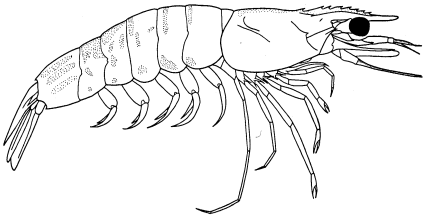
Short, J. W., 2015. *Mangrove Estuary Shrimps of the Mimika Region – Papua, Indonesia*. PT Freeport: Kuala Kencana, viii + 99 pp.

MANGROVE ESTUARY SHRIMPS

OF THE MIMIKA REGION - PAPUA, INDONESIA

JOHN W. SHORT

THE 8TH BOOK IN A SERIES OF FIELD GUIDES TO THE FLORA AND FAUNA OF MIMIKA REGION, PAPUA



Mangrove Estuary Shrimps

of the

Mimika Region

Papua, Indonesia

John W. Short

PT FREEPORT INDONESIA
Affiliate of Freeport-McMoRan Copper & Gold

Published by:

PT FREEPORT INDONESIA
Affiliate of Freeport-McMoRan Copper & Gold

PT Freeport Indonesia
Environmental Department
Jl. Mandala Raya Selatan No. 1
Kuala Kencana, Timika 99920
Papua, Indonesia

Design:
John W. Short

Cover Design:
Diondi L. Nasution

Printed by:
PT. Indonesia Printer

ISBN 978-602-14436-2-0

9 786021 443620

Cover Illustration: Giant Tiger Prawn, *Penaeus monodon* (photo by Gesang Setyadi).

Title Page Illustrations: York Prawn, *Metapenaeus eboracensis* (after Dall, 1957), top; Common Harpiosquilla, *Harpiosquilla harpax* (photo by Gesang Setyadi), bottom.

Foreword

I am proud to welcome the Mangrove Estuary Shrimps of the Mimika Region - Papua, Indonesia book. I herewith would like to thank Dr. John W. Short and all contributors for their hard work and dedication towards documenting the aquatic fauna ecosystem, particularly shrimps, in the region for the benefit of the broader society.

PT Freeport Indonesia has been operating for more than 40 years in Papua and is located in one of the most exotic and unique environments in the world. The island is one of the most biologically diverse mangrove estuary ecosystems in the world with the largest area of mangrove vegetation in Indonesia, covering a total area of 1.75 million hectares. A large number of shrimps inhabit this mangrove estuary ecosystem and only a few species have been published up to now.

Since 1996, our mangrove estuary ecosystem monitoring efforts have identified over 250 species of fish, 300 species of invertebrates and over 20 species of mangrove. Other monitoring efforts in alpine, sub alpine, rainforest and swamps also record high numbers of varieties of flora and fauna. Some of the monitoring results have been published in a series of biodiversity books, as part of our on-going efforts to contribute to conservation of biodiversity.

This second Papua biodiversity book of Dr. John W. Short and the eighth biodiversity book published by PT Freeport Indonesia, as part of its commitments to continuously disseminate knowledge related to Papua biodiversity to the public. This book is the third and final field guide relating to the Crustacea of the Mimika region. The two previous field guides covered freshwater decapods (Short, 2009) and estuarine decapod crabs (Rahayu and Setyadi, 2009). This volume deals with estuarine, shrimp-like Crustacea from two distantly related orders, the Decapoda and the Stomatopoda. Fifty-one shrimp species and 103 crabs are presently known from the estuaries of the Mimika region. In total, 156 species of Crustacea have now been recorded from the Mimika region.

This book provides important information to help people exploring the biodiversity of mangrove and estuary ecosystems of Papua. It effectively combines important technical details and the up-to-date field information.

We congratulate all of the contributors and hope the book will bring benefit to people interested in exploring biodiversity of Papua.

Rozik B. Soetjipto
President Director
PT Freeport Indonesia

Contents

Upper Minajerwi River estuary (Photo by Abdul Haris).

Acknowledgements

This book was funded by PT Freeport Indonesia (PTFI) as part of their commitment towards documenting the flora and fauna of the Mimika region. Special thanks to Gesang Setyadi (Environmental Manager, PTFI) for arranging funding, reviewing the manuscript, providing the map of the Mimika region and for habitat and shrimp photographs. Abdul Haris (Superintendent, Coastal and Marine Monitoring, PTFI) provided habitat photos, the colour photograph of *Metapenaeus demani demani* and access to biomonitoring collection data to assist with the compilation of species abundance data. Kent Hortle (former Superintendent of the Coastal and Marine Monitoring, PTFI), is thanked for arranging funding for the identification of crustacean samples and the preparation of taxonomic keys and diagnoses on which this book is largely based. He also facilitated funding for two visits to PTFI. A number of past and present employees of PTFI's Coastal and Marine Monitoring also contributed by collecting the material on which this book is based. They include: Gesang Setyadi, Abdul Haris, Kent Hortle, Dwi Listyo Rahayu, Sigit A. P. Dwiono, Amirudin, Johanna Suprihatin, Johnny Prewitt, David Norriss, Wisnu Susetyo, Thomas Magai and Tenius Tabuni.

Jason De Araujo granted permission on behalf of the Northern Territory Government for the reproduction of penaeid prawn photographs taken by Arnold Baker and appearing in *A Guide to Australian Penaeid Prawns* by Grey *et al*. (1983). Dr William Dall reviewed an early draft of the manuscript and kindly permitted the use of a number of his line drawings from Dall (1957) and Grey *et al*, (1983). Dr Juan Carlos Miquel gave permission for the reproduction of his line drawing of the male fifth pereiopod of *Metapenaeus ensis* and the petasma and thelycum of *M. demani* from Miquel (1982). Dr Sandy Bruce kindly allowed the use of his line drawing of *Lysmata vittata* from Bruce (1990). The figure was also reproduced with

the permission of Christy Leung from Hong Kong University Press. Dr Shane Ahyong is thanked for his expert advice on stomatopod identifications and for generously providing stomatopod photographs. Dr Arthur Anker kindly provided specialist advice on alpheid identifications as well as colour photographs of *Alpheus chiragricus*, *Exhippolysmata ensirostris ensirostris* and *Latreutes anoplonyx*.

Local names and economic importance data were sourced from Muller (2006). Indonesian common names for penaeid prawns were derived from a poster produced by Balai Penelitian Perikanan Laut (Research Institute for Marine Fisheries), Jakarta.

Finally, I would like to thank my wife, Leila, for her encouragement and support during this project and for proof reading the manuscript.

Introduction

Crustaceans are the dominant arthropod invertebrates in tidal environments. Approximately 67,000 crustacean species are presently known worldwide (Ahyong *et al.*, 2011, Zhang, 2011). Although the majority of species are marine, there is also a rich diversity of species living in estuarine environments, the coastal zone of rivers and streams where tidal waters mix with freshwater outflow.

In the subtidal zone of tropical estuaries, shrimps typically dominate the invertebrate biomass. A number of species have also managed to colonise intertidal mangrove forests and mud flats where they construct burrows or co-inhabit burrows made by brachyuran crabs. Burrows provide shelter from predators and protection from desiccation during low tide.

Species of the genus *Merguia* have adopted a different strategy to avoid predators in the intertidal zone. Although they are sometimes are found in crab burrows or under rocks they are also highly adept climbers and are more typically found in mangrove trees and Nipa palms far above the high water mark.

Many shrimps are scavenging omnivores and play an important ecological role in estuarine ecosystems. The larger, more abundant species are also in high demand for human consumption wherever they occur. Species of the family Penaeidae, in particular, are among the most commercially important crustaceans.

The geographic area covered by this book, the Mimika region, is situated in the middle of the southern coast of Papua province, Indonesia (formerly Netherlands New Guinea or Irian Jaya) on the western half of the island of New Guinea (Fig. 1). The coastline of the Mimika region is covered by dense mangroves forest and faces the Arafura Sea.

The estuarine crustacean fauna of southern Papua was largely unstudied prior to the commencement of PT Freeport Indonesia's biomonitoring program in the 1990s. The estuarine crab fauna has been well studied in recent times and is discussed in detail by Rahayu and Setyadi (2009). This book is the first publication to deal extensively with the mangrove estuary shrimps of the Mimika region.

Coverage of the book

This book is the third and final field guide relating to the Crustacea of the Mimika region. The two previous field guides covered freshwater decapods (Short, 2009) and estuarine decapod crabs (Rahayu and Setyadi, 2009). This volume deals with estuarine, shrimp-like Crustacea from two distantly related orders, the Decapoda and the Stomatopoda. Fifty-one shrimp species are presently known from the estuaries of the Mimika region compared to 103 crabs (Rahayu and Setyadi (2009) and 133 estuarine fishes (Haris *et al.*, 2008).

In total, 156 species of Crustacea have now been recorded from the Mimika region including 4 Stomatopoda and 152 Decapoda (15 Dendrobranchiata, 36 Caridea, 12 Anomura, 5 Thalassinidea, 1 Astacidea and 83 Brachyura).

Many shrimps occurring in the estuaries of the Mimika region are euryhaline and are also found usptream in lowland, non-tidal, fresh waters. Most of these, particularly atyid and palaemonid shrimps, have already been discussed in Short (2009) along with land-locked freshwater Crustacea. Although these euryhaline species have been included in the identification keys and species checklist in this book, readers should refer to the relevant species accounts in Short (2009) for more detailed information.

Mangrove estuaries as habitat for shrimps

Rahayu and Setyadi (2009) have presented an excellent overview of the mangrove estuaries of the Mimika region. The distribution of mangroves in the Mimika region is shown in Figure 1. The extensive mangrove ecosystems of the region provide a rich variety of suitable habitats for shrimps.

Unlike some crab families, such as the Sesarmidae and Ocypodidae, which almost

Aerial view of the mouth of the Ajkwa River estuary looking westward towards the Tipuka River estuary, Mimika region (Photo by Gesang Setyadi).

exclusively comprise obligate, intertidal, mangrove inhabitants, few shrimp species are strictly confined to mangrove estuaries as adults. One exception is the hippolytid shrimp, *Merguia oligodon*, which is a semi-terrestrial, arboreal species found only in mangrove estuaries. The palaemonid shrimp, *Leandrites celebensis*, also appears closely associated with shallow, brackish water, usually among mangroves. The Rough River Prawn, *M.* '*equidens*' complex, is largely restricted to estuaries, although ovigerous females are commonly trawled in inshore waters. Most of the other estuarine shrimp species are also found either in lowland, non-tidal fresh waters or neighbouring shallow marine areas.

The majority of shrimps occurring in mangrove estuaries are fully aquatic and at low tide are confined to standing water in tidal pools and channels or the subtidal zone of rivers. Notable exceptions are a number of species of alpheid shrimps and squillid mantis-shrimps which are semi-aquatic and live in permanent burrows in mangrove swamps or tidal mud flats. Mangrove-climbing shrimps of

Nipa palms (*Nypa fruticans*), upper Kopi River estuary (Photo by Abdul Haris).

the genus *Merguia* are also unusual among shrimps in their ability to climb and live in mangrove trees or Nipa palms (*Nypa fruticans*) high above the water line. Although arboreal, species of *Merguia* are not fully terrestrial and require access to small pools of trapped standing water in the forks of trees or palms to avoid desiccation. *Merguia* have also been collected intertidally under rocks and from sesarmid crab burrows in mangrove swamps.

Mangrove estuaries provide important nurseries for the juveniles of many species of Penaeidae. After developing in estuaries, young adults then migrate to breeding grounds in shallow inshore or offshore waters. The banana prawn, *Penaeus merguiensis*, is particularly abundant in estuaries of the region.

Mangrove estuary shrimps of the Mimika region

As detailed in Appendix 2, the mangrove estuary shrimps of the Mimika region belong to three major taxonomic groups: (1) mantis-shrimps (Stomatopoda:

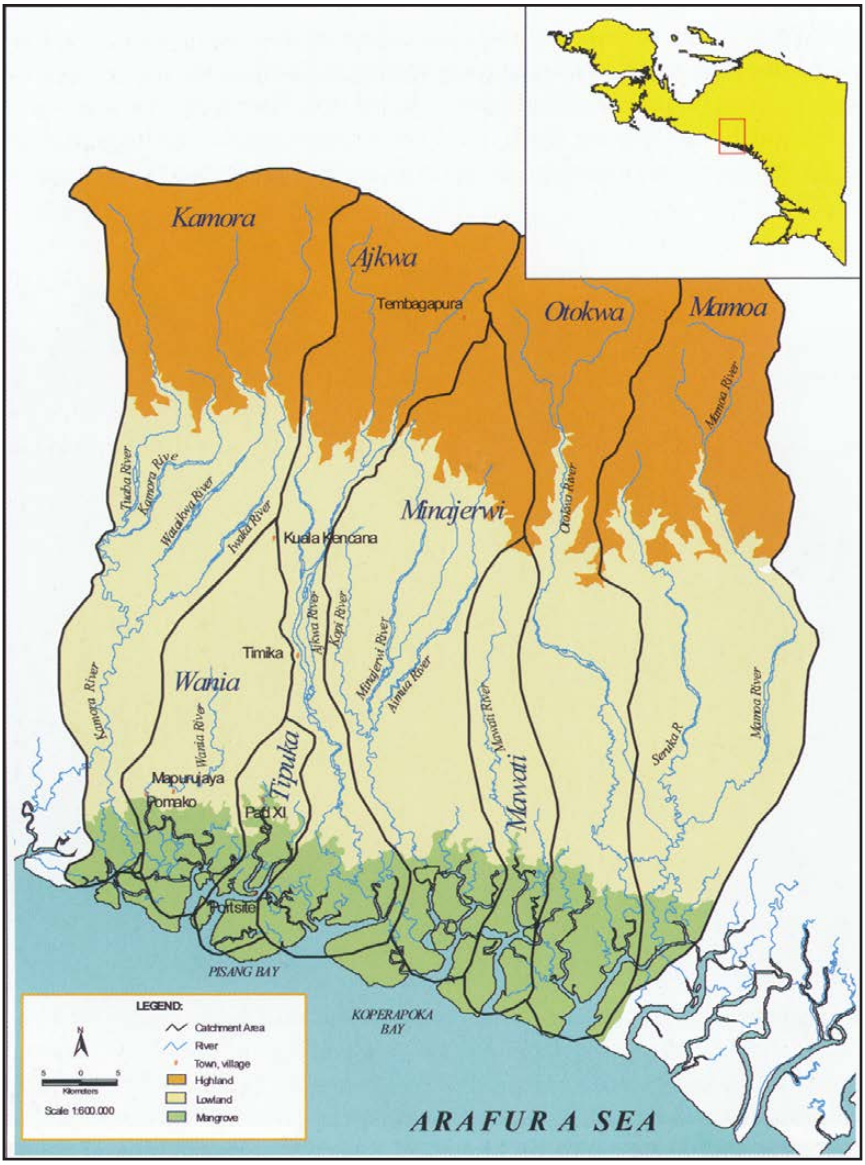


Figure 1. Map of the Mimika region, Papua. Major river catchments are outlined in black. Mangrove areas are shaded green.

Squillidae); (2) dendrobranchiate shrimps (Decapoda: Dendrobranchiata: Penaeidae and Sergestidae); and (3) caridean shrimps (Decapoda: Pleocyemata: Caridea: Alpheidae, Atyidae, Hippolytidae and Palaemonidae).

The first group, mantis-shrimps of the order Stomatopoda, comprise the only extant order of the subclass Hoplocarida, an ancient group with a fossil record dating back to the Devonian. Nineteen families comprising over 100 genera and 450 species are known worldwide.

Stomatopods all share a similar body plan (Fig. 8) characterised by an elongate, flattened, body; moveable, often T-shaped eyes; a reduced carapace which does not cover the fifth to eight thoracic somites; 5 pairs of maxillipeds with the second pair strongly developed as raptorial claws held folded under the sides of the carapace; 3 pairs of pereiopods; a long flattened tail (which includes part of the thorax, the abdomen, and the terminal telson); 5 pairs of biramous, flap-like pleopods; and an elaborate tailfan consisting of telson and highly modified uropods which together form a specialised structure that supports the abdomen off the substrate.

The second and third groups, dendrobranchiate and caridean shrimps, both belong to the Order Decapoda. The name Decapoda literally means 'ten-footed', a reference to five pairs of legs typical of the group. The five pairs of legs are usually differentiated as chelipeds (pincered legs) and walking legs. Unlike stomatopods, the carapace completely covers the thoracic somites. The eyes are variably developed but never T-shaped. There are three pairs of maxillipeds which are never developed as raptorial claws.

Decapod shrimps are classified in two suborders: the Dendrobranchiata and the Pleocyemata (which in addition to 'true shrimps' of the Infraorder Caridea also includes crabs, lobsters and crayfishes). In an older classification, dendrobranchiate and caridean shrimps were grouped together in the suborder Natantia. Although this older grouping does not accurately reflect current knowledge of the evolutionary history, gill morphology and reproductive biology of the Decapoda, it is still common to refer to long-tailed, swimming decapods in an informal way as 'natant' decapods.

The Dendrobranchiata are named after the branching form of the gills (main gill

axis with series of paired branches along length, each paired branch with vertical filaments which usually bifurcate twice). Dendrobranchiate shrimps are also unique amongst decapod crustaceans in that the fertilised eggs are not incubated on the female pleopods and are instead released directly into the water column where they hatch as nauplius larvae. One exception is the genus *Lucifer* where the eggs are carried on the third pereiopods for a short period. The nauplius larval stages are all free-swimming and do not feed before they metamorphose to protozoea larvae.

Dendrobranchiate shrimps are most easily distinguished from caridean shrimps by the form of the second abdominal pleura. In the Dendrobranchiata, the abdominal pleura of each somite overlap the preceding pair of abdominal pleura (Fig. 10), whereas in the Caridea the second pleura are enlarged and overlap both the first and third pleura (Fig. 9). In addition, the first three pairs of pereiopods are usually developed as chelipeds, whereas in caridean shrimps the third pereiopods are non-chelate and are used for walking.

The suborder Dendrobranchiata includes about 60 genera and over 530 species worldwide, including nearly all of the shrimps of high commercial value to fisheries. The majority of species belong to the superfamily Penaeoidea which comprises the families Aristaeidae, Benthesicymidae, Penaeidae, Sicyoniidae and Solenoceridae. The other dendrobranchiate superfamily, the Sergestoidea, contains only two families, the Sergestidae and the Luciferidae, and less than 120 species worldwide. Only the Penaeidae and Sergestidae have been recorded from the Mimika region, with the latter family represented by only one species, the Alamang Shrimp, *Acetes sibogae*.

The other major group of decapod shrimps, the Caridea, belong to the suborder Pleocyemata, a name which refers to the incubation of the embryos (eggs) on the female pleopods (swimmerets) until hatching. Pleocyemate decapods also have phyllobranchiate (plate-like or leaf-like branches arranged in paired series along main axis) or trichobranchiate (fine branches around a central axis) rather than dendrobranchiate gills. The Pleocyemata is a highly diverse group and includes seven infraorders of shrimps, lobsters, crayfishes and crabs.

The infraorder Caridea, comprising 'true shrimps', is the second largest of the

pleocyemate decapod groups and currently includes 35 families, 389 genera and over 3400 species worldwide (De Grave and Fransen, 2011). Most caridean shrimp families are strictly marine. Only the Alpheidae, Atyidae, Hippolytidae and Palaemonidae commonly occur in estuarine waters.

It is important to note that 'shrimp' and 'prawn' are imprecise names and are not consistently applied to specific taxa throughout the world. The usage of the terms has also changed with time. Both terms were first used for European caridean shrimps. In Britain and in former British colonies, including Australia, the larger species, particularly in the families Penaeidae and Palaemonidae, are now often referred to as prawns and the smaller species as shrimps. In the Americas, shrimp is the commonly used term for all natant decapods. In general, 'shrimp' is the more popular name throughout the world. In this book, for simplicity, higher taxa are usually referred to as shrimps, e.g. dendrobranchiate shrimps rather than dendrobranchiate shrimps and prawns.

Biology

Feeding
Estuarine shrimps occurring in the Mimika region display a wide variety of feeding strategies ranging from microphagic feeders, which pick and scrape the substrate e.g. atyid shrimps of the genus *Caridina*, to active, ambush predators e.g. most species of mantis-shrimps.

Atyid shrimps of the genus *Caridina* use the pincers of the first and second chelipeds to sweep the substrate for detritus or algae using the dense brushes of setae on the fingertips. Estuarine palaemonid shrimps are typically scavenging, macrophagic omnivores, occasionally capturing live prey such as invertebrates or small fish using the second chelipeds. Detritus and smaller food items are picked from the substrate using the first pereiopods. Snapping shrimps (*Alpheus* spp.) are typically free-living, macrophagic predators and use the snapping claw of the major first cheliped to stun their prey. Apart from the Medusa shrimp, *Latreutes anoplonyx*, which lives symbiotically on jellyfish, the hippolytids recorded from the Mimika region are likely to be macrophagic omnivores.

In general, dendrobranchiate shrimps can be described as opportunistic omnivores.

Many burrow in soft sediments during the day and leave the substrate at night to feed. The three pairs of chelipeds are used to pick and scrape prey from the substrate or to capture free-swimming prey. The chelae are usually relatively small and best suited to grasping small objects. Live prey include molluscs, crustaceans, chaetognaths, radiolarians and small fish. Sergestids of the genus *Acetes* also consume significant amounts of algae and detritus.

Stomatopods are well known as active predators of other invertebrates and fish. In terms of the manner in which they use the raptorial claws to hunt prey, they can be grouped into two broad functional groups, 'spearers' and 'smashers'. In spearers, the dactylus of the raptorial claw bears a row of forwardly directed spines which penetrate and hold mobile prey species while they are killed. Smashers have a raptorial claw with a basally inflated dactylus which they use to club rather than spear their prey. All stomatopods presently known from the Mimika region are of the spearing type and belong to the family, Squillidae.

Reproductive anatomy

The reproductive anatomy of stomatopods is highly developed. In female squillids, there is a pair of genital openings on the sixth thoracic sternite connected by a slit to the seminal receptacle. Males have a pair of penes that arise from the last pair of walking legs on the eighth thoracic sternite and the first pleopods modified as a specialised reproductive structure, the petasma. During mating, sperm is stored in the seminal receptacle of the female and sealed with a sperm plug. Fertilisation occurs externally when the eggs are extruded from the female genital openings. Females then stick the eggs together as an egg mass using an adhesive substance from a special cement gland on the sternum behind the genital openings. The egg mass is carried by the female using the anterior thoracic appendages and constantly cleaned until hatching. The eggs hatch as free-swimming, planktonic larvae.

Dendrobranchiate shrimps also have well-developed reproductive anatomy. Like stomatopods, the male first pleopods are modified as a petasma (Figs 10, 37–39) for transferring sperm to the female sperm receptacle, the thelycum (Fig. 36), during mating. The male genital pores are located on the coxae of the fifth pereiopods and the female pores on the coxae of the third pereiopod just anterior to the thelycum. Most species also have appendix masculinae on the male second pereiopods. In

PTFI biologists collecting fish and invertebrates from a river mouth trawl as part of PTFI's coastal biomonitoring program (Photo by PTFI).

sergestids, there is a modification of the lower antennular flagellum of males, the clasping organ, which is used for holding females during copulation.

Caridean shrimps, by contrast, have relatively simple reproductive biology. Males lack a petasma and penes and in females there is no sperm receptacle for storing sperm. The male genital pores are located on genital papillae on the coxae of the fifth pereiopods. In palaemonid shrimps, there is also a conspicuous flap (genital operculum) covering the papilla (Fig. 3E). The female genital openings are on the coxae of the third pair of legs. In most caridean shrimps, males have appendix masculinae (Figs 3F–G) on the second pair of pleopods which aid the transfer of spermatophores to females during mating. Spermatophores are attached directly to the female sternum. Mated females fertilise the eggs as they are laid by rupturing the spermatophores. The fertilised eggs are then attached to the swimmerets for brooding. In small-egged euryhaline and marine species, the larvae typically hatch as planktonic zoeae which then develop through many stages to postlarvae. In

large-egged, land-locked, freshwater species, the larval cycle is typically short and abbreviated. The first larval stages may be either planktonic or benthic, sometimes resembling miniature adults.

Collecting methods

The shrimps included in this book were mostly collected as part of PTFI's biomonitoring program, either using a dedicated electrofishing boat in the freshwater, upper estuarine reaches of major rivers or by otter trawling in the lower estuaries.

Handling and Preservation

Many shrimps are easily damaged if transported live in containers or buckets. Live specimens should be kept cool and placed in separate plastic bags or containers with just enough water to cover the body.

If there is no need to bring specimens back to the laboratory alive, it is usually best to preserve the specimens immediately. This is especially the case for material which is going to be transported over a considerable distance or used in molecular studies. The latter should be preserved as soon as possible in absolute ethanol.

With samples containing more than one species, it is often preferable to quickly sort to putative species while in the field using live colour patterns. This can save a large amount of sorting time back at the laboratory after the material is preserved and the colour patterns have largely disappeared.

Live specimens, other than those to be used for molecular studies, should not be dropped straight into preservative, otherwise they are likely to throw legs and chelipeds. Live specimens can be frozen or chilled in ice or by refrigeration before being placed in preservative. Specimens should be chilled gradually. Another alternative is to use an anaesthetic such as clove oil. A few drops of clove oil in a litre or so of water is more than enough to quickly anaesthetise most small shrimps or juvenile crabs and crayfishes. The amount of clove oil used can be adjusted accordingly for large prawns, crabs and crayfishes.

In general, the most convenient preservative for small to medium-sized specimens is a 70–75% solution of ethanol in water. To ensure the appendages remain flexible and do not easily break off during handling, glycerine should also be added at a rate of about 10 ml of glycerine per litre of alcohol. This also helps to protect specimens from drying out if the alcohol level in a jar drops too low. Specimens which are being kept for future molecular research should be preserved in absolute ethanol without glycerine and checked regularly.

For very large species such as the Australasian Giant River Prawn, *Macrobrachium spinipes*, or collections which are being preserved with fish, it is often more convenient to initially fix the material in formalin. Formalin is a highly effective fixative which rapidly penetrates and excludes water from the body tissues, thereby preventing decomposition. To make the formalin solution, dilute one part of 40% formaldehyde with nine parts of water. Formaldehyde may be obtained from a pharmacy, university, museum or fisheries department. Specimens should be fully immersed in formalin. If there are only one or two very large individuals to preserve, the internal body tissues can be injected with formalin using a syringe and then the specimens placed into alcohol.

As formalin is a hazardous chemical, the utmost care must be taken not to breathe the fumes (use a fume hood where possible) or make contact with the skin (always use gloves) or eyes (wear protective eyewear). Formalin can also react with metals, so only plastic or glass containers without metal lids should be used for storage. It is best not to preserve crustaceans in formalin for extended periods as this tends to harden connective tissue, making it difficult to manipulate the appendages. Unbuffered formalin is also acidic and rapidly softens the exoskeleton. To reduce this problem, a pH buffering agent such as a small amount of borax may be added.

If neither formalin or ethanol are available and the specimens are not intended for molecular studies, methylated spirits can also be used (diluted to 70% and glycerin added as with ethanol).

To prepare a dried specimen, first fix the specimen in formalin (as described above) with its appendages in the desired position. After one to two weeks in formalin the specimen can then be mounted using pins on a display board to dry.

As colouration is lost during the fixing process, the fully dried specimen should be painted and then coated with clear resin or varnish.

Colour patterns

In caridean shrimps, the exoskeleton is generally thin and often semi-transparent. Colour patterning is controlled by chromatophores on the soft tissue beneath the exoskeleton. These chromatophore patterns may be highly transient and often change dramatically when shrimps are removed from their natural habitat. Caridean shrimps with distinctive colour patterns in the wild often change to a lightly speckled appearance after transportation to a laboratory. In caridean shrimps, colour patterning fades quickly after initial alcohol preservation whereas in stomatopods and dendrobranchiate shrimps patterning tends to fade more slowly after preservation.

In *Macrobrachium*, patterning on the carapace is often more developed in juveniles and gradually changes to a more uniform colour in adults whereas patterning on the second pereiopods (large chelipeds) is usually more developed in adult males.

Using this guide

This book follows a similar format to other field guide books in PTFI's series on the flora and fauna of the Mimika region, Papua. After the introduction, the book starts with a key to the seven families of stomatopod and decapod Crustacea recorded from the mangrove estuaries of the Mimika region, Papua. This is a good place to start for readers identifying shrimps for the first time.

Families are then presented in approximate phylogenetic order. For each of the seven families occurring in the Mimika region, there is an introductory section including distinguishing features, geographic distribution, biology and commercial importance. For the six families with more than one species recorded from the Mimika region, a key to species from the Mimika region is then provided.

Each identification key in this guide consists of a series of numbered either-or alternatives. For example, at step 1 in each key, the alternatives are numbered

1a and 1b. At each step, a choice is made between the two alternatives depending on which is more correct. The number in bold at the end of each alternative leads you to the next step. When you have been through all the steps leading to an identification, a taxon name is given. If at one point in a key the choice to make is ambiguous due to missing or damaged appendages etc., work through the key using both alternatives and then check which answer is more appropriate. All identifications made using the keys should be checked against the figures and diagnoses provided in this guide and in Short (2009).

Although an attempt has been made to make the keys as easy to use as possible, some practice is required before identifications can be made quickly and reliably. A powerful stereo microscope (at least 40x magnification) is also required to clearly see some of the features used for atyid shrimps. The characters used in the keys are also more reliable with sexually mature, adult specimens.

In the keys and species accounts, the term 'cheliped' refers to the first pereiopod in alpheid shrimps, the second pereiopod in palaemonid shrimps, and either the first or second pereiopod in atyid shrimps, unless specified otherwise. In stomatopods, 'raptorial claw' refers to the second maxilliped.

Within each family, species accounts are presented in alphabetic order by their scientific names. Each species account is divided into the following sections:

- **Common name**: in large print and bold above the photograph or line drawings of each species is the common name in English. When many alternative common names exist, this is generally the name most widely used or the name which I consider most suitable.

- **Scientific name**: in smaller print and italics immediately below the common name is the scientific name. This usually consists of two words, a binomial. The first word of the binomial is the genus (plural: genera) which always starts with a capital letter. The genus is the group name for the species and its closest relatives. The second word in the binomial is the species epithet (the name given to the species when it was described). A species epithet is always given in combination with its genus, although the genus may be abbreviated e.g. *P. monodon* instead of *Penaeus monodon*. When the genus is known but the species identity is uncertain

or the species is undescribed, the species epithet is replaced with 'sp.', e.g. *Alpheus* sp. In the case of the Greentail Prawn, a trinomial (genus, species and subspecies) has been used in the text, i.e. *Metapenaeus demani demani*.

• **Authority**: immediately below the scientific name in regular print is the person who first described the species and the year of publication. If the species is currently placed in a different genus to that used in the original description, the authority is enclosed in parentheses.

• **Diagnosis**: a summary of the main distinguishing features. Many of the technical terms are explained in the glossary (p. 81) and illustrated in Figs 2–8.

• **Habitat and abundance**: the environment in which the species is commonly found and general comments on its relative abundance in the Mimika region.

• **Distribution**: the geographic range. The distribution of wide-ranging Indo-West Pacific species are given from the western-most occurrence through to the northern, eastern and southern limits in the Pacific. For example, the distribution of *Penaeus merguiensis* is listed as 'Indo-West Pacific: Persian Gulf to Hong Kong, the Philippines, New Guinea, New Caledonia and northern Australia'.

• **Other names**: English FAO common names are provided in cases where they differ from the common name used in this guide. Also included are local Indonesian and Papuan names as listed by Muller (2006).

• **Notes**: special interest information e.g. comments on taxonomic status or closely related species.

Abbreviations used in text

A, abdominal segment; **CL**, carapace length, measured from the orbit to the posterior carapace margin; **P**, pereiopod; **Pl**, pleopod; **T**, thoracic sternite; **TL**, total length, measured from the tip of the rostrum to the tip of the telson.

Explanatory Figures

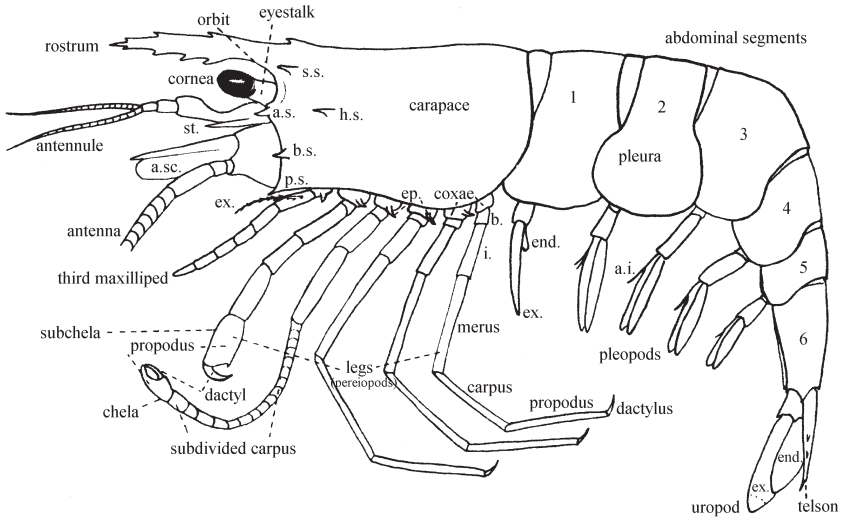


Figure 2. Key features of a generalised caridean prawn (modified from Schmitt, 1921). **a.s.**, antennal spine; **a.sc.**, antennal scale (scaphocerite); **a.i.**, appendix interna; **b.**, basis; **b.s.**, branchiostegal spine; **end.**, endopod; **ep.**, epipod; **ex.**, exopod; **h.s.**, hepatic spine; **i.**, ischium; **p.s.**, pterygostomial spine; **st.**, stylocerite; **s.s.**, supraorbital spine.

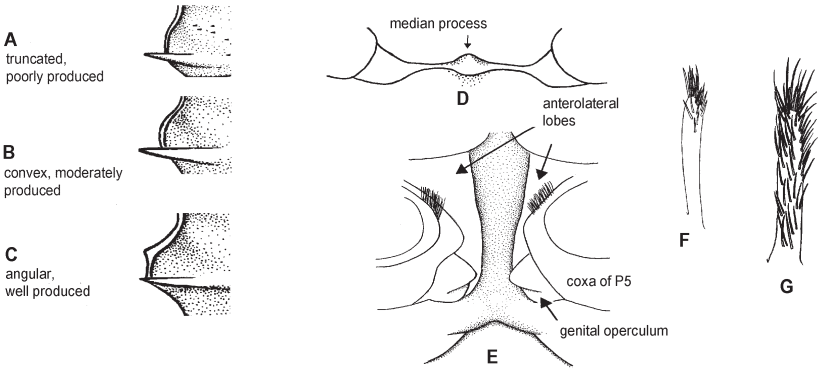


Figure 3. Selected morphological characters of *Macrobrachium* (family Palaemonidae): **A-C**, variation in shape of inferior orbit; **D**, T4 median process; **E**, genital operculum on male T8; **F**, appendix masculina of immature male; **G**, appendix masculina of sexually mature male.

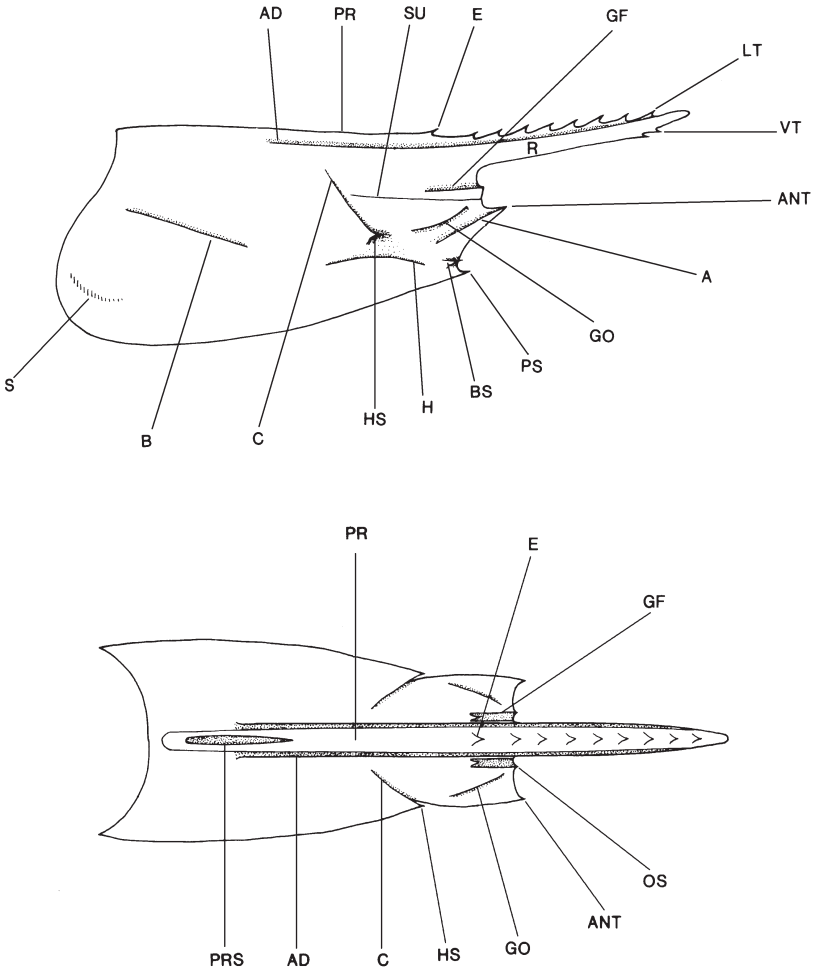


Figure 4. Key features of a penaeid prawn, lateral view above, dorsal view below (modified from Grey *et al*., 1983, Fig. 3). **A**, antennal carina and sulcus (above); **AD**, adrostral carina and sulcus; **ANT**, antennal spine; **B**, branchiocardiac carina and sulcus; **BS**, branchiostegal spine; **C**, cervical carina and sulcus; **E**, epigastric tooth; **GF**, gastrofrontal carina and sulcus; **GO**, gastro-orbital carina and sulcus; **H**, hepatic carina and sulcus; **HS**, hepatic spine; **LT**, last or distal rostral tooth; **OS**, orbital spine; **PR**, postrostral carina; **PRS**, postrostral sulcus; **PS**, pterygostomial spine; **R**, rostrum; **S**, serrated ridge (stridulating organ); **SU**, longitudinal suture, **VT**, ventral rostral tooth.

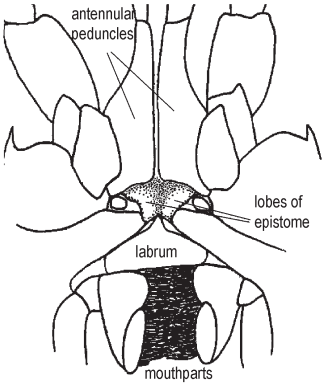


Figure 5. Position of epistome in caridean shrimps.

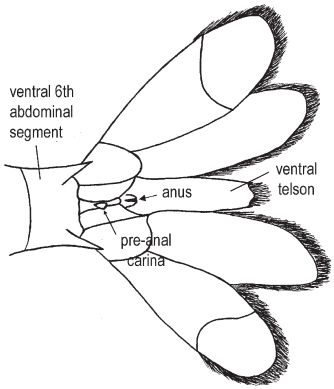


Figure 6. Location of pre-anal carina in caridean shrimps.

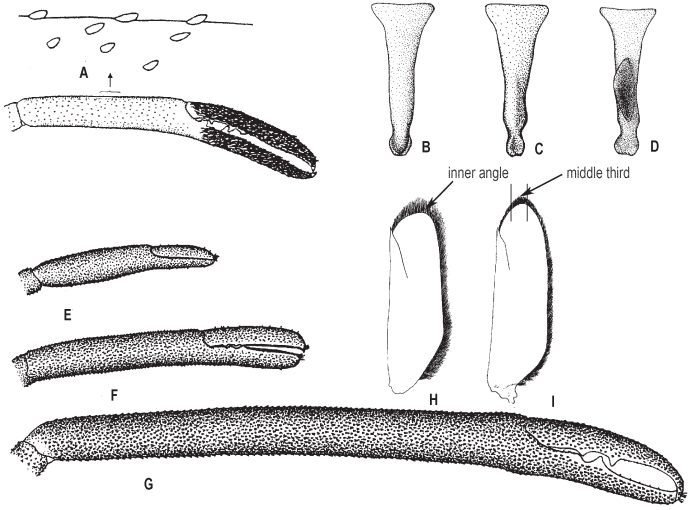


Figure 7. Selected morphological characters of *Macrobrachium* (family Palaemonidae): **A**, magnified view of tubercles on manus of developed male chela of *M. australiense*; **B**, ventral inter-uropodal sclerite without pre-anal carina; **C**, ventral inter-uropodal sclerite with low, rounded pre-anal carina; **D**, ventrolateral view of inter-uropodal sclerite showing high, well-developed pre-anal carina; **E**, undeveloped male chela of *M. tolmerum*; **F**, developing male chela of same; **G**, fully developed male chela of same; **H**, anterior margin of scaphocerite lamina projected forward at inner angle; **I**, anterior margin of scaphocerite lamina projected forward in middle third.

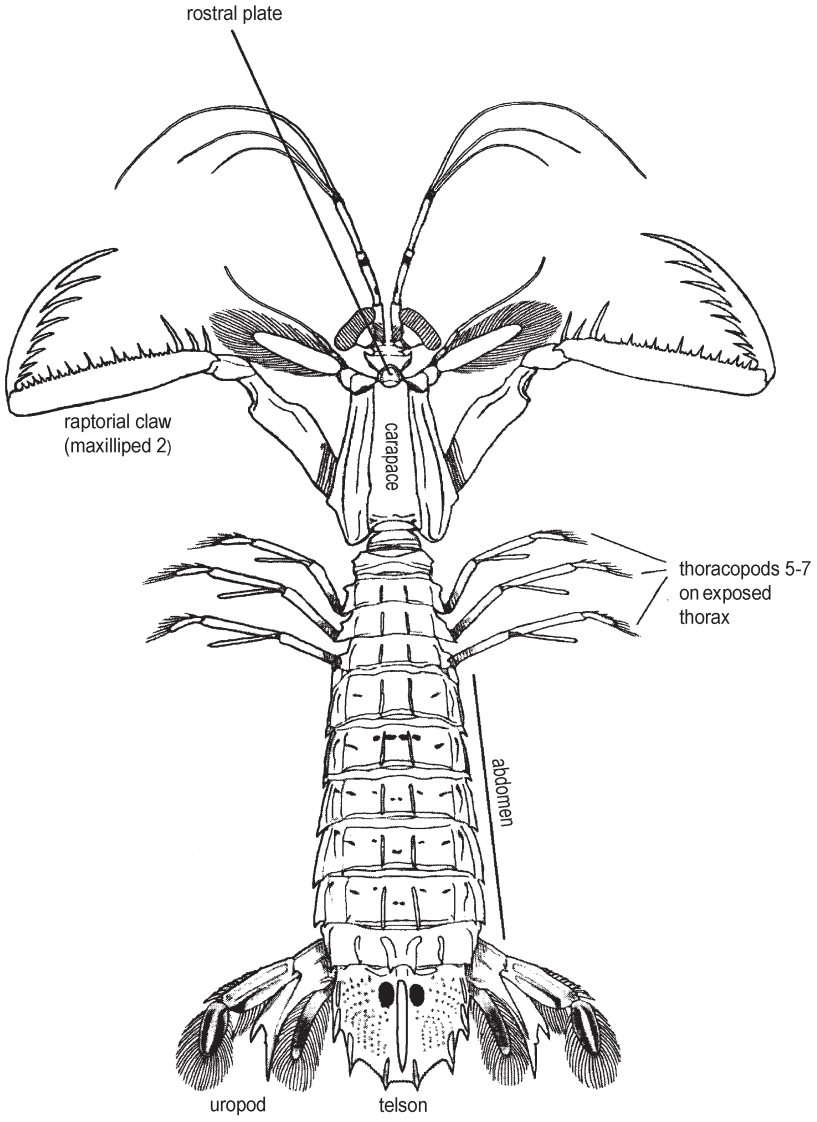


Figure 8. Key features of a stomatopod (based on Kemp's 1913 figure of *Squilla annandalei* (= *Harpiosquilla annandalei*)).

Key to Families

The following key covers the decapod and stomatopod shrimp families recorded from estuaries of the Mimika region.

1a Carapace covering all thoracic segments (Fig. 2); second maxilliped not developed as raptorial claw; last five pairs of thoracopods developed as legs (fourth and fifth pair lost in some Sergestidae). . . . . Order Decapoda **2**

1b Carapace short, exposing the last 4 or 5 thoracic segments (Fig. 8); second maxilliped very large and developed as raptorial claw (Fig. 8); last 3 pairs of thoracopods developed as legs. . . . . Order Stomatopoda . . . . . **Squillidae** (p. 22)

2a Pleuron of second abdominal segment overlapping first and third pleura (Fig. 9); well-developed appendix internae present on pleopods 2–5 and sometimes on male pleopod 1 (Fig. 70); fertilised eggs carried attached to swimmerets during incubation period (Fig. 9); gills phyllobranchiate. . . . . Caridean shrimps **3**

2b Pleuron of second abdominal segment not overlapping first and third pleura (Fig. 10); appendix internae present on male pleopod 2 only (absent in Penaeidae and Sergestidae); eggs released directly into the sea without incubation; gills dendrobranchiate. . . . . Dendrobranchiate shrimps **6**

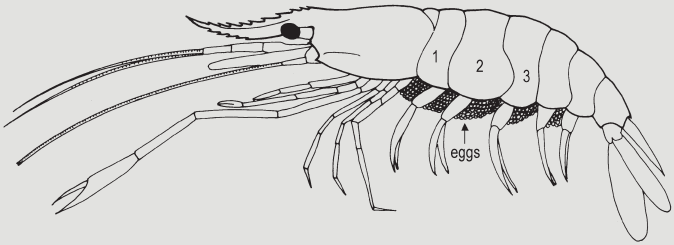


Figure 9. Ovigerous female caridean prawn showing eggs carried under abdomen (modified from Grey *et al*., 1983). First 3 abdominal pleura numbered – note second pleuron overlapping first and third.

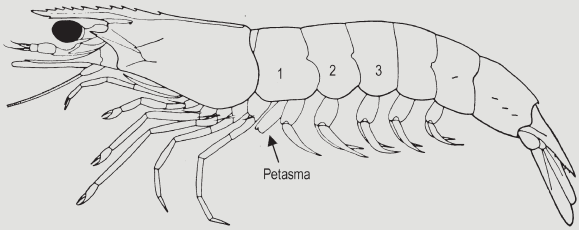


Figure 10. Male penaeid prawn, *Penaeus latisulcatus* (modified from Grey *et al*., 1983). First 3 abdominal pleura numbered – note first pleuron overlapping second which overlaps third. Male reproductive structure, the petasma, indicated on first pleopod.

