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PRAWNS OF THE MALACCA STRAITS AND SINGAPORE WATERS*

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ABSTRACT

A listing is given of the 215 species of prawns known from marine habitats at Singapore and in the Malacca Straits. Comments on biology, distribution etc., are given for the more important commercial species. Notes are given on habitat distribution, commercial importance and commensalism.

INTRODUCTION

PRAWNS are a major marine resource throughout the shallow seas of the Sundanian shelf area. They are intensively exploited in the Malacca Straits and around Singapore. Reasonable estimates give a catch of 21 kilotons per annum of larger prawns and 6 kilotons of 'udang baring' (mainly, if not entirely, *Acetes* spp.) for Malaysia and 0.5 kilotons per annum for local Singapore waters. The Thai catch in this area is probably about 4 to 5 kilotons per annum. Statistics for Indonesian waters are inadequate and the present catch is probably small but the great extent of mangroves along the eastern coast of Sumatra leaves little doubt that there is a high potential. Everywhere, even in Malaysia, large quantities of prawns are not recorded in the statistics either because they appear only in unrecorded subsistence fisheries or because they are subsumed under general heads such as 'manure fish'. Thus an estimated potential of 50 kilotons per annum for the area seems to be reasonable. Of this about 40 kilotons per annum might well consist of good quality prawns. Inclusion of potential fisheries at the top of the continental slope near the northern end of the Straits would still further increase the figure.

Unfortunately nowhere in the area are detailed statistics kept by species or even by genera, despite the fact that species are often sorted out and priced differently by prawn vendors. Thus estimates of relative importance of the different species must

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† Deceased.

be subjective. Apart from the interrupted work of the former Singapore Regional Fisheries Research Station, summarized for the Penaeidae by Hall (1962), there has been little attempt at any intensive survey of the occurrence of edible prawns.

The following listing is an attempt to bring together information known to me either from collections which I have examined or from published sources. Detailed localities are given only for the Malacca Straits proper. Occurrence at Singapore is normally noted without localities since I intend to deal with the Singapore material in more detail elsewhere. I have also tried to give a general indication of the distribution of each form within the general Sundanian-Thailand area. In this connection it may be noted that in my view (Johnson, 1966) this area is a faunal unit and there is no real faunal boundary in the southern Malacca Straits such as has been postulated by Tweedie (1954) and Hall (1962). Recent collecting has only served to reduce still further the small group of species whose distributions appear to support the conclusions of those authors and it is becoming evident that it is unsafe to assume the absence of any Malacca Straits species from the Singapore—S. China Sea—Gulf of Thailand area, though some species are certainly more abundant in one area than in the other.

I have tried wherever possible to use up-to-date nomenclature. To save space synonyms are only listed where this appears to be necessary to prevent confusion. Freshwater species are not included unless they are commonly found in mixohaline waters and penetrate at least as far as the mesohaline zone.

An asterisk against the name of a locality indicates that I have seen specimens from that locality but it does not necessarily mean that I have examined the specimens on which a cited published record is based and so does not necessarily constitute any endorsement of such a record.

Only brief citations are given to rare species and in general I have given a fuller treatment to species of known or potential economic importance.

For convenience I have followed the order of caridean families adopted by Holthuis (1955) but this is definitely not to be taken as implying my agreement to all details of that classification. For convenience subfamilies, genera, and species within genera are listed alphabetically. Type species, genera, etc. are indicated by an asterisk.

Distributions outside Sundania are indicated by: W. Indian Ocean; N. Sino-Japanese; and E. Wallacea, Australasia, Polynesia.

PUBLISHED SOURCES

Recent published works on marine prawns in the area include: Penaeidae, Hall (1956, 1961, 1962); *Acetes*, Pathansali (1966); Alpheidae of Singapore and Phuket Island, Banner and Banner (1966). Holthuis and Rosa (1965) produced a preliminary world listing of species of prawns of economic value. Comments and corrections applying to the present area have been made by Johnson (1968, 1969) and by Tham (1968 b). Planktonic prawns are dealt with by Wickstead (1961) and Hall (1962) summarizes data on penaeid larvae in the plankton. Johnson (1961) has given a brief general listing of Singapore carideans and there are scattered records of individual species principally by Johnson, Bruce, and Chuang. For the most

up-to-date account of local prawn fishing and prawn culture methods one should refer to Hall (1962) supplemented by Tham (1968 a and b).

Data recently compiled for the Indicative World Plan by Longhurst is still only available in restricted circulation form (Longhurst, 1969). Most of the information for the present area is based on data collected by myself. Sources included official statistics from the governments of Singapore, Thailand, and Malaysia. Recently Mr. Leong Cheng Whye, working under me, has carried out a very thorough study of the genus *Acetes*, incorporated in a report deposited in this department, and Miss Chan Chwee Yin is studying palaemoninid prawns. I am grateful to these workers for allowing me to use their unpublished results.

PENAEIDEA

Family : Penaeidae

Subfamily : Penaeinae

This is ecologically the dominant group of prawns in mesohaline-polyhaline waters, in the infra-littoral fringe of muddy and sandy beaches, and on smooth sandy to muddy bottoms offshore on the continental shelf. These prawns are rare on reefs and on rocky bottoms, where the variety of forms is much restricted. Commercially they are by far the most important group of prawns and the potential annual production is of the order of 40 kilotons.

In terms of value the genus *Penaeus* outweighs all the others and this relative value is likely to increase if intensive culture methods can be developed on a large scale. Species of *Metapenaeus* are currently of considerable importance but these prawns are individually less valuable than prawns of the genus *Penaeus* and the relative importance of the group is likely to diminish with changes in fishing and culture methods. On the other hand *Parapenaeopsis* has been under-exploited in the past and its relative importance is increasing and likely to continue to increase with increasing development of offshore trawl fishing. The other genera are and are likely to remain unimportant.

Atypopeneus Alcock, 1905

*compressipes** (Henderson), 1892=*stenodactylus* Stimpson

1. *A. stenodactylus* (Stimpson), 1860

An uncommon offshore species extending from depths of a few m to over 80 m but mostly below 30 m. A small species which does not attain 10 cms in length it is of no commercial value. It has been included in lists of commercial species from several countries but it is fairly certain that it is everywhere as unimportant as in the present area.

Singapore* ; Batu Maung Flats, Penang, one only (Hall, 1962). Extends W. N. and E. of Sundanian area †.

† In subsequent species citations Singapore will be abbreviated to S and the words 'Extends' and of 'Sundanian area' will be omitted.

Heteropeneaus de Man, 18962. *H. longimanus** de Man, 1896

S* ; also E.

Uncommon, small, and of no commercial value. The preferred and only habitat, coral reefs, is unique for the family.

Metapenaeopsis Bouvier, 1905

Offshore prawns of very minor economic importance.

3. *M. assimilis* (de Man), 1920

Off P. Weh, N. Sumatra* (de Man)

4. *M. barbata* (de Haan), 1850

S* ; several stations in central Malacca Straits off Selangor, 40-53 m, mainly on mud but also other bottoms (Hall, 1962) ; from commercial catches S. of Pulau Langkawi*. Occurs in commercial catches from Gulf of Thailand* ; off East coast of Peninsular Thailand* (Leiden Museum) ; in commercial catches from S.W. part of S. China sea* ; off Sarawak and Brunei (Hall, 1962); off Sabah (Chin, 1967); and off south coast Borneo (Kubo, 1949); doubtless also elsewhere. Also occurs N and E.

In the Singapore Straits and immediately adjoining areas of the S.China Sea this is by far the commonest offshore penaeid and is nearly ubiquitous at depths of 2 m to over 90 m but is rare in estuary mouths and does not occur in inner estuaries or mangrove creeks. Apart from the small concentration off Selangor it is relatively rare elsewhere ; so far there is no explanation for this localized abundance. The breeding depth is probably 20 to 40 m and within the feeding area. Breeding at Singapore is twice yearly on the *Metapenaeus* pattern (Hall, 1962). The food comprises small crustaceans and vegetable debris (Hall, 1962).

Despite the local abundance this species is of no commercial importance in our area since it is small and never much exceeds 10 cm with most specimens much smaller. The value is slight and individuals only appear in commercial catches incidentally to other species.

5. *M. coniger andamanensis* (Wood-Mason and Alcock), 1891

N. W. of Pulau Langkawi, 159 m (Hall, 1962) ; also W. E. A continental slope species of no commercial value.

6. *M. lamellata* (de Haan), 1850

S*, 82 m, one only (Hall, 1962) ; elsewhere only from Japan.

7. *M. mogiensis* (Rathbun), 1902

S* ; also at Kuala Pahang* (Leiden Museum) and in catch from kelong off Mersing, Johor* ; not yet known from Malacca Straits proper; W. N. and E.

In Singapore area comes less close to shore than *M. barbata* and is mainly from deeper waters ; not very common ; of negligible commercial importance.

8. *M. novaeguineae* (Haswell), 1879.

I have synonymized *M. barbeensis* Hall, 1962 with this form.

S*, at west of area (Hall, 1962); the main local distribution is in the South China Sea east of the Natuna Is. at over 80 miles from the nearest large land mass and in depths of 40 to 120 m (Hall, 1962); also occurs off Nhatrang*, Vietnam (Leiden Museum); New Guinea area. The occurrence at Singapore is anomalous and unexplained.

9. *M. stridulans* (Wood-Mason and Alcock), 1905

Hall (1961) gives distinctions from related forms.

S*; in small numbers at Batu Maung flats, Penang and west of Kuala Merbok, Kedah (Hall, 1962); Langkawi* (Leiden Museum). Widespread in S. China Sea area: Mersing*; Kuala Pahang* and Bachok*, Kelantan (Leiden Museum); Lake Songkla*; Nhatrang* (Leiden Museum); Sabah (Chin, 1967); common in S. W. portions of S. China Sea to over 60 m and appear in commercial catches*; between Borneo and Lingga, 37m (Hall, 1962).

Coastal but not found in immediate infra-littoral fringe and not in Mangroves though in brackish waters at Kuala Pahang and Songkhla; from about 10 m to over 90 m; at Singapore less common than *M. barbata* and also in central Malacca Straits; position reversed elsewhere in area. Tham (1968b) lists as a Malaysian commercial species but importance is slight because of low abundance, small size, and shelliness.

Metapenaeus Wood-Mason and Alcock, 1891

Because several occur in very large numbers these are the bread and butter prawns of our local prawn fisheries but weight for weight they are much less valuable than most species of *Penaeus*.

10. *M. affinis** (H. M. Edwds), 1837

Despite Hall's arguments (1962) this name cannot be applied to a species of *Parapeneopsis* and must be used for the species which Hall termed *M. mutatus* (Lanchester). Older records under this name often refer to *M. burkenroadi*. Distinctions between juveniles of this species and *M. ensis* are very slight and they will probably be confused in routine sampling.

S*; Hall records from 8 coastal localities from off Kukup to Langkawi in depths of 22-62 m (Hall, 1962); Pontian Kechil*, (Leiden Museum; commercial catches); Malacca-Port Dickson coasts* (commercial catches); Tg. Bruas* and Kuala Panchor*, Perak (Leiden Museum); Penang* (Lanchester, 1901); K. Jalan Bahru, Penang* (Leiden Museum); K. Muda* and K. Sanglang*, Kedah (Leiden Museum). In S. China Sea area occurs around coasts of Gulf of Thailand* (commercial catches; Leiden Museum); K. Trengannu* (commercial catches; Leiden Museum; etc.); Telok Chendering* (Leiden Museum) and Marang lagoon* (commercial catches etc.) near K. Trengannu; off Sarawak 20 to 31m (Hall, 1962); Sabah (Chin, 1967); coasts S. E. Thailand (Kemp, 1918); W.

Common and sometimes dominant in infra-littoral fringe of sandy beaches and extends into estuaries, mangroves, prawn ponds, though usually less abundant there. According to Hall may attain 6.5% of prawn pond catch for short periods but overall abundance much less and over year forms only about 1% of catch. Off-shore this is mainly a coastal species and rarely descends below 50 m; occurs equally on sand, mud, rock. Appears to breed close to shore and Hall (1962) suggests most move *inshore* to breed. Two breeding peaks at Singapore as for *M. ensis* and one at Penang during S. W. Monsoon.

Mainly consumes angiosperm debris but takes significant quantities of invertebrates (Hall, 1962).

A moderate sized species which often exceeds 11cm. The flavour is poor* and the price per weight is consequently low (Tham, 1968a) but may nonetheless be of major commercial importance because of abundance.

11. *M. brevicornis* (H. M. Edwds), 1837

avirostris (Dana), 1852=*brevicornis* (H. M. Edwds)

In older records *M. spinulatus* was usually not distinguished but this is unimportant since that species is rare.

S* ; Hall (1962) records in small numbers from 4 coastal stations in Kedah and Batu Maung flats ; specimens in Leiden Museum from P. Ketam*, Selangor, Port Weld* and K. Panchor*, Perak, K. Jalan Bahru*, Penang, K. Sanglang*, Kedah, and Langkawi* ; mangrove creeks in S. W. Johor* ; Pt. Swettenham mangrove area* ; occurs in S. China Sea area at S. E. Thailand (Kemp, 1918), Bangkok (Kubo, 1949), Lake Songkla* (also Leiden Museum), Kuala Trengannu area* (small scale commercial catches), and off western Sarawak at about 30 m (Hall, 1962).

Moderately common in estuaries and mangrove areas and forms about 5% of annual catch of Singapore prawn ponds (Hall, 1962) ; seasonally abundant and including mature individuals in infra-littoral fringes of open, muddy-sandy beaches ; thus apparently breeds close to shore in very shallow water ; Hall (1962) suggests *inshore* migration for breeding with two peaks at Singapore and one at Penang as for *M. affinis*.

Food at Singapore is largely angiosperm material taken in a fairly fresh state but also takes filamentous algae and various invertebrates whilst sand-grains are not uncommon (Hall, 1962) ; remains of *Enhalus* occur.

This is a large species for the genus and specimens exceeding 15 cm in length are not uncommon ; the skeleton is rather thin and the flavour is superior to that of other species thus the price is weight for weight higher than for most prawns but less than that for *Penaeus* spp. Tham, (1968a). Large specimens are often sorted out and sold separately from the general prawn catch. The commercial importance is thus currently fairly high and higher than would appear on the basis of abundance alone. The general biology suggests that this might well be a satisfactory species for intensive culture.

Common name : udang kuning, yellow prawn (Tham, 1968a).

brevicornis de Man, 1924 = *spinulatus* Kubo,

[6]

12. *M. burkenroadi* Kubo, 1954

This is the species which has commonly but incorrectly been reported as *M. affinis* and which Hall (1962) called *M. mastersii*. *M. dalli* Racek is a further synonym. Juveniles can be confused with *M. affinis* and *M. ensis* but the relatively small size at which the sexual characters develop helps to prevent such confusion.

S* ; mangrove areas near Kukup* where appears in commercial catches ; Pt. Swettenham*. In S. China Sea area occurs in mangroves of S. E. Johor*, Mersing* and Endau* estuaries, coastal lagoons and creeks between Kuantan* and Kemaman*, near Trengannu* (commercial catches), Marang lagoon, Trengannu estuary and adjoining creeks* ; L. Songkla and neighbouring mangroves and, lagoons*, and at Chantaburi* (Leiden Museum) ; W (Ceylon), N and E.

Common and widespread in brackish waters but does not penetrate into oligohaline waters. Hall (1962) states that it forms 17% of annual catch of Singapore prawn ponds ; the percentage appears to be higher in ponds adjoining the Johore Straits where this species may dominate the catches. It also occurs but is less important on open sandy to muddy beaches where the adjoining sea-water is polyhaline rather than euhaline.

Offshore it is not found below 50 m and is rare below 20 m. Breeding sites are not found far from the shore but are beyond the immediate infra-littoral fringe at depths of 10 to 20 m ; Hall's data (1962) suggest that breeding situation at Singapore is more complex than his summary indicates : the prawn pond records indicate two breeding peaks at the monsoon changeovers but observations at the main breeding grounds on the Johore Shoals suggest a single main spawning period from August to November. Hall suggests that late maturers may delay maturity from November to the following July.

Predominantly vegetarian feeding on angiosperm debris but takes invertebrates and appears to prefer these when available (Hall, 1962).

This is a small species which rarely attains a length of 10 cm and has a poor flavour but it is of considerable local commercial importance because of its abundance and the ready accessibility of the main nursery and spawning grounds.

13. *M. dobsoni* (Miers), 1878

Hall (1962) records in small numbers from K. Sanglang and Tg. Dawai, Kedah ; W, ? Celebes.

Only in the northernmost part of the Malacca Straits ; small and rare and of no commercial importance.

14. *M. elegans* de Man, 1907

S (Hall, 1956, 1962) ; also known from off Sarawak, 33 m (Hall, 1962) ; Ceylon (fide Hall) ; Menado, Celebas (de Man, 1907).

A rare mangrove species with adults coastal between 15 and 40 m ; it is reported as one of the abundant commercial species of eastern Ceylon but this requires confirmation since it conflicts so much with experience in other areas.

15. *M. ensis* (de Haan), 1850

I am following Hall in maintaining this as distinct from *monoceros* but further investigations seem to be needed since occasional *monoceros*-like individuals are found and what appears to be *M. ensis* occurs at Ceylon* in what should be a *monoceros* area. Various marked variants are known (e.g. v. *baramensis* Hall, 1962). *M. mastersii* (Haswell) is based on this form and not on the form correctly known as *M. burkenroadi* for which Hall used the name. When immature it is difficult to distinguish this species from *M. affinis*.

S* ; Kukup* ; Muar area* ; Malacca area* ; Pt. Swettenham mangrove swamps and creeks* ; Langkawi* and Kuala Muda* ; Kedah (Leiden Museum) ; Hall (1962) records in small numbers from K. Sangland and Tg. Dawai, Kedah and Batu Maung flats, Penang and also from 8 off shore stations off Selangor and Langkawi* , mostly less than 30 miles from land and in less than 60 m, on mud bottoms. In S. China Sea area : estuaries etc. on southern coasts Johor* ; S. Sri Gading* near K. Sedili, Mersing* and Endau* estuaries, Johor ; K. Pahang* (Leiden Museum) ; Kuantan* ; lagoons and streams near Kemasek* ; mangrove swamps and lagoons at Marang* and Chendering* , Trengannu ; estuary and lagoons at K. Trengannu* ; Pasir Puteh* , Kelantan, associated with freshwater fish ; Lake Songkla and adjoining mangroves* ; lagoon south of Songkla* ; Ban Klong Sone* (Leiden Museum) ; off Sarawak, 20 to 70 m (Hall, 1962) ; Kuching estuary* ; mangrove areas, Brunei Bay* ; mouth of Brunei Bay, 37 m (Hall, 1962) ; coasts of Sabah (Chin, 1967) ; coasts of Java* (Leiden Museum) ; N, E, and presumably west to *M. monoceros* area and to Ceylon*.

Probably the most abundant penaeid and by far the most abundant species of this genus in estuarine and mangrove areas ; more frequently penetrates into low salinities than other species and may be found associated with freshwater forms in salinities at least as low as 3 pts. per thou. It probably does not penetrate into fully limnetic habitats and only very small (hence presumably young) individuals occur in the lowest salinities. The distribution suggests that the initial inland migration takes young individuals far upstream but these either fail to survive or later migrate back into mesohaline or polyhaline waters. At Singapore may form 46% of the annual prawn pond catch (Hall, 1962). It is occasionally found on open muddy to muddy-sandy beaches. Such catches are mainly of small juveniles and the species is not important in these habitats.

Appears to breed close to the shore but well beyond the immediate infralittoral fringe in depths of 20 to 50 m over mud or muddy sand ; it is probable that over most of its range there is only one breeding peak a year but at Singapore there are 2 peaks corresponding to the changeover periods of the monsoons (Hall, 1962). Size diagrams indicate that some individuals may survive for two spawning periods or alternatively have spawning delayed for six months (Hall, 1962). It appears to leave the mangrove areas before fully mature and to undergo a short period of accelerated growth in the open sea before reaching full maturity (Hall, 1962).

The food is mainly angiosperm debris but it also takes filamentous algae and diatoms and larger individuals take some polychaetes, small crustacea, etc. (Hall, 1962).

This is a large species for the genus and it may attain a length of over 15 cm but the flavour is not very good ; market value is low but it is of major commercial

importance because of its abundance, relative large size, and occurrence in easily accessible and easily fished habitats.

ensis Balss, 1914 = *intermedius* (Kishinouye).

incisipes (Bate), 1888 = *ensis* (de Haan).

16. *M. intermedius* (Kishinouye), 1900

Includes the var. *anchista* de Man, 1922.

S* ; Penang* ; near coast, N. of Phuket, 33 m mud (Hall, 1962) ; probably more widespread but easily missed in ordinary collecting for penaeids. In S. China Sea area : Gulf of Thailand coasts* and L. Songkla* (Leiden Museum) ; commercial catches off K. Trenggannu, one only* ; 4 stations in south-western portion of S. China Sea, 31 to 62 m and off mouth of Brunei Bay, 37 m (Hall, 1962) ; large specimens exceeding 15 cm in commercial catches from south-western S. China Sea* ; Andamans (Alcock, 1906) and N.

May be found in almost any littoral habitat from mangroves through to rocky beaches and reef flats. It is the only species apart from *Heteropeneaus longimanus* commonly found in the latter habitat. In all habitats numbers are usually only small to moderate. The offshore records show a similar catholicity with individuals occurring on all types of bottom in depths of from 2 to over 80 m but mature individuals and large juveniles are uncommon close inshore. The breeding grounds are uncertain but are probably in rather deep water well away from land.

This species is mainly carnivorous with smaller specimens taking small crustaceans and larger specimens a mixed diet of polychaetes, various crustaceans, and perhaps fish (Hall, 1962).

This is a large species which reaches about 20 cm in length when full-grown ; the flavour is superior to that of most species of the genus ; currently it is of little importance because of the scattered nature of the inshore populations but the importance is increasing with the increase in trawler fishing.

17. *M. lysianassa* (de Man), 1887

Includes var. *malaccensis* Hall, 1962.

S* ; Kukup area* ; near Pt. Swettenham* ; Malacca* (Hall, 1962) ; K. Sanglang* and Batu Maung flats* where it forms 6.4% of the catch (Hall, 1962) ; close to Selangor Coast, 22 m (Hall, 1962) ; Bagan Si-api-api, Sumatra de Man 1924). In S. China Sea area : estuaries and creeks in Mersing area* , Johor ; Kemasek* , Trengannu (Leiden Museum) ; Pasir Puteh* , Kelantan, associated with freshwater fish ; 2 localities off east coast of Peninsular Thailand* (Leiden Museum) ; off western corner of Sarawak, 33 m, one only (Hall, 1962) ; W.

Occurs in small numbers in estuaries and mangrove creeks and penetrates into the oligohaline zone but is commoner at higher salinities. At Singapore it forms just over 1% of annual prawn pond catch (Hall, 1962). It is much more abundant on open muddy or muddy-sandy beaches where it penetrates into intertidal pools and is sometimes the dominant species of the infra-littoral fringe ; in sung dong

net catches off such coasts it is usually second to *M. affinis* in numbers but much less important in terms of biomass. It does not occur far from the shore and off-shore records are usually over mud in less than 30 m but Hall (1956) records a single individual in surface plankton above a depth of 90 m. Breeds very close to the shore in depths of less than 10 m.

This is a small species mature at 5 to 6 cm and of inferior flavour. Thus it is only of slight commercial importance despite its abundance.

mastersii (Haswell), 1879 = *ensis* (de Haan)

mastersii Hall, 1961 = *burkenroadi* Kubo

monoceros (Fabricius), 1798 See comment under *M. ensis*.

necopinans Hall, 1956 = *affinis* (H. M. Edwds).

singaporensis Hall, 1956 = *elegans* de Man.

spinulatus Kubo, 1949 = *tenuipes* Kupe, 1949.

18. *M. tenuipes* Kubo, 1949

This species is better known under the name *M. spinulatus*; it was formerly confused with *M. brevicornis*.

S (Hall, 1956, 1961, 1962); K. Jalan Bahru, Penang* (Leiden Museum); east coast of Sumatra (de Man, 1924); also known from S. E. Thailand (Kemp 1918); Bangkok (Kubo, 1949), 2 stations off western Sarawak on sand at about 30 m (Hall, 1962), and Java (de Man, 1924).

Appears to be a rare species with a very restricted range but has perhaps been overlooked. Onshore records are all from mangrove or brackish areas but it is certainly rare in such habitats.

There is no known commercial importance but it may form a small part of the 'yellow prawn' catch (see *M. brevicornis*).

Parapenaeus S. I. Smith, 1885

19. *P. fissurus* (Bate), 1881

N. E. of Diamond Head, Sumatra, 86 m, mud (Hall, 1962); Hall also reports it from no less than 14 stations on the outer shelf of the S. China Sea to the N and E of the Natuna Is. on various bottoms at depths of 99 to 121 m. The species thus appears to be a regular inhabitant of nearly flat areas on the outer shelf at depths of more than 80 m. Commercially exploitable concentrations have not yet been reported.

It is possible that other species of this genus may yet be found at the shelf edge but it is most unlikely that any will prove to be of commercial importance.

Parapeneopsis Wood-Mason in Alcock, 1901

affinis Hall, 1962 not *Penaeus affinis* H. M. Edwds, 1837 = *sculptilis* Heller, 1868.

aroensis Hall, 1962

[10]

A doubtfully valid species based on a single female from the central area of the Malacca Straits (Hall, 1962) which may merely be a monstrous individual of *P. hardwickii*.

cornuta (Kishinouye), 1900

I am not in a position to decide on the difficult general question of the identity or otherwise of this species with *P. maxillipedo* but feel that it is best, for the present, to follow Hall (1956) in assigning all local specimens to the latter species.

cultrirostris Alcock, 1906

The exact identity of this form can only be determined after a re-examination of Alcock's material. In the meanwhile I follow Hall (1962) in synonymizing it with *P. hardwickii*.

dofleini Balss, 1913 = *gracillima* Nobili

20. *P. gracillima* Nobili, 1903

S* ; close to Selangor Coast, 22 m, mud and centrally off Selangor, 48 m, mud/sand, single specimens (Hall, 1962) ; off P. Ketam, Selangor*, one male (Leiden Museum) ; also known from off north-western Sumatra about 30 m, sand, at 2 stations in fair numbers (Hall, 1962) and off south coast of Borneo (Nobili, 1903).

An uncommon coastal species apparently restricted to the central Sundanian area at depths between 20 and 90 m ; small ; of no commercial importance.

21. *P. hardwickii* (Miers), 1878

Includes *P. cultrirostris* Alcock as interpreted by Hall.

S* ; Hall (1962) records from Malacca* and from Batu Maung flats where it forms 42.1% of the catch ; P. Ketam*, Selangor, Tg. Bruas*, Perak, K. Jalan Bahru*, Penang, and K. Sanglang*, Kedah (Leiden Museum) ; offshore reported from close to Selangor Coast and at 6 stations in central straits off Selangor on various bottoms at depths of 22 to 62 m (Hall, 1962) ; Commercial catches from area south off Langkawi*. In S. China Sea area from : 2 stations off Sarawak, 20 and 33 m (Hall, 1962) ; Kemasek, Trengannu* (Leiden Museum) ; extreme mouth of Trengannu estuary* ; commercial catches off K. Trengannu* ; commercial catches in S. W. portion of S. China Sea* ; W and N.

Juveniles and small males are not uncommon in infralittoral fringes of sandy and muddy-sandy beaches on open coasts ; fully mature males and females occur further offshore but within about 30 miles of the coast in depths of 20 to at least 90 m, usually over clean bottoms.

Apparently mature males occur in two forms, one with a cultrate rostrum and one with an ordinary rostrum resembling that of juveniles and females. The transition bears no simple relationship to size since some large males still retain the juvenile rostral form. The species also show a very pronounced sexual size dimorphism with mature females about twice the size of mature males. Females also appear to be less common than males. These facts strongly suggest that the species may show protandrous hermaphroditism of the type which is now well-known in *Pandalus* spp.

Evidently the phenomenon is worth a more carefully investigation especially since other species of the genus show similar patterns of sexual dimorphism.

Evidence from Singapore, Penang, and commercial catches suggests that spawning occurs fairly close to shore but in rather deep water, probably commonly at over 60 m. In the Singapore area there are two main spawning peaks corresponding to those of *Metapenaeus* spp. but at Penang, again as in *Metapenaeus*, there is one main season during the S. W. monsoon (Hall 1962). At Kuala, T, Trengannu there is also only one main spawning period, during April/May, when the species dominates the commercial catches.

Mature males are small, about 6 to 7 cm long, but mature females may exceed 13 cm. In markets such as that at Kuala Trengannu the sexes are separated before sale and the females fetch a much higher price. The flavour of this and other species of the genus is excellent and they are beginning to be widely used in restaurants. Hall (1962) has suggested that these species should be of relatively low value because of the high carapace/abdomen ratio and the thick exoskeleton. These disadvantages are more than offset by good flavour, firm flesh, and good keeping qualities so that females of above 10 cm find a ready market at good prices not merely in small towns but to the catering trade in large cities.

The food, at least at Penang is mainly small protobranch molluscs, crustaceans, and polychaetes.

A few years ago this species was of little commercial importance but the importance is already moderate and it is steadily increasing with the switch to offshore fishing. In a few areas, as at Trengannu, it is a mainstay of the local catch.

22. *P. hungerfordi* Alcock, 1907

S (Hall, 1962); Batu Maung flats, Penang where it forms 12.4% of the catch (Hall, 1962); K. Panchor*, Perak, K. Sanglang* and K. Muda*, Kedah (Leiden Museum); also known from L. Songkla* (and Leiden Museum*), Ban Klong Sone*, Thailand (Leiden Museum), and Java Sea; N.

On limited evidence it appears to be a continually breeding non-migratory species living on shallow flats close to the shore but with a centre just beyond the immediate infra-littoral fringe; at Singapore it has been found at a depth of over 30 m but only at the edge of such a shallow area.

This species is similar in size to *P. hardwickii* and shows a similar sexual dimorphism in size with the maximum size of the female perhaps slightly less. It is not of any great commercial importance.

23. *P. maxillipede* Alcock, 1906

I am provisionally maintaining this as distinct from *P. cornuta*. As found in the Sundanian area the species is, however, exceedingly variable and the complex clearly needs further study.

S*; reported by Hall (1962) from Malacca* and the Batu Maung flats, Penang, also off the mouth of the Perak at 44 m on a clean bottom. Elsewhere occurs: in small quantities amongst commercial prawn catches at Songkhla* and Kuala Trengannu*; 2 stations off Sarawak at 20 and 33 m (Hall, 1962); Bezuki, Java* (Leiden Museum); south coast of Borneo (Kubo, 1949); W.

At Singapore at least abundant in infra-littoral fringe of open muddy-sand to sandy-mud beaches and may extend in pools into the tidal zone. Not found in estuaries or lagoons. Few specimens are taken off shore but these collections contain most really large individuals; males from beaches though small appear to be mature and it is possible that breeding occurs in the infra-littoral fringe but against this large females of up to 11cm are scarcely known except from scattered off-shore records in depths of up to 44 m; this indicates the probable existence of as yet unknown off-shore breeding or at least spawning grounds.

Despite its abundance on suitable coasts the species is currently of little importance since the individuals are normally small or very small in size.

24. *P. probata* Hall, 1961

This species closely resembles *P. uncta* and it is just possible that it is a sub-species of that form.

S (Hall, 1961, 1962); 2 stations off mouth of Perak River on sand at 44 m and 51 m (Hall, 1962); also in commercial catches from S.W. portion of S. China Sea. If a subspecies of *P. uncta*, extends to W.

An off-shore species occurring between 44 m and (at least) 82 m but with most records from below 70 m; nonetheless not found far from shore; not very common.

Large females exceed 15 cm in length and the flavour is good but the importance of the species is small since it only contributed a small fraction of the catch of large individuals of *Parapeneopsis* spp.

25. *P. sculptilis* (Heller), 1868

Unfortunately Hall's use of the name *P. affinis* for this species is not acceptable (see under *Metapenaeus affinis*).

Not at S (records by Kubo, 1949 and Hall, 1961 are based on material of doubtful origin and probably not even from the immediate vicinity of Singapore). Batu Maung flats, Penang where it forms 10.8% of the catch and Tg. Dawai, Kedah (Hall, 1962); P. ketam*, Selanger, Tg. Bruas*, Perak, K. Jalan Bahru*, Penang, and K. K. Muda*, Kedah (Leiden Museum); close to Selangor coast, 22 m, mud (Hall, 1962); also at Java* (Leiden Museum) but so far no other Sundanian records; W, N, E.

This species shows a coastal-oceanic pattern of distribution such as is found in a number of other decapod crustaceans (Johnson, 1961, 1966) and it is either absent or very rare in the southern Malacca Straits, the western Java Sea, and the southwestern S. China Sea.

This species shows a similar pattern of sexual size and form dimorphism to that found in *P. hardwickii* and it should also be investigated from the viewpoint of possible protandrous hermaphroditism. The breeding biology in the Penang area probably involves deep water breeding during the S.W. Monsoon (Hall, 1962).

At Penang a mixed invertebrate feeder taking protobranch bivalves, polychaetes, various crustaceans, and perhaps some fish (Hall, 1962).

This is a very large species with males attaining to over 10 cm and females ranging from this size to nearly 20 cm ; the flavour is excellent and for this reason large females fetch a high price despite their 'shelliness' ; the present commercial importance is slight but is likely to increase and the species may well prove to be an important asset in the northern part of the Malacca Straits.

26. *P. stylifera** (H. M. Edwards), 1837

Hall treats the eastern form as a separate species, *P. coromandelica* Alcock, 1906, but the differences are slight and I follow the consensus in not separating the two forms.

N. of K. Muda, Kedah, 1 m, mud, K. Sanglang*, Kedah, 1 m, mud, in large numbers, and Batu Maung flats, Penang where it forms 4.3% of the catch (Hall, 1962) ; K. Jalan Bahru*, Penang and K. Pancher*, Perak (Leiden Museum) ; also W.

The above records represent the extreme S.E. limits of the known distribution ; the local range is apparently restricted to the northern part of the straits with nursery grounds in very shallow water near the coast ; Hall (1962) suggests breeding on an undiscovered off-shore deep water ground with one seasonal peak a year and the possibility that some individuals survive for more than 2 years.

The data given by Hall suggest a similar size range and size dimorphism to that found in *P. hardwickii*. The commercial importance is moderate within the restricted area of occurrence.

27. *P. tenella* (Bate), 1888

S* ; Batu Maung flats where it forms 9% of catch and also off eastern Sarawak at 20 m (Hall, 1962) ; Ceylon*, M, E.

Seldom found in the littoral zone and not normally in brackish water but I have seen one specimen taken in a prawn pond ; on various bottoms at 10 m (? less at Penang) to 91 m ; at Singapore probably breeds in depths of over 30m whilst at Penang breeding probably resembles that of *P. hardwickii* (Hall, 1962).

This is a very small species with size dimorphism poorly developed ; males mature at about 2.5 cm and mature females range from about this size to somewhat more than 5 cm. The species is of no commercial importance.

uncta Alcock, 1905 See *P. probata*.

28. *P. venusta* de Man, 1907

S* ; also at Aru Is. (de Man, 1911) and near Cape York (Dall, 1957).

At Singapore appears to be a rare species occurring on clean to rocky bottoms with most specimens taken at 91 m but occasionally specimens in shallower water to as little as 11 m ; feeds on invertebrates (Hall, 1962) ; of no commercial importance.

Pennaeus Fabricius, 1798

The most important genus commercially and including several of the commonest species. Thin exoskeleton, good flavour, large size, and accessibility all contribute to the commercial value of several species.

bubulus Kubo, 1949 = *monodon* Fabricius

29. *P. indicus* H. M. Edwards, 1837

Easily confused with *P. merguensis* and it is doubtful if young specimens are always separable.

S* ; Mukup* ; Kalacca* ; Pt. Dickson* ; Pt. Swettenham* ; off Kukup, 29 m, mud (Hall, 1962) ; probably general in mangrove areas on both sides of the straits ; also known from : various localities in S. and E. Johor* ; kelong off Mersing* , Johore* ; trawling grounds to east of Johor* ; where may be important in commercial catches ; commercial catches in lagoons and estuaries, Kuala Trengannu* ; L. Songkla and adjoining mangroves* and commercial catches at Songkla* ; commercial catches from Gulf of Thailand* ; Kuching area, Sarawak* ; mangrove swamps in Brunei Bay* ; Sabah coasts* (Chin, 1967) ; west coast of Sumatra* ; Java* etc. ; W, N, E.

Not common on open beaches even where the water is polyhaline and the beach fronts on to a narrow arm of the sea but post-larvae* and young* may occur especially in pools and amongst *Enhalus* beds ; often abundant in estuaries, mangrove creeks, prawn ponds etc. in polyhaline to mesohaline water ; at Singapore it is commercially the most important prawn pond species (Tham, 1968a) ; according to Hall (1962) in terms of numbers sometimes the dominant species and over the whole year the second most abundant, forming over 25% of the catch.

Breeds offshore where it appears to congregate on restricted breeding grounds often many miles from the nursery areas ; Hall (1962) predicted that the Singapore stock bred in two areas off eastern Johor in depths of 20-40 fms. Subsequent collecting and commercial experience has confirmed the existence of the northern ground extending up towards Mersing but the southern is still uncertain. Everywhere appears to breed throughout the year but with a single main breeding peak which occurs at Singapore from February to April (Hall, 1962).

This is more of a brackish water species than is *P. merguensis* and tends to be the dominant species on wet coasts with extensive brackish habitats. Thus in general it is likely to predominate in interior areas of extensive systems of shallow seas where the rainfall is high.

The young feed mainly on angiosperm debris with some filamentous algae, copepods etc. but larger individuals also take much crustacean material including other prawns (Hall, 1962) ; feeds avidly on the mysid *Mesopodopsis orientalis* when this is present in large numbers.

This is a large species which may exceed 20 cm though commercially caught individuals are usually much smaller ; because of its fine flavour it fetches a higher price, size for size than any species apart from *P. merguensis*. Almost certainly

the most important commercial species in this area and at least potentially the most important commercial prawn in the Indo-West Pacific if not in the entire world.

Common names : Where distinction from other species is needed this species shares the names of udang pisang and banana prawn with *P. merguensis*. The name Indian prawn is sometimes used but is not a true vernacular name in the area.

30. *P. japonicus* Bate, 1888

Not at S. (off) Pt. Dickson* (Leiden Museum); on clean to rocky bottoms S.W. of Pangkor and over 20 miles from land at about 50 m (Hall, 1962); also at : Bengkalis, Sumatra* and Java Sea* (Leiden Museum); W, N, E.

An uncommon off-shore prawn of rather small size and inferior flavour which is of no commercial importance locally. This prawn is cultured in Japan but it is not a suitable candidate for culture in areas where better species are found.

31. *P. latisulcatus* Kishinouye, 1900

S* ; beaches near Malacca* ; off mouth of Perak River, ? sand, 44 m (Hall, 1962); Belawan Deli* and P. Weh*, Sumatra (Leiden Museum); also at : off western Sumatra, one (Hall, 1962); Surabaya* (Leiden Museum); W, N, E.

Occurs regularly but usually in small numbers on sandy beaches away from estuaries; occasional off-shore to depths of 50 m; more diurnal than most species of the family; rather small, maturing at 12 cm; rather shelly and not especially well flavoured; commercially negligible in this area as elsewhere wherever other prawns are available in numbers.

32. *P. merguensis* de Man, 1888

See note on *P. indicus*.

S* ; Off Selangor close to shore and to 51 m, mud* (Hall, 1962); Tg. Bruas*, Perak (Leiden Museum); P. Kendis*, Penang (Leiden Museum); Kuala Muda*, Kedah (Hall, 1962; Leiden Museum); 4 localities along Kedah coast including Merbok estuary where a commercial fishery exploits migrating prawns, and off Kuala Kedah (Hall, 1962). Also at : Sabah (Chin, 1967); Brunei Bay*; Sarawak coasts*; Kuala Pahang* (Leiden Museum); Chendering near K. Trengannu* (Leiden Museum); Mouth of Trengannu river* (also Leiden Museum); Bachok, Kelantan* (Leiden Museum); Gulf of Thailand* (Leiden Museum). Specimens reported as this species from L. Songkla, examined by me proved to be *P. indicus*; W, N, E.

The overall range is less extensive than that of *P. indicus*. Where both species are found *P. merguensis* tends to predominate in areas where the salinity of the sea water is higher so that the distribution is more oceanic. In the Singapore area it is rarer than *P. indicus* and less of a mangrove species. In other respects the biology of the two forms appears to be very similar. Conforming with this pattern *P. merguensis* tends to predominate in the northern Malacca straits as it does off Sabah but is absent or rare in the southern part of the straits.

This is probably the best flavoured of all marine prawns though some prefer the more 'prawny' flavour of *P. monodon* and *P. semisulcatus*. Size for size it fetches higher prices than any other local species (Tham, 1968a). The size is similar to that of *P. indicus* but large specimens exceeding 20 cm are somewhat more common. In the area it ranks second to *P. indicus* as a commercial prawn.

Common names : large specimens are distinguished as udang pisang or banana prawn but small specimens are not specially named.

33. *P. monodon** Fabricius, 1798

The neotype was designated by Holthuis (1949). Older records of this species and its varieties often refer to *P. semisulcatus*.

S* ; central straits off Selangor, 40 m, mud/sand and off P. langkawi, 51m, mud, total 3 specimens (Hall, 1962) ; *P. Kendi** and K. Jalan Bahru*, Penang, and E. Coast of Sumatra* (Leiden Museum) ; commercial catches from Pt. Swettenham* and ? Perak estuary*. Also at : Sabah (Chin, 1967) ; Brunei Bay (verbal report) ; Sarawak coasts* ; off Sarawak, 29 m, sand (Hall, 1962) ; S. China Sea to east of Singapore Straits, 62 m, mud* ; Kuala Pahang* and coasts of Gulf of Thailand* (Leiden Museum) ; Cambodia* (Tham, 1968b) ; W, N, E.

The growing stages appear to be more thoroughly restricted to estuarine and mangrove environments than are those of other species. Individuals are occasionally taken in kelong catches but otherwise the species is seldom taken in shallow water on open coasts ; however, occasional adults are taken from deep water.

The local breeding biology is far from clear and there is little evidence to support Hall's view that it resembles *P. indius* in this respect. The breeding is clearly offshore and probably as in the Philippines (Caces-Borja and Rasalam, 1968) it is year round with one main seasonal breeding peak. It does not appear to use the *P. indicus* ground and perhaps breeds in rather deeper water.

Large specimens are predominantly carnivorous feeding predominantly on other prawns and crabs (Hall, 1962) ; small specimens are presumably more vegetarian.

This is a very large species which attains a length of over 25 cms. The flavour is less fine than that of *P. merguensis* or *P. indicus* and the flesh is a little 'tough' but still excellent eating and large specimens fetch very high prices. The Philippine form of culture is not carried out locally and other species are more likely to prove desirable as culture prawns. It is of considerable commercial importance despite low relative abundance.

Common names : udang harimau, udang harimau besar, giant tiger prawn, king sized prawn.

34. *P. penicillatus* Alcock, 1905

S (Hall, 1962) ; close to shore off Kedah and Penang, 3 only (Hall, 1962) ; P. Ketam*, Selangor, Tg. Bruas*, Perak, K. Jalan Bahru*, Penang (Leiden Museum) ; in fairly large numbers at six stations in central straits off Selangor, 40-62 m, mud or partly mud (Hall, 1962) ; also at : Surabaya (Kubo, 1949) ; W and N.

Mainly an off-shore species which seldom enters brackish areas; Hall's records strongly suggest a minor concentration in the central part of the Malacca straits. The localized occurrence in rather deep water means that the present importance is slight.

35. *P. semisulcatus* de Haan, 1950

In older literature often subsumes under *P. monodon* or a variety of that species.

S* ; Pontian Kechil* ; Malacca area* ; Batu Maung flats, Penang, 3 only (Hall, 1962) ; K. Kedah* and K. Muda* , Kedah (Leiden Museum) ; E. coast of Sumatra (Leiden Museum) ; 12 stations from central straits north to Phuket, 20-73 m (Hall, 1962) ; also at : Mersing area* ; K. Pahang* (Leiden Museum) ; Kemaman area* ; Kemasek* (Leiden Museum) ; Telok Chendering* (also Leiden Museum) ; Bachok* , Kelantan (Leiden Museum) ; off northern Sarawak and Brunei Bay, 20 and 37 m (Hall, 1962) ; Sabah (Chin, 1967) ; W, N, E.

Specimens can usually be found amongst commercial catches taken by beach seine from any open beach and it appears to be common in the infra-littoral fringe of sandy or muddy beaches ; small specimens occur in beach pools ; uncommon in mangrove or estuarine areas ; at Singapore forms less than 0.2% of catch from prawn ponds (Hall, 1962) ; rather common offshore on various bottoms but especially mud at depths of less than 10 to over 70 m ; generally more important in drier areas and less so in areas with extensive mangrove swamps.

Hall (1962) suggested that the breeding biology was similar to that of *P. indicus* but this has not been fully confirmed by recent collecting and the relative frequent occurrence of large specimens close to the shore may indicate breeding closer to the nursery range.

This species is more diurnal than are most penaeids. Large specimens are carnivorous taking mysids and other large crustaceans (Hall, 1962).

Some rank the flavour of this prawn very high but local preference is for other species so that size for size it is the least valued of the commonly exploited species (Tham, 1968a) ; this is offset by the large size of mature specimens which gives them a disproportionately high market value since the larger the prawn the higher the price per unit weight. Large specimens considerably exceed 20 cm and it attains a relatively large size whilst still close to the shore and thus is of major commercial importance.

Common names : udang harimau, green tiger prawn ; smaller specimens are often pale and sold as udang puteh or white prawn.

semisulcatus Alcock, 1906 = *monodon* Fabricius.

Additional species : In addition to the above species 2 or 3 others may yet occur marginally. *P. longistylus* Kubo, 1943 occurs on the outer shelf of the S. China Sea and might yet be found in the deep water at the northern end of the Malacca straits ; *P. jejunus* Hall, 1956 based on a specimen of doubtful provenance may prove to be a synonym of the last or may be distinct ; *P. esculentus* Haswell, 1879 is said to occur off northern Sabah but is not listed by Chin (1967) and is somewhat unlikely to occur in the present area.

Trachypeneus Alcock, 1901*asper* Alcock, 1905=*curvirostris* (Stimpson)*asper* Kubo, 1959=*fulvus* Dall36. *T. curvirostris* (Stimpson), 1860

S* ; at eight stations from central straits of Selangor to Langkawi and N.E. of Diamond Head, Sumatra, at 44 to 86 m (Hall, 1962) ; Hall also reports from east of Singapore Straits, 62 m ; between Borneo and Lingga, 37 m ; mouth of Brunei Bay, 37 m ; and 7 stations on outer shelf off S. China Sea east of Natuna at depths of 64 to 115 m ; W, N, E.

Predominantly an offshore species occurring at depths of over 40 m but at Singapore has been taken at 10 m (Hall, 1962) and even less than 5 m*. Similar occurrence in shallow water has been reported from Bombay (Kunju, 1960).

The food consists of small crustaceans and polychaetes (Hall, 1962). This is a rather small species which is distinctly shelly and seldom exceeds 10 cms. It is thus of negligible commercial importance.

37. *T. fulvus* Dall, 1957

S (Hall, 1961, 1962) ; Batu Maung flats, Penang in small numbers and off Selangor at 53 m, one only (Hall, 1962). Also at : Kemasek* (Leiden Museum) ; commercial catches from off K. Trengannu* , one only ; Lake Songkla* (Leiden Museum) ; east coast of Peninsular Thailand* (Leiden Museum) ; Sabah (Chin, 1967) ; S. coast of Borneo (Kubo, 1949) ; E.

This is much more of an inshore species than *T. curvirostris* and is often taken in depths of less than 20 m but has not been found at over 70 m ; Hall (1962) records a casual single specimen from a prawn pond ; fair numbers appear to be present in 'manure fish' catches from outer Lake Songkla* ; Hall (1962) claims breeding at Singapore on extensive shoal area at about 10 m depth in August/November ; feeds on bivalves, crustaceans, polychaetes (Hall, 1962).

This is a small and shelly species which probably never exceeds 10 cm ; Tham (1968b) includes it in his list of Malaysian commercial species but its importance is very little.

furcilla Hall, 1961=*salaco* de Man, 1907*granulosus* Hall, 1961 not (Haswell), 1879=*salaco* de Man ?

pescadoreensis Schmitt, 1931 Contrary to Hall I can find no good grounds for separating this form from *salaco* de Man.

38. *T. salaco* de Man, 1907

Includes the three forms just listed.

S* ; five stations in central Malacca Straits off Selangor and Perak River, 37 to 53 m (Hall, 1962). Also at : two stations to east of Singapore Straits, two between

Borneo and Lingga, 2 off western Sarawak, and mouth of Brunei Bay in depths of 31 to 64 m Hall, 1962 ; Ceylon* (Leiden Museum), N. E.

Occurs mainly between 20 and 60 m but with full range 10 to 91 m on various bottoms but mainly mud ; small, shelly and of negligible importance.

39. *T. sedili* Hall, 1961

S (Hall, 1961) ; three localities off mouth of Perak River, 44 to 51 m (Hall, 1962) ; Ceylon* (Leiden Museum).

Occurs on sandy or rocky bottoms ; small, shelly and of no commercial importance.

Other Penaeinae

It is possible that *Trachypenaeopsis richtersii** (Miers), 1884 may be found in future since it occurs at Nhatrang* (Leiden Museum). One or both of the two species of *Miyadiella* might occur at the shelf edge at the northern end of the Malacca straits.

Subfamily : Sicyoniinae

No local species is of any actual or potential economic importance. Only one genus occurs on the shelf.

*Sicyonia** H. M. Edwards, 1830

40. *S. lancifer* (Olivier), 1811

Penang* (Lanchester, 1901 ; Hall, 1962) a single specimen ; W, N, E, with a distinctly 'oceanic' pattern of distribution.

41. *S. ommameyi* Hall, 1961

S* at depths of 22 to 91 m (Hall, 1961) ; unknown elsewhere.

42. *S. parvula* de Haan, 1849

S, one only (Hall, 1962) ; N, E, rare.

Additional species : *S. ocellata* Stimpson, 1860, reported from the general Sundanian area (Kubo, 1949) may occur.

Subfamily : Solenocerinae

Only one species is of any local importance.

*Solenocera** Lucas, 1850

43. *S. alticarinata* Kubo, 1949

Reported by Hall (1962) from 2 stations at northern end of Malacca Straits on mud at 75 and 86 m ; also from 5 stations on outer shelf of S. China Sea to N. and N.E. of Natunas on mud to rock at 102-121 m.

44. *S. bedokensis* Hall, 1962

S*, one only ; Ceylon* (Leiden Museum) ; E (de Man, 1911)

depressa Kubo, 1949=*melanthero* de Man.

kuboi Hall, 1956=*subnuda* Kubo, 1949

45. *S. melanthero* de Man, 1907

At three stations in central Malacca straits off Selangor, 48 to 55 m and west of Langkawi, 75 m, on various bottoms (Hall, 1962) ; also at over 60 miles north of Sarawak coast, 60 m, mud (Hall, 1962) ; N, E. ; never close to coast.

46. *S. spinajugo* Hall, 1961

West of Langkawi, 75 m, mud (Hall, 1962). The only known specimen.

47. *S. subnuda* Kubo, 1949

Includes *S. kuboi* Hall.

S* ; Batu Maung flats where it forms 5.2% of catch (Hall, 1962) ; P. Ketam, Selangor* (Leiden Museum) ; close to shore at 45 to 80 m*, Sembilan Is.*, Perak ; Tg. Bruas*, Perak (Leiden Museum) ; three stations in central straits off Selangor, 37 to 45 m (Hall, 1962) ; also at : Kemasek*, Trengganu (Leiden Museum) ; two stations off western Sarawak, 29 and 33 m (Hall, 1962) ; south coast of Borneo (Kubo, 1949) ; Ceylon* (Leiden Museum), N.

Never found far from land and not certainly from depths of more than 50 m in moderate to moderately large numbers ; an invertebrate feeder taking some vegetable matter (Hall, 1962). The females are slightly larger than the male and attain about 10 cm. The 'head' is large. The commercial importance is very slight.

Additional species : *S. pectinata* (Bate), 1888 occurs on the outer shelf of the S. China Sea (Hall, 1962).

No other member of this subfamily is likely to occur since the other species are deep water forms. The shallow water record for *Hymenopenaeus propinquus* (de Man), 1911 to the east of Borneo along with other deep water prawns must surely involve some locality error.

Family : Sergestidae

The type genus does not occur on the continental shelf and the record of *Sergestes challengerii* Hansen from 11 m to the east of Borneo must surely involve a locality error.

Acetes H. Milne-Edwards, 1830

The members of this genus are abundant small prawns of shallow waters, treated locally under the commercial classification of udang baring with a recorded catch

of the order of 6 kilotons per annum. Until recently the taxonomy was in utter chaos and the only up-to-date published account is a very brief review by Pathansali (1966). Many of the difficulties have been removed by the work of Mr. C. C. W. Leong but unfortunately this work has not been published as yet though available in manuscript form in the University of Singapore.

On occasion individuals occur in vast swarms, sometimes in very shallow water. The swarms appear to be somewhat nomadic. A swarm may be monospecific or consist of several species; it may be an apparent breeding aggregation or consist partly or entirely of immature individuals. The occurrence of large swarms in any given area is usually predictable so that the main fishery can often be concentrated in a small area over a short period of the year. Though of very small size these prawns have a large abdomen and a good flavour. The exoskeleton is very delicate. Thus they are of considerable commercial importance.

Large specimens are sold fresh or dried and may be fried or eaten whole mixed in with egg or embedded in cakes made of a batter-like preparation. Smaller specimens are converted into a variety of prawn preparation. These include: Belachan, a savoury prawn paste; petis udang, a black and slightly sweet prawn paste which can be used in soups or eaten as a spread on bread; sambal, a very hot preparation/used as a spice in Indonesia and Holland; sambal udang kering, a rather mild sambal based on minced prawns and eaten with curries; trassi udang, a dry prawn cake which is crumbled and sprinkled on curries etc.; chenchalok, made especially around Malacca, a type of pickle based on whole prawns; and keropek udang or prawn crackers. Surplus prawns are used in the preparation of animal or fish foods, fed to poultry, or converted into prawn dust for use as fertilizer.

No separate statistics are kept locally except in West Malaysia where the catch is listed under the name udang baring, a term which, however, is not understood even in neighbouring parts of Indonesia. The common 'English' vernacular name is belachan shrimp.

The species are not easily separated as adults and very difficult to separate as juveniles. Available evidence indicates that the species differ in distribution and abundance but not enough is known as yet to assess these accurately. Probably all are of some importance but the more planktonic *A. serrulatus* is perhaps less so than the rest, whilst both *A. sibogae* and *A. vulgaris* appear to be localized, and *A. erythraeus* (the most important species on the east coast of the Malay Peninsula) appears to be absent from the main part of the Malacca Straits.

dispar Hansen, 1919. I follow the consensus in equating this species with *A. japonicus* but with reservations since the synonymy appears unlikely on distributional grounds. Pathansali (1966) merely states that the two forms are 'remarkably similar'. Clearly a more thorough comparison taking into account a greater number of characters is desirable.

48. *S. erythraeus* Nobili, 1905

S* (Pathansali, 1966; Tham, 1950, 1954); also at Kuala Trengannu (Pathansali, 1966); Telok Chendering, April 1969, vast swarms over sand in 0-2 m*; Sengkla* (also Leiden Museum); Rayong*, Thailand (Leiden Museum); W, eastern Indonesia.

On infra-littoral fringe of open beaches ; much less abundant at Singapore than at Trengganu. Pathansali's record refers to a similar breeding swarm to that reported here and it is likely that his material was from this locality. Breeding individuals occur all along the neighbouring coasts but the massive swarms are confined to this small sheltered bay where they appear regularly and reach a peak in late April and May. Small hand nets in a few inches of water can easily yield a catch of over 2 kilogrammes per person per hour and the swarms are collected commercially by local fishermen. They also attract large numbers of fish and these in turn attract sea-eagles, six of which were circling the site during my visit.

erythraeus Kemp, 1917. The Penang record for this species should be assigned to *A. sibogae* (Pathansali, 1966).

49. *S. indicus** H. M. Edwards, 1830

The description is totally inadequate and could apply to several species. I follow the consensus in using it for the species which was better described by Hansen under the name *A. spiniger*. Clearly, however, the type should be re-examined and re-described if this is possible.

S* ; (Wickstead, 1961 ; Tham, 1968b), common but seasonal ; near Malacca* and Perak coast (Pathansali, 1966) seasonal ; Kukup/Pontian area* ; Bagan Siapiapi, Sumatra* (Leiden Museum) ; commercial catches from Malaysia (Tham, 1968b) ; Indo-Chinese seas and Surabaya (Hansen, 1919) ; W.

Occurs seasonally in large breeding swarms which tend to be centred in depths of several metres with only stragglers appearing on beaches ; swarms occur at Singapore in September, at Malacca in October, and off Perak in November.

insularis Kemp, 1917=*serrulatus* Kroyer.

50. *A. japonicus* Kishinouye, 1905

See under *A. dispar* to which species the present records should be assigned should the two forms prove to be distinct.

S* (Tham, 1950, 1954 ; Pathansali, 1966) ; Glugor and Batu Maung flats, Penang, present most of the year, and K. Tg. Dawai, Kedah (Pathansali, 1966) ; K. Sanglang*, Kedah (Leiden Museum). Also at : Malaysia, commercial catches (Tham, 1968b) ; Johor, commercial catches* ; Lem Ngob, Thailand (Hansen, 1919) ; Ban Klong Sone*, near Rayong*, and Chantaburi*, Thailand (Leiden Museum) ; Cheribon, Java (Hansen, 1919) ; Japan region.

A regular inhabitant of shallow water where it may be dominant as at Batu Maung or relatively rare as at Singapore ; seldom in mangroves but I have collected it in a mangrove creek at Singapore ; a very small species which may mature at 12 mm and seldom exceeds 22 mm.

51. *S. serrulatus* Kroyer, 1859

Includes var. *johni* of Nataraj, 1947. A very distinct species both in form and preferred habitat.

S* (Tham, 1950, 1954 ; Pathansali, 1966 ; Wickstead, 1961) ; certainly present in the southern part of Malacca Straits* but detailed information on distribution lacking. Also at : Malaysia, commercial catches (Tham, 1968b), off mouth of Kajang River, Sarawak, young (Wickstead, 1961).

Large specimens are occasionally caught close to the shore and even in the infra-littoral fringe but this is mainly an offshore species occurring in depths of 20 to 90 m ; the adults are partially planktonic and the young are fully planktonic and may be an important element in plankton taken close to the surface. This is usually a very small species with mature individuals from 12 to 20 mm in length but occasional specimens attain 30 mm ; the commercial importance is very slight.

S. spiniger Hansen, 1919 See under *A. indicus* H. M. Edwds.

52. *S. sibogae* Hansen, 1919

Includes Kemp's (1917) material from Penang which is named *A. erythraeus* (Pathansali, 1966). The species is very close to *A. vulgaris* but small morphological differences can be established and these are supported by ecological and distributional differences.

Absent from Singapore and the southern Malacca Straits ; Penang (Kemp, 1917) ; Glugor and Batu Maung flats, Penang, Pt. Weld, Perak, K. Tg. Dawai and south of K. Perlis, Kedah (Pathansali, 1966) ; also at Sibolga*, west Sumatra, in large numbers and Bawean (Hansen, 1919) ; E.

