

MARINE RESEARCH IN INDONESIA

No. 25

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LEMBAGA OSEANOLOGI NASIONAL
(National institute of Oceanology)
LEMBAGA ILMU PENGETAHUAN INDONESIA
(Indonesian Institute of Sciences)
JAKARTA, INDONESIA
1985

MARINE RESEARCH IN INDONESIA

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ERRATA

PAGE	LINE	ERROR	CORRECTION
p.6	L.11	1945-1947	1845-1847
p.8	L.8	cintinum	continuum
p.10	L.12	Identation	indentation
p.18	L.23	<u>hipothoe</u>	<u>hippotoe</u>
p.20	L.13	<u>microrhunchus</u>	<u>microrhynchus</u>
p.21	L.9	Sumatera	Sumatra
p.24	** ftnt		
	L.11	deletion of as	<u>microrhynchus</u> as having
p.25	L.12	deletion of reach	fronds reach upward
p.29	L.17	perpleced	perplexed
p.30	L.7	<u>philocetes</u>	<u>philoctetes</u>
p.30	L.8	<u>philocetes</u>	<u>philoctetes</u>
p.35	L.11	previous	pervious
p.36	L.26	eliminate period	a 20 mm male
p.37	L.9	rorstrum	rostrum
p.37	L.28	wel	well
p.40	L.15	central	Central
p.44	L.26	pari	pair
p.45	L.6	rwo	two
p.46	L.36	possible	possibly
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p.69	L.31	Bedot,K	Bedot, M...
p.70	L.12	<u>Alpheus de</u>	<u>Alpheus du</u>
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p.78	L.5R	sarenei	serenei

THE ALPHEID SHRIMP OF INDONESIA, BASED UPON
J.G. DE MAN'S

"The Decapoda of the Siboga Expedition, Part II. Family Alpheidae."
(1911)

by

DORA M. BANNER and ALBERT H. BANNER¹⁾

ABSTRACT

We wish not only to up-date the taxonomy used by DE MAN in his 1911 study but also to add to his list of species those new records of species from Indonesia based upon collections made subsequently by various individuals and agencies. DE MAN reported that he had 113 species and 20 varieties of these shrimp from the Siboga Expedition; of these, 54 species and varieties have been reduced to synonymy in the subsequent years. In the present study these additional species are also being so reduced:

Alpheopsis hummelinki SCHMITT (= *Neopalpheopsis euryone* (De Man))

Neopalpheopsis hiatti BANNER (= *N. euryone* De Man)

Synalpheus jedanensis De Man (= *S. iphinoe* De Man)

S. miscellaneous De Man (= *S. neomeris* (De Man))

S. physocheles Coutière (= *S. triunguiculatus* (Paulson))

S. sluiteri De Man (= *S. paraneomeris* Coutière)

S. stimpsonii var. *maldivensis* Coutière (= *S. stimpsonii* (De Man))

S. streptodactyloides De Man (= *S. streptodactylus* Coutière)

From the post-Siboga collections, we list an additional 28 established species from Indonesian waters as well as two new species: *Alpheus nipa* and *Synalpheus mortenseni*; we also have reviewed the status of *Alpheus* (= *Synalpheus*) *tricuspidatus* Heller (1861) and consider it to be a *nomen dubium*. We now recognize a total of 145 species from Indonesian waters plus an additional 2 species left unnamed by De Man and by us.

INTRODUCTION

The first species of alpheid shrimp ever described, *Cancer (Astacus) malabaricius* Fabricius (1775) and the generic name *Alpheus* Fabricius

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1. Hawaii Institute of Marine Biology, P.O. Box 1346, Kaneohe, Hawaii 96744. Work supported in part by a series of grants from the U.S. National Science Foundation, the most recent being No. BSR 81-17603 (for additional support see Acknowledgment). Hawaii Institute of Marine Biology Contribution No. 716.

The co-author of this paper, Dr. Albert H. Banner, died on 19 August, 1985.