3a First and second pereiopods more or less similar, of moderate size, carpus of second pereiopod undivided, fingertips with conspicuous tufts of setae (Fig. 11) . . . . . **Atyidae** (p. 50)

3b First and second pereiopods usually dissimilar, carpus of second pereiopod divided or undivided, fingertips without conspicuous tufts of setae **4**

4a Carpus of second pereiopod divided into 2 or more segments (Fig. 12). **5**

4b Carpus of second pereiopod undivided . . . . . **Palaemonidae** (p. 54)

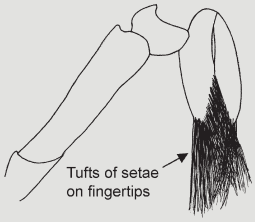


Figure 11. Tufts of setae on fingertips of chela of *Atyoida pilipes*.

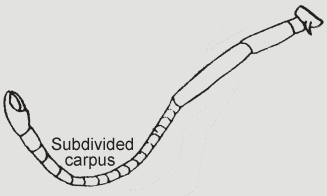


Figure 12. Divided carpus of generalised caridean cheliped (after Schmitt, 1921).

5a Eyes covered or partially covered by frontal margin of carapace (Fig. 13) . . . . . **Alpheidae** (p. 62)

5b Eyes fully exposed . . . . . **Hippolytidae** (p. 70)

6a Fourth and fifth pereiopods present; rostrum well developed, clearly over-reaching acron. . . . . **Penaeidae** (p. 28)

6b Fourth and fifth pereiopods absent, rostrum greatly reduced, not over-reaching acron (Fig. 14). . . . . **Sergestidae** (p. 48**)**

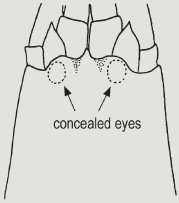


Figure 13. Concealed eyes in *Alpheus*.

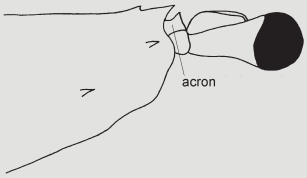


Figure 14. Anterior carapace and rostrum of *Acetes sibogae*.

SQUILLID MANTIS-SHRIMPS

Family Squillidae

Squillids are small to very large stomatopod Crustacea (to around 330 mm TL). Like other stomatopods, the carapace is short and the last 4 or 5 thoracic segments are exposed. The second maxillipeds are very large and developed as raptorial claws. The last 3 pairs of thoracopods are developed as legs. Squillid stomatopods have a depressed, compact body; T-shaped eyes with bilobed cornea; longitudinal carinae on the carapace, thorax, abdomen and medial telson; posterolateral margins of carapace rounded or deeply excavate; and second maxillipeds (raptorial claws) with the dactylus uninflated basally, inner dactylar margin bearing a series of spines, distal margin of ischiomerus articulating with carpus.

The Squillidae is by far the largest of the 19 stomatopod families. Around 44 genera are currently recognised worldwide. Although the majority of squillids prefer marine, subtidal habitats, some occur intertidally in lower estuarine areas. A number of squillids are of minor commercial importance to fisheries and are commonly part of the bycatch of prawn trawlers.

Key to the Estuarine Stomatopoda of the Mimika Region

1a. Raptorial claw propodus with irregularly spaced, erect spines (Fig. 15). . . . . ***Harpiosquilla harpax*** (De Haan) (p. 26)

1b. Raptorial claw propodus bluntly pectinate (Fig. 16). **2**

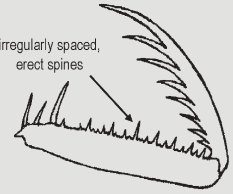


Figure 15. Distal raptorial claw of *Harpiosquilla annandalei* (modified from Kemp, 1913).

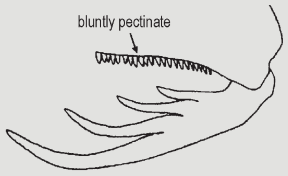


Figure 16. Distal raptorial claw of *Clorida depressa*.

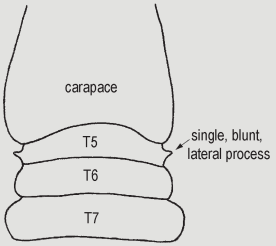


Figure 17. Thoracic somites 5–7 of *Clorida depressa* (Miers).

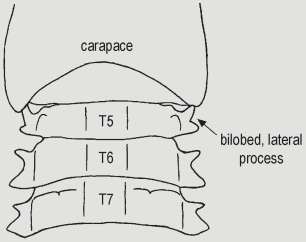


Figure 18. Thoracic somites 5–7 of *Oratosquillina interrupta* (Kemp).

2a. Single lateral process on fifth thoracic segment (Fig. 17); dactylus of raptorial claw with 4–5 spines; carapace with or without median carina, carina if present not bifurcate anteriorly; without dorsal pit on middle of carapace. **3**

2b. Bilobed lateral process on fifth thoracic segment (Fig. 18); dactylus of raptorial claw with 6 spines; carapace with discontinuous median carina, carina bifurcate anteriorly, dorsal pit present on middle of carapace behind anterior bifurcation of median carina (Fig. 20).
. . . . . ***Oratosquillina interrupta*** (Kemp) (p. 27)

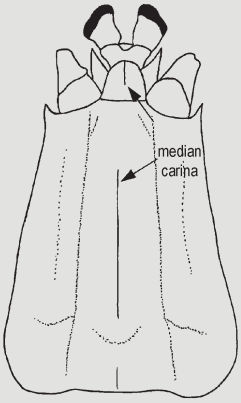


Figure 19. Carapace of *Cloridopsis terrareginensis* (Stephenson).

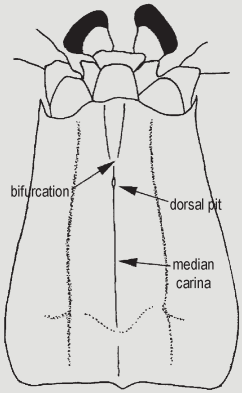


Figure 20. Carapace of *Oratosquillina interrupta* (Kemp).

3a. Carapace and distal rostral plate with median carina (Fig. 19).
. . . . . ***Cloridopsis terrareginensis*** (Stephenson) (p. 25)

3b. Carapace and rostral plate without median carina. . . . . ***Clorida depressa*** (Miers) (p. 24)

Australo-papuan Clorida

Clorida depressa

(Miers, 1880)

Shane Ahyong

Figure 21. Preserved specimen from Wellington Point, Queensland, Australia.

Diagnosis: Medium-sized, squillid species (up to 110 mm TL). Cornea of eye poorly developed, clearly narrower than maximum breadth of peduncle. Rostral plate short, broad, without median carina. Carapace with posterolateral margins rounded, without median carina, without dorsal pit. Mandibular palp present, usually 3-segmented. Raptorial claw with 4–5 spines on inner margin of dactylus; propodus pectinate on margin opposing dactylar spines; dorsal carina of carpus undivided; merus without inferodistal spine on outer face. Lateral process of fifth thoracic segment a short, blunt, laterally directed projection. Dorsal telson with well-developed, continuous median carina; with irregularly spaced, posterolateral tubercles. General body colour pale green or yellowish-green. Carapace, thoracic segments 6–8 and abdominal segments 1–5 with posterior margins dark grey to black.

Habitat and abundance: Large burrows in sandy-mud substrates from intertidal zone to about 10 m. In the Mimika region collected from mangroves in the West Ajkwa Estuary.

Distribution: Previously known from northern Australia.

Australo-papuan Cloridopsis

Cloridopsis terrareginensis

(Stephenson, 1953)

Shane Ahyong

Figure 22. Preserved specimen from Papua New Guinea.

Diagnosis: Medium-sized, squillid species (up to 100 mm TL). Cornea of eye moderately developed, broader than peduncle. Rostral plate long, median carina present. Carapace with posterolateral margins rounded; with discontinuous median carina, carina not bifurcate anteriorly; without dorsal pit on middle of carapace. Mandibular palp present, 2-segmented. Raptorial claw with 5 spines on inner margin of dactylus; propodus pectinate on margin opposing dactylar spines; dorsal carina of carpus undivided; merus without inferodistal spine on outer face. Fifth thoracic segment with broad, anteriorly or anterolaterally directed, sharply pointed, lateral process. Dorsal telson with well-developed, discontinuous median carina, without tubercles posterolaterally. In alcohol-preserved specimens, posterior margins of the thoracic and abdominal segments dark and distinctive black patch present at base of lateral process of the fifth thoracic segment.

Habitat and abundance: Burrows in mud substrates from intertidal zone to 25 m. Common on estuarine mudflats.

Distribution: Previously known from northern Australia and Papua New Guinea.

Notes: This species closely resembles the Asian species, *C. scorpio* (Latreille, 1828), which occurs as far east as western Indonesia and the Philippines, but differs in having a mandibular palp.

Common Harpiosquilla

Harpiosquilla harpax

(De Haan, 1844)

Gesang Setyadi

Figure 23.

Diagnosis: Large, squillid species (up to 262 mm TL). Cornea of eye very large, much broader than peduncle. Rostral plate long, with slender median projection, median carina absent. Carapace with posterolateral margins deeply excavate; median carina not bifurcate anteriorly. Raptorial claw with 8 spines on inner margin of dactylus; propodus with irregularly spaced, large and small erect spines on margin opposing dactylar spines; carpus without dorsal carina; merus without inferodistal spine on outer face. Mandibular palp present, 3-segmented. Fifth thoracic segment rounded laterally. Dorsal telson with well-developed median carina and conspicuous posterior spines, without tubercles posterolaterally. General body colour mottled light greenish-grey to grey-brown. Carinae and grooves of carapace as well as posterior margins of body somites, dark brown or black. Telson with carinae green, median carina bordered by pair of dark spots proximally, primary teeth on posterior margin yellow.

Habitat and abundance: Level, sandy-mud substrates in estuaries, bays and shallow coastal waters from the intertidal zone to about 90 m depth.

Distribution: Wide-ranging Indo-West Pacific: the Red Sea and western Indian Ocean to Taiwan, Japan, the Philippines, New Caledonia and Australia.

Notes: This is the most common and widely distributed species of the genus.

Bi-lobed Oratosquillina

Oratosquillina interrupta

(Kemp, 1911)

Shane Ahyong

Figure 24. Specimen from Taiwan.

Diagnosis: Moderately large, squillid species (up to 160 mm TL). Cornea of eye well developed, much broader than peduncle. Rostral plate long, median carina absent. Carapace with discontinuous median carina, carina bifurcate anteriorly; dorsal pit present behind anterior bifurcation of median carina. Raptorial claw with 6 spines on inner margin of dactylus; carpus with dorsal carina divided into two triangular lobes; merus with inferodistal spine on outer face. Mandibular palp present, 3-segmented. Fifth thoracic segment with bilobed lateral process, anterior lobe more strongly developed than posterior lobe. Dorsal telson with sharp, discontinuous median carina, without tubercles posterolaterally. General body colour pale olive green. Carapace grooves and posterior margin of body somites dark green. Median carina of carapace and submedian carinae of body segments dark red to green. Telson with carinae of primary teeth dark green, tips of teeth red; anterior median carina with large dark maroon spot.

Habitat and abundance: Level sand or mud substrates in bays and sheltered waters from intertidal zone to around 25 m. Commonly trawled in estuaries and inshore waters.

Distribution: Wide-ranging Indo-West Pacific: Persian Gulf to Taiwan, Hong Kong, Vietnam and Australia.

Notes: Highly distinctive among species of the genus in having two distinct lobes on the dorsal carina of the carpus of the raptorial claw.

COMMERCIAL PRAWNS

Family Penaeidae

Penaeids are small to large shrimps (up to 350 mm TL) with a thin to heavily calcified cuticle and a well-developed rostrum clearly overreaching the acron and eyestalks. The lower antennular flagellum of males lack a clasping organ and the gills are dendrobranchiate. All five pairs of pereiopods are well developed and the first three pairs are chelate. The posterior abdominal tergites are medially carinate and the second abdominal pleura do not overlap the first and third pleura. The pleopods lack appendix internae and the eggs are released directly into the sea without incubation.

The Penaeidae is the largest of seven recent families in the suborder Dendrobranchiata, with over 200 species in more than 20 genera. Although superficially resembling caridean shrimps, the Dendrobranchiata are an ancient group with a fossil record extending back to the late Devonian, about 360 million years ago.

Penaeids are found from shallow estuarine waters to the deep sea. Most are benthic and found on soft substrates such as mud or sand. Others are pelagic or found on coral reefs. Many species reach a suitable size for human consumption. Those that are active at night on soft-bottomed estuarine and inshore habitats are excellent target species for trawler fishermen and the family includes the most commercially important shrimp species. Cultivated penaeids are also of high commercial importance. The Giant Tiger Prawn, *Penaeus monodon,* which is moderately common in the Mimika region, reaches a large size and is widely cultivated throughout Asia. Females have been recorded up to 336 mm in total body length and a weight of 150 g.

Of the species occurring in the estuaries of the Mimika region, the Banana Prawn, *P. merguiensis*, is the most commonly caught and sold species locally. Juveniles of the Greasyback Prawn, *Metapenaeus ensis*, are also abundant in estuaries in the Mimika region. Muller (2006) reported that penaeid shrimps are heavily exploited along the Kamoro coast by shrimp boats operating out of Sorong and elsewhere.

Major changes to the generic classification of the family have been proposed by Pérez Farfante and Kensley (1997) and more recently by Sakai and Shinomiya (2011). The taxonomic changes in both of these studies are largely based on the morphology of the male and female genitalia. Pérez Farfante and Kensley's classification has been tested to a large degree by a number of independent molecular studies (Chan *et al*., 2008; Lavery *et al*., 2004; Ma *et al*., 2009, 2011; Voloch *et al*., 2005). In most cases, there has not been strong support for the new classification, although other groupings were revealed which had not previously been recognised in morphological taxonomic studies. For example, there is general agreement among molecular studies that *Penaeus* sensu lato comprises only two natural groups, grooved species (*Melicertus* and *Marsupenaeus* of Pérez Farfante and Kensley, 1997) and ungrooved species (*Penaeus*, *Farfantepenaeus, Fenneropenaeus* and *Litopenaeus* of Pérez Farfante and Kensley, 1997). Of the *Penaeus* sensu lato species occurring in the Mimika region, *P. latisulcatus* and *P. longistylus* are 'grooved' species and were assigned by Pérez Farfante and Kensley (1997) to *Melicertus*. The 'ungrooved' species occurring in the Mimika region are *P. merguiensis* (assigned to *Fenneropenaeus* by Pérez Farfante and Kensley) and *P. monodon*, the type species of *Penaeus* sensu stricto (sensu Pérez Farfante and Kensley, 1997).

Pérez Farfante and Kensley (1997) also split *Trachypenaeus* sensu lato into four genera. Of the two species occurring in the Mimika region, *T. curvirostris* was assigned to *Trachysalambria* by Pérez Farfante and Kensley (1997) and *T. gonospinifer* to *Megokris*.

Sakai and Shinomiya's recent splitting of *Parapenaeopsis* into nine genera has not yet been tested by molecular data. The three species occurring in the Mimika region were assigned to three different genera by Sakai and Shinomiya (2011): *P. cornuta* to *Kishinouyepenaeopsis*, *P. sculptilis* to *Mierspenaeopsis* and *P. tenella* to *Batepenaeopsis*.

Pending a new generic classification with strong support from both morphological and molecular data, I have taken a conservative approach and continued to use the older, more broadly defined genera *Penaeus*, *Trachypenaeus* and *Parapenaeopsis*.

Key to the Estuarine Penaeidae of the Mimika Region

1a Rostrum with ventral teeth (Fig. 25A) . . . . . *Penaeus* spp. **2**
1b Rostrum without ventral teeth (Fig. 25B) **5**
-

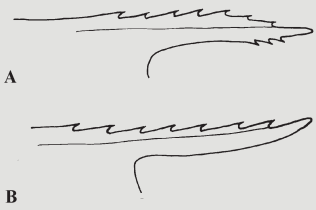


Figure 25. **A**, rostrum with ventral teeth; **B**, rostrum without ventral teeth (after Grey *et al*., 1983).

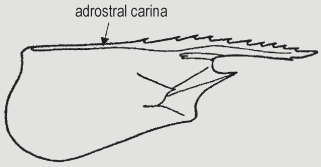


Figure 26. Cephalothorax of *Penaeus latisulcatus* Kishinouye (after Dall, 1957).

2a Adrostral carina almost reaching posterior border of carapace (Fig. 26); gastrofrontal carina present (Fig. 4) **3**
2b Adrostral carina not reaching behind middle of carapace; gastrofrontal carina absent **4**

3a Postrostral sulcus less than half length of carapace; distinct ischial spine present on pereiopod 1 (Fig. 29); red oval patch on each side of third abdominal segment.
. . . . . ***Penaeus longistylus*** Kubo (p. 43)
3b Postrostral sulcus more than half length of carapace; ischial spine indistinct or absent on pereiopod 1; abdomen without red patches on third segment . . . . ***Penaeus latisulcatus*** Kishinouye (p. 42)

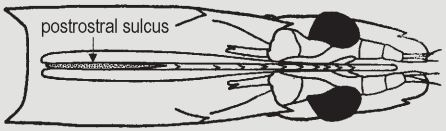


Figure 27. Postrostral sulcus in *Penaeus latisulcatus* Kishinouye (modified from Grey *et al*., 1983)

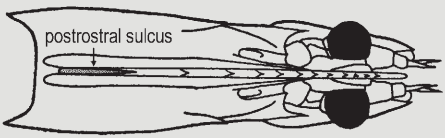


Figure 28. Postrostral sulcus in *Penaeus longistylus* Kubo (modified from Grey *et al*., 1983).

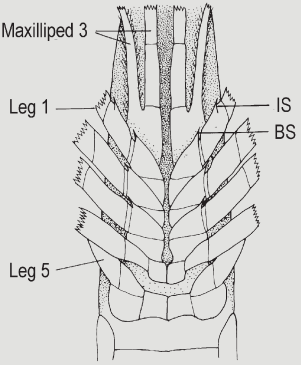


Figure 29. Position of ischial (IS) and basial (BS) spines (after Grey *et al*., 1983).

4a Hepatic carina (Fig. 30) prominent; body strongly banded (tiger prawn appearance), cross bands blue to black with white saddles . . . . . ***Penaeus monodon*** Fabricius (p. 45)

4b Hepatic carina indistinct or absent (Fig. 31); body yellow or green, semi-translucent, without banding, speckled with reddish-brown dots (banana prawn appearance).
. . . . . ***Penaeus merguiensis*** De Man (p. 44)

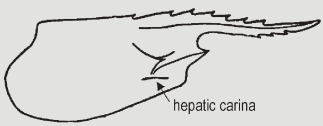


Figure 30. Cephalothorax of *Penaeus monodon* Fabricius (after Dall, 1957).

Figure 31. Cephalothorax of *Penaeus merguiensis* De Man (after Dall, 1957).

5a Exopods present on fifth pereiopods (Fig. 32). **6**

5b Exopods absent on fifth pereiopods. . . . . *Metapenaeus* spp. **11**

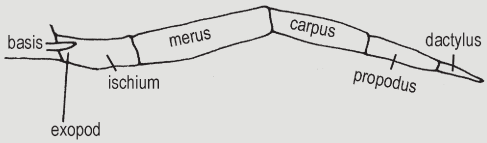


Figure 32. Location of exopod on fifth pereiopod (modified from Grey *et al*., 1983).

6a Ischial spine present on inner edge of second legs (Fig. 29); carapace without longitudinal sutures; body very smooth; eyes small and spherical. . . . . ***Atypopenaeus formosus*** (Dall) (p. 34)

6b Ischial spine absent on inner edge of second pereiopods; carapace with longitudinal sutures (may be short and obscured by pubescence) (Fig. 34); eyes large. **7**

Figure 33. Cephalothorax of *Atypopenaeus formosus* (Dall) (after Dall, 1957).

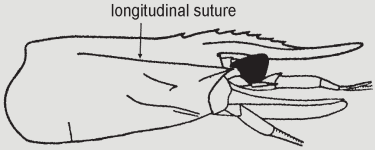


Figure 34. Longitudinal suture on *Parapenaeopsis sculptilis* (Heller) (modified from Dall, 1957).

7a Carapace and abdomen with dense pubescence (greasyback); cuticle thick.
. . . . . *Trachypenaeus* spp. **8**

7b Abdomen without pubescence; cuticle thin . . . . . *Parapenaeopsis* spp. **9**

8a Rostrum fairly deep, lower border convex, at least to some extent (Fig. 35); in adult females, thelycum without large median spine on anterior plate; body pink to reddish-brown, legs whitish, tips of uropods red. . . . . ***Trachypenaeus curvirostris*** (Stimpson) (p. 46)

8b Rostrum slender, lower border concave; in adult females, thelycum with large median spine on anterior plate (Fig. 36); body translucent, faintly pink, appendages, telson, uropods and rostrum

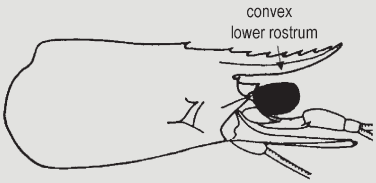


Figure 35 Cephalothorax of *Trachypenaeus curvirostris* (Stimpson) (after Dall, 1957).

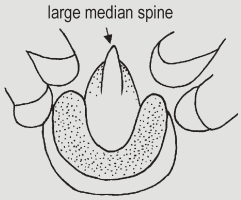


Figure 36. Thelycum of *Trachypenaeus gonospinifer* Racek and Dall.

transparent. . . . . ***Trachypenaeus gonospinifer*** Racek and Dall (p. 47)

9a Longitudinal sutures well defined and reaching three quarters length of carapace (Fig. 34); in males, petasma with spout-like projections (Fig. 37); four whitish transverse bands evenly spaced along body with pink and brown bands in between . . . . . ***Parapenaeopsis sculptilis*** (Heller) (p. 40)

9b Longitudinal sutures not exceeding two thirds length of carapace, sometimes not easily visible; in

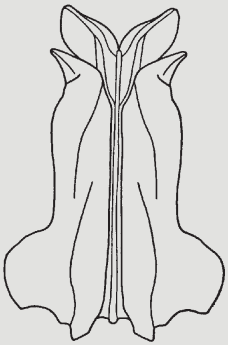


Figure 37. *Parapenaeopsis sculptilis* (Heller) petasma (after Grey, 1957).

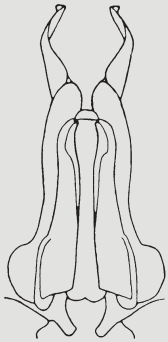


Figure 38. *Parapenaeopsis cornuta* (Kishinouye) petasma (after Grey et al., 1983)

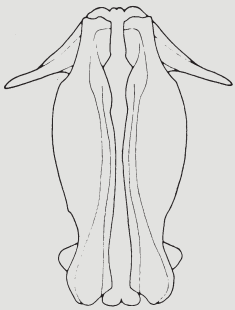


Figure 39 *Parapenaeopsis tenella* (Spence Bate) petasma (after Grey *et al*., 1983).

males, petasma without spout-like projections **10**

10a Longitudinal suture not exceeding half length of carapace; body faintly pink with transverse blue-brown bands . . . . . ***Parapenaeopsis cornuta*** (Kishinouye) (p. 39) [petasma illustrated in Fig. 38]

10b Longitudinal sutures reaching 2/3 length of carapace; body translucent to pale brown with faint brown transverse bands on abdomen . . . . . ***Parapenaeopsis tenella*** (Spence Bate) (p. 41)

[petasma illustrated in Fig. 39]

11a Dorsal rostrum without teeth on distal third (Fig. 40) or with single tooth widely separated from remaining teeth **12**

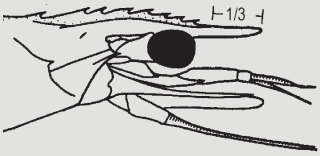


Figure 40. Rostrum of *Metapenaeus eboracensis* Dall (modified from Dall, 1957).

