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Singapore, with notes on their distribution and a key to the
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By D. S. JOHNSON

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Introduction

THE DECAPODA Caridea and Stenopodidea of the Indo-Australian Archipelago, especially those of its eastern portion, are rather well-known. In general this is also true of the area extending from eastern Peninsular India to the Andamans and Peninsular Thailand. By contrast there are few published records of members of either of these groups from the Malayan area. Thus there are many species which are known both from areas to the north-west of Malaya and areas to the south-east of Malaya, but which have not yet been reported from Malayan waters. It is possible that certain of these do not occur in the Malayan area, especially its southern portion, since the extensive shallow water seas surrounding the south of Malaya must be unfavourable to many oceanic species. Nonetheless it is abundantly clear that the present paucity of records does not truly represent the real nature of the Malayan fauna.

Singapore is ideally located for a study of the crustacea of this south Malayan area. It is in the very centre of the system of shallow Malaysian seas. Around its shores there are representatives of almost every type of coast-line found in this region, from mud-flats and mangrove swamps to coral-reefs. There are also extensive brackish-water areas and several types of freshwater habitat. Thus a list of the Decapoda Caridea and Stenopodidea of Singapore would form a desirable addition to our knowledge of this group of animals. Though this listing is admittedly incomplete it does include far more species than have been recorded from any other single locality in the Indo-Pacific region and it is hoped that all of the commoner species and most of the less common species have been included.

There are very few published records of Caridea and Stenopodidea from Singapore. Thus the present list is almost entirely based on collections which I have been able to examine myself. These include: the non-Alpheid material of the Bedford-Lanchester collection and some other specimens housed in the British Museum (Natural History), London; some specimens in the collection of the Rijksmuseum van Natuurlijke Historie, Leiden; the collections of the former Singapore Regional Fisheries Research Station, at present housed in the Department of Zoology, University of Malaya in Singapore; a small collection made by Mr. Patton on a visit to Singapore and donated to this department; the main portion of the Archer collection, housed in the Liverpool Free Public Museums; and collections made by myself and my colleagues and students in this department. In the preparation of this list I have also examined for the purposes of comparison many specimens of non-Singaporean origin housed in the above museums and

also in the Zoologisch Museum at Amsterdam and the Zoology Museum of Cambridge University. The work could not have reached its present state had it not been for a grant of study leave by the authorities of the University of Malaya, which enabled me to visit the European museums mentioned. I wish to thank the authorities of all the institutions mentioned for their assistance. My thanks are also due to all who have helped in this work and especially to my colleagues who have borne with and encouraged my enthusiasm, to Dr. Isabella Gordon and Mr. R. Ingle of the British Museum for their unstinting help, and to Dr. L. B. Holthuis of Leiden for his very useful advice and criticism.

In order to keep this paper of a reasonable length I have not included individual synonymies. Throughout I have followed the generic nomenclature of Holthuis (1955). With this exception the names used for species are those used in the Siboga monographs, except where otherwise indicated. The Atyidae are not included in the Siboga monographs. For this family I have followed Bouvier (1925), except where otherwise indicated.

In order to make this paper more useful to Malaysian zoologists I have included a key to the genera of Caridean prawns known from or likely to occur in Malayan waters. This key is based on the world key of Holthuis (1955) with some modifications and simplifications. At the end of this paper I have appended a reference-list of basic works on the Caridea and Stenopodidea of the Indo-Australian area, and a further list of other papers containing records of members of these groups occurring in Malaya and Peninsular Thailand.

Systematic Account

CARIDEA

Pasiphaeidae

The Pasiphaeidae are mainly members of the deep-sea plankton. Only one genus and species occurs in the shallow seas of Malaya.

Leptochela robusta Stimpson, 1860

This small prawn is a regular constituent of the plankton in the Singapore Straits. It is the only fully planktonic caridean found in Singapore waters.

Atyidae

The Atyidae are poorly represented in Singapore freshwaters, though abundant in low-salinity brackish waters.

Caridina gracilirostris De Man, 1892

In Singapore island this species is confined to low-salinity and, more rarely, high-salinity brackish waters and to adjoining freshwaters which are subject to tidal influence. In such localities it may be very numerous, though seldom abundant.

Caridina brachydactyla peninsularis Kemp, 1918

This species is not common in Singapore. I have collected it at Sungai Seletar in low-salinity brackish water and in freshwater subject to tidal influence. I have also found it in a freshwater stream just above the tidal area near Jurong village. There are specimens in the Bedford-Lanchester collection from Tanglin; but the species has not been found in that part of Singapore in recent years and may have been exterminated there by the increasing urbanization of Tanglin.

I have previously (Johnson, 1961) accepted the view of Bouvier (1925) that *C. brachydactyla* is a synonym of *C. nilotica* P. Roux. I now think that it is a valid species (Johnson, 1960 a). Singapore specimens, as well as all others which I have seen from Malaya, agree in all essential features with Kemp's types from Penang and I consider that *peninsularis* Kemp is a valid subspecies of *C. brachydactyla*.

***Caridina propinqua* De Man, 1908**

C. propinqua is the most abundant member of its family in Singapore. It inhabits low-salinity brackish waters and adjoining freshwaters which are subject to tidal influence. It is often abundant in such habitats, and occurs everywhere in the island where they are found. Elsewhere *C. propinqua*, though essentially a brackish water form, is sometimes found in freshwaters which are not connected with the sea. It ranges from Lake Chilka through to Thailand and Malaya. Singapore is its most southerly known locality.

***Caridina tonkinensis* Bouvier, 1919**

Like the preceding species, *C. tonkinensis* characteristically inhabits low-salinity brackish waters. It is apparently somewhat rarer than *C. propinqua* and in Singapore it has so far only been found in the north-eastern portion of the island. I have collected in a number of similar localities in western Malaya. Until its recent discovery in Malaya (Johnson, 1961), *C. tonkinensis* was only known from the type-specimens collected by Sollaud at Tonkin.

***Caridina weberi sumatrensis* De Man, 1892**

C. weberi sumatrensis is apparently rather rare in Malaya, though widely distributed. I have collected a single specimen from a shaded stretch of the Sungai Seletar, below the Nee Soon swamp forest, but above the tidal zone. It does not appear to extend into either the swamp forest or the tidal zone.

Pandalidae

With the exception of the aberrant *Chlorotocus*-group the members of this family are essentially cold-water organisms. Most tropical species are thus inhabitants of deep waters and would not be able to survive in the shallow seas around southern Malaya. Of the three species found in Singapore two belong to the *Chlorotocus*-group and only one is common. It is most unlikely that any further species will be discovered in this area.

***Heterocarpoides levicarina* (Bate), 1888**

H. levicarina occurs in a small pocket of relatively deep water in the Singapore Straits which exceeds 70 metres in depth.

***Chlorotocoides spinicauda* (De Man), 1902**

This species has been collected in a small pocket of relatively deep water in the Singapore Straits which exceeds 70 metres in depth. In the British Museum there are specimens collected by the cable-ship *Patrol* from 80 miles south of Penang. In the eastern part of the Indo-Australian Archipelago it occurs in similar and slightly lesser depths.

De Man assigned this species to the genus *Chlorotocus*. Kemp (1925) created for it the genus *Chlorotocoides*, an action which was undoubtedly correct.

Chlorotocella gracilis Balss, 1914

This small prawn is not very common; but it is widely distributed in Singapore waters. Young individuals have been taken in *Enhalus*-beds at Bedok and in *Sargassum*-beds at Pulau Sudong, in both places at extreme low-water spring tide mark. Adults have been taken offshore over clean bottoms at several localities in the Singapore Straits and on the crinoid grounds of the Johore Shoals at a depth of about 18 meters. It is probable that, at least as an adult, *C. gracilis* is sub-planktonic since it has sometimes been taken in plankton nets in the Singapore Straits. This habit would agree with its slender, compressed build and feeble swimming powers. The nearest previously recorded localities to Singapore are the Andaman Islands and Java.

Hippolytidae

The Hippolytidae of the Indo-Pacific region are morphologically varied; but, as compared with those of the northern Pacific, they are represented by comparatively few species. Many Indo-Pacific species are found in Singapore waters, including nearly two-thirds of those which are widely distributed. There are several notable absentees including: *Ligur uveae* (Borradaile), 1899; *Thorulus amboinensis* (De Man), 1888; *T. maldivensis* (Borradaile), 1915; *Latreutes anoplonyx* Kemp, 1914; *Tozeuma armatum* Paulson, 1875; *Lysmata dentata* (De Haan), 1841; *L. trisetacea* (Heller), 1861; *Hippolyasmata kukenthali* (De Man), 1902; and *Merguia oligodon* (De Man), 1888. *M. oligodon* appears to have unusual habitat requirements and may well have been overlooked. *Latreutes anoplonyx*, which is possibly a commensal of Scyphozoans, has been collected in Malayan waters by the cable ship *Patrol*, 80 miles to the south of Penang (specimen in the British Museum), and so may well be found at Singapore in the future. *Tozeuma armatum* was recorded from Singapore by Stephensen (1927) but this record is very doubtful. It seems to be replaced in Singapore waters by the closely related *T. lanceolatum*. The remaining species all have pronouncedly oceanic distributions and so may well be really absent from the shallow seas around Singapore.

Saron marmoratus (Olivier), 1811

There is one male of this species in the Bedford-Lanchester collection which was taken from the shore at Blakang Mati. This is probably the most abundant and widely distributed species of coral-reef Hippolytid in the Indo-Pacific region. Its rarity at Singapore may well be a consequence of the enclosed nature and low salinity of the local seas.

Saron neglectus De Man, 1902

I have collected a single specimen of this species from the reef-flat at Pulau Sudong. I have also seen a specimen from a reef on the south-west coast of Singapore Island. This species is widely distributed in the Indo-Pacific region; but it appears to be rarer than *S. marmoratus*. In addition to the localities cited by Holthuis it occurs at Samoa (specimens collected by Whitnee in the British Museum).

Thor paschalis (Heller), 1862

Kemp (1916) recorded this species from Tanah Merah Besar, Singapore. It has not been collected here in recent years.

Hippolyte ventricosa H. Milne-Edwards, 1837

This species is a common inhabitant of littoral weed-beds, and is found amongst both *Enhalus* and *Sargassum*. It is also found amongst floating masses of *Sargassum*.

Latreutes mucronatus (Stimpson), 1860

L. mucronatus is apparently rare in the Singapore area. Young individuals have been collected in *Enhalus*-beds at Bedok and Changi.

Latreutes porcinius Kemp, 1916

L. porcinius is a regular inhabitant of *Halophyllum*-pools and *Enhalus*-beds. It has only been known previously from the Andaman islands.

Latreutes pygmaeus Nobili, 1904

L. pygmaeus is a regular inhabitant of *Enhalus*- and *Sargassum*-beds. It is not known from other habitats in the Singapore area.

Tozeuma lanceolatum Stimpson, 1860

This is an offshore species. It has been collected at various localities in the Singapore Straits, down to depths of over 70 metres, and on the crinoid grounds of the Johore Shoals at a depth of about 18 metres. It has been occasionally taken in plankton nets in the Singapore Straits and is probably sub-planktonic. It occurs over clean bottoms of shell-gravel, coral-brash, etc.

I follow Holthuis (1955) in adopting the generic name *Tozeuma*, since this work is likely to remain the standard work on caridean genera for many years to come. There is only one species of the genus in Singapore waters, as far as I can determine. In view of the confusion that formerly prevailed in this genus I consider that Stephensen's (1927) record of *T. armatum* from Singapore almost certainly refers to the present species.

Singapore specimens, in their long rostrum, relatively short and broad antennal scale, and numerous ventral rostral teeth, agree with *T. lanceolatum* rather than with *T. armatum*. *T. lanceolatum* has only previously been known from Hong Kong; but there are specimens in the British Museum from Fukien. It is possible that some of the more north-easterly records of *T. armatum*, as for instance that of Balss (1914) from Japan, really refer to *T. lanceolatum*.

Gelastocaris paronae (Nobili), 1905

G. paronae occurs on clean gravelly bottoms in depths of 18 to 70 metres. It has been taken on the crinoid grounds of the Johore Shoals and in the Singapore Straits. In life it bears a marked resemblance to a cirrolanid Isopod and it probably has similar habits.

Mimocaris heterocarpoides Nobili, 1903

There are seven specimens of this rare species in the collections of the department of zoology. They were collected off Singapore at some date prior to October 1951 by an unknown collector. The species is otherwise known from eastern Sumatra and north-western Borneo.

Hippolysmata (Hippolysmata) vittata Stimpson, 1860

This is probably the most abundant caridean of Singapore offshore waters. It is generally distributed on clean bottoms in depths of from 0 to over 70 metres; but it does not occur above low water spring tide mark. Specific localities include: Sultan Shoal,

around coral-heads on pier; Singapore Straits, several localities at varying depths on bottoms varying from gravelly to rocky.

Hippolysmata (Exhippolysmata) ensirostris Kemp, 1914

Both the typical form of this species and the form *punctata* Kemp are found in Singapore waters. It is apparently a species of shallow waters with sandy bottoms. Specific localities include: the shallow waters just below low-water spring tide mark off the Bedok-Siglap coast, where it may be very abundant, and the Singapore Straits to the south of Bedok in a depth of 40 metres.

Hippolysmata (Lysmatella) prima (Borradaile), 1915

This species is less common in the Singapore area than are the two preceding species. It has been collected once in the Singapore Straits and once from an unspecified locality, where it was associated with a large sea-anemone living on a bottom of mixed mud and shell-gravel.

Alpheidae

The Alpheidae are the most abundant and varied family of marine Caridea in the Indo-Pacific region. Unfortunately the family is in need of a thorough revision so that the identification of individual specimens is difficult and sometimes impossible. Thus several of the identifications in the following list are somewhat uncertain. This is indicated by a ? preceding the trivial name. There are a number of species of the genus *Alpheus* which occur in Singapore waters; but which I am unable to identify, even tentatively, with any known species. Some of these may be new species; others probably belong to previously known but inadequately described species. I have omitted these forms from my list since no useful purpose can be served by the mere listing of undescribed specimens under code designations.

Athanas parvus De Man, 1910

This species has been found on coral at the reef edge of Pulau Hantu.

Athanas jedanensis De Man, 1910

A. jedanensis occurs in the Singapore Straits at a depth of between 38 and 40 metres on a crinoid ground with gravelly-stony bottom.

Athanas monoceros (Heller), 1861

A single male was obtained from a coral-head growing in a depth of 1 to 2 metres at Pulau Sudong; a female was obtained from crevices in coral-rock on the lower beach at Labrador. These specimens were intermediate in character between *A. monoceros* Heller and *A. dimorphus* Ortmann, 1894. I consider that these two species are synonymous. *A. monoceros* has clear priority as the specific name.

Salmoneus hilarulus (De Man), 1910

Several specimens of this species have been collected from flats of very soft mud at Tanjong Penuru; a single male was obtained from dredgings on the shell-gravel, coral-brash grounds in Selat Sinki. The species was previously known from the type-specimen collected at a depth of 32 metres between Misool and New Guinea, on a bottom of sand and shells.

Jousseaumea De Man, used in the Siboga report, appears to be pre-occupied by *Jousseaumia* Sacco, a genus of molluscs. Holthuis (1955) proposed that the former genus be named *Salmoneus*.

Synalpheus sp. (*laevimanus* group)

This species is certainly a member of the *laevimanus* group; but it is quite unlike any described species known to me. It is found in crevices of honeycomb rock on the lower beach at Labrador and the reef-flat at Pulau Hantu.

***Synalpheus amboinae* (Zehntner), 1894**

S. amboinae occurs on the crinoid grounds of the Johore shoals at a depth of about 18 metres; on the Ajax-Sultan Shoal at a depth of about 17 metres; and at various localities in the Singapore Straits in depths of down to over 70 metres. It is known from similar localities in the eastern portion of the Indo-Australian archipelago in depths of down to 40 metres. Its occurrence on crinoid grounds, together with its general form and colouration, suggest that it is a crinoid commensal, though this cannot yet be said to be proved.

***Synalpheus comatularum* (Haswell), 1882**

This species was recorded from Singapore by Walker (1887). I could not find the specimen in my short visit to Liverpool and the record must be considered doubtful.

***Synalpheus stimpsoni* (De Man), 1888**

S. stimpsoni is a commensal of comatulid crinoids. It has been collected from these organisms at Raffles Light.

***Synalpheus neomeris* (De Man), 1897**

This species has been collected from a small area of deep water in the Singapore Straits which reaches a depth of over 70 metres.

***Synalpheus gravieri* Coutière, 1905**

S. gravieri occurs on hard bottoms in the Singapore Straits at depths of between 35 and 70 metres. Collections made on the Outer Shoal suggest that it may be commensal with Alcyonaceans.

***Synalpheus iphinoe* De Man, 1909**

S. iphinoe is found on the crinoid grounds of the Johore Shoals at a depth of about 18 metres. It has been recorded from similar localities in the eastern portion of the Indo-Australian archipelago in depths of from 18 to 90 metres. On the Johore Shoals it appears to be commensal with *Telesto*.

***Synalpheus jedanensis* De Man, 1909**

S. jedanensis occurs on the crinoid grounds of the Johore Shoals at a depth of about 18 metres. It was originally described from pearl banks in the Aru islands at a depth of 13 metres.

***Synalpheus triunguiculatus* (Paulson), 1875**

A single male has been collected from a bushy alcyonacean on the Outer Shoal.

***Synalpheus stormi* De Man, 1910**

De Man (1910; 1911) treated this as a variety of *Synalpheus bakeri* Coutière, 1908; but there seems to be no clear reason why it should not have full specific status. A single specimen has been collected from a coral-head growing in a depth of 1 to 2 metres at Pulau Sudong.

Synalpheus tumidomanus (Paulson), 1875

S. tumidomanus has been found on the reef-flat at Pulau Hantu associated with the dead part of living coral-heads.

Synalpheus acanthitelsonis Coutière, 1905

This is one of the commonest species of *Synalpheus* in the Singapore area. It is generally distributed on beaches below mid-tide level and in shallow offshore waters wherever the bottom has crevices in which it can live. Specific localities include: Labrador beach, crevices in honeycomb rock; Pulau Sudong, coral-head growing in a depth of 1 to 2 metres; Johore Shoals, crinoid grounds at a depth of about 18 metres; Kuala Johore, off Angler Bank at a depth of about 18 to 27 metres.

Synalpheus hilarulus De Man, 1910

One individual of this species has been collected on a submerged shoal to the west of Pulau Pawai in a depth of about 10 metres on a shell-gravel bottom.

Synalpheus exilipes Coutière, 1905

I prefer to treat this as a separate species, rather than as a variety of *S. biunguiculatus* (Stimpson). One specimen has been collected from a coral-head growing in a depth of 1 to 2 metres at Pulau Sudong.

Synalpheus bituberculatus De Man, 1910

S. bituberculatus has been collected from crevices in honeycomb rock on the lower beach at Labrador; from crevices on the reef-edge at Pulau Hantu; and from a submerged shoal west of Pulau Pawai in about 10 metres depth on shell-gravel.

Synalpheus quadrispinosus De Man, 1910

S. quadrispinosus occurs on the crinoid grounds of the Johore Shoals at a depth of about 18 metres. It has also been collected in the Singapore Straits. It appears to be commensal with crinoids.

Synalpheus neptunus (Dana), 1852

This species was recorded from Singapore by Walker (1887). The specimen is in the Archer collection.

Synalpheus theano De Man, 1910

S. theano has been collected on shell-gravel, coral-brash grounds in Selat Sinki at a depth of about 10 metres.

Synalpheus pescadorensis Coutière, 1905

S. pescadorensis has been collected from a coral-head growing in a depth of 1 to 2 metres at Pulau Sudong.

Alpheus ventrosus H. Milne Edwards, 1837

This species has been collected from a submerged coral-gorgonian ground to the west of Pulau Pawai in a depth of between 6 and 10 metres; from a submerged coral reef off Pulau Tembakul; and from sub-littoral coral at Raffles Light. *A. ventrosus* is a well-known commensal of living coral.

Alpheus splendidus Coutière, 1897

A single specimen of this species has been collected from a submerged coral-reef in a depth of about 6 metres off Pulau Tembakul to the east of Pulau Sakijang Pelepah.

Alpheus lutini Coutière, 1905

A. lutini has been collected from crevices in coral rock at Pulau Hantu.

Alpheus paraleyone Coutière, 1905

This species appears to be associated with living sponges and corals. It is a common offshore form. Specific localities include: Selat Sinki, shell-gravel, coral-brash grounds in a depth of about 10 metres, on living coral; off Pulau Tembakul to the east of Pulau Sakijang Pelepah, coral-reef in a depth of about 6 metres; off Tanjong Rhu, 4 metres, mud; Singapore Straits, various localities in depths of from 35 to over 70 metres; Johore Shoals, crinoid grounds, in a depth of about 18 metres.

Alpheus spongiarum Coutière, 1897

A. spongiarum is specialized for life inside massive sponges. It is found wherever such sponges occur at levels below low water spring tide level. Specific localities include: Selat Sinki, shell-gravel, coral-brash grounds at a depth of about 10 metres; Pulau Sudong, sponges growing on coral-heads in depths of 1 to 2 metres; Singapore Straits, hard bottoms at depths of between 35 and 70 metres; Johore Shoals, crinoid grounds, at a depth of about 18 metres; lower beach at Labrador, small heads of sponge attached to coral boulders.

Alpheus stanleyi Coutière, 1908

A. stanleyi has been collected on the shell-gravel, coral-brash grounds of Selat Sinki at a depth of about 10 metres.

Alpheus cf. lanceoloti Coutière, 1905

A single specimen which belongs to this or a closely related species has been collected from a coral-head growing in a depth of 1 to 2 metres at Pulau Sudong.

Alpheus bengalensis Coutière, 1905

De Man treats this as a variety of *A. paracrinitus* Miers, 1881. Whilst this may ultimately turn out to be correct there is at present no evidence to support the use of a trinomial, so that I prefer to treat it as a full species. *A. bengalensis* is abundant in crevices of honeycomb rock at Labrador.

Alpheus alpheopsides Coutière, 1905

A. alpheopsides has been collected from a coral-head growing in a depth of 1 to 2 metres at Pulau Sudong, and from crevices in dead coral at about low water spring tide mark at Pulau Hantu.

Alpheus rapax Fabricius, 1798

This is by far the commonest large caridean prawn of Singapore beaches. An errant form, it is neither a burrower nor a crevice dweller, but wanders in and out with the tide. It is abundant on sandy beaches and reef-flats and it has been taken on muddy beaches. Specific localities include: Tanjong Gul; Labrador beach; Bedok; Mata Ikan; Changi; Tanjong Kranji; Pulau Hantu; and Raffles Light. Visual observations suggest that it occurs everywhere where there is an extensive flat beach.

Alpheus angustidigitus De Man, 1911

Since the characters of this form seem to be constant I prefer to treat it as a separate species rather than to follow De Man in treating it as a variety of *A. brevirostris* (Olivier), 1789. This species is very similar to the last in form and habits. It seems to be less common in the Singapore area. Specific records include: Labrador beach; mud-flats at Tanjong Penuru; shoal west of Pulau Pawai in a depth of about 12 metres.

Alpheus distinguendus De Man, 1909

This species has been obtained in beach seines on the muddy-sand beach at Bedok. It is very similar to *A. rapax* but it can readily be distinguished in life by its beautiful and distinctive colouration.

Alpheus rapacida De Man, 1908

This species occurs in abundance in burrows in a flat of very soft mud at about mid-tide level at Tanjong Penuru where it is associated with *Salmoneus hilarulus*. It has not so far been found elsewhere in the Singapore Area.

Alpheus bisincisus De Haan, 1849

A single ovigerous female of this species was dredged from a submerged coral reef in a depth of about 6 metres off Pulau Tembakul to the east of Pulau Sakijang Pelepah.

Alpheus microrhynchus De Man, 1897

A. microrhynchus is not uncommon in prawn ponds in Singapore island. These ponds are brackish with a high but variable salinity, and are situated in mangrove areas.

Alpheus edwardsi Audouin, 1826

This species was recorded from Singapore by Walker (1887); but examination of the specimen in the Archer collection has convinced me that it really is a specimen of *A. audouini*. Thus *A. edwardsi* should no longer appear in the Singapore list.

Alpheus audouini Coutière, 1905

A. audouini is one of the commoner littoral Alpheids of the Singapore area. It is essentially a reef-flat species. Specific localities include: Labrador, lower beach; Bedok, lower beach; Pulau Hantu, reef-flat; Burun Darat, reef-flat; Pulau Subar Laut, reef.

Alpheus sp. cf. audouini Coutière, 1905

A prawn which is very close to *A. audouini*, and keys out to that species in De Man's (1912) key, lives and breeds in the prawn ponds of the Jurong area.

Alpheus chiragricus H. Milne-Edwards, 1837

This species seems to be a common offshore form in the Singapore area. It has been collected from: off the Siglap obelisk on muddy-sand at a depth of 2 to 8 metres; off Tanjong Rhu, on mud at a depth of about 4 metres; and off Tanjong Stapa at a depth of nearly 50 metres.

Alpheus crassimanus Heller, 1865

Several specimens of this species were obtained from cavities in a piece of ship-worm infested, drifted bamboo at Changi beach; and 2 specimens have been collected from the middle beach at Bedok.

Alpheus pareuchirus Coutière, 1905

I have collected this species on the reef-flat at Pulau Sudong and it has also been collected from hard grounds in the Singapore Straits.

Alpheus cf. leptochirus Coutière, 1905

A female which appears to be close to this species was obtained from crevices in drifted, ship-worm infested bamboo at Changi; a similar female has been collected from a crinoid ground in a depth of about 45 metres in the Singapore Straits to the south of Bedok.

Alpheus cf. maindroni Coutière, 1898

A single specimen which probably belongs to this species has been collected on the reef at Pulau Hantu.

Alpheus parvirostris Dana, 1852

This is one of the commoner littoral Alpheids of the Singapore area. It is a crevice-dwelling species. Specific localities include: Labrador, crevices in honeycomb rock on lower beach; Pulau Hantu, crevices in honeycomb rock on reef-flat; and in coral-rock at the reef-edge; Raffles Light, crevices in *Heliopora*-heads at low water spring tide mark and crevices in sub-littoral coral rock.

Alpheus hippothoe De Man, 1888

I have collected this species from a submerged coral-reef at a depth of about 6 metres off Pulau Sakijang Pelepah. It has also been obtained from submerged stakes of permanent fish-traps in the Nanas channel to the north of Pulau Ubin.

Alpheus euchirus Dana, 1852

This is one of the commonest of Singapore Alpheid prawns. It is found in both littoral and offshore habitats. It is a crevice dweller and is thus limited to hard bottoms. Specific localities include: Labrador beach, crevices in honeycomb rock on the lower beach; Pulau Hantu, crevices in coral rock at the reef edge; Pulau Sudong, coral-heads growing in a depth of 1 to 2 metres; Selat Sinki, shell-gravel, coral-brash grounds at a depth of about 10 metres; off the main harbour breakwater; Ajax-Sultan shoal, on stone at a depth of about 17 metres; submerged coral reef off Pulau Tembakul to the east of Pulau Sakijang Pelepah at a depth of about 6 metres; Singapore Straits, various localities, on hard bottoms in depths of from 35 to just over 70 metres; off Tanjong Stapa, at a depth of nearly 50 metres on mud.

Processidae

Members of this family appear to be rare in the Singapore area.

Processa processa (Bate), 1888

A single specimen of this species has been collected from the *Enhalus*-zone of the beach at Changi. De Man (1920) lists the species from Singapore.

Processa australiensis Baker, 1907

This species has been collected from *Halophyllum*-pools at Changi beach. It is probably not a true weed-bed form. Singapore represents its most north-westerly locality.

Nikoides sibogae De Man, 1918

N. sibogae has been collected by push-netting on the sandy-beach at Siglap.

Palaemoninae

The Palaemoninae are well-represented in the Singapore area by marine, brackish, and freshwater species. The freshwater species include the most abundant decapod crustaceans in the local freshwater fauna.

The generic nomenclature used for this sub-family is that of the Official List of Generic Names in Zoology, and of Holthuis (1955). The genera *Leander*, *Leandrites*, and *Palaemon* correspond with the genus *Leander* of most zoologists, whilst the genus *Macrobrachium* corresponds with the *Palaemon* of most zoologists. However unfamiliar these names may be to many zoologists they must be accepted in the interests of promoting a stable nomenclature for this group.

***Leander urocaridella* Holthuis, 1950**

I am not fully convinced that Holthuis was right in including this species in the genus *Leander* or even in this sub-family. There is much to be said for Borradaile's original assignation. Since, however, this is not the place for a full enquiry into this question I have tentatively followed Holthuis, though with reservations.

L. urocaridella is probably sub-planktonic in habits. It has been collected in various offshore habitats over bottoms of shell-gravel, coral-brash, and similar material. Though widely distributed around Singapore it does not appear to be a common species. Specific localities include: Johore Shoals, crinoid grounds at a depth of about 18 metres; Singapore Straits, two localities in depths of 38 to 40 metres and 45 to 58 metres respectively; Outer Shoal buoy, in plankton haul. The only other Malayan locality, known to me is off the Sembilan Islands, Perak, on shell-gravel, coral-brash at a depth of 45 to 80 metres.

***Leander tenuicornis* (Say), 1818**

This is a characteristic but only moderately abundant inhabitant of littoral and offshore weed-beds around Singapore. It has been found both amongst *Enhalus* and *Sargassum* but is more frequent in the latter.

***Leandrites deschampsi* (Nobili), 1903**

Singapore is the type-locality for this species. It has not yet been reported from other areas. It is abundant in suitable high-salinity, brackish waters in the Jurong and Sungai Seletar areas.

L. deschampsi was originally described as a species of *Leander*. Holthuis (1950) listed it under that generic name as a doubtful species. Subsequently (1952 a) he was able to re-examine the type-specimens and concluded that this was a valid species of the genus *Leandrites*. *Leandrites deschampsi* is very closely related to *L. indicus* Holthuis, 1950. In my opinion it is very probable that they will ultimately be considered to be sub-species of the same species; but, for the present, it is best to treat them as separate species.

***Palaemon (Palaemon) serrifer* (Stimpson), 1860**

There are 12 specimens of this species in the Bedford-Lanchester collection which were collected from 'very low water' at Raffles Light. I have not seen any specimens collected in this area in recent years; but I have obtained specimens from tide-pools to the north of Kuantan, Pahang.

Until 1950, when Holthuis recorded it from Java and Madura, *P. serrifer* had not been known south of Hong Kong and the Pescadores. The present records help to fill in the large gap in the known distribution of this species.

At present *P. serrifer* is the only member of the sub-genus *Palaemon* known from Singapore; but two other species, *P. concinnus* Dana and *P. debilis* Dana, may yet be found there.

***Palaemon* (*Palaeander*) *semmelinki* (De Man), 1881**

P. semmelinki was recorded from Singapore by Nobili (1903). It occurs in high-salinity prawn-ponds in various parts of the island; it is abundant in the high-salinity reaches of the Sungai Seletar; and it occurs over mud-flats at Tanjong Kranji. I have seen specimens from brackish waters in Penang Island and there are specimens in the British Museum collection from the Langkawi islands. Holthuis (1950) considers this as being essentially a marine species; but, in my experience, it is most abundant in high-salinity, brackish waters.

***Palaemon* (*Exopalaemon*) *carinicauda* Holthuis, 1950**

Balss (1914) reported this species from Singapore. Kemp (1917) considered that this record was very doubtful, since the most southerly of its other recorded localities was Hong Kong. In view of subsequent discoveries Kemp's reasoning does not seem to be entirely sound. Nonetheless I think that his conclusion was correct, and that the species cannot be accepted as a member of the Singapore fauna. If a species of this sub-genus does occur at Singapore, itself a doubtful proposition, then it is most likely to be *Palaemon styliferus* H. Milne-Edwards, which is known from several Malaysian localities.

***Macrobrachium rosenbergi* (De Man), 1879**

This species was recorded from Singapore by Walker (1887) under the name of *Palaemon carcinus*. The specimens are certainly members of this species.

M. rosenbergi is not uncommon in suitable freshwaters. It occurs in the reservoirs of the Singapore catchment area and at the Woodleigh waterworks. In other areas *M. rosenbergi* has been collected from brackish and marine habitats; but there are no certain non-freshwater records from Singapore.

***Macrobrachium lanchesteri* (De Man), 1911**

This species occurs in abundance in a single large fishpond near the Sungai Simpang Kiri. A single specimen has been collected from the non-forest, freshwater stretch of the Sungai Seletar at Nee Soon village. It has not been found in any other ponds which I have investigated. This species is abundant in rice-lands and ponds in western Malaya; but it has not yet been found in southern Johore. This fact, combined with the rarity of the species in Singapore Island, suggests that *M. lanchesteri* has been accidentally introduced at the two known Singapore sites. Singapore is the most southerly locality for the species, which has a continental distribution.

***Macrobrachium idae* (Heller), 1862**

In Singapore this species is only known from ponds in the Tanglin area, where it is uncommon.

***Macrobrachium equidens* (Dana), 1852**

M. equidens is essentially an inhabitant of high-salinity, brackish waters; it is also sometimes found in the sea. It has been recorded from low salinity waters and freshwaters in other parts of its range; but it has not been found in such waters in Singapore. *M. equidens* is a regular inhabitant of prawn-ponds, where it breeds. It is also sometimes

abundant in mangrove creeks, such as the lower reaches of the Sungai Seletar. It has also been taken at Bedok beach in a fully marine habitat, where, however, heavy rains may temporarily reduce the local surface salinity to as little as 20 parts per thousand.

Macrobrachium trompi (De Man), 1879

M. trompi is abundant in acid-water forest streams in the Mandai Road and Nee Soon areas.

Macrobrachium pilimanus (De Man), 1879

M. pilimanus has been collected in streams in the Nee Soon swamp forest; but it is very rare there. The specimens correspond with *M. pilimanus* as strictly defined.

Macrobrachium scabriculum (Heller), 1862

There are a number of specimens of this species in the Bedford-Lanchester collection which were collected in the Tanglin area. They correspond in all important characters with *Palaemon dubius* Henderson and Matthai, 1910. I agree with Holthuis in considering that this species is a synonym of *Macrobrachium scabriculum*. Until now the most southerly known localities for this species in south-east Asia have been the island of Enganno to the west of Sumatra and the Padang lowland of Central Sumatra. The species has not been found in Singapore in recent years and may have been exterminated by the increasing urbanization of the Tanglin area.

Macrobrachium geron Holthuis, 1950

This species is not uncommon in streams in the Nee Soon swamp forest area. There are specimens in the British Museum collections from Bukit Timah and from the Singapore Botanic Gardens. I have recently collected it in some numbers from a stream on the northern face of Bukit Timah. Elsewhere in Malaya it is abundant in a number of fast-flowing, acid-water streams at least as far north as Merbau, near Kuala Selangor. Previously it had only been known on the basis of the single specimen described by Holthuis, which had been collected in the island of Banka, almost one hundred years before. A fuller account of the Malayan specimens will be published elsewhere.

Pontoniinae

In comparison with the Indo-Pacific area as a whole, Singapore seems to be poor in members of this sub-family. Many of those species which are known from Singapore are very abundant. The absence of many species from the Singapore list may reflect the fact that they are rare, commensal species, which are easily overlooked in general collecting.

Palaemonella pottsi (Borradaile), 1915

I have collected a single male with the colouration of this species from crinoids taken on a coral-gorgonian ground at a depth of 2 to 8 metres to the west of Pulau Pawai. There is also a single specimen in the Bedford-Lanchester collection from Singapore which appears to belong to this species, rather than to *P. vestigialis*.

I have re-examined Borradaile's types and cannot find any certain morphological characters in these or my own specimens which would serve to separate *P. pottsi* from *P. vestigialis*. However, the two forms differ markedly in coloration and ecology. *P. pottsi* is brightly pigmented and occurs associated with comatulid crinoids. *P. vestigialis* is hyaline in life, and is usually colourless when preserved. It is a coral associate. Holthuis

(1952), whilst suggesting that the two forms may ultimately prove to be conspecific, tentatively keeps them separate because of these differences. I am in full agreement with this procedure, especially since minute differences may well be revealed when it is possible to examine and compare closely extensive series of both species.