According to Pathansali resident on the Batu Maung flats.

53. *S. vulgaris* Hansen, 1919

S* (Tham, 1950, 1954 ; Wickstead, 1961 ; Johnson, 1965) ; Kukup*, Johor sometimes in immense numbers ; Skudai River area*, Johore ; Malacca* (Hansen, 1919) ; Pt. Swettenham mangroves*. Also at : Malaysia, commercial catches (Tham, 1968B) ; mangrove creeks in S. and S. E. Johor* ; Koh Kahdat, Thailand (Hansen, 1919) ; Surabaya and Cheribon, Java (Hansen, 1919) ; Kuching River*.

May be very abundant and form the basis of a large fishery, as at Kukup, in mangrove creeks and channels, prawn ponds etc. ; extends out on to open coasts especially where bottom is somewhat muddy and water is polyhaline ; occasionally penetrates into oligohaline waters but not into fully freshwater ; the distribution within the Malacca Straits is uncertain but it is the dominant species on mangrove coasts on the eastern shores of the southern portion and probably occurs on such coasts throughout.

Sicyonella Borradaile, 1910

The species of this genus are rather uncommon inhabitants of coral reefs and of no commercial importance.

54. *S. antennata* Hansen, 1919

S* on reefs*, also in plankton (Wickstead, 1961). Otherwise known from the Gulf of Thailand and Kei Is (Hansen, 1919) in depths of less than 25 m.

Additional species : *S. maldivensis* Borradaile, 1910 with a somewhat 'oceanic' pattern of distribution occurs at Nhatrang* (Leiden Museum) and may therefore be found in the Phuket area.

Family : Luciferidae.

Leucifer H. M. Edwards, 1837. An invalid emendation of *Lucifer* Thompson.

*Lucifer** Thompson, 1829.

Small prawns which are abundant in the neritic plankton throughout the area. The genus has been little studied locally and only two species are certainly recorded but 4 species might well occur generally with a fifth, *L. typus** H. M. Edwds, possible at the extreme northern end of the Malacca straits.

55. *L. hanseni* Nobili, 1905

Includes *L. inermis* Borradaile, 1915.

S* where quite common ; W, N, E.

56. *L. penicillifer* Hansen, 1919

S* (Wickstead, 1961) where much the commonest species ; throughout the offshore waters of the Malacca Straits north to Langkawi* (detailed localities in Wickstead, 1961). Also at : S. China Sea off Pahang* and off Sarawak* (Wickstead, 1961) ; eastern Java Sea and Borneo Bank (Hansen, 1919) ; W, N, E.

STENOPODIDEA

Family : Stenopodidae.

The only family.

Microprosthema Stimpson, 1860

Many older records use the name *Stenopusculus*.

57. *M. validum** Stimpson, 1860

Appears to be absent at S and in the southern straits ; P. Bidan* between Penanga and Kedah (Lanchester, 1901) ; also at Djakarta Bay (de Man, 1888) ; W, E, rare.

Stenopus Latreille, 1819

58. *S. hispidus** (Oliver), 1811

S* ; east of Sigli, Sumatra, 80-140 m* (Holthuis, 1946) ; south of Langkawi* at over 20 m sand, in trawl hauls. Also at : off Perhentian Is., Trengannu*, sand ; Tambelan Is., about 60 m (Holthuis, 1946) ; Simalur, Djakarta Bay, Java Sea, and Borneo Bank* (Holthuis, 1946) ; tropicopolitan.

Distinctly uncommon in central Sundanian Seas where it is mostly an offshore form occurring in over 20 m, though occasionally found inshore (Johnson, 1961); a very sedentary species which occurs in pairs of opposite sexes; a facultative fish-cleaner (Limbaugh *et al.*, 1961; Yaldwyn, 1968). Survives well in aquaria and is very handsome so that it has potential value in the aquarium trade.

There are many so-called common names (Yaldwyn, 1968) but most are misleading and likely to cause confusion. Perhaps 'Spiny Prawn' (Tinker, 1965) is the best.

Additional species: *S. tenuicornis* de Man, 1888 has not been found in the central Sundanian area despite search but, since it occurs at Simalur, it may well be present at the northern end of the Malacca Straits.

Stenopusculus Richters, 1880 = *Microprosthema* Stimpson.

CARIDEA

The caridean prawns are far more diversified in both form and ecology than the penaeidean prawns. They tend to be relatively rare in habitats favoured by the latter but common on rocky coasts, reefs, bottoms rich in crevices etc. Many are commensals (Johnson, 1961, 1962, etc.). Some are clearly of considerable economic importance but no fully marine species is of direct commercial importance in this area, though several of the species which occur are exploited elsewhere. A few brackish water species are of slight importance. Because of this lack of importance the treatment of the group will be briefer than for the Penaeidea.

Family: Atyidae.

The members of this family are predominantly inhabitants of fresh waters and oligohaline brackish waters. The peculiar littoral genera, *Antecaridina* Edmondson and *Halocaridina* Holthuis are either absent or very rare in the area. The species of *Atya* and several species of *Caridina* have salt tolerant phases which may occur in brackish or even marine habitats without the species being a regular part of the marine or brackish community. These are omitted from the listing. The following species are regular inhabitants of brackish waters and may extend into the mesohaline zone.

Caridina H. M. Edwds, 1837

The three species listed have some potential economic importance as a means of harnessing the productivity of low salinity brackish waters (Johnson, 1968, 1969) but none are currently of significant commercial value in this area.

59. *C. gracilirostris* de Man, 1892

The local forms belong to the typical subspecies.

S* (Johnson, 1961, 1964); west coast of Johor* ; Malacca River* ; Pt. Swettenham* ; Penang* (Johnson, 1964) ; Belawan Deli* , Sumatra ; also at : south and east coasts of Johor* in estuaries etc. ; estuaries and lagoons in Pahang* , Trengganu* , and southern Peninsular Thailand* ; Bangkok area* ; almost certainly throughout the Sundanian region ; W, N, E.

[26]

The headquarters of the species are in oligohaline to mesohaline waters where it may be very abundant and from which it extends into fresh waters on the one hand and polyhaline waters on the other.

Attains a length of 23 mm without rostrum ; shelly as compared with *Acetes*, and little valued but it is sometimes eaten by rural people in the more impoverished areas, as the neighbourhood of Kuala Trengannu and is reportedly regularly eaten in Thailand though I saw no evidence of this in the Songkla area. Small quantities may be accidentally included amongst prawns used for belachan and similar preparation. There appears to be no basis for the statement of Holthuis and Rosa (1965) that it is cultured in this general area (Johnson, 1968, 1969).

60. *C. propinqua* de Man, 1908

S* (Johnson, 1961); Malacca area*; near Pt. Swettenham*. Also at; southern and eastern Johor*; near Kuala Trengannu*; Tale Sap* and Patani River* (Kemp, 1918); Bangkok*; W.

Abundant in oligohaline and adjoining fresh waters and sometimes extends into the mesohaline zone. Matures at 14.5 mm and rarely attains 22 mm ; no current commercial importance.

61. *C. tonkinensis* Bouvier, 1919

S* (Johnson, 1961); Malacca area*. Also at: several localities in Johor* and Pahang*; near Tonkin (Bouvier, 1919). Easily confused with the last species and probably more widespread than records indicate. Occurrence, dimensions etc. much as last but females can attain at least 25 mm.

Family: Pasiphaeidae.

With the exception of the genus *Leptochela* these are deep water prawns not likely to be encountered in the present area.

Leptochela Stimpson, 1860

Only one species has so far been found in the present area.

62. *L. robusta* Stimpson, 1860

S* (Johnson, 1961; Wickstead, 1961); a regular part of the plankton in the southern Malacca Straits and occurs throughout the Straits and in the portions of the S. China Sea adjoining Singapore waters ; probably general over entire shallow areas of Sundanian shelf. Adults probably only partially planktonic. No commercial importance. W, N, E.

Family: Rhynchocinetidae.

Somewhat surprisingly no member of this family has been found within the present area but one or more might well occur at Phuket.

Family: Palaemonidae.

Subfamily: Palaemoninae.

The majority of local species are freshwater prawns but a number are common in brackish or marine habitats. The listing does not include species which only occur in higher salinity brackish waters on migration or as larval stages.

Cryphiops Dana, 1852

I can see no good grounds for separating this as a genus from *Macrobrachium* Bate, 1868 since the only species assigned by Holthuis is merely a slightly aberrant member of a specialized S. American species cluster and comes far closer to these than the group as a whole comes to many other species he includes in *Macrobrachium*. Since the hepatic spine does not prove to be a fully reliable guide for generic separation the position of *Leptocarpus* Holthuis, 1950 must be reconsidered. These prawns come very close to juveniles of the *rosenbergi* group and once again I find it difficult to justify full generic separation. My experience is that students readily learn to recognize this whole complex as being related and different from *Palaemon* but that field separation of *Macrobrachium* and *Leptocarpus* is by no means easy. I believe it is best to place all forms in one genus but to recognize three subgenera of which only two occur in this region.

subgenus : *Leptocarpus* Holthuis, 1950.

63. *C. potamiscus** (Kemp), 1917

S* ; Pt. Swettenham area* ; Penang area* ; W.

Found in mangrove creeks and channels with centre apparently in the mesohaline zone but extending into polyhaline waters ; sometimes in lower salinities but not into freshwater in our area ; small and not very common.

subgenus : *Macrobrachium* Bate, 1868.

Most of the species of this subgenus are not found in waters of more than slight salinity or are only found there as larvae and post-larvae or as migrating adults.

64. *C. equidens* (Dana), 1852

Occurs in numbers in mangrove swamps throughout the area. I have seen specimens from : S* ; Kukup* ; near Malacca* ; Pt. Dickson* ; Pt. Swettenham* ; the Perak Estuary* ; Pangkor Is.* ; Pt. Weld* ; Penang* ; Prai* ; Belawan Deli* and elsewhere on east coast of Sumatra*. Appears to be generally common in the Sundanian area and I have seen specimens from Sarawak* ; the Mersing area* ; Kuantan* ; near K. Trengannu* ; Lake Songkla* ; Thailand* and Java*. W, N, E. Records of this species from the western Indian Ocean are based on misidentified specimens of *C. (M.) rudis* (Heller), 1862 but it certainly extends to Ceylon* and the southern part of the west coast of India*.

This species is primarily an inhabitant of estuaries and mangrove creeks where it may be abundant in the mesohaline to polyhaline zones. Occasionally abundant in prawn ponds as noted by Hall (1962). It is sometimes taken on open coasts in polyhaline waters and young individuals especially are occasionally found in the oligohaline zone but it does not occur in permanently freshwater at least in W. Malaysia and Singapore.

The food is mainly small animals including other prawns. This is a moderately large species becoming mature at about 6.5 cm and capable of attaining over 10 cm in length. The flavour is good. Small local fisheries are conducted in Perak and also on the east coast of Malaysia but in the Singapore area it is usually treated as trash.

65. *C. mirabilis* Kemp, 1917

Pangkor Is*. Elsewhere known from brackish waters at head of Bay of Bengal and Sarawak.

66. *C. rosenbergii* (de Man), 1879

Occurs generally in freshwaters throughout the Sundanian area and also W, N, E. Spawning females and post-larvae are found in low salinity brackish waters and sometimes in higher salinities. Taken on a commercial scale in estuaries in Johor (and also at Songkla). Cultured in ponds in the Tualang area of Perak where the source is post-larvae from the Perak River. The value of this very large (up to 30 cm or more) and fine flavoured prawn is well known and intensive culture methods are being developed in many areas of the world as the outcome of work initiated in Malaysia by Ling. For general details of life-history etc. see Ling (1969a) and of culture methods, Ling (1969b).

Additional species : *C. (M.) idae* (Heller), 1862 is not uncommon in low salinity waters in the area but has not yet been recorded from higher salinities though found in such salinities elsewhere. *C. (M.) scabriculus* (Heller), 1862, another species which enters high salinities was formerly present at Singapore but has not been found in recent years. Occasional adults of *C. (M.) javanicus* (Heller), 1862 have been taken at river mouths.

Leander Desmarest, 1849

The extent of this genus has been greatly reduced by the work of Holthuis (1950). Many species formerly included are now transferred to other genera such as *Leandrites* and *Palaemon*. Only two species are certainly known from the present area.

67. *L. tenuicornis** (Say), 1818

S* ; Penang* ; I have seen it in numbers at Mersing. Lives amongst littoral weed beds and floating *Sargassum* ; apparently not very common in the area ; probably tropicopolitan ; called udang ronggeng or dancing girl prawn from its habit of leaving the water and skipping along the surface when pursued.

68. *L. urocaridella* Holthuis, 1950

S* (Johnson, 1961 ; Wickstead, 1961) in depths of 10 to over 70 m ; Off Sembilan Is., Perak, 45 to 80 m depth (Johnson, 1961) ; W, N, E ; semiplanktonic.

Leandrites Holthuis, 1950

69. *L. celebensis* (de Man), 1881

S*, not previously reported; W and E. Not uncommon but rarely abundant in the polyhaline waters at the mouth of small rivers and on open beaches in polyhaline waters as in the inner Johor Straits. Will probably be found in similar situations elsewhere in the Malacca Straits.

70. *L. deschampsi* (Nobili), 1903

S* (Nobili, 1903; Johnson, 1961); Pt. Swettenham area*; Prai area*; also L. Songkla*. If *L. indicus* Holthuis, 1950 a synonym extends E. Common and sometimes abundant in mangrove creeks and prawn ponds but does not normally extend out on to open beaches and does not enter very low salinities. At least partially vegetarian.

71. *L. stenopus* Holthuis, 1950

S*, not previously reported; also Java (Holthuis, 1950); in brackish creeks, prawn ponds etc., rare.

Nematopalaemon Holthuis, 1950

Created as a subgenus this group appears to merit generic distinction from *Palaemon*. Despite search no member of the group has been found in the present area. However *N. tenuipes** Henderson, 1893 may well prove to extend south into the northern part of the area as do other forms with similar habitats.

Palaemon Fabricius, 1798

This name is used in the sense defined by Holthuis and not for the group which is here called *Cryphiops*. Very old records include under *Palaemon* species from a wide variety of genera some of which are no longer placed in this family.

Subgenus: *Exopalaemon* Holthuis, 1950.

72. *L. styliferus* H. M. Edwds, 1840

? S (see Johnson, 1961).

Additional species: *P. (E.) carinicauda* Holthuis, 1950 cannot be maintained on the Singapore list (see Johnson, 1961).

Subgenus: *Palaeander* Holthuis, 1950.

73. *P. semmelinkii* (de Man), 1911.

S* (Nobili, 1903; Johnson, 1961 etc.); I have seen specimens from: Kukup*; Pontian Kechil*; Malacca area*; Pt. Swettenham*; brackish creeks, Pangkor Is.*; brackish areas and oil-polluted beaches, Penang*; Langkawi*; Belawan-Deli*, Sumatra; also from southern and eastern Johor*; Kuantan*; Trengganu area*; Lake Songkla*; Bangkok area*; Kuching area*; extends W and E.