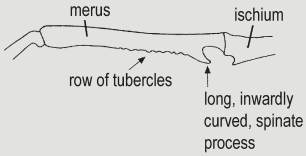


Figure 41. Merus and ischium of male fifth pereiopod in *Metapenaeus ensis* (De Haan) (after Miquel, 1982).

11b Dorsal rostrum with more than one tooth on distal third. **13**

12a Distal third of rostrum typically without teeth (Fig. 40); in adult females, lateral plates of thelycum much larger than anterior plate (Fig. 42A); in adult males, distolateral projections of petasma slender (Fig. 42B) . . . . . ***Metapenaeus eboracensis*** Dall (p. 36)

12b Distal third of dorsal rostrum typically with single tooth, tooth widely separated from remaining teeth; in adult females, lateral plates of thelycum much smaller than anterior plate (Fig. 43A); in adult males, distolateral projections of petasma broad (Fig. 43B).
. . . . . ***Metapenaeus demani demani*** (Roux) (p. 35)

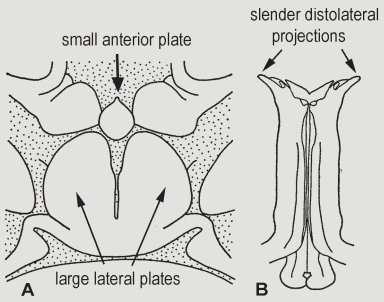


Figure 42. Reproductive structures in *Metapenaeus eboracensis* Dall. **A**, thelycum; **B**, petasma. After Dall (1957).

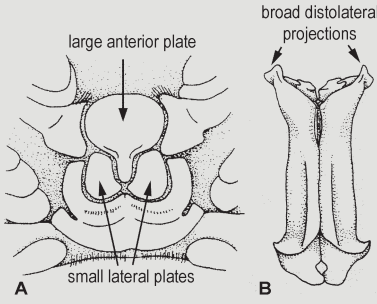


Figure 43. Reproductive structures in *Metapenaeus demani* (R(oux). **A**, thelycum; **B**, petasma. After Miquel (1982).

13a Second and third abdominal segments with distinct dorsal carina; proximal merus of male fifth pereiopod with long, inwardly curved, spinate process followed by distinct row of tubercles (Fig. 41); moderately large species, females reaching maximum size of 190 mm TL, males 155 mm TL. . . . . ***Metapenaeus ensis*** (De Haan) (p. 37)

13b Second and third abdominal segments without dorsal carina; merus of male fifth pereiopod with short blunt process, without row of tubercles; medium-sized species, maximum size less than 100 mm TL . . . . . ***Metapenaeus papuensis*** Racek and Dall (p. 38)

Orange Prawn

Atypopenaeus formosus

(Dall, 1957)

Figure 44.

Diagnosis: Medium-sized, penaeid species (up to 100 mm TL). Cornea of eye small. Rostrum reaching between distal antennular peduncle and distal end of antennal scale or slightly beyond, slender, upcurved, 6–9 (1 epigastric) dorsal teeth; ventral margin unarmed; adrostral carina indistinct; adrostral sulcus absent; postrostral carina indistinct, not reaching more than ½ carapace length. Body smooth, without pits or dense pubescence. Carapace without longitudinal sutures; orbital spine small and blunt; hepatic and antennal spines conical; pterygostomial spine absent; hepatic carina distinct anterior to hepatic spine; antennal carina absent; postocular sulcus very deep, sigmoidal in lateral view; cervical sulcus short, poorly defined; hepatic sulcus absent; branchiocardiac sulcus at most feebly developed. Pereiopods 1–2 with ischial spine mesially; pereiopods 2–3 with basial spines; pereiopod 5 slender and very elongate, much longer than preceding pereiopods, exopod present. Thelycum with paired, distinctly separated, long, flap-like, lateral plates. Petasma with large, rounded, knob-like, distal processes. Abdominal segments 4–6 with high dorsal carina ending in an acute spine. Telson unarmed, without fixed spines near tip. Body and appendages bright pink to orange-pink in colour.

Habitat and abundance: Inshore waters to 30 m depth, generally on soft mud. Uncommon in the Mimika region.

Distribution: New Guinea and northern Australia.

Other names: Udang krosok kuning, apolo (Indonesia); orange shrimp (FAO); go home prawn (Australia).

Greentail Prawn

Metapenaeus demani demani

(J. Roux, 1921)

Abdul Haris

Figure 45. Frozen specimen.

Diagnosis: Medium-sized, penaeid species (up to 121 mm TL). Cornea of eye large. Rostrum slender, sigmoidal; 7–8 (1 epigastric) dorsal teeth, subapical tooth generally widely separated from remaining teeth by edentate region; ventral margin unarmed; adrostral carina well defined; adrostral sulcus indistinct, ending just below epigastric tooth; postrostral carina broad and low, reaching almost to posterior carapace margin. Body smooth, without pits or dense pubescence, occasionally with scarce and short tomentum. Carapace without longitudinal sutures; orbital spine and pterygostomial spines absent; antennal and hepatic spines well developed; gastrofrontal, branchiocardiac and hepatic sulci poorly defined; postocular sulcus deep; orbito-antennal and cervical sulci distinct; branchiocardiac carina indistinct anteriorly; gastro-orbital carina absent; antennal carina poorly developed. Pereiopod 1 with minute, usually blunt, ischial spine; pereiopods 1–3 with basial spine; pereiopod 5 elongated, without exopod, male merus armed with keeled, triangular tooth. Anterior plate of thelycum large, rounded anteriorly, much larger than lateral plates. Distolateral projections of petasma expanded distally. Abdominal segments 4–6 dorsally carinate, segment 6 terminating in dorso-median tooth. Telson with single row of minute moveable spines near tip. Body translucent, speckled with greenish-grey, antennal flagella and pleopods reddish.

Habitat and abundance: Abundant in river mouth trawls and upper estuarine, electroshocking sites in the Mimika region.

Distribution: Southwest New Guinea and northwest Australia.

Other names: Demon shrimp (FAO); demon prawn (Australia).

York Prawn

Metapenaeus eboracensis

Dall, 1957

Figure 46.

Diagnosis: Medium-sized, penaeid species (up to 111 mm TL). Cornea of eye large. Rostrum reaching or slightly exceeding tip of antennular peduncle, sigmoidal; 7–8 (1 epigastric) dorsal teeth, teeth subequally spaced proximally, distal third edentate; ventral margin unarmed; adrostral carina well developed; adrostral sulcus shallow, poorly defined; postrostral carina broad and low. Body with pubescent patches small and widely spaced. Carapace without longitudinal sutures; antennal and hepatic spines well developed, orbital and pterygostomial spines absent; branchiocardiac, cervical, gastrofrontal, hepatic, orbito-antennal and postocular sulci present, postocular sulcus deep; branchiocardiac and antennal carinae present, gastro-orbital carina absent. Pereiopod 1 without ischial spine; pereiopods 1–3 with basial spine; pereiopod 5 of normal length, exopod absent, male merus with small tubercle only, without spinate process. Anterior plate of thelycum small, with bluntly pointed anterior end, lateral plates enlarged, much larger than anterior plate. Distolateral projections of petasma slender. Abdominal segments 4–6 dorsally carinate. Telson with single row of minute moveable spines near tip, without fixed spines. Body semi-translucent, speckled with brown or green.

Habitat and abundance: Inshore mud or sandy mud substrates to 30 m depth. Abundant in river mouth trawls and occasionally collected from upper estuarine, electroshocking sites in the Mimika region.

Distribution: Central Indo-West Pacific: eastern Timor Sea, Arafura Sea, New Guinea and northern Australia.

Other names: Udang dogol, udang api-api (Indonesia); york shrimp (FAO).

Greasyback Prawn

Metapenaeus ensis

(De Haan, 1844 [in De Haan, 1833–1850])

Figure 47.

Diagnosis: Moderately large, penaeid species (up to 190 mm TL). Cornea of eye large. Rostrum extending to about tip of antennular peduncle, dorsal margin almost straight, 9–11 (1 epigastric) dorsal teeth, dorsal teeth subequally spaced; ventral margin unarmed; adrostral carina ending between epigastric and first rostral tooth; adrostral sulcus reaching ⅓–½ carapace length; postrostral carina distinct, continuing to posterior border of carapace. Body with extensive pubescence (greasyback) continuing well down sides of carapace, extensive on abdominal pleura. Carapace without longitudinal sutures; orbital and pterygostomial spines absent; antennal and hepatic spines well developed; postocular, orbito-antennal, cervical and hepatic sulci present; branchiocardiac sulcus indistinct; branchiocardiac and antennal carinae present; gastro-orbital carina absent. Pereiopod 1 generally with small ischial spine (indistinct in juveniles); pereiopods 1–3 with basial spine; pereiopod 5 of normal length, exopod absent, male merus with long inwardly curved spinate process followed by distinct row of tubercles. Anterior plate of thelycum tongue shaped, lateral plates ear shaped. Petasma with very large, parallel, distomedian projections. Abdominal segments 2–6 with distinct dorsal carina. Telson with single row of minute moveable spines near tip. Body greyish-green, dark green, pale brown or light to bright pink, legs pink to red, uropods red.

Habitat and abundance: Prefers mud or sandy mud substrates. Juveniles abundant in estuaries of the Mimika region.

Distribution: Indo-West Pacific: eastern India and Sri Lanka to Japan and Australia.

Other names: Udang dogol, udang berus (Indonesia); red endeavour prawn (Australia).

Papuan Prawn

Metapenaeus papuensis

(Racek and Dall, 1965)

Gesang Setyadi

Figure 48.

Diagnosis: Medium-sized, penaeid species (up to 98 mm TL). Cornea of eye large. Rostrum reaching to around tip of antennular peduncle, distinctly upturned in distal third in adult females, less so in adult males; dorsal margin dentate along entire length, teeth subequally spaced, 10–11 (1 epigastric) teeth; ventral margin unarmed; adrostral carina extending from epigastric to penultimate rostral tooth; adrostral sulcus extending past epigastric tooth; postrostral carina distinct, continuing to one tenth carapace length from posterior carapace border. Pubescence on body restricted to dorsal carapace and fifth (sometimes sixth) abdominal pleurae. Carapace without longitudinal sutures; orbital and pterygostomial spines absent; antennal and hepatic spines well developed; postocular, orbito-antennal, cervical and hepatic sulci present; branchiocardiac sulcus short; gastrofrontal sulcus poorly defined; branchiocardiac and antennal carinae present; gastro-orbital carina absent. Pereiopod 1 with minute, usually blunt, ischial spine; pereiopods 1–3 with basial spine; fifth pereiopod of normal length, exopod absent, male merus with short blunt process, without row of tubercles. Thelycum with ear-shaped lateral plates, each with well developed lateral carina. Petasma with distomedian projections more or less separated into two anteriorly directed, hood-like lobes. Abdominal segments 4–6 with distinct dorsal carinae, carinae terminating in a sharp tooth. Telson with single row of minute moveable spines near tip, without fixed spines.

Habitat and abundance: Uncommon in estuaries of the Mimika region.

Distribution: Previously known from the Gulf of Papua and Hercules Bay, Papua New Guinea.

Coral Prawn

Parapenaeopsis cornuta

(Kishinouye, 1900)

Figure 49.

Diagnosis: Medium-sized, penaeid species (up to 112 mm TL). Cornea of eye large. Rostrum failing to reach tip of antennular peduncle, sigmoidal; distal half of dorsal margin unarmed, 7–8 (1 epigastric) teeth; ventral margin unarmed; adrostral carina ending halfway between first and second rostral tooth, adrostral sulcus shallow, postrostral carina distinct, continuing to one tenth carapace length from posterior carapace border. Body minutely pitted, without pubescence. Carapace with longitudinal sutures, sutures rather indistinct, reaching about ½ length of carapace; antennal, hepatic and orbital spines present; pterygostomial spine absent; branchiocardiac, cervical and hepatic sulci present; postocular sulci present, sometimes very indistinct; hepatic and antennal carinae present. Pereiopods 1–2 without ischial spine but with basial spine (small basial spine on pereiopod 3 in males); pereiopod 5 of normal length, exopod present. Posterior process of thelycum without median boss, tuft of dark setae present immediately behind thelycum. Petasma with slender calliper-like projections, tip of projection with small dorsal spiniform process. Abdominal segments 4–6 dorsally carinate. Telson without pair of fixed spines near tip. Body faintly pink with transverse blue-brown bands.

Habitat and abundance: Inshore to 40 m depth, often over mud or sandy mud substrates. Uncommon in the Mimika region.

Distribution: Indo-West Pacific: India to Japan, New Guinea and Northern Australia.

Other names: Udang krosok belang, udang pasir (Indonesia); coral shrimp (FAO).

Rainbow Prawn

Parapenaeopsis sculptilis

(Heller, 1862)

Figure 50.

Diagnosis: Moderately large, penaeid species (up to 170 mm TL). Cornea of eye large. Rostrum sexually dimorphic, failing to reach tip of antennular peduncle in mature males, curving downwards, dentate along length, reaching beyond antennular peduncle in mature females, sigmoidal; dorsal margin unarmed in distal ½, strongly upcurved, 7–9 (1 epigastric) teeth; ventral margin unarmed. Body minutely pitted, without pubescence. Carapace with distinct longitudinal sutures, sutures reaching ¾ length of carapace; antennal, hepatic and orbital spines present; pterygostomial angle sharp, spine absent; branchiocardiac (feeble indication only), cervical and hepatic sulci present; hepatic and antennal carina present. Pereiopods 1–2 without ischial spine; pereiopod 5 of normal length, exopod present. Petasma with spout-like projections. Abdominal segments 4–6 dorsally carinate, segments 4–5 ending in angular, sometimes minutely spinate projections, segment 6 ending in large spine. Telson without pair of fixed spines near tip. Four whitish transverse bands evenly spaced along body with pink and brown bands in between.

Habitat and abundance: Inshore to 90 m depth on sand to fine mud substrates. Occasionally collected in lower estuarine trawls in the Mimika region.

Distribution: Indo-West Pacific: India to Hong Kong, New Guinea and northern Australia.

Other names: Udang belang, udang loreng (Indonesia); rainbow shrimp (FAO); Jakarta rainbow prawn.

Smooth Shell Prawn

Parapenaeopsis tenella

(Spence Bate, 1888)

Figure 51.

Diagnosis: Small penaeid species (up to 44 mm TL). Cornea of eye large. Rostrum failing to reach tip of antennular peduncle, almost straight; 6–8 (epigastric absent) dorsal teeth; ventral margin unarmed; adrostral carina ending at ¼ carapace length; postrostral carina ending at ½ carapace length. Body minutely pitted, without pubescence. Carapace with longitudinal sutures, sutures reaching ⅔ length of carapace; orbital angle acute without spine; antennal spine and hepatic spines present; pterygostomial angle sharp, spine absent; postocular sulcus present; cervical sulcus feeble, wide; hepatic sulcus present; antennal and hepatic carinae present. Pereiopods 1–2 without ischial spine; pereiopod 5 of normal length, exopod present. Prominent tuft of dark setae present immediately behind thelycum. Petasma with slender tapering, backward-slanting projections. Abdominal segments 4–6 dorsally carinate. Telson without pair of fixed spines near tip. Body generally translucent to pale brown with brown spots often forming a faint brown transverse band on each segment of the abdomen.

Habitat and abundance: Inshore to 35 m depth on mud or sandy mud substrates. Occasionally collected in lower estuarine trawls in the Mimika region.

Distribution: Indo-West Pacific: Pakistan to Japan, New Guinea and northern Australia.

Other names: Udang lemah (Indonesia).

Western King Prawn

Penaeus latisulcatus

Kishinouye, 1896

Figure 52.

Diagnosis: Moderately large, penaeid species (up to 202 mm TL). Cornea of eye large. Rostrum reaching tip of antennular peduncle, almost straight; 8–11 dorsal teeth, 1–2 ventral teeth; with minute accessory carina in large specimens; adrostral carina extending to one fifteenth carapace length from posterior carapace margin; adrostral sulcus slightly wider than postrostral carina; postrostral sulcus present, at least half length of carapace. Body smooth, without pits or dense pubescence. Carapace without longitudinal sutures; antennal and hepatic spines well developed; pterygostomial spine absent; postocular sulcus absent; gastrofrontal sulcus present, divided in two posteriorly; gastrofrontal and hepatic carinae present. Pereiopod 1 with ischial spine indistinct or absent; pereiopods 1–2 with reduced basial spine; pereiopod 5 of normal length, with exopod. Thelycum with overlapping lateral plates, anterior plate with acute distolateral projections. Petasma with distomedian projections short, slightly overhanging distal margin of costae. Abdominal segments 4–6 dorsally carinate, segment 6 ending in a spine. Telson with 3–4 pairs of conspicuous moveable spines near tip. Body generally light yellow to brown, without crossbands, legs light blue.

Habitat and abundance: Continental shelf to 90 m depth on sand, sandy mud or gravel. Uncommon in the Mimika region.

Distribution: Indo-West Pacific: Red Sea and southeast Africa to Japan, New Guinea and Australia.

Other names: Udang raja, udang kembang (Indonesia); blue-legged king prawn (Australia).

Red Spot King Prawn

Penaeus longistylus

Kubo, 1943

Figure 53.

Diagnosis: Moderately-large, penaeid species (up to 180 mm TL). Cornea of eye large. Rostrum reaching to around tip of antennular peduncle, slightly sigmoidal, 10–13 dorsal teeth, 1 ventral tooth; postrostral carina extending to ⅓ carapace length; postrostral sulcus present, less than half length of carapace; adrostral carina ending at one tenth carapace length from posterior carapace margin; adrostral sulcus twice width of postrostral carina. Body smooth, without pits or dense pubescence. Carapace without longitudinal sutures; antennal and hepatic spines well developed; pterygostomial spine absent; postocular sulcus absent; gastrofrontal sulcus present, divided in two posteriorly; gastrofrontal and hepatic carinae present. Pereiopod 1 with well developed ischial spine; pereiopods 1–2 with reduced basial spine; pereiopod 5 of normal length; with exopod. Thelycum with divided plate. Petasma with short distomedian projections not overhanging distal margin of costae. Abdominal segments 4 and 5 dorsally carinate. Telson with 3–4 pairs of conspicuous spines near tip. Body translucent with postero-ventral band of red on carapace, distinctive large red oval patch on third abdominal pleura, narrow red-blue bands on lower lateral portions of abdominal segments.

Habitat and abundance: Usually found on hard substrates near reefs. Occasionally collected from lower estuarine trawls in the Mimika region.

Distribution: Central Indo-West Pacific: South China Sea, Malaysia, Indonesia, southern New Guinea, northern Australia and Lord Howe Island.

Other names: Udang raja ceplok merah (Indonesia).

Banana Prawn

Penaeus merguiensis

De Man, 1888

Figure 54.

Diagnosis: Moderately large, penaeid species (up to 240 mm TL). Cornea of eye large. Rostrum clearly exceeding tip of antennular peduncle in juveniles and young adults, shorter than antennular peduncle in large adults, with prominent, broadly triangular, basal crest in large adults, 5–8 dorsal teeth, 2–5 ventral teeth; adrostral carina not reaching behind middle of carapace; adrostral groove shallow, ceasing at about level of epigastric tooth; postrostral carina ending in posterior one fifth of carapace. Body smooth, without pits or dense pubescence, integument thin. Carapace without longitudinal sutures; antennal and hepatic spines present; orbital and pterygostomial spines absent; orbito-antennal sulcus wide and ill defined; cervical sulcus present; postocular sulcus absent; gastro-orbital carina absent or feeble; branchiocardiac and gastrofrontal carinae absent; antennal carina present; hepatic carina indistinct or absent. Pereiopod 1 with well-developed ischial spine; pereiopods 1–2 with basial spine. Thelycum with large lateral plates forming thick mesial lips meeting along midline. Petasma with short distomedian projections. Abdominal segments 4–6 dorsally carinate in large specimens. Telson without spines near tip. Body yellow (small specimens) or green (large specimens), semi-translucent, finely speckled with reddish-brown dots.

Habitat and abundance: Abundant in lower estuarine trawls in the Mimika region.

Distribution: Indo-West Pacific: Persian Gulf to Hong Kong, New Caledonia and northern Australia.

Other names: Udang jerbung (Indonesia); kauwani, nepani or bepani (Kamoro); me awauni (Nawaripi); urumoko (Atuka).

Giant Tiger Prawn

Penaeus monodon

Fabricius, 1798

Figure 55.

Diagnosis: Large penaeid species (up to 336 mm TL). Cornea of eye large. Rostrum exceeding tip of antennular peduncle, sigmoidal, 7–8 dorsal teeth, 2–3 ventral teeth; adrostral carina reaching to or almost to epigastric tooth; adrostral sulcus deep; postrostral carina reaching to or almost to posterior border of carapace, at most with feeble postrostral sulcus. Body smooth, without pits or dense pubescence. Carapace without longitudinal sutures; antennal and hepatic spines well developed; pterygostomial spine absent; postocular sulcus absent; cervical sulcus shallow; orbito-antennal sulcus well defined; hepatic sulcus poorly defined; gastro-orbital, gastrofrontal and hepatic carinae present. Pereiopod 1 with ischial spine; pereiopods 1–2 with basial spine; pereiopod 5 of normal length, without exopod. Thelycum with sub-oval lateral plates with tumid lips mesially, anterior process concave, bluntly pointed posteriorly. Petasma with distomedian projections slightly overhanging distal margin of costae. Abdominal segments 4–6 dorsally carinate. Telson without spines near tip. Body generally dark, carapace and abdomen transversely banded, crossbands blue to black with white saddles. Juveniles with distinctive longitudinal dorsal stripe from rostrum to sixth abdominal segment.

Habitat and abundance: Moderately common in lower estuarine trawls in the Mimika region.

Distribution: Indo-West Pacific: eastern Africa to Japan, New Guinea and northern Australia.

Other names: Udang windu, udang pacet (Indonesia); bepani (Kamoro, Atuka); me mimaperetia (Nawaripi); jumbo tiger prawn, blue tiger prawn, black tiger prawn, leader prawn, panda prawn.

Southern Rough Prawn

Trachypenaeus curvirostris

(Stimpson, 1860)

Figure 56.

Diagnosis: Medium-sized, penaeid species (up to 100 mm TL). Cornea of eye large. Rostrum failing to reach tip of antennular peduncle, lower border convex, at least to some extent, dorsal carina upturned to varying degrees; 7–10 dorsal teeth (1 epigastric); ventral margin unarmed. Body stout, with well-developed pubescence (greasyback), cuticle thick and rigid. Carapace with longitudinal sutures, sutures sometimes obscured by dense pubescence; hepatic sulcus present. Pereiopod 1 with small ischial spine; pereiopod 5 of normal length, exopod present. Thelycum without distinct median depression on posterior plate, anterior plate without large median spine. Petasma with pair of laterally directed, wing-like extensions. Abdominal segments 4–6 dorsally carinate; small dorsomedian tubercle on segment 2. Telson without pair of fixed spines near tip. Body pink to reddish-brown with whitish legs, tips of uropods red.

Habitat and abundance: Continental shelf, 13–150 m depth, generally on muddy sand. Uncommon in the Mimika region.

Distribution: Indo-West Pacific: eastern Africa and Red Sea to Indonesia, New Guinea and northern Australia. Also occurs through the Suez Canal to the Mediterranean (Egypt, Israel and Turkey).