***Palaemonella vestigialis* Kemp, 1922**

This species is closely associated with living coral. It is not uncommon on reefs around Singapore; but it is easily overlooked because of its small size and colourless, hyaline body. Specific localities include: Pasir Panjang, Bedford-Lanchester collection; Blakang Mati, Bedford-Lanchester collection; Pulau Hantu, reef; Pulau Sudong, reef and in crevices of large heads of *Pavona frondifera* growing in a depth of 1 to 2 metres; Raffles Light, on branching corals and *Heliopora*-heads; Rabbit Island (= Pulau Biola) 'very low water' on shoal, Bedford-Lanchester collection. The record from Pasir Panjang is somewhat puzzling. The locality is certainly not suitable for this species at the present day, and the name, which means 'long sands' suggests that it never has been. There may have been a small reef in the area 50 years ago which has vanished owing to the extensive silting which is still continuing on this coast. Alternatively the specimen may have come either from a submerged reef offshore or from a neighbouring area, such as Labrador.

As I have pointed out above this species cannot at present be distinguished from *P. pottsi* except on grounds of colouration and ecology. *P. pottsi* is the older name and will have to be used in the event that these two species should prove synonymous.

***Periclimenes (Periclimenes) aesopius* (Bate), 1863**

This species is both very abundant and generally distributed in all types of littoral weed-beds around Singapore.

***Periclimenes (Periclimenes) parvus* Borradaile, 1898**

There is a single specimen of this species in the Bedford-Lanchester collection which was obtained from 'outer coral' at 'very low tide' at Raffles Light

***Periclimenes (Harpilius) spiniferus* De Man, 1902**

Specimens of this species were collected by Patton from sub-littoral corals at Raffles Light.

***Periclimenes (Harpilius) amymone* De Man, 1902**

This species occurs on living coral-heads. It has been found at about low water spring tide mark at Tanjong Gul and on sub-littoral coral at Raffles Light.

***Periclimenes (Harpilius) grandis* (Stimpson), 1860**

This is a regular but rather unimportant member of littoral weed-bed assemblages. It occurs in both *Enhalus* and *Sargassum*-beds. I have also collected it away from weed-beds at Burun Darat and around the piles of the pier of Sultan Shoal.

***Periclimenes (Harpilius) cf. lutescens* (Dana), 1852**

This coral species has been collected by Patton from sub-littoral coral at Raffles Light.

***Periclimenes (Harpilius) seychellensis* Borradaile, 1915**

This species is a dominant member of littoral weed-bed assemblages. It is found in both *Enhalus* and *Sargassum*-beds; but it is usually more abundant in the latter.

Periclimenes (Harpilius) suvativensis Borradaile, 1915

This species occurs sparingly in *Enhalus*-beds at Changi and Bedok and in *Sargassum*-beds at Pulau Sudong.

Periclimenes elegans (Paulson), 1875

A single specimen of this species has been collected from *Enhalus*-beds at Changi.

Periclimenes (Harpilius) calmani Tattersall, 1921

This species occurs in abundance in mangrove channels in the Jurong area. It has also been found in *Enhalus*-beds adjacent to mangrove at Tanjong Gul.

Periclimenes (Harpilius) brooki (De Man), 1888

Two specimens of this species have been obtained from two different localities in the Singapore Straits at depths of about 40 metres and about 50 metres respectively.

Periclimenes (Harpilius) brevicarpalis (Schenkel), 1902

This species is an obligate commensal of giant sea-anemones of the genus *Stoichactis* and allied genera. It does not appear to be common around Singapore; but specimens have been obtained at Tanjong Penuru and Raffles Light.

Periclimenes (Harpilius) sp. nr. digitalis Kemp, 1922

A single specimen from the reef-flat at Burun Darat appears to belong to a new species allied to *P. digitalis* Kemp.

Anchistus custos (Forsk.) 1775

This species is an obligate commensal of the bivalve *Pinna*. In the Singapore area it is the only prawn associated with this bivalve which is at all common. Most specimens of *Pinna* contain from one to four specimens of *Anchistus custos*. The species, which inhabits the mantle cavity, occurs wherever *Pinna* is found, i.e. on the lower beach of sandy and muddy-sandy beaches all round the island and the offshore islands.

Anchistus miersi (De Man), 1888

I have seen a single specimen of this species which was taken from the mantle cavity of a species of *Tridacna* collected off Singapore. Despite search, it has not been subsequently found.

Periclimenaeus tridentatus (Miers), 1884

This is the only species of *Periclimenaeus* which has been found in the Singapore area. A single male has been collected from a coral-gorgonian ground at a depth of 2 to 6 metres to the west of Pulau Pawai, and a female has been taken from a crevice in sub-littoral coral rock at Raffles Light. These records indicate that the species is in some way associated with coral, though they do not imply that it is necessarily a coral commensal. They give no support to Holthuis's (1952) conclusion that it is an associate of sponges and ascidians. The previously known distribution of this species was distinctly oceanic. Thus, these Singapore records are of considerable interest.

Philarius imperialis Kubo, 1940

A single ovigerous female has been collected from a coral-head at Tanjong Gul. *P. imperialis* was recorded from the Indo-Australian archipelago by Holthuis (1952) under the name *Philarius gerlachei* (Nobili), 1905, which is a very different species.

Harpiliopsis beaupresi (Audouin), 1825

Specimens of this species have been collected from sub-littoral coral at Raffles Light by Patton.

Coralliocaris graminea (Dana), 1852

Specimens of this species have been collected by Patton from sub-littoral coral at Raffles Light.

Conchodytes monodactylus Holthuis, 1952

There is a single specimen of this rare species in the British Museum collections, which was obtained from *Pinna atropurpurea* at Siglap, Singapore by R. Winckworth. It has only been known previously from Holthuis's (1952) specimens.

Crangonidae**Pontophilus angustirostris** De Man, 1918

This species has been obtained from the Singapore Straits at a depth of between 35 and 70 metres, on a shell-gravel, coral-brash bottom. Another specimen was caught in a stramin net in the same area.

Pontophilus parvirostris Kemp, 1916

This species was obtained from a mud bottom at station SBA 1 by the Singapore Regional Fisheries Research Station, at a depth of over 90 metres. I have not been able to trace this station, which, whilst probably a Malayan locality, is unlikely to be within the Singapore area.

Pontocaris orientalis (Henderson), 1893

A single specimen of this species was obtained from the crinoid grounds of the Johore Shoals in a depth of about 18 metres. *Aegeon*, the name by which this genus is usually known, is an erroneous spelling of *Egeon* Bosc, 1813, which is an invalid, junior, homonym of *Egeon* Montfort, 1808, a genus of Protozoa. Thus the name *Pontocaris* Bate, 1888 must be adopted.

STENOPODIDEA**Stenopodidae**

The names Stenopidea and Stenopidae are sometimes used for this group; but are incorrectly formed according to the international rules. The Stenopodidae only include two genera in Malayan waters and only one species is known from Singapore.

Stenopus hispidus (Olivier), 1811

There are two specimens of this species in the Bedford-Lanchester collection. One, an ovigerous female, is from a shoal of Rabbit Island (= Pulau Biola) at 'very low water'. The other, a non-ovigerous female, is labelled as coming either from that locality or from a depth of 15 fathoms off Pulau Bukom. The latter locality is relatively improbable in view of the known ecology of this species. Pulau Biola is thus the only acceptable locality for this species in the Singapore area. Records in the literature suggest that this is a very common species; but it is distinctly rare at Singapore. In nine years we have not collected a single specimen.

General notes on distribution

There are nearly 100 species of Caridea and a single species of Stenopodidea known from Singapore. Many of these are uncommon. The following 39 species are common, at least locally, in suitable habitats: *Leptochela robusta*; *Caridina gracilirostris*; *C. propinqua*; *C. tonkinensis*; *Hippolyte ventricosa*; *Latreutes porcinus*; *L. pygmaeus*; *Hippolysmata vittata*; *H. ensirostris*; *Salmoneus hilarulus*; *Synalpheus amboinae*; *S. acanthitelsonis*; *S. bituberculatus*; *Alpheus ventrosus*; *A. paralcione*; *A. bengalensis*; *A. spongiorum*; *A. rapax*; *A. angustidigitus*; *A. rapacida*; *A. chiragricus*; *A. microrhynchus*; *A. audouini*; *A. parvirostris*; *A. euchirus*; *Leander tenuicornis*; *Leandrites deschampsi*; *Palaemon semmelinki*; *Macrobrachium rosenbergi*; *M. lanchesteri*; *M. equidens*; *M. trompi*; *M. geron*; *Palaemonella vestigialis*; *Periclimenes aesopius*; *P. amymone*; *P. grandis*; *P. seychellensis*; and *Anchistus custos*.

No species occurs in all types of habitat or even in all types of marine habitat. Despite the rarity of many species the following summaries of distribution by habitat type may be of some interest. In these summaries an asterisk indicates that the habitat type is probably a minor one for the species concerned. Crevice-dwelling species are indicated by the symbol(cr) whilst commensals are indicated by the symbol(co). The latter have been listed separately under their hosts. The numbers in brackets are the total numbers of species recorded from the respective habitat types.

Freshwater species (11):

Caridina brachydactyla peninsularis; **C. propinqua*; **C. tonkinensis*; *C. weberi sumatrensis*; *Macrobrachium rosenbergi*; *M. lanchesteri*; *M. idae*; *M. trompi*; *M. pili-manus*; *M. scabriculum*; *M. geron*.

Low-salinity brackish waters (4):

**Caridina brachydactyla peninsularis*; *C. propinqua*; *C. tonkinensis*; *C. gracilirostris*.

High-salinity brackish waters (including prawn ponds) (6):

Alpheus microrhynchus; *A. cf. audouini*; *Leandrites deschampsi*; *Palaemon semmelinki*; *Macrobrachium equidens*; *Periclimenes calmani*.

Littoral weed-beds (16):

**Chlorotocella gracilis* (young); *Hippolyte ventricosa*; *Latreutes porcinus*; *L. mucronatus* (young); *L. pygmaeus*; **Hippolysmata ensirostris*; **Alpheus rapax*; **Processa processa*; **P. australiensis*; *Leander tenuicornis*; *Periclimenes aesopius*; *P. calmani*; *P. grandis*; *P. elegans*; *P. seychellensis*; *P. suvadivensis*.

Elsewhere on muddy beaches (6):

Salmoneus hilarulus; *Alpheus rapax*; *A. angustidigitus*; *A. rapacida*; *Palaemon semmelinki*; *Anchistus custos* (co).

Sandy and muddy-sandy beaches, excluding weed-bed forms (9):

Hippolysmata ensirostris; **Alpheus audouini*; *A. crassimanus*; *A. rapax*; *A. distinguendus*; *Nikoides sibogae*; **Macrobrachium equidens*; *Anchistus custos* (co); *Conchodytes monodactylus* (co).

Reef-flats and beaches of similar character, excluding weed-bed forms (21):

Saron marmoratus; *S. neglectus*; *Athanas monoceros*; *Synalpheus tumidomanus* (cr); *S. acanthitelsonis* (cr); *S. bituberculatus* (cr); *Synalpheus* sp. (*laevimanus* group) (cr); *Alpheus lutini* (cr); **A. spongiarum* (co); *A. bengalensis* (cr); *A. rapax*; *A. angustidigitus*; *A. audouini*; *A. pareuchirus* (cr); *A. parvirostris* (cr); *A. euchirus* (cr); *Palaemonella vestigialis*; **Periclimenes amymone* (co); **P. grandis*; *Periclimenes* sp. nr. *digitalis*; **Philarius imperialis* (co).

Reef-edges, excluding weed-bed forms (30):

Saron neglectus; **Hippolysmata vittata*; *Athanas parvus*; *A. monoceros*; *Synalpheus stimpsoni* (co); *S. stormi* (cr); *S. acanthitelsonis* (cr); *S. exilipes* (cr); *S. bituberculatus* (cr); *S. pescadorensis* (cr); *Alpheus ventrosus* (co); *A. spongiarum* (co); *A. cf. lanceoloti* (cr); *A. alpheopsides* (cr); *A. maindroni* (cr); *A. parvirostris* (cr); *A. euchirus* (cr); *Palaemon serrifer*; *Palaemonella vestigialis*; *Periclimenes parvus* (?co); *P. spiniferus* (co); *P. amymone* (co); *P. grandis* (co); *P. cf. lutescens* (co); *P. brevicarpalis* (co); *Anchistus miersi* (co); *Periclimenaeus tridentatus* (cr); *Harpiliopsis beaupresi* (co); *Coralliocaris graminea* (co); *Stenopus hispidus*.

Soft bottoms offshore (3 to 4):

Hippolysmata ensirostris; *H. prima* (?co); *Alpheus chiragricus*; ? *Pontophilus parvirostris*.

Submerged coral-reefs (8):

Alpheus ventrosus (co); *A. splendidus* (co); *A. bisincisus*; *A. paralcycione* (co); *A. hippothoe* (cr); *A. euchirus* (cr); *Palaemonella pottsi* (co); *Periclimenaeus tridentatus* (cr).

Crinoid grounds (bottom usually of sand and shells with telestaceans), shell-gravel grounds, and other hard bottoms offshore, in depths of less than 70 metres (27):

Chlorotocella gracilis; *Tozeuma lanceolatum*; *Gelastocaris paronae*; *Hippolysmata vittata*; *Athanas jedanensis*; **Salmones hilarulus*; *Synalpheus amboinae* (?co); *S. gravieri* (?co); *S. iphinoe* (co); *S. jedanensis*; *S. trianguiculatus* (?co); *S. acanthitelsonis* (cr); *S. hilarulus*; *S. bituberculatus* (cr); *S. quadrispinosus* (co); *S. theano*; *Alpheus paralcycione* (co); *A. spongiarum* (co); *A. stanleyi*; *A. angustidigitus*; *A. pareuchirus* (cr); *A. cf. leptochirus*; *A. euchirus* (cr); *Leander urocaridella*; *Periclimenes brocki*; *Pontophilus angustirostris*; *Pontocaris orientalis*.

Deep water species (in depths of over 70 metres) (8 to 9):

Heterocarpoides levicarina; *Chlorotocoides spinicauda*; *Tozeuma lanceolatum*; *Hippolysmata vittata*; *Synalpheus amboinae* (co); *S. neomeris*; *Alpheus paralcycione* (co); **A. euchirus* (cr); ? *Pontophilus parvirostris*.

Sub-planktonic (3):

Chlorotocella gracilis; *Tozeuma lanceolatum*; *Leander urocaridella*.

Planktonic (1):

Leptochela robusta.

In floating *Sargassum* (2):

Leander tenuicornis; *Hippolyte ventricosa*.

In drifted bamboo (2):

Alpheus crassimanus; *A. cf. leptochirus*.

Commensals (about 23):

A query before the specific name indicates that the occurrence of the species at Singapore is doubtful. A query after the name indicates that the commensalism is presumptive only and not yet fully approved.

Of sponges (2):—

Alpheus paralcione; *A. spongiarum*.

Of medusae (1):—

Latreutes mucronatus (not yet proved at Singapore).

Of Alcyonaceans (2):—

Synalpheus gravieri ?; *S. triunguiculatus* ?.

Of *Telesto* (1):—

Synalpheus iphinoe.

Of sea-anemones (2):—

Hippolysmata prima ?; *Periclimenes brevicarpalis*.

Of corals (11):—

Alpheus ventrosus; *A. splendidus*; *A. paralcione* ?; *Palaemonella vestigialis* ?; *Periclimenes parvus* ?; *P. spiniferus*; *P. amymone* ?; *P. cf. lutescens*; *Philarius imperialis*; *Harpiliopsis beaupresi*; *Coralliocaris graminea*.

Of crinoids (4 to 5):—

Synalpheus amboinae ?; ? *S. comatularum*; *S. stimpsoni*; *S. quadrispinosus* ?; *Palaemonella pottsii*.

Of *Pinna* (2):—

Anchistus custos; *Conchodytes monodactylus*.

Of *Tridacna* (1):—

Anchistus miersi.

General comments

The most striking feature of this list is the absence of deep-water species and the rarity of those species, such as *Heterocarpoides levicarina*, which are characteristic of intermediate depths. This is easily explained by the absence of truly deepwater in the area, and the very restricted area of water lying over deep pockets of the continental shelf.

The absence or rarity of a considerable number of widespread, and generally common, littoral species is more surprising. Most of these species also appear to be absent from the whole of the area of shallow seas extending from Siam to Sumatra, Java, and

Borneo. Several are present on the western coast of Sumatra, the southern coast of Java, and the eastern coast of Borneo. When the general distribution of such species are considered it becomes clear that many of them have a distinctly oceanic distribution. Such species include all members of the small families Rhynchocinetidae and Gnathophyllidae, a number of species of Hippolytidae (noted under that family), and several freshwater prawns such as *Atya pilipes*, *Caridina typus*, *Macrobrachium australe*, *M. lar*, and *M. latimanus*. Doubtless many members of the families Alpheidae and Pontoniinae are similarly restricted; but the distributions of members of these groups are less well-known.

The Singapore list does include a number of species which have previously been considered to be rare; but which are common in the Singapore area. In addition there are a number of undescribed species, mostly small forms with specialized habitats. The majority of these species which are common at Singapore and apparently rare elsewhere are forms which are liable to be overlooked in general collecting. When these are removed there are few species left which can be claimed to be non-oceanic in the sense of being absent or rare in oceanic areas. These are mostly freshwater or brackishwater species such as: *Caridina propinqua*; *C. tonkinensis*; *Macrobrachium trompi*, *M. lanchesteri*, *M. pilimanus*, and *M. geron*. There are very few marine species which apparently have this sort of distribution. These include *Mimocaris heterocarpoides* and *Hippolytina ensirostris*.

Thus the Caridean and Stenopodidean fauna of Singapore is a rather depauperate version of the general Indo-West Pacific fauna. This phenomenon agrees with experience of the faunas of shallow enclosed seas in other parts of the world. The depauperization is most clearly revealed by the coral-reef association. Though there are many coral-reefs in the area there is good reason to believe that conditions are not ideal for the full development of the coral-reef assemblage. Coral-reefs disappear to the north-west of Singapore and are absent throughout much of the Straits of Malacca. Many coral-reef organisms belonging to groups other than the crustacea are either absent or very rare on Singapore reefs. Whilst this depauperization of the coral-reef assemblage is probably the result of a complex of factors the most important single factor is probably the low salinity of the local seas.

Detailed comparison of the Singapore fauna with that of other areas is difficult because no other Indo-West Pacific area of comparable size is so well-known. The fauna of comparable localities from other regions is inevitably much smaller, since these regions are much poorer in species than the Indo-West Pacific. Table 1 gives a comparative tabulation of the non-freshwater species of Singapore with those of the Moluccas and the Andamans. Both of these areas are larger than the Singapore area so that the wider coverage to some extent balances out the lesser intensity of collection. It is probable that many of the differences between the three lists represent collecting accidents; but others are real. In the Mollucan list there are more oceanic, and especially coral-dwelling species than at Singapore. The Alpheidae and Pontoniinae are much better represented there. The Andamans records include Kemp's extensive collections from the very well-developed littoral weed-beds and muddy areas around Port Blair. As at Singapore the weed-bed fauna is well-represented and includes some forms, such as *Phycocaris simulans* and *Paralatreutes bicornis* which have not been found at Singapore. Another striking feature of the Andaman list is the large variety of Crangonids, presumably associated with the muddy bottom of many of the seas collected. The three lists have much

in common and should probably be regarded as representing different facies of the same association. Viewed in this light the Singapore facies seems to represent the basic association, lacking the divergent specializations of the two other facies.

Certain generalizations are possible concerning the detailed local distribution of Singapore Caridea and Stenopodidea. In contrast to the Penaeidea and the Brachyura, the Caridea are almost equally well represented in variety of species on the shore and in offshore waters. There is no striking predominance of offshore species. Whilst several species are confined either to offshore or littoral waters there are a considerable number of species which are known from both types of habitat.

In both littoral and offshore areas the hard bottomed areas have a very much richer association than is found on soft-bottomed areas. Excluding the weed-bed species whose presence is controlled by the nature of the vegetation rather than that of the substrate, there are only about 17 marine species which have been found on soft bottoms. Two of these, *Anchistus custos* and *Conchodytes monodactylus* are commensals, whilst *Lysmata prima* may also be a commensal. *Palaemon semmelinki* and *Macrobrachium equidens* are more characteristically brackish water forms. *Alpheus audouini* is more usually found on hard bottoms. This leaves only about 12 fully marine, free-living species which are characteristic of soft bottoms. This distribution contrasts strongly with that of the local Penaeidea, which are both more abundant and more varied on soft bottoms than they are on hard bottoms. The vast preponderance of hard-bottom species amongst the local Caridea is due to the abundance and variety of small crevice dwelling forms, especially in the family Alpheidae.

The Singapore caridean association agrees with those of other tropical areas in showing a great abundance and variety of Alpheidae and to a lesser extent Pontoniinae. By contrast the Pandalidae and marine Palaemoninae, together with the Spirontocaris group of the Hippolytidae are poorly represented as compared with cold-water regions.

Key to the genera of Malayan Caridea

The following key is adapted from Holthuis (1955). Genera which are unlikely to occur in Malayan waters or which are unlikely to be collected in depths of less than 100 metres have been omitted. Genera which have not yet been found in Malaya are marked with a + sign.

Caridean prawns are distinguished from all other prawns by a combination of characters of which the most easily observed are those shown by the abdomen, the thoracic legs, and the gills. In the Caridea the 2nd abdominal segment overlaps both the 1st and 3rd segments. This usually results in a characteristic humping of the abdomen. The 1st and 2nd walking legs are variously developed; but, in contrast to the Stenopodidea and Penaeidea the 3rd pereopods are always simple and non-chelate. The gills are phyllobranchiate and are comparatively few in number as compared with those of the family Penaeidae.

The major groupings within the Caridea are not as yet firmly established. The superfamilies recognized by Holthuis (1955) differ considerably from those recognized by Borradaile (1907) and Balss (1927). Holthuis's treatment seems to represent a definite advance; but it is still somewhat unsatisfactory. Thus Holthuis still places the Atyidae in the Oplophoroidea, though they have little in common with the more typical members of that superfamily, beyond the retention of a few primitive characters which

were presumably common to the ancestors of all Caridea. Again Holthuis's new superfamily, the Bresiloidea, in which he includes the Rhynchocinetidae, seems to me to be a most unnatural grouping. In these circumstances I have felt it best to abandon all superfamily groupings for the purposes of this key.

The key is frankly artificial and is only safely usable for littoral prawns in the Indo-Pacific area.

- 1 (10). Carpus of 2nd pereiopods divided into two to many sub-joints or annuli 2.
- 2 (3). First pereiopods stouter (except in *Ogyrides*), though often shorter, than the second pereiopods; at least one of the first pereiopods with a well-developed chela 4.
- 3 (2). First pereiopods slender, simple or with only a minute chela *Pandalidae*.
- 4 (5). Only one of the first pereiopods chelate, the other being simple *Processidae*.
- 5 (4). Both first pereiopods chelate 6.
- 6 (7). Eye-stalks slender and very elongate, almost attaining the end of the antennular peduncle; rostrum reduced; first pereiopods feeble + *Ogyrididae*.
- 7 (6). Not showing this combination of features 8.
- 8 (9). Carpus of second pereiopods with 2 to many, but never 5 or 4, annuli; eyes free and not covered by carapace; first pereiopods usually not greatly enlarged; fingers of first pereiopods usually with dark tips; dactylus of first pereiopods never hammer-shaped *Hippolytidae*.
- 9 (8). Carpus of second pereiopods with 5 or more rarely 4 annuli; eyes partly or wholly covered by carapace; first pereiopods usually greatly enlarged and massively built; fingers of first pereiopods rarely with dark tips; dactylus of first pereiopods often hammer-shaped *Alpheidae*.
- 10 (1). Carpus of second pereiopods not subdivided into annuli 11.
- 11 (12, 13). First pereiopods simple *Thalassocaridae*.
- 12 (11, 13). First pereiopods subchelate *Crangonidae*.
- 13 (11, 12). First pereiopods chelate 14.
- 14 (15). Rostrum movable *Rhynchocinetidae*.
- 15 (14). Rostrum not movable 16.
- 16 (17). Fingers of chelae terminating in conspicuous brushes of long stiff hairs *Atyidae*.
- 17 (16). Fingers of chelae hairy or not but never terminating in hair-brushes of this type .. 18.
- 18 (19). First and second pereiopods subequal, with pectinate cutting edges; posterior pereiopods with exopods *Pasiphaeidae*.
- 19 (18). Second pereiopods larger than the first, the fingers not usually pectinate; posterior pereiopods lack exopods 20.
- 20 (21). Third maxillipedes expanded, leaf-like + *Gnathophyllidae*.
- 21 (20). Third maxillipedes not expanded and leaf-like *Palaemonidae*.

Family Pasiphaeidae

Leptochela is the only Malayan genus. This is represented by *L. robusta* a minute, planktonic form with reduced rostrum, which cannot well be confused with any other species.

Family Atyidae

- 1 (2). First and second pereiopods equal or subequal with the chelae cleft to or almost to the base, and the carpus short and deeply excavated *Atya*.
- 2 (1). First and second pereiopods differing both in size and structure; chelae less deeply cleft; carpus of the second pereiopods elongate and not or scarcely excavated .. *Caridina*.

Family Rhynchocinetidae

The genus +*Rhynchocinetes* is not as yet known from Malaya, but may yet be found there.

Family Pandalidae

- 1 (4). Carpus of second pereopods multiarticulate 2.
- 2 (3). Carapace without lateral keels. Carpus of second pereopods with more than 6 sub-joints; last three pairs of pereopods very long and slender *Plesionika*.
- 3 (2). Carapace with pronounced lateral keels. Carpus of second pereopods with 6 sub-joints; last three pairs of pereopods not excessively elongate *Heterocarpoides*.
- 4 (1). Carpus of second pereopods with 2 or 3 sub-joints 5.
- 5 (6). Carpus of second pereopods 3-jointed; the first four pairs of pereopods with epipodites; heavy bodied, with short rostrum bearing many teeth *Chlorotocoides*.
- 6 (5). Carpus of second pereopods 2-jointed none of the pereopods with epipodites; very slender, with long rostrum the larger portion of which is devoid of teeth
Chlorotocella.

Family Thalassocaridae

Thalassocaris is the only genus in this family.

Family Palaemonidae

Only two of the four sub-families recognized by Holthuis, the Palaemoninae and the Pontoniinae, are known from or likely to occur in Malayan waters. The distinction between these two sub-families is by no means clear cut when the more primitive members are considered. *Leander urocaridella* which Holthuis includes in the Palaemoninae could almost as well be included in the Pontoniinae to which sub-family it was assigned by the original describer.

- 1 (18). With a pleurobranch at the base of the third maxillipede; posterior margin of telson armed with 2 pairs of spines and 2 or more pairs of setae (in primitive forms one of these can be considered as a spine or a setae with equal propriety); never commensal; Malayan forms never possessing a supra-orbital spine *Palaemoninae* 2.
- 2 (3). Carapace lacks an antero-lateral spine *Leptocarpus*.
- 3 (2). Carapace with an antero-lateral spine 4.
- 4 (7). Carapace with the antero-lateral spine in the hepatic region, well removed from the anterior carapace margin, except in very young individuals of certain species 5.
- 5 (6). Dactyli of last 3 pairs of pereopods biunguiculate *Brachycarpus*.
- 6 (5). Dactyli of last three pairs of pereopods uniunguiculate *Macrobrachium*.
- 7 (4). Carapace with the antero-lateral spine in the branchiostegal region, on or almost on the anterior margin of the carapace and below the pterygostomial line, where this is present 8.
- 8 (15). Propodus of fifth pereopod with transverse rows of short setae on its posterior margin; almost always with a well-defined pterygostomial line; first pleopod of male with *appendix interna* absent or rudimentary; setae of posterior margin of telson slender and never spiniform *Palaemon*¹ 9.
- 9 (10). Mandibular palp 2-jointed s.g. *Palaeander*.
- 10 (9). Mandibular palp 3-jointed 11.
- 11 (12). Rostrum with an elevated basal crest; pleurae of fifth abdominal segment broadly rounded 13.
- 12 (11). Rostrum lacking such a crest; pleurae of fifth abdominal segment usually pointed
s.g. *Palaemon*.
- 13 (14). With a well-marked pterygostomial line; dactyli of last three pairs of pereopods not excessively elongated s.g. *Exopalaemon*.

1. The genus *Palaemonetes*, which is not likely to be encountered in Malaya, differs from *Palaemon* in lacking a mandibular palp.

- 14 (13). No pterygostomial line; dactyli of last three pairs of pereopods longer than the combined lengths of the carpi and propodi of their respective legs
s.g. + *Nematopalaemon*.
- 15 (8). Propodus of the fifth pereopod without these hair rows; no pterygostomial line; first pleopod of male with a well-developed *appendix interna*; one pair of the setae of the posterior margin of the telson is stout and often spine-like 16.
- 16 (17). Mandible without palp; median setae of posterior margin of telson not markedly spiniform; in brackish or polyhaline waters *Leandrites*.
- 17 (16). Mandibular palp well-developed; median setae of posterior margin of telson very stout and more or less markedly spiniform; marine *Leander*.
- 18 (1). No pleurobranch at the base of the third maxillipede; posterior margin of telson with three pairs of spines (except in *Anchistioides* which has only two pairs)
Pontoniinae 19.
- 19 (22). Mandible with palp 20.
- 20 (21). With hepatic spines *Palaemonella*.
- 21 (20). Without hepatic spines + *Vir*.
- 22 (19). Mandible without palp 23.
- 23 (56). Third maxillipedes with exopods 24.
- 24 (25). Dactyli of last three pairs of pereopods with a distinct basal protuberance which remains visible when the dactylus is flexed on the propodus 50.
- 25 (24). Dactyli of last three pairs of pereopods without such a protuberance or with a protuberance which disappears into a slit in the propodus when the dactylus is flexed . . 26.
- 26 (45). Pleurae of first five abdominal segments broadly rounded or at most bluntly pointed . 27.
- 27 (32). Hepatic spines present 28.
- 28 (29). Hepatic spines movable + *Paranchistus*.
- 29 (28). Hepatic spines not movable *Periclimenes* 30.
- 30 (31). Dactyli of last three pairs of pereopods biunguiculate s.g. *Periclimens*².
- 31 (30). Dactyli of last three pairs of pereopods uniunguiculate s.g. *Harpilius*².
- 32 (27). Hepatic spines absent 33.
- 33 (40). Rostrum compressed and usually armed with teeth 34.
- 34 (35). Second pereopods very unequal in size and differing in shape; large chela *Alpheus*-like with the dactylus provided with a large, basal, molar-like tooth which fits into a cavity in the inner surface of the fixed finger *Periclimenaeus*.
- 35 (34). Second pereopods equal or unequal in size but similar in shape; no such specialized armature of the fingers 36.
- 36 (37). Rostrum very short and not reaching beyond the eyes, without or with very few teeth; chela of second pereopod high and somewhat compressed, the fingers provided with 2 or 3 teeth + *Onycocaris*.
- 37 (36). Rostrum reaching distinctly beyond the eyes and usually toothed; chela of second pereopods cylindrical and somewhat swollen, with the fingers provided with numerous denticles 38.
- 38 (39). Tooth of the antennal scale not reaching beyond the end of the broad, oval lamella; rostral teeth sometimes absent, when present minute and placed near to the apex of the rostrum *Anchistus*.
- 39 (38). Tooth of the antennal scale reaches beyond the end of the slender lamella; rostrum with large teeth along the whole of the dorsal margin *Philarius*.
- 40 (33). Rostrum depressed or cylindrical and usually without teeth 41.
- 41 (42). Outer margin of exopod of the uropods ends in 2 spines, the inner of which is movable + *Pontoniopsis*.
- 42 (41). Outer margin of exopod of the uropods ends in a single non-movable spine 43.
- 43 (44). Body not strongly depressed; dactyli of last three pairs of pereopods not strongly curved and generally with one or more accessory teeth + *Pontonia*.

2. These must be regarded as units of convenience only; they are almost certainly not natural sub-genera.

- 44 (43). Body very strongly depressed; dactyli of last three pairs of pereopods simple and strongly curved + *Platycaris*.
- 45 (26). Pleurae of at least the fourth and fifth abdominal segments produced into a distinct, sharp point 46.
- 46 (47). Body clumsily built but not depressed; carapace and abdomen areolated; lower margin of rostrum entire; third abdominal pleurae pointed + *Dasycaris*.
- 47 (46). Body strongly depressed; carapace and abdomen smooth; lower margin of rostrum toothed; third abdominal pleurae rounded + *Harpiliopsis*.
- 48 (51). Body strongly depressed; basal protuberance of last three pairs of pereopods hoof-like; rostrum usually toothed 49.
- 49 (50). No hepatic spine; second pereopods not differing greatly in shape though sometimes differing in size + *Coralliocaris*.
- 50 (49). With an hepatic spine; second pereopods differing greatly both in shape and size + *Jocaste*.
- 51 (48). Body clumsily built but not strongly depressed; basal protuberance of last three pairs of pereopods not hoof-like; rostrum often without teeth 52.
- 52 (53). Antennal spine absent; rostrum depressed and toothless *Conchodytes*.
- 53 (52). Antennal spine present; rostrum compressed, with or without teeth 53.
- 54 (55). Rostrum toothless; basal protuberance of dactyli of last three pairs of pereopods rounded and smooth + *Dasella*.
- 55 (54). Rostrum toothed; basal protuberance of dactyli of last three pairs of legs pointed and covered ventrally with small scales + *Cavicheles*.
- 56 (23). Third maxillipedes without exopods 57.
- 57 (58). Hepatic spine present; dactyli of second pereopods much longer than fixed fingers and hook-shaped + *Hamodactylus*.
- 58 (57). Hepatic spine absent; dactyli of second pereopods normal in shape and size 58.
- 59 (60). Second maxillipedes with well-developed exopods; rostrum compressed; posterior margin of telson bears only 2 pairs of spines + *Anchistioides*.
- 60 (59). Second maxillipedes without exopods; rostrum depressed basally; posterior margin of telson with 3 pairs of spines + *Pontonides*.

Since many Pontoniinae are commensals the following summary of normal associations will be of value in determination of Pontoniine genera.

Free-living: *Palaemonella*; *Vir*; *Periclimenes*; *Anchistioides*.

With sea-anemones: *Periclimenes*.

With corals: *Palaemonella*; *Periclimenes*; *Periclimenaeus*; *Onycocaris*; *Philarius*; *Platycaris*; *Harpiliopsis*; *Coralliocaris*; *Jocasta*.

With sponges: *Periclimenaeus*.

With bivalves: *Paranchistus*; *Anchistus*; *Pontonia*; *Conchodytes*; *Pontonides*.

With crinoids: *Palaemonella*; *Pontoniopsis*.

With tunicates: *Periclimenaeus*; *Dasycaris*; *Dasella*.

Family Hippolytidae

- 1 (2). A movable tooth-like process at the base of the uropod; arthrobranches present at the bases of the first four pairs of pereopods *Saron*.
- 2 (1). No such process; no arthrobranches at the bases of the first four pereopods 3.
- 3 (4:5). Carpus of the second pereopods 2 or 3-jointed 6.
- 4 (3:5). Carpus of the second pereopods 6 or 7-jointed 16.
- 5 (3:4). Carpus of the second pereopods with more than 7 subdivisions 20.
- 6 (7). Carpus of the second pereopods 2-jointed; endopodites of the second to fifth pleopods greatly enlarged and lamelliform + *Phycocaris*.

- 7 (6). Carpus of the second pereopods 3-jointed; endopodites of the pleopods normal 8.
- 8 (9). Dactyli of the last three pairs of pereopods armed with a cluster of large teeth; outer margin of antennal scale armed with small movable teeth; superficially resembling a cirrolanid Isopod in life *Gelastocaris*.
- 9 (8). Dactyli of the last three pairs of pereopods normal in shape and armature; no such teeth on antennal scale; not isopod-like in life 10.
- 10 (11). With a supra-orbital spine; mandible with an incisor process *Hippolyte*.
- 11 (10). No supra-orbital spine; mandible without incisor process 12.
- 12 (13). Antero-lateral angle of carapace entire; rostrum very elongate and ensiform; (third maxillipedes lack exopods) *Tozeuma*.
- 13 (12). Antero-lateral angle of carapace armed with a series of small teeth; rostrum relatively short and deep 14.
- 14 (15). Third maxillipedes possess exopods *Latreutes*.
- 15 (14). Third maxillipedes lack exopods + *Paralatreutes*.
- 16 (17). Upper part of third segment of antennular peduncle bearing a broad, movable plate; mandible without palp *Thor*.
- 17 (16). This segment without such a plate; mandible with a palp 18.
- 18 (19). Supra-orbital spine present; mandibular palp 3-jointed + *Alope*.
- 19 (18). No supra-orbital spine; mandibular palp 2-jointed + *Heptacarpus*.
- 20 (21). Carapace with prominent longitudinal carinae; abdominal segments with large, mid-dorsal, posterior spines; pleurae of abdominal segments ending in 1 or 2 sharp points *Mimocaris*.
- 21 (20). Carapace lacks these carinae; no such mid-dorsal, abdominal spines; abdominal pleurae rounded 22.
- 22 (23). Third maxillipedes without exopods + *Merguia*.
- 23 (22). Third maxillipedes with exopods *Hippolysmata*³ 24.
- 24 (25). Rostrum longer than carapace and with a basal crest of closely set teeth
s.g. *Exhippolysmata*.
- 25 (24). Rostrum shorter than the carapace and lacking such a crest 26.
- 26 (27). Bases of pereopods lack epipodites s.g. *Lysmatella*.
- 27 (26). Bases of the first four pereopods provided with epipodites s.g. *Hippolysmata*.

Family Alpheidae

The key to this family is adapted from that of Holthuis (1955) by the exclusion of all genera which have not been reported from the Indo-Australian area.

- 1 (2). Carpus of the second pereopods 4-jointed + *Arete*⁵.
- 2 (1). Carpus of the second pereopods 5-jointed 3.
- 3 (10). With a movable plate articulated to the postero-lateral angle of the 6th abdominal segment 4.
- 4 (5). Rostrum absent or indistinct + *Betaeus*.
- 5 (4). Rostrum prominent 6.
- 6 (7). Rostrum round at the tip in lateral view and with a broad vertical lamella
+ *Aretopsis*.
- 7 (6). Rostrum slender and pointed at the tip in lateral view 8.
- 8 (9). Eyes almost completely concealed in dorsal view; first pereopods with arthrobranchis at their bases + *Alpheopsis*.

³ The closely allied genus *Lysmata*, which is not likely to be found in Malayan waters, can be distinguished by the bifid, upper antennular flagellum.

- 9 (8). Eyes partially exposed in dorsal view; first pereopods without arthrobranches
*Athanas*⁵.
- 10 (11). Dactylus of large second leg with a large molar tooth which fits into a cavity in the fixed finger 14.
- 11 (10). Dactylus of large second leg lacks such a tooth 12.
- 12 (13). Eyes completely exposed in dorsal view. Rostrum absent or rudimentary
+ *Automate*.
- 13 (12). Eyes almost completely covered in dorsal view; rostrum well-developed and reaching far beyond the end of the eye-stalks *Salmoneus*.
- 14 (15). The first four pairs of pereopods bear epipodites *Alpheus*.
- 15 (14). None of the pereopods bear epipodites *Synalpheus*.

Family Ogyrididae

This family contains only the genus + *Ogyrides*, which has not yet been reported from Malaya.

Family Processidae

- 1 (2). The first pereopods bear exopods *Nikoides*.
- 2 (1). The first pereopods lack exopods *Processa*.

Family Gnathophyllidae

No genera of this family are known from Malaya but three are included here since they may yet be found in Malayan waters.

- 1 (2). Outer antennular flagellum deformed by the extreme broadening of most of its joints into a broad, flat, leaf-like appendage; chelae of second pereopods also flattened and leaf-like + *Hymenocera*.
- 2 (1). Outer antennular flagellum normal; chelae of 2nd legs not leaf-like 3.
- 3 (4). Chelae of second pereopods broad and flattened, though not leaf-like; last 2 joints of the third maxillipede almost as broad as the antepenultimate joint; outer margin of dactylus of second pereopods serrated + *Phylloganthia*.
- 4 (3). Chelae of second pereopods not greatly broadened or flattened; last two joints of third maxillipede less than half as broad as the antepenultimate joint; outer margin of dactylus of second pereopod not serrated + *Gnathophyllum*.

Family Crangonidae

The genus *Crangon* Fabricius, 1798 is included in the key because of Kemp's record of a variety of *C. vulgaris* from Akyab (Kemp, 1916). *C. vulgaris* is a common European species and there are no other records of any member of this genus from anywhere in the Indo-Pacific region. Kemp's record is therefore very surprising; but Kemp was a very careful worker and there are no positive grounds for disputing his conclusion. In these circumstances one must accept the possibility that *Crangon* may be found in Malaya, though this possibility seems to be very remote.

- 1 (2). Second pereopods almost equal in length to the succeeding pereopods .. + *Crangon*.
- 2 (1). Second pereopods much shorter than the succeeding pereopods 3.
- 3 (4). With 6 or 7 gills on each side of the body, each with its apex directed backwards
Pontophilus.
- 4 (3). With 8 gills on each side of the body, each with its apex directed forwards
Pontocaris.

⁵ Since this paper went into press, I have been able to consult the important paper of Banner, A. H. & Banner, D. M. (1960), Contributions to the Knowledge of the Alpheid Shrimps of the Pacific Ocean Part V. Members of the genus *Athanas*, *Pacific Sci.*, 14, 129-155. As a result I am now convinced that *Arete* and *Athanas* cannot be maintained as distinct genera.

TABLE 1

Comparative table of the Caridea and Stenopodidea of Singapore and two non-Malaysian, Indo-Pacific areas. Species only known from freshwater and/or brackish water habitats have been excluded.

Species	Singapore	Andamans ⁴	Moluccas	Remarks
<i>Leptochela robusta</i> ..	*	..	*	Planktonic
<i>Heterocarpoides levicarina</i> ..	*	..	*	Rare species
<i>Chlorotocella gracilis</i> ..	*	*	*	
<i>Chlorotocoides spinicauda</i> ..	*	*	*	
<i>Saron marmoratus</i> ..	*	*	*	Rare at Singapore
<i>neglectus</i> ..	*	*	*	Rare at Singapore
<i>Ligur uveae</i>	*	Rare species
<i>Thor maldivensis</i>	*	*	
<i>paschalis</i> ..	*	*	*	Very rare at Singapore
<i>amboinensis</i>	*	*	
<i>intermedius</i>	*	Very rare species
<i>Hippolyte ventricosa</i> ..	*	*	*	
<i>commensalis</i>	*	..	Very rare species
<i>Phycocaris simulans</i>	*	..	Very rare species
<i>Paralatreutes bicornis</i>	*	..	Very rare species
<i>Latreutes mucronatus</i> ..	*	*	..	
<i>porcinus</i> ..	*	*	..	Common where found at all
<i>pygmaeus</i> ..	*	*	..	
<i>Tozeuma armatum</i>	*	*	
<i>lanceolatum</i> ..	*	Replaces <i>T. armatum</i> at Singapore
<i>Gelastocaris paronae</i> ..	*	*	..	
<i>Mimocaris heterocarpoides</i> ..	*	Rare, Malaysian
<i>Lysmata dentata</i>	*	
<i>trisetacea</i>	*	
<i>Hippolysmata amboinensis</i>	*	Rare species
<i>kukenthali</i>	*	
<i>vittata</i> ..	*	*	*	
<i>prima</i> ..	*	*	..	
<i>ensirostris</i> ..	*	Common where found
<i>Athanas monoceros</i> ..	*	
<i>parvus</i> ..	*	
<i>jedanensis</i> ..	*	..	*	

4. The Alpheidae of the Andamans are very incompletely known and so have been omitted.

TABLE 1—continued

Comparative table of the Caridea and Stenopodidea of Singapore and two non-Malaysian, Indo-Pacific areas. Species only known from freshwater and/or brackish water habitats have been excluded.

Species	Singapore	Anda- mans ⁴	Moluccas	Remarks
<i>Salmoneus hilarulus</i> ..	*	..	*	
<i>Arete amboinensis</i>	*	
<i>iphianassa</i>	*	
<i>Synalpheus amboinae</i> ..	*	..	*	
<i>comatularum</i> ..	*	..	*	
<i>stimpsoni</i> ..	*	..	*	
<i>carinatus</i>	*	
<i>neomeris</i> ..	*	..	*	
<i>gravieri</i> ..	*	..	*	
<i>iphinoe</i> ..	*	..	*	
<i>jedanensis</i> ..	*	
<i>streptodactylus</i>	*	
<i>modestus</i>	*	
<i>iocasta</i>	*	
<i>paraneomeris</i>	*	
<i>nilandensis</i>	*	
<i>fossor</i>	*	
<i>triunguiculatus</i> ..	*	
<i>stormi</i> ..	*	
<i>demani</i>	*	
<i>tumidomanus</i> ..	*	
<i>hastilicrassus</i>	*	
<i>acanthitelsonis</i> ..	*	..	*	
<i>hilarulus</i> ..	*	..	*	
<i>exilipes</i> ..	*	..	*	
<i>amabilis</i>	*	
<i>bituberculatus</i> ..	*	..	*	
<i>bispinosus</i>	*	
<i>quadrispinosus</i> ..	*	..	*	
<i>neptunus</i> ..	*	..	*	Very rare at Singapore
<i>theano</i> ..	*	..	*	
<i>pescadorensis</i> ..	*	
sp. (<i>laevimanus</i> group) ..	*	
<i>Alpheus hailstonei</i>	*	
<i>collumianus</i>	*	
<i>acutofemoratus</i>	*	
<i>ventrosus</i> ..	*	..	*	

4. The Alpheidae of the Andamans are very incompletely known and so have been omitted.

TABLE 1—continued

Comparative table of the Caridea and Stenopodidea of Singapore and two non-Malaysian, Indo-Pacific areas. Species only known from freshwater and/or brackish water habitats have been excluded.

Species	Singapore	Anda- mans ⁴	Moluccas	Remarks
<i>Alpheus splendidus</i>	.. *	Rare species Found in Malaya
<i>macrochirus</i>	*	
<i>lutini</i> *	
<i>malleodigitus</i>	*	
<i>alcyone</i>	*	
<i>paralcyone</i>	.. *	..	*	
<i>spongjarum</i>	.. *	..	*	
<i>eulimene</i>	*	
<i>pachychirus</i>	*	
<i>stanleyi</i>	.. *	..	*	
<i>frontalis</i>	*	
<i>bidens</i>	*	
<i>praedator</i>	*	
<i>insignis</i>	*	
<i>philoctetes</i>	*	
<i>cf. lanceleti</i>	.. *	
<i>gracilipes</i>	*	
<i>bengalensis</i>	.. *	
<i>alpheopsides</i>	.. *	
<i>rapax</i> *	
<i>angustidigitus</i>	.. *	Occurs at Penang
<i>distinguendus</i>	.. *	
<i>rapacida</i>	.. *	
<i>pubescens</i>	*	
<i>miersi</i>	*	
<i>bisincisus</i>	.. *	
<i>microrhynchus</i>	.. *	
<i>audouini</i>	.. *	..	*	
<i>chiragricus</i>	.. *	..	*	
<i>crassimanus</i>	.. *	..	*	
<i>pareuchirus</i>	.. *	..	*	
<i>polyxo</i>	*	
<i>strenuus</i>	*	
<i>cf. leptochirus</i>	.. *	
<i>cf. maindroni</i>	.. *	
<i>pacificus</i>	*	
<i>parvirostris</i>	.. *	..	*	
<i>hippotohoe</i>	.. *	..	*	
<i>euchirus</i>	.. *	..	*	

4. The Alpheidae of the Andamans are very incompletely known and so have been omitted.

TABLE 1—continued

Comparative table of the Caridea and Stenopodidea of Singapore and two non-Malaysian, Indo-Pacific areas. Species only known from freshwater and/or brackish water habitats have been excluded.

Species	Singapore	Andamans ⁴	Moluccas	Remarks
<i>Alpheus funafutensis</i>	*	Rare species
<i>edamensis</i>	*	
<i>Gnathophyllum fasciolatum</i>	*	
<i>Hymenocera elegans</i>	*	
<i>Leander tenuicornis</i>	..	*	*	
<i>urocaridella</i>	..	*	..	
<i>Leandrites deschampsii</i>	..	*	..	Common at Singapore
<i>Palaemon concinnus</i>	*	
<i>debilis</i>	*	Not known from east of Madura
<i>serrifer</i>	..	*	..	
<i>semmelinki</i>	..	*	..	
<i>Macrobrachium equidens</i>	..	*	*	
<i>Palaemonella lata</i>	*	Possibly only a form of <i>P. vestigialis</i>
<i>vestigialis</i>	..	*	*	
<i>pottsi</i>	..	*	..	
<i>tenuipes</i>	*	
<i>affinis</i>	*	
<i>Vir orientalis</i>	*	
<i>Periclimenes aesopius</i>	..	*	*	
<i>impar</i>	*	Rare species
<i>parvus</i>	..	*	..	Rare species
<i>ceratophthalmus</i>	*	Rare species
<i>signatus</i>	*	Rare species
<i>agag</i>	*	Rare species
<i>amboinensis</i>	*	Rare species
<i>amymone</i>	..	*	*	
<i>andamensis</i>	*	Rare species
<i>brevicarpalis</i>	..	*	*	
<i>brocki</i>	..	*	*	
<i>calmani</i>	..	*	..	
<i>digitalis</i>	*	Rare species

4. The Alpheidae of the Andamans are very incompletely known and so have been omitted.

TABLE 1—*continued*

Comparative table of the Caridea and Stenopodidea of Singapore and two non-Malaysian, Indo-Pacific areas. Species only known from freshwater and/or brackish water habitats have been excluded.

Species	Singapore	Anda- mans	Moluccas	Remarks
<i>Periclimenes</i> sp. nr. <i>digitalis</i>	*	Rare species
<i>elegans</i> ..	*	*	*	Rare at Singapore
<i>galene</i>	*	Rare species
<i>grandis</i> ..	*	
<i>inornatus</i>	*	..	Rare species
<i>lutescens</i> ..	* (?)	..	*	
<i>platycheles</i>	*	Rare species
<i>proximus</i>	*	..	Rare species
<i>psamathe</i>	*	
<i>seychellensis</i> ..	*	*	*	
<i>sibogae</i>	*	Rare species
<i>spiniferus</i> ..	*	*	*	
<i>suvadivensis</i> ..	*	
<i>tenuipes</i>	*	*	Occurs in Malaya
<i>Paranchistus biunguiculatus</i>	*	Papuanian
<i>Anchistus custos</i> ..	*	*	..	
<i>demani</i>	*	..	Rare species
<i>miersi</i> ..	*	*	..	
<i>Thaumastocaris streptopus</i>	*	Rare species
<i>Periclimenaeus minutus</i>	*	Rare species
<i>rhodope</i>	*	
<i>tridentatus</i> ..	*	
<i>truncatus</i>	*	Rare species
<i>Philarius imperialis</i> ..	*	..	*	
<i>Pontonia katoi</i>	*	
<i>styliferus</i>	*	Rare species
<i>Harpiliopsis beaupresi</i> ..	*	*	..	
<i>depressus</i>	*	*	
<i>Coralliocaris graminea</i> ..	*	*	*	
<i>superba</i>	*	*	
<i>venusta</i>	*	
<i>Jocaste lucina</i>	*	
<i>Conchodytes biunguiculatus</i>	*	*	
<i>monodactylus</i> ..	*	Rare species
<i>tridacnae</i>	*	*	

TABLE 1—*continued*

Comparative table of the Caridea and Stenopodidea of Singapore and two non-Malaysian, Indo-Pacific areas. Species only known from freshwater and/or brackish water habitats have been excluded.

Species	Singapore	Anda- mans	Moluccas	Remarks
<i>Cavicheles kempii</i>	*	Rare species
<i>Hamodactylus boschmai</i>	*	Rare species
<i>Anchistioides compressus</i>	..	*	..	
<i>Pontophilus angustirostris</i>	..	*	*	
<i>parvirostris</i>	..	(?)	..	
<i>candidus</i>	Rare species
<i>incisus</i>	*	Rare species
<i>lowisi</i>	*	Rare species
<i>plebs</i>	Rare species
<i>sabsechota</i>	Rare species
<i>Pontocaris orientalis</i>	..	*	..	
<i>Stenopus hispidus</i>	..	*	..	Rare at Singapore
<i>tenuirostris</i>	*	
<i>Odontozona ensifera</i>	*	Rare species

References

LIST A

Basic reference works on Indo-Pacific Caridea and Stenopodidea (Many of these works include extensive bibliographies from which further literature can be traced).

- HOLTHUIS, L. B., 1946. Biological results of the Snellius Expedition XIV The Decapoda Macrura of the Snellius Expedition I. The Stenopodidae, Nephropsidae, Scyllaridae, and Palinuridae. *Temminckia*, 7, 1-178.
- , 1947. The Decapoda of the Siboga Expedition, part IX The Hippolytidae and Rhynchocinetidae, collected by the Siboga and Snellius Expeditions with remarks on other species. *Siboga Exped.*, XXXIXa⁸, 1-100.
- , 1950. The Decapoda of the Siboga Expedition, part X The Palaemonidae, collected by the Siboga and Snellius Expeditions with remarks on other species I. Sub-family Palaemoninae. *Siboga Exped.*, XXXIXa⁹, 1-268.
- , 1952. The Decapoda of the Siboga Expedition, part XI The Palaemonidae, collected by the Siboga and Snellius Expeditions with remarks on other species II. Subfamily Pontoniinae. *Siboga Exped.*, XXXIXa¹⁰, 1-253.
- , 1952. On some Indo-West pacific Palaemoninae (Crustacea Decapoda Caridea). *Zool. Verh. Rijksmus. Nat. Hist. Leiden*, 26, 1-157.
- , 1955. The recent genera of the Caridean and Stenopodidean shrimps (Class Crustacea, Order Decapoda, Supersection Natantia) with keys for their determination. *Zool. Verh. Rijksmus. Nat. Hist. Leiden*, 26, 1-157.

LIST A—continued.

- HEMMING, F. (ed), 1958. *Official list of generic names in zoology, first instalment, names 1-1274*. pp. i-xxxv, 1-200.
- , 1958. *Official index of rejected and invalid generic names in zoology, first instalment, names 1-1169*. pp. i-xii, 1-132.
- KEMP, S., 1914. Hippolytidae. Notes on Crustacea Decapoda in the Indian Museum. V. *Rec. Indian Mus.*, **10**, 81-129.
- , 1916. Further notes on Hippolytidae. Notes on Crustacea Decapoda in the Indian Museum. VII. *Rec. Indian Mus.*, **12**, 385-405.
- , 1917. *Leander styliferus*, Milne Edwards, and related forms. Notes on Crustacea Decapoda in the Indian Museum. IX, *Rec. Indian Mus.*, **13**, 203-231.
- , 1922. Pontoniinae. Notes on Crustacea Decapoda in the Indian Museum. XV. *Rec. Indian Mus.*, **24**, 113-288.
- , 1925. On various Caridea. Notes on Crustacea Decapoda in the Indian Museum. XVII. *Rec. Indian Mus.*, **27**, 249-343.
- KUBO, I., 1940. Pontoniinae. Studies on Japanese Palaemonoid Shrimps. II. *Journ. Imp. Fish. Inst. Tokyo*, **34**, 31-75.
- , 1940. A new Shrimp. *Harpilius imperialis*. *Journ. Imp. Fish. Inst. Tokyo*, **34**, 1-4.
- MAN, J. G. DE, 1888. Report on the Podophthalmous Crustacea of the Mergui Archipelago, collected for the Trustees of the Indian Museum, Calcutta, by Dr. John Anderson, F.R.S., Superintendent of the Museum. *Journ. Linn. Soc. London Zool.*, **22**, 1-312.
- , 1892. Decapoden des Indischen Archipels. In: Weber. M., *Zool. Ergeb. einer Reise in Nederl. Ost-Indien*, **2**, 265-527.
- , 1915. The Decapoda of the Siboga Expedition. part II, family Alpheidae. *Siboga Exped.*, XXXIXa¹ suppl., 133-465.
- , 1920. The Decapoda of the Siboga Expedition part IV, Families Pasiphaeidae, Stylo-dactylidae, Hoplophoridae, Nematocarcinidae, Thalassocaridae, Pandalidae, Psalidopodidae, Gnathophyllidae, Processidae, Glyphocrangonidae, and Crangonidae. *Siboga Exped.*, XXXIXa³, 1-318.
- , 1922. On a collection of Macrurous Decapod Crustacea of the Siboga Expedition, chiefly Penaeidae and Alpheidae. *Siboga Exped.*, XXXIXa⁴, 1-51.

LIST B

- Papers on Malayan Caridean and Stenopodidean Crustacea (excluding any in LIST A)
- BALSS, H., 1914. Östasiatische Decapoden II Die Natantia und Reptantia. In: Doflein, F., *Beitrage zur Naturgeschichte Ostasiens. Abh. Bayer Akad. Wiss.*, suppl. **2**, pt. 10, 1-101.
- BOUVIER, E. L., 1925. Recherches sur la morphologie, les variations, et la distribution géographique des Crevettes de la famille des Atyidés. *Encycl. ent.*, series A, **4**, 1-370.
- DANA, J. D., 1852. Conspectus Crustaceorum quae in Orbis Terrarum circumnavigatione, Carolo Wilkes e Classe Reipublicae Foederatae Duce, lexit et descripsit. *Proc. Acad. Nat. Sci. Phila.*, 1852, 10-28.
- JOHNSON, D. S., 1957. A survey of Malayan freshwater life. *Malayan Nat. Journ.*, **12**, 57-65.
- , 1960. Some aspects of the distribution of freshwater organisms in the Indo-Pacific area, and their relevance to the validity of the concept of an Oriental region in zoogeography. *Proc. Cent. and Bicent. Congr. of Biol., Singapore*, 1958, 170-181.
- , 1960. Sub-specific and infra-specific variation in some freshwater prawns of the Indo-Pacific region. *Proc. Cent. and Bicent. Congr. of Biol., Singapore*, 1958, 259-267.
- , 1961. Notes on the freshwater Crustacea of Malaya. I. The Atyidae. *Bull. Raffles Mus., Singapore*, **26**, 120-153.
- KEMP, S., 1918. Decapod and Stomatopod Crustacea. In: Annandale, N., *Zoological Results of a Tour in the Far East. Mem. Asiat. Soc. Bengal*, **6**, 217-297.
- LANCHESTER, W. F., 1901. On the Crustacea collected during the "Skeat" Expedition to the Malay Peninsula, together with a Note on the genus *Actaeopsis*. Part I. Brachyura, Stomatopoda, and Macrura. *Proc. Zool. Soc. London*, 1901, 534-574.

LIST B—continued

- _____, 1906. Report on the Crustacea. In: Annandale, N. and Robinson, H. C., *Fasciculi Malayenses. Anthropological and Zoological Results of an Expedition to Perak and the Siamese Malay States. 1901-1902. Zoology*, **3**, 127-134.
- NOBILI, G., 1903. Crostacei di Singapore. *Boll. Mus. Zool. Anat. Comp. Torino*, **18**, no. 455, 1-39.
- ROUX, J., 1934. New Freshwater Decapod Crustaceans from the Malay Peninsula. *Bull. Raffles Mus. Singapore*, **9**, 28-33.
- _____, 1936. Second Note upon Freshwater Decapod Crustaceans from the Malay Peninsula. *Bull. Raffles Mus. Singapore*, **12**, 29-43.
- STEPHENSON, K., 1927. Crustacea from the Auckland and Campbell Islands. Papers from Dr. Th. Mørtensen's Pacific Expedition 1914-16. XL. *Vidensk. Medd. Naturh. Foren. Kbh.* **83**, 289-300.
- SUVATTI, C., 1937. *A checklist of aquatic Fauna in Siam (excluding Fishes)*, 1-116.
- WALKER, A. O., 1887. Notes on a Collection of Crustacea from Singapore. *Journ. Linn. Soc. Lond. Zool.*, **20**, 107-117.
- WEITENWEBER, W. R., 1854. Aus James Dana's *Conspectus of the Crustacea*, *Lotos Praha*, **4**, 5-14, 60-63, 107-115, 153-157, 251-254.

Explanation of Plate 2

1. Map of Singapore Island and surrounding areas with localities of Caridea and Stenopodidea.