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(1798) as applied to this group were both based upon specimens from the Indo-Pacific. In the now two centuries of work on the taxonomy and systematics of this widespread and important family of caridean shrimp in the Indo-Pacific faunal realm, only one truly comprehensive monograph has appeared, that of J.G. De Man entitled: "*The Decapoda of the Siboga Expedition, Part II. Family Alpheidae*" (1911). While this comprehensive work concentrated on the alpheidids of what is now Indonesia, it listed all known Indo-Pacific species and included them as well as the Indonesian species in the keys under each genus considered, together with their bibliographic references. De Man also summarized the known synonymies for all species up to the date of his publication. From the time of its publication to the present, De Man's work has continued to be a most valuable, almost indispensable, reference for all of those who wished to identify these shrimp within the whole faunal realm, from Hawaii to the Red Sea, from southern Japan to most of Australia.

Little is available on the life of J. G. De Man in standard international encyclopedias or biographical collections and we are fortunate to have been given a short review of his life by Dr. Lipke B. Holthuis of Leiden Natural History Museum, here summarized:

Johannes Govertus (or Jan Govert) De Man was born on 2 May 1850 in Middelburg, Zeeland, Netherlands to the family of a physician of standing; he also had two younger sisters. His early schooling was in Middelburg, and in 1868 he entered Leiden University where he obtained his bachelor's degree in 1871 and his master's degree in 1872. After some months of study at Leipzig, Germany under Dr. R. Leuckart he returned to Leiden for his doctorate in 1873 with his dissertation written upon the comparative myology and neurology of amphibians and birds. (His first publication for which we could find a record was dated 1874 and was upon these studies). He was appointed to be assistant curator on invertebrates (exclusive of insects) at the Rijksmuseum van Natuurlijke Historie in 1872 and elevated to curator there in 1875. However, for reasons of health and as he "was not quite happy in the museum" (Holthuis), he retired from his post at the museum and, supporting himself on his independent means, devoted his life to the study of crustaceans and nematodes, first in the family home of Middelburg and then in his individual home in Ierseke, also in Zeeland. He had "a rather shy and retiring personality" (Holthuis) and never married, devoting his life to his studies. He had spent some months at the Zoological Station in Naples, and had travelled to England, Germany and Scandinavia, but had never left Europe. He became ill in September, 1929 and died in Middelburg on 19 January 1930. According to Dr. Holthuis's bibliography,* he had published over 80 studies upon the higher crustaceans, some, like the Siboga Reports, quite lengthy. He had been a close friend of Dr. Max Weber (of the Siboga Expedition — see

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below) who was then director of the Zoological Museum of Amsterdam and he bequeathed to that museum his library and collections.

While De Man had published as early as 1888 upon alpheids from Indonesia, the collections from the Siboga Expedition were his most important. The research ship, *Siboga*, was originally designed to be a small naval gunboat for military service in the Dutch East Indies but was modified for oceanographic research before leaving for Indonesia. It was a comfortable ship for Indonesian waters, with a 50.6 m length, 9.4 m beam and a 3.3 m draft; it was equipped for dredging, plankton hauls, sounding and water sampling, and also carried boats and launches that could be used for parties doing shallow-water collecting (Tydeman, 1902). The instigator and director of the expedition was Dr. Max Weber of the Netherlands who was accompanied by a small scientific field staff.

In the period from 7 March, 1899 to 25 February, 1900 the *Siboga* made 323 numbered dredge, trawl, etc. hauls and some un-numbered "reef explorations". While the ship carried on no studies about Sumatra and western Java and only twice touched along the eastern coast of Borneo, its track crossed much of central and eastern Indonesia from the Sulu Sea and the small islands of Pulau-Pulau Nanusa in the north to Timor and Roti in the south and to Halmahera, West Irian and Kepulauan Kai and Kepulauan Aru in the east. Almost all dredge hauls were in the relatively shallow waters of the Indonesian basin, but a few exceeded 3000 m and some were in the 4000 m range (Weber, 1902). Upon the return of the expedition to the Netherlands the collections were sorted and sent to various European specialists for identification; some groups have never been reported upon. All resultant studies were published in the *Siboga Reports*, and extensive series of quarto volumes.

The scientific field staff was charged with sampling all of the marine biota of the archipelago, from algae and protozoans to the chordates, and from all types of environments. It is not surprising that these "generalists"

* We have been remiss in not previously acknowledging our debt to Dr. Holthuis for the use of his bibliography, compiled by him while confined during World War II. When Dr. Holthuis visited at the Smithsonian Institution in Washington, D.C. in 1949 he carried this bibliography with him on cards. It focused on "some groups of higher crustacea", mostly on caridean shrimp, and was a historical bibliography covering all references to individual species of these groups from the time they were described (and even going back to Rumphius's pre-Linnean *D'Amboinsche Rariteitkamer* . . . of 1705) up to about 1947 or 1948. When Dr. Waldo L. Schmitt, the then Curator of the Crustacea for the U.S. National Museum, saw this bibliography he obtained permission from Dr. Holthuis to have a typed copy made, with some extra carbon copies (the dry photocopy technique was not yet perfected) for distribution to American workers. Fortunately, Dr. Schmitt saw fit to offer one of these few copies to me (AHB) and the University of Hawaii that has been available to us since 1953. As our library then was so new and so meager, our work could not have been accomplished without the references to older works available in Holthuis's bibliography, and we are and will be always in his debt for its use.

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produced only a limited number of specimens of alpheids but a collection that was surprisingly diverse. Indeed, the total collection that De Man reported upon in his 1911 work was less than a thousand specimens, including those that were fragmentary or immature (in his 1922 supplement he added 36 specimens, a few of which were collected by individuals subsequent to the Siboga Expedition).

Synonyms in De Man's Study

From this limited but diverse collection De Man reported 113 species and 20 varieties. He had therefore a limited basis for studying variation within the species: only 31 of the named forms were represented in the collections by 10 or more specimens, and 57 of the named forms were represented by only one or two specimens. Of these 57 forms so inadequately represented, 30 were designated by De Man as new species or new varieties.

Certainly one distinctive specimen is sufficient to be used as a type for a new species if the differences between it and other known species are firm and not subject to variation that encompasses the differences when a larger population is studied. Unfortunately, during the period of the great works by Coutière and De Man the extent of natural variation in larger populations was not appreciated and new species were described on the basis of such variable characteristics as differences in the length/breadth ratios of individual articles of the appendages or numerical counts of the meral spines on the pereopods. Indeed, De Man wrote in his first paragraph of his 1911 work: "Coutière also first called attention to the great importance of the relative measurements of the thoracic appendages and of the telson as specific characters, characters that previously had been overlooked by the carcinologists and it was just by means of these new characters, that often specimens of small size of *Alpheus* or *Synalpheus* prove to belong to species that were still unknown . . . "

In addition to having but few specimens and seeking subtle differences between species and "varieties" that did not allow for natural variation in characteristics, the earlier workers were largely dependent upon collections made by others without supplementary field observation made by themselves. Coutière did have a three-month study on the reefs of Djibouti in the Gulf of Aden in 1897 (Chace & Forest, 1970 : 1399), a study that greatly contributed to his Thesis (1899). De Man, on the other hand, never had the opportunity to visit a tropical coral reef.

This combination of conditions obtaining in the latter 19th and early 20th centuries has resulted in long lists of synonyms as is shown by the listing of synonyms created by De Man in the Appendix of this paper. Examples of proliferation of synonyms is especially apparent in species

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of specialized habitats, such as those in the *Obesomanus* Group of the genus *Alpheus* (see, among other references, Banner & Banner 1966a: 162 and Banner & Banner 1983 : 44) and such species groups within the genus *Synalpheus* as those in the *S. neomeris* complex (discussed in the text below). (Incidentally, we are not content with the attempted resolution we have presented of either of these two cited complexes).

However, the creation of these synonymous names does not denigrate the work accomplished by De Man nor cast aspersions upon his *Siboga Report*. He was a methodical and meticulous worker whose detailed descriptions and accurate figures are a firm basis for the later classification of many groups of decapods, and especially the alpheid shrimp. Our foregoing discussion should be regarded as merely an explanation of his times, not a criticism of his work. We therefore wish to honor his work by the dedication of this study to him.

To facilitate the use of our present work, when compared to older works, we have listed what are now considered to be junior synonyms used by De Man in 1911 and subsequent works in the Appendix, together with the name under which it appears in our text and giving also the citation for the change in nomenclature.

AREA STUDIED AND GEOGRAPHICAL NAMES

The geographic limits of this study are basically those of the Indonesian state as presently established, with the exception of the waters of the southern Sulu Archipelago that were visited by the *Siboga*. These Philippine islands are included because specimens from them have been listed by De Man and because the marine biota does not recognize the political boundaries of modern states. (Note: We have touched upon the alpheids of this archipelago in our Philippine paper, Banner & Banner 1979).

De Man's colonial Dutch place names have been used where they have been cited. Place names for collections since 1911 have been given as far as possible as the presently accepted official names as taken from the official gazeteer (see bibliography under "Badan Koordinasi . . .").

COLLECTIONS AVAILABLE FOR THE PRESENT STUDY

We have been able to reexamine many of De Man's *Siboga* specimens in the museum in Amsterdam, and other of his Indo-Pacific material including various types in the museum in Leiden. Our new material, the primary basis of this paper, came from four major sources:

I. The collections of the Lembaga Oseanologi Nasional (National Institute of Oceanology) of Jakarta. These collections came primarily from the *Rumphius I and II Expeditions*, field studies in eastern Indonesia centered about the island of Ambon. The participants in these included both Indonesians and foreign nationals, the latter selected and invited based

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upon their fields of expertise. The collections were made by shore collecting, diving and dredging in deeper waters. Other specimens in the collections of the Institute were made by individuals, both Indonesian and visitors, in various parts of Indonesia.

II. A large set of collections came from the Zoologiske Museum of Copenhagen, Denmark. Most of these specimens came from the several large expeditions headed by Th. Mortensen of Denmark, including a major one to Ambon and the Pulau-Pulau Kai in 1922 when he was searching for a possible site for a new Danish tropical marine laboratory. These were supplemented by specimens collected by the *Galathea* Expeditions of 1945 — 1947 and 1950 — 1952. A few of the specimens loaned by the museum came from other trips by individuals and by other expeditions. Most of these specimens were dredged from waters less than 100 m deep, although Mortensen's party did shore and reef collecting about Ambon.

III. A collection loaned by the Smithsonian Oceanographic Sorting Center of Washington, D.C. The collection was made incidental to his other studies by Dr. Paul M. Taylor, a cultural anthropologist from the Smithsonian Institution, during field studies on Halmahera and Ternate; most were made near Pasir Putih, on Halmahera. While the collections was large, containing 734 specimens, it had a limited number of species reflecting the limited environment where the collections were made: a shallow, sandy bay protected by a basaltic cape with only scattered heads of living and dead corals.

IV. The collection we made for ourselves during the month of June, 1975. We collected about the island of Ambon, near Ujung Pandang on Sulawesi and on Pulau Putri in the Pulau-Pulau Seribu (Thousand Islands) near Jakarta. In all areas we attempted to make transects from the beaches to the deepest depths we could easily reach by skin-diving (about 3 — 8 m); we also attempted to investigate as far as possible areas of different general ecology, such as sand and mud flats, decadent and vigorous coral reefs, etc. At the first two sites we had the advice and assistance from Dr. M. Kasim Moosa of the Lembaga Oseanologi Nasional, Jakarta; in the Seribu Islands we were alone. We made tentative field identifications of the specimens with a small low-power monocular microscope and improvised lighting and left the specimens with the Institute; when we returned to Hawaii we were loaned the specimens for confirmatory laboratory examinations.

Other smaller collections were also made available to us, such as that made by the French R.V. *Corindon* of ORSTOM when it passed through Indonesian waters in 1980; these specimens were loaned to us by the Museum National d'Histoire naturelle (Paris); some were from dredge hauls as deep as 450 m.

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ADEQUACY OF SAMPLING

We believe that with the collections of the earlier workers, culminating in the extensive collections of the Siboga Expedition, and with the more modern collections, such as those of the Danish and Rumphius expeditions, the alpheid fauna of Indonesia is well-known, perhaps better than any other area in the Indo-Pacific. Unless ecologically diverse areas can be sampled, such as those exposed to heavy continuous wave action similar to the windward side in the trade wind areas of the central Pacific or specialized deep water habitats, similar to those sampled by the MUSEORSTOM Expedition off Manila, most collections will result neither in new distributional records nor new species. For reasons given below, we do not believe that the sampling of any of the largely unstudied areas such as Ceram, Timor, Sulawesi or Sumatra, will add much, if anything, to the records of alpheids from Indonesia.

NOTES ON FORMAT

The text is arranged in a strictly alphabetical order by genera and then by species, using the currently accepted names. A similar order is followed in the index but here all names appearing in the introduction or main text are listed (but not those in the appendix).

As this paper is merely an up-date of De Man's 1911 work and as we presume that anyone working upon Indonesian alpheids will have to have a copy of his work available, we are not repeating references, synonymies and records given by De Man in the main work (his later works were treated as are other post — 1911 references). The only exception to our rule against earlier citations is the 1902 paper of Schenkel in which he lists 3 species from the Celebes (Sulawesi), a paper that was somehow overlooked by De Man.

In our running citations we have continued to cite our own works as "Banner" or "Banner & Banner" with date but without reference to the alphabetizing of our individual names; in the bibliography we also did not differentiate between senior or junior authorships in our papers.

For the specimens we have studied, we have given specific collection data only for new species and for a few species where such information might be valuable (except for maximal depths for dredged specimens); any ecological information we could derive from collection records has been placed under remarks. Otherwise, we have summarized all geographic records under three arbitrary zones we have established for Indonesia: the eastern, central and western areas. The eastern area lies to the east of the Molucca Sea and the Banda Sea and includes the Maluku Islands, the Pulau-Pulau Sula, Kai, Tanimbar and Aru as well as West Irian. The central area includes the Sulawesi Archipelago and the lesser Sunda Islands from Timor to the Lombok Straits. The western area includes the Philip-

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pine Sulu Archipelago, Borneo, Java, Sumatra and their associated islands.

We have so summarized the distributional records as we, after long years of study, place little significance on differences in "distribution" within groups of associated islands such as those that compose Indonesia. It may well be significant that a species found in Indonesia may not be found in Fiji or Madagascar, but whether it has been found on Ambon and not the Pulau-Pulau Kai or Pulau-Pulau Seribu is not biologically important. With a virtual continuum of islands in Indonesia and with currents to carry the planktonic larvae of any species from one island to another, the only reason that a species may be found on Ambon and not Seribu Islands can be sought only in different ecological niches found on one and not the other, for example river mouths on Ambon that are lacking in Pulau-Pulau Seribu, or in differences in collectors and collecting techniques between the two islands see, for example, the differences in species lists from Mauritius and Reunion (Banner & Banner 1983, explanation, p. 109 and Table 3, p. 112), islands that are less than 200 km apart. Thus we believe that any species that we list for Indonesia may be found almost anywhere in Indonesia where comparable ecological conditions are obtained.

ACKNOWLEDGMENTS

This work, in part, was supported by U.S. National Science Foundation Grant BSR 81 - 17603 and by previous NSF Grants DEB 77 - 23378 and BMS 74 - 11844, all entitled "Alpheid Shrimp of the Indo-Pacific"; it was Grant BMS 74 - 11844 that in part supported our field studies in Indonesia in 1975. We also wish to thank the Hawaii Institute of Marine Biology, University of Hawaii at Manoa, for the continued support through our use of space, facilities and secretarial assistance, especially since the official retirement of one of us (AHB) at the end of 1982.

This study would not have been possible without the support of Dr. Aprilani Soegiarto and Dr. M. Kasim Moosa of the Lembaga Oseanologi Nasional, Jakarta, for their sponsorship of our studies and field work and for their cooperation in loaning us specimens. