

GUIDE TO THE COASTAL AND SURFACE ZOOPLANKTON OF THE SOUTH-WESTERN INDIAN OCEAN

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DEFRA Darwin Initiative Zooplankton Programme

Version 1 June 2003



**Marine Biological Association of the United Kingdom
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UK-DEFRA Darwin Initiative Project 162/09/004
Zooplankton of the Mascarene Plateau

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CONTENTS

Introduction	Page 4
Background to the Zooplankton programme	4
Sampling programme	4
Scope of this guide	5
Acknowledgements	6
Phytoplankton and cyanobacteria	7
Protozoan Zooplankton	8
Phylum Sarcomastigophora	8
Radiolaria	8
Acantharia	9
Foraminifera	10
Phylum Ciliophora	10
Tintinnida	10
Eumetazoan Zooplankton	11
Phylum Cnidaria	11
Class Anthozoa	11
Class Scyphozoa	12
Class Hydrozoa	13
Sub-class Hydroidomedusae	13
Sub-class Siphonophorae	25
Phylum Ctenophora	38
Phylum Platyhelminthes	39
Phylum Nemertina	40
Phylum Rotifera	41
Phylum Mollusca	42
Phylum Annelida	63
Phylum Arthropoda	73
Subphylum Uniramia	73
Class Insecta	73
Subphylum Chelicerata	74
Class Pycnogonida	74
Subphylum Crustacea	74
Class Brachiopoda	74
Suborder Cladocera	74
Class Maxillipoda	75
Infraclass Facetotecta	75
Infraclass Cirripedia	75
Subclass Copepoda	76
Order Calanoida	82

Order Cyclopoida	195
Order Harpacticoida	208
Order Poecilostomatoida	218
Order Monstrilloida	263
Order Siphonostomatoida	263
Class Ostracoda	264
Class Malacostraca	265
Order Stomatopoda	265
Order Mysida	266
Order Amphipoda	266
Order Isopoda	267
Order Cumacea	268
Order Euphausiacea	269
Order Decapoda	281
Phylum Phoronida	292
Phylum Bryozoa	292
Phylum Brachiopoda	293
Phylum Echinodermata	293
Phylum Chaetognatha	294
Phylum Hemichordata	319
Phylum Urochordata	319
Class Ascidiacea	319
Class Larvacea	320
Class Thaliacea	320
Subphylum Cephalochordata	321
Bibliography	322

The background to the cover of the guide is page 100, Pontellid copepods, from Dakin, W.J. & Colefax, A.N. 1940. The plankton of the Australian coastal waters off New South Wales. Part 1. Publications of the University of Sydney, Department of Zoology.

INTRODUCTION

This guide has been compiled, as part of a UK DEFRA Darwin Initiative Project, as an aid to researchers, particularly new researchers, in the identification of south-western Indian Ocean zooplankton. It has been compiled because much of the identification literature covering this area of amazing biodiversity is currently spread through the scientific literature and not easily accessible without extensive library resources. The guide was produced in a limited time period, so some specialist groups have not been dealt with in great detail. However, we hope to gradually extend the guide to fill any gaps. We would welcome any comments and corrections (please contact Dr Dave Conway at dvpc@mba.ac.uk).

Background to the DEFRA Darwin Initiative, Zooplankton Project

The Mascarene Plateau is a 2,200 km crescent-shaped ridge that runs roughly north-south from the Seychelles Bank to the island of Mauritius. The ridge's islands, banks and shoals form a barrier modifying predominantly westward passage of the South Equatorial Current and waves across the Indian Ocean. The ridge shallows to less than 30m in many areas of the banks at the north of the plateau and places, where the depth of the plateau is less than 200m can be more than 250km wide. The Mascarene Plateau is a rare example of an extensive shallow-shelf sea completely detached from land boundaries, and is a large, almost completely unexplored marine ecosystem.

Because it is a little studied region, the Royal geographical Society (with the institute of British geographers) and Royal Society set up the *Shoals of Capricorn* marine programme. The purpose of the research, coupled with education and training, was to help with sustainable development and conservation of the marine and coastal environments of the Seychelles and Mauritius, including the off lying island of Rodrigues. A second aim was to develop a better picture of how the Mascarene ridge affects water flows and ecological processes in a key global ocean-climate system – the western Indian Ocean.

In April 2000, the UK (DEFRA) Darwin Initiative funded a joint training and research programme between local agencies in Mauritius and Seychelles, the *Shoals of Capricorn* programme and Plymouth Marine Laboratory with the Marine Biological Association. The programme, called *Biodiversity in the basement of the marine food web*, was to focus on the zooplankton of the Mascarene Plateau. One of the project's primary objectives was, for the first time, to identify important zooplankton species around the Seychelles and Mauritius and start local training and research programmes to monitor plankton diversity and abundance.

When the *Shoals of Capricorn* field programme formally came to an end in November 2001, the Shoals bases were handed over to the host nations. In the Seychelles this was undertaken by the new Seychelles Centre for Marine Research and Technology – Marine Parks Authority (SCMRT– MPA) under the Ministry of Environment, and in Rodrigues through a new non-governmental organisation, Shoals Rodrigues, associated with the Mauritius Oceanography Institute (MOI). At the same time the management of the Darwin project was passed to the Plymouth Marine Laboratory (PML).

The zooplankton Darwin Initiative project ended in 2003 with a regional conference and workshop in the Seychelles to consolidate the three years of research and training, as well as to help map out strategies for each regional team. The workshop was used to launch this “Guide to the coastal and surface zooplankton of in the South Western Indian Ocean”.

Sampling programme

A weekly zooplankton sampling programme was started in September 2000 in both the Seychelles and Rodrigues. The sampling equipment used is a conical 0.4 m diameter hand net of 125 µm mesh aperture, fitted with a General Oceanics (GO) flowmeter. Because the stations are shallow and over coral, the net is towed on a horizontal haul for at least 5 minutes at approximately 5 m depth. Whenever possible, temperature and salinity measurements are taken in association with the hauls and records kept of meteorological conditions. Zooplankton samples are preserved in 4%, borax buffered formaldehyde. Zooplankton is being identified to as precise a taxonomic detail as possible and counted using sub-sampling techniques.

Counting of samples is also being carried out at both sites using an Optical Plankton Counter (OPC), which also gives zooplankton volumes, which can then be used to estimate biomass. The plankton net mesh size of 125µm was specifically chosen, as it samples organisms to the lower end of the size discrimination of the OPC. This net also efficiently samples the small copepods, which compose the bulk of the zooplankton biomass at the surface and in the coastal regions of these tropical waters.

In the Seychelles three stations are sampled for zooplankton, one off the capital Victoria (outside the immediate influence of the harbour), the second off the island of St Anne and the third in more open water, outside the small island of Seche. In Rodrigues one station is sampled, in water of 12 m deep, just beyond the reef edge, outside the shipping channel leading into the capital, Port Mathurin. Sampling stations were chosen to be accessible, except in extreme weather, and which were under the influence of both the reefs and open sea. Sampling is carried out, for safety reasons, only during the day and close to high water, to standardise sampling conditions as closely as possible.

Scope of this guide

This guide attempts to cover all pelagic zooplankton species sampled in the Seychelles and Rodrigues. However, it also includes information from ancillary sampling carried out using a Continuous Plankton Recorder (CPR) towed from HMS ‘Beagle’, south-east of the Seychelles, from 08°58'S, 59°41'E to 05°28'S, 55°45'E in February 1999, as well as samples taken between Seychelles and Rodrigues on the research yacht ‘Zuza’ in April 2001 and from some samples taken close to Aldabra in February 2001. We have also included species recorded from inshore zooplankton studies in Madagascar (Furnestin & Radiguet, 1964; Gaudy, 1967; Binet & Dessier, 1968; Patrity, 1970). This guide therefore includes a high proportion of the island-coastal and surface water zooplankton of the south-western Indian Ocean. The location where a particular species has been sampled has been noted. Some species, that have not been sampled but that are known to occur in the region, have been included.

For some specialist groups, which we did not have time to fully identify, a selection of representative members have been given, so that organisms can at least be assigned to perhaps a particular genus within the main group. This particularly applies to some of the meroplankton groups such as decapod larvae, which have many morphological changes between phases and

also between stages. For brevity, comprehensive taxonomic information has not been presented, but we feel sufficient information is contained to identify each species. Keys have not yet been included for genera, as further species will be added.

Classification of organisms is always in a state of flux, but for convenience here generally follows the scheme set out by Brands (1989-2002). For crustacea, we have followed the classification of Martin & Davis (2001).

Bibliography

A bibliography of relevant plankton references useful for identification of Indian Ocean species has been included, separated where possible into different groups. Some references are not specific to the Indian Ocean, but contain information on species that are recorded there.

ACKNOWLEDGEMENTS

We would like to acknowledge the UK-DEFRA Darwin Initiative (Project No. 162/09/004) who provided funding for this work, the Royal Geographical Society (with the Institute of British Geographers) and the Plymouth Marine Laboratory who have administered it, the original *Shoals of Capricorn* team, particularly Juliet Burnett, Jessica Kavanagh, Iain Watt, Jan Robinson, Martin Callow, Caroline Laughton, Tara Lynch, Sabrina Meunier, Tom Hooper and Jane Dodd, who have all contributed to the project in different ways. We would also like to thank the Seychelles Centre for Marine Research and Technology - Marine Parks Authority (SCMRT-MPA), Shoals Rodrigues, the Mauritius Oceanographic Institute, the University of Mauritius, the Rodrigues Ministry and the Albion Fisheries Research Centre for their continued support. In the Seychelles, the work would not have been possible without the support of many of the staff from the SCMRT-MPA, Coastguard Service, Meteorological Office, Public Utilities Corporation, Seychelles Bureau of Standards and Ministry of Environment and Transport. We would also like to acknowledge the National Marine Biological Library at the Marine Biological Association Laboratory in Plymouth and the Wolfson Library at the University of Wales, Bangor, whose comprehensive collections of literature and support from staff, greatly facilitated compilation of this guide.

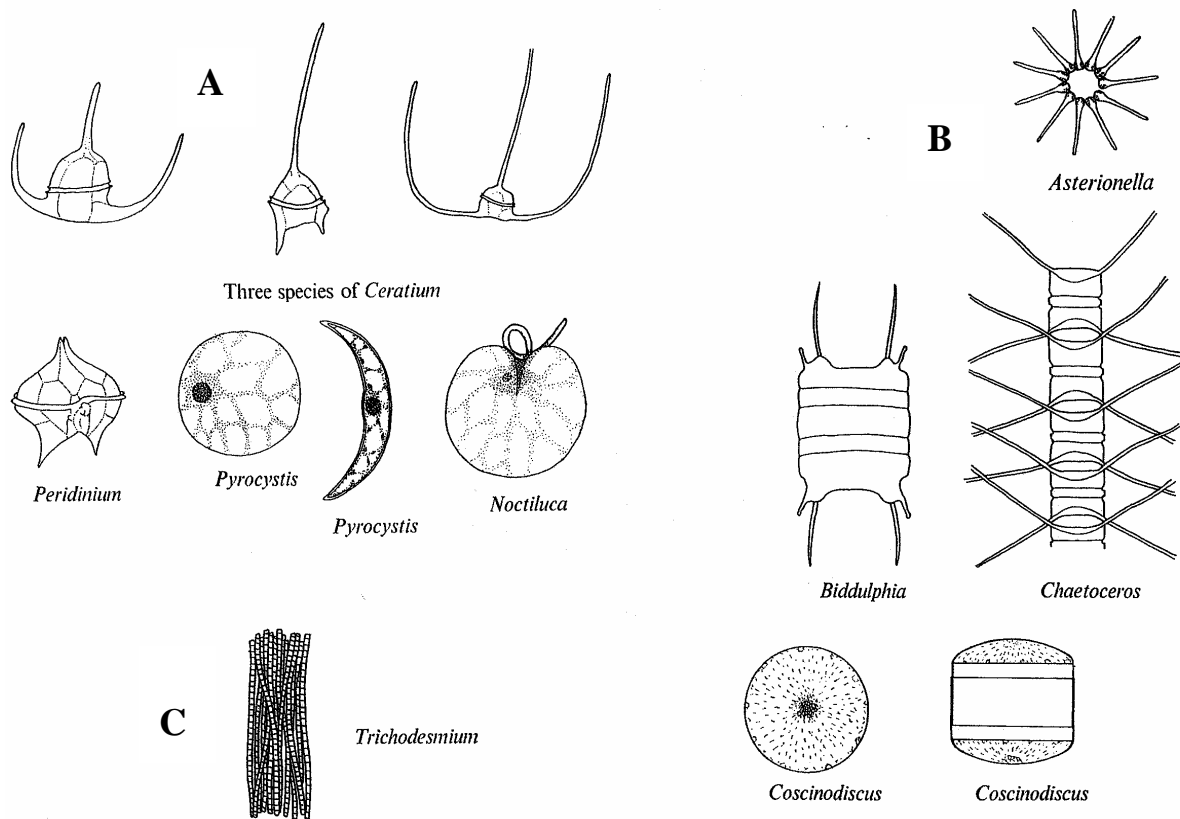
The guide could not have been prepared without the generous permission of journals, publishers and individual authors to use the many figures. The source of each figure has been individually acknowledged, but some sources we have relied on particularly heavily. In particular we would like to thank Janet Bradford-Grieve, who has prepared and compiled figures and descriptions of so many previously poorly described calanoid copepods of this southern area, for a large number of excellent calanoid copepod figures, Shuhei Nishida for cyclopoid and calanoid figures, John Mauchline for figures of copepod morphology, John Wickstead for figures of many of the smaller zooplankton groups, Francesc Pagès, Josep-Maria Gili and Jean Bouillon for their figures of medusae and siphonophores from Scientia Marina, which were beautifully drawn by Jordi Corbera, the University of California, Scripps Institution of Oceanography who gave permission to use the wonderfully detailed drawings of chaetognaths by Angeles Alvarino, the New Zealand Oceanographic Institute for the drawings of chaetognaths by Sigrid Lutschinger and the Zoological Museum Copenhagen who gave permission to use the mollusc figures from the Dana Report. Annelies Pierrot-Bults gave helpful advice on the chaetognath section.

PHYTOPLANKTON AND CYANOBACTERIA

The single celled plants are placed in the group we call **phytoplankton**. While phytoplankton is not being counted in the present work, a few examples are given in case they are noticed in samples. The two main groups which will be found are **dinoflagellates**, which have two thin whip-like flagellae (usually only visible in living specimens) used in swimming and **diatoms** which do not have flagellae. Examples of dinoflagellates are *Noctiluca* and *Pyrocystis*. These are both luminescent when disturbed and can cause the silvery trails seen behind boats at night. Other examples are *Ceratium*, many species of which are anchor-shaped and *Peridinium* which is a stubby, spindle-shaped species. Dinoflagellates, when alive, can vary in colour from brownish to green or red and can occur in high enough numbers to colour the sea.

Diatoms may be found singly, or because of the way they can reproduce, they can also be found in long chains. Some chains can be straight as in *Chaetoceros*, or in a spiral as in *Asterionella*. A common diatom called *Coscinodiscus* appears circular from above, but when turned on its side is actually a circular box.

Trichodesmium is a "blue-green algae" which can occur in high numbers, typically found in samples as a tangle of tiny elongated fibres, which may be in bunches. It was first described in Australian waters by Captain Cook in the 1700's who mistook the large brown blooms of *Trichodesmium* as sandbanks. They are not "algae" at all, but in fact photosynthetic bacteria, cyanobacteria. *Trichodesmium* is globally distributed in tropical and subtropical seas. They have large gas vacuoles which enable it to regulate its position in the water column.



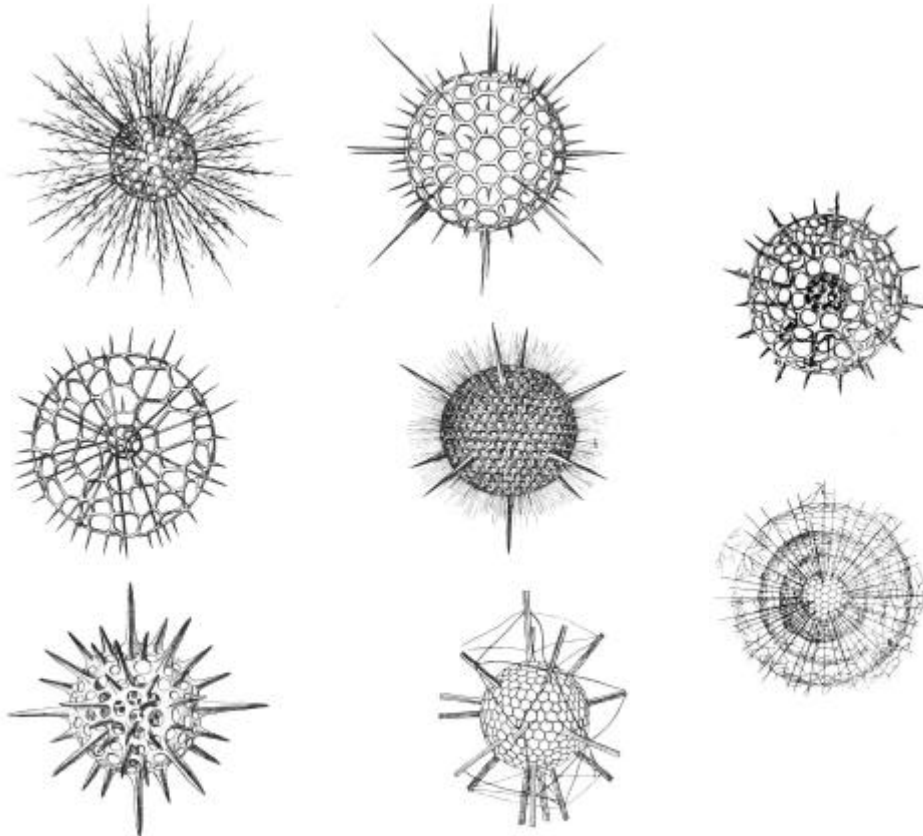
Examples of phytoplankton and cyanobacteria. A: Dinoflagellates; B: Diatoms; C: Cyanobacteria (From Wickstead 1965).

PROTOZOAN ZOOPLANKTON

PHYLUM SARCOMASTIGOPHORA

Radiolaria

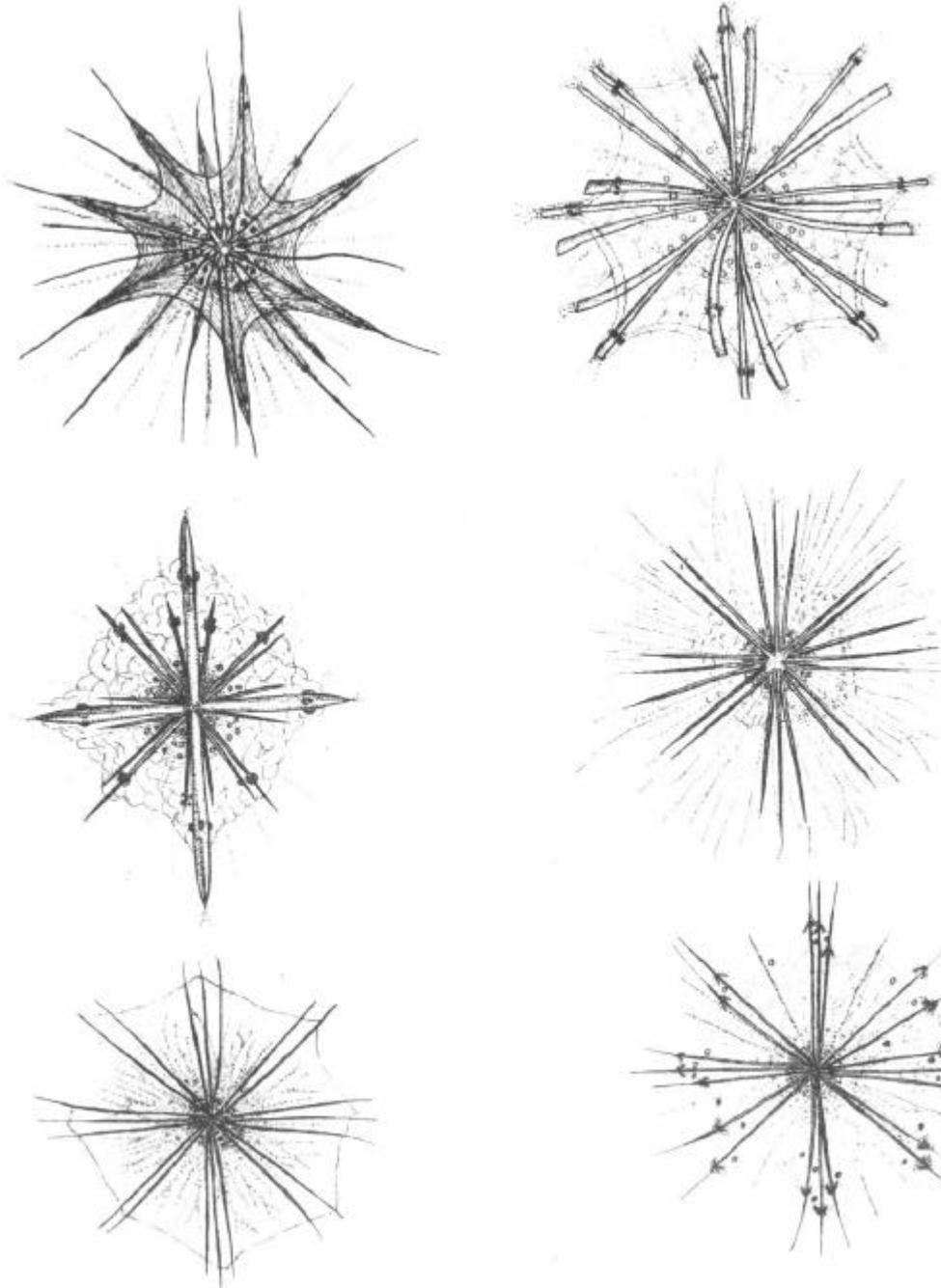
Radiolaria are protozoa, distinguished by segregation of their soft body into the central capsule, containing the endoplasm, and the surrounding ectoplasm and by the siliceous (opaline) skeletons of most species. They take their name from the radial symmetry, often marked by radial skeletal spines, characteristic of many forms, although this symmetry is sometime lacking. Skeletal elements of radiolarians, even the radially symmetrical ones, do not actually meet at the center of the organism. This distinguishes them from the superficially similar skeletons of acantharians, which are composed of celestite rather than opal. They are generally found as single structures, although some form colonies. Some radiolarians can reach up to 5 mm in diameter, which is very large for a single celled organism.



Representative radiolaria (From Haeckel, 1862, 1867).

Acantharia

These planktonic protozoa are now separated from the Radiolaria into a separate class. They have skeletons of celestite formed by a set of spicules which, unlike Radiolaria, always meet at the centre of the protoplasmic body.

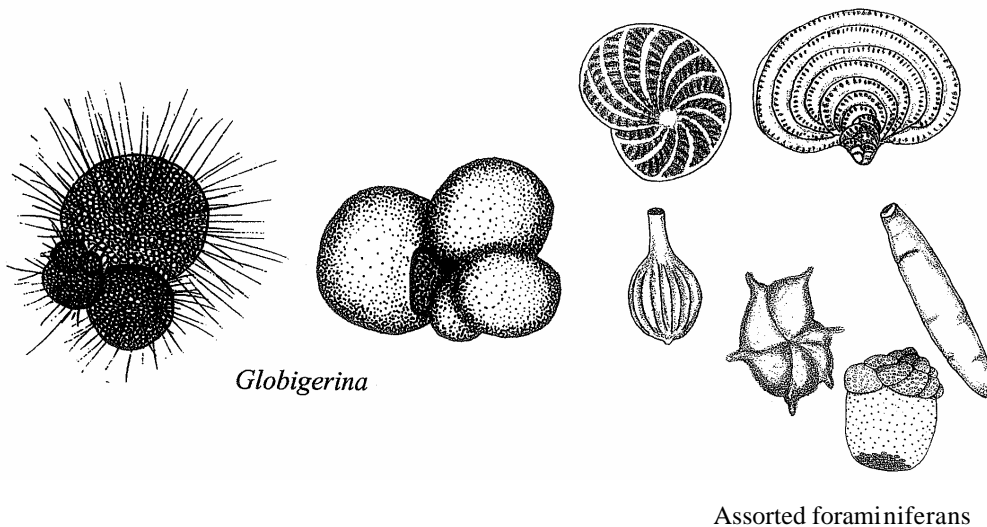


Representative Acantharians (From Trégouboff & Rose, 1957).

Foraminifera

The shell of foraminifera may be made of organic compounds, sand grains and other particles cemented together, or crystalline calcite. The skeleton is usually arranged in a series of chambers of increasing size, the last open to the outside. Some appear like flattened snail shells but there are a great variety of shapes, the simplest forms being open tubes or hollow sphere. *Globigerina* is a very common foraminiferan in the tropics and is usually found as a group of spheres of different sizes stuck together. They also have spines like a sea urchin, but these can be missing.

In some species the protoplasm covers the outside of the shell. The largest species can have a symbiotic relationship with algae. Food ranges from dissolved organic molecules, bacteria, diatoms and other single celled phytoplankton, to small animals such as copepods. They move and catch their food with a network of thin extensions of the cytoplasm similar to the pseudopodia of an amoeba, although much more numerous and thinner.

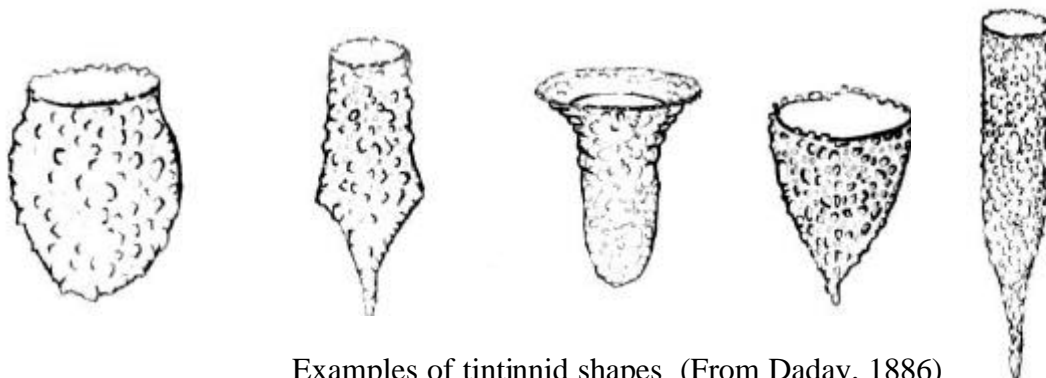


Examples of foraminiferans (From Wickstead, 1965)

PHYLUM CILIOPHORA

Tintinnida

The main body is enclosed in a flask-shaped lorica composed of gelatinous material, usually smooth, but in some groups embedded with fragments, giving a granular external appearance. Cilia on the body are reduced or absent. In live animals a crown of cilia emerges from the flask, sometimes interspersed with small tentacles.



Examples of tintinnid shapes (From Daday, 1886)

EUMETAZOAN ZOOPLANKTON

The majority of zooplankton organisms sampled in the plankton nets will be eumetazoans, which are a subkingdom of the animal kingdom comprising all animals except the sponges and the wormlike mezozoans. Their bodies are composed of many cells, usually arranged in tissues and organs.

PHYLUM CNIDARIA

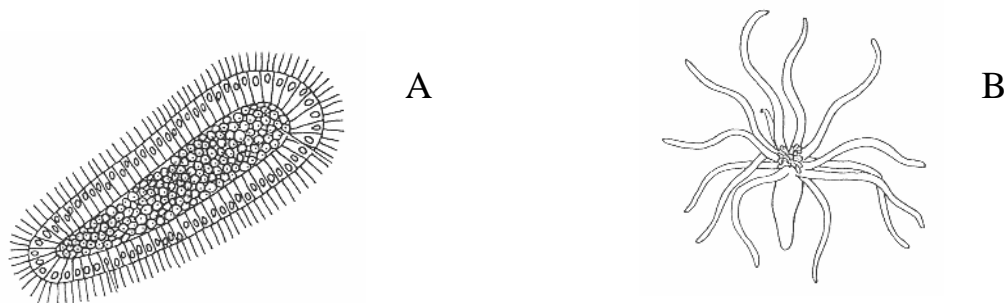
The Phylum Cnidaria (sometimes called Coelenterata) obtains its name from the stinging cells, called cnidoblasts which members of this phylum possess. Cnidarians are usually mainly composed of “jelly” and includes the group of animals commonly called jellyfish. The planktonic forms generally swim in pulses, by muscular contractions of part or all of their bodies, pumping water out of a cavity.

Within the Phylum Cnidaria there are three classes which have representatives in the plankton of the south-west Indian Ocean region. They are separated using distinctive features in their bottom living polypoid (or hydroid) or free-swimming jellyfish (or medusoid) phases:

- **Class Anthozoa** - includes sea anemones and corals
- **Class Scyphozoa** – the large jellyfish
- **Class Hydrozoa** – there are five Subclasses in Class Hydrozoa, but only two have many planktonic members, **Subclass Hydroidomedusae** which includes the small jellyfish and **Subclass Siphonophora**, the siphonophores.

CLASS ANTHOZOA

Anthozoa means the flower animals and included in this group are corals and sea anemones. The anthozoans have a polyp shape and medusae are never produced. Very few anthozoans occur in the plankton, but corals have a larva called a planula which may be found for a short time in high numbers in the plankton at particular times of year. The planula is flat, oval-shaped and may be up to around 1 mm in length. Additionally, some larvae of sea anemones are found in the plankton, particularly a species called *Cerianthus*, which has a larva called an arcanactis. This has tentacles and resembles a tiny sea anemone.

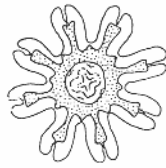


A, planula larva; B, arcanactis larva (From Wickstead, 1965).

CLASS SCYPHOZOA

This class includes the easily recognisable large jellyfish, which, because they drift with the currents are still considered to be planktonic. Thankfully, they are rarely caught in plankton nets, as the plankton can get tangled in their bodies. The life cycle of scyphozoa either lacks a polyp stage, or they have a larval polyp attached to rocks or other substrate that may develop directly into a single medusa, or give rise to many medusae by budding off a small larva called an ephyra. The ephyra stage is often found in plankton samples.

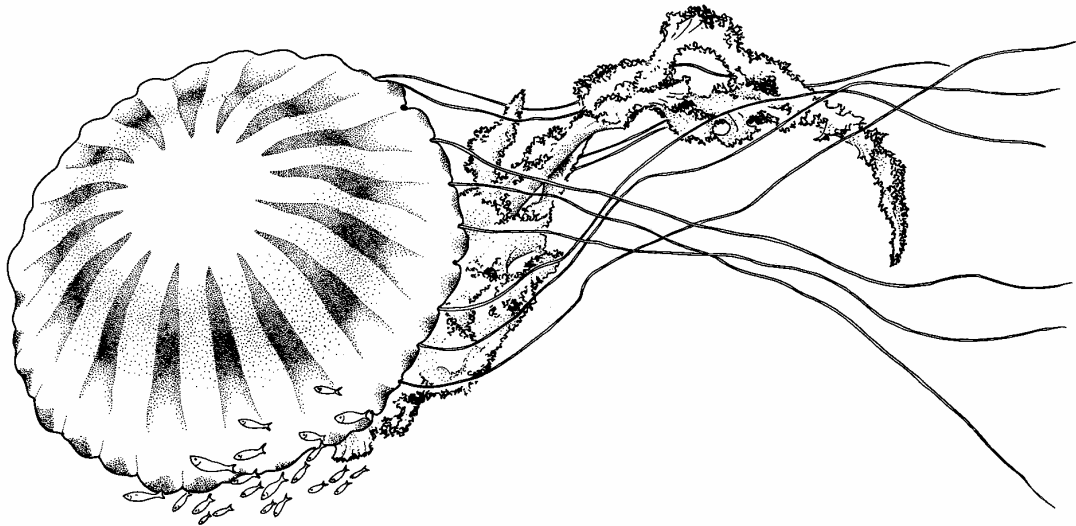
Young fish are often found associated with these large jellyfish (see the illustration of *Chrysaora* below), using them for protection. They do not seem to be affected by the stinging cells and the jellyfish are probably important for their survival and dispersal.



Ephyra larvae (From Wickstead, 1965)

Chrysaora hysoscella (Linnaeus, 1766)

Umbrella flat smooth and thick, 30 cm or wider in diameter. The colour is variable, but is characterised by 16 v-shaped brown marks on the upper umbrella, radiating from the central region. There are 24 marginal tentacles, which are easily broken off, and thirty-two pigmented semi-circular marginal lappets.



Chrysaora hysoscella (Figure by J. Corbera, From Pagès *et al.*, 1992)

CLASS HYDROZOA

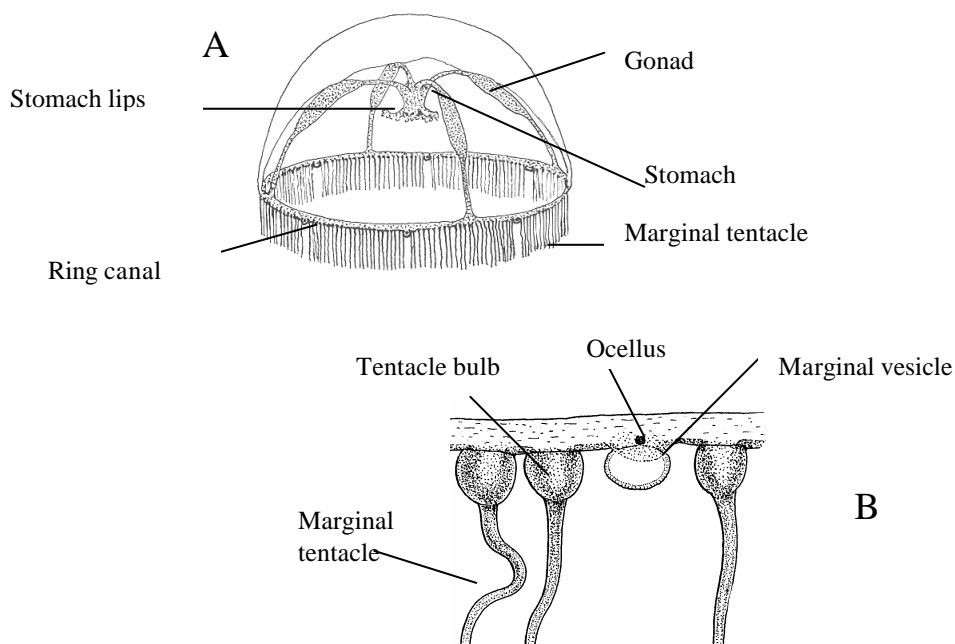
These are either single (solitary), or form colonies and may have a life cycle which is exclusively polypoid, exclusively medusoid, or with both phases.

Subclass Hydroidomedusae

This group includes the small jellyfish (or medusae), which occur in a variety of different shapes and thickness of jelly, some flat others bell shaped. The commonest ones are budded of asexually from flower-like hydroid polyps, which are found attached to rocks, seaweed etc. The free swimming medusoid stage then reproduces sexually. A free swimming planula larva develops from the egg, which settles and grows into a new hydroid polyp. Some members do not have a sessile bottom living stage, but have a completely planktonic existence.

The medusoid stages have a central stomach which may be short, or on a stalk (peduncle). Tentacles are arranged in bunches or spread round, at or close to the edge of the body in different combinations of numbers and sizes, depending on the species. Ocelli coloured black, brown or red are sometimes found on the base of the marginal tentacles. These are organs for light reception. Statocysts can also be found round the umbrella margin. These are probably organs of orientation, informing the medusa how it is positioned in relation to gravity. They can be internal open pits, closed vesicles or external club shaped organs. The gonads are usually situated on the stomach, or on the radial canals which run between the stomach and circumference of the medusa.

It is difficult to identify the medusae in their young stages, before adult characteristics develop. Some of the most useful publications on hydroida are by Mayer (1910), Pagès *et al.* (1992) and Russell (1953). Hydroidomedusae have five main Orders, which are all represented in the south western Indian Ocean - **Anthomedusae**, **Leptomedusae**, **Linnomedusae**, **Trachymedusae** and **Narcomedusae**. Few specimens in good condition have been sampled. However, a guide to some of the species likely to be present has been obtained from a survey done in the Seychelles of the bottom living hydroid stages (Millard and Bouillon, 1973). Examples of a variety of species are given, even though many of them have not yet been found in the samples.

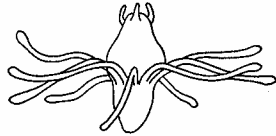


A, Structure of medusae; B, Details of umbrella margin (From Russell, 1953).

Order Anthomedusae

Usually have a deep, bell-shaped body (umbrella), but very variable in shape. The gonads are usually situated on the stomach or occasionally both on the stomach and extending a short distance along the radial canals. They have no statocysts.

Some anthomedusae produce an actinula larva, which can be found in the plankton. The larva has tentacles and resembles a small sea anemone, although the tentacles are not at the end of the body, but mid-way down.



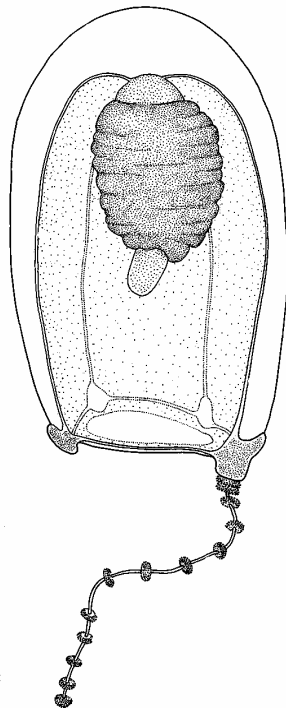
Actinula larvae (From Wickstead, 1965).

Family Tubulariidae

Euphysa sp.

The umbrella is barrel-shaped with a rounded apex; jelly thick especially at apex. Stomach large and cylindrical, two-thirds the length of the umbrella cavity, at full extension never reaching beyond the umbrella margin. The mouth is simple and circular. There are 4 narrow ring canals, one single short marginal tentacle and 3 marginal bulbs without tentacles. In good specimens the tentacle can be seen to be covered in rings of nematocysts. A small medusae, around 1.4-6.0 mm in height.

Recorded: Seychelles (Millard and Bouillon, 1973), as *Corymorpha* sp. It is uncertain which genera this specimen belonged to, so *Euphysa* is given as an example of the Tubulariidae.



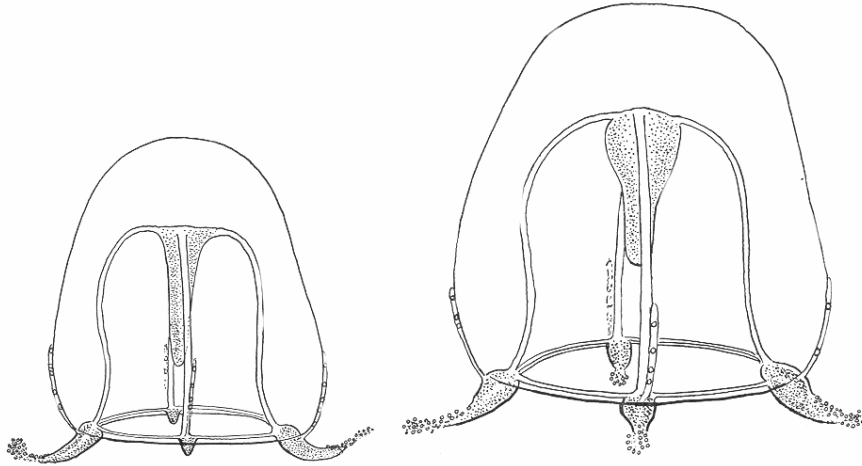
Euphysa aurata (Figure by J. Corbera, From Pagès *et al.*, 1992)

Family Zancleidae

Zanclea costata Gegenbaur, 1856.

Umbrella bell-shaped, about as high as wide, with quite thick jelly. 2 or 4 marginal tentacles. Stomach cylindrical, never reaching beyond the umbrella margin. Mouth simple, 4 straight radial canals. Can have two opposite marginal tentacles and 2 opposite marginal bulbs without tentacles, or 4 marginal tentacles. Umbrella height usually 1.5-3.0 mm.

Recorded: Seychelles (Millard and Bouillon, 1973) as *Zanclea? costata*.



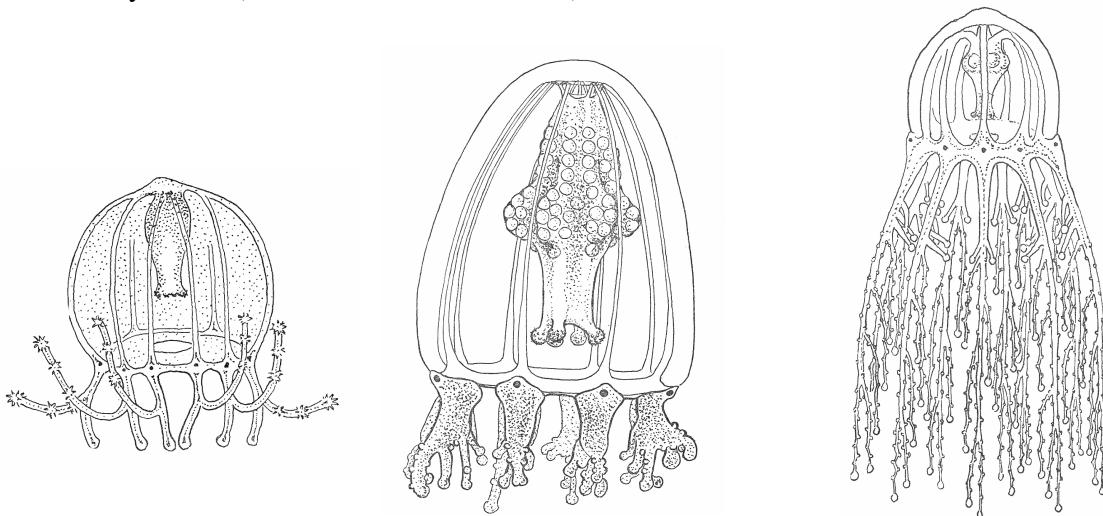
Zanclea costata. Different development stages (From Russell, 1953).

Family Cladonemidae

Cladonema radiatum Dujardin, 1843.

Very distinctive, creeping and swimming medusae. Umbrella bell-shaped, slightly higher than broad. Stomach spindle-shaped usually with 5, sometimes 4 pouch-like outgrowths in the central section. Mouth with 5, sometimes 4 protuberances armed with stinging cells. Stomach not extending beyond umbrella margin. 5 sometimes 4 radial canals, some of which can branch forming 8 or 10 canals. Usually 8, sometimes 10 marginal tentacles, corresponding to the number of radial canals. Marginal tentacle branched, with ocelli on tentacle bulb. Height up to about 4 mm.

Recorded: Seychelles (Millard and Bouillon, 1973).

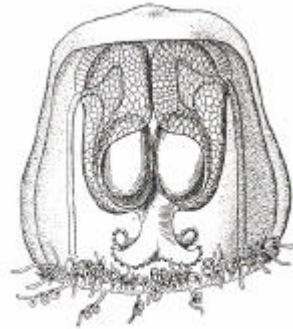


Cladonema radiatum. Different developmental stages (From Russell, 1953).

Family Clavidae

Turritopsis nutricula McCrady, 1859

Umbrella bell-shaped, slightly higher than wide composed of thin jelly. Stomach cross-shaped in section, not reaching beyond umbrella margin. 4 radial compact masses of vacuolated cells above the stomach. Mouth with 4 lips, with many circular masses of stinging cells along its edge. 4 radial canals. 80-90 marginal tentacle, close together in a single row. Small ocelli on tentacle bulbs. Height 4-5 mm. Recorded: Seychelles (Millard and Bouillon, 1973).



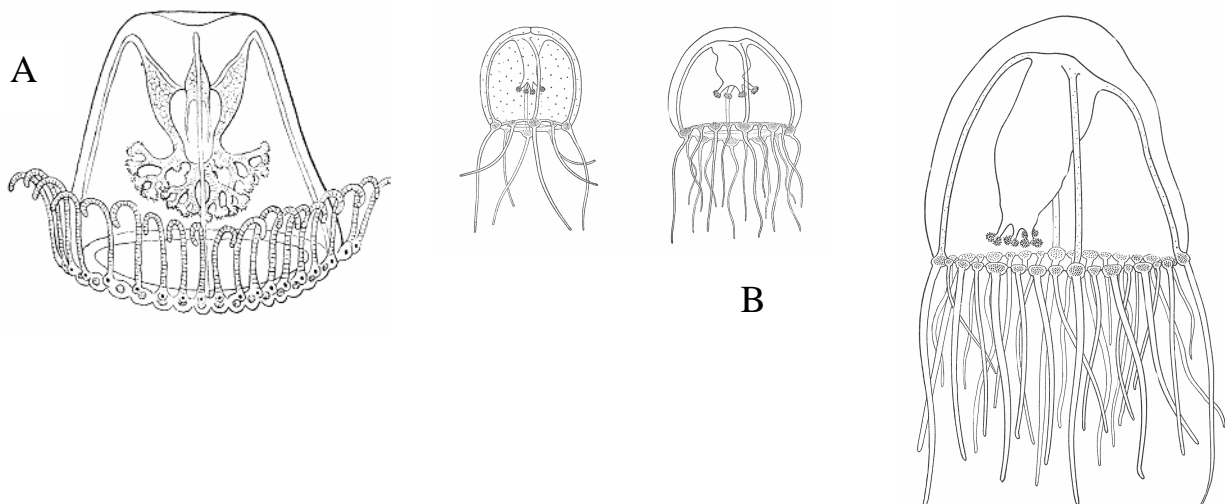
Turritopsis nutricula. (From Mayer, 1910).

Family Hydraciniidae

Podocoryne sp.

Umbrella bell-shaped with rounded apex. Stomach not extending beyond stomach margin. Gonads on stomach wall or extending slightly onto radial canals. Four radial canals. Mouth with 4 simple or branching lips with circular nematocyst clusters. 4, 8 or more marginal tentacles. No ocelli on tentacle bulbs.

Recorded: Seychelles.



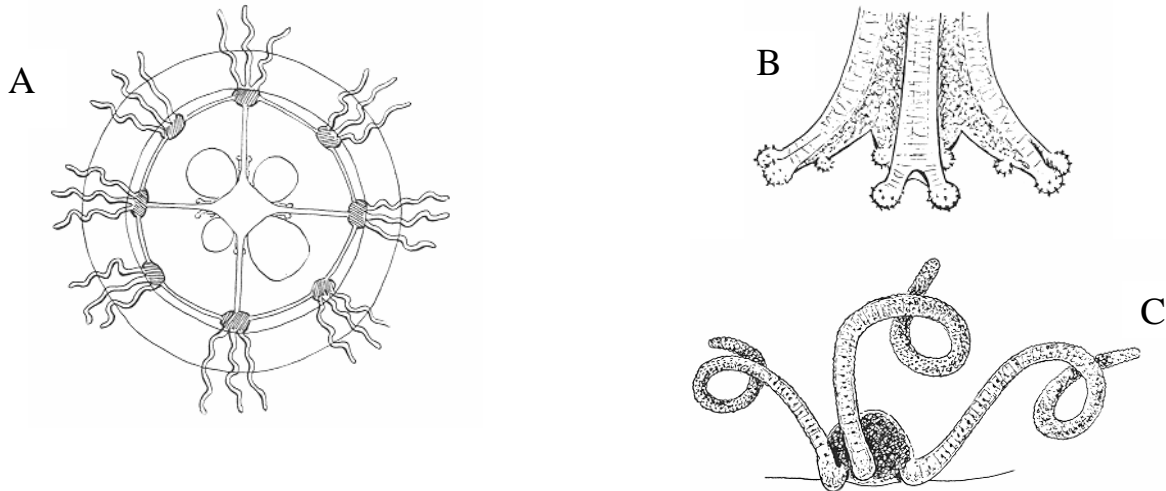
Podocoryne spp. A, (From Mayer, 1910); B, (From Russell, 1953).

Family Rathkeidae

Rathkea sp.

Apex of umbrella thick and high. Stomach not extending beyond umbrella margin; with short peduncle. Mouth with 4 lips with circular clusters of nematocysts on the extension of the lips and also between. 4 radial canals. Gonads completely surround the stomach. 8 marginal tentacle bulbs, each with up to 5 perradial tentacles and 3 interradial. No ocelli.

Recorded: Seychelles *Rathkea* sp. (Millard and Bouillon, 1973).



Rathkea sp. A, view from above; B, oral tentacles; C, marginal tentacle and bulb (From Russell, 1953).

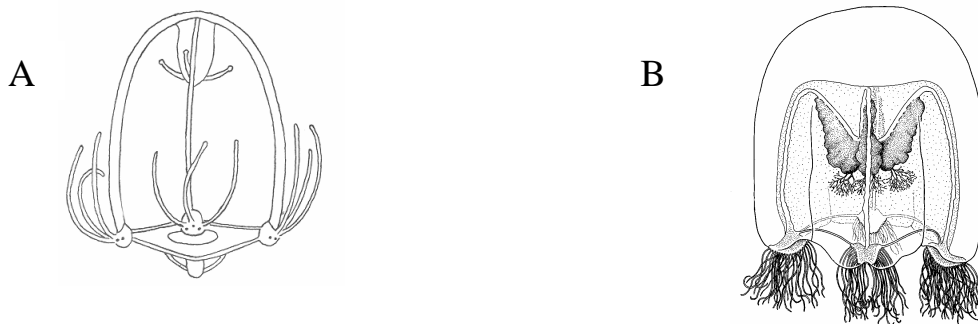
Family Bougainvillidae

Rounded body with thick jelly, especially at the apex. Marginal tentacles arranged in four clusters of similar structure. Number of tentacles variable depending on species and stage of development. Ocelli on tentacle bulbs. 4 radially placed oral tentacles which branch several times, depending on species and stage of development. 4 radial canals. Gonads on the sides of the stomach. Some immature specimens have been sampled in Seychelles.

Bougainvillia macloviana Lesson, 1830

Cylindrical umbrella with rounded apex and thick jelly. Stomach with pyramidal peduncle and broad base. The 4 oral tentacles divide 5-7 times. Gonads slightly folded, extending along stomach. 4 radial canals, wide with slightly ragged edges. 4 broad tentacle bunches, each with up to 60 tentacles. A dark red ocellus on the base of each tentacle.

Recorded: Seychelles (Millard and Bouillon, 1973).



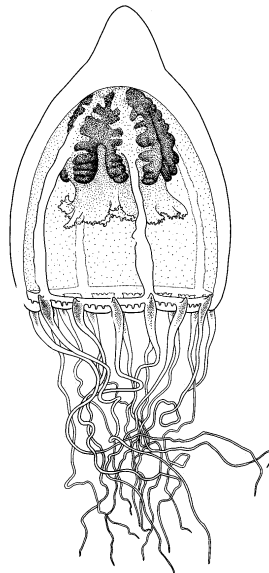
Bougainvillia macloviana Different development stages. A, (From Russell, 1953); B, (Figure by J. Corbera, From Pagès *et al.*, 1992)

Family Pandeidae

Leukartiara octona (Fleming, 1823)

The umbrella is bell-shaped, up to around 15 mm in height, with a thick apical process that can vary in size. The stomach is large, occupying up to half of the stomach cavity and is connected to 4 broad radial canals, which have jagged outlines. The mouth lips are very frilled. The gonads are typically orange in colour with transverse folds. Up to 23 long, hollow marginal tentacles, each with a spur. Between each of these tentacles are one to three smaller secondary tentacles. Each tentacle has an ocellus on the base.

Recorded: None recorded yet, but *L. octona* is given as an example of this family.



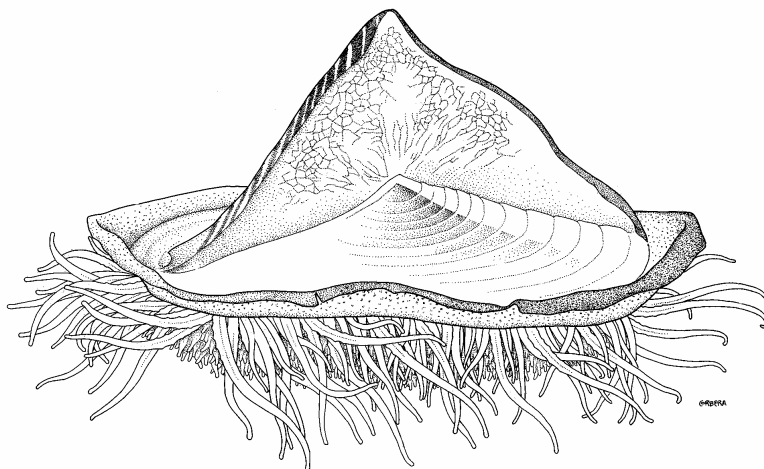
Leukartiara octona (Figure by J. Corbera, From Pagès *et al.*, 1992).

Family Porpitidae

Verella verella (Linnaeus, 1758)

The characteristic blue, asexual, polyp bearing colony with its upright sail, is found floating on the sea surface and may be sampled as the net is at the surface. The chitinous float/base can be up to 37 mm long and has a triangular thin sail, set perpendicularly.

Recorded: Mauritius, stranded on beach.



Verella verella Colony. (Figure by J. Corbera, From Pagès *et al.*, 1992)

Order Leptomedusae

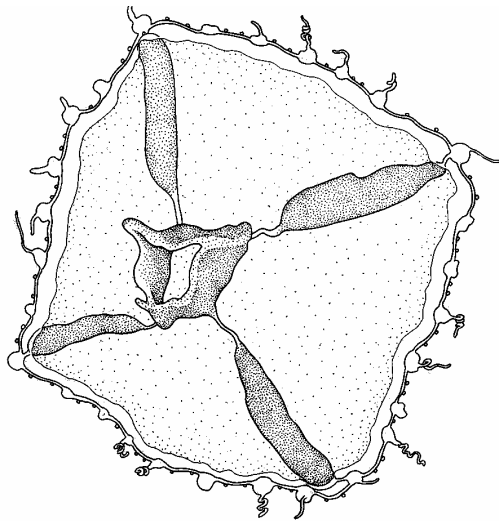
These have hemispherical or flattened umbrellas. The gonads are only found on the radial canals, though sometimes connecting onto the stomach. With or without statocysts.

Family Campanulariidae

Clytia sp.

Jelly thin, almost hemispherical. Stomach short, without peduncle, with four simple or frilled lips. Four oval or straight gonads, extending over half to three quarters of the radial canals, up to 70 marginal tentacles with prominent bulbs. 1-3 marginal vesicles between each pair of tentacles.

Recorded: Seychelles *Clytia* sp. (Millard and Bouillon, 1973).

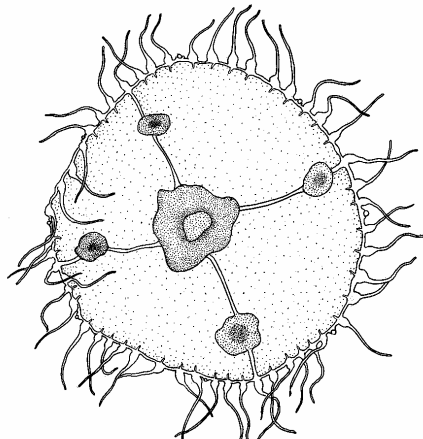


Clytia sp. (Figure by J. Corbera, From Pagès *et al.*, 1992).

Obelia sp.

Circular umbrella, flat and thin. Stomach short and with four simple lips. Four straight radial canals with oval or circular gonads on the canals, situated towards the outside. Many short marginal tentacles with basal bulbs. Eight statocysts on umbrella margin.

Recorded: Seychelles.



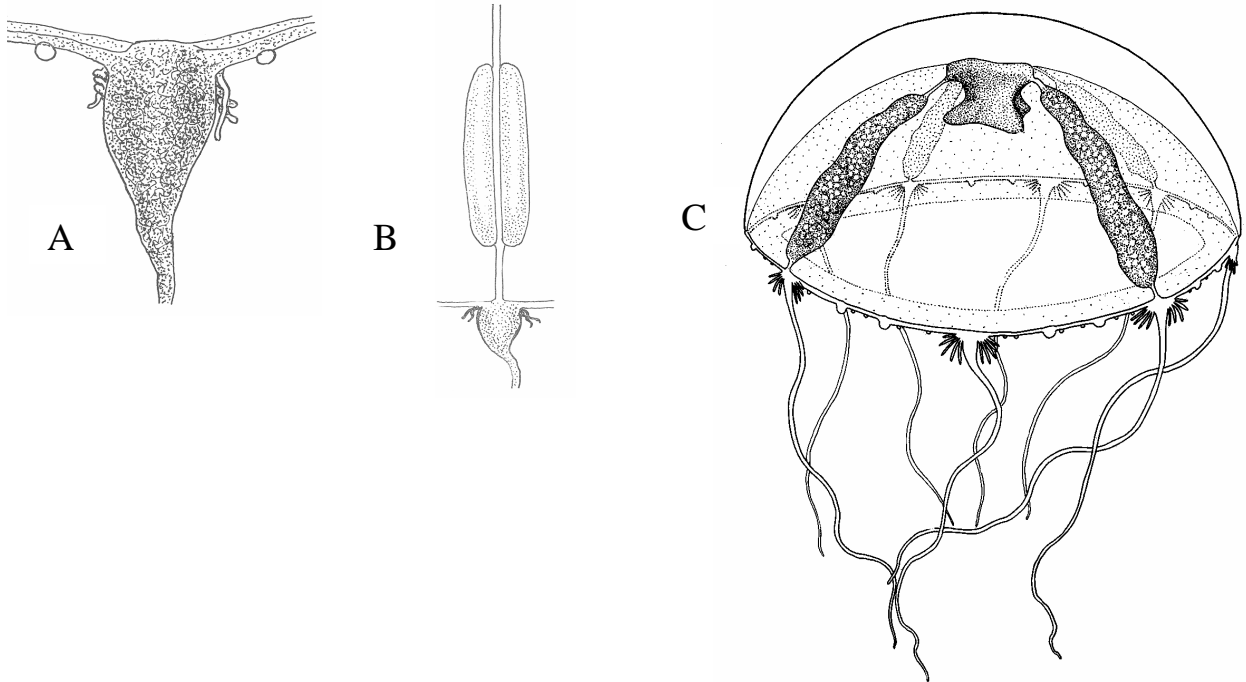
Obelia sp. (Figure by J. Corbera, From Pagès *et al.*, 1992)

Family Lovenellidae

Lovenella sp.

Umbrella hemispherical with thin jelly. Small stomach without peduncle. 4 simple radial canals. The gonads, are sausage shaped in adults, but more circular in young stages, on the radial canals, separate from the stomach. The marginal tentacles have small cirri beside the tentacle bulbs. Without ocelli.

Recorded: Seychelles *Lovenella* sp. (Millard and Bouillon, 1973).



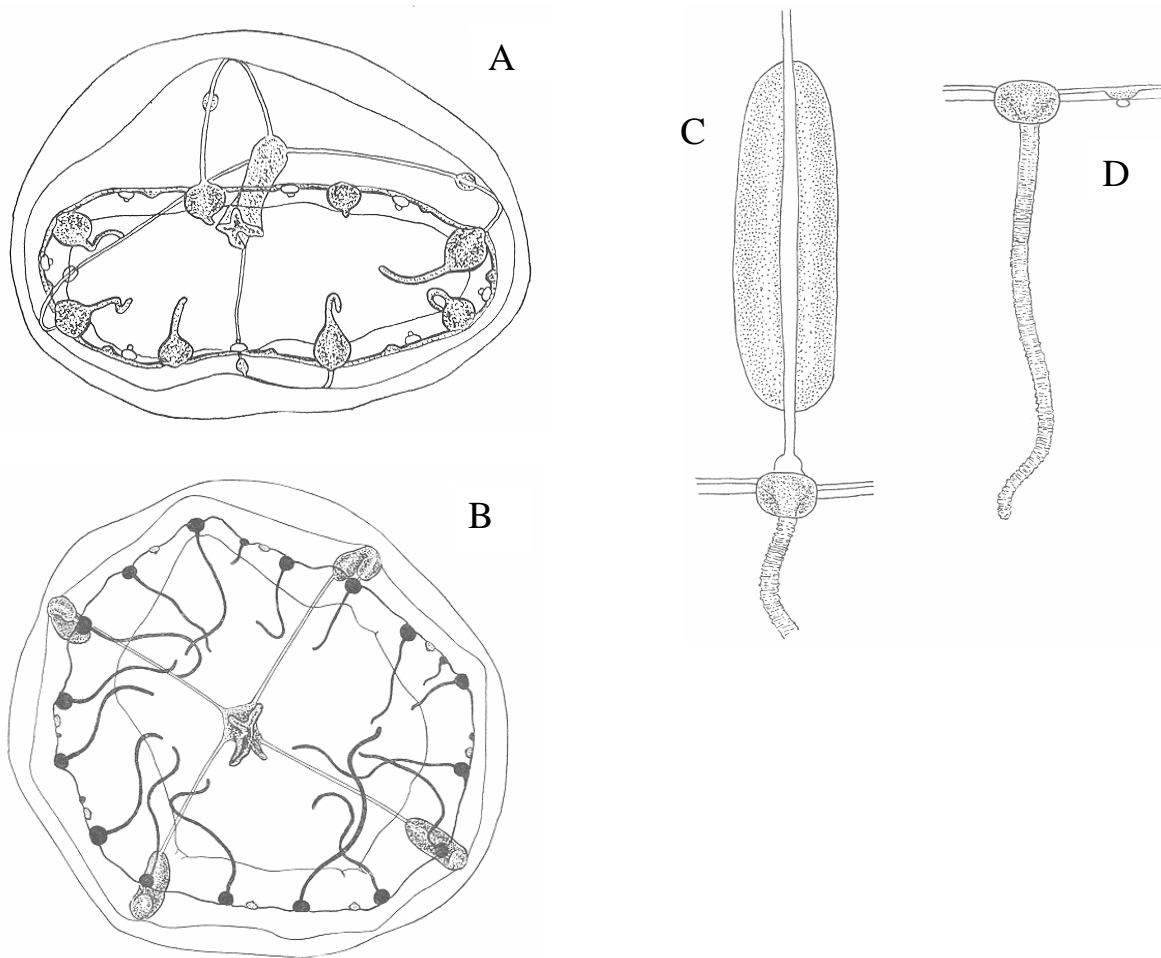
Lovenella sp. A, marginal tentacle, cirri and vesicles; B, gonad and marginal tentacle; C, adult medusa (A, B From Russell, 1953; C Figure by J. Corbera, From Pagès *et al*, 1992).

Family Phialellidae

Phialella quadrata

Umbrella nearly hemispherical; jelly fairly thick. Elongated gonads on outer third of the 4 radial canals, but not reaching the margin. 16-32 marginal tentacles with globular bases. No ocelli. 8 marginal vesicles. Stomach short with no peduncle. Mouth with 4 short lips, with slightly folded margins. Many specimens have 4 black spots at the base of the stomach, visible from above, one in each interradius. Diameter of umbrella up to 13 mm.

Recorded: Seychelles (Millard and Bouillon, 1973).



Phialella quadrata. A, B, different development stages; C, gonad and marginal tentacle; D, Marginal tentacle and vesicle (From Russell, 1953).

Order Linnomedusae

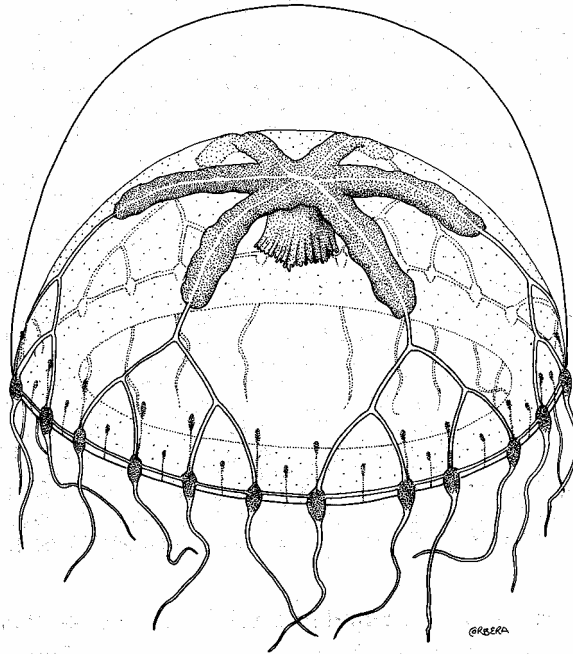
Most with thick bell-shaped umbrellas, with gonads either only on stomach, on stomach extending for a short distance along the radial canals, or only on the radial canals. With or without statocysts.

Family Proboscidactylidae

Proboscidactyla stellata (Forbes, 1846)

Umbrella dome-shaped around 8 mm high and 9 mm wide, thick at the apex. Stomach short with a hexagonal base and six lobes. Mouth with six frilled lips. Six radial canals, each dividing twice, so that 24 canals reach the umbrella margin, although this number is variable. The gonads are located at the base of the stomach wall and extend over the six stomach pouches. There are twenty-four marginal tentacles and a broad velum in well preserved specimens.

Recorded: Not yet recorded, but given as an example of the Family.



Proboscidactyla stellata. (Figure by J. Corbera, From Pagès *et al.*, 1992)

Order Trachymedusae

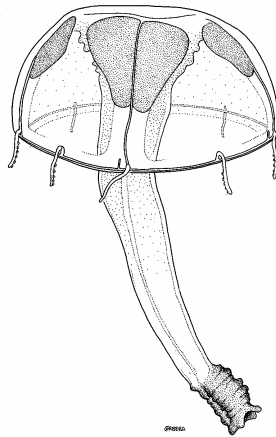
Hemispherical or deep, bell-shaped umbrella, gonads only on the radial canals, with statocysts.

Family Geryonidae

Liriope tetraphylla (Chamisso and Eysenhardt, 1821)

Hemispherical umbrella, up to 30 mm in diameter, with thick jelly, especially on the apex where it can be slightly flattened. Small stomach on elongated peduncle of varying length. 4 straight radial canals with large flattened leaf-like gonads of varying shape, sometimes almost covering the whole under surface. 4 large marginal tentacle and four small interradial. 8 statocysts and a broad velum in well preserved specimens.

Recorded: Seychelles, Zuza, Aldabra, Rodrigues.



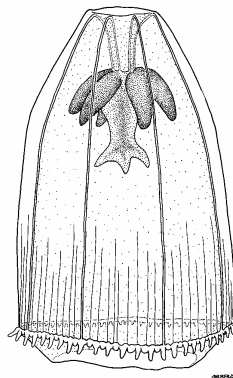
Liriope tetraphylla (Figure by J. Corbera, From Pagès *et al.*, 1992)

Family Rhopalonematidae

Aglaura hemistoma Péron and Lesueur, 1810

The umbrella is conical with a flattened apex in which there is a small depression. The umbrella is octagonal in cross-section with narrow longitudinal ridges (although this may not be obvious in poorly preserved specimens), composed of thin jelly and up to around 6 mm in height. The short stomach is on a thin peduncle. Eight sausage-shaped gonads are suspended from the peduncle above the stomach. There are eight radial canals running along the ridges on the umbrella and around 50-75 short marginal tentacles, which are easily damaged and usually partially missing. The velum can be very broad.

Recorded: Rodrigues, Seychelles, Zuza



Aglaura hemistoma (Figure by J. Corbera, From Pagès *et al.*, 1992)

Order Narcomedusae

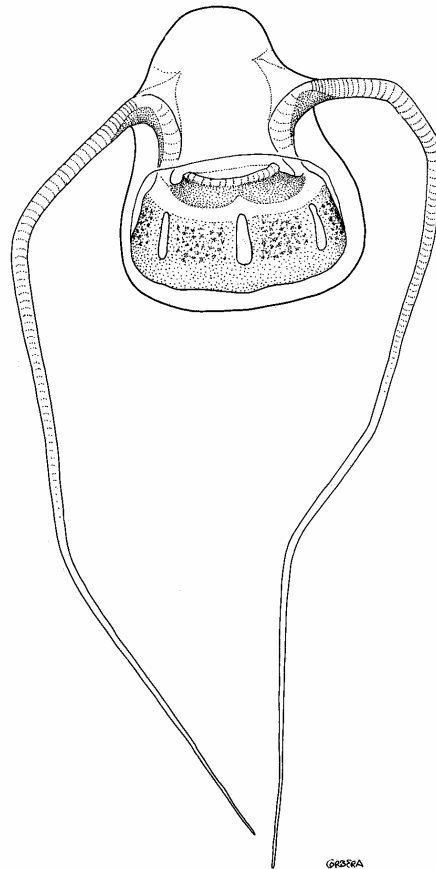
With thick upper umbrella, no radial canals and with the gonads only on the broad circular stomach. With statocysts. The marginal tentacles do not emerge on the edge of the umbrella, but some distance above.

Family Aeginidae

Solmundella bitentaculata (Quoy and Gaimard, 1833)

The umbrella is bell-shaped, up to 12 mm high by 15 mm wide. The jelly is thick, especially in the upper half. The stomach is broad, circular and short with a simple circular mouth. There are 8 rectangular stomach pouches on which the gonads are located. There are 2 long tentacles emerging on either side of the body from above the stomach.

Recorded: Seychelles, Zuza, Aldabra, Madagascar, Rodrigues.



Solmundella bitentaculata. (Figure by J. Corbera, From Pagès *et al*, 1992)

Subclass Siphonophorae

The siphonophores are usually composed of clear jelly, but are completely different in structure from the free-swimming stage of hydrozoan jellyfish. Siphonophores do not have an alternation of generation between an attached, asexual polyp stage and a free-swimming sexual medusa like most other hydrozoans, but modifications of both stages are found, attached to the free-swimming organism. Different siphonophores species can have a very different appearance and they are often made up of many different parts which usually all fall apart when caught in a plankton net, so it is often difficult to estimate the number of complete individuals in a sample. Because of their complicated life cycles, the fragments we find in the samples can often only be accurately identified by a specialist. Thus, in many instances we can only note down the general group to which they belong, or simply “unidentified siphonophore pieces”. Because many of the structures found in siphonophores are only found in these organisms, a unique terminology has been developed which can be daunting to people trying to identify them.

Some useful works on siphonophores, which include species from the south western Indian Ocean area are by Kirkpatrick and Pugh (1984), Mackie *et al.* (1987), Pagès and Gili (1992), Pugh (1999), Rengarajan (1973) and Totton (1954, 1965).

The Subclass Siphonophorae is divided into three Orders, **Cystonectae**, **Physonectae** and **Calycophorae**, on the basis of whether or not they have a gas-filled float called the **pneumatophore**, or swimming bells called **nectophores**.

Order Cystonectae

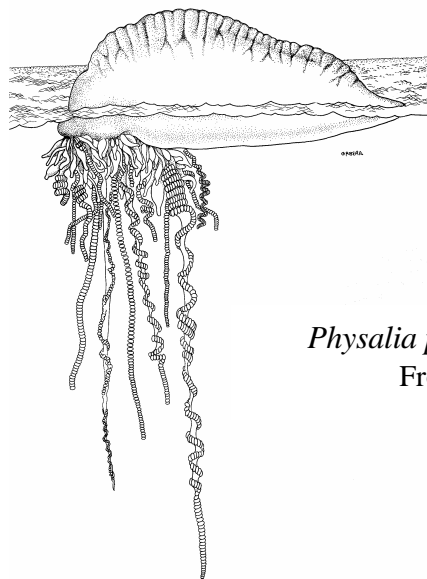
Siphonophores in Sub-order Cystonectae have no nectophores, only a large gas filled pneumatophore.

Family Physaliidae

Physalia physalis (Linnaeus, 1758)

Commonly known as the Portuguese Man of War, this species with its large float is the only member of this family likely to be found in the region. It may be familiar to some people who have seen it floating on the sea surface or stranded on a beach, but hopefully, because of the painful stings it can give, will not often be caught in plankton nets.

Recorded: Mauritius, stranded on rocks.



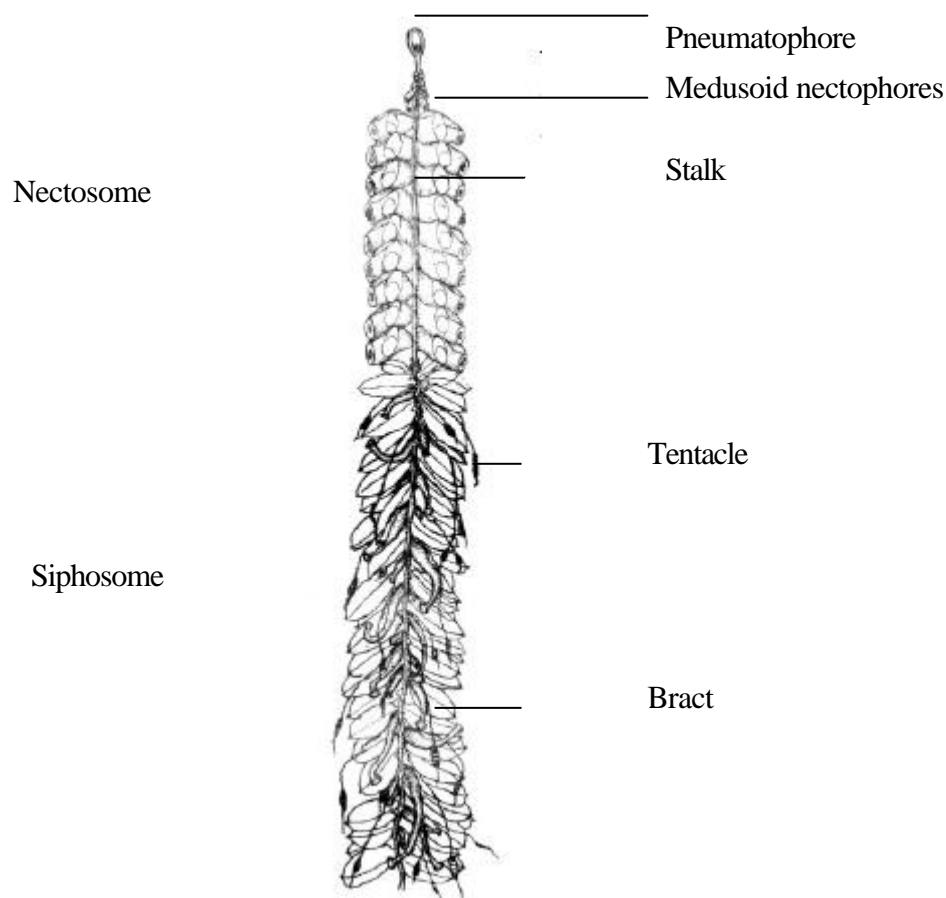
Physalia physalis (Figure by J. Corbera,
From Pagès *et al.*, 1992)

Order Physonectae

There are only a few members in Order Physonectae. They have a pneumatophore and swimming bells and a long stem forming a tube through which food and body fluids pass and to which the different body parts are attached in two regions. The **nectosome** region is situated just below the pneumatophore and usually only bears asexual (non-reproductive), medusoid nectophores which are swimming bells used in jet propulsion. The morphology of the nectophores is an important characteristic used in identification and as most physonectids have the same basic design, they are easily distinguished to this group. The nectophores never have a **somatocyst**, an organ that is part of the digestive system in Calycophoran siphonophores.

Below the nectosome lies the **siphosome**, which is usually the longest part of the body. Here both polypoid and medusoid structures are attached to the stem, which have different functions, arranged in a succession of groups called **cormidia**. The cormidium consists of a single **gastrozooid**, which is used, in feeding and digestion. The gastrozooids usually have a tentacle and several small tentacles called **tentilla**, which bear stinging cells, used in capturing prey. **Palpons**, which are modified gastrozooids, are also usually present on the cormidia and may have a sensory or excretory function. These also may have a tentacle attached. Another part is the **gonodendron**, which bears the developing sexual medusoids or **gonophores**, which can be both male and female in the same cormidium. The cormidia can also bear asexual nectophores and **bracts** composed of thick jelly, the latter probably for buoyancy or protection of the other structures.

The complete animal is referred to as the **polygastric** stage. In most physonectids the cormidia remains attached to the stem, although the gonophores which produce eggs and sperm can become detached. In physonectids only one egg is produced in each gonophore and fertilisation is external. A planuloid larva is produced which eventually develops a float, then progressively the other features.



Physonectid colony, *Agalma* sp., showing Structure (From Trégouboff & Rose, 1957).

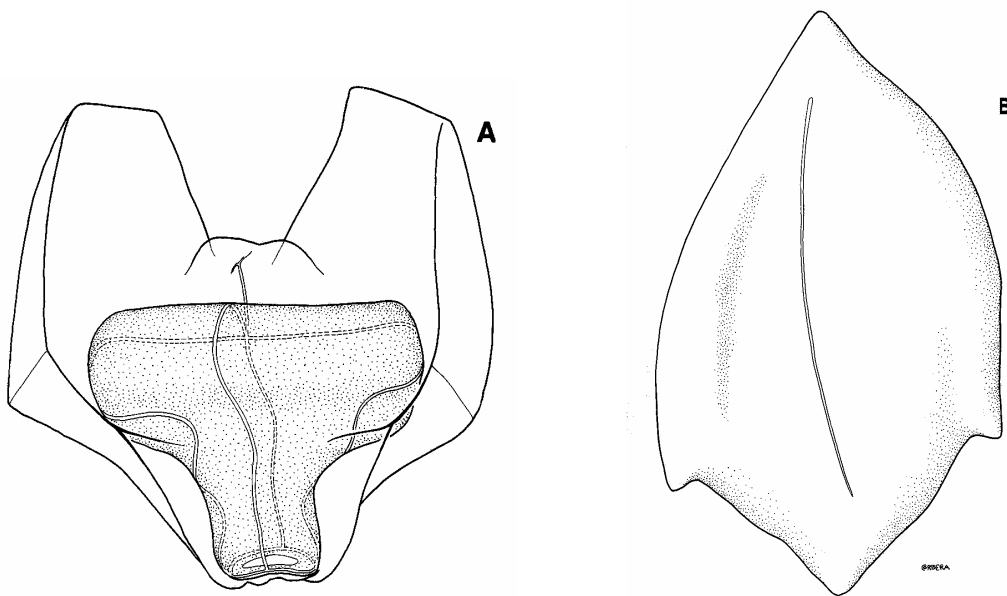
Family Agalmatidae

Agalma elegans (Sars, 1846)

This is one of the few physonectid species occurring in the region. Early *A. elegans* specimens, usually less than 4 mm in length, are sometimes sampled and can be recognised as a young physonectid by the presence of a pneumatophore with a cap tinged dark red. They have a ring of 4-6 thick, triangular serrated bracts and a single gastrozoid and tentacle.

Adult specimens, which will only be represented by fragments in the plankton samples, have a terminal pneumatophore, approximately 1 mm in height with a red cap. Often the siphosomal stem is found on its own with the pneumatophore still attached. The nectophores are up to 7 mm in length, v-shaped and have two prominent lateral wings and an internal t-shaped nectosac. The bracts are triangular, approximately 9 mm in length with three terminal projections and a convex dorsal surface.

Recorded: Rodrigues, Aldabra.



Agalma elegans. A, nectophore; B, bract (Figures by J. Corbera, From Pagès *et al.*, 1992)

Order Calyophorae

Calycophoran siphonophores do not have a pneumatophore and are the siphonophores group with by far the most members. The nectophores are often very specialised and their structure is variable between different species. The number of nectophores present can be from 1-15, depending on species, all appearing quite similar. Usually the stem groups of the polygastric phase, the cormidia, break off successively to form the free swimming sexual eudoxid stage. They have a somatocyst, an organ associated with digestion.

Family Prayidae

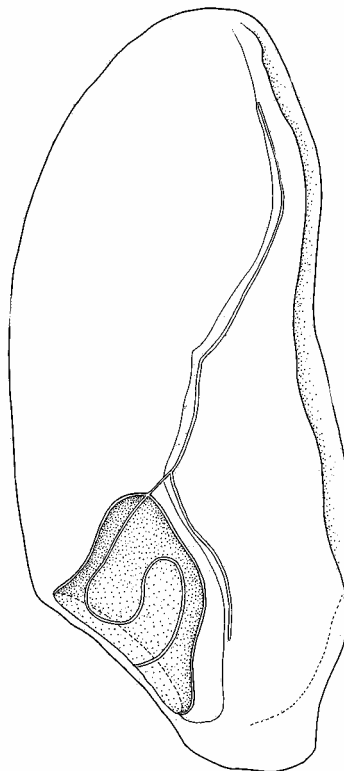
Prayids are large, slow swimming siphonophores, generally rounded with thick jelly. When the jelly is thick, the small thin somatocyst may branch complexly.

Sub-family Prayinae

Rosacea cymbiformis (Chiaje, 1882).

The asexual polygastric stage is composed of 2 simple rounded nectophores up to 17.5 mm in height, attached ventrally, although usually broken apart in plankton samples. One nectophore partially surrounds the other. The jelly is very thick giving buoyancy to the animal. The inner cavity, the nectosac, which is used in propulsion, is small, so the animal is slow swimming. The nectosac is less than two-fifths the height of the nectophore. The nectophores have a shallow furrow called the **hydroecium**, extending the length of the ventral surface, inside which the siphosomal stem is attached, so the region of the stem where budding of the cormidia takes place is protected from damage. The stem can be drawn up into the hydroecium, both for protection and to streamline the body during swimming. Alongside the hydroecium runs the somatocyst. The polygastric stage buds off and releases the sexual cormidia, which develop into the **eudoxid** stage.

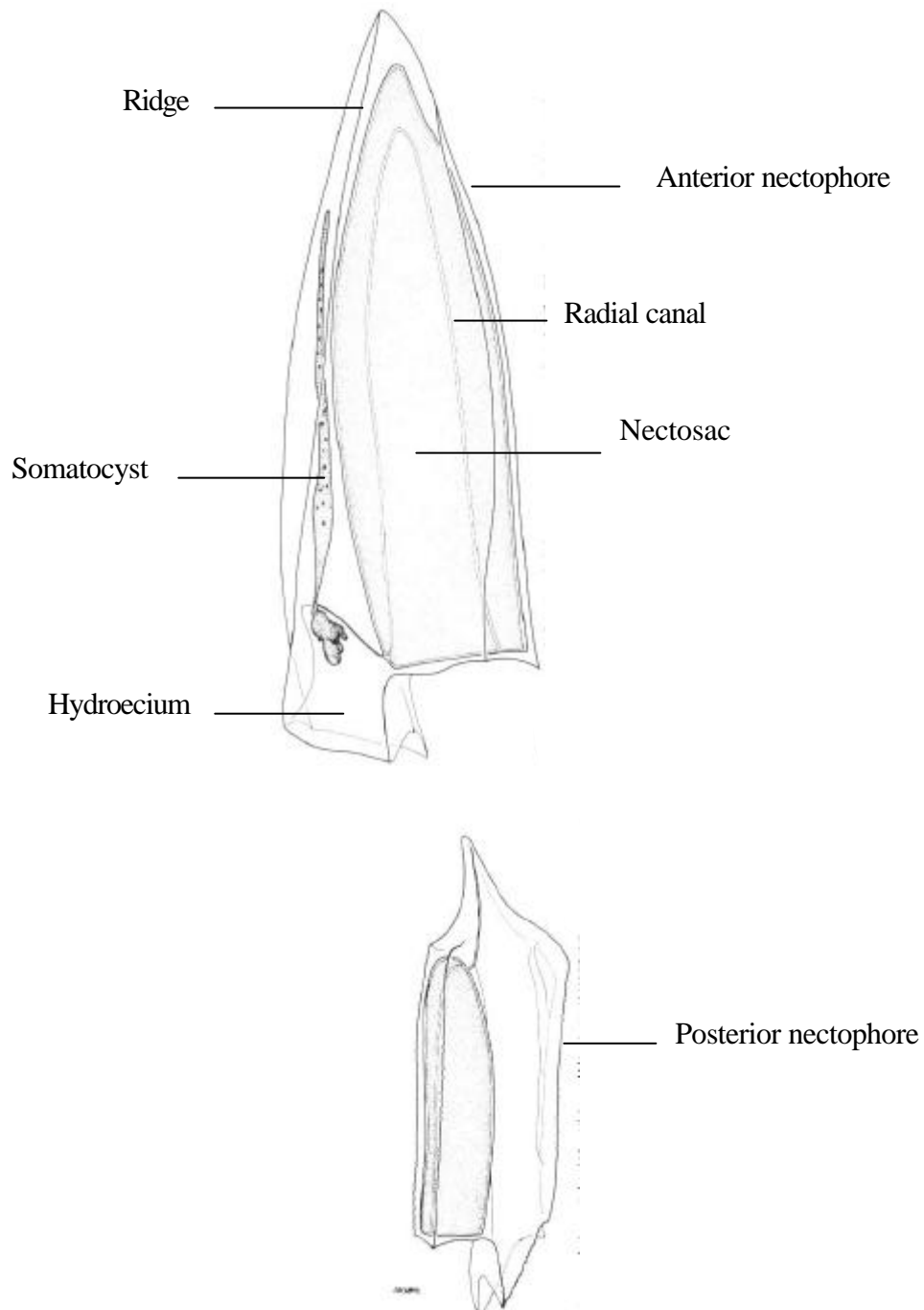
Recorded: Aldabra, Madagascar.



Rosacea cymbiformis. (Figure by J. Corbera, From Pagès *et al.*, 1992)

Family Diphyidae

This group have streamlined bodies with a large nectosac, features related to their generally fast swimming speed. They usually only have one or two nectophores present at one time, in both the asexual polygastric and sexual eudoxid stage. The upper nectophore is called the **anterior nectophore**. The second nectophore if present has a different structure and is called the **posterior nectophore**. The anterior nectophore of the polygastric stage is the most useful for identification and is the main part described and figured here. It can be identified by the presence of the sac-like somatocyst. The shape of the somatocyst and hydroecium and the number of ridges (if any) on the nectophore are particularly useful for identification.



General Diphyidae structure, polygastric, stage, showing nectophores separated (Figures by J. Corbera, From Pagès *et al.*, 1992).

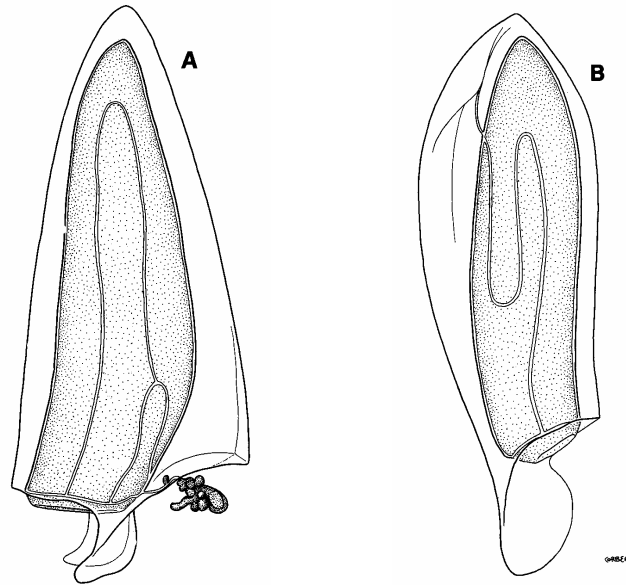
Subfamily Sulculeolariinae

The anterior nectophore of the polygastric phase is smooth and rounded, without ridges.

Sulculeolaria turgida (Gegenbaur, 1853)

The polygastric stage, anterior nectophore, is conical with a rounded apex, reaching up to 15mm in height. There are no teeth on the ostial margin. Tiny somatocyst, one twentieth of the height of the nectophore. The basal lamella is quite long, divided into two sections by a deep furrow.

Recorded: Zuza, Madagascar.

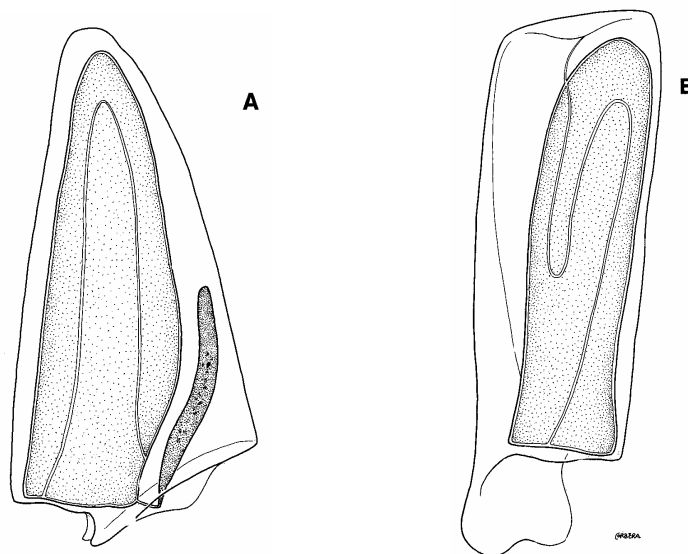


Sulculeolaria turgida A anterior nectophore; B, posterior nectophore (Figures by J. Corbera, From Pagès *et al.*, 1992).

Sulculeolaria chuni (Lens and van Riemsdijk, 1908)

The anterior nectophore of the polygastric stage has a rounded apex, no ridges no teeth on the ostial margin and is up to 8mm in height. The somatocyst is quite long and sausage-shaped, two to three fifths of the height of the nectophore. The basal lamella is short, divided into two sections.

Recorded: Rodrigues, Zuza, Madagascar.



Sulculeolaria chuni. A, anterior nectophore; B, posterior nectophore (Figures by J. Corbera, From Pagès *et al.*, 1992)

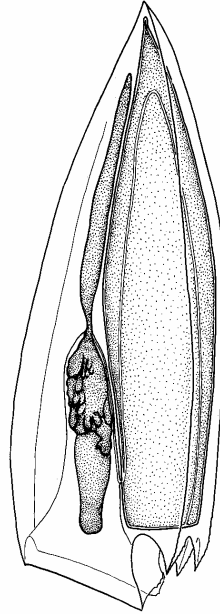
Subfamily Diphyinae

Nectophores of all but a few species are ridged.

Diphyes bojani (Escholtz, 1829)

The anterior nectophore of the polygastric phase has five long ridges, which are serrated, to varying degrees. Size is up to approximately 10 mm in height and 3 mm in width. There are 3 ostial teeth of approximately the same length. The nectosac reaches nearly to the top of the nectophore. The hydroecium is very deep, generally reaching almost half way up the nectophore. The somatocyst is sausage shaped, tapering towards its apex and reaches almost to the end of the nectosac.

Recorded: Aldabra, Zuza, Madagascar.

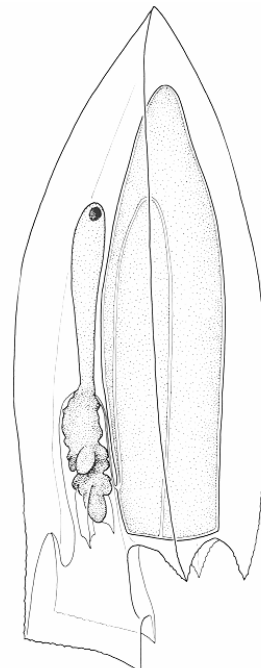


Diphyes bojani. Anterior nectophore (Figure by J. Corbera, From Pagès *et al.*, 1992)

Diphyes chamissonis Huxley, 1859.

In the polygastric phase there are five serrated ridges on the anterior nectophore, which is approximately 5 mm in height and 1.6 mm wide. The hydroecium is deep and the somatocyst is club shaped and approximately half the length of the nectosac. The basal lamella is deeply indented. There are 3 ostial teeth of the same size. A posterior nectophore does not develop.

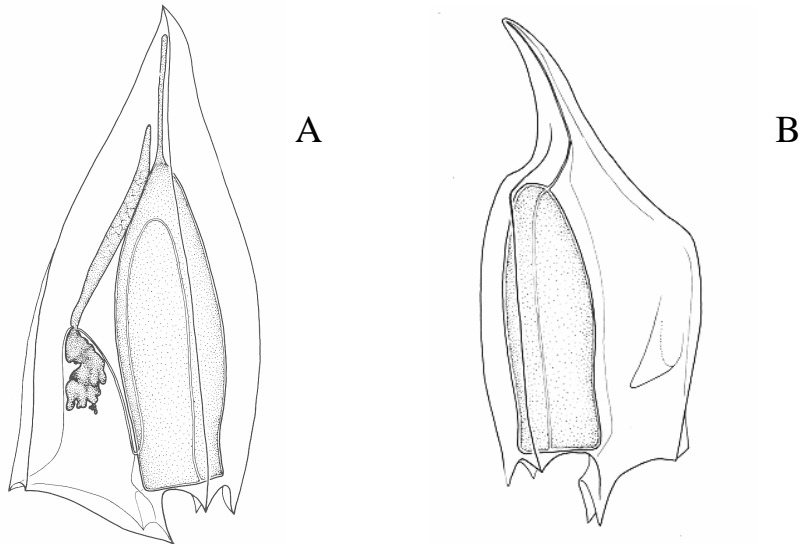
Recorded: Rodrigues, Seychelles. Aldabra, Madagascar.



Diphyes chamissonis. Anterior nectophore
(Figure by J. Corbera, From Pagès *et al.*, 1992)

Diphyes dispar Chamisso and Eysenhardt, 1821

The anterior nectophore of the polygastric phase is large, up to 36 mm in height, by 18 mm wide. There are 5 ridges, with only one slightly serrated. The teeth on the basal lamella closest to the opening of the nectosac are larger than the outer ones. There are 3 ostial teeth. The hydroecium is very deep. The nectosac tapers to a thin process, which then extends almost to the apex of the nectophore. The somatocyst is sausage shaped and varies in length, but does not reach the end of the nectosac. Recorded: Rodrigues, Seychelles, Zuza, Madagascar.

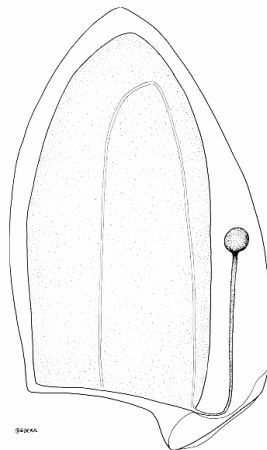


Diphyes dispar. A, anterior nectophore; B, posterior nectophore (Figure by J. Corbera, From Pagès *et al.*, 1992)

Lensia subtilis (Chun, 1886).

The anterior nectophore of the polygastric phase is small, fragile, rounded at the apex and flattened laterally. It does not have any ridges and is up to 10 mm in height. The hydroecium is short and slants outwards. The somatocyst has a long thin stalk terminating in a small ball. The basal lamella is small with two wings and runs obliquely outwards.

Recorded: Zuza, Aldabra, Madagascar.

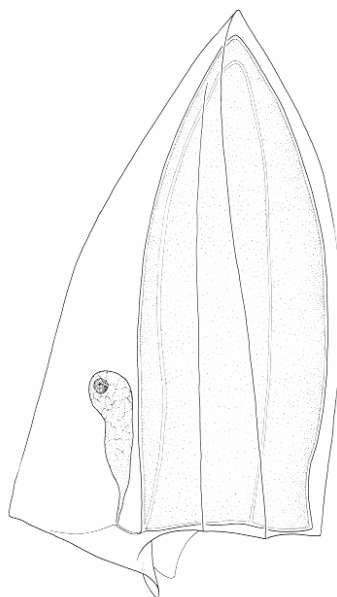


Lensia subtilis. Anterior nectophore (Figure by J. Corbera, From Pagès *et al.*, 1992)

Lensia subtiloides (Lens and van Riemsdijk, 1908).

The anterior nectophore of the polygastric phase has 5 ridges and is approximately 3.7 mm high and 1.4 mm wide. The hydroecium is very shallow, reaching the level of the base of the nectosac. The basal lamella slopes slightly upwards towards the outside of the nectophore, with two short rounded wings. The somatocyst is club-shaped and about one third the length of the nectosac.

Recorded: Seychelles, Aldabra, Madagascar.

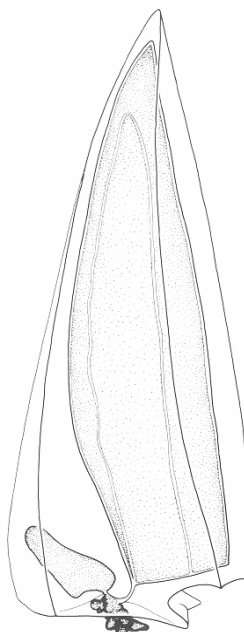


Lensia subtiloides. Anterior nectophore (Figure by J. Corbera, From Pagès *et al.*, 1992).

Lensia hotspur Totton, 1941

The anterior nectophore of the polygastric phase has 5 complete ridges and is up to 7.2 mm in height and 2.3 mm in width. The hydroecium is very shallow and does not reach the bottom of the nectosac. The basal lamella is quite flat, divided into 2 downwardly slanting wings. The somatocyst varies in shape, but tends to be short and broad with a short stalk and sloping outwards.

Recorded: Aldabra, Madagascar.

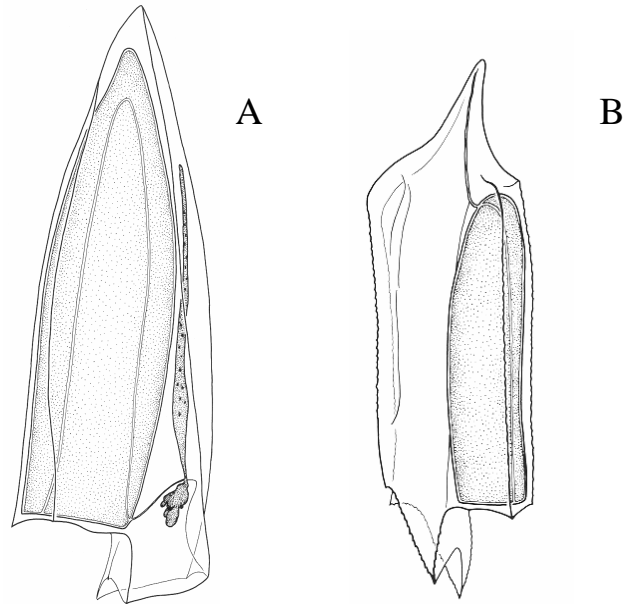


Lensia hotspur. Anterior nectophore (Figure by J. Corbera, From Pagès *et al.*, 1992)

Chelophyes appendiculata (Escholtz, 1829).

The anterior nectophore of the polygastric stage is very rigid, up to 20 mm in height. There are 5 ridges but only 3 reach the apex. The hydroecium is quite deep, directed outwards. The basal lamella is divided into 2 square wings. The somatocyst is long and spindle shaped, varying between narrow and thin, reaching two-thirds to three-quarters the length of the nectosac.

Recorded: Rodrigues, Zuza, Madagascar.

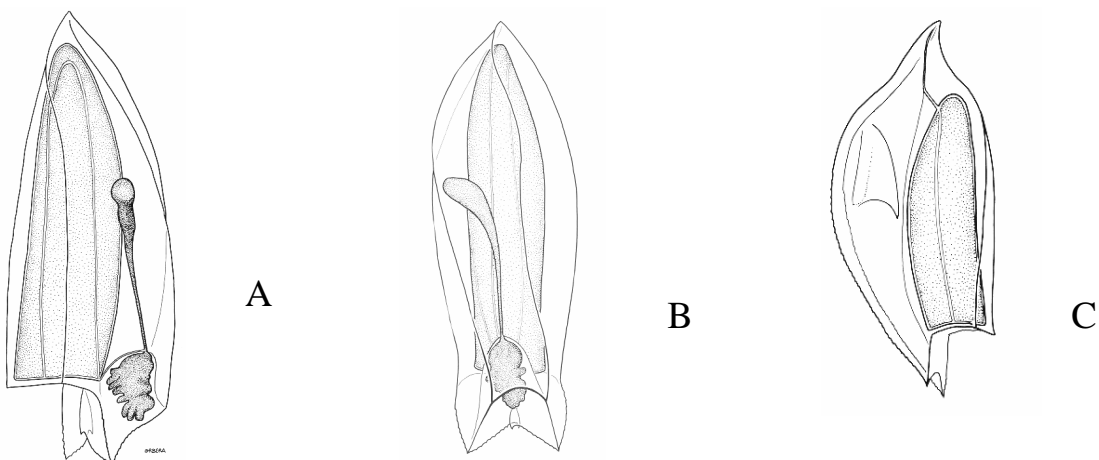


Chelophyes appendiculata. A, Anterior nectophore; B, Posterior nectophore (Figure by J. Corbera, From Pagès *et al.*, 1992)

Chelophyes contorta (Lens and van Riemsdijk, 1908).

The anterior nectophore of the polygastric phase is similar in shape and rigidity to that of *C. appendiculata*. It is up to 4.6 mm in height by 1.7 mm in width. 5 slightly serrated ridges on nectophore, 1 very short, only 3 reaching the apex. Somatocyst characteristically twisted to the right, as are also the ridges close to the somatocyst. Somatocyst is around two thirds of the length of the nectosac. Hydroecium bends outwards, not as deep as in *C. appendiculata*. Basal lamella divided into two wings with a small tooth on either side in the lower central part.

Recorded: Rodrigues, Seychelles, Zuza, Aldabra, Madagascar.

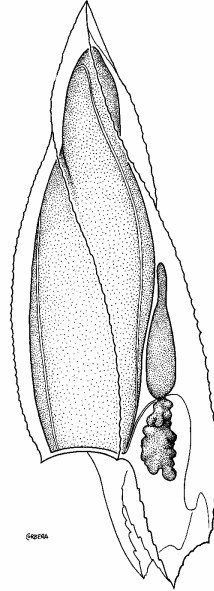


Chelophyes contorta. A, anterior nectophore; B, anterior nectophore side view; C, Posterior nectophore (Figure by J. Corbera, From Pagès *et al.*, 1992).

Eudoxoides spiralis (Bigelow, 1911).

The polygastric anterior nectophore (no posterior nectophore develops) is rigid and characteristically twisted. It is up to 12 mm in height. There are 5 toothed ridges, only 4 reaching the apex. The hydroecium is deep with a rounded apex. Basal lamella divide into 2 pointed wings, one longer than the other. The somatocyst reaches half way up the nectosac.

Recorded: Rodrigues, Seychelles, Zuza, Aldabra, Madagascar.

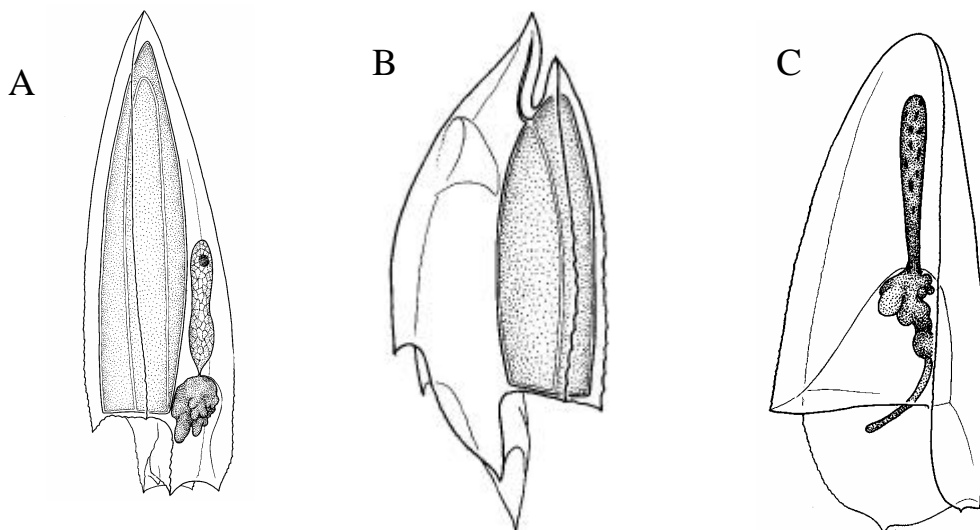


Eudoxoides spiralis. Anterior nectophore (Figure by J. Corbera, From Pagès *et al.*, 1992).

Eudoxoides mitra Huxley, 1859.

The polygastric stage anterior nectophore is rigid and not spiralled, up to 7.4 mm high by 2.5 mm wide. There are 5 ridges on the nectophore which all reach the apex, serrated on the lower nectophore. Hydroecium has a rounded projection. The basal lamella are divided into 2 serrated wings, the left wing with a central tooth-like projection. The somatocyst is sausage shaped, starting off very narrow and reaches halfway up the nectosac.

Recorded: Zuza, Madagascar.



Eudoxoides mitra. A, anterior nectophore; B, posterior nectophore; C, eudoxid stage (Figures by J. Corbera, From Pagès *et al.*, 1992)

Family Abylidae

The anterior nectophore of the polygastric stage is much smaller than the posterior nectophore.

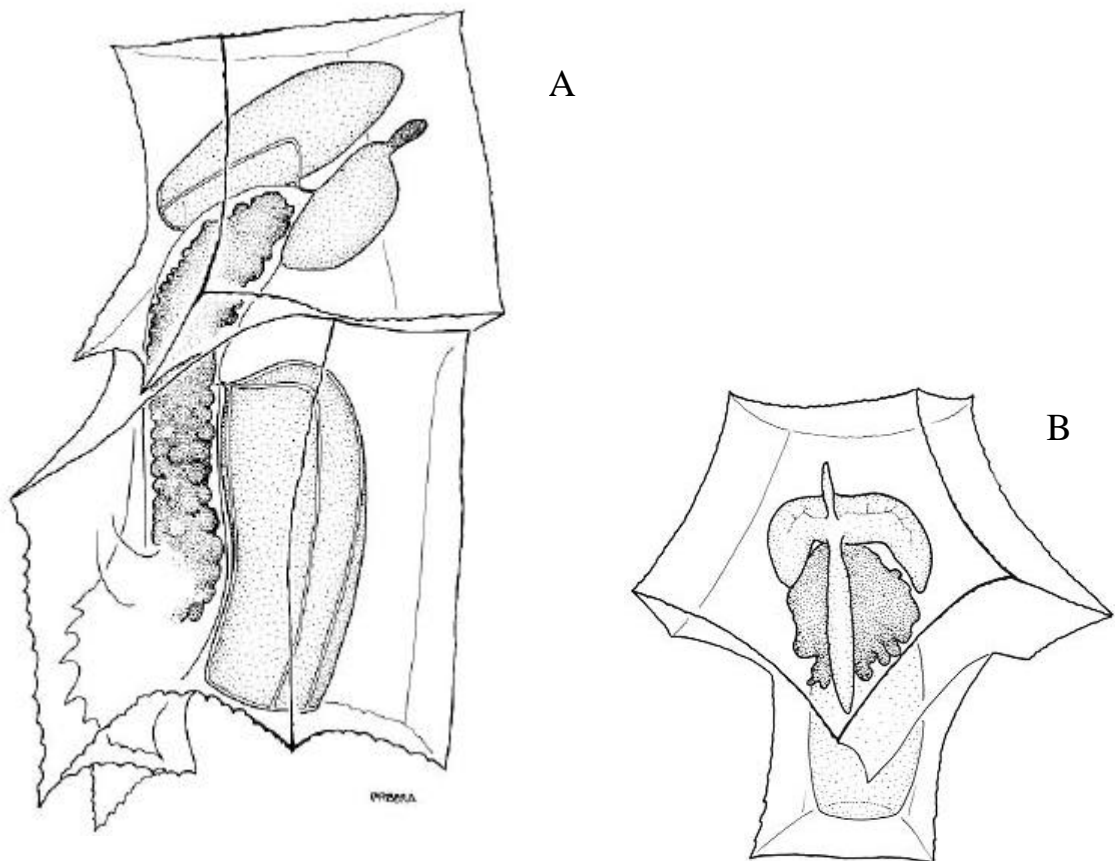
Subfamily Abylopsinae

Nectophores very rigid and the anterior nectophores usually beautiful box-like structures with many ridges or facets, like a crystal.

Abylopsis eschscholtzi (Huxley, 1859).

The polygastric stage is rigid with pronounced serrated edges. The wide somatocyst has a short projection at the top.

Recorded: Rodrigues, Seychelles, Aldabra, Madagascar.

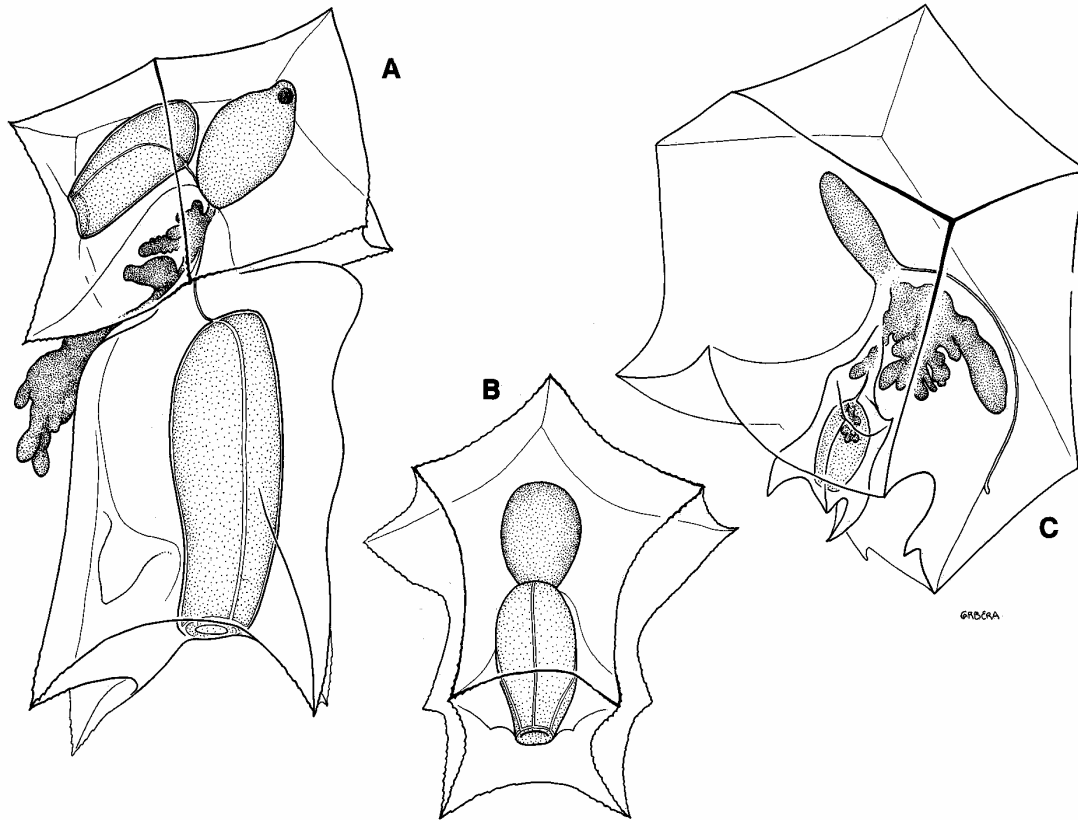


Abylopsis eschscholtzi. A, complete polygastric stage; B, eudoxid stage (Figures by J. Corbera, From Pagès *et al.*, 1992)

Bassia bassensis (Quoy and Gaimard, (1833) 1834).

The polygastric anterior nectophore is very similar to that of *A. eschscholtzi*, but the somatocyst has no apical projection.

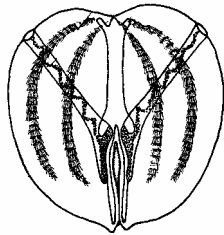
Recorded: Rodrigues, Seychelles, Aldabra, Madagascar, Mauritius.



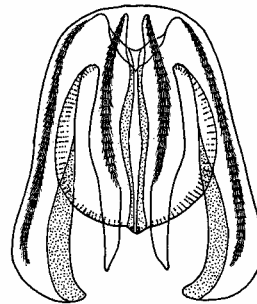
Bassia bassensis. A, complete polygastric stage; B, eudoxid stage; C, anterior nectophore (Figures by J. Corbera, From Pagès *et al.*, 1992).

PHYLUM CTENOPHORA

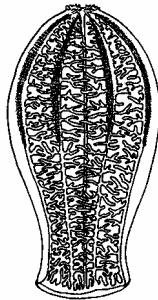
Ctenophores are also composed of jelly, but because of their very individual structure, have a phylum all to themselves. They are not common in the tropics but occur regularly in samples. They do not have stinging cells like cnidarians; many such as *Pleurobrachia* capture their prey with sticky adhesive cells on their tentacles, while the bell-shaped *Beroë* captures prey inside the bell. They swim by cilia, but the characteristic of this group is that the cilia are joined together in rows like a comb - which is why they have been given the common name of comb-jellies. *Velamen* whose common name is Venus's girdle, is a beautiful ribbon-like ctenophore, but unfortunately, like many of the ctenophores, it breaks up when caught in the plankton net and can only really be observed by divers.



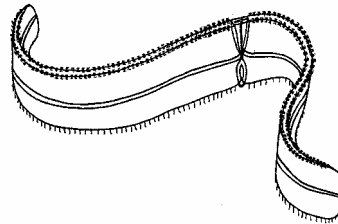
Pleurobrachia sp.



Mnemiopsis sp.



Beroë sp.



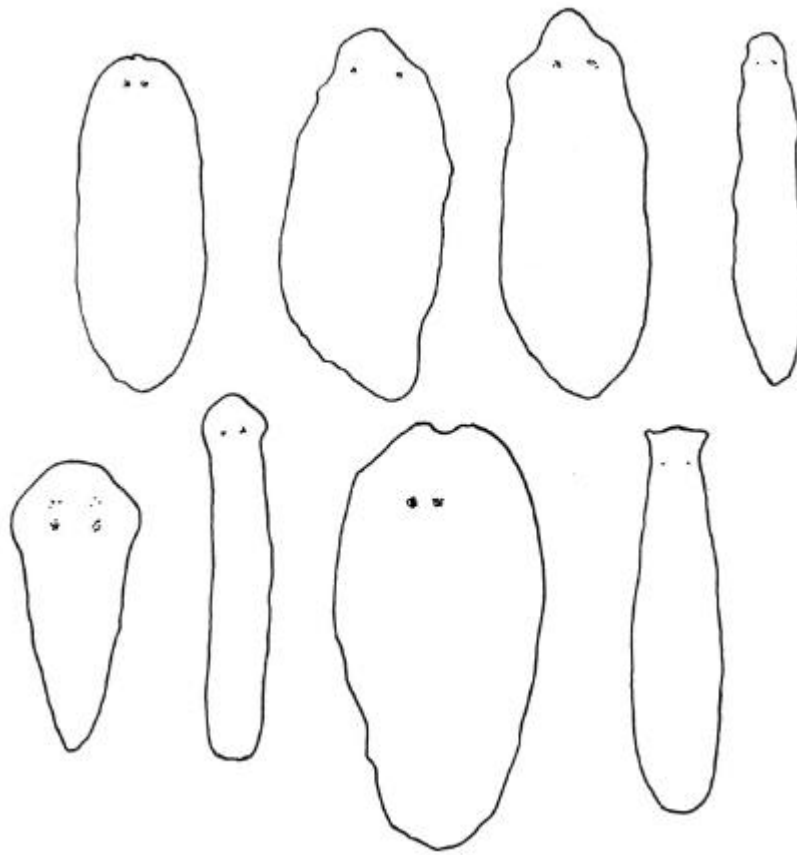
Velamen sp.

Examples of ctenophores (From Wickstead, 1965).

PHYLUM PLATYHELMINTHES

Order Turbellaria

The Order Turbellaria are commonly called the flatworms. Only low numbers of a few species are found in the plankton and most species are less than 5 mm in length. They are generally flattened and leaf shaped, with rounded corners, although often curled up in the samples. Their bodies are opaque and cream coloured, certainly in preserved specimens, and the internal organs are not usually visible. Externally they usually have two clusters of black pigment spots on their upper surface, associated with light sensitivity. The Turbellaria are free living or commensal and there are around 3,000 known species, most of which are marine. They are the most primitive of the Platyhelminthes.

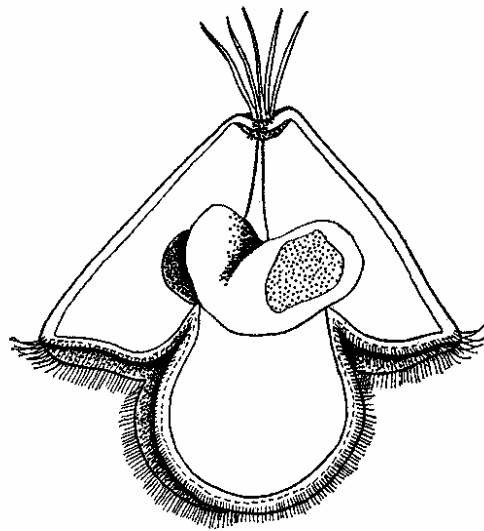


Typical Turbellarian shapes.

PHYLUM NEMERTINA

This Phylum has been spelt in different ways by different authors - Nemertini, Nemertinea, Nemerteia or Nemertina.

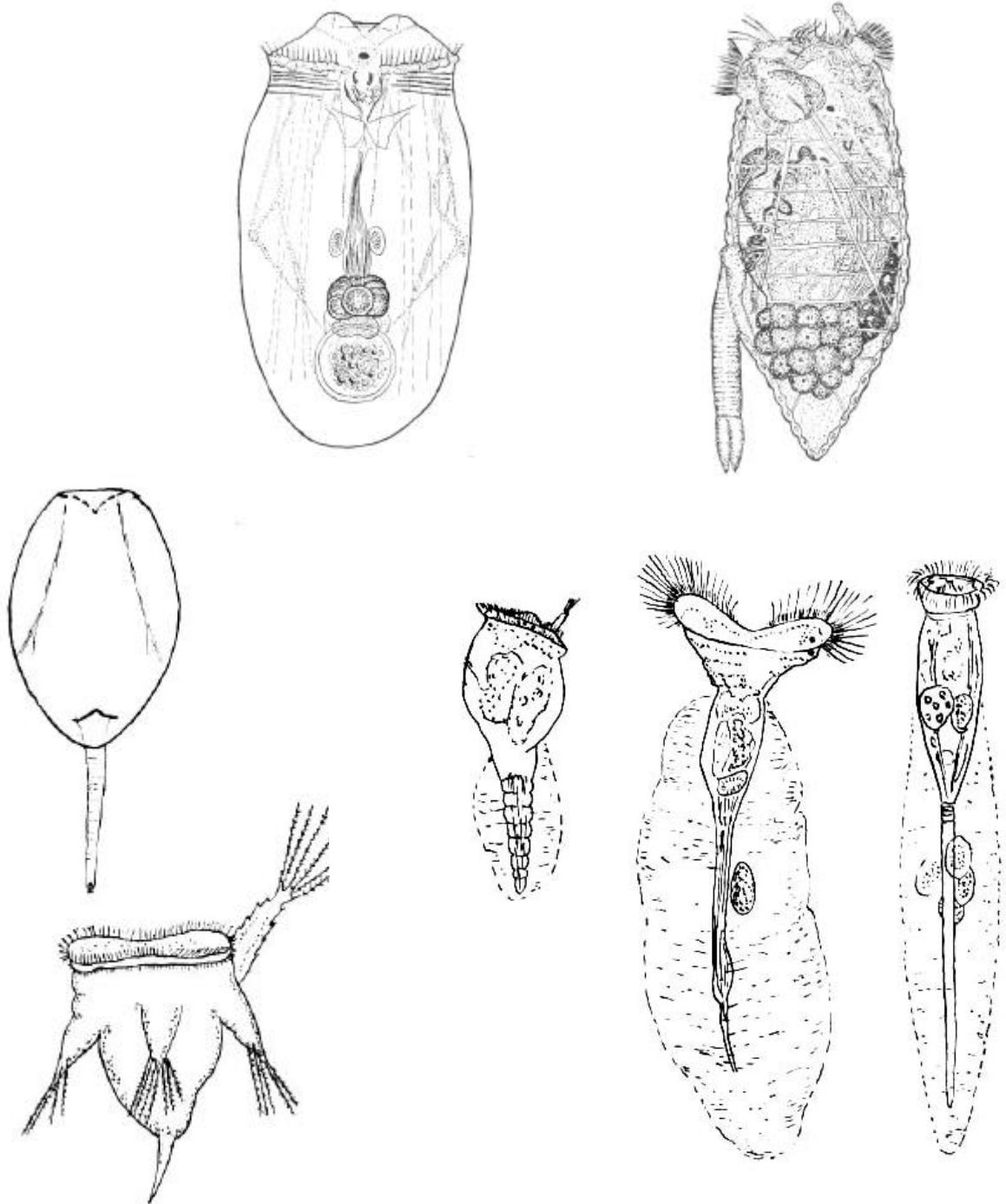
Nemertines are worm-like organisms, the adults of which are generally found on and in the sea bottom, although some species are deep-water pelagic species. They are commonly called ribbon-worms as some are very long, or sometimes proboscis worms, because they can extend a proboscis to capture their food. Most look like flatworms, but tend to be larger, thicker bodied, and longer. Most species are less than 20 cm in length, and some just a few millimetres long, but a few species may measure several metres or more. Most are pale, but some are brightly coloured with patterns of yellow, orange, red and green. Their free-swimming, ciliated pilidium larvae can occasionally be common in plankton samples..



Pilidium larvae (From Wickstead, 1965).

PHYLUM ROTIFERA

Rotifers are small (0.1-0.5 mm) flask-shaped organism, with a characteristic crown of fine hairs or cilia surrounding the mouth area. These cilia beat together in waves to draw water currents (and thus food) toward their mouth. Rotifers primarily eat phytoplankton, bacteria, and also detritus. Some will occasionally eat another rotifer if it is small enough. Rotifers are commonly cultured in fish farms to feed to larval fish as their first food.



Examples of rotifers (From Berzins, 1960a,b).

PHYLUM MOLLUSCA

The Phylum Mollusca comprises the chitons, abalones, snails, clams, squid and octopus as well as many other less well known groups. Molluscs range in size from a few mm through to several metres in length for the giant squid (the largest living invertebrate). The bodies are soft and partly or wholly covered by a mantle, a sheet of tissue exclusive to molluscs. The majority of species have a protective shell, usually external, that is excreted by the mantle. In a few species the shell is internal or absent altogether. Locomotion is usually achieved using a muscular foot, this may be modified for burrowing or swimming. The majority of molluscs are benthic, a few species have adapted to a free-swimming existence (e.g. squid, heteropods, pteropods, janthinids and a few nudibranchs).

Molluscs may be dioecious (i.e. sexes are separate) where fertilisation can be internal or external, they may be simultaneous hermaphrodites (i.e. produce eggs and sperm simultaneously), or protandric hermaphrodites (i.e. change sex with age). Development may be direct, or through two planktonic larval stages, a trochophore and a veliger larva. The molluscan trochophore is similar to the that of segmented worms. The typical trochophore is small, top-shaped, with a small mouth opening just below an equatorial ring of cilia. The trochophore stage may be passed through in the egg. The trochophore is relatively short-lived and passes into the exclusively molluscan larva, the veliger. The veliger characteristically possesses a shell and a densely ciliated velum of between one and six lobes. The ciliated lobes are used for locomotion, feeding and respiration and can be withdrawn into the protective shell. The time the larva spends in the plankton varies with species, but can be anything from a few hours to over a year for some cone shells and cowries. In addition to the trochophore and veliger larva, there is an unusual 'echinospira' larva typical of a few families of Gastropoda (e.g. Lamellariidae, Eratoidea and Capulidae). The individual is housed in a large transparent, sometimes ornately ridged, spiral shell.

The Phylum Mollusca is large and the taxonomic relationships between many of the species is under review. The Phylum is subdivided into seven classes:

Class Monoplacophora. A group of small, limpet-like, deep-sea molluscs. The sexes are separate and fertilisation is usually external. The group is not included in the guide.

Class Aplacophora. A group of primitive, worm-like molluscs without shells. Fertilisation is usually external. The group is not included in the guide.

Class Polyplacophora. Chitons or 'coat-of-mail-shells'.

Class Scaphopoda. Tusk-shells.

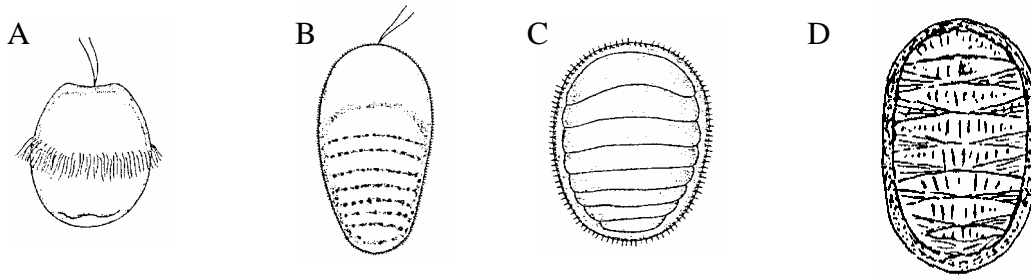
Class Gastropoda. The largest class of snails, sea slugs, sea butterflies. Further subdivided into three Subclasses, Prosobranchia, Opisthobranchia and Pulmonata.

Class Pelecypoda. Bivalves.

Class Cephalopoda. Squid, cuttlefish, octopus and nautilus.

CLASS POLYPLACOPHORA

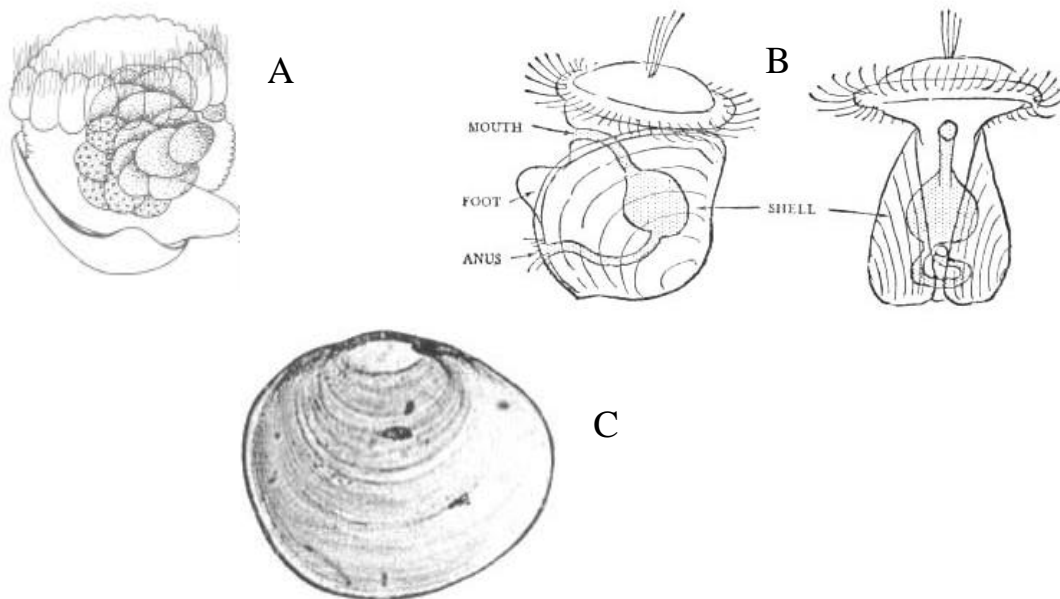
The chitons, or 'coat of mail' shells. Polyplacophora (in Greek meaning 'many plate bearing') have a characteristic shell consisting of a series of eight overlapping plates covering the dorsal surface. Chitons usually live close inshore on hard surfaces. Sexes are separate and fertilisation is external. There is no veliger larval stage. The planktonic trochophore develops directly into a juvenile chiton.



Chiton development stages. A, trochophore; B, later trochophore; C, juvenile; D, adult. Figures A, B from Christiansen (1925); D from Pilsbry (1892, 1893).

CLASS PELECYPODA

The Pelecypoda have shells of two valves, bivalves. The majority are benthic, either attached to structures or burrowing in the substratum. The typical bivalve releases eggs and sperm into the water where external fertilisation takes place. The larva passes through a trochophore and a veliger stage before developing into a juvenile. The trochophore is similar to the Polyplacophoran trochophore. The veligers and juveniles are readily recognised as bivalves, as they have a small flattened shell attached. When preserved the organs are usually retracted within the shell.



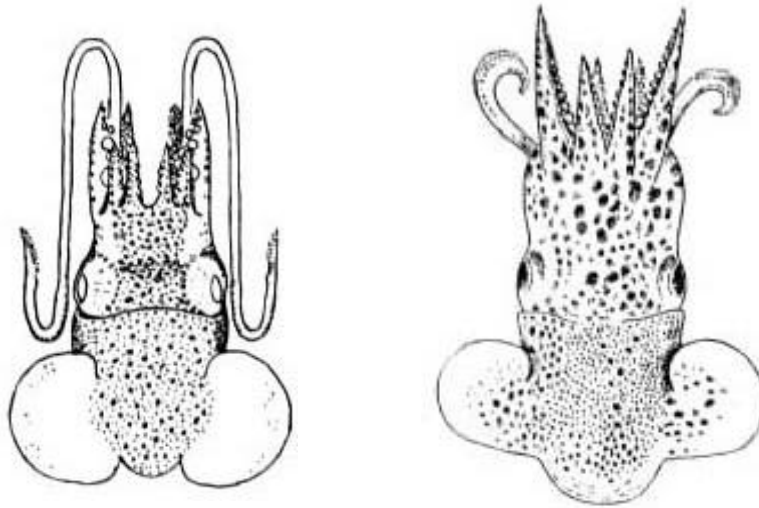
Bivalve development stages. A, trochophore; B, oyster veliger stage, dorsal and lateral; C, later larva. Figure A from Crofts (1937); B, from Hardy (1972); C, from Rees (1950).

CLASS CEPHALOPODA

The Class Cephalopoda comprises the nautilus, cuttle fish, squid and octopus. The cephalopods have no distinctive larval stage, the juveniles emerge as miniature adults.

Order Sepioidea

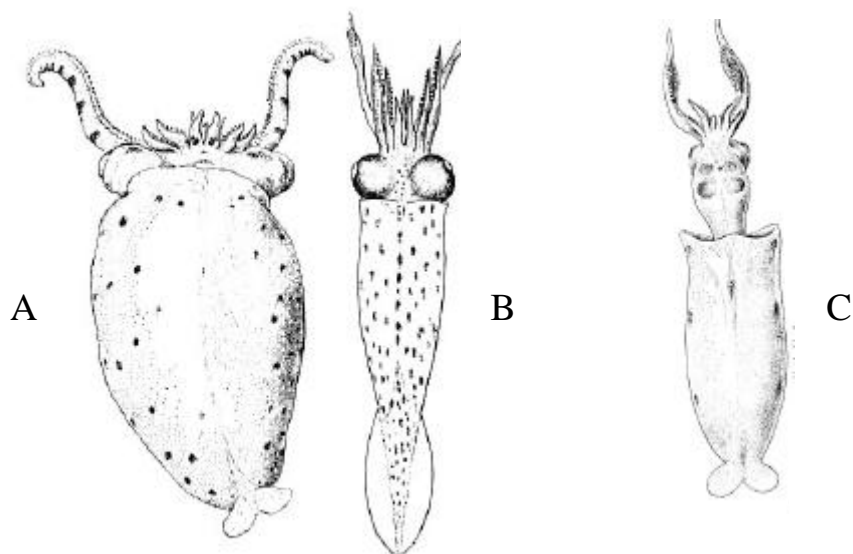
This order includes the cuttle fish. The larvae have ten tentacles round the mouth, with one pair longer than the others. They either have a sac-like body with long narrow lateral fins, or the body is rounded posteriorly with circular lateral fins.



Examples of Sepioidea larvae (From Muus 1963a)

Order Teuthoidea

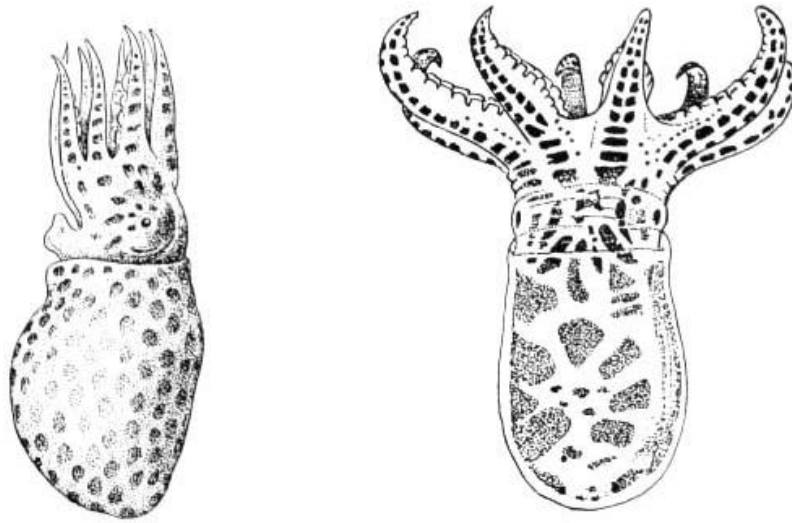
This order includes the squids, the larvae of which, as with the Sepioidea have 10 tentacles round the mouth, one pair longer than the others. Their bodies are sac-like or torpedo-shaped with terminal or sub-terminal fins



Examples of squid larvae (A,B from Muus 1963b; C from Muus 1963c)

Order Octopoda

This order includes the octopus which has eight tentacles, more or less all the same size, round the mouth. In the Genus *Octopus* there are no fins on the body.



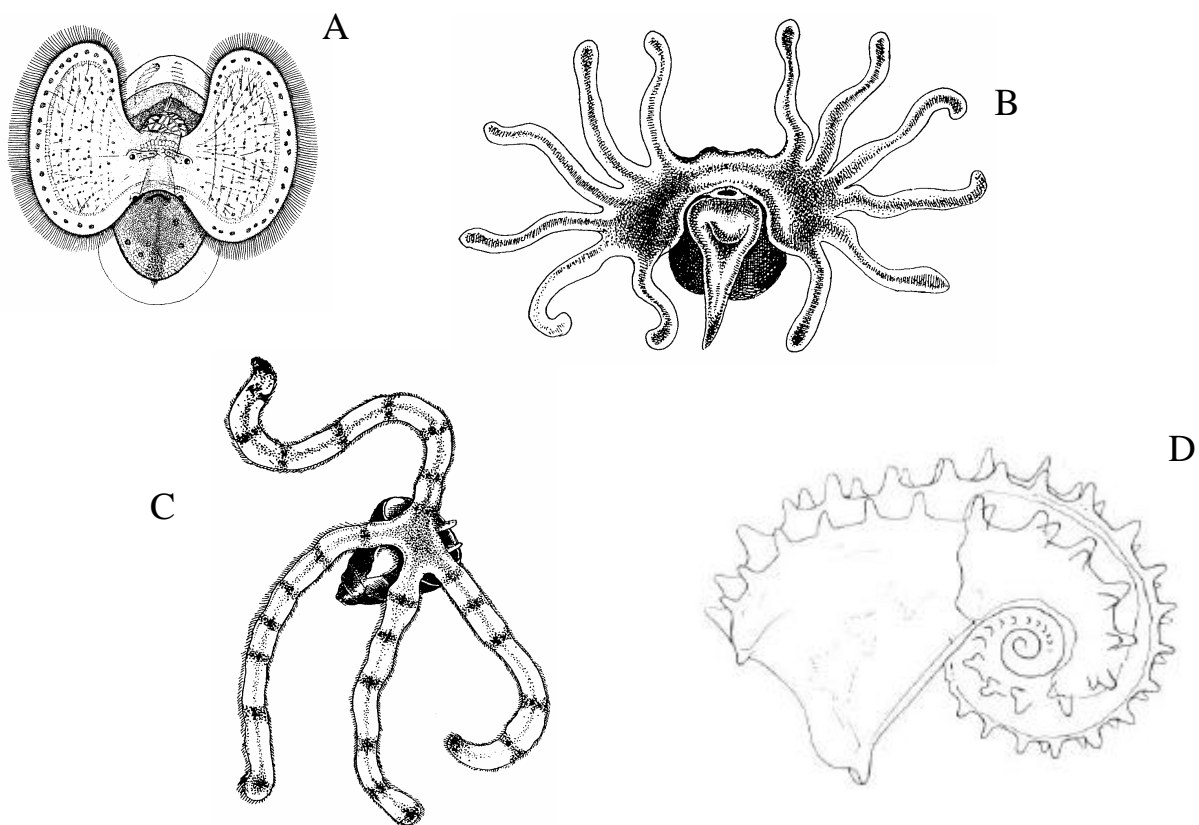
Examples of the Genus *Octopus* (From Muus 1963d).

CLASS GASTROPODA

The Gastropoda is the largest class of molluscs and includes the truly planktonic forms as well as the familiar benthic snails and sea slugs. The typical gastropod consists of a head and a visceral mass (the internal organs) sitting on top of a muscular foot. The visceral mass is usually protected by a typically coiled shell. During development the visceral mass is rotated through 180 degrees anticlockwise. The Class Gastropoda comprises two Subclasses, Streptoneura (also known as Prosobranchia) and Euthyneura (comprising the pulmonates and opisthobranchs). We have followed the molluscan system proposed by Taylor & Sohl (1962) and adopted by Van der Spoel *et al.* (1997).

Larval stages

Gastropod larvae are always present in coastal plankton, and can occur in large numbers. Some gastropods have a trochophore larvae, and the majority have a veliger larvae. The trochophore larva is very small and usually passes through the mesh used in sampling. The veligers are easy to pick out as they look like what they are, miniature snails. All veliger larvae have a shell, even those that have a reduced or lost shell as an adult. The veliger swims using a lobed, ciliated structure called the velum. Although the velum is often diagnostic, it is usually withdrawn into the shell in preserved specimens. The size of the larva varies from approximately 0.5 up to 3 mm or more. The veliger larvae are difficult to identify to species and we have not attempted to do so in this guide.



Gastropod larval types: A, veliger with 2-lobed velum; B, veliger with 12-lobed velum; C, veliger with 4-lobed velum; D, echinospira larva. Figures A from Werner (1955); B,C, from Dawydoff (1940); D from Dakin & Colefax (1940).

Subclass Streptoneura

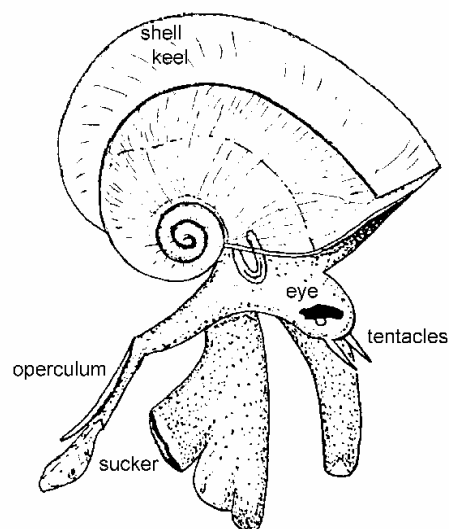
This group of gastropods is also known as Prosobranchia. Prosobranchs are the most primitive of the gastropod subclasses. Prosobranch bodies are typically enclosed in a coiled shell (spirals in a clockwise direction when viewed from above) and the animal has an operculum. The head has a single pair of tentacles, each bearing an eye at its base. The sexes are separate. There is usually a planktonic dispersal phase in the life cycle, trochophore, and veliger larvae, and some species release free-floating eggs. This subclass has considerable functional and anatomical diversity, and there is no single characteristic by which prosobranchs can be distinguished from other gastropod groups. The planktonic heteropods and the family Janthinidae belong.

Superfamily Atlantacea – Heteropoda

The planktonic heteropods show striking modifications to the basic prosobranch body plan and life style. The shell may be larger than the body (as in *Atlanta*), may be reduced (as in *Carinaria*) or absent (as in *Firoloida*). The foot is developed into a tool for propulsion. The body is nearly transparent. Sexes are separate. Heteropods produce eggs in gelatinous egg masses that may form strings. The embryos develop to the veliger stage before emerging into the plankton, the velum of the veligers with three or four pairs of lobes. Heteropods are voracious carnivores, they swim upside down and are restricted to shallow warm waters. The Heteropoda is composed of the families Atlantidae, Pterotracheidae and Carinariidae.

Family Atlantidae

The family is composed of three genera, *Oxygyrus*, *Protatlanta* and *Atlanta*. All have a generally flattened, coiled shell, with a keel extending around all or part of the outer edge of the shell. The keel is characteristic in atlantids, but is not always obvious in younger specimens. In young specimens the shell is sufficiently transparent for the eyes to be clearly visible. The eye has a semi-transparent, amber-coloured lens with an area of dense black pigment behind. The animal is able to withdraw into the shell completely. The species are separated according to the shape of the coils in the shell, the start and end of the keel, the shape of the shell opening, the length of the tentacles and the shape of the eyes. The foot is laterally flattened, shaped like a fin with an operculum and a sucker. Atlantid species range in size from 0.5-11 mm, but the majority are in the 1



Typical atlantid features. Figure from Souleyet (1852).

Genus *Atlanta*

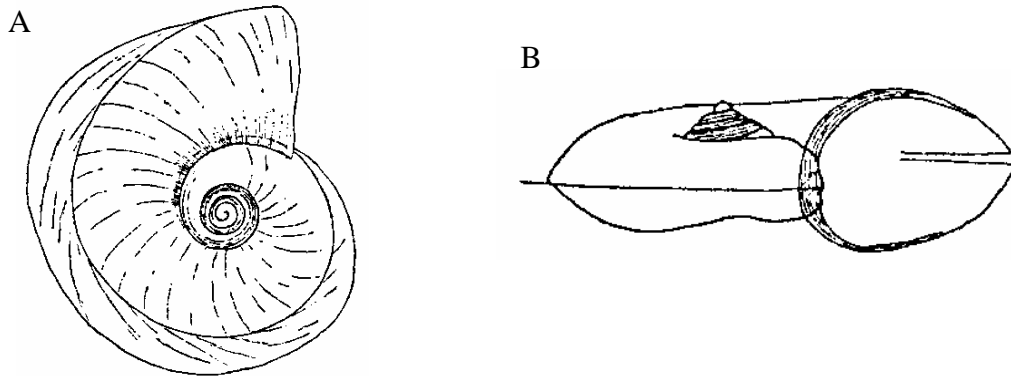
Body large with a prominent proboscis and a swimming fin. Genus comprised of twenty one valid species. The velum of atlantid veligers is 6-lobed.

Atlanta inflata Souleyet, 1852

Length: body up to 2 mm, shell diameter up to 1.5 mm (keel excluded).

A small atlantid with large eyes and a single swimming fin. The shell is flattened with a darkly coloured keel. 7 whorls to shell. The spire is low and coloured violet or yellow/brown.

Recorded: Madagascar.



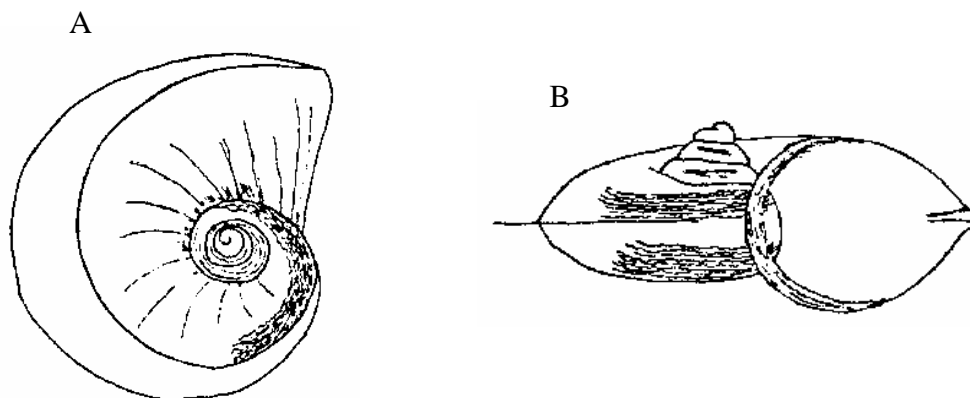
Atlanta inflata; A dorsal; B lateral. Figures from Tesch (1949).

Atlanta fusca Souleyet, 1852

Length: body up to 2 mm diameter, shell diameter up to 1.7 mm (keel excluded).

A small atlantid with large eyes and a single swimming fin. The shell is flattened with a white coloured keel. 5 whorls to shell. The spire is high with a buff colour. The apical angle of the spire is 90 degrees.

Recorded: Madagascar.



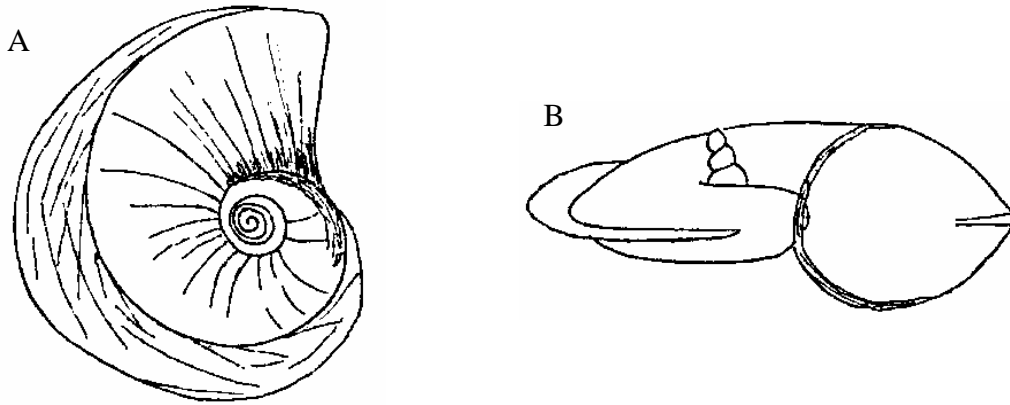
Atlanta fusca; A dorsal; B lateral. Figures from Tesch (1949).

Atlanta turriculata d'Orbigny, 1836

Length: body up to 3 mm diameter, shell diameter up to 3 mm (keel excluded).

A small atlantid with large eyes and a single swimming fin. The shell is flattened with a keel that slightly penetrates between the body whorl and spire. 5.5 whorls to shell. The spire is high with a buff or rosy colour. The apical angle of the spire is 40 degrees.

Recorded: Madagascar.



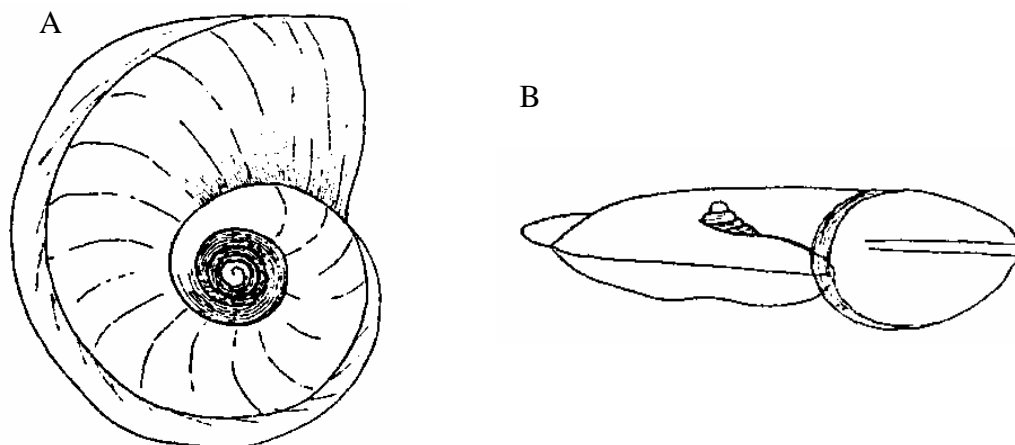
Atlanta turriculata; A dorsal; B lateral. Figures from Tesch (1949).

Atlanta helicinoides Souleyet, 1852

Length: body up to 2 mm diameter, shell diameter up to 2 mm (keel excluded).

A small atlantid with large eyes and a single swimming fin. The shell is flattened with a keel that slightly penetrates between the body whorl and spire. 7 whorls to shell. The spire is large with a yellowish-violet colour, the keel is a slightly darker colour.

Recorded: Madagascar.



Atlanta helicinoides; A dorsal; B lateral. Figures from Tesch (1949).

Genus *Oxygyrus*

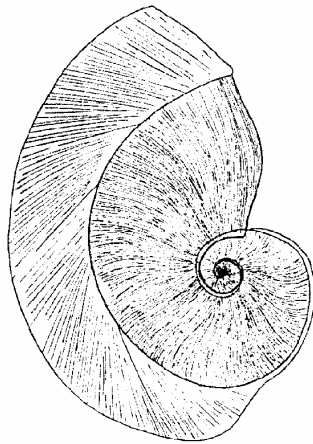
Only one species.

Oxygyrus keraudreni (Lesueur, 1817)

Length: body up to 10 mm diameter, shell diameter up to 10 mm.

Atlantid with large eyes and a single swimming fin. The shell is flattened with a keel that ends near the aperture. The spire and keel are non-calcareous. 1 whorl to shell is visible. The shell is a brown colour.

Recorded: Madagascar



Oxygyrus keraudreni; dorsal. Figure from Tesch (1949).

Genus *Protatlanta*

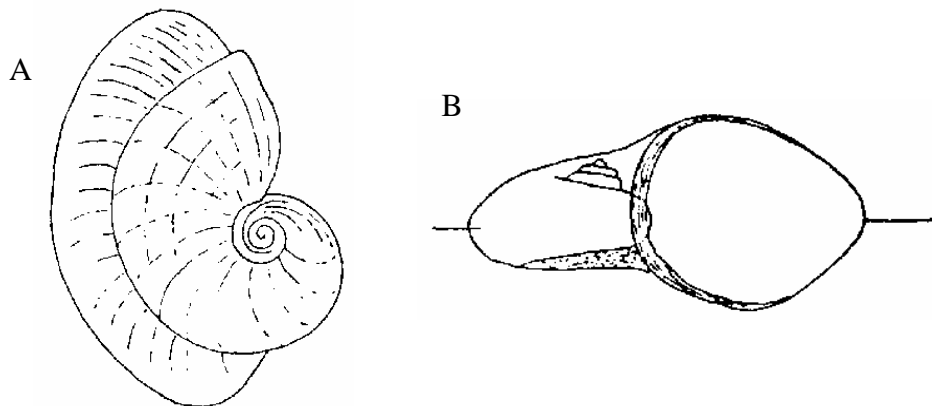
Only one species.

Protatlanta souleyeti (Smith, 1888)

Length: body up to 1 mm diameter, shell diameter up to 1.5 mm (keel excluded).

A small atlantid with large eyes and a single swimming fin. The spire and body whorl is calcareous but the keel is cartilaginous. The shell is flattened and the keel extends over half the circumference of the shell and ends just before the aperture. 3.5 whorls to shell. The shell is transparent.

Recorded: Madagascar



Protatlanta souleyeti; A dorsal; B lateral. Figures from Tesch (1949).

Family Pterotracheidae

Medium to large planktonic animals, from 5-250 mm in length, but usually between 5-15 mm. Adults have completely lost their shell. Body usually transparent. The eye is conspicuous, a spherical, semi-transparent, amber-coloured lens with an area of black pigment behind. Two genera in the family, *Pterotrachea* and *Firoloida*.

Genus *Pterotrachea*

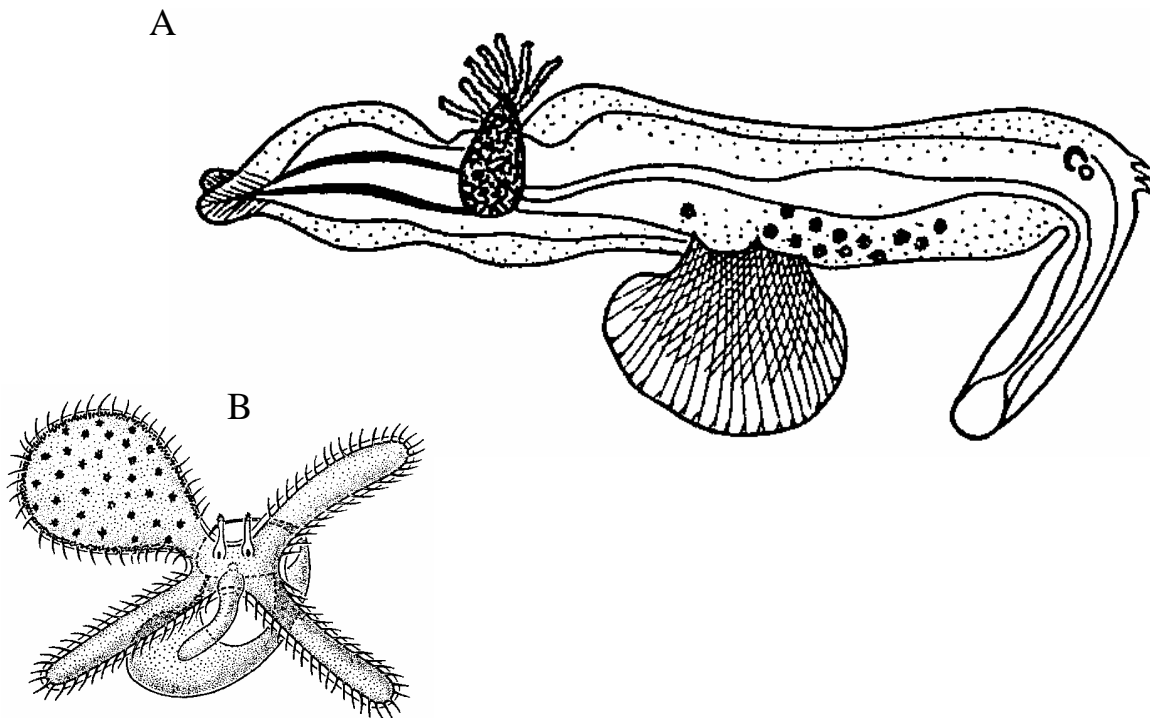
Genus comprises four species (*P. coronata*, *P. hippocampus*, *P. minuta* and *P. scutata*), all occur in the western Indian Ocean. The body is transparent and cylindrical with one swimming fin. The large proboscis is perpendicular to the body.

Pterotrachea hippocampus Philippi 1836

Length: 20-80 mm.

Eyes are triangular with the base of the retinal part widened. The outer surface is scattered with red dots in live specimens. Eyes and mouth parts are visible through the transparent body. The female spawns by extruding a long filament of encapsulated fertilised eggs within a transparent gelatinous matrix. The egg-string extends to over five times the length of the female.

Recorded: Madagascar.



Pterotrachea hippocampus: A, adult; B, veliger. Figures from Thiriot-Quévèreux (1973).

Genus *Firoloida*

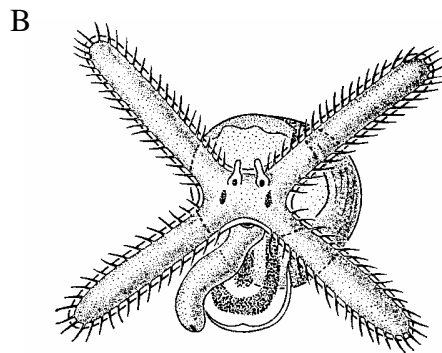
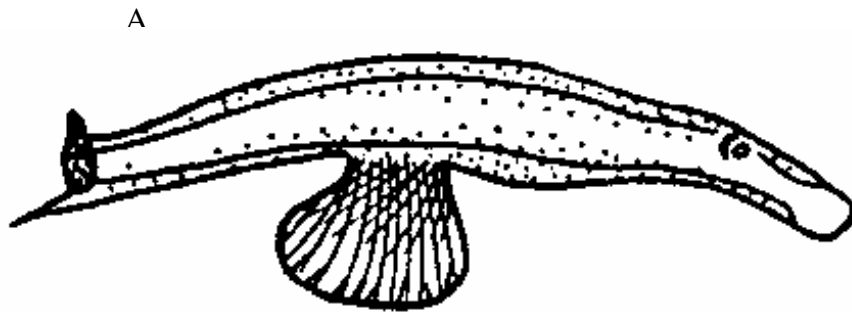
Only one species. Sexes are separate.

Firoloida desmaresti Lesueur 1817

Length: 15-40 mm.

The body is colourless and transparent. Elongate proboscis anteriorly and a visceral nucleus posteriorly. Body long, cylindrical with one swimming fin. The female bears an internal filament nearly as long as the body. This remains attached and receives embryos that pass from the uterus. The embryos are gradually pushed by successive spawn to the open end where they emerge as free-swimming veliger larvae.

Recorded: Seychelles, Rodrigues, Madagascar.



Firoloida desmaresti: A, adult; B, veliger. Figures A from Franc (1948), B from Thiriot-Quiévreux (1973).

Family Janthinidae

The janthinids are surface dwelling oceanic animals, they have a large float consisting of a mucous-coated bubble of air. The animals float upside down. The shell is globular and rather delicate, it is frequently washed ashore but seldom intact. The shells are spiral, the animal and the shell are a vivid blue or violet colour, often the part under the water is white. *Janthina* doesn't have eyes, but nonetheless is a carnivore. Prey consists largely of the similarly drifting *Velevella* or 'by-the-wind-sailor'. The family is composed of two genera *Janthina* and *Recluzia*.

Genus *Janthina*

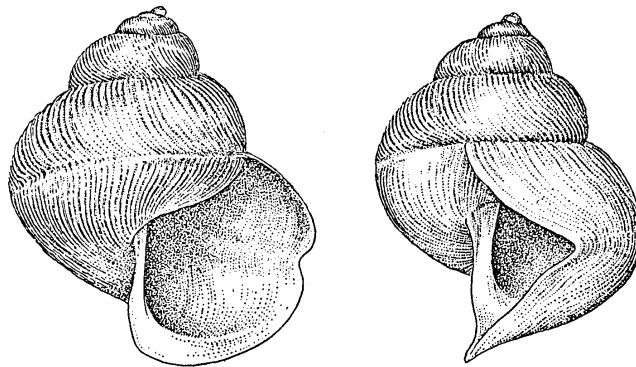
The genus is composed of five valid species. All species do not possess swimming fins and live in the pleuston. The species are viviparous protrandric hermaphrodites. The shell is thin and fragile.

Janthina exigua Lamarck, 1816

Length: shell up to 17 mm high, aperture height up to 11 mm..

Approximately 5 whorls in the shell. The shell is dark violet in colour. The spire has a well-defined tip. The edge of the shell opening is characterised with an incision in the middle.

Distribution: western Indian Ocean



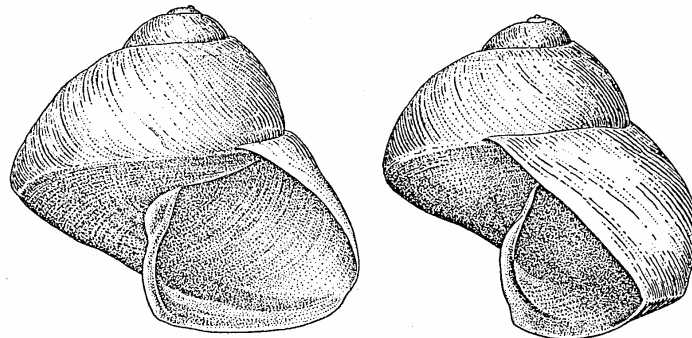
Janthina exigua. Figures from Laursen (1953).

Janthina janthina Linnaeus, 1758

Length: shell up to 31.5 mm high, aperture up to 21.8 x 20 mm.

Approximately 4 whorls in the shell. The shell is blue to violet in colour. The spire tip fairly flat. The edge of the shell opening has a small incision.

Distribution: Kenya, Mauritius, western Indian Ocean



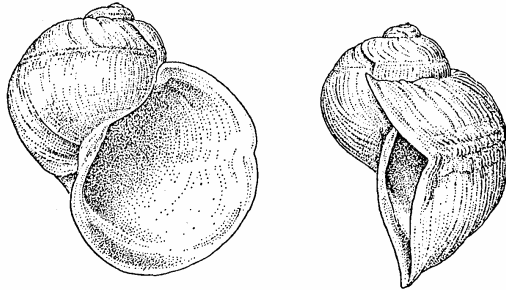
Janthina janthina. Figures from Laursen (1953).

Janthina pallida Thompson, 1841

Length: shell up to 24 mm high, aperture up to 22 x 13.5 mm.

Approximately 4 whorls in the shell. The shell is a deep violet colour. The aperture is large in comparison to the shell height. The edge of the shell opening has a small incision.

Distribution: western Indian Ocean



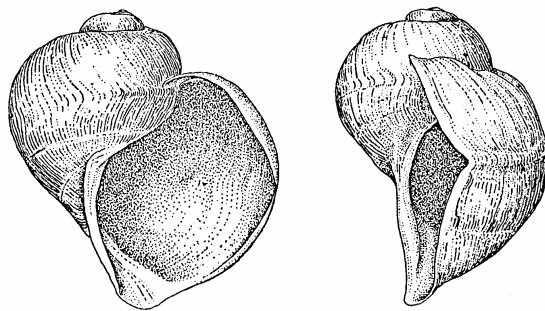
Janthina pallida. Figures from Laursen (1953).

Janthina prolongata de Blainville, 1822

Length: shell up to 24 mm high, aperture up to 22 x 13.5 mm.

Approximately 4 whorls in the shell. The shell is a deep violet colour. The spire tip is flattened. The edge of the shell opening has a small incision.

Distribution: western Indian Ocean



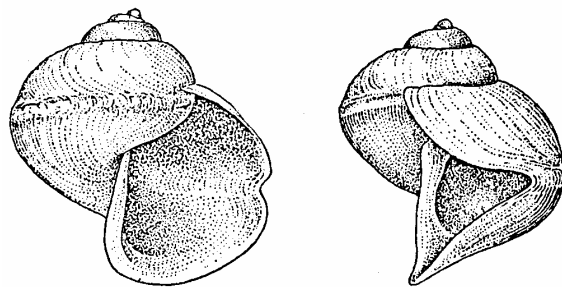
Janthina prolongata. Figures from Laursen (1953).

Janthina umbilicata D'Orbigny 1840

Length: shell up to 9 mm high, aperture up to 6 x 4.5 mm.

Approximately 4 whorls in the shell. The shell is thin, transparent and a deep violet colour. The spire has a well-defined tip. The edge of the shell opening has a distinct incision.

Distribution: western Indian Ocean



Janthina umbilicata. Figures from Laursen (1953).

Subclass Euthyneura

The subclass Euthyneura comprises the opisthobranchs and the pulmonates. The opisthobranchs comprise marine species with reduced shells and the pulmonates comprise the freshwater and land gastropods. The opisthobranch larvae hatch as veligers, or less commonly, as juveniles having passed through the trochophore stage within a gelatinous egg mass. All veliger larvae have a shell, this is lost during metamorphosis for those species without a shell as an adult (e.g. the nudibranchs). Of the planktonic species, the majority fall under the group of pteropods. Pteropod adults may have a shell as in the Order Thecosomata, the 'sea butterflies' or may lose it during metamorphosis as in the Order Gymnosomata.

Order Nudibranchia

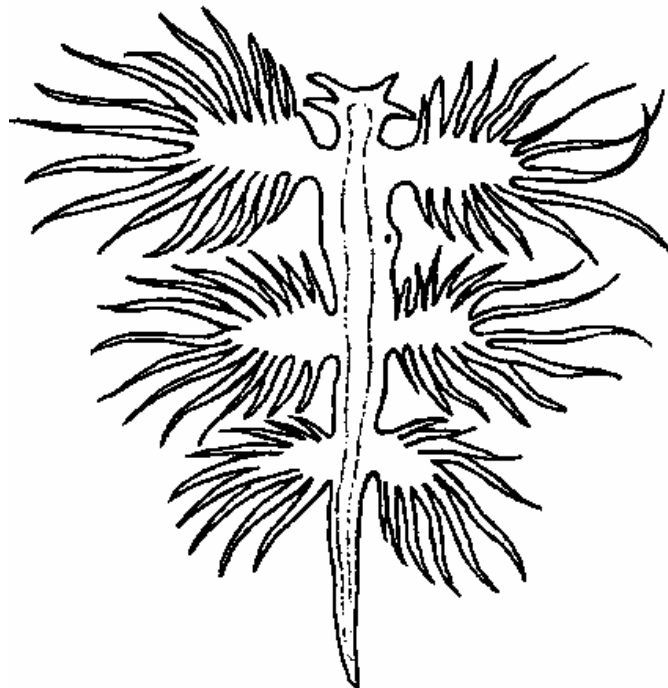
Nearly all nudibranchs are benthic, very few have adapted to a pelagic existence.

Glaucus atlanticus Forster, 1777

Length: up to 43 mm.

A surface living nudibranch that is a vivid blue-green colour dorsally and white ventrally. There are three or four branched processes on either side of the body. The species is hermaphroditic. *Glaucus* are carnivorous and are frequently associated with the siphonophore *Velevella*.

Distribution: western Indian Ocean.



Glaucus atlanticus adult. Figure from Woodward (1875).

Order Thecosomata

Thecosomata are shelled pteropods.

Family Limacinidae

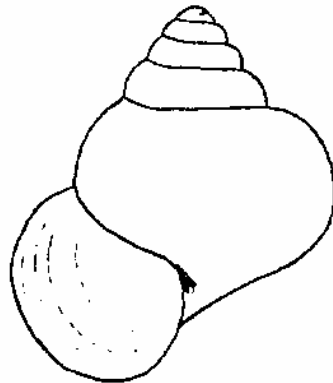
The family comprises one genus, *Limacina*. The shell is a left-handed spiral, transparent and the spire can be high or flattened. The adults usually possess an operculum. The large winged-feet protrude from the shell opening, they are used in locomotion and move the animal in a spiral course. Most species produce egg masses, larvae hatch out as veligers. The species are protandric hermaphrodites. There are eight species of *Limacina*.

Limacina trochiformis (d'Orbigny, 1836)

Length: shell height 1 mm, width to 0.8 mm.

5 whorls in the shell. The shell is white to light-purple in colour and transparent. The outer surface of the shell is smooth.

Recorded: Madagascar.

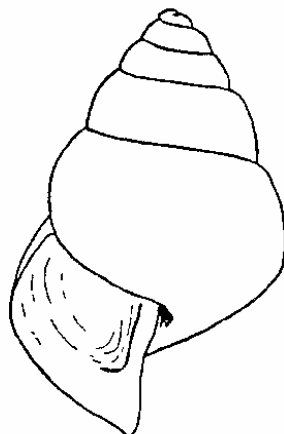


Limacina trochiformis. Figure from Tesch (1946).

Limacina bulimoides (d'Orbigny, 1836)

Length: shell height 2 mm, width to 1.4 mm.

6 whorls in the shell. The shell is transparent and colourless. The outer surface of the shell is smooth.

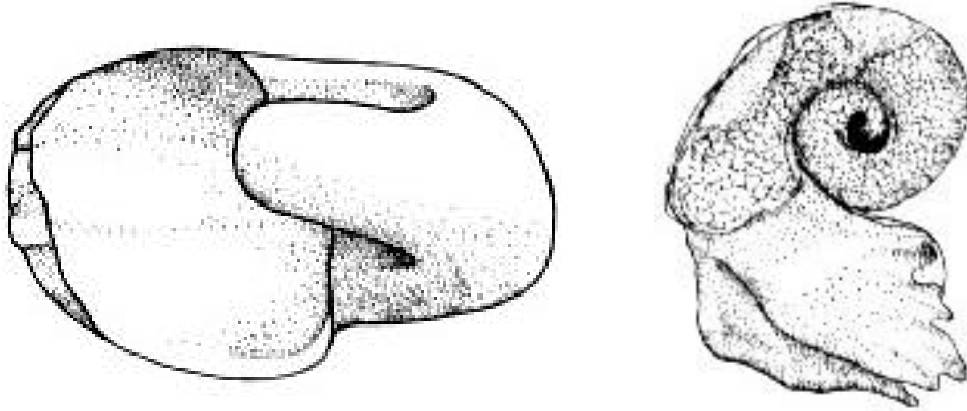


Limacina bulimoides. Figure from Tesch (1946)..

Limacina inflata (D'Orbigny, 1836)

Shell with 3 whorls coiled in one level, border of the heart-shaped aperture with a tooth supported by a rib, umbellicus and suture deep and distinct. Shell diameter up to 1.5mm. Common species in the Indian Ocean.

Distributed: Seychelles, Rodrigues, Zuzi.



Limacina inflata lateral and dorsal views (From Van der Spoel, 1972)

Family Cavoliniidae

Shells are straight or slightly curved. Cavoliniidae is composed of eight genera *Creseis*, *Styliola*, *Hyalocylix*, *Clio*, *Cuvierina*, *Diacria*, *Diacavolinia* and *Cavolinia*.

Subfamily Clioinae

Clioinae is composed of four genera, *Creseis*, *Styliola*, *Hyalocylix* and *Clio*. All are characterised by straight or slightly curved shells. The species are protandric hermaphrodites.

Genus *Creseis*

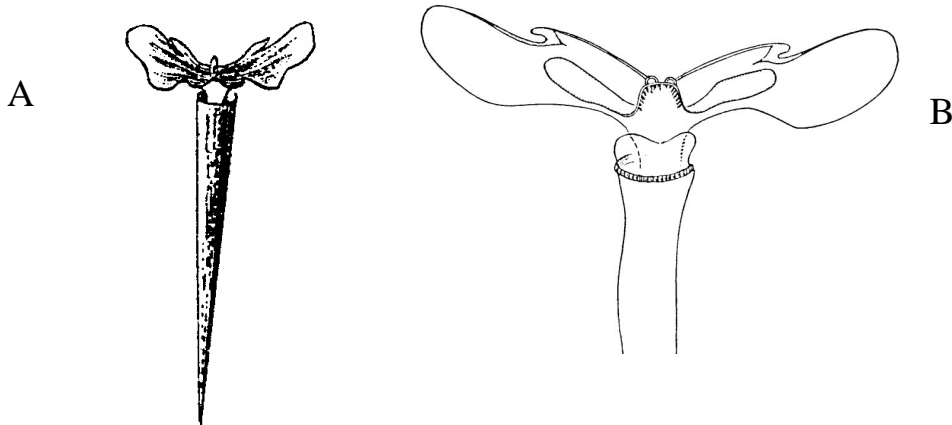
Four species of *Creseis*, three of them have been recorded in the western Indian Ocean.

Creseis acicula (Rang, 1828)

Length: shell is up to 35 mm long and 1.5 mm across.

Shell is transparent, long and straight, and round in cross section. The shell surface is smooth. A distinctive tentacular lobe on the anterior margin of the fins.

Recorded: Seychelles, Rodrigues, Madagascar.



Creseis acicula: A, Adult, B detail of 'wings'. Figure A from Woodward (1875), B from Meisenheimer (1905).

Creseis virgula (Rang, 1828)

Length: shell length up to 7 mm, opening diameter 1 mm.

Shell is transparent, curved and round in cross section. The shell surface is smooth and colourless. There are three varieties forma *conica*, forma *constricta* (recorded from Rodrigues) and forma *virgula* based on characteristics of the shell shape.

Recorded: Seychelles, Rodrigues, Madagascar.



Creseis virgula: Adult shell shapes. Figures from Tesch (1946).

Genus *Styliola*

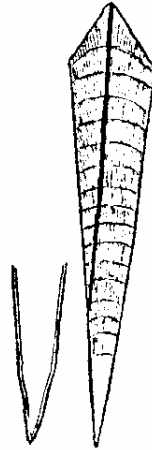
Only one species.

Styliola subula (Quoy & Gaimard, 1827)

Length: shell length up to 13 mm.

Shell is needle-like in shape, transparent and round in cross-section. A characteristic straight ridge runs obliquely from the opening down to the left. There is no tentacular lobe on the anterior margin of the fins. The species can occur in swarms.

Recorded: Madagascar.



Styliola subula: Adult shell. Figure from Tesch (1946)

Genus *Hyalocylix*

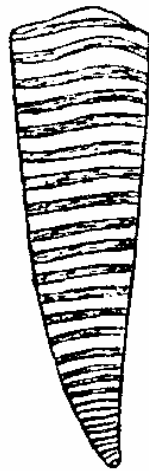
Only one species.

Hyalocylix striata (Rang, 1828)

Length: shell length up to 8 mm.

The shell is cone-shaped, slightly curved dorsally and completely transparent. The opening is oval in transverse section. The surface of the shell has transverse thickened bands that progressively get wider apart near the aperture. The animal is often separated from its shell when preserved, but is easily recognised by the very large fins. The species can occur in swarms.

Recorded: Madagascar.



Hyalocylix striata: Adult shell. Figure from Tesch (1946).

Subfamily Cavoliniinae

Cavoliniinae is composed of three genera, *Diacria*, *Cavolinia* and *Diacavolinia*.

Genus *Cavolinia*

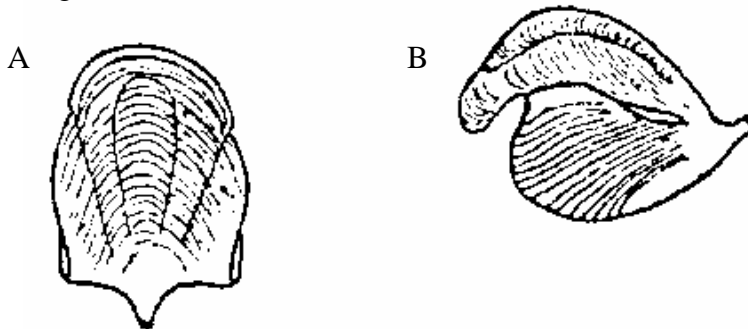
Five species of *Cavolinia*. A very distinctive shape of shell with a marked bulge on the ventral plate. The species are protandric hermaphrodites. Several species occur in the western Indian Ocean.

Cavolinia globulosa (Gray, 1850)

Length: shell up to 6 mm long and 4.5 mm wide.

The shell is globular, transparent with a brownish colour. The anterior section of the shell is rounded. The anterior section of the ventral side has strong transverse ribs.

Recorded: Madagascar.



Cavolinia globulosa: A, dorsal view of shell; B, lateral view of shell. Figures A & B from Tesch (1946).

Genus *Diacavolinia*

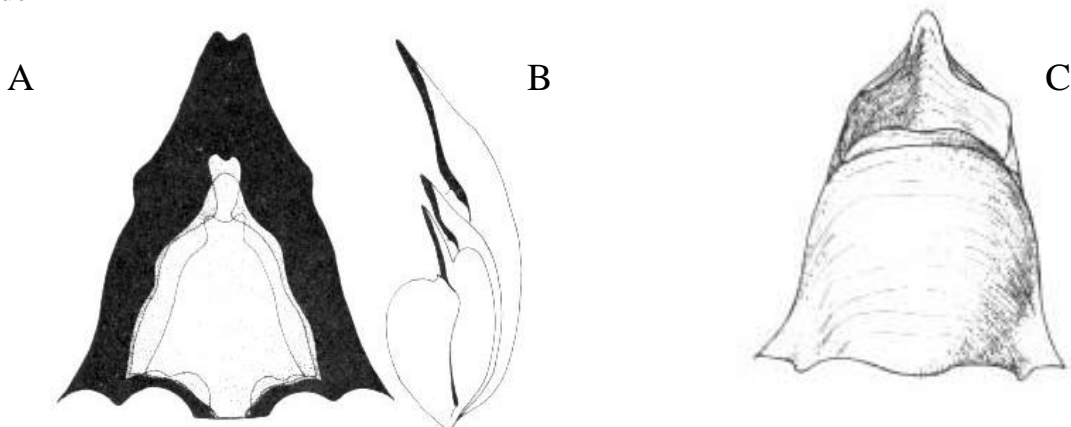
Twenty two species of *Diacavolinia*, *Diacavolinia* species are characterised by the absence of a caudal spine.

Diacavolinia longirostris (de Blainville, 1821)

Length: shell length 5.2 – 7.2 mm, width 4.9 – 6.8 mm.

Dorsal side of the shell is relatively flat whereas the ventral side is deeply vaulted. The shell has well developed lateral spines. The shell is brown in colour. Different forms have been noted.

Recorded: Madagascar



Diacavolinia longirostris: A outlines of different shell forms ventral. In decreasing size forma *limbata*, *longirostris*, *strangulata* and *angulosa*; B, same in lateral excluding forma *strangulata*; C, forma *limbata* ventral view. Figures from Van der Spoel (1972).

Genus *Diacria*

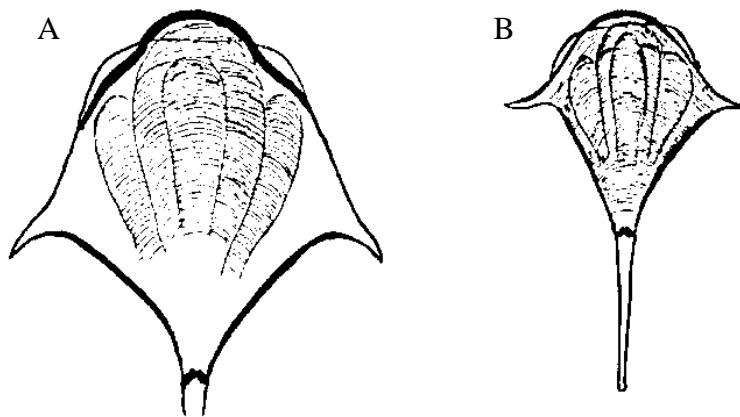
The genus comprises two species groups, ten species. The species may be globular, with both dorsal and ventral sides rounded, or bilaterally symmetrical with a long caudal spine. The species are protandric hermaphrodites.

Diacria trispinosa (de Blainville, 1821)

Length: shell length 8 mm, width 10 mm.

The shell is bilaterally symmetrical. Very long caudal spine and strong lateral spines. There are five ribs on the dorsal side and three ribs on the ventral side. The shell is slightly transparent and coloured brown, a darker colour on the ribbed sections.

Recorded: Madagascar.



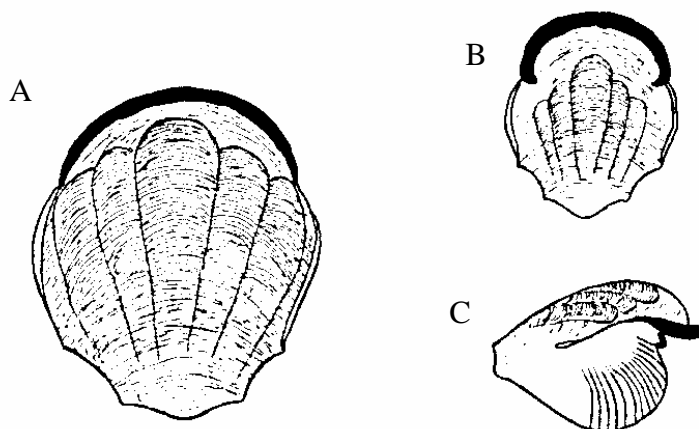
Diacria trispinosa: A, shell, dorsal; B, shell, ventral. Figures A & B from Tesch (1946).

Diacria quadridentata (de Blainville, 1821)

Length: shell length .2.0 – 3.0 mm, width 1.8 – 2.5 mm.

The shell is small, globular, with rounded dorsal and ventral sides. There are no caudal or lateral spines. The dorsal side extends further than the ventral side, this section can be seen when viewed ventrally.

Recorded: Madagascar.



Diacria quadridentata: A, ventral; B, dorsal; C lateral. Figures A, B & C from Tesch (1946).

Order Gymnosomata

Gymnosomata are pteropods without shells.

Family Desmopteridae

Only one genus, *Desmopterus*.

Genus *Desmopterus*

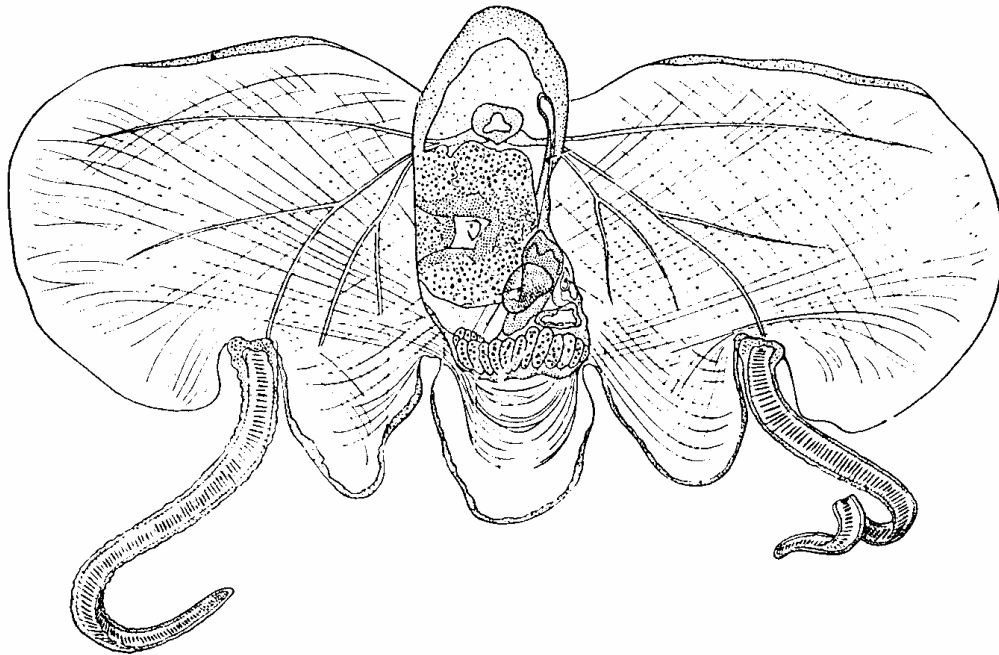
Three species in the genus, two are present in the western Indian Ocean. The species are protandric hermaphrodites.

Desmopterus papilio Chun, 1889

Length: body length between 0.5 – 2.0 mm, swimming wings between 2.0- 4.0 mm..

There is no shell. The animal has wings that are disc-shaped and transparent. There are two long tentacles off the lateral wings. The body is large and situated centrally between the lateral wings.

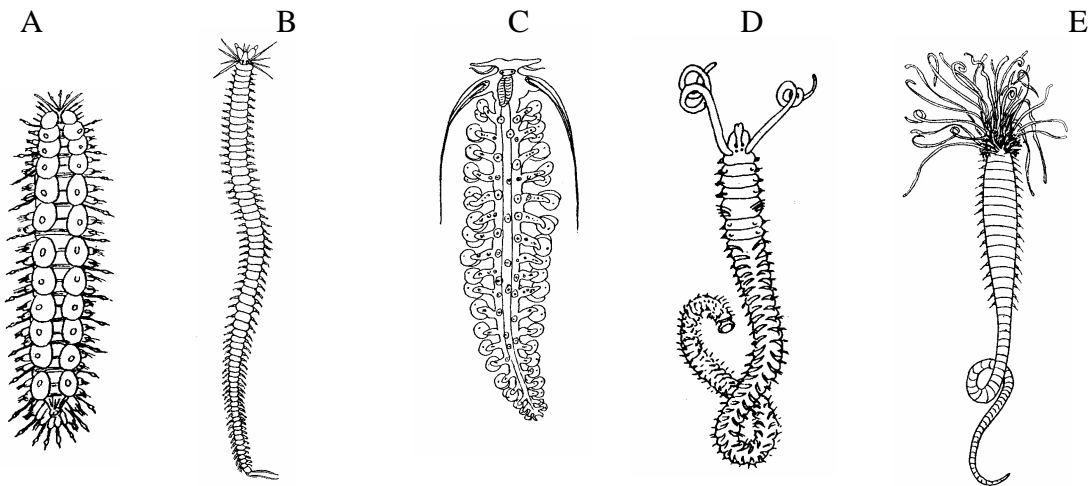
Recorded: Seychelles.



Desmopterus papilio: Adult. Figure from Meisenheimer (1905).

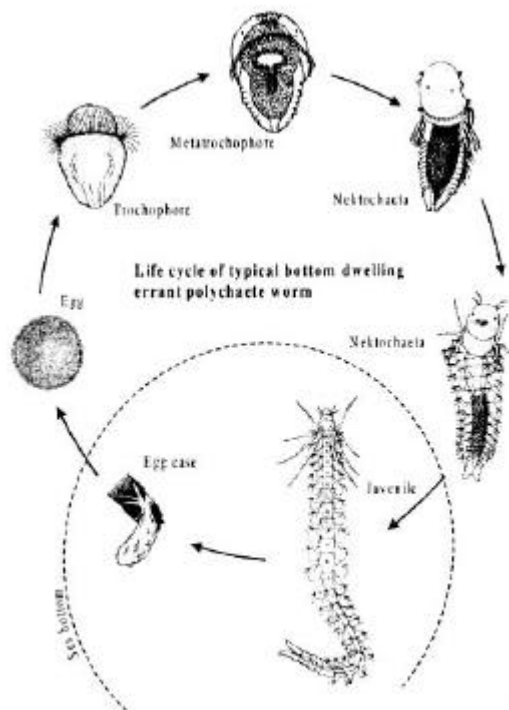
PHYLUM ANNELIDA

The phylum Annelida comprise segmented invertebrates characterised by the possession of a coelom (body cavity) and hair-like bristles known as setae or chaetae. The chaetae occur along the body in various configurations and aid in locomotion, feeding and sometimes protection. The phylum is subdivided into the Oligochaeta and Polychaeta (latin derived from greek meaning few and many bristled respectively). The former have few marine representatives and are not included in the guide. The Polychaeta can be further subdivided into the Errantia, or free living mobile worms, and the Sedentaria, the tube dwelling or burrowing forms.



Polychaete life forms. Errantia: Bottom dwelling: A, polynoid; B, nereid. Pelagic: C, tomopterid. Sedentaria: D, spionid; E, terebellid. Figures A-C from Fauvel (1923), D and E from Fauvel (1927).

Polychaetes may be represented in the plankton by larval stages of bottom living species, adults and larvae of pelagic species, and adults of some species that ascend into the plankton to breed at specific times of the year. Not all polychaetes have planktonic larvae, some release them onto the substratum.

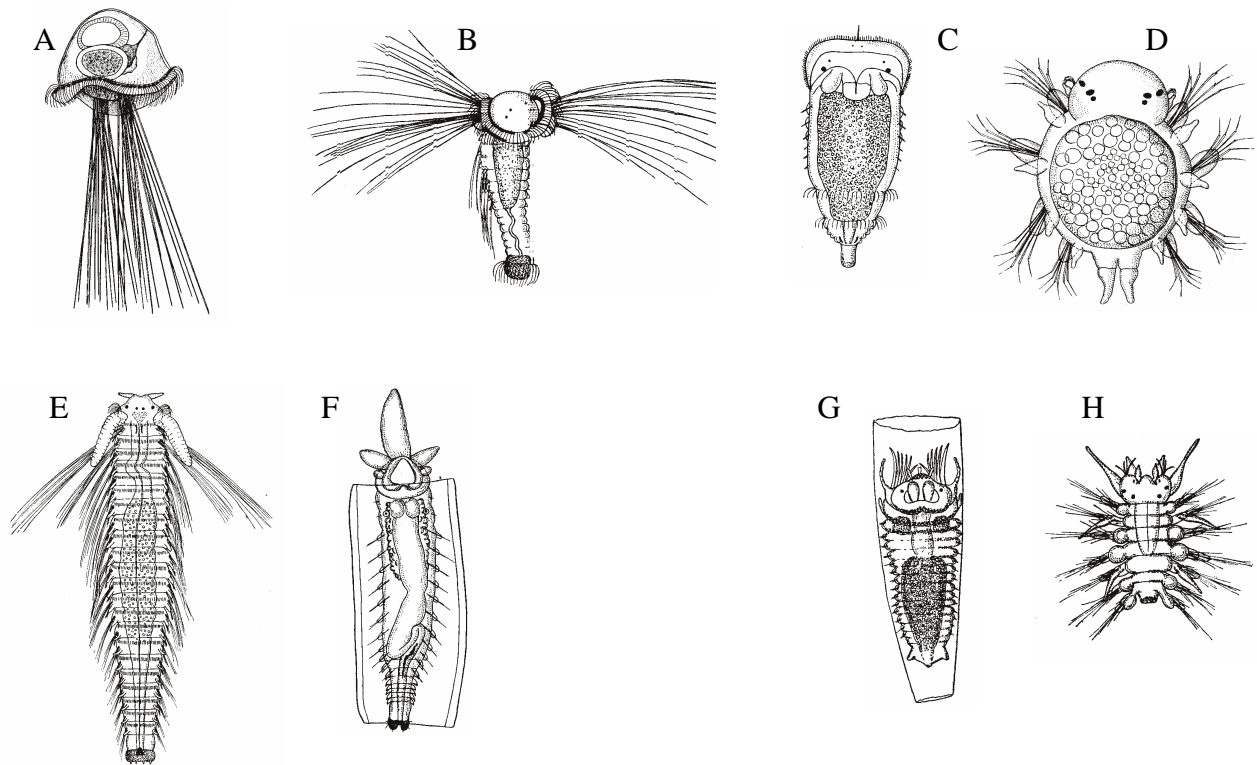


Life cycle of typical bottom dwelling errant polychaete worm. Figure adapted from Thorson (1946).

Larval Stages

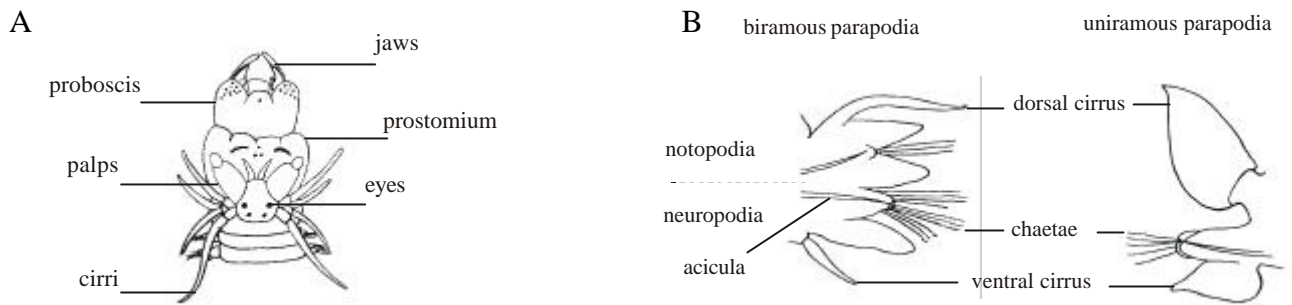
Similar to the molluscs, annelids start their larval life as a 'trochophore'. Development begins with a pronounced extension of the head section of the trochophore, with segmentation of the body beginning behind (i.e. the anterior segments are the oldest). The larva is known as a metatrochophore at this stage. Each segment extends laterally and gives rise to flap-like parapodia, special pits on the parapodia produce the hair-like setae. The setae may be very long in young individuals, but tend to be replaced by shorter setae before settling on the seabed. The nektophore larva has further head development and more segmentation of the body. As segmentation continues, the larva is referred to as a nektochaeta. There are no great changes in body form between the nektochaeta and the juvenile worm when it finally sinks to the bottom and begins its benthic life.

Identification of polychaete larvae is difficult, we have not attempted to identify them to family or genera. Polychaete larvae are usually present in the plankton of tropical waters all year round in low numbers, however if sampling coincides with the breeding period, the larvae may make up as much as 10% of the sample.



Post trochophore polychaete larvae: A, *Myriochele* sp.; B, *Spionid* sp.; C, *Chaetopterus* sp.; D, *Hediste* sp.; E, *Spiophanes* sp.; F, *Lanice* sp.; G, *Lagis* sp.; H, *Lepidonotus* sp. Figures from Thorson (1946).

Body parts of polychaete worms.



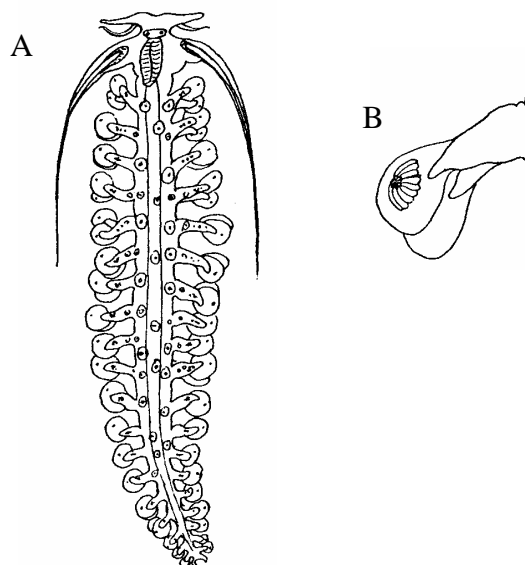
Errant polychaetes: A, anterior detail of *Nereis* sp.; B, detail of parapodia, biramous (nereid) and uniramous (phyllodocid). Figures from Fauvel (1923).

Adult pelagic polychaetes

There are several species of pelagic polychaetes. They show a variety of adaptations to their pelagic life, these adaptations aid in identifying the polychaetes to family level. It is often difficult to identify the polychaetes further to genera or species level. Pelagic polychaetes come under four main families, Tomopteridae, Typhloscolecidae, Phyllodocidae and Alciopidae.

Family Tomopteridae

The Tomopteridae are wholly pelagic and are one of the more easily identified of the pelagic polychaete families, however further identification to species requires some skill. They are transparent, they usually possess a pair of eyes, there are no chaetae and the biramous parapodia extend laterally into paddle like structures. The prostomium is drawn out into horn like antennae. The parapodial aciculae (supporting chitinous rods) of the second segment are drawn out into long streamers, which sweep back up to two-thirds or more of the body length. Key features for identification to species level include 1) the presence/absence of the small cirrus of the second segment, between the prostomial horns and acicular streamers, 2) the occurrence and position of various glands in the parapodia and 3) presence/absence of reduced posterior segments forming a tail.



Tomopteris kefersteini: A, adult, whole body; B, middle parapodia showing rosette glands. Figures A and B from Fauvel (1923).

Family Typhloscolecidae

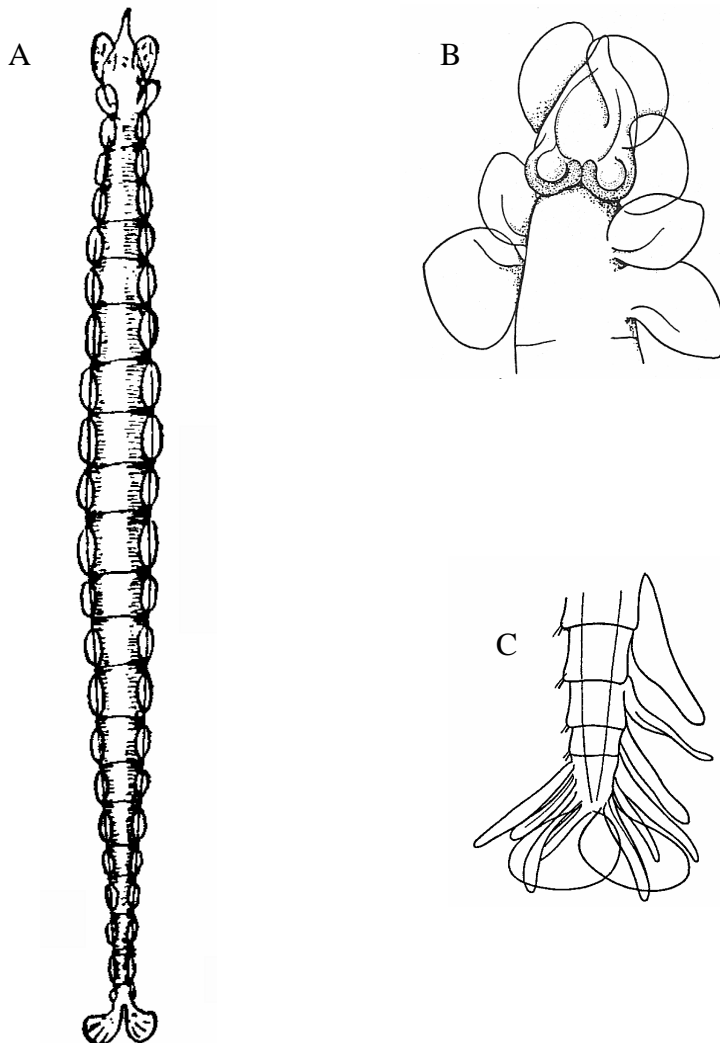
The Typhloscolecidae are small pelagic polychaetes. They are slender, cylindrical, transparent worms, with the prostomium extending forward as a papilla and merging posteriorly into the anterior segments. Eyes are always absent, but the prostomium has well developed nuchal organs. The three segments behind the prostomium bear a single pair of large foliaceous cirri. Remaining segments carry two cirri, the dorsal and ventral cirri of the parapodia. Setae may be present in the posterior segments. Paired anal cirri also show a similar paddle shape. Common genera include *Typhloscolex* and *Sagitella*.

Sagitella kowalevskii Wagner, 1872

Length: 5-15 mm.

Only one species in the genus. Up to 30 body segments. Nuchal organs are not extended as freely projecting lobes, they are usually hidden by the pair of large foliaceous cirri. The parapodial cirri are easily lost in preserved specimens.

Recorded: Seychelles, Rodrigues.



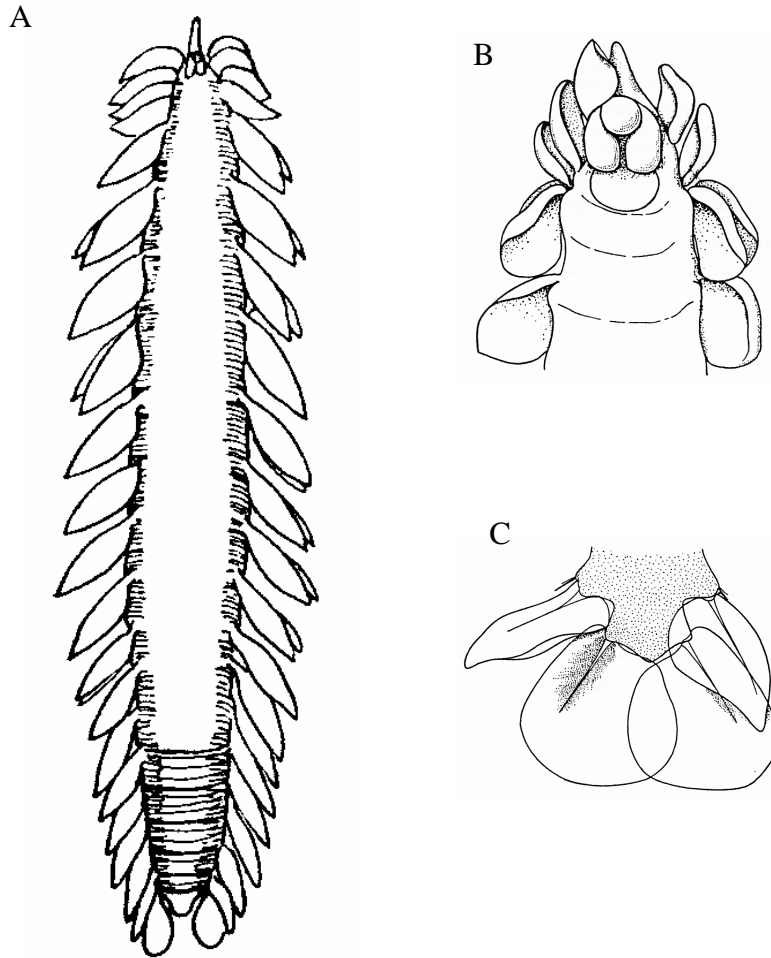
Sagitella kowalevskii: A, adult; B, anterior detail with some cirri removed to show nuchal ridges; C, tail showing anal cirri. Figure A from Fauvel (1923), B and C from Dales (1957).

Travisiopsis lobifera Levinsen

Length: 25-39 mm.

Body more plump than *Sagitella*. Nuchal organs prominent and extend as backwardly projecting lobes, they encircle a raised caruncle. The parapodial cirri are large and foliaceous. Anal cirri large and foliaceous, each with a transparent supporting rib.

Recorded: Indian Ocean.



Travisiopsis lobifera: A, adult; B, anterior detail; C, posterior detail. Figures A from Fauvel (1923), B and C from Dales (1957).

Family Alciopidae

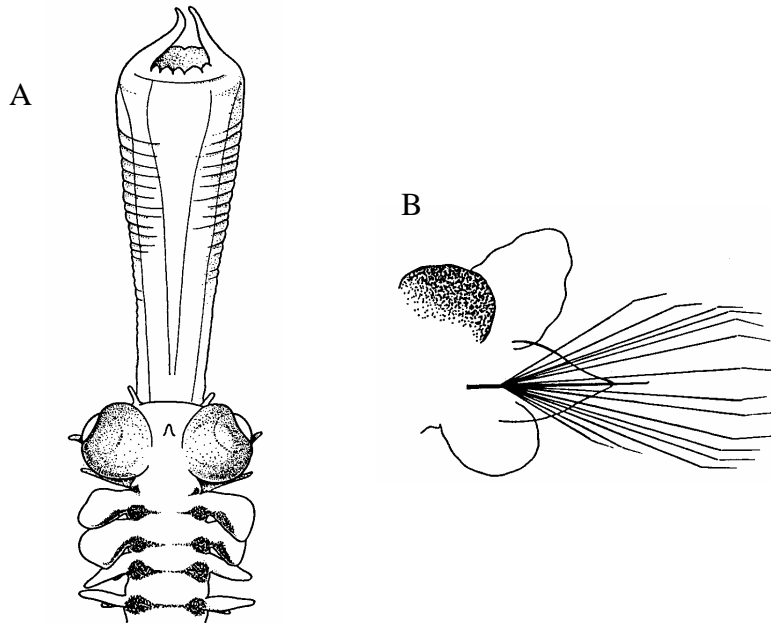
The Alciopidae are all pelagic. The worms are often small and usually transparent, with varying amounts of brown pigmentation at the base of the parapodia 'segmental glands'. The main feature is the presence of a pair of large bulging eyes, which are red in life, but turn brown in preserved specimens. Unlike phyllodocids the prostomium usually has five small antennae. The papillate proboscis is eversible, and is sometimes found with two anterior cirri and occasionally teeth. Parapodia are uniramous with dorsal and ventral cirri. Alciopids are slender fragile worms, which fragment easily on collection.

Torrea candida (Delle Chiaje, 1828)

Length: 150-250 mm.

Characterised by dark segmental glands in each segment with a line of dark pigment dorsally. Prostomium not projecting in front of eyes. Prostomium with two pairs of frontal antennae and a single median antenna between the eyes. Proboscis long, typically with two long horns and papillae on the rim. Parapodia with foliaceous dorsal and ventral cirri.

Recorded: Indian Ocean



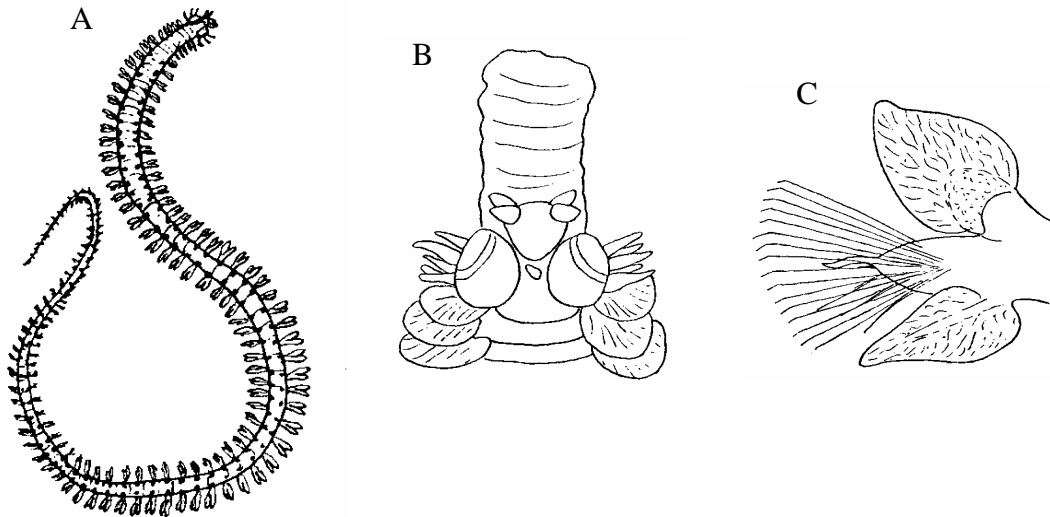
Torrea candida: A, adult; B, detail of parapodia. Figures from Dales (1957).

Rhynchonerella angelini Kinberg, 1866

Length: 60-20 mm.

Body with 150 segments. Coloured yellowish or brown in preserved specimens. Body segments and prostomium darkly pigmented dorsally. Four short fat antennae arise from the prostomium, a rounded lobe projects in front of the eyes. Parapodia with large foliaceous dorsal and ventral cirri.

Recorded: Indian Ocean



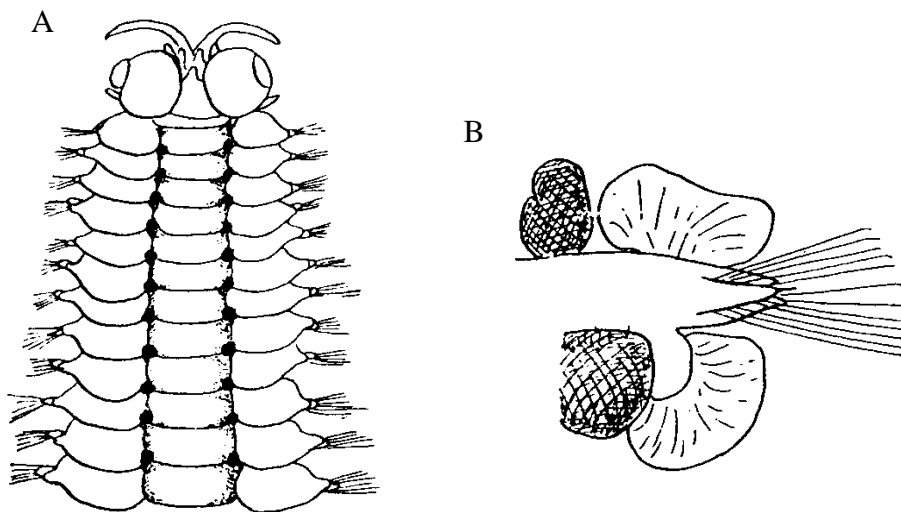
Rhynchonerella angelini: A, adult; B, detail of head; C, detail of parapodia. Figures from Fauvel (1923).

Alciopa reynaudii Audouin and Milne Edwards, 1829

Length: 10-15 mm.

A long, slender, delicate pelagic polychaete. A pair of large lensed eyes. Body segments terminate in two cirriform appendages. The prostomium with five short antennae, doesn't extend in front of the eyes.

Recorded: Indian Ocean.



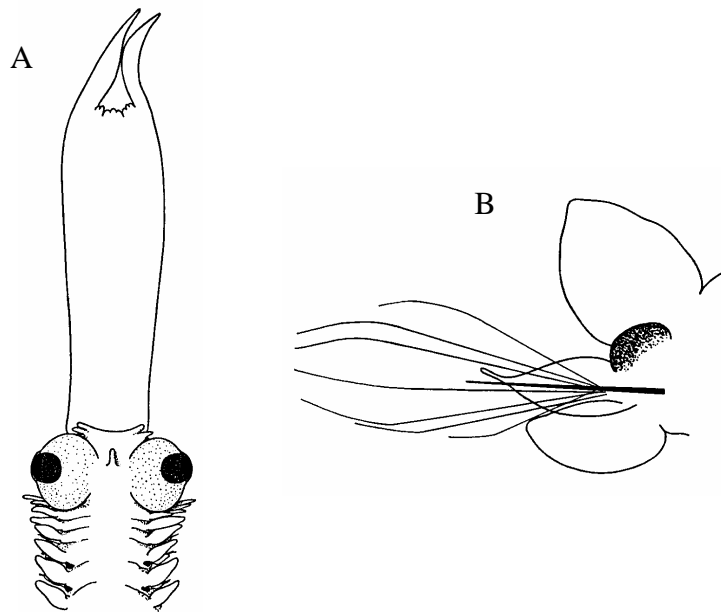
Alciopa reynaudii: A, adult; B, detail of parapodia. Figures from Fauvel (1923).

Vanadis formosa Claparède, 1870

Length: 200- 300 mm.

Body long and many segmented. Proboscis long, typically with two long horns. Three pairs of tentacular cirri. Prostomium with two pairs of frontal antennae and a single median antenna between the eyes. Prostomium not projecting in front of eyes. Parapodia with foliaceous dorsal and ventral cirri. Parapodia with pigmented glands except in 3rd and 4th parapodia. Specimens are frequently broken when sampled.

Recorded: Indian Ocean.



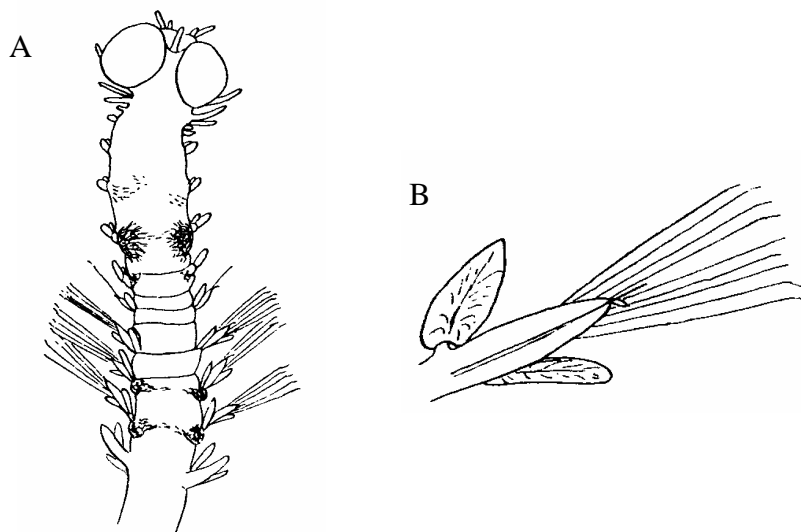
Vanadis formosa: A, adult; B, detail of parapodia. Figures from Dales (1957).

Vanadis longissima (Levinsen, 1885)

Length: 120 – 200 mm.

Eyes very large, lens not visible dorsally. Proboscis without horns. Three pairs tentacular cirri. Prostomium with two pairs of frontal antennae and single long median antenna between eyes. Pigmented segmented glands in intervals from the fifth parapodium creating brown bands.

Recorded: Indian Ocean.



Vanadis longissima: A, adult; B, detail of parapodia. Figures from Fauvel (1923).

Family Phyllodocidae

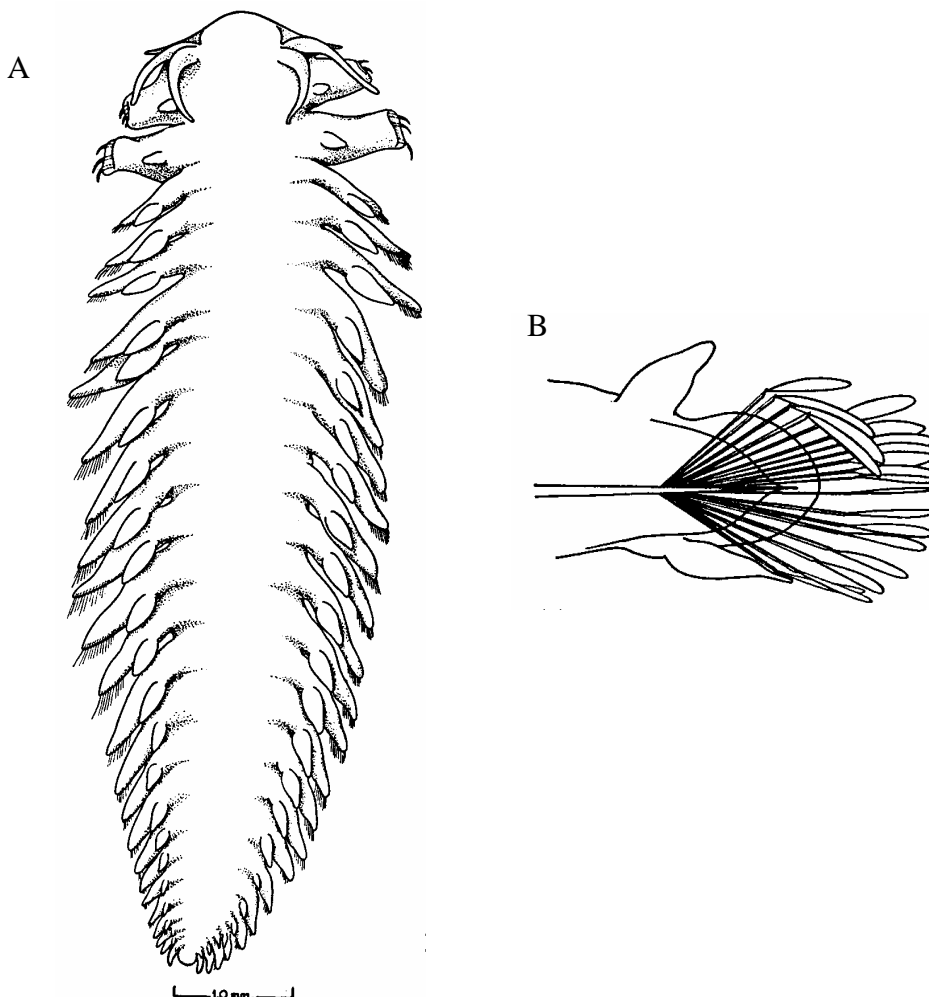
The Phyllodocidae are not exclusively pelagic. The pelagic phyllodocids are small, usually between 1 and 30 mm in length, with few segments and a short wide body. The head bears four small antennae and a single pair of eyes, which may be reduced in some species. The body is often flattened. The first three segments carry finger like extensions known as cirri, the following segments bear a pair of paddle shaped parapodia with dorsal and ventral foliaceous (leaf like) cirri. The cylindrical proboscis may be everted beyond the prostomium in preserved individuals. The proboscis may be smooth or bear papillae.

Lopadorhynchus uncinatus Fauvel 1915

Length: 5-25 mm, typically 12 mm.

Prostomium broad with two pairs of antennae, one long and one short. Three pairs of tentacular cirri. First two segments are swollen with simple chaetae, the following parapodia with paddle-shaped chaetae. The first two segments have dorsal cirri only, following segments have dorsal and ventral cirri.

Recorded: Indian Ocean.



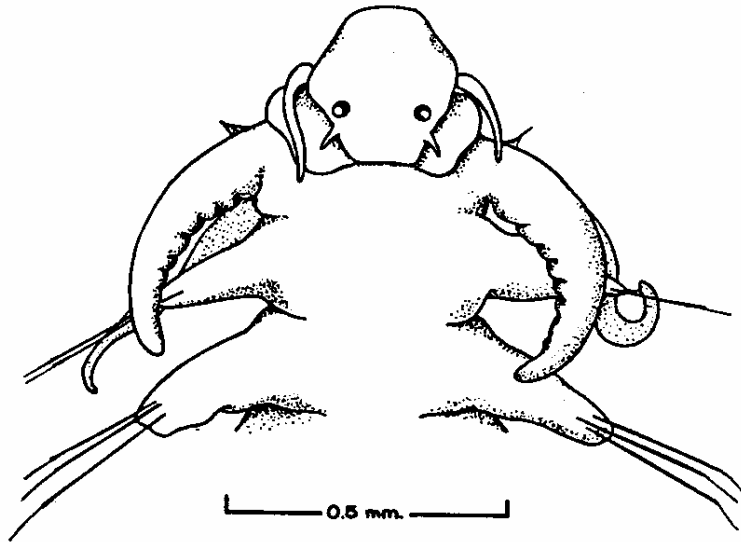
Lopadorhynchus uncinatus: A, adult; B, posterior parapodia showing paddle-shaped chaetae. Figures A and B from Dales (1957).

Pelagobia longicirrata Greeff 1879

Length: up to 12 mm.

Body with 15-25 segments. Prostomium with two pairs of short antennae and a single pair of eyes. Two pairs of tentacular cirri. Dorsal cirri absent from first two segments, following segments with long dorsal and ventral cirri. Chaetae with serrated tips.

Recorded: Indian Ocean.



Pelagobia longicirrata: Adult. Figure from Dales (1957).

PHYLUM ARTHROPODA

SUBPHYLUM UNIRAMIA

CLASS INSECTA

There is only one true marine insect, *Halobates*. It belongs to the Family Gerridae, the pond skaters or water striders. It has long legs and lives on the sea surface and do not dive. While it cannot be considered planktonic, it is often caught in plankton nets as they sample through the surface layer.

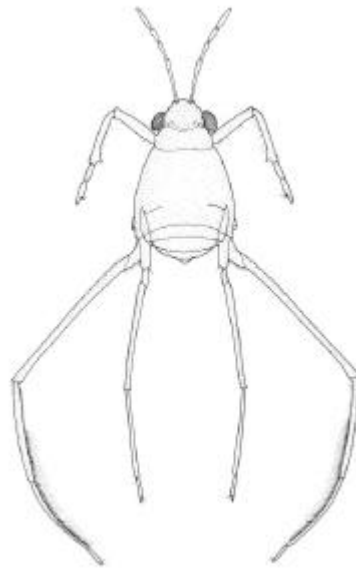
The genus *Halobates* contains over 40 species. Like other gerrids, the sea skaters have a life cycle consisting of the egg, 5 nymphal instars, and the adults. Females are usually larger than the males.

They are predators, typically feeding by liquefying the muscles and the internal organs of their prey. The diet of the open ocean species is not fully known. They have been observed feeding on zooplankton, dead jellyfish, fish eggs and larval fish trapped on the ocean surface and have never been observed breaking the water surface to feed.

Although they spend their entire lives on the ocean, *Halobates* requires floating objects on which to deposit their eggs. The objects include sea bird feathers, floating seashells, pieces of wood, plastic and lumps of tar. The eggs are oval in shape and quite large (~1 mm x 0.2 mm).

Other insects are often found in plankton samples, but these will have been blown into the sea by the wind.

Recorded: Seychelles

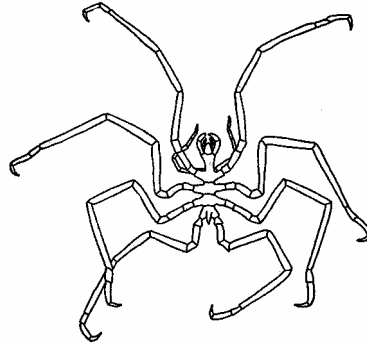


Halobates sp. (from Cheng, 1975)

SUBPHYLUM CHELICERATA

CLASS PYCNOGONODA

Unconventional looking arthropods, sometimes called sea-spiders, and certainly resemble spiders in appearance. The body is reduced and they usually have 4 pairs of legs (rarely 5 or 6). They are found crawling over the bottom, feeding on hydroids and other fleshy animals. They are not really planktonic, but can turn up in plankton samples in shallow water. Most are small but the largest have a leg spread of 40 cm.



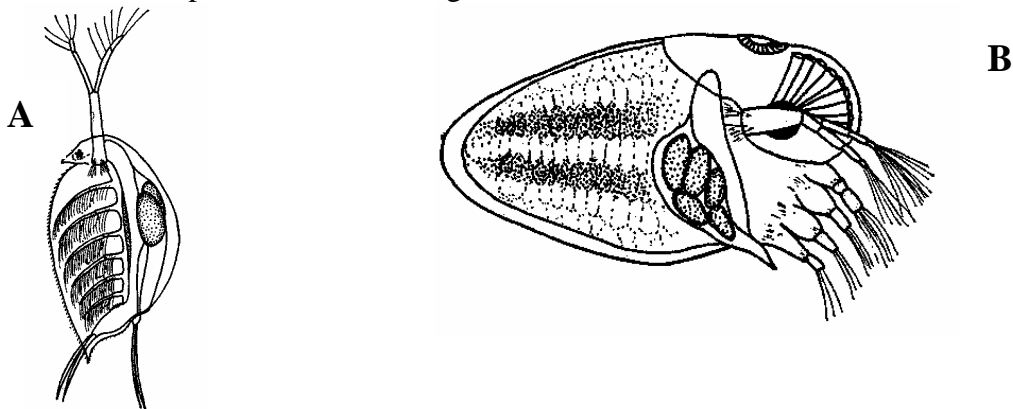
Example of pycnogonid (From Wickstead, 1965).

SUBPHYLUM CRUSTACEA

CLASS BRACHIOPODA

Sub-order Cladocera

Cladocera are small crustaceans with a large compound eye with the limbs originating just behind. Some species have a transparent triangular brood pouch, which can contain eggs or many young larvae, small replicas of the adult e.g. *Evadne* and *Penilia*.



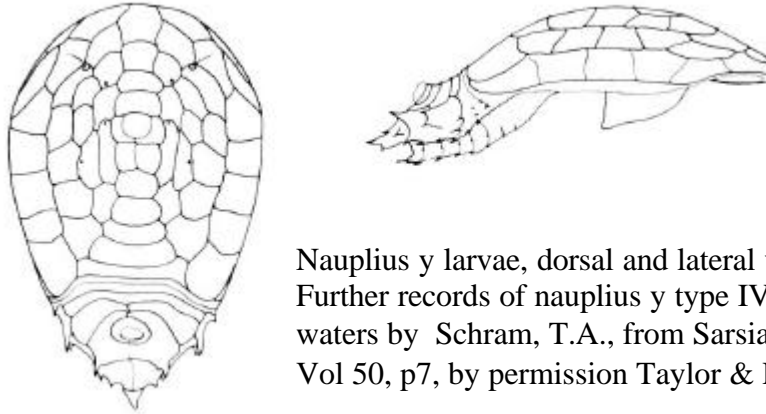
A: *Penilia avirostris*; B: *Evadne tergestina* (From Wickstead, 1965).

CLASS MAXILLIPODA

Infra class Facetotecta

A tiny unusual larva, considered to be related to the barnacles. Previously recorded from European and Japanese waters. The carapace has a typical reticulated surface.

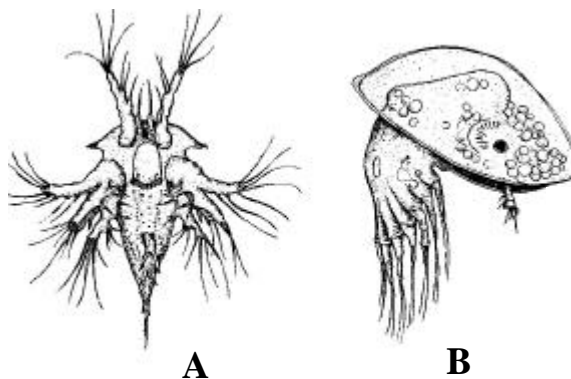
Recorded: Rodrigues, Seychelles.



Nauplius y larvae, dorsal and lateral views (Reproduced from Further records of nauplius y type IV Hansen from Scandinavian waters by Schram, T.A., from Sarsia, www.tandf.no/sarsia 1972, Vol 50, p7, by permission Taylor & Francis).

Infra-class Cirripedia

Larvae of the cirripedes or barnacles can be common in the inshore plankton. Their nauplius larva resembles a copepod nauplius and they also go through a series of moults. They typically have two horns on the front of the carapace. A cypris stage develops inside the last nauplius, which then attaches itself to a rock or some other suitable site and develops into the adult. This cypris stage has a two-section shell and resembles an ostracod. It usually has a dark eyespot on the side.



A: Cirripede nauplius; B cirripede cypris (From Fraser, 1962).

Sub-class Copepoda

Copepods are one of the most numerous, diverse and biologically important zooplankton groups in the sea, so more background information on them is provided here than for the other groups. There are ten orders of copepods. The orders with most species are Calanoida, Cyclopoida, Poecilostomatoida and Harpacticoida and to a much lesser extent Siphonostomatoida and Monstrilloida. It is likely that Orders Cyclopoida and Poecilostomatoida will be merged in the near future. The other small orders have not been included in this guide as none have been sampled. They are either very rare, cave dwelling or live very deep or close to the sea bottom.

Development of the egg and nauplius stages

Typical free-living copepod development is from a small, generally circular or sub-circular egg, which depending on species is around 30-450 μ m in diameter. The egg surface is smooth in some species and spiny in others (Fig. 1), so size and surface ornamentation can be useful in identification. Eggs may be held in an egg sac, matrix of tissue, egg mass without an enclosing membrane, or be spawned directly into the sea, depending on the copepod order.

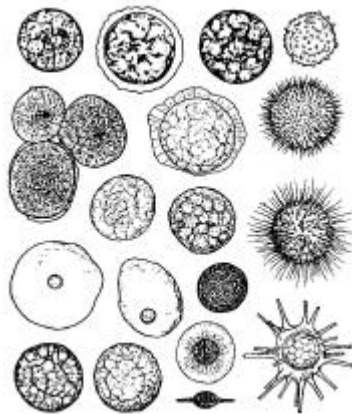


Fig. 1. Examples of free-spawned calanoid copepod eggs (From Koga, 1984).

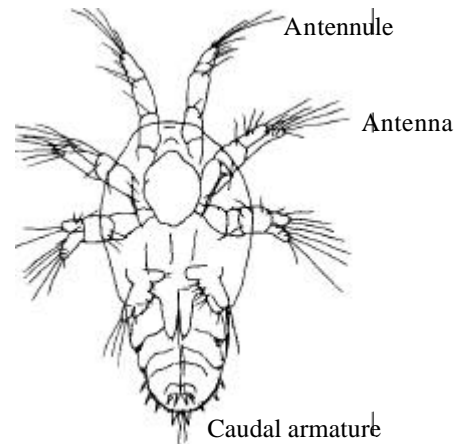


Fig. 2. Calanoid copepod nauplii (From Koga, 1984).

When the egg hatches, a nauplius stage emerges, the typical crustacean larva (Fig 2). As with other crustaceans, the nauplius has an external skeleton, which has to be moulted between each subsequent developmental stage. The nauplii of most free-swimming copepods typically moult six times (Stages NI-NVI), the sixth time developing into the first copepodite stage (CoI), the stage from which the adult features start to appear. Each of the nauplius stages can be identified by changes between moults in body segmentation and particularly by changes in the number of setae on the terminal segment of the antennule and number and arrangement of spines (caudal armature) on the posterior end of the body.

Identifying nauplii

It is not difficult to roughly distinguish to at least which of the major groups a nauplius belongs. Calanoid nauplii are usually reasonably robust, tend to have a humped back and quickly develop an elongated body, which protrudes well beyond the cephalic shield (Fig. 3). The caudal armature is usually arranged in pairs of spines but often not of the same length. Cyclopoid nauplii are shield-shaped and flattened (Fig. 4), the posterior body hardly protruding beyond the cephalic shield, and as they tend to be small copepods, their nauplii are mainly small. Their limbs also tend to be much slenderer than calanoid nauplii. Poecilostomatoid nauplii (Fig. 5) are similar to cyclopoid nauplii (As mentioned above these two orders are in the process of being merged).

Harpacticoid nauplii tend to have bizarre shapes and unlike most of the other three main orders, are often not bilaterally symmetrical (number of spines each side a mirror image of the other). Some have single spines sticking backwards (Fig. 6), rather than a paired arrangement as found in most, but not all of the other orders. For some common copepod species, in well-researched regions of the world, descriptions of each nauplius stage are available, thus, where there is low species diversity, identification to species can be possible.

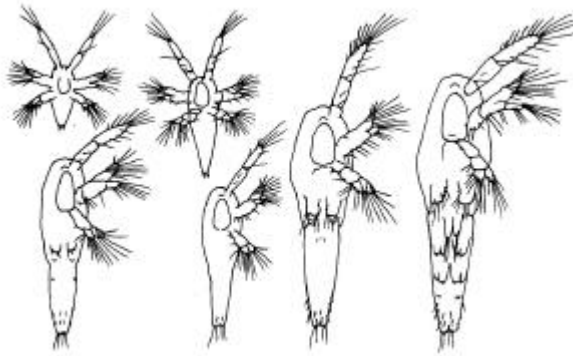


Fig. 3. Example of calanoid (*Eucalanus*) copepod nauplii stages (From Koga, 1984).

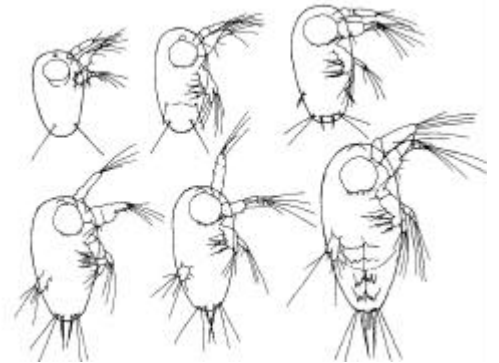


Fig. 4. Example of cyclopoid (*Oithona*) nauplii stages (From Koga, 1984).

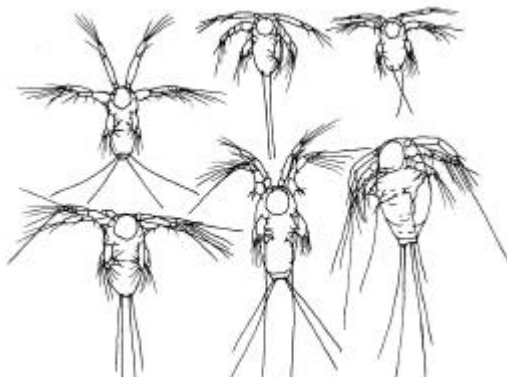


Fig. 5. Example of poecilostomatoid (*Oncaea*) copepod nauplii stages (From Koga, 1984).

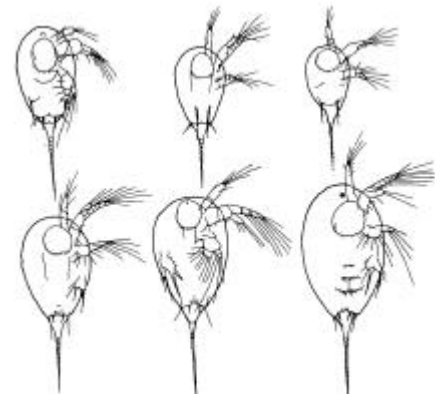


Fig. 6. Example of harpacticoid (*Longipedia*) copepod nauplii stages (From Koga, 1984).

Copepodite body segmentation and limbs

A generalised copepod description is given here; specific differences between copepod orders are given under the description of their order. Morphological terminology for the copepod body has varied between authors, but here follows Huys and Boxshall (1991) and Mauchline (1998).

There are typically six copepodite stages, the sixth being either the adult male or female (Fig. 7). Number of body segments and swimming legs usually changes between moults, so stage of development (Stages CoI-CoV1) can be distinguished. Segmentation and leg number differences between species/genera is common. The body is divided into cephalosome, metasome and urosome (Fig. 8); the cephalosome and metasome together, are termed the prosome. Theoretically, the adult copepod body consists of 16 segments. In all copepods the cephalosome (sometimes

called the head) consists of 6 segments fused together, outwardly appearing as one segment (5 cephalic segments + the first thoracic segment), all bearing limbs. The first pair of limbs, the antennae 1 (or antennules) are sensory (Fig. 9). In the males of many orders, either one or both may be modified, sometimes drastically, related to grasping the female during copulation. The modified A1 is called the prehensile or geniculate A1. In some orders the A1 are small.

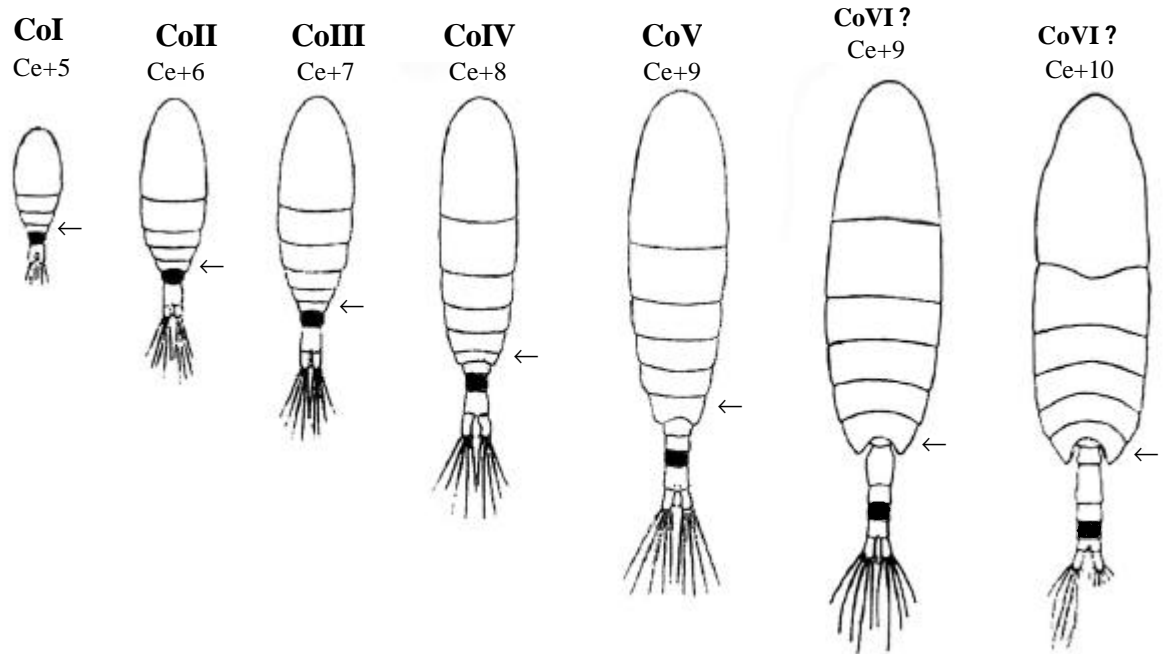


Fig. 7. Sequence of development of body segmentation between copepodite stages 1-6 of *Calanus finmarchicus*. Arrows indicate the last metasome segment. The shaded segment indicates the segment added at the previous moult. Number of segments in addition to the cephalosome is noted as Ce+5 etc. (Based on a figure from Mauchline, 1998 and incorporating figures from Lebour, 1916 and Sars, 1903).

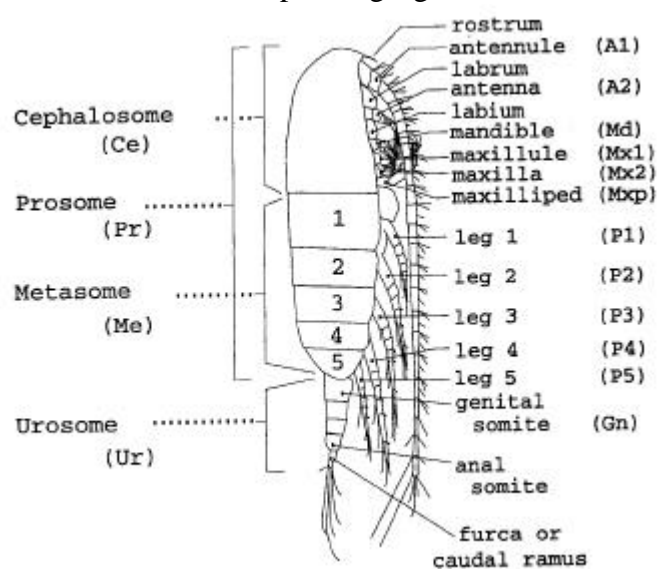


Fig. 8. Diagrammatic illustration of the external morphology and appendages of a calanoid copepod (From Mauchline, 1998, copyright 1998, with permission from Elsevier).

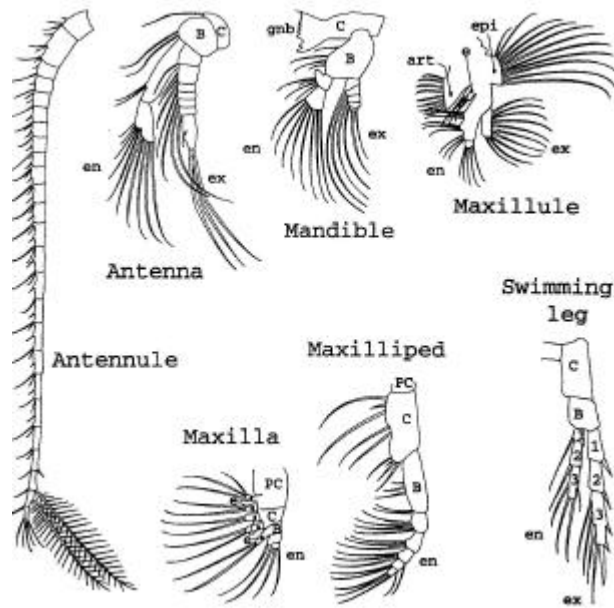


Fig. 9. Diagrammatic representations of the appendages of a calanoid copepod. The swimming legs usually have developed endopods and exopods with up to three segments, here numbered 1-3. art: arthrite; b: Basis; c: Coxa; e: Endite; en: Endopodite; epi: Epipodite; ex: Exopodite; gnb: Gnathobase; PC: Praecoxa (From Mauchline, 1998, copyright 1998, with permission from Elsevier).

The next five limb pairs make up the feeding appendages: antennae 2 (or antennae), mandibles, maxillae 1 (or maxillules), maxillae 2 (or maxillae) and maxillipedes. One or other of the latter two limb pairs can be greatly enlarged in some species, associated with carnivorous feeding e.g. the maxillae 2 in *Candacia* spp. and the maxillipedes in *Euchaeta* spp.

Some of the next 5 segments (second to sixth thoracic segments; Fig. 8) may be partially or completely fused to the cephalosome, or together, so there are interspecific differences in the number of segments that can outwardly be seen. They generally all bear paired swimming limbs (P1-P5) and because of this are referred to as pedigerous segments. The fifth legs are often reduced in size and complexity compared to the other legs, which is typical of many female copepods, completely missing, which is again typical of many females, or modified. Heavily modified P5 legs are typical of many male copepods, the leg being adapted to deposit the spermatophore. The swimming legs are joined at their bases so they beat together. The basal segment is called the coxa (Fig. 9) and the next segment the basis. From the basis, the limbs typically become biramous (with two branches), although one branch may be reduced or missing. The inner branch is the endopodite and the outer the exopodite. The next segment (thoracic segment seven) bears the genital openings in both sexes and is termed the genital segment. The sixth legs have become completely reduced to form the structure which closes off the genital opening in the two sexes. In female copepods the genital segment is usually fused with the following or more segments, giving the appearance of at least one less segment in the urosome than found in the males. The segments posterior to the genital segment do not bear any limbs. The last segment of the urosome has the anus located on the ventral side and is termed the anal segment. This segment ends in two furca, sometimes called caudal rami, and bears several setae.

Development

While in theory there are 16 segments in the copepod body, because of segment fusion, outwardly this cannot be seen. The variation in number of prosome and urosome segments between the adults of species, is also reflected in the 6 (CI-CVI) developmental stages, and this can be useful in separating species. Additionally, the number of swimming legs changes between the early

moult. An example of the sequential development of segmentation in a calanoid copepod (*Calanus*) is given in Figure 7. Mauchline (1998) gives a table (page 27) with examples of how segmentation of the urosome and number of pairs of swimming legs changes between developmental stages, depending on how many segments or swimming legs are finally developed in the adult. The table does not include details for calanoid copepods that develop 4 urosome segments in the adult female, one of the commonest arrangements in calanoid copepods. Between moults a segment is added, always immediately anterior to the anal segment. In the example in Figure 7, addition of a segment in CoI and CoII results in a segment being incorporated into the metasome between each moult. In CoIII the final metasome number is reached, so after this, further segments added anterior to the anal segment leads to an increase in the number of segments in the urosome, till the final number is reached. In this example it is five segments in the male and would have been five in the female, but the first segment of the urosome fused with the second segment during the last moult, forming the genital segment. Urosome segment number thus remains at four between the female CoV and CoVI.

In species which develop an asymmetric P5 in the male, the ultimate sex of the copepodite can be seen from CIV, because of morphological differences between the female and male P5's (Fig. 10). In species in which the female does not develop a P5 the male will have a rudimentary P5 in CIV which will be missing in the female.

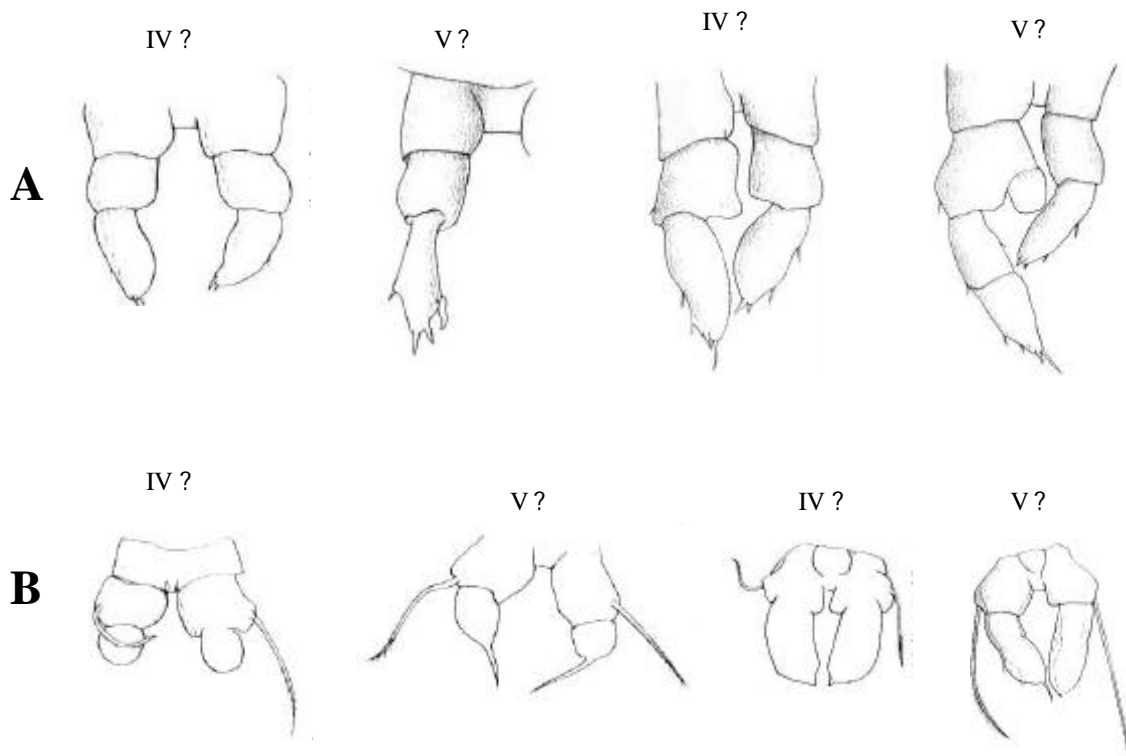


Fig. 10. Fourth and fifth swimming legs of female and male developmental stages CIV and CV of A, *Temora longicornis* and B, *Acartia clausi* (From Kraefft, 1910).

Morphological differences to distinguish between the main copepod Orders

In copepods the major movable articulation (bending joint) of the body is located between the prosome and urosome. In calanoids, the articulation is actually between the eleventh and twelfth segments of the body (Fig. 11), thus all the limbs are on the broader part of the body. In cyclopoid, poecilostomatoid and harpacticoid copepods, the major articulation of the body occurs between

the tenth and eleventh body segments, thus the first segment of the urosome bears a pair of limbs (usually much reduced). In most poecilostomatoida and cyclopoids, as in calanoids, the urosome is much narrower than the prosome. In harpacticoids, there is much less of a difference in segment width between the prosome and urosome e.g. *Microsetella*.

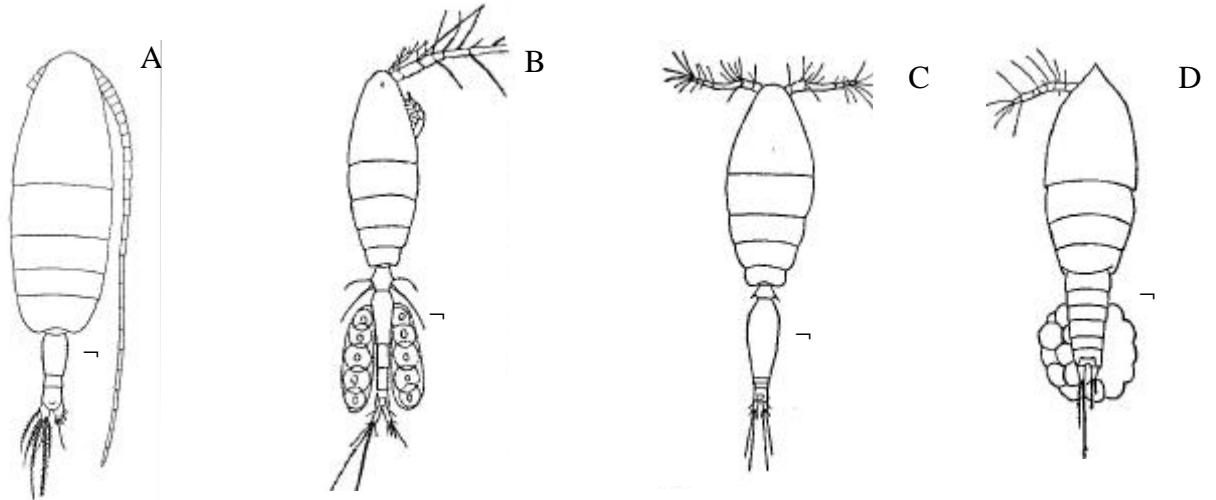


Fig. 11. A, Calanoid; B: cyclopoid (with twin egg sacs); C: poecilostomatoid; D: harpacticoid (with single egg sac). All female copepods (A from Sars, 1925; B, C from Sars, 1918; D from Giesbrecht, 1892). Arrows indicate the genital segments. In the cyclopoid and poecilostomatoid copepods, rudimentary limbs can be seen immediately after the articulation and in the harpacticoid copepod there is less clear separation of the cephalosome and urosome.

Points to note

Most identification texts only give descriptions of the adult CVI copepods, so before trying to identify a copepod to species, it is important to check that it is an adult. In most female copepods the presence of a swollen genital segment indicates that it is mature. However, a problem with some females e.g. *Acartia* is that the genital segment starts to swell in CV, while the body segmentation is often identical between CV and CVI. However, in both female and male pre-adult copepods, the segmentation of the P5 and urosome is not as distinct as in the adult stages, which becomes obvious when you examine them together.

In many figures, for clarity, some of the limbs, or part of the limbs such as setae, are not drawn. Many copepods have very distinctive features, even in the pre-adult stages; so can often be identified at least to genera.

There are often far fewer male copepods than females sampled. This is because in many species a single fertilization is adequate for several batches of eggs, so fewer males are required. In species where each batch of eggs requires fertilization, the numbers of each sex may be similar.

While most identification texts only give total body lengths (anterior cephalosome to tip of furca), prosome length is a useful comparative body measurement, as the urosome is often bent at an angle or damaged, which can make measurement of total length imprecise.

Order Calanoida

One of the most numerous and diverse copepod orders. The adults tend to be much larger than those of other orders. The A1 is long and the A2 is biramous. Males often have a geniculate A1, sometimes remarkably modified, for grasping the female during copulation e.g. *Anomalocera*. The prosome is much broader than the urosome and the body articulates between them i.e. between the last metasome segment (body segment 11) and the genital segment (body segment 12). In females, the posterior of the last metasome segment, tends to be bilaterally symmetrical or in most cases only slightly asymmetric, while in males it is often asymmetric e.g. *Anomalocera*.

Females usually have 5 pairs of swimming legs, occasionally 4 pairs as in Families Aetideidae and Euchaetidae, or in individual genera such as *Acrocalanus*. The female P5, when present, are usually, symmetrical, although often much reduced in size and complexity compared to the other swimming legs e.g. *Paracalanus*. Males always have 5 pairs of swimming legs, the P5 usually greatly modified and asymmetrical, used during copulation e.g. *Candacia*. Females have between 2 and 4 segments in the urosome (not counting the furca) while in males there are generally 5, occasionally 4 as in some *Labidocera* spp. There are usually 5 setae on each furca, but sometimes only 4 or 3. Females either spawn their eggs directly into the sea (e.g. *Temora*, *Acartia*), or are typically held in a single egg sac (e.g. *Euchaeta*), occasionally paired egg sacs (e.g. some *Pseudodiaptomus* spp.), or egg mass, although some deep-water species carry a pair of very large eggs. Egg sacs are usually knocked off during sampling, but some species e.g. *Euchaeta* are often found bearing eggs.

Family Augaptiliidae

Cephalosome and first pedigerous segment separate. Urosome in female 3-4 segments, male 4-5 segments, symmetrical in both sexes. Mandible with few teeth. P5 of female similar to the other legs, biramous. A1 of male geniculate on the left, P5 with a 3-segmented exopodite, endopodite of 1-3 segments. P5 without claws and not very asymmetric.

Genus *Euaugaptilus*

Euaugaptilus hecticus (Giesbrecht, 1889)

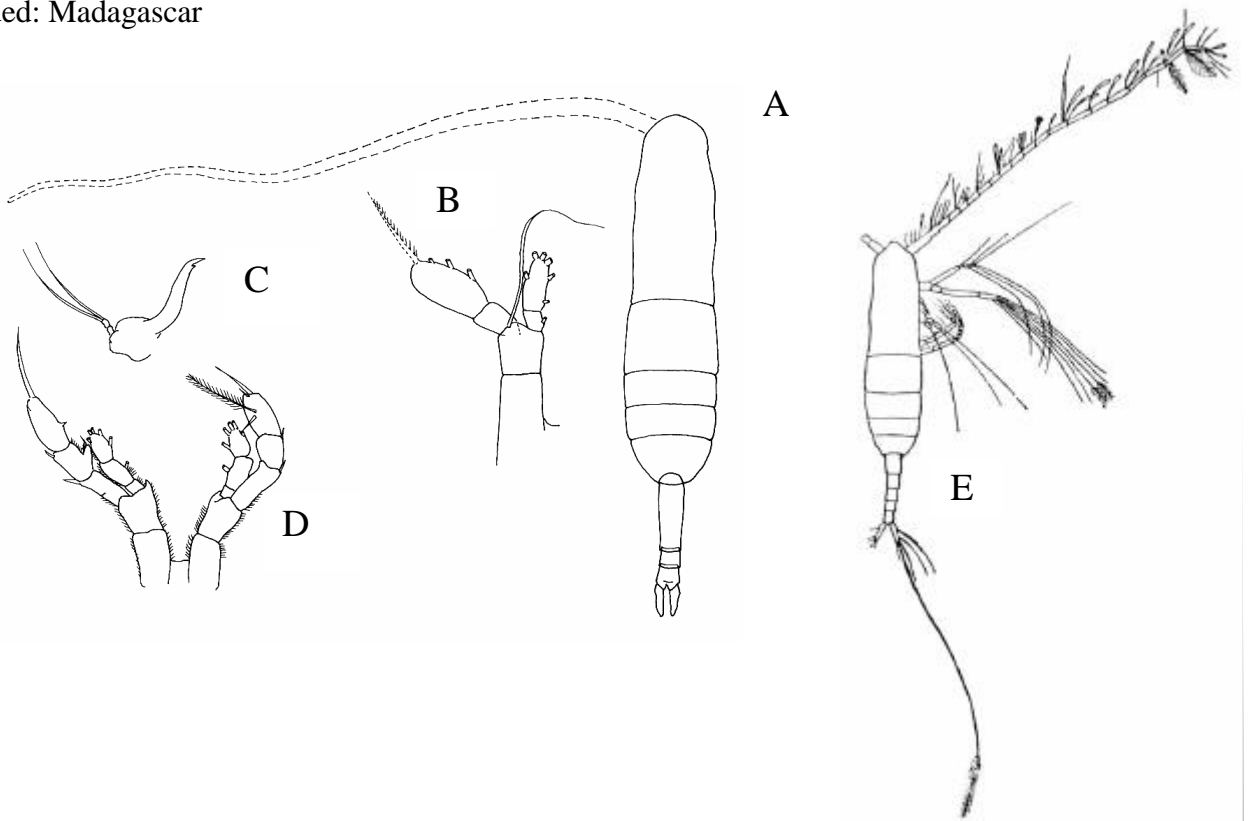
Length: females: 2.45-2.75 mm; males: 2.28-2.40 mm.

Cephalosome appendages of both sexes generally long and setose.

Female: Urosome long and slender, narrowing slightly at the distal end, genital segment twice as long as the two following segments together. Furca equal in length to the anal segment, around three times as long as wide. In perfect specimens, the inner furcal seta is as long as the whole body. A1 much longer than the body. The endopodites and exopodites of P5 both 2-segmented. Mandible very simple, with only 2 teeth.

Male: Similar in appearance to the female. Urosome long and slender. Genital segment as wide as long. A1 geniculate on the right. The second segment of the right P5 exopodite, with an internal process, the last segment terminating in a long seta.

Recorded: Madagascar



Euaugaptilus hecticus: Female. A, dorsal; B, P5; C, mandible. Male. D, P5; E, dorsal. Figures A-B from Bradford-Grieve (1999), C-E from Giesbrecht (1892).

Genus *Haloptilis*

Haloptilis longicornis (Claus, 1863)

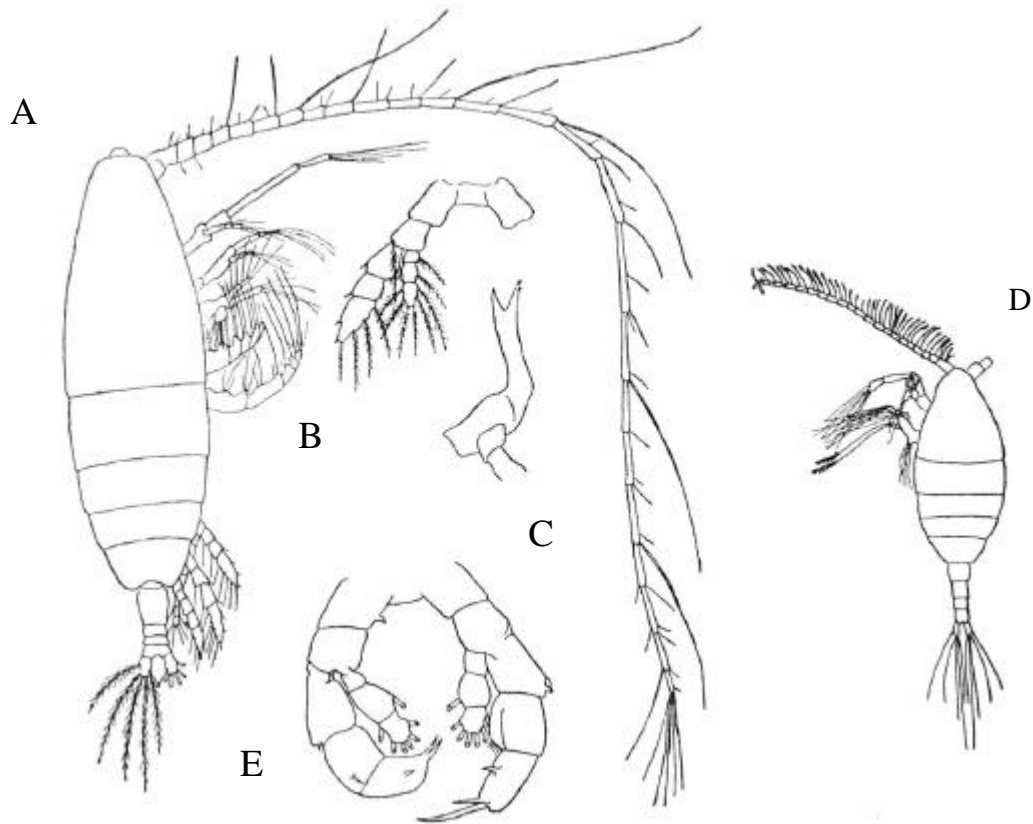
Length: females: 1.95-2.5 mm; males: 1.18-1.24 mm.

Cephalic appendages of both sexes large and plumose.

Female: A knob-like projection on the anterior cephalosome when viewed dorsally. Long A1, which extends beyond the furca by around the last 9 segments. P5 almost symmetrical, with the last inner seta on the terminal segment of the exopodite shorter than the other inner setae. Mandible very simple.

Male: Considerably smaller than the female. A1 reaches the end of furca. The 2 setae on the terminal segment of the right P5 equal in length. Long spine on the end of the left P5.

Recorded: Madagascar, Aldabra.



Haloptilis longicornis: Female. A, Dorsal; B, P5; C, mandible. Male. D, dorsal; E, P5. Figures from Giesbrecht (1892).

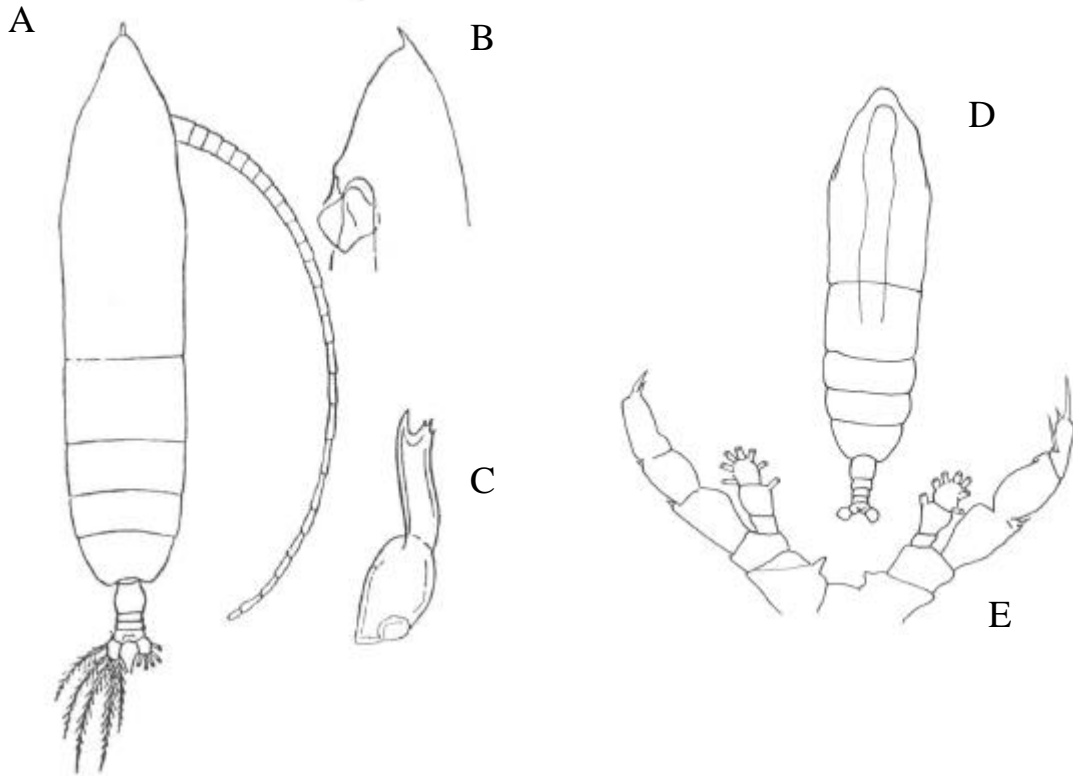
Haloptilus mucronatus (Claus, 1863)

Length: females: 3.0-3.6 mm; males: 2.17-2.28 mm.

Female: The cephalosome is tapered anteriorly with a point on the forehead, which curves downwards. The A1 reaches around the end of the furca. Very short urosome.

Male: Anterior cephalosome rounded. Spination on the P5 terminal exopodite segments weak.

Recorded: Madagascar



Haloptilus mucronatus: Female. A, dorsal; B, head lateral; C, mandible. Male. D, dorsal; E, P5. Figures A-C from G.O. Sars (1925), D-E from Giesbrecht (1892).

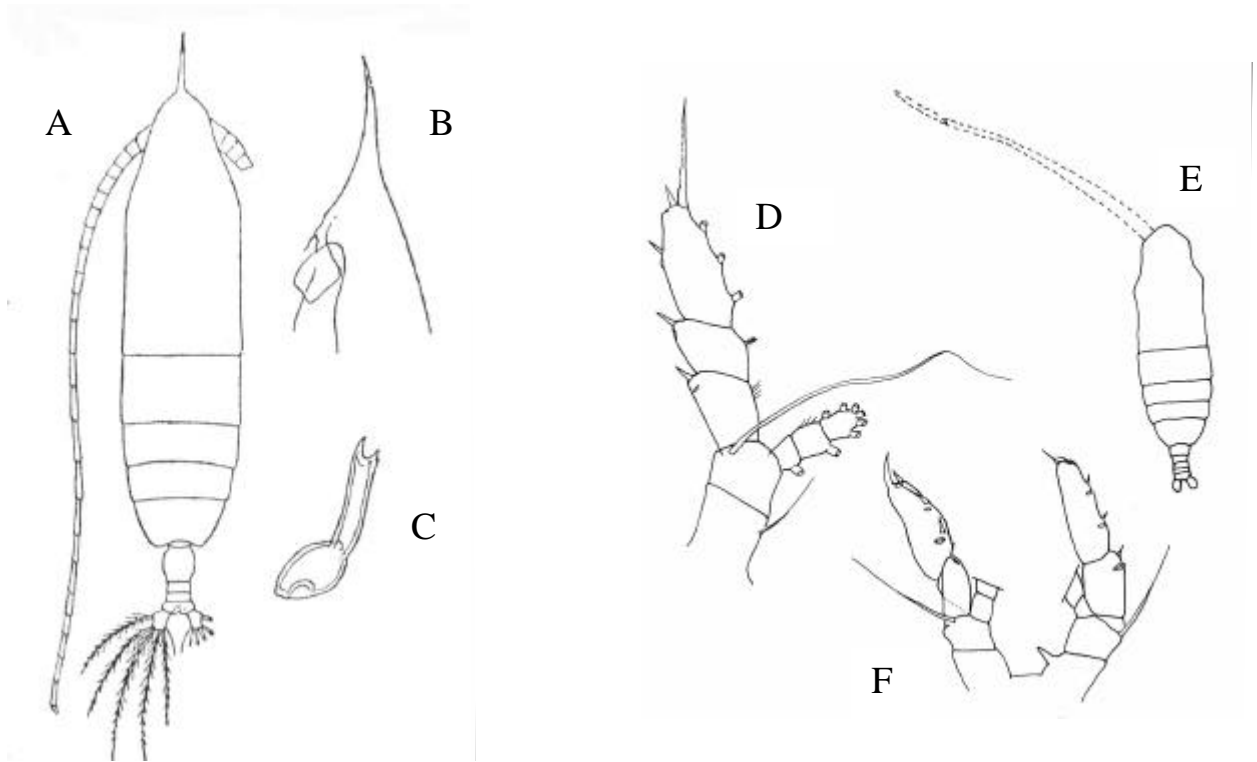
Haloptilis oxycephalus (Giesbrecht, 1889)

Length: females: 3.0-4.1mm; males: 2.4-2.85 mm.

Female: Body quite slender with a very long projection on forehead, curving slightly downwards. Urosome short and furca diverge slightly. The A1 reaches slightly beyond the furca. Mandible simple.

Male: Cephalosome broadly triangular with apex rounded. P5 with glandular pores at the base of every spine on the exopodite, quite large projection on the basal segment.

Recorded: Madagascar



Halopsis oxycephalus: Female. A, dorsal; B, head lateral; C, mandible; D, P5. Male. E, dorsal. F, P5. A-C from G.O. Sars (1925) D-F from Bradford-Grieve (1999).

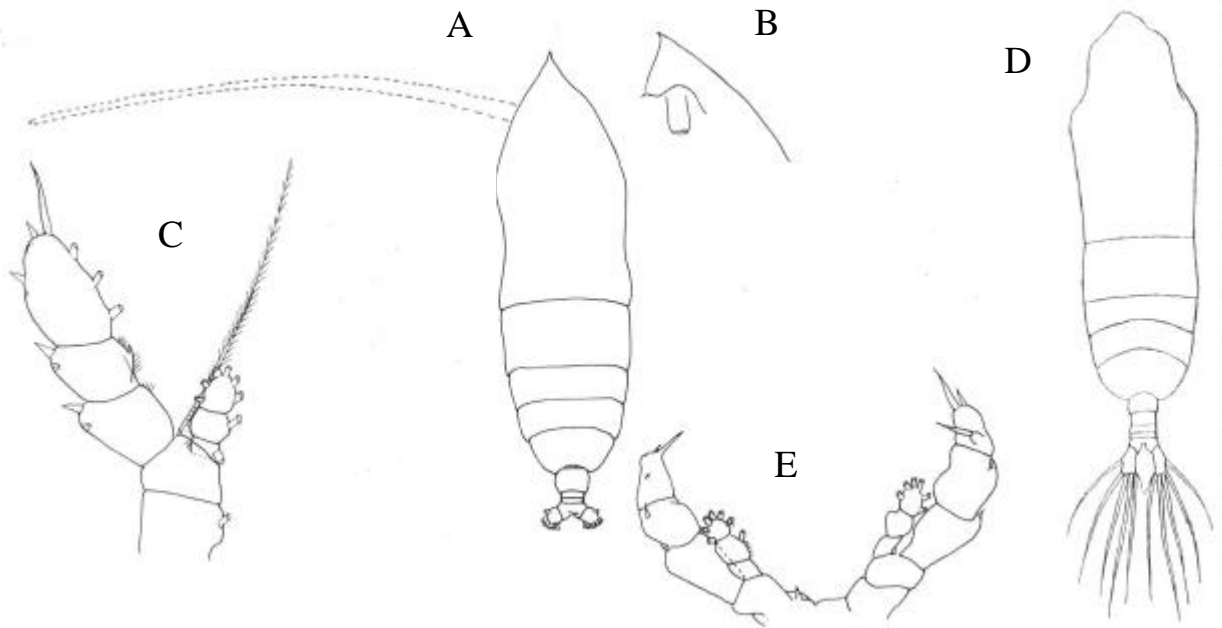
Haloptilus spiniceps (Giesbrecht, 1892)

Length: females: 3.7-5.45 mm; males: 2.30-2.55 mm.

Female: Body quite robust, anterior cephalosome with a short curved point similar to *H. mucronatus*. The A1 reaches slightly beyond the furca.

Male: Cephalosome rounded without point. P5 slightly asymmetric, the third segment of the right exopodite terminating in 2 quite strong short spines and with a median transverse spine.

Recorded: Madagascar



Haloptilus spiniceps: Female. A, dorsal; B, head lateral; C, P5. Male. D, dorsal; E, P5. Figures A-C from Bradford-Grieve (1999), D from Mori (1937), E from Giesbrecht (1892).

Family Heterohabidae

Genus *Heterohabdus*

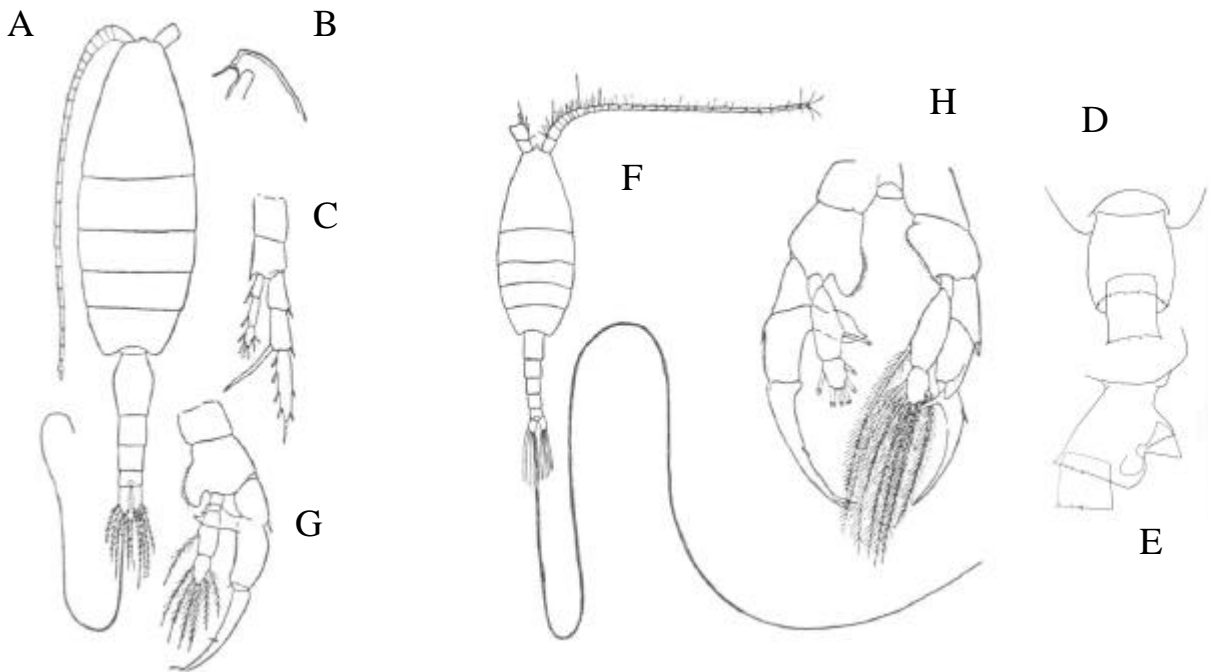
Heterohabdus papilliger Claus, 1863

Length: females: 1.85-2.15 mm; males: 1.70-2.00 mm.

Female: Anterior cephalosome rounded in dorsal view with a small papilla on forehead, but no point. A1 hardly reaches the end of furca. Genital segment in lateral view with a pronounced angular protrusion. The inner marginal spine of segment 2 of the exopodite of P5 is around the same length as the third segment.

Male: P5 is asymmetrical. The proximal portion on the inner margin of segment 2 of the exopodite of the right P5 has a process with a distal tooth; segment 3 is wider than the corresponding segment on the left leg; basis has a rounded projection.

Recorded: Madagascar



Heterohabdus papilliger: Female. A, dorsal; B, head lateral; C, P5; D, genital segment dorsal; E genital segment lateral. Male. E, dorsal. F, P5; G, P5. Figures A-C, F-H from G.O.Sars (1925) and Giesbrecht (1892), D, E, from Bradford-Grieve (1999).

Family Lucicutiidae

Males and female have very long urosomes, typically over half the length of their bodies. They also have long furca. In perfect specimens there is a seta on each furca, much longer than the other setae.

Genus *Lucicutia*

Lucicutia flavicornis (Claus, 1863)

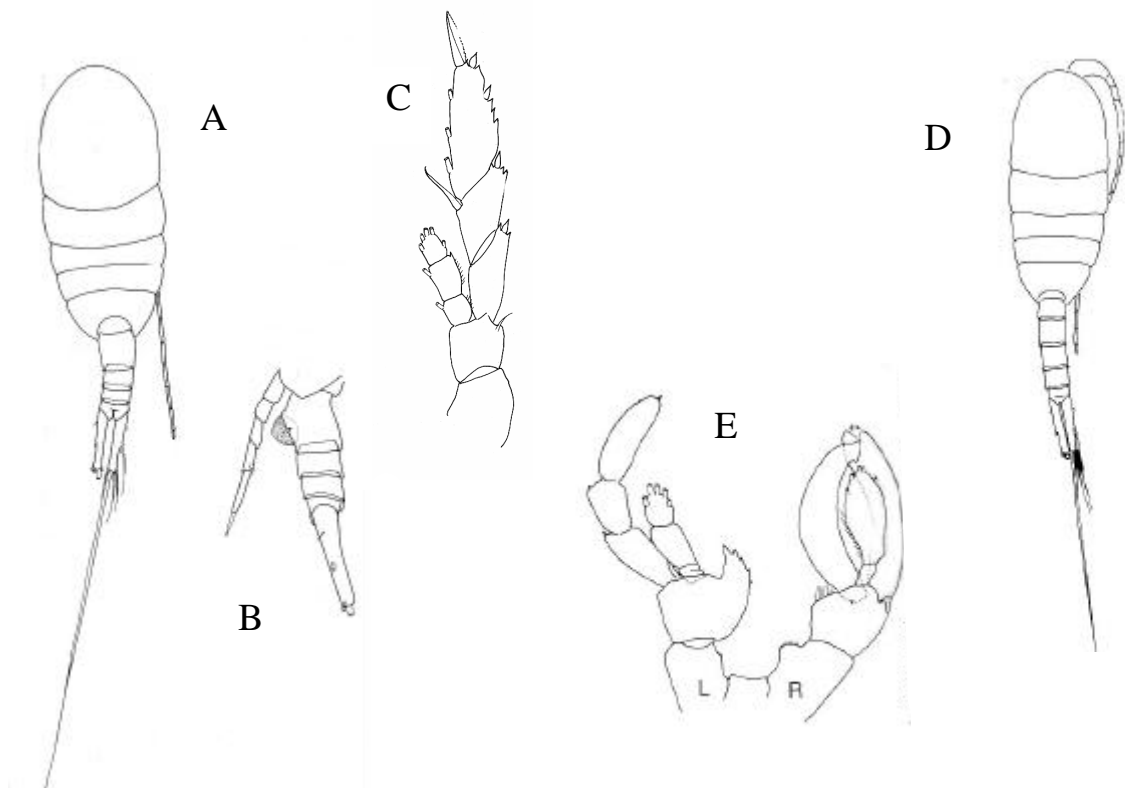
Bradford-Grieve (1999; p 98) points out that there are several distinct size classes attributed to this species, indicating that there may be several different species.

Length: females: 1.75-2.0 mm; males: 1.55-1.70 mm.

Female: Cephalosome without lateral protrusions. Large genital boss, placed centrally on the ventral segment. Furca slightly more than 5 times as long as wide; innermost terminal seta small and slender. A1 reaches middle of furca. P5 endopodite with 3 segments; inner spine on exopodite segment 2 is long and straight, except for a slight bend at tip, reaching beyond base of first inner seta on exopodite segment 3; terminal segment on exopodite segment 3 less than half the length of the segment. Outer margin of exopodite segment 3 with several teeth.

Male: Cephalosome without lateral protrusions. Furca slightly more than 5 times as long as wide; innermost terminal seta small and slender. A1 reaches middle of furca. P5 right coxa inner margin with a conspicuous rounded protrusion, right basis with a triangular inner border bearing hairs distally; left coxa with a ridge on the inner margin, left basis inner distal corner protruding and ending in a point and with 3-5 extra teeth and sometimes a proximal spinule. Inner margins of both basis segments without pointed projections.

Recorded: Rodrigues, Seychelles, Zuza, Madagascar.



Lucicutia flavicornis: Female. A, dorsal; B, urosome lateral; C, P5. Male. D, dorsal; E, P5. From Bradford-Grieve (1999).

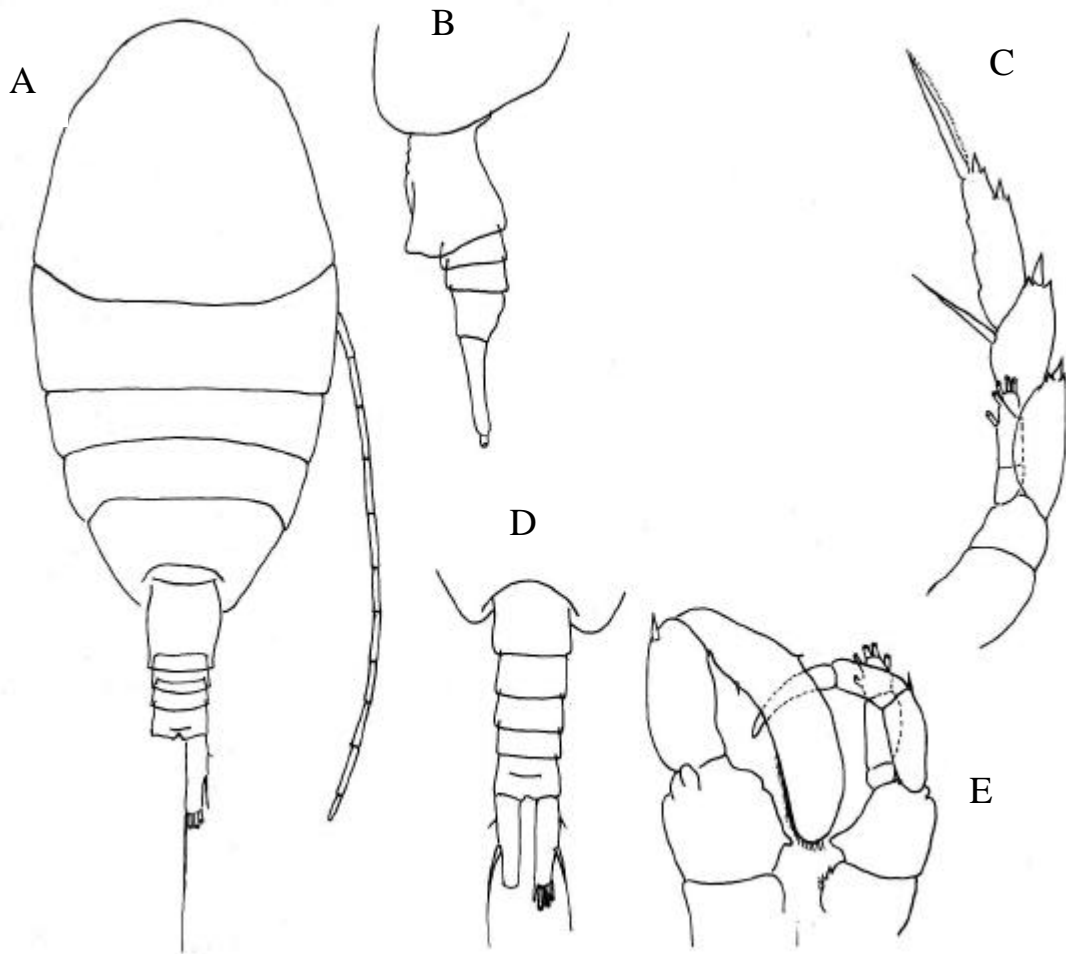
Lucicutia ovalis (Giesbrecht, 1889)

Length: females: 1.50-1.80 mm; males: 1.20-1.50 mm.

Female: Cephalosome without lateral protrusions, furca 4 times longer than wide. In lateral view genital segment with a ventral protrusion on posterior half of segment. In dorsal view urosome symmetrical. A1 extends to posterior border of anal segment. P5 endopodite with 2 segments.

Male: Cephalosome without lateral protrusions. Furca 1.4 times longer than wide. A1 extends to posterior border of anal segment. P5 right coxa smooth, left one with small spines; proximal part of inner margin of both the basis segments with pointed projections; right endopodite 3-segmented.

Recorded: Madagascar



Lucicutia ovalis: Female. A, dorsal; B, urosome lateral; C, P5. Male. D, urosome dorsal; E, P5. A Figures A from Bradford-Grieve (1999), B-E from Tanaka (1963).

Family Metridinidae

Males and females have a long urosome, over half the length of the body. In lateral view, the body is generally widest just behind the head and behind this the back may curve in slightly. The female P5 is small and simple.

Genus *Pleuromamma*

Typically have a brown or red button on the side of the body around the junction of the first body segment. Depending on the species this can be on the right or left side.

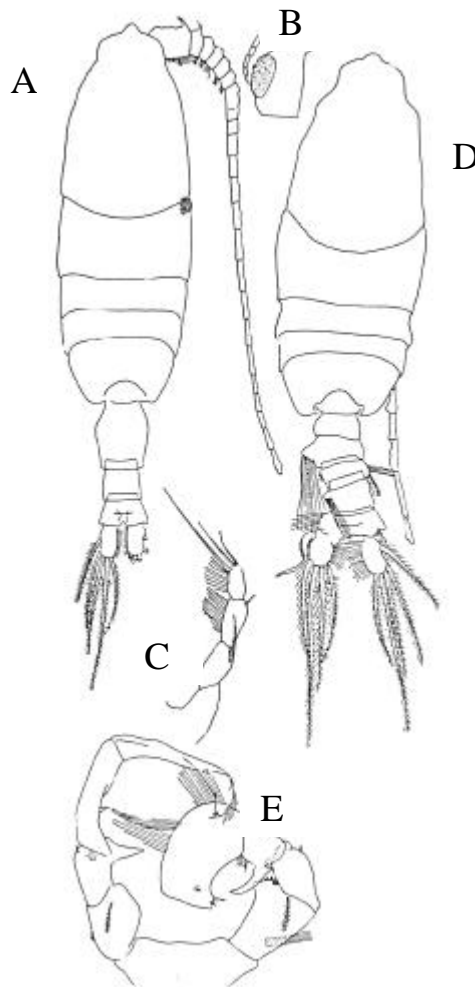
Pleuromamma abdominalis (Lubbock, 1856)

Length: females: 2.40-4.36 mm; males: 2.68-4.30 mm.

Female: Anterior cephalosome without pointed process. The brown button can be on either side in the female. The first two segments of the A1 of the female bears two strong spines of varying size and appearance, one on first segment stronger and usually more curved than that on second segment. Genital swelling centrally placed on segment, genital pore region has a dark protruding cap. P5 with 3 free segments, terminating in three unequal spines, the innermost the longest.

Male: The brown button is on the left side. Only small spines at base of A1. The male urosome is very asymmetric with tufts of hairs. Right A1 geniculate. P5 left with a wide terminal segment.

Recorded: Rodrigues, Seychelles, Zuza, Madagascar. CPR.



Pleuromamma abdominalis: Female. A, dorsal; B, genital segment lateral; C, P5. Male. D, dorsal; E, P5. From Bradford-Grieve (1999).

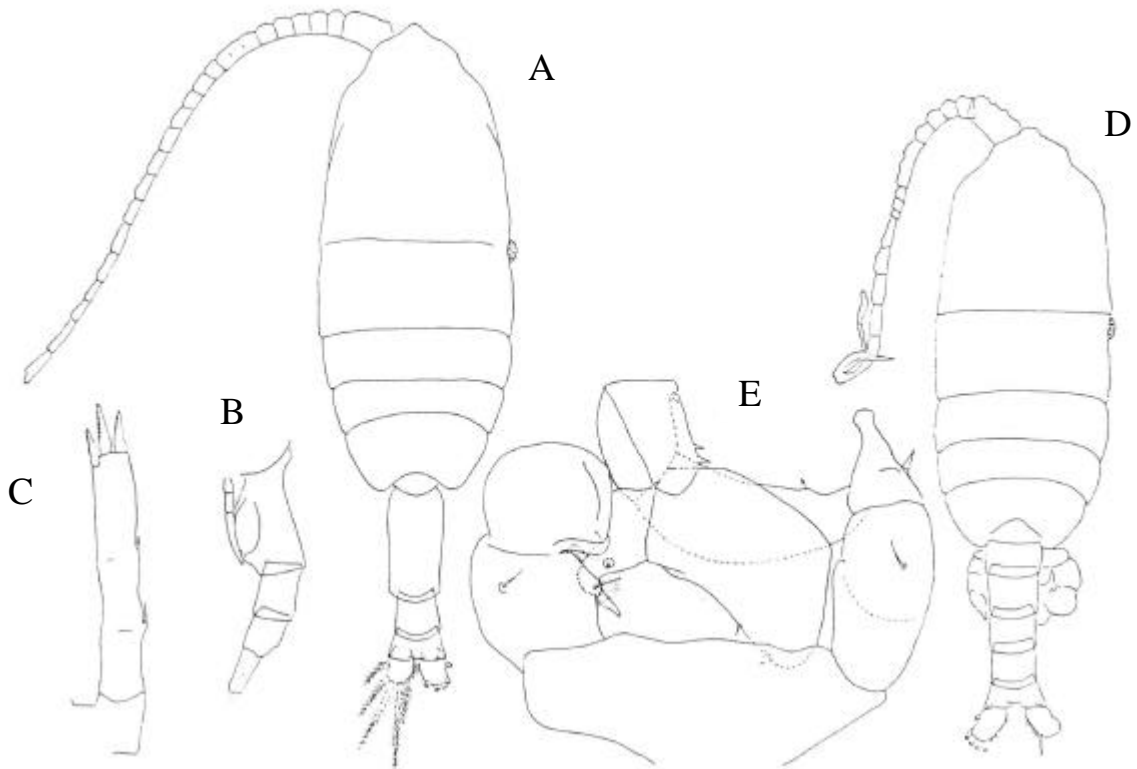
Pleuromamma gracilis (Claus, 1863)

Length: females: 1.20-2.55 mm; males: 1.51-2.25 mm.

Female: Brown button on right side of body. First segment of A1 with only small, low teeth. P5 with only one free segment, terminating in 3 short spines with 2 thin spines on outer side.

Male: Pigment spot on right side. Urosome almost symmetrical, except that segment 3 has a patch of hairs on the left rear border. Left A1 geniculate.

Recorded: Zuza, Madagascar, CPR.



Pleuromamma gracilis: Female. A, dorsal; B, urosome lateral; C, P5. Male. D, dorsal; E, P5. From Bradford-Grieve (1999).

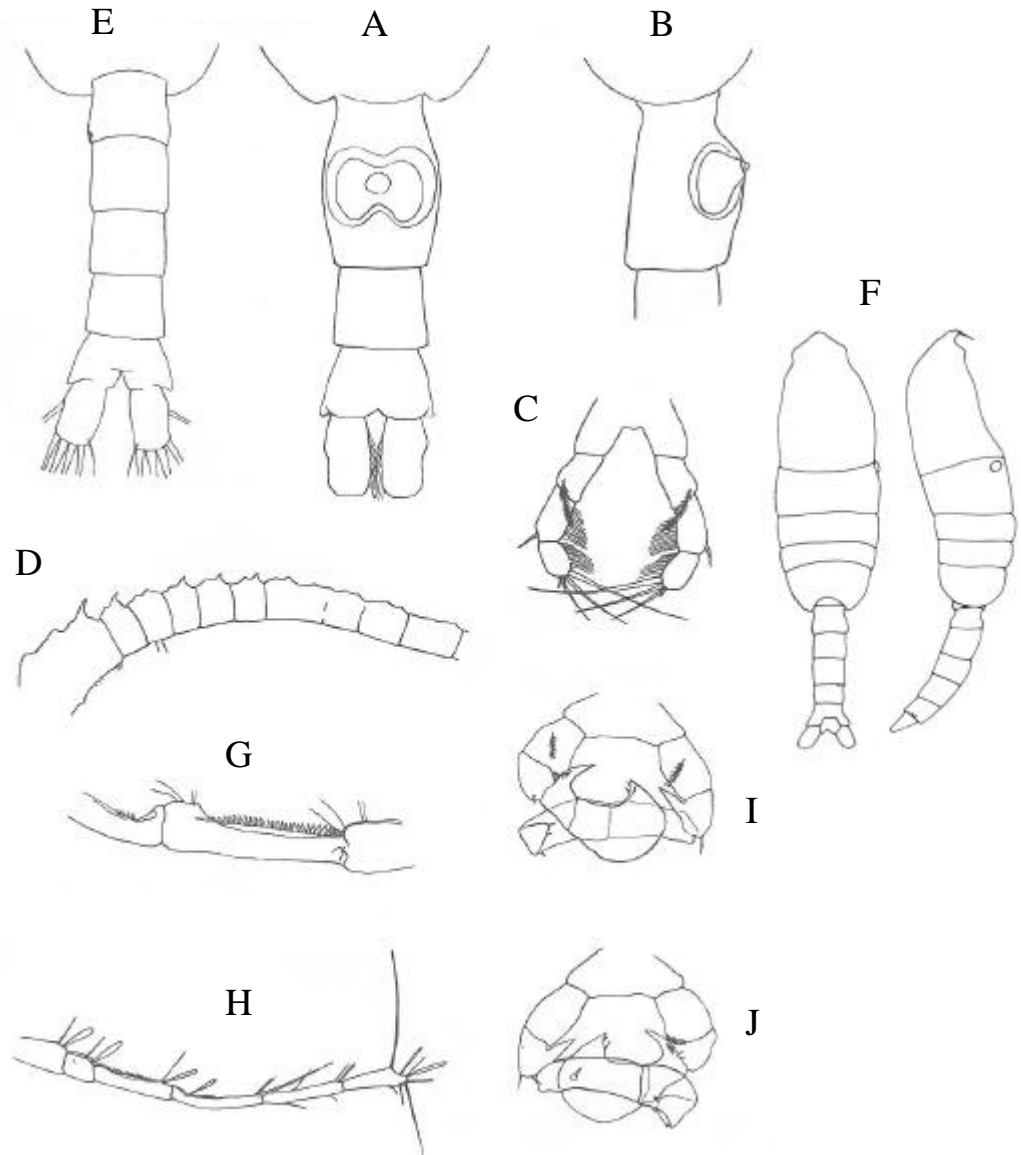
Pleuromamma indica Wolfenden, 1905

Length: females: 2.06-2.72 mm; males 1.62-2.38mm.

Female: Quite like *P. robusta* but has a small projection on the genital pore. Small spines on first 2 segments of the A1. The 3 terminal spines on the P5 reduce in size by 50% each time from the longest inner spine.

Male: Button on right hand side. Symmetrical abdomen. Divergent furca.

Recorded: Zuza.



Pleuromamma indica: Female. A, urosome dorsal; B, urosome lateral; C, P5; D, base A1. Male. E, urosome; F, dorsal and lateral; G, Geniculate A1, segments 17-21; H, geniculate A1; I P5 ventral; J, P5 dorsal. Figure F from Grice (1962), other figures from Steuer (1933).

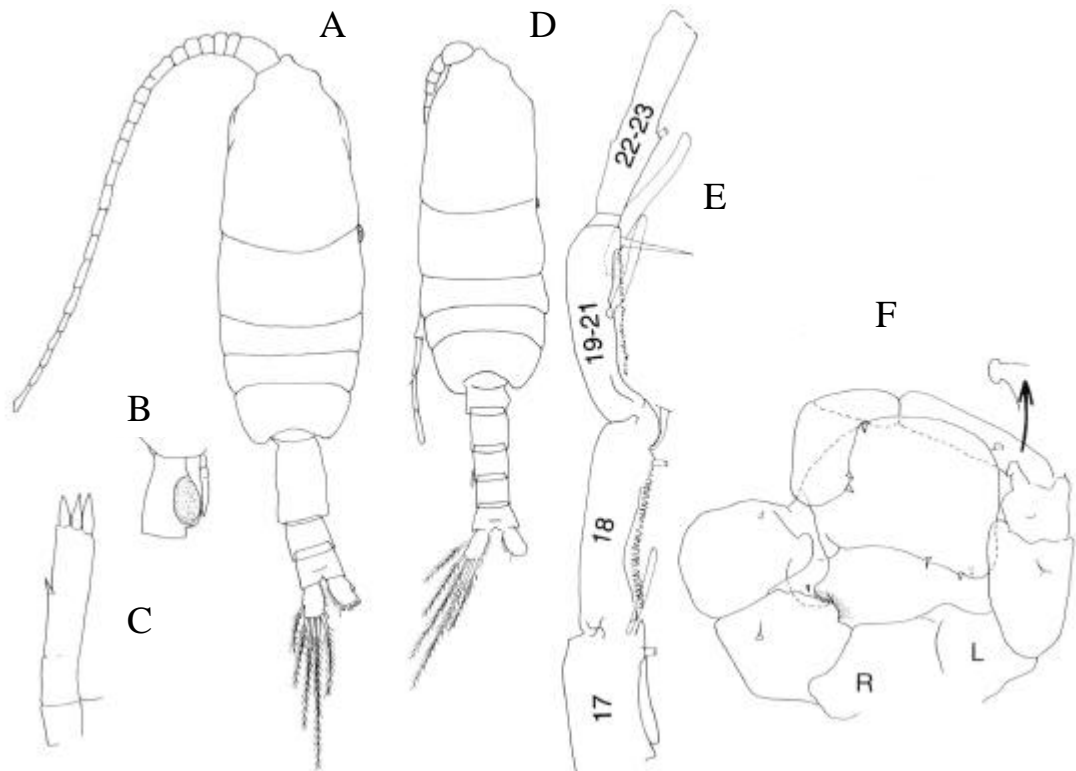
Pleuromamma piseki Farran, 1929

Length: females: 1.70-2.02 mm; males: 1.70-1.96 mm.

Female: Slightly larger than *P. gracilis*. In dorsal view, the genital segment has a marked groove or constriction on the left side, parallel to the posterior margin of the segment and a large black-pigmented area around the genital pore. P5 is imperfectly segmented, terminating in 3 short spines, shorter than the width of the segment.

Male: Geniculate A1 with a double-toothed row on segment 18, as well as on proximal part of segments 19-21, segment 17 is naked. Left P5 segment 3 with process with a knob, separated from the process by a slight notch.

Recorded: Zuza, CPR.



Pleuromamma piseki: Female. A, dorsal; B, urosome lateral; C, P5. Male. D, dorsal; E, geniculate A1; F, P5. From Bradford-Grieve (1999).

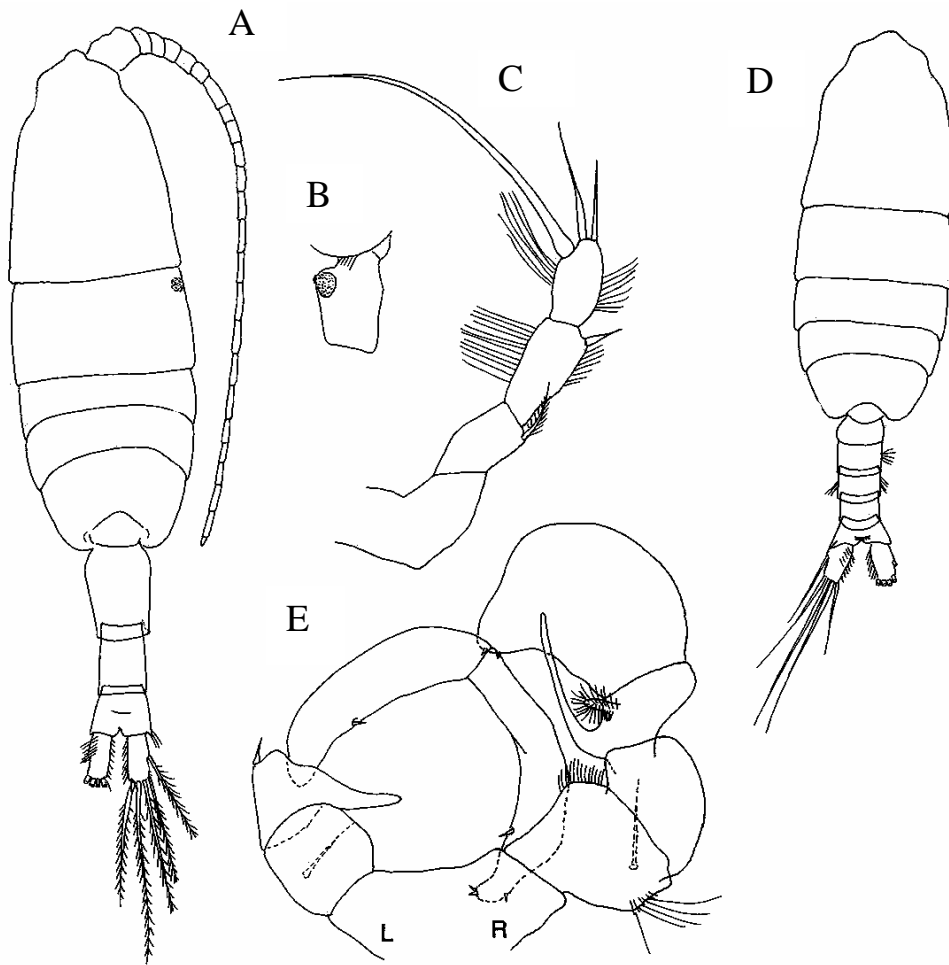
Pleuromamma robusta (F. Dahl, 1893)

Length: females: 3.0-4.7mm; males 3.0-4.0 mm.

Female: Genital swelling on anterior part of genital segment. Teeth on basal segments of A1 small and low. P5 has 4 segments and 3 terminal setae, the innermost considerably longer than the others. Pigment button on right side.

Male: Urosome almost symmetrical. Pigment button on right side. Left A1 geniculate. Right exopodite segment 2 with a long thin process.

Recorded: Madagascar.



Pleuromamma robusta: Female. A, dorsal; B, urosome lateral; C, P5. Male. D, dorsal; E, P5. From Bradford-Grieve (1999).

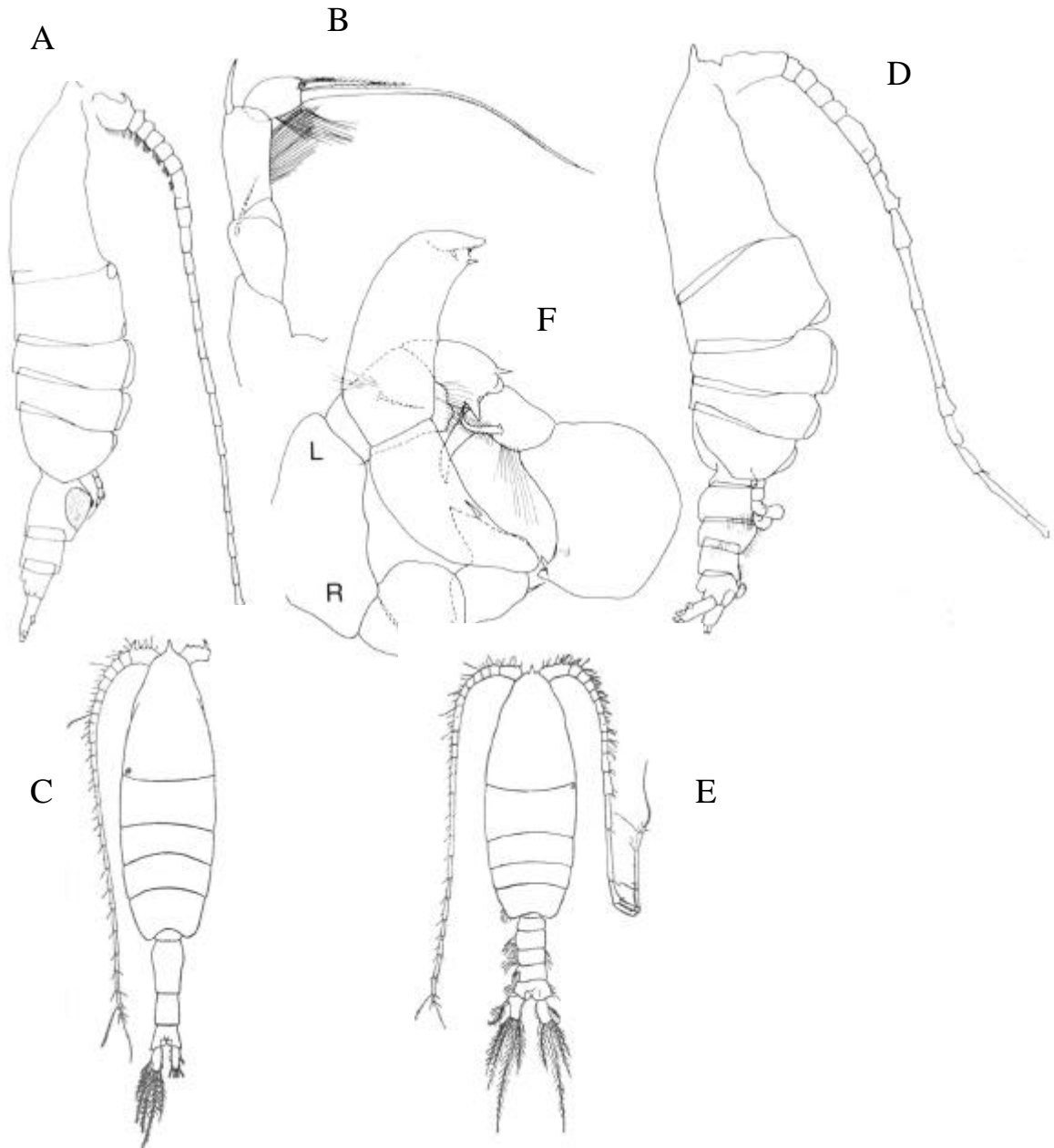
Pleuromamma xiphias (Giesbrecht, 1889)

Length: females: 3.5-5.87 mm; males: 4.0-6.42 mm.

Female: resembles *P. abdominalis* but differs in outline of anterior cephalosome, which extends forwards into a pointed process, bent slightly downwards. Large curved spine on basal segment of A1 and small spine on second segment

Male: Cephalosome pointed as in female, but pointed forwards rather than downwards. Urosome asymmetric and A1 geniculate

Recorded: Zuza.



Pleuromamma xiphias: Female. A, lateral; B, dorsal; C, P5. Male. D, lateral; E, dorsal; F, P5. Figures A, B, D, F from Bradford-Grieve (1999), figures C, E from Sars (1925).

Family Acartiidae

In this family, only the Genus *Acartia* has been sampled in the region.

Genus *Acartia*

Typically both sexes have slender bodies, often coffin-shaped. When freshly preserved they are usually quite transparent, sometimes tinged blue, often with a single prominent eyespot. The A1 typically bears many quite long fine setae. The furca each bear a fan of fine setae, which have a characteristic spiky appearance. These setae are often damaged or broken off in other preserved copepods, but are usually intact in *Acartia*, even in young stages. No rostrum, but some species have paired fine rostral filaments. In the female the urosome is 3-segmented. The tiny P5 is usually uniramous, 3-segmented, with the last segment modified into a long slender spine. In the male the urosome is 5-segmented. The A1 is usually geniculate on the right side only, with expanded segments in the middle. The tiny P5 is uniramous and asymmetric.

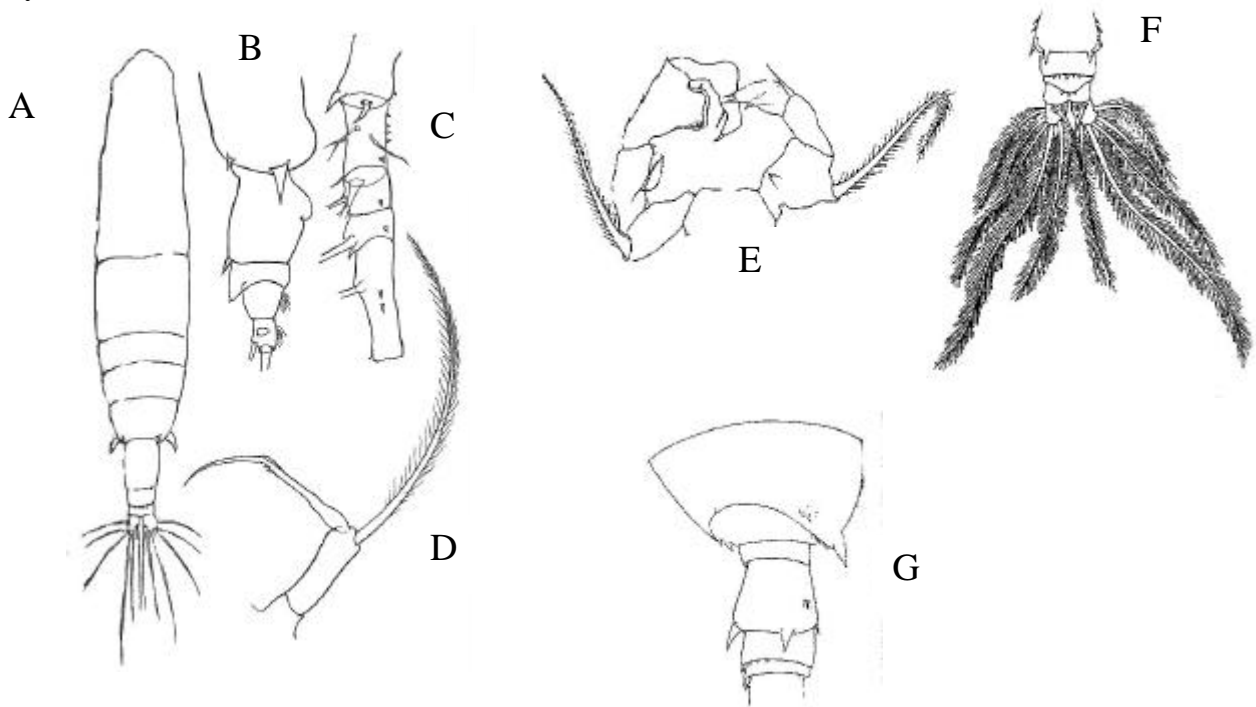
Acartia amboinensis Carl, 1907

Length: females: 1.34-1.51 mm; males: 1.30 mm.

Female: Corners of posterior metasome segment produced into a strong spine on either side laterally and with 2 small spines dorsolaterally. The first segment of the A1 has 2 strong spines and a minute spine on the posterior margin. The second segment has a moderate sized spine on the distal posterior margin and 4 minute spines on the posterior margin. The third and fourth segments each have a small spine on the posterior dorsal margin and the fifth segment has 4 small spines. Ueda (1986) gives an A1 spine arrangement as 2 stout spines on the first segment, one small spine on the second segment and one small spine on each of segments 3 and 4. He appears to disregard some of the smaller spines described by Tanaka (1965). The genital segment has 2 spines on the dorsal distal margin. The following segment has 4 tiny spines on the distal margin. In the P5, the terminal spiny segment has 2 slight swellings near the base and bends abruptly inwards in the distal half. The external seta is over 1.5 times as long as the terminal spine.

Male: Posterior metasome segment with 2 strong lateral spines. A pair of small spines on each side of the dorsal posterior metasome margin. Strong spines on the posterior margin of urosome segment 2 with a smaller lateral spine each side; third segment with 2-4 small marginal spines and the fourth segments with 4-6 small marginal spines. P5 basis segments with long strong external setae.

Recorded: Madagascar by Binet and Dessier (1968), but their illustrations differs slightly from those of Carl (1907) and Tanaka (1965), especially in the structure of the female P5, so this record may be invalid.



Acartia amboinensis: Female. A, dorsal; B, urosome lateral; C, proximal A1; D, P5. Male. E, P5; F, urosome dorsal; G, thorax and urosome lateral. Figures A-D from Tanaka (1965), figures E-G from Carl (1907).

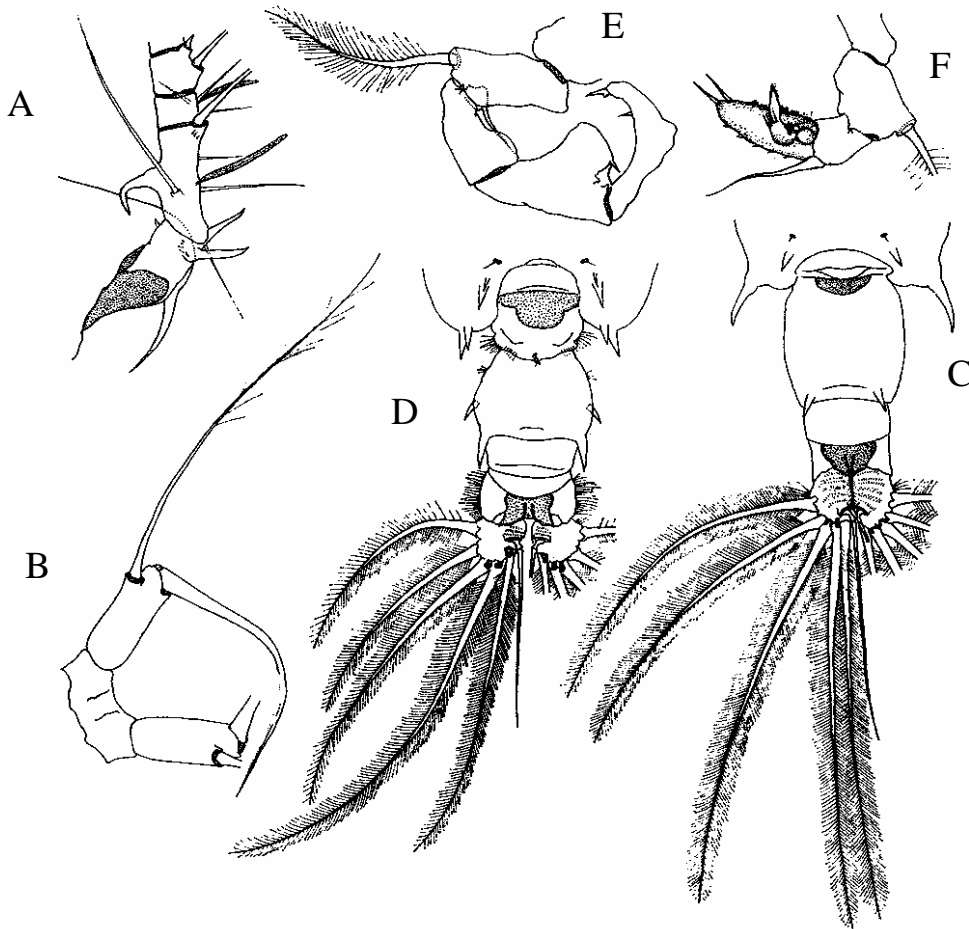
Acartia bispinosa Carl, 1907

Length: females 1.32 mm; males: 1.30 mm.

Female: Rostral filaments present. Corners of posterior metasome segment with strong spines; 2 smaller spines dorsal and medially each with a tiny spinules just behind them. Posterior edge of the genital segment with a pair of strong spines dorsolaterally. First segment of the A1 with 2 strong spines and a smaller spine near the base of these spines. The second segment with a characteristic, obvious, strong curved spine. The terminal slender spines of the P5 curved strongly from around the middle.

Male: Each corner of the posterior metasome segment with a pairs of spines, one slightly shorter than the other. A pair of spine one each side of the same segment dorsolaterally, one much smaller than the other and with a fine setule just behind them. Carl (1907), in the original description, only draws a single dorsal curved spine on either side. The second urosome segment has a strong dorsolateral spine on each side of the posterior margin and smaller ones on each side ventrolaterally. Terminal segment of P5 left with 2 fine terminal spines, a stout spine on the midanterior surface with fine setae at its base, tufts of hairs proximal to the medial spine, row of spinules along inner margin, and several spinules along outer margin.

Recorded: Seychelles



Acartia bispinosa: Female. A, rostrum and base of A1; B, P5; C, thorax and urosome dorsal. Male. D, thorax and urosome dorsal; E P5 right; F P5 left. From Nishida (1985).

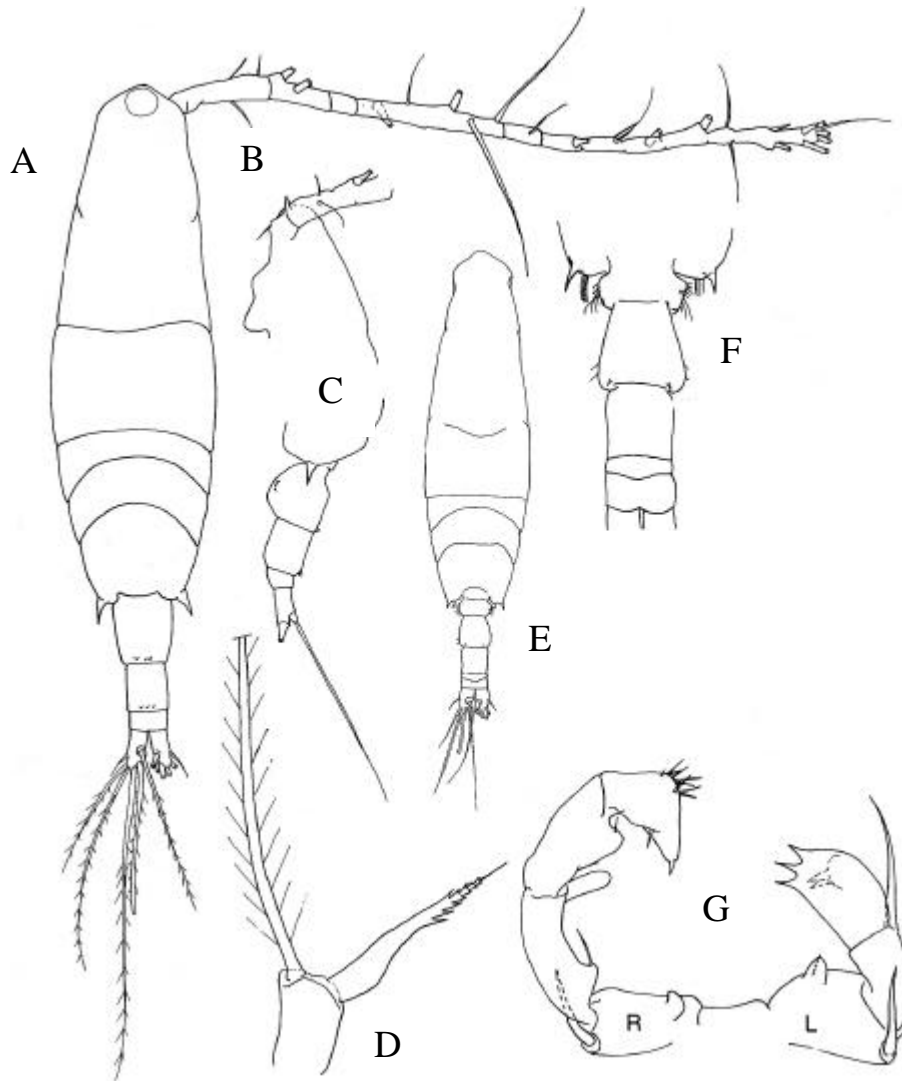
Acartia danae Giesbrecht, 1889

Length: females: 1.05-1.27 mm; males: 0.73-0.80 mm.

Female: Rostral filaments present. Spine present on the basal segment of the A1. A strong spine on each posterior corner of the metasome. The urosome does not bear strong spines, but the first two segments have small hairs on the posterior dorsal edge. The P5 terminal spiny segment is coarsely serrated on both sides, twice as long as the previous segment, while the outer marginal seta is three times the length of the spine.

Male: Posterior metasome as in female. Urosome segment 1 with lateral hairs, and a pair of small spines on the rear edge of segment 2.

Recorded: Seychelles, Zuza, Madagascar.



Acartia danae: Female. A, dorsal; B, head lateral; C, urosome lateral; D, P5. Male. E, dorsal; F, urosome dorsal; G, P5. From Bradford-Grieve (1999).

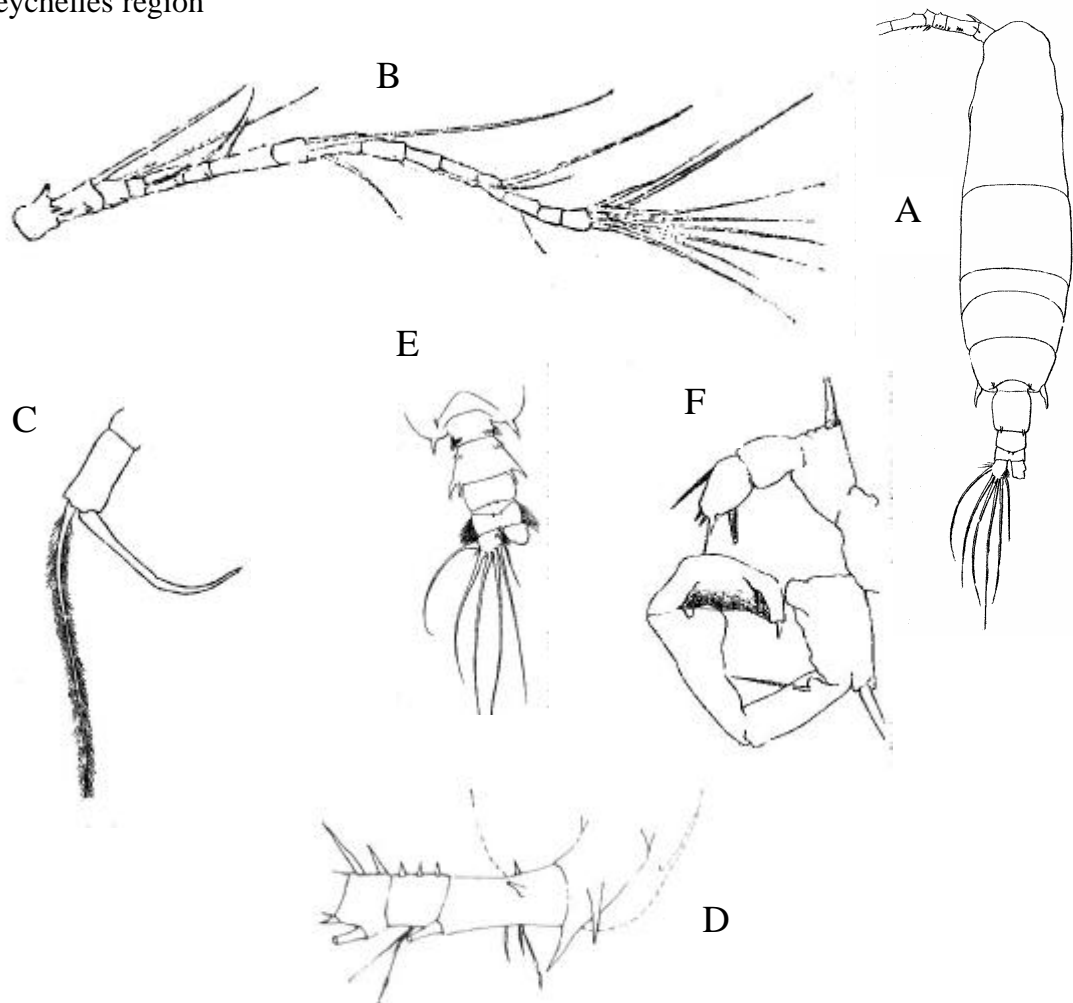
Acartia erythraea Giesbrecht, 1889

Length: females: 1.4 mm; males: 1.2 mm.

Female: Rostral filament present; 2 strong spines on segment 1 of the A1, a smaller spine on the second segment, 3 small spines on the third and 2 larger spines on the fourth segment. A very strong spine on each corner of the posterior metasome segment and a pair dorsally, towards the posterior edge of the same segment. A pair of spines on the dorsal rear edge of the genital segment and a tiny pair on the following segment. The P5 is simple, with a curved terminal spiny segment (Giesbrecht (1889) drew the spine gently curved, while Mori (1937) drew a much stronger curve); the outer plumose seta is one and a half times the length of the spiny segment.

Male: No strong spines at the base of the A1. The same spine arrangement on the last metasome segment as the female. The second urosome segment is wider than long, with a pair of prominent spines either side on the posterior margin, of the same size. Two tiny dorsal medial spines on the rear edges of urosome segments 3 and 4. Ueda (1986) draws 4 spines on segment 3.

Recorded: Seychelles region



Acartia erythraea: Female. A, dorsal; B, A1; C, P5; D, base of A1. Male. E, thorax and urosome dorsal; F, P5. Figures A, E, F from Giesbrecht (1892), B, C from Mori (1937), D from Ueda (1986).

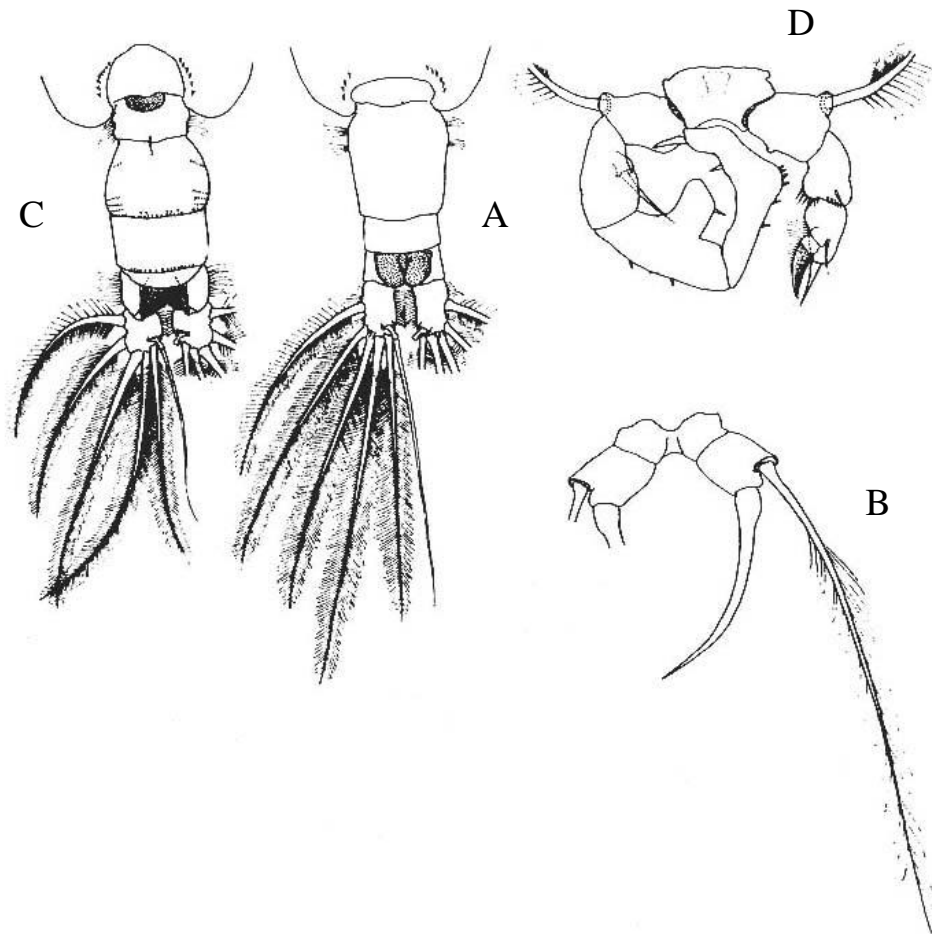
Acartia fossae Gurney, 1927

Length: females: 1.03-1.40 mm; males: 0.91-1.30 mm.

Female: Posterior metasome segment with a row of 4-5 tiny spinules on the dorsoposterior margin. A1 extends to the posterior border of urosome segment 2. Genital segment with 2 pairs of lateral tufts of hair on anterior part. No spines on this or succeeding segments. Terminal segment of P5 almost square, terminal spine swollen near its base, length about half that of outer seta. Bradford-Grieve (1999b) illustrates the P5 with the outer seta only slightly longer than the terminal spine.

Male: Posterior metasome segment with row of tiny spinules on dorsoposterior margin as in the female. First urosome segment with lateral tufts of hair. Second urosome segment with dorsolateral rows of tiny spinules arranged across and on the posterior edge of the segment. Third and fourth segments also have tiny spinules on posterior dorsal edge. The left P5 has a terminal segment with a thick naked terminal spine, one modified spine and one seta on the midanterior surface. The inner margin has a row of fine hairs.

Recorded: Madagascar



Acartia fossae: Female. A, urosome dorsal; B, P5. Male. C, urosome dorsal; D, P5. From Nishida (1985).

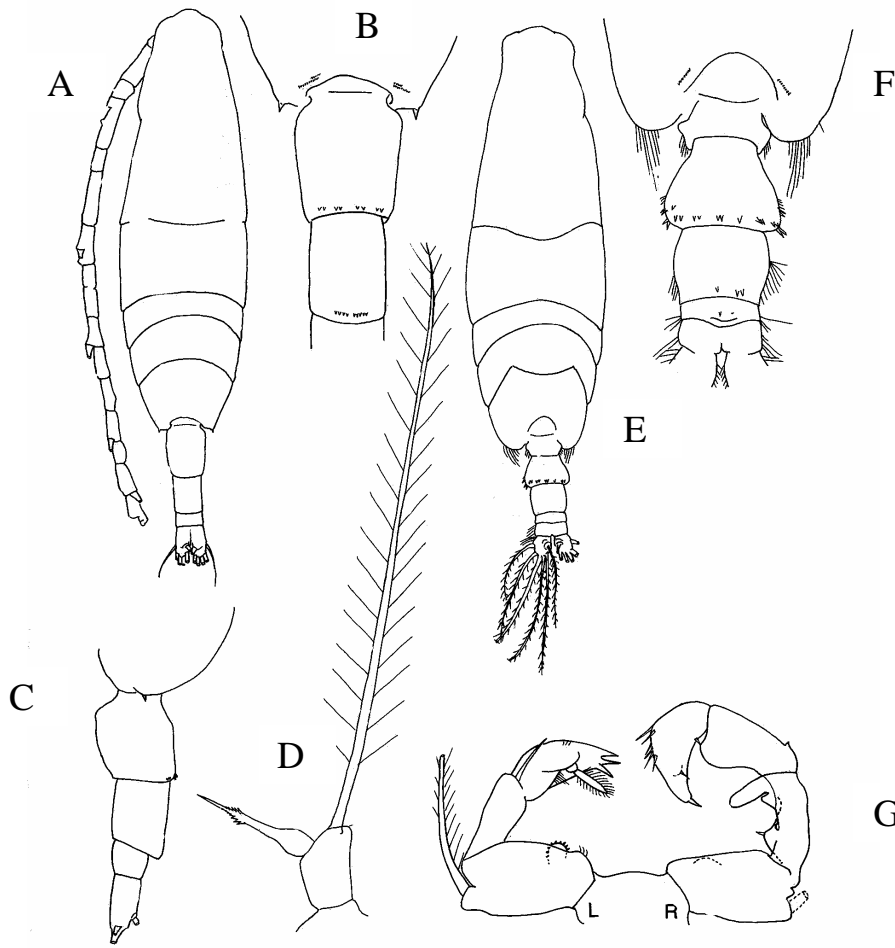
Acartia negligens Dana, 1849

Length: females: 0.98-1.30 mm; males: 0.80-1.18 mm.

Female: Rostral filaments present. Small species, with one or sometimes more small spines on the posterior corners of the last metasome segment. A row of tiny hairs may also be present dorsally, although difficult to see except under very high power. A1 reaches to furca, its first segment with a small slender spine. The first two urosome segments have a dorsal row of fine spinules on the posterior border. The P5 is very simple, similar to *A. danae*, terminating in a very short, straight, spiny segment with serrated outer edges and a very long outer seta at least 5 times longer than the spine.

Male: A1 shorter than body. The male is also reported to have a tiny spine on either side of the last body segment, although some authors suggest tufts of hairs. Urosome segments 1 and 2 hairy laterally, segments 2, 3 and 4 with tiny dorso-posterior spinules. P5 similar to *A. danae*.

Recorded: Rodrigues, Seychelles, Zuza, Madagascar.



Acartia negligens: Female. A, dorsal; B, anterior urosome dorsal; C, urosome lateral; D, P5. Male. E, dorsal; F, urosome dorsal; G, P5. From Bradford-Grieve (1999).

Family Candaciidae

Typically medium sized robust copepods, with a very square front to the cephalosome and pronounced shoulder shape anteriorly. In almost all species the last segment of the metasome, in both males and females, ends in widely spaced spines. Both the male and female P5 are small and simple. Many species, even in the young stages, have tinges of black pigment on the ends of the swimming legs or on other parts of the body. The genital segment in both sexes often bears prominent spines. Maxilla 2 large, associated with their carnivorous diet. Female P5 uniramous, usually symmetrical. Male posterior segment of the urosome always asymmetrical and genital segment almost always asymmetrical. A1 geniculate on right; 23 segments, segments 17-18 and 19-20 fused, with or without teeth at bend. P5 4-segmented on left and 3-segmented on right; may be chelate (have a claw-like process) on right or ending in a feather-like seta.

Genus *Candacia*

Female P5 terminal segments may end in one or more spine like processes, a finger-like process or a single long setae; setae may or may not be present on the inner lateral margins. Right A1 of male with teeth present on one or more segments at the bend in the geniculate region. Male right P5 is chelate.

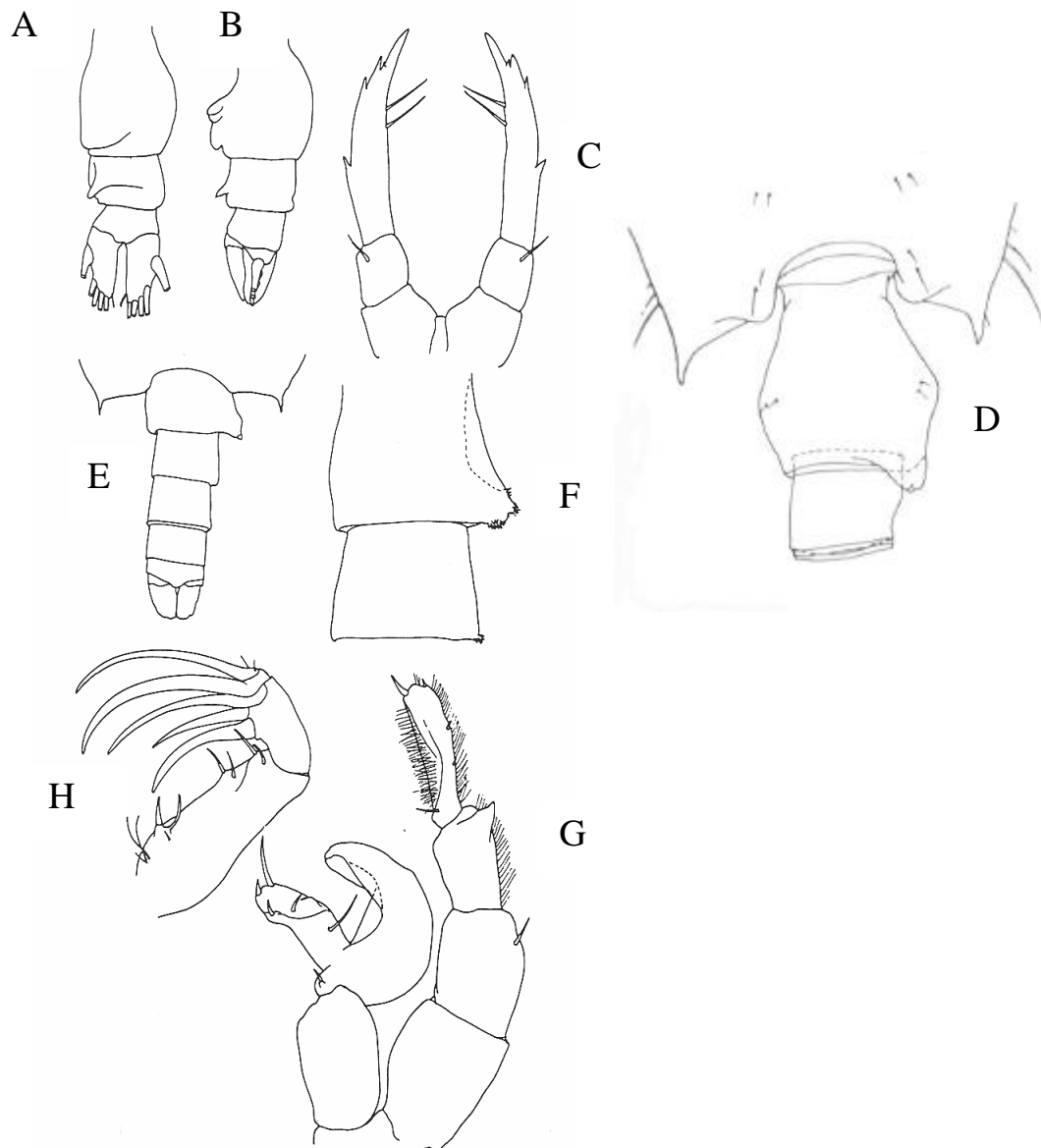
Candacia bradyi A. Scott

Length: females: 1.4-2.1 mm; males 1.4-1.8 mm.

Female: Posterior metasome segment corners each end in a short spine. Genital segment broad and almost symmetrical in dorsal view, with a slight anterior protrusion on right side. Urosome segment 2 has a pointed protrusion on the mid ventral surface. P5 segment 3 curved slightly inwards, with 2 seta on inner margin and three spines on the distal outer edge with an additional spine further back.

Male: Genital segment produced into a small toothed process on right side. Left P5 segment 3 is produced at outer distal angle into a short stout pigmented tooth-like process, which is divided into 3 blunt points, segment 4 is elongated and narrow with 3 small terminal spines.

Recorded: Madagascar



Candacia bradyi: Female. A, urosome ventral; B, urosome lateral; C, P5; D, urosome dorsal. Male. E, urosome dorsal; F, urosome segments 1 and 2; G, P5; H, maxilla 2. Figures A-C, E-H from Greenwood (1978), figure D from Lawson (1973).

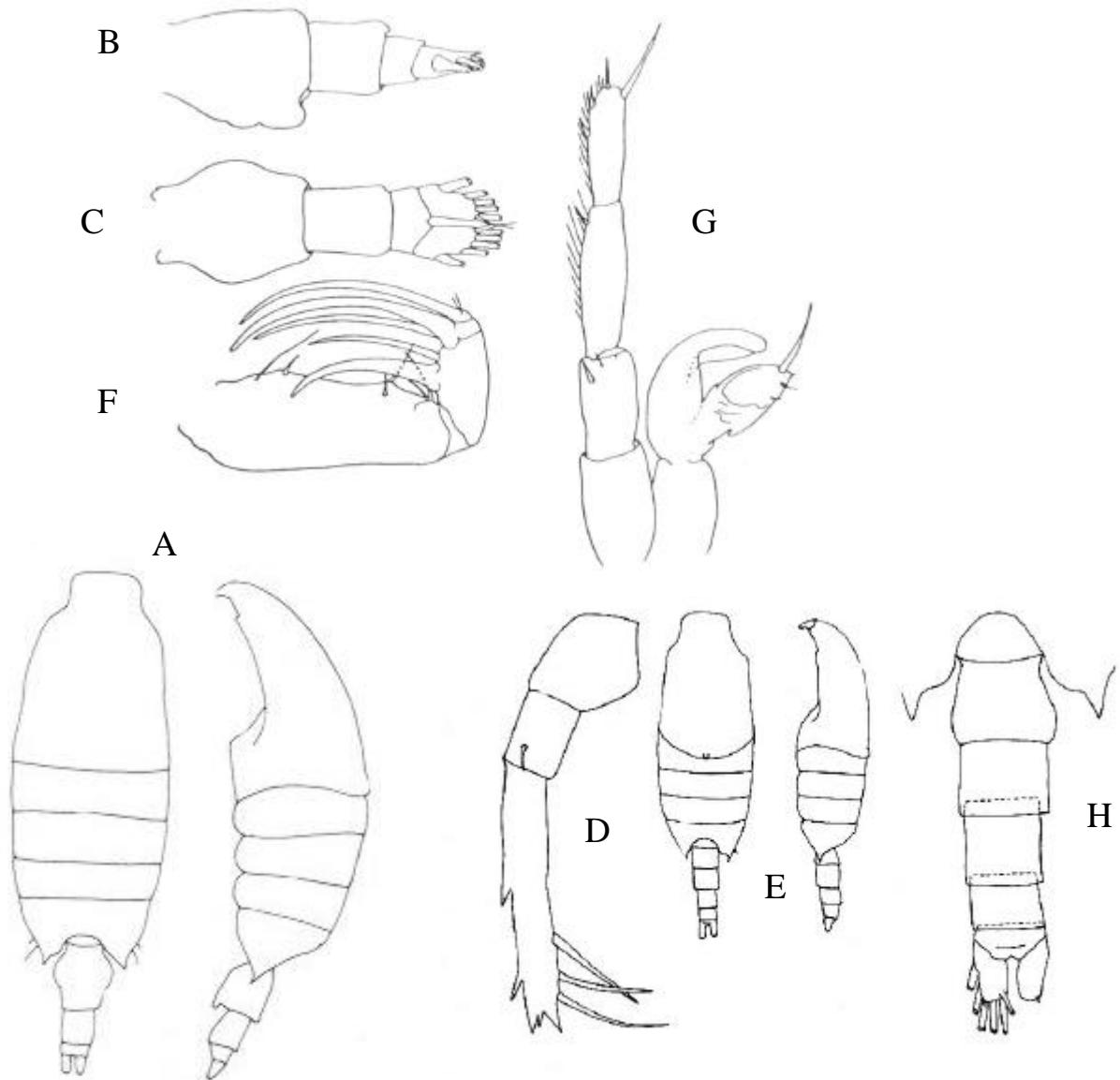
Candacia catula (Giesbrecht, 1889)

Length: females: 1.40-1.67 mm; males: 1.30-1.62 mm.

Female: Posterior metasome symmetrical and pointed. Genital segment symmetrical with both sides swollen. No spines on genital segment, but with a backward projecting protuberance on the ventral surface, situated towards the rear edge. Segment 3 of P5 is long and has 2 outer marginal spines and 3 inner marginal setae and 3 teeth at the end.

Male: Last segment of the metasome pointed, but not prominently. Points are slightly asymmetric. Unusual among *Candacia* males in having no protuberances on the genital segment.

Recorded: Rodrigues, Seychelles, Zuza, Madagascar, Aldabra.



Candacia catula: Female. A, dorsal and lateral; B, urosome lateral; C, urosome dorsal; D, P5. Male. E, dorsal and lateral; F, maxilla 2; G, P5; H, urosome. Figures B, C, F, G from Greenwood (1978), A, D, E, H from Grice (1962).

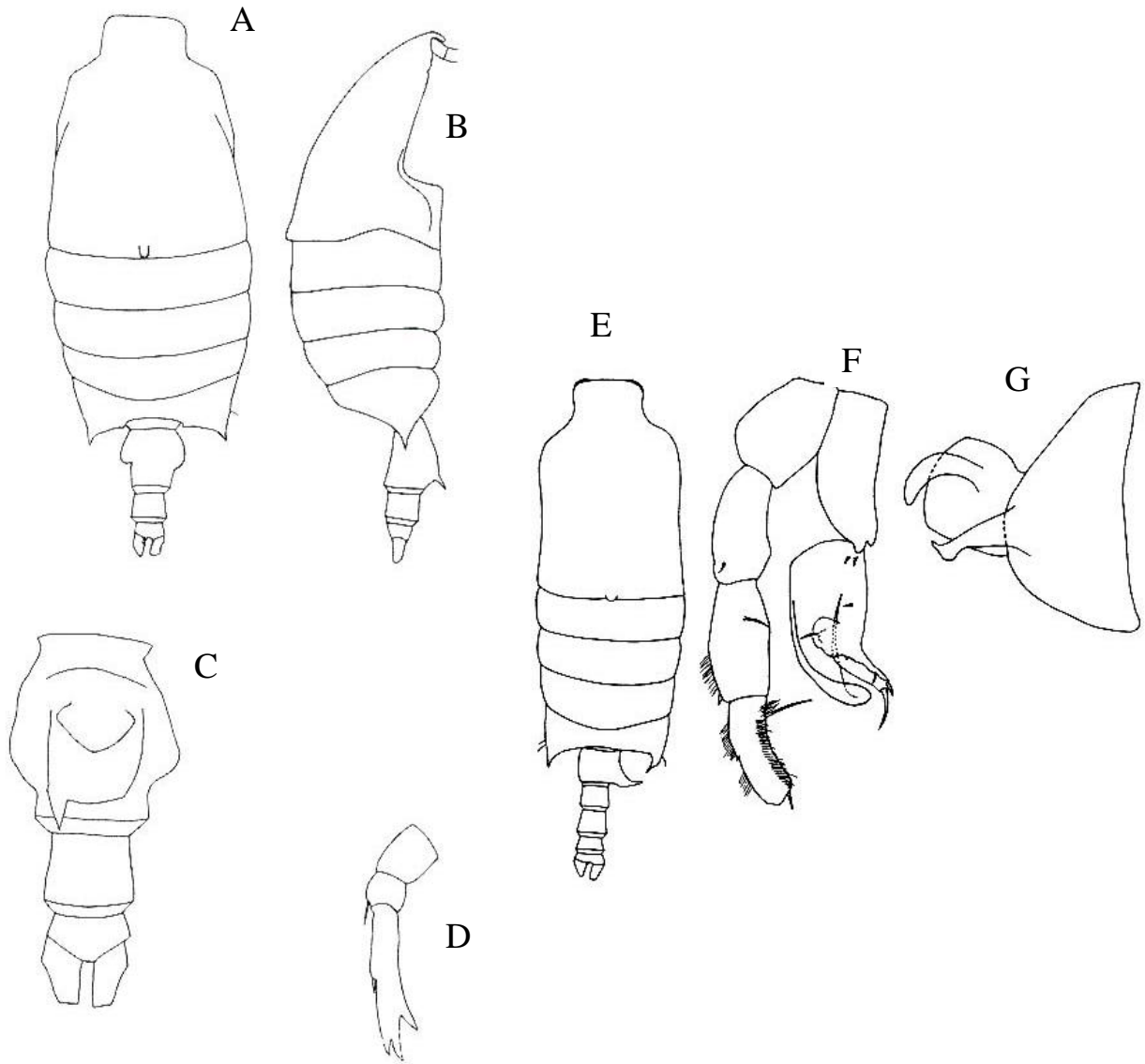
Candacia curta (Dana, 1849)

Length: females: 1.82-2.70 mm; males: 1.90-2.65 mm.

Female: The body is broad and the spines on the last metasome segment are set wide apart. Has an asymmetric genital segment with a sharp downward projecting spine on the ventral surface, originating from the right side of the segment. There are 2 points on the end of the P5 with a further point set further back

Male: One of the spines on the last metasome segment is very crooked, and there is a very obvious curved sharp protuberance on the genital segment.

Recorded: Zuza, Aldabra, Madagascar, CPR.



Candacia curta: Female. A, dorsal; B, lateral; C, urosome ventral; D, P5. Male. E, dorsal; F, P5; G, corner of last metasome segment and urosome segment 1. From Grice (1962).

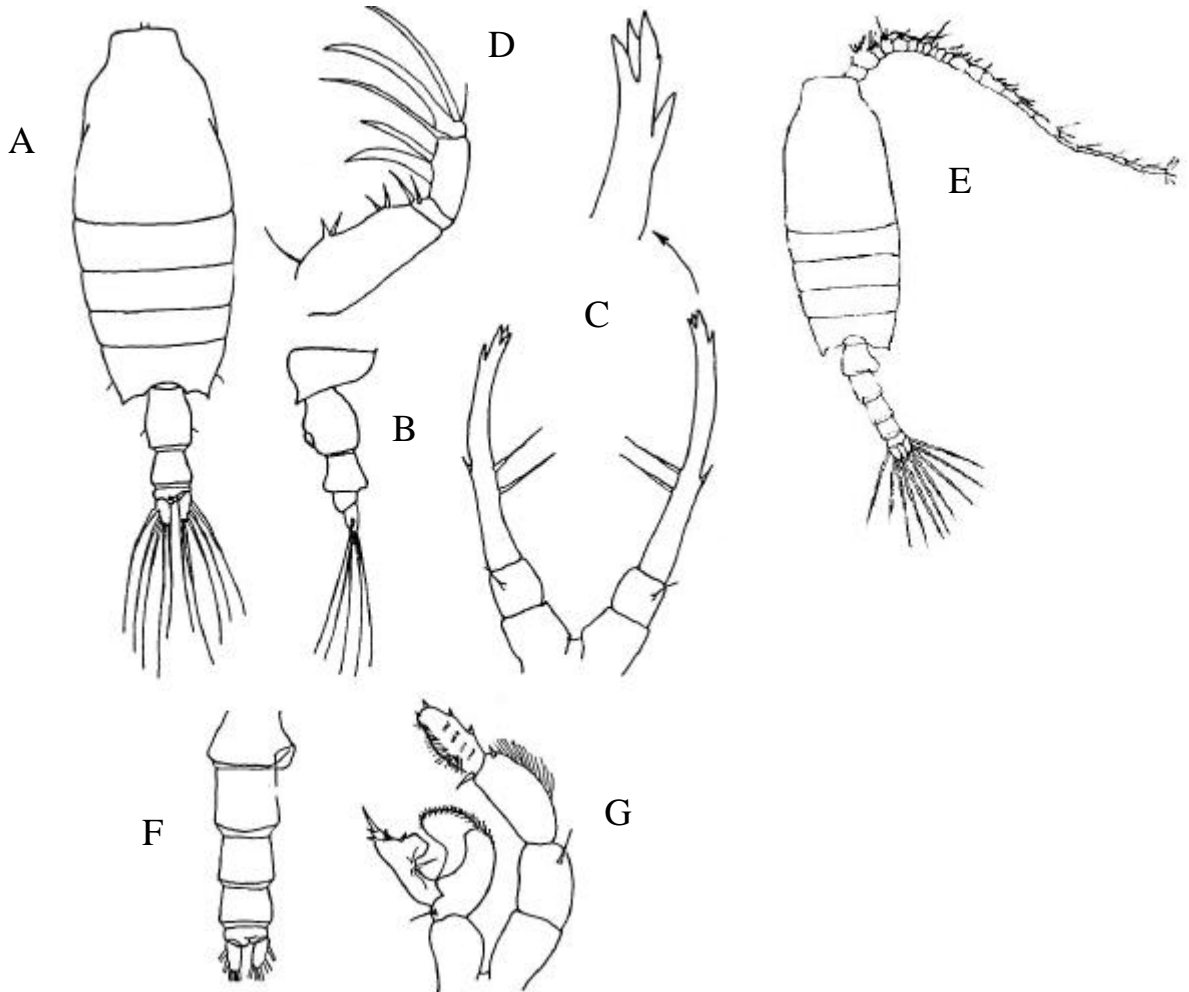
Candacia discaudata A. Scott, 1909

Length: females: 1.55-1.94 mm; males: 1.48-1.80 mm.

Female: The spines on the last metasome segment of the female are not as obvious as in most of the other *Candacia* species and project forwards slightly in lateral view. The genital segment is quite symmetrical, with a slight protuberance on the front. The second urosome segment has a ventral rounded projection in lateral view. The anal segment is short and asymmetrical. The P5 are almost symmetrical.

Male: The genital segment is asymmetrical and bulges on the right side. Viewed from the right the inflated region bears a small tooth at each end. The anal segment is asymmetrical.

Recorded: Rodrigues, Aldabra, Seychelles.



Candacia discaudata: Female. A, dorsal; B, urosome lateral; C, P5; D maxilla 2. Male. E, dorsal; F, urosome dorsal; G, P5. Figures A-D, F, G from Scott (1909), E from Mori (1937).

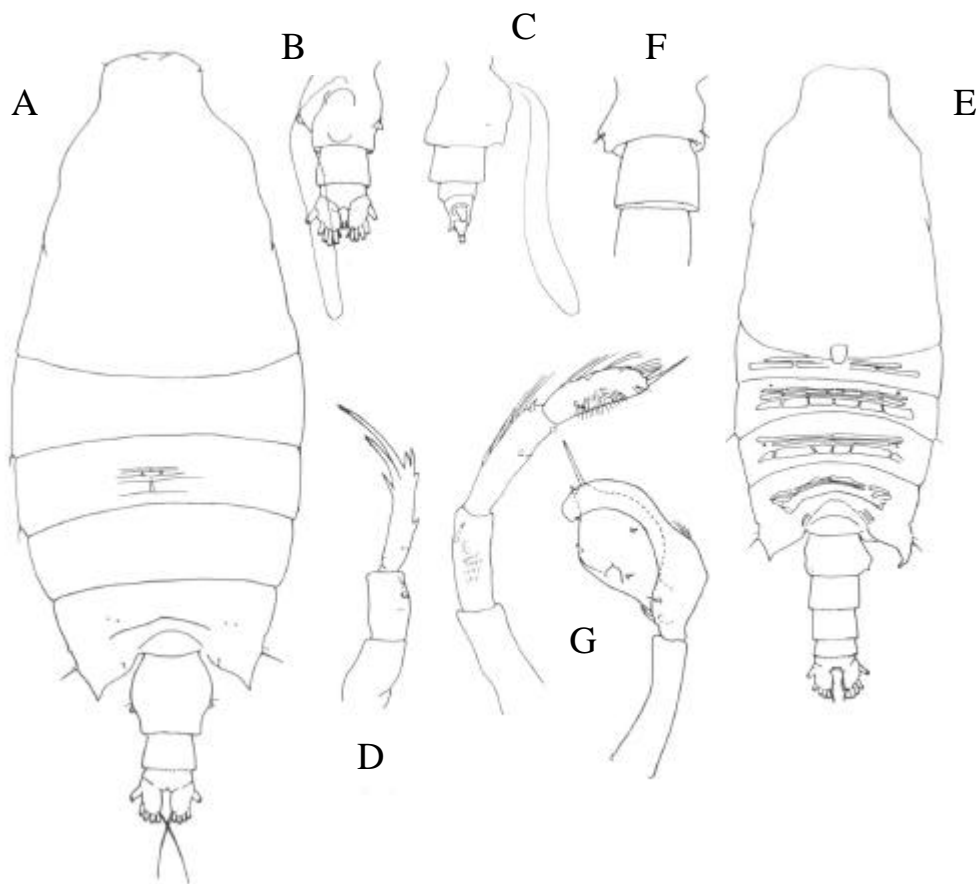
Candacia ethiopica (Dana, 1849)

Length: females: 1.97-3.03 mm; males: 2.0-2.93 mm.

Female: The prosome is often very darkly pigmented. Easily distinguished from the other species of the genus by the small lateral and ventral spiny processes of the genital segment and by the terminal segment of the P5, which has 7 spines. In the female the last cephalosome segment rises to a small crest on the back at the rear edge. The genital segment is slightly asymmetric, with protrusions on each side, one larger than the other.

Male: Recognised by the curved, spiny projection of the right posterolateral corner of the metasome. The genital segment has 2 triangular processes on the right margin. There is also a small crest on the last cephalosome segment, which is also found in some other *Candacia* spp. The genital segment has protuberances on one side, consisting of a rounded knob in front of which is a pointed projection.

Recorded: Rodrigues, Seychelles, Zuza, Madagascar, Aldabra.



Candacia ethiopica: Female. A, dorsal; B, urosome ventral; C, urosome lateral; D, P5. Male. E, dorsal. F, urosome ventral; G, P5. From Bradford-Grieve (1999).

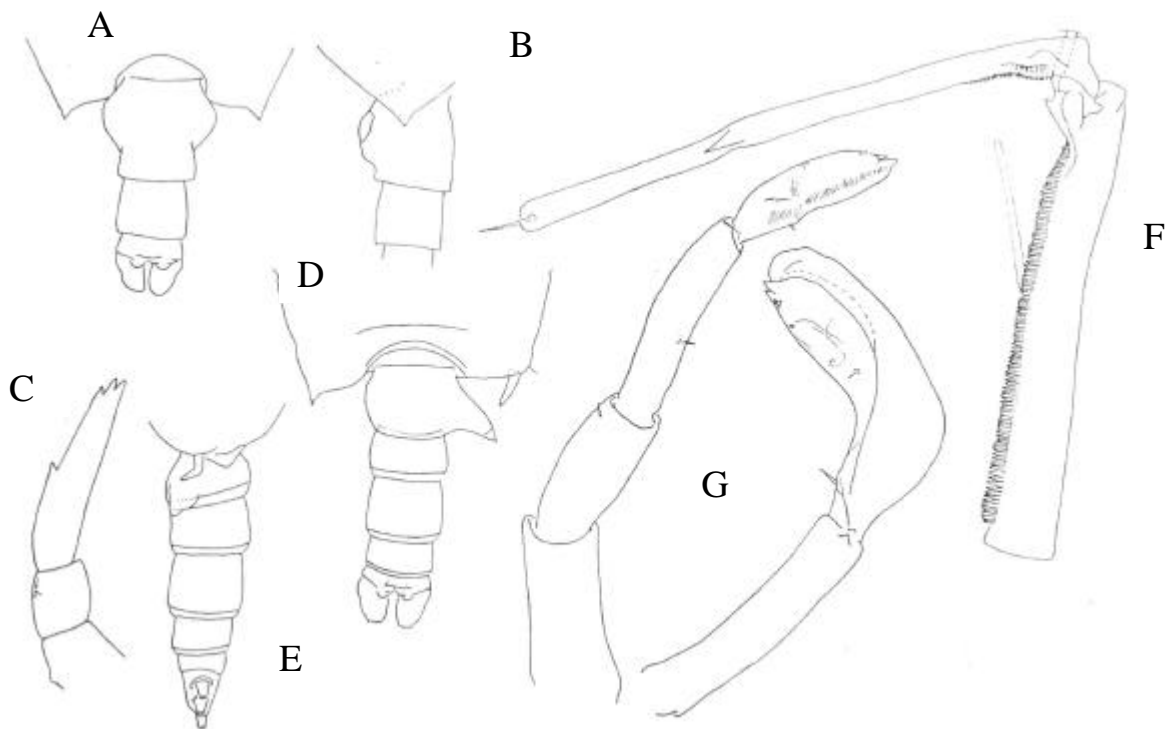
Candacia longimana (Claus, 1863)

Length: females 2.86-3.90 mm; males: 2.40-3.55 mm.

Female: Posterior metasome segment with small points. Genital segment swollen and symmetrical. Segment 3 of P5 terminated by 3 short teeth of similar length and a further tooth set half way back along the segment.

Male: Can be identified by the spiny process on the right posterolateral margin of the asymmetric metasome, the knob-like process on the right side of the genital segment, and the structure of the P5. There is a fine-toothed comb on the right geniculate A1.

Recorded: Madagascar.



Candacia longimana: Female. A, urosome dorsal; B, urosome lateral; C, P5. Male. D, urosome dorsal. E, urosome lateral; F, geniculate A; G, P5. From Bradford-Grieve (1999).

Candacia pachydactyla (Dana, 1849)

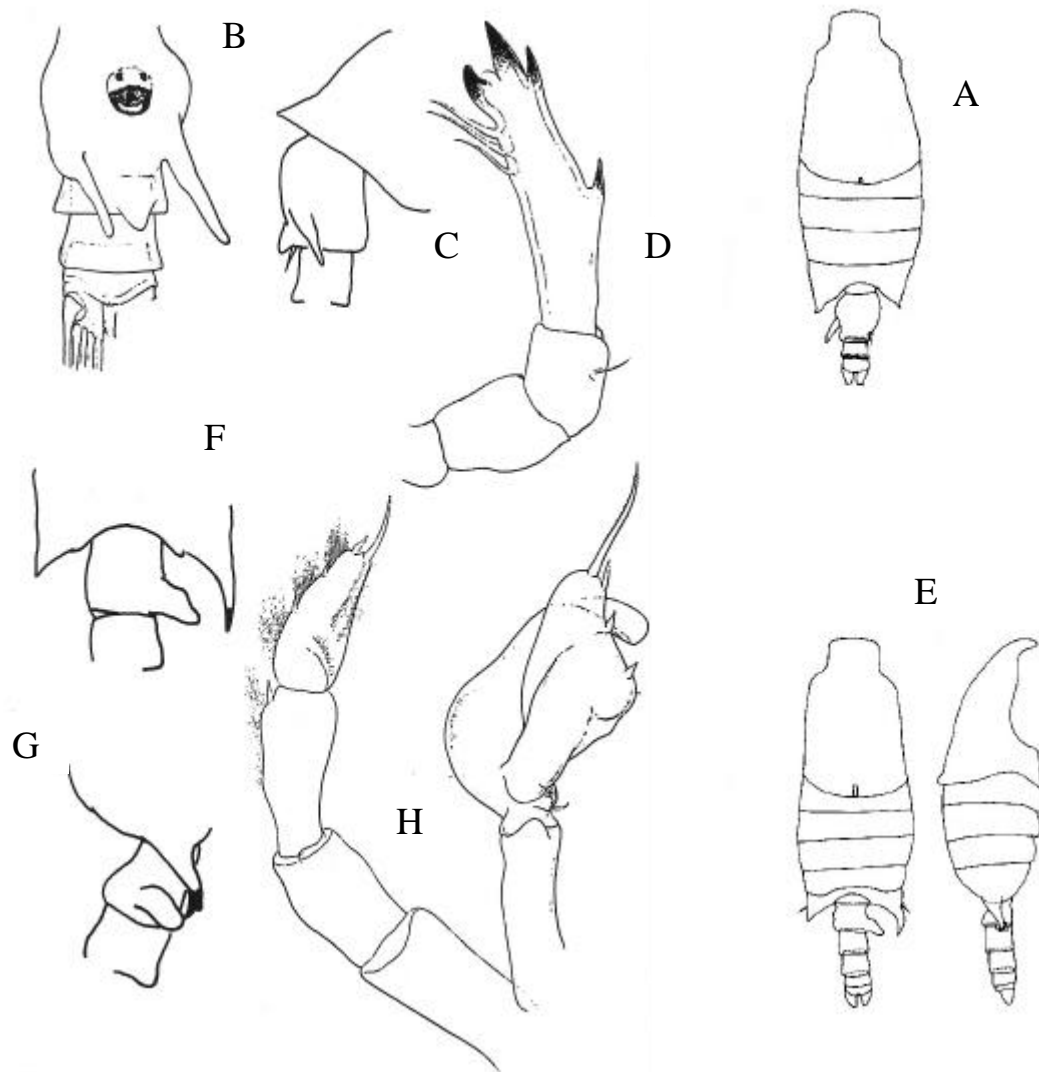
Length: females: 2.15-3.00 mm; males: 2.07-2.72 mm.

Both the female and male have small ridges on the back at the rear of the last cephalosome segment.

Female: Posterior metasome segment pointed and asymmetrical. A markedly asymmetric genital segment with characteristic large pointed protuberances extending obliquely Segment 3 of P5 thickened with 3 strong terminal spines, three seta on the inner side and a strong spine on the outer edge.

Male: Posterior metasome asymmetrical. Genital segment with a large process on the right, consisting of a single, broad, rounded projection. Has a large characteristic protuberance on the genital segment.

Recorded: Rodrigues, Seychelles, Zuza, Madagascar.



Candacia pachydactyla: Female. A, dorsal; B, urosome ventral; C, urosome lateral; D, P5. Male. E, dorsal and lateral; F, urosome ventral; G, urosome lateral; H, P5. Figures B-D and F-H from Goesbrecht (1892), A, E from Grice, 1962).

Genus *Paracandacia*

Female P5 terminal segments end in a finger-like process which may be finely serrated on one or both margins. There are 2 setae on the inner lateral margin of these segments. Genuiculate right A1 of male with no teeth at the bend. Male right P5 never chelate, ending in a feather-like seta.

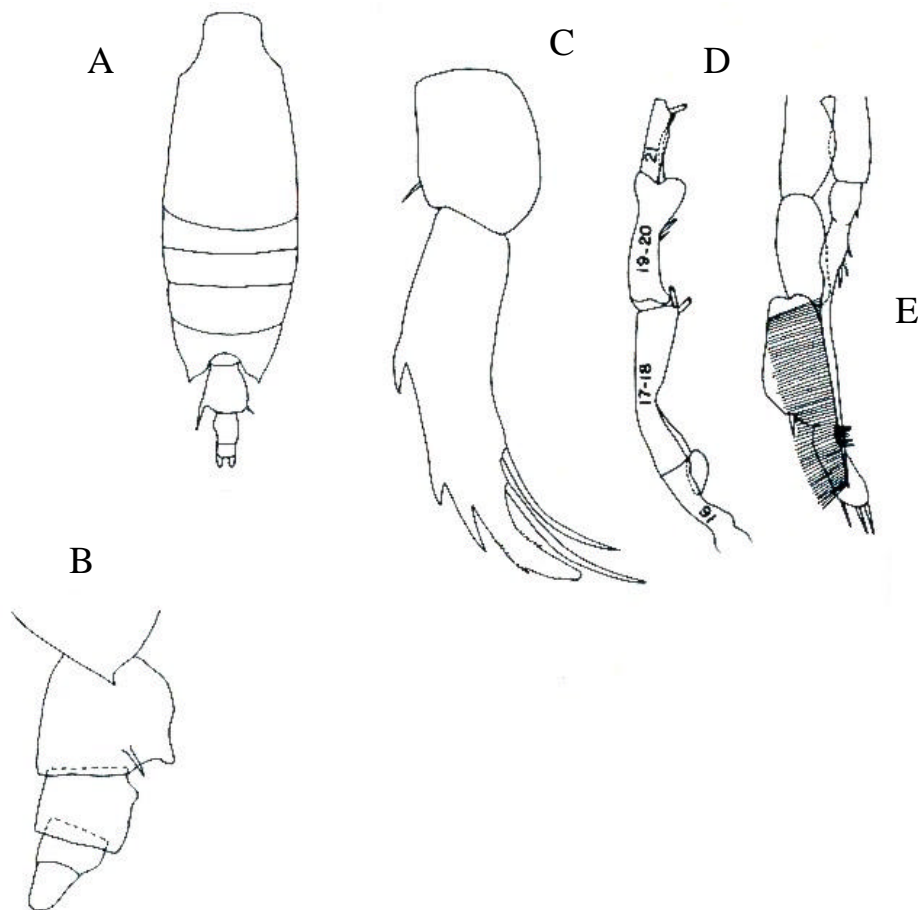
Paracandacia bispinosa (Claus, 1863)

Length: females: 1.74-2.01 mm; males: 1.88-2.11mm.

Female: The posterior metasome is produced into spines either side. The genital segment is nearly triangular when viewed from above. Each side of the segment is produced into a small spine; the spine of the left side is longer and directed backward. These spines, particularly the one on the left are variable in shape and size. There is a small rounded knob arising from the ventral side of the genital segment. Segment 3 of the P5 is wide and terminates in a broad spine, finely serrated on both sides. There are 2 sharper spines slightly further back on the outside, with a further spine half way back and 2 setae on the inside.

Male: No diagrams of the male body seem to be available, but presumably the posterior metasome is produced into spines as in the female. Can be distinguished by the swollen segment 20 of the genuiculate portion of the right A1. There are 3 outer edge spines on the distal segment of the right P5

Recorded: Rodrigues, Zuza, Madagascar, Aldabra.



Paracandacia bispinosa: Female. A, dorsal; B, urosome lateral; C, P5. Male. D, genuiculate A1 segments 16-21; E, P5. From Grice, (1962).

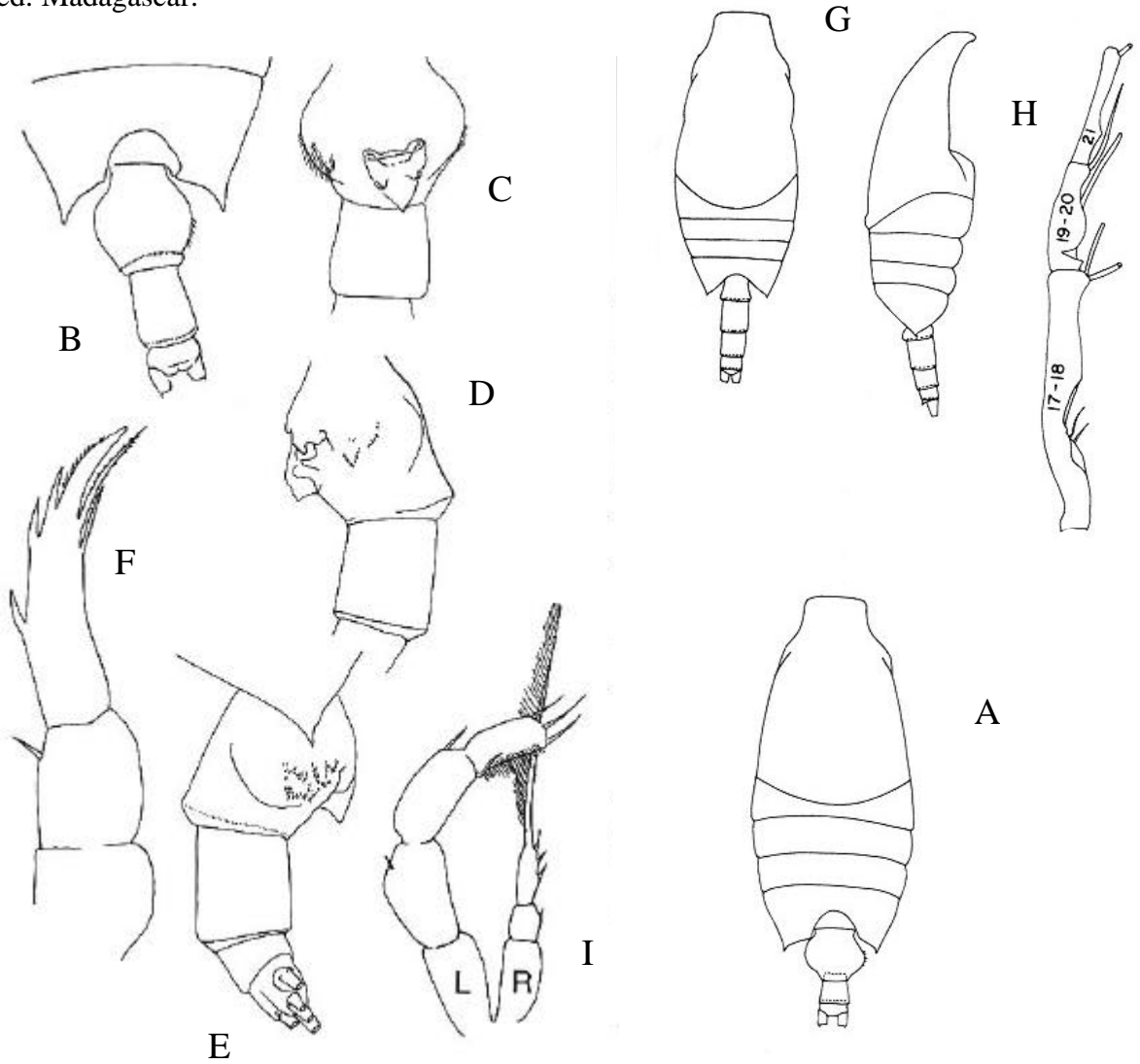
Paracandacia simplex Giesbrecht

Length: females 1.67-1.93 mm; males 1.73-1.80 mm.

Female: Posterior corners of the metasome pointed and directed backwards. Genital segment almost symmetrical and without lateral spine-like protrusions. Dorsal side of genital segment with pointed protrusion. P5 segment 3 with a broad finger-like terminal processes, finely serrated proximally. There are two inner edge spines, the distal one twice the length of the proximal one.

Male: Posterior corners of the metasome pointed but not prominently so. Geniculate A1 segments 19-20 fused, but without any protrusions.

Recorded: Madagascar.



Paracandacia simplex: Female. A, dorsal; B, urosome dorsal; C, urosome ventral; D, urosome lateral left; E, urosome lateral right; F, P5. Male. G, dorsal and lateral; H, geniculate A1 segments 17-21; I, P5. Figures B-F Bradford-Grieve (1999), A, G, H, from Grice (1962), I from Giesbrecht (1892).

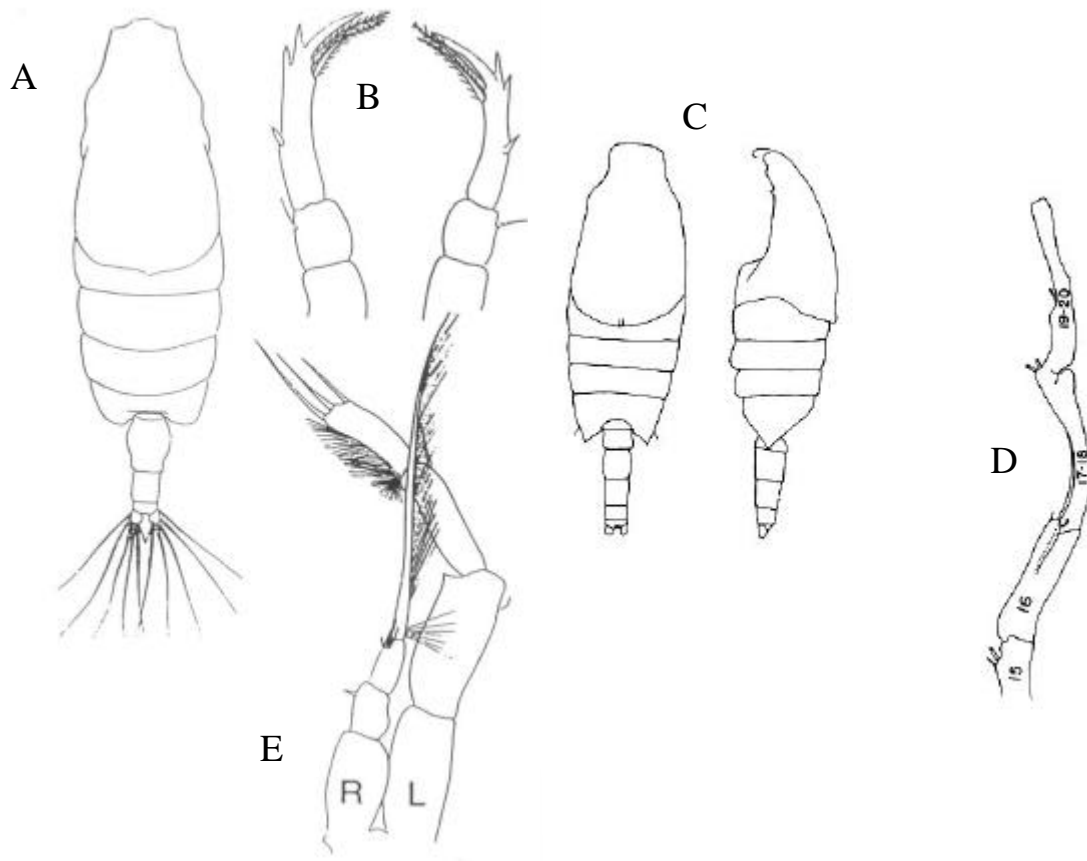
Paracandacia truncata (Dana, 1849)

Length; females: 1.84-2.10 mm; males: 1.87-2.11 mm.

Female: A very characteristic square end to the last metasome segment when viewed laterally. The corners of the metasome are pointed and directed forwards, so the points are not visible in dorsal view. The urosome is quite symmetrical, with no protuberances. P5 has 3 terminal finger-like processes, finely serrated distally and 2 terminal setae of slightly different lengths.

Male: Last metasome segment symmetrical, with sharp points. The urosome is symmetrical with no projections. The P5 is quite similar to the P5 of *P. bispinosa* but can be distinguished as it has a small spine on the external distal side of the left leg segment 2. There is another spine on the external distal corner of segment 3, and 4 long spines of almost equal length on the end of segment 4. Segment 3 of this limb is also much narrower than in *P. bispinosa*. The geniculate A1 has a series of stout proximal segments followed by a thin section, then a very broad club section. Beyond the club section, segment 16 has a finger-like protrusion which is difficult to observe clearly. Fused segments 17 and 18 are characteristically curved.

Recorded: Rodrigues, Zuza, Aldabra, Madagascar, CPR



Paracandacia truncata: Female. A, dorsal; B, P5. Male. C, dorsal and lateral; D, geniculate A1 segments 15-20; E, P5. Figures A, B, E from Dakin and Colefax (1940), C, D from Grice (1962).

Family Centropagidae

A wide range of *Centropages* spp are recorded from the Indian Ocean. They are small to medium sized copepods and tend to have quite square cephalosomes. Some have the lateral corners of the posterior metasome segment ending in a spine, with a characteristic undulating edge on the section between the spine and the urosome. The males have a complex P5 with one side forming a large claw. One side of the male A1 is typically very thickened along part of its length.

Genus *Centropages*

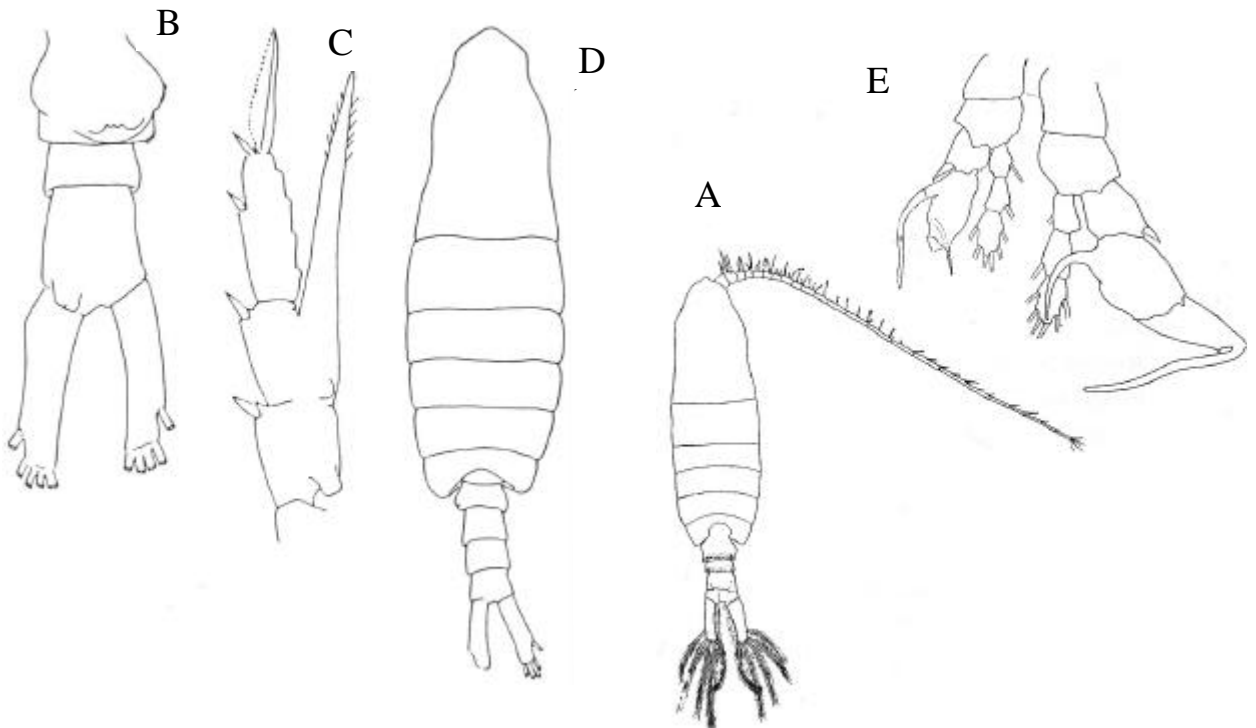
Centropages calaninus (Dana, 1849)

Length: females: 1.72-2.18 mm; males: 1.80-2.06 mm.

Female: The last metasome segment is rounded. Both the female genital segment and furca are slightly asymmetric. The genital segment swells laterally in dorsal view. The anal segment is almost twice as long as urosome segment 2. A1 extends beyond furca by its last 2 segments. P5 exopodite segment 2 inner edge spine is straight and longer than exopodite segment 3. There is a notch on the proximal inner margin of exopodite segment 1.

Male: The last metasome segment is rounded. Right P5 exopodite segment 3 claw is longer than the inner extension of exopodite segment 2 and is sharply bent.

Recorded: Rodrigues, Seychelles, Madagascar, Aldabra.



Centropages calaninus: Female. A, dorsal; B, urosome dorsal; C, exopod of P5. Male. D, dorsal; E, P5. Figures B-D from Giesbrecht (1892), A, E from Mori (1937).

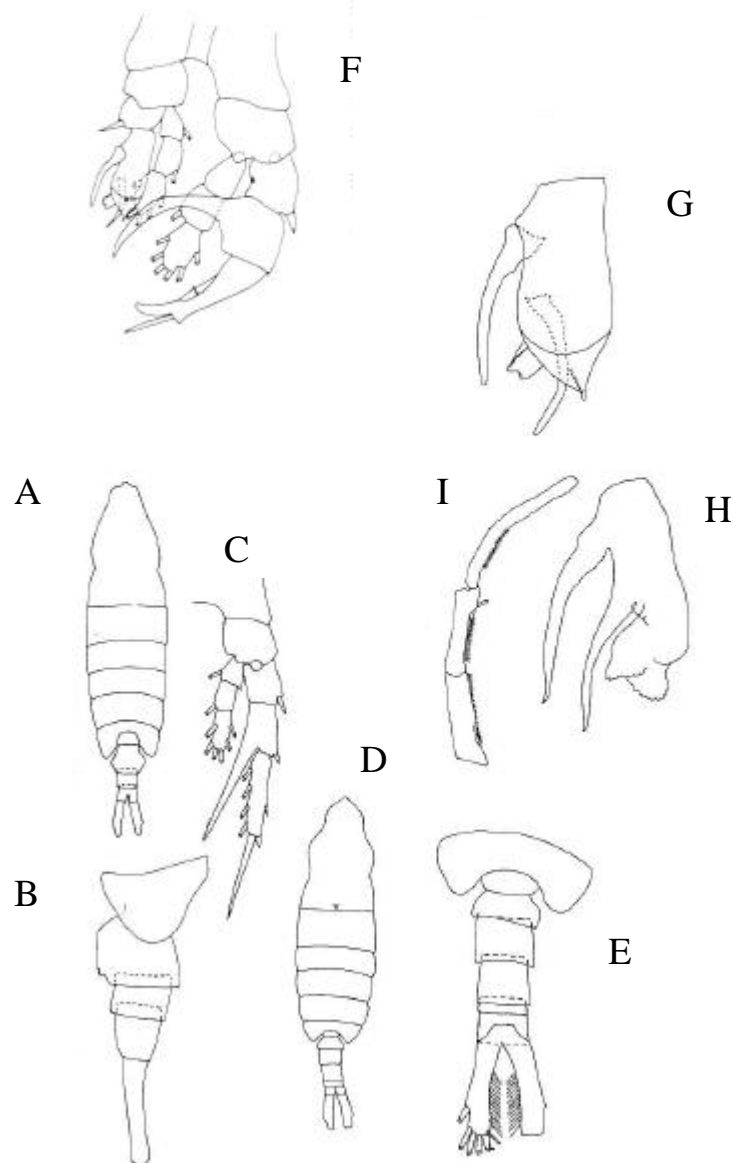
Centropages elongatus Giesbrecht, 1896

Length: females: 1.50-1.90 mm; males: 1.74-2.0 mm.

Female: Last metasome segment is quite rounded; genital segment almost symmetrical. A1 passes the furca by the last 2 segments. The spine-like extensions of the exopodite segment 2 of the P5 exceed the distal end of exopodite segment 3. Notch in proximal internal part of segment 1 of P5. The furca are as long as the 2 preceding segments together.

Male: Last metasome segment quite rounded. Long external spine terminating the right exopodite; distinctive shape to end of left exopodite.

Recorded: Rodrigues, Seychelles, Zuza, Madagascar, Aldabra.



Centropages elongatus: Female. A, dorsal; B, urosome lateral; C, P5. Male. D, dorsal; E, urosome dorsal; F, P5; G, terminal segments of exopodite of P5 left; H, terminal exopodite of left P5 other side; I, geniculate A1 segments 17-21. From Grice (1962).

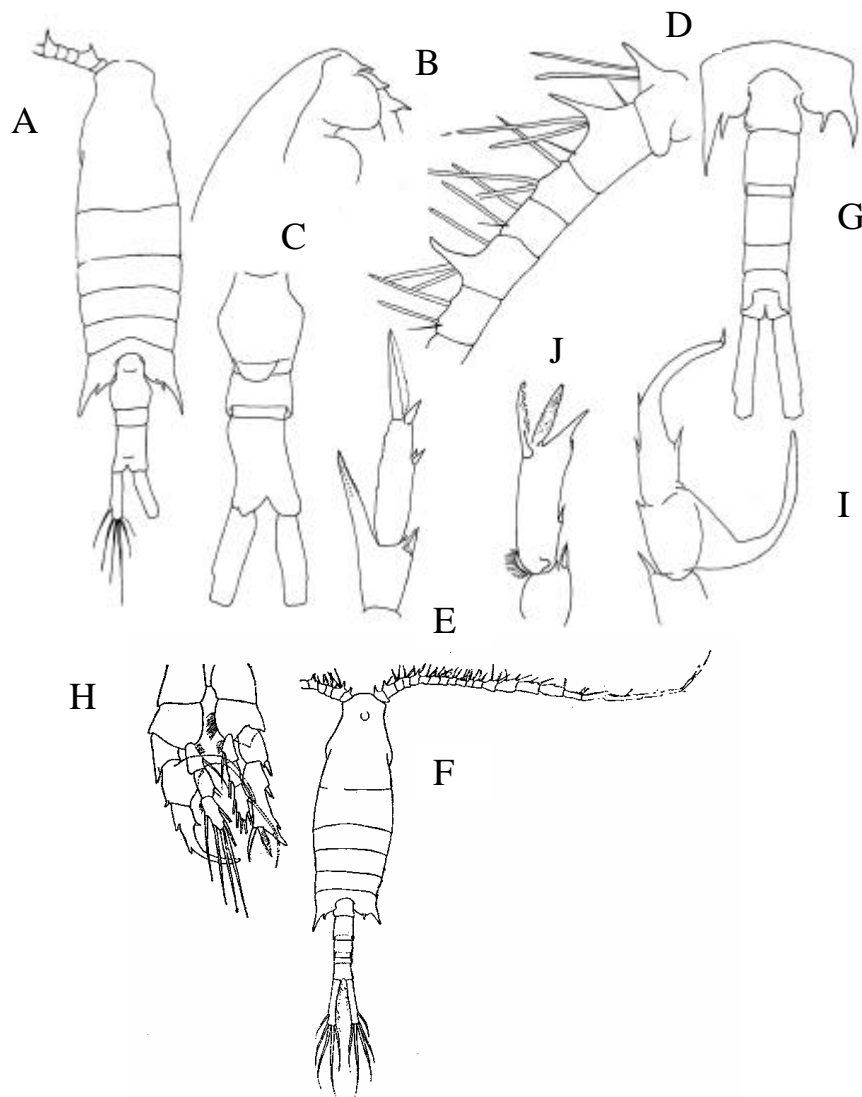
Centropages furcatus (Dana, 1849)

Length: females: 1.60-1.78 mm; males: 1.55-1.65 mm.

Female: Quite transparent species. Cephalosome has a conspicuous ventral ball-like eye, obvious even in young stages. Prominent second spines between the lateral spines on the last metasome segment and the urosome. Strong spines on segments 1, 2 and 5 of the A1. P5 exopodite segment 2 inner edge spine does not reach the distal border of exopodite segment 3. No spines on genital segment. Anal segment not quite symmetrical, long, around twice the length of urosome segment 2. The furca are long and slender

Male: Posterior metasome border asymmetrical. Prominent second spines between the lateral spines on the last metasome segment and the urosome. P5 right extension on exopodite segment 2 has a rounded protrusion on the proximal portion; exopodite segment 3 claw is stout and has a spine on inner margin and 2 spines on outer margin; left exopodite segments 2 and 3 with long terminal fixed appendages. The furca are very long and slender.

Recorded: Rodrigues, Seychelles, Zuza, Madagascar, Aldabra.



Centropages furcatus: Female. A, dorsal; B, head lateral; C, urosome ventral; D, anterior A1; E, exopodite segments 2 and 3 of P5. Male. F, dorsal ; G, urosome dorsal; H, P5; I, right P5 exopodite segments 2 and 3; J, left exopodite segments 2 and 3 of P5. Figures A-E, G, I, J from Giesbrecht (1892), F, H from Mori (1937).

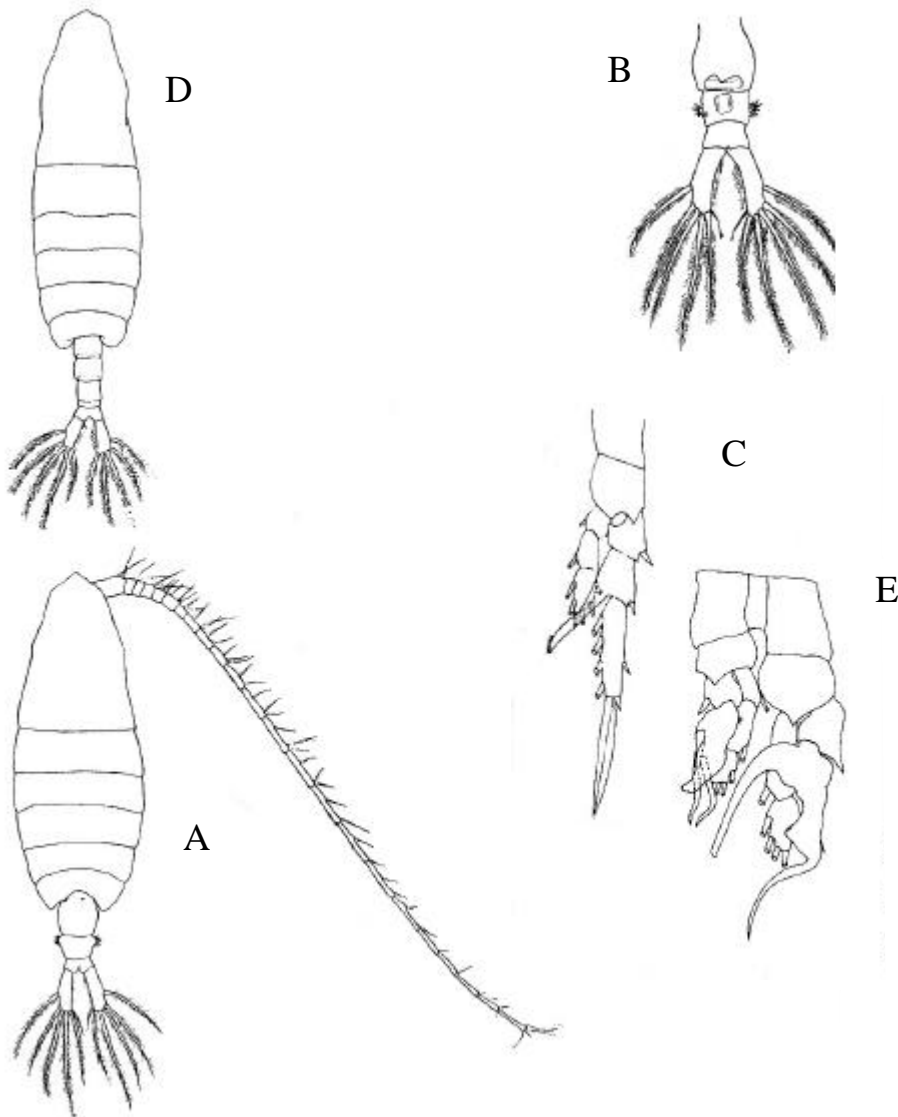
Centropages gracilis (Dana, 1849)

Length: females: 1.85-2.00 mm; males: 1.81-2.04 mm.

Female: The lateral angles of the last metasome segment are rounded. The second urosome segment has lateral knobs covered in short spines. The furca is symmetrical. The A1 extends beyond the furca by about the last 5 segments. The inner marginal spine on exopodite 2 of the P5 does not reach the end of segment 3.

Male: The terminal claw of the grasping right P5 is longer than the thumb and has a pronounced triangular protrusion, absent in other species of the genus.

Recorded: Rodrigues, Seychelles, Zuzi, Madagascar.



Centropages gracilis Female. A, dorsal; B, urosome ventral; C, P5. Male. D, dorsal ; E, P5. Figures A, B, D from Mori (1937), C, E from Grice (1962).

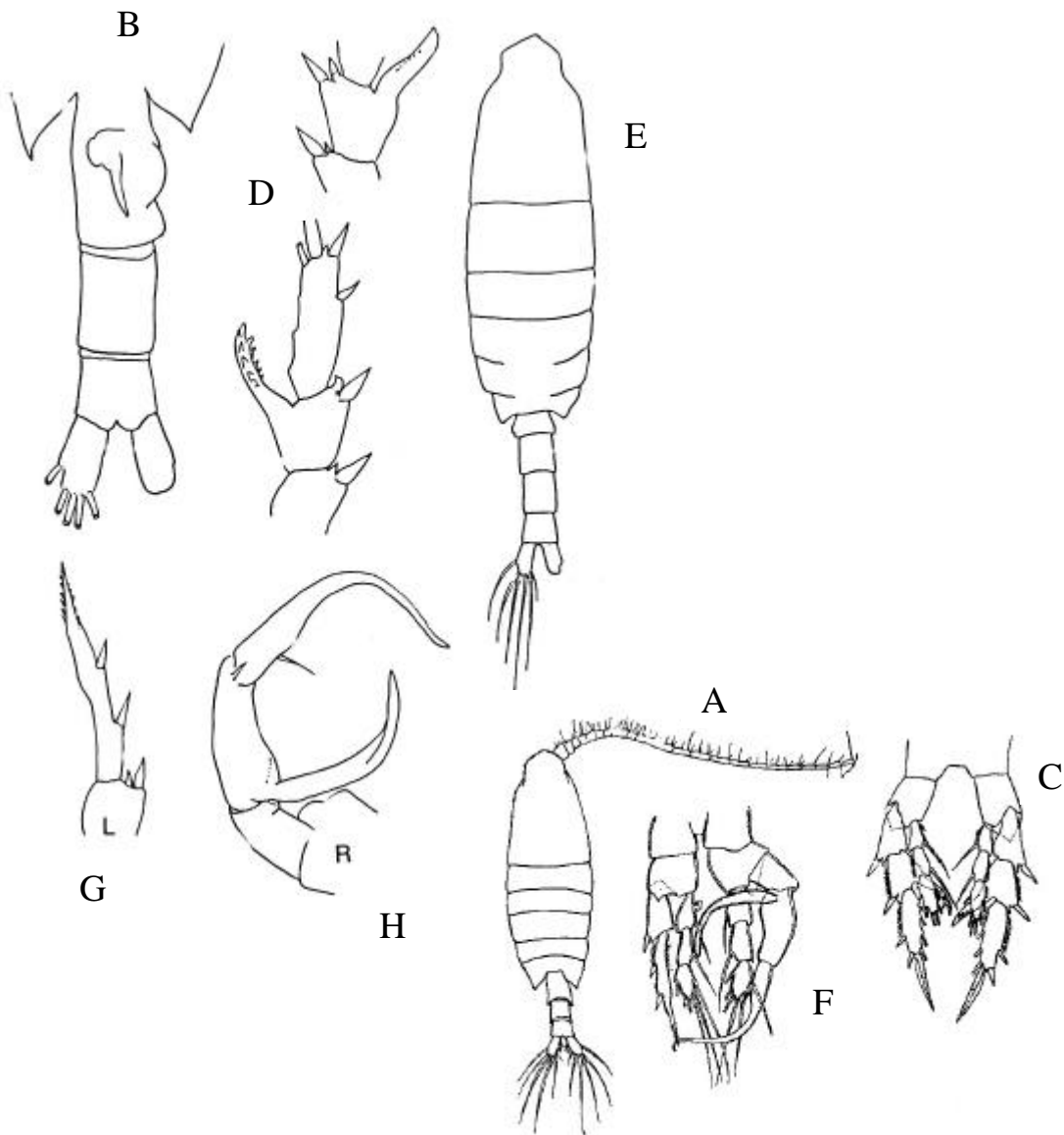
Centropages orsinii Giesbrecht, 1889

Length: females: 1.40-1.60 mm; males: 1.25-1.30 mm.

Female: The last metasome segment corners are pointed, but not sharply. The furca are around twice as long as wide. The genital segment is symmetrical and has an offset spine on the ventral surface, which points backwards. The A1 does not have spines on segments 1, 2 and 5 and reaches the end of the furca. P5 are nearly symmetrical and the inner marginal spine on exopodite 2 is curved, is usually covered in small spines and does not reach the end of segment 3.

Male: The last metasome segment corners are weakly pointed. The terminal claw of the grasping right P5 is longer than the thumb. The terminal portion of exopodite segment 3 of the left P5 projects into a spine.

Recorded: Rodrigues, Seychelles, Madagascar.



Centropages orsinii: Female. A, dorsal; B, urosome ventral; C, P5; D, exopodite segments 2 and 3 of P5. Male. E, dorsal ; F, P5; G, left exopodite segments of P5; H, right exopodite of P5. Figures B, D, E, G, H from Giesbrecht (1892), A, C, F from Mori (1937).

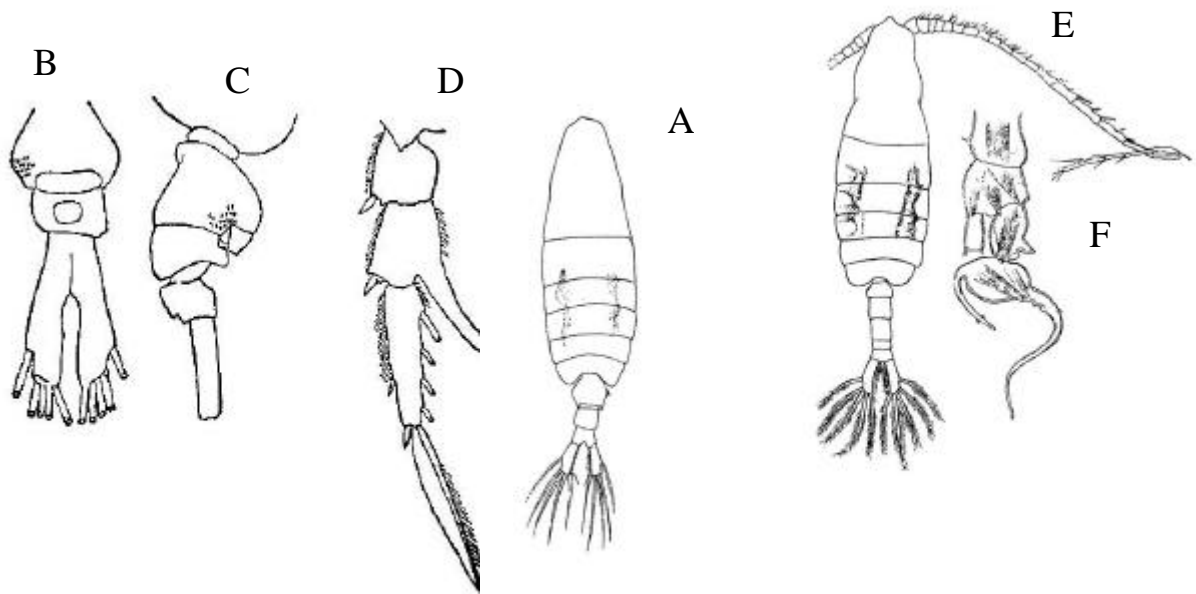
Centropages violaceus (Claus, 1863)

Length: females: 1.76-2.04 mm; males: 1.77-1.92 mm.

Female: Posterior metasome segments rounded. Genital segment moderately swollen, without seta or spines but with a patch of spinules on right side and a ventral downward facing projection. Urosome segment 2 with a centrally placed ventral protrusion. A1 without spines on proximal segments; extends beyond the furca. P5 exopodite segment 2 does not reach distal border of exopodite segment 3.

Male: Right geniculate A1 segments 15 and 16 without spines. Right P5 exopodite segment 2 bulbous, with an inner process with a narrow base, which is situated at mid-segment; exopodite segment 3 long and s-shaped, 3 times the length of the inner process on exopodite segment 2. The second segment of the exopodite of the left P5 has 2 outer marginal appendages.

Recorded: Madagascar



Centropages violaceus: Female. A, dorsal; B, urosome ventral; C, urosome lateral; D, P5. Male. E, dorsal ; F, P5. Figures B-D from Giesbrecht (1892), A, E, F from Mori (1937).

Family Pontellidae

Many have prominent hooks on the sides of the cephalosome and paired lenses on the dorsal cephalosome. P5 of the female is small and simple, but robust.

Genus *Calanopia*

The P5 of the female has a 1 or 2-jointed exopodite. The endopodite is completely missing. The male P5 has a 2-jointed exopodite. The exopodite of the right foot is in the form of a claw.

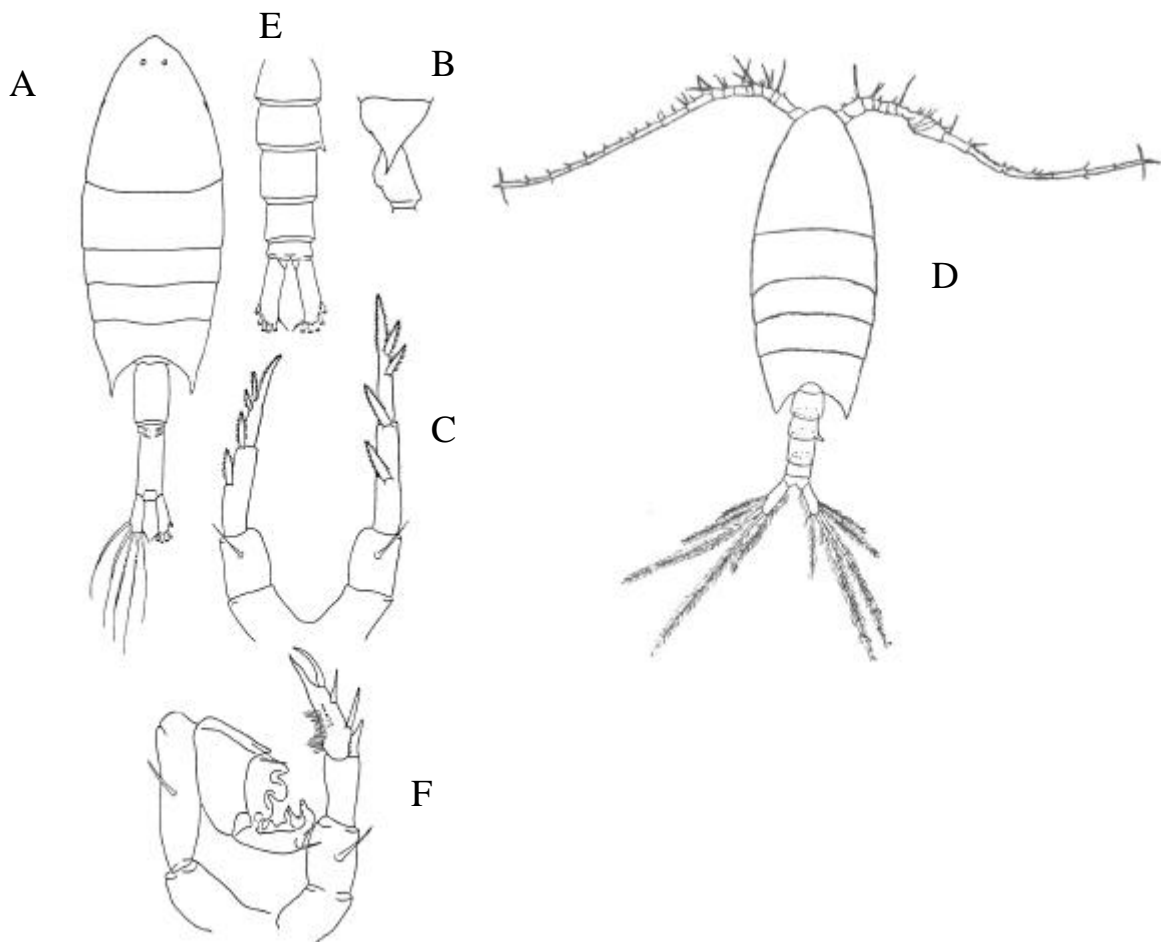
Calanopia elliptica (Dana, 1846, 1849)

Length: females: 1.70-2.00 mm; males: 1.80-1.90 mm.

Female: The prosome nearly twice as long as the combined length of the urosome. Long points on posterior metasome. Urosome segment 2 as long as genital segment. Furca nearly 3 times as long as broad. P5 asymmetrical, each limb uniramous of 4 segments. Left leg longest, exopodite of 2 segments.

Male: Urosome segment 2 right side distal border produced into a well defined tooth. P5 terminal segment of the left exopodite with a pad of fine hairs, pointed at the distal end with three seta on the outer margin and a seta on the posterior side. The flattened margin of the right exopodite segment 1 with 3 blunt teeth, while the claw-like third segment has 3 small pointed teeth.

Recorded: Madagascar.



Calanopia elliptica: Female. A, dorsal; B, urosome lateral; C, P5. Male. D, dorsal ; E, urosome; F, P5. Figures A-C, E, F from Scott (1909), D from Mori, (1937).

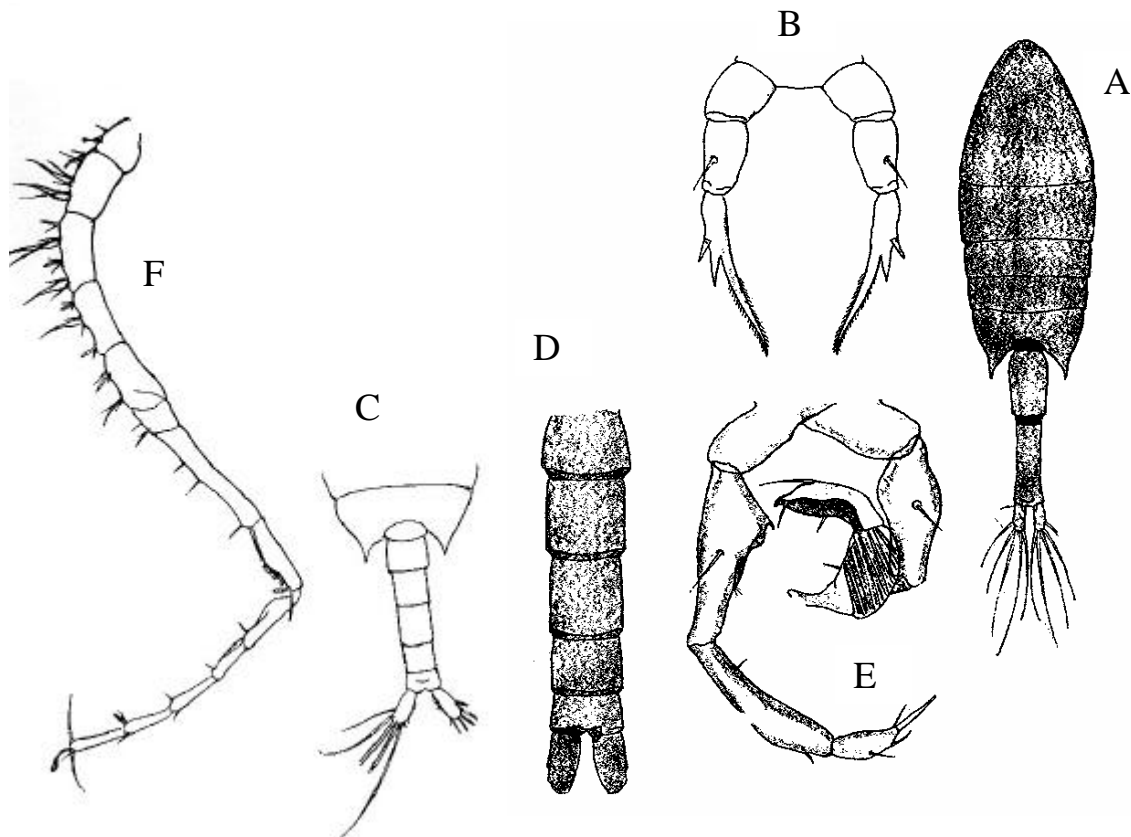
Calanopia minor A. Scott, 1902

Length: females: 1.24-1.40 mm; males: 1.11-1.18 mm.

Female: Superficially resembles a small *C. elliptica*. The last metasome segment produced on each side into an acute spine; the rostrum pointed. Urosome 2-segment, the second segment distinctly longer than the genital segment. The P5 is quite symmetrical with 4 segments; the distal segment terminates in long inner spine (which is not stout as in *Calanopia elliptica*) and one short spine, with a further spine on outside mid segment.

Male: The second urosome segment has no spiny process. A1 extends to the end of the third thoracic segment; the right A1 is geniculate. The basis of the left P5 is swollen towards the proximal end of the inner margin, the swollen part produced into a small tooth-like spine. The basis of the right exopodite is also swollen. Flattened joint of the first exopodite segment, with a seta on the inner margin; outer thumb is short and naked. The claw-like second segment is spoon-shaped and without any teeth, but with 2 inner marginal seta.

Recorded: Seychelles, Madagascar.



Calanopia minor: Female. A, dorsal; B, P5. Male. C, metasome and urosome dorsal; D, urosome; E, P5. Figures A, B, D, E from Scott, (1909), C, F from Tanaka (1964).

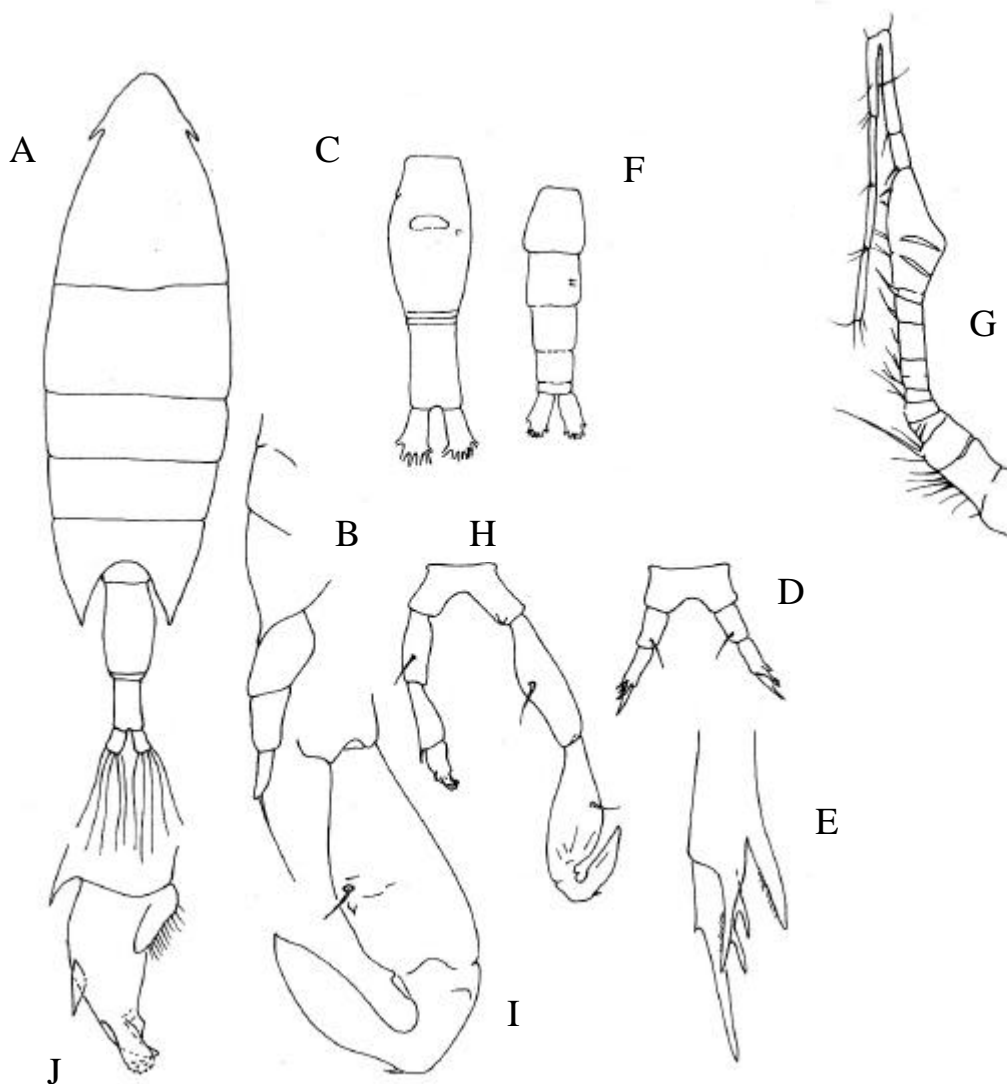
Calanopia parathompsoni Gaudy, 1969

Length: females: 2.4 mm; males: 1.9 mm.

Female: Lateral hooks on cephalosome, spines on last metasome segment reaching the middle of the genital segment. Urosome 2-segmented as in other members of this genus. Genital segment clearly asymmetric in dorsal view, twice as long as anal segment and is not produced on the ventral surface into 2 lobes as in *C. thompsoni*. The furca are symmetrical. The A1 reaches half way down the genital segment. P5 are very similar to those of *C. thompsoni*.

Male: Urosome symmetrical with the exception of 2 fine spines situated ventrally on the second segment, on the left side. These laterally directed spines have not been reported in the males of other species. The geniculate A1 and the P5 are similar to those of *C. thompsoni*. However, *C. parathompsoni* has on the median part of the second segment of the right P5, a small spine, swollen at the base. The second segment of the left P5 is also straighter. The terminal segment has a curved spine and a rounded knob with small projections.

Recorded: Madagascar



Calanopia parathompsoni: Female. A, dorsal; B, urosome lateral; C, urosome ventral; D, P5; E, distal segment of P5. Male. F, urosome ventral; G, geniculate A1; H, P5; I, Right P5; J distal portion of left P5. From Gaudy (1969).

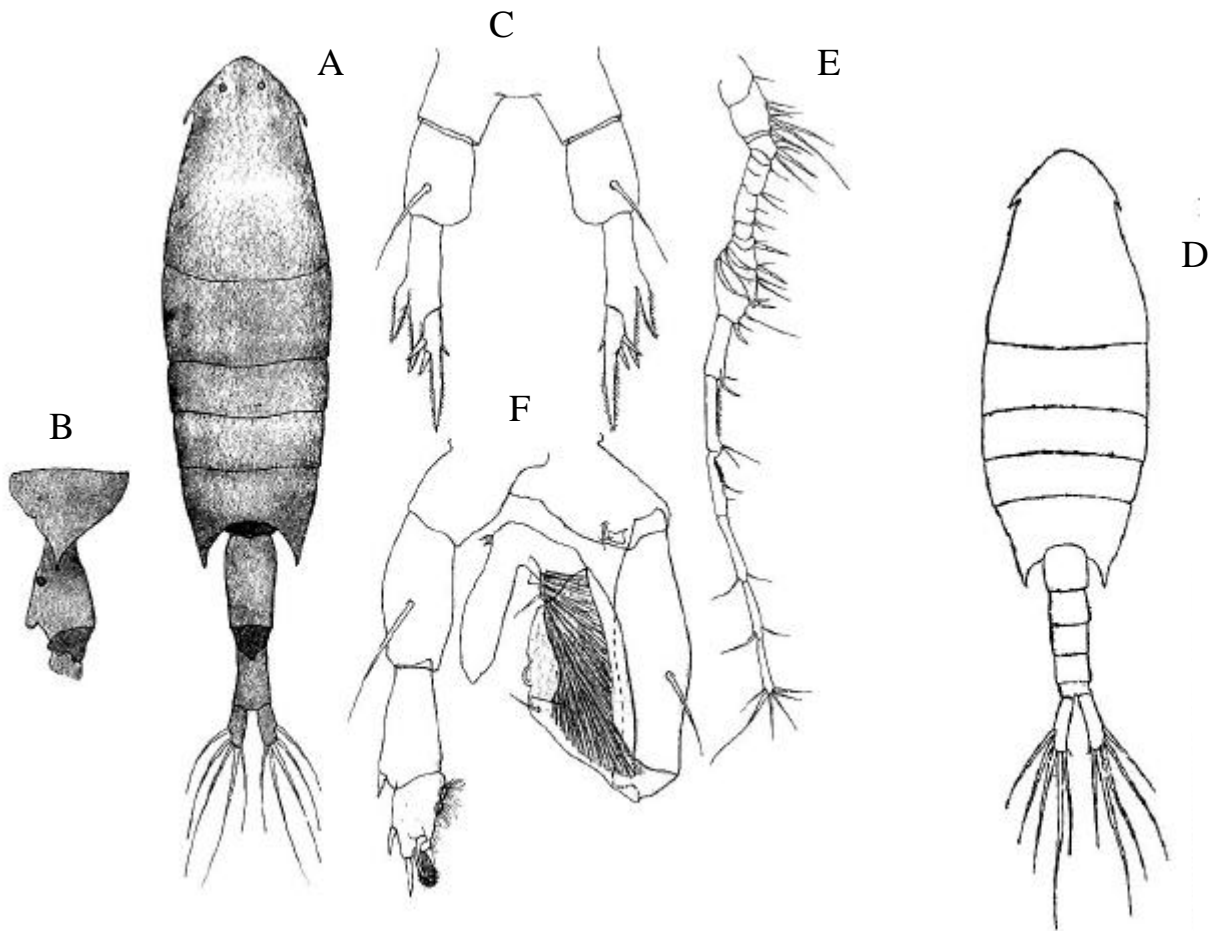
Calanopia thompsoni A. Scott, 1909

Length: females: 2.62 mm; males: 2.19-2.31mm.

Female: Lateral hooks on cephalosome. Strong spines on last metasome segment, reaching half way down genital segment. Genital segment slightly longer than the second urosome segment. Genital segment ventrally is produced anteriorly and posteriorly into 2 blunt lobes. Furca slightly asymmetrical, longer on left. P5 symmetrical, endopodite of 2 segments, first one moderately long with distal portion of outer margin with 2 very strong spines. Second segment narrow, terminating in a long stout spine, serrated on both edges, segment also with 2 outer marginal spines and a short inner one.

Male: Lateral hooks on cephalosome, forehead angular in outline. Posterior metasome segment sharply pointed. No spine on urosome segment 2. Right A1 geniculate. Furca symmetrical. P5 asymmetric, exopodite of the right leg claw-like.

Recorded: Madagascar



Calanopia thompsoni: Female. A, dorsal; B, urosome lateral; C, P5. Male. D, dorsal; E, geniculate A1; F, P5. Figures A-C, E, F from Scott (1909), D from Mori (1937).

Genus *Labidocera*

Cephalosome with or without hooks and with 1 pair of cuticular lenses and a ventral eye which extends anterioventrally between the deeply bifurcate rostrum. Posterior of metasome with large pointed processes. Female urosome 2 or 3 segmented, male urosome 4 or 5 segmented.

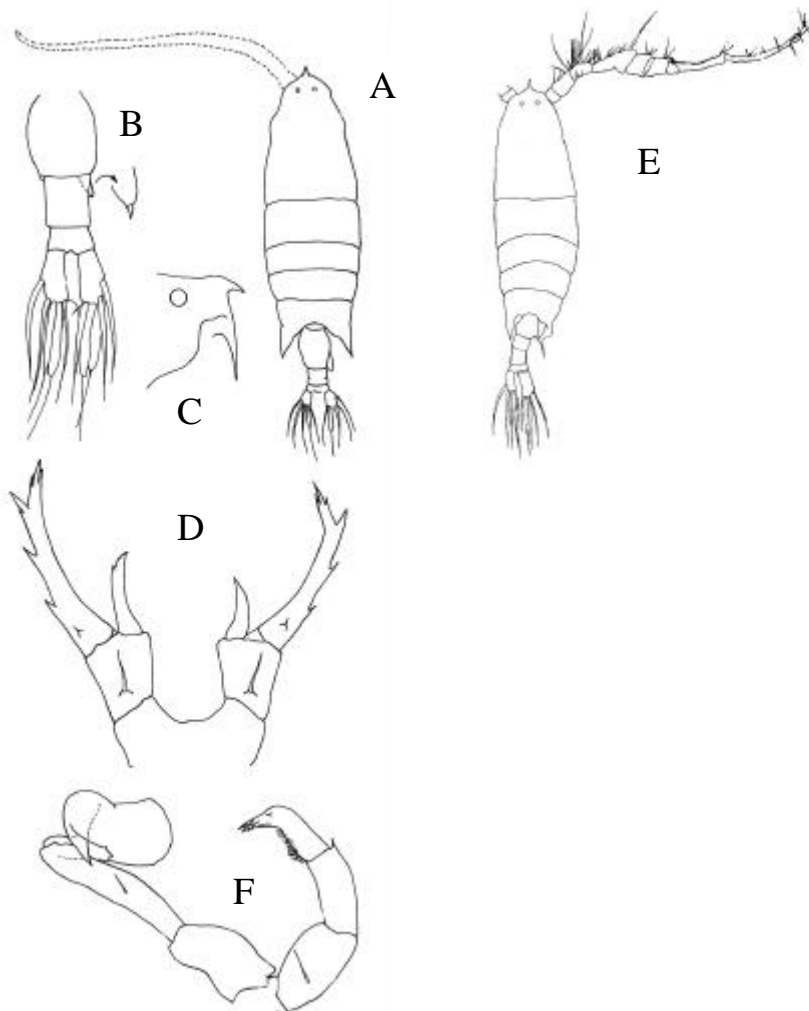
Labidocera acuta (Dana, 1849)

Length: females: 3.05-3.40 mm; males: 2.80-3.30 mm.

Female: Sharp spine on front of cephalosome, directed slightly downwards. No lateral cephalic hooks; posterior metasome symmetrical with large lateral points. Urosome 3-segmented, genital segment asymmetrical, with a projection on the posterior right side which extends half way along the next segment, visible from the dorsal side. P5 with a rather variable exopodite, with relatively large spines on the outer border; endopodite claw-like.

Male: Posterior metasome border asymmetric, right side longest and bent outwards. Urosome segment 1 with a small spine on the right. Left P5 with 3 terminal and 1 outer spine; right P5 without a thumb on the claw, but with a curved triangular flap.

Recorded: Rodrigues, Seychelles, Madagascar.



Labidocera acuta: Female. A, dorsal; B, urosome dorsal; C, head lateral; D, P5. Male. E, dorsal; F, P5. Figures A from Giesbrecht (1892); B-D, F from Greenwood (1979); E from Mori (1937).

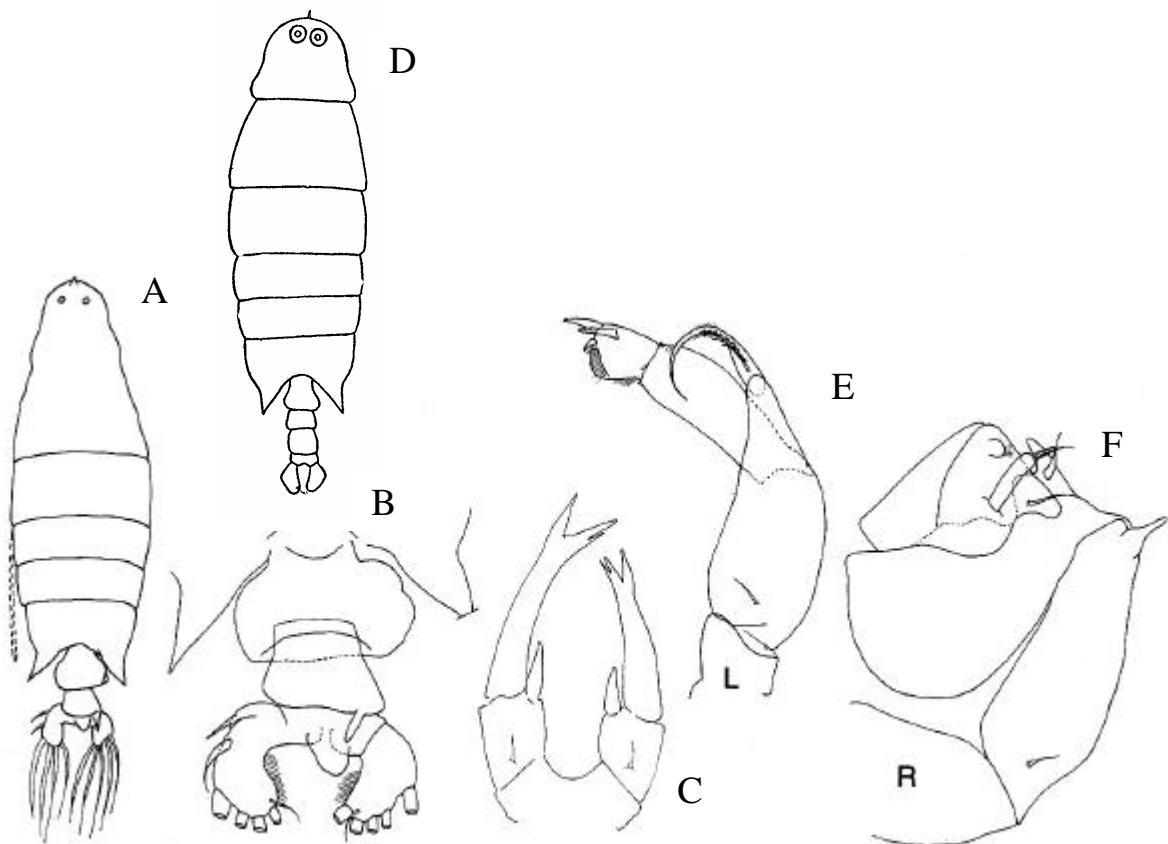
Labidocera acutifrons (Dana, 1849)

Length: females: 3.2-4.15 mm; males: 3.28-4.08 mm.

Female: Anterior cephalosome with dorsal lenses and median spine, without lateral hooks; posterior metasome segment produced into points on each side, the corners of which are slightly divergent. Urosome 3-segmented, genital segment slightly asymmetrical with a small lump on the right side; second segment with a dorsoposterior spine on the right side, pointing towards a large anal flap. P5 asymmetrical, left leg slightly larger, exopodite with 3 spines, endopodite reduced to a spiny process.

Male: Anterior cephalosome with a median spine as in female, dorsal lenses well developed and placed close together; urosome 5-segmented; posterior metasome symmetrical. Left P5 with a rudimentary endopodite, exopodite segment 2 with 3 terminal spines; right P5 exopodite claw with an extra small segment bearing 2 setae and with a spine.

Recorded: Madagascar



Labidocera acutifrons: Female. A, dorsal; B, urosome dorsal; C, P5. Male. D, dorsal; E, P5 left; F, P5 right. Figures A from Giesbrecht (1892) B-C, E-F from Bradford-Grieve (1999), D from Wilson (1932).

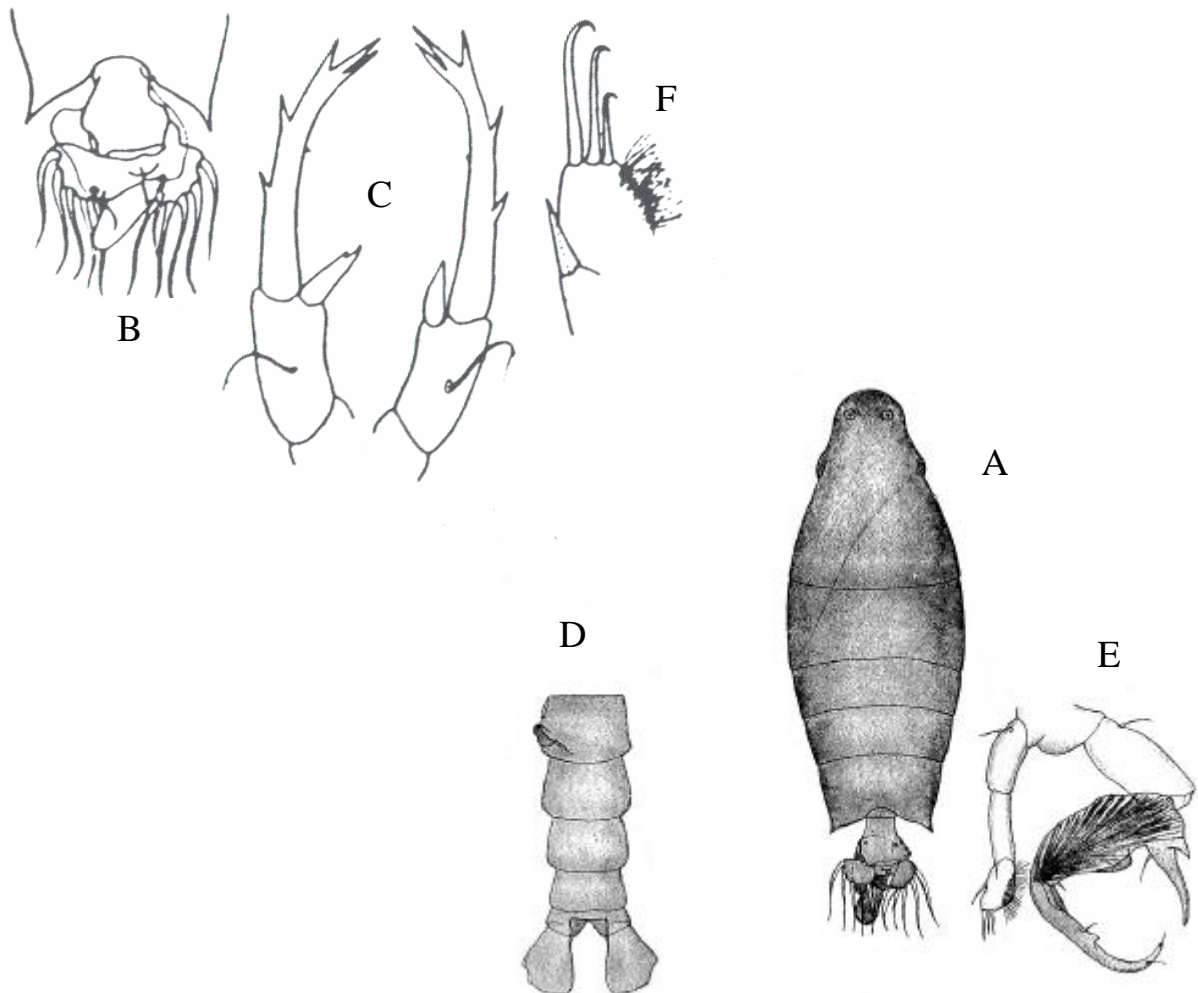
Labidocera bataviae A. Scott, 1909

Length: females: 2.06-2.38 mm; males: 1.92-1.97 mm.

Female: No lateral cephalic hooks, rounded cephalosome, dorsal eye lenses spaced apart. Posterior metasome segment almost symmetrical and produced into 2 divergent points; urosome short with 2 segments, genital segment asymmetrical and large, produced on the right side; well developed lamina on the anal segment; furca very asymmetrical, left ramus almost 2 times wider than long and arranged at right angles to the urosome. P5 asymmetrical, left leg longer, exopodite with 2 outer marginal spines and a minute spine on inner margin; terminating in 3 unequal spines, middle spine longer and serrated along both edges. Endopodite much reduced with bifurcated tip.

Male: Body resembles female, but posterior metasome quite asymmetrical, right point longer than left; urosome 5-segmented, the first segment with a notch on left side. Furca slightly asymmetric, right ramus rounder than left. Right A1 geniculate. Right P5 claw like, thumb at proximal end of exopodite segment 1, long and robust, with a distinct spine and seta close to base of thumb; terminal segment curved inwards, with a conical protrusion on its inner mid-margin. Left P5 terminal segment with 1 outer mid-marginal spine and 3 terminal curved spines of which the outermost is longest.

Recorded: Rodrigues



Labidocera bataviae: Female. A, dorsal; B, urosome dorsal; C, P5. Male. D, urosome dorsal; E, P5; F, terminal segment of left P5 enlarged. Figures A, D, E from Scott (1909), B, C, F from Silas and Pillai (1973).

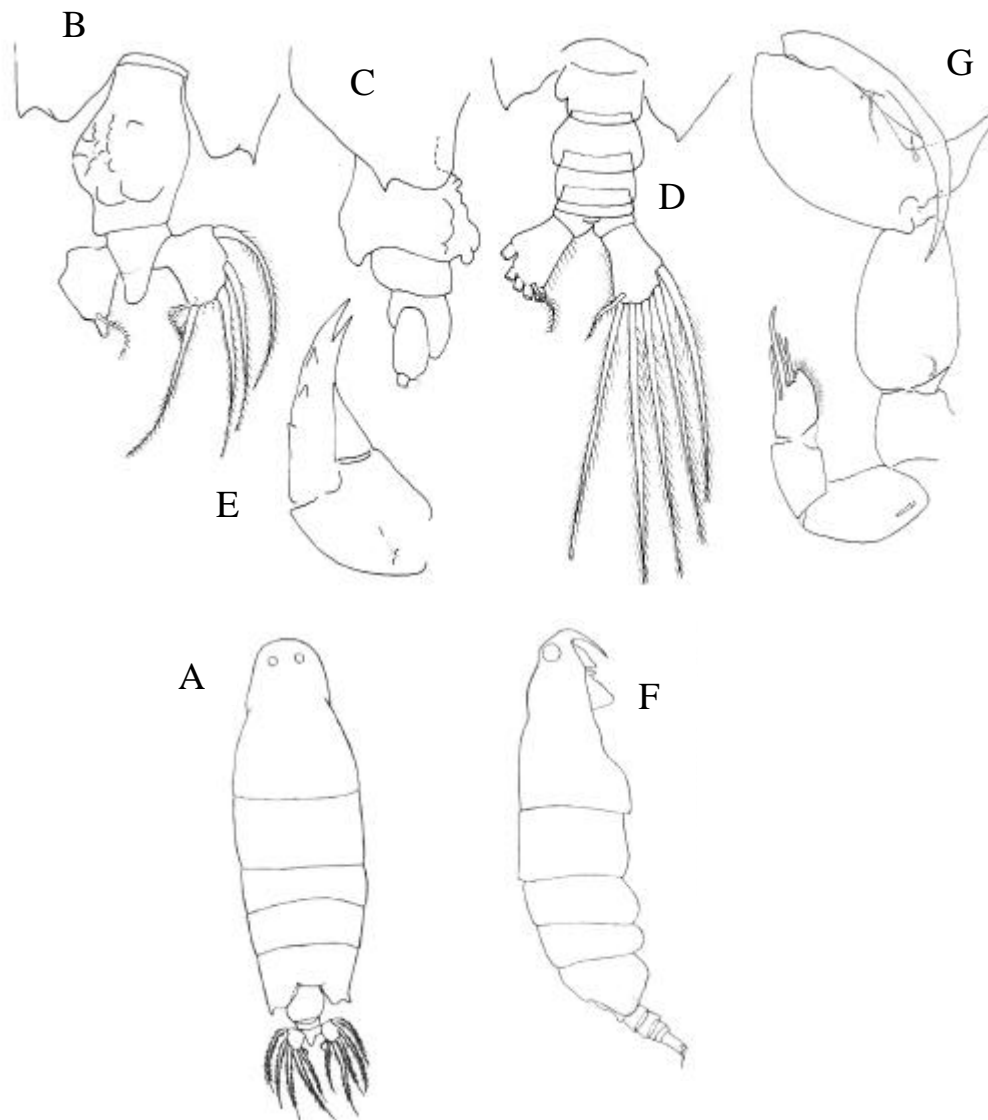
Labidocera detruncata (Dana, 1849)

Length: females: 2.42-2.72 mm; males: 2.20-2.70mm.

Female: Forehead anterior prosome rounded, dorsal eyes spaced apart, no lateral cephalic hooks; last metasome segment asymmetric, extending further back on left, with small lateral points; internal to the points the segment curves outwards to the level of the points. Urosome 3-segmented with left dorsal surface uneven, lined and notched, furca broad and almost symmetrical. P5 symmetrical, exopodite with 3 outer marginal spines, terminating in a bifurcated end, endopodite small.

Male: In dorsal view posterior metasome segment pointed, rounded in lateral view; urosome 5-segmented. Right A1 geniculate. P5 asymmetrical, the right leg claw like with a short triangular thumb on the first exopodite segment, terminating in a spine which is as long as the preceding segment. Left P5 terminal segment with 4 characteristic long spines, one of which is longer.

Recorded: Seychelles, Zuza, Madagascar, CPR.



Labidocera detruncata: Female. A, dorsal; B, urosome ventral; C, urosome lateral; D, urosome dorsal; E, P5. Male. F, body lateral; G, P5. Figures B-E, G from Bradford Grieve (1999), A, F from Mori (1937).

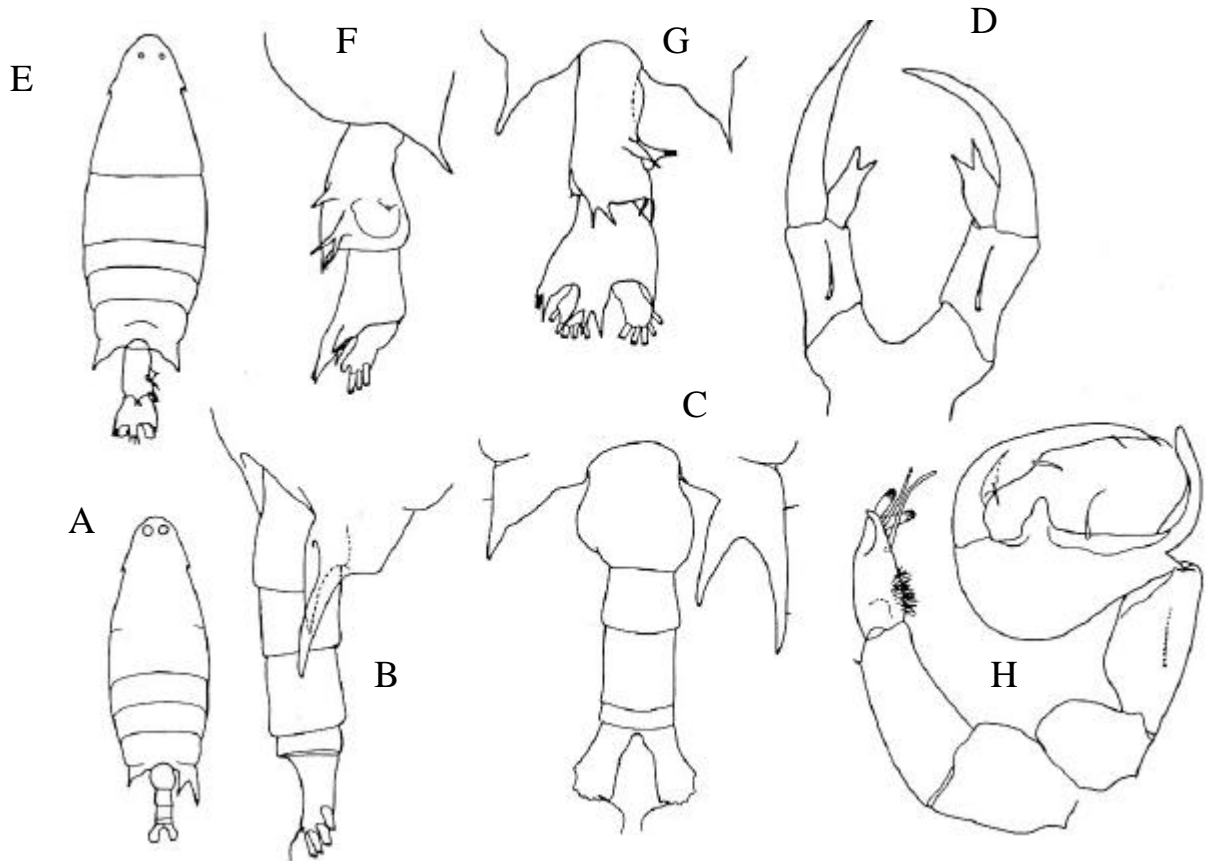
Labidocera kröyeri (Brady, 1883)

Length: females: 2.40-2.50 mm; males: 1.05-2.14 mm.

Female: Cephalosome with lateral cephalic hooks, lateral wings of last metasome segment pointed and symmetrical. Urosome 3-segmented; anal segment short, genital segment and urosome segment 2 asymmetrical, with many spines and hooks (variable in appearance); furca symmetrical. P5 endopodite reduced and bifurcate at the end.

Male: Lateral cephalic hooks on cephalosome. Lateral corners of the last metasome segment asymmetrical, left one pointed the right one bifurcated. 5-segmented urosome, genital segment swollen on left side. Right A1 geniculate. Right P5 exopodite segment 1 claw-like, with curved thumb, middle portion of the external margin with 2 processes.

Recorded: Madagascar



Labidocera kröyeri: Female. A, dorsal; B, urosome lateral; C, urosome dorsal; D, P5. Male. E, body dorsal; F, urosome lateral; G, urosome dorsal; H, P5. Figures from Greenwood (1979).

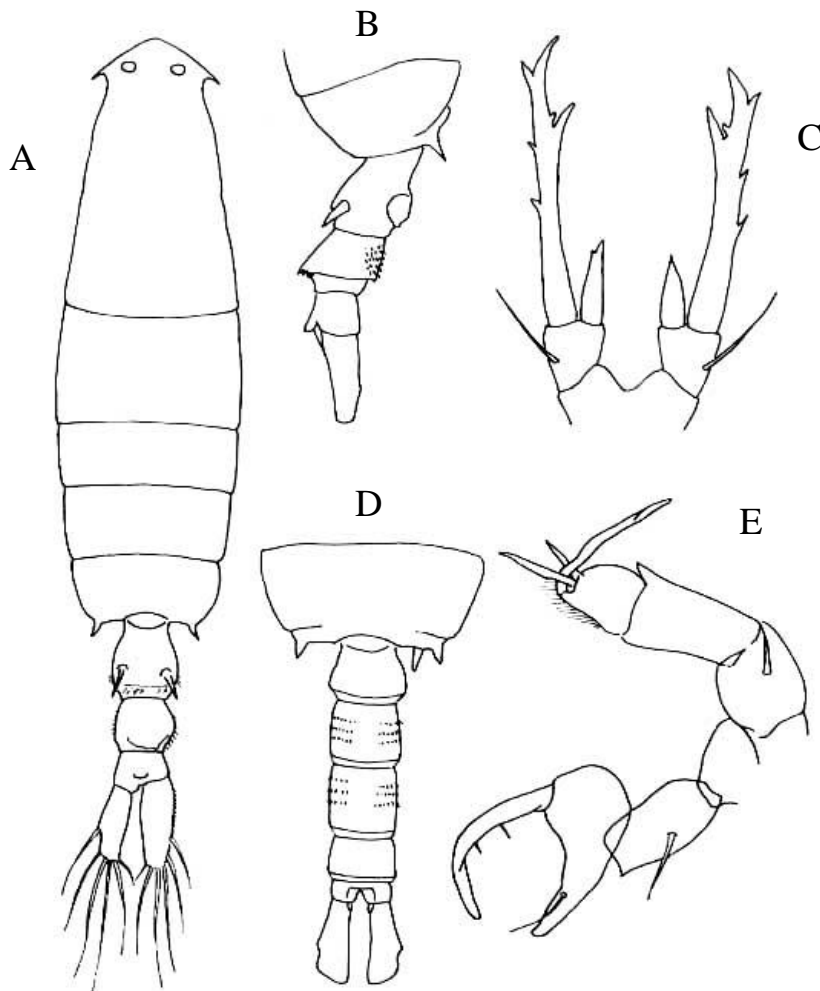
Labidocera laevidentata (Brady, 1883)

Length: females: 1.60-1.95 mm; males: 1.70 mm. (Silas and Pillai (1973) give lengths of 2.20-2.36 mm for females).

Females: Lateral cephalic hooks on cephalosome closer to anterior than in most other species; posterior metasome symmetrical with divergent pointed wings. Urosome 3-segmented, genital segment almost symmetrical, with a pair of posterior dorsal spines. Urosome segment 2 and anal segment asymmetrical; anal segment shorter on right side; furca asymmetrical, right furca broader and longer than left. Dorsal posterior margin of urosome segment 2 with a bifurcated spine, ventral lateral margin with a fringe of small spines. P5 slightly asymmetrical, right exopod shorter and stouter than left. Exopodites with 3 outer and 2 inner spines, with a curved spine on end. Endopodites reduced, short with a weakly bifurcate tip.

Males: Elongate body, posterior metasome asymmetrical, one spine on right, 2 on left. Cephalic hooks present. P5 with hook on right side; left P5 terminating in 3 unequal crooked spines, the largest at right angles to the other 2 spines.

Recorded: Madagascar



Labidocera laevidentata: Female. A, dorsal; B, urosome lateral; C, P5. Male. D urosome dorsal; E, P5. Figures from Scott (1909).

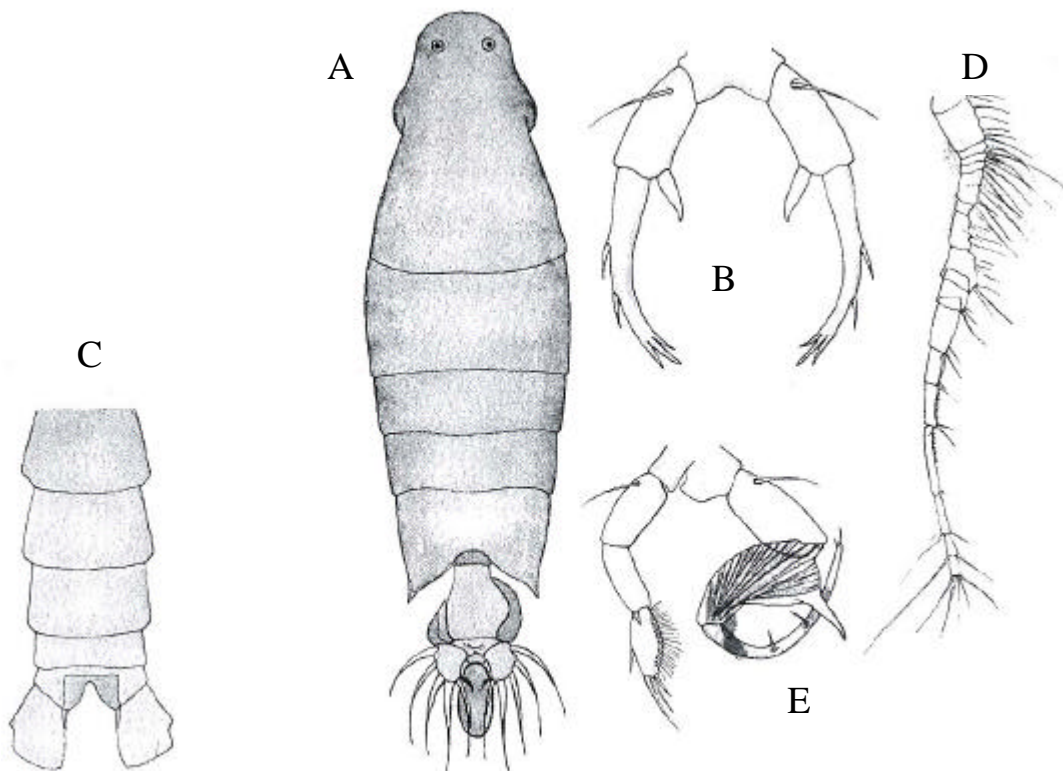
Labidocera madurae A. Scott, 1909

Length: females: 2.11-2.80 mm; males: 1.62-1.96 mm.

Females: Prosome elongated and narrow, rounded anteriorly, without cephalic hooks; dorsal eye lenses feeble and small. Last metasome segment pointed laterally and symmetrical. Short 2-segmented urosome; genital segment quite large and asymmetrical, bulging on the right side. Furca symmetrical, longer than broad. P5 nearly symmetrical, exopod with 2 outer spines, terminating in 3 unequal spines. Endopodite simple and not bifurcated.

Males: Resembles female, but eye lenses slightly larger, urosome 5-segmented, the fourth and fifth shorter than the others. Right A1 geniculate but only slightly swollen. Thumb-like process on the first segment of the right exopodite, short and curved, no tooth at the base of the process as in *L. bataviae*. Terminal joint long and narrow. Terminal joint of left P5 elongate and oval, twice as long as broad, outer margin with 3 spines, inner with a fringe of hairs.

Recorded: Madagascar



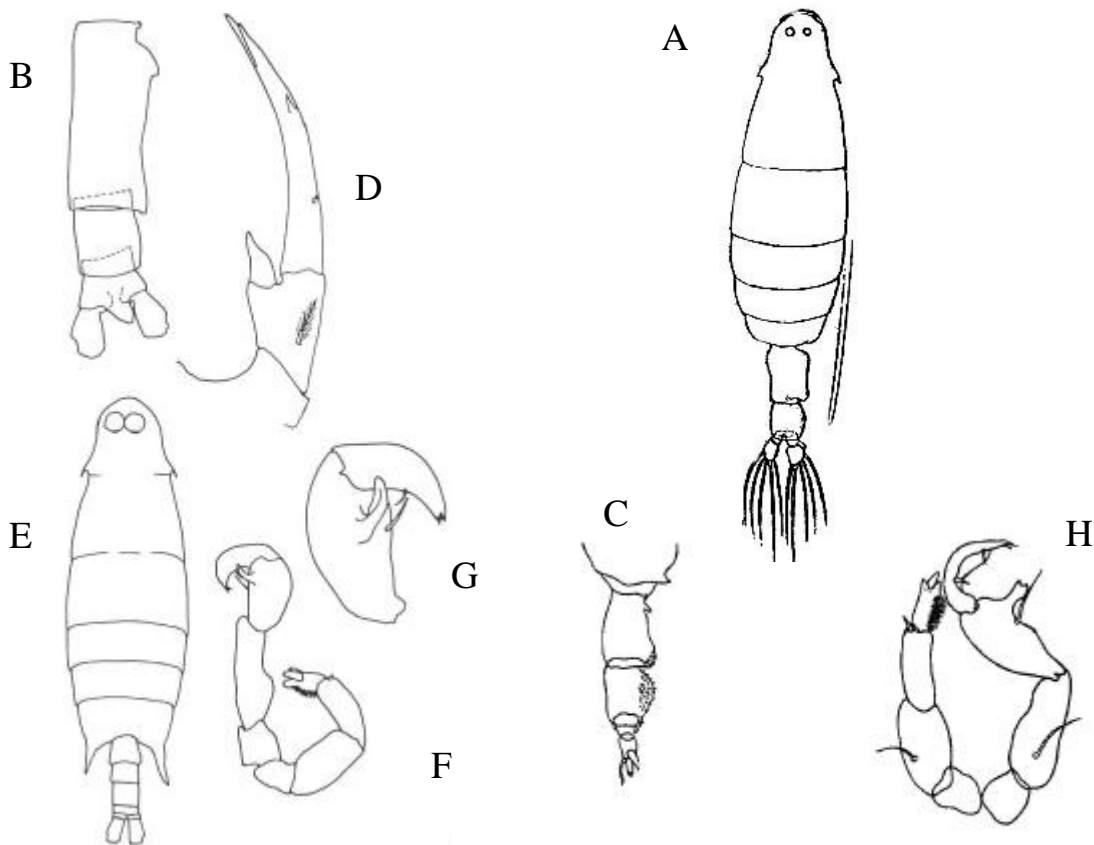
Labidocera madurae: Female. A, dorsal; B, P5. Male. C, urosome dorsal; D, geniculate A1; E, P5. Figures from Scott (1909).

Labidocera minuta Giesbrecht, 1889

Length: females: 1.76-2.26 mm; males: 1.46-1.83 mm.

Females: Cephalosome narrow and rounded, small dorsal eye lenses; small lateral hooks present. Lateral posterior margin of metasome rounded, but extended on the right side with a ventrally pointing spine; left side without any spine; urosome 3-segmented, genital segment elongated and half the length of urosome; right anterior and also posterior corner of genital segment with lateral swellings, in the proximal centre of the ventral surface is a small chitinous outgrowth. Right ventral surface of urosome and second urosome segment with chitinous knobs along right margin; furca asymmetrical, right side larger. P5 symmetrical, exopodite bifurcated at tip; the endopod is normally bent outwards over the exopodite, short, broad based and ends in an apical spine plus a rather shorter spine on the inner margin. Two minute spines on outside margin of exopod (Greenwood, 1979) or one spine (Silas and Pillai, 1973).

Males: Cephalosome similar to female, but dorsal eye lenses are very large and close together. Last metasome segment asymmetrical, shorter point on left, extended into a longer flat curved tip on right. Urosome 5-segmented, genital segment broader than long, with a small lobe at the right posterior margin. Right A1 geniculate. Right P5 with a claw on the first exopod segment, thumb short with a seta at the base, terminal segment curved, with 3 setae along internal margin and two seta distally. Left leg terminal segment with at least 3 lobe-like processes. Recorded: Seychelles, Madagascar.



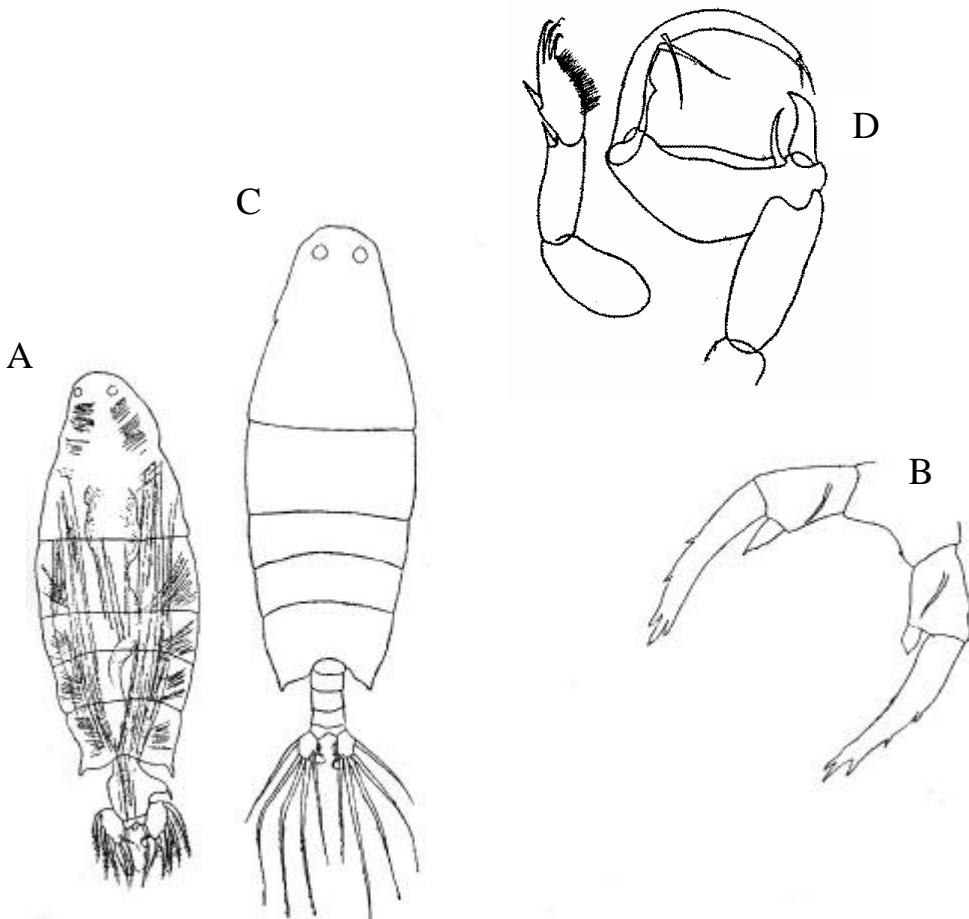
Labidocera minuta: Female. A, dorsal; B, urosome dorsal; C, urosome lateral; D, P5. Male. E, body dorsal; F, P5; G, terminal segment of P5 right; H, P5. Figures A from Giesbrecht (1892); B, D-G from Greenwood (1979), C, H from Silas and Pillai (1973).

Labidocera pavo Giesbrecht, 1889

Length: females: 1.92-2.52 mm; males: 1.61-2.06 mm.

Female: Body robust, no lateral hooks on cephalosome; dorsal eyes quite well developed; posterior metasome segment pointed and symmetrical; urosome short, 2-segmented; right side of genital segment has a process with a spine on the end, ventrally the posterior margin produced into a long lobe, second urosome segment short. Some specimens with a transparent elliptical plate on ventral surface of urosome. Furca nearly symmetrical; P5 almost symmetrical, exopod with 2 outer marginal spines and terminates in 3 spines, endopod is simple and not bifurcated, left endopod quite rounded and right ending in a sharp point.

Male: Dorsal eye lenses arranged close together. Posterior metasome segment symmetrical with lateral points. Urosome 5-segmented. Urosome and furca quite symmetrical. Right A1 geniculate. P5 asymmetrical; right exopod claw-like with well developed thumb, towards inner base of thumb is a robust seta; terminal segment elongated, curved, with a blunt conical projection on proximal inner margin, with 2 inner mid-marginal seta, terminates in a point with one terminal seta; left leg terminal segment with 1 outer marginal spine and 3 terminal sub-equal spines, all curving inwards. Recorded: Madagascar



Labidocera pavo: Female. A, dorsal; B, P5. Male. C, body dorsal; D, P5. Figures A-C from Mori, (1937); D from Silas and Pillai (1973).

Genus *Pontella*

Cephalosome with lateral hooks, usually without a crest; with one pair of cuticular lenses and usually with an additional lens in rostrum; last metasome segment usually with pointed lateral lobes; female urosome 2 or 3-segmented and asymmetrical, male urosome 4 or 5-segmented, symmetrical. Right male A1 geniculate. Female P5 biramous with exopodites and endopodites of 1 segment, male P5 uniramous.

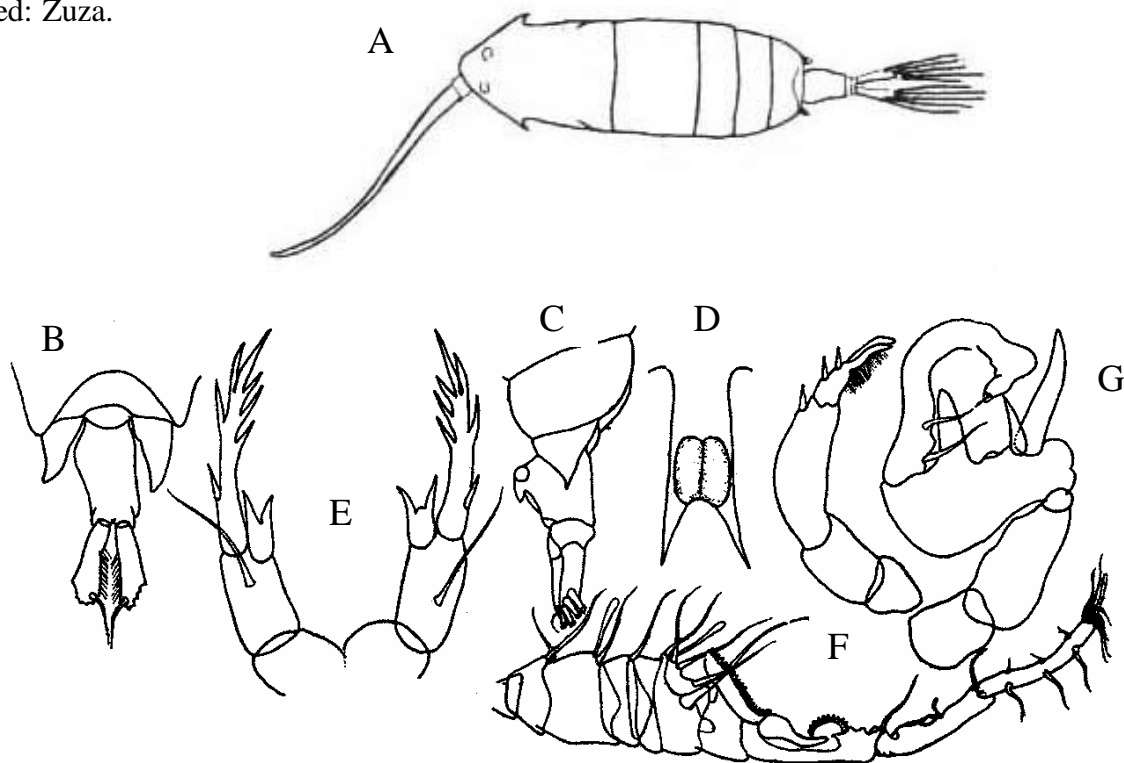
Pontella fera Dana, 1849

Length: females: 2.36-2.92 mm; males: 2.33-2.67 mm.

Female: Rostrum slender and pointed with weakly developed rostral lens, dorsal eye lenses moderately large; posterior corners of last metasome segment asymmetrically produced into wing-like processes which extend beyond middle of genital segment; urosome 2-segmented, genital segment asymmetrical, bulging laterally on left side; ventrally the genital segment has 2 knob-like processes, varying in size and shape. Furca asymmetrical, left furca larger. P5 symmetrical, endopodite short and bifurcated at tip, variable in appearance. Exopodite elongated, with 3 spines on both inner and outer margins, terminating in another spine, outer marginal spines more widely spaced.

Male: Cephalosome as in female; last metasome segment ending in bluntly rounded posterior projections of more or less equal size. A1 geniculate; urosome 5-segmented, genital segment with a small lateral bulge on right side, furca asymmetrical slightly broader on right. Right P5 with claw. Base of claw with a large projecting thumb with a small process at its base and a short and a large process between this and the terminal segment. Terminal segment initially almost straight, but the distal half curves backwards, the tip bearing a small seta. Left P5 terminating in 3 unequal processes.

Recorded: Zuza.



Pontella fera: Female. A, dorsal; B urosome dorsal; C, urosome lateral; D, rostrum; E, P5. Male. F, geniculate A1; G, P5. Figures A from Giesbrecht (1892), B-F from Silas and Pillai (1973).

Genus *Pontellina*

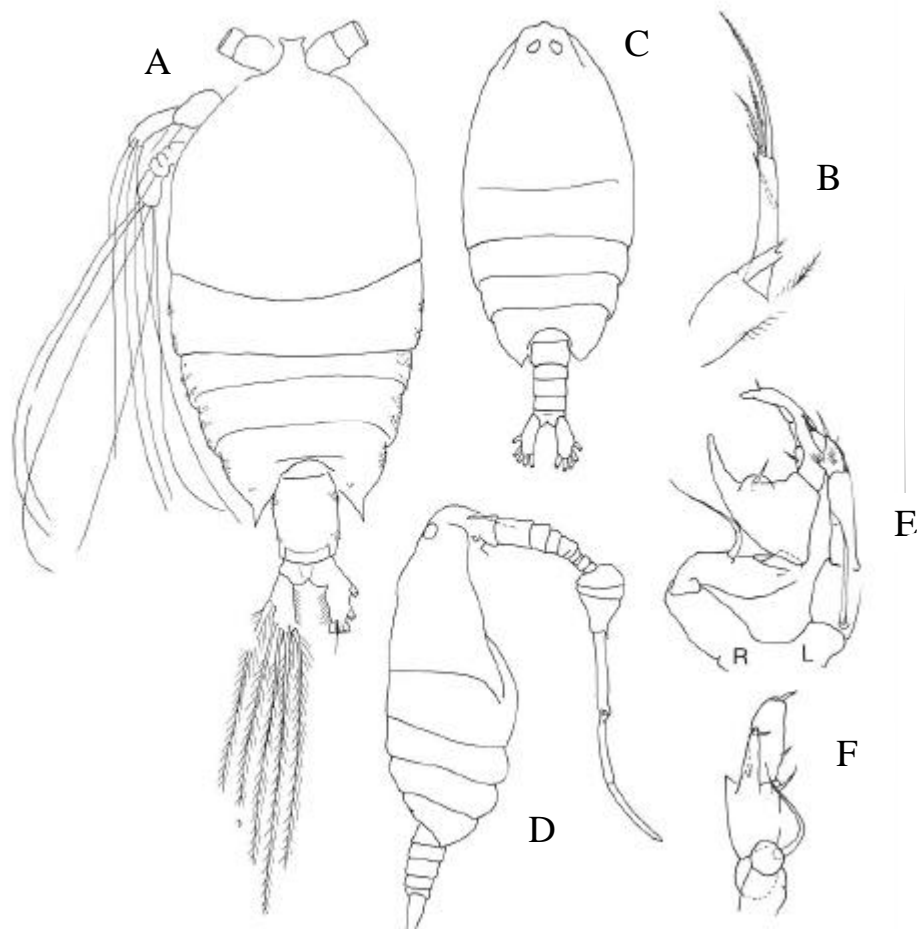
Pontellina plumata (Dana, 1849)

Length: females: 1.43-1.94 mm; males: 1.34-1.92 mm.

Female: Prosome in dorsal view quite oval; posterior metasome segments almost symmetrical and conspicuously pointed in lateral view; cephalosome without lateral hooks, without cuticular lenses, with inconspicuous ventral eye without a lens. The A1, A2 and furca bear very long plumose setae. Urosome 2-segmented, right furca fused to anal segment; P5 with 1-segmented exopodite, bearing one lateral and 3 terminal seta, as well as 1 medial seta; endopodite is bifurcated, or may come to a single point.

Male: Posterior metasome segments symmetrical, less pointed than in the female when viewed laterally; one pair of cuticular lenses. A1 geniculate. P5 uniramous; right P5 ending in a claw, base of claw broad, with a conical tooth-like elevation on inner margin and a seta. Left leg distal segment with prominent outer marginal spine and 3 terminal subequal spines, inner margin with a tuft of hairs.

Recorded: Seychelles, Zuza, Madagascar, Aldabra, CPR.



Pontellina plumata: Female. A, dorsal; B, P5. Male. C, body dorsal; D, body lateral; E, P5; F, P5 left terminal segments. Figures A, B from Bradford-Grieve (1999); C-F from Fleminger and Hülsemann (1974).

Genus *Pontellopsis*

Head without lateral hooks, dorsal or rostral lenses. Last metasome segment with lateral points, usually asymmetrical in the male. Urosome asymmetrical in both sexes, 1 or 2-segmented in the female, 5-segmented in the male. The male right A1 is geniculate, the terminal section with 2 segments. Male urosome segment 3 with a projection on the right.

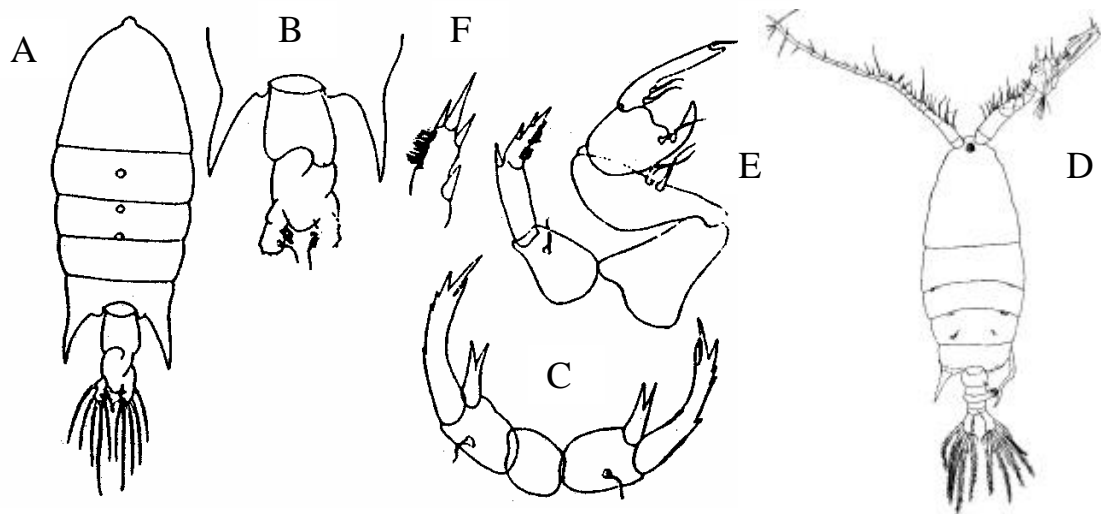
Pontellopsis armata (Giesbrecht, 1889)

Length: females: 2.36-2.51mm; males: 1.90-2.11 mm.

Female: Cephalosome broadly rounded anteriorly; posterior metasome symmetrical, produced into long lateral, sharply pointed projections. Urosome 2-segmented, genital segment with a backwardly pointed spine above the genital opening and a dorsal swelling on the right side. Anal segment symmetrical, dorsally overlapping the furca. P5 asymmetrical, exopodite stout and curved inwards, with 3 minute external marginal spines and 3 apical spines, the middle the longest. Endopodite bifurcated apically.

Male: Cephalosome resembles female. Lateral angles of the last metasome segment are asymmetrical, the left side produced into a pointed straight spine reaching the third urosome segment, the right side bluntly rounded, bearing a thin pointed curved process, longer than the spine on the left. Urosome 5-segmented, with spine on the dorsal right genital segment; right side of segment 3 with large protuberance with spinules on tip. P5 asymmetrical, the right leg with a claw, basis broad in middle and with 2 sub-equal seta. Short thumb on claw segment, with a long seta at the base; terminal segment slightly bent, with 2 setae at proximal inner end and one distal seta, a short spine at outer base of segment.

Recorded: Zuza.



Pontellopsis armata: Female. A, dorsal; B, urosome lateral; C, P5. Male. D, body dorsal; E, P5; F, P5 left, terminal segments. Figures A-C, E, F from Silas and Pillai (1973); D from Mori (1937).

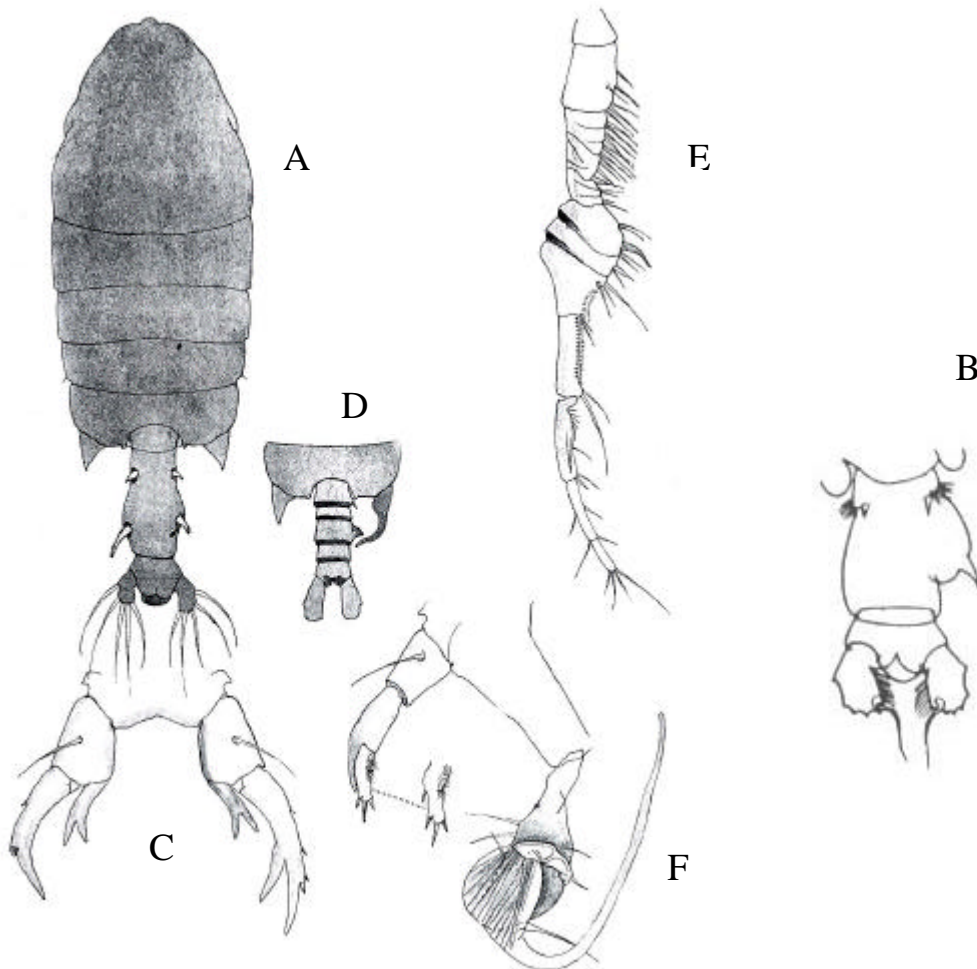
Pontellopsis macronyx A. Scott, 1909

Length: females: 1.80-1.97 mm; males: 1.55-1.68 mm.

Female: Last metasome segment with 2 robust points. Genital segment long, bearing four dorsal spines, the posterior left one larger than the others. (Silas and Pillai (1973) only found 3 spines on the genital segment, the largest one was missing). Furca short and symmetrical. P5 is small, robust and asymmetrical, longer on right. Right exopodite has 2 outer marginal spines, 2 small and 1 large terminal spine and a very long spine on the inside proximal margin. The left exopodite resembles the right, but does not have the large inner spine. Endopodites are bifurcated at tip.

Male: Cephalosome is similar to female. Last metasome segment pointed on the left, reaching the posterior of urosome segment 1, with a long thin process on the right, reaching the fourth urosome segment. Urosome 5-segmented, segment 1 with a small spine on right, segment 3 with a well defined blunt process on the right lateral margin. Right A1 geniculate. P5 right terminal segment claw-like; thumb slender, curved and very elongated, with a seta at the base; terminal segment of leg short and curved inwards, with 2 outer marginal setae and one inner mid-marginal seta situated on a raised process. Left P5 with 3 terminal spines.

Recorded: Seychelles



Pontellopsis macronyx: Female. A, dorsal; B, urosome lateral; C, P5. Male. D, urosome dorsal; E, geniculate A1; F, P5. Figures A, D-F from Scott (1909); figure B from Silas and Pillai (1973).

Family Temoridae

Genus *Temora*

The cephalosome in *Temora* is typically the widest and deepest part of the prosome and they have very long furca. P5 of female small, uniramous, 3-segmented; P5 male asymmetrical, left leg larger and 4-segmented, segment 2 produced on inner edge into a long curved thumb-like process; right P5 3-segmented, terminal segment curved inwards, claw-like.

Temora discaudata Giesbrecht, 1889

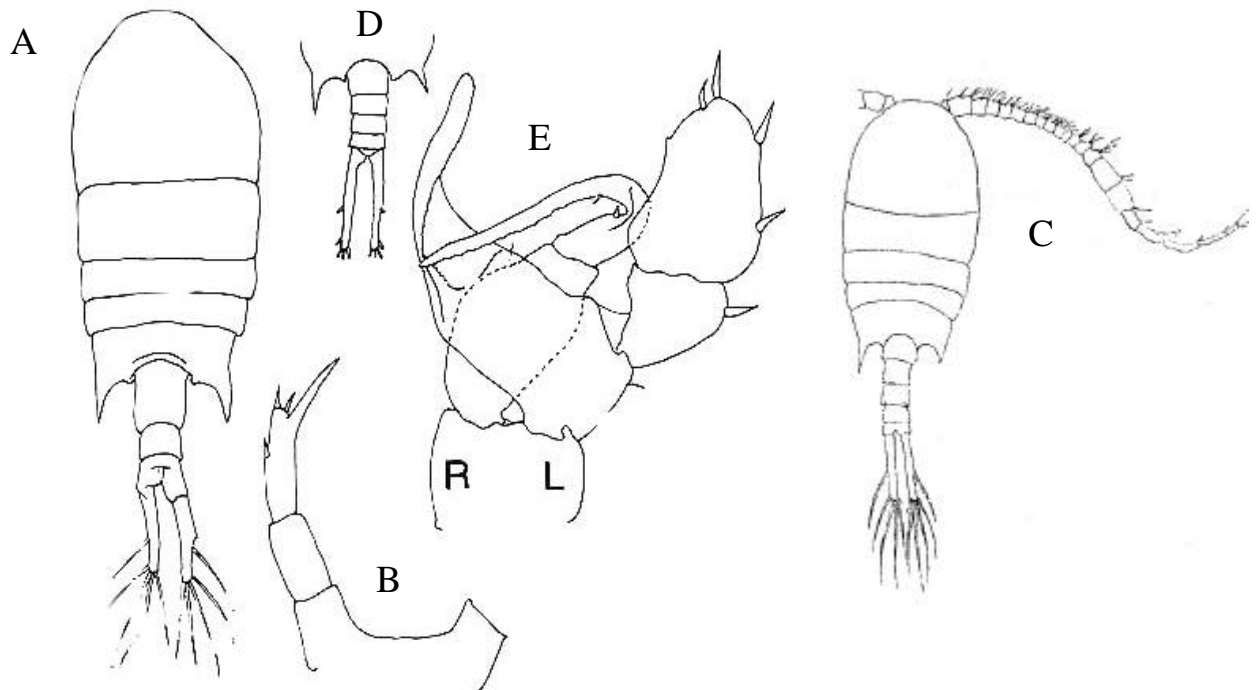
Length: females: 1.69-2.00 mm; males: 1.70-1.97 mm.

Female: Quite a large robust species; posterior metasome segments produced into spines. This species bears some resemblance to *T. stylifera* and several authors have recorded this latter species as being present in the Indian Ocean. However, as Arcos and Fleminger (1991) suggested, the records are misidentifications of immature specimens. *T. discaudata* immature specimens have an extension of the cephalosome laterally over the metasome segments, which is similar to the segment arrangement found in adult *T. stylifera*. However, in adult *T. discaudata* this cephalosome extension is not present.

In *T. discaudata* the anal segment and long slender furca are asymmetrical. P5 uniramous and symmetrical, inner spine of segment 3 longer than the 2 terminal spines, which are almost equal in length.

Male: Lateral angles of the last metasome segment pointed and slightly asymmetrical; right A1 geniculate. Urosome of 5 segments, almost symmetrical, with long slender furca. The thumb-like process on the basis of the left P5 is wide, the terminal segment is flattened and has 4 marginal spines. The terminal segment of the right P5 is hook-like and sharply bent backwards.

Recorded: Rodrigues, Seychelles, Zusa, Madagascar, Aldabra.



Temora discaudata: Female. A, dorsal; B, P5. Male. C, body dorsal; D urosome dorsal; E, P5. Figures A, from Giesbrecht (1892); B, D, E from Greenwood (1978); C from Mori (1937).

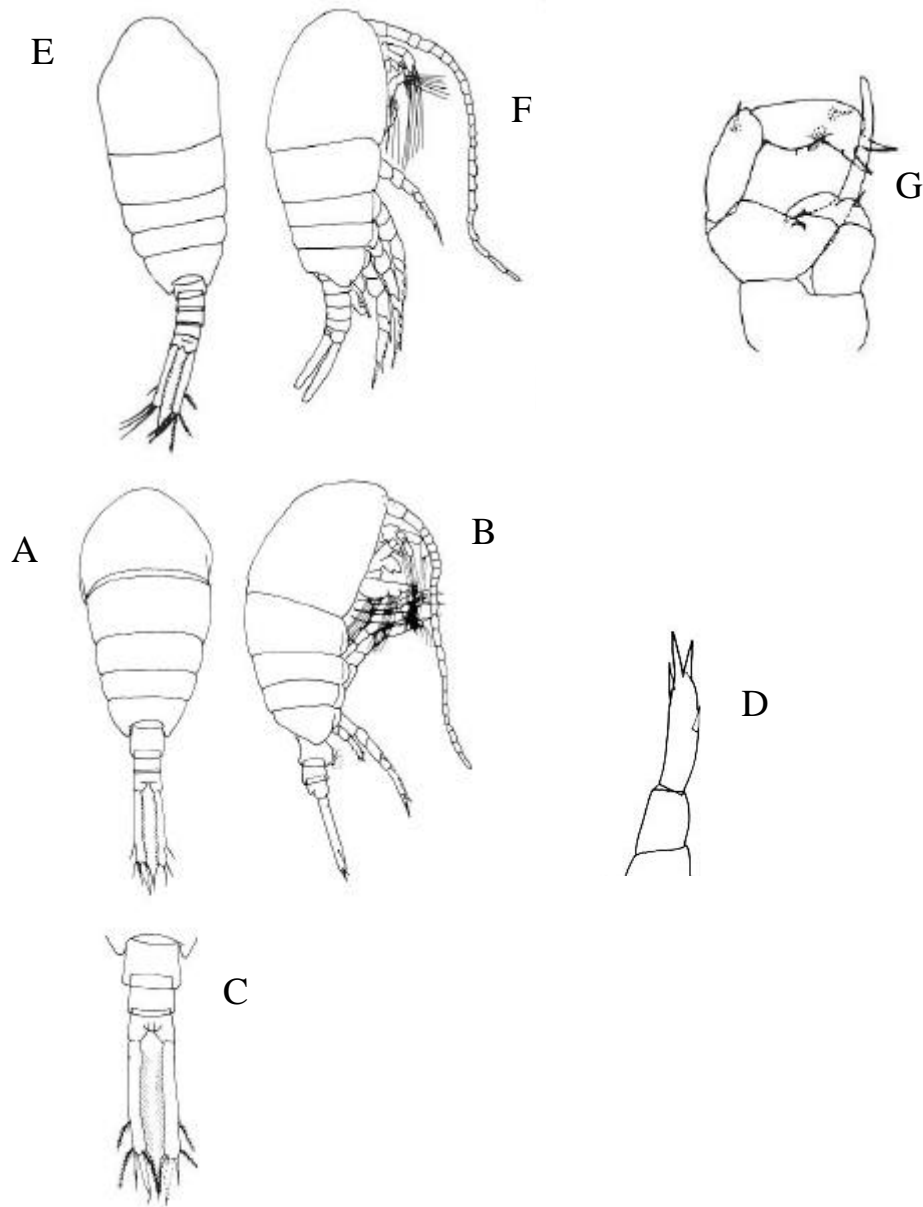
Temora turbinata (Dana, 1849)

Length: females: 1.05-1.61 mm; males: 0.93-1.56 mm.

Female: Body widest at cephalosome, tapering anteriorly to urosome; last metasome segment rounded. Urosome 3-segmented; anal segment symmetrical, shorter in length than previous segment; furca almost symmetrical, very long and slender. P5 symmetrical, inner marginal spine of the 3 terminal spines shorter than the other two.

Male: body shape similar to female; Urosome quite symmetrical; furca long and slender; P5 asymmetrical, the left with a claw; thumb of claw is slender and gradually curved.

Recorded: Madagascar



Temora turbinata: Female. A, dorsal; B, lateral; C, urosome; D, P5. Male. E, body dorsal; F body lateral; G, P5. Figures from Bradford-Grieve (1999).

Family Tortanidae

Genus *Tortanus*

Copepods with a median eye, but no lateral hooks or cuticular lenses; no rostrum. Well developed maxilliped associated with their carnivorous diet. Right A1 of male geniculate with swollen middle section. Urosome long, 2 or 3-segmented in female, 5-segmented in male. Furca sometimes asymmetrical. P5 uniramous in both sexes; the male right leg forms a claw.

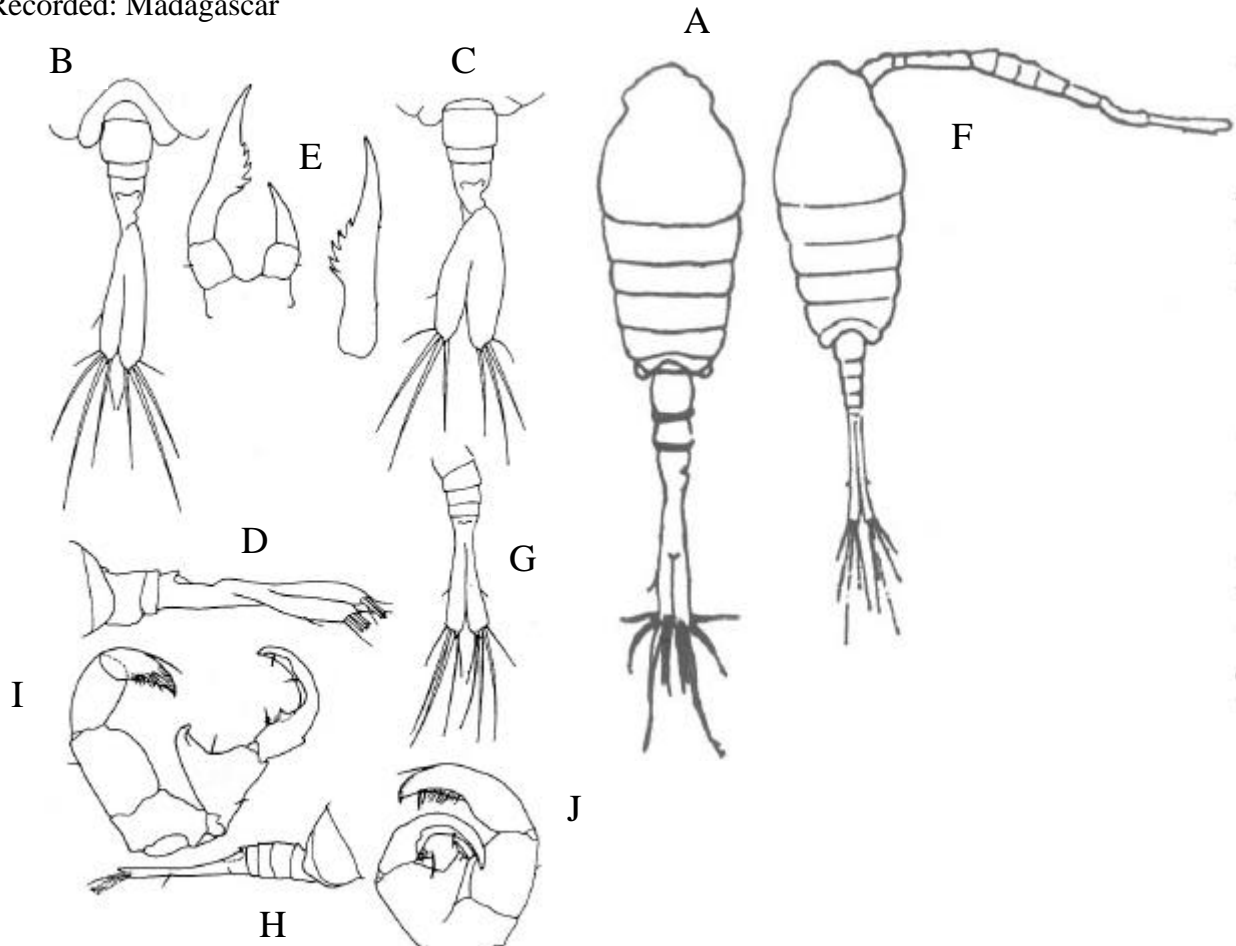
Tortanus barbatus (Brady, 1883)

Length: females: 1.25-2.10 mm; males: 1.05-1.12 mm.

Female: Urosome 3-segmented; anal segment and furca fused, asymmetrical; segment 3 in lateral view with dorsal projection. P5 asymmetrical, terminal segment on one side short and tapering to a point, on the other side elongated and with an inner median serrated margin, the teeth of which are variable in appearance.

Male: Anal segment and furca of urosome fused, slightly asymmetric. Right P5 second segment with a triangular projection with a seta half way along inner margin; left P5 penultimate segment with no setae, terminal segment with a long outer seta, numerous spinules on the inner and outer distal edges.

Recorded: Madagascar



Tortanus barbatus: Female. A, dorsal; B, urosome dorsal; C, urosome dorsal of broad ramus form; D, urosome lateral of broad ramus form; E, P5 with left leg variant. Male. F, dorsal; G, urosome dorsal; H urosome lateral; I, P5 posterior view; J, P5 anterior view. Figures A, F from Steuer (1926); B-E, G-J from Greenwood (1978).

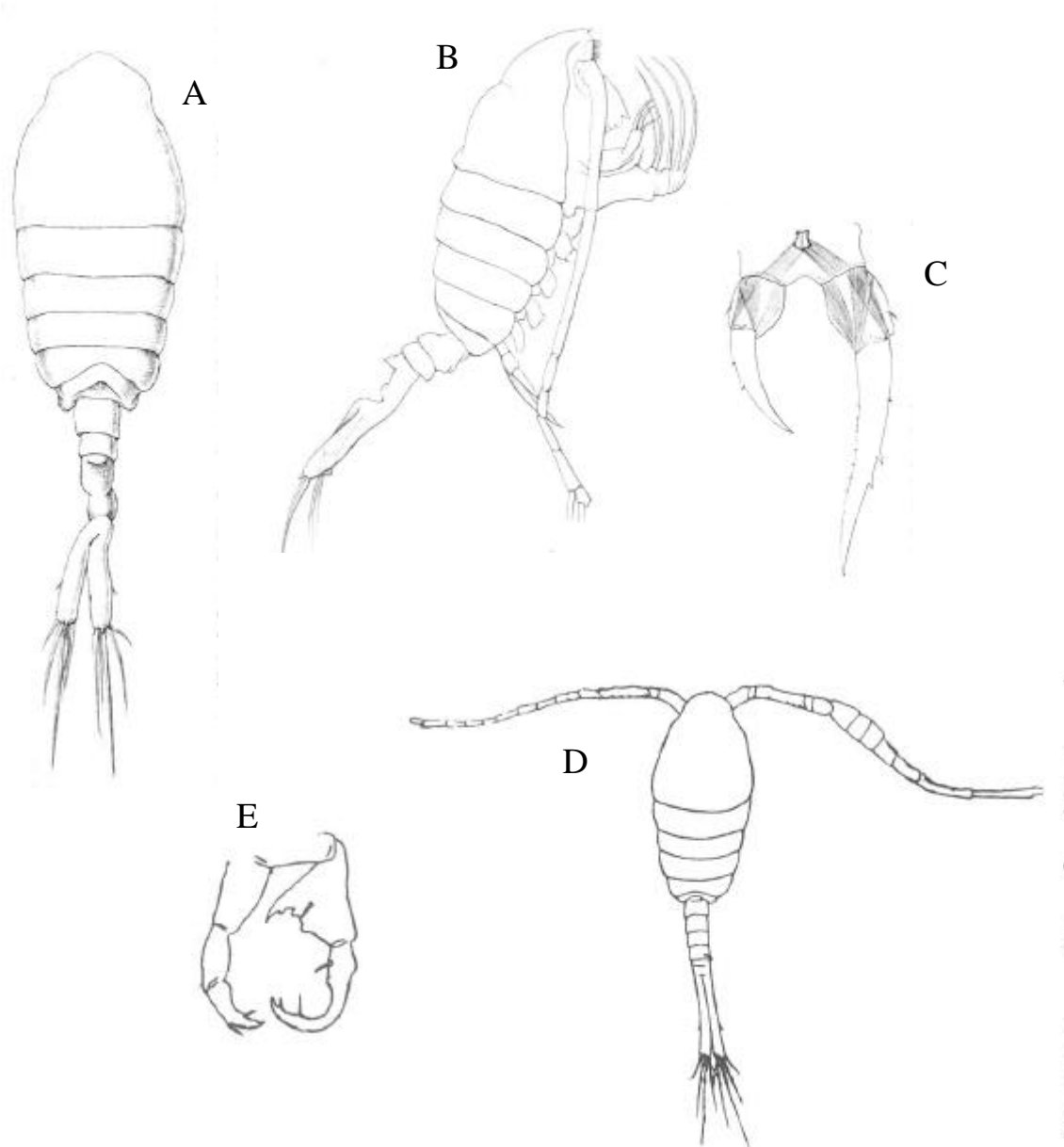
Tortanus forcipatus (Giesbrecht, 1889)

Length: females: 1.25-1.91mm; males: 1.01-1.08 mm.

Female: Urosome 3-segmented, anal segment and furca fused, asymmetrical. In lateral view the third urosome segment has a large irregular notch. P5 asymmetrical, terminal segment on right around half the length of left. Left P5 terminal segment with 1 small and 2 larger spines on outer margin; right P5 with 2 small spines on mid outer margin.

Male: Anal segment and furca of urosome fused, slightly asymmetric. Right P5 second segment with a pointed triangular projection; left P5 terminal segment curved, with an inner and outer marginal spine.

Recorded: Madagascar



Tortanus forcipatus: Female. A, dorsal; B, lateral; C, P5. Male. D, body dorsal; E, P5. Figures A-C from Giesbrecht (1892); D, E from Steuer (1926).

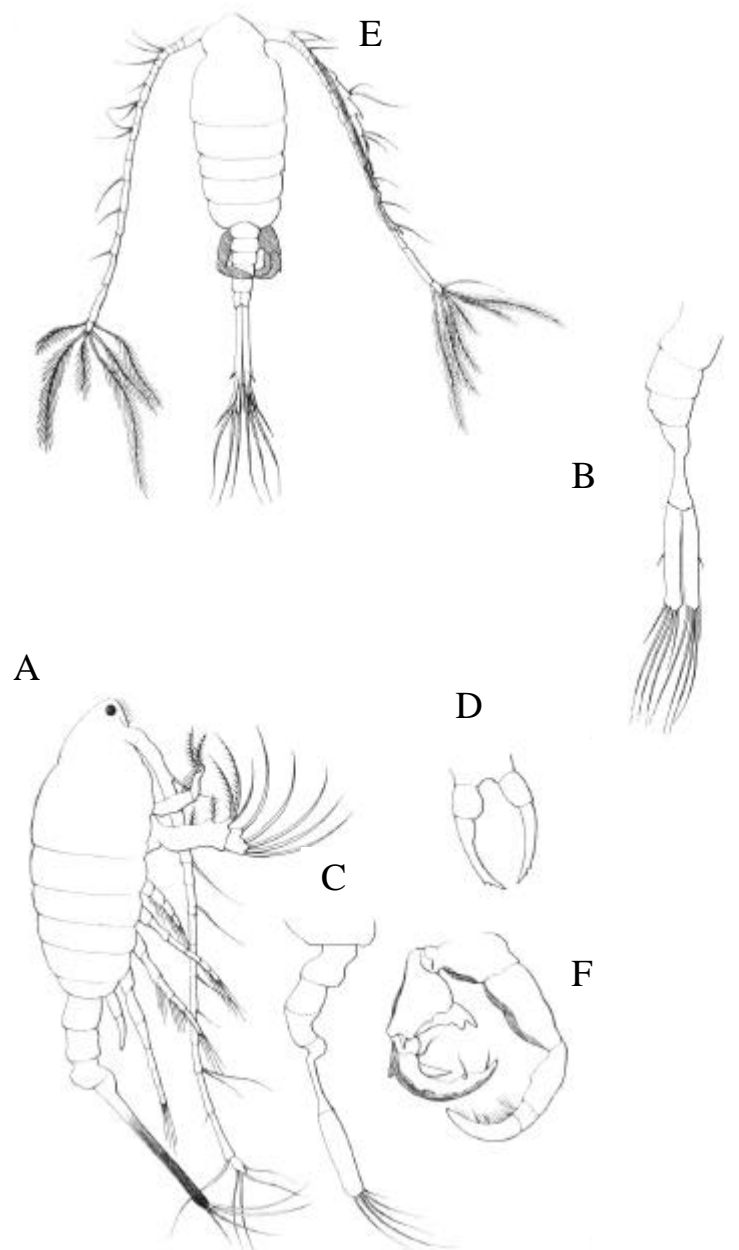
Tortanus gracilis (Brady, 1883)

Length: females: 1.52-2.10 mm; males: 1.50 mm.

Female: Posterior of last metasome segment rounded, knob-like. Urosome 3-segmented; anal segment and long furca fused, asymmetrical; anal segment very narrow in dorsal and lateral view, reminiscent but differing from *T. forcipatus*. P5 slightly asymmetrical, longer on left, terminal segments with 2 small spines on distal outer margin. Steuer (1926) drew a seta on the outer middle margin of each basis, not figured in Brady's original drawings reproduced here.

Male: Urosome slightly asymmetric. Right P5 second segment with a pointed triangular projection with tooth just internal to the point; left P5 longer than right, terminal segment curved, inner margin with a fringe of fine hairs and 2 small spines. Steuer (1926) drew this outer segment with 1 inner and 1 outer marginal spine.

Recorded: Seychelles



Tortanus gracilis: Female. A, lateral; B, urosome dorsal; C, urosome lateral; D, P5. Male. E, dorsal; F, P5. Figures from Brady (1883).

Tortanus insularis Ohtsuka and Conway, 2003

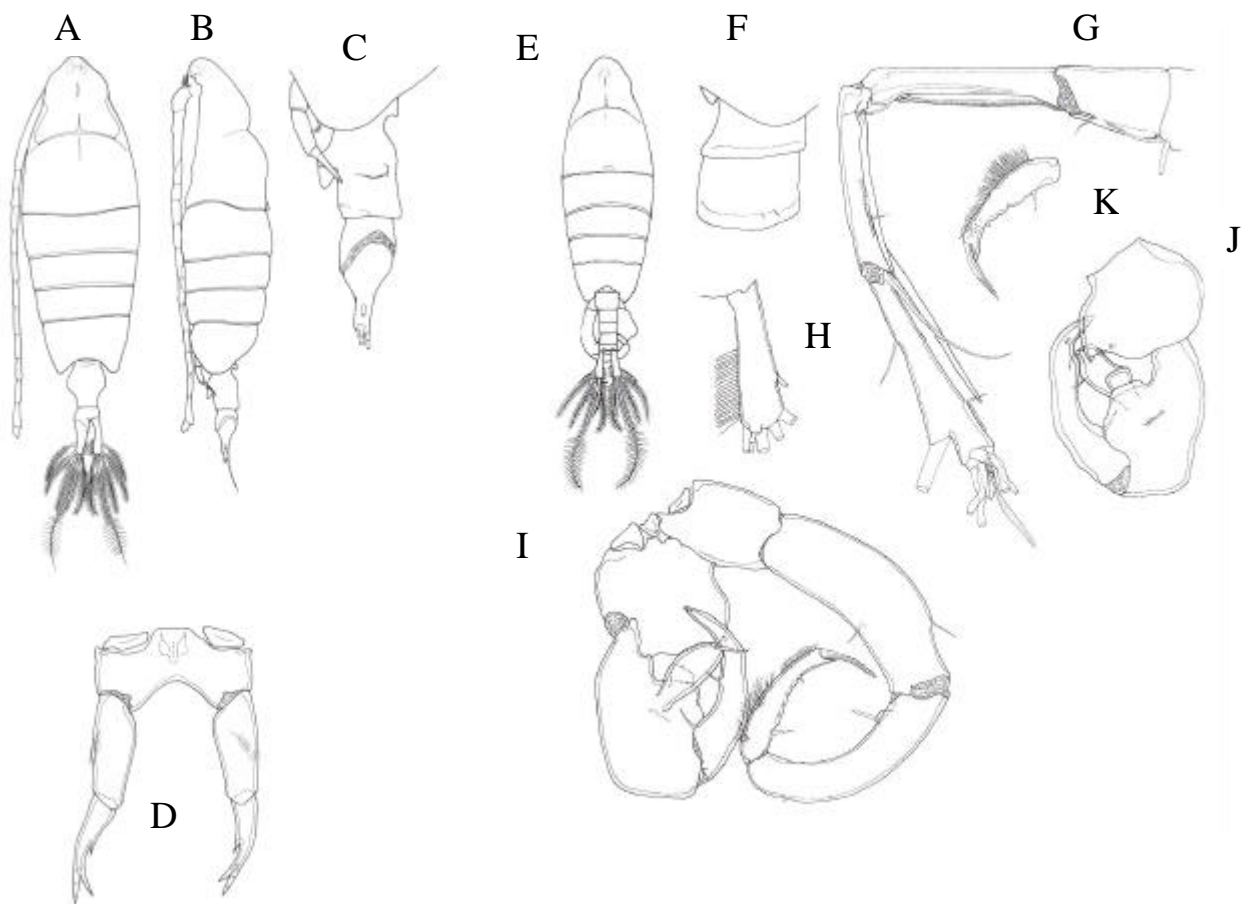
Length: females: 2.23-2.72 mm; males: 1.94-2.44 mm.

Large robust species, with a bulbous forehead that is tinged red in fresh specimens.

Female: Prosome approximately three times longer than urosome. Posterior metasome nearly symmetrical in dorsal view. Urosome 3-segmented, genital segment as long as remainder of urosome, slightly asymmetrical, bulging anterolaterally on both sides, with a small spine on tip of bulges, downward pointing projection on ventral surface. Anal segment very asymmetric, protruding posterolaterally on left side; furca very asymmetric with proximal half of left ramus swollen dorso-ventrally. P5 slightly asymmetric, with right leg longer than left; 1-segmented exopodite bearing 1 inner and 2 terminal pointed spines; outer terminal spine with 2 minute spines on anterior surface.

Male: Body narrower than the female; posterior metasome rounded and symmetrical. Genital segment slightly asymmetrical; right A1 geniculate. Right P5 very robust; basis massive, bearing large inner bilobed process at mid-length. Left P5 with elongated basis, slightly curved inwards, with 1 inner and 1 outer setule; exopodite 2-segmented, proximal segment with inner proximal round process bearing a setule and with tiny spinule on outer distal edge; outer segment with dense patch of setules along proximal half of outer margin, row of finer setules along distal half, terminating in a sharp point.

Recorded: Rodrigues



Tortanus insularis: Female. A, dorsal; B, lateral; C, urosome lateral; D, P5. Male. E, dorsal; F, urosome lateral, G, A1; H, right furca; I, P5; J, right P5; K, distal exopodite segment of left P5. Figures from Ohtsuka and Conway (2003).

Family Calanidae

Head and first pedigerous segment usually fused, pedigerous segments 4 and 5 always separate. Rostrum composed of 2 filaments. Generally with two characteristic, strong, backwardly directed setae on the third and second last segments of the A1. The various genera are mainly based on characters of the male P5. Females have 4 segments in the urosome, 5 swimming legs of similar size and appearance with both rami 3-segmented. Exopodal joints 3 of P2-P4 each with 2 spines on outer edge and 5 setae on inner edge. Male A1 are alike and only slightly transformed, never exhibiting any geniculate structure, 25 segmented with segments 1 and 2 always fused. Males usually with a hump on mid-dorsal region. P1-P4 as in the female, the right P5 is usually similar in appearance and size to the other swimming legs (less so in *Undinula*) while the left varies from being similar (*Calanus*) to drastically modified (*Cosmocalanus*). Urosome 5-segmented.

Genus *Canthocalanus*

Only one species.

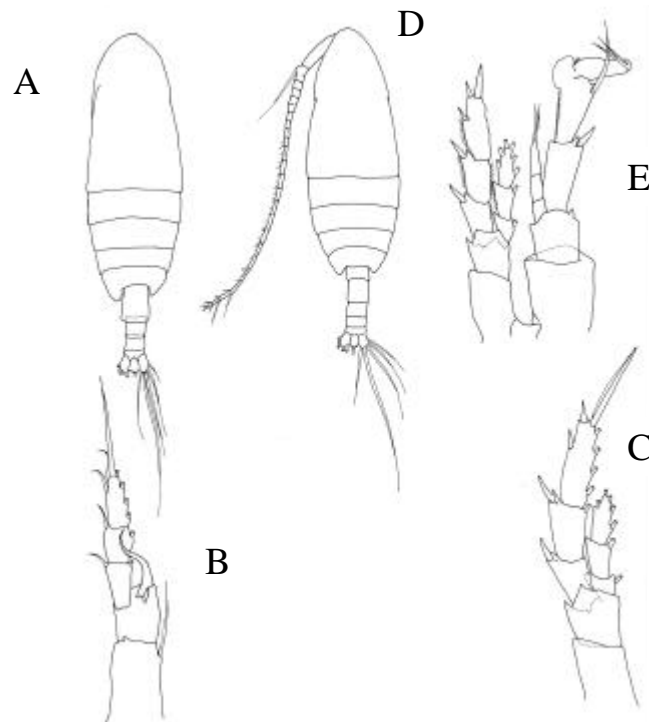
Canthocalanus pauper (Giesbrecht, 1888)

Length: females: 1.30-1.60 mm; males: 1.30-1.5 mm.

Female: Similar in shape to *Nannocalanus minor*, but urosome is not as deeply inset into metasome, and the inner margins of the P5 coxa are not denticulate. Head and pedigerous segment 1 fused. Anterior cephalosome and posterior metasome rounded. Described as having a slightly asymmetrical last metasome segment, however this does not appear to be the case with specimens sampled. Urosome 4-segmented. Strong setae on furca.

Male: Right P5 asymmetric, exopodite no inner marginal spines; left endopodite with 2 terminal setae; left exopodite with elongated segments with long outer distal setae on segments 2 and 3. Inner margins of the P5 coxa are not denticulate

Recorded: Rodrigues, Seychelles, Zuza, Madagascar.



Canthocalanus pauper: Female. A, dorsal; B, P1 endopod removed; C, P5. Male. D, body dorsal; E, P5. Figures from Mori (1937).

Genus *Cosmocalanus*

Only 2 species, although the separate validity of *C. caroli* is in some doubt.

Cosmocalanus darwini (Lubbock, 1860)

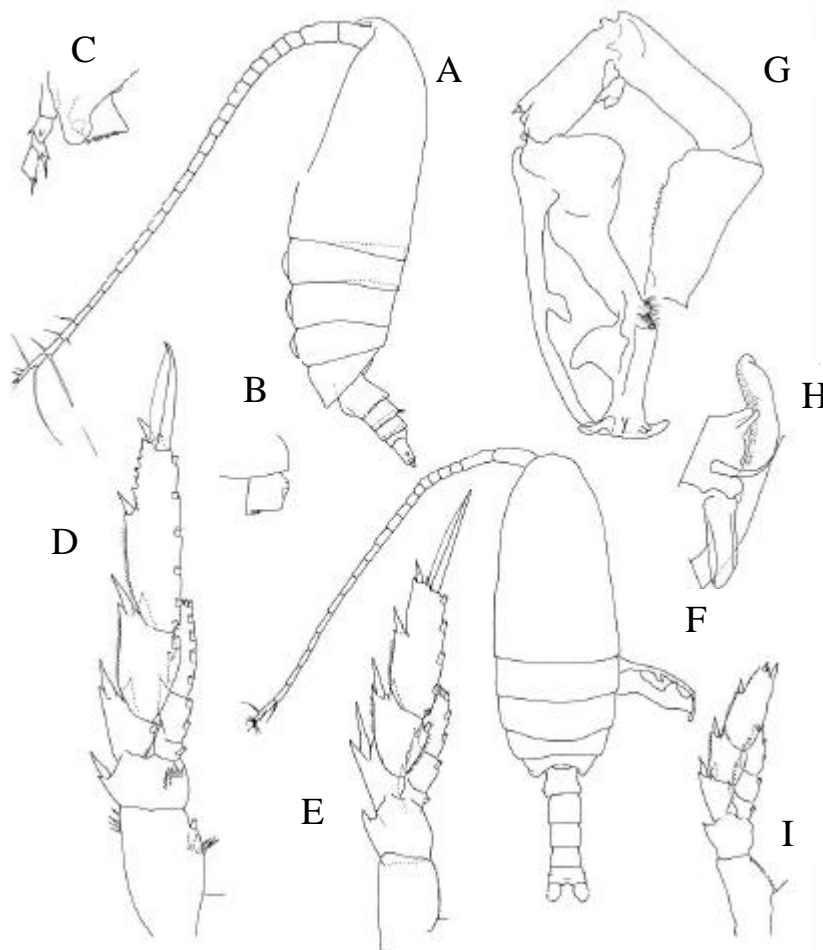
Length: females: 1.60-2.40 mm; males: 1.63-2.05 mm.

The furcal setae sometimes branch. Inner margin of P5 coxa finely serrated.

Female: The 5 swimming legs are the same size and similar structure. The last metasome segment comes to a blunt point when viewed laterally. Short spinules round the posterior margins of the genital and second urosome segments, with a prominent tuft of longer spinules on the dorsal edge of the second urosome segment. Sometimes spinules are only present along the posterior left side of the genital segment. Genital segment in lateral view bulges quite strongly and comes to a blunt point towards the anterior segment. A1 reaches almost to the end of the urosome. The posterolateral metasome borders may take 3 forms (symmetrical, forma *symmetrica*; very asymmetrical with left border produced into a squared-off lappet, forma *typica*; an intermediate form which is slightly asymmetrical, forma *intermedia*).

Male: Extremely large P5, very asymmetrical, sometimes projecting from the side of the body. Similar in size to the male P5 of *Undinula vulgaris* but different structure. The tooth on the inner edge of the external spine, which is part of the last segment of the left P5, is placed about one third of the length from the base of the spine.

Recorded: Rodrigues, Seychelles, Zuza, Madagascar, Aldabra, CPR.



Cosmocalanus darwini: Female. A, lateral; B, urosome lateral; C, urosome lateral of forma *typica*; D, P3; E, P5. Male. F, body dorsal; G, P5; H, Distal portion of left P5; I, right P5. Figures from Bradford-Grieve (1994).

Cosmocalanus caroli (Giesbrecht, 1888)

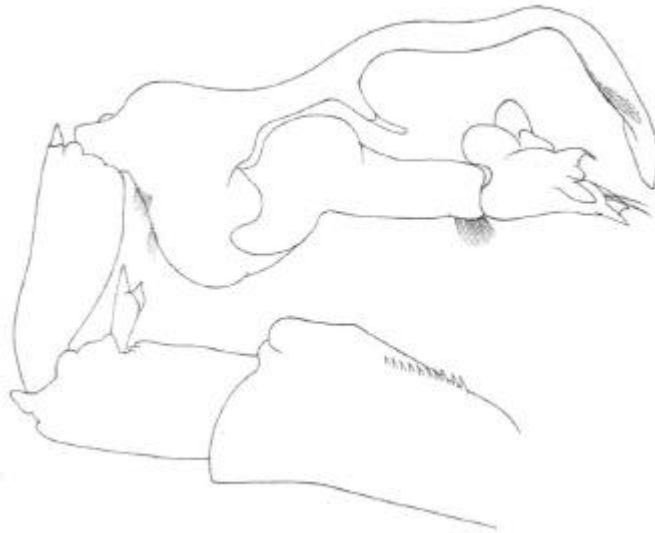
Length: females: ? mm; males: ? mm.

The separate status of this species is in some doubt (Bradford-Grieve, 1994), as it is very similar to *C. darwini*. There appear to be a difference between males, which is described.

Female: Very similar to *C. darwini*. Wolfenden (1906) found a female which differed, as the denticulation of the last joint of the exopodite of the P2 and P3 (external margin) was absent. This specimen also had 3-4 fine teeth on the inner margin of the coxa of the P1. He suggested it might be *C. caroli*.

Male: The position of the tooth on the inner edge of the external spine, which is part of the last segment of the left P5, is the specific character distinguishing this species from *C. darwini*. In *C. caroli* the tooth is placed about one sixth of the length of the spine from the base of the spine and in *C. darwini* the tooth is one third from the base of the spine.

Recorded: Madagascar.



Cosmocalanus caroli: Male. Terminal portion of left P5. From Wolfenden (1906).

Genus *Mesocalanus*

In both sexes pedigerous segment 1 separate; P5 coxa with a smooth inner margin, endopodite with a total of 7 setae. Male P5 with both rami 3-segmented. Only 2 species.

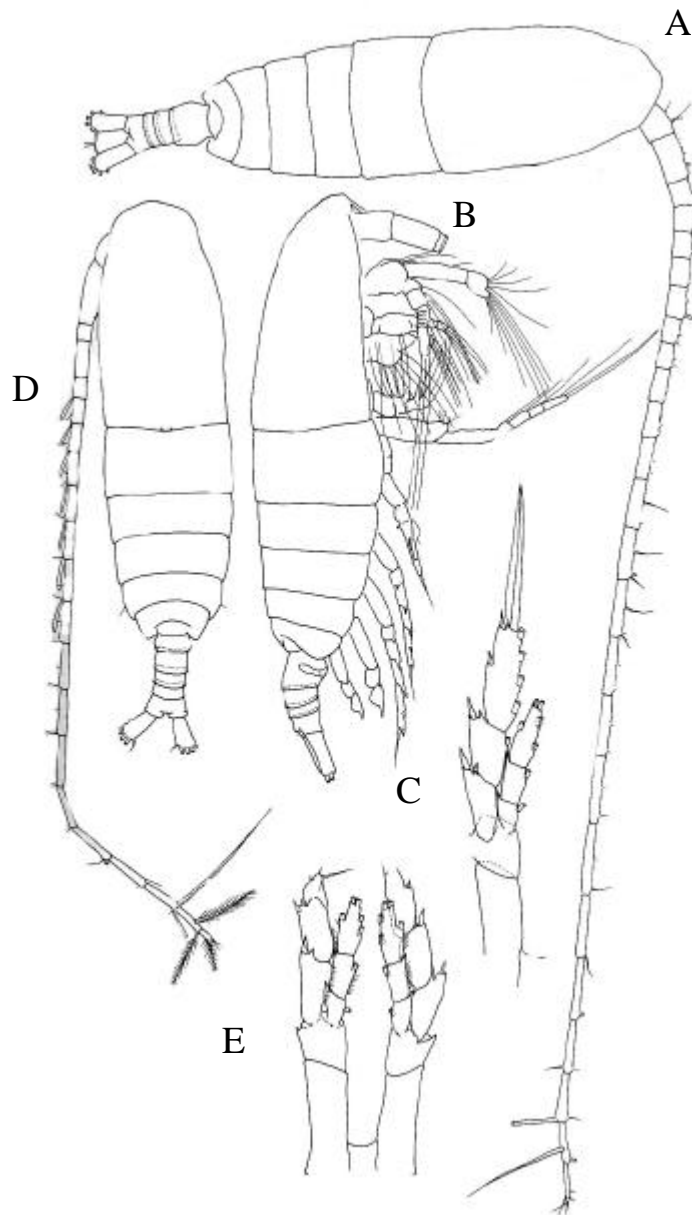
Mesocalanus tenuicornis (Dana, 1849)

Length: females: 1.80-2.50 mm; males: 1.50-2.20 mm.

Female: Prosome quite slender. The lateral angles of the last metasome segment are rounded. The furca and seta are symmetrical. The A1 are around twice the length of the prosome. The internal margin of the P5 coxa is not denticulate.

Male: The A1 are around twice the length of the prosome. The P5 are only slightly asymmetric, left P5 terminal segment with spine almost as long as the segment. Furca divergent.

Recorded: Rodrigues, Madagascar.



Mesocalanus tenuicornis: Female. A, dorsal; B, lateral; C, P5. Male. D, body dorsal; E, P5. Figures from Bradford-Grieve (1994).

Genus *Nannocalanus*

There was only one species but a new species, *N. elegans*, has just been described by Andronov (2001).

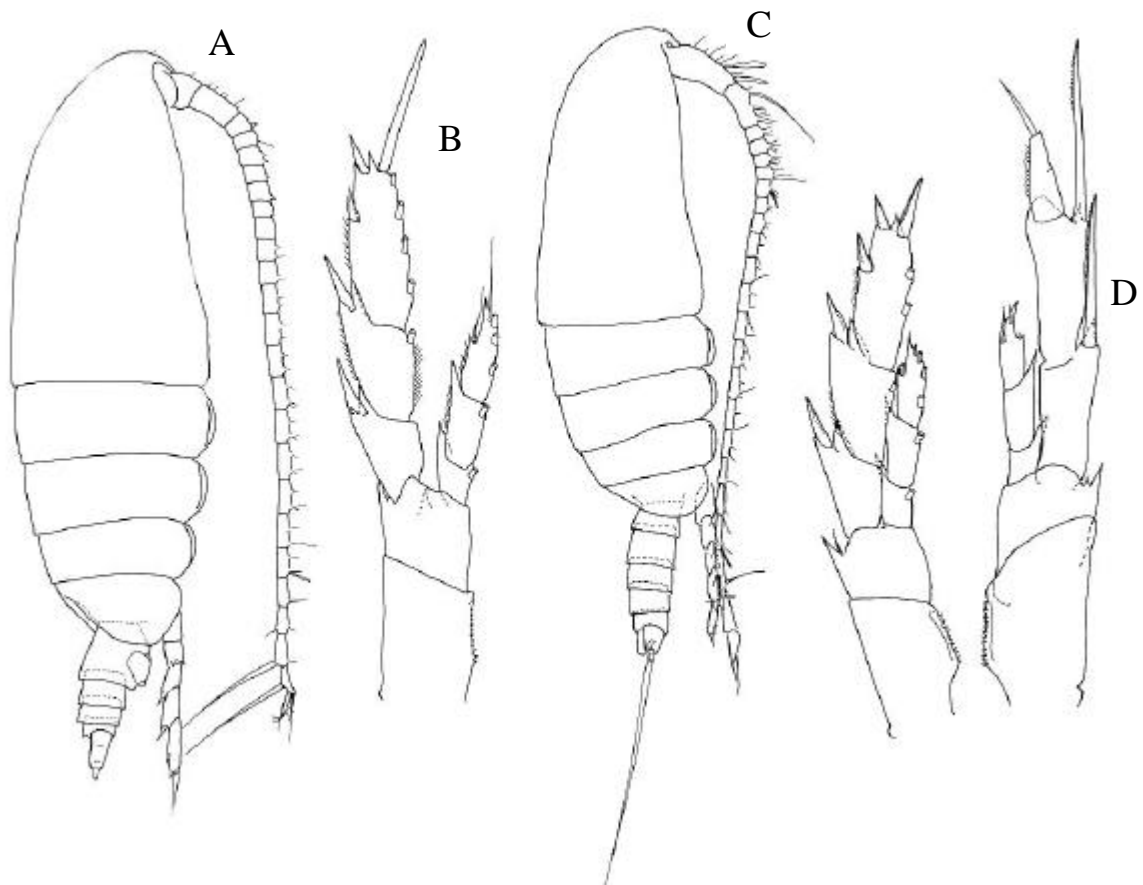
Nannocalanus minor (Claus, 1863)

Length: females: 1.70-2.30 mm; males: 1.20-2.01 mm

Female: Short stubby urosome, which is characteristically inset into the metasome, the rounded last metasome segment extending almost halfway down the genital segment. The genital segment bulges strongly when viewed from the side, with a small projection low on the surface. In fresh specimens the edges of the prosome segments are sometimes tinged with red. The female has 5 swimming legs which are all the same size and of similar structure. The P5 coxa has serrations on the inner surface. These serrations separate it from a closely related species that also occurs in this region, *Canthocalanus pauper*, which does not have these serrations. The A1 reach almost to the end of the urosome.

Male: Similar in appearance to the female but with a longer urosome. Furca divergent in dorsal view. P5 slightly asymmetric, right P5 similar to other swimming legs, with spines on the inner border of the exopodite; left endopodite with no spines on internal edge, left exopod with elongated outer edge spines. The P5 coxa has serrations on the inner surface.

Recorded: Rodrigues, Seychelles, Zuza, Madagascar, Aldabra, CPR, Mauritius.



Nannocalanus minor: Female. A, lateral; B, P5. Male. C, body lateral; D, P5. Figures from Bradford-Grieve (1994).

Genus *Neocalanus*

Head and pedigerous segment 1 usually fused in female, separate in male. Swimming leg 2 in both sexes with a recurved spine at the outer distal border or exopodite segment 1. Coxa of P5 inner border without serrations in both sexes. Male leg 5 with both exopodite and endopodite 3-segmented; left leg modified, endopodite usually with 8 setae; right leg unmodified, or with inner edge setae of exopodite absent.

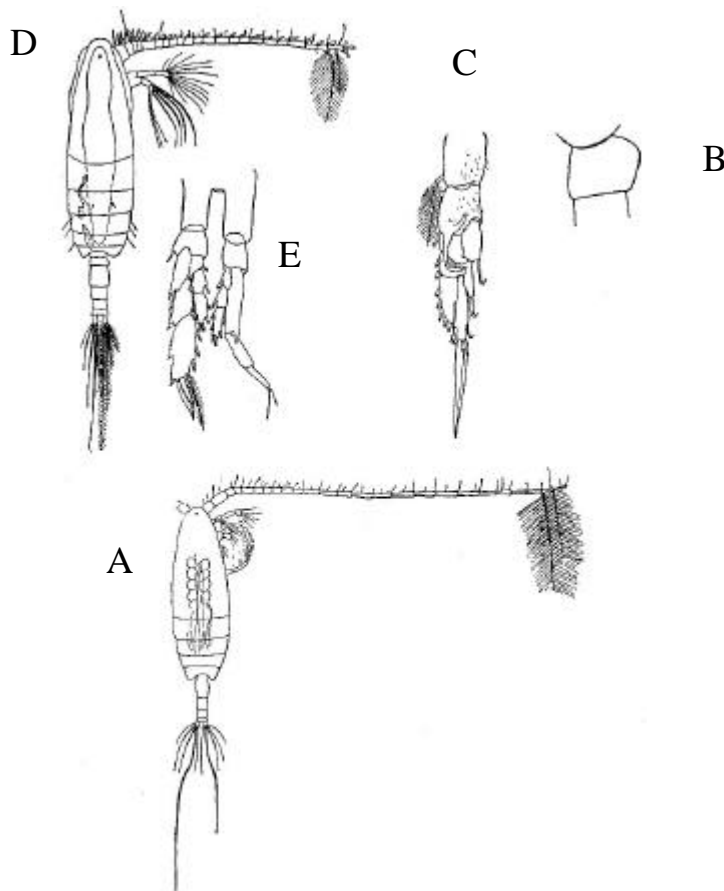
Neocalanus gracilis (Dana, 1849)

Length: females: 2.43-4.00 mm; male: 2.3-3.10 mm.

Female: Body robust; head and pedigerous segment 1 fused; 5 pairs of swimming legs, all of similar structure and size. A1 is approximately twice the length of the prosome. The urosome is approximately one third the length of the prosome; genital segment, in lateral view, rounded and protruding on distal portion of the segment; furca short, second inner marginal seta on left side very long (if not damaged). Basis of P1 each with a prominent hook on anterior surface.

Male: Head and pedigerous segment 1 separate. Swimming legs are all very similar; right P5 same general structure as other swimming legs, terminal exopodite segment with setae on the inner edge; left P5 with first 2 exopodite segments elongated, the terminal segment with 2 spines; the 3-segmented endopodite is not well developed and in some specimens the number of seta can be greatly reduced. A1 much shorter than in the female, reaching halfway down urosome. Urosome approximately one third length of prosome. Small process close to dorsal posterior margin of the cephalosome, further forward than the same process in *N. robustior*.

Recorded: Rodrigues (offshore), Zuza, Madagascar, CPR.



Neocalanus gracilis: Female. A, dorsal; B, urosome lateral; C, P1. Male. D, body dorsal; E, P5. Figures from Giesbrecht (1892).

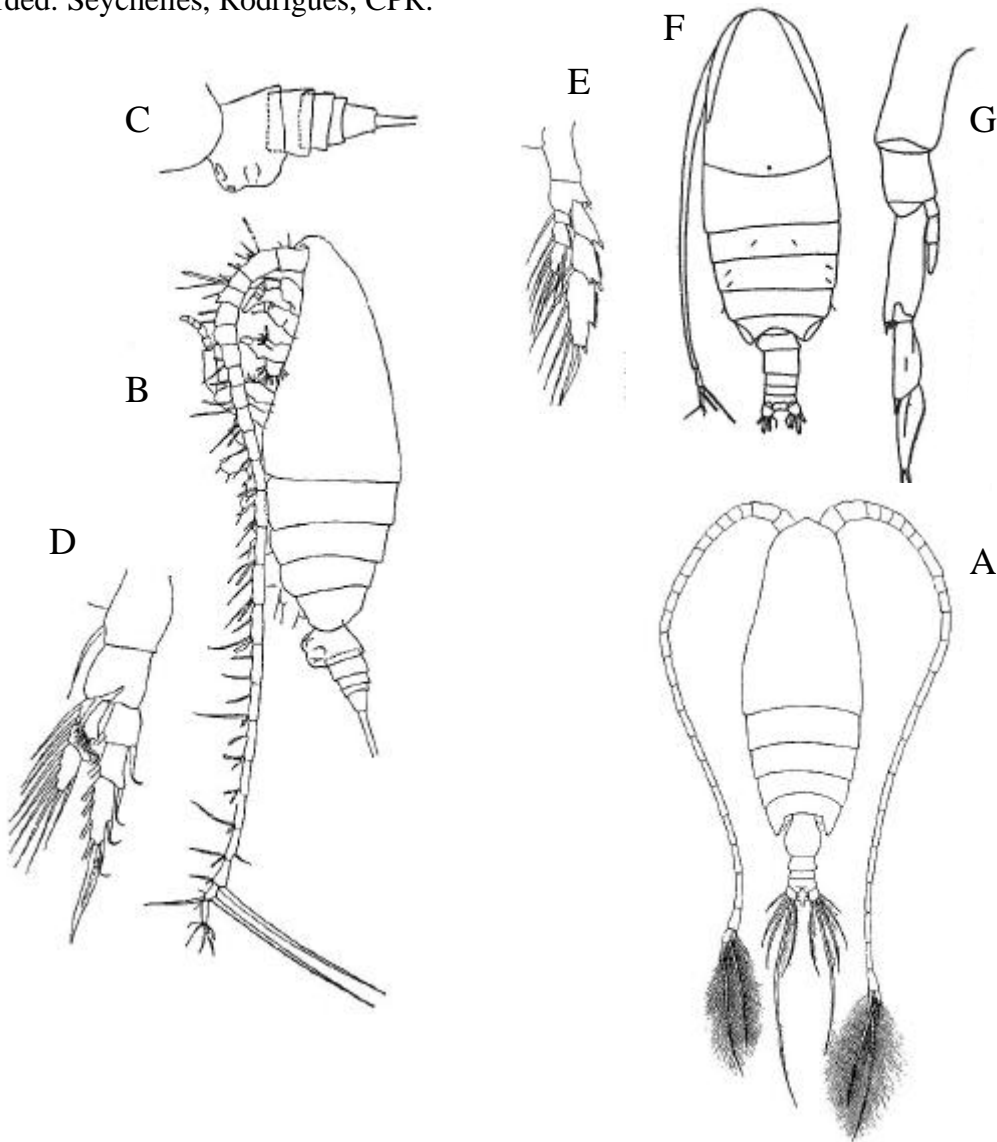
Neocalanus robustior (Giesbrecht, 1888)

Length: females: 3.17-4.41 mm; males: 2.84-3.55 mm.

Female: Distinguishable from *Neocalanus gracilis* by its usually larger size, the shape of the genital segment which is squarer, convex and more prominent in lateral view. Head and pedigerous segment 1 fused. The basis of the P1 has a process on the anterior surface, similar to that of *N. gracilis*.

Male: Head and pedigerous segment 1 separate. Small process close to the dorsal poster margin of the cephalosome. The left P5 with a rudimental 3-segmented endopodite, the distal segment of which in some specimens has 2 or 3 setae; the exopod with very elongated segments; right P5 similar to the other swimming legs.

Recorded: Seychelles, Rodrigues, CPR.



Neocalanus robustior: Female. A, dorsal; B, lateral; C, urosome lateral; D, P1; E, P5. Male. F, body dorsal; G, P5. Figure A from, Wolfenden (1906); B-E, Mori (1937); F, G, Park (1968).

Genus *Undinula*

Only one species

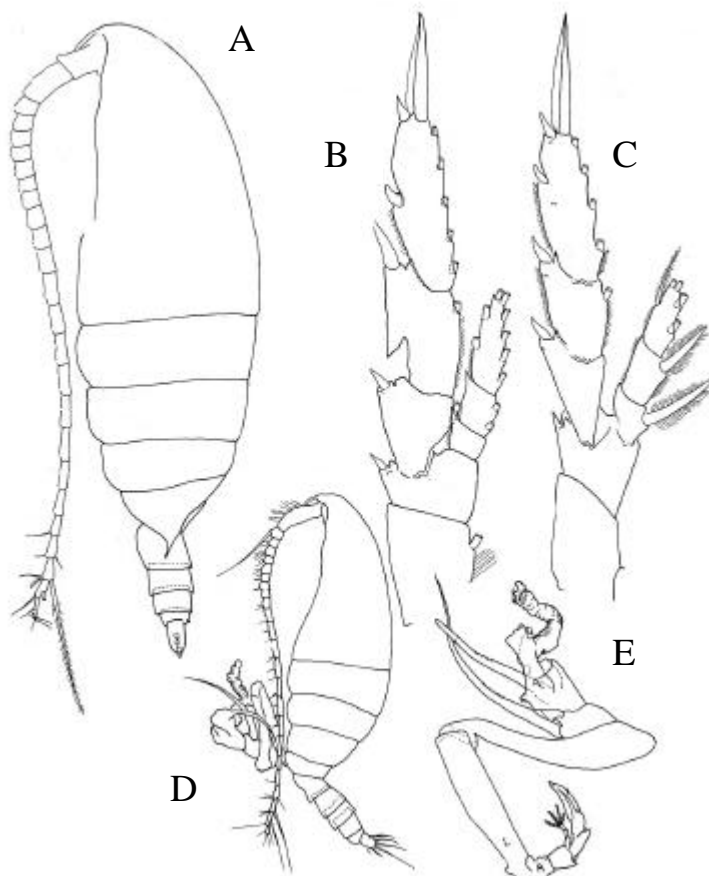
Undinula vulgaris (Dana, 1849)

Length: females: 2.25-3.25 mm; male: 2.04-2.50 mm.

Female: Head and pedigerous segment 1 fused. 5 swimming legs, all the same size and also similar structure. Similar to *Cosmocalanus darwini* but the last metasome segment comes to a sharp point in lateral view. Some specimens have two points on the left side. The A1 reaches almost to the end of the urosome. P2 with a notch on the external margin of the second segment of the exopodite. Coxa of the P5 without serrations on the internal margin, endopodite with 7 setae, those on segments 1 and 2 spine-like.

Male: Head and pedigerous segment 1 fused. P2 with a notch on the external margin of the second segment of the exopodite. Has an extremely large P5, similar in size to that of *C. darwini* and very asymmetric. Coxa of the P5 without serrations on the internal margin. P5 left is highly modified, without endopodite and bears two large spikes on exopod segments 1 and 2 and a structure like a wrinkled trunk on the end of the limb. Right P5 is tiny and has an endopodite.

Recorded: Rodrigues, Seychelles, Zuza, Aldabra, CPR.



Undinula vulgaris: Female. A, lateral; B, P2; C, P5. Male. D, body lateral; E, P5. Figures A, B from Bradford-Grieve (1994); D from Mori (1937); E, from Dakin and Colefax (1940).

Family Mecynoceridae

Genus *Mecynocera*

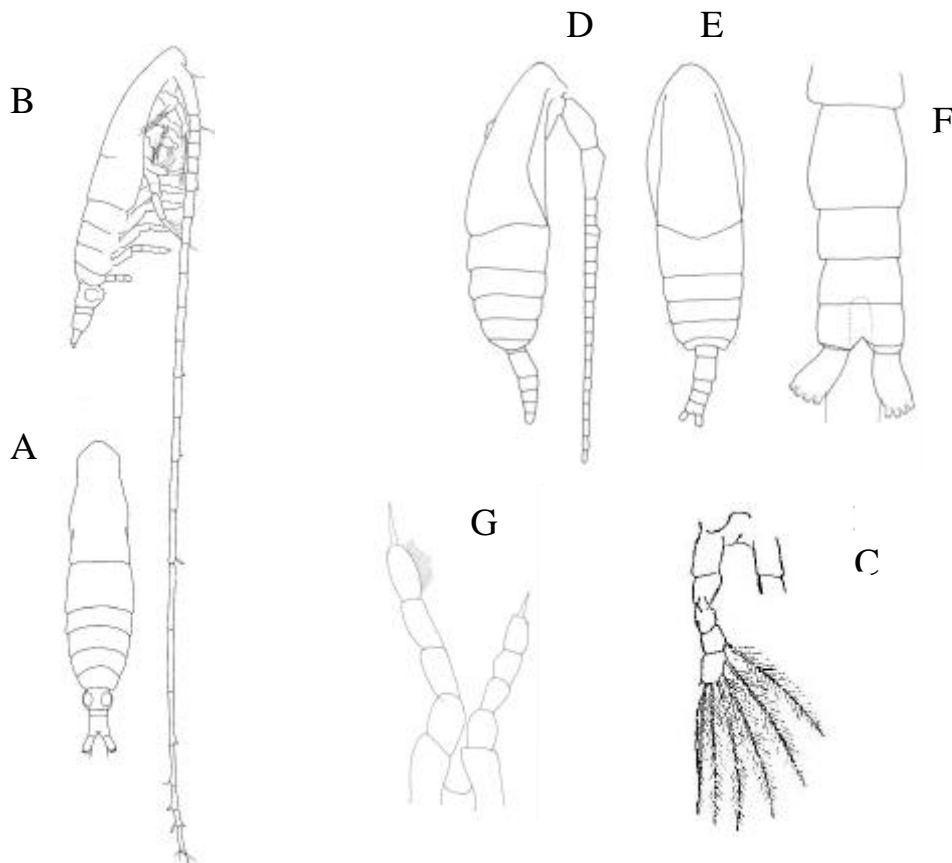
Mecynocera clausi Thompson, 1888

Length: females: 0.92-1.21 mm; males: 0.94-1.12 mm.

Female: This is a very small species that initially may be confused with *Calocalanus*, but the prosome is 6 segmented while in *Calocalanus* it is 4 or 5-segmented. The A1 is over twice the length of the whole body and plumose, but is often broken off. The limbs seem also easily damaged. The prosome is separate from the segment bearing the P1. The posterior metasome segments are rounded. The urosome is 3-segmented; the genital segment is symmetrical and very swollen in lateral view. P5 are very simple, uniramous with straight symmetrical limbs, with 5 segments on each side, with 1 seta on the fourth and 3 inner and 2 terminal setae on the fifth segment.

Male: Dorsal hump on cephalosome. A1 shorter than in female, extending slightly beyond the end of the urosome. Urosome 5-segmented; P5 are very simple quite straight limbs, with 5 segments on each side, asymmetrical, longer on right. Right P5 inner border hairy; terminal segments on both legs with a stout terminal spine and a small disto-lateral spinule. End of left P5 reaches to middle of segment 4 of right P5.

Recorded: Seychelles, Rodrigues, Madagascar.



Mecynocera clausi: Female. A, dorsal; B, lateral; C, P5. Male. D, body lateral; E, body dorsal; F, urosome; G, P5. Figures A, B from Bradford-Grieve (1994); D-G from Corral (1972); C from Giesbrecht (1888).

Family Paracalanidae

Cephalosome and first pedigerous segment usually at least partially fused, pedigerous segments 4 and 5 fused or separate. In the female the urosome is 2-4 segmented, the anal segment usually much longer than any segment between it and the genital segment. Exopodites of P1-4 3-segmented, external border of P1-P4 usually fringed with small spines; endopodite of P1 usually 2-segmented, those of P2-4 3-segmented. Distal spine of exopods with smooth blade-like border. P5 when present is uniramous and symmetrical. Male urosome 5-segmented; dorsal hump usually present on cephalosome. P1-4 similar to female, P5 uniramous.

Genus: *Acrocalanus*

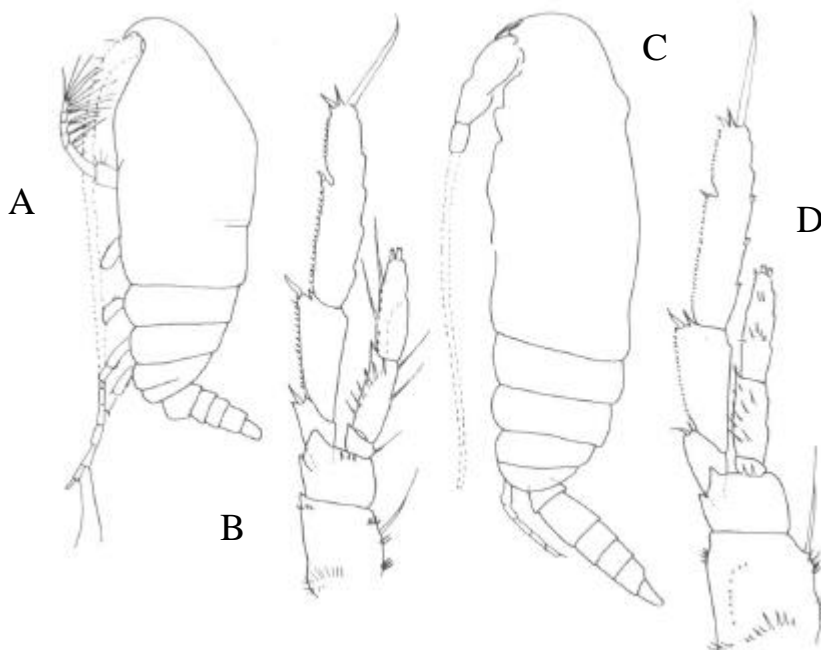
Small copepods, rostrum with long slender filaments. Pedigerous segments 4 and 5 incompletely separated. Obvious small spines on outer edge of exopodite segments of P2-4. Females with a short urosome and superficially resemble *Paracalanus*, but they only have four pairs of swimming leg, which are all of similar size and structure, although sometimes there is a rudimentary fifth pair present. The male P5 is only present on the left. Males of the different species are difficult to tell apart.

Acrocalanus gibber Giesbrecht, 1888

Length: females: 0.93-1.28 mm; males: 0.94-1.24 mm.

Female: Deep body in lateral view, with a pronounced hump on the dorsal cephalosome; distinct though partial line of separation of the cephalosome from the first pedigerous segment is obvious; A1 reaches just to the furca, or slightly beyond. 4 pairs of swimming legs, the distal toothed outer border of exopodite segment 3 of P4 is about 60% of the length of the proximal part of the toothed border; the distal teeth are strong compared to the fine teeth in *A. longicornis*. Genital segment longer than any of the others, with a prominent ventral swelling.

Male: Distinct hump on the dorsal cephalosome; P5 is only present on the left and extends to the end of the urosome segment 3, or the middle of urosome segment 4 when this leg is fully extended; very simple limb, composed of four segments with two tiny spines on the last segment. Recorded: Rodrigues, Seychelles, Zuza, Madagascar, Aldabra.



Acrocalanus gibber: Female. A, lateral; B, P4. Male. C, lateral; D, P4. Figures from Sewell (1929).

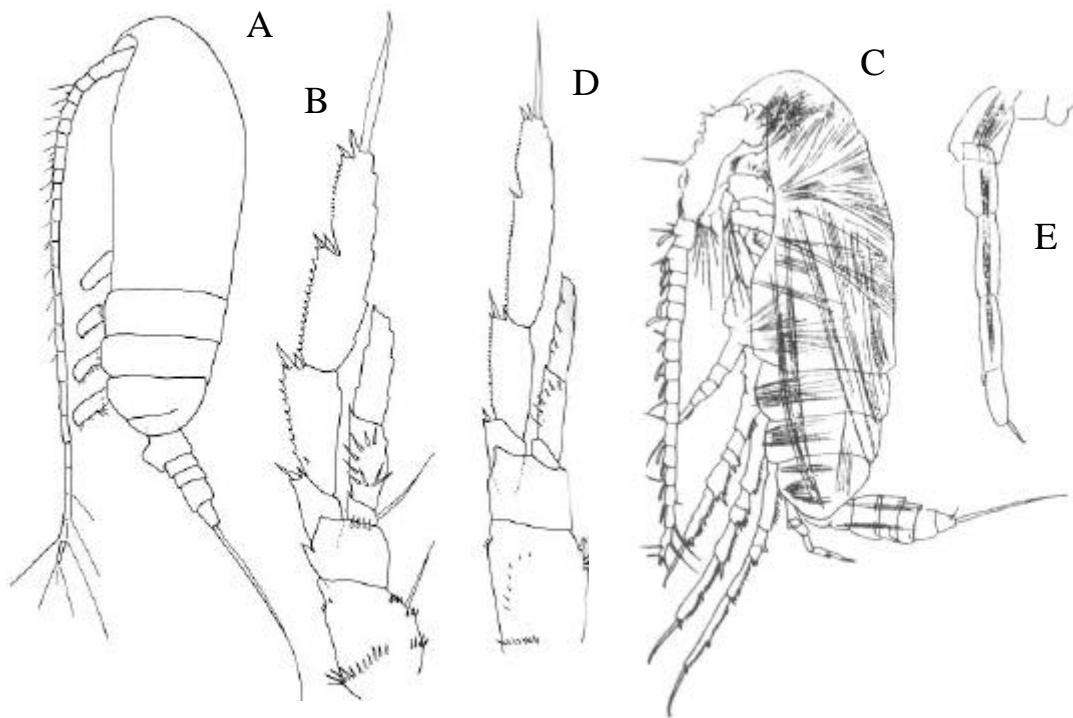
Acrocalanus gracilis Giesbrecht, 1888

Length: females: 1.20-1.40 mm; male: 0.88-1.14 mm.

Female: The anterior cephalosome is evenly round in lateral view and the line of separation of the cephalosome from the first pedigerous segment is very slight, if it can be seen at all; no obvious hump on cephalosome; A1 exceeds the end of the furca by 2-4 terminal segments; the distal toothed outer border of exopodite segment 3 of the P4 is about 80% of the length of the proximal part of the toothed border. The coxa of P4 is more convex than in *A. longicornis* and there are more spines distally.

Male: The anterior cephalosome is evenly round in lateral view and there is no hump. The P5 is asymmetrical, when fully extended reaches the end of urosome segment 2, the right foot is vestigial or absent, the left P5 is of 5 segments, the distal the largest. A1 reaches just beyond the furca, although the drawing by Mori (1937) suggests it being shorter than this?

Recorded: Seychelles, Zuza, Madagascar.



Acrocalanus gracilis: Female. A, lateral; B, P4. Male. C, lateral; D, P4; E, P5. Figures A, B, D from Sewell (1929); C, E from Mori (1937).

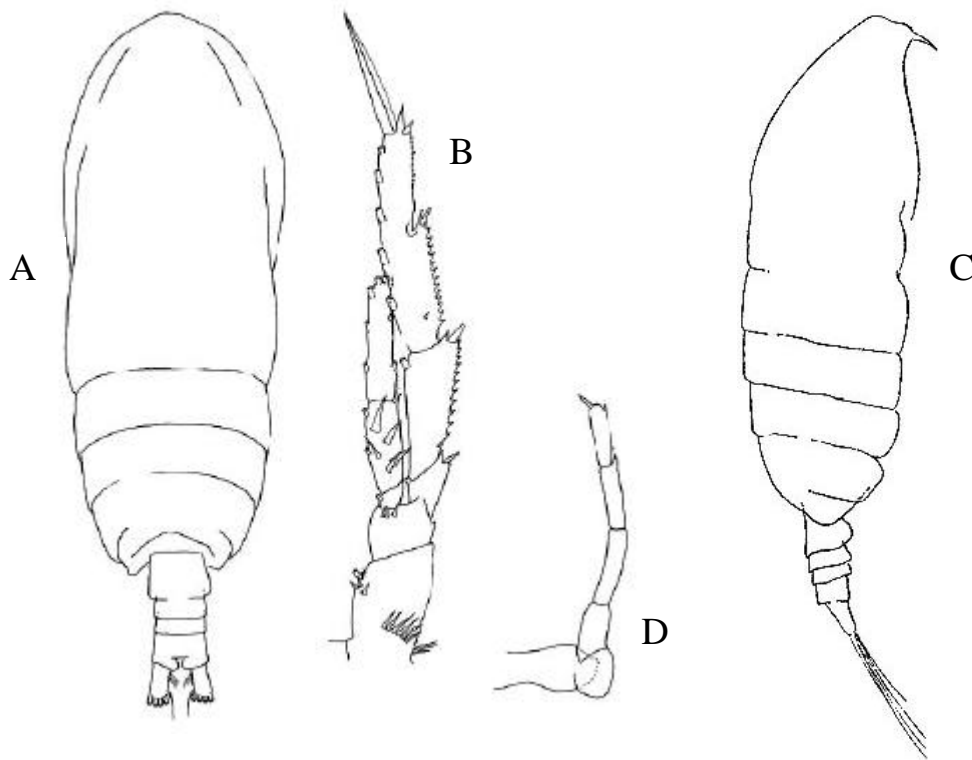
Acrocalanus longicornis Giesbrecht, 1888

Length: females: 1.00-1.26 mm; males: 0.90-1.25 mm.

Female: Can be distinguished from other species as the A1 extends further beyond the furca than in other species, by its last 5 segments. The anterior cephalosome is rounded in lateral view but the dorsal surface is quite strongly arched at the level of the mouth, but less so than in *A. gibber*. There is reported to be a partial segmentation between the cephalosome and the first pedigerous segment (Wolfenden, 1906; Sewell, 1929). Genital segment broader than long, laterally swollen and projecting ventrally. Outer distal border of exopodite segment 3 of P4 with over 18 very small teeth and with coarse larger teeth on the proximal border.

Male: P5 only present on the left; 5-segmented. A1 only extends just beyond the posterior metasome. Cephalosome partially separated from the first pedigerous segment.

Recorded: Madagascar



Acrocalanus longicornis: Female. A, dorsal; B, P4. Male. C, lateral; D, P5. Figures A, B from Bradford-Grieve (1994); C from Sewell (1929); D from Wolfenden (1905).

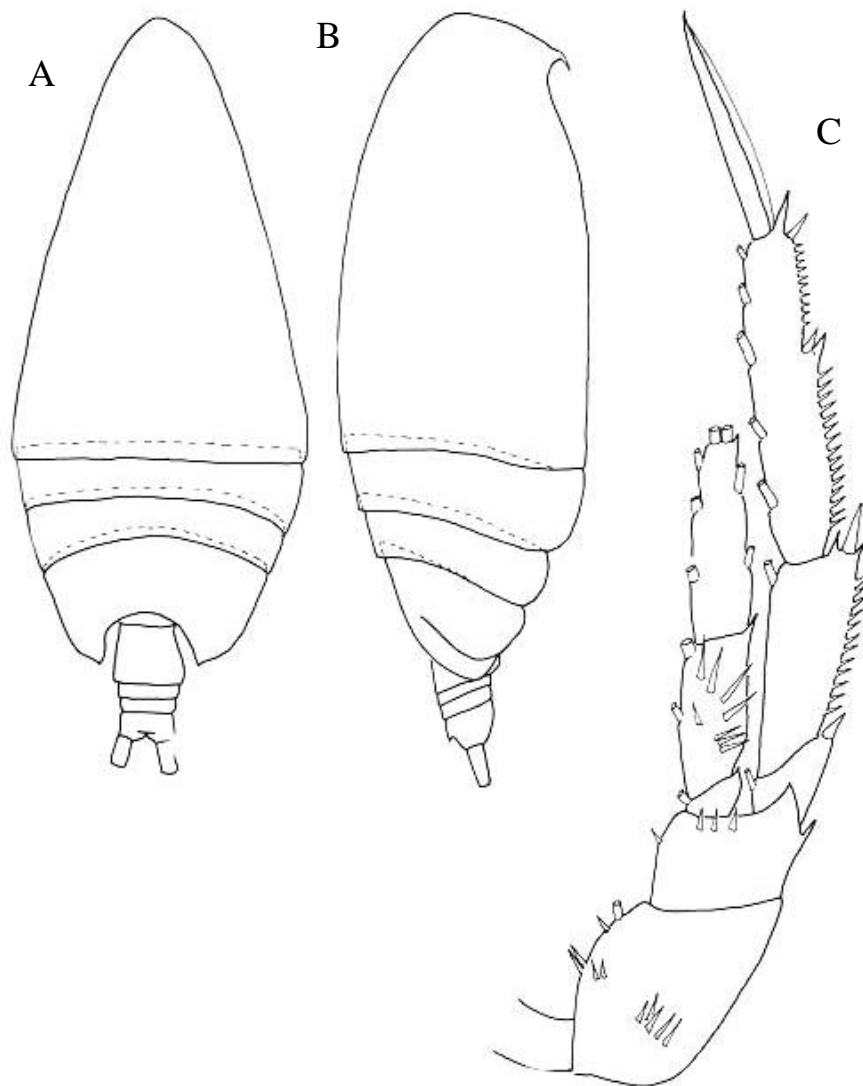
Acrocalanus monachus Giesbrecht, 1888

Length: females: 0.90-1.10 mm; males ? mm.

Female: Similar to *A. gracilis* but in lateral view the cephalosome of the female produced forward forming a sort of hood, anteriorly with a very characteristic blunt point which slopes down in a straight line towards the rostrum, immediately distinguishing it from other members of the genus. The anterior cephalosome in dorsal view is very narrow compared with the rest of the prosome. No indication of any division between the cephalosome and the first pedigerous segment and little evidence of a dorsal hump. A1 extends beyond the furca by at most, 2 or 3 segments. Outer distal border of exopod segment 3 of P4 with about 10-12 large teeth, similar to the 16 on the proximal margin.

Male: Not described.

Recorded: Rodrigues, Seychelles, Zuza, Madagascar, Aldabra.



Acrocalanus monachus: Female. A, dorsal; B, lateral; C, P4. Figures from Grice (1961).

Genus *Calocalanus*

Females generally with a broad, bulbous genital segment when viewed from above. A1 often much longer than the body. Prosome of 4 or 5 segments, compared to *Mecynocera* which has 6 segments. Female urosome 2 or 3-segmented, often 2 setae on the furca much thicker than the others. The P5 is uniramous and simple, symmetrical, 3 or 4-segmented with varying number of setae on the end of the terminal segment. Male P5 asymmetrical, uniramous, 4-segmented on the right and 5 on the left.

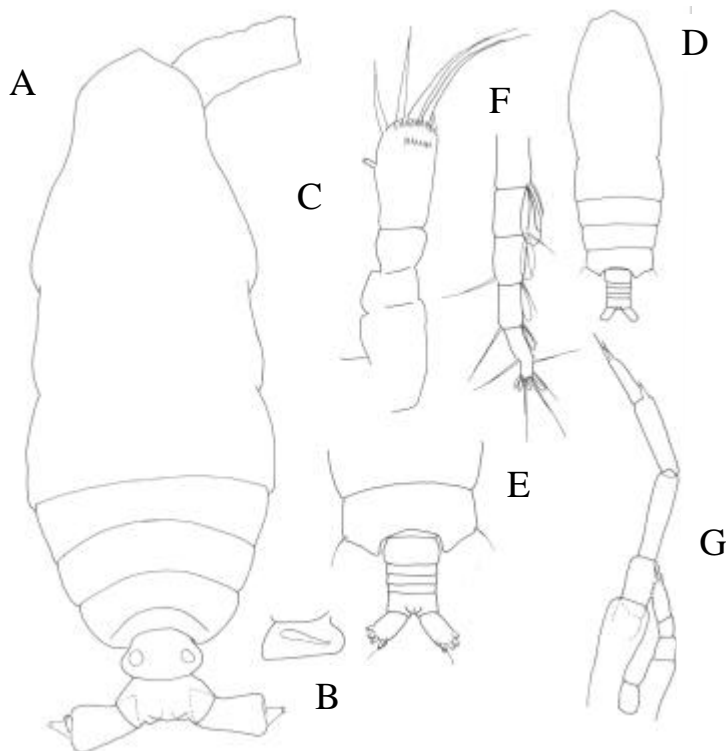
Calocalanus pavo (Dana, 1849)

Length: females: 0.85-1.40 mm; males: 1.04-1.18 mm.

Female: Small quite transparent species; in well-preserved specimens have plumose A1 and furca. Prosome stout, 3 times as long as wide. Cephalosome and first pedigerous segment fused. Urosome 2-segmented, genital segment onion-shaped, furca symmetrical, elongate and typically divergent, arranged almost at right angles to the urosome. P5 uniramous and symmetrical, 4-segmented; terminal segment with 5 plumose setae and 1 spine on the outer distal border and 2 rows of tiny spinules.

Male: Body quite different from the female, but can also have plumose A1 and furca. Cephalosome and first pedigerous segment are more or less separate, posterior metasome extending laterally into almost square corners. Urosome 5-segmented, furca longer than wide, not divergent. P1-4 as in the female. The P5 is small and biramous, limbs of very unequal lengths. Both P5 legs terminating in 2 small sub equal spines; right leg does not extend as far as the distal border of the second segment of the left leg.

Recorded: Seychelles, Madagascar



Calocalanus pavo: Female. A, dorsal; B, genital segment lateral; C, P5. Male. D, dorsal; E, urosome; F, distal A1; G, P5. Figures A-C from Bradford-Grieve (1994); D-G from Corral (1972).

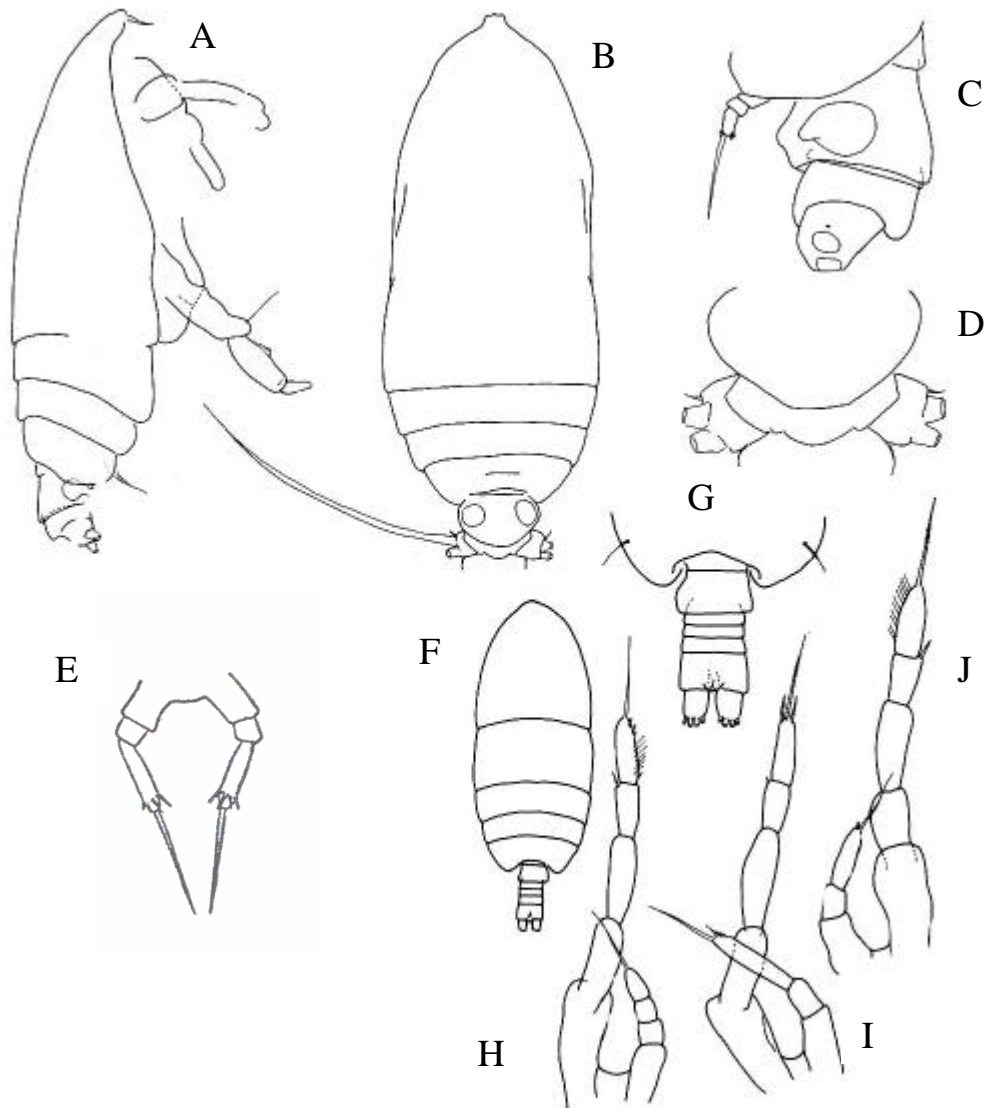
Calocalanus styliremis Giesbrecht, 1888

Length: females: 0.59-0.95mm; males: 0.48-0.55 mm.

Female: Wide robust prosome; cephalosome and first pedigerous segment fused; metasome 3-segmented. Urosome short, 3-segmented; genital segment swollen like an onion; furca symmetrical and typically divergent; P5 3-segmented, uniramous, terminal segments with a spine with 4 or 5 minute spinules at its base.

Male: Very different from the female. Cephalosome and first pedigerous segment fused. Urosome 5-segmented, furca not divergent. Left P5 may be 4 or 5-segmented, right P5 is much shorter and may be 3 or 4 segmented. These latter differences may be because closely related species have been mistakenly examined (Bradford-Grieve, 1994).

Recorded: Madagascar



Calocalanus styliremis: Female. A, lateral; B, dorsal; C, genital segment lateral; D genital segment dorsal; E, P5. Male. F, dorsal; G, urosome; H-J, P5 variations. Figures A-E from Bradford-Grieve (1994); F-J from Corral (1972).

Genus *Ischnocalanus*

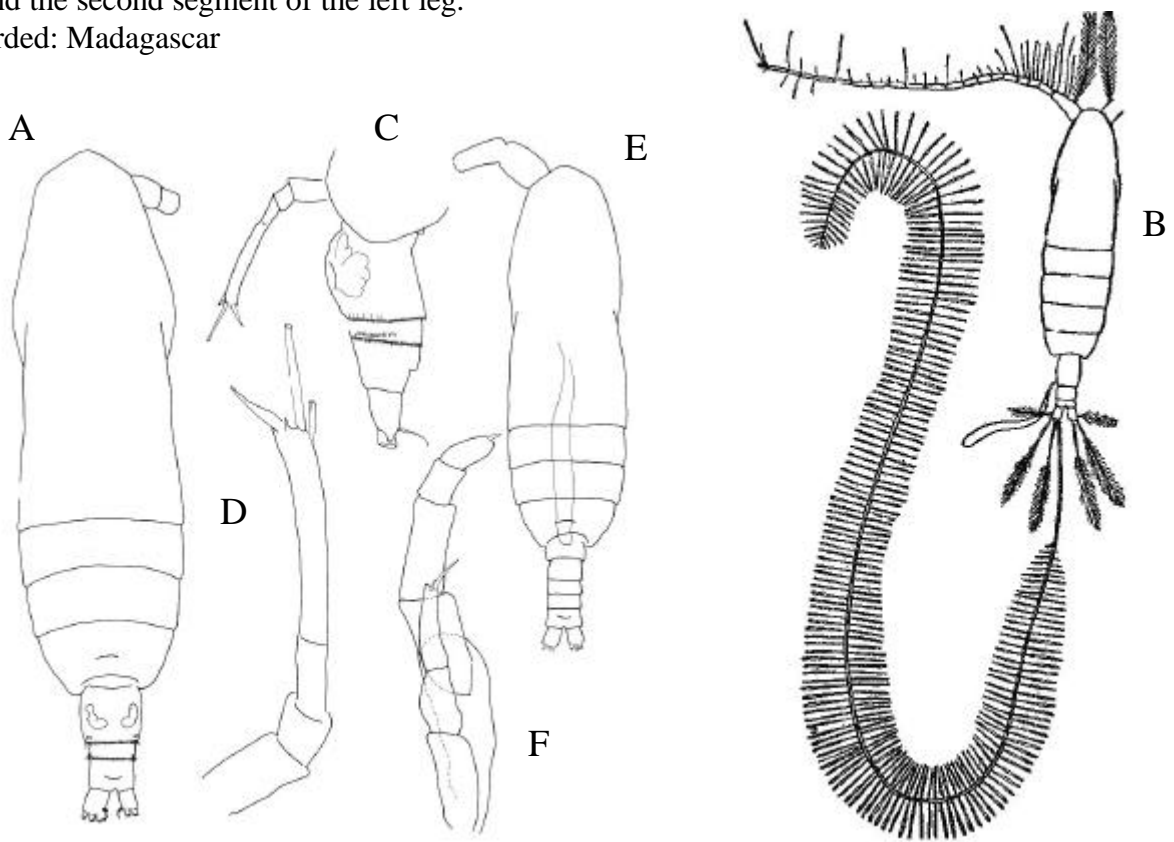
Ischnocalanus plumulosus (Claus, 1863)

Length: females: 0.87-1.25 mm; males: 0.83-0.90 mm

Female: Body slender, 4 times as long as wide. Cephalosome and first pedigerous segment fused. Urosome 3-segmented, genital segment almost cuboidal in shape. Posterior border of genital segment and urosome segment 2, lined with fine spinules; furca and their setae asymmetrical, in good specimens a very long, plumose seta on the left. Furca only slightly divergent Terminal segment of A1 twice the length of the penultimate segment. P5 of 4 segments, the terminal segment with 1 plumose seta between 2 sharp setae, 1 external spine and a horizontal row of fine spinules. The last 2 segments of P5 are hairy.

Male: Cephalosome and first pedigerous segment not fused. A1 exceeds the furca by the distal 5 segments. P5 left terminating in a single spine, P5 right terminating in 2 spines and reaching beyond the second segment of the left leg.

Recorded: Madagascar



Ischnocalanus plumulosus: Female. A, dorsal; B, dorsal; C, genital segment lateral; D, P5. Male. E, dorsal; F, P5. Figures A, C-F from Bradford-Grieve (1994); figure B from Giesbrecht (1892).

Genus *Paracalanus*

Quite small oval copepods; cephalosome fused with first pedigerous segment; rostrum composed of 2 fine filaments; A1 extends beyond the metasome. Posterior metasome segments rounded. Exopodites of P3 and P4 with serrated outside margin. Female with 4-segmented urosome, short genital segment and a tiny, simple P5, which is slender, short, uniramous, symmetrical, 2-segmented with 2 sub-equal terminal spines. P5 in the male it is uniramous, asymmetrical, with 5 segments on the left and 2 on the right. The right leg is very similar to the female P5 legs.

Paracalanus aculeatus Giesbrecht, 1888

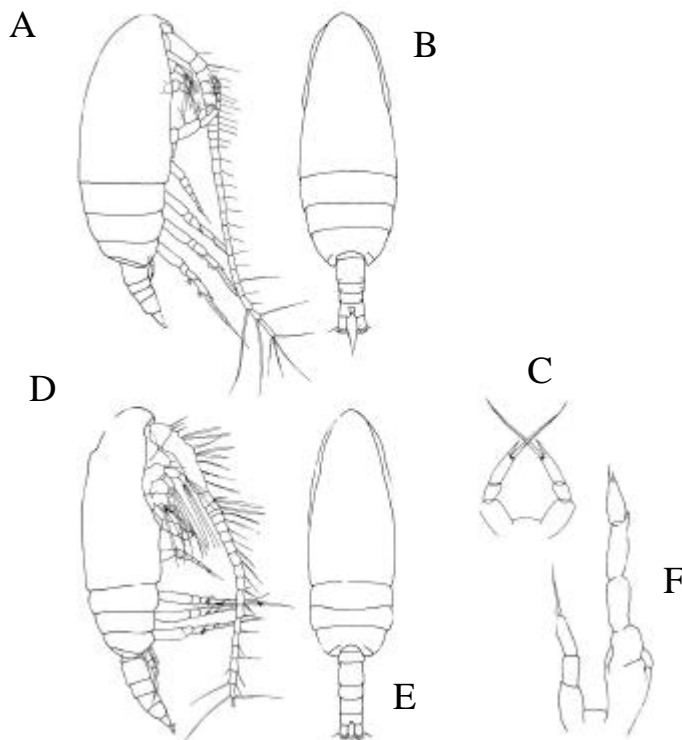
Length: females: 0.80-1.36 mm; male: 0.70-1.36 mm.

This species is sometimes sampled in 2 separate size classes.

Female: Urosome roughly a third of the length of the prosome. The longest furcal setae, when intact, are longer than the urosome. Similar to *P. parvus*, but the A1 extends beyond the furca. P5 symmetrical, uniramous, 3-segmented, the distal segment cylindrical, with a terminal spine longer than it and an outer distal spine almost half its length.

Male: Furca almost as long as wide, anal segment shorter than urosome segment 4. A1 extends almost as far as the furca. P5 extends beyond the posterior border of urosome segment 3; the 3-segmented right leg is similar to the female P5 legs and extends well beyond the distal border of segment 2 of the 5-segmented left leg.

Recorded: Madagascar.



Paracalanus aculeatus: Female. A, lateral; B, dorsal; C, P5. Male. D, lateral; E, dorsal; F, P5. Figures from Vervoort (1963).

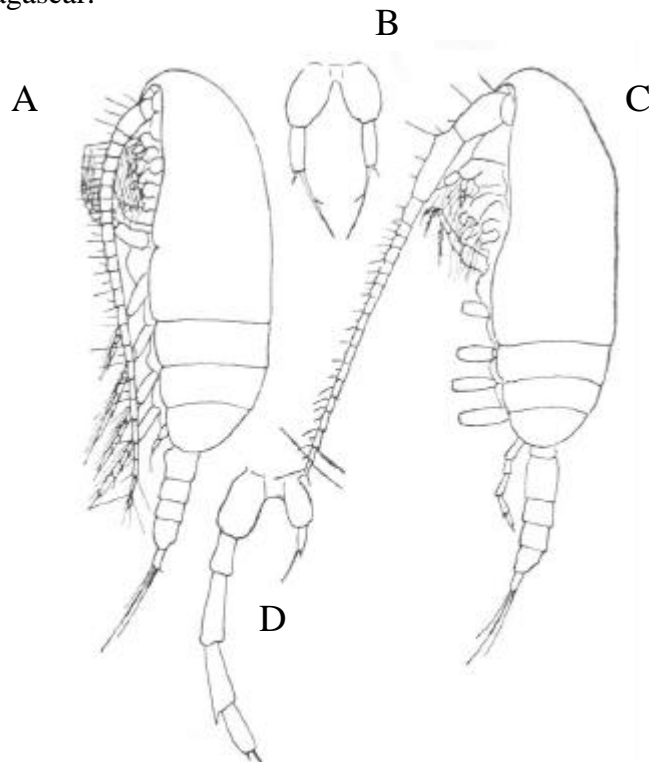
Paracalanus parvus (Claus, 1863)

Length: females: 0.70-1.20 mm; males: 0.8-1.4 mm.

Female: Cephalosome fused with the first pedigerous segment. A1 reaches around the middle of the 4-segmented urosome. Urosome around a third the length of the prosome, genital and anal segments about the same length. P5 uniramous and symmetrical, 2-segmented (one leg sometimes 3-segmented), terminal segment with a slender spine at the tip and a much smaller spine outside this.

Male: Slight ridge along the dorsal surface of the prosome. A1 quite robust. Urosome 5 segmented, second segment the longest. P5 asymmetrical, uniramous, the right foot 2-segmented, similar to the female P5 legs and the left 5-segmented. The right foot reaches the middle of segment 2 of the left foot. Both feet terminating in 2 sub-equal spines.

Recorded: Madagascar.



Paracalanus parvus : Female. A, lateral; B, P5. Male. C, lateral; D, P5. Figures from Sars (1903).

Family Eucalanidae

Mostly large copepods with elongated and often transparent bodies. Stage V females can have a swollen genital segment and resemble a stage V, but the segmentation is not clearly defined and if there is any uncertainty whether the specimen is mature, it probably is not. The female urosome is very short, 3 or 4-segmented, 5-segmented in the male, the furca usually fused to the anal segment in both sexes. Females often have a broad genital segment. Most have in dorsal view, a typical triangular anterior cephalosome. Cephalosome and first pedigerous segment fused, pedigerous segments 4 and 5 partially fused, rostrum with 2 long filaments. In some species the first antenna reaches well beyond the urosome. Female P5 missing or only on one side, or uniramous on the left and biramous on the right.

The number and arrangement of small integumental organs over the body is a useful character in identification (see Bradford-Grieve, 1994) but requires special preparation of the specimens.

Genus *Eucalanus*

Female urosome 4-segmented. The posterior margins of pedigerous segments 2-4 and urosome segment 1 without any spines. P5 missing in female, uniramous on both sides in the male.

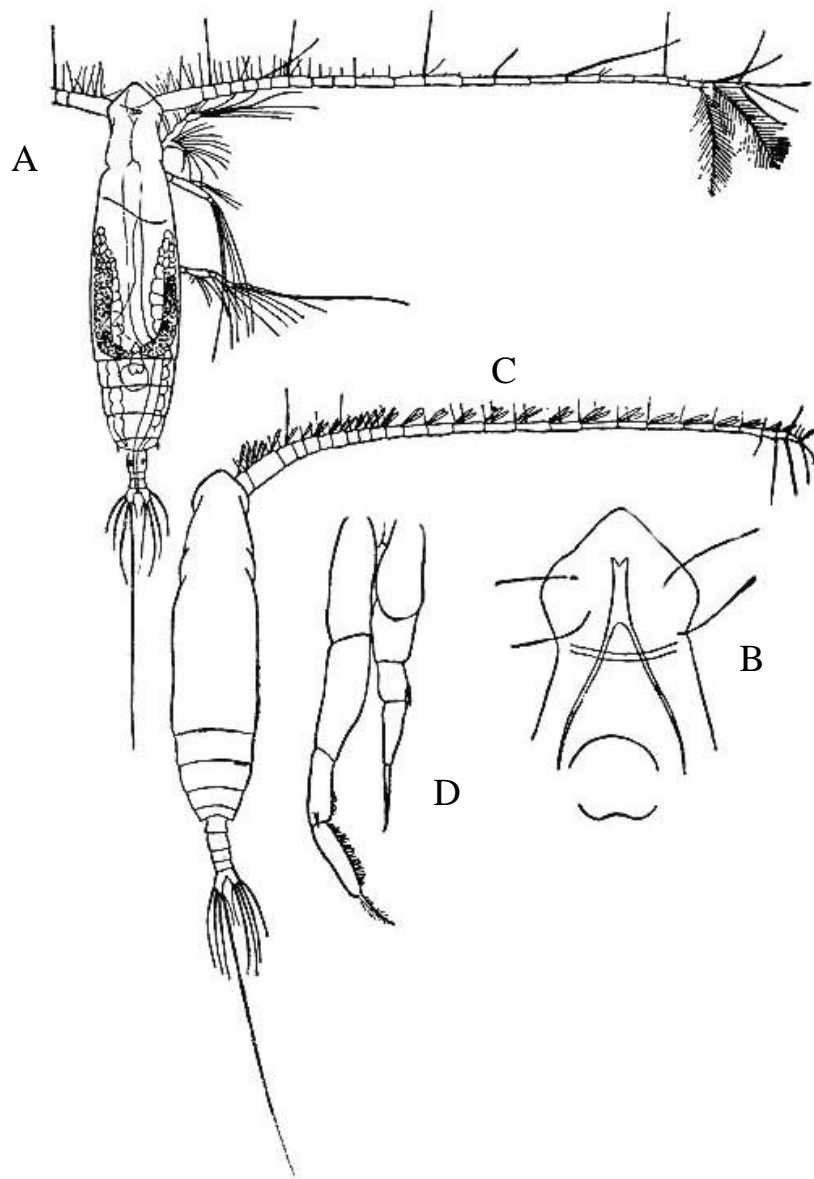
Eucalanus elongatus (Dana, 1849)

Length: females: 5.75-8.50 mm; males: 3.75-5.00 mm.

Female: Characterised by the pointed postero-lateral corners of the metasome. Transparent body. Anterior cephalosome triangular, urosome 4-segmented, genital segment longer than wide. Left furca wider and longer than the right. A1 extending beyond the furca by around the last 4 segments. Second inner seta of right furca elongated, if not broken off.

Male: Also has lateral points on the posterior metasome. Transparent body, anterior cephalosome bluntly rounded. A1 extending beyond the furca by around the last 4 segments. Urosome 5-segmented, genital segment slightly wider than long. Both P5 legs 4-segmented, terminating in spines; right leg shorter than the left, terminal segment reaching around the third segment of the left leg.

Recorded: Madagascar



Eucalanus elongatus: Female. A, dorsal; B, rostrum ventral. Male. C, dorsal; D, P5. Figures from Giesbrecht (1892).

Genus *Pareucalanus*

Includes the largest of the Eucalanidae. Female urosome 3-segmented and the posterior margins of pedigerous segments 2-4 and urosome segment 1 without any spines. P5 missing in the female, uniramous, simple in the male, the right leg shorter than the left, not extending beyond the distal part of left leg segment 2.

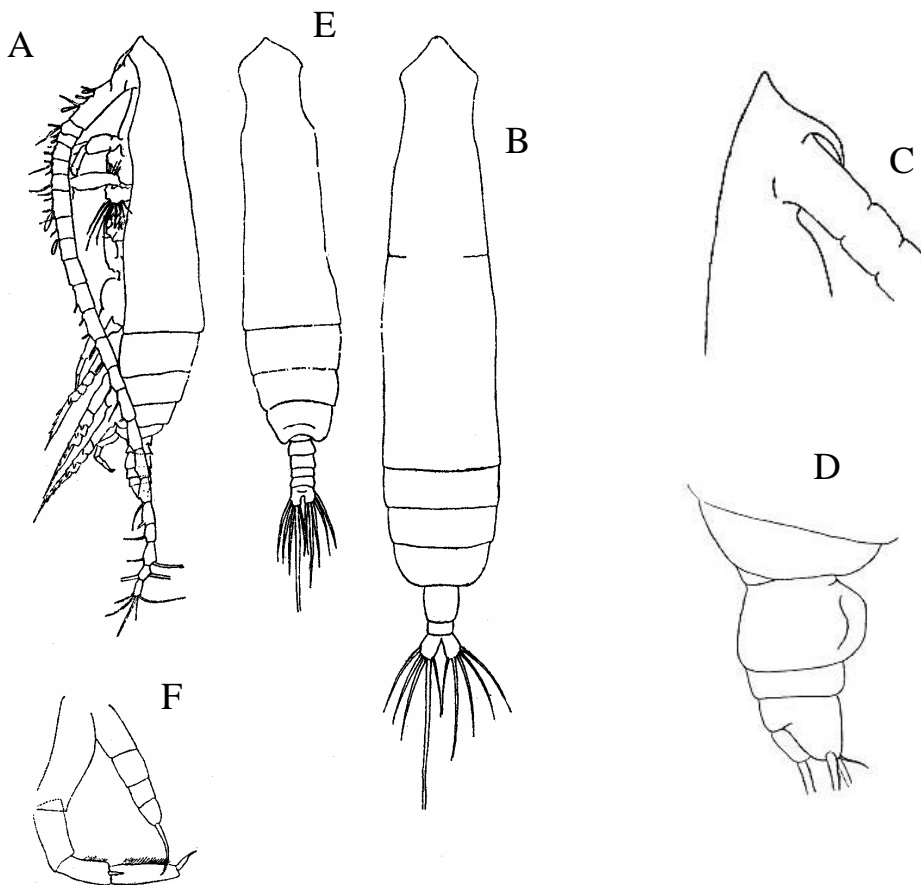
Pareucalanus attenuatus (Dana, 1849)

Length: females: 3.55-7.00 mm; males: 2.95-6.04 mm. There appears to be small and large forms and great variability in appearance of specimens. It is possible that some of the specimens are *P. sewelli* (Fleminger, 1973) but they are very difficult to tell apart without detailed examination of the integumental organs.

Female: In dorsal view, generally with a triangular, bluntly pointed cephalosome, very elongated anterior to the A2 and sometimes narrows in this region. In lateral view the anterior cephalosome is quite pointed. Posterior prosome corners rounded. A1 extends beyond the furca by the last 6-7 joints. No P5 present; genital segment is longer than wide; furca fused to the anal segment, one of the left furcal setae longer than the others.

Male: Anterior cephalosome triangular. A1 extends beyond the furca by the last 6-7 joints. Genital segment wider than long; P5 very simple, the left leg longer than the right, both legs of 4 segments and in both the terminal segment bears a spine. Furca fused to anal segment. One of the left furcal setae longer than the others.