Other names: Udang krosok kuning (Indonesia); southern rough shrimp (FAO); hardback prawn.

Notes: May be confused with *T. granulosus* and *T. fulva* but differs in having a hepatic groove on the carapace.

Northern Rough Prawn

Trachypenaeus gonospinifer

Racek and Dall, 1965

Figure 57.

Diagnosis: Small penaeid species (up to 74 mm TL). Cornea of eye large. Rostrum not reaching tip of antennular peduncle, slender, dorsal carina convex, 8–10 dorsal (1 epigastric) teeth, ventral margin unarmed, concave. Body covered in pubescence (greasyback), cuticle thick and rigid. Carapace with longitudinal sutures, sutures obscured by dense pubescence. Pereiopod 1 with small ischial spine; pereiopods 1–2 with basial spine, pereiopod 5 elongate, slender, exopod present. Thelycum with large median spine on anterior plate. Petasma with very broad distolateral projections. Abdominal segments 3–6 dorsally carinate; dorsomedian tubercle on segment 2; segments 4–5 with posteromedian notch dorsally and 2 acute processes on either side; segment 6 with small median tooth. Telson without pair of fixed spines near tip. Body translucent, faintly pink.

Habitat and abundance: Widespread on continental shelf from 13–52 m depth on muddy substrates. Uncommon in the Mimika region.

Distribution: New Guinea and northern Australia.

Other names: Northern rough shrimp (FAO); hardback prawn (Australia).

PASTE SHRIMPS

Family Sergestidae

Sergestids are small or microscopic shrimps (mostly less than 5 cm TL) with a thin, often very soft cuticle and poorly developed rostrum (sometimes absent) failing to over-reach the acron. A clasping organ is present on the lower antennular flagellum of males and the gills are dendrobranchiate. The first pereiopods are chelate or non-chelate, the second and third pereiopods usually minutely chelate and the fourth and fifth pereiopods generally reduced or absent. The second abdominal pleura do not overlap the first and third abdominal pleura. The first to fifth abdominal tergites are non-carinate and the sixth tergite is weakly carinate medially. All pleopods lack appendix internae and the eggs are released directly into the sea without incubation.

This cosmopolitan family includes over 80 species in six genera. Most representatives of the family are marine and occur from shallow water to depths of over 2100 m. Species of the genera *Sergia* and *Sergestes* are able to produce light using either special internal organs (organs of Pesta) or from photophores just under the cuticle.

Species of the tropical/subtropical genus *Acetes* are of moderate commercial importance. Although small in size, they are seasonally abundant in lower estuaries and inshore waters. Large quantities are marketed in southeast Asian countries. They are sold fresh, boiled, dried, salted, processed as shrimp sauce, or fermented with salt and made into a paste – hence the common name for the family, 'paste shrimps'.

Only one species, the Alamang Shrimp, *Acetes sibogae* Hansen, 1919, has been recorded from the Mimika region.

Alamang Shrimp

Acetes sibogae

Hansen, 1919

Figure 58.

Diagnosis: Medium-sized, sergestid species, (up to 34 mm TL). Cornea of eye well developed. Rostrum very short, clearly shorter than eyestalks, acute, with 2 dorsal teeth, ventrally unarmed. Lower antennular flagellum with 20 segments or less in females, 12 segments or less in males. Body smooth, without pits or dense pubescence. Carapace with supraorbital and hepatic spines; branchiostegal and pterygostomial spines absent. Third thoracic sternite with pair of small protuberances. Pereiopods 1–3 with minute chelae; pereiopods 4–5 absent; distal inner margin of basis of pereiopod 3 ending in projection or small tooth; anterior margin of genital coxa (paired protuberance on sternum between third legs and first pleopods) pointed. Curved tooth absent between bases of first male pleopods. Abdominal somites rounded dorsally. Telson without spines, apex triangular. Body translucent with pink blotches on anterolateral carapace, abdominal pleura and uropods.

Habitat and abundance: Epipelagic, marine, 0–55 m, generally over muddy substrates. Abundant in lower estuarine trawls in the Mimika region.

Distribution: Indo-West Pacific: southwest India to the Philippines and Australia.

Other names: Bubok (western Borneo); alamang (the Philippines).

Notes: Although several subspecies of *A. sibogae* have sometimes been recognised, their geographic limits are not well defined and they may instead represent a complex of closely related species.

ATYID SHRIMPS

Family Atyidae

Atyids are small to medium-sized shrimps (up to 124 mm TL) with the first and second pereiopods more or less of similar size, moderately developed, chelate and typically bearing dense tufts of setae on the fingertips of the chelae. The carpus of the second pereiopod is undivided. The eyes are fully exposed and are not concealed by the front of the carapace. Well-developed appendix internae are present on pleopods 2–5 and in males of some species on pleopod 1. Like other caridean shrimps, the gills are phyllobranchiate and the second abdominal pleura overlap the first and third pleura. Fertilised eggs are carried attached to the swimmerets underneath the female abdomen during incubation.

Over 460 atyid species are currently known from 40 genera, although the majority of species belong to the genus, *Caridina,* with around 290 species. In the Mimika region, species of *Caridina* are commonly collected in fresh water and upper estuaries near the limit of tidal influence. *Caridina* are typically small in size (< 35 mm TL) and feed by picking and scraping detritus and algae using the tufts of setae on the finger tips of the chelae.

In parts of the Indo-West Pacific region, atyids are highly abundant and are of considerable economic importance, either for human consumption or as stock feed. Species of *Caridina* are familiar to the Kamoro and are referred to as 'wautete' or 'niti'. The dominant species in the upper estuaries of the Mimika region are the Slender-beaked caridina, *C. gracilirostris* and *Caridina* sp. 3.

The following illustrated key includes only species which have been commonly collected in estuaries of the Mimika region as adults. A more comprehensive key to the Atyidae of Southern Papua as well as species accounts for all Mimika region species are provided in Short (2009).

Key to the Estuarine Atyidae of the Mimika Region

1a Rostrum of medium length to very long; reaching beyond distal end of antennular peduncle **2**

1b Rostrum short, failing to reach distal end of antennular peduncle (Fig. 59) . . . . . ***Caridina* sp. 4**
[Moderately common in upper estuaries of the Minajerwi, West Minajerwi, Mawati and Otokwa Rivers, Mimika region, Papua.]

Figure 59. Anterior cephalothorax of *Caridina* sp. 4.

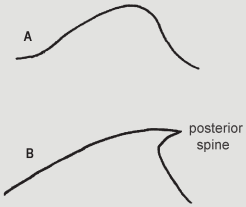


Figure 60. **A**, rounded pre-anal carina, **B**, pre-anal carina with posterior spine.

2a Inter-uropodal sclerite with well developed pre-anal carina armed with posterior spine (Figs 6, 60B). **3**

2b Inter-uropodal sclerite without well developed pre-anal carina or with well-developed pre-anal carina lacking posterior spine (Fig. 60A). **6**

3a Distal third to half of dorsal rostrum armed, typically with 1-3 subapical teeth **4**

3b Distal third to half of dorsal rostrum unarmed (Fig. 61] . . . . . .****Caridina brevicarpalis*** De Man[1]
[Wide-ranging Central Indo-West Pacific: the Philippines, eastern Indonesia, New Guinea and Fiji. Euryhaline, adults generally in lowland fresh waters and upper estuaries. Common in the Mimika region.]

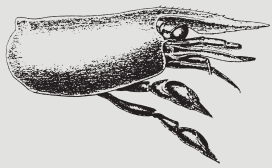


Figure 61. Cephalothorax of *Caridina brevicarpalis* De Man (after De Man, 1892).

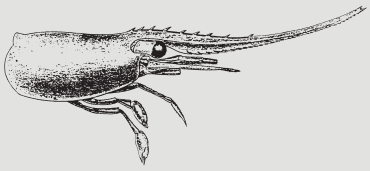


Figure 62. Cephalothorax of *Caridina gracilirostris* De Man (after De Man, 1892).

4a Rostrum extremely long and slender, about twice length of blade of antennal scale, proximal half of dorsal margin with 5–11 rather widely spaced teeth, dorsal margin otherwise unarmed except for 0–3 (generally 1) subapical teeth, 0–1 rostral teeth on carapace behind orbit (Fig. 62).
. . . . . .****Caridina gracilirostris*** De Man
[Wide-ranging Indo-West Pacific: Madagascar to Micronesia and northeast Australia. Euryhaline, lowland fresh waters and upper estuaries. Abundant in the Mimika region.]

4b Rostrum not extremely long and slender, when over-reaching antennal scale much less than twice length of blade of antennal scale; proximal half of dorsal margin with closely spaced teeth, 1–5 rostral teeth on carapace behind orbit. **5**

5a Rostrum clearly over-reaching antennal scale, 1–3 dorsal teeth situated on carapace behind orbit, proximal series of closely spaced teeth continuing uninterrupted to about half to three quarters length of dorsal margin, generally followed by conspicuous edentate region, dorsal margin distinctly sinuous or upturned (Fig.63). . . . . ***Caridina longirostris*** H. Milne Edwards
[Wide-ranging Indo-West Pacific: Madagascar to the Philippines, Indonesia, northeast Australia and Fiji. Euryhaline, adults generally in middle and lower fresh water reaches. Moderately common in the Mimika region.]

5b Rostrum reaching between distal end of antennular peduncle and distal end of antennal scale (sometimes slightly over-reaching antennal scale); 3–5 teeth situated on carapace behind orbit, proximal series of closely spaced teeth continuing to at least three quarters length of dorsal margin, often followed subdistally by short edentate region, dorsal margin generally straight (Fig. 64), sometimes sinuous. . . . . ***Caridina* sp. 1**
[Common in upper estuaries of the Mimika region.]

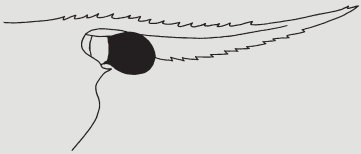


Figure 63. Anterior cephalothorax of *Caridina longirostris* H. Milne Edwards.

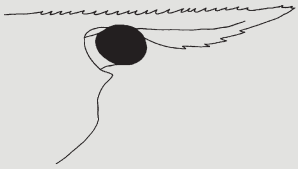


Figure 64. Anterior cephalothorax of *Caridina* sp. 1.

6a Dorsal rostrum straight or at most slightly sinuous, usually with sub-equally spaced teeth to near tip (Fig. 65) . . . . . ***Caridina* sp. 3**
[Abundant in upper estuaries of the Mimika region.]

6b Rostrum distinctly sinuous or upturned, 1 or more subapical teeth separated from proximal dorsal series by edentate region or small number of widely spaced teeth (Fig. 66) . . . . . ***Caridina* sp. 5**
[Known only from the upper estuaries of the Kamora and Kopi Rivers, Mimika region, Papua.]

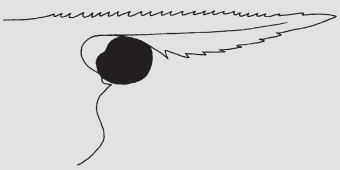


Figure 65. Anterior cephalothorax of *Caridina* sp. 3.

Figure 66. Anterior cephalothorax of *Caridina* sp. 5.

[1] As discussed by Short (2009), material from the Mimika region is intermediate between the two subspecies recognised by Chace (1997) and later treated as full species by Cai and Shokita (2006), viz. *C. brevicarpalis* and *C. endehensis* both of De Man, 1892.

Upper Jaramaya River estuary (Photo by Gesang Setyadi).

PALAEMONID SHRIMPS

Family Palaemonidae

Palaemonids are small to large shrimps (to 320 mm TL) with the second pereiopods typically more developed than the first, both first and second pereiopods chelate, and all chelipeds lacking dense tufts of setae on the fingertips. The carpus of the second pereiopod is typically undivided (except in the marine genus *Thaumastocaris*) and the eyes are not concealed by the anterior carapace. Well-developed appendix internae are present on pleopods 2–5 and in males of some species on pleopod 1. Like other caridean shrimps, the gills are phyllobranchiate and the second abdominal pleura overlap the first and third pleura. The fertilised eggs are carried attached to the swimmerets underneath the female abdomen during the incubation period.

This cosmopolitan family is the most speciose and morphologically diverse of all shrimp families with almost 1000 species currently known. Palaemonids are particularly abundant on coral reefs where many species live in commensal relationships with other invertebrates. Of the 130 genera of Palaemonidae currently recognised, most are marine and comparatively few occur in freshwater and estuarine habitats.

In freshwater and estuarine habitats throughout tropical and subtropical regions of the world, the dominant genus is *Macrobrachium* with approximately 240 species known worldwide. Species of *Macrobrachium* are commonly referred to as river prawns or freshwater prawns. Two wide-ranging Indo-West Pacific species of *Palaemon* have also been recorded from estuaries in southern New Guinea, viz. the Slender Mangrove Shrimp, *P. debilis* and the Elegant Mangrove Shrimp, *P. concinnus*. Only the latter species is presently known from the Mimika region.

The Palaemonidae contains numerous species used for human consumption and of commercial importance to fisheries and aquaculture. By far the most significant is the Oriental Giant River Prawn, *M. rosenbergii*, which is the largest and most commercially important caridean shrimp. The species is extensively cultured in Asia, the Americas and Africa. Until recently, *M. rosenbergii* was considered a wide-ranging Central Indo-West Pacific species,

possibly comprising an eastern and a western subspecies. Following a reappraisal of the taxonomy of the species (Wowor and Ng, 2007, 2008; Anon, 2010; Ng and Wowor, 2011) it is now treated as two, closely allied species. The name *M. rosenbergii* now applies to the western species which is widely distributed in the Oriental zoogeographic region as far east as the vicinity of Huxley's line (excluding Palawan and Bali) and is the species commonly cultured around the world. The eastern species, the Australasian Giant River Prawn, *M. spinipes,* occurs east of Huxley's line in the Philippines (including Palawan), eastern Indonesia (including Bali), New Guinea and northern Australia. Consequently, the species previously recorded from the Mimika region as *M. rosenbergii* by Short (2009) is now known as *M. spinipes*.

Although both species of giant river prawn are of similar size and appearance, they differ significantly in their biology and the larvae of *M. spinipes* are reportedly more difficult to culture. Recent research by Lober and Zeng (2009) on the larval development of the Australian strain of *M. spinipes* (as *M. rosenbergii*) using a greenwater technique and the microalga, *Nannochloropsis* sp., may lead to increased interest in the aquaculture of the species.

An illustrated key to the freshwater/estuarine Palaemonidae of southern New Guinea and accounts of the species recorded from the Mimika region are provided in Short (2009). Five *Macrobrachium* species are abundant in upper estuaries of the Mimika region, viz. the Australasian Giant River Prawn, *M. spinipes*; the Broad-fingered River Prawn, *M. latidactylus;* the Knob-fingered River Prawn, *M. mammillodactylus;* Weber's River Prawn, *M. weberi* and the Rough River Prawn, *M.* '*equidens*' complex. The latter species is also abundant in lower estuarine trawls in the Mimika region.

According to Muller (2006), *M. spinipes* (as *M. rosenbergi*) is in danger of over-exploitation in the Mimika region. In Indonesian, it is known as 'udang hitam', in Kamoro and Atuka as '(m)be' and in Nawaripi as 'me poawa'. The other *Macrobrachium* common in the estuaries of the Mimika region and of local commercial importance is *M. mammillodactylus.* It is referred to in Indonesian as 'udang putih', by the Kamoro as 'mbiti', the Nawaripi as 'meo' and the Atuka as 'uroko'.

Key to the Estuarine Palaemonidae of Southern New Guinea

(species recorded from the Mimika region marked with an asterisk)

1a Carapace with branchiostegal spine (Fig. 67); P2 not enlarged in developed males, segments smooth, not covered in spinules, spines, tubercles or scales **2**

1b Carapace with hepatic spine (Fig. 68); P2 enlarged in developed males, often exceeding body length, segments covered with spinules, spines, tubercles or scales.
. . . . . *Macrobrachium* spp. **5**

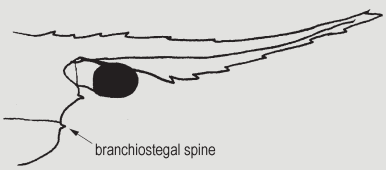


Figure 67. Position of branchiostegal spine.

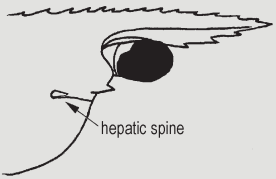


Figure 68. Position of hepatic spine.

2a Carapace with branchiostegal groove (Fig. 71); branchiostegal spine located on carapace margin (Figs 71, 72); male Pl1 without appendix interna or with small vestigial appendix interna.
. . . . . *Palaemon* spp. **3**

2b Carapace without branchiostegal groove; branchiostegal spine located behind carapace margin (Fig. 83); male Pl1 with well developed appendix interna (Fig. 70).
. . . . . ****Leandrites celebensis*** (De Man) (p. 61)

3a Dorsal rostrum with subapical tooth on distal third; P1 with carpus more than twice as long as chela **4**

3b Dorsal rostrum edentate on distal third (Fig. 69); P1 with carpus less than twice length of chela.
. . . . . ***Palaemon semmelinkii*** (De Man)
[Wide-ranging Indo-West Pacific: India to the Philippines and northern Australia. Common in pools and drainage channels in lower estuarine, mangrove areas. Also shallow, marine waters.]

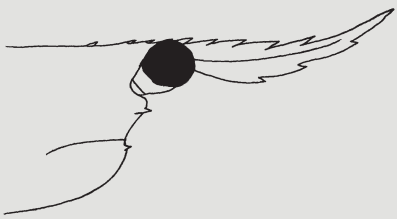


Figure 69. Carapace and rostrum of *Palaemon semmelinkii* (De Man).

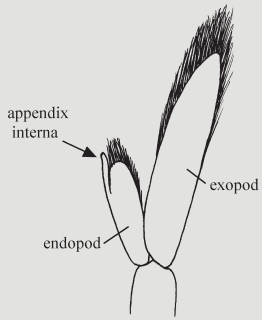


Figure 70. Location of appendix interna.

4a Branchiostegal spine located well below branchiostegal groove (Fig. 71); upper flagellum of antennule with fused portion less than one third length of shorter free ramus; male first pleopod with vestigial appendix interna on inner endopod . . . . . ***Palaemon concinnus*** (Dana)
[Wide-ranging Indo-West Pacific: east Africa to Hong Kong, northeast Australia, the Marshall Islands and the Tuamotu Archipelago. Euryhaline, coastal fresh, brackish and marine waters. Tolerant of stagnant water.]

4b Branchiostegal spine located immediately below branchiostegal groove (Fig. 72); upper flagellum of antennule with fused portion about equal in length to shorter free ramus; male first pleopod without appendix interna on inner endopod. . . . . ***Palaemon debilis*** (Dana)
[Wide-ranging Indo-West Pacific: east Africa to the Ryukyu Islands, Hawaii, northern Australia and the Tuamotu Archipelago. Euryhaline, shallow marine and coastal fresh or brackish waters.]

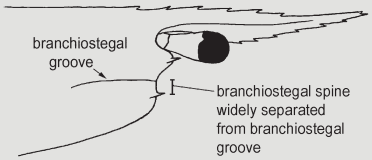


Figure 71. Carapace and rostrum of *Palaemon concinnus* (Dana).

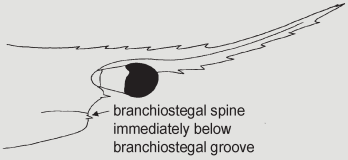


Figure 72. Carapace and rostrum of *Palaemon debilis* (Dana).

5a Scaphocerite lamina projecting forward in middle third of anterior margin (Fig. 7I); developed male chelipeds with velvety setal pubescence on proximal 2/3 of dactylus, absent on propodus (Fig. 73); very large species reaching over 250 mm TL . . . . . ***Macrobrachium spinipes*** (Schenkel)
[Wide-ranging Australasia: eastern Indonesia, the Philippines, Palau, New Guinea, northern Australia. Euryhaline, adults widely distributed from middle catchment fresh waters to upper estuaries. Common in Mimika region.]

5b Scaphocerite lamina projecting forward at inner angle of anterior margin (Fig. 7H); developed male chelipeds without setal pubescence on fingers of chela or with setal pubescence on both fingers; small to moderately large species less than 140 mm TL **6**

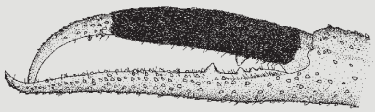


Figure 73. Fingers of developed male cheliped of *Macrobrachium spinipes* (Schenkel).

Figure 74. Rostrum of *Macrobrachium* sp. 2.

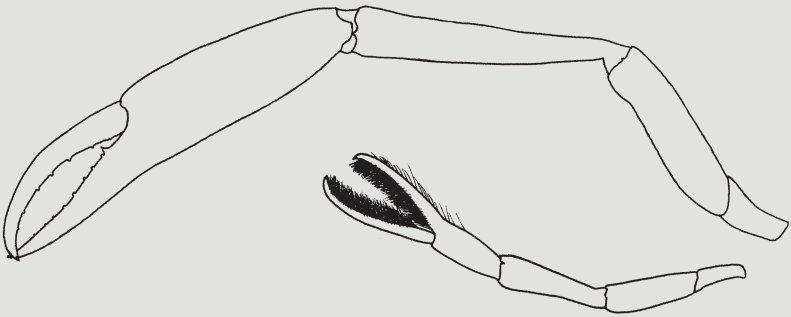


Figure 75. Major and minor chelipeds of fully developed male of *Macrobrachium latidactylus* (Thallwitz).

6a Inferior orbit angular (Fig. 3C) or truncated (Fig. 3A). **7**
6b Inferior orbit rounded (Fig. 3B) **11**

7a Anterior epistome lobes acute or projected antero-mesially (Figs 5, 76A); left and right chelipeds of developed males highly dissimilar in size and shape, major cheliped with carpus elongate, much longer than merus (Fig. 75) . . . . . ***Macrobrachium latidactylus*** (Thallwitz) [Central Indo-West Pacific: Malaysia, Taiwan, the Philippines, Indonesia and northeast Australia. Euryhaline, lowland fresh waters to lower estuaries.]

7b Anterior epistome lobes rounded (Figs 5, 76B); left and right chelipeds of developed males similar in size and shape or, if dissimilar, with carpus short and about equal in length to or distinctly shorter than merus. **8**

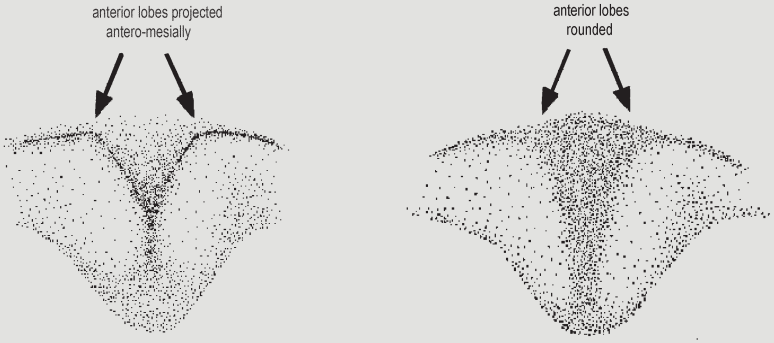


Figure 76. Variation in the shape of the anterior epistome in *Macrobrachium*.

8a Dorsal margin of rostrum with series of closely spaced teeth in proximal half followed by edentate region or few widely spaced teeth distally (sometimes two closely spaced teeth near tip), distal teeth well differentiated from proximal series (Fig. 77). . . . . ***Macrobrachium weberi*** (De Man) [Celebes, New Guinea and New Britain. Euryhaline, lowland, fresh waters to lower estuaries. Abundant in upper estuaries in the Mimika region.]