Holthuis (1950) considers this to be a marine species but in our experience it is primarily a species of polyhaline waters abundant in mangrove creeks, prawn ponds

etc., and extending out on to open beaches of mud or muddysand where the water is not fully euhaline ; in contrast to the penaeidean prawns this is a diurnal prawn, quiescent at night ; it is strongly carnivorous and somewhat cannibalistic. Though edible it is of little commercial value because of shell and small size. Singapore prawn pond operators regard it as a pest and some of them, at least, selectively weed it out.

Subgenus : *Palaemon** Fabricius, 1798.

74. *P. concinnus* Dana, 1852

Occurs at P. Weh (Holthuis, 1950) but not found further into Malacca Straits ; distribution 'oceanic' ; W, N, E. Largely a freshwater and low-salinity form.

75. *P. debilis* Dana, 1852

Penetrates along west coast of Malacca Straits at least to Belawan-Deli region (Holthuis, 1950) ; Recently found in abundance in brackish water at P. Tioman* off eastern Johor. Distribution and biology much as last species but appears to be slightly less 'oceanic' ; appears to be largely vegetarian but since it is diurnal does not compete directly with penaeidean prawns.

76. *P. serrifer* (Stimpson), 1860

S* (Johnson, 1961 and additional records) ; I have also seen specimens from Tg. Tokong*, Penang and various localities on the east coast of west Malaysia. Also from Java and Madura (Holthuis, 1950) ; N. Probably more common than records indicate. Usually taken in small sand-bottomed pools adjacent to rocks or on reef flats. Not in brackish water.

Additional species : Though the distribution is predominately oceanic it is possible that *P. pacificus* (Stimpson), 1860 might yet be found. Some of the species reported by Heller and Kemp from Burmese Coasts may also extend into the north of the area.

Subfamily : Pontoniinae.

The detailed distribution of members of this subfamily is poorly known. Many are commonsals and do not appear in general collecting. In these circumstances the account will be confined to a brief listing with few comments.

Anapontonia Bruce, 1967

77. *A. denticauda** Bruce, 1967 S*

Anchistioides Paulson, 1875

78. *A. willeyi* (Borradaile), 1899 S*

Anchistus

79. *A. custos** (Forsskal), 1775. S* (Johnson, 1961, 1962 ; Johnson and Liang, 1966) ; P. Bideem, Penang* (Lanchester, 1901).

80. *A. miersi* (de Man), 1888. S* (Johnson, 1961, 1962).

Chernocaris Johnson, 1967

81. *C. placunae** Johnson, 1967 S*

Conchodytes Peters, 1852

82. *C. monodactylus* Holthuis, 1952. S* (Johnson, 1961, 1962 ; Johnson and Liang, 1966) ; occurs also at Hong Kong (Bruce, personal communication) and E.

The common *C. biunguiculatus* (Paulson), 1875 is surprisingly still unrecorded though apparently not uncommon off the east coast of the Malay Peninsula.

Coralliocaris Stimpson, 1860

83. *C. graminea* (Dana), 1852 S* (Johnson, 1961, 1962).

Hamodactylus Holthuis, 1952

84. *H. beschmai** Holthuis, 1952 S*, commensal with gorgonians.

Harpillopsis Borradaile, 1917

85. *H. beaupresii** (Audouin), 1825 S* (Johnson, 1961, 1962).

Ischnopontonia Bruce, 1965.

86. *I. lophos* (Barnard), 1962 S (Bruce, 1965).

Palaemonella Dana, 1852

87. *P. pottsi* (Borradaile) 1915 S* (Johnson, 1961, 1962).

88. *P. tenuipes* Dana, 1852 Off Sembilan Is., Perak*, 45 to 80 m, shell-gravel, coral-brash.

89. *P. vestigialis* Kemp, 1922 S* (Johnson, 1961, 1962) ; Pangkor Is* ; Penang*. Common facultative commensal of corals but also around rocks sometimes even when these are isolated on sandy shores.

Periclimenaeus Borradaile, 1915.

90. *P. tridentatus* (Miers), 1884 S* (Johnson, 1961, 1962) has proved to be common in sponges. Surprisingly not other species of the genus has yet been found.

Periclimenes Costa, 1844

In view of the admitted relationships between several species it is impossible to maintain the two subgenera recognized by Holthuis (1952).

aesopius (Bate), 1888. This species, the type of which I have seen, is quite distinct from all the Indo-West Pacific forms which have been assigned here.

91. *P. aesopius* Holthuis, 1952. Needs a new name. S*, also at several stations of east coast of West Malaysia*; a fish-cleaner*; often associated with *Cerianthus*.

aesopius Johnson, 1961. =? *P. indicus* Kemp.

92. *P. amymone* de Man, 1902. S* (Johnson, 1961, 1962).

93. *P. brevicarpalis* (Schenkel), 1902. S* (Johnson, 1961, 1962); Penang*; also off Perhentian Is*, Trengganu.

94. *P. brockii* de Man, 1888. S* (Johnson, 1961).

95. *P. calmani* Tattersall; 1921. S* (Johnson, 1961 in part); enters polyhaline estuaries and may be common on occasion.

96. *P. cristimanus* Bruce, 1965. S* (Bruce, 1965).

97. *P. digitalis* Kemp, 1922. S* (Includes most of material referred by Johnson, 1961 to *P. suvativensis*).

98. *P. elegans* (Paulson), 1875. S* (Johnson, 1961).

99. *P. grandis* (Stimpson), 1860. S* (Johnson, 1961); P. Nangka off Malacca*; P. Berhala* off Sumatra* (Holthuis, 1952); Penang*.

100. cf. *P. indicus* Kemp, 1915. The species referred to as *P. aesopius* by Johnson (1961). Differences in ecology and possible morphological differences make me hesitate to identify this form with Kemp's species in the absence of re-examination of the original material; S* and also at Johor side of Johore Straits; probably in weed beds elsewhere.

101. *P. impar* Kemp. S*

102. *P. investigatoris* Kemp, 1922. S*; also off Perhentian Is.*, Trengganu; in shallow water from 6 m depth; commensal with nephthyid alcyonaceans.

103. *P. lutescens* (Dana), 1852. S* (Johnson, 1961, 1962).

104. *P. parvus* Borradaile, 1898. S* (Johnson, 1961, 1962).

105. *P. psamathe* (de Man), 1902. S*; also off Perhentian Is., Trengganu; under coral heads, rock overhangs, piers etc., from just below L.T.M. to 30 m; a fish cleaner mimic; survives well in aquaria.

106. *P. seychellensis* Borradaile, 1915. S* (Johnson, 1961).

107. *P. spiniferus* de Man, 1902. S* (Johnson, 1962; later confirmed by material sent to Bruce, personal communication); P. Berhala, off Sumatra* (Holthuis, 1952); also off Perhentian Is* (In material sent to Bruce).

108. *P. suvadiensis* Borradaile, 1915. Should be deleted from the Singapore list as based on material mainly belonging to *P. digitalis* Kemp.

Philarius Holthuis, 1952.

109. *P. imperialis* (Kubo), 1940. S* (Johnson, 1961, 1962).

Platycaris Holthuis, 1952.

110. *P. latirostris** Holthuis, 1952. S* (material sent to Bruce).

Family : Gnathophyllidae.

This spelling has been validated by the International Commission.

Phyllognathia Borradaile, 1915.

111. *P. ceratophthalma** (Balss), 1913. S* ; P. Tioman*.

Family : Alpheidae.

Alpheopsis Coutiere, 1896.

112. *A. chalciope* de Man, 1910.

Phuket (Banner and Banner, 1966) ; E ; rare.

113. *A. equalis* Coutiere, 1896.

Phuket (Banner and Banner, 1966) ; W and E.

Alpheus Fabricius, 1798.

The use of this name for the present genus has been validated by the International Commission. This is by far the most diverse genus of carideans in the area. Most are rather small to very small crevice dwellers or commensals but a few are of fair size and one or two are of minor commercial importance.

114. *A. acutofemoratus* Dana, 1852.

S* ; Phuket (Banner and Banner, 1966) ; also at coasts of Gulf of Thailand (Banner and Banner, 1966) ; N and E ; on reefs.

115. *A. alcyone* de Man, 1902.

Includes *A. aculeipes* Coutiere, 1905.

Not at S (the apparent record in Banner and Banner, 1966 is an obvious *lapsus calami*) ; Phuket (Banner and Banner, 1966) ; on reefs on dead coral ; W and E.

116. *A. alpheopsides* Coutiere, 1905.

S* (Johnson, 1961) ; dead coral on reefs ; W. and E.

117. *A. angustidigitus* de Man, 1911.

S* (Johnson, 1961); for other distribution see de Man (1911); habits and habitat as for *A. rapax*; also sometimes offshore; not very common.

118. *P. audouini* Coutiere, 1905.

The exact status of this form and its distinctions from other species are still in dispute. Older records (especially those from Hawaii and New Zealand) are suspect. Banner and Banner (1966) suspect that this species will ultimately be merged with *A. edwardsi* and *A. chiragicus*. The latter species appears to be distinct at least in the Singapore area and no specimens in that area approach the characteristics of *A. edwardsi*. Even so the Singapore material is highly variable and there is a possibility that two very similar species are present. The commoner of these forms, which appears to be that figure by Banner and Banner, seems to correspond with the bulk of the material which de Man (1911) assembled under the name *A. bisincisus* var. *variabilis*. The record of *A. bisincisus* given by Johnson (1961) certainly belongs here. On the other hand some of the material referred here by the same worker belongs to *A. crassimanus*.

S* (Johnson, 1961, part; Banner and Banner, 1966); Tg. Tokong, Penang* ; Phuket (Banner and Banner, 1966); also at coasts of Gulf of Thailand, 17 stations (Banner and Banner, 1966); W and E.

Occurs on reef-flats and mixed beaches with rocks; sometimes also under isolated rocks on muddy-sand beaches. It is rarely found on such beaches away from rocks or in offshore collections. May mature at 17.7 mm and rarely exceeds 30 mm but occasional larger individuals may attain as much as 50.5 mm. Sometimes collected and eaten by 'strand-gatherers' but of not real commercial importance.

119. *A. bisincisus* de Ham, 1849.

The central species is quite distinct but the varieties of de Man and Coutiere certainly include material that does not belong here.

S (Banner and Banner, 1966; not Johnson, 1961); also west of Gt. Natuna, 70 m* (S.R.F.R. Station C 9/37); W, N, S; a rare species occurring from littoral to considerable depths.

bisincisus Johnson, 1961 = *A. audouini* Coutiere.

bisincisus var. *variabilis* de Man, 1911. Part at least belongs to *A. audouini* Coutiere or to an unidentified form close to this and not yet separated.

brevirostris de Man, 1888 not (Olivier), 1789 = *rapax* Fabricius.

brevirostris var. *angustidigitus* de Man, 1911. Treated as a full species.

120. *A. bucephalus* Coutiere, 1905.

Includes *A. consobrinus* de Man, 1908.

S* ; Phuket (Banner and Banner, 1966) ; also coasts of Gulf of Thailand (Banner and Banner, 1966) ; in coral on reefs ; W and E.

bucephalus Edmondson, 1925=*paralcyone* Coutiere.

121. *A. chiragricus* H. M. Edwds, 1837.

See comments under *A. audouini*. Part of de Man's material of *A. bisincisus* var. *variabilis* appears to belong here but this requires confirmation by re-examination of his material.

S* (Johnson, 1961) ; N and E ; on mud and sand at 0 to just over 40 m ; mature at 32.5 mm and not very common ; no commercial importance.

122. *A. collumianus* Stimpson, 1861 var. *probabilis* Banner, 1956 Phuket (Banner and Banner, 1966) ; the species as a whole ranges W, N, E ; on reefs.

123. *A. crassimanus* Heller, 1865.

S* (Johnson 1961 including part of material assigned to *A. audouini*) ; (Banner and Banner, 1966) ; Penang* ; Phuket (Banner and Banner, 1966) ; also coasts of Gulf of Thailand and commercial catches L. Songkla* (Banner and Banner, 1966) ; W, N, E.

Especially common on sandy to muddy sandy beaches with stones etc. and on mixed beaches, less commonly on reef flats from the infra-littoral fringe at least as high as low water neap tide level ; may occur in rock crevices but also borrows in muddy-sand etc. near or away from rocks ; rare offshore and only in shallow water. Usually mature 1.8 or slightly more cm and rarely exceeds 3.0 cm but giants may reach 6.0 cm ; some subsistence gathering by 'strand-gatherers' but of no real commercial importance.

124. *A. crockeri* (Armstrong), 1941.

Phuket (Banner and Banner, 1966) ; also at Koh Samui, Gulf of Thailand (Banner and Banner, 1966) ; Polynesia ; sublittoral in dead coral heads.

125. *A. cythereus* Banner and Banner, 1966.

Patong Beach, Phuket in dead coral (Banner and Banner, 1966) ; Tahiti.

126. *A. deuteropus* Hilgendorf, 1878.

Phuket (Banner and Banner, 1966) ; W and E ; crevices in massive *Porites* heads.

127. *A. distinguendus* de Man, 1909.

Certainly the form described from Indonesia ; some doubts as to identity with Japanese doubt were expressed by de Man.

S* (Johnson, 1962) ; N and E ; on muddy/sandy beaches at low levels ; habits like those of *A. rapax* ; no real commercial importance.

128. *A. djeddensis* Coutiere, 1898.

S*, a single specimen from a prawn pond ; Red Sea area.

129. *A. edamensis* de Man, 1888.

S* (Banner and Banner, 1966) ; P. Edam near Djakarta (de Man, 1888) ; W and E.

Under rocks on reef flats at and below L.W.N.T. ; well flavoured and may exceed 5.0 cm so is sometimes collected and eaten by picnickers but of no real commercial importance.

edwardsii Audouin, 1826. See *A. audouini*.

130. *A. ehlersi* de Man, 1909.

Phuket (Banner and Banner, 1966) ; also at Koh kradard, Thailand (Banner and Banner, 1966) ; Djakarta (de Man, 1888) ; W and E ; dead coral heads.

131. *A. euchirus* Dana, 1852 sensu de Man, 1911.

It seems likely that many records of *A. hippothoe* really refer to this species.

S* (Johnson, 1961 etc.) ; Penang* ; it is possible that some of the Phuket material referred to *A. hippothoe* by Banner and Banner (1966) belongs to this form ; W and E.

This is a common crevice dweller occurring in rocks and coral heads at low levels on beaches and offshore to at least 70 m ; of no commercial importance.

132. *A. euphrosyne* de Man, 1897.

Includes *Alpheus* cf. *audouini* Johnson, 1961.

S* ; mudflats and mangroves Pt. Swettenham* ; Phuket, under rocks on sandy mud or mud on reef flat (Banner and Banner, 1966). Also at : lagoons and estuaries near Kuala Trengannu* ; Lake Songkla* (Banner and Banner, 1966) ; numerous localities around coasts of Gulf of Thailand (Suvatti, 1937 ; Banner and Banner, 1966) ; klongs at Bangkok* (Suvatti, 1937 ; Banner and Banner, 1966).

