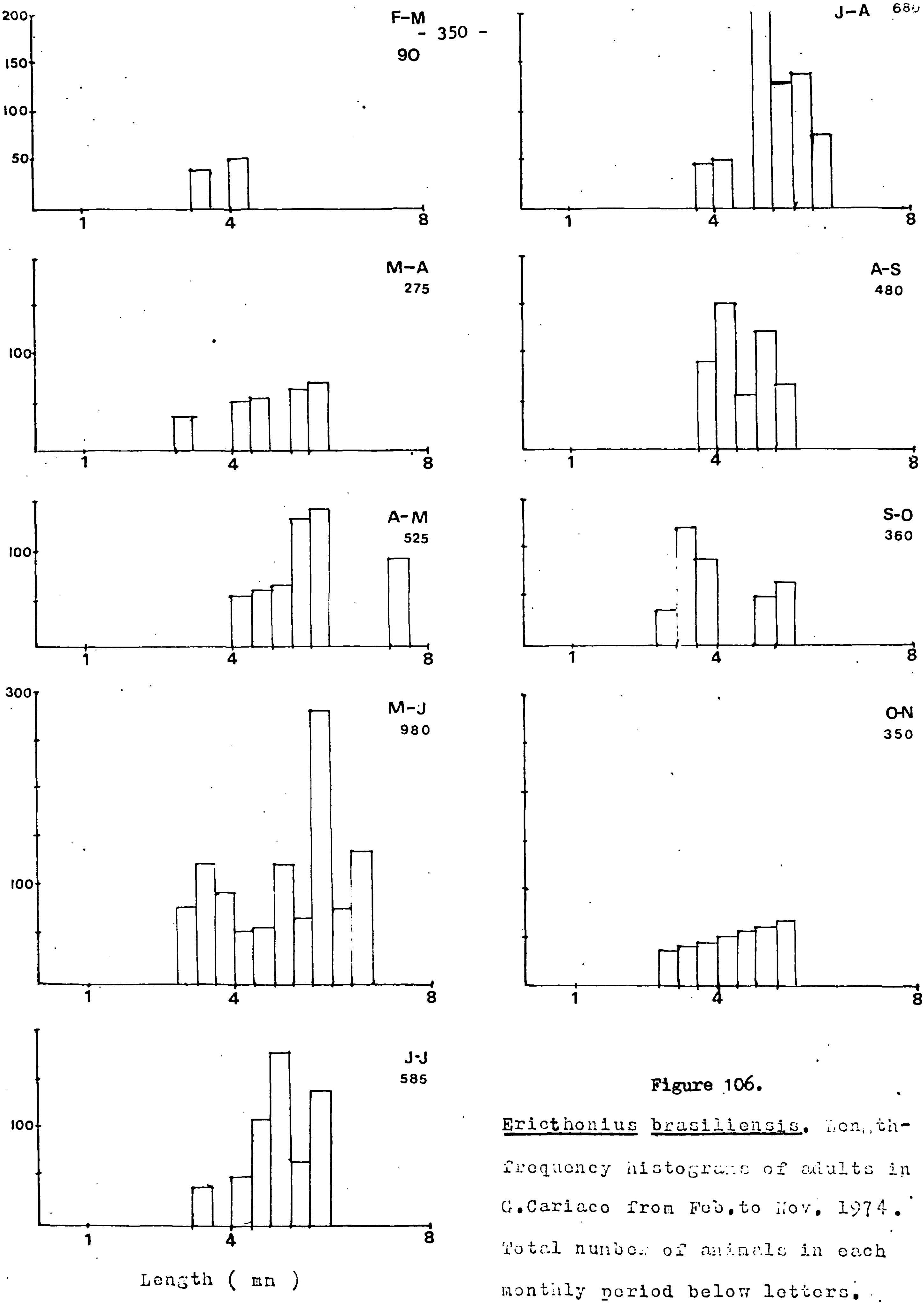


Figure 106.

Ericthonius brasiliensis. Length-frequency histograms of adults in G.Cariaco from Feb.to Nov, 1974. Total number of animals in each monthly period below letters.

Distribution:

Cosmopolitan, tropical and temperate; widespread in Atlantic, Pacific and Indian Oceans (Chevreux & Fage, 1925; Bousfield, 1973; Barnard, 1979).

Venezuela: Isla de Margarita (Galan, 1976); Golfo de Cariaco; Bahia de Mochima; Golfo Triste.

Remarks:

Ericthonius brasiliensis is now reported from the southern Caribbean as a useful indicator species.

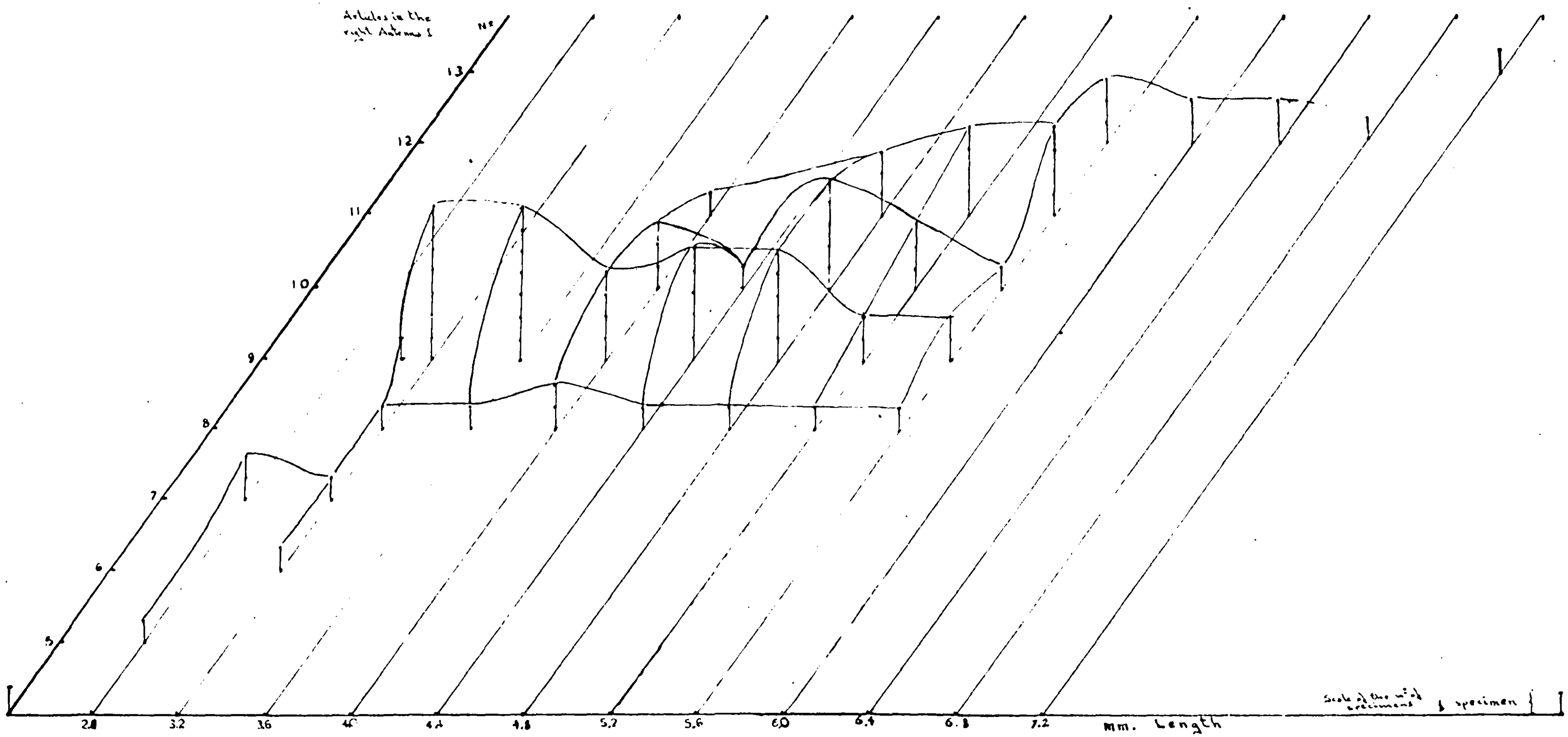


Figure 107. The relation between length, n$^{\underline{o}}$ of articles in the right antenna 1 and n$^{\underline{o}}$ of specimens, in 80 <u>Ericthonius</u> <u>brasiliensis</u>

Family PODOCERIDAE

Body depressed or subcylindrical, smooth or processiferous. Urosome depressed and flexed under thorax. Urosome segment 1 elongate, at least twice as long as segment 2, segments 2-3 very short. Coxal plates small and shallow, often widely separate, occasionally splayed laterally. Antennae robust, setose or spinose, with flagella shorter than peduncles; accessory flagellum small. Mouthparts basic, mandible generally bearing molar flake. Gnathopods subchelate; gnathopod 2 larger than 1, particularly in male. Pereopods not glandular, subequal, or pereopods 5-7 elongate, basis not expanded. Uropod 3 vestigial or absent. Telson entire, oval to rounded. Coxal gills recurved, present on plates 2 or 3-6. Oostegites very large, present on plates 2-5; last pair reduced.

The family Podoceridae Stebbing (1906: 694) (Dulichidae Dana, 1849: 135) comprises 11 genera in two groups. The Dulichia group having a cylindrical pereon are typically crawlers and climbers on rods such as hydroids, bryozoans and polychaete tubes. These are boreal-arctic and cold temperate, and are probably the ancestors of the suborder Caprellidea. The Podocerus group with depressed pereon, are botton dwellers and epifaunal on large organisms such as macroalgae and ascidians. These have a tropical warm-temperate shallow water distribution and are well represented in the Caribbean Sea off Venezuela by the genus Podocerus, recorded herein for the first time.

Podocerus Leach

Podocerus Leach, 1814: 433; Chevreux & Fage, 1925: 373;
Barnard, 1969: 431.
Platophium Dana, 1852: 309.

Pereon broadly depressed; coxal plates small and shallow; pleon narrow and flexed beneath pereon; epimeral plates subrounded. Urosome with 3 segments, segment 1 elongate, segments 2-3 very short. Head subquadrate with rounded lateral lobes bearing the prominent eyes. Antenna 1 shorter than 2, with small accessory flagellum; antenna 2 longer in male than female. Mandible with 2 or 3 spines in the spine row, molar flake present, palp distally widened. Gnathopod 1 much smaller than 2 particularly in male. Pereopods not glandular. Uropods 1 and 2 biramous with unequal rami. Uropod 3 reduced to small hollow plate resting against the lateral margin of the telson. Telson entire, short and rounded, apically spinose. Female similar to male but antennae and gnathopods smaller; oostegites very large.

A cosmopolitan genus comprising 21 bottom dwellers and epiphytic species in shallow sublittoral or intertidal communities. Two species are recorded from the southern Caribbean Sea.

Key to the Venezuelan species of Podocerus

Body carinate on pereon segments 6 and 7 and pleon segments 1 and 2. Palm of gnathopod 2 with toothed process. — cristatus

Body smooth. Palm of gnathopod 2 without process or tooth. — brasiliensis

Podocerus brasiliensis (Dana)

(Figs 108-109)

Platophium brasiliense Dana, 1853: 838.

Podocerus brasiliensis; Stebbing, 1899: 239.

Material examined:

2 ♂♂ from Turpialito, Gulf of Cariaco, Venezuela, August 1974.

3 ♂♂, 2 ♀♀ " " " " September 1974.

6 ♂♂, 4 ♀♀ from La Restinga lagoon, Isle of Margarita, 15 February 1975.

4 ♂♂, 2 ♀♀ " " " 26 February 1976.

Description:

Length up to about 6.5 mm, colour brownish. Body strongly depressed and oval, broader in female than male; pleon compressed and flexed beneath pereon. Coxal plates very shallow, not overlapping; epimeral plates subrounded distally. Head with prominent eyes at the front, colour bright red. Antenna 1 peduncle article 2 slightly longer than 3, flagellum 5-articulate, accessory flagellum small 1-articulate. Antenna 2 longer than 1, particularly in male, peduncle very large, flagellum 5-articulate. Mandible with very large palp, apically expanded; spine row of 3 elements on the left mandible and 2 on the right one; molar robust with molar flake on both left and right mandible. Gnathopod 1 basic subchelate, strongly setose; carpus broadly lobate; propodus oval, palm long and oblique; dactylus elongate, inner margin serrate. Gnathopod 2 powerful, subchelate, especially in male; basis produced antero-distally; propodus elongate, oblong or oval, strongly setose with long plumose setae, palm not defined from posterior margin;

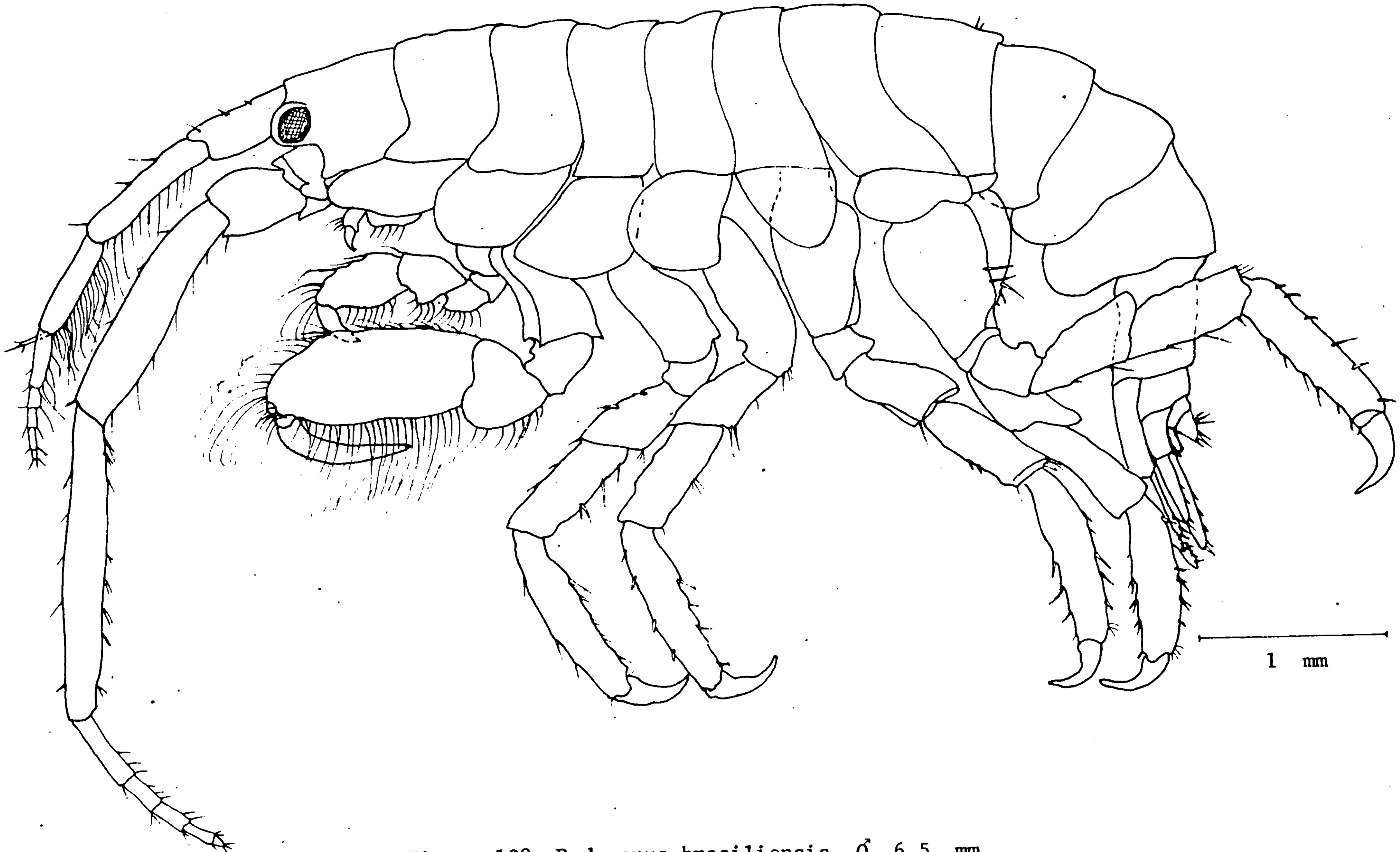


Figure 108. Podocerus brasiliensis ♂ 6.5 mm

dactylus robust and elongate, about two-thirds the length of propodus. Pereopods 3-7 propodus spinose on both margins, dactylus strongly curved. Pereopods 5-7 basis narrowing distally. Uropods 1-2 rami unequal, spinose. Uropod 3 vestigial, rounded. Telson with about 8 spines radiating around the projecting distal margin.