8b Dorsal margin of rostrum without edentate region (spacing between teeth may gradually increase from proximal to distal half but proximal series not well differentiated from distal teeth) **9**

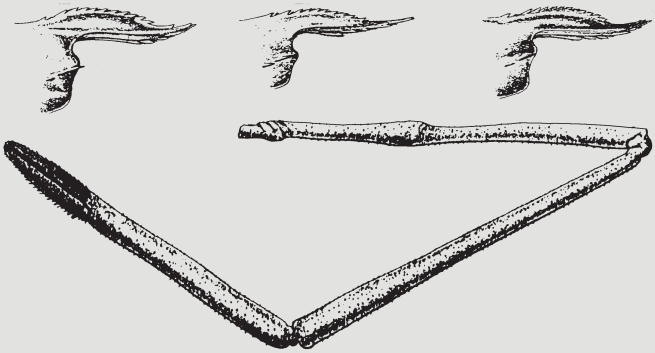


Figure 77. Rostrum variation and developed male cheliped of *Macrobrachium weberi* (De Man) (after De Man, 1892).

9a Teeth on upper rostrum at most a little more closely spaced proximally above cornea of eye than in distal half; developed male cheliped without setal pubescence completely covering both fingers; adults found from upper estuaries to non-tidal, lowland, fresh waters **10**

9b Teeth on upper rostrum much more closely spaced proximally above cornea of eye than distally, spacing between teeth gradually increasing towards apex (except for a number of closely spaced, subapical teeth) (Fig. 78); developed male cheliped with setal pubescence completely covering both fingers (Fig. 79); restricted to tidal waters . . . . . ***Macrobrachium* 'equidens' complex** [Recent molecular studies indicate that *M. equidens* sensu lato comprises a number of closely related species in the Indo-West Pacific region. Abundant in estuaries of the Mimika region.]

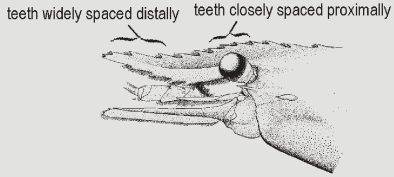


Figure 78. Rostrum of *Macrobrachium 'equidens'* complex.

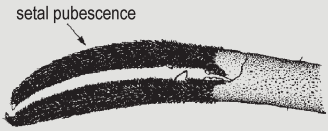


Figure 79. Fingers of fully developed developed male cheliped of *Macrobrachium 'equidens'* complex.

10a Chela distinctly longer than carpus in adults; developed male chela with submedial rows of tubercles along cutting edges of fingers, setal pubescence absent (Fig. 81); rostrum deep proximally, abruptly tapered distally. . . . . ***Macrobrachium mammillodactylus*** (Thallwitz)
[Wide-ranging Central Indo-West Pacific: the Philippines, Indonesia, New Guinea and northeast Australia. Euryhaline, lowland fresh waters. Abundant in upper estuaries of the Mimika region.]

10b Chela distinctly shorter than carpus in developed males, equal in length to slightly longer than carpus in females and undeveloped males; setal pubescence on fingers of developed male chela extensive on lateral dactylus but restricted to cutting edge of propodus, tubercles absent along cutting edges (Fig. 80); proximal rostrum moderately deep or slender, rostrum gradually tapered in distal half . . . . . ***Macrobrachium idae*** (Heller)
[Wide-ranging Indo-West Pacific: east Africa and Madagascar to the Philippines, the Admiralty Islands, New Guinea and northeast Australia. Euryhaline, lowland fresh waters to inshore areas. In the Mimika region abundant in coastal freshwater swamps.]

Figure 80. Fingers of fully developed male cheliped of *Macrobrachium idae* (Heller).

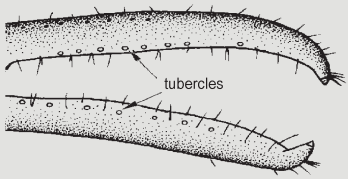


Figure 81. Fingers of fully developed male cheliped of *Macrobrachium mammillodactylus* (Thallwitz).

11a Rostrum generally with less than 15 dorsal teeth, if with 15 dorsal teeth then more than 2 ventral teeth present; dorsal margin of rostrum straight or slightly to moderately convex **12**

11b Rostrum with 15 or more dorsal teeth and 1–2 ventral teeth, dorsal margin strongly convex (Fig. 74); cheliped morphology of developed male unknown . . . . . ***Macrobrachium* sp. 2**
[Only known from New Guinea. In the Mimika region recorded from the Kamora and Tipuka River estuaries.]

12a Dorsal rostrum distinctly convex; upper palm of major chela of developed male without carinate flange. . . . . ***Macrobrachium handschini*** (J. Roux)
[Southern New Guinea and northern Australia. Landlocked freshwater species extending downstream to upper estuaries.]

12b Dorsal rostrum straight or at most slightly convex; upper palm of major chela of developed male developed as carinate flange (Fig. 82) . . . . . ***Macrobrachium bariense*** (De Man)
[Central Indo-West Pacific: eastern Indonesia to the Philippines, Palau and New Guinea. Euryhaline, lowland fresh waters and estuaries.]

Figure 82. Major cheliped of fully developed male of *Macrobrachium bariense* (De Man).

Common Leandrites

Leandrites celebensis

(De Man, 1881)

Figure 83. Cephalothorax.

Diagnosis: Small palaemonid species (up to 27 mm TL). Acron without bec ocellaire. Cornea of eye well developed. Antennule upper flagellum with fused portion about 0.3 length of shorter free ramus. Rostrum of medium length, reaching to or slightly beyond the distal margin of the scaphocerite; dorsal carina more or less straight, dentate along entire length, teeth subequally spaced, 13–17 teeth, 2 teeth postorbital; ventral carina with 3–7 teeth and continuous row of submarginal setae on either side above teeth. Body smooth, glabrous. Mandible without palp. Carapace without branchiostegal groove; branchiostegal suture absent; antennal and branchiostegal spines present, branchiostegal spine postmarginal; inferior orbital margin well produced, obtuse. Thoracic sternite 4 with well-developed, spinate, median process. Second pereiopods isomorphic; short, carpus reaching tip of scaphocerite; smooth; fingers of chelae long, lacking teeth on cutting edges. Pereiopod 5 propodus without transverse rows of setae distolaterally. Appendix interna well developed on first male pleopod. Telson with 2 pairs of dorsolateral spines; posterior margin armed with 2 pairs of moveable spines (pair of short lateral spines and pair of longer sublateral spines) and pair of submedial plumose setae. Pre-anal carina absent. Eggs small, *ca*. 0.4 mm length.

Habitat and abundance: Common in shallow, brackish waters. In the Mimika region, collected from a lower estuarine trawl in the Kamora River.

Distribution: Wide-ranging Central Indo-West Pacific: India to Singapore, Indonesia, southern New Guinea and northern Australia.

SNAPPING SHRIMPS

Family Alpheidae

Alpheids are small to medium-sized shrimps (up to about 100 mm TL) with the first pereiopods often strongly chelate and usually markedly more developed than the second pereiopods. The carpus of the second pereiopod is divided into 2 or more segments and the fingertips of the first and second pereiopods lack conspicuous tufts of setae. The eyes are partially to fully concealed by the front of the carapace. Well-developed appendix internae are present on pleopods 2–5 and in males of some species on pleopod 1. Like other caridean shrimps, the gills are phyllobranchiate and the second abdominal pleura overlap the first and third pleura. Fertilised eggs are carried attached to the swimmerets underneath the female abdomen during the incubation period.

This is the second largest caridean shrimp family with over 660 species in 45 genera. The group has a cosmopolitan distribution and is found to 60˚ latitude in a wide variety of marine and estuarine habitats from the littoral zone to depths of 875 m. The most common genera are *Alpheus* with around 290 species and *Synalpheus* with approximately 160 species.

Alpheids are commonly referred to as snapping or pistol shrimps. Most species have the larger chela of the first pereiopods developed as a snapping claw. The moveable finger of the snapping claw has a large plunger which snaps into a socket on the opposing fixed finger. This snapping mechanism emits a powerful wave of bubbles which is capable of killing prey and startling predators. The snapping sound is also used in social interactions between individuals.

Only six species, all belonging to the genus *Alpheus*, have been recorded from the Mimika region. According to Muller (2006), the Kamoro use species of *Alpheus* as bait and they appear to be referred to in general by the Kamoro as ‘menauni’.

Key to the Estuarine Alpheidae of the Mimika Region

1a Pereiopod 1 with proximal shoulder of superior saddle of major chela moderately to strongly produced and overhanging groove (Figs. 85, 88) **2**

1b Pereiopod 1 with proximal shoulder of superior saddle of major chela poorly developed, blunt, not overhanging groove (Figs 84, 86–87, 89) **3**

2a Proximal shoulder of superior saddle of major chela of P1 strongly produced, acute (Fig. 85). . . . . ***Alpheus chiragricus*** H. Milne Edwards (p. 65)

2b Proximal shoulder of superior saddle of major chela of P1 moderately produced, blunt (Fig. 88). . . . . ***Alpheus* sp. 3** (p. 68)

3a Scaphocerite lamina reaching to tip of lateral tooth or clearly over-reached by lateral tooth, distal lamina narrow (Figs 84B, 89B) **4**

3b Scaphocerite lamina clearly over-reaching lateral tooth, distal lamina broad (Fig. 86B); major P1 cheliped shown in Fig. 86A . . . . . ***Alpheus* sp. 1** (p. 66)

4a Pereiopod 1 major chela with short but well developed carina near tip of fixed finger, fixed finger highly granular (Fig. 87) . . . . . ***Alpheus* sp. 2** (p. 67)

4b Pereiopod 1 major chela without carina and granules on fixed finger **5**

5a Scaphocerite lamina much shorter than lateral tooth, very narrow distally (Fig. 89B); distomesial merus of P1 major cheliped without spine (Fig. 89A) . . . . . ***Alpheus* sp. 4** (p. 69)

5b Scaphocerite lamina reaching to around tip of lateral tooth, moderately narrow distally (Fig. 84B); distomesial merus of P1 major cheliped generally with spine (Fig. 84A). . . . . ***Alpheus* cf. *euphrosyne*** De Man (p. 64)

Alpheus cf. *euphrosyne*

De Man, 1897

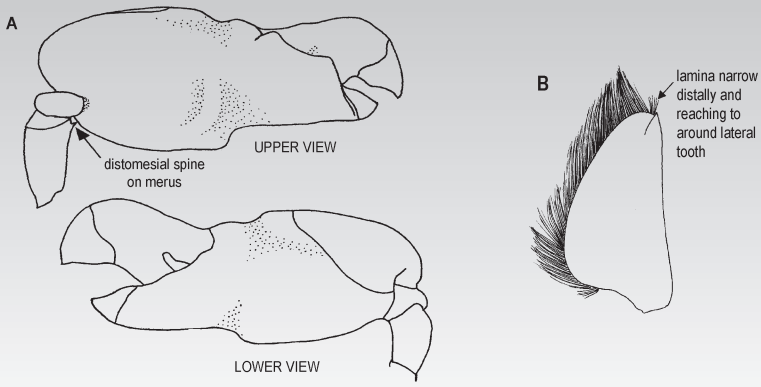


Figure 84. **A**, upper and lower view of major chela; **B**, scaphocerite.

Diagnosis: Medium-sized, alpheid species (up to 58 mm TL). Rostrum short, clearly failing to reach distal margin of first segment of antennular peduncle, triangular. Scaphocerite lamina reaching to around tip of lateral tooth, moderately narrow distally. Pereiopod 1 major cheliped with proximal shoulder of superior saddle of major chela poorly developed, blunt, not overhanging groove, fixed finger without carina or granules, distomesial merus generally with spine; minor cheliped sexually dimorphic, male chela with balaeniceps dactylus, female chela without balaeniceps dactylus. Pereiopod 3 with dactylus simple, slightly curved, spatulate, with or without distinct median carina on upper face, merus unarmed.

Habitat and abundance: Shallow, muddy, estuarine habitats, often in mangrove swamps. The Mimika material originates from mangrove swamps in the Ajkwa River estuary.

Distribution: Wide-ranging Indo-West Pacific: Kenya to the Philippines, Indonesia and northern Australia.

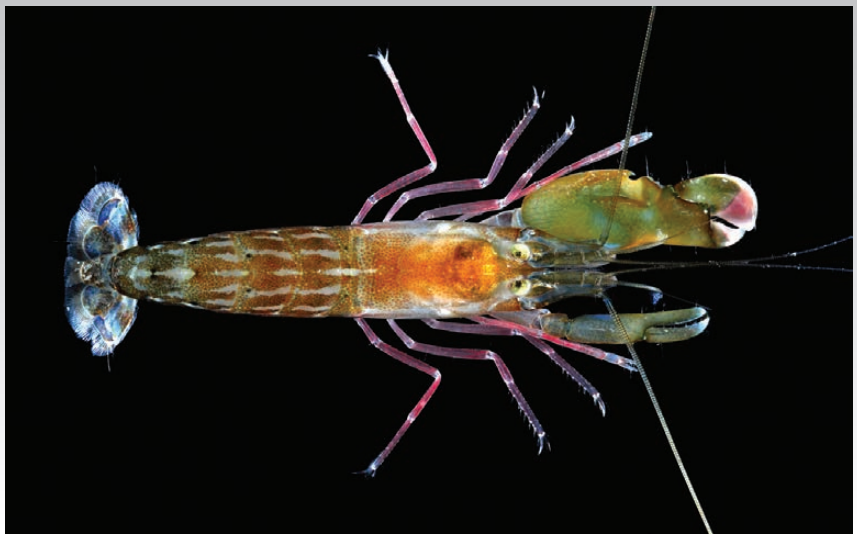
Other names: menauni (Kamoro).

Notes: Anker (2001) noted that *Alpheus euphrosyne* De Man, 1897 may represent a complex of closely related species. The present species appears closely allied to *A. euphrosyne* but differs in having a distomesial spine on the merus of the major cheliped.

Spurred Snapping Shrimp

Alpheus chiragricus

H. Milne Edwards, 1837



Arthur Anker

Figure 85. Specimen from Singapore.

Diagnosis: Medium-sized, alpheid species (up to 50 mm TL). Rostrum short, just failing to reach distal margin of first segment of antennular peduncle, triangular. Scaphocerite lamina just failing to reach tip of lateral tooth, slender distally. Pereiopod 1 with proximal shoulder of superior saddle of major chela strongly produced, acute, overhanging groove, distomesial merus with spine, fixed finger without carina or granules; minor cheliped sexually dimorphic, male chela with balaeniceps dactylus, female chela without balaeniceps dactylus. Third pereiopod with dactylus simple, slightly curved, non-spatulate, merus unarmed. Uropodal exopod with sublateral lobe of diaeresis rounded.

Habitat and Abundance: Intertidal and shallow subtidal to 20 m. In the Mimika region collected from lower estuarine trawls.

Distribution: Wide-ranging Indo-West Pacific: east Africa to the Philippines, Indonesia and northern Australia.

Other names: menauni (Kamoro).

Notes: This species is very closely allied to *A. edwardsii* (Audouin, 1827). According to Banner and Banner (1981), it differs in having the superior and inferior shoulders on the manus of the major cheliped acute and almost spinate versus obtuse in *A. edwardsii*. The fingers of the major cheliped are also relatively longer in *A. chiragricus*.

Alpheus sp. 1

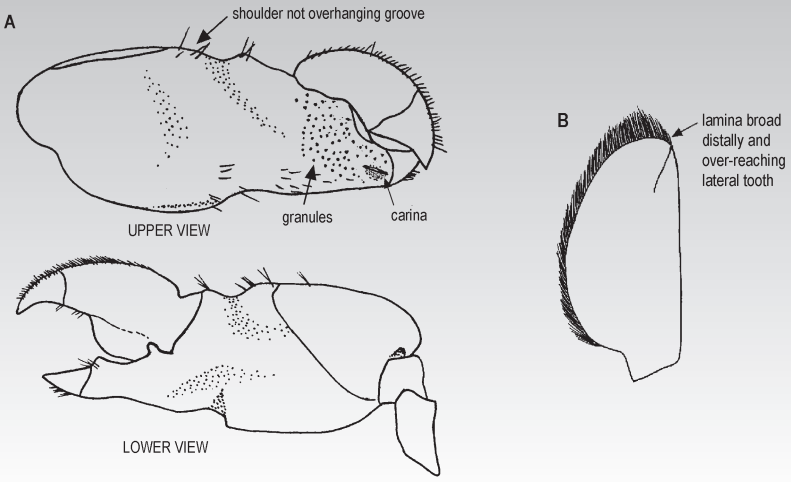


Figure 86. **A**, upper and lower view of chela of first pereiopod; **B**, scaphocerite.

Diagnosis: Large alpheid species (up to 70 mm TL). Scaphocerite lamina generally clearly reaching beyond lateral tooth, distal lamina broad. Pereiopod 1 with proximal shoulder of superior saddle of major chela poorly developed, blunt, not overhanging groove, distomesial merus without spine, fixed finger granular, bearing well developed carina near tip; minor cheliped sexually dimorphic, male chela with balaeniceps dactylus, female chela without balaeniceps dactylus. Third pereiopod with dactylus simple, spatulate, slightly curved, without distinct median carina on upper face, merus unarmed.

Habitat and abundance: Intertidal, mangroves.

Distribution: Ajkwa River estuary, Mimika region, southern Papua and Turkey Beach, near Gladstone, Queensland, Australia.

Other names: menauni (Kamoro).

Notes: *Alpheus tirmiziae* Kazmi, 1974, and *Alpheus* sp. 2 (this volume) also have a well developed carina near the tip of the fixed finger of the major cheliped. The present species differs from both species in lacking a longitudinal carina on the upper face of the dactylus of the third pereiopod. The large mangrove species, *A. microrhynchus* De Man, 1898, may also be confused with this species but lacks the carina near the tip of the fixed finger on the major cheliped.

Alpheus sp. 2

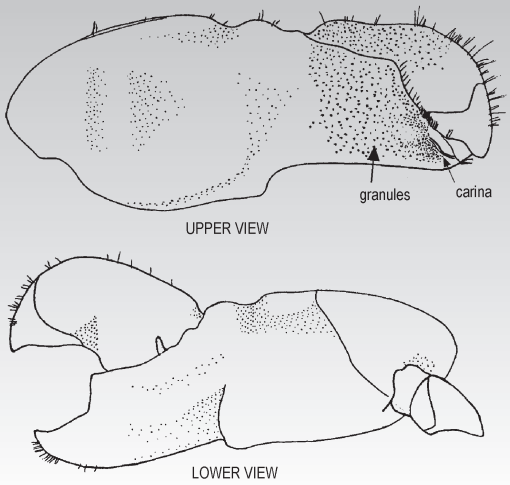


Figure 87. Upper and lower view of chela of first pereiopod.

Diagnosis: Medium-sized, alpheid species (up to 47 mm TL). Scaphocerite lamina reaching to around lateral tooth, distal lamina slender. Pereiopod 1 with proximal shoulder of superior saddle of major chela poorly developed, blunt, not overhanging groove, distomesial merus without spine, fixed finger highly granular, bearing short, well-developed carina near tip; minor cheliped sexually dimorphic, male chela with balaeniceps dactylus, dactylus of female chela without balaeniceps dactylus. Third pereiopod with dactylus simple, slightly curved, spatulate, with distinct median carina on upper face, merus unarmed.

Habitat and abundance: Estuarine.

Distribution: Known from lower Minajerwi River and Kamora River estuaries, Mimika region, Papua.

Other names: menauni (Kamoro).

Alpheus sp. 3

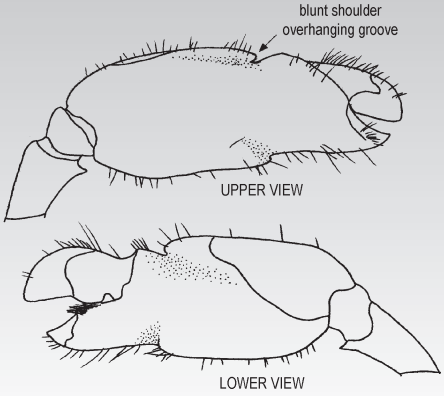


Figure 88. Upper and lower view of chela of first pereiopod.

Diagnosis: Small alpheid species (up to 30 mm TL). Pereiopod 1 with proximal shoulder of superior saddle of major chela moderately produced, blunt, overhanging groove, distomesial merus bearing a small spine, fixed finger without granules or carinae; minor cheliped of male with dactylus sub-balaeniceps.

Habitat and abundance: Collected from a lower estuarine trawl.

Distribution: Known from the Tipuka River estuary, Mimika region, Papua.

Other names: menauni (Kamoro).

Notes: Known from a single damaged male specimen which lacks the carapace, anterior appendages and third pereiopod.

The characters which easily distinguish this species from *A. chiragricus* have been discussed under that species.

Alpheus sp. 4

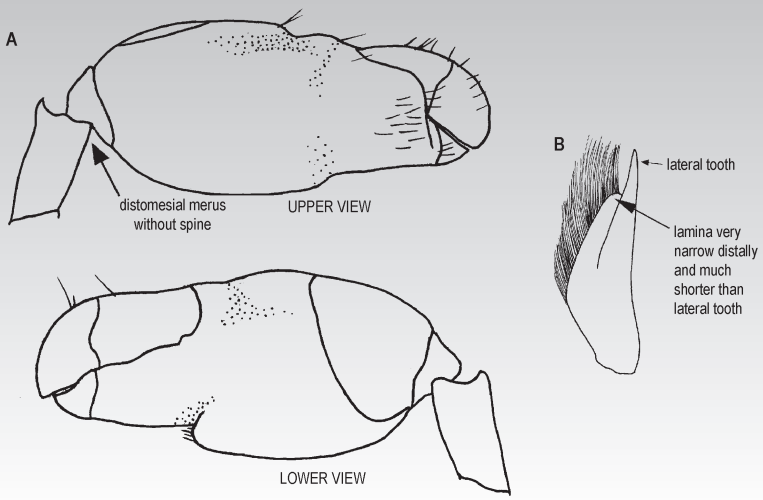


Figure 89. **A**, upper and lower view of chela of first pereiopod; **B**, scaphocerite.

Diagnosis: Small alpheid species (up to 15 mm TL). Scaphocerite lamina much shorter than lateral tooth, very narrow distally; pereiopod 1 with proximal shoulder of superior saddle of major chela poorly developed, blunt, not overhanging groove, fixed finger without carina or granules, distomesial merus without spine; uropodal exopod with sublateral lobe slightly produced.

Habitat and abundance: Collected from a lower estuarine trawl.

Distribution: Only known from the mouth of the West Ajkwa River, Mimika region, Papua.

Other names: menauni (Kamoro).

Notes: Known from two specimens, both of which are missing the minor cheliped (first pereiopod) and third pereiopod.

HIPPOLYTID SHRIMPS

Family Hippolytidae

Hippolytids are small to medium-sized shrimps (up to about 80 mm TL) with the first and second pereiopods usually dissimilar in size, moderately developed and chelate. The carpus of the second pereiopod is divided into 2 or more segments and the first and second pereiopods lack conspicuous tufts of setae on the fingertips. The eyes are exposed and are not concealed by the front of the carapace. Like other caridean shrimps, the gills are phyllobranchiate and the second abdominal pleura overlap the first and third pleura. The fertilised eggs are carried attached to the swimmerets underneath the female abdomen during the incubation period.

This cosmopolitan group is the third largest shrimp family after the Palaemonidae and Alpheidae and includes around 340 species in 37 genera. Hippolytid shrimps are highly diverse in morphology and occur in a wide variety of marine habitats from intertidal pools to abyssal depths. The greatest diversity of species occurs in temperate and arctic waters. In the tropics, species diversity is highest in seagrass and reef habitats. The genus *Merguia* includes the only known arboreal shrimps and is associated with mangrove areas.

Holthuis (1980) listed six genera and 19 species of hippolytid shrimps of minor commercial importance to fisheries. Three of these species, the Hunter Shrimp, *Exhippolysmata ensirostris ensirostris,* the Medusa Shrimp, *Latreutes anoplonyx*, and the Red-striped lysmata, *Lysmata vittata*, are known from the Mimika region.

Key to the Estuarine Hippolytidae of the Mimika Region

1a Carpus of second pereiopod with 3 segments; anterolateral margin of carapace armed with series of sharp spines (Fig. 90); often associated with jellyfish . . . . ***Latreutes anoplonyx*** Kemp (p. 73)

1b Carpus of second pereiopod with more than 7 segments; anterolateral margin of carapace armed with a single pterygostomial spine or unarmed **2**

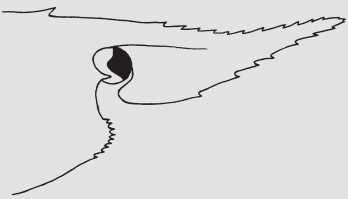


Figure 90. Anterior cephalothorax of *Latreutes anoplonyx* Kemp.

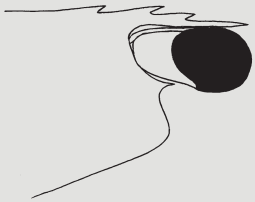


Figure 91. Anterior cephalothorax of *Merguia oligodon* (De Man).

2a Rostrum with ventral teeth; pterygostome spinate (Figs 92, 93); littoral or sublittoral **3**

2b Rostrum without ventral teeth; pterygostome unarmed (Fig. 91); semi-terrestrial in mangrove areas. . . . . ***Merguia oligodon*** (De Man) (p. 75)

3a Rostrum with prominent basal crest, armed with 9–18 dorsal teeth and 4–16 ventral teeth (Fig. 92); telson tapering rapidly to sharp posterior point. . . . . ***Exhippolysmata ensirostris ensirostris*** (Kemp) (p. 72)

3b Rostrum without prominent basal crest, armed with 4–8 dorsal teeth and 1–5 ventral teeth (Fig. 93); telson not tapering rapidly to sharp posterior point . . . . .***Lysmata vittata*** (Stimpson) (p. 74)

Figure 92. Carapace and rostrum of *Exhippolysmata ensirostris ensirostris* (Kemp).

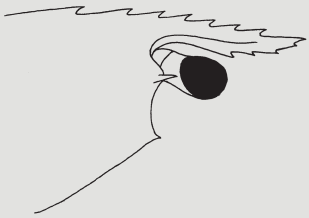
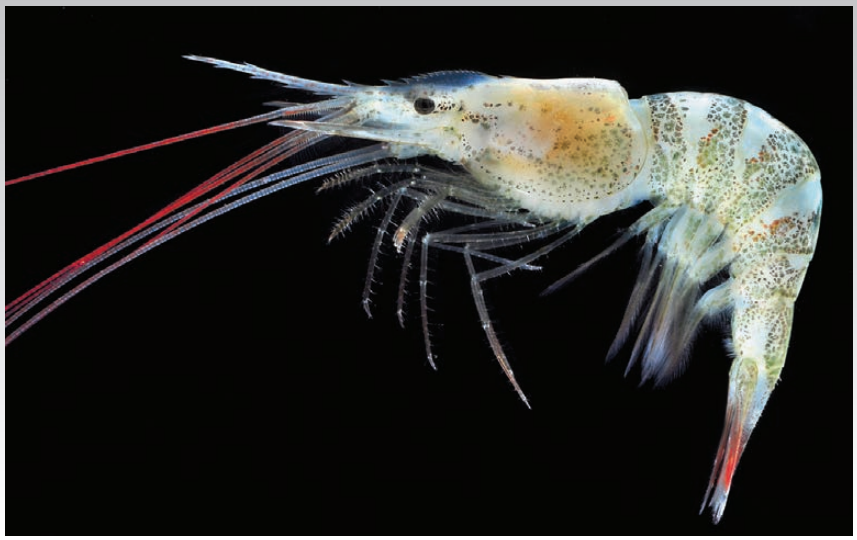


Figure 93. Anterior cephalothorax of *Lysmata vittata* (Stimpson).

Hunter Shrimp

Exhippolysmata ensirostris ensirostris

(Kemp, 1914)



Arthur Anker

Figure 94. Specimen from Madang, Papua New Guinea.

Diagnosis: Large hippolytid species (up to 79 mm TL). Cornea of eye well developed. Rostrum long, far exceeding distal margin of antennal scale, sinuous, with well-developed basal crest, apex acute; 6–18 dorsal teeth comprising 5–12 closely spaced teeth on basal crest and 1–6 widely spaced teeth on remaining rostrum; ventral margin with 4–16 teeth. Body smooth, glabrous. Carapace with antennal spine and pterygostomial spine. Third maxilliped with exopod. Epipods present on third maxilliped, short and rudimentary on pereiopods 1–4. Pereiopod 1 carpus slightly shorter than chela. Pereiopod 2 carpus divided into 12–17 segments. Uropodal exopod of normal length, a bit longer than endopod. Telson tapering rapidly to sharp apex posteriorly, bearing two pairs of dorsolateral moveable spines, without moveable spines posteriorly near apex.

Habitat and abundance: Marine, shallow water. Uncommon in lower estuarine trawls in the Mimika region.

Distribution: Wide-ranging in the Indo-West Pacific from India to Indonesia.

Notes: Chace (1997) recognized two subspecies although both have a similar geographic range and may in the future be treated as species. According to Chace (1997), *E. e. punctata* (Kemp, 1914) is armed with more teeth on the ventral rostrum (17–23 versus 7–16) and has a more sculptured carapace (longitudinal furrows and pits).

This species is of high commercial importance in northwest India where it is a dominant species in trawl catches (Holthuis, 1980).

Medusa Shrimp

Latreutes anoplonyx

(Kemp, 1914)

Arthur Anker

Figure 95. Specimen from Singapore.

Diagnosis: Medium-sized, hippolytid species (up to 39 mm TL). Cornea of eye well developed. Body smooth, glabrous. Rostrum long, exceeding distal margin of scaphocerite lamina; triangular in lateral view, apex acute or bifid; dorsal margin concave, 10–21 teeth including 1 postorbital tooth widely separated from anterior teeth, without prominent basal crest; ventral carina strongly developed, dentate, 5–15 teeth. Carapace with antennal spine and series of 8–13 spines on anterolateral margin. Third maxilliped with exopod. Epipods present on third maxilliped and pereiopods 1–4. Pereiopod 1 carpus about half length of chela, slightly excavate for reception of propodus. Pereiopod 2 carpus divided into 3 segments, middle segment more than twice as long as subequal first and third segments. Uropodal exopod of normal length, of similar length to endopod. Telson bearing two pairs of dorsolateral moveable spines; apex narrow, bearing two pairs of moveable spines (sublateral pair twice length of lateral pair). Body speckled with reddish-brown dots except for transverse white bands across the mid-dorsal carapace and abdominal segments.

Habitat and abundance: Shallow marine to 15 m depth, associated with scyphozoan medusae.

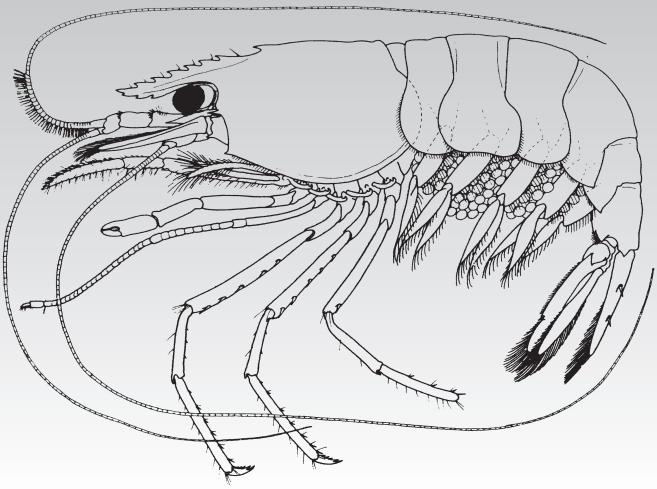
Distribution: Wide-ranging in the Indo-West Pacific from India to China, Japan, the Philippines and Australia.

Other names: Kurage mo ebi (Japan).

Red-striped Lysmata

Lysmata vittata

(Stimpson, 1860)



After Bruce (1990)

Figure 96.

Diagnosis: Medium-sized, hippolytid species (up to 43 mm TL). Cornea of eye well developed. Rostrum short, reaching to slightly beyond distal end of intermediate segment of antennular peduncle, apex acute; dorsal carina slightly convex, without prominent basal crest, dentate along entire length, 4–8 teeth, 2–3 teeth postorbital; ventral margin with 1–5 teeth. Body smooth, glabrous. Carapace with well-developed antennal spine and small pterygostomial spine. Third maxilliped with well-developed exopod. Epipods present on third maxilliped and pereiopods 1–4. Pereiopod 1 with carpus clearly shorter than chela. Pereiopod 2 with carpus divided into 15–31 segments. Uropodal exopod of normal length, slightly longer than endopod. Telson with 2 pairs of dorsolateral moveable spines; posterior margin well defined, angular, armed with small acute median process, 2 pairs of moveable spines (small lateral pair and longer sublateral pair) and pair of submedial plumose setae. Body semi-transparent with fine, red, longitudinal bands.

Habitat and abundance: Intertidal pools under rocks and coral, subtidal reefs to 55 m depth. Often living in pairs.

Distribution: Wide-ranging Indo-West Pacific: east Africa to Hong Kong, Japan, the Philippines, Indonesia and Australia.

Other names: Indian Lined Shrimp (FAO); Akashima mo ebi (Japan).

Mangrove climbing shrimp

Merguia oligodon

(De Man, 1888)

Figure 97. Cephalothorax.

Diagnosis: Small hippolytid species (up to 30 mm TL). Rostrum short, failing to reach distal margin of basal segment of antennular peduncle, without prominent basal crest, apex acute; 2–3 dorsal teeth, 1 tooth postorbital; ventral margin unarmed. Body smooth, without pitting; carapace with antennal spine, pterygostome unarmed. Third maxilliped without exopod. Epipods absent on third maxilliped and pereiopods. Pereiopod 1 carpus subequal in length to chela. Pereiopod 2 carpus with 20–27 segments. Uropodal exopod greatly elongated, much longer than endopod. Telson with 2 pairs of dorsolateral moveable spines, posterior margin truncate, armed with 2 pairs of moveable spines (small lateral pair and longer sublateral pair) and 2 pairs of submedial plumose setae. Body dark brown, with one or more white transverse bands on body.

Habitat and abundance: Semi-terrestrial, usually in mangrove areas. Arboreal or intertidal under rocks and boulders or among mangrove roots. Also reported from sesarmid crab burrows.

Distribution: Wide-ranging Indo-West Pacific: east Africa to the Ryukyu Islands, Japan and eastern Indonesia.

Notes: Two species of the genus are presently known. The other species, *M. rhizophorae*, is confined to similar habitats on the Atlantic coasts of South America and Africa. Both species are remarkable among shrimps in their agility out of water. When disturbed they jump or climb upwards to escape danger rather than seek shelter under water. *M. oligodon* is nocturnally active and has been collected at night from mangrove trees using knockdown aerosol insecticide.

Further Reading and References

Ahyong, S. T. 2001. Revision of the Australian Stomatopod Crustacea. *Rec. Aust. Mus., Supp.* **26**: 1–326, figs 1–150.

Ahyong, S. T., Lowry, J. K., Alonso, M., Bamber, R. N., Boxshall, G.A., Castro, P., Gerken, S., Karaman, G. S., Goy, J. W., Jones, D. S., Meland, K., Rogers, D. C. and Svavarsson, J. 2011. Subphylum Crustacea Brünnich, 1772. (In: Zhang, Z.-Q., ed.), *Animal Biodiversity: An Outline of Higher-Level Classification and Survey of Taxonomic Richness*. *Zootaxa* **3148**: 165–191.

Allen, G. R., Hortle, K. G. and Renyaan, S. J. 2000. ***Freshwater Fishes of the Timika Region New Guinea***. PT Freeport Indonesia, Timika, Indonesia and Tropical Reef Research, Perth, Australia. 175 pp.

Anker, A. 2001. Two new species of snapping shrimps from the Indo-Pacific, with remarks on colour patterns and sibling species in Alpheidae (Crustacea: Caridea). *Raffles B. Zool.* **49**(1): 57–72.

Anon, 2010. Opinion 2253. *Palaemon rosenbergii* De Man, 1879 (currently *Macrobrachium rosenbergii*; Crustacea, Decapoda): usage conserved by designation of a neotype. *Bull. Zool. Nomencl.* **67**: 258–260.

Banner, D. M. and Banner, A. H. 1982. The alpheid shrimp of Australia. Part III: The remaining alpheids, principally the genus *Alpheus*, and the family Ogyridae. *Rec. Aust. Mus.* **34**(1): 1–357, figs 1–95.

Bruce, A. J. 1990. Redescriptions of five Hong Kong Carideans first described by William Stimpson, 1860. In: (Moreton, B. ed.). *The Marine Flora and Fauna of Hong Kong and Southern China, Hong Kong, 1986*, Hong Kong University Press, Hong Kong: 569–610.

Bruce, A. J. 1993. The occurrence of the semi-terrestrial shrimps *Merguia oligodon* (De Man 1888) and *M. rhizophorae* (Rathbun 1900) (Crustacea Decapoda Hippolytidae) in Africa. *Trop. Zool.* **6**: 179–187, figs 1–4.

Bruce, A. J. 1995. *Latreutes anoplonyx* Kemp, 1914 (Crustacea: Decapoda: Hippolytidae), a jelly-fish associate new to the Australian fauna. *Beagle, Occ. Pap. N.T. Mus. Arts Sc.* **12**: 61–64, figs 1–2.

Cai, Y. and Shokita, S. 2006. Report on a collection of freshwater shrimps (Crustacea: Decapoda: Caridea) from the Philippines with the description of four new species. *Raffles B. Zool.* **54**(2): 245–270.

Chace, F. A., Jr. 1997. The caridean shrimps (Crustacea: Decapoda) of the Albatross Philippine Expedition, 1907–1910, Part 7: Families Atyidae, Eugonatonotidae, Rhynchocinetidae, Bathypalaemonellidae, Processidae, and Hippolytidae. *Smithson. Contr. Zool.* **587**: 1–106.

Chace, F. A. Jr. and Bruce, A. J. 1993. The caridean shrimps (Crustacea: Decapoda) of the Albatross Philippine Expedition, 1907–1910, Part 6: Superfamily Palaemonoidea. *Smithson. Contr. Zool.* **543**: 1–152.

Chan, T.-Y., 1998. Shrimps and Prawns. (In: Carpenter, K. E. and Niem, V. H. eds.), *FAO Species Identification Guide for Fishery Purposes. The Living Marine Resources of the Western Central Pacific. Vol. 2 Cephalopods, crustaceans, holothurians and sharks.* FAO, Rome: 851–971.

Chan, T.-Y., Tong, J., Tam, Y. K. and Chu, K. H. 2008. Phylogenetic relationships among the genera of the Penaeidae (Crustacea: Decapoda) revealed by mitochondrial 16S rRNA gene sequences. *Zootaxa* **1694**: 38–50.

Dall, W., 1957. A revision of the Australian species of Penaeinae (Crustacea Decapoda: Penaeidae). *Aust. J. mar. Freshwat. Res.* **8**(2): 136–230, figs 1–29.

Dall, W., Hill, B. J., Rothlisberg, P. C. and Sharples, D. J. 1990. The biology of the Penaeidae. *Adv. Mar. Biol.* **27**: 1–489.

Dall, W., 2007. Recent molecular research on *Penaeus* sensu lato. *J. Crust. Biol.* **27**(2): 380–382.

De Grave, S. and Fransen, C. H. J. M. 2011. Carideorum catalogus: the recent species of the dendrobranchiate, stenopodidean, procarididean and caridean shrimps (Crustacea: Decapoda). *Zool. Med. Leiden* **85**(9): 195–589, figs 1–59.

Grey, D. L., Dall, W. and Baker, A., 1983. *A Guide to the Australian Penaeid Prawns*, Department of Primary Production of the Northern Territory, Darwin, Australia. 140 pp.

Hanamura, Y. 1999. Occurrence of *Acetes sibogae* Hansen (Crustacea: Decapoda: Sergestidae) in Western Australia, with notes on the northern Australian population. *Rec. West. Aust. Mus.* **19**: 465–468, figs 1–2.

Hansen, H. J. 1919. The Sergestidae of the Sibogae-Expedition. *Siboga-Expeditie* (Leiden) **38**: 1–65, 5 pls.

Haris, A., Lala, D. and Setyadi, G. 2008. Fishes of the estuaries of Mimika district, Papua province. *Mar. Res. Indonesia* **33**(2): 155–166.

Holthuis, L. B. 1950. The Decapoda of the Siboga Expedition. Part X. The Palaemonidae collected by the Siboga and Snellius expeditions, with remarks on other species, Part I: Subfamily Palaemoninae. *Siboga-Expeditie* (Leiden) **39**(a9): 1–268.

Holthuis, L. B. 1980. FAO species catalogue. Vol.1. Shrimps and prawns of the world. An annotated catalogue of species of interest to fisheries. *FAO Fisheries Synopsis* **1**(125): 261 pp.

Holthuis, L. B. 1993. *The recent genera of the Caridean and Stenopodidean shrimps (Crustacea, Decapoda)*, [2nd ed.], Ridderprint Offsetdrukkerij B.V., Alblasserdam. 328 pp.

Kemp, S. 1911. Preliminary descriptions of new species and varieties of Crustacea Stomatopoda in the Indian Museum. *Rec. Indian Mus.* **6**(2): 93–100.

Kemp, S. 1913. An account of the Crustacea Stomatopoda of the Indo-Pacific Region based on the collection in the Indian Museum. *Mem. Indian Mus.* **4**(1): 1–217, figs 1-10, pls 1-10.

Kemp, S. 1914. Hippolytidae. Notes on Crustacea Decapoda in the Indian Museum. V. *Rec. Indian Mus.* **10**: 81–129, pls 1–7.

Komai, T. 2002. New record of a semi-terrestrial hippolytid shrimp, *Merguia oligodon* (De Man) (Crustacea: Decapoda: Caridea) from Japan and Thailand. *Nat. Hist. Res.* **7**: 75–82, figs 1–3.

Lavery, S., Chan, T.-Y., Tam, Y. K. and Chu, K. H. 2004. Phylogenetic relationships and evolutionary history of the shrimp genus *Penaeus* s. l. derived from mitochondrial DNA. *Mol. Phylogenet. Evol.* **31**(1): 39–49.

Lober, M. and Zeng, C. 2009. Effect of microalgae concentration on larval survival, development and growth of an Australian strain of giant freshwater prawn *Macrobrachium rosenbergii*. *Aquaculture* **289**(1): 95–100.

Ma, K. Y., Chan, T.-Y. and Chu, K. H. 2009. Phylogeny of penaeoid shrimps (Decapoda: Penaeoidea) inferred from nuclear protein-coding genes. *Mol. Phylogenet. Evol.* **53**: 45–55.

Ma, K. Y., Chan, T.-Y. and Chu, K. H. 2011. Refuting the six-genus classification of *Penaeus* s.l. (Dendrobranchiata, Penaeidae): a combined analysis of mitochondrial and nuclear genes. *Zool. Scr.* **40**(5): 498–508.

Man, J. G., de. 1879. On some species of the genus *Palaemon* Fabr. with descriptions of two new

forms. *Notes Leyden Mus.* **1**: 165–184.

Man, J. G., de. 1892. Decapoden des Indischen Archipels. (In M. Weber, ed.). *Zool. Ergebn. einer Reise nach Nierderl. Ost-Indien* **2**, E. J. Brill, Leiden: 265–527.

Man, J. G. de. 1915. Zur Fauna von Nord-Neuguinea. Nach den Sammlungen von Dr. P. N. van Kampen und K. Gjellerup in den Jahren 1910-1911. Macrura. *Zool. Jb.* **38**: 385–458.

Manning, R. B. 1969. A review of the genus *Harpiosquilla* (Crustacea, Stomatopoda), with descriptions of three new species. *Smithson. Contr. Zool.* **36**: 1–41.

Manning, R. B., 1998. Stomatopods. (In: Carpenter, K. E. and Niem, V. H. eds.), *FAO Species Identification Guide for Fishery Purposes. The Living Marine Resources of the Western Central Pacific. Volume 2 Cephalopods, crustaceans, holothurians and sharks.* FAO, Rome: 827–849.

Miquel, J. C. 1982. Le genre *Metapenaeus* (Crustacea, Penaeidae): taxonomy, biologie et peches mondiales. *Zool. Verh.* **195**: 1–137, figs 1–57.

Morgan, G. J. 1988. A checklist of decapod Crustacea from the Madang region, Papua New Guinea. *Sci. New Guinea* **14**(3): 124–139.

Muller, K. 2006. *Keanekaragaman Hayati Tanah Papua* [The Biodiversity of Papua]. Manokwari Universitas Negeri Papua (kerjasama dgn Dinas Pendidikan dan Pengajaran Provinsi Papua). xi + 284 pp.

Ng, P. K. L. and Wowor, D. 2011. On the nomenclature of the palaemonid names *Palaemon spinipes* Desmarest, 1817, *Palaemon spinipes* Schenkel, 1902, and *Macrobrachium wallacei* Wowor & Ng, 2008 (Crustacea: Decapoda: Caridea). *Zootaxa* **2904**: 66–68.

Omori, M. 1975. The systematics, biogeography, and fishery of epipelagic shrimps of the genus *Acetes* (Crustacea, Decapoda, Sergestidae). *Bull. Ocean Res. Inst. Univ. Tokyo* **7**: 1–91.

Pérez Farfante, I. and Kensley, B. 1997. Penaeoid and sergestoid shrimps and prawns of the world. Keys and diagnoses for the families and genera. *Mém. Mus. natn. Hist. nat.* **175**: 1–233.

Racek, A. A. and Dall, W. 1965. Littoral Penaeinae (Crustacea Decapoda) from northern Australia, New Guinea and adjacent waters. *Verh. K. ned. Akad. Wet.* **56**(3): 1–119, figs 1–16, pls 1–13.

Rahayu, D. L. and Setyadi, G. 2009. *Mangrove Estuary Crabs of the Mimika Region - Papua, Indonesia.* PT Freeport Indonesia, Kuala Kencana, Papua: vii + 154 pp.

Roux, J. 1933. Crustacés Décapodes d'eau douce. (In V. van Straelen), Résultats scientifiques du voyage aux Indes Orientales Néerlandaises de L L. A A.RR. le Prince et la Princesse Léopold de Belgique. *Mém. Mus. roy. Hist. nat. Belgique* (hors sér.) **3**(14): 1–18.

Sakai, K. and Shinomiya, S. 2011. Preliminary report on eight new genera formerly attributed to *Parapenaeopsis* Alcock, 1901, *sensu lato* (Decapoda, Penaeidae). *Crustaceana* **84**: 491–504.