Especially in inhabitant of mangrove swamps and other brackish waters but may as at Phuket occur in mud on open coasts. Enters low salinities but probably not in water which is fresh at all seasons at least in most areas. The size appears to be variable. At Singapore it is mature at 27.5 mm and I have seen no specimens larger than 40 mm but at Bangkok can attain to 76 mm (Banner and Banner, 1966). Considered good eating at Trengannu and in parts of Thailand where there are small fisheries but considered to be bitter and regarded as trash at Singapore and does not appear to be exploited anywhere in the Malacca Straits area.

133. *A. facetus* de Man, 1908.

Phuket (Banner and Banner, 1966) ; also at Koh Samui, Thailand (Banner and Banner, 1966) ; E ; reefedges.

134. *A. funafutensis* Borradaile, 1898.

One specimen probably from Phuket (Banner and Banner, 1966) ; E.

135. *A. gracilis* Heller, 1861.

The species has been separated into several 'varieties' the taxonomic status of which is obscure. Banner and Banner (1966) created a new variety *simplex* for material from Thailand. This material appears to be identical with Singapore material which I cannot separate from the variety *alluaudi* Coutiere. The form is very distinct from the typical form of the species and may well ultimately prove to be a distinct species.

S* , on reef ; also at five stations around Gulf of Thailand in coral heads at 0 to 3 m (Banner and Banner, 1966) ; W and E.

136. *A. hippothoe* de Man, 1888.

This species is easily confused with *A. euchirus* and it seems probable that some of the material referred here in the literature really belongs to that species.

S* (Johnson, 1961) ; part at least of the material from Phuket and the Gulf of Thailand listed by Banner and Banner (1966) ; W and E.

On coral reefs, around silted rocks at low tide levels, around piers, etc., and on shoals to depths of several metres.

137. *A. lanceleti* Coutiere, 1905.

S* (Johnson, 1961) ; coral heads, sub-tidal.

138. *A. leptochirus* Coutiere, 1905.

S* (Johnson, 1961) ; W and E ; mainly young specimens ; on drifted bamboo etc. and offshore to depths of 45 m ; rare.

lutini Coutiere, 1905=*obesomanus* Dana, 1852.

139. *A. lottini* Guerin, 1830.

On the basis of Guerin's description his species is unidentifiable and it is by no means certain that the name is correctly applied to this form better known as *A. ventrosus*. Since some recent authors have adopted the present name I am following them, though with reluctance, in the hopes of promoting future nomenclatural stability.

S* (Johnson, 1961 ; Banner and Banner, 1966) ; Phuket (Banner and Banner, 1966) ; also at five localities round the coasts of the Gulf of Thailand (Banner and Banner, 1966) ; W, N, E.

A well known commensal of the coral *Pocillopora* ; sublittoral and to at least 6.5 m depth.

140. *A. maindroni* Coutiere, 1896.

S* (Johnson, 1961) ; W ; a crevice form from reefs and soft rocks to depths of over 10 m.

141. *A. malabaricus* (Fabricius), 1775, Henderson, 1893.

Almost every local population of this species appears to be distinct and in consequence there are numerous described varieties; the distribution and ecology of these so-called varieties suggests that there is but a single variable species which cannot be divided into recognizable subspecies. Thus all varietal names should be abandoned at least in the absence of a thorough revision based on careful statistical studies of numerous populations.

S* ; mangroves at Pt. Swettenham* ; Phuket, sandy mud to mud under rocks on reef flat (Banner and Banner, 1966). Also at : mangroves etc. near L. Songkla* ; commercial catches from L. Songkla (Banner and Banner, 1966) ; W, N, E.

Usually burrowing on mud-flats or in mangroves in polyhaline waters ; does not exceed 3.0 cm and is of no real economic importance ; treated as trash at Singapore.

142. *A. malleodigitus* (Bate), 1888.

Pangkor Laut* , Perak, crevices in isolated coral boulders ; Phuket (Banner and Banner, 1966) ; also at five stations around coasts of Gulf of Thailand (Banner and Banner, 1966) ; in dead coral heads.

143. *A. microrhynchus* de Man, 1898.

S* (Johnson, 1961) ; Pt. Swettenham mangroves* ; also at : Trengannu area in lagoons* , commercially exploited on small scale ; Bangkok (Banner and Banner, 1966 ; de Man, 1898) ; west coast of Borneo, etc. (de Man, 1898). So far only known in the general Sundanian area.

This is a very large pistol-prawn which becomes mature at about 4.0 cm and which can exceed 6.0 cm.

It appears to be common in mangroves and high salinity lagoons where it burrows in mud. In Bangkok reported from so-called freshwater klongs during the rainy season (Banner and Banner, 1966). I am also informed that it is caught in large numbers in lagoons near K. Trengannu during the rainy season. It is nonetheless unwise to regard it as a freshwater prawn since the phenomenon resembles the appearance of other brackish burrowers on the surface, e.g. *Thalassina*, when heavy rains make conditions unsuitable in their burrows. Regarded as bitter and unsuitable for human consumption at Singapore but eaten at Bangkok and regarded as a delicacy at K. Trengannu.

144. *A. microstylus* (Bate), 1888.

Phuket (Banner and Banner, 1966) ; in coral heads ; W and E.

145. *A. obesomanus* Dana, 1852.

Includes *A. lutini* Coutiere.

S* (Johnson, 1961 ; Banner and Banner, 1966) ; Phuket (Banner and Banner, 1966) ; also several stations around coasts of Gulf of Thailand (Banner and Banner, 1966) ; W, N, E ; on reefs in crevices etc.

146. *A. paracrinthus* Miers, 1881.

The concensus treats *bengalensis* Coutiere as synonymous with this form and I follow this with some reluctance.

S* (Johnson, 1961 ; Banner and Banner, 1966) ; Phuket (Banner and Banner, 1966) ; also coasts of Gulf of Thailand (Banner and Banner, 1966) etc. ; pan-tropical in all probability and throughout the Indo-West Pacific.

147. *A. paralcione* Coutiere, 1905.

S* (Johnson, 1961, 1962 ; Banner and Banner, 1966) ; also coasts of Gulf of Thailand (Banner and Banner, 1966) ; W and E ; on reefs and also flat bottoms etc. from L.W.S.T. be at least 70 m ; commensal with sponges and sometimes found on living or dead corals or free on hard bottoms.

148. *A. paralpheopsides* Coutiere, 1905.

S*, reef slopes, rare ; W.

149. *A. pareuchirus* Coutiere, 1905.

S* (Johnson, 1961) ; Pangkor Is.* ; also at : near Mersing, rocky beach ; rocky headland at Chendering*, near K. Trengannu ; on reef flats, rocky beaches etc. and hard grounds offshore to over 30 m ; extends above mid-tide level in pools.

150. *A. parvirostris* Dana, 1852.

S* ; Phuket area (Banner and Banner, 1966) ; also at : coasts of Gulf of Thailand (Banner and Banner, 1966) ; W, N, E ; a very common crevice dwelling form of the littoral and immediate infra-littoral zones.

151. *A. pomatoceros* Banner and Banner, 1966.

S* (Banner and Banner, 1966) ; Phuket (Banner and Banner, 1966) ; Koh Samui, Gulf of Thailand (Banner and Banner, 1966) ; not known elsewhere but perhaps confused with *A. splendidus*.

152. *A. rapacida* de Man, 1908.

S* (Johnson, 1961) ; mud flats etc., associated with gobies ; W and E.

153. *A. rapax* Fabricius, 1798.

S* (Johnson, 1961) ; Malacca* ; Pt. Swettenham* ; Pangkor* ; Penang* ; Sumatra* ; also at : east coasts West Malaysia* ; Lake Songkla* (Banner and Banner, 1966) ; Cholburi and Koh Kradard, Gulf of Thailand (Banner and Banner, 1966) ; Java* ; W, N, E.

Moderately large and very common ; on sandy to muddy beaches and reef flats where it makes burrows often of considerable depth and also wanders freely ; associated with gobies ; may be collected as bait or food by 'strand-gatherers' but of no real commercial importance.

154. *A. sibogae* de Man, 1908.

S* ; on shoal at about 10 m ; E ; rare.

155. *A. splendidus* Coutiere, 1897.

S* (Johnson, 1961, 1962) ; infralittoral on coral ; W and E.

156. *A. spongiarum* Coutiere, 1897.

S* (Johnson, 1961, 1962) ; in massive sponges from L.W.S.T. to 70 m ; W, N, E.

157. *A. stanleyi* Coutiere, 1908.

S* (Johnson, 1961) ; rare.

158. *A. strenuus* Dana, 1852.

S*, rare ; Penang* (Lanchester, 1901) ; Phuket (Banner and Banner, 1966) ; Ang Sila, Thailand (Banner and Banner, 1966) ; W, N, E ; under rocks on beaches and reef flats ; uncommon.

159. *A. sudara* Banner and Banner, 1966.

Phuket (Banner and Banner, 1966) ; Gulf of Thailand Coasts ; on coral heads, *supachai* Banner and Banner, 1966.

S*, on reef ; Koh Samui, Gulf of Thailand (Banner and Banner, 1966).

ventrosus H. M. Edwds, 1937. See *A. lottini*.

Arete Stimpson, 1860=*Athanas* Leach, 1814.

Athanas Leach, 1814.

dimorphus Ortmann, 1894=*A. monoceros* (Heller), 1861 (see Johnson, 1961).

jedanensis de Man, 1910.

S* (Johnson, 1961) ; offshore to about 40 m ; E.

monoceros (Heller), 1861.

S* (Johnson, 1961) ; crevice dweller on beaches ; W and E.

parvus de Man, 1910.

S* (Johnson, 1961) ; crevice dweller ; E.

sibogae de Man, 1910.

I believe this to be distinct from the last despite the views of Banner and Banner (1960).

S* ; E. Not between tide marks.

Banner and Banner (1966) record a species which may be new from Phuket.

Automate de Man, 1888.

gardineri Coutiere, 1905.

Phuket (Banner and Banner, 1966) ; also around coasts Gulf of Thailand (Banner and Banner, 1966) ; W and E.

Crangon Weber 1797. This name has been suppressed and is not available in the Alpheidae.

Jousseamea Coutiere, 1897. An invalid homonym=*Salmoneus* Holthuis, 1955.

Racilius Paulson, 1875.

160. *R. compressus** Paulson, 1875.

S* (Banner and Banner, 1966) ; also off P. Tioman and P. Perhentian off east coast West Malaysia ; on *Galaxea*.

Salmoneus Holthuis, 1955.

161. *S. brevirostris* (Edmondson), 1930.

Phuket (Banner and Banner, 1966) ; Hawai (Edmondson).

162. *S. cristatus* (Coutiere), 1897.

Phuket (Banner and Banner, 1966) ; Djibouti (Coutiere).

163. *S. hilarulus* (de Man), 1910.

S* (Johnson, 1961) ; between Misool and New Guinea (de Man, 1910).

Synalpheus Bate, 1888.

For the same reasons as for the pontoninids I list these forms for the most part without details. There appear to be several undescribed species in the area.

164. *S. acanthitelsonis* Coutiere, 1905. S* ; Phuket etc. ; very common.

165. *S. amboinae* (Zehntner), 1894. S* ; S. China Sea area* ; *bakeri*
Coutiere, 1908. See *S. stormi* de Man.

166. *S. bispinosus* de Man, 1910. S*

167. *S. bituberculatus* de Man, 1910. S* ; Phuket etc. ; common.
Banner and Banner (1966) are in error in claiming their record as the first since the original description.

168. *S. consobrinus* de Man, 1909. I agree with Banner and Banner (1966) in regarding this as a synonym of *S. stimpsonii* de Man. Singapore material spans the gap between the two supposed forms.

coutierei Banner, 1953. Substitute name for *S. biunguiculatus* Coutiere. Available only to those who treat the form as being distinct from the var. *exilipes* Coutiere which was used as a specific name by me in 1961 and thus has clear priority even as a full species name.

169. *S. exilipes* Coutiere, 1905. S* ; Phuket etc. ; common.
170. *S. gravieri* Coutiere, 1905. S* ; also off eastern coast W. Malaysia ; Gulf of Thailand etc. on alcyonaceans etc. ; appears to be a not uncommon offshore form.
171. *S. heroni* Coutiere, 1909. Phuket (Banner and Banner 1966) ; Red Sea area ; Indonesia.
172. *S. hilarulus* de Man, 1910. S* , at about 20 m depth ; E.
173. *S. iocasta* de Man, 1909. S* ; E.
174. *S. iphinoe* de Man, 1909. S* ; E ; in internal cavity of hollow stony alcyonarians etc.
175. *S. jedanensis* de Man, 1909. S* ; ? W, E.
176. *S. neomeris* (de Man), 1897. S* ; also off Perhentian Is. on large nephthyid alcyonacean ; in depths of over 30 m to over 70 m.
177. *S. neptunus* (Dana), 1852. S* (Walker, 1887) ; not taken in recent years ; E.
178. *S. pescadorensis* Coutiere, 1905. S* ; E and W ; reefs.
179. *S. quadrispinosus* de Man, 1910. S* ; E ; possibly a crinoid commensal but not around reefs.
180. *S. stimpsonii* (de Man), 1888. S* ; Penang* ; Langkawi* ; Phuket ; also at : off P. Tioman* ; off P. Perhentian* ; etc. ; W, N, E. A very common commensal of crinoids on reef slopes from L.W.S.T. downwards etc. Singapore specimens show that *A. consobrinus* de Man and the var. *maldivensis* Coutiere cannot be maintained.
181. *S. stormi* de Man, 1911. This form is better treated as a full species than as a variety of *S. bakeri* Coutiere. S* ; Atjeh area* ; Phuket*. Excluding a very doubtful record from S. Australia all reports are from the Malacca Straits or the immediate vicinity.
182. *S. streptodactylus* Coutiere, 1905. The species *S. streptodactyloides* de Man and the var. *hadrunus* Banner and Banner 1966b are only doubtfully separable. S* ; Gulf of Thailand and its coasts ; E and W ; sometimes with sponges ; mainly an offshore form but has been reported from the littoral zone.

183. *S. theano* de Man, 1910. S* ; E ; in shallow water to at least 10 m ; sometimes at least in sponges ; Possibly, as already suggested by Banner and Banner (1966), identical with *S. neptunus* Dana but more material is needed to confirm this.

184. *S. triunguiculatus* (Paulson), 1875. S* ; on nephthyid ; W.

185. *S. thai* Banner and Banner, 1966. S* ; Gulf of Thailand coasts.

186. *S. tumidomanus* (Paulson), 1875. S* ; Phuket ; Gulf of Thailand and coasts etc. ; W and E ; very common.

Family : Hippolytidae.

Angasia Bate, 1863 = *Tozeuma* Stimpson, 1860.

Eretmocaris Bate, 1888 = *Lysmata* Risso, 1816. Based on larval stages. Indo-West Pacific records may also refer to larvae of *Hippolysmata*.

Gelastocaris Kemp, 1914.

187. *G. paronae** (Nobili), 1905.

S* ; offshore form in 18 to 70 m on shell gravel and similar bottoms where it appears to be a scavenger ; form and behaviour in life resembling isopods of similar habits.