Female similar to male except for antennae and weaker gnathopods.

Ecology:

Podocerus brasiliensis has been observed throughout the year in mangrove-root communities and fouling communities in the Gulf of Cariaco and La Restinga lagoon on Margarita Island - both in the upwelling area. This cosmopolitan species lives in the tropical shallow waters on tubes of other amphipods, hydroids, bryozoans and macroalgae. Juveniles were present every month through the years 1974 to 1976 but were most abundant in the spring.

Distribution:

This species has been recorded from the Indian Ocean, the Red Sea and the Atlantic Ocean from Puerto Rico to the Falklands. The type-locality is Rio de Janeiro. Recently it has been reported from California and is now reported from the southern Caribbean Sea.

Remarks:

Specimens of Podocerus brasiliensis from the upwelling area of Venezuela have a slightly smaller body size than those from other latitudes (type material 7.5 mm; Caribbean material up to 6.5 mm).

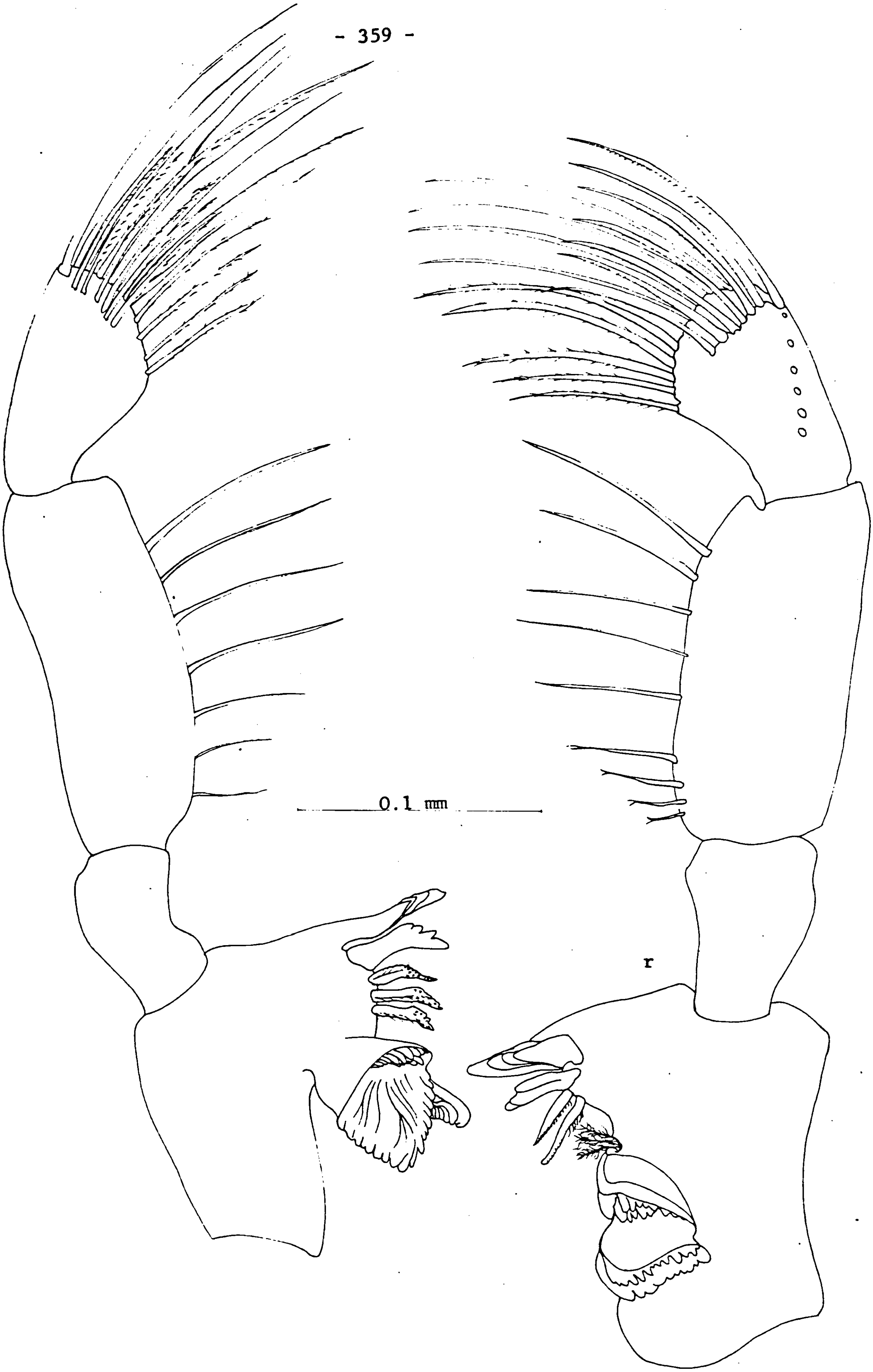


Figure 109. Podocerus brasiliensis ♂ 6.5 mm: Mandibles.

Podocerus cristatus (Thomson)

(Figs 110-111)

Cyrtophium cristatum Thomson, 1879: 331.

Podocerus cristatus; Stebbing, 1899: 239.

Material examined:

3 ♂♂, 6 ♀♀ from Los Roques Archipelago, Venezuela, 23 June 1980.

3 ♂♂, 2 ♀♀ " " " " 25 June 1980.

Description:

Length up to 3.5 mm, colour reddish. Body carinate; pereonal segments 6-7 and pleon segments 1-2 each with mid-dorsal carinate process. Pereon depressed, pleon compressed and flexed beneath pereon. Coxal plates very short and not overlapping; epimeral plates short, distally subrounded. Head with prominent eyes, colour bright red. Antenna 1 flagellum 8-articulate; accessory flagellum small, 1-articulate plus vestigial second article; antenna 2 longer than 1 particularly in male, flagellum about 4-articulate. Mandible with very large palp widened at apex; spine row of 3 elements on the left mandible and 2 on the right; molar robust with conspicuous molar flake on both left and right mandibles. Gnathopod 1 basic, subchelate, setose; carpus broadly lobate; propodus oval with oblique palm; dactylus elongate with serrate inner margin. Gnathopod 2 powerful, subchelate, especially large in male; basis produced anterodistally; merus with posterodistal apex acutely produced; propodus very long and oval, palm setose with denticulate lobe and tooth near the dactylar hinge; dactylus elongate and curved, closely fitting palm. Pereopods 5-7 basis slightly broader than in previous species. Uropods 1-2 spinose,

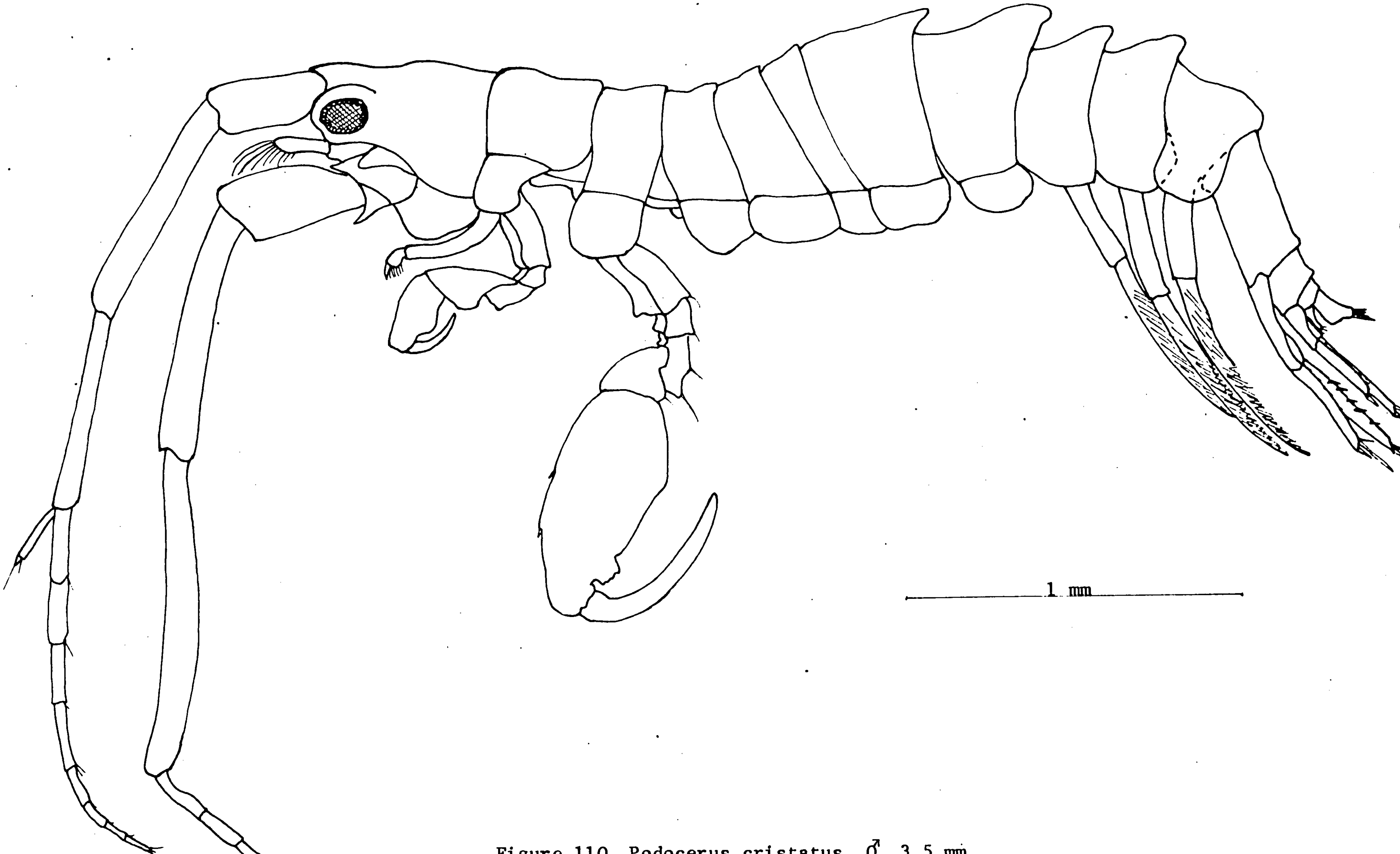


Figure 110. Podocerus cristatus ♂ 3.5 mm.

rami unequal. Uropod 3 vestigial. Telson conical, apex with spines.

Female similar to male except for weaker antennae and gnathopods; pereon broader than in male.

Ecology:

A shallow subtidal species that was collected at 5 m depth amongst a community of hydroids and bryozoans on shells of *Strombus gigas* and *S. costatus* around the coral atolls of Los Roques Archipelago.

Distribution:

This species had an Indian Ocean and Pacific Ocean distribution, only recently recorded from California and herein recorded for the first time from the Caribbean coast of Venezuela.

Remarks:

The Venezuelan material fits closely with the type-description but at 3.5 mm body length is rather smaller than the Indo-Pacific material (up to 4.5 mm).

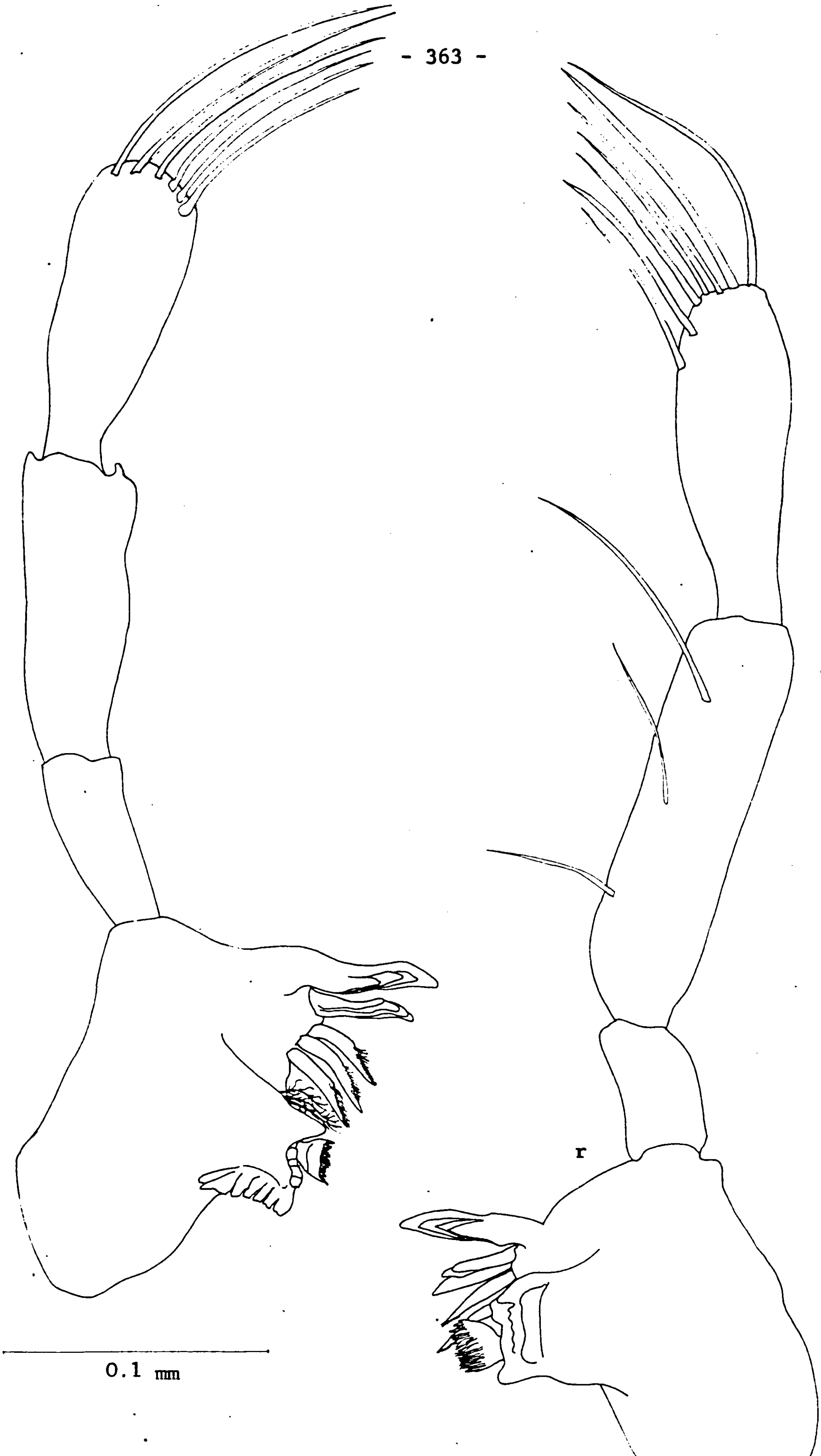


Figure 111. Podocerus cristatus ♂ 3.5 mm: Mandibles.

Suborder HYPERIIDEA

Family HYPERIIDAE

Body compact and subglobular. Head large and globular. Eyes large occupying most of the head surface. Pereonites usually separate; coxal plates fused with or separate from pereon segments. Gills present on coxal plates 2-6; oostegites on coxae 2-5. Antennae long and filiform with multiarticulate flagellum in males; short with a 1-articulate flagellum in females; accessory flagellum and calceoli absent. Mouthparts modified; mandible with molar and palp, palp sometimes absent in females. Maxilliped palp absent. Gnathopods carpochelate. Perepods 3-4 simple or subchelate. Pereopods 5-7 similar in size and shape. Pleopods powerful. Uropods biramous and lanceolate. Telson entire and unarmed.

The Hyperiidae Dana, 1852 is the main family in the suborder which comprises about 400 mostly pelagic, open-ocean species, probably evolved from a synopioid-pardaliscoid branch of the Gammaridea. The family is cosmopolitan and includes about 13 genera and nearly 50 species. They are mainly planktonic and form the food of pelagic fish, sea birds and marine mammals; some are associated with medusae, ctenophores and salps. The present record is the first for the Caribbean Sea.

Hyperoche Kroyer

Metoecus Kroyer, 1838: 288.

Hyperoche; Bovallius, 1887: 17; Bowman & Grüner, 1973: 32.

Body robust. Head globular. Pereon smooth; coxal plates separate from pereon segments. Eyes immense and contiguous. Antennal peduncles cylindrical; peduncle of antenna 1, 3-articulate. Mandible with palp. Maxilliped inner lobe well developed, outer lobes separated. Gnathopods subsimilar and distinctly chelate, carpal processes laterally compressed and knife-shaped. Pereopods 3-7 subequal; pereopods 3-4 with posterior margin of carpus produced into thin ridge.

A cosmopolitan genus comprising 8 pelagic species, symbiotic on jellyfish. Hyperoche martinezii (Müller), reported only once from the Atlantic Ocean, is recorded for the first time from the Caribbean seas of Venezuela.

Hyperoche martinezii (Müller)

(Fig. 112)

Hyperia martinezii Müller, 1864: 51.

Hyperoche martinezii; Bovallius, 1887: 20; 1889: 107.

Material examined:

2 ♂♂ from Tucuchare beach, Gulf of Cariaco, Venezuela, 24 July 1978.

Description:

Length up to 5 mm, body subglobular almost transparent. Eyes occupying the whole head, facets coloured black. Head of equal length to pereonal segments 1-2 combined. Antennae elongate; antenna 1 with broad peduncle, article 1 twice as long as 2-3 combined; article 1 of flagellum very long and thick, almost cylindrical, with brush setae; flagellum 18-articulate. Antenna 2 peduncle short and stout, with the last article as long as the two preceding ones combined; flagellum 14-articulate. Mouthparts basic hyperiid. Gnathopods subequal, meral process not nearly reaching base of carpal process which is serrated anteriorly and shorter than the posterior margin of propodus; dactylus straight, smooth, sharply pointed and less than half length of propodus. Coxal gills short on pereopods 2-7. Pereopods 3-4 similar, carpus dilated with slightly produced lower corners, propodus posterodistally toothed, dactylus curved. Pereopods 5-7 not longer than 3-4, more or less similar, narrow, dactylus slender and feebly curved. Pleon about as long as entire pereon; pleonal plates distally rounded, pleopod peduncles broad, slightly longer than rami. Urosome segments 2-3 fused. Uropod 1 not reaching the apex of uropod 3; uropod 2 extending to almost

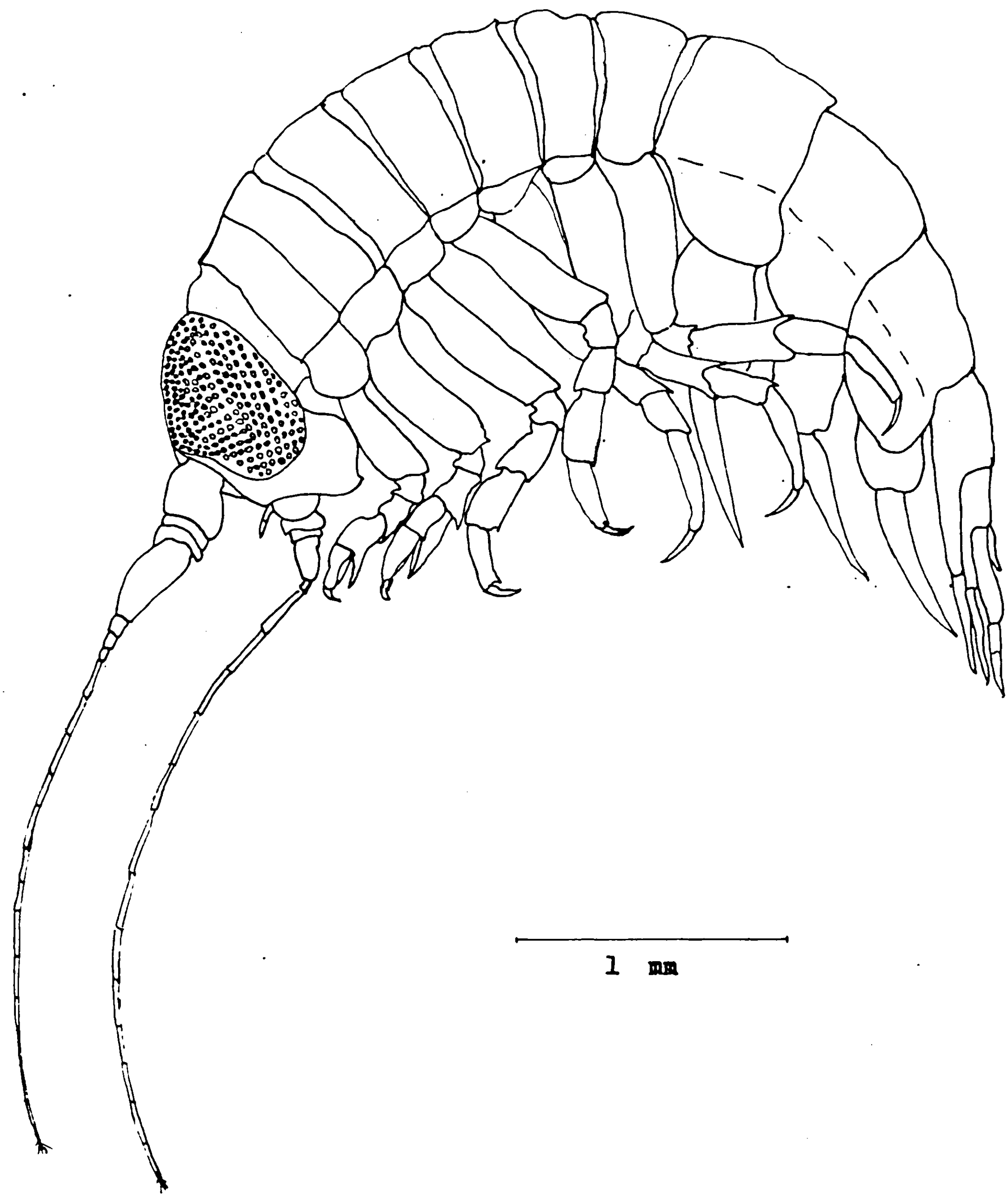


Figure 112. <u>Hyperoche</u> <u>martinezii</u> ♂ 5 mm.

to the apex of 3. Telson slightly less than half length of peduncle of uropod 3, entire, subtriangular, as long as broad, margins curved.

Female unknown.

Ecology:

After the annual spring plankton bloom it is usual to find some huge strands of jellyfish on the beaches of the Cariaco Gulf and other parts of the upwelling area. These hyperiids were associated with Ctenophora collected along the sea shore.

Distribution:

The only previous record of this species is of a male from the type locality, Desterro in Brazil. In the southern Caribbean, the current systems originate from the North Atlantic as the Tropical Current and the Guyana Current. It is not surprising, therefore, that a tropical Atlantic pelagic species should form one of the components of the Caribbean fauna.

Remarks:

The specimens fitprecisely the description given by Bovallius (1889) who had re-examined the holotype deposited by Müller in the Natural History Museum, Paris.

Suborder INGOLFIELLIDEA

Family INGOLFIELLIDAE

Body vermiform. Head without rostrum and eyes, but with minute unpigmented ocular lobes. Pereon 1 short but not fused with the head. Antennae short; calceoli absent; aesthetascs present on antenna 1 which has a small accessory flagellum. Buccal mass indistictly beneath the head; maxilliped dactylate. Gnathopods short, subsimilar, slightly or not sexually dimorphic; gnathopod 1 carpochelate or subchelate; gnathopod 2 carpo-subchelate. Pereopods with stout dactylus bearing nails. Coxal plates, gills and brood plates reduced. Lenticular organs present on mesosome. Pleopods much reduced. Uropods very small. Telson short and broad.

The family Ingolfiellidae Hansen, 1903: 130 comprises to date about 30 small hypogean species, mainly interstitial in littoral marine, brackish and freshwaters of tropical and warm temperate zones of the world. There are also some cave species of the genus Trogloleleupia from Africa and the original Ingolfiella abysii of Hansen, was from the abyssal benthos of the North Atlantic near Greenland. Recently, Ruffo (1969: 234) removed the monotypic genus Metaingolfiella (M. mirabilis from an Italian well) to the new family Metaingolfiellidae, based on the fusion of pereon segment 1 with the head. The group remains unified, with mostly interstitial limnic species close to the sea, and resemble superficially the vermiform Bogidielloidea, with which they overlap considerably in geographical distribution.

Ingolfiella Hansen

Ingolfiella Hansen, 1903: 127; Stock, 1976: 59.

Body small and vermiform with poorly developed pleon appendages. Head without eyes, but with ocular lobes. Antennae subsimilar, antenna 1 longer than 2, accessory flagellum 3-articulate. Mouthparts reduced; mandibles styliform, molar elongate. Coxal plates very much reduced. Gnathopods weakly dissimilar, propodus and dactylus together subchelate against the carpus; dactylus toothed posteriorly. Gnathopod 2 with almost vertical palm and very long dactylus. Sexual dimorphism of gnathopods and the pleopods absent. Pereopods alike, dactylus with nail. Pleopods reduced and unique. Uropod 1-2 subequal; uropod 3 vestigial. Telson short.

Ingolfiella is the main genus of the suborder and comprises more than 20 named species. It was recently discovered in the islands of the Caribbean by Stock (1976), where it is represented in all interstitial habitats (Stock, 1977 - following the Venice (1959) water habitats classification system). The 6 species known from the Caribbean and Lesser Antilles (Stock, 1979) are:
Ingolfiella quadridentata - marine; Curaçao (shallow littoral).
Ingolfiella tabulareis - polyhaline; Curaçao and Aruba.
Ingolfiella grandispina - polyhaline; Curaçao.
Ingolfiella putealis - mesohaline; Bonaire.
Ingolfiella fontinalis - oligohaline; Bonaire.
Ingolfiella margaritae - limnic; Margarita Island.

Ingolfiella margaritae Stock

(Fig. 113)

Ingolfiella margaritae Stock, 1979: 86.

Material examined:

Holotype ♂ from La Plaza well, Isla de Margarita, Venezuela, 1 June 1978, deposited in the Zoological Museum, Amsterdam.

Description:

Length up to 1.3 mm, body vermiform. Eyes absent. Antenna 1 slender. Maxilliped palp with distal claw longer than the anterior segment. Gnathopod 1 with nearly vertical palm; gnathopod 2 slightly different, carpus with strong reversed spine plus two spines on the palmar angle, palm also bearing six triangular teeth; claw with three inner teeth. Pereopod 3 with dactylus slender and bifid; pereopod 4 subsimilar to 3; pereopod 5 slender, dactylus with lanceolate distal process and slender bifid unguis; pereopod 6 subsimilar to 5; pereopod 7 the longest, deactylus very slender, with tall distal process and slender bifid unguis. Pleopod 1 narrow and triangular; pleopods 2-3 broadly triangular. Uropod 1 peduncle longer than rami, outer ramus smaller than inner; uropod 2 rami subequal.

Female unknown.

Ecology:

This species was recently discovered in a sample of sediment from La Plaza well, a freshwater reservoir in Margarita Island, together with Bogidiella perla. Both are members of the interstitial infauna.

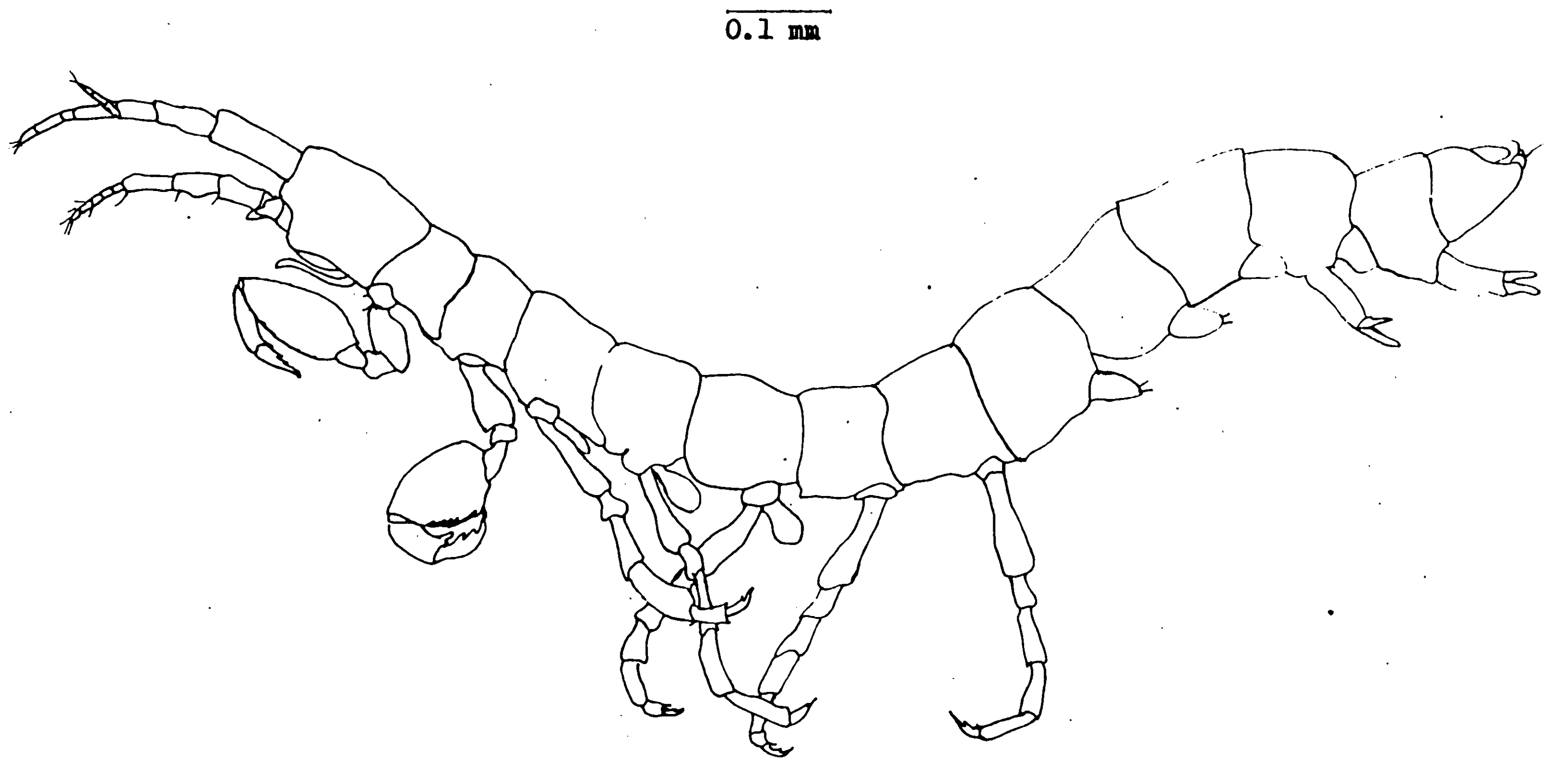


Figure 113. <u>Ingolfiella</u> <u>margaritae</u> ♂ 1.3 mm.

Distribution:

Ingolfiella margaritae Stock (1979) is only known by a single male from the type locality, on the Venezuelan continental island of Margarita.

Remarks:

Ingolfiella margaritae not only differs from the other Caribbean species morphologically but also ecologically in that it inhabits a freshwater biotope. The full range of salinity conditions are represented within the genus each characteristic of the species, illustrating the antiquity of the group. It is probably older than its counterpart bogidiellids, as is testified by the broader spectrum of environmental habitats and the more widespread geographical distribution.

Suborder CAPRELLIDEA

Family CAPRELLIDAE

Body cylindrical and vermiform, segment 1 fused to the head; abdomen vestigial. Antennae well developed; antenna 2 usually 2-articulate. Mouthparts basic; molar bearing molar flake; maxilliped outer plates larger than inner ones. Coxal plates reduced or absent; two pairs of gills present and two pairs of oostegites. Pereopods 3 and 4 greatly reduced or absent. Pereopods 5-7 six-segmented; with strong palm. Pleopods and uropods vestigial or absent.

The family Caprellidae White, 1847 is the main family of this amphipod suborder (Caprellini Leach, 1814: 403), which comprises nearly 300 benthic marine species worldwide. They are thought to have evolved from podocerid gammarideans. The family comprises about 40 genera, including the speciose genus *Caprella* with over 120 species. There are a few records for Venezuela, such as *Caprella* sp. (Galan, 1976). A common species in the upwelling region is identified as *Luconacia incerta* Mayer.

Luconacia Mayer

Luconacia Mayer, 1903: 49; McCain & Steinberg, 1970: 52.

Body caprellid type, of medium size. Antenna 1 about half body length; antenna 2 biarticulate. Eyes small. Mandibles with molar developed, palp 3-segmented. Maxilliped outer lobe larger than inner lobe. Gills and oostegites on pereon segments 3-4. Pereopods 3-4 very reduced, 2-articulate, Pereopod 5, 6-articulate and inserted near the mid-point of pereon segment 5. Pereopods 6-7 inserted posteriorly on respective pereon segments, powerfully developed, six-segmented and with strong palm. Abdomen vestigial but with pair of small appendages, and pair of lobes in male; appendages and lobes absent in females.

A monotypic genus widely distributed in the temperate and tropical areas of the western North Atlantic. Common in the littoral, upwelling area of Venezuela.

Luconacia incerta Mayer

(Figs 114-115)

Luconacia incerta Mayer, 1903: 49.

Protiellopsis stebbingii Pearse, 1908: 30.

Deutella incerta; Steinberg & Douherty, 1957: 281.

Luconacia incerta; McCain, 1968: 68.

Material examined:

Several specimens from Turpialito, Gulf of Cariaco, Venezuela, November 1974. Samples with several specimens from La Restinga, Isla de Margarita, Venezuela, 15 February 1975 and 26 February 1976.

Description:

Length up to 9 mm, body of variable coloration, sometimes spinose. Eyes rounded, small, colour reddish. Antenna 1 longer than 2, about half body length, flagellum more than 12-articulate, antenna 2 biarticulate. Mandible with 3-segmented palp, molar flake present on right molar; maxilla 1 with developed palp; maxilla 2 outer plate longer than inner; maxilliped with 4-articulate palp. Gnathopod 1 propodus triangular, dactylus with minutely serrate inner margin. Gnathopod 2, palm of propodus with spine on produced proximal process, and well developed tooth at mid-point; dactylus powerful. Pereon segment 2 with anterolateral projections. Gills long and sack-like on pereonal segments 3 and 4. Pereopods 3-4 small, two-segmented. Pereopod 5 slender. Pereopods 6-7 strong, dactylate, dactylus curved. Abdomen inconspicuous.

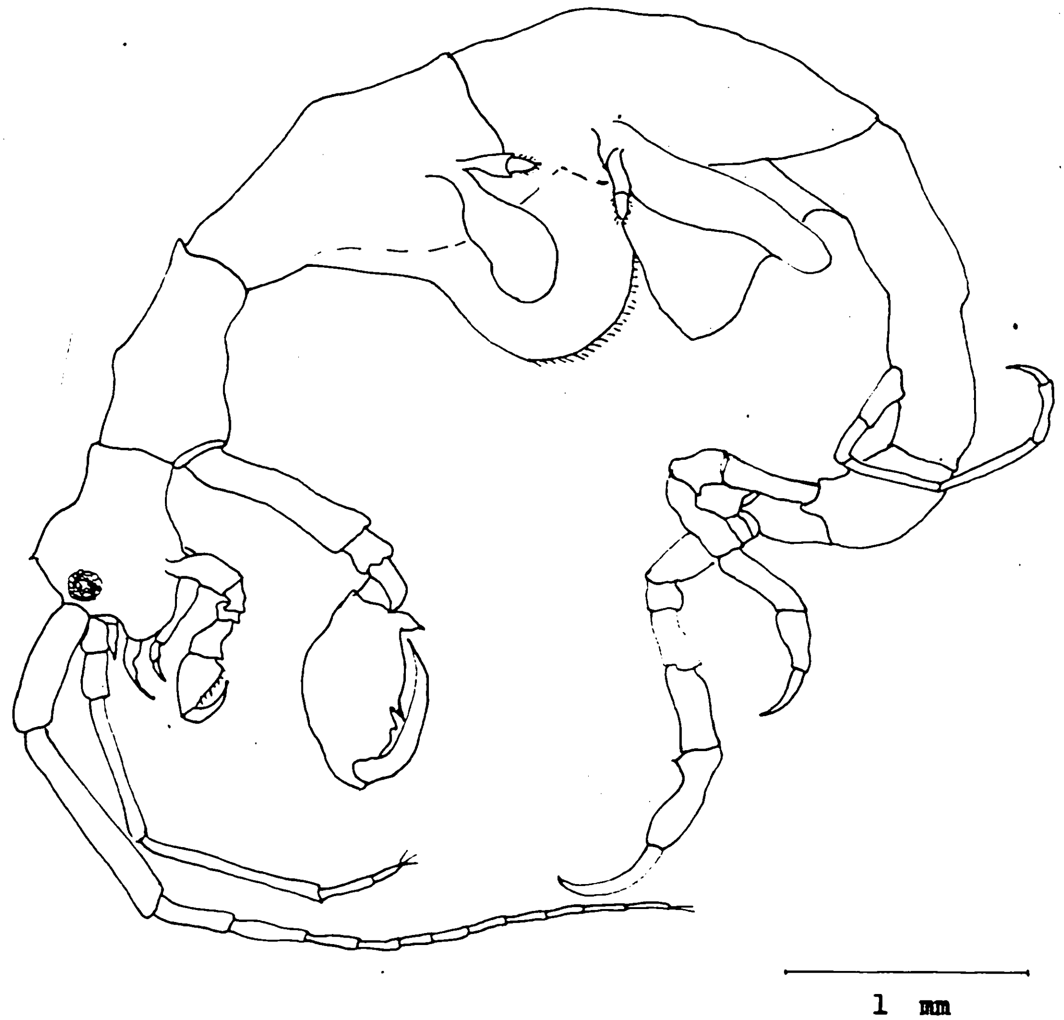


Figure 114. Luconacia incerta ♀ 6 mm.

Ecology:

This species has been collected in shallow waters around mangrove roots, on algae, sea grass, hydroids, bryozoans and colonial ascidians.

Distribution:

Luconacia incerta is widespread in the Atlantic from the southern Caribbean to the south-east coast of Canada. The known range is now extended to the Cariaco Gulf. The species has also been found on Sargassum.

Remarks:

Luconacia incerta varies considerably in the degree of body spination which is practically absent in the Venezuelan material. Other characters agree with the original and subsequent descriptions of the species that also make note of this variability.

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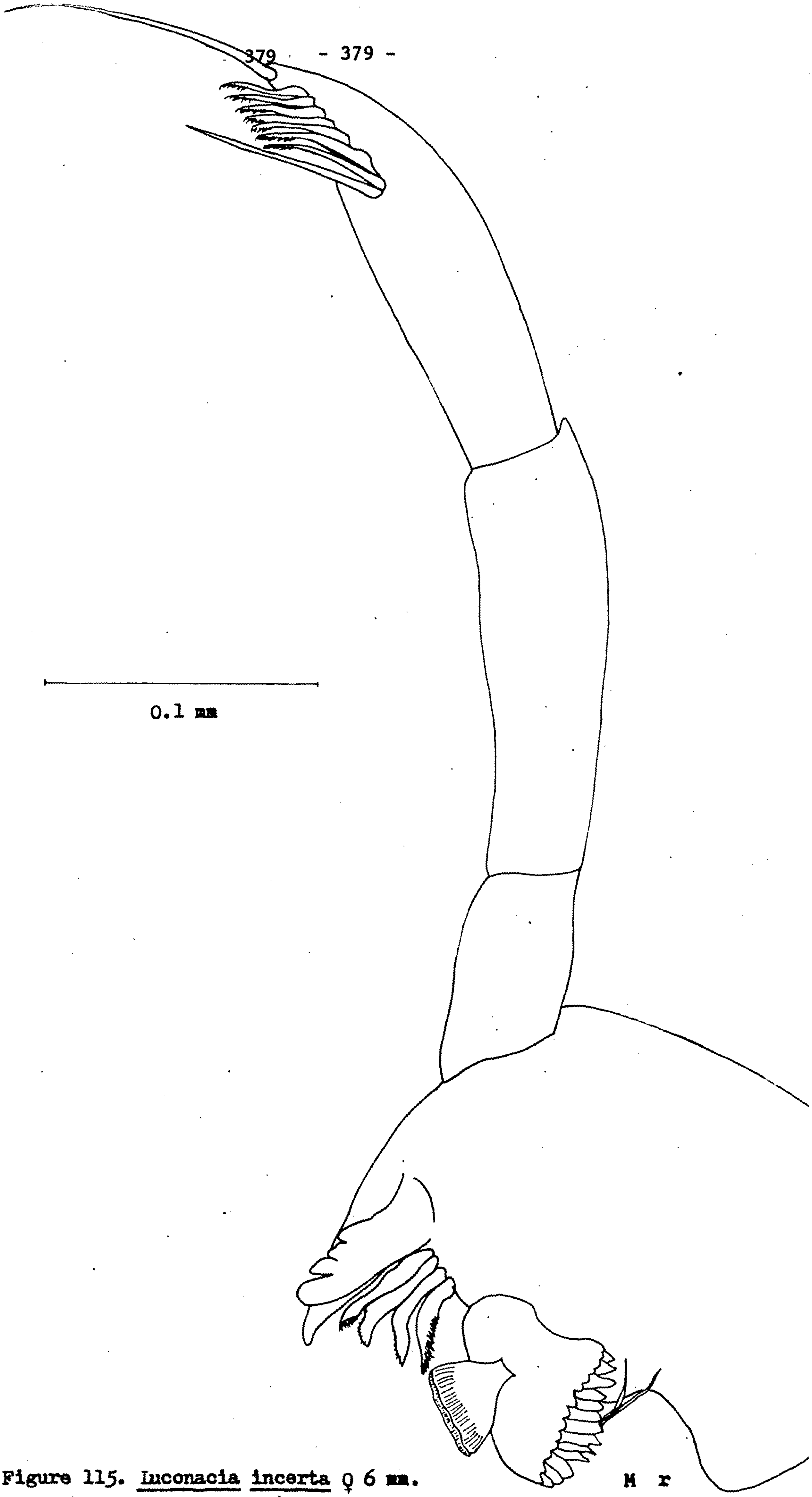

Figure 115. Luconacia incerta ♀ 6 mm. M r

DISCUSSION

The Crustacea is a large and diverse group of invertebrates at the arthropodan level of organization. Crustaceans share the arthropodan features of jointed limbs and a chitinous exoskeleton with other major groups, such as the insects, myriapods, merostomes, pycnogonids and arachnids, and were classified together with them in the phylum Arthropoda. Within the Arthropoda the class Crustacea was closely linked with the Myriapoda and Insecta into a superclass, the Mandibulata, characterized by the possession of mandibles, whilst the other classes were linked into the superclass Chelicerata, characterized by the possession of chelicerae. The elegant researches of Manton (1964) into the functional morphology of the arthropodan groups revealed that the biting surface of the crustacean mandible was derived from the basal part of the limb whereas in insects it was derived from the tip of the whole limb. This latter type of mandible is found in the Onycophora, Myriapoda and Insecta (Hexapoda) and these three classes were grouped by Tiegs & Manton (1958) into the phylum Uniramia. The Crustacea have since been regarded as either a distinct phylum, or a subphylum or superclass within a large phylum comprising all the trilobitomorphan groups, including the fossil Trilobita and the Chelicerata, characterized by the possession of gnathobases. Whilst their relationship with the other arthropodan groups remains the subject of debate, the Crustacea itself is readily distinguishable on the basis of the possession of two pairs of preoral antennae. Evolutionary relationships within the Crustacea have been the subject of much debate during the last two decades. Interest has been focussed on relationships between the various lower crustacean groups and on relationships within the Malacostraca. The hypothetical ancestral crustacean constructed by Hessler & Newman (1975) has gained wide acceptance although Schram (1983) has recently questioned some aspects of its structure. The ancestral crustacean envisaged by Hessler & Newman (1975) is based primarily on the characters exhibited by the Cephalocarida and this group has been regarded as the most primitive extant crustacean class. Newly discovered fossil forms have added to this debate and the micro-fossils with preserved appendages described by Muller (1979) have greatly increased knowledge of the appendages of early crustaceans. In addition, this debate has been fuelled by the discovery of the new class of extant crustacean, the Remipedia (Yager, 1981). Many of the current issues are covered in the recent symposium volume edited by Schram (1983). The majority of crustaceans are malacostracans and amongst them the largest groups are the Amphipoda and Decapoda. The classification of the malacostracan orders is in a state of turmoil, partly as a result of the application of cladistic techniques to assessing their relationships. The central problem in malacostracan classification is whether the "caridoid facies" of Calman (1909) represents a monophyletic ancestral character of the Eumalacostraca. Hessler (1983) argues strongly that it does whereas Watling (1983) and Dahl (1983) raise some doubts. The Amphipoda belongs to the superorder Peracarida which is diagnosed primarily by the presence of a thoracic brood pouch. Other characters that have been used to diagnose the Peracarida, such as the "lacinia mobilis", have been shown to be of dubious significance, being present also in non-peracaridan groups (Dahl & Hessler, 1982). Amphipods have usually been regarded as having a recent evolutionary origin (Siewing, 1963) although this has been questioned by some workers. Watling for example in 1983 separates them from the ancestral peracaridan stock at a very early stage. However, amphipods appear to be in a very rapid, or even explosive phase of evolutionary radiation and this can be interpreted as evidence of a recent origin (Bousfield, 1983). One unfortunate consequence of this is that taxonomic boundaries within the group are indistinct, and as a result the classification of the order Amphipoda at the subordinal, superfamily and family level is in a rather fluid state.

The first move to accommodate the traditional families of Amphipoda, arranged semi-phyletically in a Linnean system by Sars and Stebbing during the 19th century, into superfamilies was made by Bulycheva (1957) who proposed the superfamily Talitroidea. Barnard (1973) diagnosed the superfamily Corophioidea, fusing together the families Isaeidae, Photidae, Aoridae into the Corophiidae and including five other families - Ampithoidae, Biancolinidae, Ischyroceridae, Cheluridae and Podoceridae. Barnard (1974) suggested an evolutionary scheme for the Amphipoda based on the main superfamily groups. Bousfield (1977) extracted six superfamilies and many new families from the established family Gammaridae which, until that time, had contained 200 genera and over 1200 species. In 1978 he published a comprehensive phylogenetic classification for the whole order Amphipoda, which was further revised and updated in 1982 and 1983, incorporating the work of Bowman & Gruner (1973) on the suborder Hyperiidea. To date this is the only phyletic classification which encompasses the Amphipoda as a whole, comprising four suborders, 28 superfamilies and 114 families (plus a few other informal groups). This scheme is the one adopted in the present work.

Recently, Barnard & Karaman (1983) proposed a new subordinal classification of Amphipoda in which the group is divided into just three suborders, Corophiidea, Gammaridea and Hyperiidea. Part of the old Gammaridea has been removed and joined with the Caprellidea to form the Corophiidea, and the Ingolfiellidea incorporated into the new Gammaridea. Karaman expressed some points of disagreement in an appendix to the paper. Barnard & Barnard (1983) further support the thesis using additional data based on all the freshwater amphipod taxa of the world.

Diametrically opposing views on amphipod evolution have been arrived at within the main group Gammaridea. Bousfield based his scheme mostly on the morphology of mature males in which four kinds are recognised. The phylogenetic tree starts with the plesiomorphic Eusiroidea and ends with the apomorphic Corophioidea. Barnard's scheme is based mainly on the fleshiness of the telson, plesiomorphy of the accessory flagellum and the form of gnathopod 2 in males. His phylogenetic tree starts with the Corophioidea as plesiomorphic and finishes with the Talitroidea; several families remaining unplaced. The schemes of Bousfield and Barnard are compatible in part; both share the origin of Caprellidea from ancestral Corophioidea through the Podoceridae and there is consistency in the Talitroidea and several smaller groupings.

The discrepancies between the two schemes are based mainly on the assumed plesio-apomorphic polarity of the morphological characters, which are somewhat subjective (Hennig, 1966), and relate to the choice of a mysid versus a syncarid as the ancestor of amphipods. In spite of the lack of a significant fossil record, the amphipods are conjectured to have had a marine Jurassic origin by the former author and a late Palaeozoic one by the latter. However, a monophyletic origin of the Amphipoda through dispersal and vicariance since Pangean times is accepted by both authors.

The study of synapomorphies and their usefulness in systematics requires careful and thorough correlations with ecological and biological data, especially in amphipods where the relative plesio-apomorphic state of major taxonomic characters may change at different taxonomic levels. The apomorphic lack of coxal gill 7 at both superfamily and family levels (Bousfield, 1983) may be variable within an ecologically diverse or sympatric genus. Margalef (1970), for example, mentioned some variability within the genus Echinogammarus. Pinkster & Stock (1972) subdivided the genus Echinogammarus and proposed species groups. Indeed, Karaman (1977) fused and synonymized species complexes and other genera in his revision of Echinogammarus and showed that some species had a coxal gill 7 and others did not.

In the light of new functional morphology and micro-structural studies, Lincoln (1979) and Lincoln & Hurley (1981) have re-assessed the inter-relationships of important plesio-morphic groups of Amphipoda. This work has been based on the presence of calceoli in seven superfamilies, and a comparative study of the nine main types of this structure distributed amongst twenty families. The seven calceoliferous super-families are: Eusiroidea, Oedicerotoidea, Crangonyctoidea, Phoxocephaloidea, Lysianassoidea, Pontoporeioidea and Gammaroidea. This work is being extended with a special study of the molar flake (Lincoln, pers. comm.) which seems to be a synapomorphy for the superfamilies, Dexaminoidea, Hadzioidea, Corophioidea and the suborder Caprellida. Coincidentally, in these groups the calceolus and the coxal gill 7 are lacking, except for the special gills of Dexaminoidea. The molar flake is a microscopic surface structure on the molar, or between it and the spine row, generally about 0.01 mm in length; morphologically variable from massive to setulose. Usually it is present on the right molar only, exceptionally on both left and right. This character supports the ancestral origin of the Caprellidea in the Corophioidea, based on the structural similarity of the molar flake in the Caprellidae and Podoceridae. Within the Corophioidea, in the present study, this character proved useful for separating the recently erected family Neomegamphopidae from the families Isaeidae and Aoridae. In many characters the Neomegamphopidae is intermediate between the latter two, but the new family lacks a molar flake, having at best a small vestige, and can be separated for the first time in a taxonomic key.

Cosmopolitan species have frequently been given different names in different geographical areas. Oliveira (1953) described Grubia sardenata and recorded Ampithoe brasiliensis and A. filicornis from Brazil. These have been recognized here as the terminal male, the male and the female of the single cosmopolitan species Cymadusa filosa. The anamixid, Anamixis hanseni, is here recognized as a terminal male of the leucothoid Leucothoides pottsi. Biological problems such as these complicate amphipod taxonomy even up to family level. For example, Thomas & Barnard (1983) recently proposed the synonymy of Anamixidae within the Leucothoidae. Some cosmopolitan species on the other hand prove to be a complex of two or more allopatric species, especially when the revision of all available material is made by the same authors. Myers & McGrath (1984) showed this to be the case for the North Atlantic material of Ericthonius brasiliensis (Dana). Nevertheless, sympatric speciation amongst typically small sized amphipods with short life spans and fast individual turnover is common and rapid in tropical ecosystems and a consequence of this is a marked complexity at the species level in the mature amphipod taxocoenosis. An unfortunate consequence of this richness for the taxonomist is the description of polyphyletic taxa such as Maeraceradocus.

Problems of biogeography are inter-related with complex taxonomic problems. The small size of tropical amphipods was noted by early workers. For example, Ruffo (1950), describing the species of Hyale from Venezuela, named a new species "pygmaea". Many cosmopolitan species recorded from the Southern Caribbean coast in this study show a similar small body size. In temperate waters, Stenothoe gallensis, Ericthonius brasiliensis, Leucothoe spinicarpa and Ceradocus rubromaculatus reach body lengths of up to 5, 12, 18 and 20 mm respectively, but in Venezuela they attain lengths of only 4, 7.2, 8 and 8 mm. There is also subtle variation in taxonomic characters related to size, that are more difficult to quantify. In the upwelling area of relatively cold waters, Leucothoe spinicarpa reaches to 8 mm in length and has epimeral plate 3 produced posterodistally into a blunt tooth. This species in Venezuelan warm offshore waters of coral atolls, reaches to only 4 mm in length and has epimeral plate 3 posterodistally subquadrate. Atylus minikoi illustrated from the Atlantic by Schellenberg (1938), reaches to 8.5 mm in length and has two pairs of spines on the telson, but in the Caribbean attains only 7 mm in length and has three pairs of spines on the telson. The original material of Corophium rioplatense from the Southern Hemisphere attains a length of 4 mm and has one distal spine on the first article of the peduncle of female antenna 1, while Orinoco specimens 3 mm in length have two distal spines, and Maracaibo specimens reach 4 mm in length and have more spines. The possible splitting of the South American rioplatense into Caribbean, North and South Atlantic taxa waits a more detailed comparative study of material from all the localities and size ranges.

The main regions of the Caribbean coast of Venezuela exhibit subtle ecological differences reflected in the association of amphipod species. The great estuarine systems of the Orinoco Delta and Maracaibo Lake, that mark the eastern and western limits of the Caribbean coast of Venezuela, are characterized by the presence of Corophium rioplatense Giambiagi in the mud around the roots of mangroves in the brackish waters.

The upwelling region of the South East Caribbean Sea is characterized by mostly cosmopolitan species, together with some newly described ones, such as Leucothoe spinicarpa (Abildgaard), Stenothoe gallensis Walker, Parhyale hawaiensis (Dana), Orchestia aparicioi sp. nov., Atylus minikoi (Walker), Elasmopus rapax Costa, E. cervigoni sp. nov., Dulichiella appendiculata Say, Cymadusa filosa Savigny, Ampithoe ramondi Audouin, Amphideutopus dolicocephalus Myers, Ericthonius brasiliensis (Dana) and Podocerus brasiliensis (Dana). To this list could be added the two endemic freshwater species of Margarita Island, Bogidiella perla and Ingolfiella margaritae, described recently by Stock. Cariaco Trench is characterized by the bathypelagic Stegocephaloides calypsae sp. nov.

The amphipod fauna of the tropical waters of the Central Litoral and Golfo Triste, include the widespread Venezuelan Talorchestia margaritae Stephensen and more local and mainly Atlantic species such as Hyale pygmaea Ruffo, Talorchestia marcuzzii Ruffo, T. fritzi Muller, Pontogeneia longleyi Shoemaker, Microprotopus shoemakeri Lowry, Sunamphithoe pelagica Milne-Edwards and Ampithoe marcuzzii (Ruffo). This area shares with the upwelling zone the cosmopolitan Parhyale hawaiensis (Dana), Atylus minikoi (Walker), Cymadusa filosa Savigny and Ericthonius brasiliensis (Dana). Finally the two endemic troglobiont species Hyalella anophthalma Ruffo and Metaniphargus venezolanus Stock & Botosaneanu inhabit caves of this coastal system.

The chain of coral islands has a more locally distributed amphipod fauna. It includes several species from the neighbouring Pacific area and some endemic sympatric species, such as Leucothoides pottsi Shoemaker, Anamixis hanseni Stebbing, Hyale macrodactyla Stebbing, Platyischnopus metagracilis Barnard, Ceradocus rubromaculatus (Stimpson), Maera kermackae sp. nov., Maeraceradocus reyesi gen. et sp. nov., Elasmopus spinidactylus Chevreux, E. laughlini sp. nov., E. lincolni sp. nov., Lembos unifasciatus Myers and Podocerus cristatus (Thomson).

The multiple origin of the complex South Caribbean fauna, already discussed in the context of commercially exploited fish species is further supported by evidence from the amphipod species. It is possible to recognize the local tropical components of that fauna by listing with the marine endemic species: Hyale pygmaea Ruffo, Talorchestia margaritae Stephensen, T. marcuzzii Ruffo, Orchestia aparicioi sp. nov., Stegocephaloides calypsae sp. nov., Maera kermackae sp. nov., Maeraceradocus reyesi gen. et sp. nov., Elasmopus cervigoni sp. nov., E. laughlini sp.nov., E. lincolni sp. nov., Ampithoe marcuzzii (Ruffo) and Amphideutopus dolicocephalus Myers. Other Caribbean components of the amphipod fauna share their origin with nearby Gulf of Mexico and North West Atlantic species such as Pontogeneia longleyi Shoemaker, Leucothoides pottsi Shoemaker, Anamixis hanseni Stebbing, Microprotopus shoemakeri Lowry, Lembos unifasciatus Myers and Luconacia incerta Mayer, their known southerly range being extended by the present study.

In the region of upwelling, a relatively new area of more temperate conditions because of the resurgence of bottom waters, cosmopolitan species of higher latitudes are recorded. These include Stenothoe gallensis Walker a component of fouling communities, Ericthonius brasiliensis (Dana) an indicator of high organic matter, Elasmopus rapax Costa a widespread species, and Podocerus brasiliensis (Dana), together with those tropical cosmopolitan species mentioned already.

On coral atoll and in hypersaline mangrove communities it is also possible to illustrate the presence in the Caribbean Sea of Pacific species, mostly from the area between California and Galapagos Islands. These were presumably present four or five million years ago, before the Panama Isthmus was formed, and include such species as Platyischnopus metagracilis Barnard, Ceradocus rubromaculatus (Stimpson), Elasmopus bampo Barnard, Elasmopus spinidactylus Chevreux, Neomegamphopus roosevelti Shoemaker and Podocerus cristatus (Thomson),

Finally, the presence in the South East Caribbean Sea of marine species from the Canary Islands and Mediterranean-Atlantic such as Hyale media (Dana) and Sunamphithoe pelagica Milne-Edwards, may be the result of transport westwards by the North Atlantic Tropical Current and the presence of Brazilian species such as Talorchestia fritzi (Muller) and Hyperoche martinezii (Muller), the result of transport northwards by the Guyana Current.

Unravelling the biogeographical history of the freshwater amphipods is no less complex. The distribution of the South

American brackish water species Corophium rioplatense of the great estuarine system of Rio de la Plata, and also recorded in this study from the Orinoco Delta and Maracaibo Lake, could perhaps be explained by recent human or artificial dispersion.

The endemic interstitial freshwater species of the continental island of Margarita, Bogidiella perla and Ingolfiella margaritae are representatives of intercontinental distribution groups (the isle of Margarita was fused to the South American plate until the last interglacial period, about 15,000 years ago). These groups remain epicontinentally distributed in Neo and Palaearctic, Neo and Palaeotropics. These relict distributions may be explained only by accepting a Pangean origin for these groups and invoking continental drift within a vicariant model of evolution. Bogidiellids and ingolfiellids are vermiform-bodied amphipods with distinctive features. The former has lenticular Hertzog organs and the latter articulated ocular lobes, and most are blind interstitial forms. There is no evidence of recent dispersion, so it seems likely that they represent very ancient groups.

Until recently, the only known stygobiont amphipod from the South American continental plate was the endemic Hyalella anophthalma Ruffo (1957), a neotropical hyalellid found in an ancient calcareous mountain cave on the western coast of Venezuela. In 1983, Stock & Botosaneanu described a second troglobitic amphipod, Metaniphargus venezolanus, a tethyan hadziid, from a limestone seashore cave on a peninsula in western Venezuela. The neighbouring Caribbean island of Curaçao has a closely related species of Metaniphargus which is interstitial. Spelaeogammarus bahiensis Silva (1975) was described as a trolobiont amphipod but no cave was mentioned in the locality details and the figures look somewhat like an interstitial crangonyctid without sternal gills. However, Silva listed the species as a bogidiellid.

The Caribbean tectonic plate is one of the most controversial and lacks clear demarcation from its neighbours, especially the South American plate. This point is illustrated by Metaniphargus a vicariant, probably Cretaceous genus from the Tethyan Sea found in a variety of interstitial habitats from marine through brackish to freshwater. The species venezolanus completes the range of interstitial habitats of the genus being a freshwater cave amphipod on the South American continent. It is of Caribbean marine origin, with troglobitic adaptations that include anophthalmia, depigmentation and elongation of appendages. Further adaptations to freshwater are shown by Hyalella anophthalma such as extra gills, enormous antennal glands and long aesthetascs. Nevertheless these two subterranean amphipods - the only ones known in South America - illustrate the two ways in which troglobitic adaptations may evolve from marine and freshwater habitats. They illustrate also both the dispersal and vicariant origin of the Caribbean and South American amphipod fauna.

Freshwater gammarids are found in all continents except South America. Here the hyalellids are a diverse group of neotropical species with Lake Titicaca as the probable centre of origin. This is an ancient lake basin ten million years old, with a richness in endemicity paralleling the Lake Baikal gammarids of Laurasia (twenty-five million years old). Hyalella curvispina is widespread over the continent, except in the northern tropical area, where Hyalella anophthalma is the only species, inhabiting a limestone region surrounded by sea and desert, and isolated from any freshwater system. Adaptations to life in caves, in this case, probably date from long periods of glacial drought. Therefore, in the case of Hyalella anophthalma these unusual conditions comprise a "dry model" that together with fragmentation and regression models in vicariant evolution may help to explain the complex origin of the Caribbean and South American amphipod fauna.

The forty four species recorded in the present work represent the most comprehensive study on amphipods from the Caribbean coast of Venezuela. Seventeen of the nineteen species listed previously for the Southern Caribbean are described here. The two remaining species, not collected in this introductory monograph, are from an island used as a military base, and it was not possible to collect there. However, this Venezuelan material represents all the suborders and most super-families of amphipods recorded from tropical shallow water. For a variety of reasons certain species were not dealt with in the present work. Melita sp., Eriopisa sp. and Caprella sp. were collected but were represented by females only. The eusirid Eusiroides sp., calliopid Apherusa sp. and colomastigid Colomastix sp. were represented only by juveniles therefore these families are not dealt with in the text. Finally the superfamilies Lysianassoidea, Liljeborgioidea and Ampeliscoidea were represented in the collections sorted from grab samples of relatively deep offshore areas but were outside the scope of this study of coastal Caribbean amphipods. A more extensive exploration of the Southern Caribbean coast will be required, therefore, to complete alpha-taxonomic studies of the amphipod fauna. Such an extension would help resolve some of the biogeographical problems of the marine species.

A carefully planned, comprehensive sampling programme on the continental shelf is therefore required which, together with bathyal exploration, and work on freshwater amphipods from the area, should provide exciting new insights into Caribbean amphipod systematics.

References

Abildgaard, P.C. 1789. Zoologia Danica seu animalium Daniae et Norvegiae rariorum ac minus notorum. Descriptiones et Historia 3. Havniae (Molleri et Filii) 66-67.

Amanieu, M. & Savat, B. 1963. Note sur la presence a Arcachon de Talitridae: Talorchestia spinifera (Mateus, 1962) & Orchestia microphthalma sp. n. Publications de la Société Linneenne de Bordeux 99: 302-305.

Andres, H. 1978. Liagoceradocus acutus sp. n., ein Gammaridae aus der Jameos del Agua auf Lanzarote (Amphipoda, Crustacea). Mitteilungen aus den Hamburgischen Zoologischen Museum und Institut. 75: 249-253.

Audouin, J.V. 1826. Explication sommaire des planches dont les dessins ont êté fournis par M.J.C. Savigny. Description de l'Egypte, ou recueil des observations et des recherches qui ont êté faites en Egypte, pendant l'expédition de l'armee Francise (1798-1801). Paris (Commision d'Egypte) 1 (4): 399 pp.

Barnard, J.L. 1955. Two new spongicolous Amphipods (Crustacea) from California. Pacific Science 9: 26-30.

Barnard, J.L. 1955. Gammaridean Amphipoda (Crustacea) in the collections of Bishop Museum. Bernice P. Bishop Museum Bulletin 215: 46 pp.

Barnard, J.L. 1958. Index to the families, genera, and species of the Gammaridean Amphipoda (Crustacea). Allan Hancock Foundation Publications, Occasional Paper 19: 145 pp.

Barnard, J.L. 1958. Amphipod crustaceans as fouling organisms in Los Angeles Long Beach harbours, with reference to the influence of sea water turbidity. California Fish and Game 44: 161-170.

Barnard, J.L. 1959. Estuarine Amphipoda in Ecology of Amphipoda and Polychaeta of Newport Bay, California. Allan Hancock Foundation Publications, Occasional Paper 21: 13-69.

Barnard, J.L. 1961. Relationship of Californian Amphipod Faunas in Newport Bay and in the open sea. Pacific Naturalist 2: 166-186.

Barnard, J.L. 1962. Benthic marine Amphipoda of Southern California: Families Tironidae to Gammaridae. Pacific Naturalist 3: 73-115.

Barnard, J.L. 1962. Los amphipodos bentonicos marinos de la costa occidental de Baja California. Revista de la Sociedad Mexicana de Historia National 24: 205-273.

Barnard, J.L. 1965. Marine Amphipoda of atolls in Micronesia. Proceedings of the United States National Museum 117: 459-551.

Barnard, J.L. 1967. Bathyal and Abyssal Gammaridean Amphipoda of Cedros Trench, Baja California. United States National Museum, Bulletin 260: 205 pp.

Barnard, J.L. 1969. The Families and Genera of Marine Gammaridean Amphipoda. United States National Museum, Bulletin 271: 535 pp.

Barnard, J.L. 1969. Gammaridean Amphipoda of the rocky intertidal of California: Mounteray Bay to La Jolla. United States National Museum, Bulletin 258: 230 pp.

Barnard, J.L. 1972. Gammaridean Amphipoda of Australia. Part I. Smithsonian Contribution to Zoology 103: 1-333.

Barnard, J.L. 1972. The marine fauna of New Zealand: Algae-living littoral Gammaridea (Crustacea Amphipoda). New Zealand Oceanographic Institute Memoir 62: 7-216.

Barnard, J.L. 1973. Revision of Corophiidae and related families (Amphipoda). Smithsonian Contribution to Zoology 151: 1-27.

Barnard, J.L. 1974. Gammaridean Amphipoda of Australia. Part II. Smithsonian Contribution to Zoology 139: 1- 148.

Barnard, J.L. 1976. Affinities of Paraniphargus leouparum Monod, a blind anchialine amphipod (Crustacea) from the Galapagos islands. Proceedings of the Biological Society of Washington 89 (36): 421-432.

Barnard, J.L. 1977. The cavernicolous fauna of Hawaiian Lavà tubes 9. Amphipoda (Crustacea) from brackish lava ponds on Hawaii and Maui. Pacific Insects 17 (2-3): 267-299.

Barnard, J.L. 1979. Littoral Gammaridean Amphipoda from the Gulf of California and the Galapagos Islands. Smithsonian Contribution to Zoology 271: 1-149.

Barnard, J.L. & Barnard, C.M. 1983. Fresh water Amphipoda of the world. Mt. Vernon, Virginia (Hayfield Associates) 830 pp.

Barnard, J.L. & Drummond, M. 1978. Gammaridean Amphipoda of Australia. Part III. The Phoxocephalidae. Smithsonian Contribution to Zoology 245: 1-551.

Barnard, J.L. & Drummond, M. 1979. Gammaridean Amphipoda of Australia. Part IV. Smithsonian Contribution to Zoology 269: 69 pp.

Barnard, J.L. & Drummond, M. 1982. Gammaridean Amphipoda of Australia. Part V. Superfamily Haustorioidea. Smithsonian Contribution to Zoology 360: 148 pp.

Barnard, J.L. & Karaman, G.S. 1980. Classification of Gammarid Amphipoda. Crustaceana, Supplement 6: 16 pp.

Barnard, J.L. & Karaman, G.S. 1982. Classificatory revisions in Gammaridean Amphipoda (Crustacea). Part 2. Proceedings of the Biological Society of Washington 95: 167-187.

Barnard, J.L. & Karaman, G.S. 1983. Australia as a major evolutionary centre for Amphipoda (Crustacea). Memoir Australian Museum 18: 45-61.

Barnard, K.H. 1916. Contributions to the Crustacean Fauna of South Africa. The Amphipoda. Annals of the South African Museum 15: 105-302 + 3 pls.

Barnard, K.H. 1940. Contributions to the crustacean fauna of South Africa. XII. Further additions to the Tanaidacea, Isopoda, and Amphipoda, together with keys for the identification of the hitherto recorded marine and freshwater species. Annals of the South African Museum 32: 381-543.

Barnard, K.H. 1951. New Records and Descriptions of New Species of Isopods and Amphipods from South Africa. Annals & Magazines of Natural History (12) 4: 698-709.

Barnes, R. 1981. Invertebrate Zoology. Tokyo (Holt-Saunders International Edition) 1089 pp.

Bate, C.S. 1862. Catalogue of the specimens of Amphipodous Crustacea in the collection of the British Museum, London 399 pp.

Bate, C.S. & Westwood, J.O. 1863. A history of the British sessile-eyed Crustacea. London (John van Voorst) 1: 1-507.

Becker, G. 1971. On the biology, physiology and ecology of wood-boring crustaceans. Marine borers, fungi and fouling organisms of wood. Edited by E.B. Gareth Jones and S.K. Eltringham. Paris (Proc. OECD-workshop 1968) 304-326.

Bousfield, E.L. 1973. Shallow-water Gammaridean Amphipods of New England. Ithaca and London (Cornell University Press) 312 pp.

Bousfield, E.L. 1977. A new look at the systematics of Gammaroidean Amphipoda of the world. Crustaceana, Supplement 4: 282- 316.

Bousfield, E.L. 1978. A revised classification and phylogeny of Amphipod Crustaceans. Transactions of the Royal Society of Canada (Series IV) 16: 343-390.

Bousfield, E.L. 1982. Amphipoda. Synopsis and classification of living organisms. New York (Mc. Graw Hill) 254-294.

Bousfield, E.L. 1982. The Amphipoda (Paleohistory). Mc. Graw Hill Yearbook of Science & Technology. New York (Mc. Graw Hill) 96-100.

Bousfield, E.L. 1982. The amphipod superfamily Talitroidea in the north-eastern Pacific region. I. Family Talitridae systematics and distributional ecology. Ottawa, National Museum of Natural Sciences. Publications in Biological Oceanography 11: 73 pp.

Bousfield, E.L. 1983. An updated phyletic classification and paleohistory of the Amphipoda. Crustacean Phylogeny. Rotterdam (Balkema) 257-277.

Bovallius, C. 1887. Systemmatical list of the Amphipoda Hyperiidea. Bihang til Kungliga Svenska Vetenskaps Akademiens Handlingar 11 (16): 1-50.

Bovallius, C. 1889. Contributions to monograph of the Amphipoda Hyperiidea. Part I : 2. Kungliga Svenska Vetenskaps Akademiens Handlingar 22 (7): 434 pp. + 18 pls.

Bowman, T.E. 1973. Pelagic Amphipoda of the genus Hyperia and closely related genera (Hyperiidea: Hyperiidae). Smithsonian Contribution to Zoology 136: 76 pp.

Bowman, T.E. & Abele, L.G. 1982. Classification of the recent Crustacea. The Biology of Crustacea I. New York & London (Academic Press) 1-27.

Bowman, T.E. & Gruner, H.E. 1973. The families and genera of Hyperiidea. Smithsonian Contribution to Zoology 146: 64 pp.

Boxshall, G.A. & Lincoln, R.J. 1983. Tantulocarida, a new class of Crustacea ectoparasite on other crustaceans. Journal of Crustacean biology 3 (1): 1-16.

Bulycheva, A.I. 1952. New species of Gammaridae from Japan sea. Academia Nauk SSSR, Trudy Zoologicheskogo Instituta 12: 194-250.

Bulycheva, A.I. 1957. Morskie bloxi morej SSSR i sopredel'nyx vod (Amphipoda-Talitroidea). Academia Nauk SSSR, Opredeliteli po Faune SSSR 65: 1-185.

Calman, W.T. 1909. A treatise on zoology. The Amphipoda. Part VII. London (A. & C. Black) 224-243.

Cecchini, C. 1928. Gli anfipodi del Museo Zoologicodi Firenze. Atti della Reale Accademia Fisiocritici Siena (10) 3: 377-393.

Cervigon, F. 1966. Los peces marinos de Venezuela. Caracas (Fundacion La Salle de Ciencios Naturales) 951 pp. + 5 suppl.

Chapman, P. 1980. The invertebrate fauna of caves of the Serrania de San Luis, Edo. Falcon, Venezuela. Transactions of British Cave Research Association 7 (4): 179-199.

Chen, T. 1939. Notes on some freshwater amphipods of Peiping. Peking National University, 40th Anniversary Papers 1: 107-121.

Chevreux, E. 1907. Diagnoses d'Amphipodes nouveaux recueillis dans les possessions Francaises de l'Oceanie, par M.L. Senrat, Directeur de laboratoire de recherches biologiques de Rikitea. Bulletin du Museum d'Histoire Naturelle 6: 412-417.

Chevreux, E. 1907. Amphipodes recueillis dans les possessions Francaises de l'Oceanie par M. le Dr Senrat, Directeur du laboratoire de recherches biologiques de Rikitea (iles Gambien) 1902-1904. Mémoires de la Société Zoologique de France 20: 470-527.

Chevreux, E. 1910. Campagnes de la Melita. Les Amphipodes d'Algerie et de Tunisie. Mémoires de la Société Zoologique de France 23: 145-285 + 15 pls.

Chevreux, E. 1913. Crustacea. Voyague de M. Ch. Alluaud et R. Jeaunel en Afrique Orientale (1911-1912). Résultats Scientifiques: 11-22.

Chevreux, E. 1915. Amphipodes de la Nouvelle Caledonie et des Iles logalty. (Sarasin & Roux) Nova Caledonia, Zoologie 2, L. 1: 3-14 + 3 pls.

Chevreux, E. & Fage, L. 1925. Amphipodes. Faune de France 9: 1-488.

Chilton, C. 1915. The New Zealand species of the Amphipodean Genus Elasmopus. Transactions & Proceedings of the New Zealand Institute 47 (1914): 320-330.

Chilton, C. 1917. The New Zealand sand-hoppers belonging to the genus Talorchestia. Transactions & Proceedings of the New Zealand Institute 49 (1916): 292-303.

Chilton, C. 1925. On a species of Talorchestia. China Journal of Science and Arts 3 5: 283-284.

Conlan, K.E. 1982. Revision of the gammaridean amphipod family Ampithoidae using numerical analytical methods. Canadian Journal of Zoology 60 (8): 2015-2027.

Conlan, K.E. 1983. The amphipod superfamily Corophioidea in the Northeastern Pacific Region. 3. Family Isaeidae: Systematics and distributional ecology. Ottawa, National Museum of Natural Sciences. Publications in Natural Sciences 4: 74 pp.

Conlan, K.E. & Bousfield, E.L. 1982. The amphipod superfamily Corophioidea in the Northeastern Pacific Region. Family Ampithoidae: Systematics and distributional ecology. Ottawa, National Museum of Natural Sciences. Publications in Biological Oceanography 10: 41-77.

Conlan, K.E. & Bousfield, E.L. 1982. The superfamily Corophioidea in the North Pacific Region. Family Aoridae: Systematics and distributional ecology. Ottawa, National Museum of Natural Sciences. Publications in Biological Oceanography 10: 77-101.

Costa, A. 1853. Realazione sulla memoria del Dottor Achille Costa, di ricerche su' crostacei anfipodi del regno di Napoli. Rendiconti dell' Accademia delle Sciente Fisiche & Matematiche Napoli 2: 166-178.

Costa, A. 1857. Ricerche sui crostacei anfipodi del regno di Napoli. Memorie della Reale Accademia de Scienze di Napoli 1: 165-235.

Crawford, G.I. 1937. A review of the amphipod genus Corophium, with notes on the British species. Journal of the Marine Biological Association of the United Kingdom 21 (2): 589-630.

Dahl, E. 1976. Structural plans as functional models exemplified by the Crustacea Malacostraca. Zoological Scripta 5: 163-166.

Dahl, E. 1983. Malacostracan phylogeny and evolution. Crustacean Phylogeny. Rotterdam (Balkema) 189-212.

Dahl, E. & Hessler, R. 1982. The crustacean lacinia mobilis: a reconsideration of its origin, function and phylogenetic implications. Journal of the Linnean Society of London, Zoology 74: 133-146.

Dana, J.D. 1849. Synopsis of the genera of Gammaracea. American Journal of Science and Arts (2nd series) 8 (22): 135-140.

Dana, J.D. 1852. Conspectus crustaceorum quae in orbis terrarum circumnavigatione, Carolo Wikles e classe reipublicae faederatae duce, lexit et descripsit Jacobus D. Dana, Pars. III: Amphipoda No. I Proceedings of the American Academy of Arts and Sciences 2: 201-220.

Dana, J.D. 1852. On the classification of the crustacean Choristopoda or Tetradecapoda. American Journal of Science (2) 14: 297-316.

Dana, J.D. 1853. Crustacea. Part II. United States Exploring Expedition 13: 689-1618.

Darlington, P. 1957. Zoogeography. The geographical distribution of animals. New York (John Wiley & Sons) 675 pp.

Della Valle, A. 1893. Gammarini del Golfo di Napoli. Fauna und Flora des Golfes von Neapel und der angrenzenden Meeres - Abschnitte, Monographie 20: 1-948 + 61 pls.

Derjavin, A.N. 1938. Talitridae of the Soviet coast of the Japan sea. Explorations des Mers, USSR 23: 87-112.

Edgar,N, Ewing,J.& Hennion,J.1971. Seismic Refraction and Reflection in the Caribbean Sea. The American Association of Petroleum Geologists. Bulletin. 55 (6): 833-870.

Edmondson, C.H. 1951. Some Central Pacific Crustaceans. Occasional Papers of the Bernice P. Bishop Museum 20: 183-243.

Ercoloni, A. & Scapini, F. 1974. Sun compass and shore slope in the orientation of littoral amphipods (Talitrus saltator Montagu). Monitore Zoologico Italiano (N.S.) 8: 85-115.

Ercolini, A. & Scapini, F. 1976. Sensitivity and reponse to light in the laboratory of the littoral amphipod Talitrus saltator Montagu. Monitore Zoologico Italiano (N.S.) 10: 293-309.

Filhol, H. 1885. Crustacea. Recueil de Mémoires, Rapports et documents relatifs al' Passage de Venus sur le seleil 111 (2): 349-516.

Fox, R.S. 1973. Ceradocus shoemakeri and Eriopisa schoenerae, New Amphipods (Crustacea: Gammaridae) from the Bahama Islands. Journal of the Elisha Mitchell Scientific Society 89: 147-159.

Galan, A. 1976. Contribucion al estudio de las incrustaciones biologicas en la Laguna de la Restinga, Isla de Margarita, Venezuela. Boletin del Instituto Oceanografico Venezuela, 15 (2): 153-169.

Galan, A. 1978. Contribucion al conocimiento de la colonizacion en sustratos artificiales del Mar Caribe. Resumens V simposio Latinoamericano de Oceanografia biologica. Sao Paulo (Universidade de Sao Paulo) 51-52.

Giambiagi, D. 1926. Un nuevo anfipodo de agua dulce del genero Corophium. Anales del Museo Nacional de Historia Natural 34: 137-143.

Graham, A.L. 1981. Plate tectonics in: Chance, change and challenge. London (British Museum (Natural History)) (1): 165-179.

Griffiths, C.L. 1976. Guide to the benthic marine amphipods of Southern Africa. Cape Town (Trustees of the South Africa Museum) 106 pp.

Gurjanova, E.F. 1951. Gammaridea of the seas of the USSR and adjacent waters. Akademia Nauk SSSR, Opredeliteli po Faune SSSR 41: 1-1031.

Gurjanova, E.F. 1962. Amphipoda. Gammaridea of the Northern part of the Pacific Ocean. Akademia Nauk SSSR, Opredeliteli po Faune SSSR 74: 440 pp.

Hansen, H. 1903. The Ingolfiellidae, fam. n., a new type of Amphipoda. Journal of the Linnean Society of London, Zoology 29: 117-137.

Haswell, W.A. 1879. On some Additional New Genera and Species of Amphipodous Crustaceans. Proceedings of the Linnean Society of New South Wales 4: 319-350, plates 18-24.

Haswell, W.A. 1879. On Australian Amphipoda. Proceedings of the Linnean Society of New South Wales 4: 245-279.

Haswell, W.A. 1880. On Some New Amphipods from Australia and Tasmania. Proceedings of the Linnean Society of New South Wales 5: 97-105.

Heller, C. 1866. Beiträge zur näheren Kenntniss der Amphipoden des Adriatischen Meeres. Denkschriften der Kaiserlichen Akademie der Wissenschaften Wien 26 (2): 1-57.

Hennig, W. 1966. Phylogenetic Systematics. Urbana (University of Illinois Press) 236 pp.

Herring, P. Editor 1978. Bioluminescence in action. London (Academic Press) 570 pp.

Hertzog, L. 1933. Bogidiella albertimagni sp. nov., ein neuer Grundwasseramphipode aus der Rheinbene bei Strassburg. Zoologischer Anzeiger 102 (9-10): 225-227.

Hertzog, L. 1936. Crustaces de biotopes hypogees de la vallée du Rhin D'Alsace. Bulletin de la Societe Zoologique de France 61: 356-372.

Hessler, R. 1983. A defense of the caridoid facies: wherein the early evolution of the Eumalacostraca is discussed. Crustacean Phylogeny. Rotterdam (Balkema) 145-164.

Hessler, R. & Newman, W. 1975. A trilobitomorph origin for the Crustacea. Fossils and Strata 4: 437-459.

Holme , N.A. 1964. Methods of sampling the Benthos. Advances in Marine Biology, Vol. 2. London (Academic Press) 171-260.

Holsinger, J.R. 1977. A New Genus and Two New Species of Subterranean Amphipod Crustaceans (Gammaridae S. Lat.) from the Yucatan Peninsula in Mexico. Association for Mexican Cave Studies, Bulletin 6: 15-25.

Holsinger, J.R. 1981. International Journal of Speleology 11 (3-4): in press .

Holsinger, J.R. & Longley, G.L. 1980. The Subterranean Amphipod Crustacean Fauna of an Artesian Well in Texas. Smithsonian Contributions to Zoology 308: 62 pp.

Holsinger, J.R. & Minckley, W.L. 1971. A New Genus and Two New Species of Subterranean Amphipod Crustaceans (Gammaridae) from Northern Mexico. Proceedings of the Biological Society of Washington 83 (37): 425-444.

Holsinger, J.R. & Peck, S.B. 1968. A new genus and species of subterranean amphipod (Gammaridae) from Puerto Rico, with notes on its ecology, evolution and relationship to other Caribbean Amphipods. Crustaceana 15: 249-262.

Hurley, D.E. 1956. Studies on the New Zealand Amphipodan Fauna. 13 Sandhoppers of the Genus Talorchestia. Transactions of the Royal Society of New Zealand 84 (2): 359-389.

Hurley, D.E. 1973. An annotated checklist of Fossils attributed to the Crustacea Amphipoda. New Zealand Oceanographic Institute Records 1: 211-217.

International Code of Zoological Nomenclature. 1964. London (International Trust for Zoological Nomenclature) 176 pp.

Isaacs, J. & Schwartzlose, R. 1975. Active animals of the deep-sea floor. Scientific American, Oct. 1975: 41-48.

Iwasa, M. 1939. Japanese Talitridae. Journal of the Faculty of Science, Hokkaido Imperial University, Series 6, Zoology 4: 255-296.

James, S. & Frame, A. 1976. Some effects of a power plant effluent on estuarine epibenthic organisms. International Revue der Gesamten Hydrobiologie und Hydrographie 61 (1):37-61

Kaestner, A. 1970. Crustacea. Invertebrate Zoology. Vol. 3. New York (Interscience Publishers) 523 pp.

Karaman, G.S. 1977. Revision of the Echinogammarus genera-complex (Gammaridae). Arhiv BiolosKih Nauka Beograd 27 (1-2): 69-93.

Karaman, G.S. 1981. Re-description of Melita planaterga Kumkel 1910 from Bermuda islands with revision of genera Melita Leach and Abludomelita n. gen. Poljoprivreda I Sumarstvo, Titograd 27: 29-50.

Karaman, G.S. & Barnard, J.L. 1979. Classificatory Revisions in Gammaridean Amphipoda (Crustacea), Part I. Proceedings of the Biological Society of Washington 92: 106-165.

Karaman, G.S. & Pinkster, S. 1977. Freshwater Gammarus Species from Europe, North Africa and adjacent regions of Asia (Crustacea Amphipoda) Part I. Gammarus Pulex-group and related species. Bijdragen Tot de Dierkunde 47: 1-97.

Karaman, G.S. & Ruffo, S. 1971. Contributo alla conoscenza delle specie Mediterranee del genere Maera (Crustacea Amphipoda). Memorie del Museo Civico di Storia Naturale, Verona 19: 113-176.

Karaman, S. 1932. Beitrag zur Kenntnis der Susswasser-Amphipoden. (Amphipoden unterirdischer Gewasser). Prirodoslovne Razprave, Ljubljana 1: 179-232.

Karaman, S. 1933. Uber zwei neue Amphipoden Balcanella und Jugocrangonyx aus dem Grundwasser von Skoplje. Zoologischer Anzeiger 103: 41-47.

Klein, G. 1969. Amphipoden aus der Wesermündung und der Helgoländer Bucht, mit Beschreibung von Talorchestia frisiae n. sp. Veröffentlichen Institut des Meeresforschungen Bremerhaven 11: 173-194.

Kossmann, R. 1880. Malacostraca. Zoologische Ergebnisse Auftrage Koniglichen Academie Wissenschaften Berlin Reise Kunstengebiete Rothen Meeres 2 (1): 67-140.

Krapp-Schickel, G. 1974. Camill Helles Sammlung Adriatischer Amphipoden 1866 und heute. Annales des Naturhistorischer Museum Wien 78: 319-379.

Kröyer, H. 1838. Grönlands Amfipoder beskrevne af Henrik Kröyer. Det Kongelige Danske Videnskabernes Selskabs Naturvidenskabelige og Mathematiske Afhandlinger 7: 229-326.

Kröyer, H. 1845. Karcinologiske Bidrag. Naturhistorisk Tidsskrift (NS) 1: 453-638.

Kunkel, B.W. 1910. The Amphipoda of Bermuda. Transactions of the Connecticut Academy of Arts and Sciences 16: 1-115.

Laubitz, D. 1979. Phylogenetic relationships of the Podoceridae (Amphipoda, Gammaridea). Bulletin of the Biological Society of Washington 3: 144-152.

Latreille, P.A. 1802. Histoire Naturelle, génèrale et particulière des Crustaces et des Insectes. Paris. Vols 1-4: 445 pp.

Latreille, P.A. 1816. (Amphipoda). Nouveau dictionnaire d'histoire naturelle, appliquée aux arts, à l'agriculture, à l'économie rurale et domestique, à la médecine, ... Vol. I. 2nd ed. Paris: 467-469.

Latreille, P.A. 1817. Les Crustaces, les Arachnides et les Insectes. Le règne animal. Vol. 3. Edited by Cuvier. Paris (M. Deterville) 653 pp.

Leach, W.E. 1813. Crustaceology. The Edinburgh Encyclopaedia. Edited by D. Brewster. Edinburgh. 7 (1): 383-384.

Leach, W.E. 1814. Crustaceology. The Edinburgh Encyclopaedia. Edited by D. Brewster. Edinburgh. 7 (2): 385-437.

Ledoyer, M. 1973. Etude des Amphipodes Gammariens des biotopes de substrats sableux et sablo-vaseux de la région de Tulear et de Nosy-Bé (Madagascar). Tethys, Supplement 5: 51-94.

Ledoyer, M. 1979. Les Gammariens de la pente externe de Grand Recif de Tulear, Madagascar (Crustacea, Amphipoda). Memoire del Museo Civico di Storia Naturale Verona 2: 1-150.

Lessona, M. 1865. Sopra due nuove di animale invertebrai raccolte nel Golfo di Genova. Atti della Societa Italiana di Scienze Naturali 8: 423-428.

Lincoln, R.J. 1979. British Marine Amphipoda: Gammaridea. London (British Museum (Natural History)) 658 pp.

Lincoln, R.J. & Boxshall, G.A. 1983. Deep sea asellote isopods of the north-east Atlantic: the family Dendrotionidae and some new ectoparasitic copepods. Journal of the Linnean Society of London, Zoology 79: 297-318.

Lincoln, R.J. & Hurley, D. 1981. The calceolus, a sensory structure of gammaridean amphipods. British Museum (Natural History), Zoology 40 (4): 103-116.

Lincoln, R.J. & Sheals, J.G. 1979. Invertebrate animals: collection and preservation. London (British Museum (Natural History)). 150 pp.

Linnaeus, C. 1758. Systema Naturae Per Regna Tria Naturae, Secundum Classes, Ordines, Genere, Species, Cum Characteribus, Differentis, Synonymis, Lacis. 10th ed. Vol. I: 1-824.

Lloyd, J. 1963. Tectonic history of the South central-America Orogeny. Backbone of the Americas. Edited by O. Childs & Beebe, B. Tulsa (Memoirs of the American Association of Petroleum Geologists). 320 pp.

Lowry, J.K. 1972. Taxonomy and distribution of Microprotopus along the east coast of the United States (Amphipoda, Isaeidae) Crustaceana, Supplement 3: 277-286.

Lowry, J.K. & Fenwick, G.D. 1983. The shallow water gammaridean Amphipoda of the subantarctic islands of New Zealand and Australia: Melitidae, Hadziidae. Journal of the Royal Society of New Zealand 13 (4): 201-260.

Lucas, H. 1846. Expl. Algerie 1840-42. Zoologie. I. Histoire naturelle des animaux articulés. Part I. Crustaces. Paris (Imprimerie Nationale) 403 pp.

Lucks, R. 1928. Palaeogammarus balticus, nov. spec. ein neuer Gammaride aus dem Bernstein. Naturforschung Gesellenschaft im Danzig, Schriften 18 (3): 12 pp.

Maccagno, T.P. 1936. Crostacei di Assab Decapodi Stomatopodi Anfipodi. Spedisione del Barone Raimondo Francetti in Dancalia (1928-29). Annalia Museo Civico di Storia Naturale di Genova 59: 171-186.

McCain, J. 1968. The Caprellidae (Crustacea Amphipoda) of the western North Atlantic. Smithsonian Institution, Bulletin 248: 147 pp.

McCain, J. & Steinberg, C.E. 1970. Crustaceorum catalogus. Part 2. Caprellidea. Den Haag (Dr W. Junk) 78 pp.

Manton, S. 1964. Mandibular mechanisms and the evolution of arthropods. Philosophical Transactions of the Royal Society of London (B) 247: 1-183.

Manton, S. 1973. Arthropod phylogeny, a modern synthesis. Journal of Zoology. Proceedings of the Zoological Society of London 171: 111-130.

Manton, S. 1977. The Arthropoda: Habits, Functional Morphology and Evolution. Oxford (Oxford University Press) 527 pp.

Margalef, R. 1953. Los crustaceos de la aguas continentales Ibericas. Madrid (Instituto Forestal de Investigaciones y Experiencias) 243 pp.

Margalef, R. 1970. Anfipodos recolectados en aguas subterraneas del Pais Vasco. Munibe, San Sebastian 22: 169-174.

Margalef, R. 1970. Anfipodos recolectados en aguas subterraneas Ibericas. Speleon, Barcelona. 17: 63-65.

Margalef, R. 1974. Ecologia. Barcelona (Omega S.A.) 951 pp.

Margalef, R. et al. 1967. Ecologia Marina. Caracas (Fundacion La Salle de Ciencias y Naturales) 711 pp.

Mateus, E. 1962. Une nouvelle éspèce d'Orchestia (Crustacea Amphipoda Talitridae) Publicacoes do Instituto de Zoologia "Dr Augusto Nobre", Faculdade de Ciencias do Porto 86: 9-22.

Mateus, A. & Mateus, E. de O. 1966. Amphipodes littoraux de Principe et de Sao Tômé. Annales de l'Institut Oceanographique, Paris 44: 173-198.

Mateus, A. & Mateus, E. de O. 1978. Amphipoda hypoges du Portugal. Publicacoes do Instituto de Zoologia "Dr Augusta Nobre", Faculdade de Ciencias do Porto 142: 11-26.

Mayer, P. 1903. Die Caprellidae der Siboga Expedition. E.J. Brill, Leiden. Siboga Expeditie 34: 160 pp., 10 plates

Milne-Edwards, H. 1830. Extrait de Recherches pour servir a l'histoire naturelle des crustaces amphipodes. Annales des Sciences Naturelles 20: 353-399.

Milne-Edwards, H. 1840. Histoire naturelle des Crustaces. Vol. 3. Paris. 638 pp., 1 atlas.

Miro, M. 1974. Morfologia submarina y sedimentos recientes del margen continental del N.E. de Venezuela. Cuadernos Azules, 14. Venezuela (Instituto Oceanografico) 155 pp.

Moore, P. 1979. Crystaline structures in the gut coeca of the amphipod Stegocephaloides christieniensis Boeck. Journal of experimental marine Biology and Ecology, Amsterdam 39: 223-229.

Moore, P.G. 1984. Gammaridean Amphipoda (Crustacea) collected by the Yacht Tulip from surface waters of the Arabian Sea. Journal of Natural History 18: 369-380.

Moore, R. & McCormick, C. 1969. General features of Crustacea. Treatise on Invertebrate Paleontology. Geological Society of America 1: 57-120.

Morino, H. 1972. Studies on the Talitridae (Amphipoda Crustacea) in Japan. I. Taxonomy of Talitridae and Orchestoidea. Publications of the Seto marine biological laboratory 21 (1): 43-65.

Müller, F. 1864. Für Darwin. Leipzig (Wilhelm Engelman) 91 pp.

Muller, K. 1979. Phosphatocopine ostracods with preserved appendages from the Upper Cambrian of Sweden. Lethaia 12: 1-27.

Myers, A.A. 1968. Two Aoridae (Amphipoda Gammaridea) including a new species of Amphideutopus Barnard from Venezuelan waters. Crustaceana 14 (2): 127-130.

Myers, A.A. 1973. Neomegamphopus kunduchii sp. nov. (Crustacea Amphipoda) from East Africa, with a discussion of gnathopod dominance in isaeid amphipods. Journal of the Linnean Society of London, Zoology 52 (3): 263-267.

Myers, A.A. 1977. Studies on the genus Lembos Bate. V Atlantic species. L. smithi (Holmes), L. brunneomaculatus sp. nov., L. minimus sp nov., L. unifasciatus sp. nov. Bolletin del Museo Civico di Storia naturale Verona 4: 94-127.

Myers, A.A. 1979. Studies on the genus Lembos Bate. VII Atlantic species. L. tigrinus sp. nov., L. tempus sp. nov., L. spinicarpus (Pearse) comb. nov. with spp. inermis nov., L. ovatipes sp. nov., L. unifasciatus Myers spp. reductus nov. Bolletin del Museo Civico di Storia naturale Verona 6: 221-248.

Myers, A.A. 1981. Amphipoda Crustacea Family Aoridae. Memoirs Hourglass Cruises. Vol. 5. Part 5. St Petersburg (Florida Department of Natural Resources: Marine Research Laboratory) 75 pp.

Myers, A. & McGrath, D. 1984. A revision of the North-East Atlantic species of Ericthonius (Crustacea: Amphipoda) Journal of the Marine Biological Association, United Kingdom 64: 379-400.

Oldevig, H. 1959. Arctic, Subarctic and Scandinavian amphipods in the collections of the Swedish Natural History Museum in Stockholm. Göteborgs Kungliga Vetenskaps-Vitterhets-Samhalles Handlingar (B) 8 (2): 132 pp. + 4 plates.

Oliveira, L.P.H. de 1951. The genus Elasmopus on the Coast of Brazil with description of Elasmopus besnardi n. sp., and E. fusimanus n. sp. (Crustacea, Amphipoda). Boletin do Instituto Paulista de Oceanografia 2: 3-35.

Oliveira, L.P.H. de 1953. Crustacea Amphipoda do Rio de Janeiro. Memorias do Instituto Oswaldo Cruz 51: 289-376, 27 figures.

Oliveira, L.P.H. de 1955. Phoxocephalus capuciatus, nove especie de Crustacea Amphipoda Phoxocephalidae. Memorías do Instituto Oswaldo Cruz 53: 313-317 + 2 plates.

Ortiz, M. 1979. Lista de especies y bibliografia de los anfipodos (Crustacea, Amphipoda) del Mediterraneo americano. Universidad de la Havana, Cuba. Ciencias, Series 8. Investigaciones marinas 43: 1-40.

Pearse, A.S. 1908. Descriptions of four new species of Amphipodous Crustaces from the Gulf of Mexico. Proceedings of the United States National Museum 34 (1594): 27-32.

Pennak, R.W. 1953. Freshwater Invertebrates of the United States. New York (Ronald Press) 321 pp.

Pinkster, S. 1972. On members of the Gammarus pulex group (Crustacea, Amphipoda) from western Europe. Bijdragen Tot de Dierkunde 42: 164-191.

Pinkster, S. & Stock, J. 1972. Member of the Echinogammarus simoni group and the genus Eulimnogammarus (Crustacea Amphipoda) from the Iberian Peninsula and North Africa, with descriptions of a new species. Bulletin Zoologisch Museum Universiteit van Amsterdam 2 (10): 85-115.

Pirlot, J.M. 1939. Résultats scientifiques des croisieres du "Mercator", vol. II. III Amphipoda. Mémoires Musée Royal d'Histoire Naturelle de Belgique (2) 15: 47-80.

Rathke, H. 1837. Zur Fauna der Krym. Ein Beitrag. Memoires presentes a l'Academie Imperiale des Sciences de Saint-Petersbourg 3: 371-380.

Rathke, H. 1843. Beitrage zur Fauna Norwegens. Amphipoda. Verhandlungen Kaiserlichen Leopoldinish-Carolinischen Akademie Naturforscher, Breslau 20: 63-98.

Reid, D.M. 1939. Hyale veamalhoi sp. n. (Crustacea, Amphipoda). Annals and Magazine of Natural History (11) 3: 29-32.

Reid, D.M. 1951. Report on the Amphipoda (Gammaridea and Caprellidea) of the coast of Tropical West Africa. Atlantide Report 2: 189-291.

Rodriguez, G. 1959. The marine communities of Margarita Island. Bulletin of Marine Science of the Gulf and Caribbean 9 (3): 237-280.

Rodriguez, G. 1980. Crustaceos Decapodos de Venezuela. Caracas (Instituto Venezolano Investigaciones Cientificas) 494 pp.

Rosen, D.E. 1976. A vicariance model of Caribbean biogeography. Systematic Zoology 24 (4): 431-464.

Ruffo, S. 1938. Gli anfipodi del Mar Rosso. S.S.C.A. IX. Estratto dagli Annali del Museo Civico di Storia Naturale di Genova 14: 152-180.

Ruffo, S. 1950. Anfipodi del Venezuela raccolti dal Dott G. Marcuzzi. Studi sui Crostacei Anfipodi XXII. Memorie de Museo Civico di Storia Naturale di Verona 2: 49-56.

Ruffo, S. 1953. Lo stato attuale delle conoscenze sulla distribuzione geografica degli anfipodi delle acque sotterance Europee e dei paesi mediterranei. Premier Congres Internationale de Speleologie 3: 13-37, 10 figures.

Ruffo, S. 1954. Nuovi anfipodi raccolti nel Venezuela dal Prof. G. Marcuzzi. Memorie del Museo Civico di Storia Naturale di Verona 4: 117-125.

Ruffo, S. 1957. Una nouva specie traglobia di Hyalella del Venezuela (Amphipoda, Talitridae). Annali del Museo Civico di Storia Naturale di Genova 69: 363-369.

Ruffo, S. 1958. Amphipodes terrestres et des eaux continentales de Madagascar, des Comores et de la Réunion. Mémoires de l'Institut Scientifique de Madagascar (A) 12: 35-66, 9 figures.

Ruffo, S. 1959. Contributo alla conoscenze degli anfipodi del Mar Rosso (1). Sea Fisheries Research Station, Haifa, Bulletin 20: 11-36.

Ruffo, S. 1969. Terzo contributo alla conoscenze degli anfipodi del Mar Rosso. Memorie del Museo Civico di Storia Naturale, Verona 67: 1-77.

Ruffo, S. 1969. Descrizione di Metaingolfiella mirabilis n. gen., n. sp. (Crustacea, Amphipoda, Metaingolfiellidae fam. nova) delle acque sotteranee del Salento nell'Italia meridionale. Memorie del Museo Civico di Storia Naturale, Verona 16: 234-260.

Ruffo, S. 1970. Considérations à propos de la systematique et de la biogéographie des ingolfielles (Crustacea, Amphipoda). Livre-du centenaire Emile G. Racovitza. Bucharest. (Editions de l'Academie de la république socialiste de Roumanie) 223-230.

Ruffo, S. 1973. Contributo alla revisione del genera Bogidiella Hertzog. Studi sur Crostacei Anfipodi, 74. Bollettino dell'Instituto di Entomologia della Universita di Bologna 31: 49-77.

Ruffo, S. Editor 1982. The Amphipoda of the Mediterranean. Part I. Gammaridea. Memoires de l'Institut Oceanographique, Monaco 13: 364 pp.

Sars, G.O. 1895. An account of the Crustacea of Norway, with short description and figures of all the species. Vol. I. Part 1-32. Christiania and Copenhagen: 711 pp., 248 plates.

Savigny, M.J.C. 1816. Mémoires sur les animaux sans vertèbres. Premiere partie. Description et classification des animaux invertébrés et articulés, connus sous les noms de Crustacés, d'Insectes, d'Annélides ... Paris: 39-117.

Say, T. 1818. An account of the Crustacea of the United States. Journal of the Academy of Natural Sciences of Philadelphia 1: 374-401.

Schellenberg, A. 1925. Crustacea VIII: Amphipoda. Michaelsen, W.; Beitrage zur Kenntnis der Meeresfauna Westafrikas, Vol. 3. Hamburg (L. Fredrichsohn & Co.) 113-204.

Schellenberg, A. 1926. Die Gammariden der deutschen Sudpolar Expedition 1901-1903. Deutsch Sudpolar Expedition 18: 233-415.

Schellenberg, A. 1931. Gammariden und Caprelliden des Magellangebietes, Sudgeorgiens und der Westantarktis. Further Zoological Results of the Swedish Antarctic Expedition 1901-1903. 2 (6): 1-290.

Schellenberg, A. 1935. Fauna Chiliensis. Amphipoden von Chile und Juan Fernandez. Zoologische Jahrbucher, Systematik 67: 225-234.

Schellenberg, A. 1936. The fishery grounds near Alexandria, 10. Amphipoda benthonica. Ministry of Commerce & Industry, Egypt. Fisheries research directorate notes & memoirs 18: 27 pp.

Schellenberg, A. 1936. Zwei neue Amphipoden des Stillen Ozeans und zwei Berichtigungen. Zoologischer Anzeiger 116: 153-156.

Schellenberg, A. 1937. Höhlenamphipoden Spaniens und ihre Beziehung zu Nordafrika. Zoologischer Anzeiger 118: 223-224.

Schellenberg, A. 1938. Brasilianische Amphipoden mit biologischen Bemerkungen. Zoologische Jahrbucher, Systematik 71: 203-218.

Schellenberg, A. 1938. Litorale Amphipoden des tropischen Pazifiks. Kungliga Svenska Vetenskapsakademiens Handlingar (3) 16 (6): 1- 105.

Schellenberg, A. 1939. Amphipoden des Kongo-Mundungsgebietes. Revue de Zoologie et de Botanique Africaines, 32; 1: 122-138.

Schellenberg, A. 1939. Verbreitung und Alter der Amphipoden Gattung Pseudoniphargus nebst Verbreitung der Gattung Niphargus. Zoologischer Anzeiger 127: 297-304.

Schellenberg, A. 1942. Krebstiere oder Crustacea IV: Flohkrebse oder Amphipoda. Die Tierwelt Deutschlands 40: 1-252.

Schram, F. 1978. Arthropoda: A Convergent Phenomenon. Fieldiana Geology 39: 61-108.

Schram, F.R. 1983. Editor Crustacean Phylogeny. Rotterdam (Balkema) 372 pp.

Sheard, K. 1939. Studies in Australian Gammaridea (1). The Genus Ceradocus. Records of the South Australian Museum 6: 278-295.

Shoemaker, C.R. 1920. Amphipods collected by the American Museum Congo Expedition 1909-1915. Bulletin of the American Museum of Natural History 43: 371-378.

Shoemaker, C.R. 1921. Report on the amphipods collected by the Barbados-Antigua Expedition from the University of Iowa in 1918. Studies in Natural History 9 (5): 99-102.

Shoemaker, C.R. 1933. Two new Genera and six new species of Amphipoda from Tortugas. Papers from Tortugas laboratory 28 (15): 247-256.

Shoemaker, C.R. 1935. The amphipods of Porto Rico and the Virgin Islands. Scientific survey of N.Y. Academy of Sciences P.R, & V.I. 15 (2): 229-262.

Shoemaker, C.R. 1941. On the names of certain California amphipods. Proceedings of the Biological Society of Washington 54: 187-188.

Shoemaker, C.R. 1942. Amphipod Crustaceans collected on the Presidential Cruise of 1938. Smithsonian Miscellaneous Collections 101 (11): 1-52.

Shoemaker, C.R. 1947. Further notes on the amphipod genus Corophium from the east coast of America. Journal of the Washington Academy of Sciences 37 (2): 47-63.

Shoemaker, C.R. 1956. Observations on the amphipod genus Parhyale. Proceedings of the United States National Museum 106: 345-358.

Siewing, R. 1963. Studies in malacostracean morphology: results and problems. Phylogeny and evolution of Crustacea. Harvard, Cambridge, Massachusetts: 85-103.

Silva-Brum, I.N. da 1975. Spelaeogammarus bahiensis g.n. sp.n. de Anfipodo cavernicola do Brasil. (A-B). Atlas da Sociedade de Biologia do Rio de Janeiro 17: 125-128.

Sims, R.W. 1980. Marine and brackish water animals. Animal identification I. (British Museum (Natural History)) London. 111 pp.

Smith, S.I. 1874. Crustacea. In: Verill, A.E. Report upon the invertebrate animals of Vineyard Sound and the adjacent waters, with an account of the physical characters of the region. U.S. Commission of Fish and Fisheries 1: 295-778.

Spandl, H. 1924. Die Amphipoden des Roten Meeres. Akademie der Wissenschaften in Wien, Mathematisch-Naturwissenschaftliche Klasse 99: 19-73.

Stebbing, T.R.R. 1888. Report on the Amphipoda collected by H.M.S. Challenger during the years 1873-1876. Report on the scientific results of the Voyage of H.M.S. Challenger during the years 1873-1876. Zoology, 29: 1737 pp., 210 plates.

Stebbing, T.R.R. 1891. On sessile-eyed crustaceans. Annals and Magazine of Natural History (6) 8: 324-330.

Stebbing, T.R.R. 1899. Amphipoda from the Copenhagen Museum and other sources. Transactions of the Linnean Society of London (2) Zoology 7: 395-432.

Stebbing, T.R.R. 1903. Amphipoda from Costa Rica. Proceedings of the United States Museum 26: 925-931.

Stebbing, T.R.R. 1906. Amphipoda I. Gammaridea. Das Tierreich 21: 806 pp.

Stebbing, T.R.R. 1922. Isopoda and Amphipoda from Angola and South Africa. Göteborg Vetenskablige Handlingar 25 (2): 1-16.

Steeman Nielsen, J.E. 1957. Primary Oceanic Production. The autotrophic production of organic matter in the oceans. Galathea Reports 1: 48-139.

Steinberg, J. & Dougherty, E. 1957. The skeleton shrimps (Crustacea: Caprellidae) of the Gulf of Mexico. Tulane Studies in Zoology, New Orleans 5(11): 267-288.

Stephensen, K. 1932. Some new Amphipods from Japan. Annotations Zoologicae Japoneses. 13: 487-501.

Stephensen, K. 1933. Fresh and brackish water Amphipoda from Bonaire, Curacao and Aruba. Zoologische Jahrbucher, Systematik 64: 415-436.

Stephensen, K. 1933. Amphipoda from the marine salines of Bonaire and Curacao. Zoologische Jahrbucher, Systematik 64: 437-446.

Stephensen,K.1935. Talorchestia rectimana (Dana) from Tahiti and Moorea. Bulletin of the Bernice Pauahi Bishop Museum. 113 : 143 - 147.

Stephensen, K. 1938. Amphipoda, Tanaidaea und Pycnogonida. Zoologische Ergebuder Reisen von Dr Kohl-Larsen nach den Südantarktischen Inseln bei Neu-Seeland und nach Süd-Georgien, 11. Senckenbergiana 20: 236-264.

Stephensen, K. 1942. The Amphipoda of N. Norway and Spitzbergen with adjacent waters. Tromsø Museum Skrifter: 526 pp.

Stephensen, K. 1948. Amphipoda from Curacao, Aruba, Bonaire and Margarita. Studies Fauna Curacao 3: 20 pp.

Stimpson, W. 1853. Synopsis of the Marine Invertebrates of Grand Manan: or the region about the mouth of the Bay of Fundy, New Brunswick. Smithsonian Contributions to Knowledge 6: 5-56.

Stimpson, W. 1855. Descriptions of some new Marine Invertebrata. Academy of Natural Sciences of Philadelphia, Proceedings 7: 375-384.

Stock, J.H. 1976. A new member of the crustacean suborder Ingolfiellidea from Bonaire with a review of the entire suborder. Studies Fauna Curacao 164: 56-75.

Stock, J.H. 1977. The taxonomy and zoogeography of the hadziid Amphipoda, with emphasis on the West Indian taxa. Studies on the Fauna of Curacao and other Caribbean Islands. 55: 1-130.

Stock, J.H. 1977. Zoogeography of Ingolfiellidea, Crustacea. Studies on the Fauna of Curacao and other Caribbean Islands. 55: 131-146.

Stock, J.H. 1979. New data on taxonomy and zoogeography of Ingolfiellid Crustacea. Bijdragen tot de Dierkunde 49 (1): 81-96.

Stock, J.H. 1980. Regression model evolution as exemplified by the genus Pseudoniphargus (Amphipoda). Bijdragen tot de Dierkunde 50 (1): 105-144.

Stock, J.H. 1980. Un Metaniphargus (Amphipoda) nouveau de l'ile Marie-Galante (Atilles). Bulletin du Museum National d'Histoire Naturelle (4) 2: 413-419.

Stock, J.H. 1981. The taxonomy and zoogeography of the family Bogidiellidae (Crustacea, Amphipoda), with emphasis on the West Indian taxa. Bijdragen tot de Dierkunde 51: 345-374.

Stock, J.H. 1982. Stygobiont crustacea malacostraca from geologically older and antillean islands: a biogeographic analysis. Amsterdam expeditions to the West Indian islands, report 18. Bijdragen tot de Dierkunde 52: 191-199.

Stock, J.H. 1983. The stygobiont Amphipoda of Jamaica. Bijdragen tot de Dierkunde 53: 267-286.

Stock, J.H. & Botosaneanu, L. 1983. Première découverte d'amphipodes Gammaridae du groupement des Hadziides dans des eaux souterraines de l'Amerique du Sud: Description de Metaniphargus venezolanus sp.n. Bijdragen tot de Dierkunde 53: 158-164.

Stout, V.R. 1913. Studies in Laguna Amphipoda. Zoologische Jahrbucher, Systematik 34: 633-659, 3 figures.

Stuart, H. 1977. Biota acuatica de Sudamerica austral. Department of Biology, San Diego State University, San Diego, California: 146-162.

Tattersall, W.M. 1914. Crustacea Amphipoda. Zoological results of the Abor Expedition, 1911-1912. Records of the Indian Museum 8: 449-453.

Thomas, J. 1979. Occurrence of the amphipod Leucothoides pottsi Shoemaker in the tunicate Ecteinascidia turbinata Herdman from Big Pinekey, Florida, U.S.A. Crustaceana 37 (1): 107-109.

Thomas, J. & Barnard, J.L. 1983. Transformation of the Leucothoides morph to the Anamixis morph (Amphipoda). Journal of Crustacean Biology 3 (1): 154-157.

Thomas, J. & Barnard, J.L. 1983. The Platyischnopidae of America (Crustacea, Amphipoda). Smithsonian Contributions to Zoology 375: 33 pp.

Thomson, G. 1879. New Zealand Crustacea, with descriptions of new species. Transactions and Proceedings of the New Zealand Institute 11: 230-248.

Thomson, G. 1885. New Crustacea. New Zealand Journal of Science 2: 576-577.

Thorsteinson, E. 1941. New or noteworthy amphipods from North Pacific coast. Seattle, University of Washington, Publications in Oceanography. 4: 55-94.

Tiegs, O. & Manton, S. 1958. The evolution of the Arthropoda. Biological Reviews of the Cambridge Philosophical Society 33: 255-337.

Urbani, F. 1967. La Sima del Agua dulce. Boletin Sociedad Venezolana Espeleologia 1 (1): 5-10, 36.

Vandel, A. 1926. La repartition de deux amphipodes, Gammarus pulex (L.) et Echinogammarus berilloni (Catta) dans le sud-ouest de la France. Bulletin de la Societe Zoologique de France 51: 35-39.

Van Lieshout, S.E.N. 1983. Presence of a member of the genus Saliweckelia (Amphipoda) on Tortuga, Venezuela. Bijdragen tot der Dierkunde 53: 244-246.

Walker, A.O. 1904. Report on the Amphipoda collected by Professor Herdman at Ceylon in 1902. Ceylon Pearl Oyster Fisheries. Supplementary Report 17: 229-300, 8 plates.

Walker, A.O. 1905. Marine crustaceans. XVI Amphipoda. The Fauna and Geography of the Maldive and Laccadive Archipelagoes 2, Supplement 1: 923-932.

Walker, A.O. & Scott, A. 1903. Decapoda and sessile-eyed crustaceans from Abd-el-Kuri. The Natural History of Sokotra, II: 216-233.

Watling, L. 1981. An alternative phylogeny of peracarid crustaceans. Journal of Crustacean Biology 1 (2): 201-210.

Watling, L. 1983. Peracaridan disunity and its bearing on eumalacostracan phylogeny with a redefinition of eumalacostracan superorders. Crustacean Phylogeny. Rotterdam (Balkema) 213-228.

White, A. 1847. List of the specimens of Crustacea in the collection of the British Museum. London. (Trustees, London) 143 pp.

Weber, M. 1892. Die Susswasser-Crustaceen des Indischen Archipels, nebst bemerkungen uber die Susswasser-Fauna in Allgemeinen. Zoologische Ergebnisse einer Reise nach Niederlandischen Ost-Indien 2: 528-571.

Yager, J. 1981. Remipedia, a new class of Crustacea from a marine cave in the Bahamas. Journal of Crustacean Biology 1: 328-333.

Zaddach, G. 1864. Ein Amphipode in Bernstein. Schriften der Koniglichen Physikalisch-Okonomischen Gesellschaft zu Konigsberg 5: 1-12.

Zimmerman, R. & Barnard, J.L. 1977. A new genus of primitive marine Hadziid (Amphipoda) from Bimini and Puerto Rico. Proceedings of the Biological Society of Washington 89: 565-580.

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