Schmitt, W. L. 1921. The Marine Decapod Crustacea of California with special reference to the decapod Crustacea collected by the United States Bureau of fisheries steamer "Albatross" in connection with the biological survey of San Francisco Bay during the years 1912-1913. *Univ. Calif. publ. zool.* **23**: 1-470, pls 1-50, text-figs 1–165.

Short, J. W. 2004. A revision of Australian river prawns, *Macrobrachium* (Crustacea: Decapoda: Palaemonidae). *Hydrobiologia* **525**(1-3): 1–100.

Short, J. W. 2009. *Freshwater Crustacea of the Mimika Region – New Guinea.* PT Freeport Indonesia, Kuala Kencana, Papua. ix + 96 pp.

Tavares, C. and Martin, J. 2010. Suborder Dendrobranchiata Bate, 1888. (In: Schram, F.R., J.C. von Vaupel Klein, J. Forest, and M. Charmantier-Daures eds.) *Treatise on Zoology – Anatomy, Taxonomy, Biology – The Crustacea, Decapoda, Volume 9 Part A Eucarida: Euphausiacea, Amphionidacea, and Decapoda (partim).* Brill, Leiden: 99–164.

Voloch, C. M., Freire, P. R. and Russo, C. A. M. 2005. Molecular phylogeny of penaeid shrimps inferred from two mitochondrial markers. *Genet. Mol. Res.* **4**(4): 668–674.

Wowor, D. and Ng, P. K. L. 2007. The giant freshwater prawns of the *Macrobrachium rosenbergii* species group (Crustacea: Decapoda: Caridea: Palaemonidae). *Raffles B. Zool.* **55**(2): 321–336.

Wowor, D. and Ng, P. K. L. 2008. *Palaemon rosenbergii* De Man, 1879 (currently *Macrobrachium rosenbergii*; Crustacea, Decapoda): proposed conservation of usage by designation of a neotype. *Bull. Zool. Nom.* **65**: 288–293.

Zhang, Z.-Q. 2011. Animal biodiversity: An introduction to higher-level classification and taxonomic richness. (In: Zhang, Z.-Q., ed.), *Animal Biodiversity: An Outline of Higher-Level Classification and Survey of Taxonomic Richness*. *Zootaxa* **3148**: 7–12.

Glossary

Abdomen: the 'tail'; posterior portion of the body; includes pleura, tergites, telson and uropods (Fig. 2).

Acron: Anteriormost portion of the body bearing the eyes. Generally, not considered a true segment. Sometimes referred to as the 'ophthalmic somite'.

Acute: pointed, with an angle distinctly less than 90°.

Adrostral carina: ridge running alongside the rostrum, sometimes extending to near posterior carapace margin (Fig. 4).

Adrostral sulcus: groove running alongside the rostrum inside the adrostral carina, sometimes extending to near posterior carapace margin (Fig. 4).

Antenna (pl. antennae): sensory appendage or 'feeler' attached to the anterior head below the eye stalks. Two pairs: first pair, the antennules, consisting of basal peduncle and pair of flagella (feelers) at the tip; second pair, the antennae, consisting of scale (scaphocerite) and long whip-like flagellum (Fig. 2).

Antennal scale: blade-like appendage arising from peduncle of second antenna; also known as scaphocerite (Fig. 2).

Antennal spine: spine on or near anterior carapace margin situated immediately below or fused with lower orbit (Fig. 2).

Anterior: situated towards the front (opposite of posterior).

Antennule: the first antenna (Fig. 2).

Appendage: any structure growing out of the body; usually with multiple segments.

Apex: tip (also apical, meaning at the apex).

Apical: at the apex.

Appendix interna: small appendage arising from inner side of endopod of pleopods tipped with minute hooks which couple with opposing appendage interna during swimming

(Fig. 70).

Appendix masculina: accessory sexual organ arising from the inner endopod of the second male pleopod between the endopod and the appendix interna (Figs 3F, 3G).

Arboreal: living on trees.

Balaeniceps: refers to shape of the dactylus in some species of the snapping shrimp genus *Alpheus* where the dactylus resembles the jaw of a baleen whale, i.e. flattened and plate-like with a fringe of strong setae on the lateral margins.

Basal: at or near the base; near the proximal portion of an appendage.

Basial spine: spine on the basis of a thoracic appendage (Fig. 29).

Basis: second most proximal segment of a thoracic appendage (Fig. 2).

Bec ocellaire: beak-like process on the acron projecting upwards from between the eyestalks towards the lower margin of the rostrum.

Benthic: living at the bottom of the water column.

Bifid: cleft.

Bifurcation: divided into two forks.

Biramous: double-branched, e.g. the pleopods in shrimps.

Boss: a rounded, cuticular process.

Branchial region: part of the carapace which covers the gill chamber.

Branchiocardiac sulcus: groove running along the dorsal edge of the branchiostegite (Fig. 4).

Branchiostegal groove: groove on anterolateral carapace at upper edge of the gill chamber (Figs 71, 72).

Branchiostegal spine: spine on or near anterior carapace margin below antennal spine (Figs 2, 71, 72).

Calcified: hardened by the deposition of calcium carbonate.

Carapace: exoskeletal plate covering to varying degrees the dorsal and lateral head-thorax.

Carina: ridge or keel.

Carpus: fourth segment from base (third from tip) or wrist of thoracic

appendage (Fig. 2).

Cephalothorax: anterior portion of the body formed by the fusion of the head segments with one or more thoracic segments.

Cervical sulcus: mesially transverse and laterally oblique, carapace groove running from the anterior limit of the hepatic region towards the midline of the carapace (Fig. 4).

Chela: the pincer of a cheliped comprising a 'moveable finger' or dactylus, a distal projection of the propodus, the pollex or 'fixed finger', and in most cases a well-defined basal portion of the propodus, the manus or 'palm' (Fig. 2).

Chelate: bearing a chela.

Cheliped: chelate pereiopod; pereiopod with a chela (pincer) on the distal end.

Chromatophore: cell containing pigment granules which by rapid changes in the disposition of the granules can alter the colouration of an animal.

Clasping organ: modification of lower antennular flagellum in male sergestid shrimps used for holding females during copulation.

Concave: curved like the interior of a circle or sphere.

Convex: curved like the outside of a circle or sphere.

Cornea: faceted, usually pigmented, portion of the eye (Fig. 2).

Costa: petasma ridge extending along the ventromesial margin of the ventrolateral lobule in penaeid prawns.

Coxa: the most proximal segment of the endopod of a thoracic leg (Fig. 2).

Crest: elevated portion of a carina.

Cuticle: dead outer layer of the exoskeleton or 'shell'.

Cutting edge: inner edge of the dactylus or propodus of a chela which in combination with the opposing digit is used for grasping, biting, tearing or cutting.

Dactylus: terminal segment or seventh segment from the base of a pereiopod (Fig. 2).

Depression: hollow or sunken area.

Distal: away from the body or point of attachment of an appendage (opposite of proximal).

Dorsal: upper or higher (opposite of ventral).

Downturned: directed or curved downwards (opposite of upturned).

Edentate: without teeth.

Elevated: raised.

Endopod: inner ramus (branch) of biramous (double-branched) appendage.

Epigastric tooth: tooth on the dorsal mid-line of the carapace situated above the gastric region and behind the posteriormost rostral tooth (fig. 4E).

Epipelagic: occurring in the sunlit, pelagic zone between the surface and 200 m depth.

Epipod: appendage attached to coxa or precoxa; often small and filamentous on pereiopods.

Epistome: transverse plate of antennal sternum lying between the labrum and the bases of the antennules (Fig. 5).

Euryhaline: tolerant of a wide range of salinity.

Excavated: dished or hollowed out.

Eyestalk: peduncle of eye or unfaceted part of the eye supporting cornea (Fig. 2).

Exopod: outer ramus (branch) attached to the basis of a biramous (double-branched) appendage; usually small when attached to legs (Fig. 2).

Fixed finger: the terminal extension of the propodus of a chela; also known as the pollex (Fig. 2).

Fixed spine: immoveable spine.

Flagellum (pl. flagella): 'whip-like' terminal portion of an appendage consisting of many short segments, e.g. antennal flagella, the 'feelers'.

Flange: projecting rim; strongly produced margin.

Gape: wide opening or space between cutting edges of fingers (when fingers closed) of chela.

Gastrofrontal carina: carina on anterior carapace in penaeid prawns running longitudinally from gastric region to

'frontal' margin of carapace near orbit (Fig. 4).

Gastro-orbital carina: carina on anterior carapace in penaeid prawns running obliquely from lower gastric region towards 'frontal' margin of carapace but terminating before margin (Fig. 4).

Genital operculum: flap on genital papilla on inner articular membrane at the base of P5 which covers the genital opening in sexually mature, male palaemonid shrimps (Fig. 3E).

Genital papilla: uncalcified protuberance bearing male genital opening at inner base of P5 in caridean shrimps. Covered by a well-developed operculum in palaemonid shrimps.

Greasyback: the 'greasyback' appearance of some penaeid prawns due to a covering of fine setae; in some species these setae are not easily seen when the surface is wet.

Hepatic carina: carina on hepatic region in penaeid prawns (Fig. 4).

Hepatic sulcus: groove on hepatic region in penaeid prawns (Fig. 4).

Hepatic region: small, triangular area between branchial and gastric regions on anterolateral carapace.

Hepatic spine: spine on hepatic region (Fig. 2).

Huxley's line: Huxley's modification of Wallace's line (the well known zoogeographic boundary between the Oriental and Australasian regions), to include the Philippines (excluding Palawan) in the Australasian region. Huxley considered the Philippines fauna to be too distinctive to be included in the Oriental region.

Inter-uropodal sclerite: calcified plate underneath the telson between the uropods and in front of the anus; often bearing a pre-anal spine or carina (Fig. 6) in caridean shrimps.

Ischial spine: spine on the ischium of pereiopods in penaeid prawns (Fig. 29).

Ischium: third segment from base of a pereiopod (Fig. 2).

Keel: sharp, high carina.

Labrum: 'upper lip' or unpaired structure bordering the front of the mouth (Fig. 5).

Lateral: situated at the side or directed to a side; away from the midline (see medial and mesial).

Littoral: intertidal zone of the sea shore.

Longitudinal: lengthways.

Macrophagic: feeding on relatively large food particles or prey.

Mandible: paired, jaw-like, mouth appendage which does most of the work of biting and crushing food.

Manus: palm region of propodus of a chelate pereiopod (Fig. 2).

Microphagic: feeding on relatively minute food particles or very small prey.

Maxilliped: one of first three pairs of thoracopods immediately preceding the pereiopods. In decapod shrimps the first two pairs are small and function as mouth parts whereas the third pair often resemble legs and are more easily seen. In stomatopods, the second pair are developed as raptorial claws (Fig. 8).

Medial: situated along the midline of body, appendage, or segment.

Median: at the middle.

Merus: fourth segment from the base of a pereiopod (Fig. 2).

Mesial: inner; towards the midline of body.

Moveable finger: dactylus or terminal segment of a cheliped (seventh segment from base); closes against pollex (fixed finger) (Fig. 2).

Nauplius: free-swimming, microscopic, first larval stage with only 3 pairs of appendages (antennules, antennae and mandibles) characteristic of dendrobranchiate shrimps.

Ocular: pertaining to the eye.

Orbit: eye socket formed by invagination of anterior carapace near the base of the eye stalk.

Orbital spine: spine projecting from the lower edge of the orbital margin in some penaeid prawns (Fig. 4).

Orbito-antennal sulcus: longitudinal or oblique depression between the orbital margin and the hepatic spine in some penaeid prawns (Fig. 4).

Organs of Pesta: processes on the gastrohepatic gland modified to produce light in some sergestid

shrimps.

Ovigerous: carrying eggs, berried.

Palm: manus region of propodus of chelate pereiopod (Fig. 2).

Pectinate: having teeth similar to the teeth of a comb.

Peduncle: stalk, e.g. multi-segmented basal portion of the antenna or antennule proximal to the flagella.

Pelagic: in the open water column of tidal waters or lakes away from the shore and not close to the bottom (see also epipelagic).

Pereiopod: one of the last five pairs of thoracopods in decapods (Fig. 2) and last three pairs in stomatopods (Fig. 8). In some sergestid shrimps the last two pairs of pereiopods are reduced or lost.

Petasma: male sexual structure on endopod of first pleopod of dendrobranchiate shrimps for transferring sperm to the thelycum of the female (Figs 10, 37–39).

Photophore: luminescent organ of the cuticle.

Pleopod: swimmeret; swimming appendage (usually biramous) attached (in pairs) to underside of abdomen (Fig. 2).

Pleuron (pl. pleura): lateral region on abdominal segments 1–5 (Fig. 2).

Pollex: fixed finger part of propodus of cheliped. The manus (palm) is the more proximal part of the propodus of a cheliped.

Posterior: rear or towards rear (opposite of anterior).

Postocular sulcus: a small groove situated near the upper orbital margin in some penaeid prawns.

Postorbital: refers to dorsal rostral teeth located behind the orbital margin.

Postrostral sulcus: groove in post-rostral carina of penaeid prawns (Fig. 4).

Postrostral carina: posterior extension of dorsal rostral carina in penaeid prawns (Fig. 4).

Pre-anal carina: carina on inter-uropodal sclerite on underside of abdomen in caridean shrimps (Fig. 6).

Pre-terminal: located just before the tip

or apex of an appendage e.g. pre-terminal merus spine.

Process: prominence or protuberance; may be pointed or blunt.

Produced: projected forward.

Propodus: sixth segment from base (second from distal end) of a pereiopod (Fig. 2).

Protozoea: free-swimming, larval stages immediately after the nauplius stage in dendrobranchiate and euphausiacean shrimps.

Proximal: towards the body or point of attachment of an appendage (opposite of distal).

Pterygostome: anterolateral corner of carapace.

Pterygostomial spine: a spine on the pterygostomial margin of the carapace.

Pubescence: thick covering of fine soft setae.

Ramus (pl. rami): branch-like structure.

Raptorial: adapted for seizing or grasping prey, e.g. raptorial claw of stomatopods (Fig. 8).

Rostral plate: articulated plate situated at mid-line of anterior carapace in stomatopods (Fig. 8.).

Rostrum: beak-like forward projection of anterodorsal carapace between eyes (Fig. 2). Generally well developed in shrimps.

Scaphocerite: see antennal scale.

Serrated: notched or grooved like the edge of a saw.

Seta: arthropod bristle.

Setation: arrangement and type of setae.

Sinuous: bent into a very shallow zigzag.

Somite: segment.

Spatulate: having a broadly rounded end.

Spinate: bearing a spine.

Spine: stiff, pointed, cuticular process.

Spinose: spiny.

Spinule: a very small spine.

Sternite: plate or segment of the sternum.

Sternum: ventral plates or segmented wall of thorax or abdomen.

Stridulating organ: a ridge or surface made up of a close series of ridges or tubercles so placed as to rub against another surface and produce sound (Fig. 4).

Subapical: near the apex or tip.

Subdivided carpus: carpus consisting of two or more articulated segments (Fig. 2).

Sublittoral: marine zone extending from the lower margin of the littoral zone to the outer edge of the continental shelf at a depth of about 200 m.

Submedial: near the midline of body or appendage.

Supraorbital: above the orbit.

Suture: flexible line or seam at the junction of two plates or segments or at the base of a spine.

Telson: the last body division immediately after the abdomen (Figs 2, 6, 8). Generally not considered a true body segment.

Tergite: arched dorsal portion of the five anterior abdominal segments in shrimps.

Thelycum: the female genitalia on the thoracic sternum of dendrobranchiate prawns serving as a receptacle for male sperm (Fig. 36).

Thoracopods: thoracic legs.

Thorax: body region between the head and abdomen; when fused with head termed the cephalothorax.

Tomentum: a mat of fine setae.

Tooth: broad-based, spine-like cuticular process.

Tumid: swollen.

Upturned: directed or curved upwards.

Uropods: biramous appendage on either side of telson; forming part of tail-fan (Figs 2, 8).

Ventral: lower or under.

Vestigial: very small, imperfectly developed; present only as small spine or lobe.

Zoeae: free-swimming, larval stages in pleocyemate decapods.

Appendix 1

Checklist of mangrove estuary shrimps recorded from the Mimika region

(* Denotes species discussed in Short, 2009)

Order Stomatopoda

Family Squillidae

1. *Clorida depressa* (Miers, 1880)
2. *Cloridopsis terrareginensis* (Stephenson, 1953)
3. *Harpiosquilla harpax* (De Haan, 1844 [in De Haan, 1833–1850])
4. *Oratosquillina interrupta* (Kemp, 1911)

Order Decapoda

Suborder Dendrobranchiata

Family Penaeidae

5. *Atypopenaeus formosus* (Dall, 1957)
6. *Metapenaeus demani demani* (J. Roux, 1921)
7. *Metapenaeus eboracensis* Dall, 1957
8. *Metapenaeus ensis* (De Haan, 1844 [in De Haan, 1833–1850])
9. *Metapenaeus papuensis* Racek and Dall, 1965
10. *Parapenaeopsis cornuta* (Kishinouye, 1900)
11. *Parapenaeopsis sculptilis* (Heller, 1862)
12. *Parapenaeopsis tenella* (Spence Bate, 1888)
13. *Penaeus latisulcatus* Kishinouye, 1896
14. *Penaeus longistylus* Kubo, 1943
15. *Penaeus merguiensis* De Man, 1888
16. *Penaeus monodon* Fabricius, 1798
17. *Trachypenaeus curvirostris* (Stimpson, 1860)
18. *Trachypenaeus gonospinifer* Racek and Dall, 1965

Family Sergestidae

19. *Acetes sibogae* Hansen, 1919

Suborder Pleocyemata

Family Alpheidae

20. *Alpheus* cf. *euphrosyne* De Man, 1897
21. *Alpheus chiragricus* H. Milne Edwards, 1837
22. *Alpheus* sp. 1
23. *Alpheus* sp. 2
24. *Alpheus* sp. 3
25. *Alpheus* sp. 4

Family Atyidae

26. **Atyopsis spinipes* (Newport, 1847)
27. **Caridina brevicarpalis* De Man, 1892
28. **Caridina gracilirostris* De Man, 1892
29. **Caridina longirostris* H. Milne Edwards, 1837
30. **Caridina serratirostris* De Man, 1892
31. **Caridina weberi* De Man, 1892
32. **Caridina* sp. 1
33. **Caridina* sp. 2
34. **Caridina* sp. 3
35. **Caridina* sp. 4
36. **Caridina* sp. 5

Family Hippolytidae

37. *Exhippolysmata ensirostris ensirostris* (Kemp, 1914)
38. *Latreutes anoplonyx* (Kemp, 1914)
39. *Lysmata vittata* (Stimpson, 1860)
40. *Merguia oligodon* (De Man, 1888)

Family Palaemonidae

41. *Leandrites celebensis* (De Man, 1881)
42. **Palaemon concinnus* Dana, 1852
43. **Macrobrachium bariense* (De Man, 1892)

44. **Macrobrachium 'equidens'* complex (Dana, 1852)
45. **Macrobrachium handschini* (J. Roux, 1933)
46. **Macrobrachium idae* (Heller, 1862)
47. **Macrobrachium latidactylus* (Thallwitz, 1891)
48. **Macrobrachium mammillodactylus* (Thallwitz, 1892)
49. **Macrobrachium spinipes* (Schenkel, 1902) [previously *M. rosenbergii* De Man, 1879]
50. **Macrobrachium weberi* (De Man, 1892)
51. **Macrobrachium* sp. 2

Appendix 2

Higher classification and genus/species diversity of Crustacea recorded from the Mimika region

Phylum Arthropoda
- Sub-phylum Crustacea
  - Order Hoplocarida
    - Suborder Stomatopoda
      - Superfamily Squilloidea
        - Family Squillidae (Squillid mantis-shrimps – 4 genera, 4 species)

  - Order Decapoda
    - Suborder Dendrobranchiata
      - Superfamily Penaeoidea
        - Family Penaeidae (Commercial prawns – 5 genera, 14 species)

      - Superfamily Sergestoidea
        - Family Sergestidae (Paste shrimps – 1 genus, 1 species)

    - Suborder Pleocyemata
      - Infraorder Caridea
        - Superfamily Atyoidea
          - Family Atyidae (Atyid shrimps – 2 genera, 11 species)

        - Superfamily Palaemonoidea
          - Family Palaemonidae (Palaemonid shrimps – 3 genera, 15 species)

        - Superfamily Alpheoidea
          - Family Alpheidae (Snapping shrimps – 1 genus, 6 species)

Family Hippolytidae (Hippolytid shrimps – 4 genera, 4 species)

Infraorder Astacidea
Superfamily Parastacoidea
Family Parastacidae (Southern hemisphere freshwater crayfishes – 1 genus, 1 species)

Infraorder Thalassinidea
Family Thalassinidae (Mud lobsters – 1 genus, 3 species)
Family Upogebiidae (Ghost shrimps – 1 genus, 2 species)

Infraorder Anomura
Superfamily Galathoidea
Family Porcellanidae (Porcelain crabs – 1 genus, 1 species)

Superfamily Paguroidea
Family Diogenidae (Hermit crabs – 2 genera, 11 species)

Infraorder Brachyura
Superfamily Calappoidea
Family Calappidae (Box crabs – 1 genus, 1 species)
Family Matutidae (Moon crabs – 1 genus, 1 species)

Superfamily Dorippoidea
Family Dorippidae (Porter crabs – 1 genus, 1 species)

Superfamily
Family Menippidae (Stone crabs – 1 genus, 1 species)
Family Oziidae (Mud crabs – 1 genus, 1 species)

Superfamily Grapsoidea
Family Grapsidae (Shore crabs – 1 genus, 2 species)
Family Sesarmidae (Mangrove or vinegar crabs – 5 genera, 20 species)

Family Varunidae (Paddler crabs – 4 genera, 4 species)

Superfamily Leucosioidea
Family Iphiculidae (Pebble crabs – 1 genus, 1 species)
Family Leucosiidae (Pebble crabs – 3 genera, 6 species)

Superfamily Majoidea
Family Hymenosomatidae (Crown or false spider crabs – 3 genera, 4 species)

Superfamily Pilumnoidea
Family Pilumnidae (Hairy crabs – 2 genera, 3 species)

Superfamily Portunoidea
Family Portunidae (Swimming crabs – 5 genera, 14 species)

Superfamily Gecarcinucidea
Family Gecarcinucidae [= Parathelphusidae, Sundathelphusidae] (Freshwater crabs - 3 genera, 4 species)

Superfamily Ocypodoidea
Family Camptandriidae (2 genera, 4 species)
Family Dotillidae (Sand bubbler and soldier crabs – 2 genera, 3 species)
Family Macrophthalmidae (Sentinel crabs – 2 genera, 7 species)
Family Mictyridae (Soldier crabs – 1 genus, 1 species)
Family Ocypodidae (Fiddler and ghost crabs – 1 genus, 5 species)

Ajkwa channel, Ajkwa River estuary (Photo by Gesang Setyadi).

Index

R

S

T

U

W

Y

DR JOHN W. SHORT is an international authority on freshwater and estuarine shrimps and has studied decapod Crustacea for over 25 years. He is the author of the *Freshwater Crustacea of the Mimika Region - New Guinea* and has contributed chapters to other popular books including the Natural History of Madagascar and the Queensland Museum's Wild Guide series. He is also the author of numerous scientific and popular articles. Dr Short is currently the principal consultant for BioAccess Australia.

PT FREEPORT INDONESIA
Affiliate of Freeport-McMoRan Copper & Gold

THE 8TH BOOK
INA SERIES OF FIELD GUIDES
TOT HE FLORA AND FAUNA
OF MIMIKA REGION, PAPUA

MANGROVE ESTUARY SHRIMPS

OF THE MIMIKA REGION - PAPUA, INDONESIA