Hippolysmata Stimpson, 1860.

subgenus : *Exhippolysmata* Stebbing, 1915.

188. *H. (E.) ensirostris** (Kemp), 1914.

S* (Johnson, 1961) ; abundant and sometimes the dominant caridean in shallow water up to L.W.S.T. adjoining gentle muddy/sandy beaches ; W. Probably forms and appreciable quantity of the general trash or 'manure fish' component of sungdong net and beach seine catches. I have seen fragmented specimens possibly belonging here at Songkla, Thailand. Singapore material includes typical specimens and others corresponding with the var. *punctata* of Kemp.

subgenus : *Hippolysmata** Stimpson, 1860.

189. *H. (H.) vittata** Stimpson, 1860.

S* (Johnson, 1961) ; Tg. Gemuroh* and Tg. Tokong*, Penang ; commercial catches (trash) S. of Langkawi ; Songkla area*, Thailand ; W, N, E.

At Singapore occurs from lowest tide levels to over 70 m and is the dominant caridean of non-rocky bottoms ; the relatively small size means it has no commercial importance.

subgenus : *Lysmatella* Borradaile, 1915.

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190. *H. (L.) prima** (Borradaile), 1915.

S* (Johnson, 1961); also off Perhentian Is.*; W; apparently commensal with giant sea-anemones on flat bottoms below tidal zone.

Hippolyte Leach, 1814.

191. *H. commensalis* Kemp, 1925.

? S* (one fragmented specimen); W.

192. *H. ventricosa* H. M. Edwds, 1837.

S* (Johnson, 1961); Penang*; W, N, E; a common inhabitant of littoral weed beds especially *Sargassum* beds and also amongst floating *Sargassum*.

Latreutes Stimpson, 1860.

193. *L. anoplonyx* Kemp, 1914.

Batu Ferringhi*, Penang; 80 miles South of Penang* (Johnson, 1961); W; commensal with large jellyfish.

194. *L. mucronatus* (Stimpson), 1860.

S* (Johnson, 1961); W, N, E; only young individuals taken in *Enhalus* beds.

195. *L. porcims* Kemp, 1916.

S* (Johnson, 1961); W; in weedy beach pools and *Enhalus* beds etc.

196. *L. pygmaeus* (Nobili), 1904.

S* (Johnson, 1961); W and E; in littoral weed beds.

Mimocaris Nobili, 1903.

197. *M. heterocarpoides** Nobili, 1903.

S* (Johnson, 1961); off eastern coasts Sumatra*; also off N.W. Borneo; rare.

Saron Thallwitz, 1891.

The two species of this genus both appear to have an 'oceanic' distribution and are rare in the present area. Probably both will be found around Phuket.

198. *S. marmoratus** (Olivier), 1811.

S* (Johnson, 1961); northern Sumatra*; W, N, E.

199. *S. neglectus* de Man, 1902.

S* (Johnson, 1961) ; northern Sumatra* ; W, N, E.

Thor Kingsley, 1878.

200. *T. paschalis* (Heller), 1862.

S* (Kemp, 1916) ; W and E ; in littoral weed beds, beach pools etc.

Tozeuma Stimpson, 1860.

The systematics of this genus is very confused. The following species certainly occurs.

201. *T. lanceolatum** Stimpson, 1860.

S* ; in trawls S. of Langkawi* ; S. China Sea* ; N.

Family : Processidae.

The taxonomy of oriental species of this family is in need of revision. The following forms certainly occur at Singapore.

Nikoides Paulson, 1875.

202. *N. sibogae* de Man, 1910. S* ; E.

Processa Leach, 1915.

australlensis Baker, 1907. Not in the Indo-West Pacific region specimens from which region belong to *P. macrognatha* (Stimpson).

203. *P. macrognatha* (Stimpson), 1860. S* ; ? W, N, E.

204. *P. processa* (Bate), 1888. S* ; W, N, E.

Family : Thalassocaridae.

Thalassocaris Stimpson, 1860.

205. *T. crinita* (Dana), 1852.

Off Sembilan Is., * Perak, 45 to 80 m ; W, N, E.

Family : Pandalidae.

Chlorocurtis Kemp, 1925.

206. *L. jactans** (Nobili), 1904.

S*, weed beds and rock pools on offshore isles.

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Chlorotocella Balss, 1914.207. *C. gracilis** Balss, 1914.

S* (Johnson, 1961); Java*; W, N, E; young in weed beds; adults semi-planktonic; sometimes commensal with jellyfish (Hayashi and Miyake, 1968).

Chlorotocoides Kemp, 1925.208. *C. spinicauda** de Man, 1902.

S* (Johnson, 1961); 80 miles S. of Penang* (Johnson, 1961).

Heterocarpoides de Man, 1917.209. *C. levicarina** (Bate), 1888.

S* (Johnson, 1961) at depths around 70 m and above.

Plesionika Bate, 1888.210. *P. martia* (A. M. Edwds).

Singapore Regional Fisheries Station C7/14, edge of continental shelf to west of Langkawi in depth of about 170 m*.

The abundance of this species in this collection strongly suggests the presence of commercially exploitable stocks which might become of value in the future. The rather small size of the species would appear to rule out immediate commercial exploitation in these rather difficult conditions.

Family : Crangonidae.

The use of the name *Crangon* Fabricius, 1798 and the family name based on it has been validated by the International Commission.

Indo-West specific material is in need of a thorough revision. In these circumstances my listing will be confined to the two following species which are certainly present at Singapore. Other species certainly occur in the area.

Pontocaris Bate, 1888.211. *P. orientalis* (Henderson), 1893. S* (Johnson, 1961).**Pontophilus** Leach, 1817.212. *P. angustirostris* de Man, 1918. S* (Johnson, 1961).

GENERAL COMMENTS

It will be clear from the above listing that our knowledge of the prawns of the Malacca Straits is far from complete. In particular we know little about the northern portion of the area and almost nothing about the east coast of Sumatra to the south

of Belawan Deli. Nonetheless the areas investigated do probably give a reasonably representative list. The picture formed is probably generally representative of the whole area of Sundanian shallow seas. Shallow water Penaeidea are varied and abundant and the stocks are of major importance. Caridea are even more varied but for the most part of no actual or even potential importance, especially in view of the high standards of living found in most of the neighbouring land areas.

The following Table summarizes the occurrence of species in various types of habitats in the area.

TABLE 1. *Distribution of prawns by habitat*

[A.* Planktonic etc.; B. Offshore, less than 60 m, other than reef slopes; C. Offshore below 60 m; D. reefs; E. open beaches including infra-littoral fringe; F. estuaries, lagoons, mangroves, etc.]

	A	B	C	D	E	F
Penaeidae						
<i>Atyopeneus</i> ..	0	1	1	0	(1)	0
<i>Heteropeneus</i> ..	0	0	0	1	0	0
<i>Metapeneaeopsis</i> ..	0	4	5	0	(1)	(1)
<i>Metapeneaeus</i> ..	0	9	(3)	1	7	8
<i>Parapeneaeus</i> ..	0	0	1	0	0	0
<i>Parapeneopsis</i> ..	0	9	5	0	6	(4)
<i>Penaeus</i> ..	0	7	(5)	(1)	4 + (3)	4 + (1)
<i>Trachypeneus</i> ..	0	4	1 + (2)	0	(2)	(1)
<i>Sicyonia</i> ..	0	3	1	0	0	0
<i>Solenocera</i> ..	0	2	4	0	1	0
Total ..	0	39	18	2	18	12
Sergestidae						
<i>Acetes</i> ..	1	2	0	(1)	5	1 + (1)
<i>Sicyonella</i> ..	(1)	0	0	1	0	0
Total ..	1	2	0	1	5	1
Luciferidae						
<i>Lucifer</i> ..	2	0	0	0	0	0
PENAEIDEA Total ..	3	41	18	3	23	13
Stenopodidae						
<i>Microprosthema</i> ..	0	0	0	1	0	0
<i>Stenopus</i> ..	0	1	0	1	0	0
STENOPODIDEA Total ..	0	1	0	2	0	0
Atyidae						
<i>Caridina</i> ..	0	0	0	0	0	3
Total ..	0	0	0	0	0	3
Pasiphaeidae						
<i>Leptochela</i> ..	1	1	1	0	0	0
Total ..	1	1	1	0	0	0

* Including jellyfish commensals and forms of floating *Sargassum*.

	A	B	C	D	E	F
Palaemonidae						
<i>Cryphiops</i> ..	0	0	0	0	(1)	3+(3)
<i>Leander</i> ..	2	1	1	1	1	0
<i>Leandrites</i> ..	0	0	0	0	(1)	3
<i>Palaemon</i> ..	0	0	0	1	2	3
<i>Anapontonia</i> ..	0	0	0	1	0	0
<i>Anchistioides</i> ..	0	1	0	0	0	0
<i>Anchistus</i> ..	0	1	0	1	1	0
<i>Chernocaris</i> ..	0	0	0	0	1	0
<i>Conchodytes</i> ..	0	0	0	0	1	0
<i>Coralliocaris</i> ..	0	0	0	1	0	0
<i>Hamodactylus</i> ..	0	1	0	0	0	0
<i>Harpiliopsis</i> ..	0	0	0	1	0	0
<i>Ischnopontonia</i> ..	0	0	0	1	0	0
<i>Palaemonella</i> ..	0	2	1	1	1	0
<i>Periclimenaeus</i> ..	0	1	0	1	0	0
<i>Periclimenes</i> ..	0	7	1	11	7	2
<i>Philarius</i> ..	0	0	0	1	0	0
<i>Platycaris</i> ..	0	0	0	1	0	0
Total ..	2	14	3	22	14	11
Gnathophyllidae						
<i>Phyllognathia</i> ..	0	0	0	1	1	0
Total ..	0	0	0	1	1	0
Alpheidae						
<i>Alpheopsis</i> ..	0	0	0	2	0	0
<i>Alpheus</i> ..	0	14	4	35	14	4
<i>Automate</i> ..	0	0	0	1	0	0
<i>Racilius</i> ..	0	0	0	1	0	0
<i>Salmoneus</i> ..	0	1	0	2	(1)	0
<i>Synalpheus</i> ..	0	14	3 + (1)	11	4	0
Total ..	0	29	7	52	18	4
Hippolytidae						
<i>Gelastocaris</i> ..	0	1	1	0	0	0
<i>Hippolysmata</i> ..	0	3	1	(1)	1 + (1)	0
<i>Hippolyte</i> ..	1	0	0	2	1	0
<i>Latreutes</i> ..	2	0	0	1	3	0
<i>Mimocaris</i> ..	0	1	0	0	0	0
<i>Saron</i> ..	0	0	0	2	0	0
<i>Thor</i> ..	0	0	0	1	1	0
<i>Tozeuma</i> ..	1	1	1	0	0	0
Total ..	4	6	3	6	6	0
Processidae						
<i>Nikoides</i> ..	0	0	0	0	1	0
<i>Processa</i> ..	0	0	0	0	2	0
Total ..	0	0	0	0	3	0

	A	B	C	D	E	F
Thalassocaridae						
<i>Thalassocaris</i> ..	0	1	0	0	0	0
Total ..	0	1	0	0	0	0
Pandalidae						
<i>Chlorocurtus</i> ..	0	0	0	1	0	0
<i>Chlorotocella</i> ..	1	1	0	1	1	0
<i>Chlorotocoides</i> ..	0	?	1	0	0	0
<i>Heterocarpoides</i> ..	0	(1)	1	0	(1)	0
<i>Plesionika</i> ..	0	0	1	0	0	0
Total ..	1	1	3	2	1	0
Crangonidae						
<i>Pontocaris</i> ..	0	1	0	0	0	0
<i>Pontophilus</i> ..	0	1	1	0	0	0
Total ..	0	2	1	0	0	0
CARIDEA Total ..	8	54	18	93	43	18
GRAND TOTAL ..	11	96	36	98	66	31

All the species of major commercial importance belong to the Penaeidea. Of a total 47 species of Penaeidae only the following are of major importance at the present time :—

Metapenaeus affinis ; *M. brevicornis* ; *M. burkenroadi* ; *M. ensis* ; *Parapeneopsis hardwickii* ; *Penaeus indicus* ; *P. merguensis* ; *P. monodon* ; *P. semisulcatus*. Several others are of minor importance and *Metapenaeus intermedius* and *Parapeneopsis sculptilis* are likely to increase in importance with the increase in offshore fishing. In the family Sergestidae the single species of *Sicyonella* is of no importance but the 6 species of *Acetes*, taken together, are of considerable importance. The two recorded species of Luciferidae are of no direct commercial importance but of considerable value as part of the food of commercial fishes.

A few brackish water species of the subfamily Palaemoninae and of the genus *Alpheus* are of minor or local commercial importance. A few forms such as : *Stenopus hispidus* ; *Periclimenes aesopius* ; and *P. psamathe* are of potential value as attractive aquarium exhibits.

Various commensal relationships are found amongst the Stenopodidea and Caridea. *Stenopus hispidus* and *Periclimenes aesopius* are fish-cleaners whilst *P. psamathe* is a fish-cleaner mimic. More thorough going commensalism is shown by many species of Pontoniinae and Alpheidae and a few species of Hippolytidae and Pandalidae. Table 2 shows the total species numbers and number of species showing commensal relationships for the Stenopodidea and Caridea.

TABLE 2. Prevalence of commensalism (with animals).

	Total	No. of species Proved	
		Loose or facultative relations	Close commensal relations
Stenopodidae	2	1	0
Atyidae	3	0	0
Pasiphacidae	1	0	0
Palaemoninae	13	0	0
Pontoniinae	34	5	19
<i>Anapontonia</i>	1	0	1
<i>Anchistioides</i>	1	0	1
<i>Anchistus</i>	2	0	2
<i>Chern caris</i>	1	0	1
<i>Conchodytes</i>	1	0	1
<i>C. rallocaris</i>	1	0	1
<i>Hamod ctylus</i>	1	0	1
<i>Ischnopontonia</i>	1	0	1
<i>Palaemonella</i>	3	1	1
<i>Periclimenes</i>	19	4	6
<i>Periclimenaeus</i>	1	0	1
<i>Philarius</i>	1	0	1
<i>Plutycaris</i>	1	0	1
Gnathophyllidae	1	0	0
Alpheidae	80	10	10
<i>Alpheopsis</i>	2	0	0
<i>Alpheus</i>	47	5	3
<i>Athanas</i>	4	0	0
<i>Automatus</i>	1	0	0
<i>I acilius</i>	1	0	1
<i>Salmoneus</i>	3	0	0
<i>Synalpheus</i>	22	5	6
Hippolytidae	15	2	2
<i>Gelastocaris</i>	1	0	0
<i>Hippolysmata</i>	3	1	0
<i>Hippolyte</i>	2	1	0
<i>Iatreutes</i>	4	0	2
<i>Mimocaris</i>	1	0	0
<i>Saron</i>	2	0	0
<i>Thor</i>	1	0	0
<i>Tozeuma</i>	1	0	0
Processidae	3	0	0
Thalassocaridae	1	0	0
Pandalidae	5	1	0
Crangonidae	2	0	0
All Caridea	157	18	31

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