Recorded: Rodrigues, Seychelles, Zuza, Madagascar, Aldabra, CPR.



Pareucalanus attenuatus: Female. A, lateral; B, dorsal; C, head lateral; D, genital segment lateral. Male. E, dorsal; F, P5. Figures A, B, E, F from Mori (1937); figures C, D from Vervoort (1946).

Genus *Subeucalanus*

Female urosome 3-segmented, the posterior margins of pedigerous segments 2-4 and urosome segment 1 without any spines. No P5 in female, uniramous in male, with only left leg present.

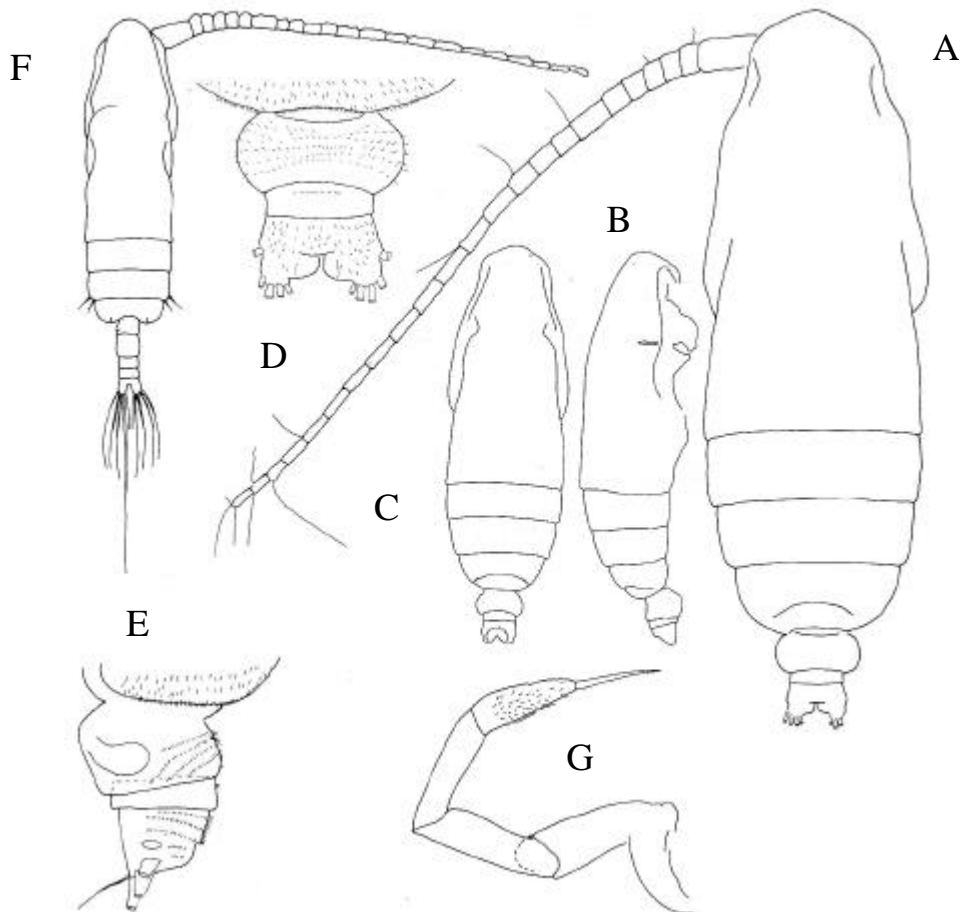
Subeucalanus crassus (Giesbrecht, 1888)

Length: females: 2.46-3.70 mm; males: 2.40-3.10 mm.

Female: Body robust, anterior cephalosome rounded and short. A1 reaches just beyond the furca. Urosome 3-segmented, genital segment wider than long and markedly onion shaped. Furca slightly asymmetrical, anal segment fused with the furca. The left second terminal seta of the furca is slightly longer than that of the right.

Male: Does not have distinct secondary sexual characters. A1 reaches around the end of the furca. Genital segment longer than wide. P5 right foot absent, left foot uniramous, 4-segmented, with terminal spine.

Recorded: Rodrigues, Madagascar.



Subeucalanus crassus: Female. A, dorsal; B, lateral; C, dorsal; D, genital segment dorsal; E genital segment lateral. Male. F, dorsal; G, P5. Figures A, D, E from Bradford-Grieve (1994); figures B, C, F, G from Fleminger (1973).

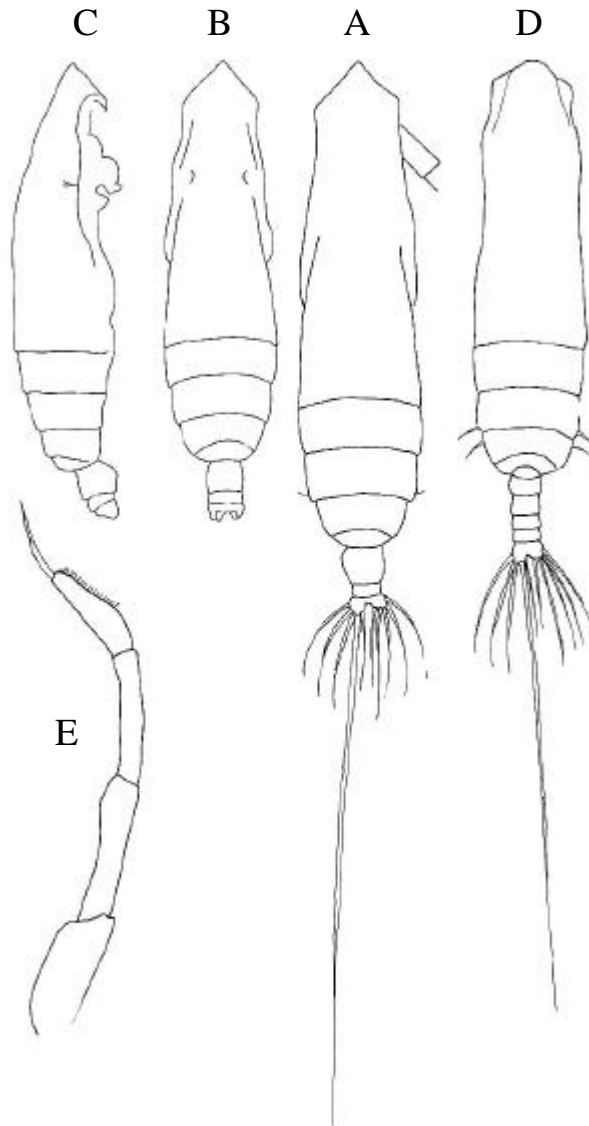
Subeucalanus mucronatus (Giesbrecht, 1888)

Length: females: 2.8-3.3 mm; males: 2.7-2.9 mm.

Female: Anterior cephalosome triangular and sharply pointed, both dorsally and laterally. Genital segment longer than wide; furca asymmetrical. Second inner seta on the right furca thicker than other setae and elongated, if not broken off.

Male: Anterior cephalosome rounded, quite square laterally. Right P5 absent. The terminal spine on the left P5 is shorter than the terminal segment, which separates it from *S. subtenuis*. Second inner seta on the right furca thicker and longer than other setae, if not broken off.

Recorded: Zuza, Madagascar, Aldabra.



Subeucalanus mucronatus: Female. A, dorsal; B, dorsal; C, lateral. Male. D, dorsal; E, P5. Figures B, C from Fleminger (1973); figures A, D, E from Mori (1937).

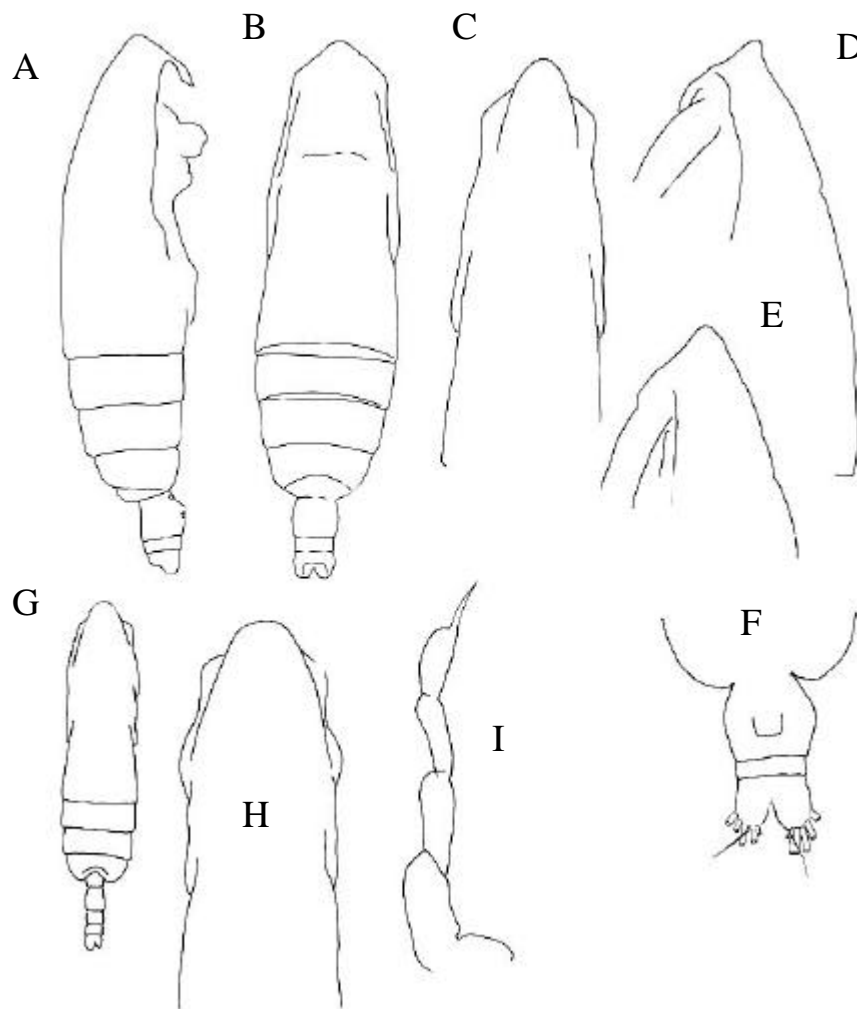
Subeucalanus pileatus (Giesbrecht, 1888)

Length: females: 1.80-2.50 mm; males: 1.80-2.25 mm.

Female: Prosome slender, widest at the posterior of the cephalosome; anterior cephalosome triangular, rounded anteriorly, more pointed than in *E. subcrassus*, but exact shape can be variable; urosome short, one sixth the length of the prosome. Posterior metasome more or less rounded. A1 passes the furca by around 5 segments. Urosome 3-segmented, genital segment slightly broader than long, moderately swollen in dorsal view, widest in the centre, moderately swollen in lateral view. The line of fusion between the furca and anal segment obvious. Furca are almost symmetrical, the second seta on the left greatly lengthened, but only slightly thicker than the other setae. P5 absent.

Male: Similar to the males of *S. crassus* but smaller. The P5 is 4-segmented and only present on the left. The terminal spine is shorter than the terminal segment.

Recorded: Rodrigues, Zuza.



Subeucalanus pileatus: Female. A, lateral; B, dorsal; C-E dorsal and lateral views of head shape variants; F, urosome ventral. Male. G, dorsal; H, head dorsal; I, P5. Figures A,B from Fleminger (1973): C-I from Giesbrecht (1892).

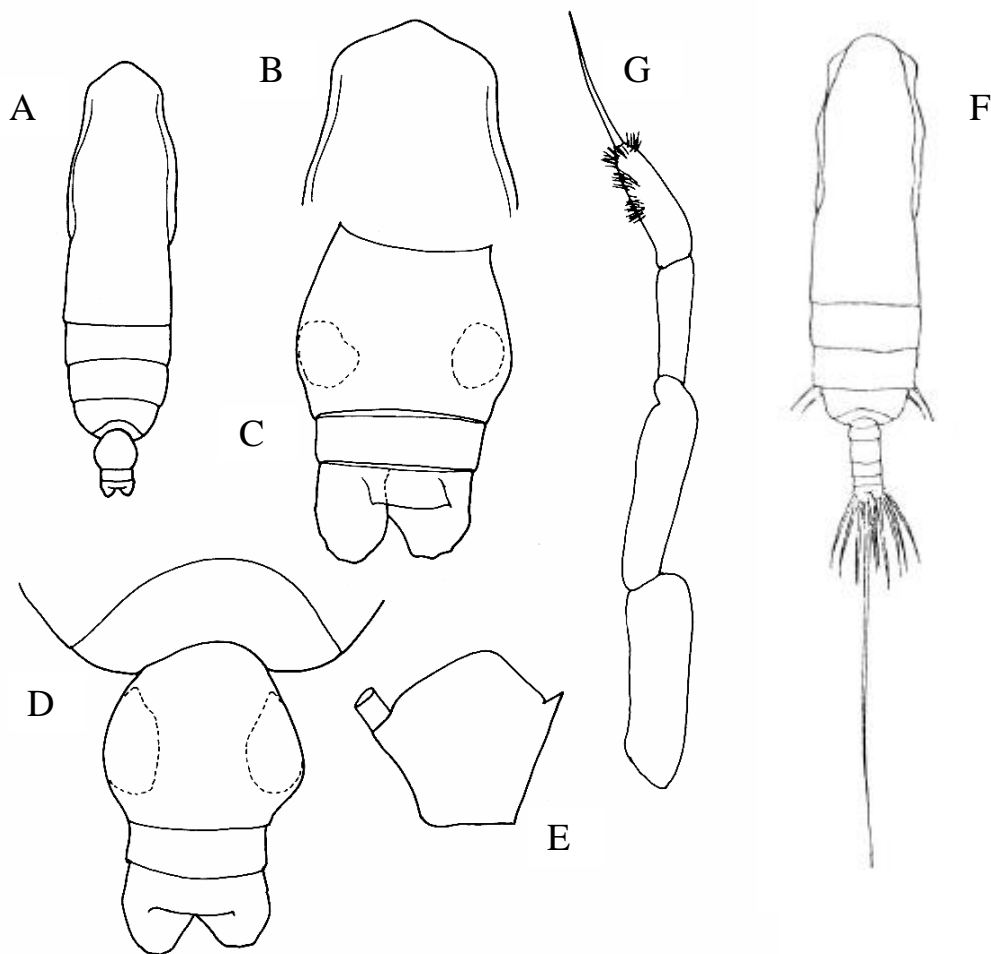
Subeucalanus subcrassus (Giesbrecht, 1888)

Length: females: 1.93-2.88; males: 2.40 mm.

Female: Similar to *S. crassus* but slimmer, head more pointed and extends further forward in lateral view, the second terminal seta on the left furca is much longer than the right seta and the genital segment is narrower. Anterior of cephalosome rounded; A1 extends beyond the furca by around 4 segments. Urosome 3-segmented, genital segment broader than long, with widest part in dorsal view on the posterior half of the segment, compare to *E. pileatus* where it is wider in the centre; furca fused with anal segment.

Male: P5 right absent, terminal seta on left P5 longer than the terminal segment. Second terminal setae of the furca are asymmetrical, as in the female.

Recorded: Rodrigues, Seychelles, Zuza, Madagascar, Aldabra.



Subeucalanus subcrassus: Female. A, dorsal; B, dorsal head profile; C, urosome ventral; D, anterior urosome and genital segment ventral; E, P3 endopod segment 2. Male. F, dorsal; G, P5. Figures A-E, G from Greenwood (1976); F from Mori (1937).

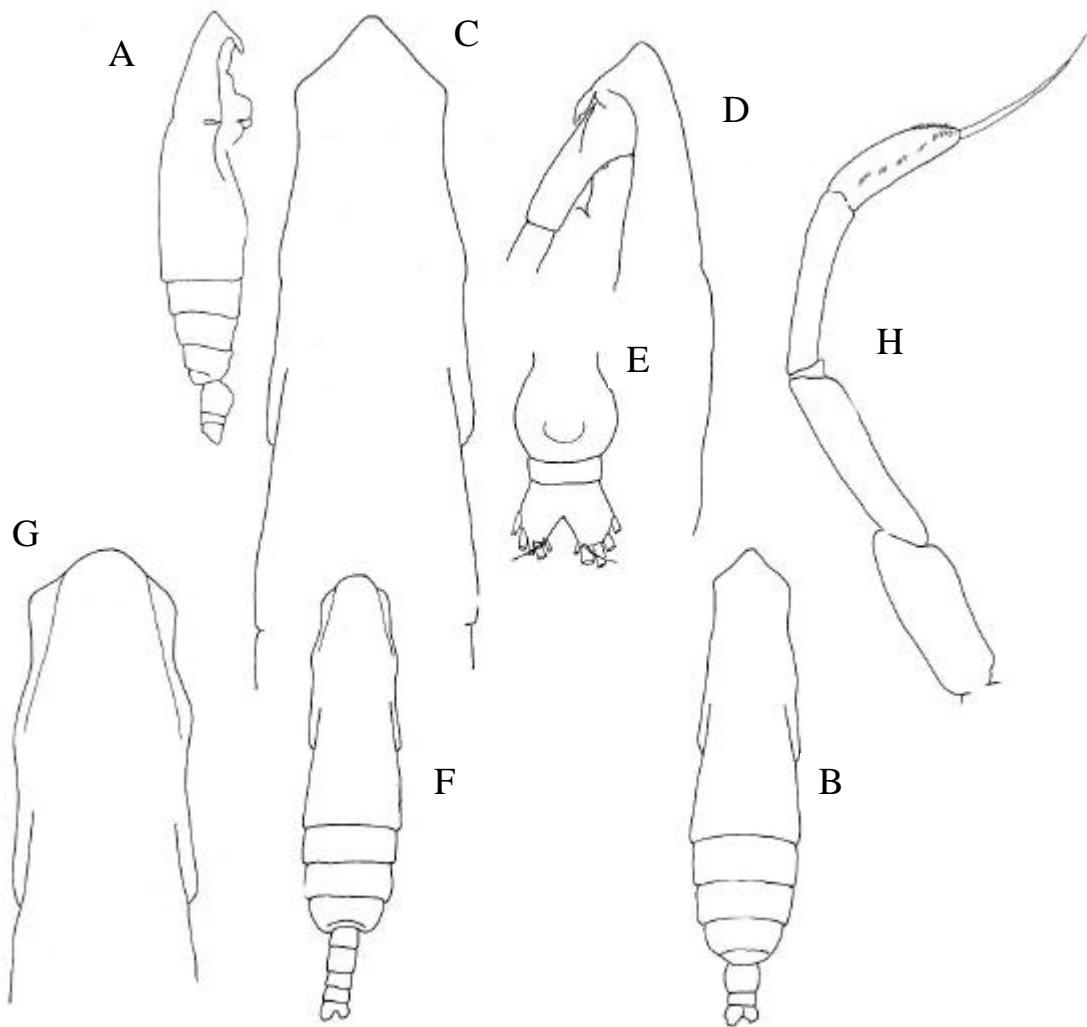
Subeucalanus subtenuis (Giesbrecht, 1888)

Length: females: 2.61-3.15 mm; males: 2.70-2.75 mm.

Female: Similar to *S. mucronatus*, as the anterior of cephalosome triangular, but its apical portion is less sharply pointed. Furca asymmetrical.

Male: Anterior cephalosome rounded. Resembles *S. mucronatus* but the terminal spine on the left P5 is longer than the terminal segment. Also similar to *S. crassus* but has more developed asymmetry of the setae of the furca, the left second seta is much longer and thicker than the right seta.

Recorded: Rodrigues, Seychelles, CPR.



Subeucalanus subtenuis: Female. A, Lateral; B, dorsal; C, head dorsal; D head lateral; E, urosome ventral. Male. F, dorsal; G, head dorsal; H, P5. Figures A from Fleminger (1973); B-H from Giesbrecht (1892).

Genus *Rhincalanus*

Long, very slim species with anterior cephalosome extended into a conical process, carrying on the ventral surface the rostral filaments. Cephalosome and first pedigerous segment fused. A1 is longer than the whole body. Metasome segments with lateral and dorsal spines. Urosome short, 3-segmented, the distal segment fused with the furca. The female P5 is uniramous, 3-segmented and very simple. The male P5 is also a very simple limb, biramous on one side.

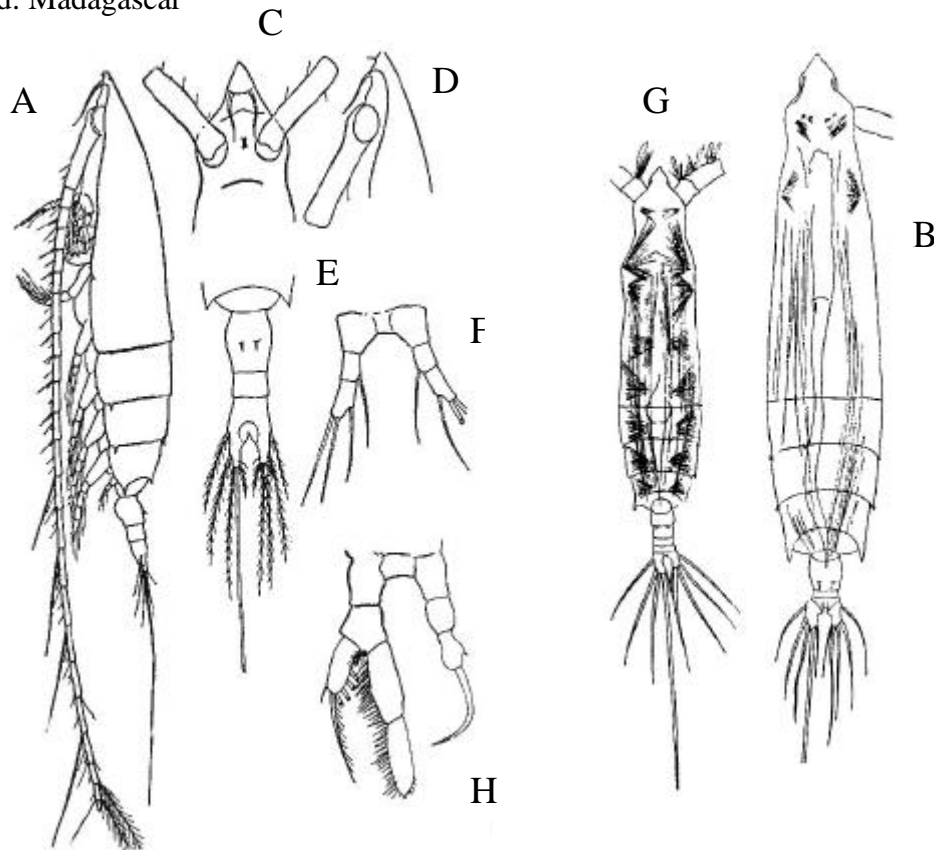
Rhincalanus nasutus Giesbrecht, 1888

Length: females: 3.90-5.50 mm; males: 2.70-4.0 mm.

Female: Strongly pointed anterior cephalosome, but less so than in *R. rostifrons*. Prosome long and slender with lateral spines and dorsal pairs of spines on the posterior margin of the first 3 metasome segments. A1 around 1.5 times the length of the whole body. Urosome 3-segmented, with pair of small spines on dorsal surface of genital segment. Rostral filaments situated under the frontal projection and are hardly visible from above. P5 are uniramous and 3-segmented, with one seta on the second segment internally and three terminal setae.

Male: Prosome similar to female, but A1 considerably shorter. Spines on the metasome segments and on the first urosome segment similar to the female. Right P5 is uniramous, 3-segmented with a slender curved terminal spine. Left P5 biramous, endopodite 3-segmented with segments of almost equal length, exopodite 1-segmented with a long terminal plumose seta and outside of it a naked, very short seta.

Recorded: Madagascar



Rhincalanus nasutus: Female. A, lateral; B, dorsal; C, head ventral; D, head lateral; E, urosome ventral; F, P5. Male. G, dorsal; H, P5. Figures A, C-F, H from Sars (1903); B, G from Mori (1937).

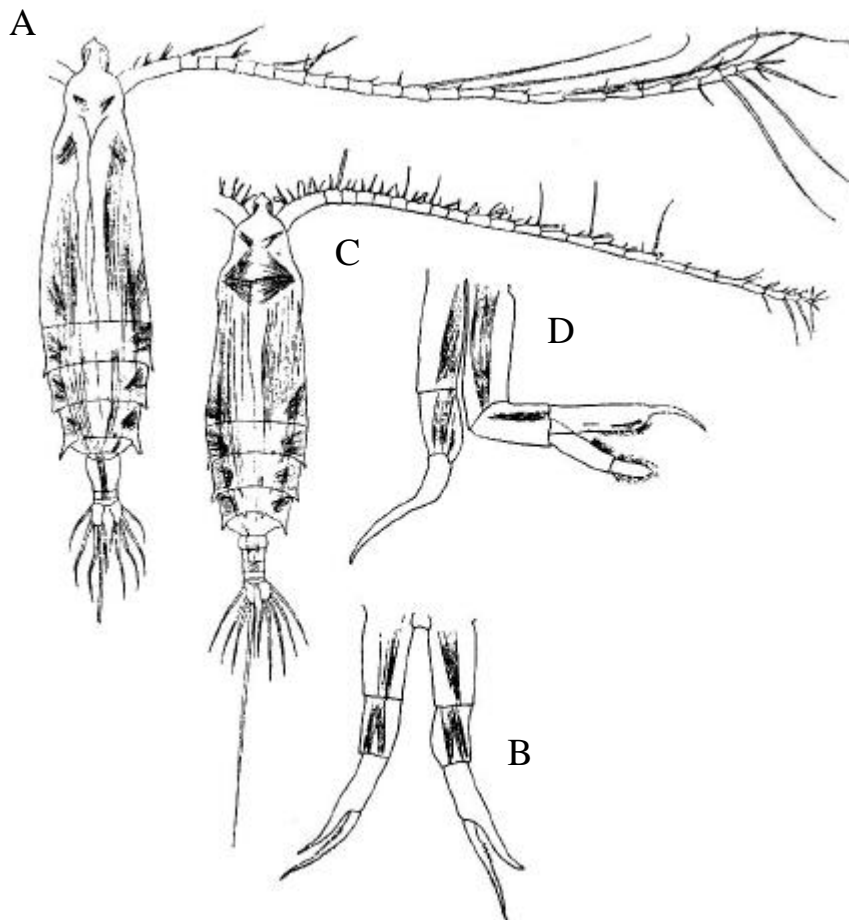
Rhincalanus rostifrons (Dana, 1849)

Length: females: 2.79-3.80 mm; males: 2.41-2.95 mm.

Female: Extremely extended point on the anterior cephalosome, with prominent rostral filaments which protrude laterally, visible in dorsal view. A1 around 1.5 times as long as whole body. P5 3-segmented, without seta on the second segment, the terminal segment extended into a stout curved point, with an internal toothed spine.

Male: Right P5 uniramous, 3-segmented with the terminal segment extended into a curved spine. Left P5 biramous with a 1-segmented exopodite bearing a curved terminal spine; a 2-segmented endopodite, the first segment longer than the second, the endopodite around the same length as the exopodite.

Recorded: Seychelles, Zuza, Madagascar, Aldabra, CPR.



Rhincalanus rostifrons: Female. A, dorsal; B, P5. Male. C, dorsal; D, P5. Figures from Mori (1937).

Family Aetideidae

Cephalosome and first pedigerous segment fused. Last metasome segment often prolonged in points. Rostrum usually strong, simple or bifurcated, rarely absent. Female urosome 4-segmented, male 5-segmented. P5 generally absent in the female, of simple structure in the male.

Genus *Aetideus*

In the female the cephalosome and first pedigerous segment are fused; sometimes with a crest on the dorsal cephalosome; rostrum bifurcated, strong, widely spaced. Posterior metasome segments usually symmetrical, prolonged into points. P5 missing, P4 coxa with a few small spinules near base of the internal setae. In the male the cephalosome and first pedigerous segment are also fused. No rostrum or crest; posterior metasome segment with lateral points. P5 with only one uniramous leg, the left, 5-segmented, simple and elongated.

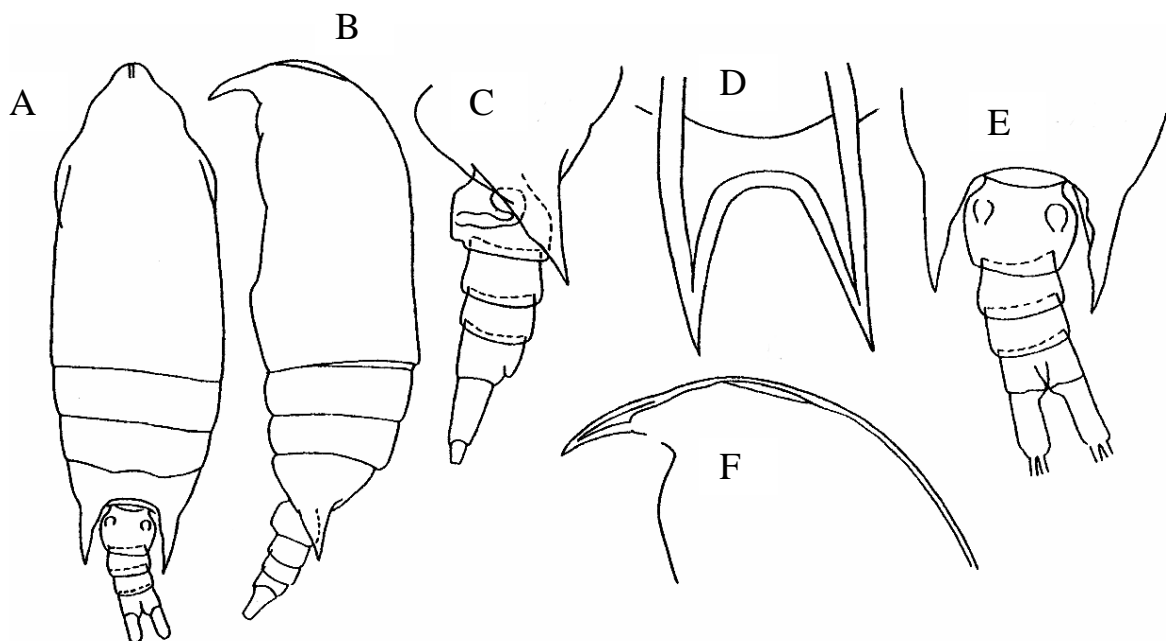
Aetideus bradyi A. Scott, 1909

Length: females: 1.38-1.80 mm; males: ? mm.

Female: Rostrum robust, bifurcated and protruding ventrally. Crest present on dorsal anterior cephalosome, visible dorsally as a line. Wing-like extensions, pointed at ends, on the posterior metasome segment, usually reaching the ends of the second urosome segment. A1 almost as long as the prosome. P5 absent.

Male: Undescribed.

Recorded: Madagascar



Aetideus bradyi: Female. A, dorsal; B, lateral; C, urosome lateral; D, rostrum; E, urosome ventral; F, head lateral. Figures from Markhaseva (1996).

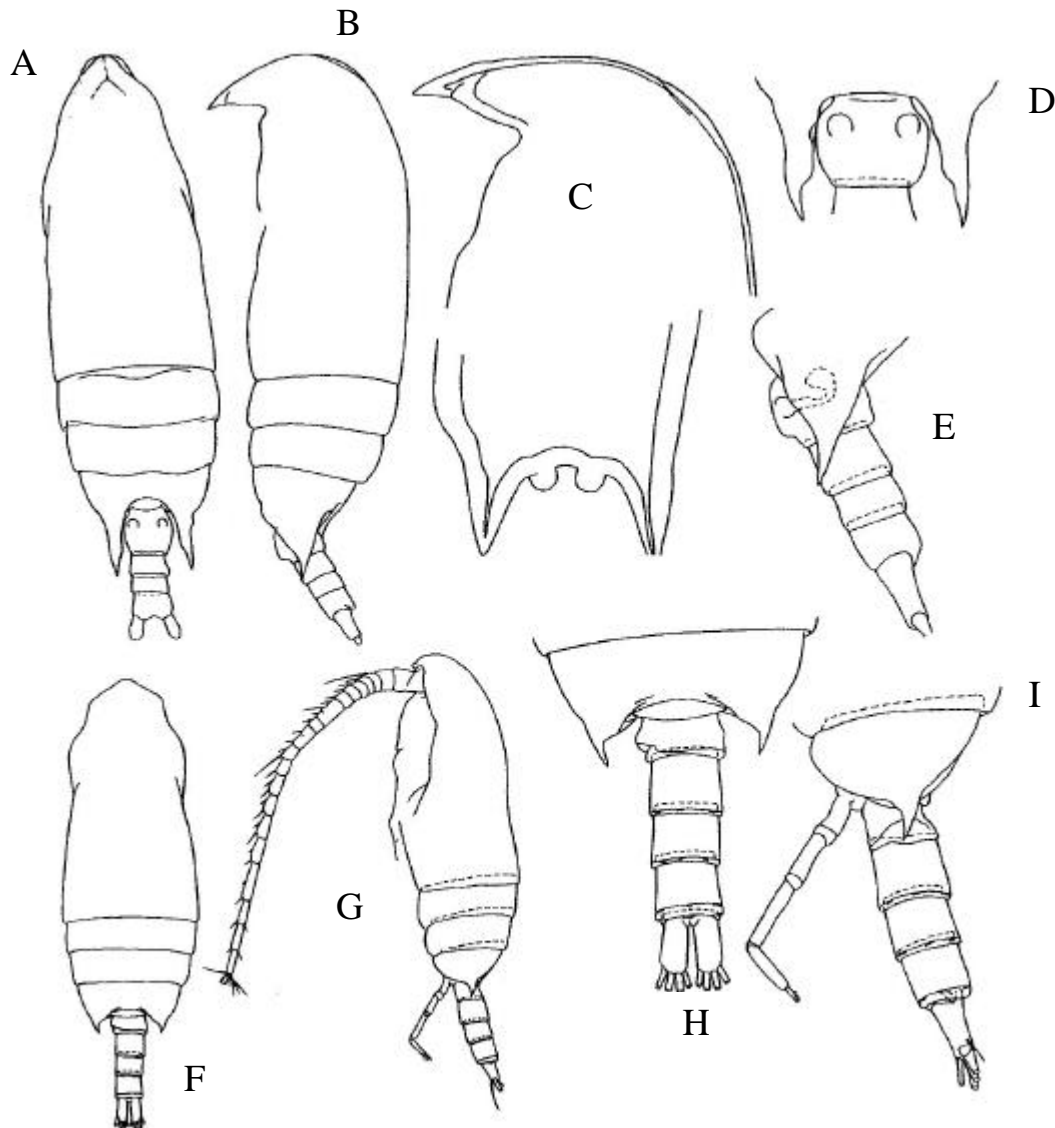
Aetideus giesbrechti Cleve, 1904

Length: females: 1.8-2.20 mm; males: 1.52-1.60 mm.

Female: Rostrum very robust and protruding ventrally, with 2 thickenings between the points. Crest not very pronounced, but visible in dorsal and ventral view. Wing-like extensions, pointed at ends, on the posterior metasome segment, usually reaching the ends of the second urosome segment. A1 reaches to around the third urosome segment. P5 absent

Male: Corners of the last metasome segment much less pointed than in the female, reaching the posterior edge of the genital segment. A1 reaches the posterior border of the third abdominal segment. P5 simple, uniramous with only the left leg present, straight and 5-jointed

Recorded: Zuza, Madagascar.



Aetideus giesbrechti: Female. A, dorsal; B, lateral; C, rostrum; D, urosome ventral; E, urosome lateral. Male. F, dorsal; G, lateral; H, urosome; I, P5. Figures from Markhaseva (1996).

Genus *Euchirella*

Robust copepods. In the female the cephalosome and the first pedigerous segment are completely or partially fused. A crest on the dorsal cephalosome may be present. Posterior metasome segments rounded or angular, usually symmetrical. Furca nearly as long as wide. A1 usually longer than the prosome. P5 absent; depending on species, coxa with variable (1-13) number of spines or spinules at the base of the internal seta, on the posterior surface. In the male a crest on the dorsal cephalosome may be present. The cephalosome and the first pedigerous segment are fused. Posterior metasome segments usually rounded. A1 longer than prosome, reaching the end of urosome segment 3, or to the end of the furca. P5 large and heavily modified.

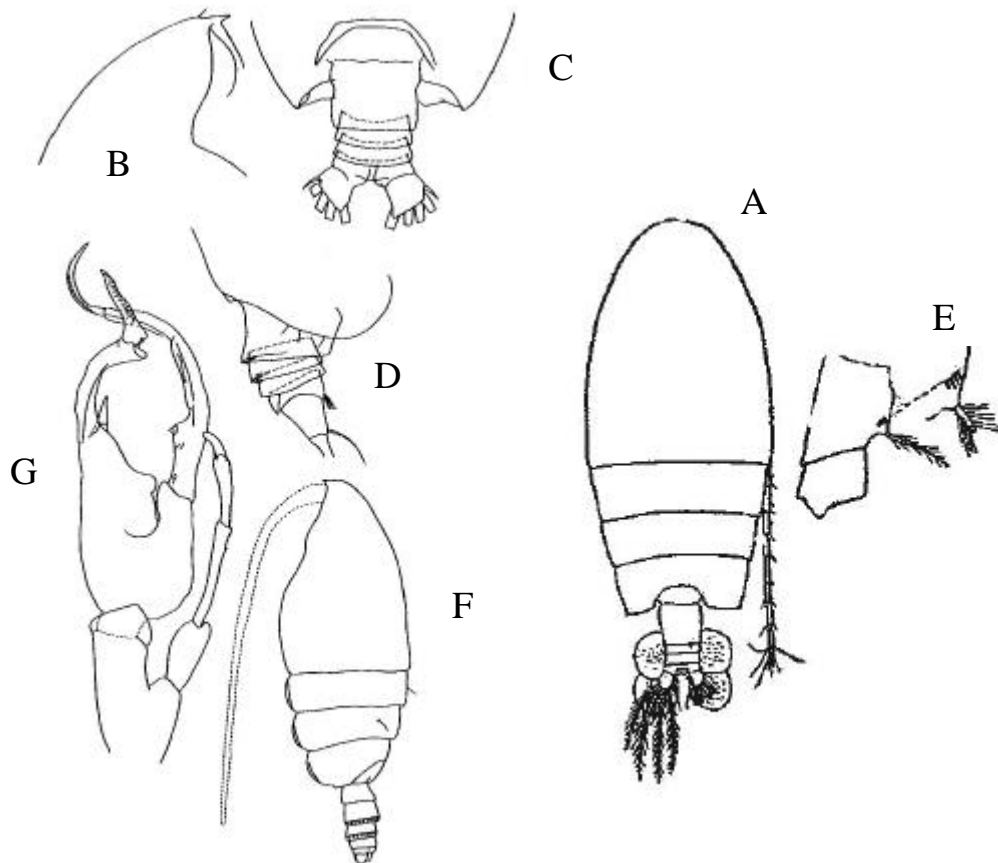
Euchirella amoena Giesbrecht, 1888

Length: females: 2.70-4.00 mm; males: 3.00-3.85 mm.

Female: Prosome 4-5 times longer than urosome. Posterior metasome segments in dorsal view nearly rectangular. Genital segment symmetrical; A1 reaching half way down the urosome. P5 missing, P4 coxa with around 5 tiny teeth at the base of a plumose seta.

Male: Similar in appearance to female. P5 with uniramous left leg and large biramous right leg. Right P5 endopodite longer than the exopodite. The first exopodite segment of right P5 with a large spine-like projection in the mid internal margin, the second exopodite segment is about one third the length of the first segment

Recorded: CPR.



Euchirella amoena: Female. A, dorsal; B, head lateral; C, urosome ventral; D, urosome lateral; E, basis of P4. Male. F, dorsal; G, P5. Figures A, E from Sars (1925; as *E. brevis*); B-D, F, G from Markhaseva (1996)

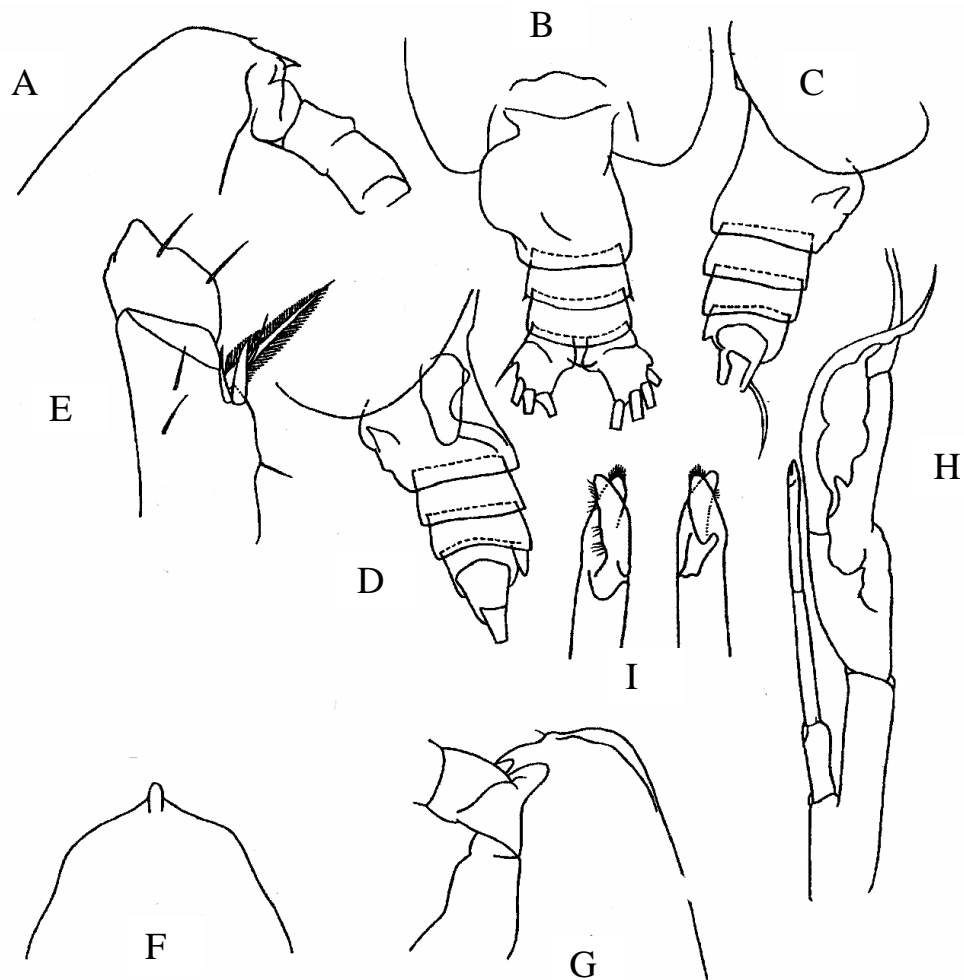
Euchirella pulchra (Lubbock, 1856)

Length: females: 3.04-4.40 mm; males: 3.06-4.15 mm.

Female: No crest on anterior cephalosome, but in lateral view this area is rounded or slightly triangular. Rostrum well developed. Genital segment asymmetrical with a large ear-like protrusion on the left and a small depression on the right. Anterior metasome segment rounded and symmetrical. A1 reaches almost to end of genital segment. P5 absent, P4 coxa with 2 spines.

Male: Low crest on anterior cephalosome. Rostrum well developed. P5 left without endopodite, the first segment of the exopodite not reaching the distal end of the right basis. The P5 right endopodite with 4 projections along the external margin; the first segment of the exopodite with 3 projections on inner margin

Recorded: Zuza.



Euchirella pulchra: Female. A, head lateral; B, urosome ventral; C, urosome lateral right; D, urosome lateral left; E, coxa P4. Male. F, head dorsal; G, head lateral; H, P5; I, detail of terminal segment of left P5 exopod. Figures from Markhaseva (1996).

Genus *Gaetanus*

In the female one pointed rostrum present, which is not large. Frontal spine sometimes present on anterior cephalosome. Cephalosome and first pedigerous segment fused. Posterior metasome segment symmetrical, rounded but with spines of different shapes and sized. Genital segment symmetrical. P5 absent; P4 coxa with group of 11-35 spines in a clump. In males a rostrum is present, but if they have a frontal spine it is smaller than in the female. Spines on the posterior metasome segment reduced compared to female. P5 asymmetrical, biramous but endopodites very reduced.

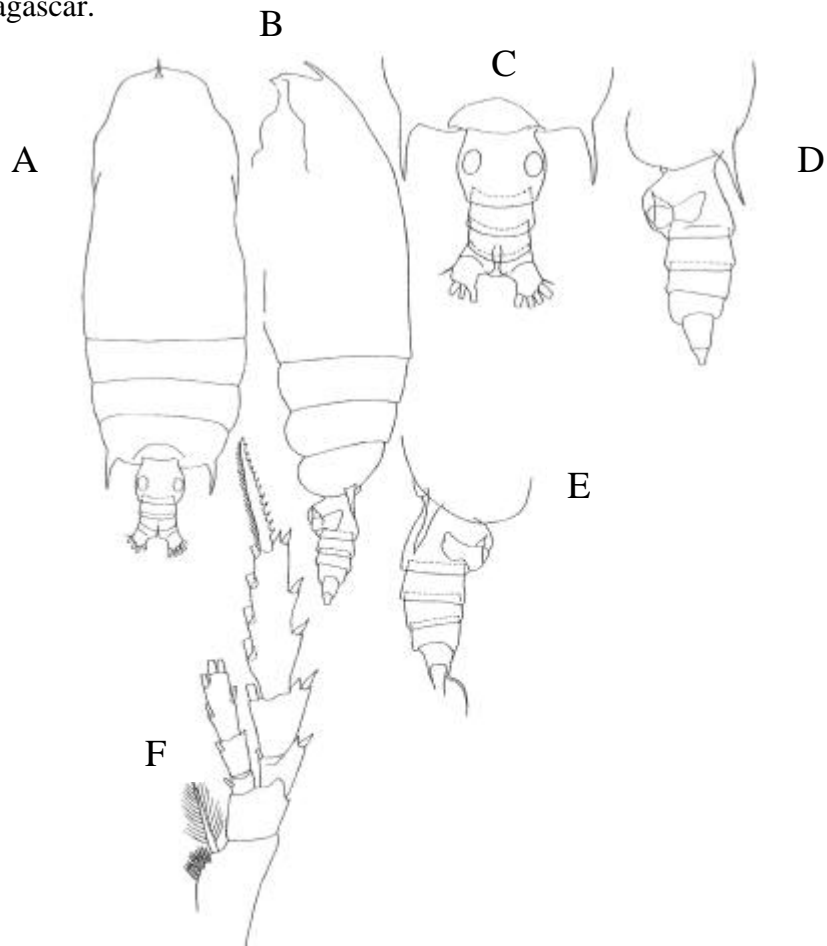
Gaetanus minor Farran, 1905

Length: females: 1.70-2.40 mm; males: ? mm.

Female: Frontal spine present on anterior cephalosome, curving towards the rostrum. Spines on posterior metasome segment reaching almost to the distal edge of genital segment. Spines straight and situated towards the dorsal side of the segment. A1 reaches almost to furca. P5 missing; P4 coxa with group of 12-15 small spines beside internal seta.

Male: Undescribed

Recorded: Madagascar.



Gaetanus minor: Female. A, dorsal; B, lateral; C, urosome dorsal ; D, urosome lateral left; E, urosome lateral right; F, P4. Figures from Markhaseva (1996).

Genus *Undeuchaeta*

In female crest sometimes present, 1-pointed rostrum present. Cephalosome and first pedigerous segment indistinctly separated or fused. Last metasome segment produced into obtuse triangular, or triangular lobes, one of which may be rounded. Genital segment asymmetrical, with small projection or spine on the right. A1 nearly as long as the prosome, or reaching to around the third urosome segment. P5 missing; P4 coxa without large spines, rarely with small spinules. In male the cephalosome and first pedigerous segment fused. Rostrum 1-pointed. Crest on anterior cephalosome sometimes present. Corners of last metasome segment slightly asymmetrical and rounded. A1 reaches the end of the prosome, or to around segment 3 of the urosome. P5 large and robust, biramous, sometimes longer than urosome. The left P5 third exopodite segment extended into a sharp projection.

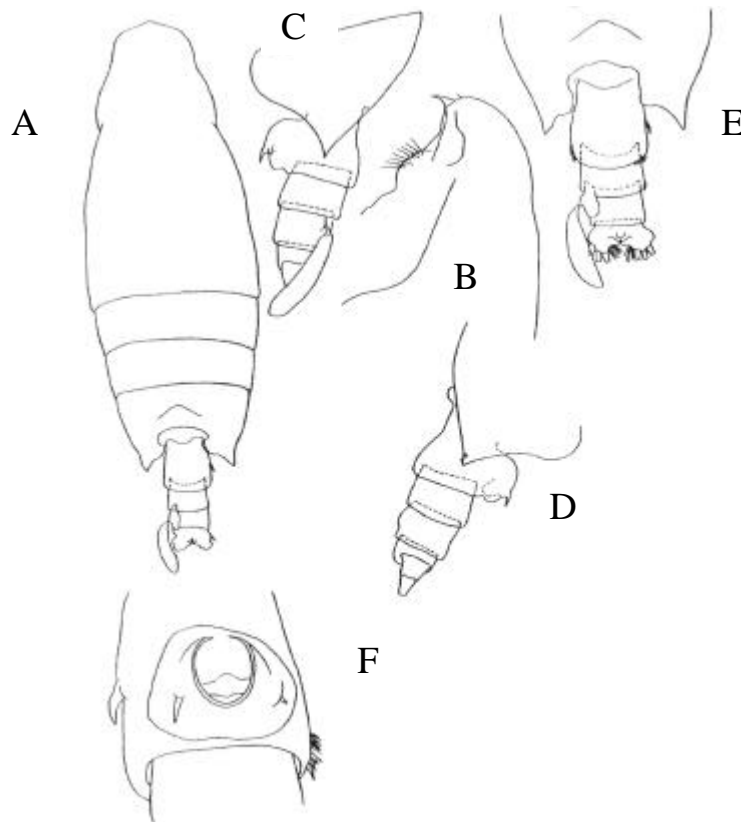
Undeuchaeta intermedia A. Scott, 1909

Length: females: 3.56-4.50 mm; males: 3.62-3.69 mm.

Female: No crest; corners of last metasome segment with triangular lobes, slightly asymmetrical, sometimes the right corner is rounded in dorsal and lateral view. In dorsal view, spine on right side of genital segment, in ventral view 2 spines on either side of same segment. In lateral view large spine-like protrusion from genital segment. A1 almost as long as prosome. P5 missing.

Male: P5 biramous, right exopodite segment 1 with sharp spine on the first third of the segment, with small projection on opposite side; internal segment covered with almost parallel wavy lines. Left endopodite reaching the distal end of the first exopod segment, second exopodite segment with spine-like projection on external distal border, third exopodite segment proximal angle extending into a spine.

Recorded: Zuza.



Undeuchaeta intermedia: Female. A, dorsal; B, head lateral; C, urosome lateral left; D, urosome lateral right; E, urosome ventral; F, genital segment ventral. Figures from Markhaseva (1996).

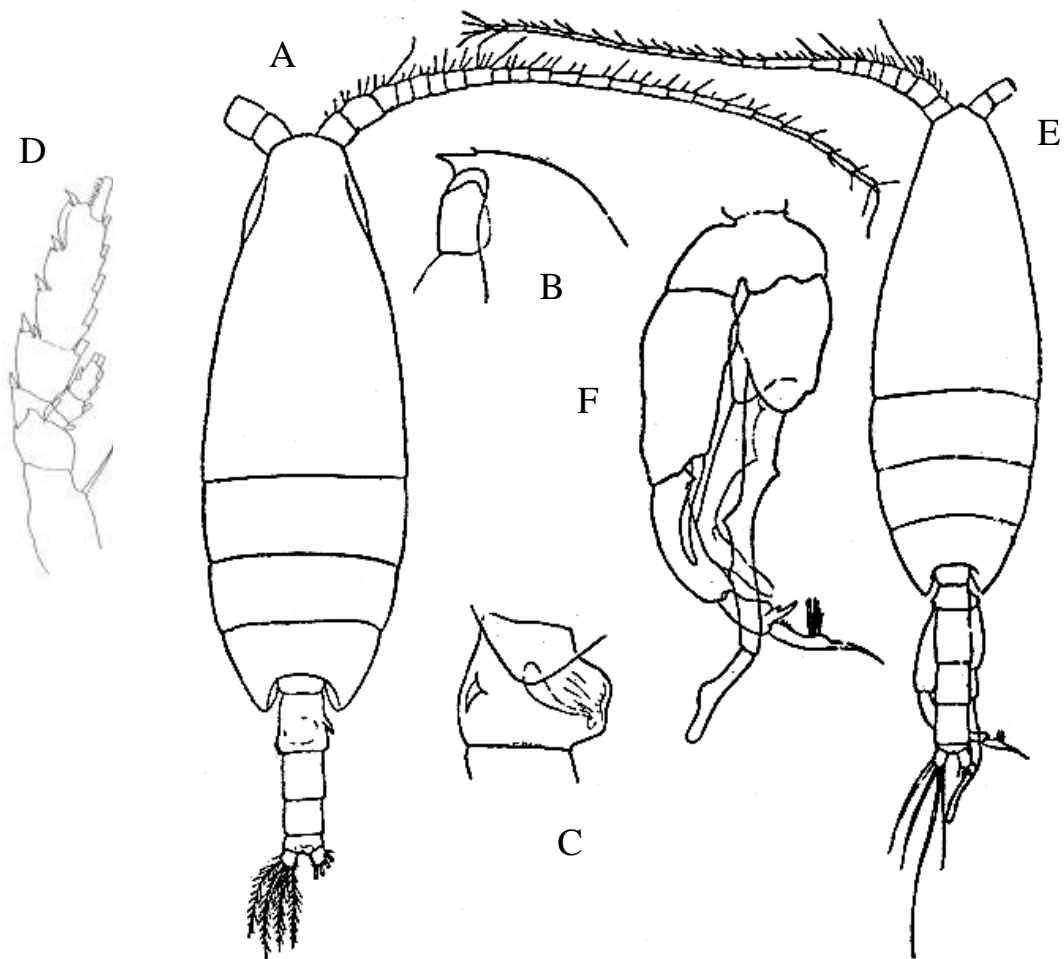
Undeuchaea plumosa (Lubbock, 1856)

Length: 3.00-4.20 females: mm; males: 2.85-3.90 mm.

Female: Posterior cephalosome without dorsal crest, rostrum single pointed, directed ventrally. Last metasome segment slightly asymmetrical in dorsal view, in lateral view the right corner rounded, the left more pointed, although this feature is variable. In dorsal view, spine on right side of genital segment. A1 equal in length to the prosome, or slightly longer. P5 absent, P4 coxa without internal spines at base of seta.

Male: No crest on cephalosome. A1 around the same length as prosome. Posterior metasome segment corners rounded. P5 asymmetrical, biramous. Right P5 exopodite and endopodite both 3-segmented. Left P5 exopodite 3-segmented, the apical portion pointed; endopodite 1-segmented, reaching around the distal part of the first exopodite segment.

Recorded: Zuza, Madagascar.



Undeuchaea plumosa: Female. A, dorsal; B, head lateral; C, urosome lateral right; D, P4. Male. E, dorsal; F, P5. Figures A-C, E, F from Sars (1925); D from Markhaseva (1996).

Family Arietellidae

Genus *Metacalanus*

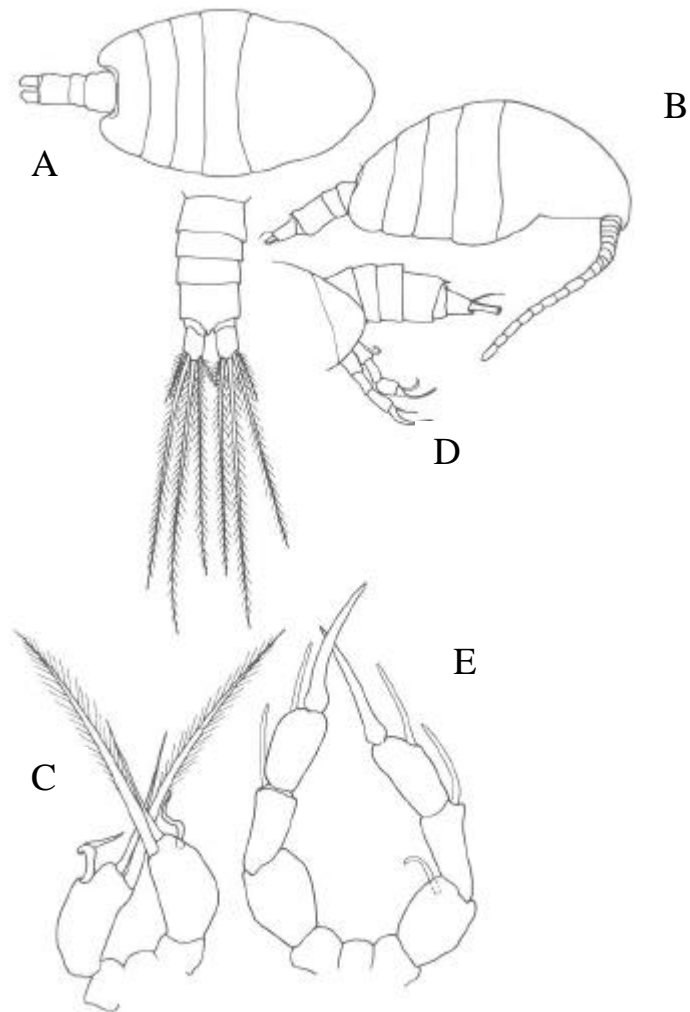
Metacalanus aurivilli Cleve, 1901

Length: females: 0.55-0.64 mm; males: 0.53-0.56 mm.

Female: Small copepod, in lateral view rounded with high prosome. Posterior of last metasome segment rounded in dorsal view. A1 short, only reaching to around the third metasome segment, proximal segments of A1 short, distal segments much longer. Urosome 4-segmented, the second and anal segment much shorter than the other segments. P5 slightly asymmetrical, uniramous, 2-segmented. Distal segment with an internal long plumose seta, a shorter terminal spine and an outer twisted spine.

Male: Urosome 5-segmented. A1 short, only reaching to around the third metasome segment, proximal segments short, distal segments much longer. Left A1 geniculate. P5 almost symmetrical, 5-segmented, uniramous, distal segment in the form of a thick spine. Segments 3 and 4 with thick spines on outer distal ends.

Recorded: Madagascar.



Metacalanus aurivilli: Female. A, dorsal; B, lateral; C, P5. Male. D, urosome; E, P5. Figures from Greenwood (1978).

Family Clausocalanidae

Genus *Clausocalanus*

Small to medium sized copepods which may initially be confused with *Paracalanus*, but differ in that the females have a longer urosome in relation to the length of the body and the P5 is more robust and simple, bifurcated distally with only tiny spikes on the end rather than a long spine. P5 uniramous on both sides, symmetrical, 3-segmented. The anterior cephalosome and posterior metasome segments are rounded. Cephalosome fused to first pedigerous segment. Rostrum bifurcated. Urosome 4-segmented. Male rostrum reduced to a knob. P5 uniramous, legs of unequal length, longer leg nearly always on the left, 5-segmented with segment 5 short and attached sub-apically to the previous segment; shorter leg, 3-segmented, less than half the length of segment 1 of the other leg.

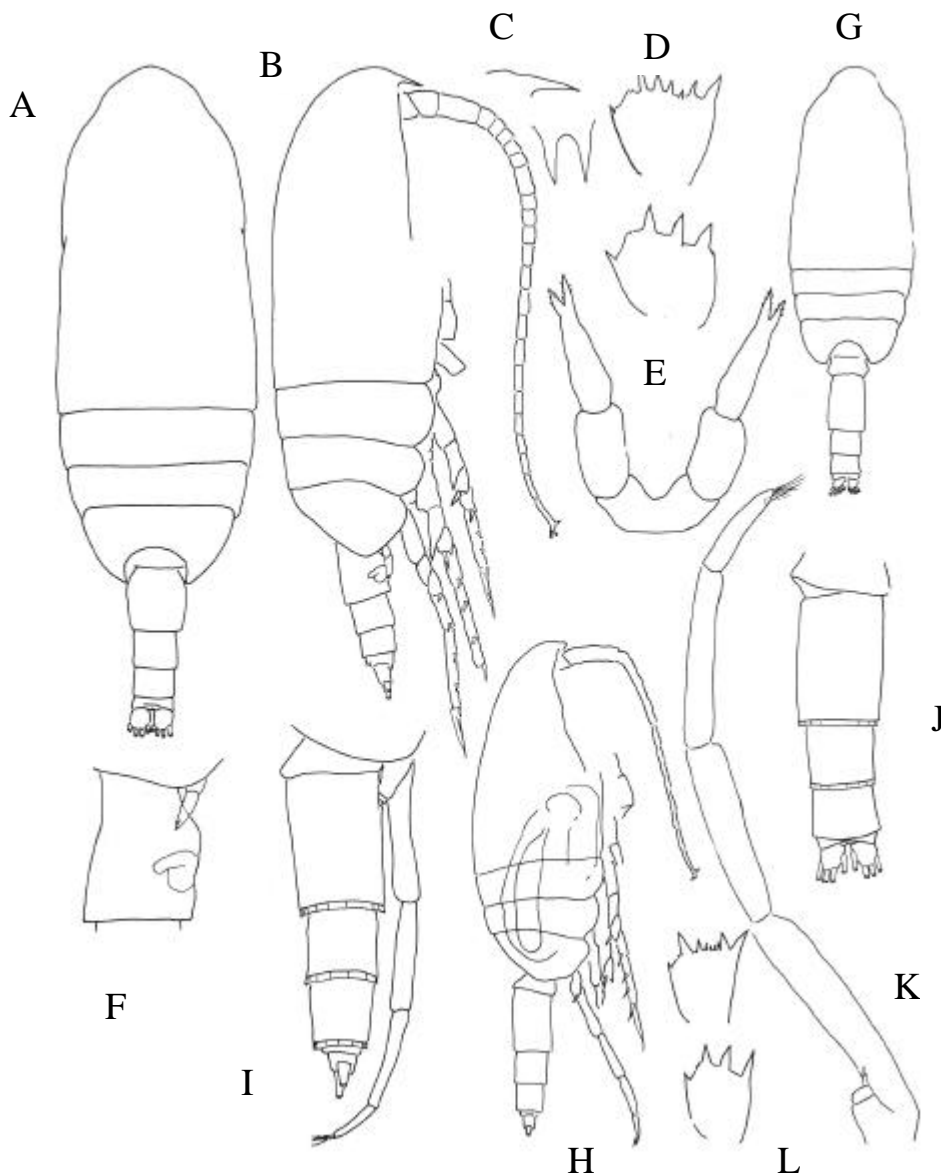
Clausocalanus arcuicornis (Dana, 1849)

Length: females: 1.08-1.62 mm; males: 0.97-1.20 mm.

Female: Rostrum in lateral view short, bifurcated, thick at its base, usually straight or slightly curved and directed ventrally. Genital segment in lateral view straight or, more often slightly concave in the region of the seminal receptacle; 1.5 times as long as urosome segment 3. The third segment of the simple P5 as long as the two preceding segments together. Terminal points of segment 3 of leg 5 bifurcated, sometimes with tiny spinules on inner and outer margins.

Male: Second urosome segment as long as the two following segments together. Rostrum in lateral view knoblike and protruding ventrally. P5 uniramous and asymmetrical, right leg short, usually 3-segmented; left leg robust, longer than urosome, armed distally with long slender straight setae.

Recorded: Rodrigues, Madagascar.



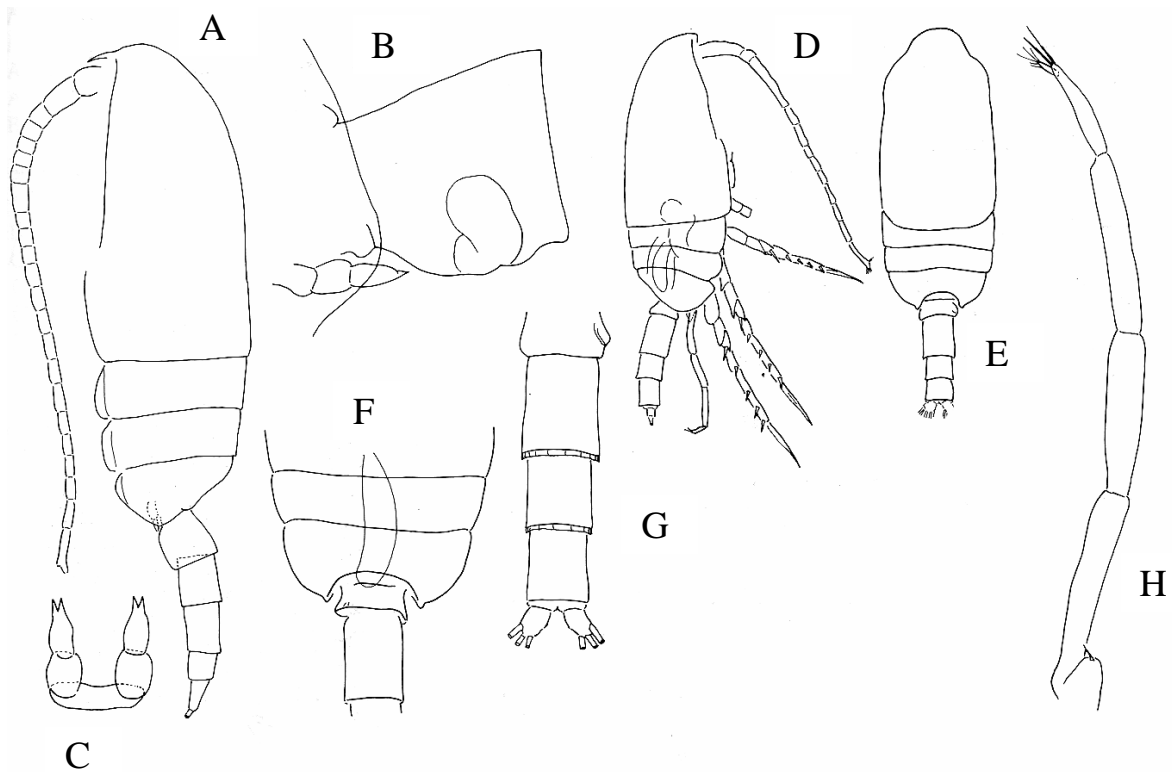
Clausocalanus arcuicornis: Female. A, dorsal; B, lateral; C, rostrum lateral and dorsal; D, basipod 2 of P2 (upper), basipod 2 of P3 (lower); E, P5; F genital segment lateral. Male. G, dorsal; H, lateral; I, urosome lateral; J, urosome dorsal; K, P5; L, basipod 2 of P2 (upper), basipod 2 of P3 (lower). Figures from Frost and Fleminger (1968).

Clausocalanus furcatus (Brady, 1883)

Length: females: 0.94-1.31 mm; males: 0.70-0.92 mm.

Female: Rostrum in lateral view usually thick, short, and slightly curved, bifurcated at tip. Genital segment profile in lateral view rather uneven, generally shorter in length than the second or third segments. The 2 distal segments of the P5 are of similar length, the coxa very short; terminal points of bifurcated segment 3 never with tiny spinules.

Male: Rostrum in lateral view not well developed and not protruding ventrally. Longer P5 usually on the right side, occasionally on the left, longer than the urosome; shorter leg usually 2-segmented, tiny distal segment spine-like. Recorded: Madagascar.



Clausocalanus furcatus: Female. A, lateral; B, genital segment lateral; C, P5. Male. D, lateral; E, dorsal; F, metasome dorsal; G, urosome; H, P5. Figures A-C from Bradford-Grieve (1994); D-H from Frost and Fleminger (1968).

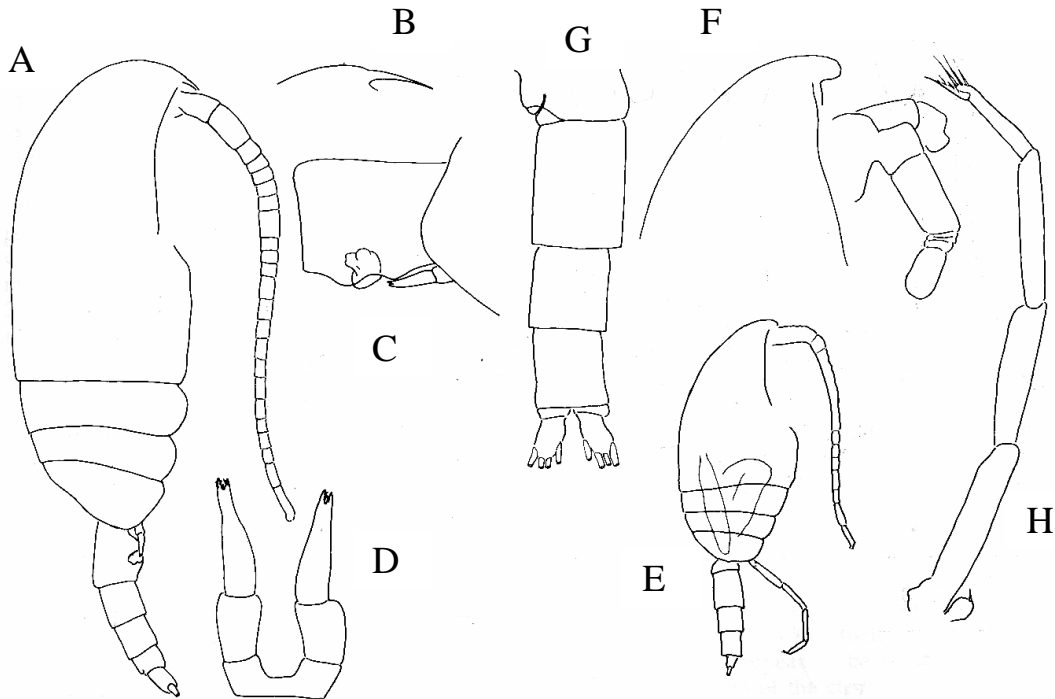
Clausocalanus paululus Farran, 1926

Length: females: 0.66-0.80 mm; males: 0.47-0.56 mm.

Female: Rostrum slender and curved posteriorly. In lateral view genital segment with a depression in mid segment, longer than either of the following 2 segments. Points on distal P5 not divergent and may have tiny spines on inner and outer margins.

Male: Short squat body. In lateral view rostrum knob-like and projecting ventrally. P5 left longer than urosome; right P5 2-segmented with tiny spine-like distal segment.

Recorded: Madagascar.



Clausocalanus paululus: Female. A, lateral; B, rostrum lateral; C, genital segment lateral; D, P5. Male. E, lateral; F, head lateral; G, urosome dorsal; H, P5. Figures from Frost and Fleminger (1968).

Family Euchaetidae

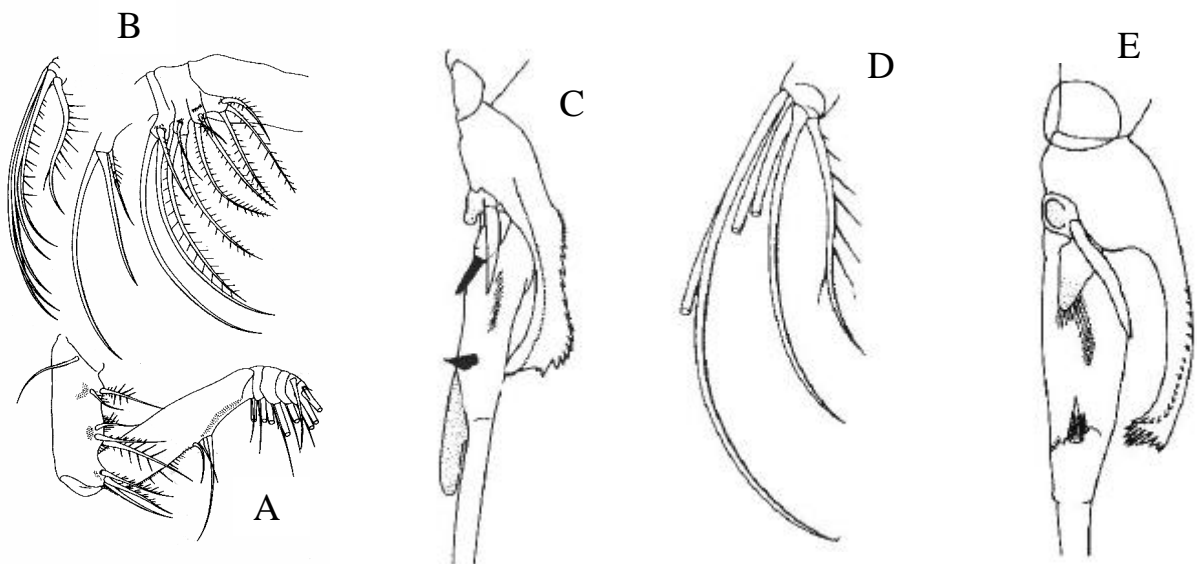
Most of this group are large copepods. Both the male and female have very large maxillipedes, associated with their carnivorous diet, and also long urosomes. The innermost (appendicular) seta on each furca is very well developed and usually much longer than the other caudal setae. The anterior of the cephalosome in both sexes, in most species, comes to a point when viewed dorsally. In lateral view a single strong rostrum is obvious and just behind this is a frontal eminence that varies from a slightly raised ledge with a small sensory bristle to a strong curved point. The A1 have characteristic very long setae. The female genital segment is very prominent when viewed laterally and different species have characteristic shapes that are used in identification. The female often has a single egg sac still attached. The P5 is absent in females. The male P5 is very large and characteristic, with rudimentary endopodites; left leg with a complex distal joint.

Genus *Euchaeta*

The innermost seta on each furca is greatly developed, straight and much thicker and longer than the other caudal setae. The P5 terminal exopodite segments in both right and left legs of the male taper into long spines.

Of the three *Euchaeta* species so far recorded for the area, *E. indica* and *E. rimana* belong to the *marina* species group while *E. longicornis* belongs to the *concinna* species group. These two groups can be distinguished by the following features.

In both groups the basis of the female maxilliped has both long and short spines along the proximal half of the medial margin (Fig. A). The serrated lamella of the male left P5 exopodite reaches or extends beyond a tuft of stiff hairs (Fig. C). In the *marina* group the two endopodal setae of the female maxillule 2 are armed with both long and short spines (Fig. B), while in the *concinna* group only one seta is armed this way (Fig. D). Males in the *marina* group have on the exopod of the left P5, 3 lobes, one which is next to the tuft of hairs (Fig C), not present in the *concinna* group (Fig E).



Identification features of limbs mentioned in the text. From Park (1994).

Euchaeta indica Wolfenden, 1905

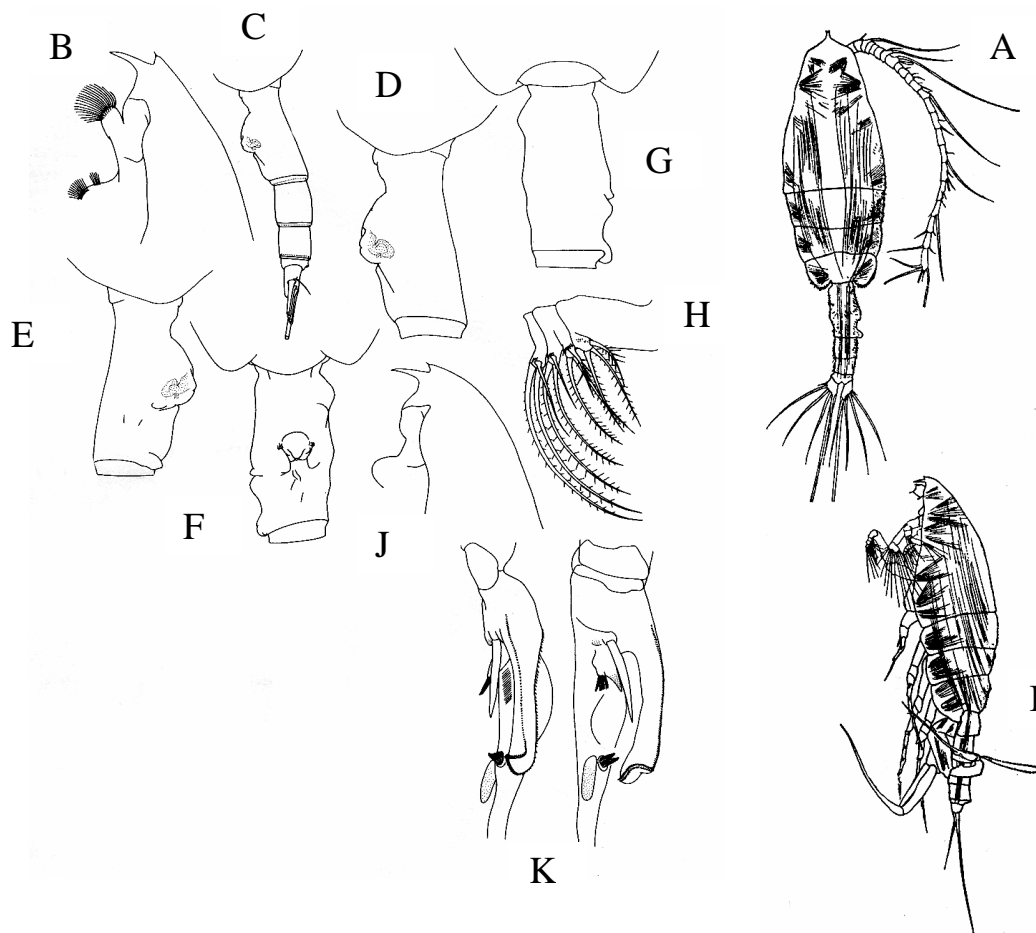
Length: females: 2.4-2.68 mm; male: 2.32-2.56 mm.

Belongs to the *marina* species group.

Female: Frontal eminence on forehead well developed. In lateral view, the genital segment is about twice as long as the broadest part. Genital segment is as long as the combined length of the next three segments and is irregular in outline when viewed from the dorsal and ventral sides. Urosome segment 2 is about half the length of the genital segment and is equal to the combined length of segments 3 and 4. The appendicular seta is much longer than any of the others. The last metasome segment and the urosome segments are densely covered with short fine hairs. A1 extend to the end of urosome segment 2.

Male: P5 like *E. marina* in general appearance, distinguished by the structure of the serrated lamella, which is bilobed distally, with double rows of teeth bordering the lobes.

Recorded: Rodrigues, Zuzá, Aldabra, CPR.



Euchaeta indica: Female. A, dorsal; B, head lateral; C, urosome left lateral; D, urosome left lateral; E, urosome right lateral; F, urosome ventral; G, urosome dorsal; H, maxilla, fifth lobe and endopod omitted. Male. I, lateral; J, head lateral; K, exopod of left P5. Figures A, I from Mori (1937; as *E. wolfendeni*); B-H, J, K From Park (1994).

Euchaeta rimana Bradford, 1974

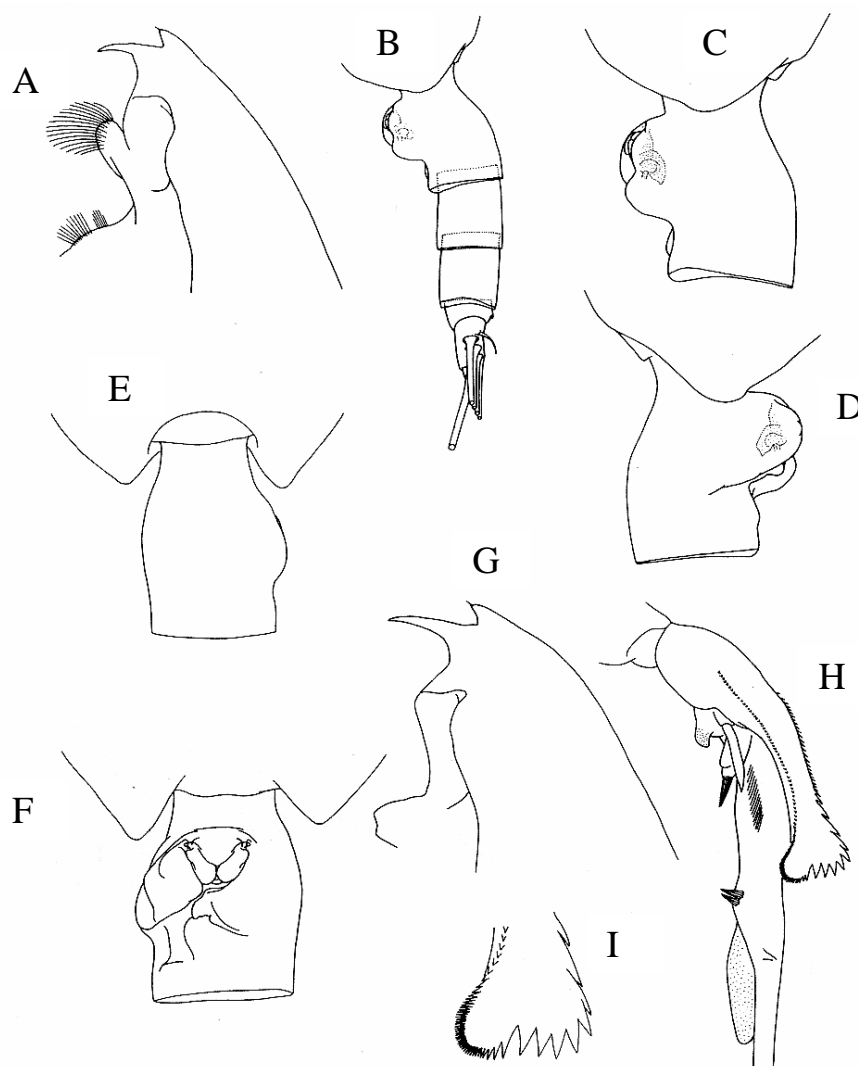
Length: females: 2.80-4.30 mm; males: 3.11-4.10 mm.

Also belongs to the *marina* species group and was originally recorded as *E. marina* which is now recognised to be restricted to the Atlantic and Mediterranean.

Female: Can only be separated from *E. marina* by the structure of the genital segment. In both dorsal and ventral view, the left side of the genital segment is smoothly curved, without any prominent projection; the right side with a moderate projection. Posterior metasome segments are slightly asymmetrical in dorsal view, slightly more extended on right.

Male: The serrated structure of the lamella of the left P5 exopod segment 2 is the only morphological feature of the appendages found to be different between this species and *E. marina*. The distal margin has an unserrated gap in *E. marina* but not in *E. rimana*. The thick spine originating at the base of the lamella is less than half the length of the lamella.

Recorded: Rodrigues, Zuzá, Madagascar, CPR.



Euchaeta rimana: Female. A, head lateral; B, urosome lateral left; C, urosome lateral left; D, urosome left right; E, urosome dorsal; F, urosome ventral. Male. G, head lateral; H, exopod of left P5; I, distal end of serrated lamella. Figures from Park (1994).

Euchaeta longicornis Giesbrecht, 1888

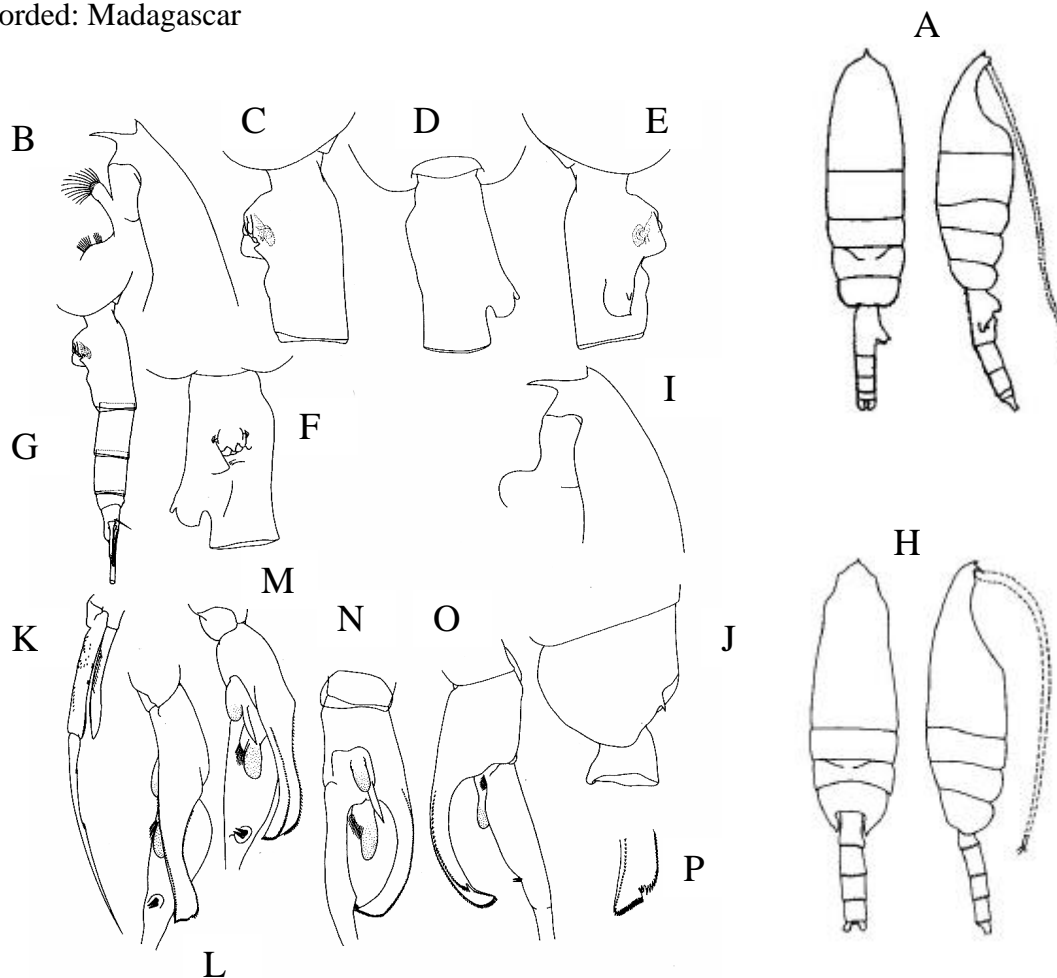
Belongs to the *concinna* species group

Length: females: 2.72-3.32 mm; males: 2.52-2.88 mm.

Female: High frontal eminence on forehead and long slender rostrum. In both lateral and dorsal view, distal end of metasome on each side broadly rounded. Dorsal and ventrally, genital segment strongly asymmetrical with a broad swelling on proximal half of left side and a large wing-like outgrowth on distal half of right side. Lateral side of wing-like outgrowth bearing a small process.

Male: First exopodite segment of right P5 with 2 patches of small teeth on inner margin. Finger-like process on left leg exopodite, sharply pointed and far short of reaching the middle of the serrated lamella. Lamella strongly curved towards exopodite segment 3 and with a conspicuous notch on the distal margin. Teeth all small along margin.

Recorded: Madagascar



Euchaeta longicornis: Female. A, dorsal, lateral; B, head lateral; C, urosome lateral left; D, urosome dorsal; E, urosome lateral right; F, urosome ventral; G, urosome lateral. Male. H, dorsal, lateral; I, head lateral; J, metasome lateral; K, right P5; L-O, exopod of left P5 different angles; P, distal end of serrated lamella. Figures A, H from Grice (1962); B-G, I-P from Park (1994).

Family Phaennidae

Genus *Phaenna*

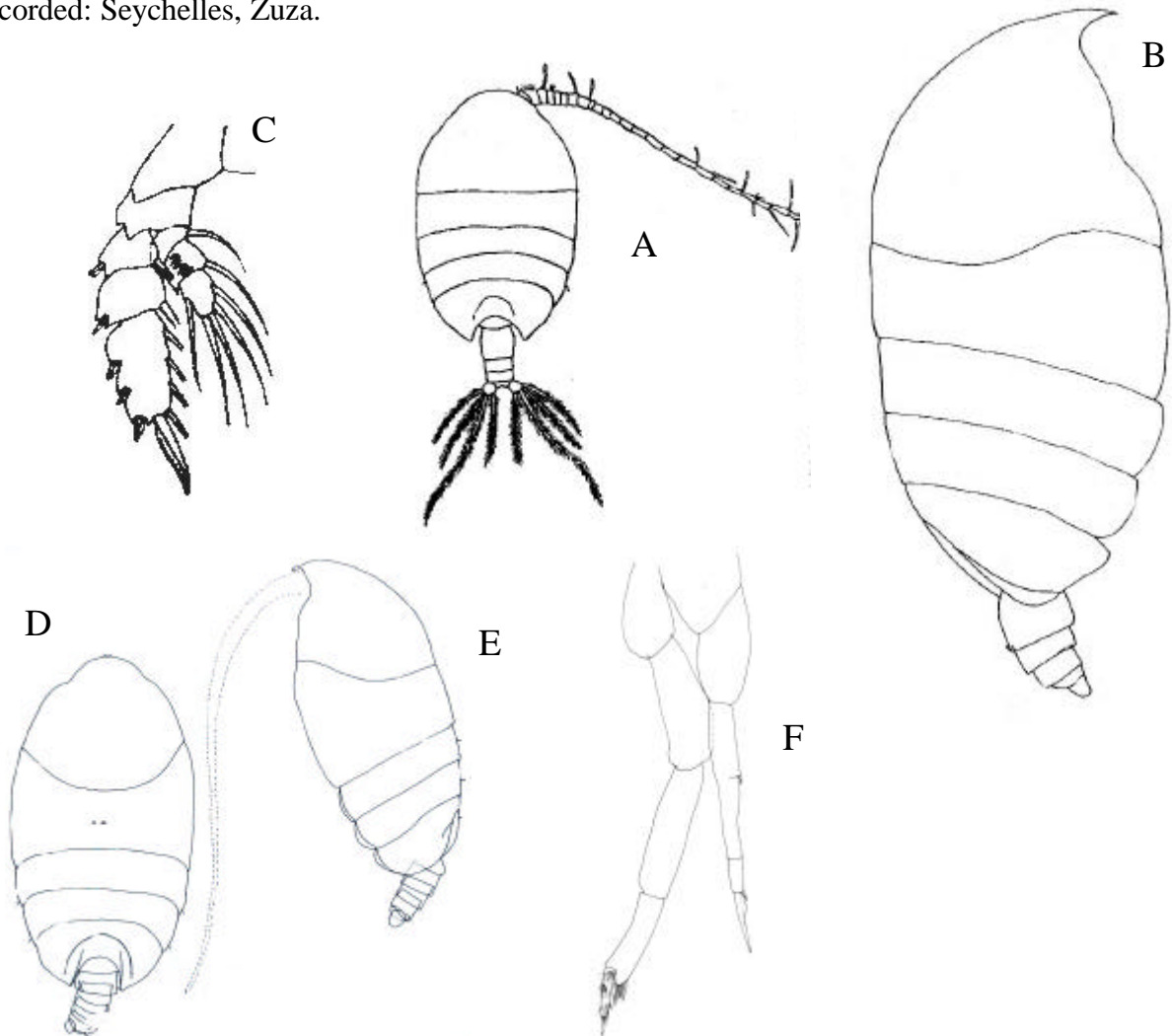
Phaenna spinifera Claus, 1863

Length: females: 1.50-2.90 mm; males: 1.80-2.50 mm.

Female: Prosome is almost round in dorsal view; head and first pedigerous segment separate. Rostrum bifurcated. Urosome 4-segmented, genital segment slightly longer than the combined length of the following 3 segments. Anal segment short, furca as wide as long. A1 reaches around the middle of the urosome. P5 missing.

Male: Prosome broad but more elongated than in the female. Urosome 5-segmented. P5 asymmetrical but legs of almost equal length, left leg slightly longer, uniramous. Left leg, 5-segmented, right leg 4-segmented.

Recorded: Seychelles, Zuza.



Phaenna spinifera: Female. A, dorsal; B, lateral; C, P4. Male. D, dorsal; E, ventral; F, P5. Figures A, C from Mori (1937); B, D-F from Bradford *et al.* (1983).

Family Scolecitrichidae

Genus *Lophothrix*

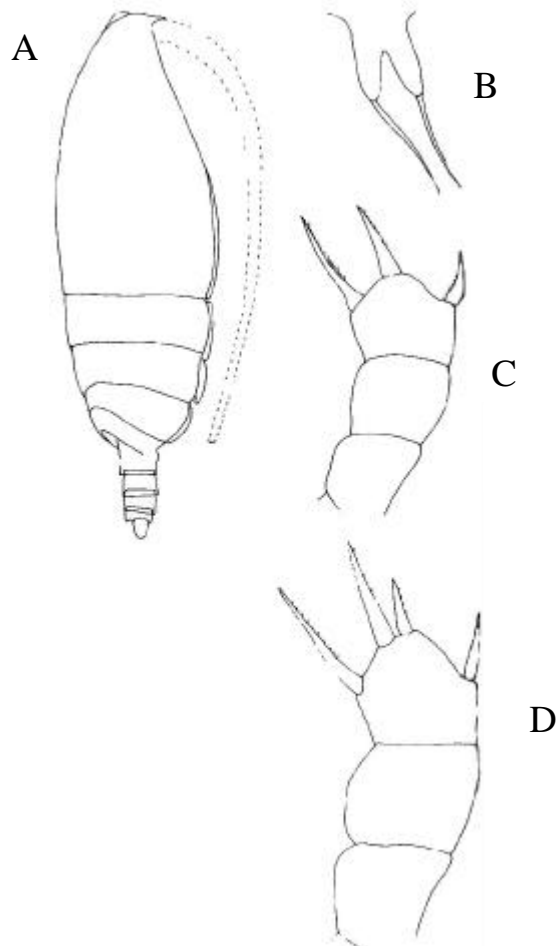
Lophothrix latipes (T. Scott, 1894)

Length: females: 2.65-3.20mm; males: 2.96-3.19 mm.

Female: Head in lateral view angular, with small crest. Rostrum bifurcated with fine setae. Cephalosome and first pedigerous segment fused. Corners of posterior metasome segment produced into small points. A1 reaches to the genital segment. P5 uniramous, 3-segmented with 3 short spines on the distal segment, the outer the shortest.

Male: Similar to female but anterior cephalosome is squarer in dorsal view and the posterior metasome segments are more rounded. A1 reaches to around the end of the metasome. P5 reaches the distal end of urosome segment 3. Right P5 exopodite 4-segmented, the last segment flattened and triangular, endopodite 2-segmented, reaching exopodite segment 2. Left exopodite 3-segmented, last segment with 2 short, broad setae distally and several spines; endopodite 2 segmented, terminating in a flattened seta.

Recorded: Madagascar



Lophothrix latipes: Female. A, lateral; B, rostrum; C, P5; D, P5 variant. Figures from Bradford *et al.* (1983).

Genus *Scolecithrix*

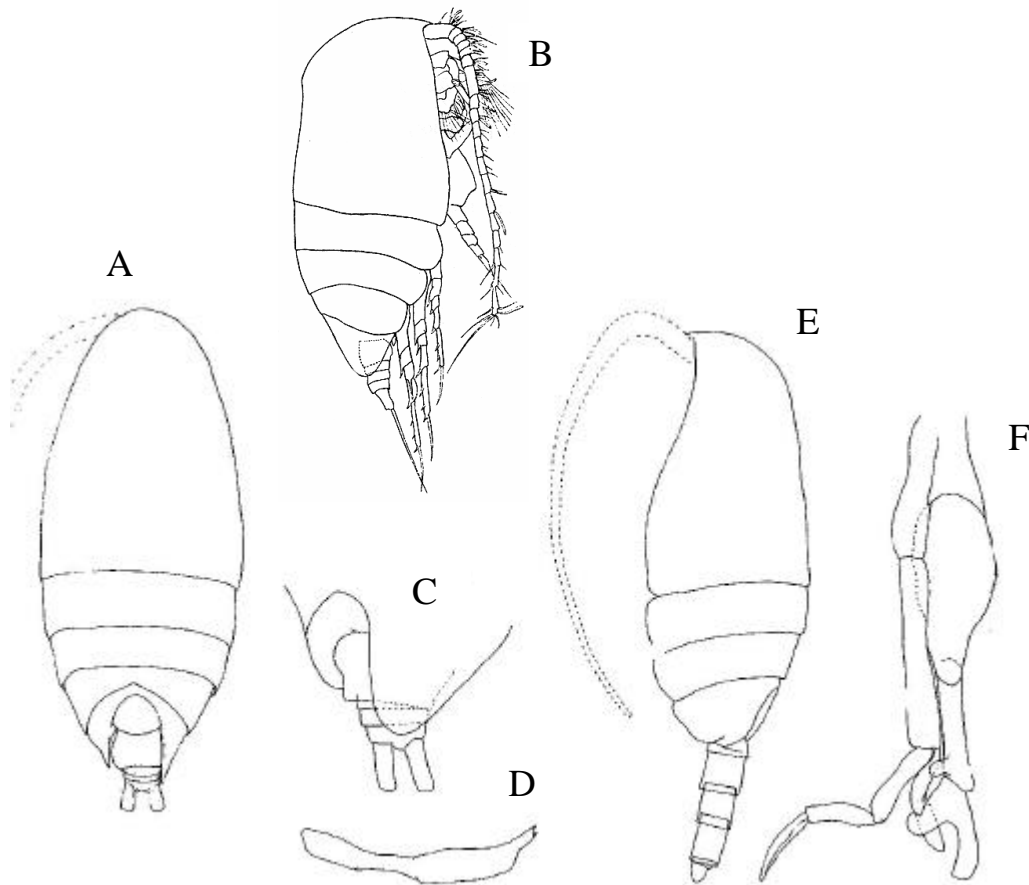
Scolecithrix bradyi Giesbrecht, 1888

Length: females: 1.10-1.61 mm; males: 1.30-1.56 mm.

Female: Posterior metasome segments extended, appearing as points in dorsal view but rounded in lateral view, the right side more prominent than the left, extending beyond the genital segment. A1 does not reach the end of metasome. Genital segment asymmetrical, left side very swollen in dorsal view, as long as the combined length of the following 3 segments. The anal segment is as long as the preceding segment. Furca twice as long as wide. P5 very small and simple, right leg longer than left, 1-segmented, each leg consisting of an elongated flattened blade with 2 small terminal spines. This copepod is similar to *S. danae*, but smaller and has longer extensions on the posterior metasome segment. *S. danae* does not have a P5.

Male: Shape similar to female. Anterior cephalosome rounded in lateral view, posterior metasome segments not produced as in female. P5 left biramous, with 3-segmented exopodite and 1-segmented endopodite as long as exopodite segment 1. Right leg uniramous, with 2-segmented exopodite, distal end of segment 1 with short finger-like process on inner margin, terminal segment divided into 2 sub-equal branches. Similar to *S. danae*, but *S. danae* does not have the bifurcated terminal segment on the right P5.

Recorded: Zuza, Madagascar.



Scolecithrix bradyi: Female. A, dorsal; B, lateral; C, metasome and urosome; D, P5. Male. E, lateral; F, P5. Figures A, C-F from Bradford *et al.* (1983); B from Mori (1937; as *Scolecithricella bradyi*).

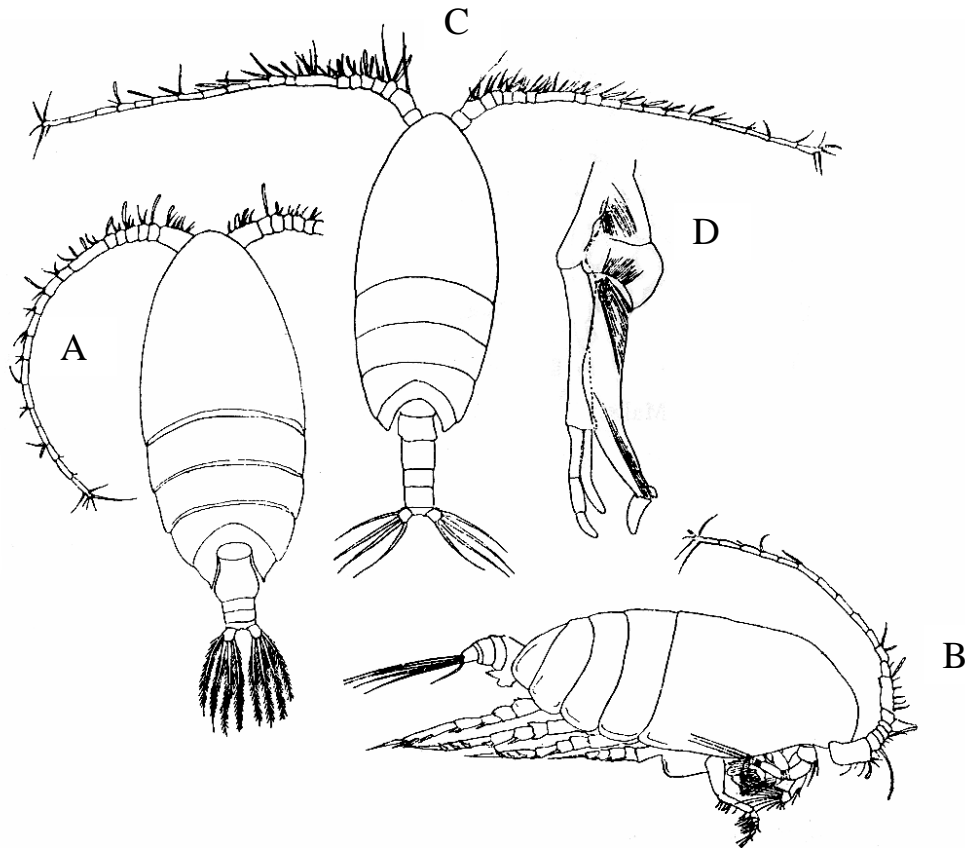
Scolecithrix danae (Lubbock, 1856)

Length: females: 1.80-2.40 mm; males: 1.92-2.25 mm.

Female: Prosome has a very characteristic shape, being very broad at the mid point. The anterior metasome segment is produced into points which extend close to the urosome, reaching half way down the genital segment. The A1 extends beyond the prosome. Urosome of 4 segments. The genital segment has a downward pointing projection when viewed from the side. Setae on the swimming legs and furca are typically very feathery and in fresh specimens tinged yellow. The setae on the furca are of similar length. P5 absent.

Male: Similar to female but posterior metasome segment not produced. Urosome 5-segmented. P5 asymmetrical, right foot uniramous with 2-segmented exopodite with a short terminal segment; left foot biramous, the exopodite with 3 segments, the simple endopodite with 1 segment.

Recorded: Rodrigues, Seychelles, Zuza, Madagascar, Aldabra, CPR.



Scolecithrix danae: Female. A, dorsal; B, lateral. Male. C, dorsal; e, P5. Figures from Mori (1937).

Genus *Scaphocalanus*

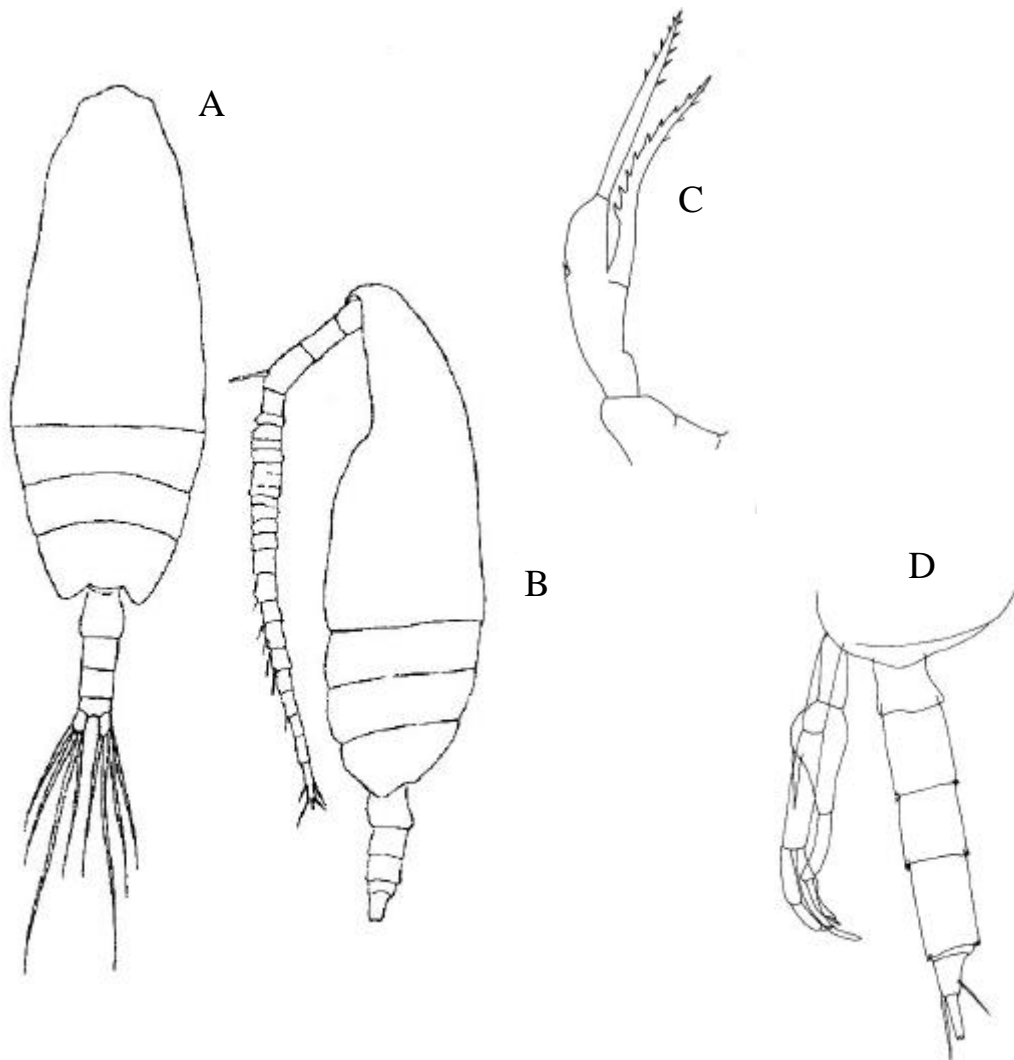
Scaphocalanus echinatus (Farran, 1905)

Length: females: 2.16-2.56 mm; males: 2.12-2.36 mm.

Female: Anterior cephalosome without median crest. Prosome slender and elongated in dorsal view. Posterior metasome segments slightly extended but not pointed. A1 reach almost to the end of the genital segment. Genital segment as long as wide. The second seta on the furca is twice the length of the urosome. P5 symmetrical, uniramous, 2-segmented, second segment with an outer marginal small spine, a terminal long spine and an inner marginal long spine which is internally bordered with coarse teeth. Some specimens may have no outer edge spine, but an additional small spine adjacent to the terminal spine; some specimens may have a rudimentary endopodite and a shorter terminal spine (Bradford *et al.*, 1983)

Male: Posterior metasome segments not extended. A1 reaches urosome segment 2. P5 reaches middle of urosome segment 4. Right P5 exopodite 3-segmented, distal segment very small and slender; endopodite reaches to exopodite segment 1. Left leg endopodite 1-segmented.

Recorded: Madagascar



Scaphocalanus echinatus: Female. A, dorsal; B, lateral; C, P5. Male. D, urosome and P5. Figures A, B from Mori (1937); C, D from Bradford *et al.* (1983).

Genus *Scolecithricella*

Cephalosome and first pedigerous segment fused. Rostrum bifurcated. No median crest on cephalosome Female P5 reduced, 2-segmented, uniramous and flattened. Male P5 biramous on both sides, with very short endopodites.

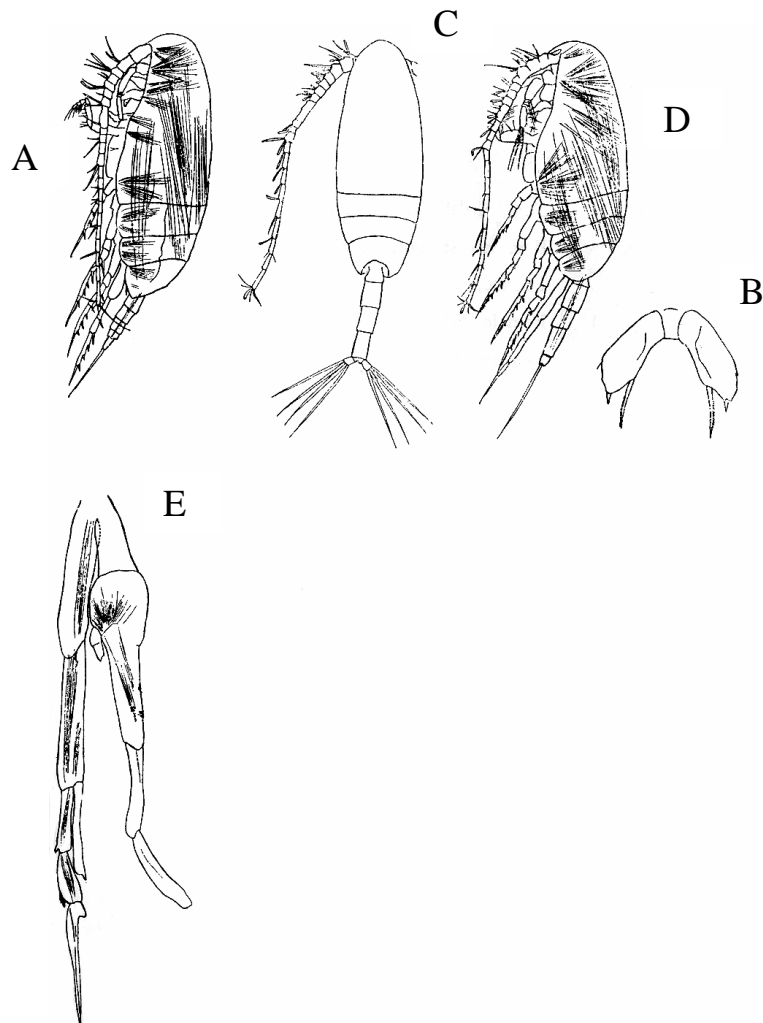
Scolecithricella minor (Brady, 1883)

Length: females: 1.08-1.46 mm; males: 1.20-1.46 mm.

Female: Anterior cephalosome rounded in lateral view, posterior metasome segment slightly produced, rounded in dorsal view and slightly angular in lateral view. A1 reaches just beyond the prosome. P5 symmetrical. Each foot 2-segmented, oval, twice as long as wide, with a slender spine on the outer margin, a short spine on the apex and a long spine on the inner margin.

Male: posterior metasome segment rounded in dorsal and lateral view. P5 asymmetrical, longer than the urosome; right foot uniramous, with a vestigial triangular endopodite; exopodite segment 3 elongated. Left P5 biramous, endopodite 1-segmented and extends to about the middle of the second segment of the exopodite. The terminal segment of the exopodite elongated and sharply pointed.

Recorded: Madagascar



Scolecithricella minor: Female. A, lateral; B, P5. Male. C, dorsal; D, lateral; E, P5. Figures from Mori (1937).

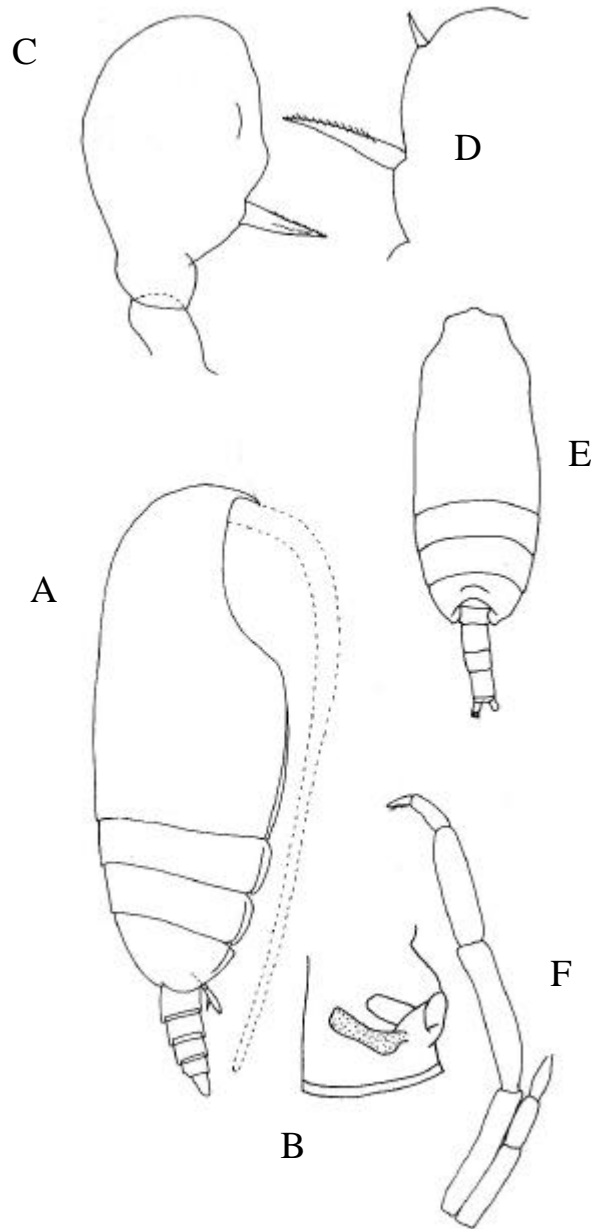
Scolecithricella ovata (Farran, 1905)

Length: females: 1.70-2.39 mm; males: 1.38-1.80 mm.

Female: Posterior metasome segment quite rounded in dorsal view. A1 extends to around urosome segment 3. P5 outer segment flattened and of irregular outline, sometimes fused to common basal segment, stout spine on internal margin, sometimes a second sub-terminal spine.

Male: A1 reaches urosome segment 3. P5 uniramous on both sides and reaches to the anal segment. Right P5 short, 3-segmented, the third segment overlapping the beginning of the second segment of the left leg. Left leg long, 5-segmented

Recorded: Madagascar.



Scolecithricella ovata: Female. A, lateral; B, urosome lateral; C, P5; D, P5 variant. Male. E, dorsal; F, P5. Figures A-D, F from Bradford *et al.* (1983); E from Tanaka (1962).

Order Cyclopoida

Cyclopoids include not only free-living species, but also commensal and parasitic species. Of the free-living cyclopoids, genera such as *Oithona* can numerically dominate the samples. Cyclopoids are generally less than 1 mm in length, they range in size from 0.3 to 1.9 mm. Cyclopoids resemble calanoids in that there is a sharp division between the prosome and urosome, however, the body articulates between thoracic segments 4 and 5 (rather than thoracic segment 5 and abdominal segment 1 as in the calanoids). The 5th thoracic segment is very narrow, it bears the simple P5 and is the first segment of the urosome. The A1 is elongate, especially in females, although not usually as long as in the Calanoida,. The A2 is uniramous. Females carry a pair of egg sacs attached to the lateral or subdorsal surface, but never to the ventral surface as in the Harpacticoida. P1-4 are well developed, except for parasitic species. P5 are small and similar in both sexes.

Family Oithonidae

The body is usually elongate, the prosome wider than the narrow urosome. The Family includes two genera that are free-swimming in the plankton, *Oithona* and *Paroithona*. 25 species have been recorded in the Indian Ocean.

Genus *Oithona*

Identification of *Oithona* species is made difficult by the small size of the organisms and the close relationship they bear to each other, especially so in the males. The males are readily separated from the females as the A1 are usually shorter and both are geniculate. The males are usually smaller than the females, and the urosome is 6-segmented in males and 5-segmented in females.

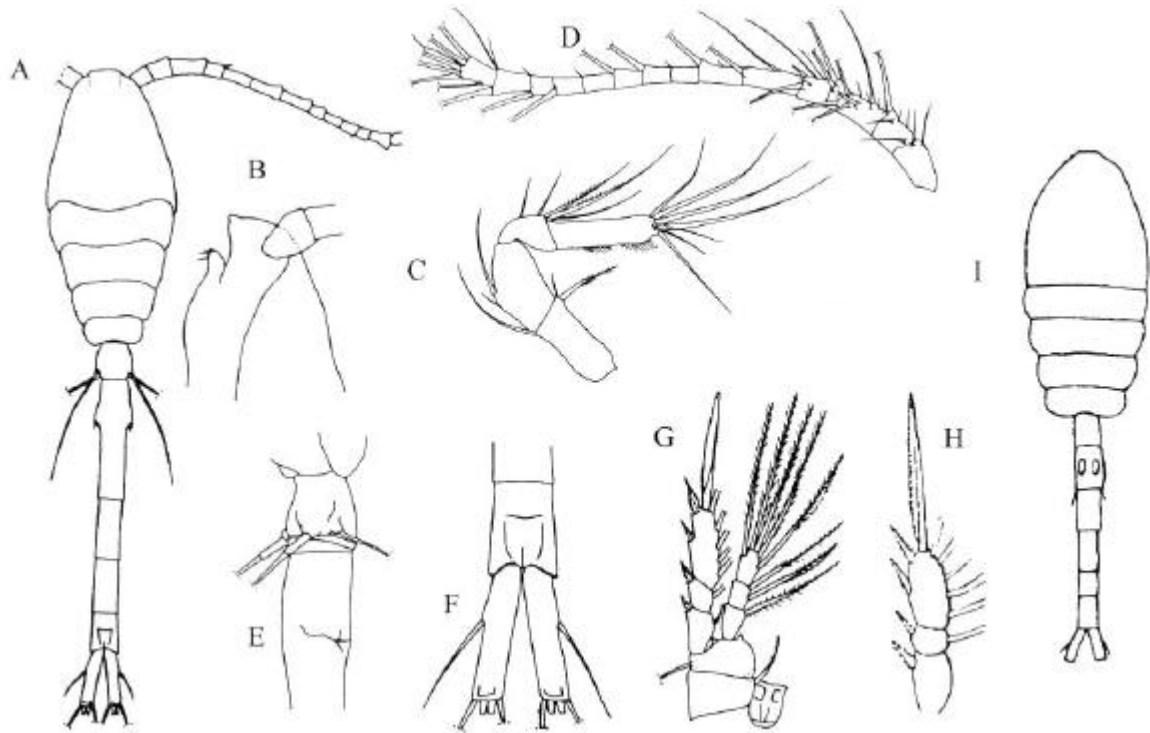
Oithona attenuata Farran, 1913

Length: females: 0.78-0.84 mm; males: 0.53 mm.

Female: Prosome ovoid. Cephalosome truncate anteriorly. Rostrum blunt and not visible dorsally. Urosome longer than prosome. Genital segment three times longer than wide, with a prominent lateral processes approximately 1/3 down the genital segment. Anal segment 1.5 times longer than wide. Furca slender and long, four times longer than wide. A1 reaches the end of the prosome.

Male: Cephalosome truncate anteriorly. Prosome just shorter than urosome. Furca longer than anal segment.

Recorded: Seychelles, Madagascar.



Oithona attenuata: Female. A, dorsal; B, lateral view of rostrum; C, A2; D, A1; E, P5 and genital segment; F, furca; G, P4. Male. H, P4; I, dorsal. Figures A-G from Nishida (1985), H and I from Rosendorn (1927).

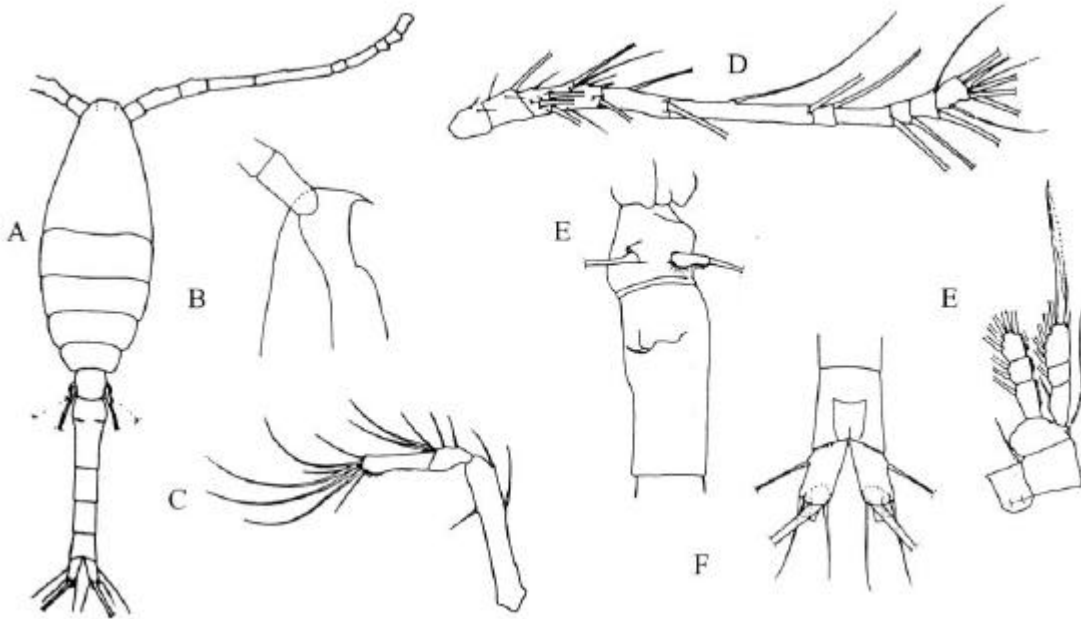
Oithona fallax Farran, 1913

Length: females: 0.85-0.96 mm; males: 0.67 mm.

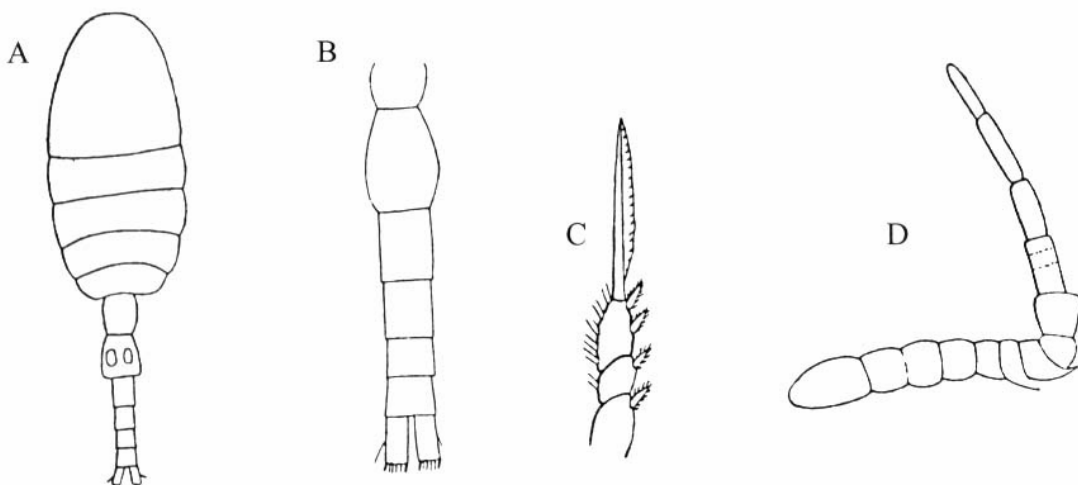
Female: Cephalosome narrowed anteriorly, but not pointed. Rostrum not visible dorsally. Anterior 1/3 of genital segment swollen laterally, over twice as long as wide. Anal segment longer than wide posterior margin serrated. Furca more than twice as long as wide. A1 reaches the beginning of genital segment. Very similar to *O. similis*, however terminal spines on the 3rd joint of the P2 exopod are shorter, and there is a small inner edge seta on the 1st joints of P2-4.

Male: Anterior of cephalosome rounded. Prosome longer than urosome. Genital segment longer than anal segment and furca together. Furca longer than anal segment. A1 geniculate once.

Recorded: Western Indian Ocean.



Oithona fallax: Female. A, dorsal; B, lateral view of rostrum; C, A2; D, A1; E, P5 and genital segment; F, furca; G, P4. Figures from Nishida (1985).



Oithona fallax: Male. A, dorsal; B, urosome; C, P4; D, A1. Figures from Rosendorn (1927).

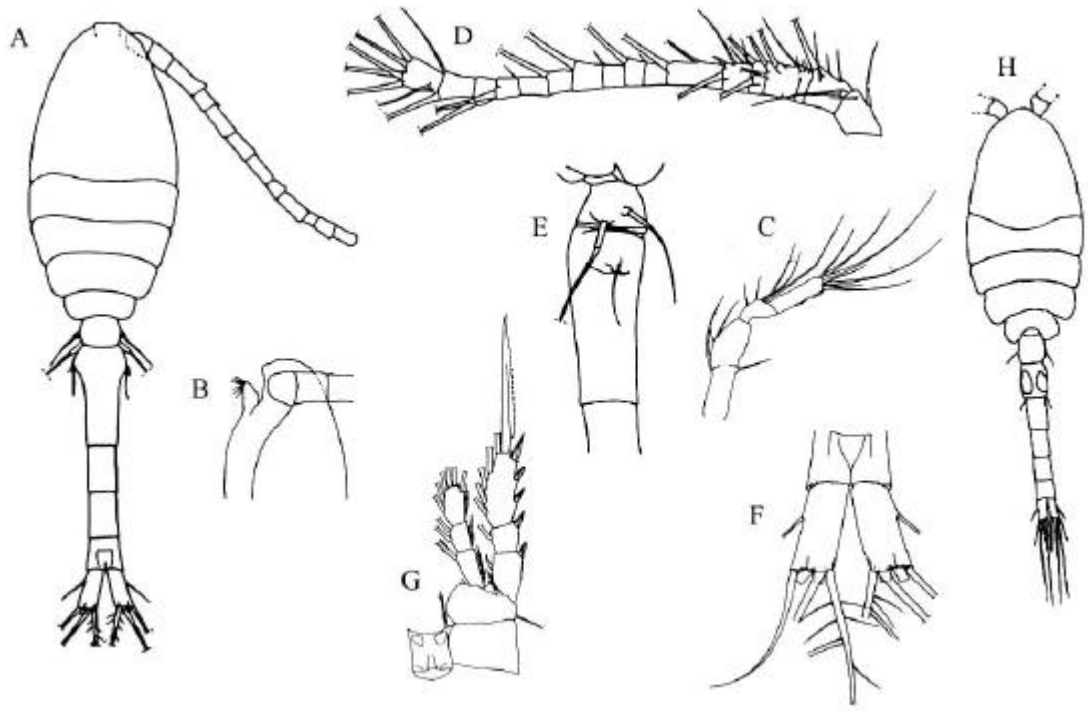
Oithona nana Giesbrecht, 1892

Length: females: 0.50-0.80 mm; males: 0.48-0.60 mm.

Female: Cephalosome truncate anteriorly. Rostrum blunt and not visible dorsally. Prosome short and stout, approximately the same length as the urosome. Genital segment approximately twice as long as wide and very rounded in the anterior quarter. Anal segment as long as wide. Furca twice as long as wide. A1 as long as the prosome.

Male: Prosome shorter and stouter than female. Genital segment longer than wide. A1 geniculate. Anal segment as long as wide. Furca twice as long as wide.

Recorded: Rodrigues, Madagascar.



Oithona nana: Female. A, dorsal; B, lateral view of rostrum; C, A2; D, A1; E, P5 and genital segment; F, furca; G, P3. Male. H, dorsal. Figures A-G from Nishida (1985), H from Mori (1937).

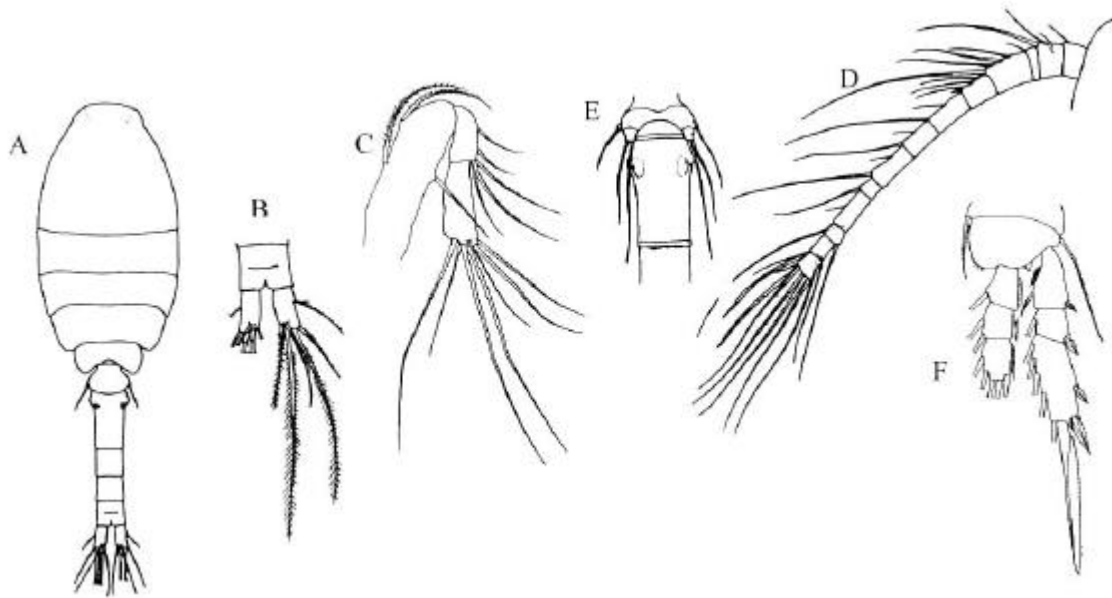
Oithona oculata Farran, 1913

Length: females: 0.62-0.80 mm; males: 0.62-0.65 mm.

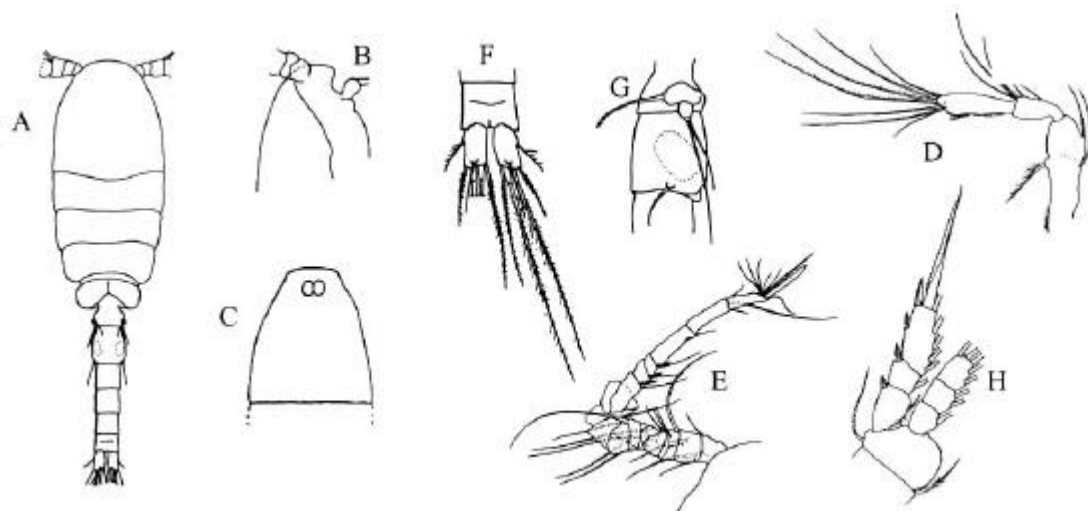
Female: Pair of dark 'eyes' visible through the anterior section of the cephalosome. Anterior section of cephalosome truncate. Rostrum present and blunt, not visible dorsally. Prosome stocky, approximately 1.5 times longer than the urosome. Genital segment 1.5 times longer than wide, the first quarter swollen laterally. Anal segment just shorter than wide, posterior ventral margin serrated. A1 shorter than prosome.

Male: Cephalosome similar to female. Prosome oblong in dorsal view, more than twice as long as wide. Genital segment just longer than wide. Anal segment shorter than wide, posterior ventral margin serrated. Furca twice as long as wide. P1-4, the terminal spine on the exopods is very long.

Recorded: Rodrigues, Madagascar.



Oithona oculata: Female. A, dorsal; B, anal segment and furcal; C, A2; D, A1; E, genital segment and P5; F, P4. Figures from Nishida (1985).



Oithona oculata: Male. A, dorsal; B, lateral view of rostrum; C, cephalosome dorsal view; D, A2; E, A1; F, furca; G, lateral view of P5 and genital segment; H, P4. Figures A, B, & D-H from Nishida (1985), C from Rosendorn (1927).

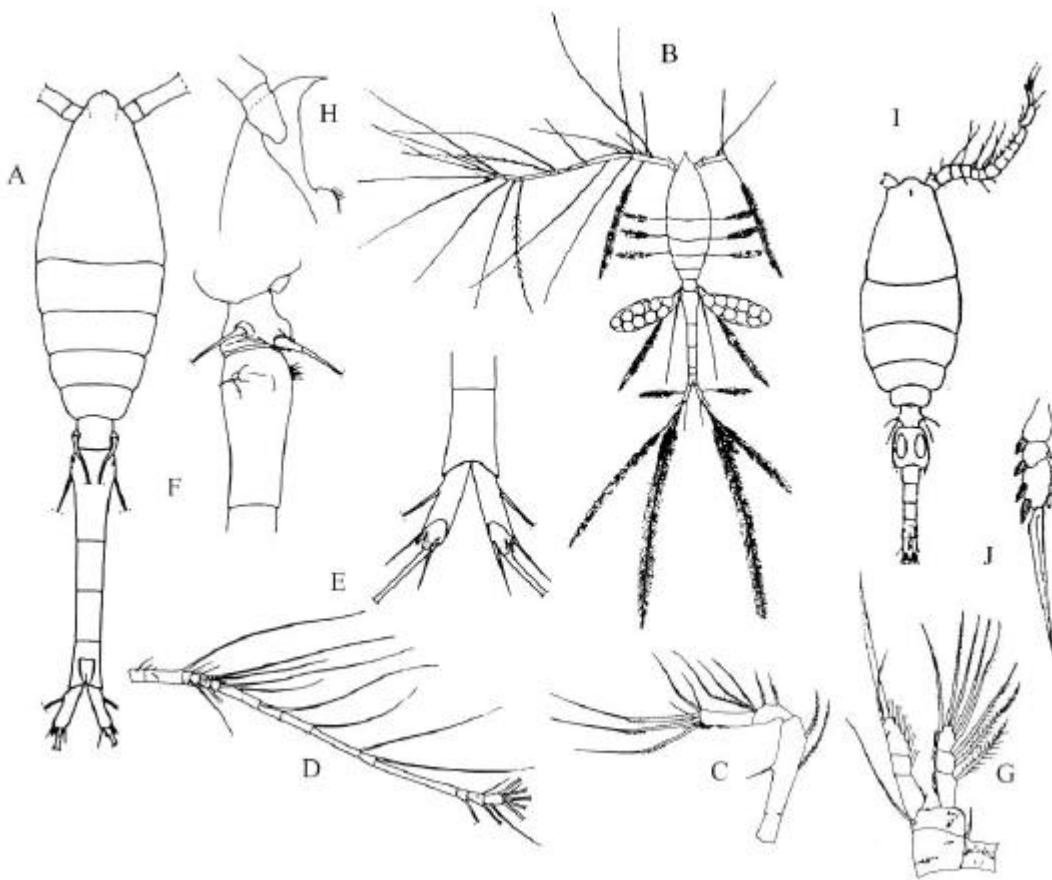
Oithona plumifera Baird, 1843

Length: females: 1.10-1.50 mm; males: 0.75-1.00 mm.

Female: Anterior section of cephalosome narrowed into the pointed rostrum. Rostrum visible in dorsal view. Genital segment twice as long as wide. Genital segment swollen laterally on the anterior third, with a characteristic tuft of hairs on the ventral side. Furca shorter than anal segment and three times longer than wide. A1 long, reaching the anal segment. Segments of A1 fringed with small spinules. Plumose setae arise from swimming legs of some specimens, not always present.

Male: Anterior of cephalosome very different to female, it is not pointed and the rostrum is blunt. A1 is twice geniculate, with a sheath just beyond the proximal elbow and a semicircular process on the 1st segment beyond the distal elbow. Genital segment large, about as wide as it is long. The anal segment is similar in length to the two preceding segments.

Recorded: Rodrigues, Seychelles, Madagascar.



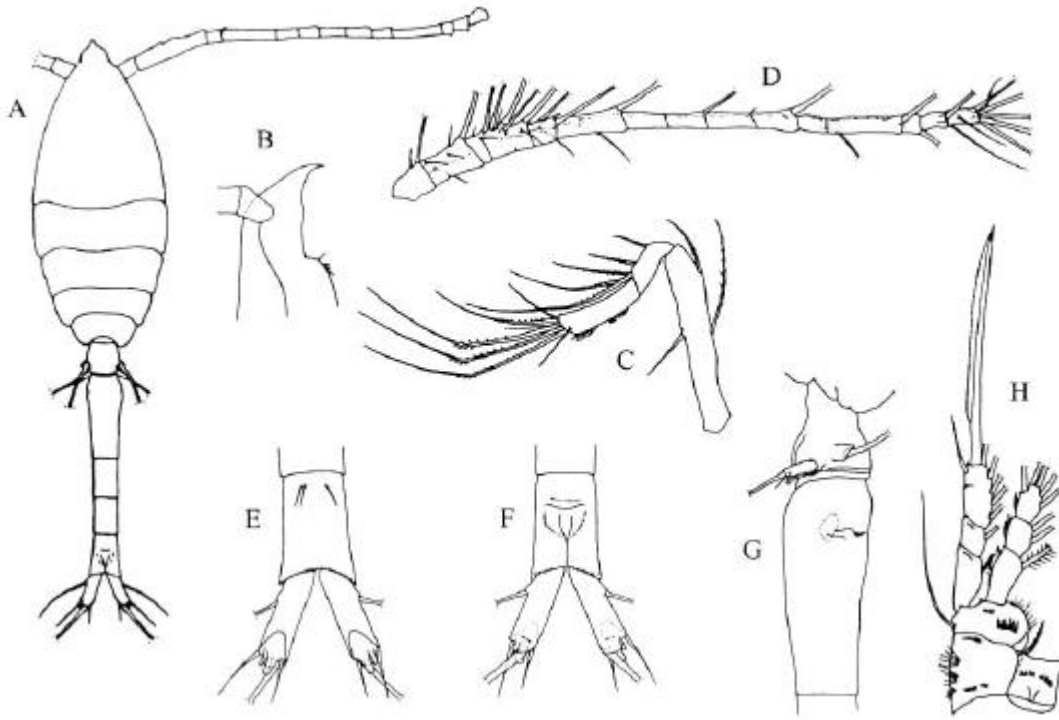
Oithona plumifera: Female. A, dorsal; B, dorsal view with appendages; C, A2; D, A1; E, furca; F, P5 and genital segment; G, P4; H, lateral view of rostrum. Male. I, dorsal; J, endopod of P4. Figures A and C-H from Nishida (1985), B, I and J from Giesbrecht (1892).

Oithona pseudofrigida Rosendorn, 1917

Length: females: 1.22-1.25 mm.

Female: Anterior section of cephalosome narrowed into a pointed rostrum. Rostrum visible in dorsal view. Anterior third of genital segment swollen laterally, genital segment without tuft of hairs ventrally. Genital segment 2.5 times longer than wide. Anal segment longer than wide. Anterior ventral section of anal segment with long setae. Furca over 3 times longer than wide. Segments of A1 fringed with small spinules.

Recorded: Western Indian Ocean.



Oithona pseudofrigida: Female. A, dorsal; B, lateral view of rostrum; C, A2; D, A1; E, furca, ventral view; F, furca, dorsal view; G, lateral view of P5 and genital segment; H, P4. Figures from Nishida (1985).

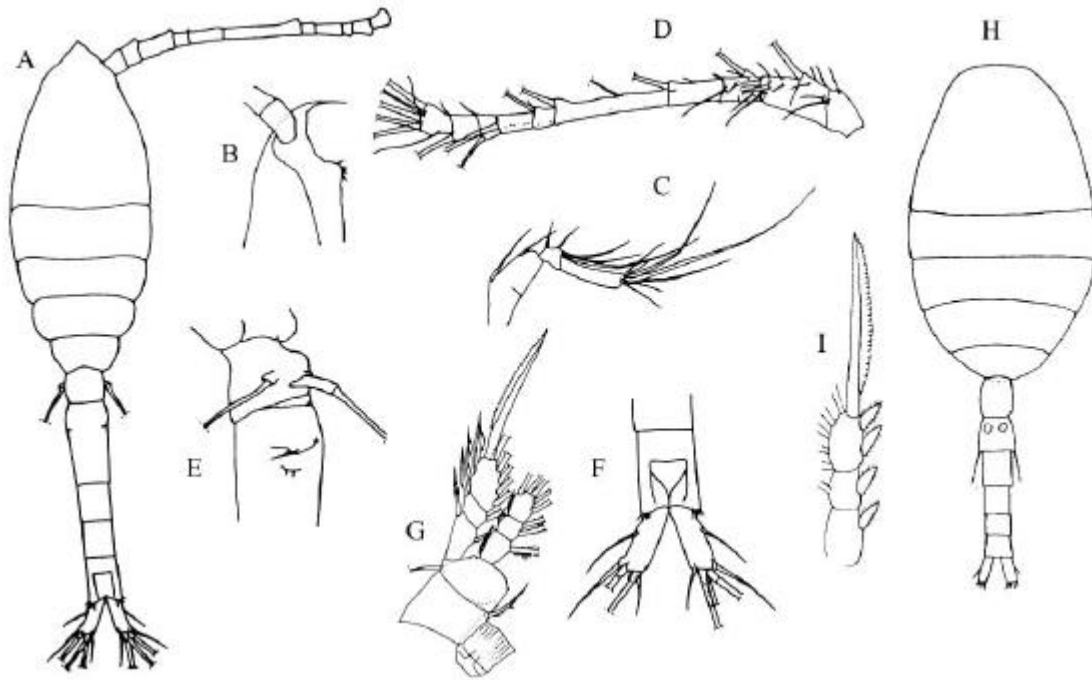
Oithona robusta Giesbrecht, 1891

Length: females: 1.42-1.60 mm; males: 1.24 mm.

Female: Cephalosome pointed anteriorly. Rostrum just visible dorsally. Anterior 1/3 of genital segment slightly swollen laterally. Genital segment twice as long as wide. Anal segment 1.5 times longer than wide, only the lateral margins of anal segment lined with spinules. Furca three times longer than wide. A1 shorter than prosome length.

Male: Cephalosome truncated anteriorly. Prosome longer than urosome. Genital segment relatively short. Furca longer than anal segment.

Recorded: Madagascar.



Oithona robusta: Female. A, dorsal; B, lateral view of rostrum; C, A2; D, A1; E, lateral view of P5 and genital segment; F, furca; G, P4. Male. H, dorsal; I, P4. Figures A-G from Nishida (1985), H and I from Rosendorn (1927).

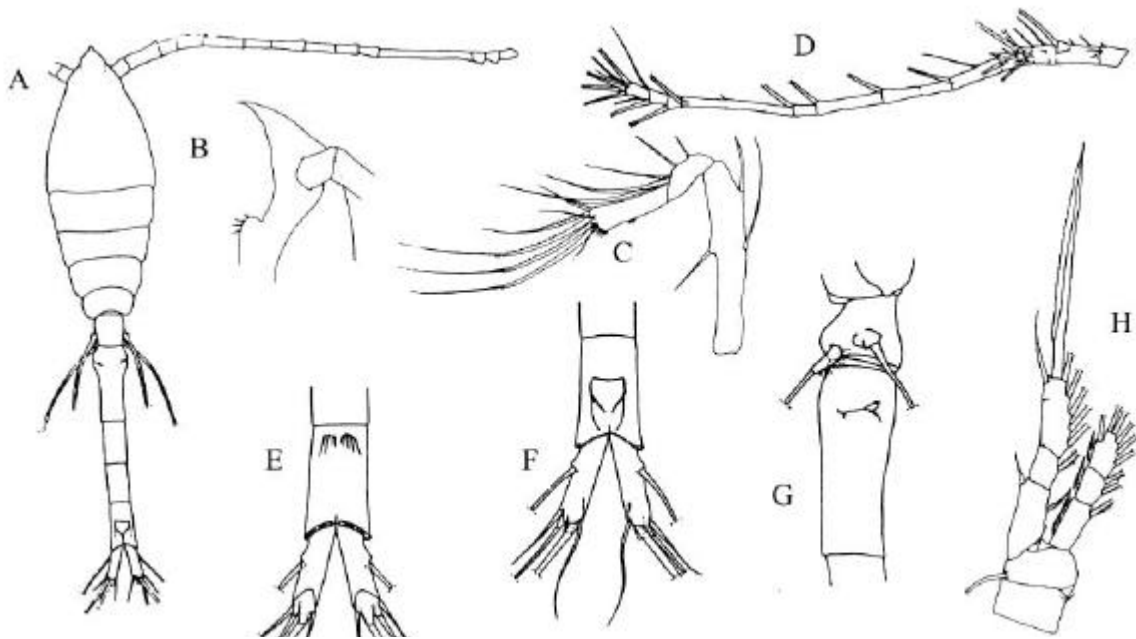
Oithona setigera (Dana, 1849)

Length: females: 1.12-1.90 mm; males: 0.90 mm.

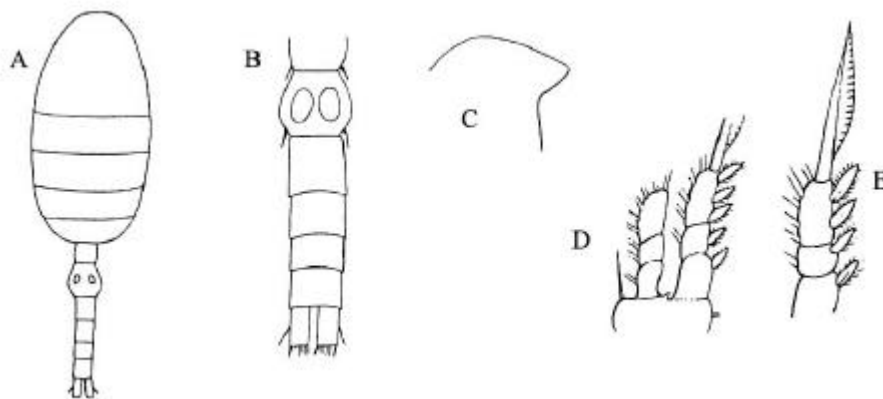
Female: Allied to *O. plumifera*, but the body is larger and A2 is shorter. Cephalosome narrows anteriorly to sharp pointed rostrum that is visible dorsally. Anterior third of genital segment swollen laterally. Genital segment twice as long as wide. Anal segment approximately twice as long as wide. posterior margin of anal segment lined with spinules, Anterior ventral section of anal segment with long setae. Furca approximately three times longer than wide. A1 longer than prosome.

Male: Rostrum not pointed. Prosome longer than urosome. Furca just longer than anal segment.

Recorded: Rodrigues, Madagascar.



Oithona setigera: Female. A, dorsal; B, lateral view of rostrum; C, A2; D, A1; E, ventral view of furca; F dorsal view of furca; G, P4. Figures from Nishida (1985).



Oithona setigera: Male. A, dorsal; B, urosome; C, lateral view of anterior cephalosome; D, P1; E, P4. Figures from Rosendorn (1927).

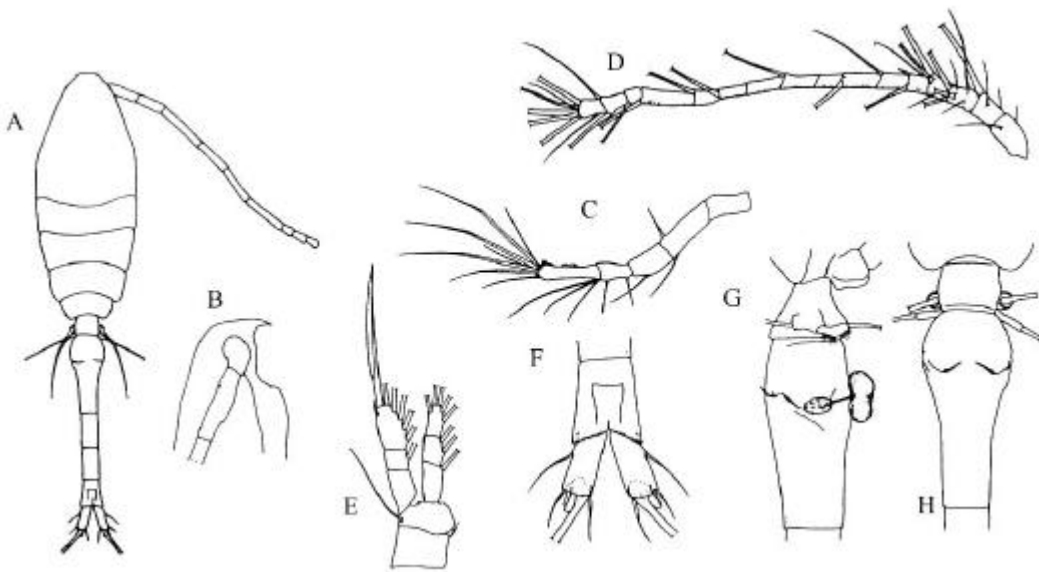
Oithona similis Claus, 1866

Length: females: 0.68-0.96 mm; males: 0.60-0.70 mm.

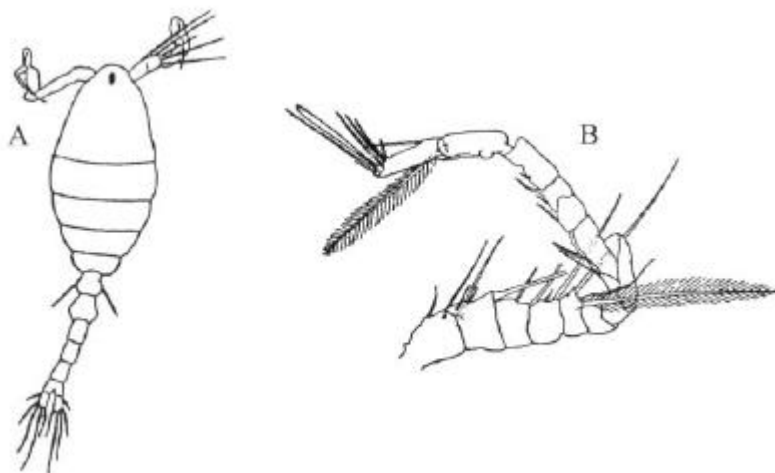
Female: Cephalosome narrowed anteriorly but not to a point. Rostrum present but not visible dorsally. Urosome approximately the length of the prosome. Anterior third of genital segment swollen laterally. Genital segment more than twice as long as wide. Anal segment just longer than width. Furca shorter than anal segment and divergent, more than twice as long as wide. Second furcal seta is longer than the urosome. Segments of A1 fringed with small spinules. A1 doesn't reach the genital segment. Ovisacs when present usually with a single row of very large eggs.

Male: Rostrum short and blunt. A1 twice geniculate, with a sheath just beyond the proximal elbow and a semicircular process on the 1st segment beyond the distal elbow, as in *O. plumifera*. Furca about as long as wide.

Recorded: Madagascar.



Oithona similis: Female. A, dorsal; B, lateral view of rostrum; C, A2; D, A1; E, P5; F, furca; G, P5 and genital segment, lateral view; H, P5 and genital segment, dorsal view. Figures from Nishida (1985).



Oithona similis: Male. A, dorsal; B, A1. Figures from Wilson (1932).

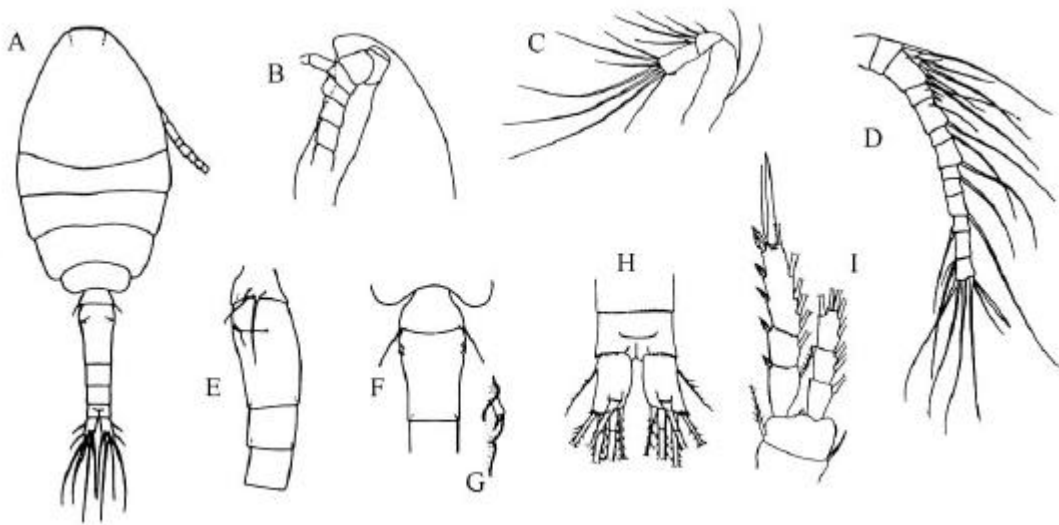
Oithona simplex Farran, 1913

Length: females: 0.36-0.42 mm; males: 0.39-0.41

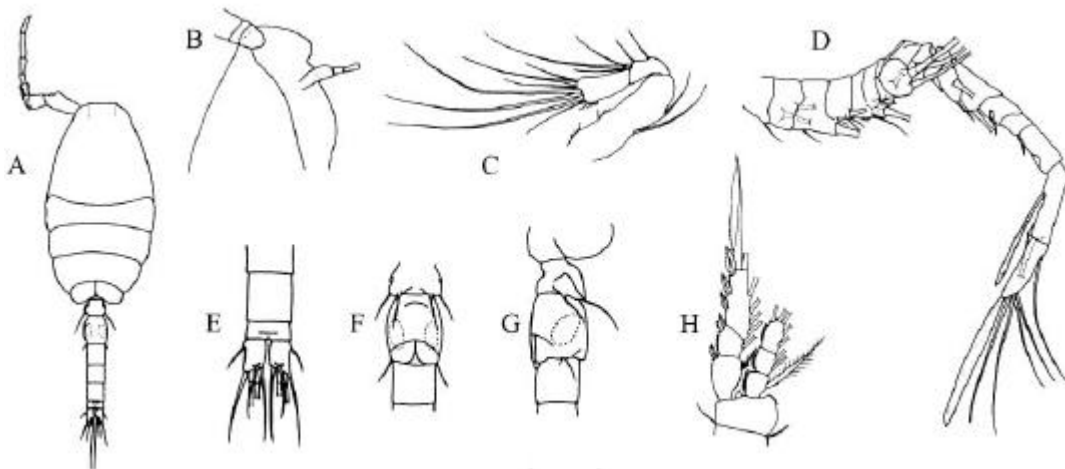
Female: Prosome oval. Cephalosome narrows anteriorly, narrow region truncate at tip. Rostrum blunt and not visible dorsally. Anterior third of genital segment swollen laterally. Genital segment 1.5 times longer than wide. Anal segment short, half as long as wide, posterior margin lined with spinules. Furca more than 1.5 times longer than wide. Furca longer than the anal segment. A1 short, reaches to the beginning of the 2nd metasome segment. The segments of A1 without a fringe of spinules.

Male: Prosome oval. Rostrum blunt and not visible dorsally. Anterior of cephalosome truncate. Genital segment just longer than wide. Anal segment short, twice as wide as long, posterior margin lined with spinules. Furca 1.5 times longer than wide.

Recorded: Madagascar.



Oithona simplex: Female. A, dorsal; B, lateral view of rostrum; C, A2; D, A1; E, lateral view of P5 and genital segment; F, dorsal view of P5 and genital segment; G, P6; H, furca; I, P4. Figures from Nishida (1985).



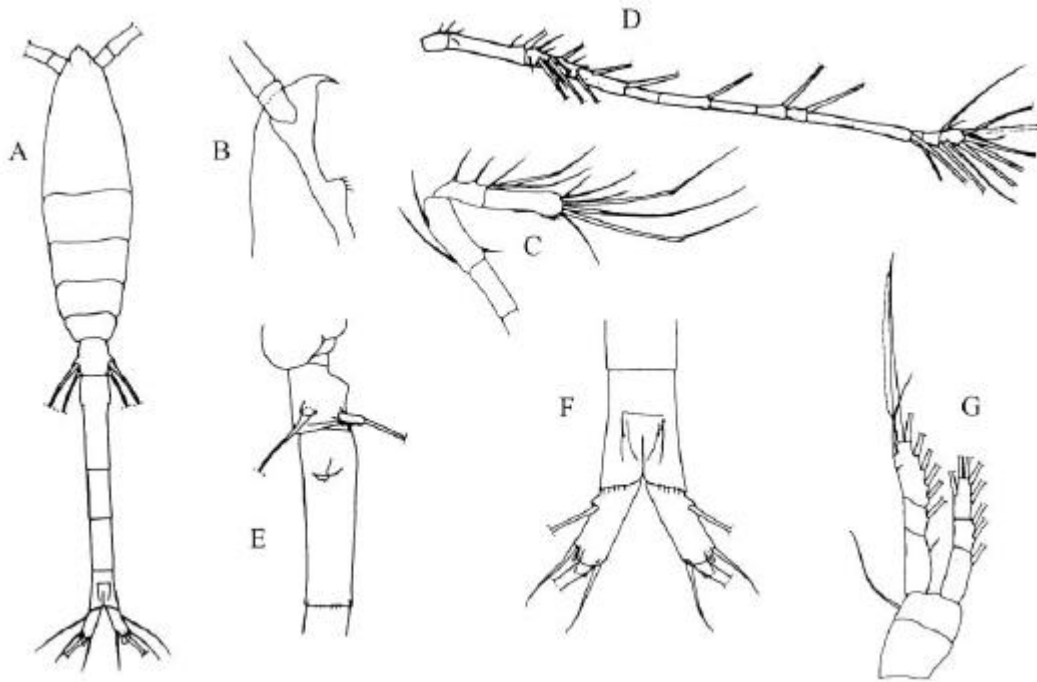
Oithona simplex: Male. A, dorsal; B, lateral view of rostrum; C, A2; D, A1; E, furca; F, dorsal view of P5 and genital segment; G, lateral view of P5 and genital segment; H, P4. Figures from Nishida (1985).

Oithona tenuis Rosendorn, 1917

Length: females: 1.11-1.12 mm.

Female: Body slender and elongate. Cephalosome narrowed anteriorly into pointed rostrum. Rostrum visible dorsally. Genital segment only slightly swollen laterally in anterior third section. Genital segment approximately three times longer than wide. Anal segment approximately 1.5 times longer than wide. Posterior margin of anal segment lined with spinules. Furca approximately 2.5 times longer than wide.

Recorded: Madagascar.



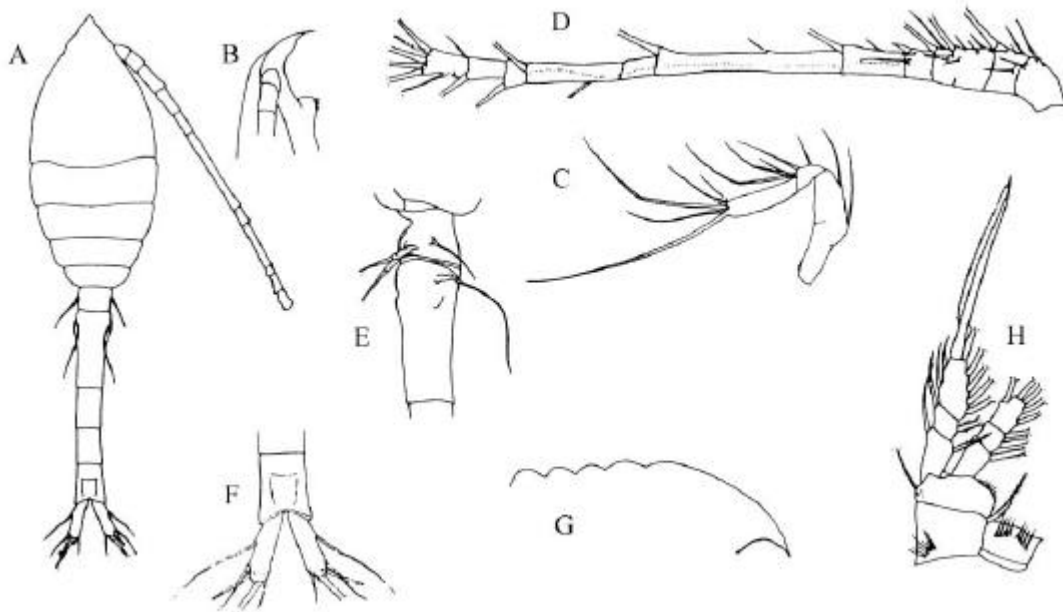
Oithona tenuis: Female. A, dorsal; B, lateral view of rostrum; C, A2; D, A1; E, lateral view of P5 and genital segment; F, furca; G, P4. Figures from Nishida (1985).

Oithona vivida Farran, 1813

Length: females: 0.69-0.83 mm.

Female: Cephalosome very pointed anteriorly, nearly triangular at the anterior-most section. Prosome approximately the same length as urosome. Anterior third of genital segment swollen laterally. Genital segment more than twice as long as wide. Anal segment more than twice as long as wide. Postero-ventral margin of anal segment lined with spicules. Furca approximately three times longer than wide. A1 longer than prosome. P6 with a very long seta – distinctive to *O. vivida*.

Recorded: Western Indian Ocean.



Oithona vivida: Female. A, dorsal; B, lateral view of rostrum; C, A2; D, A1; E, lateral view of P5 and genital segment; F, furca; G, lateral view of anterior prosome; H, P5. Figures from Nishida (1985).

Order Harpacticoida

Although a large group (approximately 3372), the Harpacticoida are numerically one of the least common sampled. Only 17 species of harpacticoids can be considered truly pelagic, most are either benthic or epibenthic. Benthic and epibenthic harpacticoids are a specialist group and are not included in this guide, although at times they are caught in plankton samples. Female harpacticoid copepods typically carry single egg sacs on the ventral surface, however, female Miraciidae carry paired egg sacs. In general there is no demarcation between the prosome and the urosome. The A1 is short and, in males both are geniculate. Males and females have 6 pairs of swimming legs, the P6 is usually rudimentary in females. The families with pelagic species are Miraciidae, Ectinosomatidae, Clytemnestridae and Euterpinidae.

Family Miraciidae

All Miraciidae are planktonic and essentially tropical and subtropical. The family characteristically possesses a pair of cuticular lenses (absent in *Macrosetella*) on the front of the head. The prosome comprises the cephalosome and three pedigerous segments. The urosome is 5-segmented in females and 6-segmented in males. The furca are usually parallel, they are as long or longer than the last 2 urosome segments combined. Each furca is furnished with 7 setae, setae I-III are closely set together and setae IV-V are spinulose. P5 are fused medially in the male but free in the female. Male P6 are symmetrical with 1-3 setae, female P6 are rudimentary. Females carry paired egg sacs, the eggs are typically large and low in number (4 in *O. gracilis* and *D. minor*, 4-6 in *M. efferata* and 2-11 in *M. gracilis*, the number varying with size of the female). The family comprises four genera *Miracia*, *Distioculus*, *Oculosetella* and *Macrosetella*.

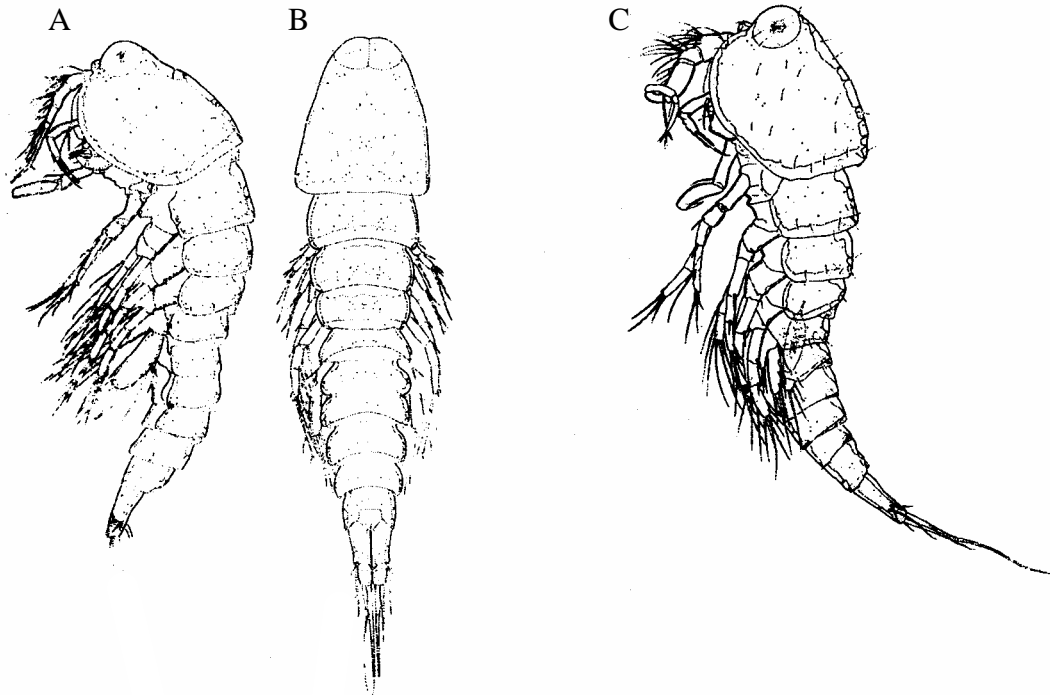
Miracia efferata Dana, 1849

Length: females: 1.55-1.85 mm; males: 1.30-1.65 mm.

Female: The front of the head is rounded. The large pair of cuticular lenses touch mid-dorsally. the cephalosome is wider than the following segment and there are distinct constrictions between each of the prosome and urosome segments. Rostrum is very small. A1 is 8-segmented. Furca 3 times longer than wide, the outer margin is stepped 2/3 down the furcal length. Seta V is shorter than the urosome. P5 is large and P6 is rudimentary.

Male: Body similar to female. A1 is 10-segmented with the geniculation between segments 7 and 8. P5 fused medially. P6 symmetrical.

Recorded: Seychelles, Madagascar.



Miracia efferata: Female. A, dorsal; B, lateral. Male. C, lateral. Figures A-C reproduced from 'Taxonomy, biology and phylogeny of Miraciidae (Copepoda: Harpacticoida)' by Huys & Böttger-Schnack from Sarsia, www.tandf.no/sarsia, 1994, volume 79, pages 212 and 218, by permission of Taylor and Francis AS.

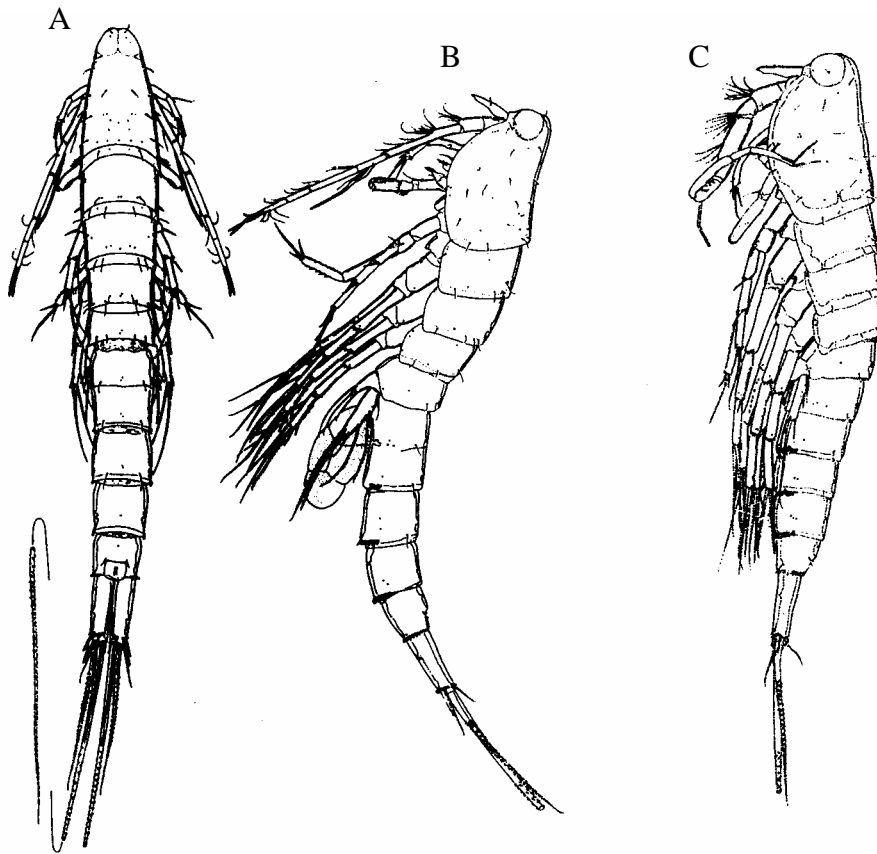
Oculosetella gracilis (Dana, 1852)

Length: females: 1.20-1.30 mm; males: 0.80 mm

Female: Body slender and elongate, without a distinct boundary between the prosome and urosome. Cephalosome is only slightly wider than first prosome segment. The front of the cephalosome bears a pair of large cuticular lenses that touch in the dorsal midline. The rostrum is conspicuous and distinctively elongate. A1 is 7-segmented. No distinct constrictions between each prosome and urosome segments. Row of spinnules on the posterior margin of the ventral surface of the last four urosome segments. Furca about 3 times longer than wide, the outer margin is almost straight (not stepped as in *Miracia*). All the setae are located in the posterior 1/6 of the furca, seta V is the longest and about 75% of total body length. P5 large. P6 vestigial. Females carry paired egg sacs, each with 4 large eggs.

Male: Body shape similar to female. A1 is 10-segmented with the geniculation between segments 7 and 8. P5 is fused medially and P6 is symmetrical.

Recorded: Seychelles, Rodrigues.



Oculosetella gracilis: Female. A, dorsal; B, lateral. Male. C, lateral. Figures A-C reproduced from 'Taxonomy, biology and phylogeny of Miraciidae (Copepoda: Harpacticoida)' by Huys & Böttger-Schnack from Sarsia, www.tandf.no/sarsia, 1994, volume 79, pages 222 and 227, by permission of Taylor and Francis AS.

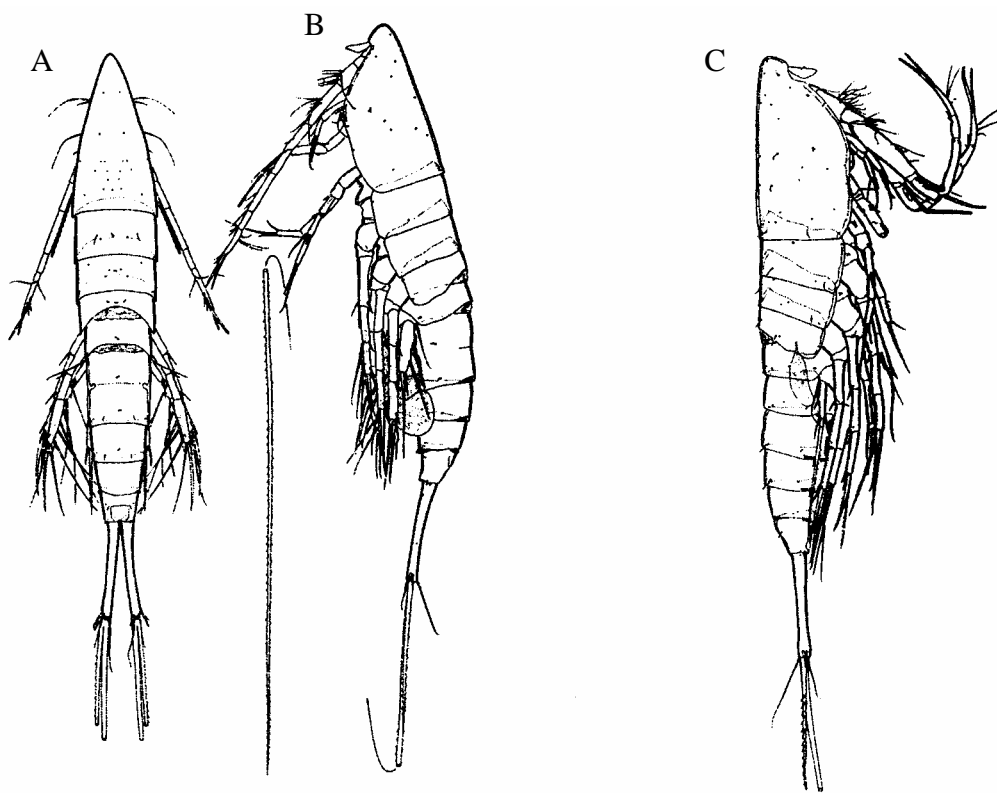
Macrosetella gracilis (Dana, 1848)

Length: females: 0.98-1.62 mm; males: 0.88-1.30 mm.

Female: Body is slender, elongate and without paired cuticular lenses. Cephalosome relatively large, about 1/3 of body length (excluding furca), and as wide as the following segment. Prosome and urosome without distinct constrictions between segments. Ventral margin of penultimate segment, and ventral and lateral margins of anal segment with spinules. Anal segment narrow. Furca about 11 times longer than wide, narrowest halfway its length. Setae V very long, distinctly longer than total body length. The rostrum is relatively large and elongate. A1 is 8-segmented. P5 is large, and P6 is rudimentary.

Male: Body shape similar to female. A1 is 10-segmented with the geniculation between segments 7 and 8. P6 are weakly developed and symmetrical. Post-genital segments with rows of spinules at the ventral posterior margin.

Recorded: Seychelles, Rodrigues, Zuza, Aldabra, Mauritius, Madagascar



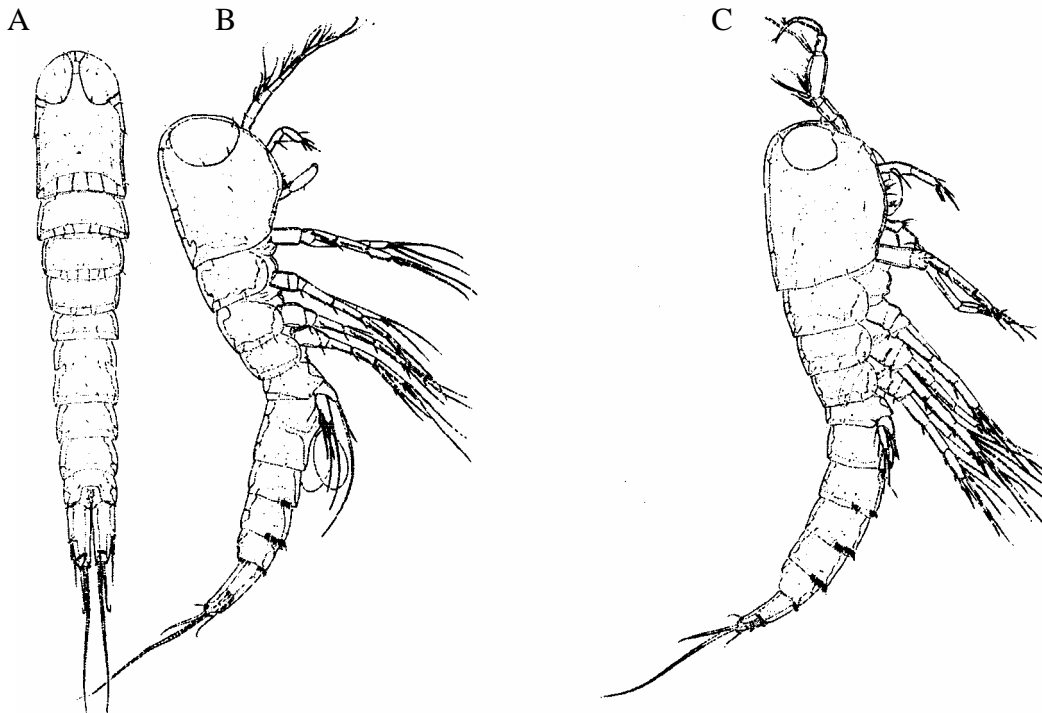
Macrosetella gracilis: Female. A, dorsal; B, lateral. Male. C, lateral. Figures A-C reproduced from 'Taxonomy, biology and phylogeny of Miraciidae (Copepoda: Harpacticoida)' by Huys & Böttger-Schnack from Sarsia, www.tandf.no/sarsia, 1994, volume 79, pages 233 and 237, by permission of Taylor and Francis AS.

Distiocolus minor (T. Scott, 1894)

Length: females: 0.79-0.91 mm; males: 0.77-0.92 mm.

Female: Cephalosome slightly narrower than the following prosome segment. The pair of large cuticular lenses (often deep red in colour) do not touch mid-dorsally. The rostrum is minute. A1 is 8-segmented. Prosome and urosome without distinct constrictions between segments. Furca about 3 times longer than wide and the outer margin is stepped at about halfway down. Setae V is the longest, but shorter than the urosome. P6 is rudimentary.

Male: Body similar to the female. A1 is 10-segmented with the geniculation between segments 7 and 8. P6 is symmetrical. Post-genital segments with rows of spinules at the ventral posterior margin. Recorded: Rodrigues, Zuza.



Distiocolus minor: Female. A, dorsal; B, lateral. Male. C, lateral. Figures A-C reproduced from 'Taxonomy, biology and phylogeny of Miraciidae (Copepoda: Harpacticoida)' by Huys & Böttger-Schnack from Sarsia, www.tandf.no/sarsia, 1994, volume 79, pages 244 and 250, by permission of Taylor and Francis AS.

Family Ectinosomatidae

The only truly pelagic genus in the family Ectinosomatidae is *Microsetella*.

Genus *Microsetella*

The body is slender and laterally compressed. The urosome is as wide as the metasome. The urosome is 4-segmented in the female and 6-segmented in the male. The A1 is slender, elongate, 5-segmented, and, in males is geniculate. The female P5 is 2-segmented and symmetrical, the male P5 is rudimentary and symmetrical. The two species of *Microsetella* are readily separated by the relative lengths of their furcal setae. The furcal setae are shorter than the body in *Microsetella norvegica* and nearly twice as long as the body in *Microsetella rosea*.

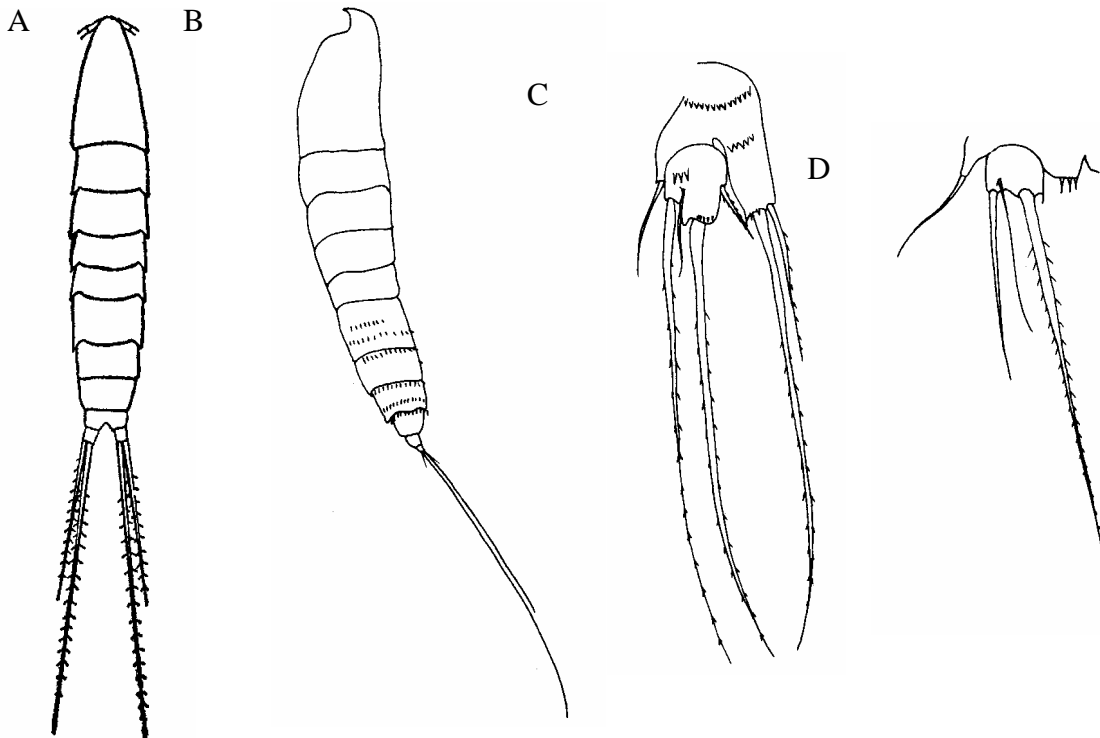
Microsetella norvegica (Boeck, 1864)

Length: females: 0.35-0.53 mm; males 0.33-0.42 mm.

Female: Body slender and laterally compressed. Rostrum short and turned downwards. Transverse rows of minute spicules on the urosome segments. Furca about as long as wide, and divergent. The longest furcal seta is nearly as long as the body. The second furcal seta is about $\frac{3}{4}$ the length of the body. P5 with the two inner setae of very different lengths, the outermost seta is twice as long as the neighbouring seta.

Male: Smaller than the female, the body is similar in shape. The furca are a little wider than long. A1 is geniculate.

Recorded: Rodrigues, Seychelles, Zuzi, Madagascar.



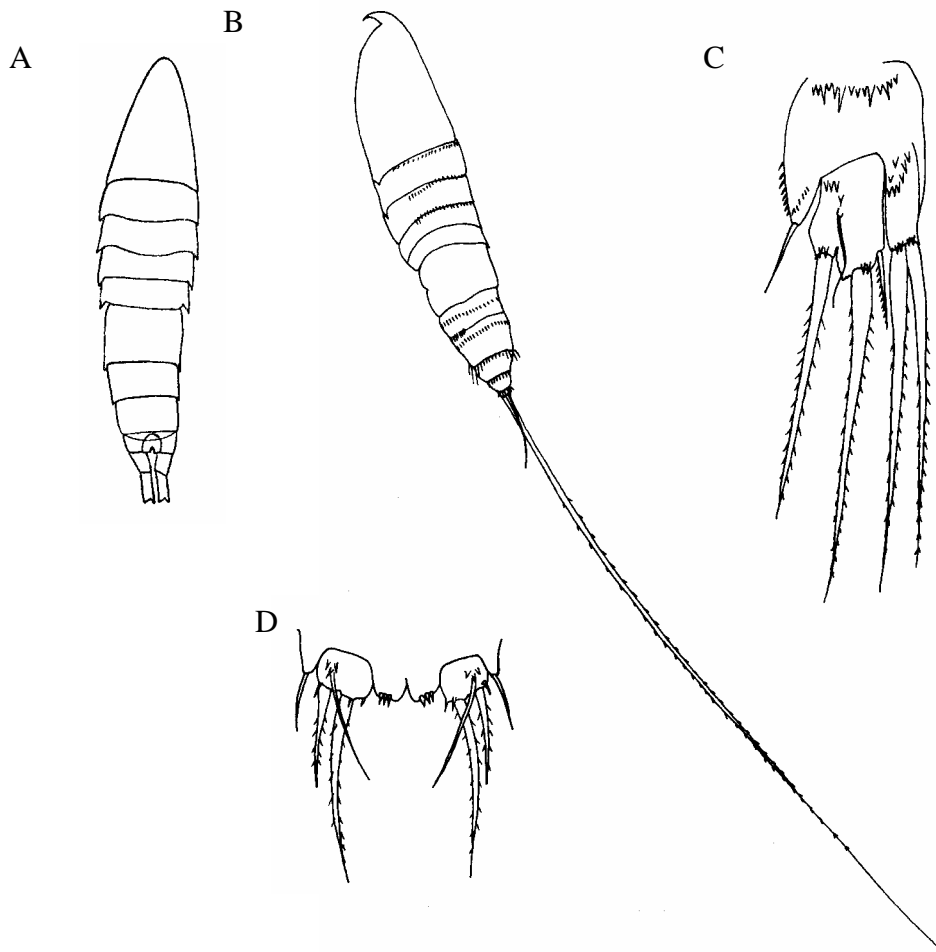
Microsetella norvegica: Female. A, dorsal; B, lateral; C, P5. Male. D, P5. Figures A from Wilson (1932), B from Sars (1904), C & D from Giesbrecht (1892).

Microsetella rosea (Dana, 1848)

Length: females 0.64-0.85 mm.

Female: Body sometimes has a rosy or reddish tinge. Body similar in shape to *Microsetella norvegica*, but almost twice the length. The 2nd, 3rd and 4th metasome segments, and the three urosome segments with transverse rows of spinules near the anterior margins. The longest seta of the furca is nearly twice as long as the body. P5 with the two inner setae approximately equal in length.

Recorded: Rodrigues, Seychelles, Zuza, Aldabra, Madagascar.



Microsetella rosea: Female. A, dorsal; B, lateral; C, P5. Male. D, P5. Figure A from Wilson (1932), B & C from Giesbrecht (1892), D from Johnson (1942).

Family Clytemnestridae

Body considerably flattened. Cephalosome and first three metasome segments with prominent angular projections at the posterior corners. Prosome comprises cephalosome and three free pedigerous segments. Urosome 5-segmented in female, 6-segmented in male. Anal segment as long as the penultimate segment. Furca short and wide. A1 7- or 8-segmented, geniculate both sides between the last two segments in males. P5 rudimentary and symmetrical, 2-segmented, segments narrow and elongate. Females carry single egg sacs.

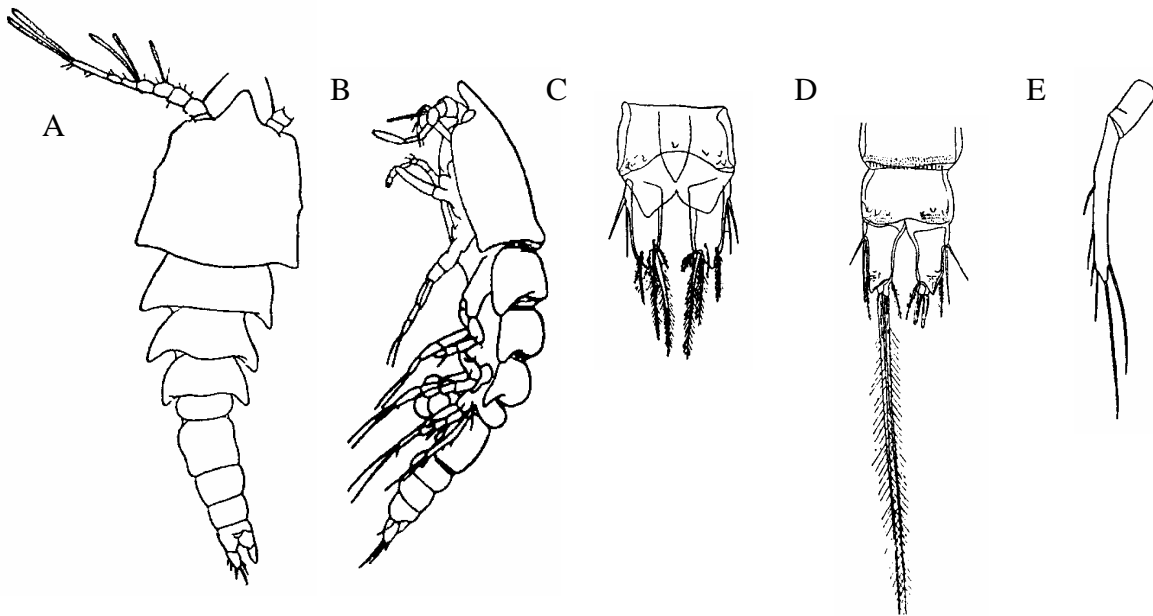
Clytemnestra scutellata Dana, 1848

Length: females: 1.05-1.20 mm; males: 1.05-1.30 mm.

Female: Body shape as for the family. A1 is 8-segmented; 4th, 5th and 8th segments with long sensory hairs. The last segment is twice as long as the preceding one. The furca is approximately twice as long as it is wide, and the 2 longest setae are plumose.

Male: Body similar to female. Both A1 are geniculate. 6th segment of A1 is short and has a spine. The longest furcal setae are longer than those of the female.

Recorded: Madagascar.



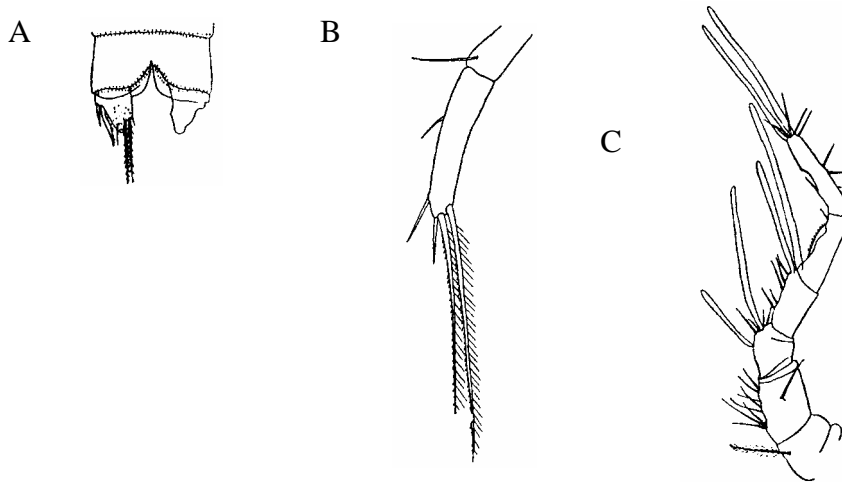
Clytemnestra scutellata: Female. A, dorsal; B, lateral; C, furca. Male. D, furca; E, P5. Figures A-E from Giesbrecht (1892).

Clytemnestra rostrata (Brady, 1883)

Length: females: 0.60-1.00 mm; males: 0.40-0.85 mm.

Female: Similar body shape to *Clytemnestra scutellata*, but generally smaller in size. A1 is 7-segmented, the last segment is nearly five times as long as the preceding one. The furca is about as long as wide, none of the furcal setae are plumose.

Male: Body similar to female, but is usually smaller. A1 geniculate between the last two segments, P5 resembles that of the female, but is a little shorter and narrower.



Clytemnestra rostrata: Female. A, furca, dorsal; B, P5. Male. C, A1. Figures A-C from Giesbrecht (1892).

Family Euterpinidae

Prosoma comprises cephalosome and three free pedigerous segments. Urosome 5-segmented in females and 6-segmented in males. Females carry single egg sacs. Only one species within the family, *Euterpina acutifrons*.

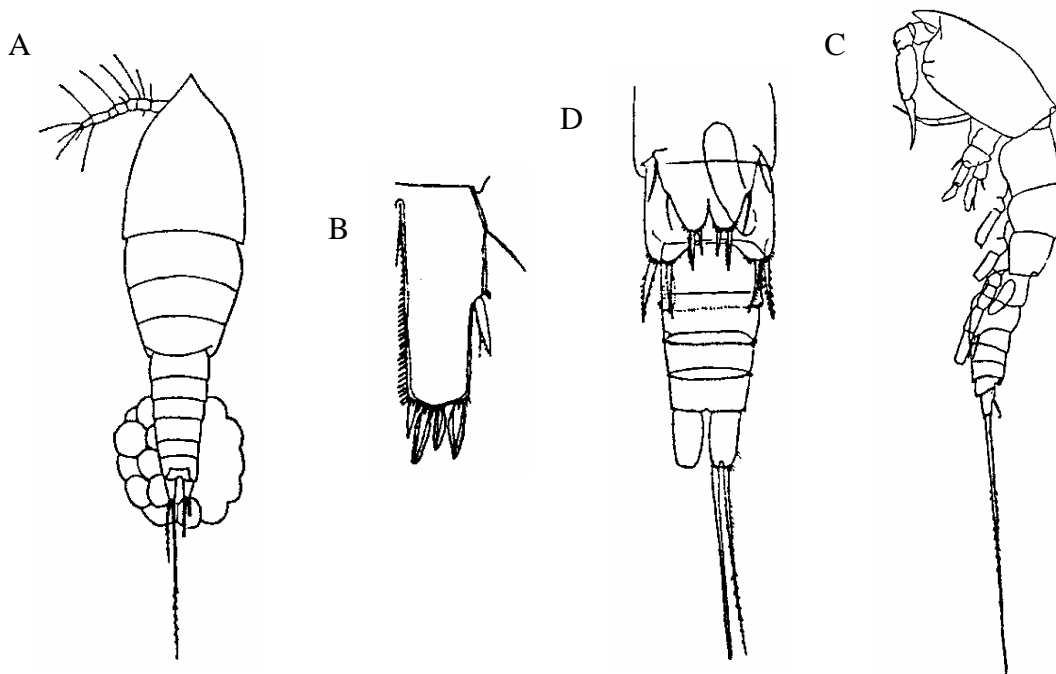
Euterpina acutifrons (Dana, 1848)

Length: females: 0.50-0.75 mm; males: 0.50-0.56 mm.

Female: The rostrum is stout. The anterior of cephalosome is sharply pointed. Body widens to the posterior of the cephalosome then narrows posteriorly. A1 is 7-segmented. P5 is symmetrical and 1-segmented. Body articulation is distinct.

Male: Body similar in shape to female. Both sides of A1 are geniculate; the 4th and 5th segments are fused and much thickened; 6th and 7th segments are fused and make up the last segment. P5 is symmetrical and rudimentary.

Recorded: Rodrigues, Seychelles, Zuza, Aldabra, Madagascar.



Euterpina acutifrons: Female. A, dorsal; B, P5. Male. C, lateral; D, Posterior prosome and urosome segments. Figures A-D from Giesbrecht (1892).

Order Poecilostomatatoida

Family Lubbockiidae

The genus *Lubbockia* has recently been reassigned from the family Oncaeidae to the family Lubbockiidae (Huys & Böttger-Schnack, 1997). Lubbockiids are small oceanic copepods. The prosome comprises the cephalosome and four free pedigerous segments. There is a distinct boundary between the prosome and urosome. The urosome is 5-segmented in females and 6-segmented in males. The genital apertures (on the genital segment) are paired and situated dorsolaterally or laterally in females and ventrally in males. A2 is 3 or 4-segmented. The maxillipeds end in a hook or claw and are 4-segmented in females and 5-segmented in males. Females carry paired egg sacs.

Genus *Lubbockia*

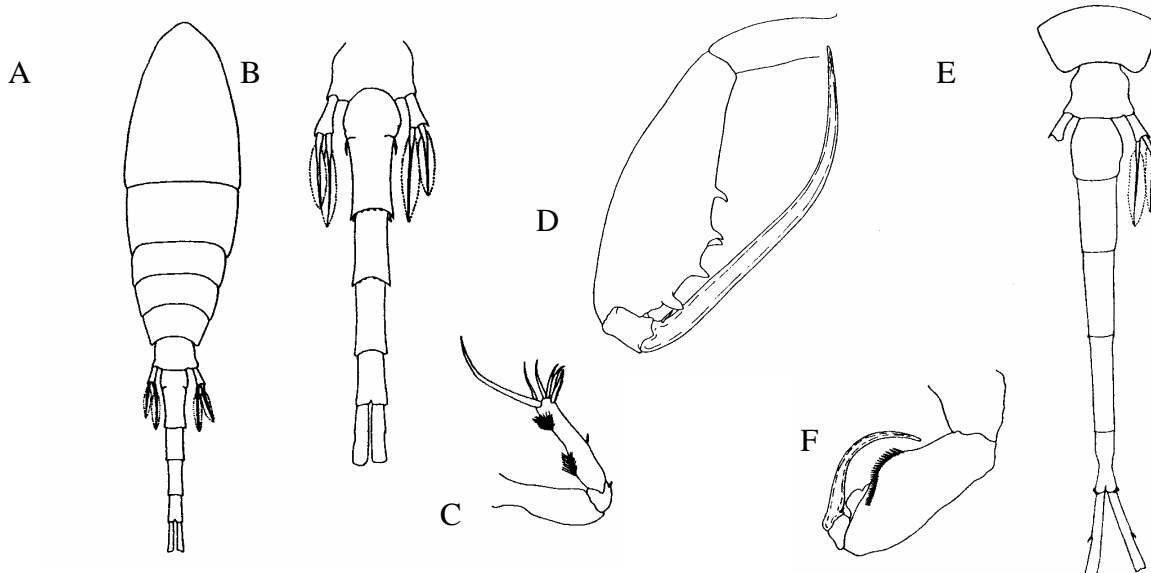
Lubbockia squillimana Claus, 1863

Length: females: 1.35-1.60 mm; males: 1.80-2.40 mm

Female: The body is slender and elongate. The anterior of the cephalosome is pointed. The greatest width is at the posterior margin of the cephalosome; the remaining prosome segments taper posteriorly. The prosome is 5-segmented and is longer than the urosome. The last prosome segment is not pronounced at the posterior corners. The genital segment is longer than the segment following. The furca is slightly longer than the anal segment, and is nearly 5 times as long as wide. A1 is 5-segmented. The maxilliped is characteristic, the 1st segment has no spines, the 2nd segment has 5 large denticles on the inner surface of the distal two third's, the 3rd segment has no spines, the 4th has smooth margins and ends in a claw.

Male: Similar body shape to the female, but larger in size. Prosome is longer than the urosome. The last prosome segment is rounded posteriorly. The maxilliped has no spines on the first segment, the 2nd segment has a row of fine spinules and a distal tubercle on the inner margin, 3rd segment very short with no spines, 4th segment terminates in a claw.

Recorded: Rodrigues, Seychelles, Zuza, Aldabra, Madagascar.



Lubbockia squillimana: Female. A, dorsal; B, urosome ventral view; C, A2; D, maxilliped. Male. E, urosome ventral view; F, maxilliped. Figures from G.A.Boxshall, The planktonic copepods of the northeastern Atlantic Ocean: some taxonomic observations on the Oncaeidae (Cyclopoida), Bulletins of the Natural History Museum, Zoology, 1977, Published by Cambridge University Press, reprinted with permission.

Family Oncaeidae

Oncaeids are small copepods, half the known species are less than 0.6 mm in length, that can be abundant in tropical coastal waters. The prosome comprises the cephalosome and four free pedigerous segments. There is a distinct boundary between the prosome and urosome. The urosome is 5-segmented in females and 6-segmented in males. The genital apertures (on the genital segment) are paired and situated dorsally in females and ventrally in males. A1 is 6-segmented in females and 4-segmented in males. A2 is 3-segmented. The maxillipeds are 3 or 4 segmented and end in a hook or claw, adapted as a grasping tool in males. Females carry paired egg sacs.

The family Oncaeidae has recently been under review (Huys & Böttger-Schnack, 1997), with the genera *Lubbockia* and *Pachos*, previously considered to be within the family Oncaeidae, reassigned to separate families. The genera *Conaea* and *Oncaea* are included in the family Oncaeidae.

Genus *Oncaea*

The genital segment is characteristically large and elongated, particularly so in the males. The genus *Oncaea* shows a variation in size within species. The front margin of the cephalosome is rounded. Characteristics used in separating the species of *Oncaea* are the proportional lengths of the body segments, the furca, the 2nd and 3rd segments of A2, the maxilliped and the structure of P4.

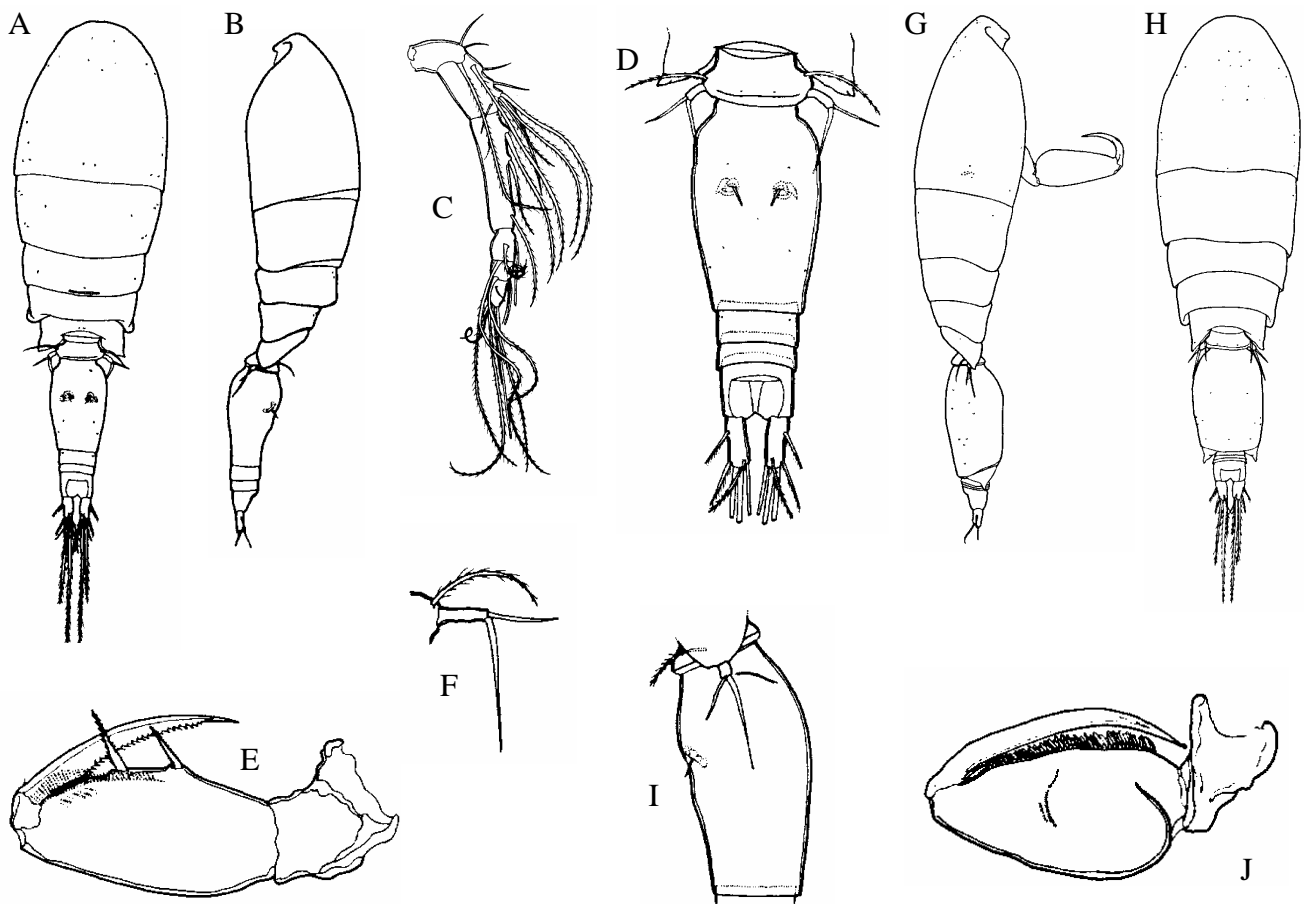
Oncaea conifera Giesbrecht, 1891

Length: females: 0.75-1.25 mm; males: 0.60-0.80 mm.

Female: In lateral view, the 2nd free pedigerous segment of the prosome has a prominent projection. The genital segment is nearly twice as long as the rest of the urosome. The 3rd urosome segment is longer than the 4th segment. The furca is as long as the anal segment. Maxilliped, the 2nd segment has two spines, the distal spine is thicker and longer than the proximal spine, and the inner margin of the terminal claw is lined with spinules. P5 is cylindrical, the inner seta is twice as long as the outer one.

Male: Considerably smaller than the female. There is no dorsal hump on the 2nd free pedigerous segment of the prosome. The genital segment is 3 times longer than the rest of the urosome. The lappets at the posterior corners of the genital segment are large, triangular and pointed outwards. The apical setae on P5 are unequal in length.

Recorded: Seychelles, Madagascar.



Oncaea conifera: Female. A, dorsal; B, lateral; C, A1; D, urosome dorsal; E, maxilliped; F, P5. Male. G, lateral; H, dorsal; I, genital segment and P5; J, maxilliped. Figures from Heron & Bradford-Grieve (1995).

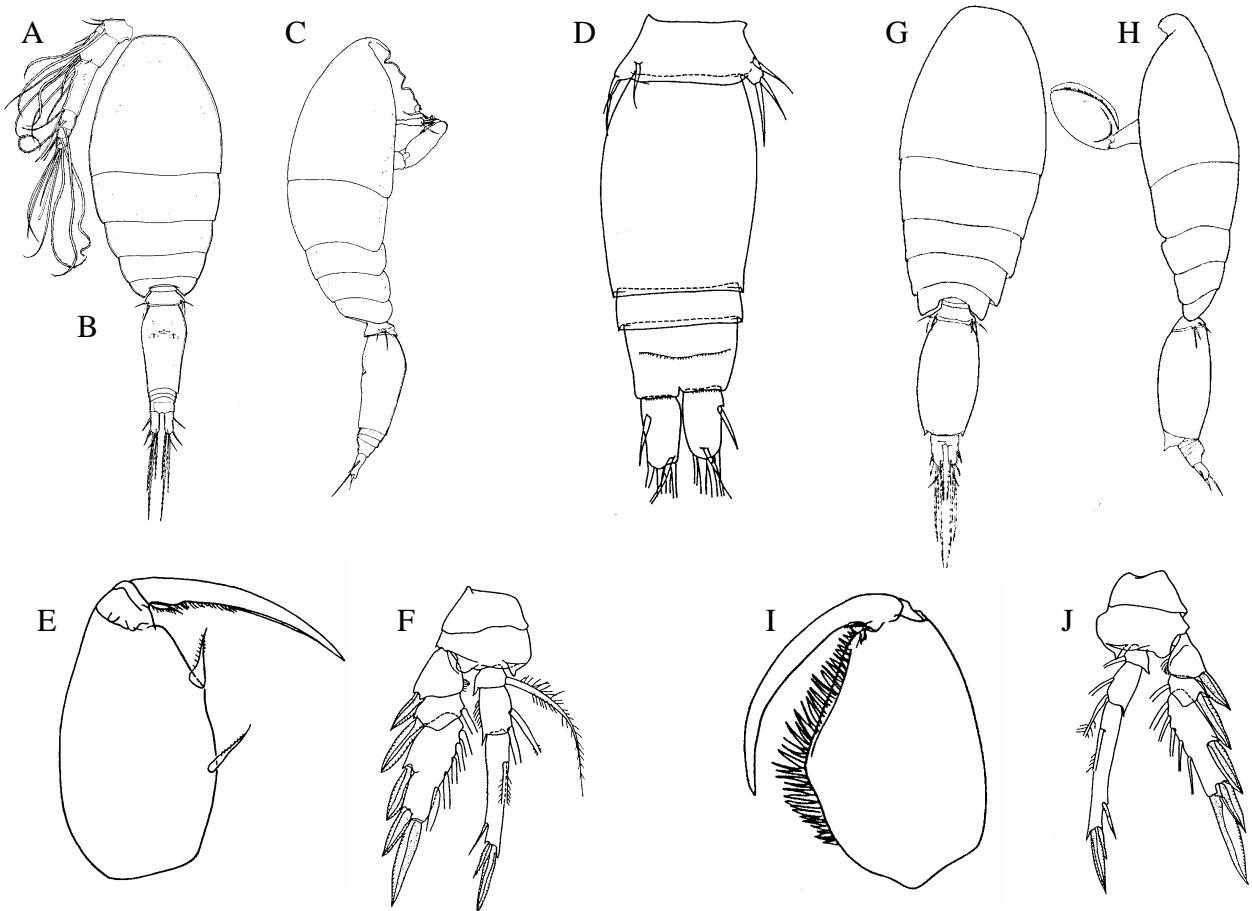
Oncaea media Giesbrecht, 1891

Length: females: 0.50-0.92; males: 0.60-0.80 mm.

Female: The widest part of the prosome is at the base of the cephalosome. The genital segment is twice the length of the rest of the urosome. The furca is nearly twice as long as wide. The distal spine on the 2nd segment of the maxilliped is thicker but of a similar length to the proximal spine. Approximately half of the inner margin of the terminal claw is lined with spinules. P5 is short, apical setae unequal in length.

Male: Genital segment is 3 times longer than the rest of the urosome. The lappets are large, rounded with a pointed projection directed outwards. The terminal claw on the maxilliped is not as long as the preceding segment. The apical setae on P5 are unequal in length. The furca are approximately twice as long as wide.

Recorded: Seychelles, Madagascar.



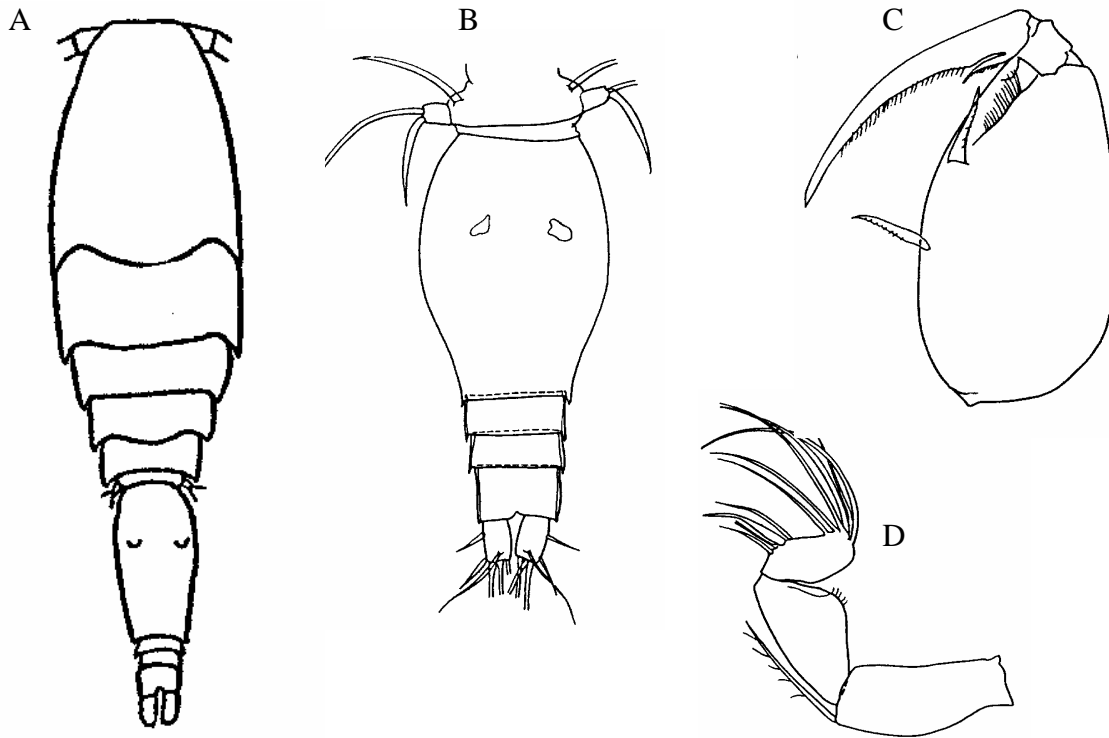
Oncaea media: Female. A, A1; B, dorsal; C, lateral; D, urosome; E, maxilliped; F, P4. Male. G, dorsal; H, lateral; I, maxilliped; J, P4. Figures A,B,C, G & H from Heron & Bradford-Grieve (1995), D-F, I & J from Razouls (1974).

Oncaea minuta Giesbrecht, 1892

Length: female: 0.45-0.58 mm; male: unknown

Female: A very small copepod with a slender body. The prosome is more than twice as long as wide. The urosome is less than half the length of the prosome. The furca is shorter than the anal segment, and is approximately twice as long as wide. The outer seta on the furca arises midway up the outer margin. P5 is as wide as long, the inner apical seta is twice as long as the outer seta.

Recorded: Indian Ocean.



Oncaea minuta: Female. A, dorsal; B, urosome; C, maxilliped; D, A2. Figure A from Wilson (1932), B-D from Razouls (1974).

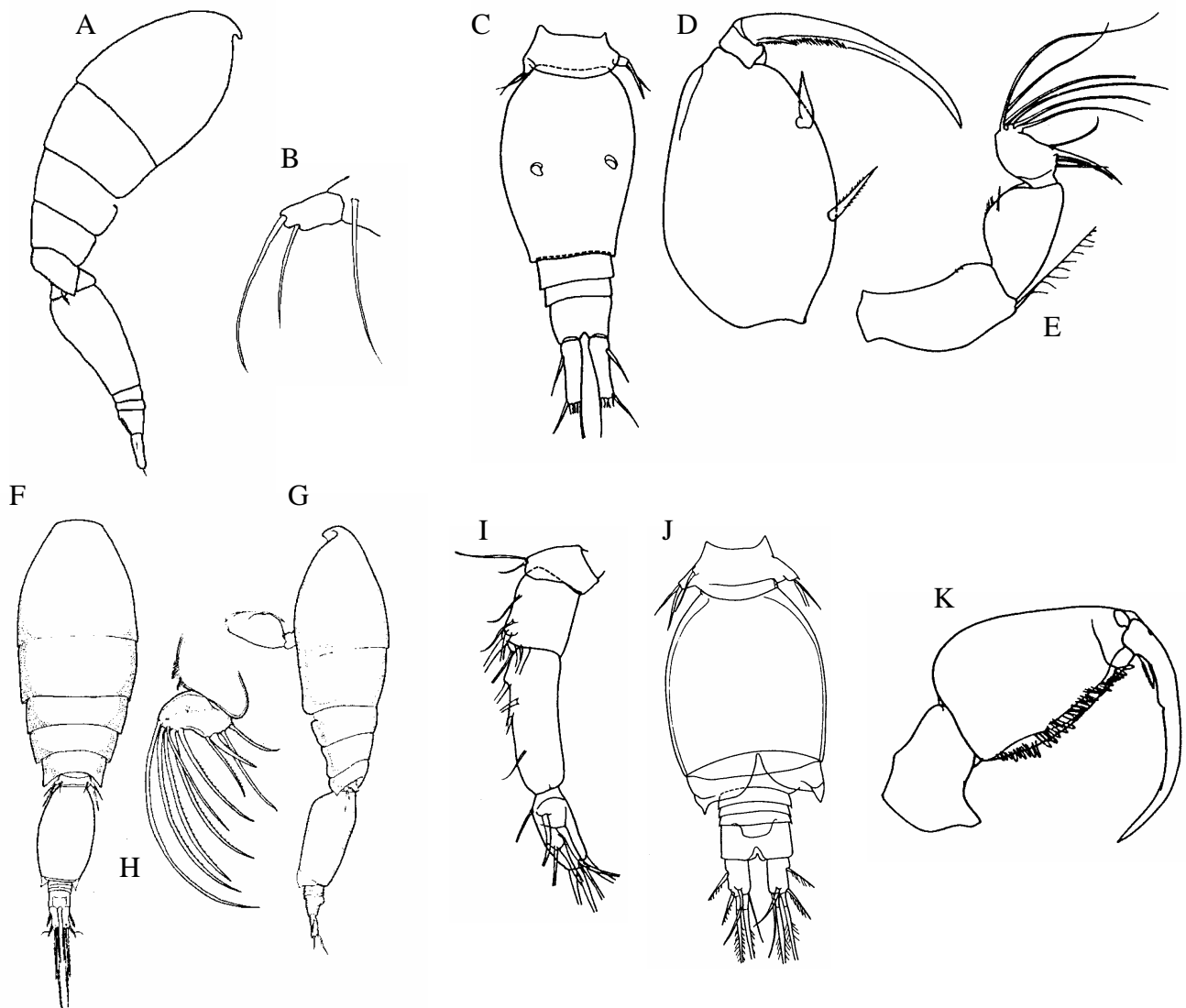
Oncaea mediterranea (Claus, 1863)

Length: females: 1.00-1.30 mm; males: 0.70- 1.05 mm.

Female: Posterior of last prosome segment not smoothly rounded, tips directed slightly outwards. Genital segment elongate and more than twice the length of the rest of the urosome. Furca is longer than anal segment and approximately three times longer than wide. The outer seta on the furca arises in the first third of the outer margin.

Male: Smaller than female. Genital segment nearly 3 times as long as the rest of the urosome. Lappets at the distal corners of the genital segment have prominent backward directed projections.

Recorded: Rodrigues, Madagascar.



Oncaea mediterranea: Female. A, lateral; B, P5; C, urosome; D, maxilliped; E, A2. Male. F, dorsal; G, lateral; H, A2; I, A1; J, urosome; K, maxilliped. Figures A, B & F-H from Heron & Bradford-Grieve (1995), C-E & I-K from Razouls (1974).

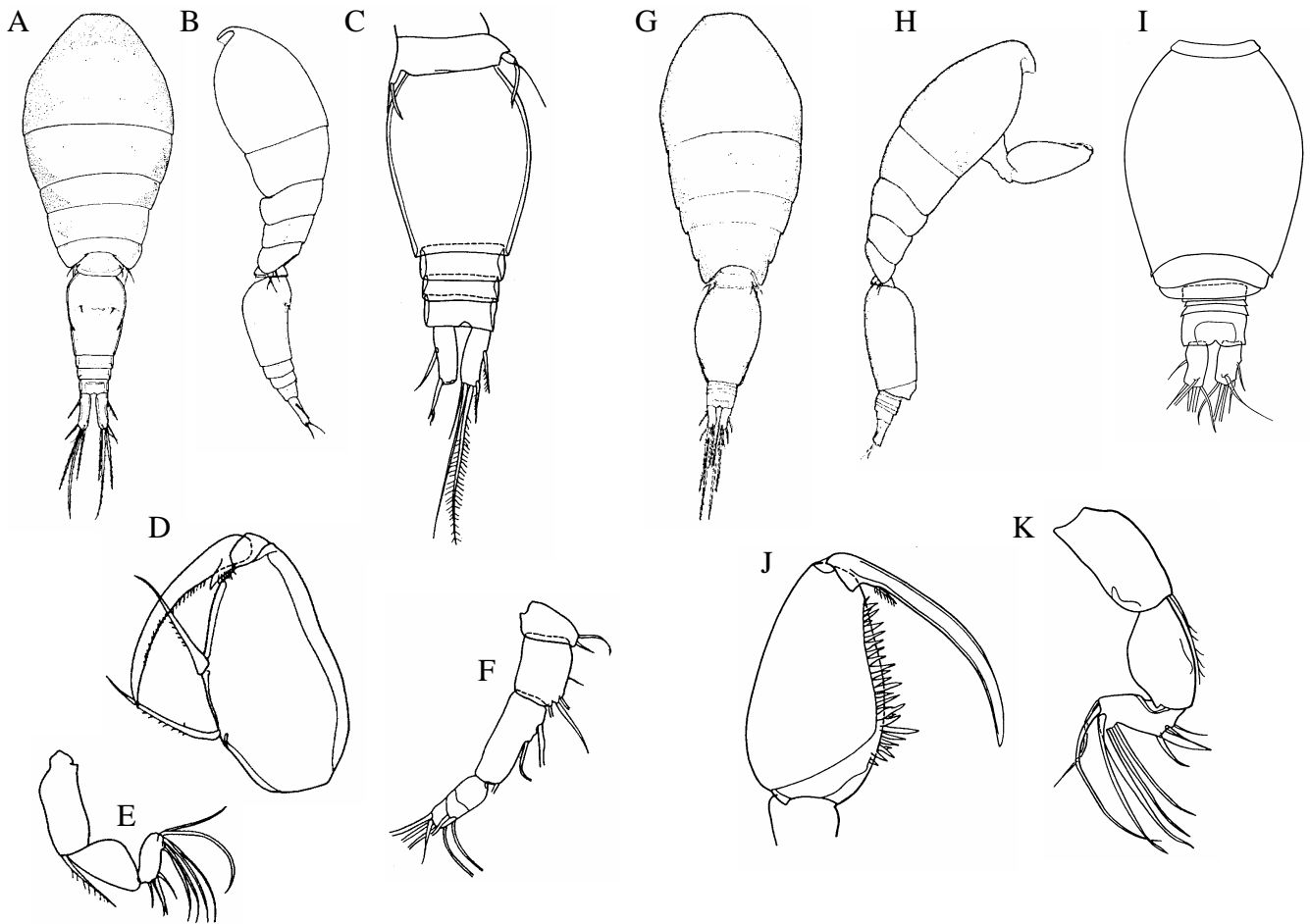
Oncaea venusta Philippi, 1843

Length: females: 1.00-1.28 mm; males: 0.70-1.00 mm.

Female: Prosome widest at the base of the cephalosome. Last prosome segment rounded at the distal corners. The genital segment is longer than the rest of the urosome and is more rounded than in *O. mediterranea*. The furca is longer than the anal segment, and nearly 4 times longer than wide. P5 is very small, same width as length, the two apical setae are not equal in length.

Male: The body is narrower than the female. The three segments between the genital segment and the anal segment are very short. The genital segment is more than 3 times longer than the rest of the urosome. The lappets at the base of the genital segment have small lateral points turned outward. The furca is shorter than 3 times longer than wide.

Recorded: Rodrigues, Seychelles, Madagascar



Oncaea venusta: Female. A, dorsal; B, lateral; C, urosome; D, maxilliped; E, A2; F, A1. Male. G, dorsal; H, lateral; I, urosome; J, maxilliped; K, A2. Figures A, B, G and H Heron & Bradford-Grieve (1995), C-F and I-K from Razouls (1974).

Family Sapphirinidae

Sapphiriniids may have a typical cyclopoid body, or the body may be characteristically flattened dorsoventrally. Cuticular lenses are present at the front of the cephalosome in all females and some males. The prosome comprises the cephalosome and three or four free pedigerous segments. Urosome typically 4-segmented in females and typically 6-segmented in males. Genital apertures are paired and situated dorsolaterally in females and ventrally in males. A1 3- to 6-segmented. Male A1 not geniculate. A2 is 4-segmented. Females carry paired egg sacs. The genera *Copilia*, *Sapphirina* and *Vetтория* (= *Corissa*) are included in the family Sapphirinidae.

Genus *Copilia*

Relatively large transparent copepods with very distinctive features that readily separate them (especially the females) from the rest of the family. The males and females have very different body shapes. The female cephalosome is usually rectangular in shape, with two prominent anterior cuticular lenses. A1 is 6-segmented. A2 is 4-segmented and uniramous. The metasome segments taper backwards. The posterior margin of the 3^d metasome segment has a stout median spine mid-dorsally that is pointed backwards. P5 is degenerate, 1-segmented and uniramous. There is a defined division between the prosome and urosome. The urosome consists of four segments and the furca are long and slender, usually longer than the urosome. The male body shape resembles that of *Sapphirina*, but the furca are long and slender in *Copilia* but leaf-like in *Sapphirina*, and the cephalosome of the male *Copilia* bears no cuticular lenses. A2 is 4-segmented and more slender than that of the female. There is no obvious division between the prosome and urosome. The prosome segments and the first four urosome segments are wide whereas the anal segment is very small. The furca are rod-like and generally shorter than those in the female.

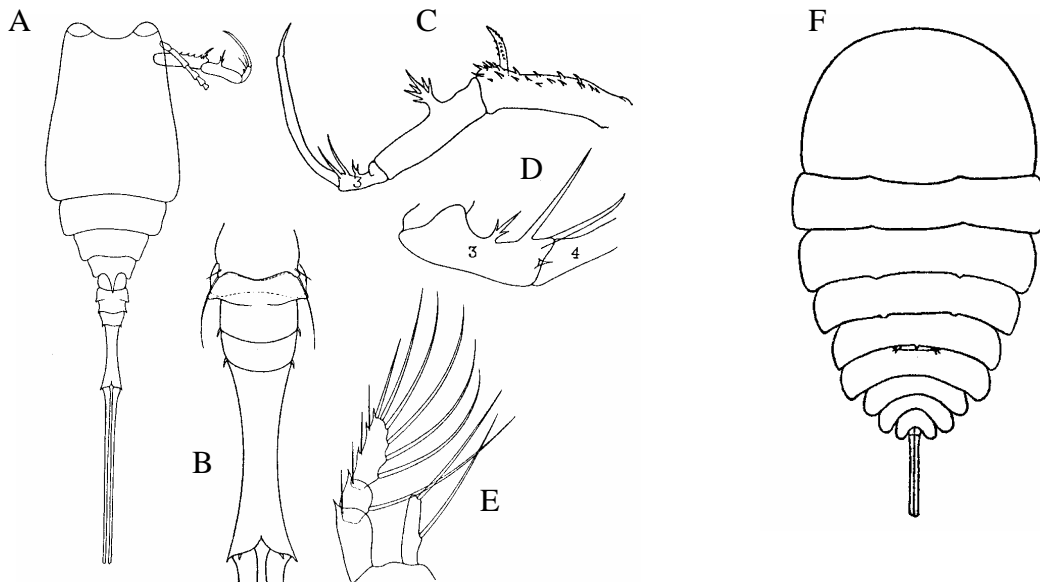
Copilia mirabilis Dana 1849

Length: females: 2.20-4.10 mm; males: 3.20-6.10 mm.

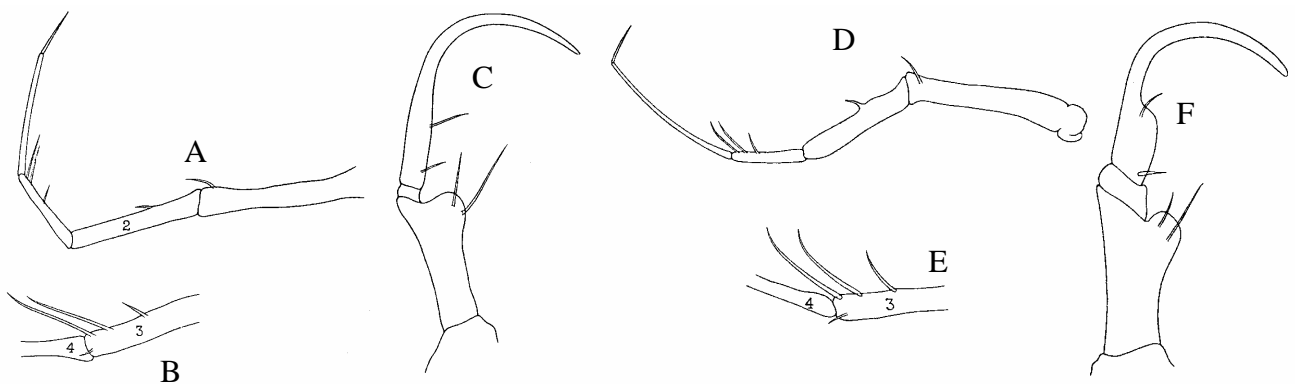
Female: The cephalosome is longer than broad; it is as long as the rest of the body (not including the furca) with the widest part at the posterior margin. The space between the two cuticular lenses is nearly twice the diameter of the lens. 1st segment of A2 with many short spines, and a large spine at the distal end covered in spinules. A large characteristic spine with several large spinules on the mid-section of the 2nd segment. The posterior margins of the urosome segments have rows of spinules. The anal segment is longer than the rest of the urosome, and wider posteriorly. The furca is longer than the urosome, with short setae near tip.

Male: The cephalosome is very rounded, and shorter than wide. The first two metasome segments are wider than the cephalosome, and the remainder of the segments taper backwards. A2 is slender, the 1st segment is longer than the 2nd and the 2nd segment is longer than the 3rd. The 4th segment is almost twice as long as the 3rd. There are two varieties *Copilia mirabilis* var. *typical* and *C. mirabilis* var. *platonyx*.

Recorded: Rodrigues, Seychelles, Zuza, Aldabra, Madagascar.



Copilia mirabilis: Female. A, dorsal; B, urosome; C, A2; D, close up of A2; E, P4. Male. F, dorsal. Figures A-G from Lehnhofer (1926), F from Wilson (1932).



Copilia mirabilis var. *typical*: Male. A, A2; B, close up of segments 3 and 4 of A2; C, maxilliped. *Copilia mirabilis* var. *platonyx*: Male. D, A2; E, close up of segments 3 and 4 of A2; F, maxilliped. Figures from Lehnhofer (1926).

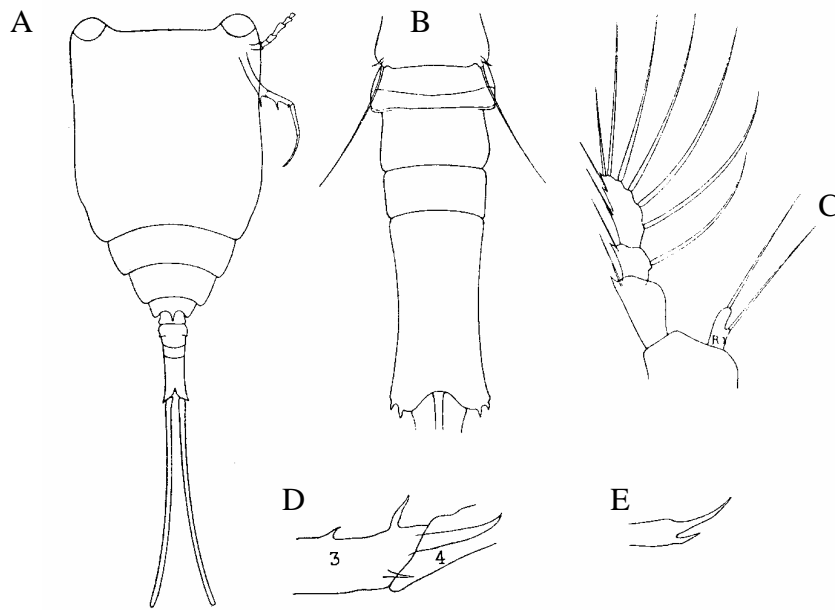
Copilia quadrata Dana, 1849

Length: females: 2.20-4.40 mm, males: 3.50-5.70 mm.

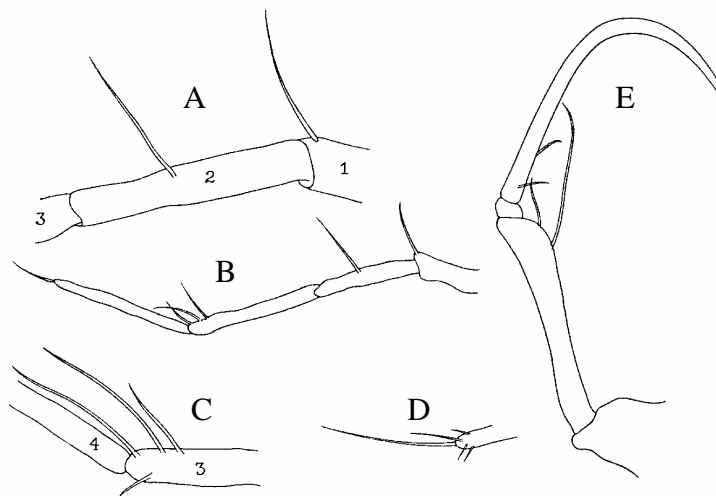
Female: The cephalosome is quadrate in dorsal view, and is as long as wide. The space between the two cuticular lenses is more than three times the diameter of the lens. The 1st segment of A2 is longer than the 2nd, with a spine at the distal end. The spine on the middle section of the 2nd segment with no spinules off it. The anal segment is as long as the rest of the urosome. The furca is more than twice as long as the urosome.

Male: The front margin of the head is straight, or slightly concave. The cephalosome is shorter than wide. The 1st segment of A2 is nearly twice as long as the 2nd segment, and the 3rd segment is as long as the 4th.

Recorded: Seychelles, Madagascar.



Copilia quadrata: Female. A, dorsal; B, ventral urosome; C, P4; D, segments 3 and 4 of A2; E, tip of A2. Figures from Lehnhofer (1926).



Copilia quadrata: Male: A, close up of segment 2 of A2; B, A2; C, close up of segments 3 and 4 of A2; D, tip of A2; E, maxilliped. Figures from Lehnhofer (1926).

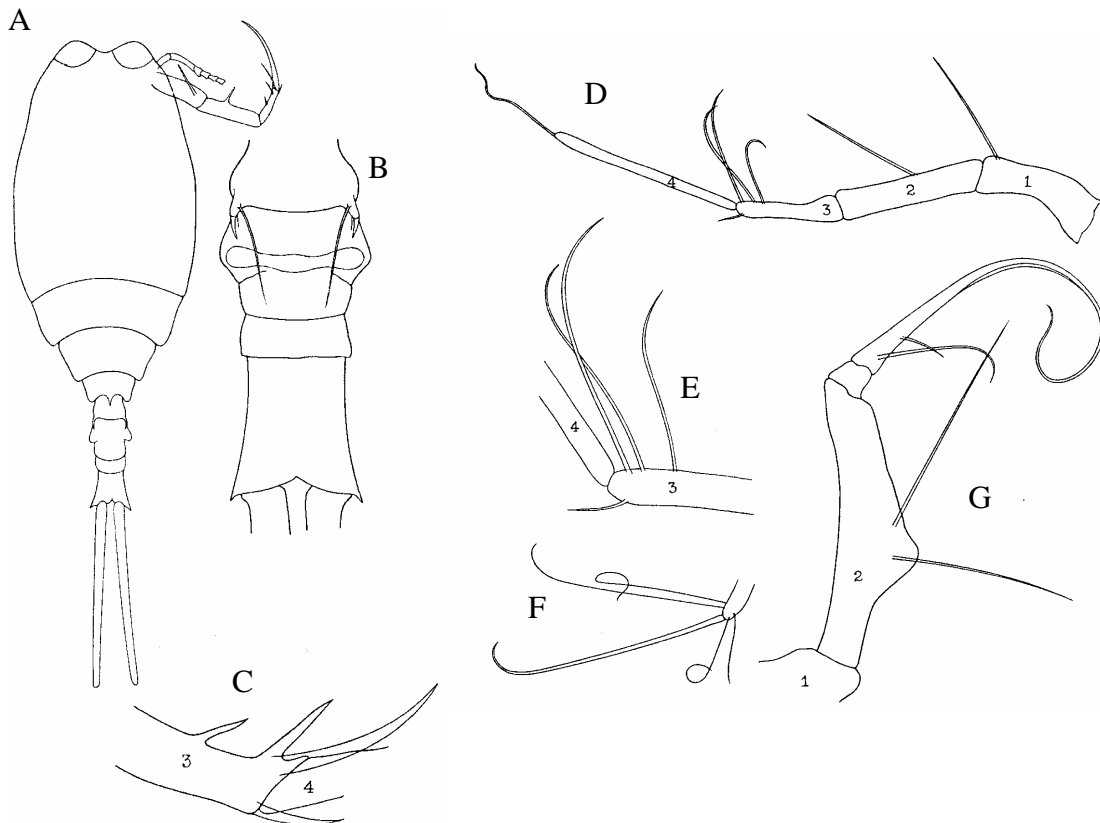
Copilia vitrea (Haeckel, 1864)

Length: females: 3.20-5.40 mm; males: 5.50-5.90 mm.

Female: The cephalosome is about 1.5 times longer than wide. The anterior of the cephalosome is narrow; the space between the cuticular lenses is less than the diameter of the lens. The anal segment is short, less than half the length of the rest of the urosome. The furca is less than twice as long as the rest of the urosome.

Male: The 1st segment of A2 is shorter than the 2nd segment; the 3rd segment is shorter than the 4th.

Recorded: Madagascar



Copilia vitrea: Female. A, dorsal; B, ventral view of urosome; C, segments 3 and 4 of A2. Male. D, A2; E, segments 3 and 4 of A2; F, tip of A2; G, maxilliped. Figures from Lehnhofer (1926).

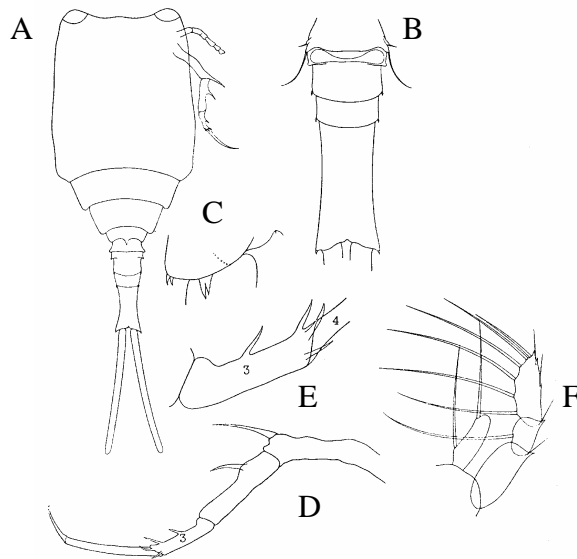
Copilia hendorffi Dahl, 1892

Length: females: 3.90-5.10 mm; males: 5.50-8.30 mm.

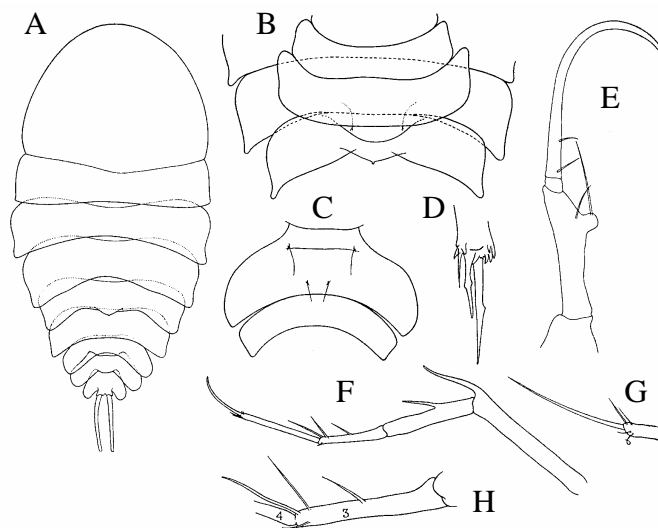
Female: The cephalosome is quadrangular in shape, longer than broad, front margin is straight. The space between the cuticular lenses is just over twice the diameter of the lens. The 1st segment of A2 has a large spine at the distal end that is about twice as long as the spine on the 2nd segment which is located about one third along its length. The anal segment is as long as the rest of the urosome. Rows of spinules on posterior margins of 2nd and 3rd urosome segments.

Male: The cephalosome is shorter than wide, and rounded anteriorly. The first two metasome segments are wider than the cephalosome, and the remainder of the segments taper backwards. The 1st segment of A2 has a large spine projecting from its distal end, the spine reaches approximately half way along the 2nd segment. 1st segment of A2 is longer than the 2nd segment, the 2nd segment is longer than the 3rd segment, and 4th segment is only just longer than the 3rd.

Recorded: Rodrigues



Copilia hendorffi: Female. A, dorsal; B, ventral view of urosome; C, distal margin of anal segment; D, A2; E, segments 3 and 4 of A2; F, P5. Figures from Lehnhofer (1926).



Copilia hendorffi: Male. A, dorsal; B, dorsal view of articulation between metasome and urosome, urosome flipped upwards; C, first 2 urosome segments; D, tip of furca; E, maxilliped; F, A2; G, tip of A2; H, segments 3 and 4 of A2. Figures from Lehnhofer (1926).

Genus *Sapphirina*

Sapphirina species are large copepods that are flattened dorso-ventrally. The majority of species are transparent and some are iridescent. A pair of large cuticular lenses are situated on the anterior of the cephalosome. The males are typically larger than the females. The prosome comprises the cephalosome and up to 4 pedigerous segments. The urosome is 5-segmented in females and 6-segmented in males. The 1st segment of the urosome (the last thoracic segment) is usually half the width of the preceding segment. In females the remaining urosome segments are a similar width whereas in males the following segment (genital segment) is nearly as wide as the last prosome segment. In males the anal segment is small. The furca is leaf-like, with a superficial seta rising from the blade and 4 setae rising from the outer margin, the exact shape of the furca varies with species. A1 is between 3- and 6-segmented. A2 is 4-segmented and ends in a claw. P5 is uniramous, 1 segmented and ends in two minute setae.

The characteristics for separating species include the overall body shape, the length of cephalosome in relation to the rest of the body, whether the cuticular lenses are visible dorsally, the shape of the furca, respective lengths of the 4 segments of A2, the number of segments in A1, the type of spines on the endopod of P2 and the relationship between exopod and endopod of P4.

Sapphirina angusta Dana, 1849

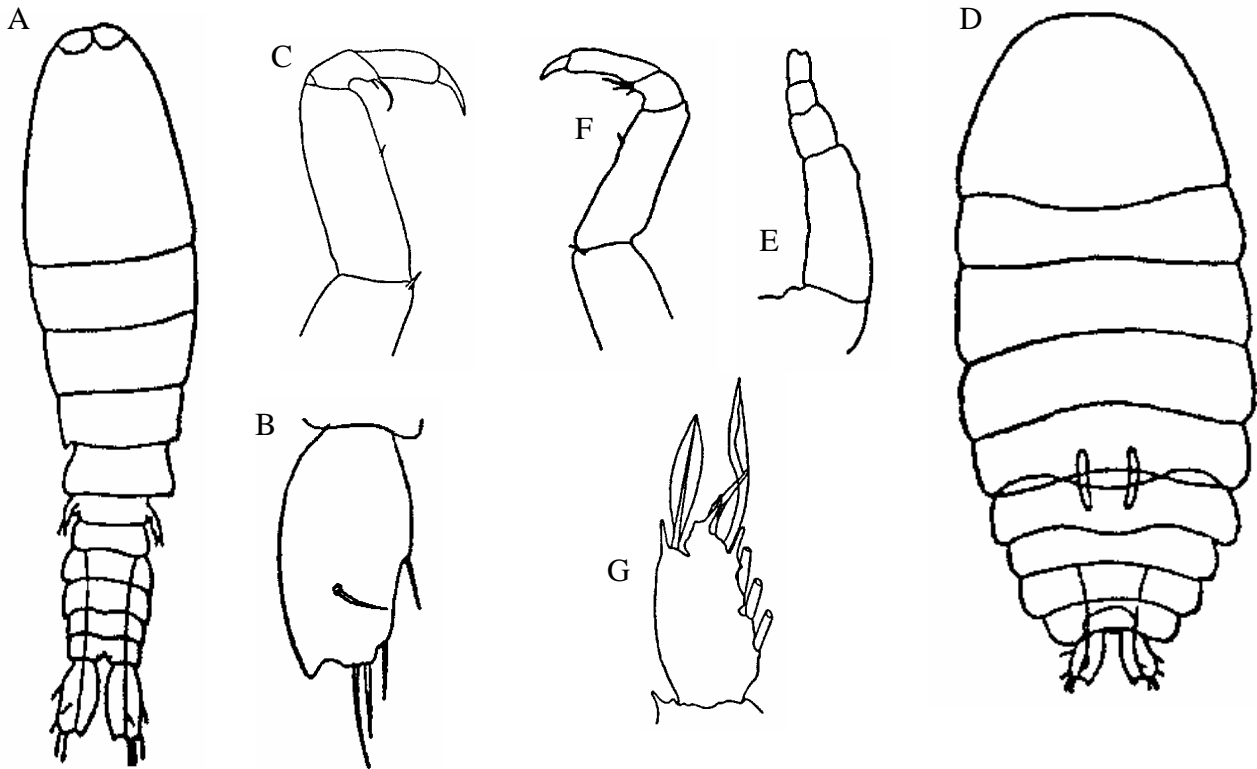
Length: females: 3.00-4.00 mm; males: 3.75-5.15 mm.

Both males and females are large copepods, they have very elongated bodies, and possess a wide blunt projection on the inner distal margin of the furca.

Female: Body elongate. Cephalosome approximately 1.5 times longer than wide. Cuticular lenses are adjacent, visible dorsally, and make up the anterior section of the cephalosome. Urosome elongate, approximately 1/3 the length of the prosome. Furca is twice as long as wide with a broad and bluntly rounded process on the distal end of the inner margin. A1 is 5-segmented, the 2nd segment is at least as long as the next three segments together. A2 has a long spine at the distal end of the 1st segment; the 2nd segment is longer than the last two segments (3rd and 4th) together. The endopod of P4 is shorter than the exopod, with two foliaceous spines of equal length at the tip.

Male: Body elongate, more than twice as long as wide. Cuticular lenses not visible dorsally. First four metasome segments wider than the cephalosome. Furca similar to that of the female. Last endopod segment of P2 with three inner setae, three foliaceous spines and two claw-like spines at the tip.

Recorded: Western Indian Ocean



Sapphirina angusta: Female. A, dorsal; B, furca; C, A2. Male. D, dorsal; E, A1; F, A2; G, P2. Figures B, C, E, F, G from Lehnhofer (1929), figures A and D from Giesbrecht (1892).

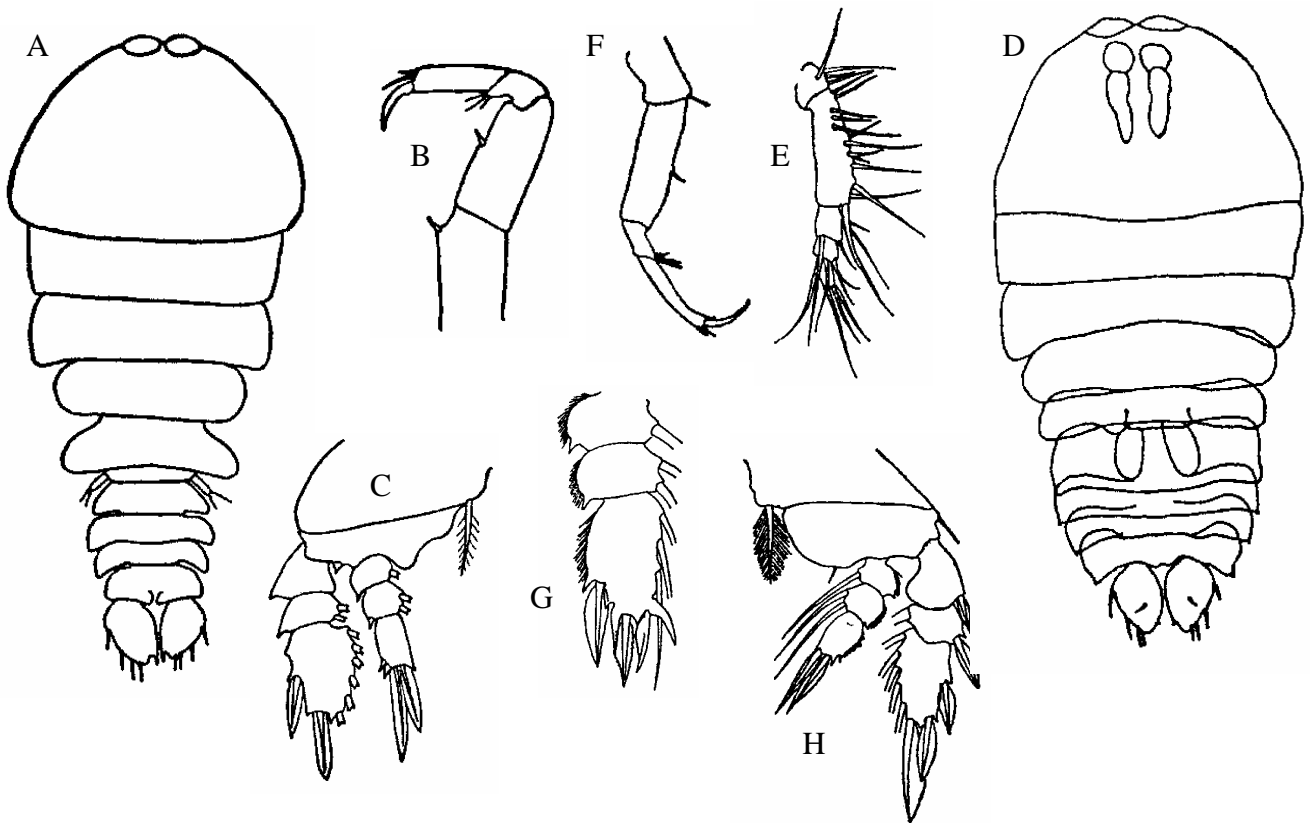
Sapphirina auronitens Claus, 1863

Length: females: 1.00-2.19 mm; males: 1.35-2.39 mm.

Female: Cephalosome wider than long. Cuticular lenses visible dorsally. 1st metasome segment not as wide as cephalosome, 2nd metasome segment wider than 1st, 3rd metasome segment approximately 2/3 the width of the 2nd, 5th metasome segment half the width of the 4th. Furca are ovate in shape and appear inclined inwards with a small spine at the distal end of the inner margin. The superficial seta on the furca is behind the first marginal seta. 4th segment of A2 is twice as long as the 3rd, the 2nd segment is as long as the 3rd and 4th together. P4 with two spines of unequal length at the tip.

Male: Cephalosome wider than long. Cuticular lenses visible dorsally. Endopod of P4 is shorter than exopod. Furca similar in shape to female, and 1.5 times longer than wide. A1 is nearly half the length of A2. The 2nd segment of A1 is longer than the 3 following segments together. The last endopod segment of P2 has a hook-like process on the inner distal corner, a foliaceous, coarsely denticulate spine at the tip, and a long foliaceous spine on the outer distal corner. The endopod of P4 is longer than the exopod, there are two foliaceous spines of unequal length at the tip.

Recorded: Madagascar.



Sapphirina auronitens: Female. A, dorsal; B, A2; C, P4. Male. D, dorsal; E, A1; F, A2; G, P2; H, P4. Figures A-C from Wilson (1932), D-H from Mori (1937)

Sapphirina bicuspidata Giesbrecht, 1891

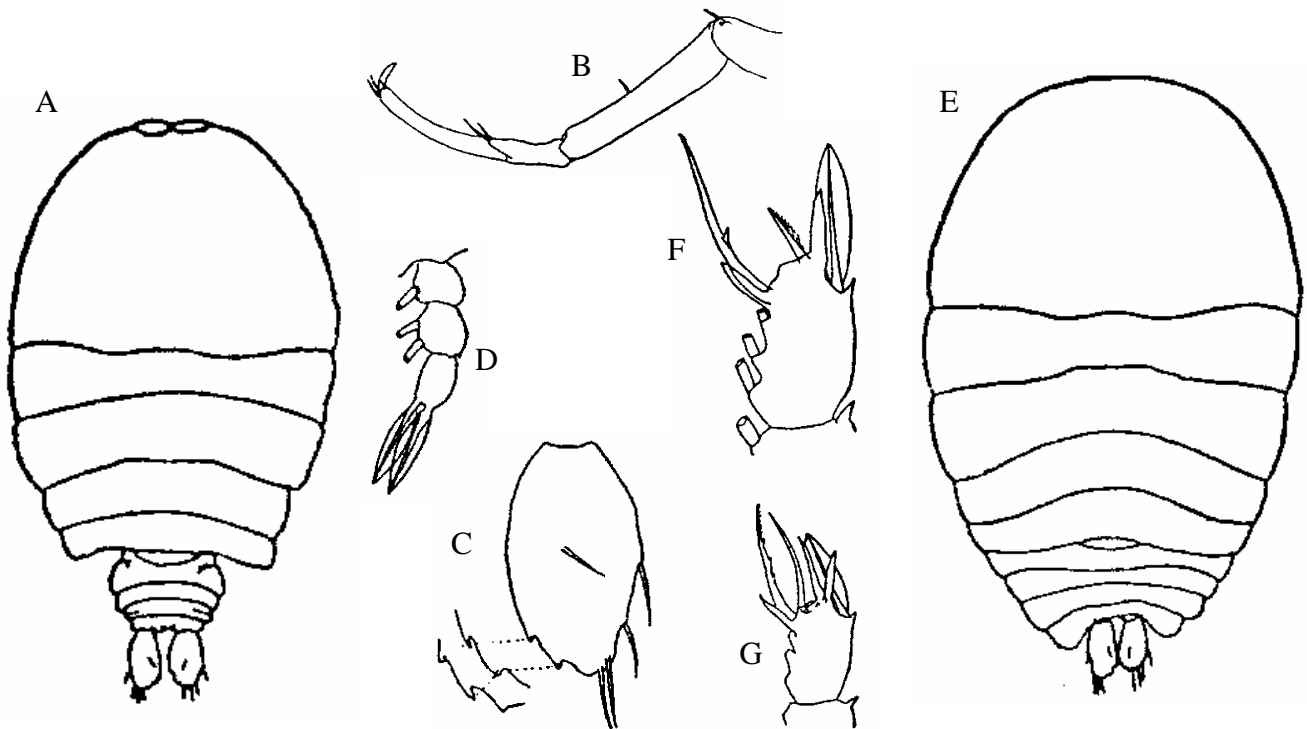
Length: females: 2.26-3.00 mm; males: 2.58-3.42 mm.

The furca is distinctive, there are two pointed projections on the inner distal end.

Female: Body short. Cephalosome wider than long, and approximately half the length of the prosome. Cuticular lenses visible dorsally. Urosome short, approximately a quarter of the length of the prosome. Furca longer than broad with two pointed projections at the inner distal margin, the superficial seta is situated in front of the 1st marginal seta. 2nd segment of A2 is as long as the following two segments. Two foliaceous spines of equal length at tip of endopod of P4.

Male: Body short and rounded. Cephalosome wider than broad. Cuticular lenses not visible dorsally. 1st metasome segment as wide as posterior section of cephalosome. Remainder of segments decrease in width giving a smoothly rounded edge (apart from the last thoracic segment, usually hidden from view dorsally). Furca longer than broad with characteristic two projections at the inner distal margin.

Recorded: Western Indian Ocean



Sapphirina bicuspidata: Female. A, dorsal; B, A2; C, furca; D, endopod of P4. Male. E, dorsal; F & G, left and right endopod of P2. Figures C & F from Lehnhofer (1929), A, B, D, E & G from Giesbrecht (1892).

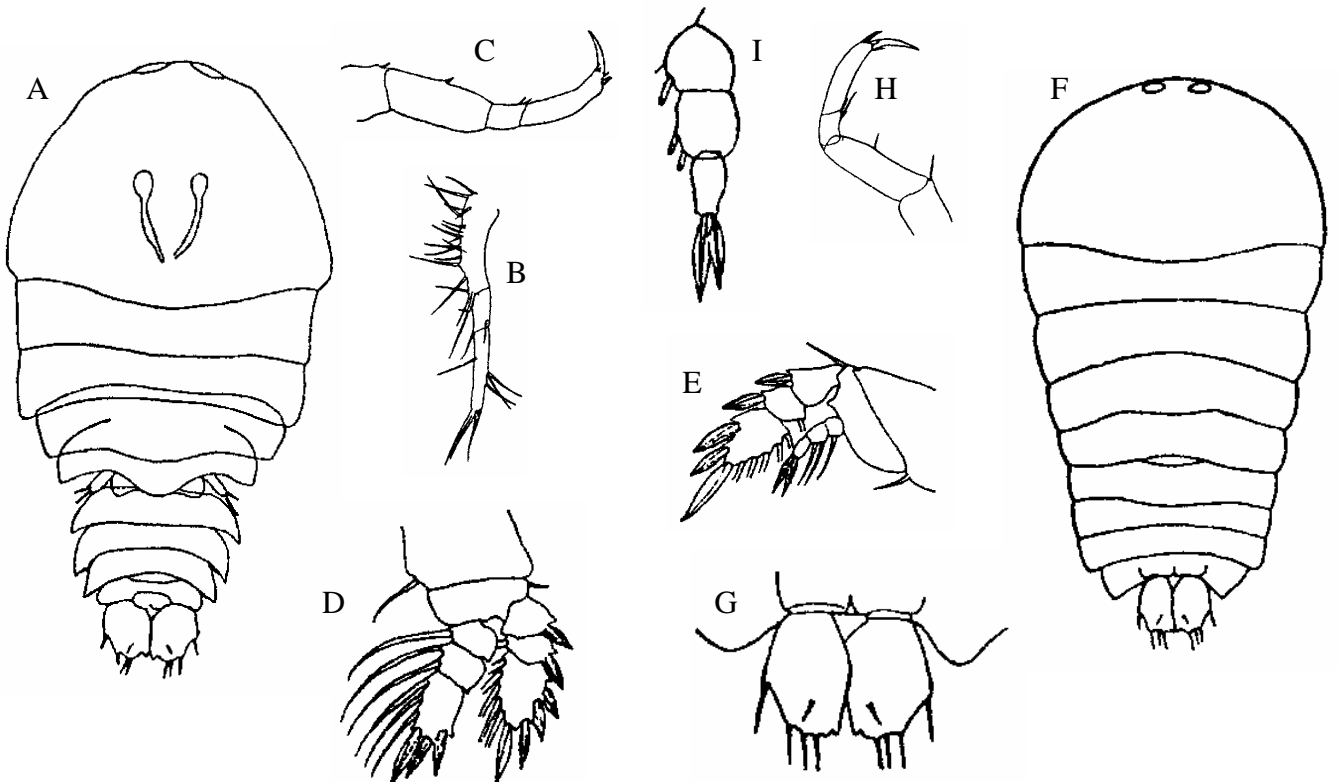
Sapphirina darwini Haeckel, 1864

Length: females: 2.00-2.79 mm; males: 1.20-2.79 mm.

Female: Cephalosome wider than long. Cuticular lenses visible dorsally and set apart. 1st metasome segment narrower than the cephalosome. Urosome 6-segmented. Anal segment small. Furca longer than wide with a small projection on the distal inner margin. The superficial seta is behind the 1st marginal seta. A1 is 3-segmented and nearly as long as A2. A2 with 1 long spine on the distal end of the first segment. The last segment on A2 is twice the length of the terminal claw. Endopod of P4 is less than half the length of the exopod, tip of endopod with two equal length foliaceous spines.

Male: Cephalosome wider than long and rounded anteriorly. Cuticular lenses visible dorsally and set apart. Furca similar to female.

Recorded: Madagascar.



Sapphirina darwini: Female: A, dorsal; B, A1; C, A2; D, P2; E, P4. Male: F, dorsal; G, furca; H, A2; I, endopod of P4. Figures A-E from Mori (1937), F-I from Giesbrecht (1892).

Sapphirina gastrica Giesbrecht, 1891

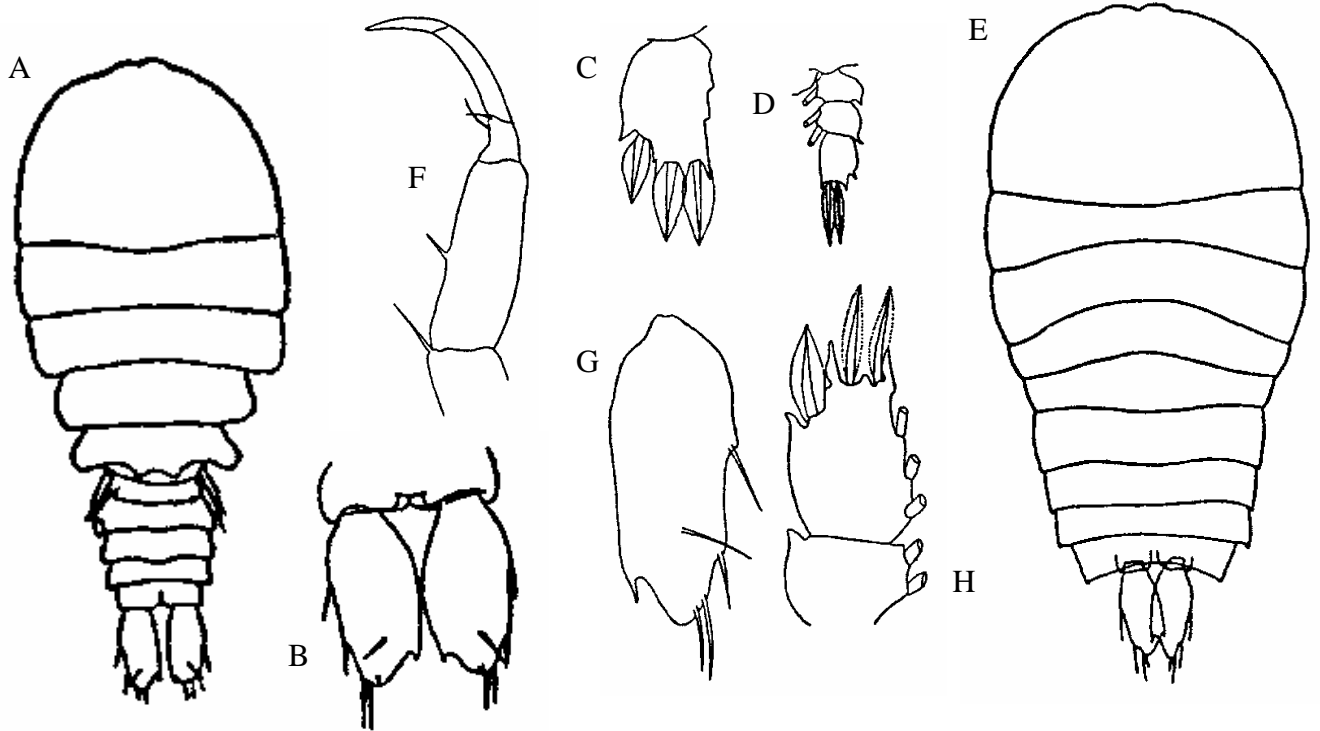
Length: females: 2.33-2.68 mm; males: 2.20-2.65 mm.

Similar body shape to *S. nigromaculata*. In *S. nigromaculata*, the superficial seta on the furca is situated in front of the 1st marginal seta, whereas in *S. gastrica* it is situated behind the 1st marginal seta, nearly level to the 2nd marginal seta.

Female: Cephalosome wider than long. Cuticular lenses just visible dorsally. Furca longer than wide with a small pointed process on the distal end of the inner margin, superficial seta situated behind 1st marginal seta. A1 is 5-segmented and just over half the length of A2. The 2nd segment of A1 is shorter than the combined length of the following 3 segments. One long spine at the distal end of the 1st segment of A2, the terminal claw is $\frac{3}{4}$ the length of the last segment. Endopod of P4 is longer than exopod and ends in two foliaceous spines.

Male: Cephalosome wider than long. Cuticular lenses only just visible dorsally. Furca more than twice as long as wide. A1 is 6-segmented. A2 and P4 resemble female. Endopod of P2 has 3 foliaceous spines off the 3rd segment.

Recorded: Western Indian Ocean



Sapphirina gastrica: Female. A, dorsal; B, furca; C, P2; D, P4. Male. E, dorsal; F, A2; G, furca; H, P2. Figures E, F, G & H from Lehnhofer (1929), A, B, C & D from Giesbrecht (1892).

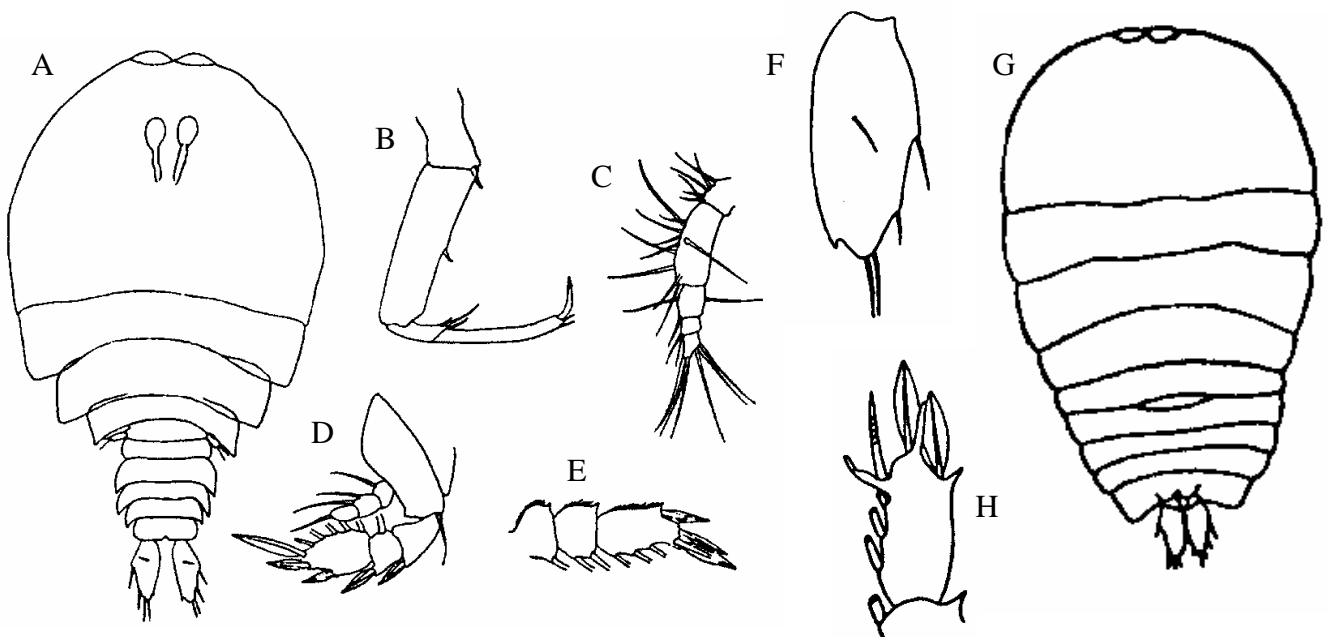
Sapphirina intestinata Giesbrecht, 1891

Length: females: 1.62-2.78 mm; males: 1.65-2.87 mm.

Female: Cephalosome wider than long. Cephalosome makes up over half the length of the prosome. Cuticular lenses adjacent and visible dorsally. Urosome 6-segmented. Furca more than twice as long as wide, small pointed projection at the distal inner margin, superficial seta in front of the 1st marginal seta. A1 is 5-segmented, 2nd segment is longer than the three following segments. Segment 1 of A2 with a long spine at the distal end. Segment 2 of A2 as long as the two following segments, the last segment is nearly three times longer than the terminal claw. Segment 3 of exopod of P2 with three foliaceous spines. Endopod of P4 is less than half the length of the exopod.

Male: Cephalosome wider than long. Cuticular lenses visible dorsally. Furca similar to female. The 3rd segment of the exopod of P2 with 2 foliaceous spines.

Recorded: Madagascar.



Sapphirina intestinata: Female. A, dorsal; B, A2; C, A1; D, endopod of P2; E, P4; F, furca. Male. G, dorsal; H, endopod of P2. Figures A-E from Mori (1937), F & H from Lehnhofer (1929), G from Giesbrecht (1892).

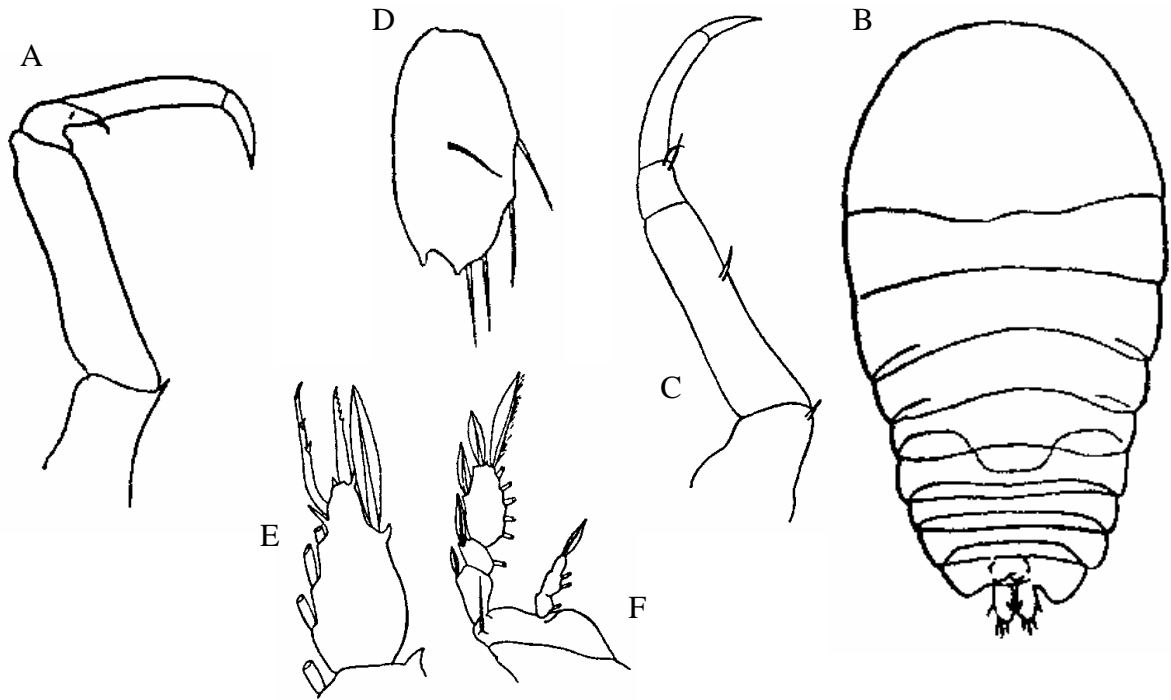
Sapphirina maculosa Giesbrecht, 1892

Length: females: 1.81-2.13; males: 2.65-2.71 mm.

Female: 2nd segment of A2 longer than the following two segments. Furca longer than wide; one blunt projection at the distal inner margin, a second blunt projection at the distal tip; superficial seta approximately the same level as the 1st marginal seta.

Male: Cephalosome wider than long. Cuticular lenses not visible dorsally. Furca similar to female. 2nd segment of A2 longer than the following two segments. Exopod of P4 approximately half the length of the endopod.

Recorded: Western Indian Ocean.



Sapphirina maculosa: Female. A, A2. Male. B, dorsal; C, A2; D, furca; E, endopod of P2; F, P4. Figures A, C, D, E & F from Lehnhofer (1929), B from Giesbrecht (1892).

Sapphirina metallina Dana, 1849

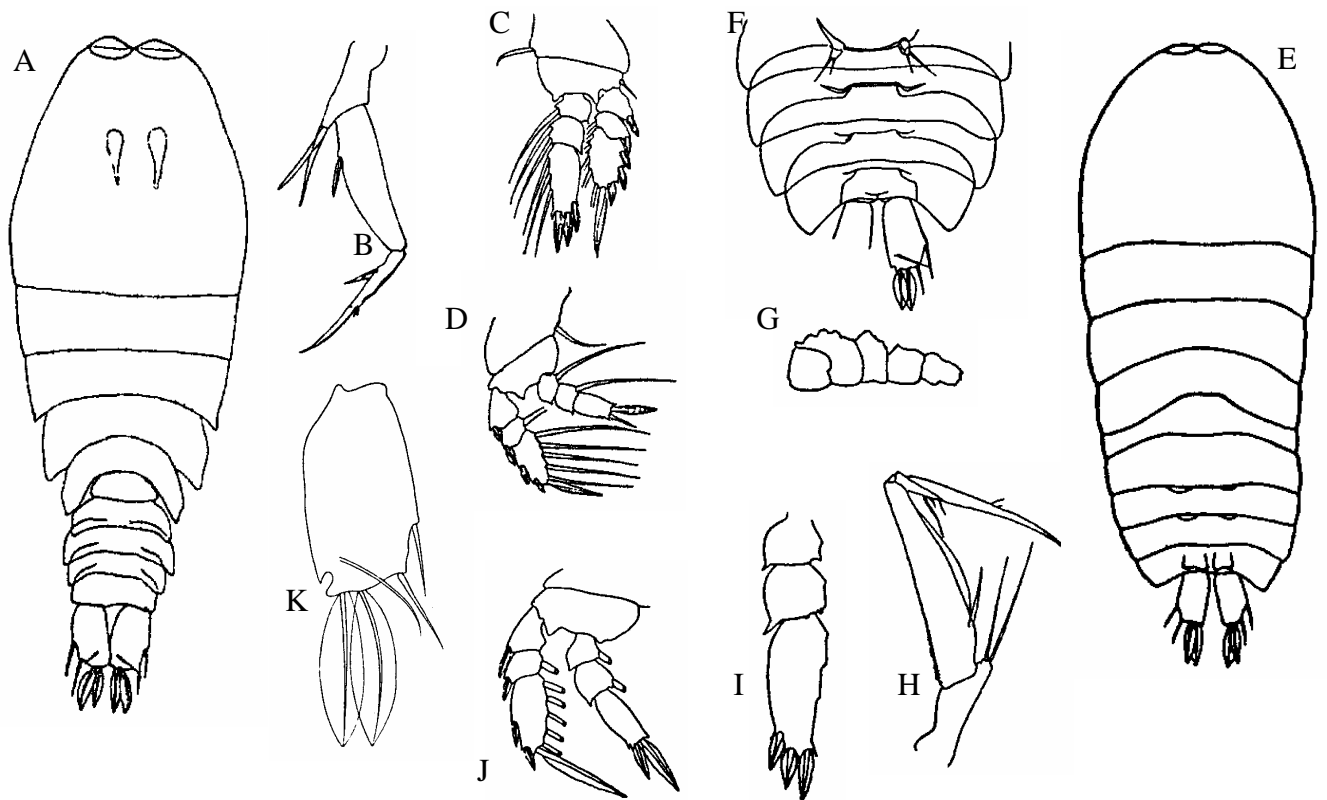
Length: females: 1.68-2.52 mm; males: 1.61-2.58 mm.

Furca is a characteristic shape with two long foliaceous spines off the distal margin.

Female: Body elongate. Cephalosome approximately as wide as long. Cuticular lenses adjacent and visible dorsally. Length of cephalosome approximately half total prosome length. Furca is characteristic, rectangular, twice as long as wide, superficial seta behind the 1st marginal seta. 2 long spines at the distal end of the 1st segment of A2. Endopod of P4 is 2/3 the length of the exopod, tip has two spines, one is foliaceous.

Male: Body elongate. Cephalosome approximately as long as wide. Cuticular lenses adjacent and visible dorsally. Furca similar to female. A2 similar to female. Endopod of P2 ends in 3 foliaceous spines.

Recorded: Madagascar



Sapphirina metallina: Female. A, dorsal; B, A2; C, P2; D, P4. Male. E, dorsal; F, close up of urosome; G, A1; H, A2; I, endopod of P2; J, P4; K, furca. Figures A-E from Mori (1937), F-L from Giesbrecht (1892).

Sapphirina nigromaculata Claus, 1863

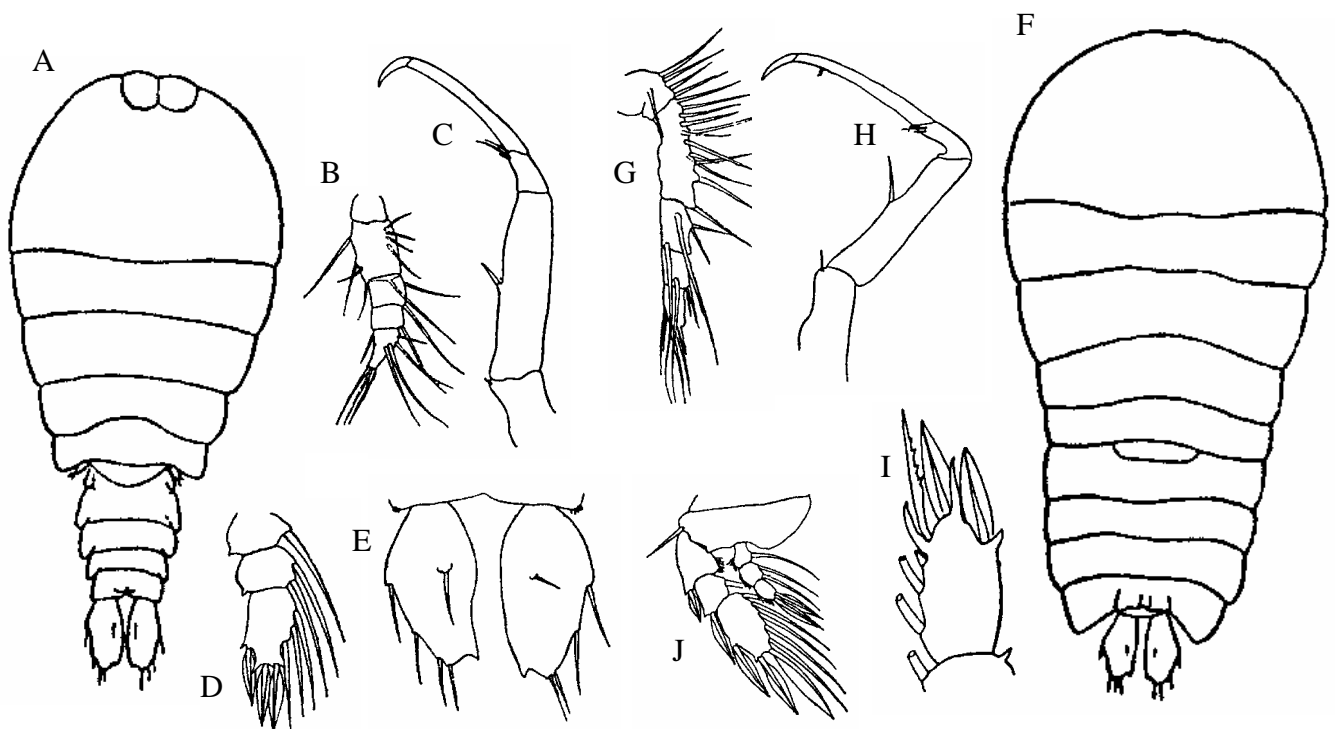
Length: females: 1.20-2.81 mm; males: 1.71-3.04 mm.

Recognised by the very reduced endopod on P4.

Female: Cephalosome rounded anteriorly and wider than long. Cuticular lenses adjacent and visible dorsally. Urosome 5-segmented. Furca is elongate ovate and twice as long as wide, the superficial seta is situated anterior to the 1st marginal seta, the inner margin ends in a small tooth. A1 is 5-segmented. 2nd segment of A2 as long as the last two segments together. Endopod of P4 less than half the length of the exopod, two equal length foliaceous spines at the tip of endopod.

Male: Cephalosome wider than long. Cuticular lenses adjacent. Furca similar to female. 2nd segment of A2 just shorter than the last 2 segments together. Tip of 3rd segment of endopod of P2 has two foliaceous spines and a third spine with one margin denticulate. P4 similar to female.

Recorded: Seychelles, Madagascar.



Sapphirina nigromaculata: Female. A, dorsal; B, A1; C, A2; D, endopod of P2; E, furca. Male. F, dorsal; G, A1; H, A2; I, endopod of P2; J, P4. Figures A & F from Giesbrecht (1892), C, H, & I from Lehnhofer (1929), B, D, E, G & J from Mori (1937).

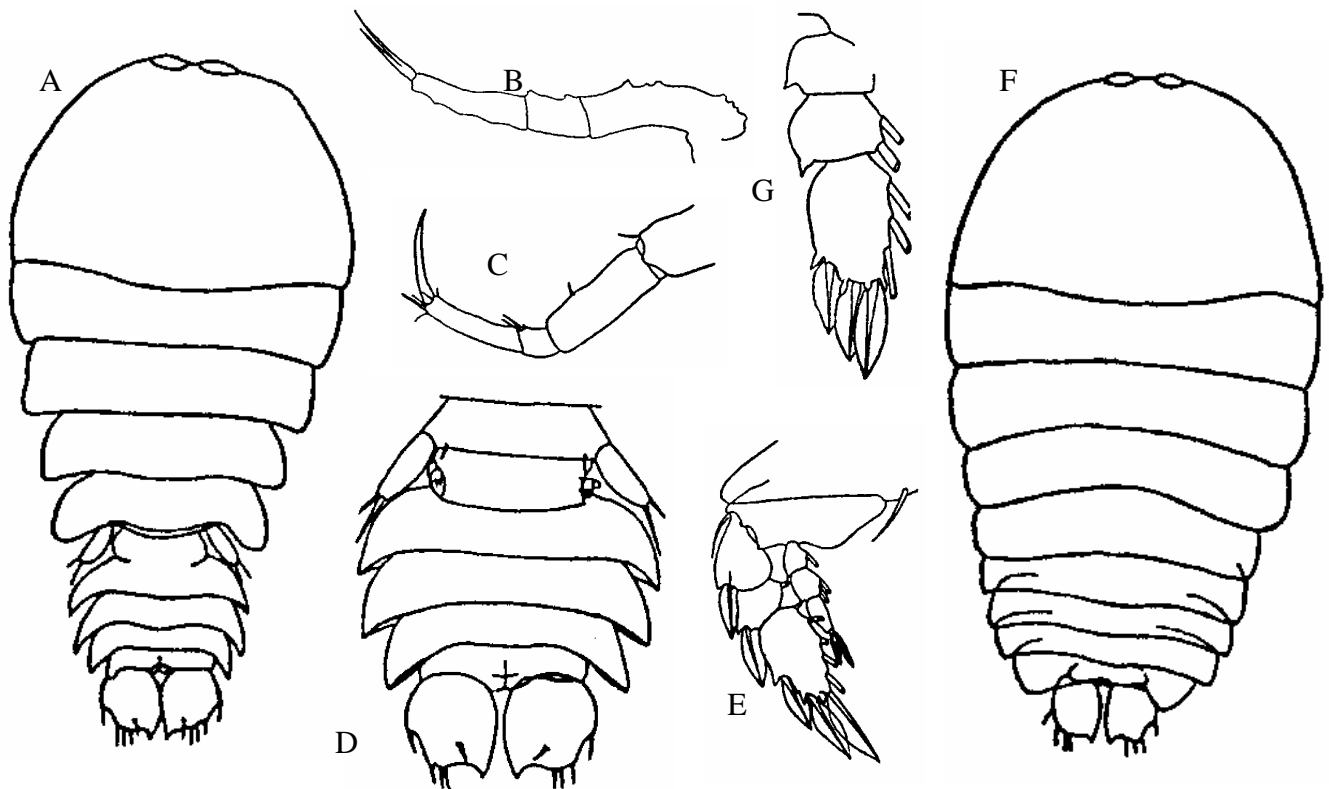
Sapphirina opalina Dana, 1849

Length: females: 1.40-3.39 mm; males: 1.20-3.59 mm.

Female: Cephalosome wider than long, anterior rounded. Cuticular lenses visible dorsally and just separate. Urosome 5-segmented. Furca characteristic shape, same length as width, pointed projection at the distal inner margin, superficial seta behind 1st marginal seta. A1 is 3-segmented, tip of 3rd segment with two setae fused at the base. A2 longer than A1. 4th segment of A2 longer than the terminal claw. 3rd segment of endopod of P2 with 3 foliaceous spines at the tip.

Male: Cephalosome wider than long. Cuticular lenses separate and visible dorsally. Furca as wide as long with projection similar to female. Swimming legs similar to female.

Recorded: Seychelles, Madagascar



Sapphirina opalina: Female. A, dorsal; B, A1; C, A2; D, urosome; E, P4. Male. F, dorsal; G, endopod of P2. Figures A-G from Giesbrecht (1892).

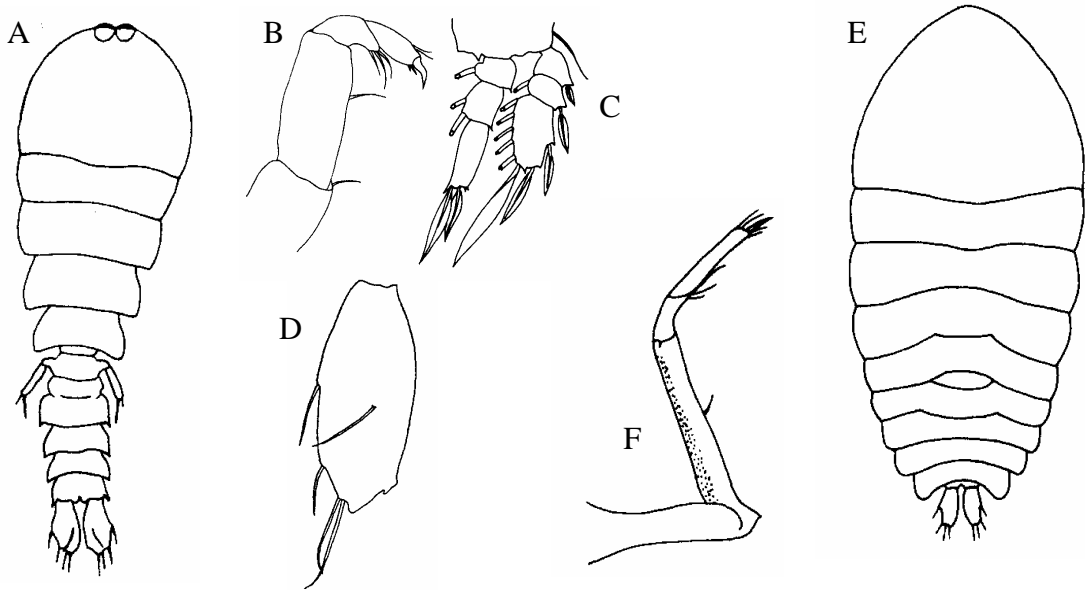
Sapphirina ovatolanceolata Dana, 1849

Length: females: 2.13-3.65 mm; males: 2.33-4.52 mm.

Female: Cephalosome wider than long. Cuticular lenses adjacent and visible dorsally. 2nd metasome segment longer than 1st segment. A1 is 5-segmented. 3rd and 4th segments of A2 of similar length, and together shorter than the 2nd segment. Furca twice as long as wide, superficial seta just behind the 1st marginal seta.

Male: Cephalosome wider than long and pointed on the frontal margin. Cuticular lenses not visible dorsally, positioned on the anterior ventral surface. A2 very different to female, longer and more slender. Furca similar to female.

Recorded: Seychelles.



Sapphirina ovatolanceolata: Female. A, dorsal; B, A2; C, P4; D, furca. Male. E, dorsal; F, A2. Figures A-F from Giesbrecht (1892).

Sapphirina scarlata Giesbrecht, 1891

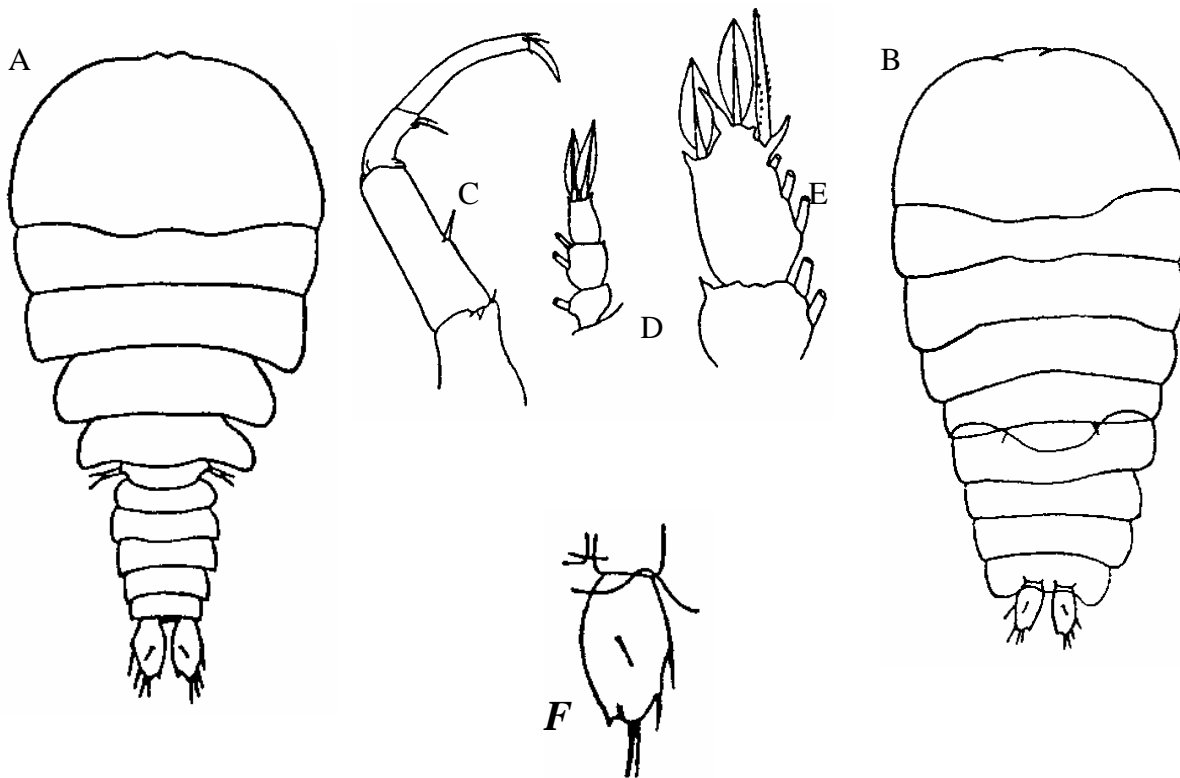
Length: females: 1.50-4.65 mm; males: 3.40-4.85 mm.

Male and female are moderately wide forms.

Female: Cephalosome wider than long. Cephalic lenses adjacent and just visible dorsally. Lateral margins of prosome not smooth due to the varying widths of the metasome segments. 1st metasome segment narrower than the cephalosome, 2nd metasome segment wider than the 1st, 3rd metasome segment 2/3 as wide as the 2nd, 4th metasome segment same width as 3rd. Furca twice as long as wide, superficial seta situated in front of the 1st marginal seta, pointed projection on the distal inner margin. A1 is 5-segmented. Endopod of P4 approximately half the length of exopod ending in two foliaceous spines.

Males: Cephalosome nearly twice as wide as long. Cephalic lenses not visible dorsally. Body tapers posteriorly, lateral margins smooth. Furca similar to female. Last segment of endopod of P2 with 2 foliaceous spines and a denticulate spine.

Recorded: Madagascar



Sapphirina scarlata: Female. A, dorsal. Male. B, dorsal; C, A2; D, endopod of P4; E, endopod of P2; F, furca. Figures A-F from Giesbrecht (1892).

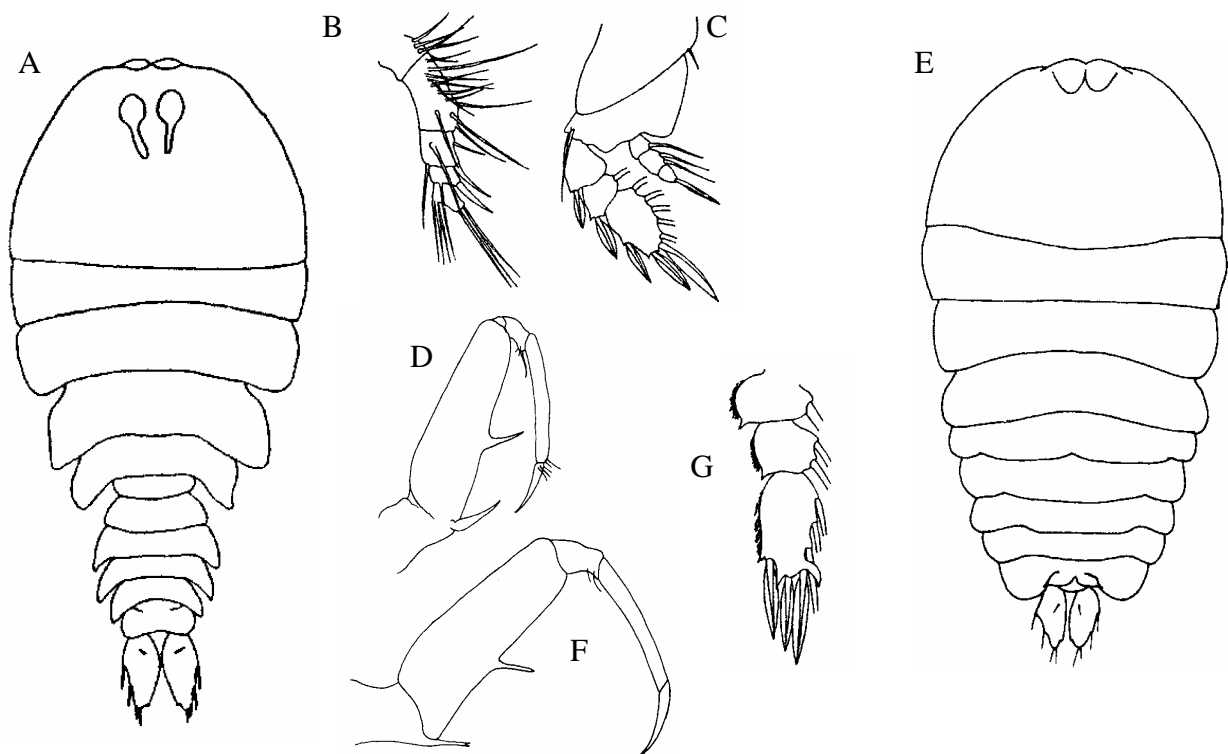
Sapphirina stellata Giesbrecht, 1891

Length: females: 1.20-3.50 mm; males: 1.60-3.50 mm.

Female: Cephalosome wider than long. Cuticular lenses are adjacent and visible dorsally. Urosome is 6-segmented. Furca is longer than wide, small projection on the inner distal margin, superficial seta is anterior to the 1st marginal seta. A1 is 5-segmented, the 3rd and 4th segments with a stout spine. The 2nd segment of A2 is longer than the 3rd and 4th segments together, 4th segment is more than twice the length of the terminal claw. Endopod of P4 is less than half the length of the exopod.

Male: Cephalosome wider than long. Body oval in shape. Cuticular lenses adjacent and visible dorsally. Furca similar to female. Last segment of endopod of P2 with 3 foliaceous spines at the tip, also a claw-like process on the inner distal margin of the segment.

Recorded: Western Indian Ocean



Sapphirina stellata: Female. A, dorsal; B, A1; C, P4; D, A2. Male. E, dorsal; F, A2; G, endopod of P2. Figures A-C and G from Mori (1937), D, E and F from Giesbrecht (1892).

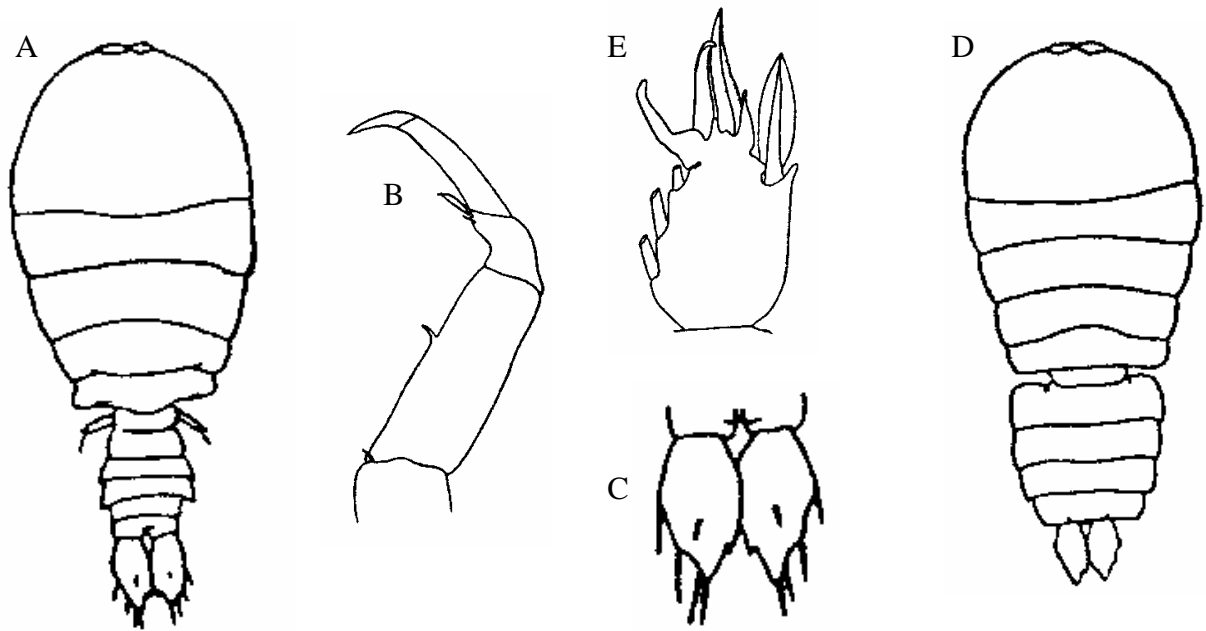
Sapphirina sinuicauda Brady, 1883

Length: females: 1.20-2.19 mm; males: 1.40-2.19 mm.

Female: Cephalosome wider than long. Cuticular lenses adjacent and visible dorsally. Furca longer than wide, sharply pointed projection on distal inner margin, superficial seta behind 1st marginal seta. 2nd segment of A2 as long as the following two segments together.

Male: Cephalosome wider than long. Cuticular lenses adjacent and visible dorsally. 1st urosome segment is narrow and visible dorsally. Furca similar to female. Last segment of endopod of P2 with one foliaceous spine and two denticulate spines.

Recorded: Madagascar.



Sapphirina sinuicauda: Female. A, dorsal; B, A2; C, furca. Male. D, dorsal; E, endopod of P2. Figures A, C & D from Giesbrecht (1892), B & E from Lehnhofer (1929).

Family Corycaeidae

A large pair of cuticular lenses at the anterior of the cephalosome. The cephalosome is long, typically longer than the rest of the prosome. Prosome comprises cephalosome and two or three free pedigerous segments, The third and fourth segments sometimes fused. The 3rd segment is produced at each postero-lateral corner into sharply pointed lateral points. The fourth segment, sometimes fused with the previous one, bears posteriorly directed lateral points that sit inside the epimeral plates. The urosome is 2- or 3-segmented in females, and 3-segmented in males. Furca is narrow and elongate. A1 is short and 6-segmented. A2 is 4-segmented and prehensile in males. Females carry paired egg sacs. The family Corycaeidae comprises the genera *Corycaeus*, and *Farranula*.

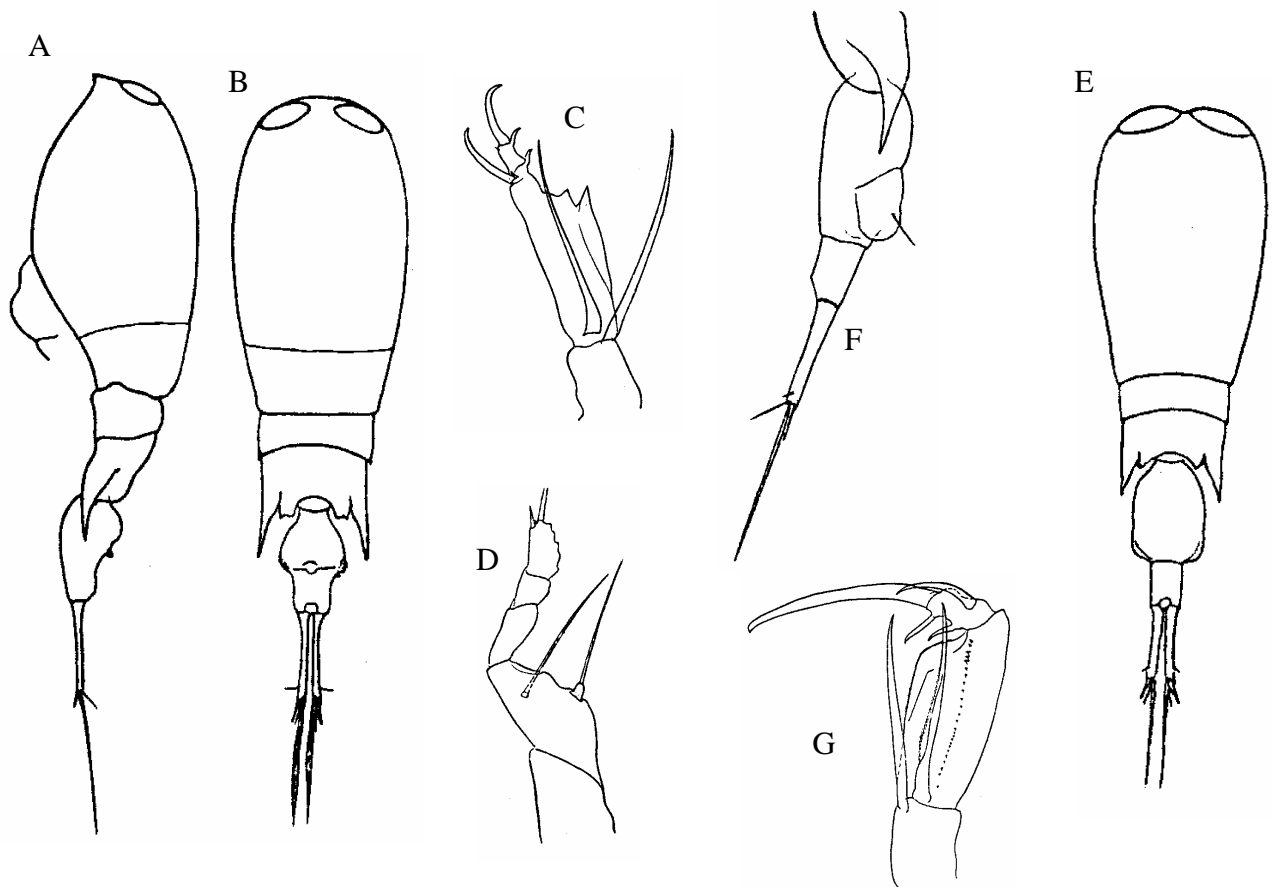
Corycaeus (Agetus) flaccus Giesbrecht, 1891

Length: females: 1.56-1.67 mm; males: 1.37-1.39 mm.

Female: Prosome 4-segmented. Prosome more than twice the length of the urosome. The outer lateral points extend to about halfway down the urosome. The inner lateral points are not sharp. Urosome 1-segmented. Urosome with a small projection mid-dorsally, visible from lateral view. Lateral margins of the urosome with short hairs. Furca greater than half the length of the urosome. The inner marginal furcal seta is the longest.

Male: Prosome 3-segmented. Prosome less than twice the length of the urosome. Urosome 2-segmented. Genital segment 1.5 times longer than wide, and not as long as the anal segment and furca together. Furca about 7 times longer than wide.

Recorded: Madagascar.



Corycaeus flaccus: Female A, lateral; B, dorsal; C, A2; D, P4. Male. E, dorsal; F, lateral view of urosome; G, A2. Figures A-G from Tanaka (1957).

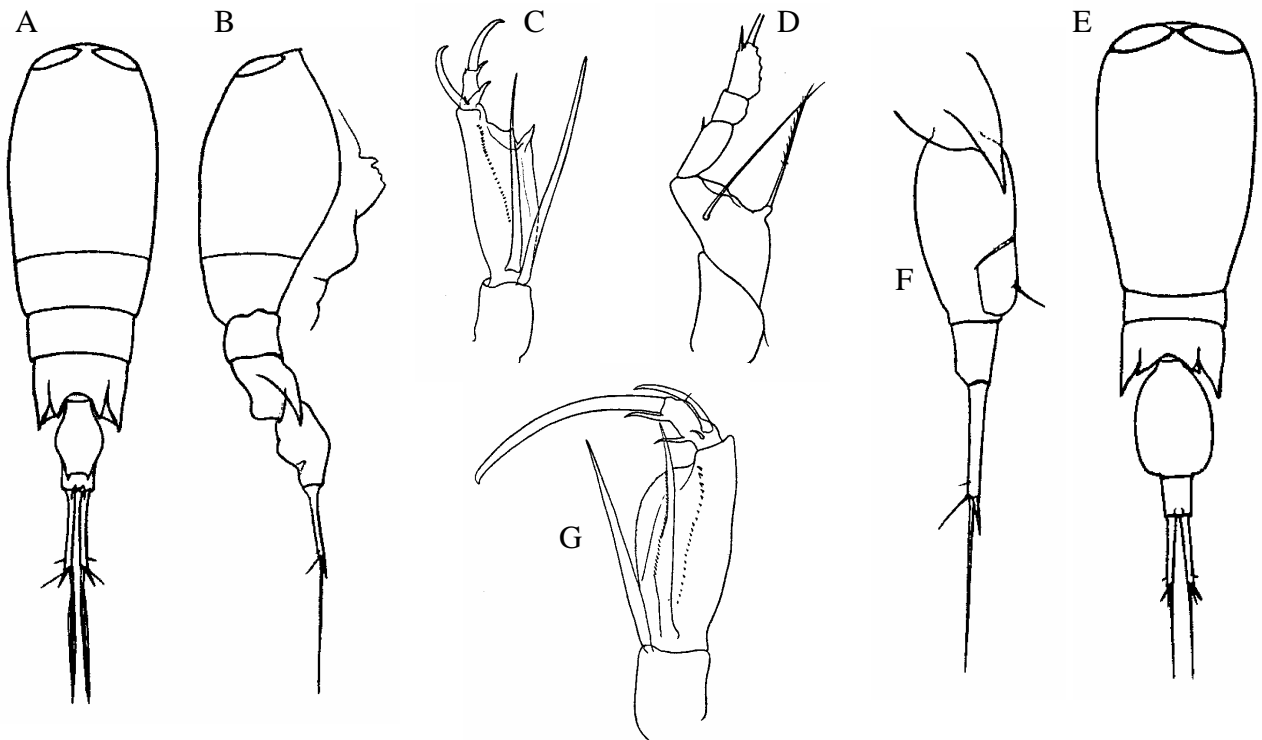
Corycaeus (Agetus) typicus (Kröyer, 1849)

Length: females: 1.45-1.65 mm; males: 1.30-1.54 mm.

Female: Prosome 4-segmented. Urosome one-segmented, the shape of the urosome and the form of the inner lateral points at the end of the prosome are characteristic. The outer lateral points do not extend to the genital openings. The inner lateral points rise up at right angles to the body and extend posteriorly to almost the same length as the outer lateral points. The furca is longer than half the length of the urosome. The inner marginal furcal seta is longer than the furca itself.

Male: Prosome 3-segmented. Urosome two-segmented. The anterior section of the genital segment rounded, the posterior section forming prominent rounded corners, each with a seta off the ventral surface. Genital segment 1.5 times as long as wide. Urosome twice as long as furca. Furca more than 6 times longer than wide.

Recorded: Rodrigues, Madagascar.



Corycaeus typicus: Female. A, dorsal; B, lateral; C, A2; D, P4. Male. E, dorsal; F, lateral view of urosome; G, A2. Figures A-G from Tanaka (1957).

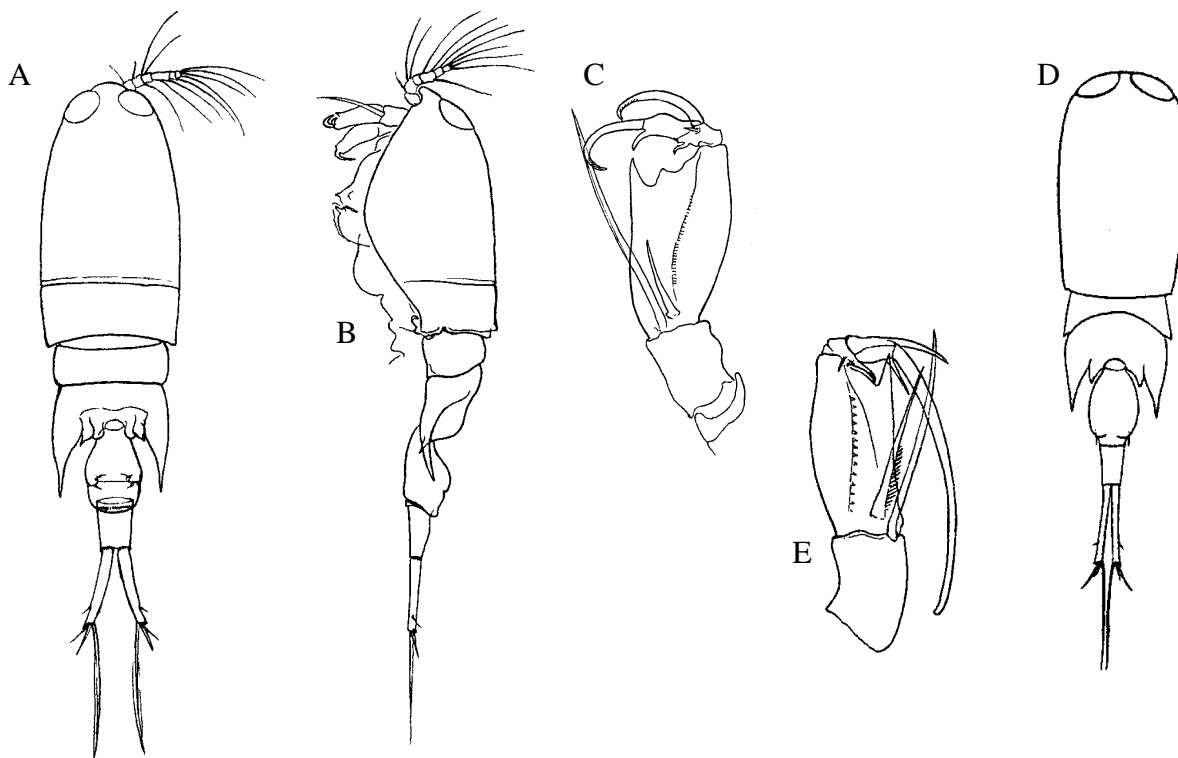
Corycaeus (Corycaeus) crassiusculus Dana, 1849

Length: females: 1.65-1.75 mm; males: 1.26-1.48 mm.

Female: Prosome 4-segmented. The lateral points at the end of the prosome do not extend as far as the genital segment. Urosome 2-segmented. The genital segment is large, oval, and about 1.3 times longer than wide. The posterior dorsal section of the genital segment overlaps the anal segment. The posterior margin of the ventral side of the genital segment with a row of minute spinules. The anal segment narrows slightly. Posterior margins of anal segment fringed with small spinules. Furca is divergent, about 6 times longer than wide, and about $\frac{3}{5}$ the length of the urosome.

Male: Prosome narrower than in the female and 3-segmented. The outer lateral points at the end of the prosome extend to the centre of the genital segment. Urosome 2-segmented. Genital segment about 1.5 times longer than wide, oval, the lateral margins are smooth and each bear a plumose seta near the posterior end. The ventral posterior margin of the genital segment with a row of minute spinules. The posterior margin of the anal segment with a row of spinules along the join with the furca. The furca are parallel, about 8x longer than wide, and about $\frac{3}{4}$ the length of the urosome.

Recorded: Rodrigues, Seychelles, Madagascar.



Corycaeus crassiusculus: Female. A, dorsal; B, ventral; C, A2. Male. D, dorsal; E, A2. Figures A, B, C and E from Sewell (1947), D from Tanaka (1957).

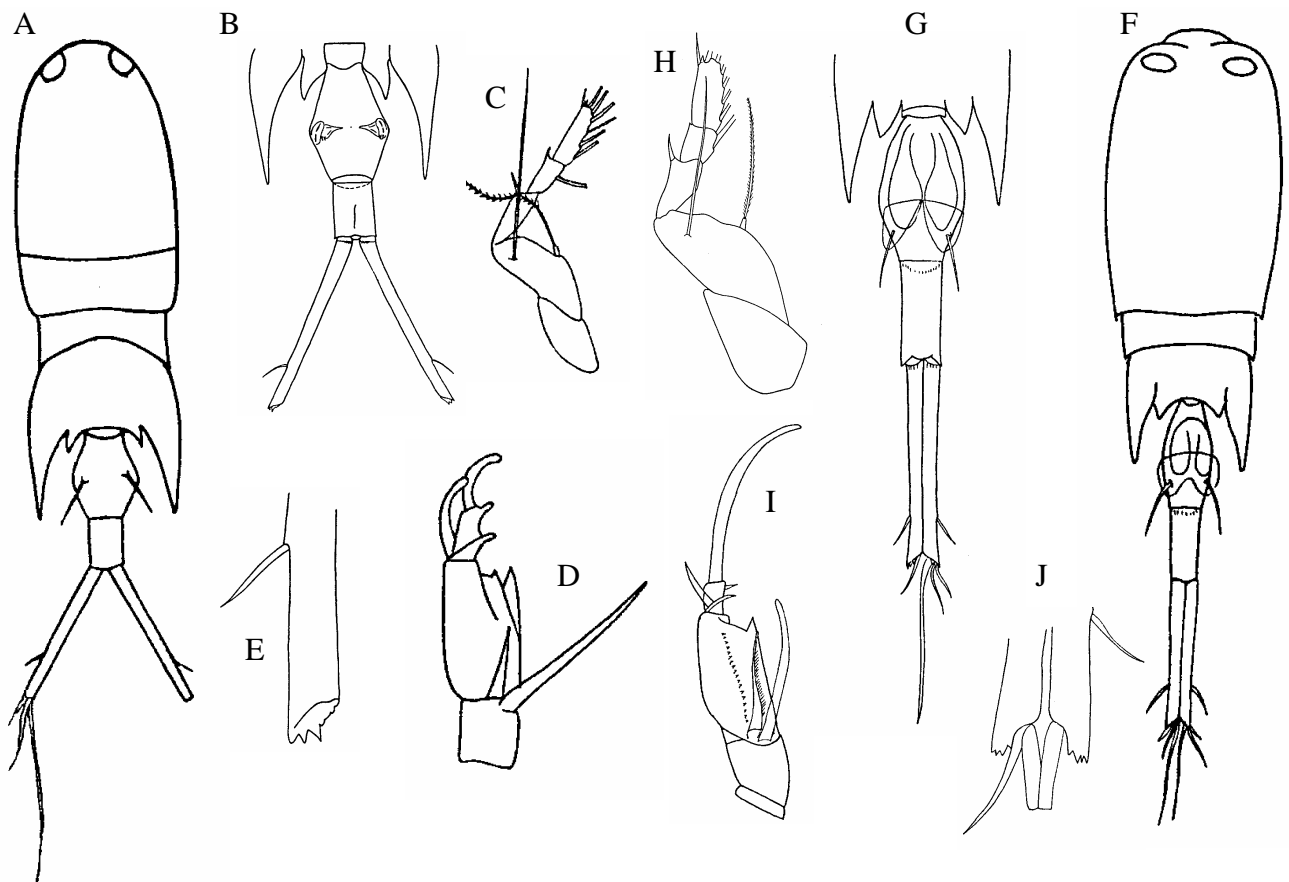
Corycaeus (Corycaeus) speciosus Dana, 1849

Length: females: 1.90-2.18 mm; males: 1.48-1.90 mm.

Female: The female is easily recognised by its large size and the moderately long and divergent furca. The prosome is 3-segmented. The outer lateral points at the end of the prosome extend beyond the end of the genital segment. The urosome is 2-segmented. The furca are divergent and as long as the rest of the urosome. The spine at the distal end of the 1st segment of A2 is more than twice the length of the spine at the proximal end of the 2nd segment.

Male: Prosome narrower than the female and 3-segmented. The outer lateral points at the end of the prosome reach the centre of the genital segment. Urosome 2-segmented. Genital segment with a seta on each postero-lateral margin. Anal segment more than twice as long as wide. Furca as long as the urosome, slender, and about 12 times longer than wide.

Recorded: Rodrigues, Seychelles, Madagascar, CPR.



Corycaeus speciosus: A, dorsal view; B, urosome; C, P4; D, A2; E, tip of furca. Male. F, dorsal; G, urosome; H, P4; I, A2; J, tip of furca. Figures A-J from Cervignon (1964).

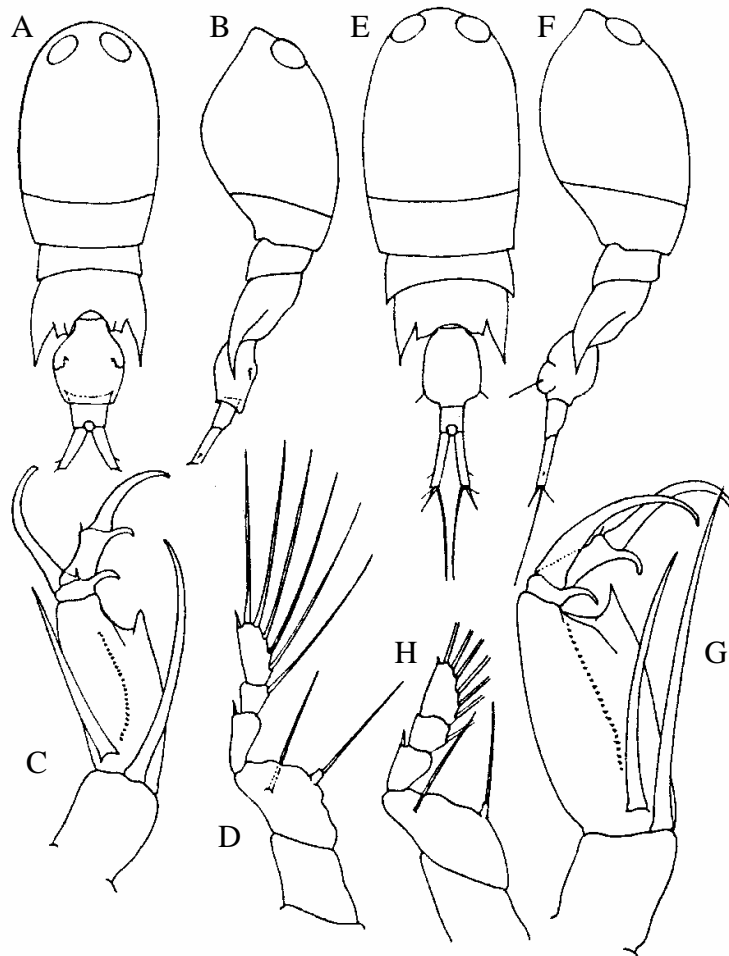
Corycaeus (Monocorycaeus) robustus Giesbrecht, 1891

Length: females: 2.10-2.40 mm; males: 1.83-1.95 mm.

Female: A large and very robust copepod. Prosome 4-segmented. The urosome is 2-segmented. The genital segment is large and oval in shape with a distinct tubercle present on the dorso-lateral margins. The posterior dorsal section of the genital segment characteristically overlaps the anal segment. The anal segment is very short. The furca are about 1.5 times longer than the anal segment and are divergent.

Male: Prosome 4-segmented. Urosome 2-segmented. Genital segment large. Anal segment short. Furca divergent and more than twice as long as anal segment.

Recorded: Seychelles.



Corycaeus robustus: Female. A, dorsal; B, lateral; C, A2; D, P4. Male. E, dorsal; F, lateral; G, A2; H, P4. Figures A-G from Motoda (1963).

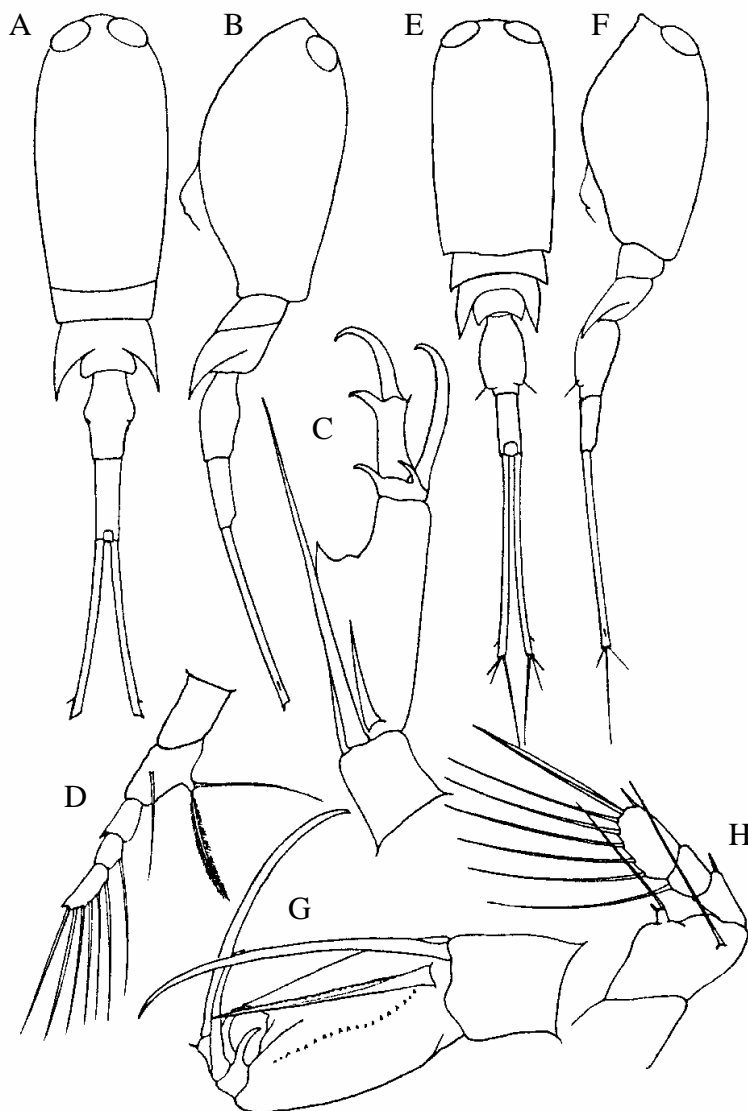
Corycaeus (Urocorycaeus) lautus Dana, 1849

Length: females: 2.29-3.05 mm; males: 2.09-2.36 mm.

Female: Prosome 3-segmented. Urosome 2-segmented. The female is similar to both *C. furcifer* and *C. longistylis*, but is larger in size and differs in the form of the urosome. The genital segment is relatively narrow. The anal segment is widest at the anterior end. The spine at the distal end of the 1st segment of A2 is more than three times longer than the length of the spine at the proximal end of the 2nd segment (in the females of *C. furcifer* and *C. longistylis*, the two spines are of a similar length). Furca are not divergent and are slightly longer than the rest of the urosome.

Male: Prosome 4-segmented. Urosome 2-segmented. Furca not divergent and about 1.2 times longer than the rest of the urosome (in *C. furcifer* the furca is almost 1.5 times longer than the urosome). The male is similar in general appearance to *C. furcifer* but is much larger. On P4 there are two setae on the endopod of *C. lautus* whereas in *C. furcifer* there is only one.

Recorded: Rodrigues.



Corycaeus lautus: Female. A, dorsal; B, lateral; C, A2; D, P4. Male. A, dorsal; F, lateral; G, A2; H, P4. Figures A-H from Motoda (1963).

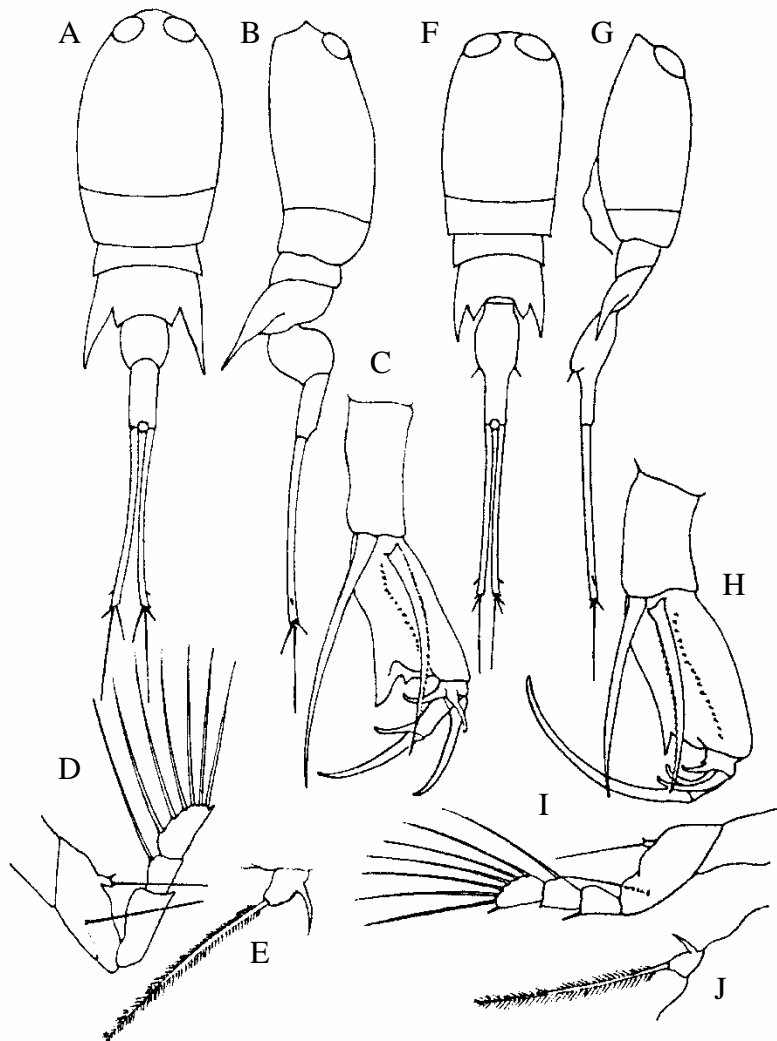
Corycaeus (Urocorycaeus) longistylis Dana, 1849

Length: females: 2.45-3.04 mm; males: 2.13-2.72 mm.

Female: Prosome 4-segmented. Prosome a little longer than the urosome and furca together. The outer lateral points at the posterior of the prosome extend 2/3 down the genital segment. Urosome 2-segmented. Furca slender and approximately 16 times longer than wide. The spine at the distal end of the 1st segment of A2 is about the same length as the spine at the proximal end of the 2nd segment.

Male: Prosome 4-segmented. Prosome only just longer than urosome. Urosome 1-segmented, the urosomes of *C. lautus* and *C. furcifer* are 2-segmented. Furca greater than 1.2 times the length of the urosome, and not divergent.

Recorded: Rodrigues, Seychelles, Madagascar



Corycaeus longistylis: A, dorsal; B, lateral; C, A2; D, P4; E, endopod of P4. Male. F, dorsal; G, lateral; H, A2; I, P4; J, endopod of P4. Figures A-J from Motoda (1963).

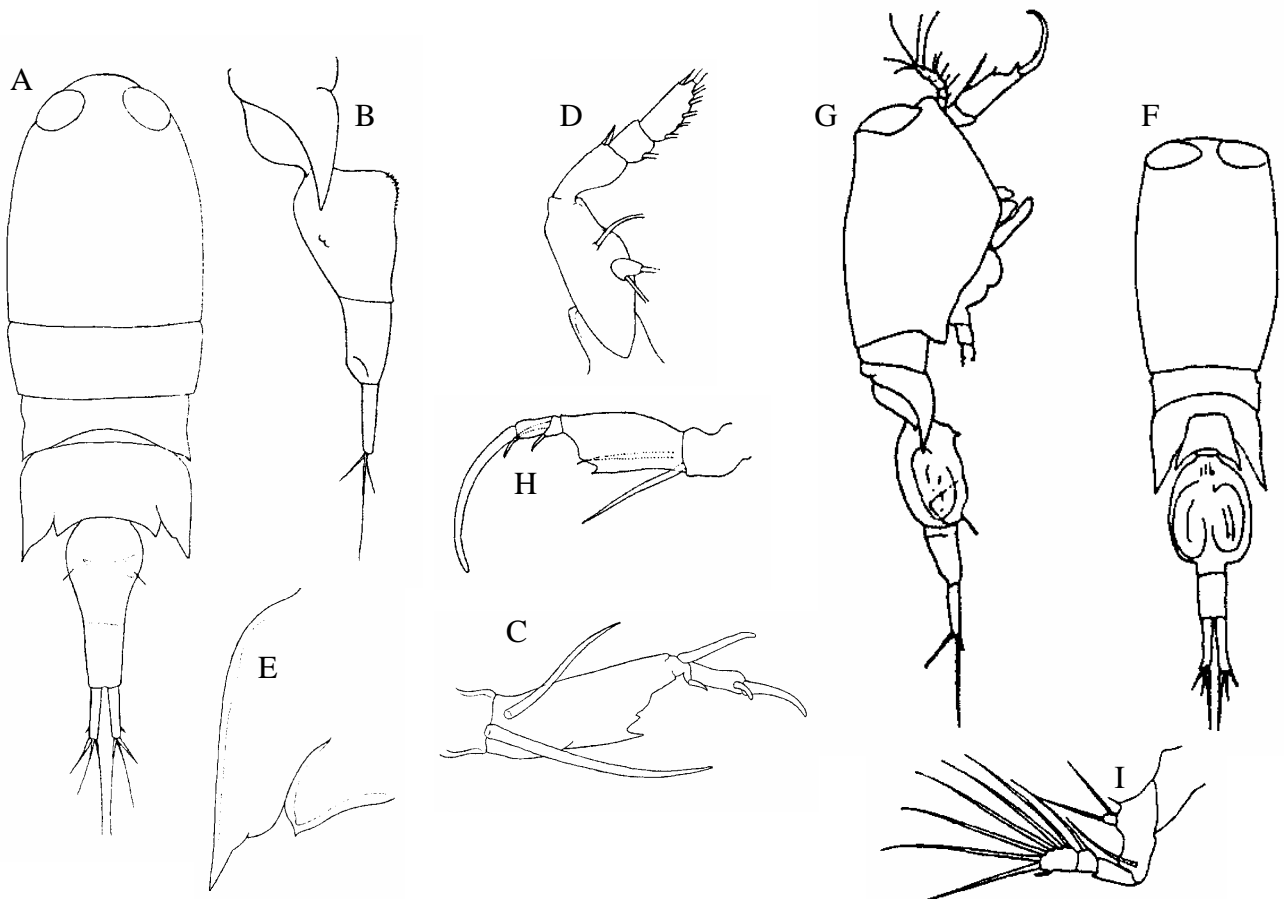
Corycaeus (Ditrichocorycaeus) andrewsi Farran, 1911

Length: females: 0.95-1.07 mm; males: 0.82-0.88 mm.

Female: Prosome 4-segmented, and twice as long as the urosome. The outer lateral points at the end of the prosome are short (not reaching the genital openings) and are notched on the inner margin. The inner lateral points are short and pointed at the tip. Urosome 2-segmented. The genital segment has a characteristic shape in lateral view, the antero-ventral angle is almost a right angle, and at the apex there is a small patch of spinules, there is no ventral hook. The genital segment is about 1.5 times longer than the anal segment. Furca about 5 times longer than wide and less than 1/3 the length of the rest of the urosome. The spine at the distal end of the 1st segment of A2 is about 1.3 times longer than the length of the spine at the proximal end of the 2nd segment.

Male: Prosome 4-segmented, and is about 1.5 times longer than the urosome. Segment immediately following the cephalosome has a slight swelling at the central lateral margins. The outer lateral points at the end of the prosome extend 1/3 the way down the genital segment. Urosome is 2-segmented. Genital segment broadly oval with a small ventral hook. Anal segment about 1.5 times longer than wide.

Recorded: Seychelles, Madagascar.



Corycaeus andrewsi: Female. A, dorsal; B, lateral view of urosome; C, A2; D, P4; E, outer and inner lateral points. Male. F, dorsal; G, lateral; H, A2; I, P4. Figures F-I from Mori (1937) and A-E from G.P. Farran 'Plankton from the Christmas Island, Indian Ocean I. On the Copepoda of the family Corycaediae' from Proceedings of the Zoological Society London, 1911, ©, The Zoological Society of London published by Cambridge University Press, reprinted with permission.

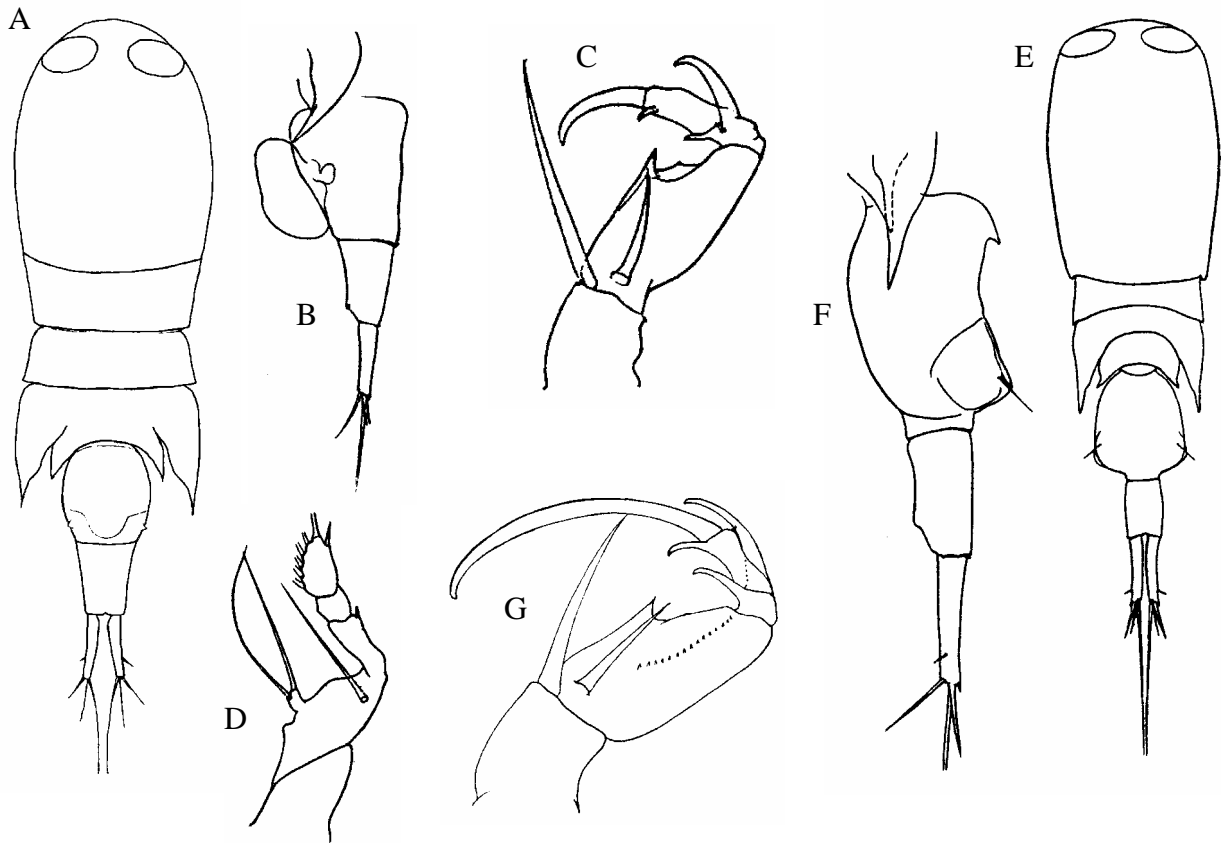
Corycaeus (Ditrichocorycaeus) asiaticus F. Dahl, 1894

Length: females: 1.15-1.20 mm; males: 1.04-1.12 mm.

Female: Prosoma 4-segmented and nearly twice as long as the urosome. The lateral points at the end of the prosoma are long and wide, almost as wide as the widest part of the cephalosome, and they extend to the genital openings. The urosome is 2-segmented. The genital segment has a small blunt process behind the genital opening, the processes are visible dorsally as small lateral projections. There is no ventral hook on the genital segment. There is a small seta from each genital opening that can be difficult to see. Furca is short and about 5 times longer than wide.

Male: Prosoma 4-segmented, and about 1.3 times longer than the urosome. The lateral points at the end of the prosoma extend to the middle of the genital segment. Urosome 2-segmented. Genital segment is about 1.3 times longer than wide with a prominent ventral hook. Anal segment is twice as long as wide. Furca about 6 times longer than wide.

Recorded: Rodrigues, Seychelles, Madagascar.



Corycaeus asiaticus: Female. A, dorsal; B, lateral view of urosome; C, A2; D, P4. Male. E, dorsal; F, lateral view of urosome; G, A2. Figures A-F from Tanaka (1957), G from Motoda (1963).

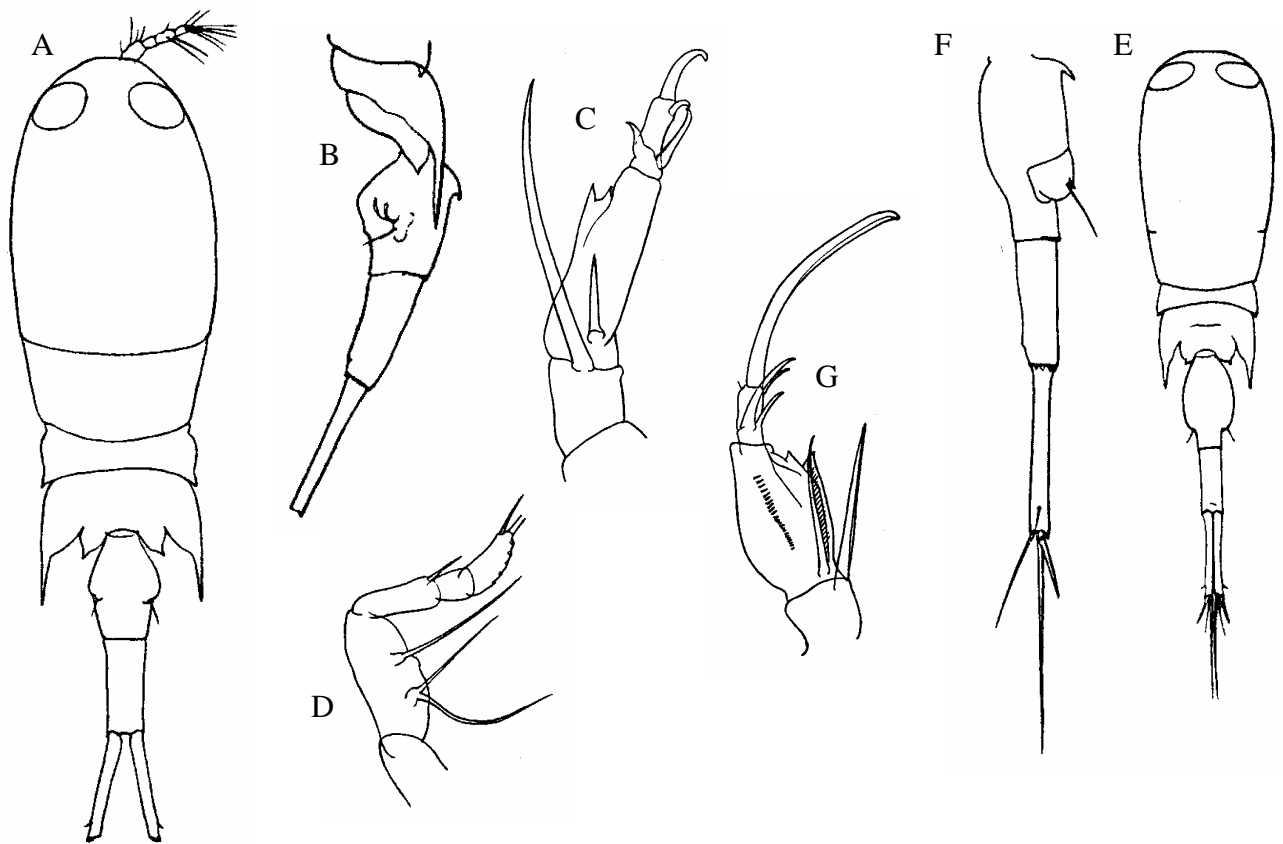
Corycaeus (Ditrichocorycaeus) erythraeus Cleve, 1904 (= *C. dubius* Farran, 1911)

Length: females: 0.88-1.09 mm; males: 0.83-0.84 mm.

Female: Prosome slender and 4-segmented. Prosome about 2.4 times longer than wide. The outer lateral points at the end of the prosome are acute and extend beyond the centre of the genital segment. The inner lateral points are sharp and acute. Genital segment with a ventral hook and setae on the genital openings. Genital segment is the same length as the anal segment. Furca just longer than anal segment. The spine at the distal end of the 1st segment of A2 is nearly 3 times longer than the length of spine at the proximal end of the 2nd segment.

Male: Prosome 3-segmented. The outer lateral points at the end of the prosome do not extend to the middle of genital segment. Urosome 2-segmented. Genital segment with a ventral hook, ventral posterior margin lined with spinules. Anal segment shorter than genital segment. Furca longer than anal segment.

Recorded: Madagascar



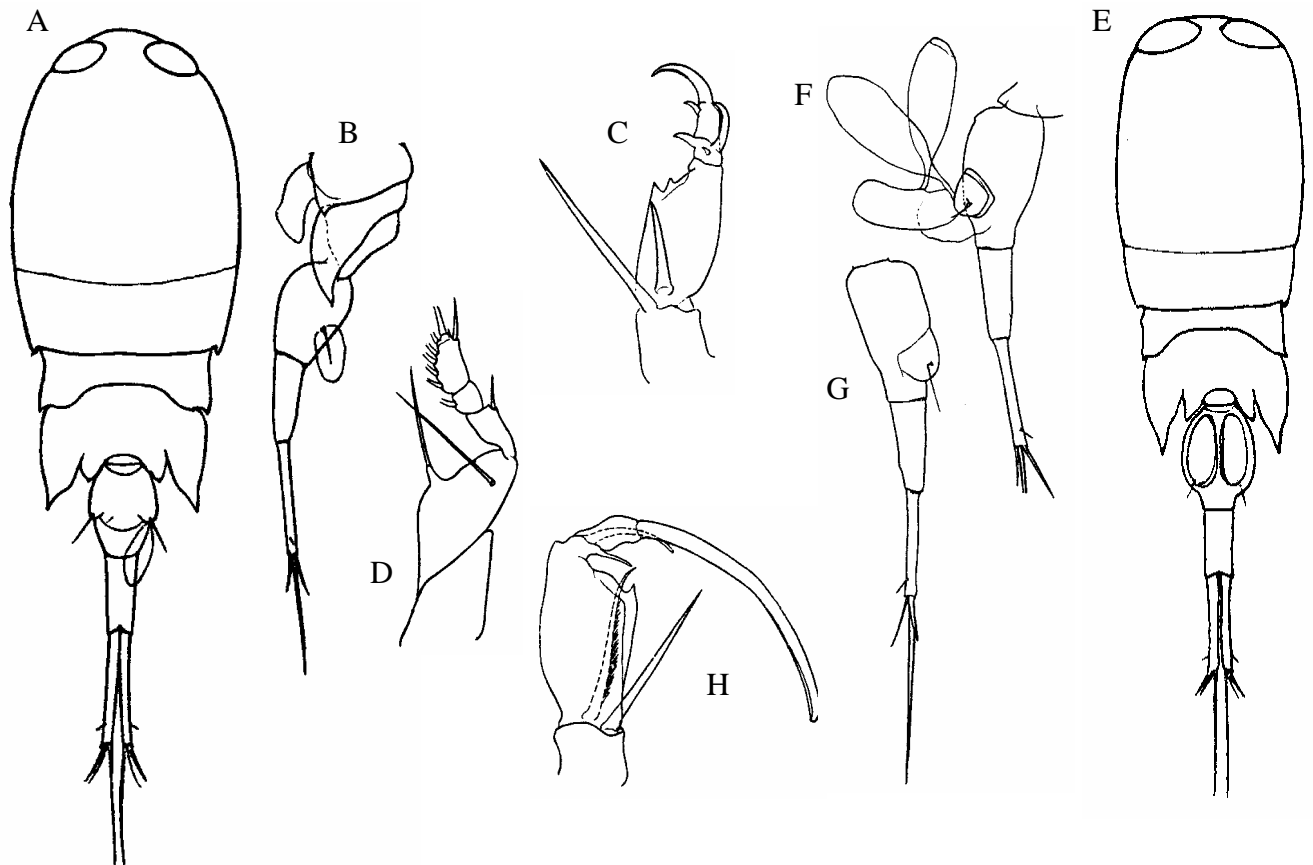
Corycaeus erythraeus: Female. A, dorsal; B, lateral view of urosome; C, A2; D, P4. Male. E, dorsal; F, lateral view of urosome; G, A2. Figures A-G from Tanaka (1957).

Corycaeus (Onychocorycaeus) agilis Dana, 1849

Length: females:0.88-1.00; males: 0.71-0.84 mm.

Female: Prosome robust and 4-segmented. Prosome is about 1.5 times longer than the urosome. Urosome is slender and 2-segmented. The lateral points at the end of the prosome do not extend to the genital apertures. The genital segment is rounded centrally and the genital aperture furnished with one seta. Anal segment slightly shorter than the genital segment. Anal segment more than twice as long as wide. Furca about the same length as the genital segment. The spine at the distal end of the 1st segment of A2 is about three times longer than the spine at the proximal end of the 2nd segment. The 2nd segment of A2 is broad and has two teeth on the distal inner margin.

Male: Prosome 4-segmented. Urosome is 2-segmented. Genital segment is oval, and the widest section equals its length. Some specimens may have a small ventral hook on the genital segment. Anal segment shorter than genital segment. Furca longer than anal segment. Recorded: Rodrigues, Seychelles, Madagascar.



Corycaeus agilis: Female A, dorsal; B, lateral view of urosome; C, A2; D, P5. Male. H, dorsal; F and G, lateral view urosome of two individuals; H, A2. Figures A-H from Tanaka (1957).

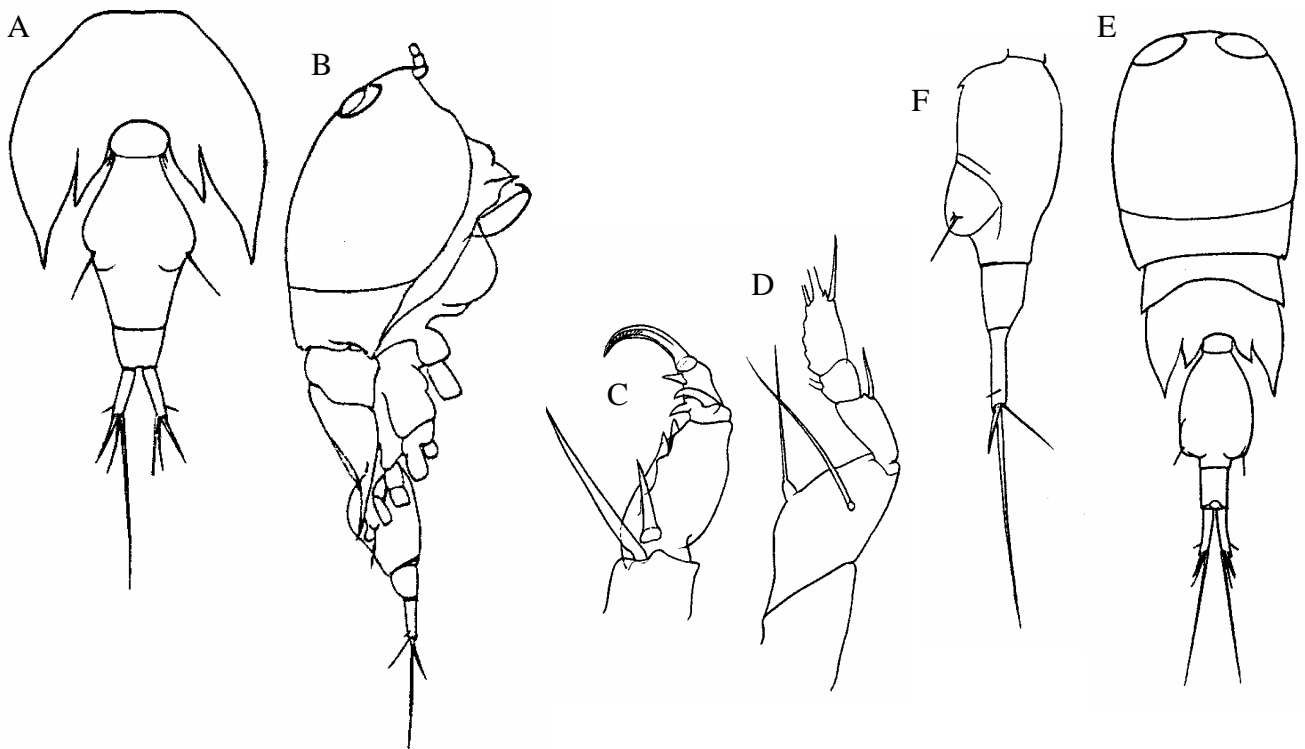
Corycaeus (Onychocorycaeus) catus F. Dahl, 1894

Length: females: 0.90-1.18 mm; males: 0.80-0.90 mm.

Female: Prosome robust and 4-segmented. Prosome more than twice the length of the urosome. The outer lateral points at the end of the prosome extend to the genital openings. The inner lateral points are characteristically long and pointed. Urosome 2-segmented. Genital segment is longer than the anal segment and furca together. Anal segment just wider than long. Furca comparatively short, slightly longer than anal segment.

Male: Prosome 4-segmented. Prosome about 1.5 times longer than the urosome. Urosome 2-segmented. Genital segment longer than the combined length of the anal segment and furca. Genital segment with a ventral median hook.

Recorded: Seychelles.



Corycaeus catus: Female. A, urosome dorsal view; B, lateral; C, A2; D, P4. Male. E, dorsal; F, lateral view of urosome. Figures A-F from Tanaka (1957).

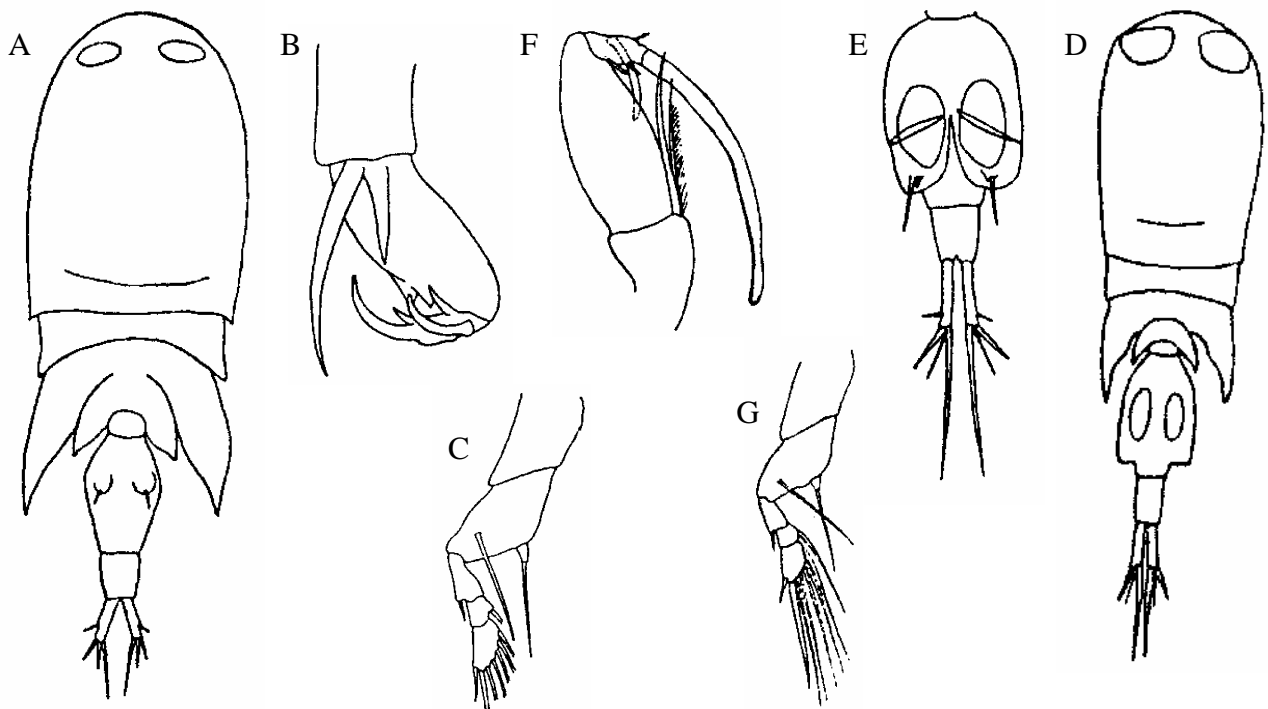
Corycaeus (Onychocorycaeus) ovalis Claus, 1863

Length: females: 1.60-1.65 mm; males: 1.30-1.40 mm.

Female: The large size and the width of the last two prosome segments are characteristic. The prosome is 4-segmented. The outer lateral points at the end of the prosome extend beyond the genital opening. The inner lateral points are very broad with acute points. The urosome is 2-segmented. The genital segment is three times longer than the anal segment. There is a seta on each genital opening. Furca is longer than the anal segment. The spine at the distal end of the 1st segment of A2 is longer than the length of the spine at the proximal end of the 2nd segment.

Male: Prosome narrower than in female and is 4-segmented. The outer lateral points at the end of the prosome do not reach the centre of the genital segment. The genital segment is twice as long as anal segment. Widest part of genital segment behind the centre, anterior end rounded. The furca is 1.5 times longer than the anal segment.

Recorded: Seychelles, Madagascar.



Corycaeus ovalis: Female. A, dorsal; B, A2; C, P4. Male. D, dorsal; E, urosome; F, A2; G, P4. Figures A-G from Mori (1937).

Genus *Farranula*

Female *Farranula* are readily separated from *Corycaeus* by the presence of a 'beak' shaped posteriorly directed ventral process, visible laterally. The last two prosome segments are fused. Inner lateral points at the posterior of the prosome are absent (present in *Corycaeus* species), the outer lateral points are present. The urosome is 1-segmented in both males and females.

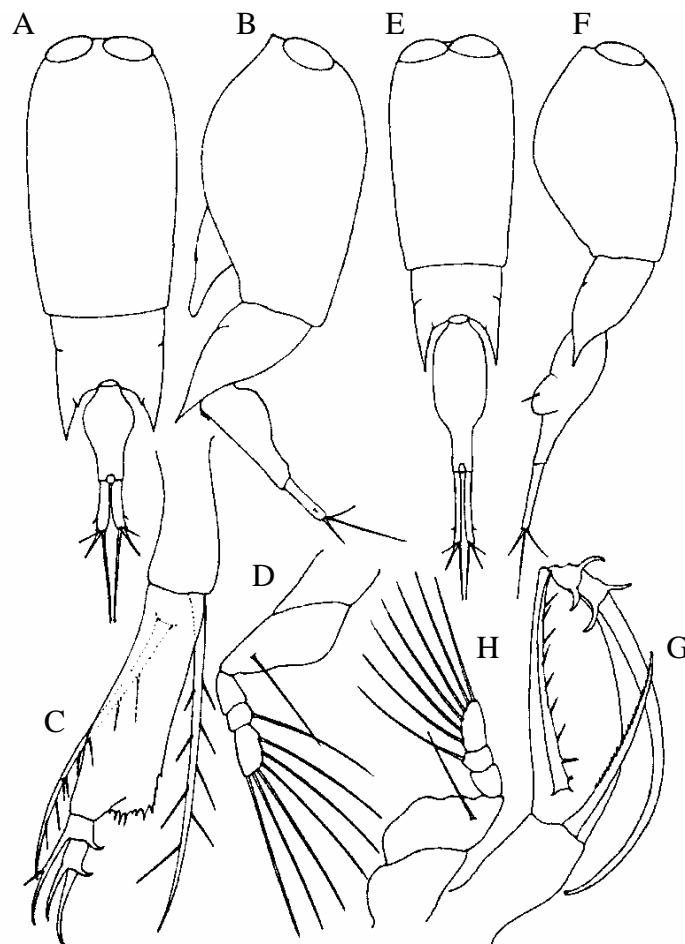
Farranula carinata (Giesbrecht, 1891)

Length: females: 0.86-0.92 mm; males: 0.75-0.85 mm.

Female: Prosome 2-segmented. Cuticular lenses in profile when viewed dorsally. Lateral points at the posterior of prosome are long and slender, they extend beyond the centre of the urosome. Furca half as long as urosome, and four times as long as wide. In lateral view the prosome appears hump-backed. The urosome has a wide projection dorsally, and a setose pad mid-ventral anteriorly.

Male: Prosome 2-segmented. Urosome widest at the centre, tapered both anteriorly and posteriorly. Urosome 2.5 times longer than the furca. Furca about ten times longer than wide. Posterior section of genital projection approximately 2/3 down the urosome.

Recorded: Seychelles, Madagascar.



Farranula carinata: Female. A, dorsal; B, lateral; C, A2; D, P4. Male. E, dorsal; F, lateral; G, A2; H, P4. Figures A-G from Motoda (1963).

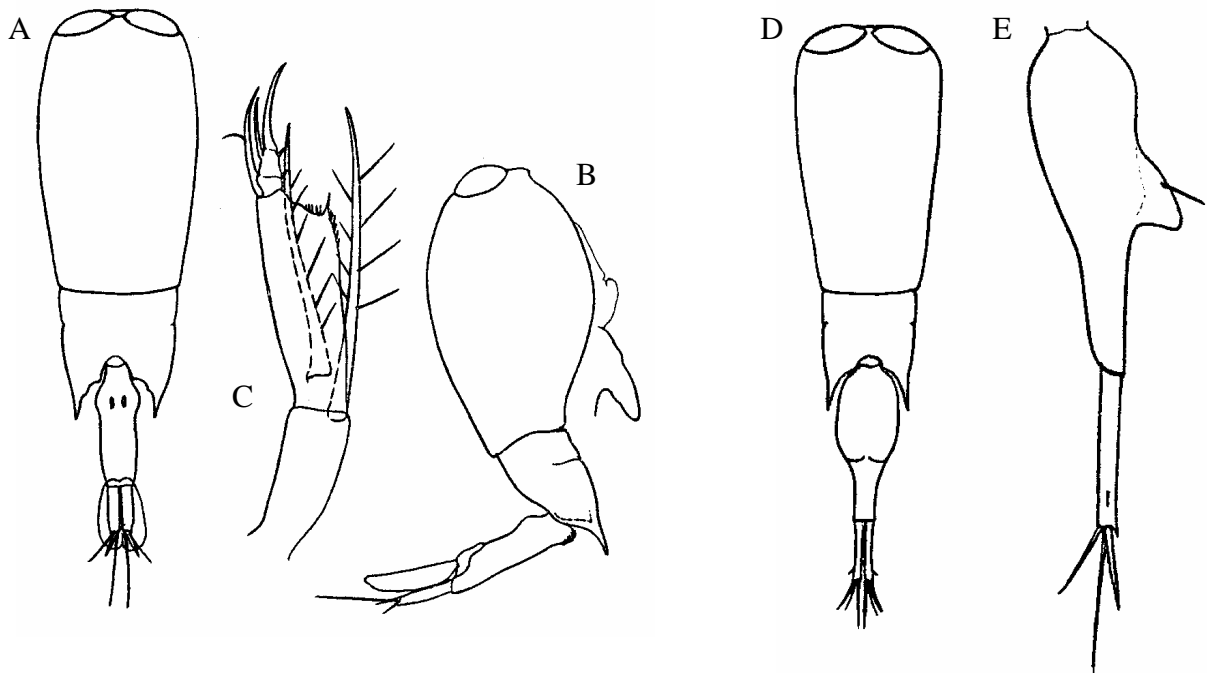
Farranula concinna (Dana, 1849)

Length: females: 0.84-0.90 mm; males: 0.73-0.78 mm.

Female: Prosome 2-segmented. Prosome is twice the length of the urosome and furca together. Urosome 1-segmented, slightly swollen towards the anterior end. Furca approximately 1/3 the length of the urosome and 3 times longer than wide. There is a small patch of setae on the antero-ventral part of the abdomen. The lateral points at the posterior of the prosome do not reach the centre of the urosome.

Male: The male is very similar to *F. gibbula*, only separated by size. *F. concinna* is shorter by 0.1 mm.

Recorded: Rodrigues, Seychelles, Madagascar.



Farranula concinna: Female A, dorsal; B, lateral; C, A2. Male. D, dorsal; E, lateral view of urosome. Figures A-E from Tanaka (1957).

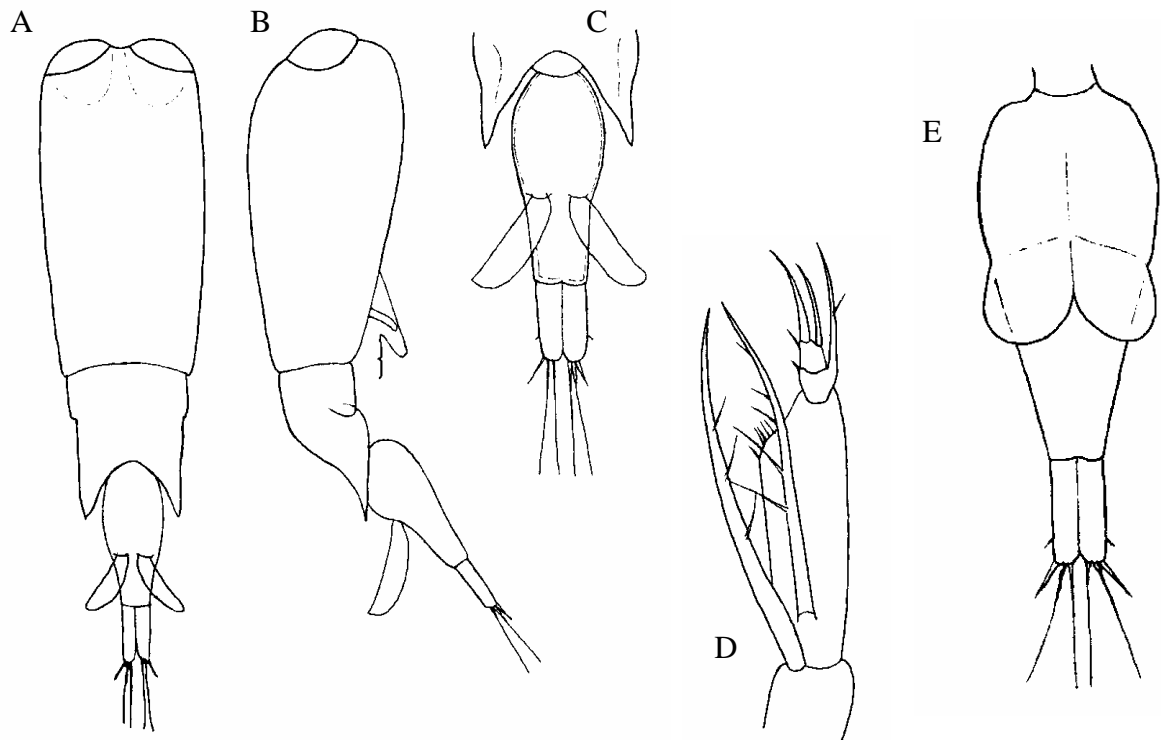
Farranula curta (Farran, 1911)

Length: females: 0.70 mm; males: 0.65 mm.

Female: Similar to female *C. carinata* but the body is more slender, the lateral spines on the prosome are shorter and do not reach the genital openings on the urosome. There is no patch of setae on the dorso-ventral surface of the urosome. Furca 3 times longer than wide.

Male: Urosome 3 times longer than furca. Furca three times longer than wide. Distinctive shape and features of urosome shown in figure.

Recorded: Rodrigues, Madagascar.



Farranula curta: Female. A, dorsal; B, lateral; C, urosome dorsal view; D, A2. Male E, urosome. Figures A-E from G.P. Farran 'Plankton from the Christmas Island, Indian Ocean I. On the Copepoda of the family Corycaediae' from Proceedings of the Zoological Society London, 1911, ©, The Zoological Society of London published by Cambridge University Press, reprinted with permission.

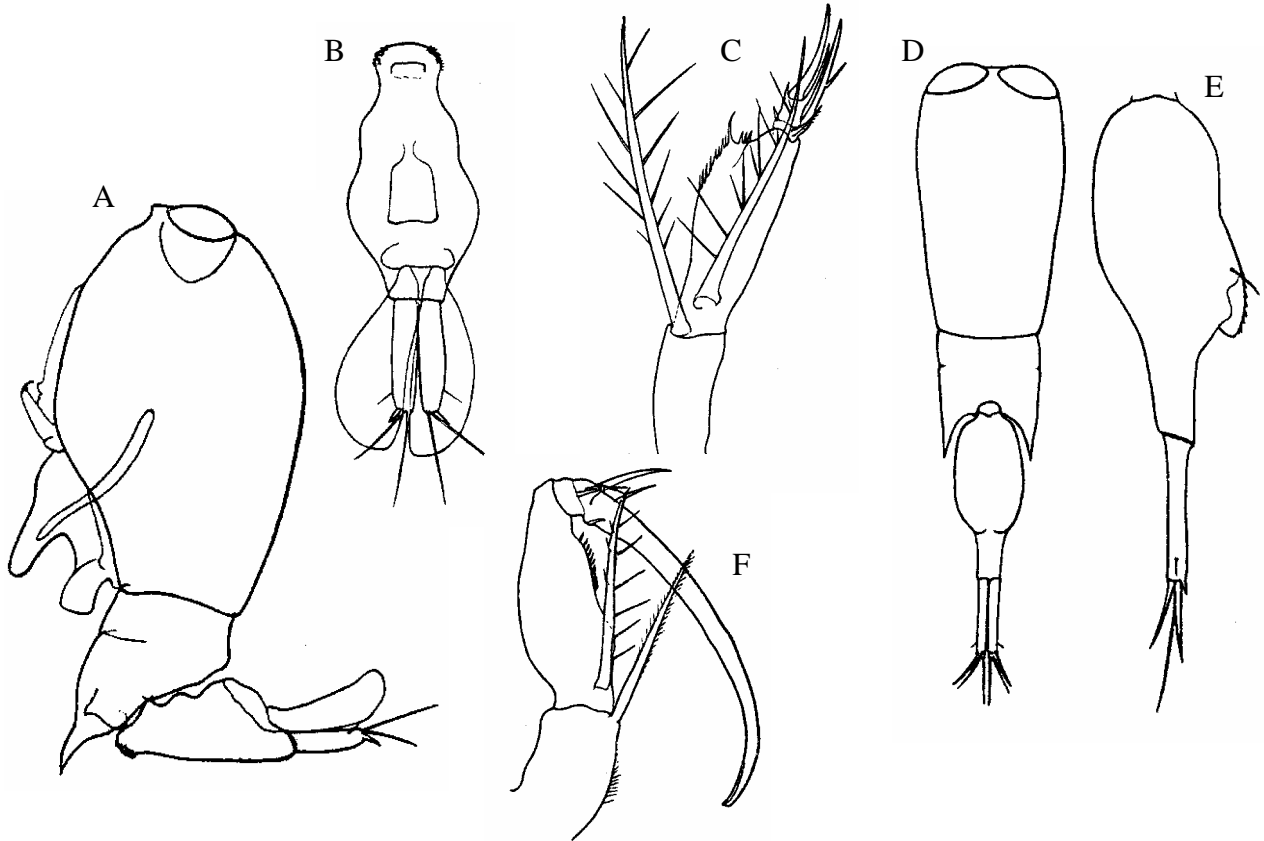
Farranula gibbula (Giesbrecht, 1891)

Length: females: 0.85-1.03 mm; males: 0.80-0.88 mm.

Female: Prosome 2-segmented. Prosome approximately 2.5 times longer than the urosome. A dorsal hump is conspicuous on the 2nd prosome segment. Lateral points at the posterior of prosome do not reach the centre of the urosome. The urosome has a characteristic shape. There is a small setose section on the antero-ventral part of the urosome. The dorsal side of the urosome is irregular in shape. Furca more than 3 times longer than wide. Urosome about 1.7 times longer than the furca.

Male: Males of *F. gibbula* and *F. concinna* are very similar, but are of different lengths, *F. gibbula* is longer by approximately 0.1 mm.

Recorded: Rodrigues, Seychelles, Madagascar.



Farranula gibbula: Female. A, dorsal; B, ventral view of urosome; C, A2. Male. D, dorsal; E, lateral; F, A2. Figures A-F from Tanaka (1957).

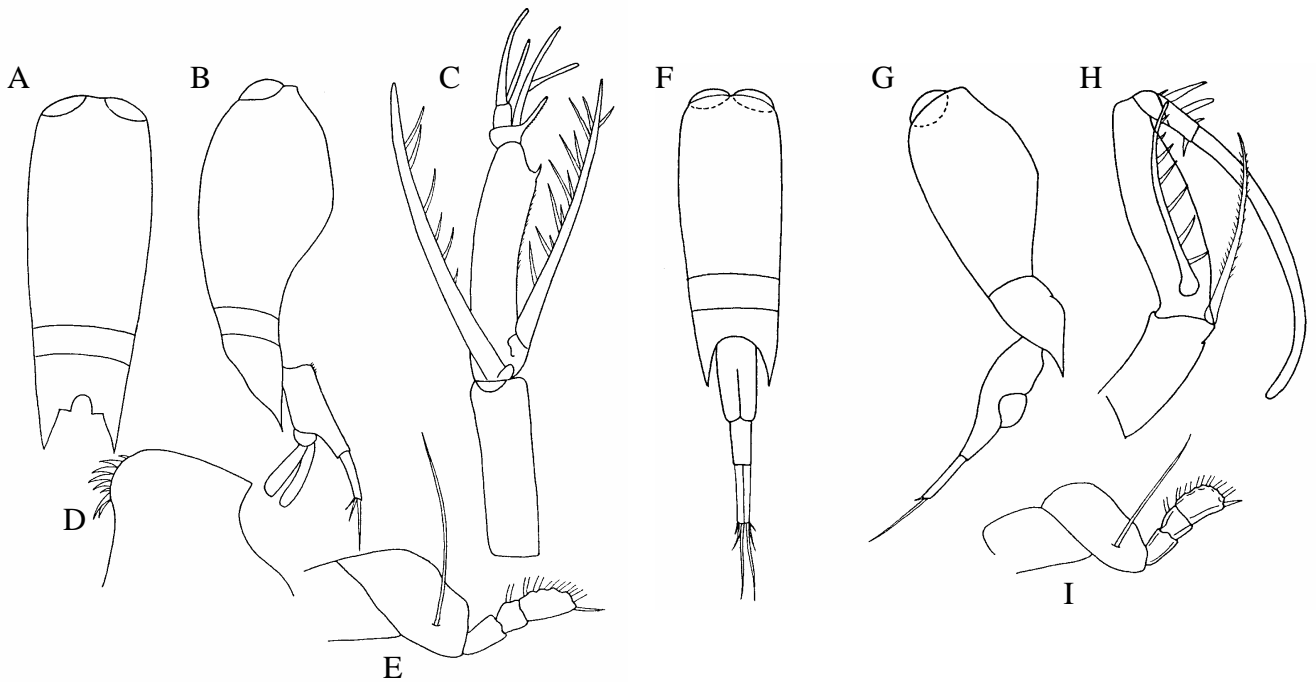
Farranula gracilis (Dana, 1849)

Length: females: 0.96-0.98 mm; males: 0.86-0.92 mm.

Female: Prosome 3-segmented. No mid-dorsal hump as in *F. gibbula*. Urosome about twice as long as furca. In lateral view of the urosome, anterior section the dorsal margin is almost parallel to the ventral margin.

Male: Prosome 3-segmented. Urosome less than three times longer than the furca. Furca longer than twice the width. The posterior margin of the genital enlargements approximately 2/3 down the length of the urosome.

Recorded: Madagascar.

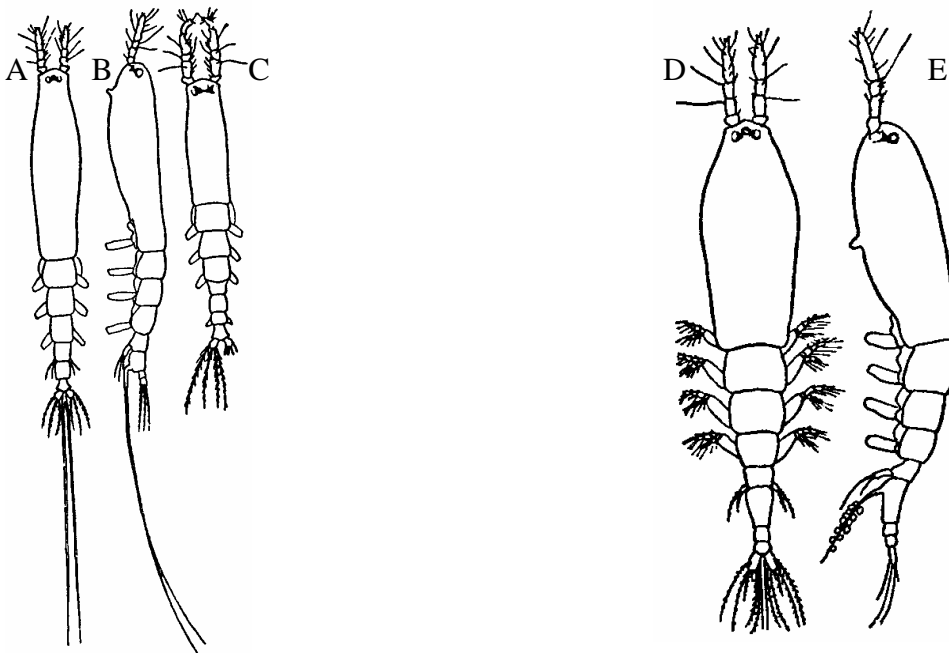


Farranula gracilis: Female. A, dorsal view of prosome; B, lateral; C, A2; D, close up of antero-ventral urosome; E, P4. Male. F, dorsal; G, lateral; H, A2; I, P4. Figures A-I from Cervignon (1964).

Order Monstrilloida

Monstrilloid copepods are rare in the plankton. The adults and first nauplius are free-swimming while all other stages are parasitic in polychaetes or gastropods. Adult males and females are immediately recognised by their elongate cylindrical shape and their lack of feeding appendages and second antennae. The first antennae are parallel and directed forwards, in line with the body. The adult copepod cannot feed and must subsist on food accumulated as a juvenile, the adult's primary function is to reproduce.

The female genital segment is equipped with a pair of slender spines from the ventral surface on which the eggs are carried. The male genital segment has a variable shaped appendage where the spermatophores are carried. In this guide we have not attempted to identify the monstrilloid copepods to species level.

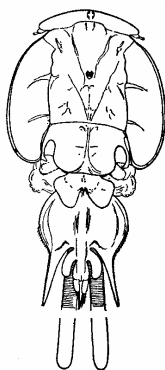


Cymbasoma longisponosum: A, female dorsal; B, female lateral; C, male dorsal. *Monstrilla helgolandica*: D, female dorsal; E, female lateral. From Sars (1916).

Order Siphonostomatoida

Family Caligidae

The family is made up entirely of parasites, largely ectoparasitic on fish. The nauplii larvae are typical and free-living. Adults mainly remain attached to their host, although most are able to swim freely and are occasionally found in the plankton.



Example of a female parasitic copepod *Alebion* sp. from the Indian Ocean. Figure from Wilson (1932).

CLASS OSTRACODA

Ostracods are small crustaceans which have a carapace of two valves, hinged across the top. They are sometimes confused with the cyprid stage of barnacles which they superficially resemble. They have 7 pairs of appendages, specialized for different tasks. Their feeding and swimming limbs stick out below the carapace. Some species have a lateral eye-spot. They shed the carapace seven times during life, growing a new larger one each time. They are sexually dimorphic, males and females are slightly different shapes.



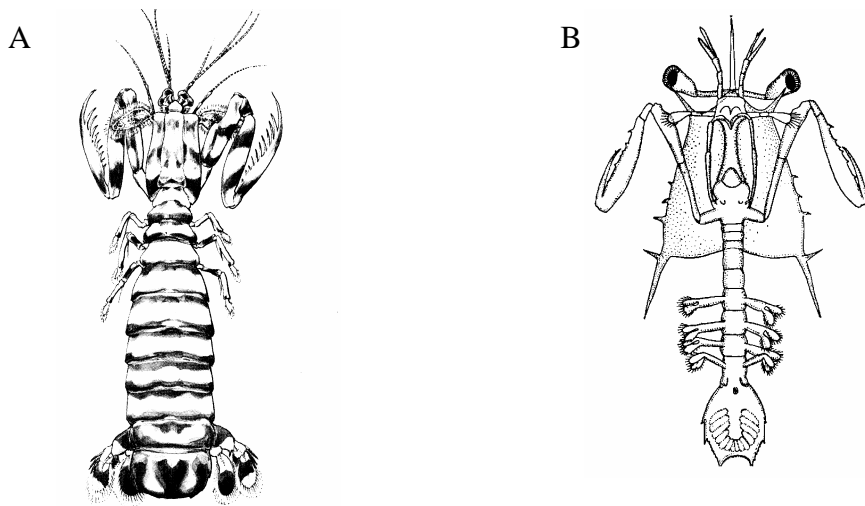
Examples of ostracods (From Wickstead, 1965).

CLASS MALACOSTRACA

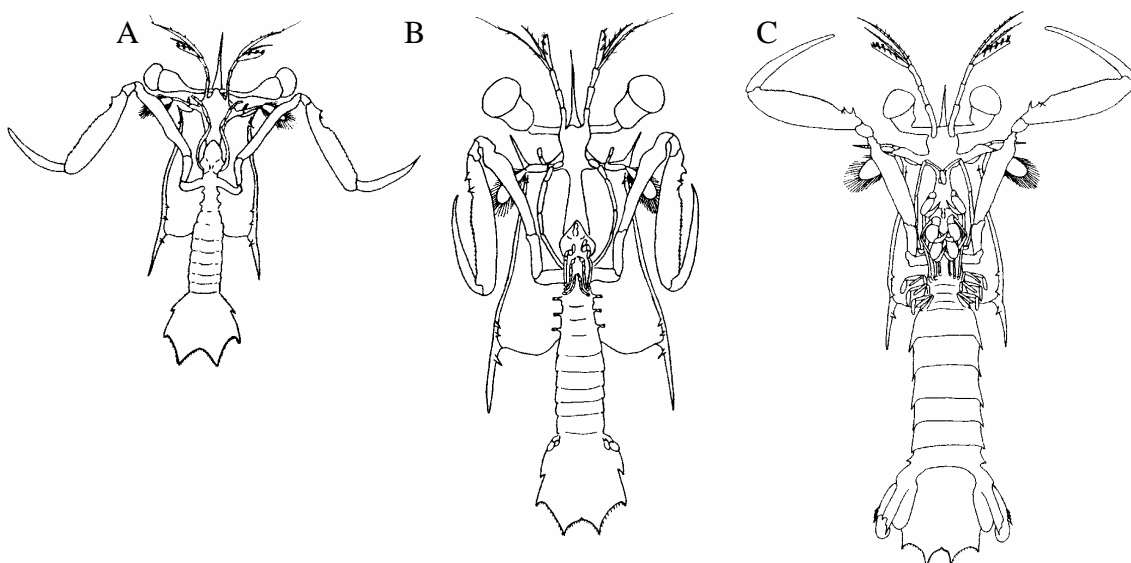
Order Stomatopoda

The stomatopods are more commonly known as ‘mantis shrimps’. The adults are benthic, and typically live in burrows or rock or coral crevices. They range in size from 5 cm to greater than 35 cm. The second pair of legs are characteristic, very large and powerful. They can be modified for smashing hard-shelled prey (bivalves, shelled gastropods, crabs etc) or for spearing fish and other soft-bodied organisms. For those modified for smashing, some species can harness enough power to shatter a pain of aquarium glass in a single high speed ‘punch’.

Adult females brood their eggs and tend them until they hatch. The larvae are transparent and pass through up to nine planktonic stages, remaining in the plankton for up to three months. All stages resemble the adult, with more adult features taken on as development progresses. In all stages the large 2nd pair of legs and large carapace are distinctive features. Larvae are usually less than 10 mm, but may reach up to 5 cm in length in some species.



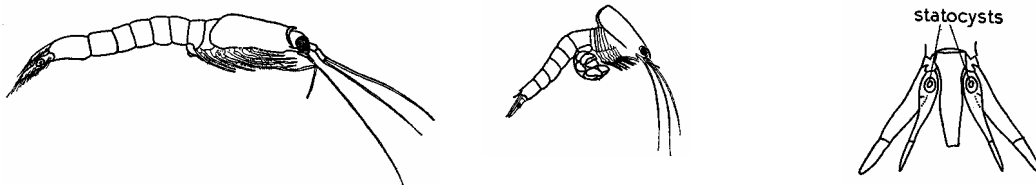
Stomatopoda: A, adult *Lysiosquilla maculata*; B, early larval stage of a species of *Squilla*. Figure A from Richmond (1997), B from Calman (1911).



Squilla sp. larval stages: A, stage I; B, stage IV; C, stage VII. Figures A-C from Diaz (1998).

Order Mysida

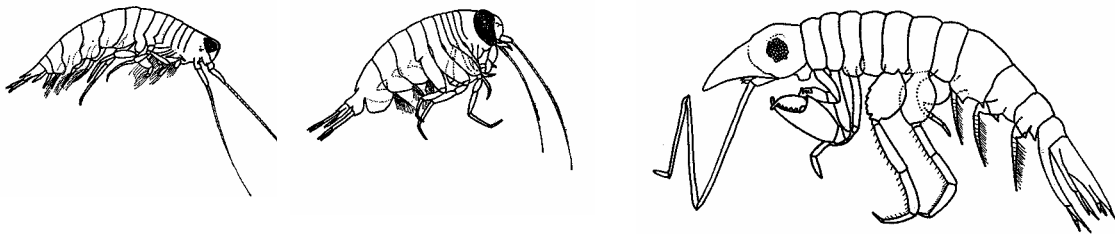
These are commonly known as opossum shrimps and can be especially numerous in areas such as estuaries. They are shrimp-like, but can be recognized by the presence of very obvious circular organs called statocysts in the tail fan. The eyes are usually black but sometimes red. Adult females often have a brood pouch with eggs or developing young inside.



Examples of mysids and structure of the tail fan showing the statocysts (From Wickstead, 1965).

Order Amphipoda

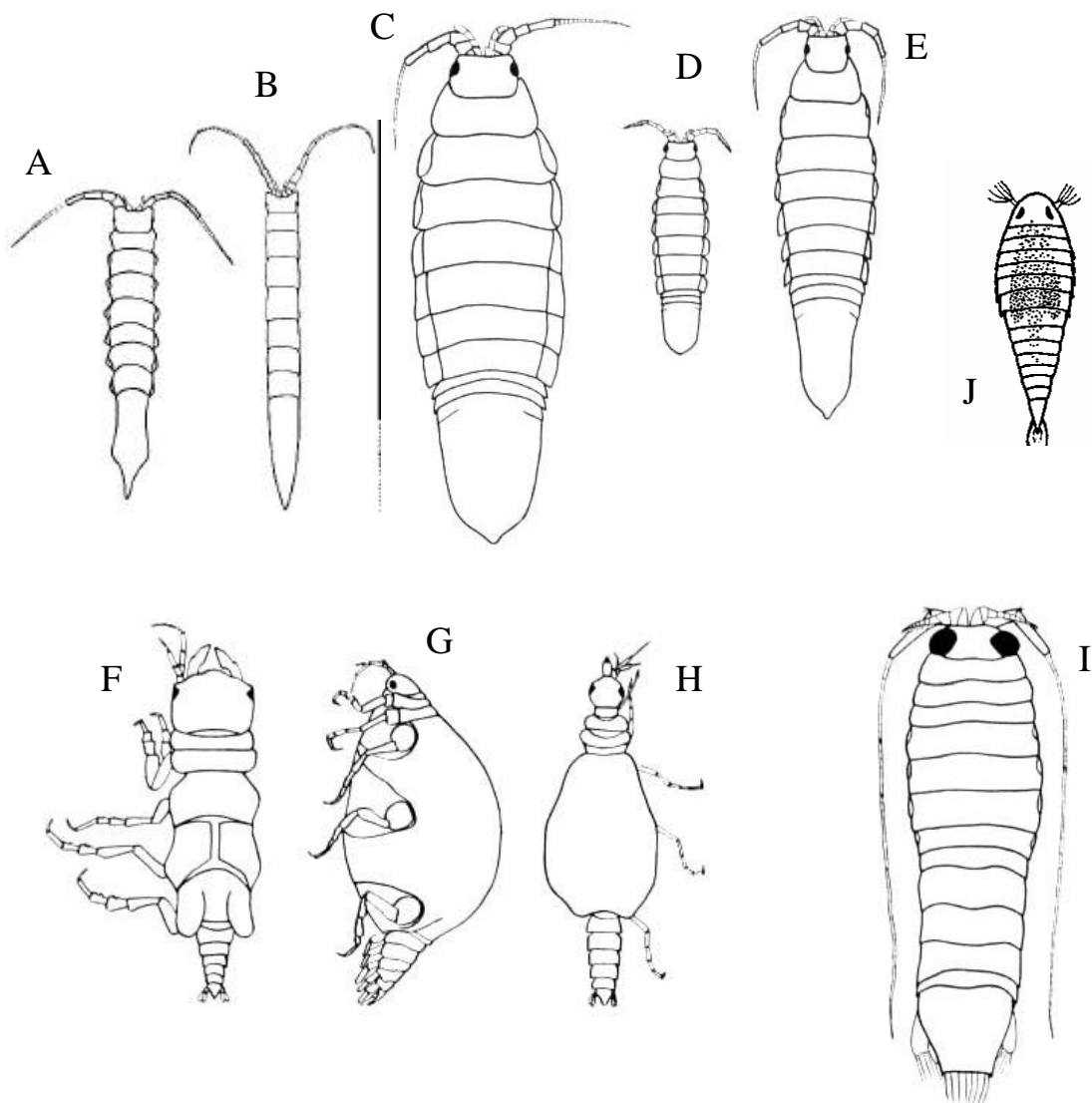
Amphipods are large crustaceans, sometimes common in the plankton samples. The eyes are usually well developed, large with many facets (compound eye), but are sometimes reduced or lacking. Their bodies are elongate and more or less flattened from side to side. They brood their young and plankton samples often contain large numbers of juveniles released from the female during the sampling process. They have two pairs of antennae, with one pair usually very small.



Examples of amphipods (From Wickstead, 1965).

Order Isopoda

Isopods are crustaceans with a flattened (dorso-ventrally) body. The body is divided into a series of segments, which generally decrease in width towards the tail, although they are very variable in shape. They usually have a pair of simple, small eyes widely separated on each side of the head and uniramous (single branch) walking legs. Some are associated with the very surface film and are only collected when this is sampled. An unusual species which can occur in plankton samples is a parasite of fish called *Gnathia*. This has a tubular body with a yellow tinge, probably because of stored lipids. The larvae of another parasitic isopod group, the epicarids, are often found in plankton samples in low numbers. An epicarid larva, which resembles a small isopod hatches from the egg and seeks out and attaches to a copepod. It moults several times, becoming a microniscid and eventually a cryptoniscid larva. It then leaves the copepod and finds its next host, usually a crab.



Selection of isopods. A-E, Representatives of family Idoteidae; F, *Gnathia* sp. male dorsal; G, female lateral; H, juvenile dorsal; I, Cirolanidae isopod; J, Cryptoniscid larva (A-E From Naylor, 1957a, F-I from Naylor 1957b, J from from Wickstead, 1965).

Order Cumacea

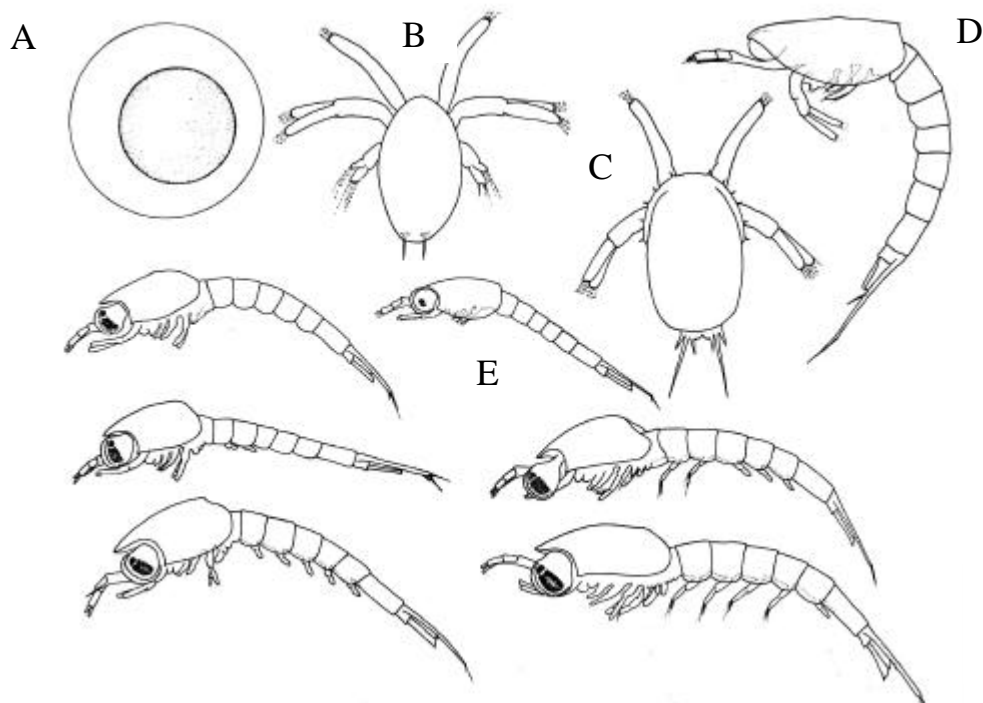
Cumaceans are bottom dwelling, shrimp-like organisms, which can occur in plankton samples when they emerge at night, or if the bottom is stirred up by wave action in shallow waters. They generally have an enlarged carapace, a slender abdomen, no tail fan and most do not have obvious eyes.



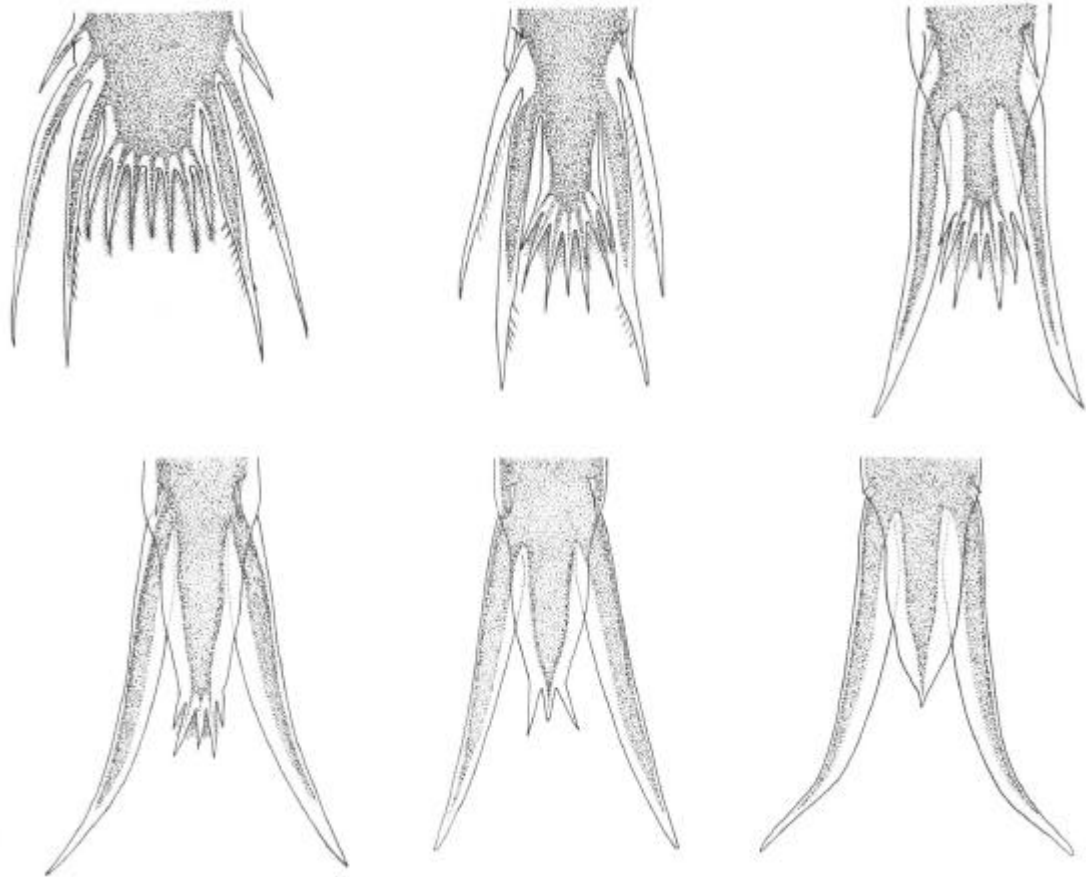
Example of a cumacean (from Wickstead, 1965).

Order Euphausiacea

Euphausiids, or krill, are relatively large shrimp-like organisms, of which there are 86 known species. There are only two families of euphausiids, Benth euphausiidae and Euphausiidae, of which only the latter have been sampled during the Darwin Programme. Euphausiids often swarm in large numbers and are generally found in greatest numbers away from the coast. Sexes are separate and eggs are either released directly into the water column (57 species) or held in an egg sacs or sacs, carried between the thoracic legs. Eggs are large, typically 0.3-0.9 mm in diameter, with, at least in free spawned eggs, a perivitelline space of varying diameter between the embryo and the outer membrane. The larva which emerges from free spawned eggs is the typical nauplius larva of crustaceans and has only 3 pairs of limbs. The nauplius develops through a second nauplius stage and then a metanauplius stage, which has only 2 pairs of limbs. Following the metanauplius are three calyptopis stages, the final of which moults into the first of several furcilia stages, the number varying with species and also determined by environmental conditions. Eyes emerge from below the carapace and start to pigment during the furcilia stages. Light organs (photophores), which are usually red, develop during this stage and are characteristic of all but 2 species of this order. Generally there are one at the base of each eye, a pair on the coxae of the second and seventh thoracic limbs and single ones on the mid line between each of the first to fourth pleopods. In the Genus *Stylocheiron* these numbers are reduced. There is a reduction in the number of spines on the telson as euphausiids approach adulthood, till there are only three spines. However, they cannot be considered adult until they are capable of reproduction, and till this time are called post-larval. In the later developmental stages their eyes are generally black or brown, sometimes red, and can be circular, sub-circular or elongated.



Developmental stages of euphausiids: A, egg; B, nauplius; C, metanauplius; D, calyptopis; E various successive furcilia stages. From Einarsson (1945).



Changes in the telson of the furcilia stage during development, showing the gradual reduction in the number of spines. From Einarsson (1945).

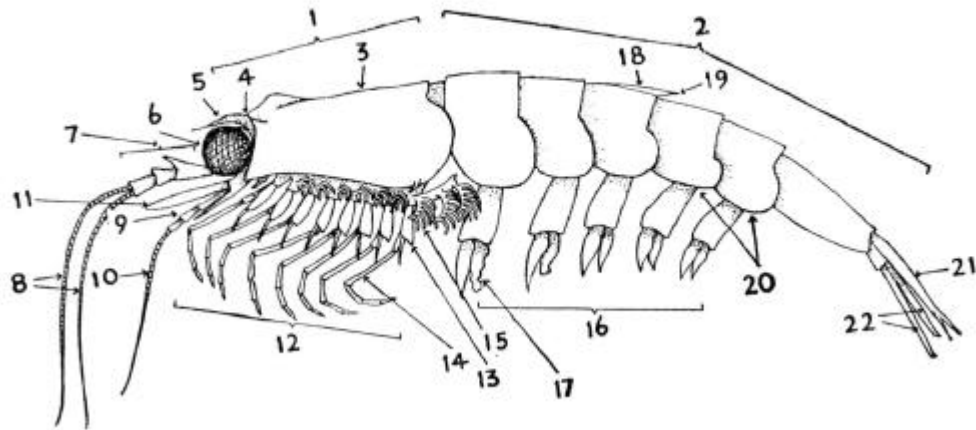
Euphausiid morphology

The body is divided into the cephalothorax and the abdomen. The cephalothorax includes the carapace, exposed gills, 5 paired mouthparts, 8 paired thoracic limbs, 2 pairs of antennae and a pair of eyes. There are 6 segments in the abdomen, which ventrally carry the paired pleopods, which are used in locomotion. The telson and uropods are found posteriorly.

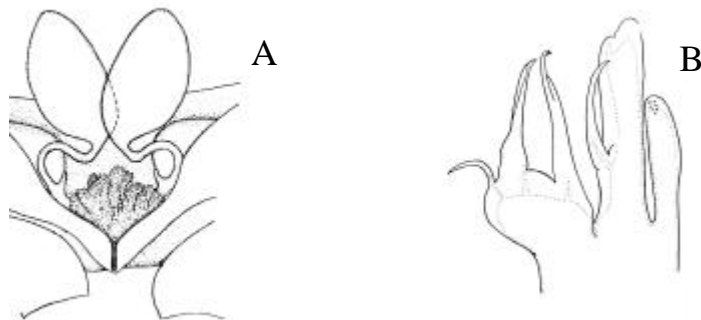
The paired first antennae, or antennules, each consists of a 3-segmented antennular peduncle and 2, multi-segmented, antennal flagellae. The anterior-dorsal edge of the first segment of the antennular peduncle is often extended, forming a plate called the antennular lappet, which varies in shape between species. The paired second antennae each consist of a basal segment, which has a 2-segmented antennal peduncle and an antennal scale. On the outer distal margin of the basal segment there is a spine, which varies in length. The antennal scale lies to the outside of the peduncle, which terminates in a single long flagellum.

Each of the abdominal pleopods carries a pair of setose plates, an inner endopodite and an outer exopodite. In Family Euphausiidae, the endopodites of the first and second pleopods are modified as sexual organs in males. The various hooks and processes, which develop on

the pleopods, are termed the petasma. The structure can be used in the identification of mature individuals. The external reproductive organ of the female is known as the thelycum and is found on the ventral surface of the sixth and seventh thoracic segments.



Generalised euphausiid, illustrating terminology. 1, Cephalothorax; 2, abdomen; 3, carapace; 4, frontal plate; 5, rostrum; 6, eye; 7, first antennal peduncle; 8, flagella of first antenna; 9, second antennal peduncle; 10, flagellum of second antennae; 11, antennal scale; 12, thoracic limbs; 13, exopodite of thoracic limb; 14, endopodite of thoracic limb; 15, gills; 16, pleopods; 17, male copulatory organ; 18, dorsal keel; 19, dorsal tooth; 20, pleuron; 21, telson; 22, uropods. From Boden (1954).



Typical euphausiid sex organs. A, female thelycum with two spermatophores attached; b, male petasma. From Einarsson (1945).

It should be noted that keys are based on adult feature and these same features may not be present in juveniles.

An excellent key and descriptions to the euphausiids of the world are given in Baker *et al.* (1990).

Family Euphausiidae

The eyes are well developed. The first and second pairs of pleopods in the male are transformed into copulatory organs. Photophores are present. The lower posterior margin of the carapace is not serrated but smooth, or carries one or two small denticles

Genus *Euphausia*

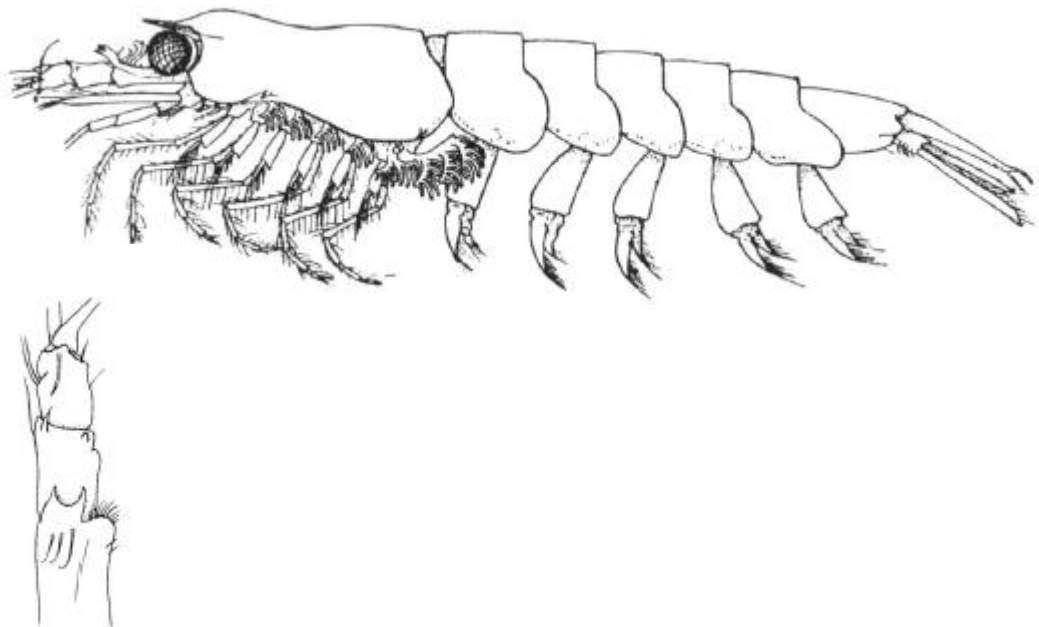
Denticle are generally present on the sides of the carapace, either one or two pairs. Eyes are always circular, or slightly sub-circular. Shape of the rostrum is variable, either pointed or gently rounded. The basal segment of the antennular peduncle often has a small lappet at the distal end. The seventh thoracic leg consists of a minute process with the exopodite missing, while the eighth thoracic leg is tiny.

Euphausia diomedea Ortmann 1894

Length: 10-18 mm.

The anterior extension of the carapace is short, sometimes extended over the eyestalks and terminates in a slender rostrum. Two denticles are present on the carapace, anteriorly and posteriorly, towards the lower edge. The basal segment of the first antennal peduncle bears a bifurcated lobe, the ends of which point forwards and outwards. The second segment has 2 processes distally, the outer one blunt and the other sharp. There is a short low ridge on the third segment.

Recorded: Zuza, Madagascar.



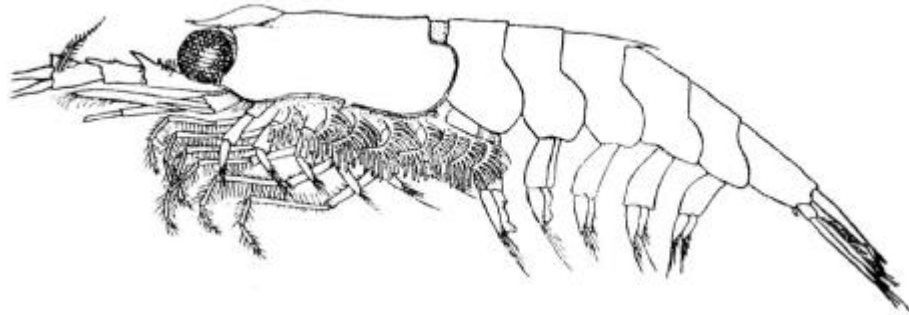
Euphausia diomedea: Adult male from left side and right first antennal peduncle from above. From Boden(1954).

Euphausia gibboides Ortmann 1893

Length: 22-27 mm.

Body quite robust. The anterior projection of the carapace is short, with a broad based but terminally sharp rostrum. There is a single spine on the carapace, on the lower margin, around half way along. There is a pronounced keel on the dorsal carapace. The eyes are large and circular. The basal segment of the first antennular peduncle is extended distally into a long lobe, which points forwards and upwards for the first half of its length and then tapers abruptly and bends sharply outwards. The upper distal end of the second segment is concave but projects as a lobe over the proximal end of the third segment. The third segment has a high dorsal keel with an acute tooth at its dorsal, distal edge. The scale of the second antennal segment reaches to around the middle of the third segment of the first antennal peduncle. The spiny process on the outer edge of the scale is just under half as long as the scale. There is a short tooth on the dorsal surface of the third abdominal segment.

Recorded: Madagascar.



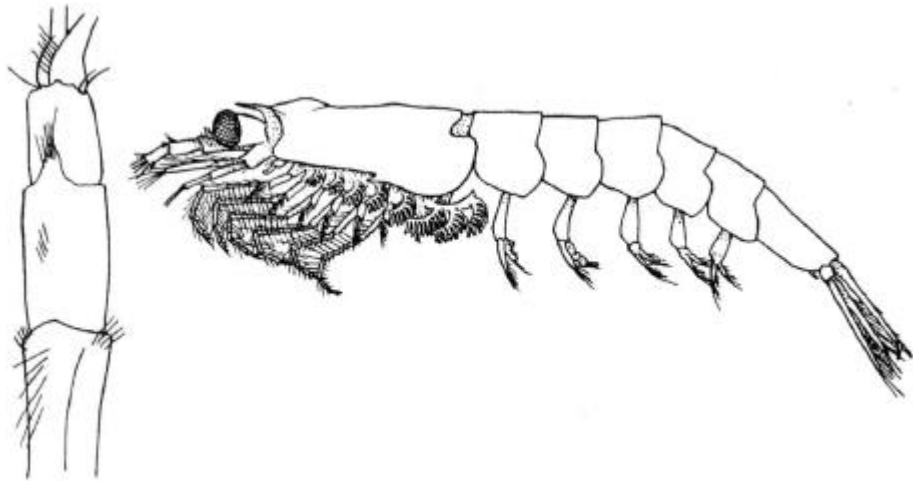
Euphausia gibboides: Adult male from left side. From Boden (1954).

Euphausia tenera Hansen 1905

Length: 7-9 mm.

The rostrum is quite short but pointed and there is a slight keel on the dorsal carapace. There is a single denticle on the edge of the carapace, just behind its mid point. The eyes are small and slightly oval. The basal segment of the first antennular peduncle of the male has several strong setae, but no processes. The second segment has a distal, which extends over the third segment. There are no strong setae on the basal segment of the first antennular peduncle of the female, but the upper terminal margin has a small flat process, pointing upward and visible from the side. The second segment has a much smaller lobe than in the male, which terminates in an angle. There are no processes on the third segment of the peduncle in either sex.

Recorded: Madagascar



Euphausia tenera: Adult male from left side and right male first antennal peduncle from above. From Boden (1954).

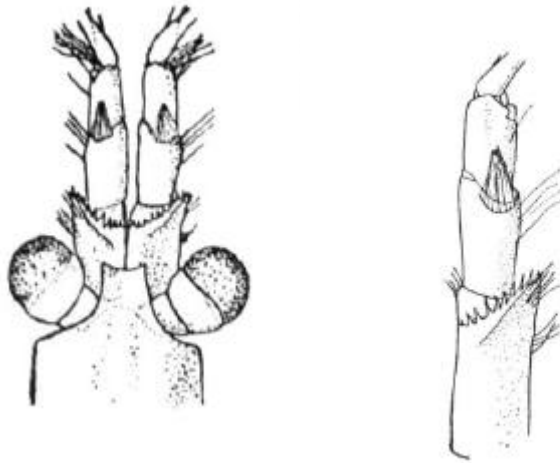
Genus *Pseudeuphausia*

Pseudeuphausia latifrons G.O. Sars, 1883

Length: 7-16 mm.

This is the only species of the genera recorded in the region. Closely related to *Euphausia*. The carapace is produced into a frontal plate, which is transversely cut off so there is no rostrum. The plate is concave anteriorly and longitudinally. There is a prominent median keel on the carapace. A small lateral denticle is present on the lower posterior border of the carapace. The first segment of the antennular peduncle has a dorsal keel bearing 9-10 spines and cuts across at an angle to the outer corner, with a conspicuous spine on the outer edge. Before the distal edge of the second segment there is a group of stiff curved setae, which converge at their tip near the middle of segment 3.

Recorded: Zuza, Madagascar



Pseudeuphausia latifrons: Front part of carapace and first antennal peduncle from above, and right first antennal peduncle from above. From Boden (1954).

Genus *Stylocheiron*

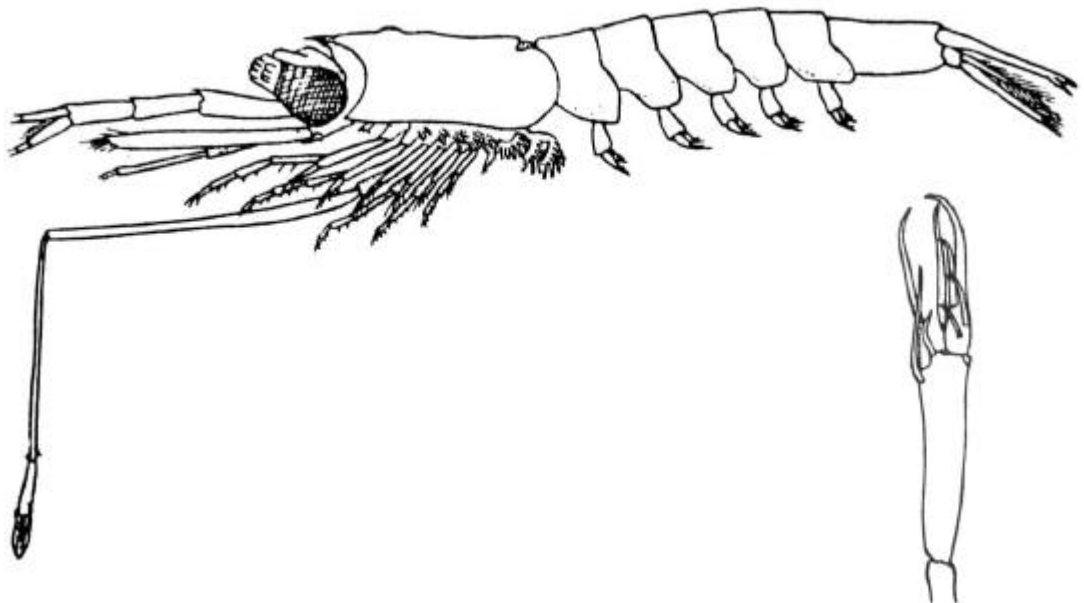
Mostly small slender species, tending to have elongated eyes with large crystal cones at the top. They never have denticles on the carapace. The second and third segments of the antennular peduncle in the female are long and slender while in the male they are short and thick. The upper flagellum is shorter than the lower in the male and the segments are flattened and broad, while in the female they are slender and cylindrical. The peduncle of the second antennal endopodite is extremely elongated, reaching beyond the end of the scale. The first 2 thoracic limbs are short, while the third is extremely elongated, terminating in a claw-like segment called a false chelae. However, this limb is fragile and is often broken off during sampling. The remaining thoracic limbs gradually reduce in size and the last is rudimentary. The number of photophores is reduced in this genera. They are found at the base of the eyes, on the coxae of the seventh thoracic limbs and in the ventral mid-line of the first abdominal segment.

Stylocheiron affine Hansen, 1910

Rostrum long and slender in the female, reaching to, or beyond the anterior eye, shorter in the male. The carapace is keeled dorsally. The eyes are less than twice as high as broad, with the lower end less than twice as wide as the upper end. At the upper narrow end are 4-7 crystalline cones in a transverse row. The first antennal peduncle in both sexes is about as long as the carapace, relatively shorter in the male. In the female the upper flagellum is cylindrical and slender and around as long as the peduncle while in the male the distal parts of both flagella are flattened and wider. The elongated third thoracic limb terminates in the typical chelae of the genera. The second last segment has a long, strong curved spine and 2 shorter spines.

Length: 5.4-8.5 mm.

Recorded: Madagascar



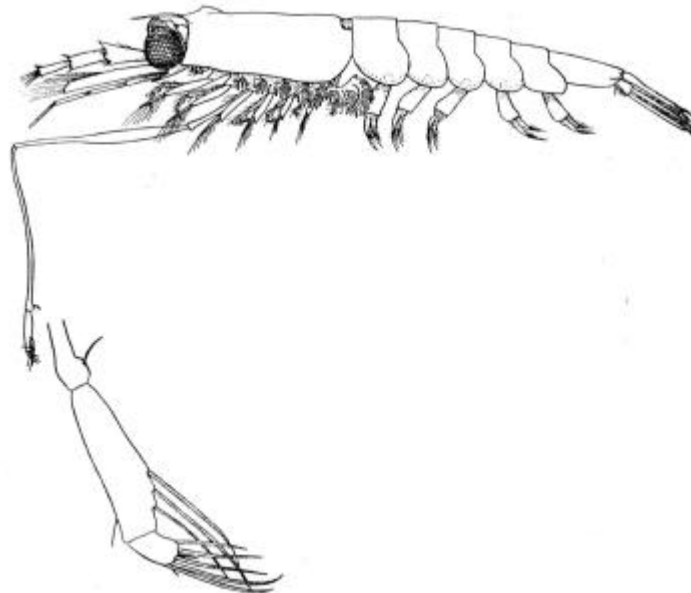
Stylocheiron affine: Adult female from left side and terminal segment of third thoracic limb. From Boden (1954).

Stylocheiron carinatum G.O. Sars, 1883

Length: 6-12 mm.

The anterior carapace is short, with a sharp rostrum. The eyes are sub-circular, quite broad at the base, upper lobe short and narrow with 6-8 slightly enlarged crystalline cones at the top, in a transverse row. There is a high dorsal keel on the carapace behind the rostrum. The basal segment of the first antennular peduncle is similar in both sexes and has no lobes or processes. The flagellae are shorter than the peduncle, the lower slightly shorter than the upper, and in the male thick at the base. The female flagellae are much thinner than in the male. At the distal end of the third last segment of the elongated third thoracic limb, there is a raised portion armed with a spine. The second last segment has three strong setae on its lower edge.

Recorded: Zuza, Madagascar



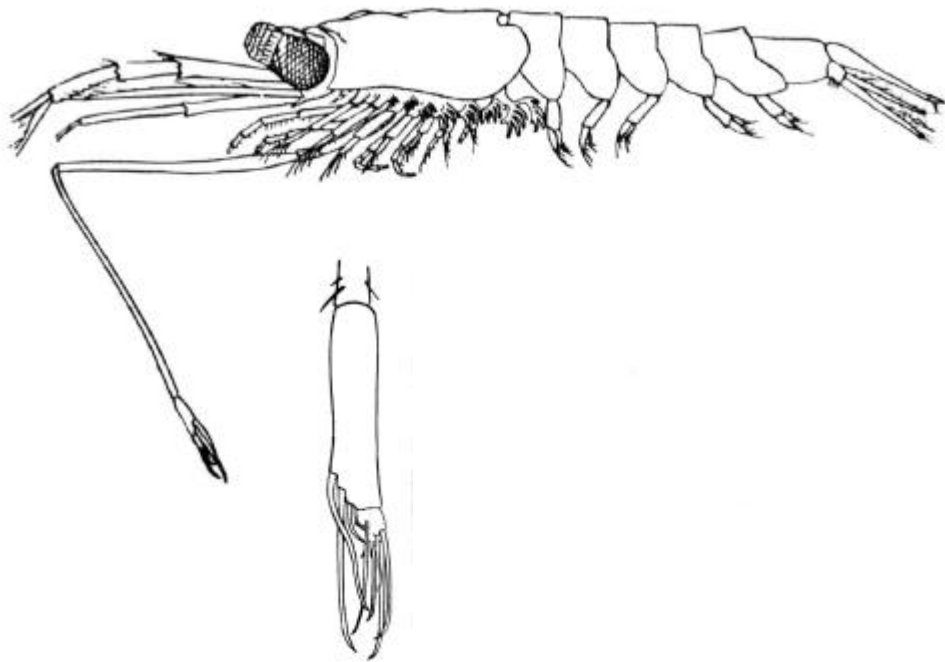
Stylocheiron carinatum: Adult female from left side and terminal segments of third thoracic limb. From Boden (1954).

Stylocheiron longicorne G.O. Sars, 1883

Length: 6.2-11.3 mm.

The rostrum is short but pointed. There is a low dorsal keel without a prominent crest. The eyes are twice as high as the width across the base, the upper part almost as wide as the lower part. The upper eye has 7-19 enlarged crystalline cones in a transverse row. The false chelae bear a number of strong bristles on the last 2 segments. The sixth abdominal segment is slightly longer than the fifth segment.

Recorded: Madagascar



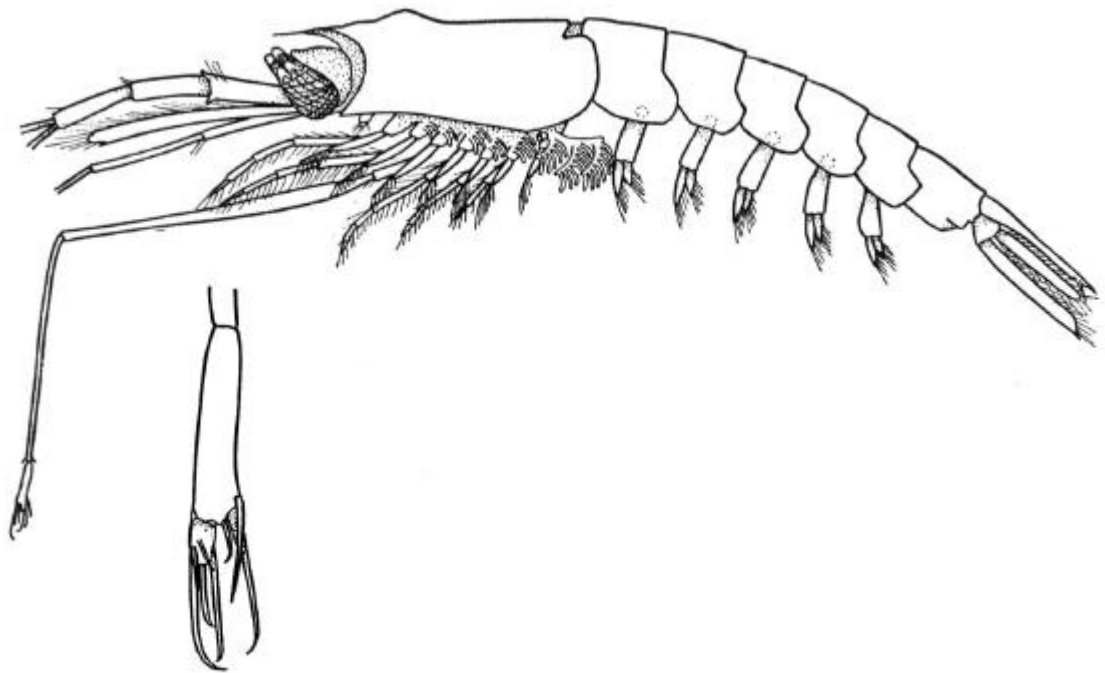
Stylocheiron longicorne: Adult male from left side and false chelae of the third thoracic limb. From Boden (1954).

Stylocheiron microphthalmum Hansen, 1910

Length: 6.1-6.9 mm.

Frontal plate triangular in the male but produced to a slender rostrum in female. Antennal scale long and narrow, about 12 to 20 times longer than wide at its widest point. Eye small, upper lobe with 2 enlarged crystalline cones in a transverse row. The false chelae of the third thoracic leg have a long distally curved spine and 2 shorter spines on the second last segment. The terminal segment has several strong spiniform bristles. The eyes of this species are small compared to *S. affine* and *S. suhmii*.

Recorded: Madagascar



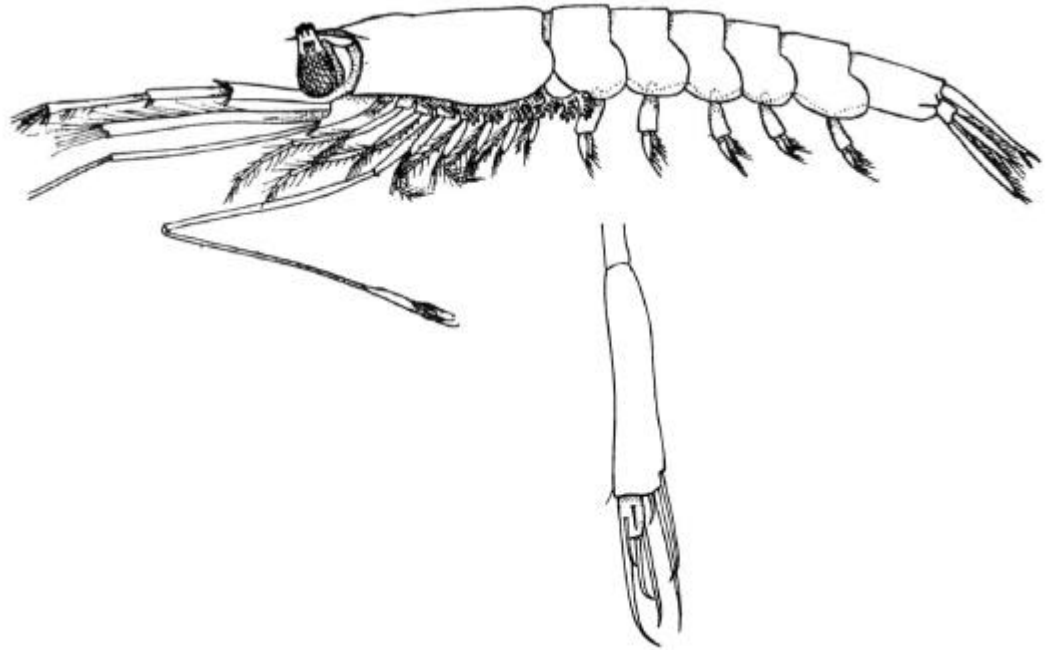
Stylocheiron microphthalmum: Adult female and false chelae of third thoracic leg. From Boden *et al.* (1955)

Stylocheiron suhmii G.O. Sars, 1883

Length: 5.5-7.8 mm.

The rostrum is short and pointed. Antennal scale long and narrow, about 12 to 20 times longer than wide at its widest point. No dorsal crest on carapace. Eyes narrower than in *S. affine* and with only 3 well developed crystal cones in a transverse row across the top.

Recorded: Madagascar



Stylocheiron suhmii: Adult female from left side and false chelae of third thoracic limb. From Boden (1954).

Order Decapoda

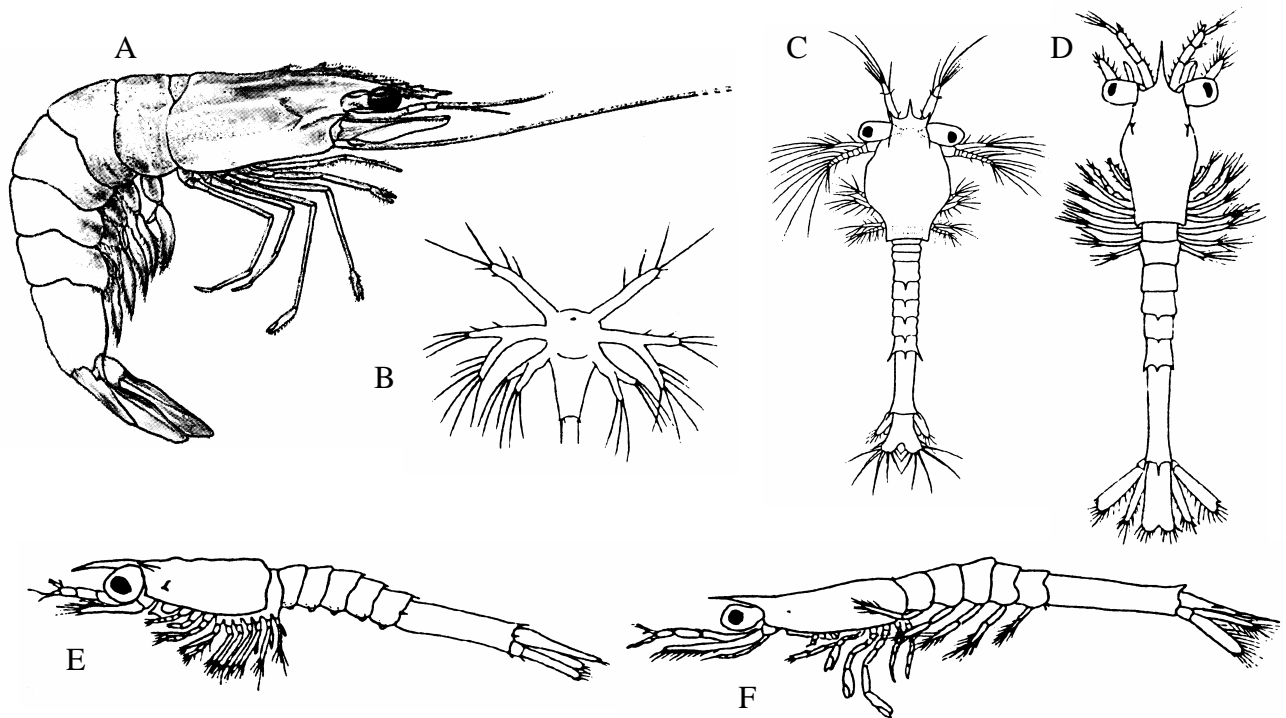
The decapods are a very diverse group that comprise the familiar crabs, prawns and shrimps. The group is split into two suborders, Dendrobranchiata and Pleocymata, separated by the gill structure. The Dendrobranchiata comprises the pelagic sergestoid and penaeoid prawns. The suborder Pleocymata comprises the shrimps, crabs, hermit crabs and lobsters.

Suborder Dendrobranchiata

Two superfamilies Penaeoidea and Sergestoidea, the commercial prawns are penaeids, the truly planktonic genus *Lucifer* is a sergestid

Superfamily Penaeoidea

Mature females do not carry or brood their eggs. Eggs are released directly into the surrounding water. On hatching the larva passes through four distinct larval types, a nauplius, a protozoa, a mysid, and a postlarva. The nauplius possesses a median eye and three pairs of appendages. There are five naupliar stages and three protozoal stages. The protozoa have paired stalked eyes, they have five pairs of thoracic appendages and two pairs of thoracic maxillipeds. The mysis stage has eight pairs of thoracic appendages and uropods. In penaeids the uropods appear before the pleopods. The pleopods develop by the postlarval stage, over several moults the telson and carapace slowly change to the adult form.



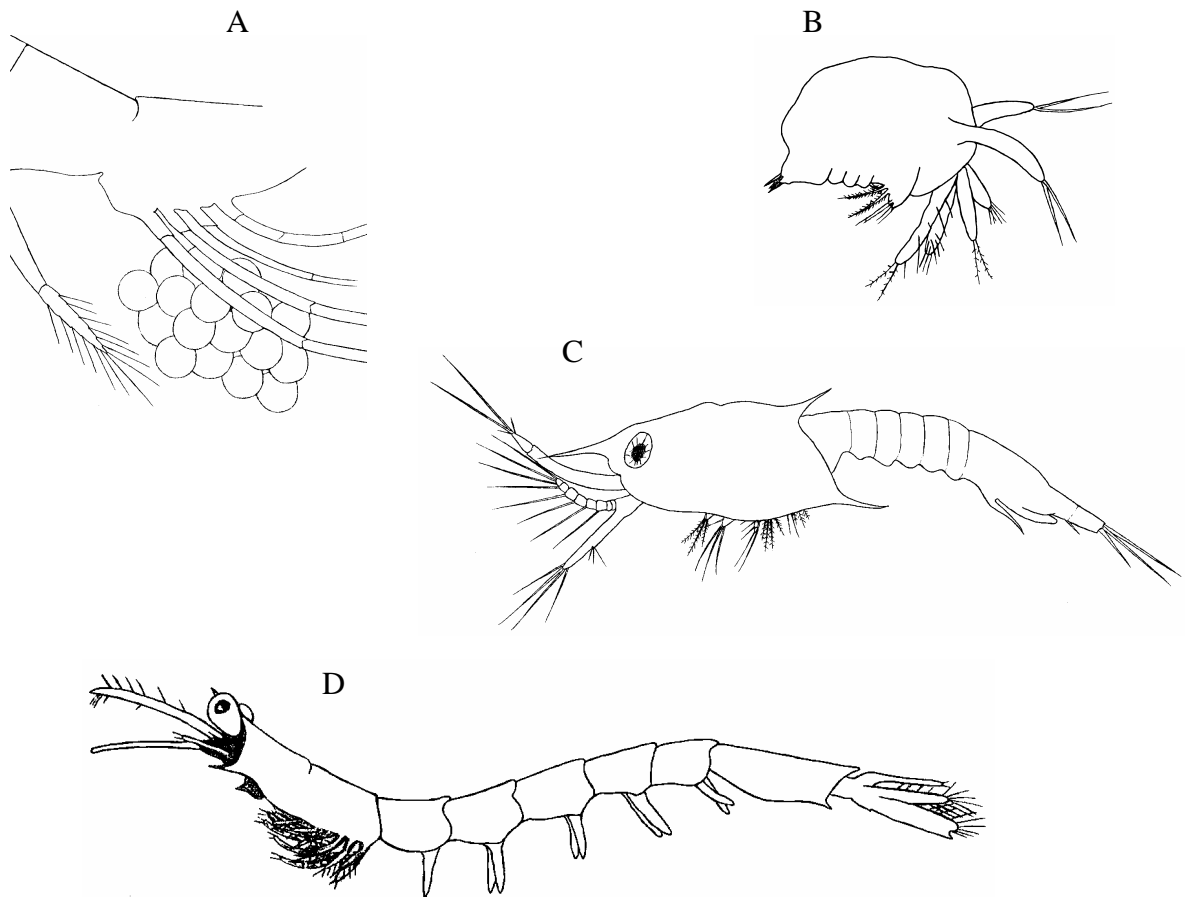
Penaeus sp. A, adult; B, nauplius; C, protozoa dorsal; D, mysis dorsal; E, mysis lateral; F, postlarva lateral. Figures A from Richmond (1997), B-F from Cook and Murphy (1971).

Superfamily Sergestoidea

Sergestoidea are represented by two families, Luciferidae and Sergestidae. The rostrum is shorter than the eye-stalk in adults. In members of the Luciferidae, the body is strongly compressed and gills are absent. For the Sergestidae, gills are present and the body is moderately compressed.

Family Luciferidae

The family is represented by a single genus, *Lucifer*. *Lucifer* typically have a long 'neck', a short pointed rostrum and very distinctive stalked-eyes. *Lucifer* species lack gills. Only the first three pairs of legs (pereopods) are present in the adult, and these lack chelae. The length of eye stalks are significant in *Lucifer* species, some species have long eye stalks, where the eye and stalk are about as long as the 'neck'; others have short eye stalks, where they are about half the length of the 'neck'. The females loosely carry eggs on the third pleopods, in preserved specimens the eggs have usually become detached. A nauplius hatches out of the egg and passes through protozoal and mysis stages before taking on the adult features. Mature males have a characteristic petasma (male genital structure) on the first pleopod, two distinctive ventral processes on the sixth abdominal segment, and a swollen section on the ventral surface of the telson. The females and immature males are not so easy to separate. Species are identified by the length of the eye-stalk, the spines on the telson, and in males, the petasma, and the shape of the swollen section on the ventral surface of the telson. Five species of *Lucifer* have been recorded in the south and western Indian Ocean, *Lucifer chacei*, *L. hanseni* (recorded from Madagascar), *L. orientalis* (recorded from the east coast of South Africa), *L. penicillifer* and *L. typus*.



Lucifer: A, female carrying eggs on 3rd pleopods; B, nauplius; C, protozoa; D, juvenile. Figures A-D from Brooks (1882)

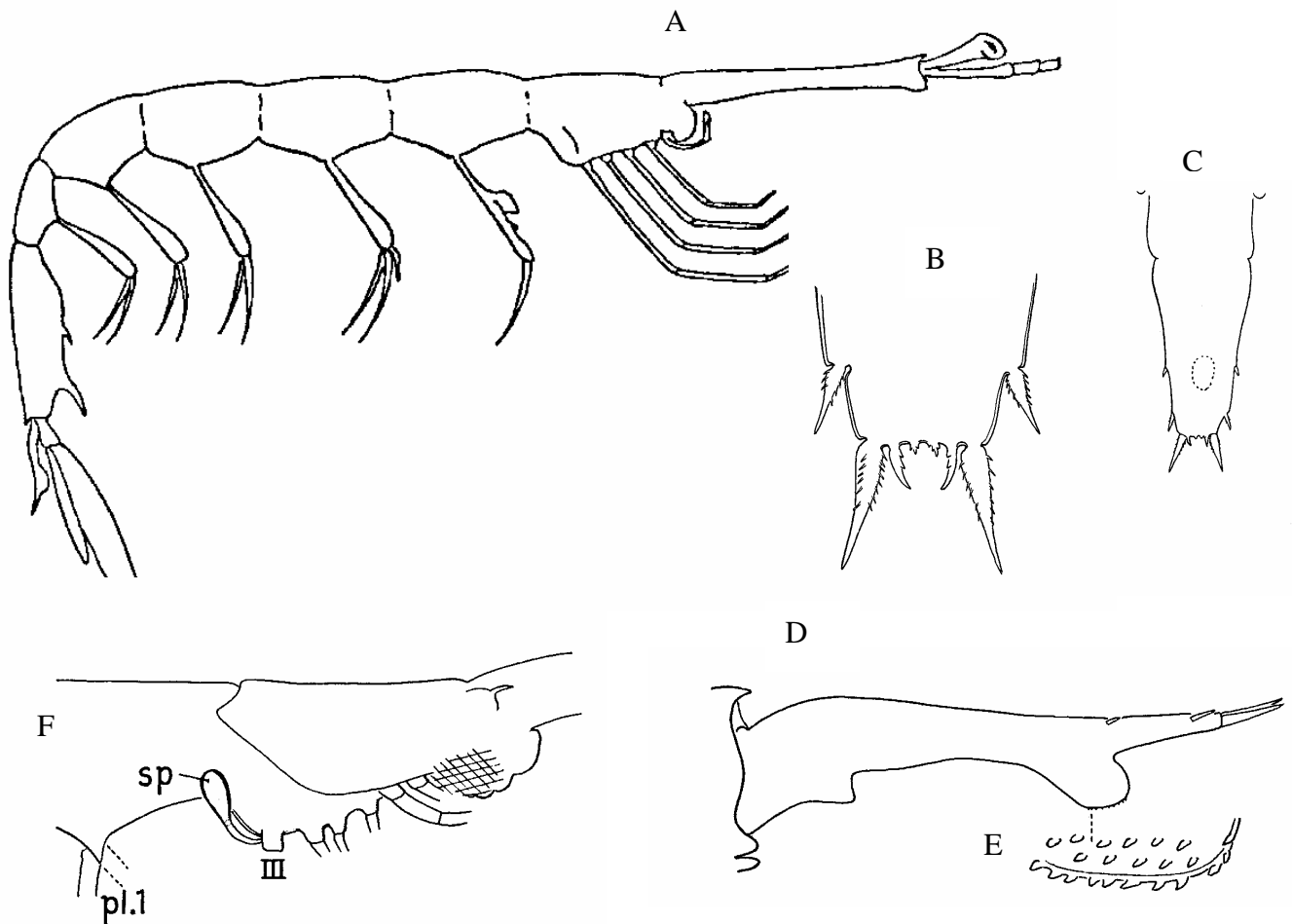
Lucifer penicillifer Hansen, 1919

Length: females: 10-11 mm; males: 9.5-10 mm

The length of the 'neck' is just greater than twice the length of the eye and stalk.

Male: There are two large hook-like processes on the ventral surface of the 6th abdominal segment, the second one is larger than the first and tapers to a point. The swollen section on the ventral surface on the telson is much smaller than that of *L. typus* and is situated further away from the tip of the telson. The last pair of lateral spines on the telson are close to the tip, they are large and have spinules off them on the first half of their length. The centre pair of spines at the tip of the telson are very short. The outer pair of spines are as long as the width of the tip of the telson, or slightly longer, and have between 5 and 8 spinules on either side.

Recorded: Seychelles, east African coast.



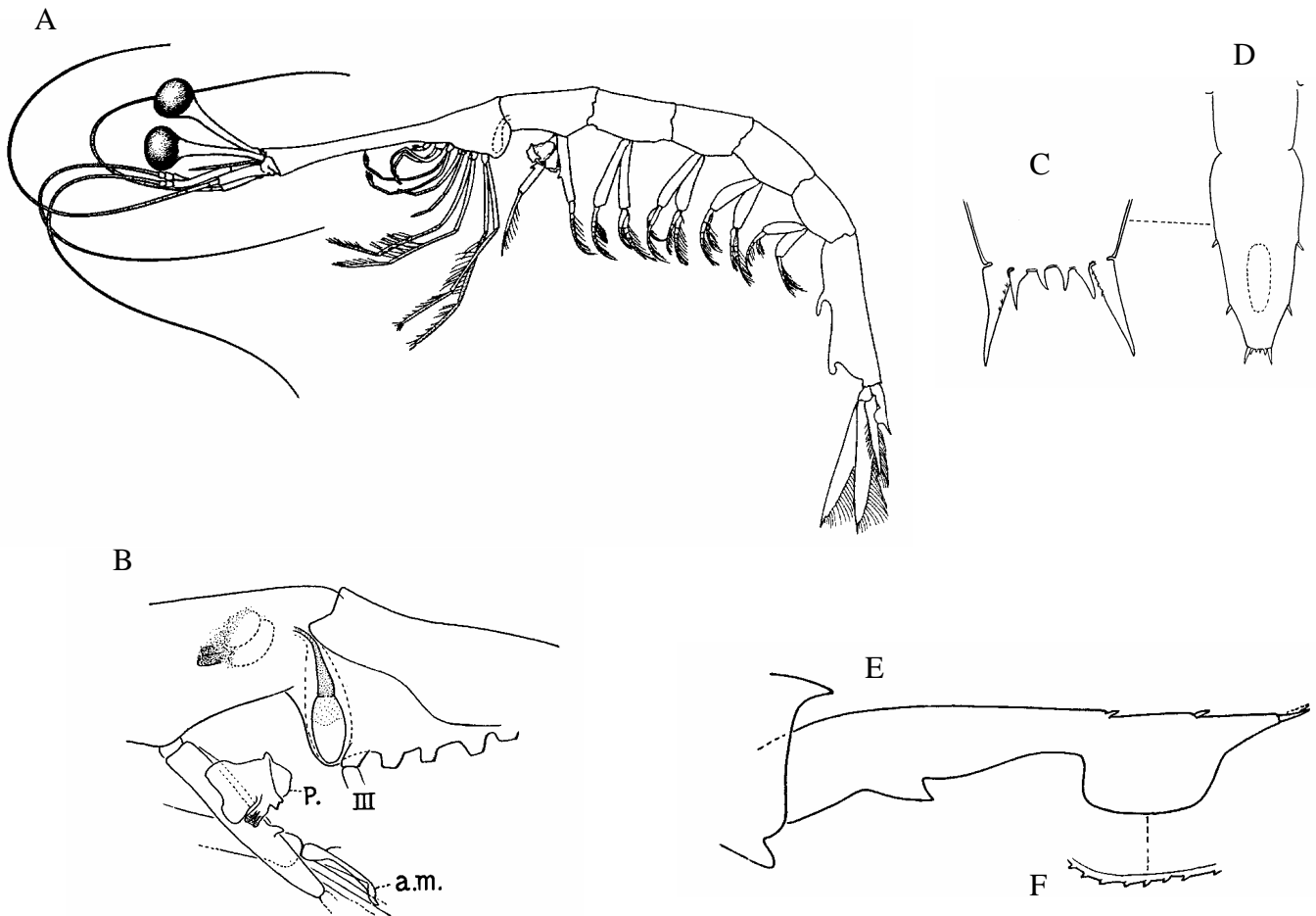
Lucifer penicillifer: Male. A, lateral; B, close up of telson; C, telson, dorsal; D, telson, lateral; E, close up of swollen section. Female. F, thorax and 1st abdominal segment, sp spermatophore case, pl 1st pair of pleopods. Figures A from Barnard (1950), B-F from Gordon (1956).

Lucifer typus H. Milne-Edwards, 1837

The length of the animal's 'neck' is just greater than the length of the eye and stalk.

Male: The swollen section on the telson of the male is large. The end of the telson narrows abruptly after the last pair of lateral spines on the telson. There are three pairs of spines on the tip of the telson. The outer pair of spines are the longest, they are shorter than the width of the tip of the telson, and each of the spines has 4 spinules on the first half of the inside edge. The two pairs of inner spines do not have any spinules.

Recorded: Seychelles, Rodrigues, east coast of South Africa.



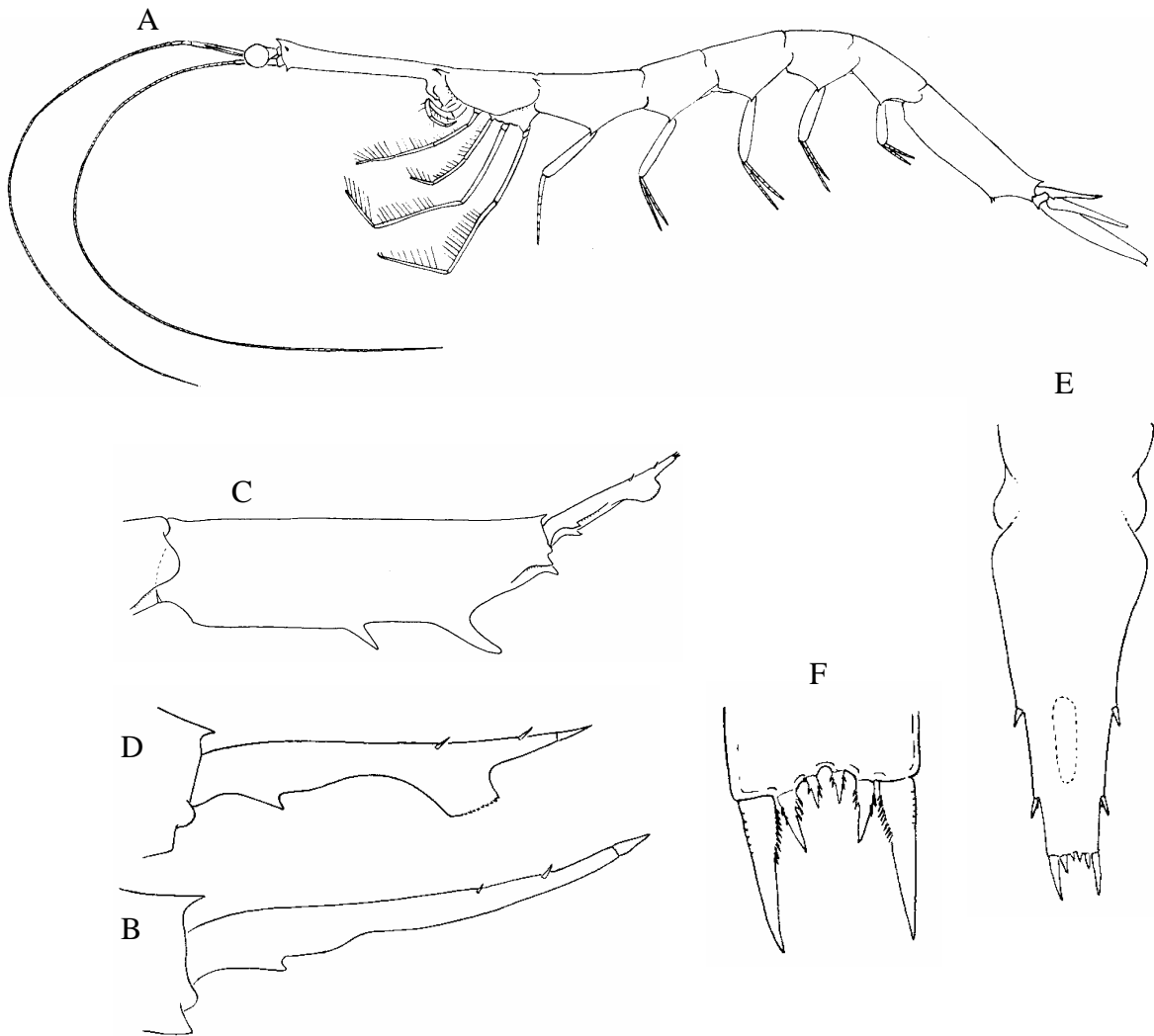
Lucifer typus: Male. A, lateral; B, posterior part of thorax and first abdominal somite of the male showing a fully formed spermatophore and two developing spermatophores, p the petasma, III, base of 3rd pereopod; C, close up of telson; D, telson, dorsal; E, telson, lateral; F, close up of swollen section. Figures A from Pérez Farfante & Kensley (1997), B-F from Gordon (1956).

Lucifer chacei Bowman, 1967

Length of the 'neck' is greater than twice the length of the eye and stalk.

Male: Two large processes on the ventral surface of the 6th abdominal segment, the second is larger than the first, not as pointed as in *L. penicillifer*. The swollen section on the ventral surface on the telson is situated closer to the tip of the telson than that of *L. penicillifer*. Three pairs of spines at the tip of the telson. The centre pair of spines are approximately half the length of the pair of spines alongside. The outer pair of spines have several spinules on either side, they are not as long as the width of the tip of the telson.

Recorded: Seychelles, Madagascar.



Lucifer chacei: Female. A, lateral; B, telson, lateral. Male. C, 6th abdominal segment and telson, lateral; D, telson, lateral; E, telson, dorsal; F, apex of telson, dorsal. Figures A-F from Bowman (1967).

Family Sergestidae

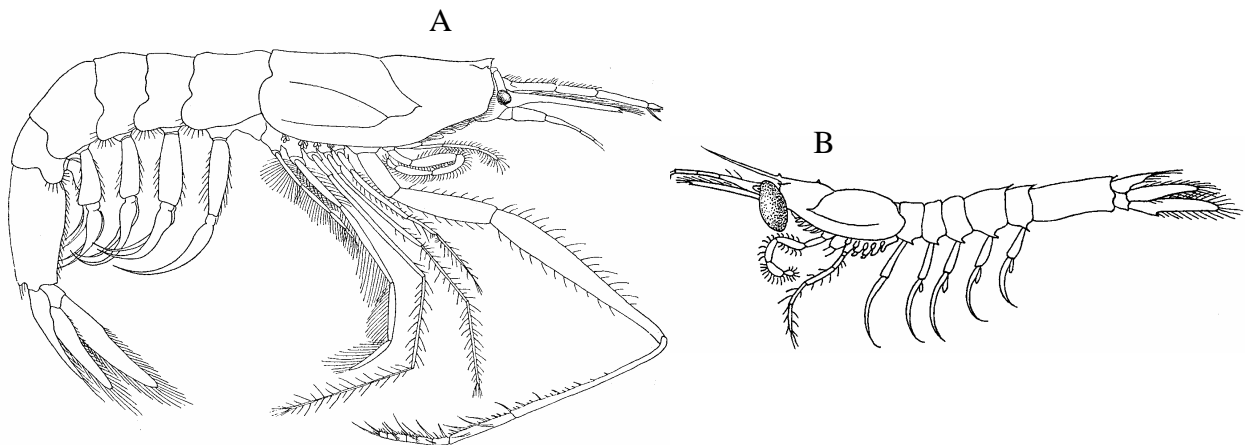
The family comprises six genera of free-swimming prawns, *Acetes*, *Sicyonella*, *Peisos*, *Petalidium*, *Sergia* and *Sergestes*. In this guide we give an example of *Sergestes nudus*. Adult *Sergestes* are difficult to separate, but the larvae are usually very distinct.

Sergestes nudus Illig, 1914

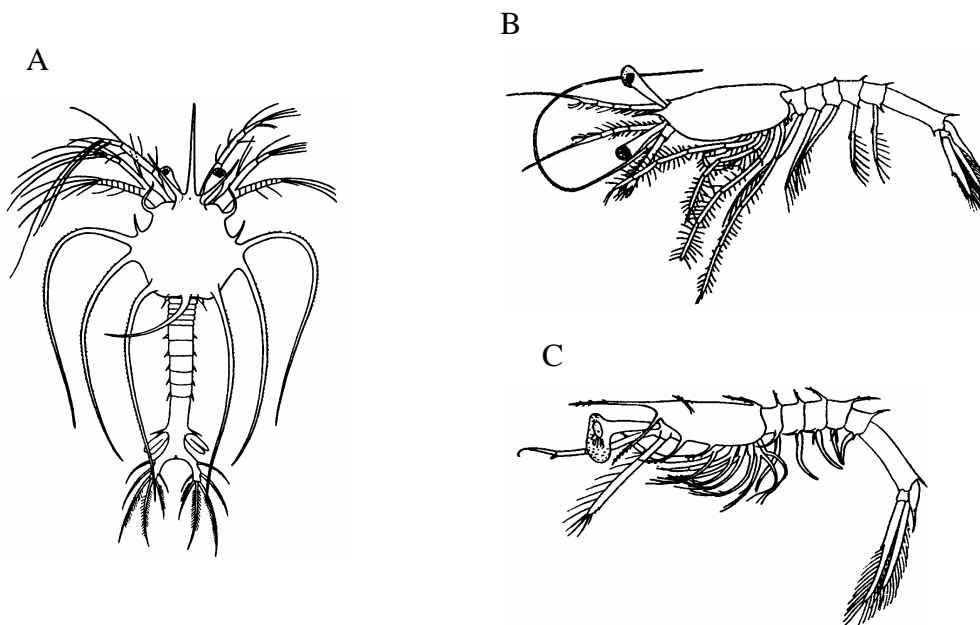
Length: females: 12-31 mm; males: 14-25 mm.

Carapace moderately compressed. Rostrum is short, only just extending beyond the anterior margin of the carapace, pointed at the tip. Ventral antennular flagellum modified in male to form clasping organ. Carapace with supraorbital and hepatic spines. Telson lacking movable spines, tapering sharply towards the tip.

Recorded: Seychelles.



Sergestes nudus: A, adult lateral; B, mysis larva at 3.5 mm. Figures A and B from Illig (1927).



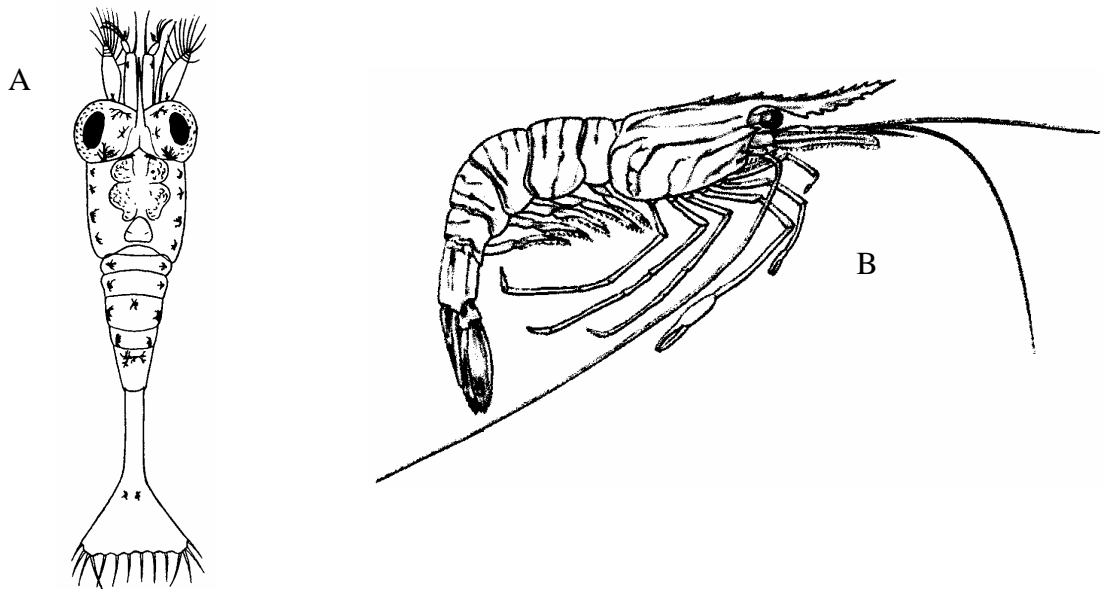
Sergestid larval types: A, protozoa; B, mastigopus; C, Acanthosoma. Figures A-C from Gurney (1960).

Suborder Pleocyemata

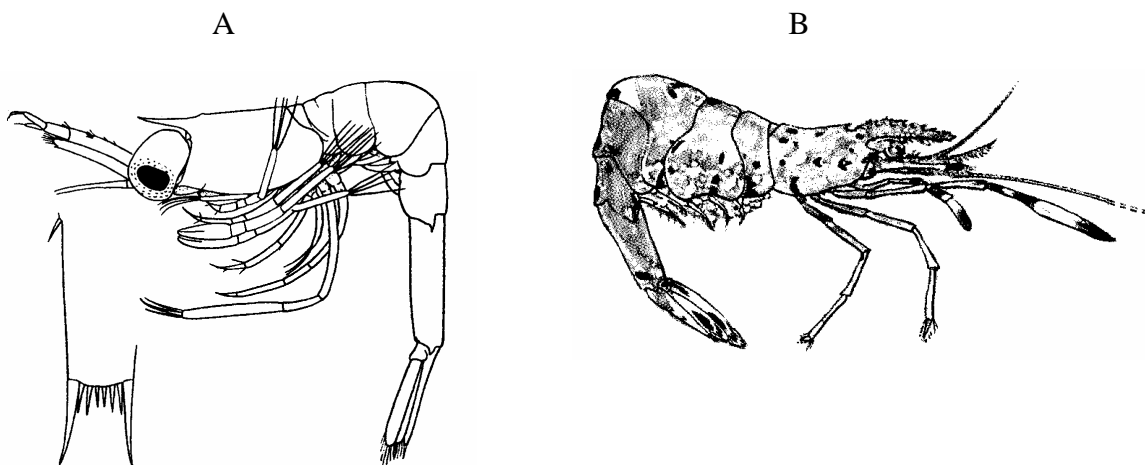
The Pleocyemata comprise the shrimps, lobsters, crabs and hermit crabs. Females carry eggs attached to pleopods. Eggs hatch as the larvae pass through a varying numbers of zoeal stages before the megalopa stage that settles on the seabed and metamorphoses into a juvenile. The group is separated into a number of infraorders: Caridea (shrimps), Palinura (spiny lobsters), Brachyura (true crabs), Anomura (porcelain crabs), Thalassinidea (burrowing lobsters).

Infraorder Caridea

Carideans comprise most of the shallow water shrimps. A characteristic feature of adults is the 2nd pleura on the abdomen which overlaps the 1st and 3rd. The prezoal telson has six spines on either side, the rostrum is cylindrical or laterally compressed, never horizontally flattened throughout. Abdominal somite 3 sometimes with dorsal process. Abdominal somite 5 often with lateral spines.



Palaemon pacificus: A, stage I; B, adult. Figure A from Gurney (1960); B from Richmond (1997).

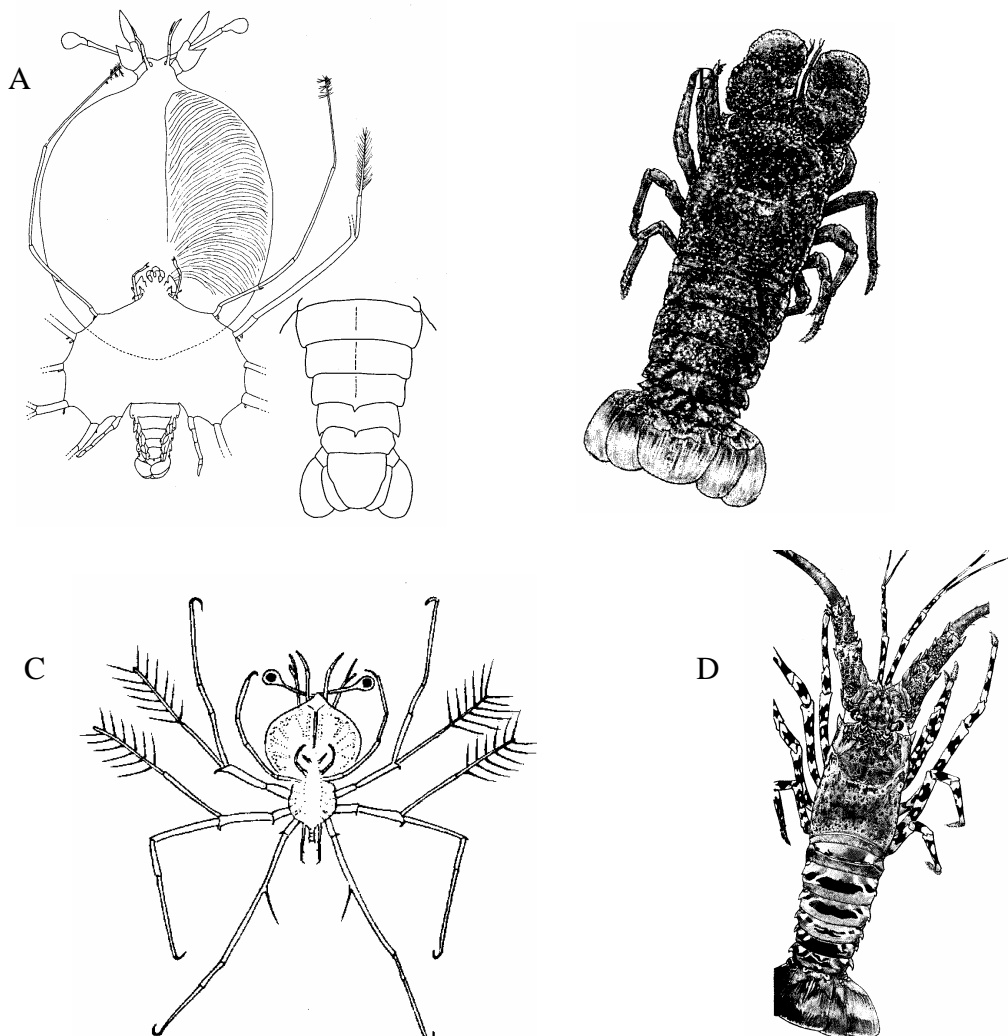


Periclimenes sp.: A, late stage; B, adult. Figures A from Gurney (1960), B from Richmond (1997).

Infraorder Palinura

The typical larval form of the palinuran families Palinuridae and Scyllaridae is the phyllosoma. The size of phyllosoma larvae varies with species and development, but can range from 1.5 mm through to 85 mm. We have not attempted to identify the phyllosoma larvae to species, or genus.

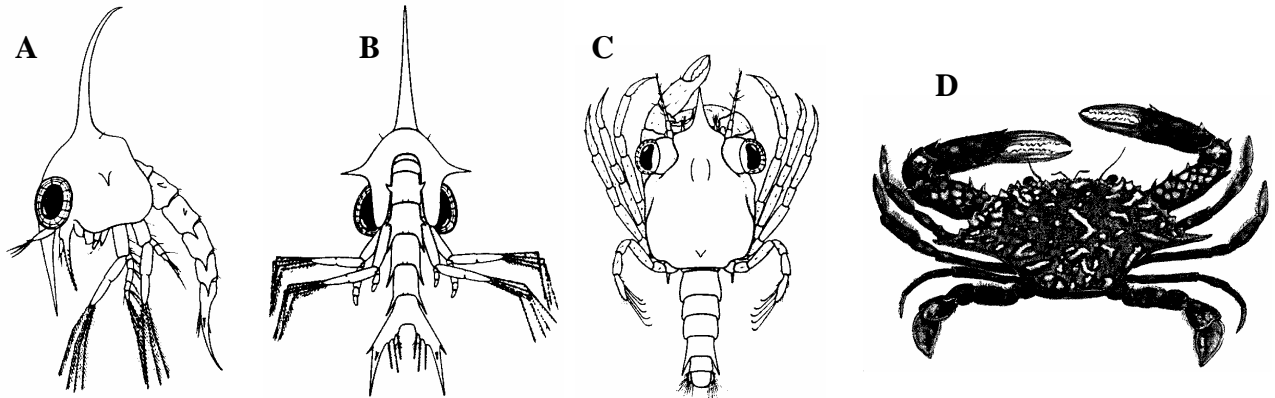
Females carry their eggs until the larvae hatch. The larva passes through a short-lived naupliosoma stage which moults to the 1st phyllosoma stage. The phyllosoma is very distinctive, it is transparent, very broad and extremely dorso-ventrally flattened. Other unusual features include the eyes, which are stalked from the first phyllosoma stage. The thin oval carapace does not cover the whole of the disc-shaped thoracic region. There are four pairs of slender legs, and a relatively small abdomen. The larvae pass through several phyllosoma stages, the uropods and pleopods making their appearance from stage V. The last phyllosoma stage passes into an unusual form of megalopa, the puerulus which resembles a lobster, it has large setose pleopods. The puerulus stage may remain in the plankton for several weeks before settling and metamorphosing into a juvenile. Development from the puerulus to the adult is gradual. The larval life ranges from 1 month for some *Scyllarus* species up to 23 months for *Jasus edwardsii*. The families of warm-water species generally have a shorter larval life than the colder water forms.



Scyllarides sp. slipper lobster: A, late stage phyllosoma; B, adult. *Palinurus* sp.: C, phyllosoma; D, adult. Figures A reproduced by permission of CSIRO Publishing, <http://www.publish.csiro.au/journals/mfr>, from the Australian Journal of Marine and Freshwater Research, vol. 32 (BF Phillips, PA Brown, DW Rimmer & SJ Braine, 1981), B and D from Richmond (1997), C from Calman (1911).

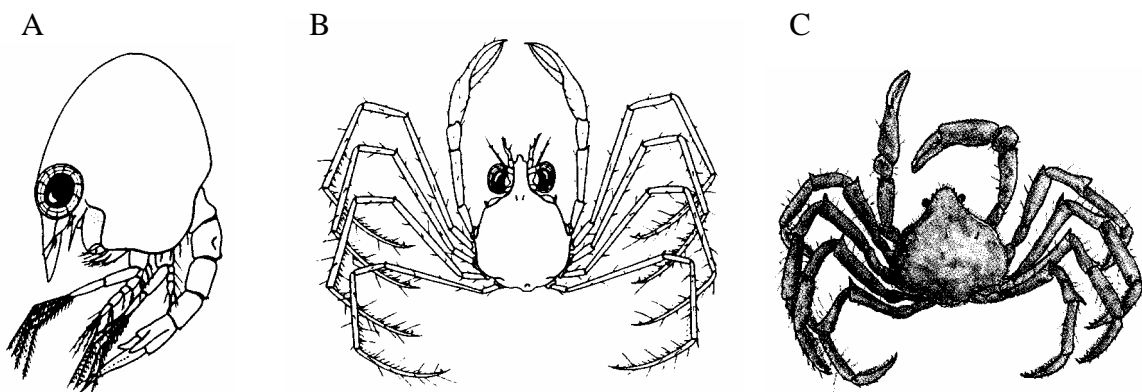
Infraorder Brachyura

Brachyurans are the true crabs. The complete larval development isn't known for all species, however the majority of species pass through a number of planktonic zoeal stages and a megalopa stage. The typical zoea has four carapace spines: a rostral, a dorsal and two lateral. The abdomen is narrow and ends in a characteristically forked telson. The compound eyes are not on stalks. Immediately after hatching the zoea is without the characteristic spines, but soon moults to the first zoeal stage. The megalopa stage resembles the adult, however the abdomen hasn't yet folded under the body.



Portunus pelagicus. A, zoea I, lateral; B, zoea I posterior view; C, megalopa; D, adult. Figures A-C from Wear & Fielder (1985), D from Richmond (1997).

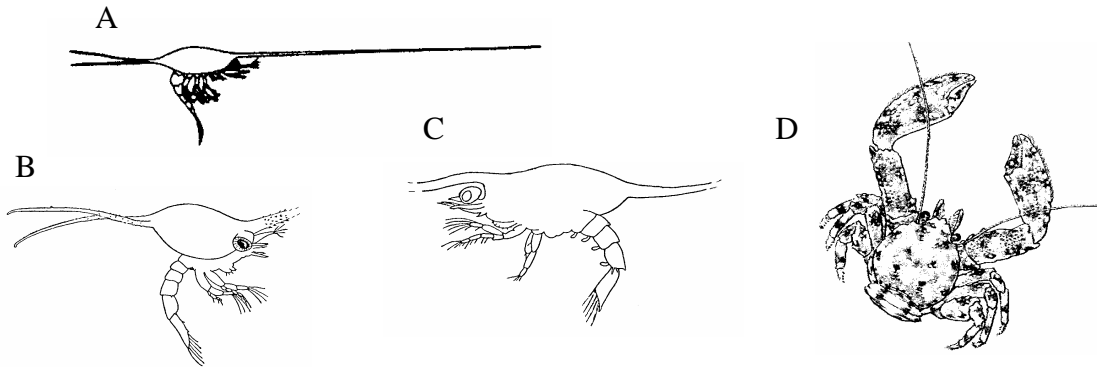
The zoeal larva of the spider crab, *Elamena*, are unusual among the brachyurans as the carapace is only equipped with a rostral spine, the lateral and dorsal spines are absent.



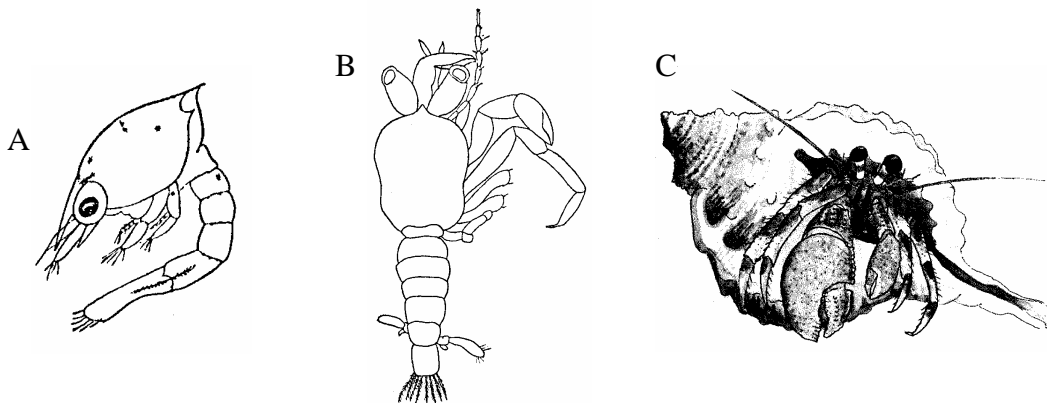
Elamena sp. A, zoea I, lateral; B, 1st juvenile crab; C, adult. Figures A and B from Wear & Fielder (1985), C from Richmond (1997).

Infraorder Anomura

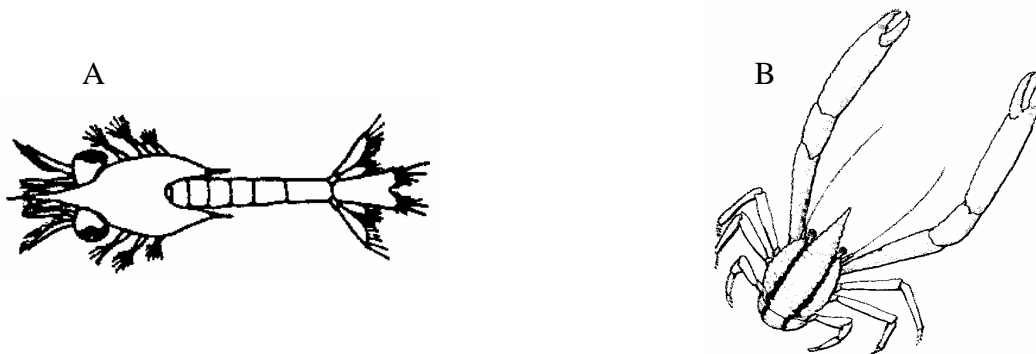
The hermit crabs, squat lobsters and porcelain crabs. Anomurans hatch out as a zoea and pass through several zoeal stages before metamorphosing to a megalopa, or, in the hermit crabs, a glaucothoe larva. In zoeal larvae the posterior end of the carapace is produced into two spines, these may be short as in the hermit crabs and squat lobsters, or long and conspicuous as in some porcelain crabs. The rostrum is typically robust and not long, with the exception of the porcelain crabs whose rostrum may be several times longer than the body.



Porcelain crab. A, unknown porcellanid larva. *Petrolisthes* sp. B, zoea I; C, zoea II; D, adult. Figures A from Wickstead (1965), B & C from Shenoy & Sankolli (1967), D from Richmond (1997).



Hermit crab, *Pagurus* sp. A, zoea I; B, glaucothoe (equivalent to a megalopa); C, adult. Figures A and B from Shenoy (1967), C from Richmond (1997).

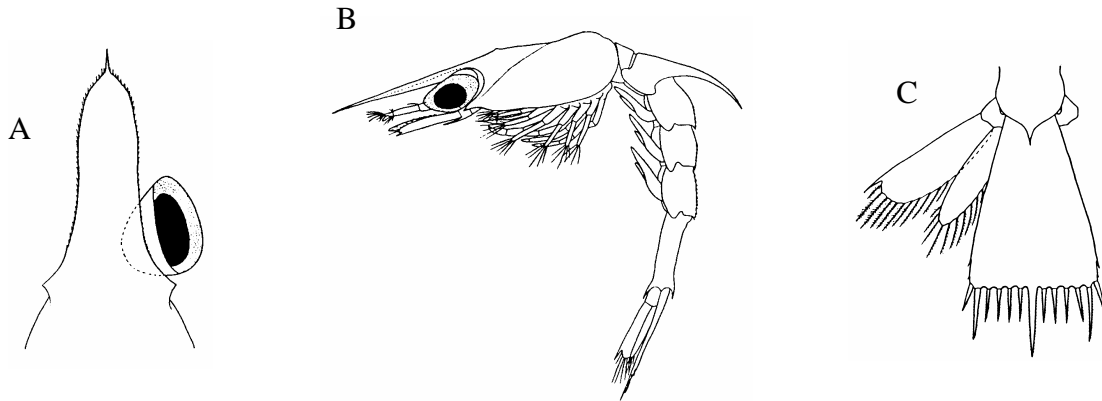


Squat lobster. A, unknown galatheid zoea; B, *Allogalatea elegans* adult. Figure A from Wickstead (1965), B from Richmond (1997).

Infraorder Thalassinidea

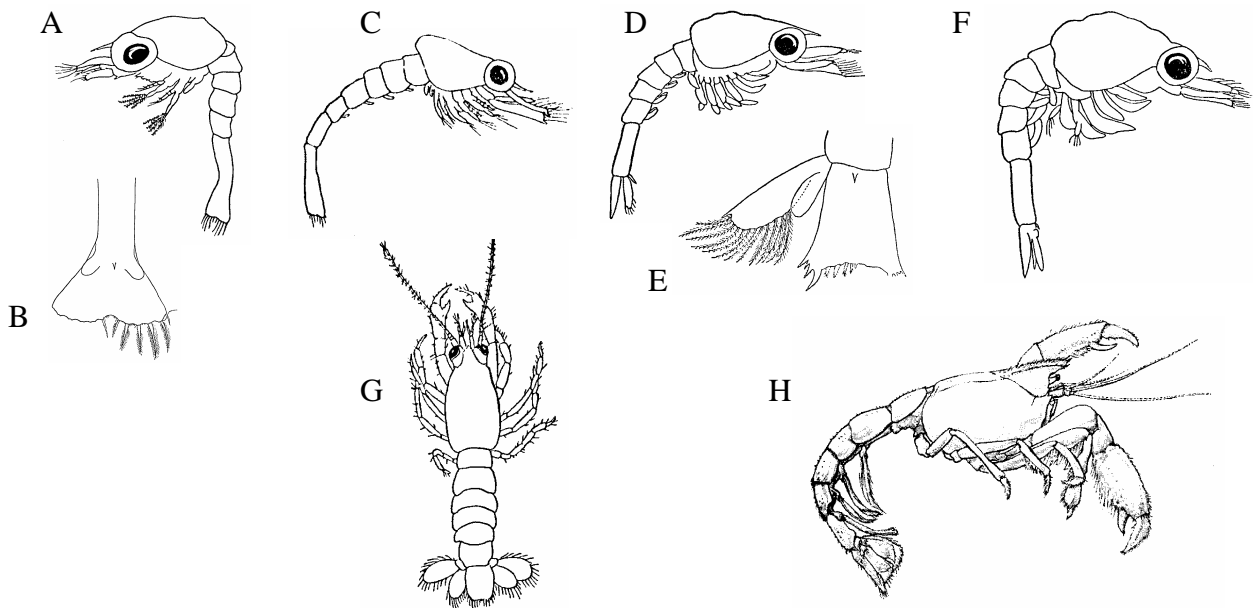
Thalassinids are burrowing lobsters, they are filter-feeding lobster-shaped crustaceans that live in complex tunnel systems within mud or muddy sand. Females carry the fertilised eggs. On hatching, the larva passes through several zoeal stages and a post-larval settlement stage. Thalassinid larvae can be separated into two types, the homarine group (families Axiidae and Callianassidae) and the anomuran group (families Upogebiidae and Laomediidae).

Homarine group. The typical zoea has a long flattened rostrum with serrated edges. There is usually at least one dorsal spine on the abdominal segments. All zoeal stages have a median spine on the telson.



Homarine group, *Callianassa* sp., last zoeal stage. A, rostrum and eye, dorsal; B, lateral; C, telson and uropods, dorsal. Figures A-C from Williamson (1967).

Anomuran group. The typical zoea has a small round rostrum. There are no dorsal spines on the abdomen. The median spine on the telson is small or absent, always absent on zoea stage I. In *Upogea* sp. there are four planktonic zoeal stages and two post-larval stages.



Burrowing lobster *Upogea* sp. A, zoea I; B, telson zoea I; C, zoea II; D, zoea III; E, telson zoea III; F, zoea IV; G, post-larva I; H, adult. Figures A-G from Shenoy (1967), H from Richmond (1997).

PHYLUM PHORONIDA

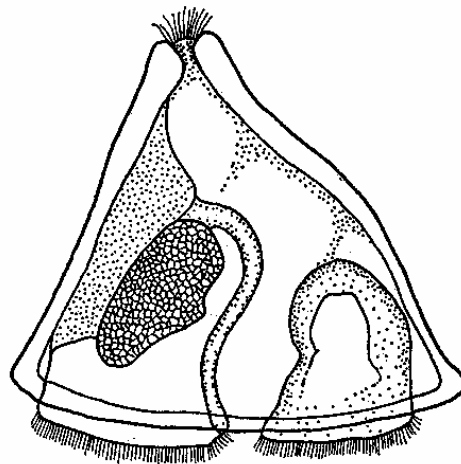
Phoronids are worm-like organisms, which live in tubes on the seabed. Their actinotroch larvae can be up to 2 mm in length and may be found in plankton samples. As the larvae grow they develop a crown of long tentacles.



Examples of actinotroch larvae. A: Early larva; B: Late larva (From Wickstead, 1965).

PHYLUM BRYOZOA

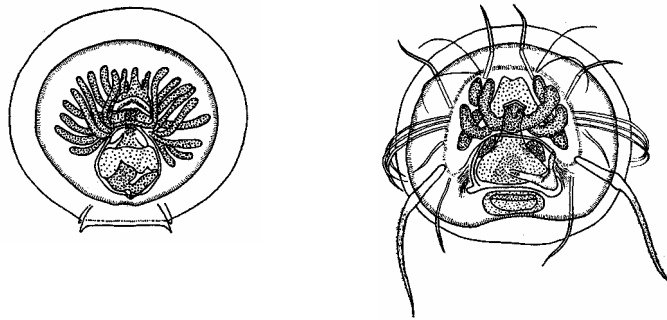
Phylum Bryozoa is sometimes called Ectoprocta. The adults of this group are colonial, forming gelatinous or firm encrusting mats, or raised coral-like structures. They have larvae with a chitinous, flattened shell composed of two triangular plates, called a cyphonautes larvae. The larvae are 0.2-0.7 mm in length and can be common in the plankton at particular times of year.



Bryozoan cyphonautes larva (From Wickstead, 1965).

PHYLUM BRACHIOPODA

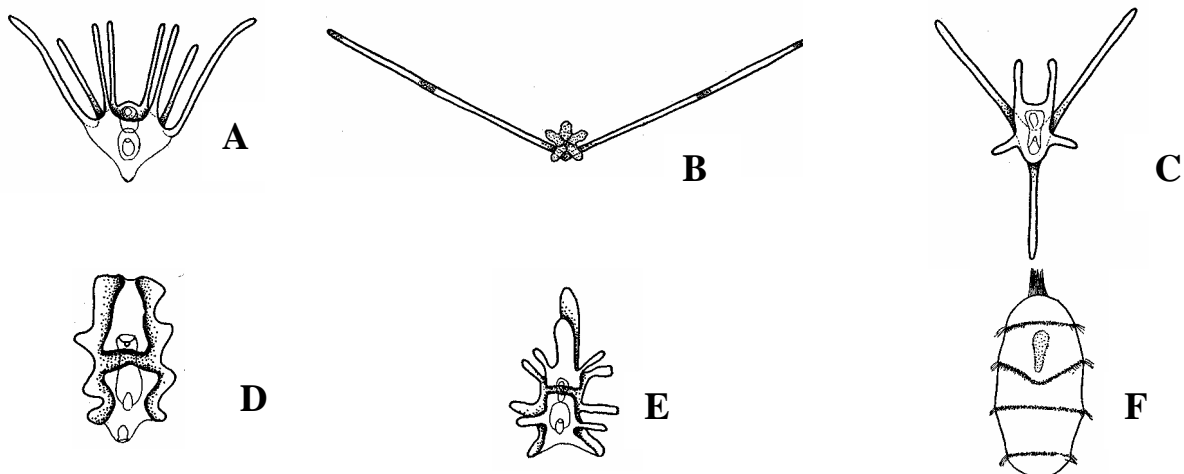
Commonly known as lamp shells, the adults of these live on the seabed and superficially resemble bivalve molluscs. They have an external calcareous bivalve shell and attach to rocks with a fleshy stalk. Their larvae occur in the plankton and also have a bivalve shell which is usually transparent. Internally they have a series of ciliated tentacles that can emerge from the shell.



Examples of brachiopod larvae (From Wickstead, 1965).

PHYLUM ECHINODERMATA

Echinoderms include starfish, brittle stars, feather stars, sea urchins and sea cucumbers (which includes the *Bêche-de-mer*). The larvae of all of these can be common in the plankton and are all slightly different. Starfish have a typical bipinnaria larva which has ciliated bands (which are difficult to see in preserved specimens). As they develop they become more complex, till a small star-shaped larva develops at one end. This then settles on the sea bottom and develops into an adult. The bipinnaria larva is similar to the auricularia larva of the sea cucumber and the doliolaria larva of the feather star. Brittle stars and sea urchins have similar larvae, which resemble arrowheads.

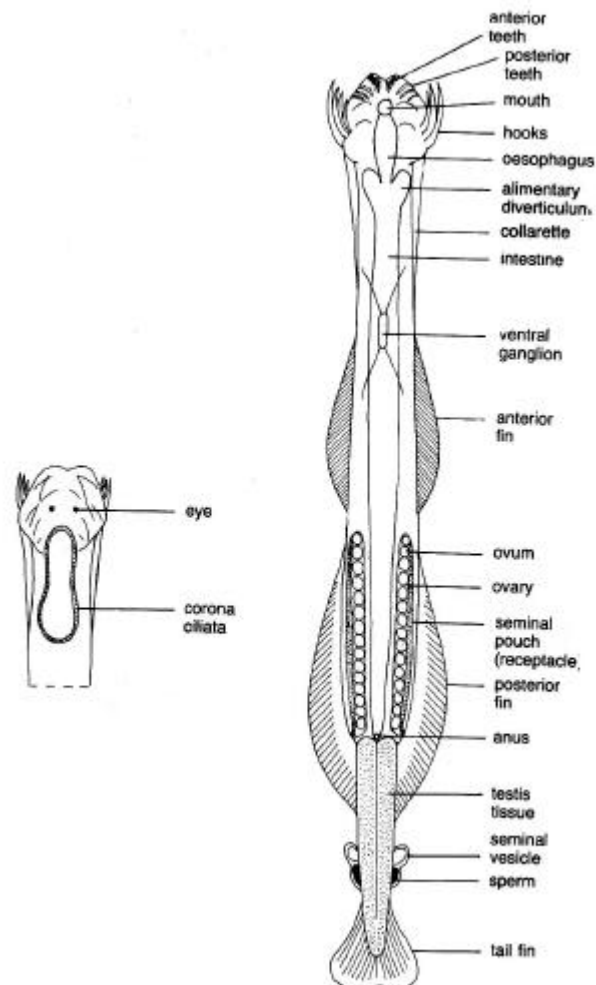


Examples of echinoderm larvae. A: Ophiopluteus larvae of brittle star; B: Late ophiopluteus larva; C: Echinopluteus larvae of sea urchin; D: Auricularia larva of sea cucumber; E: bipinnaria larva of starfish; F: Doliolaria larva of feather star. (From Wickstead, 1965).

PHYLUM CHAETOGNATHA

Chaetognaths, commonly called arrow worms, because they are slender and dart like arrows, are a very individual group, so are in a phyla of their own. Most are pelagic, but there are a few benthic species which may be taken in inshore samples. They are important, common predators, with a set of long, generally brown, grasping hooks on each side of the head for capturing prey. The mouth is behind the hooks and has one or two rows of external teeth on either side. Chaetognaths have a tubular elongated body which is usually transparent when they are alive, but in many species becomes opaque when preserved. The animal is divided by internal partitions into three sections – head, trunk and tail. The head is usually separated from the trunk by a slight constriction. Most have a pair of small eyes. Posterior to the eyes, on the head and/or anterior part of the trunk, is an oval band of ciliated cells known as the corona ciliata. This feature is important in the separation of the various genera, but is difficult to see in most preserved specimens, so has not been included in the descriptions.

Chaetognaths are hermaphrodite, having organs of both sexes. The ovaries are situated in the trunk, are usually elongate, extending from the trunk/tail septum (partition) at the posterior end of the trunk, forwards to different degrees, depending on the species and stage of maturity. Eggs are generally visible inside the ovaries in mature specimens. Because chaetognaths go through cycles of egg release and egg maturation, large mature individuals can appear immature if they have just released all their mature eggs.



General chaetognath structure: Ventral view of complete chaetognath and dorsal head view. (From Pierrot-Bults and Chidgey, 1988).

Seminal vesicles, in which sperm is stored after being produced in the testes, are found on either side of the tail section, the degree of development depending on maturity. Inside the trunk, extending along its whole length, is the intestine, which terminates in the anus on the ventral surface, at the tail/trunk septum. Around the neck region, the intestine in some species may be extended into a short lateral extension or diverticulum. There are paired fins on either side of the body, either a single short pair, two pairs or a pair of long continuous fins. The shape and arrangement of the fins is particularly useful in identification, as is also the position at which the anterior fin starts in relation to a nervous ganglion situated on the ventral anterior surface. This ganglion resembles an opaque patch. There is a further single fin on the tail. There are supportive fin rays in the fins, which may be continuous or partial, depending on species.

Some chaetognaths have a thickening of the epidermis in the neck region forming a collarette of tissue between the head and the anterior fin, particularly developed in *Pterosagitta draco*. Some species are rigid when preserved, while others are flaccid. There is gradual development of adult characteristics from hatching of the egg, so it can be difficult to positively identify immature specimens.

Chaetognaths from the Darwin samples have not been examined in detail, so mainly descriptions of the species previously recorded from the western Indian Ocean have been included here.

Further useful information on identification can be found in Alvariño (1967), Bieri (1991), Lutschinger (1993), Michel (1984) and Pierrot-Bults and Chidgey (1988).

Family Pterosagittidae

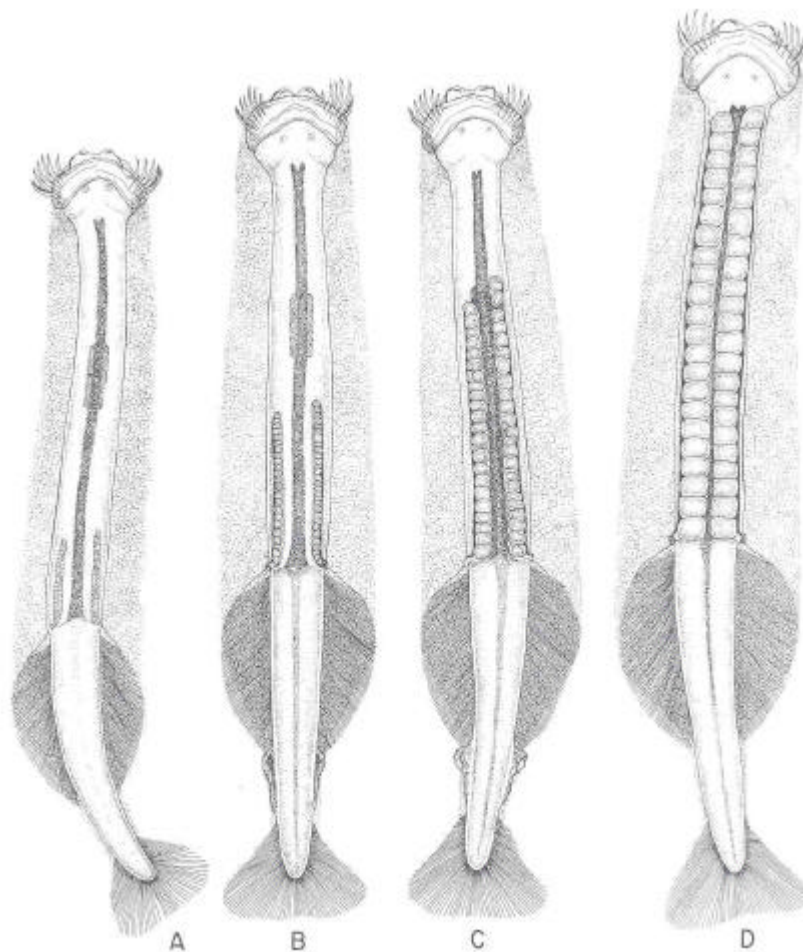
Genus *Pterosagitta*

Only one pair of lateral fins, which are completely rayed. Two rows of teeth. Massive collarette, present even in young specimens. Only one widely distributed species.

Pterosagitta draco (Krohn, 1853)

Opaque, firm and stout body. Large head with obvious neck. On each side of head 8-10 hooks, 6-10 anterior teeth, 8-18 posterior teeth. No intestinal diverticula. The ventral ganglion is situated about midway along the trunk, slightly closer to the neck. Massive collarette, present even in young specimens, extending from the neck over the paired fins, thinning towards the tip of the tail. Collarette can be damaged during sampling. A single pair of lateral fins, semicircular in shape and with no rayless zones, run between the trunk/tail septum and the seminal vesicles. Mature ovaries can reach to the neck region, ova in 2 rows arranged dorsoventrally. Ova large and round, but can be compressed into flat cylinders in mature specimens. The seminal vesicles touch the lateral fins and are close to the tail fin. Length up to 16 mm.

Recorded: Seychelles.



Pterosagitta draco: A, maturity stage 1; B, stage 2; C, stage 3; D, stage 4 (From Alvariano, 1967).

Family Krohnittidae

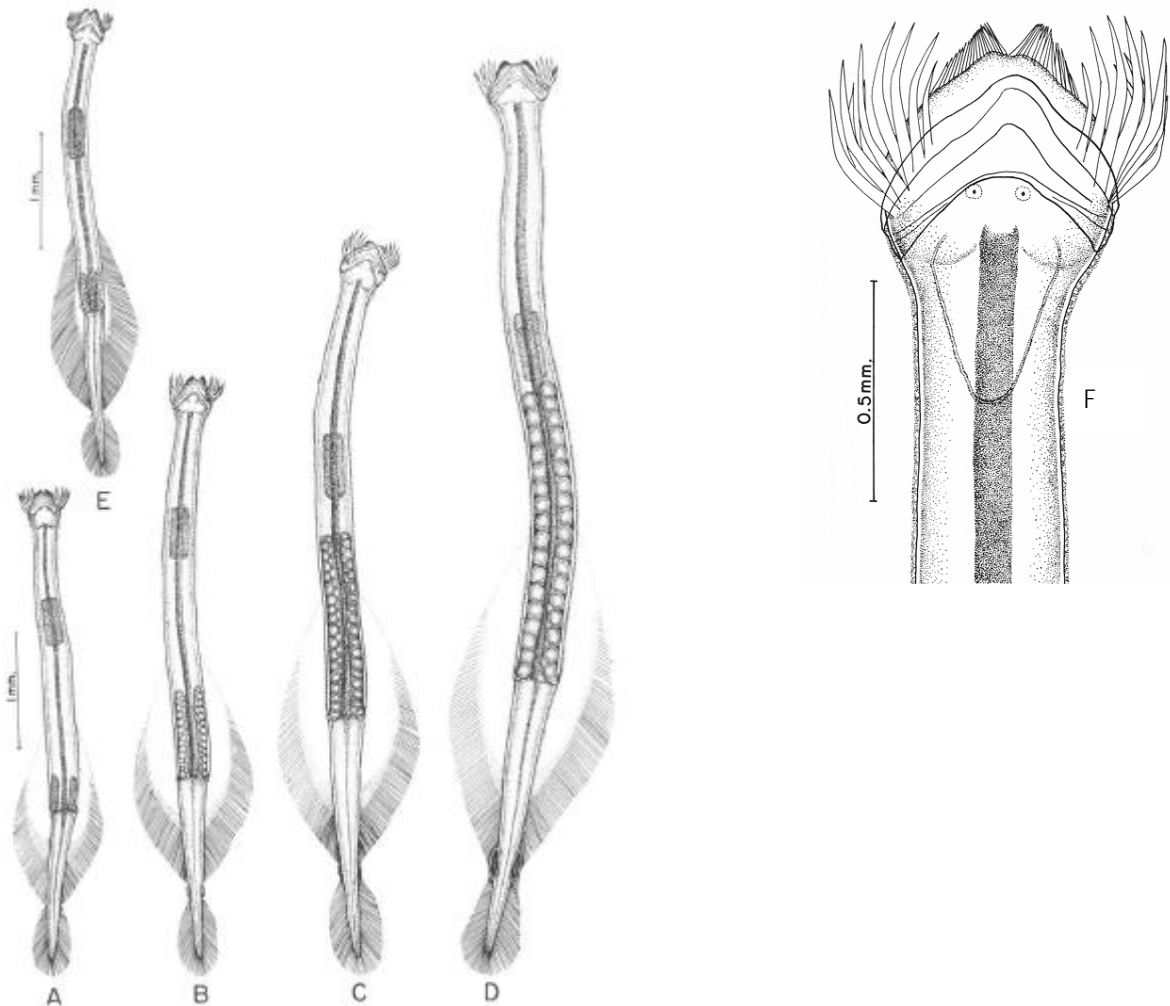
Genus *Krohnitta*

This genus has one pair of lateral fins, extending from the tail section to less than half way along the trunk. There is no collarette or gut diverticula and they have a single row of teeth on either side at the top of the head. The teeth are long and meet at the tips to give a funnel shape.

Krohnitta pacifica (Aida, 1897)

The head is small with a conspicuous neck. On either side of the head there are 8-11 hooks and up to 16 teeth in a single row. The body is slender and transparent, with a single pair of lateral fins extending from just beyond half way down the trunk, to the base of the tail fin. The fin rays cover the outer half of the fin surface, leaving the internal and anterior part without rays. There is no collarette or gut diverticula. The ovaries in mature specimens can reach the region of the ventral ganglion, extending sometimes to the neck. The ova are in one line. The seminal vesicles touch both the lateral and tail fins. Total length 6-8mm

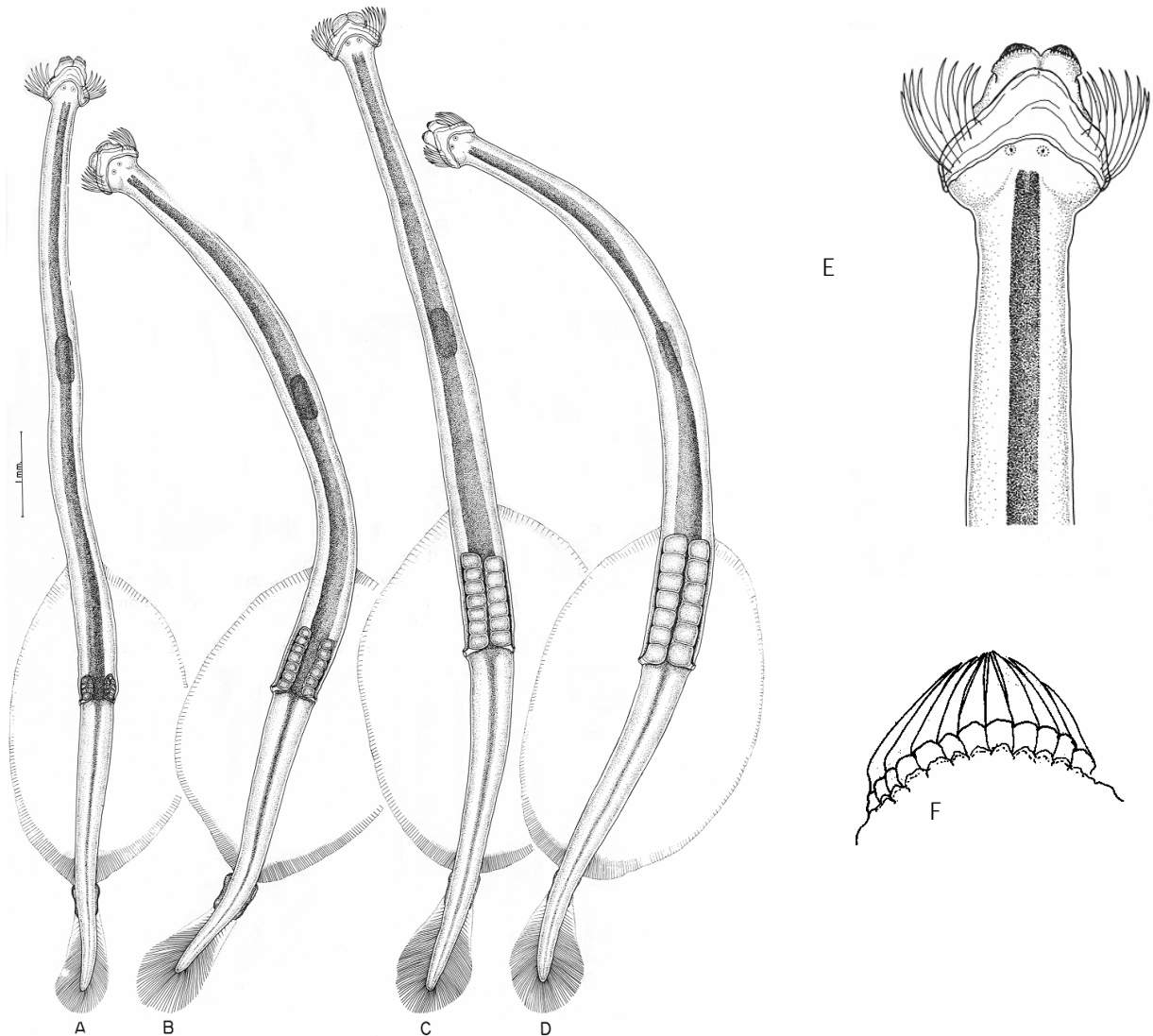
Recorded: Madagascar.



Krohnitta pacifica: A, maturity stage 1; B, stage 2; C, stage 3; D, stage 4; E, specimen from the Atlantic, stage 2; F detail of head (From Alvarino, 1967).

Krohnitta subtilis (Grassi, 1881)

The body is long, thin, transparent and floppy. On either side of the small head there are 6-9 strong hooks and 10-13 very prominent teeth in a single row covering the anterior of the head. No collarette or gut diverticula present. The single pair of broad lateral fins begin at a point between two thirds and half the distance between the ventral ganglion and the caudal septum. One third of their length is on the trunk and they are wide and semicircular in shape, almost totally without rays. The rays are short and wide apart. Lack of supportive rays means these fins are often badly damaged. The seminal vesicle touch both the lateral and tail fins. The ovaries are short, reaching the anterior end of the lateral fins. The large ova are in two dorso-ventral rows. Total length 12-16 mm.



Krohnitta subtilis: A, maturity stage 1; B, stage 2; C, stage 3; D, stage 4; E detail of head; F right teeth (From Alvariño, 1967).

Family Sagittidae

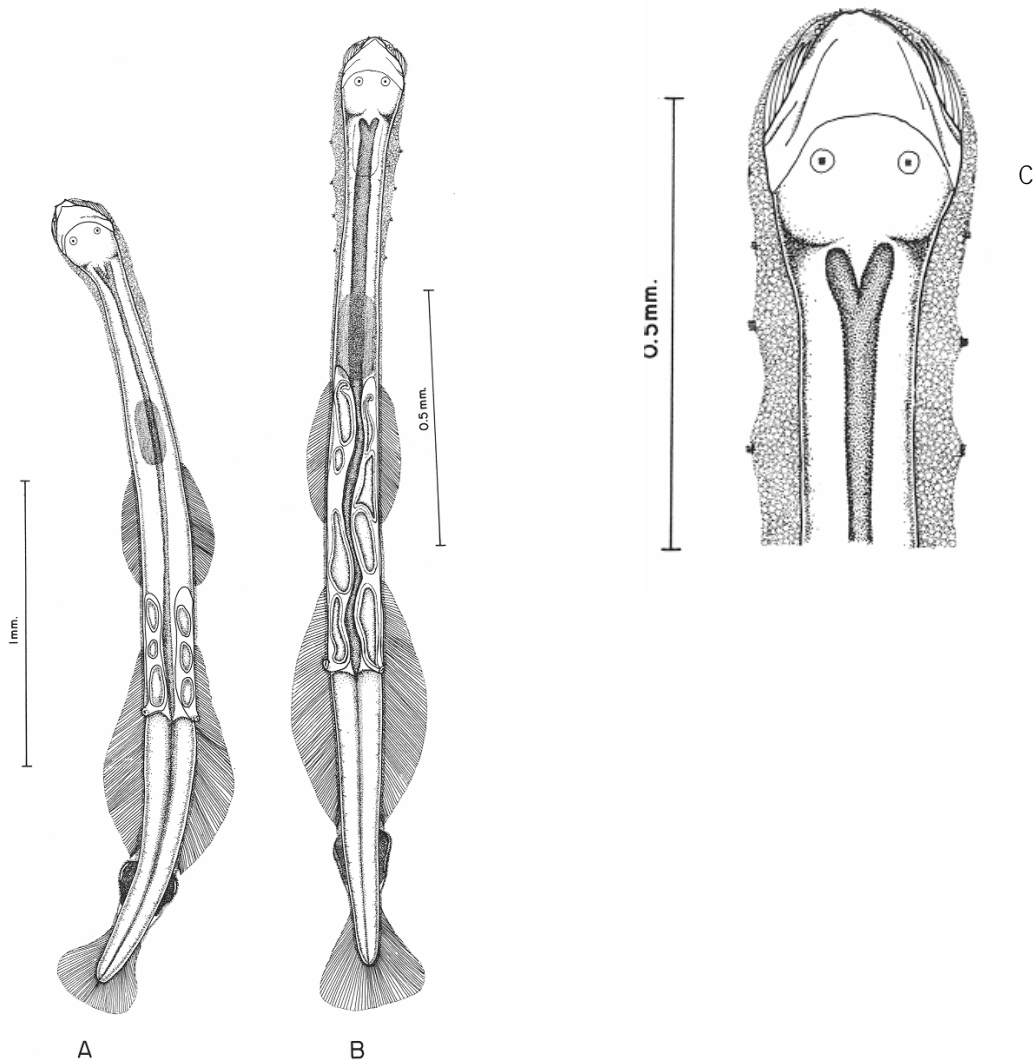
Genus *Aidosagitta*

Lateral fins are completely rayed, with fin rays almost at right angles to the body wall. Intestinal diverticula present. Seminal vesicles generally situated just behind the posterior fins, more or less apart from the tail fin. Tail segment relatively long.

Aidosagitta bedfordii (Doncaster, 1903)

A small chaetognath. Prominent collarete, especially from neck to ventral ganglion. Conspicuous gut diverticula. On each side of the head 8-12 hooks, 1-3 anterior teeth and 2-3 posterior teeth. The ventral ganglion is wide and long for the size of the chaetognath. Fins are completely rayed. In mature individuals the ovaries reach the ventral ganglion. The ova are small in number, large, oval and arranged in a single row, separated unequally. The seminal vesicles are close to the posterior lateral fins, but separated from the tail fin. Length up to 4 mm.

Recorded: Central Indian Ocean (Tokioka, 1956), but usually a coastal species??



Aidosagitta bedfordii: A, maturity stage 3; B, stage 4; C, detail of head (From Alvariño, 1967).

Aidanosagitta neglecta (Aida, 1897)

Body firm rigid and opaque, the same width from the head to the tail septa. Small head with an inconspicuous neck. A gut diverticula is present. Anterior fins begin a little behind the ventral ganglion, the posterior ones are broader and mostly situated on the tail section. Both pairs of fins are completely rayed. On each side of head 6-8 hooks, 5-7 anterior teeth and 13-18 posterior teeth. A collarette extends from the head to the front of the anterior fin and also from the seminal vesicles to the tail fin. Mature ovaries may reach beyond the ventral ganglion. The ova are large, round and arranged in a single row. The seminal vesicles almost touch the anterior fin, but are well separated from the tail fin. Length up to 10 mm.

Recorded: Rodrigues, Madagascar.

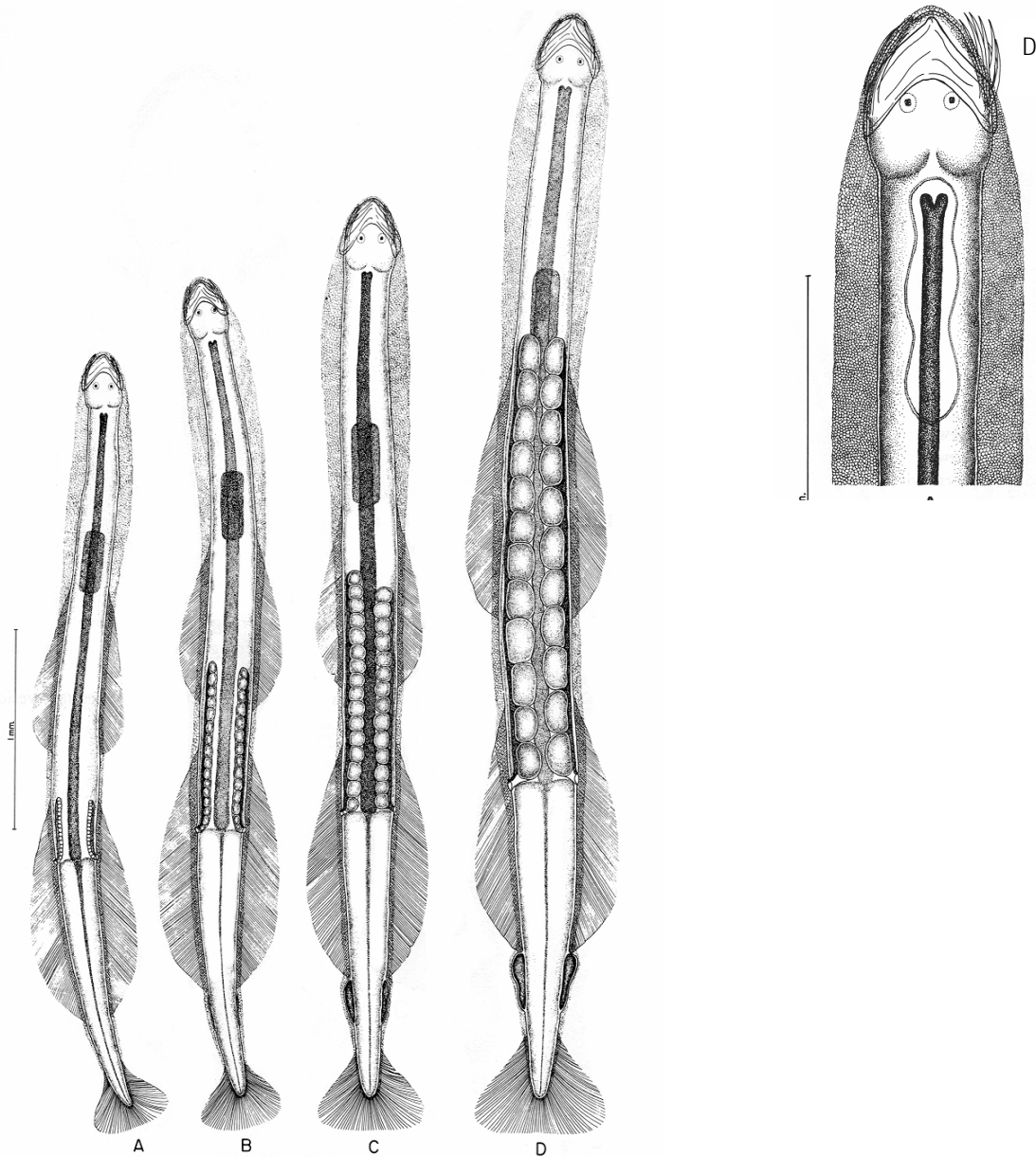


Aidanosagitta neglecta: A, maturity stage 1; B, stage 2; C, stage 3; D, stage 4; E detail of head (From Alvariño, 1967).

Aidanosagitta regularis (Aida, 1897)

The body is opaque, rigid and brittle, the same width from the head to the tail septum. The head is small and pointed at the top, and the neck is not conspicuous. Anterior fins begin just behind the ventral ganglion and are shorter and narrower than the posterior fins. Both pairs of fins are completely rayed. On each side of the head up to 11 hooks, 2-4 anterior teeth, 4-7 posterior teeth. Strongly developed collarete on the neck and also on mid-body and posterior to the seminal vesicles. A gut diverticula is present. Mature ovaries extend to the posterior end of the ventral ganglion. The ova are large and arranged in a single row. The seminal vesicles touch the posterior fin, but are well separated from the tail fin. Length up to 9.5 mm.

Recorded: Rodrigues, Madagascar.



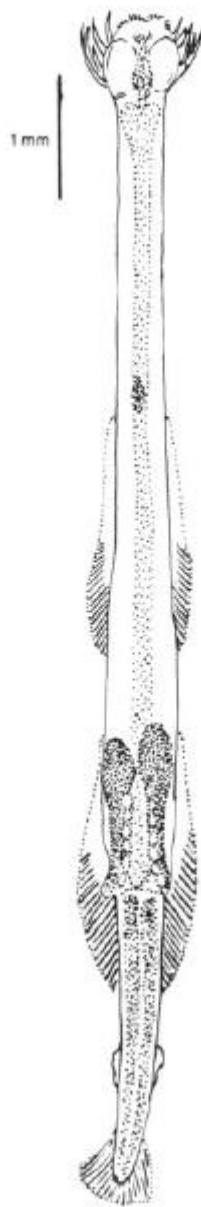
Aidanosagitta regularis: A, maturity stage 1; B, stage 2; C, stage 3; D, stage 4; E detail of head (From Alvariño, 1967).

Genus *Decipisagitta*

Intestinal diverticula present, Lateral fin rays diagonal to body wall rather than at right angles, missing in some areas.

Decipisagitta decipiens (Fowler, 1905)

Slender, variable transparency, tending to be opaque. Small square head with a conspicuous neck. On either side of the head 5-7 long strong hooks (usually 6), 4-13 anterior teeth and 6-20 posterior teeth. Well developed gut diverticula. No collarette. Anterior fins narrow, reaching the posterior edge of the ventral ganglion and have a rayless zone at their anterior edge. The posterior fins are equally situated over the trunk and tail sections, triangular and also have an anterior rayless zone. Seminal vesicles equidistant between posterior and tail fins. In mature specimens the ovaries can reach the posterior end of the anterior fins. The ova are quite large, oval-cylindrical in shape and arranged in a single row. Length up to 20 mm.



Decipisagitta decipiens: (From Pierrot-Bults and Chidgey, 1988).

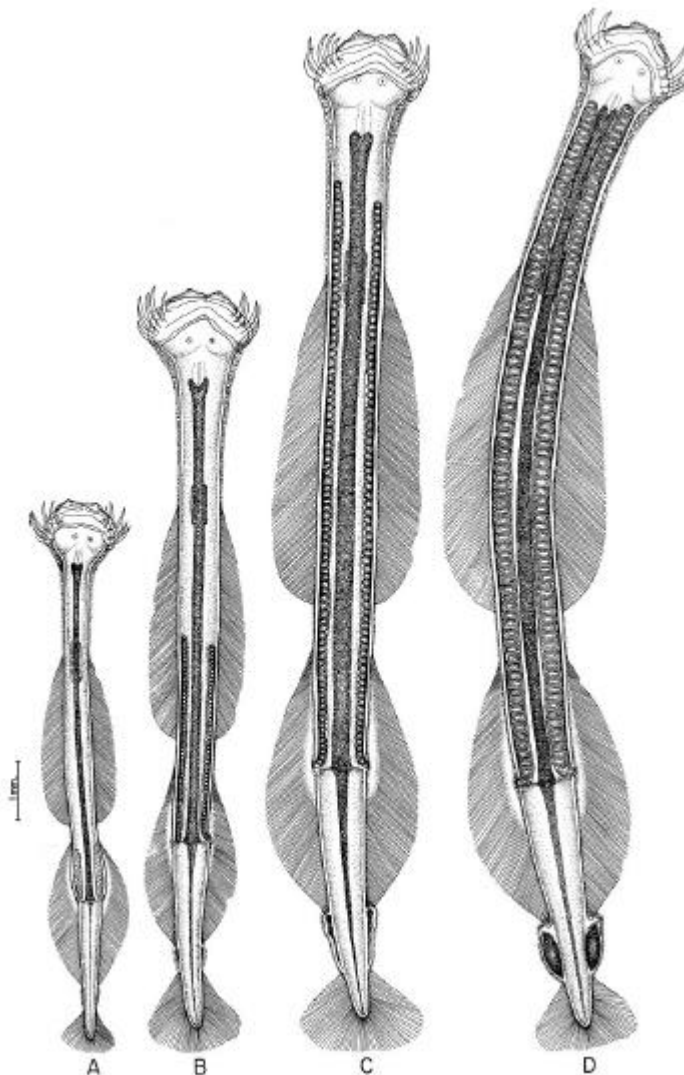
Genus *Ferosagitta*

Intestinal diverticula present. The 2 species recorded from the region in this genera *F. ferox* and *F. robusta* are very similar and there has been great confusion in their taxonomy by various authors, which may still not have been adequately resolved. Because of this, some of the details given for them may not be correct. *F. hispida* was recorded as common in Madagascar by Furnestini and Radiguet (1964). However *F. hispida* is a neritic American Atlantic species, so this record is questionable.

Ferosagitta ferox (Doncaster, 1903)

Body opaque, rigid and firm, the same width from the neck to tail section. Large head with conspicuous neck. On either side of head normally 5-6 large, strong hooks, 7-10 anterior teeth and 12-14 posterior teeth. Thick collarette, extending from neck to ventral ganglion and covering the rest of the body as a thin layer. Conspicuous gut diverticula. Anterior fins start at middle of ventral ganglion and are longer than the posterior fins. The anterior fins are completely rayed while the posterior fins have a small internal rayless zone. The ovaries are wide, in mature specimens, filling the body cavity and reaching the neck region. The seminal vesicles touch both the posterior and tail fins. Length up to 13 mm.

Recorded: Rodrigues, Madagascar.

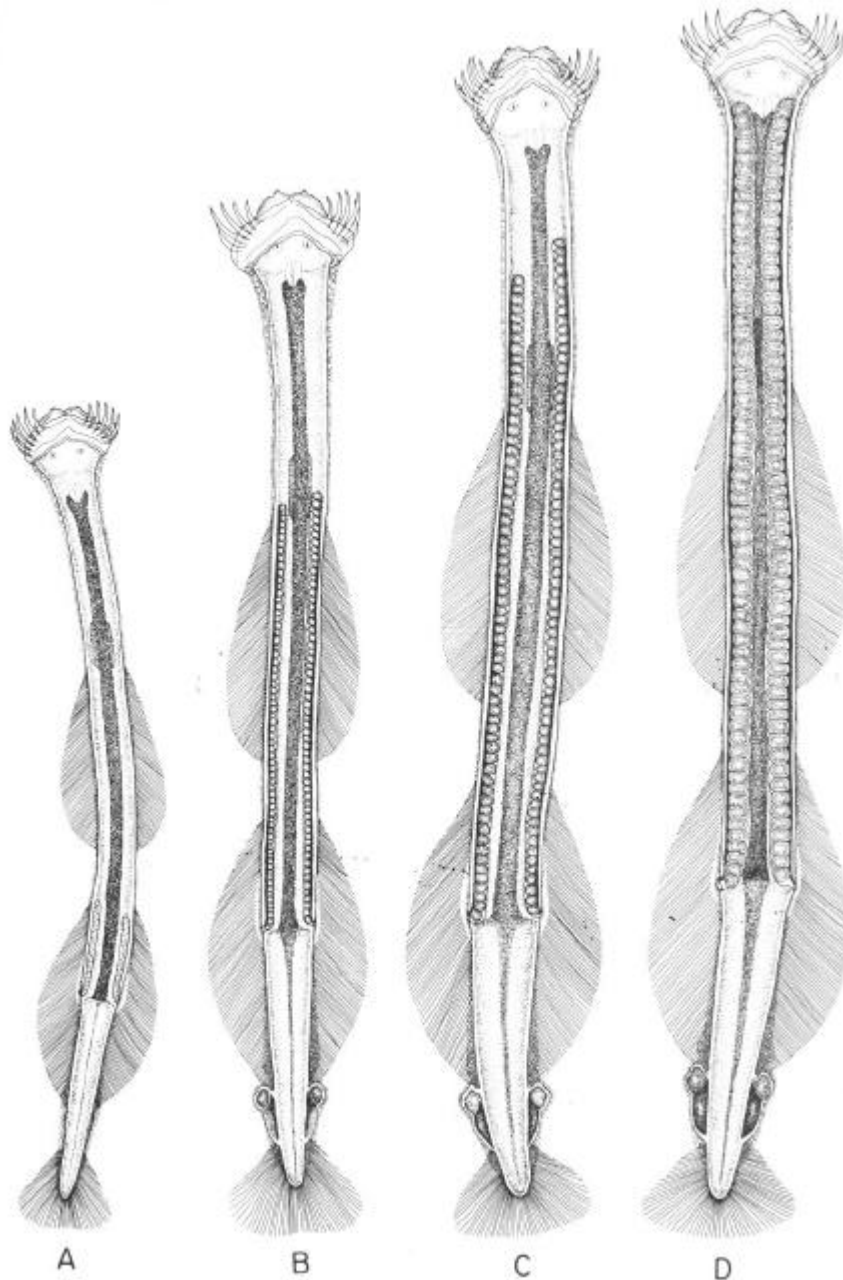


Ferosagitta ferox: A, maturity stage 1; B, stage 2; C, stage 3; D, stage 4 (From Alvariño, 1967).

Ferosagitta robusta (Doncaster, 1903)

Strong, firm, opaque body, the same width from the head to the tail septum. On either side of the head 5-7 hooks, 6-11 anterior teeth and 8-15 posterior teeth. Anterior fins start at the posterior edge of the ventral ganglion. Anterior fins completely rayed, posterior fins with a narrow rayless zone, mostly on the tail section. Very broad head and large eyes. Conspicuous collarette extending from the head to the edge of the anterior fins. Gut diverticula present. Mature ovaries can extend to the neck region. Seminal vesicles close to both lateral and tail fins. Length up to 22 mm.

Recorded: Madagascar.



Ferosagitta robusta: A, maturity stage 1; B, stage 2; C, stage 3; D, stage 4 (From Alvariño, 1967).

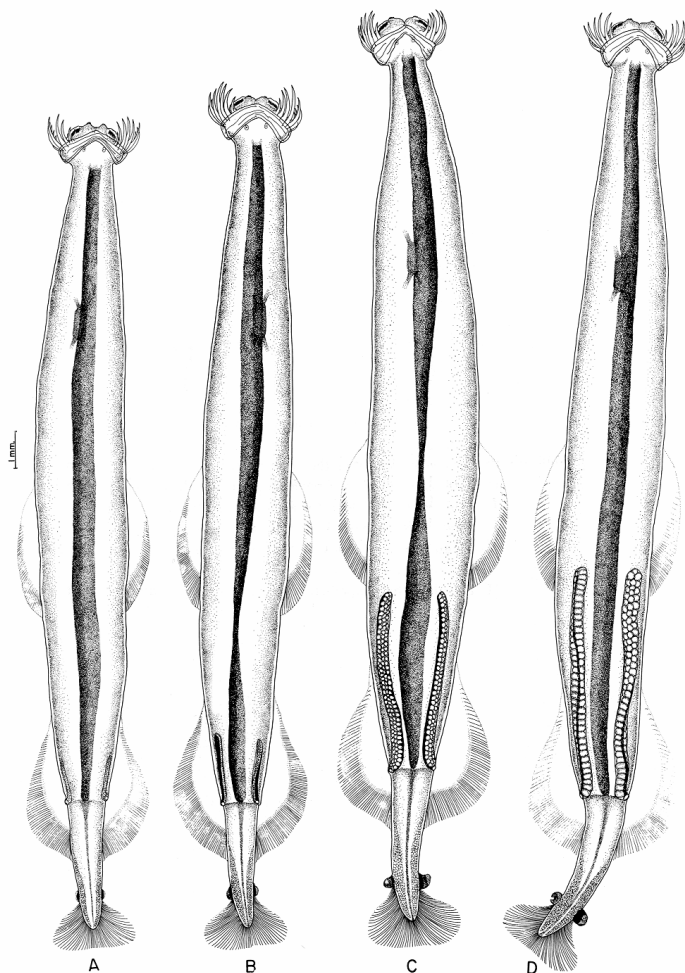
Genus *Flaccisagitta*

Very limp, flaccid body. The lateral fins show distinctive rayless zones. No intestinal diverticula. Anterior fins separate from posterior fins and start some distance behind ventral ganglion.

Flaccisagitta enflata (Grassi, 1881)

Body wide, floppy, transparent and widest around its mid-length. On either side of the head 7-10 hooks, 6-11 anterior teeth and up to 16 posterior teeth. Head is wider than long with a conspicuous neck. Anterior and posterior lateral fins short, approximately the same length, well separated from each other. Two thirds of the posterior fins are on the trunk section. Both lateral fins are only rayed on their outer posterior edges. The ventral ganglion is situated midway between the head and the anterior fins. No collarette or intestinal diverticula. Ovaries short, broad, oval, extending when mature no further than the posterior edge of the anterior fin, but are usually shorter. Ova are quite large, arranged in 3 parallel lines. Small spherical, seminal vesicles touch the caudal fin, but are well separated from the posterior fins. Length up to 30 mm.

Recorded: Rodrigues, Seychelles, Madagascar.

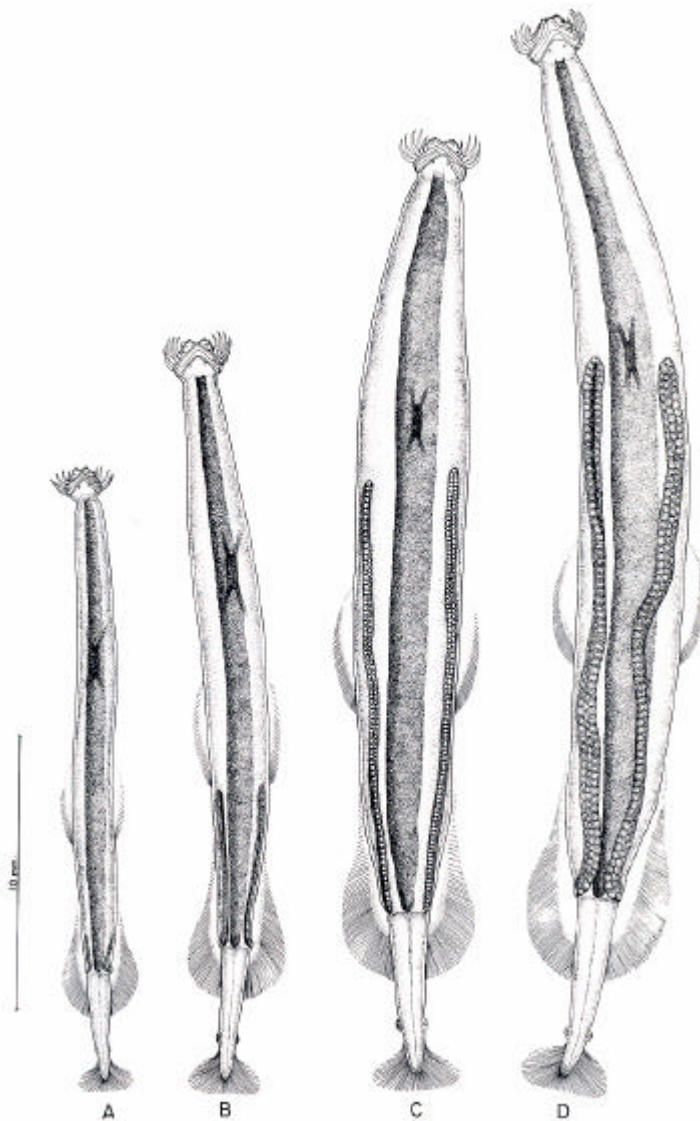


Flaccisagitta enflata: A, maturity stage; B, stage 2; C, stage 3; D, stage 4 (From Alvarino, 1967).

Flaccisagitta hexaptera (d'Orbigny, 1843)

Body transparent and floppy, widest around its mid-length. On either side of the head 6-10 hooks, 2-6 long, sharp anterior teeth which distinctively usually project forwards, 2-8 posterior teeth. Anterior fins are small and rounded, starting well behind the ventral ganglion, rays only on outer edge. The greater part of posterior fin located on the trunk section, fin rays only on outer edge, missing on the anterior portion. Broad head is small for the size of the body and the neck is conspicuous. No gut diverticula or collarette. Ovaries long and narrow and do not fill the trunk cavity, in mature specimens sometimes extending to the level of the ventral ganglion. Ova small, arranged in 3 rows. Small, spherical seminal vesicles, lying nearer to the caudal than lateral fins, but separate from both. Length up to 70 mm.

Recorded: Madagascar



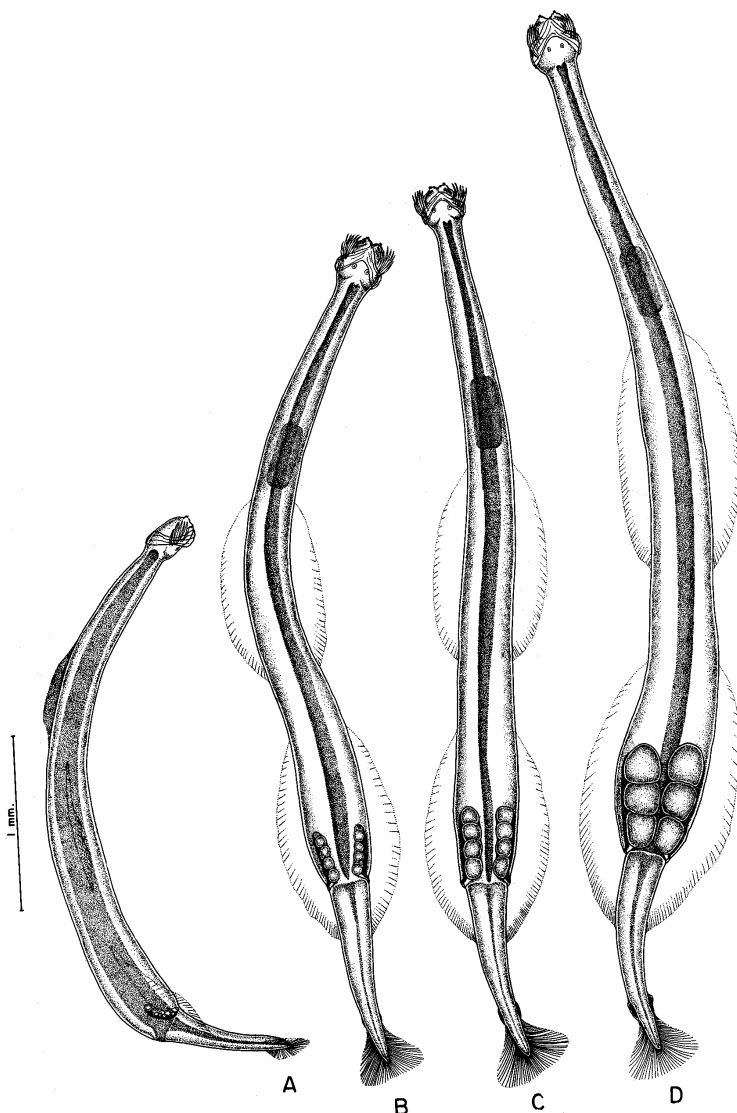
Flaccisagitta hexaptera: A, maturity stage 1; B, stage 2; C, stage 3; D, stage 4 (From Alvariño, 1967).

Genus *Mesosagitta*

Body musculature weak. Collarette inconspicuous or missing. Intestinal diverticula present. Posterior lateral fins more on the trunk than tail section. Seminal vesicles well behind the posterior fins. Fin rays are sparse or missing in some parts of the lateral fins.

Mesosagitta minima (Grassi, 1881)

Slender, opaque, limp body, wider at the level of the ovaries. Lateral fins rounded, both with widely spaced fin rays along the edges. The fins are delicate and are usually damaged. Anterior fins start slightly behind ventral ganglion. Head small and neck well defined. On either side of head 7-9 short, strongly curved hooks, 2-7 anterior teeth and 6-16 posterior teeth. No collarette. Small intestinal diverticula. The mature ovaries are short and broad, reaching half way up the posterior fins. They contain a few very large eggs arranged in a single row. Seminal vesicles are close to the caudal fin, but well separated from the posterior fins. Length up to 11 mm. Recorded: Madagascar.



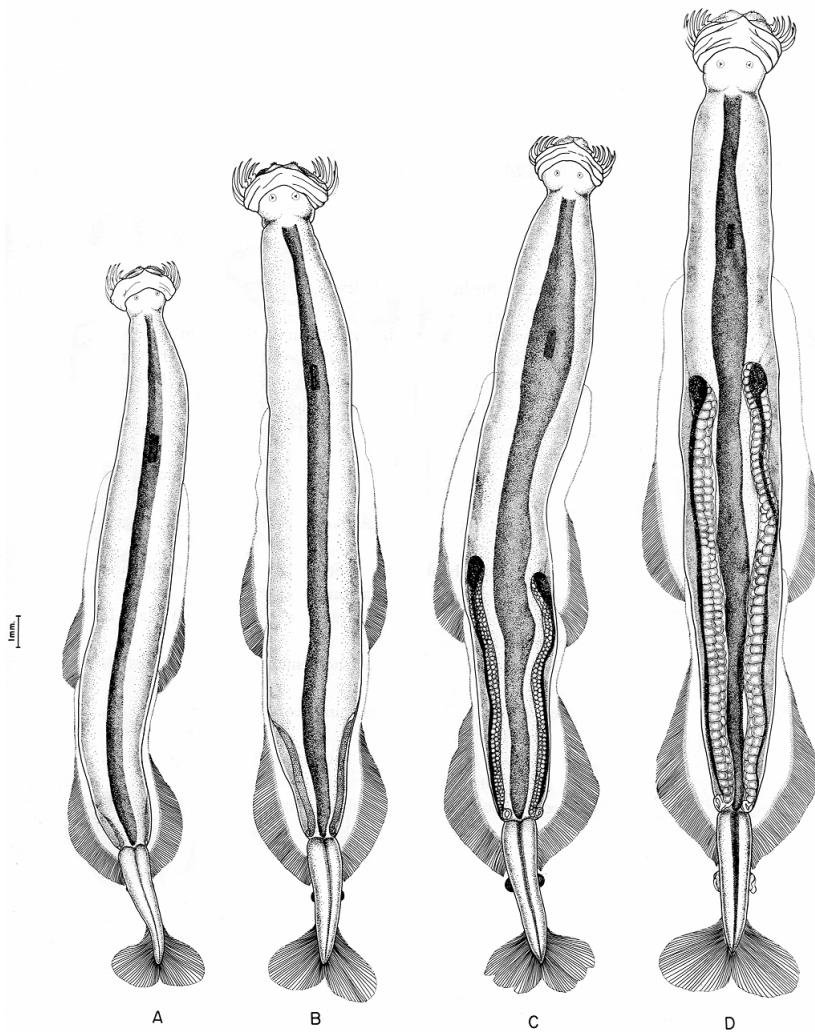
Mesosagitta minima: A, maturity stage 1; B, stage 2; C, stage 3; D, stage 4 (From Alvariño, 1967).

Genus *Pseudosagitta*

Body limp, but not as much as in *Flaccisagitta*. Distinct rayless zones on lateral fins. No intestinal diverticula. Anterior and posterior fins joined by inflated tissue. Anterior fins start at or close to the ventral ganglion.

Pseudosagitta lyra (Krohn, 1853)

Bulky, floppy, transparent body. Head wider than long. On either side of the head up to 10 hooks, 2-8 anterior teeth and up to 12 posterior teeth. Anterior and posterior fins joined by a fin bridge of tissue. In smaller specimens this fin bridge is wide, giving the impression of continuous fins. Anterior fins long and rounded, starting near the posterior end of the ventral ganglion, increasing in width towards the posterior. Internal region of both lateral fins rayless and anterior section of anterior fins completely rayless. The tail fin is split into two paddles. No gut diverticula or collarette. Mature ovaries long and broad and may reach the middle of the anterior fins. Ova are in 4 dorsoventral rows. The small, spherical seminal vesicles are separate from both the posterior and caudal fins, but are closer to the posterior fins. Length up to 42 mm.

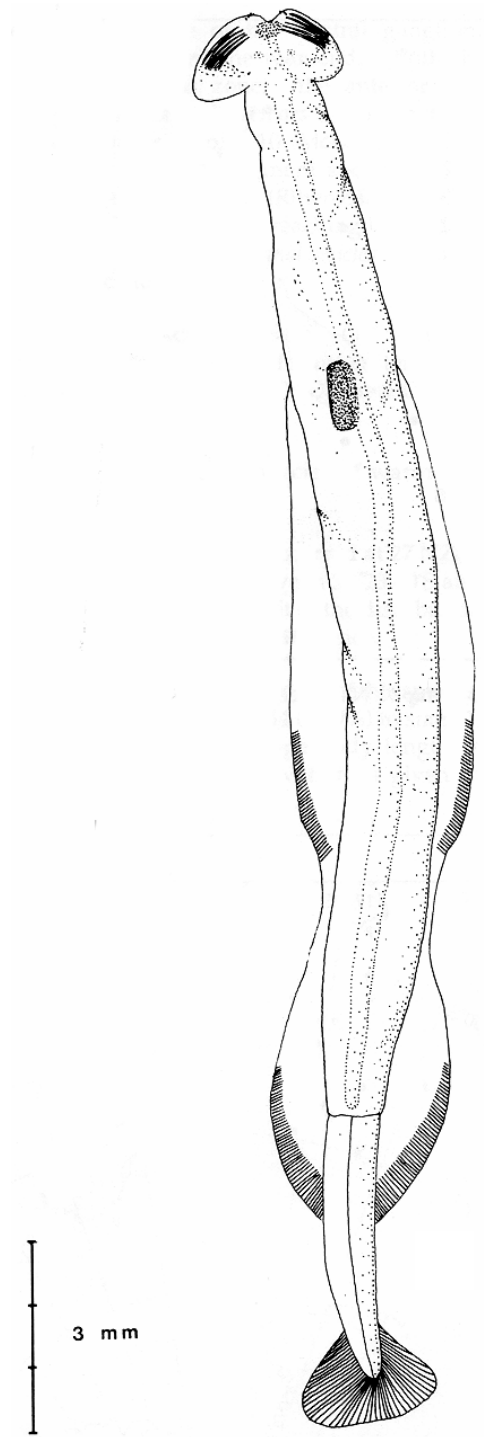


Pseudosagitta lyra: A, maturity stage 1; B, stage 2; C, stage 3; D, stage 4 (From Alvarino, 1967).

Pseudosagitta maxima (Conant, 1896)

Body large and transparent. A broad fin bridge connects the lateral fins. The anterior fins start at the anterior edge of the ventral ganglion, compared to *P. lyra* where they start at the posterior edge. Fin rays are found only on the outer posterior edges of the lateral fins. On each side of the head 5-11 hooks, 4-6 anterior teeth and 5-8 posterior teeth. Collarette and gut diverticula absent. Mature ovaries can reach around the ventral ganglion. Seminal vesicles are closer to the lateral than the caudal fins. Length up to 90 mm.

Distribution: A deep mesopelagic species, bathpelagic in warm waters, unlikely to occur near the surface.



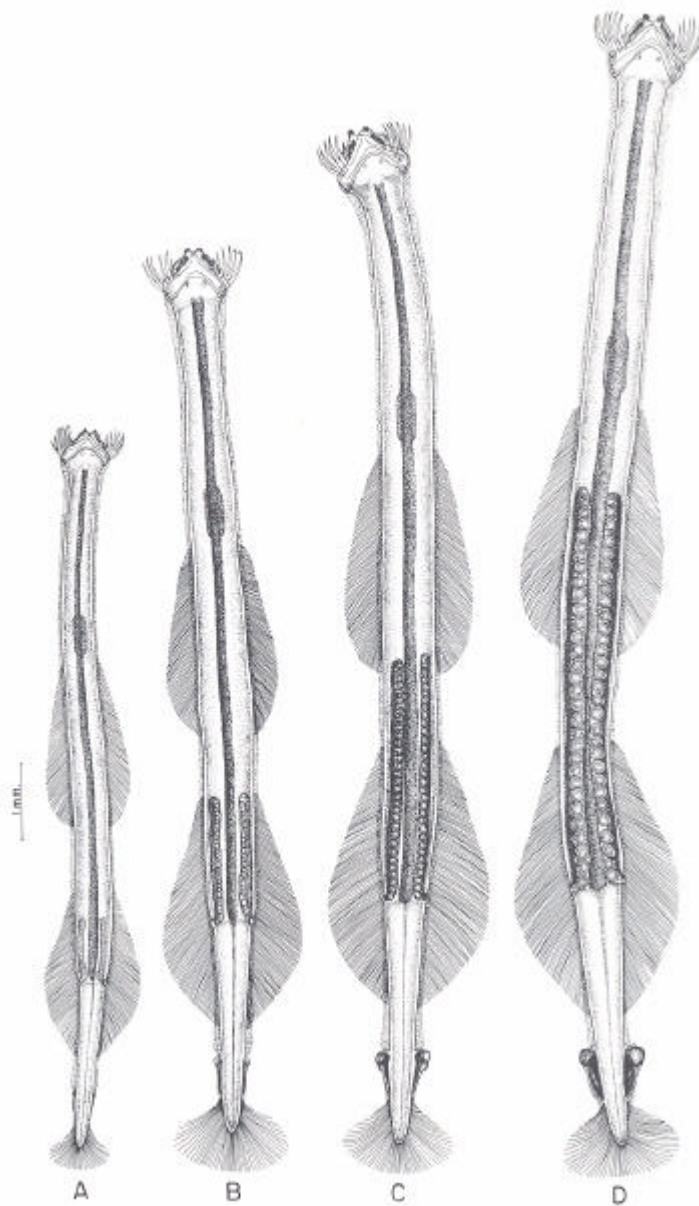
Pseudosagitta maxima: Maturity stage 0 (From Lutschinger, 1993).

Genus *Sagitta*

Intestinal diverticula absent, fins completely rayed.

Sagitta bipunctata Quoy and Gaimard, 1827

Body rigid and opaque. Trunk is about the same width along its length. No gut diverticula. Anterior fins wide and roundish, beginning just behind the ventral ganglion. The posterior fins are wider and longer than the anterior fins and are equally distributed over the body and tail sections. Fins completely rayed. On either side of head 5-10 hooks, 4-8 anterior teeth and 8-16 posterior teeth. There is a prominent collarete from the neck to the anterior fins, between the lateral fins and also between the posterior fins and the seminal vesicles. Mature ovaries are long and can reach the ventral ganglion. Ova are quite large, irregularly arranged in 1 or 2 rows. The seminal vesicles touch the caudal fins, situated well behind the posterior fins. Length up to 19 mm.



Sagitta bipunctata: A, maturity stage 1; B, stage 2; C, stage 3; D, stage 4 (From Alvariño, 1967).

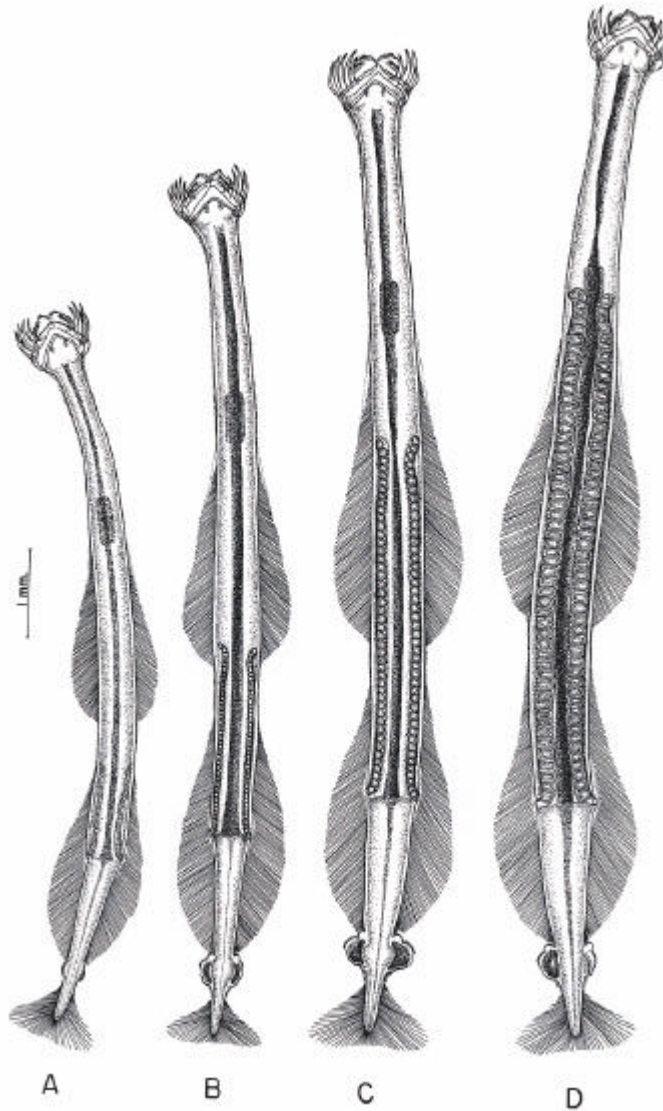
Genus *Serratosagitta*

Intestinal diverticula absent. Hooks serrated. Seminal vesicles situated just behind the posterior fins and well separated from the tail fin. This group requires sorting out with genetical techniques as misidentifications are probably occurring (A. Pierrot-Bults, pers. com.)

Serratosagitta pacifica (Tokioka, 1940)

Body translucent, slender, firm and rigid, with the trunk region of the same width along its whole length. Head small with a conspicuous neck. Lateral fins completely rayed, apart sometimes for a small portion at the front of the anterior fin. Anterior fins start slightly behind posterior edge of ventral ganglion. On either side of the head 5-9 serrated hooks, 3-13 anterior teeth and 8-24 posterior teeth. No intestinal diverticula. A thin collarette can be present on the neck and between the seminal vesicles and caudal fin. Mature ovaries can reach the anterior edge of ventral ganglion. Ova are in a single row. Seminal vesicles touch the posterior fins, but are separated from the caudal fin. When they are in good condition the vesicles have a series of chitinous teeth on the side. Length up to 14 mm.

Recorded: Madagascar

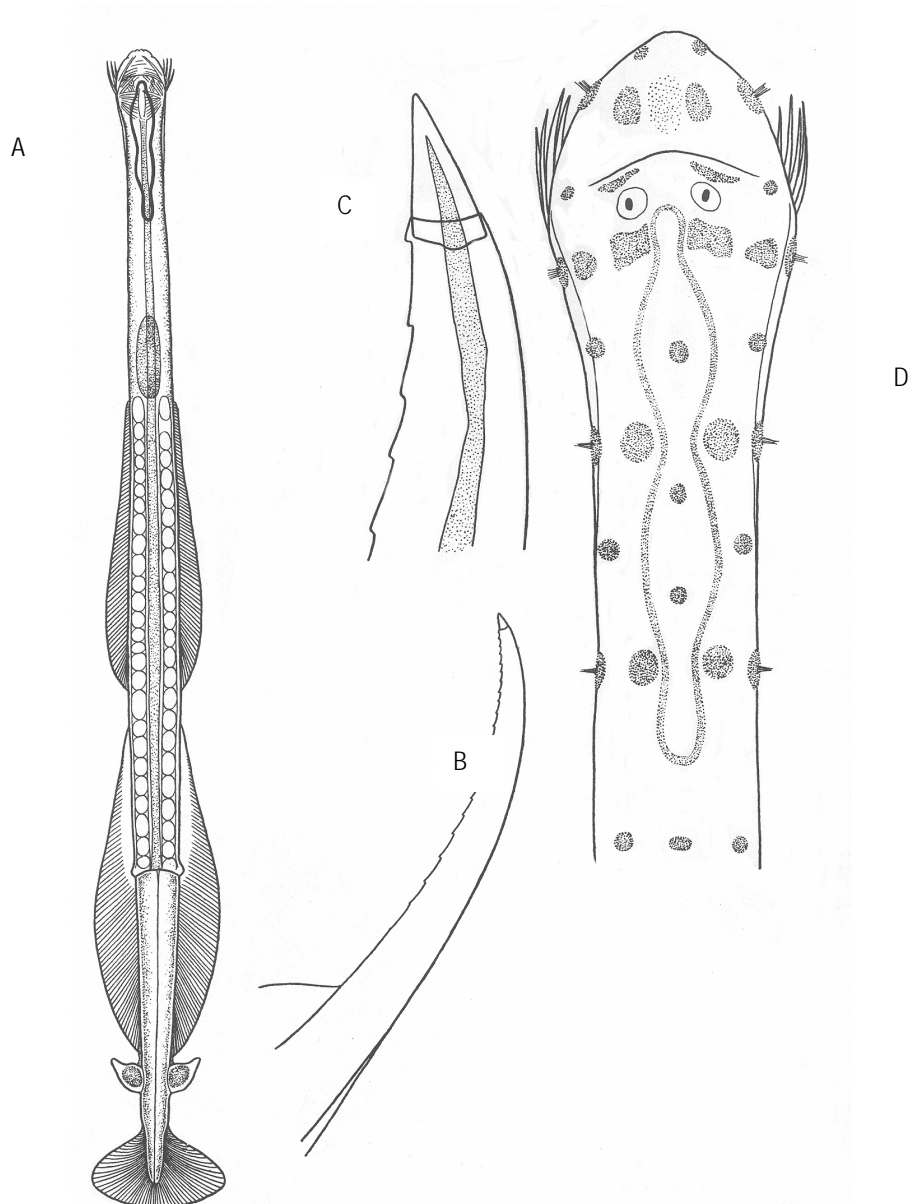


Serratosagitta pacifica: A, maturity stage 1; B, stage 2; C, stage 3; D, stage 4 (From Alvarino, 1967).

Serratosagitta pseudoserratodentata (Tokioka, 1939)

Body quite transparent and slender, slightly wider in middle. Neck not obvious, sometimes with a slight collarette. No gut diverticula. On either side of head 6-7 serrated hooks, 4-6 anterior teeth and 10-12 posterior teeth. Anterior fin starts just behind ventral ganglion, without any rayless zone. Posterior fins longer than anterior fins and rounded in shape with anterior portion and inner zone in front of tail septum rayless. In mature specimens the ovary can extend nearly to the ventral ganglion. Seminal vesicles are situated close to the end of the posterior fin, but separated from the caudal fin. This is a smaller species than *S. serratodentata*, with fewer teeth and different shape of seminal vesicles. Length up to 9 mm.

Distribution: Recorded along the east coast of Africa (Andreu *et al.* 1989), but questionable as is a north Pacific species.

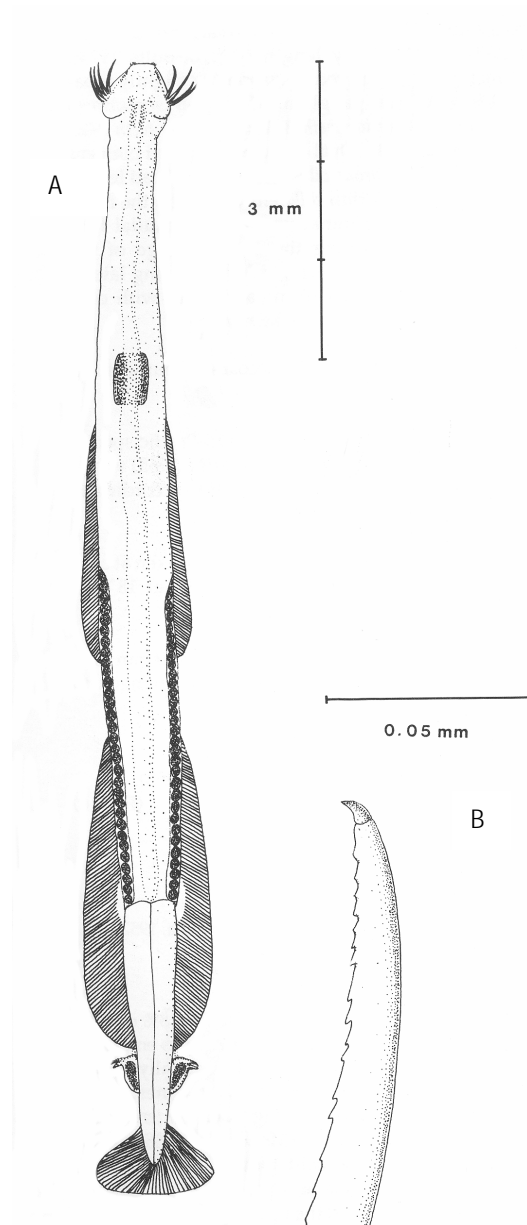


Serratosagitta pseudoserratodentata: A, stage 4 of maturity; B, hook; C, detail of hook end; D, detail of head (From Tokioka, 1939).

Serratosagitta serratodentata (Krohn, 1853)

Body needle-like, firm and opaque. Anterior fins start just at the posterior edge of the ventral ganglion. Lateral fins with small anterior internal rayless zones. On either side of the small head 5-9 serrated hooks, 6-11 anterior teeth and 12-20 posterior teeth. Small collarette present in the neck region and no gut diverticula. Ovaries, when mature, can extend to the ventral ganglion. Large ova. The seminal vesicles almost touch the posterior fins, but are separate from the tail fin, almost touching both fins when mature. Seminal vesicles in mature and perfect specimens with two anterolateral papillae. Even in immature specimens in good condition, a membranous supporting structure can extend from the lateral fins to the anterior part of each vesicle. Length up to 15 mm.

Distribution: Madagascar, east Africa.

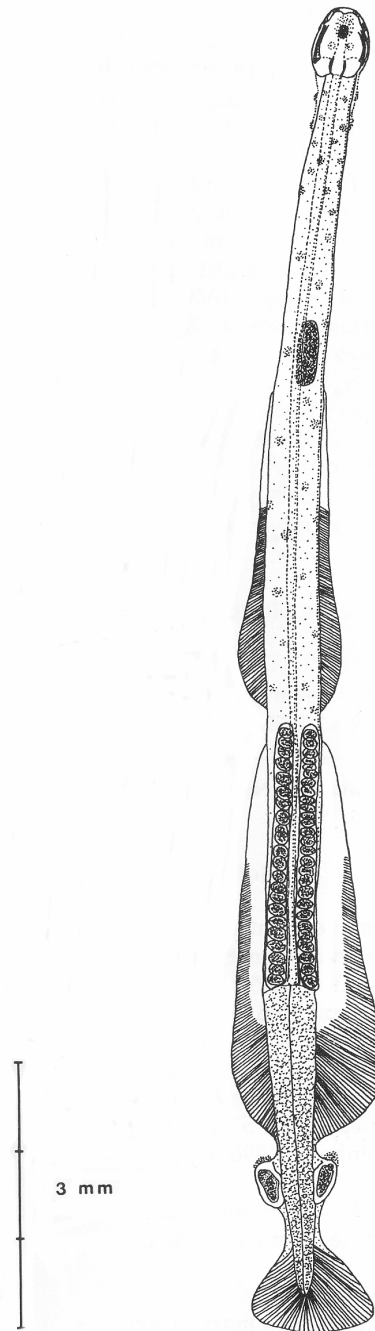


Serratosagitta serratodentata: Maturity stage 2; B, detail of hook (From Lutschinger, 1993).

Serratosagitta tasmanica (Thompson, 1947)

Rigid, firm, opaque body. Anterior fins begin at posterior end of ventral ganglion. Anterior fins rayless in their anterior part, posterior fins rayless in their anterior part and inner part. Lateral fins close together. On both side of the head 6-9 serrated hooks, 6-9 anterior teeth and 9-15 posterior teeth. No gut diverticula. A tiny collarette may occur at the neck and between the posterior and caudal fins. Mature ovaries, with quite large ova, extend to between the anterior and posterior fins. Seminal vesicles with conspicuous anterior knob with protuberances, separated from posterior and tail fins, closer to posterior fins. Length up to 30 mm.

Distribution: Really an Atlantic species, but may just penetrate round South Africa. *S. pacifica* is more likely in the Indian ocean.



Serratosagitta tasmanica: Maturity stage 2 (From Lutschinger, 1993).

Genus *Solidosagitta*

Body stout and stiff with very strong muscles and prominent collarette. Intestinal diverticula obvious. Posterior lateral fins more on body than tail section. Small pigmented area in eye. Distinct rayless zones on lateral fins.

Solidosagitta planctonis (Steinhaus, 1896) and *Solidosagitta zetesios* (Fowler, 1905)

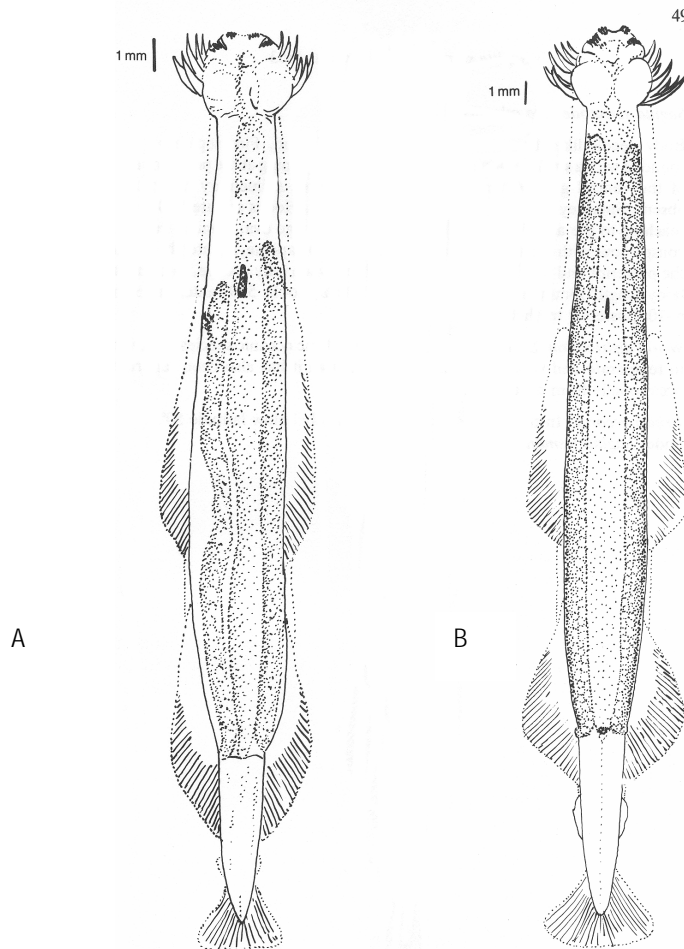
These two species are very similar and are possibly only different forms of the same species - *S. planctonis*, *forma planctonis* and *forma zetesios*.

General description - Body strong, firm and opaque. Collarette is prominent, extending to the anterior fins and even to the tail in mature specimens, forming a connecting bridge between lateral fins. Intestinal diverticula present. Anterior fins may reach the posterior end or middle of the ventral ganglion and are rayless in the anterior and inner parts. Posterior fins are triangular, with an anterior and inner rayless zone. In mature specimens the ovaries can reach beyond the ventral ganglion. Ova are small and arranged dorsoventrally in 3 rows. The seminal vesicles are located midway between the posterior and tail fins, touching neither.

Forma planctonis has a maximum body length of 37 mm, 8-11 hooks, 6-9 anterior teeth, 10-14 posterior teeth and the anterior lateral fin starts mid-way up the ventral ganglion.

Forma zetesios has a maximum body length of 45 mm, up to 11 hooks (usually 8-10), up to 12 anterior teeth (usually 8-10), up to 22 posterior teeth (usually 15-19) and the anterior fin starts at the posterior end of the ventral ganglion.

Distribution: Deep water species, unlikely to be sampled above 100 m.



A: *Sagitta planctonis forma planctonis*. B: *Sagitta planctonis forma zetesios* (From Pierrot-Bults and Chidgey, 1988).

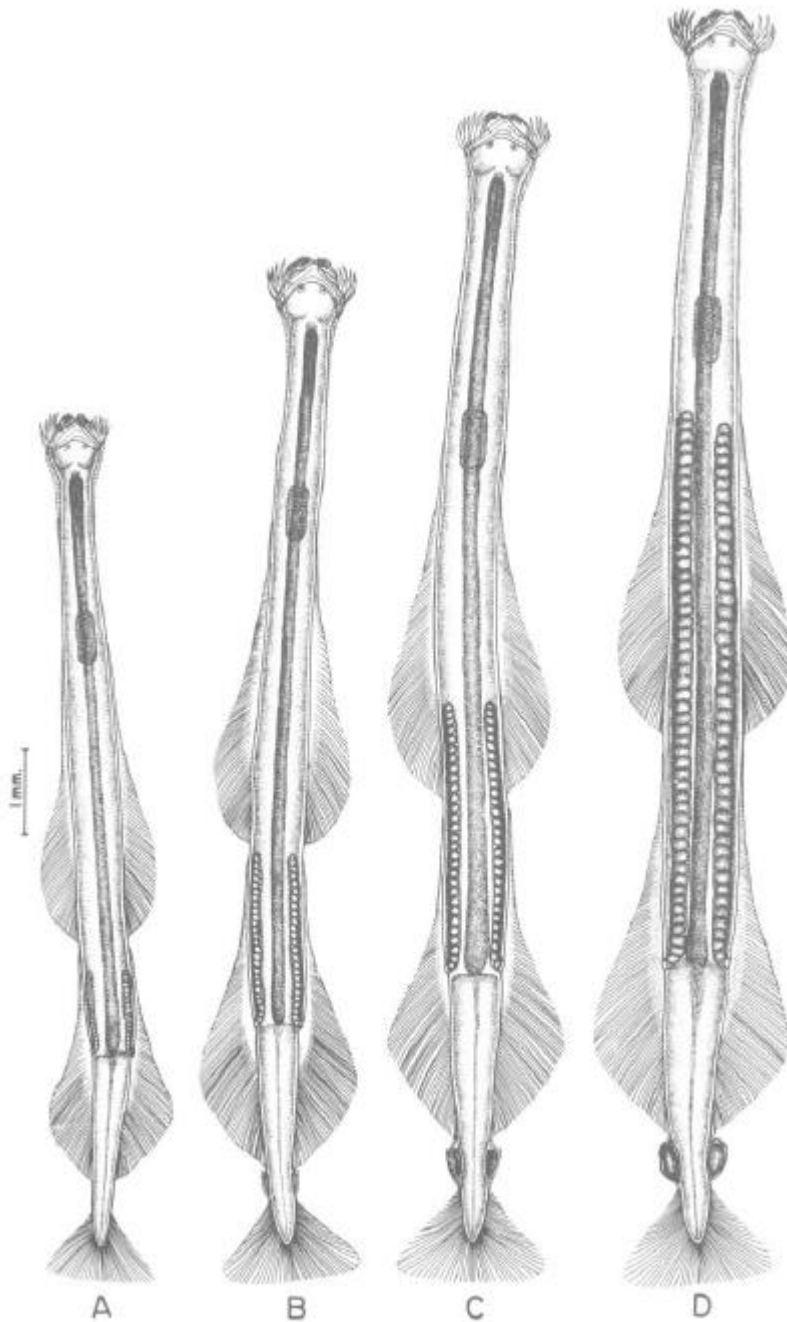
Genus *Zonosagitta*

No gut diverticula. Both pairs of fins have an anterior and long internal rayless zone.

Zonosagitta bedoti (Beraneck, 1895)

Body opaque, firm and wider at the middle. Small head with conspicuous neck. On each side of the head 6-8 thick, short, not strongly curved hooks, 8-10 anterior teeth and 18-22 thin, closely packed posterior teeth. A short thin collarette can be present. The anterior fin starts in the middle of the ventral ganglion. The anterior and inner part of the anterior fins is rayless. The innermost part of the posterior fins is rayless. The seminal vesicles touch both the posterior and caudal fins. When mature the ovaries reach the ventral ganglion. The ova are round, but can be compressed in mature specimens, arranged in 3 rows. Length up to 15 mm.

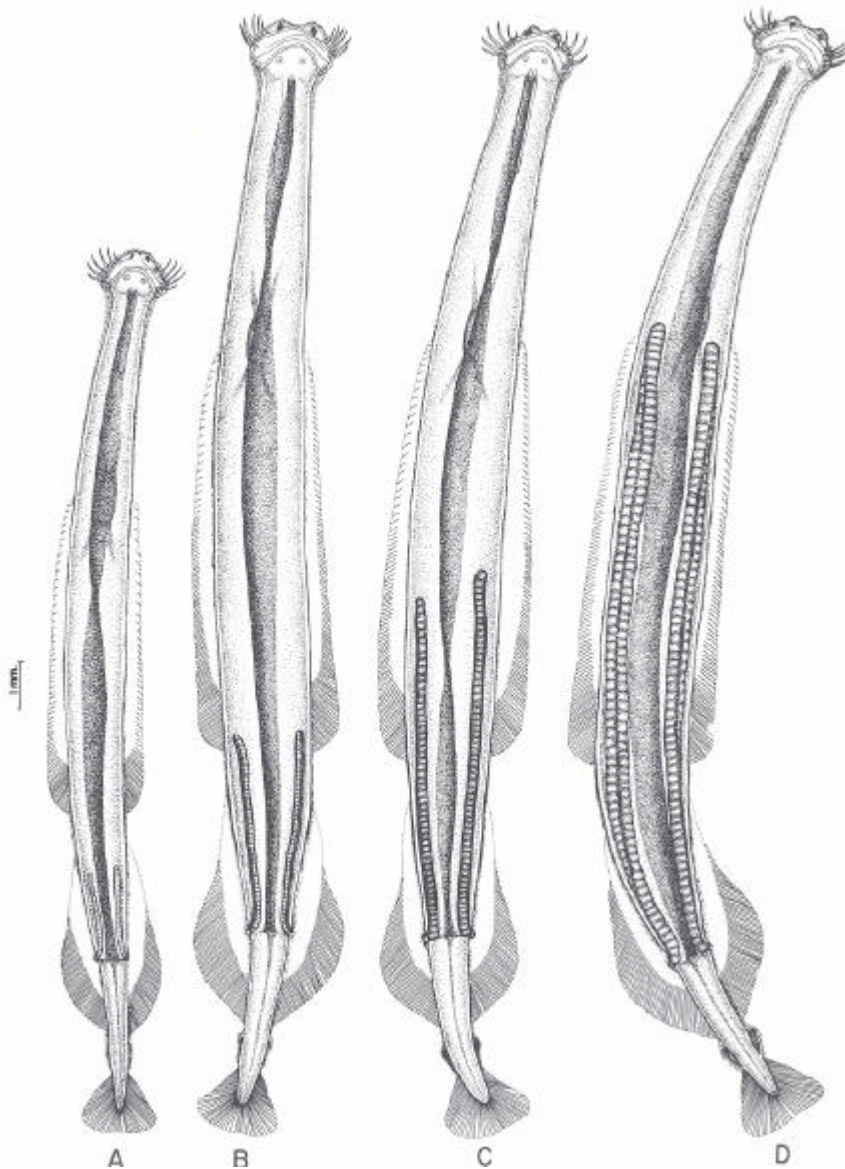
Recorded: Madagascar.



Zonosagitta bedoti: A, maturity stage 1; B, stage 2; C, stage 3; D, stage 4 (From Alvariño, 1967).

Zonosagitta pulchra (Doncaster, 1902)

Slender body, widest at its midpoint, firm and transparent. Small head. On either side of the head 6-7 hooks, 10 anterior teeth and 15 posterior teeth. Well-developed collarete in the neck region, extending one third of the distance to the ventral ganglion, also appearing in the seminal vesicle region. Anterior fins start in the middle of the ventral ganglion, broadest at their posterior part. The anterior and inner part of the anterior fin is rayless, or has a few rays, while the posterior edge is rayed. The posterior fins are roundish, with the anterior and inner parts rayless. In mature specimens the ovaries reach the ventral ganglion. The ova are roundish and arranged in 2, sometimes 3 rows. The seminal vesicles are close to both the posterior and caudal fins but separate from them. Length up to 24 mm.



Zonosagitta pulchra: A, maturity stage 1; B, stage 2; C, stage 3; D, stage 4 (From Alvariño, 1967).

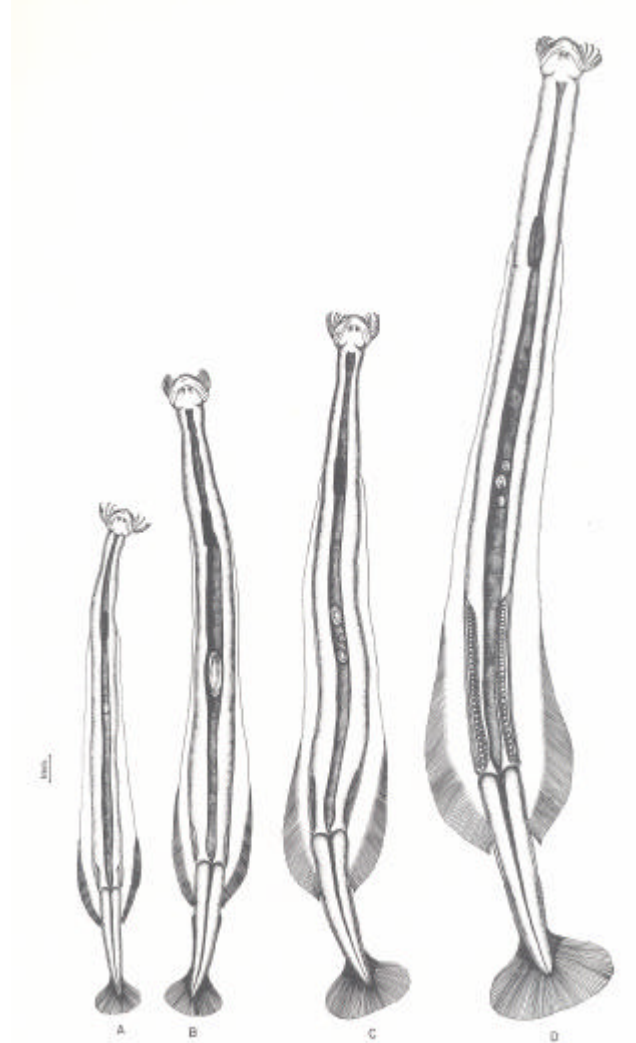
Family Eukrohniidae

Genus *Eukrohnia*

Characterised by having only one set of paired fins, which extend from the tail to the level of the ventral ganglion, tail segment comparatively short, no gut diverticula and only one row of teeth. In juveniles, the hooks on the head may have wide serrations.

Eukrohnia hamata (Möbius, 1875)

The body is firm, rigid and opaque. The head is small with a distinct neck, making the head appear broader. The eyes are large with no pigment and there are 8-10 hooks with curved tips on each side of the head. There may be as many as 26 teeth on each side of the head, in a single row. There is no collarette or gut diverticula. The intestine characteristically often contains oil droplets, which range in colour from bright orange to olive green. The single lateral fins are broader at the level of the tail septum. Most of the fins are without rays, but they are present at the posterior outer margins. The ovaries can reach up to the middle of the trunk. The ova are small, round and arranged in four rows. The seminal vesicles are elongated and oval, situated close to the posterior end of the paired fins and separate from the tail fin. Length up to 43 mm.



Eukrohnia hamata: A, maturity stage 1; B, stage 2; C, stage 3; D, stage 4 (From Alvaríno, 1967).

PHYLUM HEMICHORDATA

Hemichordates are worm-like animals living in tubes in the bottom mud or among rocks or masses of plant material. At one time they were considered to belong to the same phylum as we belong (Phylum Chordata), but now have a phylum of their own. Their casts, left exposed at low tide, are a familiar sight in the tropics. Their common name is acorn worms and their tornaria larvae can occur in plankton samples. The larvae are usually between 0.5 and 1 mm long and have obvious bands of cilia.



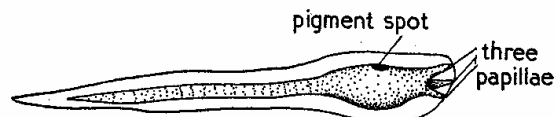
Example of tornaria larvae (From Wickstead, 1965)

PHYLUM UROCHORDATA

Urochordates do not have a backbone but share our phylum, because during a stage in their life cycle they have a primitive notochord. They are represented in the plankton by three main classes.

CLASS ASCIDIACEA

A common ascidacean is the sea squirt, which is typically found on the seabed or attached to the bottom of ships. It has a larval stage called an ascidian tadpole (as it superficially resembles a frog tadpole) which often occurs in plankton samples.



Ascidian tadpole larvae (from Wickstead, 1965).

CLASS LARVACEA

Larvaceans, also known as appendicularia, have an elongated, flat paper-like body of varying width. They have a “head” which usually appears to be very loosely attached to the body and is often broken off in samples. They secrete a jelly-like “house” inside which they live, but the house and animal are generally sampled separately when they are caught in the plankton net.

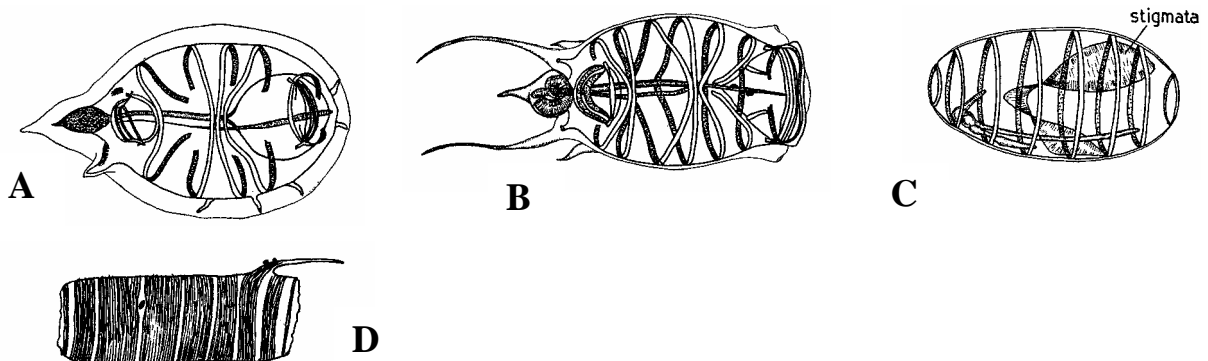


Examples of appendicularia (From Wickstead, 1965).

CLASS THALIACEA

There are two main groups of thaliaceans. The doliolids are barrel-shaped and have complete and separate circles of muscle-bands around the body e.g. *Doliolum*. They have a complex life history involving three stages, apart from the larvae. One of the stages is sometimes found in a disintegrating form (old nurse), where the individual becomes very flabby and the muscle bands widen till they can become continuous in some species.

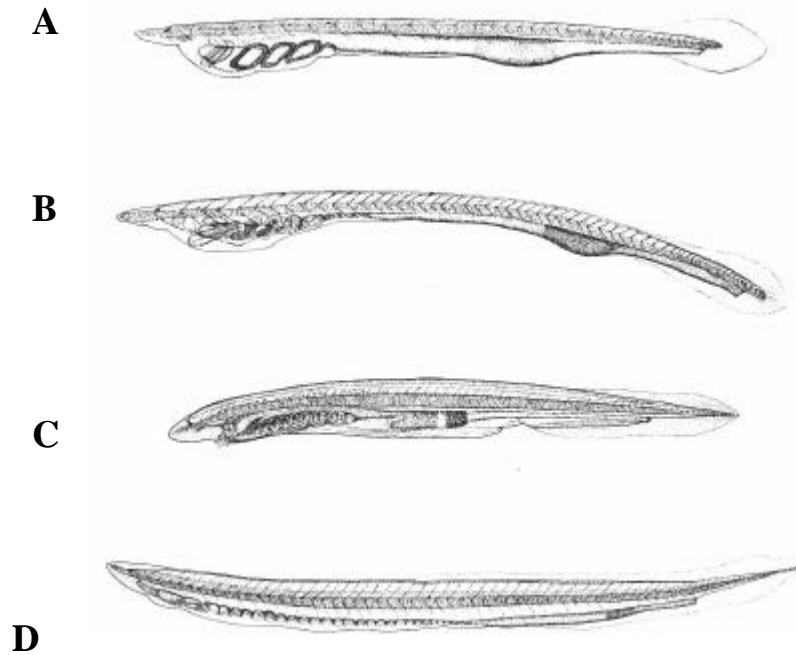
The second group, the salps, are generally larger than doliolids and have more jelly in their bodies. In salps, some of the muscle bands join together at certain points and do not go completely round the body e.g. *Thalia*. They have a less complex life cycle than doliolids. The asexual individuals live singly and are called solitary. They bud off sexual individuals in a chain, which stick together for some time, so are called the aggregate phase.



Examples of thaliaceans (A-C From Wickstead, 1965). A: *Thalia democratica*, aggregate form; B: *Thalia democratica*, solitary form; C: *Doliolum* sp. D: *Doliolum* sp. old nurse stage (From Fraser, 1947).

SUBPHYLUM CEPHALOCHORDATA

The only members of this group are the lancets, which were once called *Amphioxus*. A common genus is *Branchiostoma*. They are rigid slender organisms, flattened side to side, with segmented muscle bands and gill slits. They have a nerve cord along the whole body. They generally live in sandy bottoms but often emerge into the plankton, especially the juveniles.



Examples of cephalochordate larvae A: *Branchiostoma* sp. larva (1.5 mm); B: *Branchiostoma* sp. larva (2.8 mm); C: *Branchiostoma* sp. young adult (5 mm); D: *Amphioxides* sp. adult (9 mm). (From Wickstead, 1967).

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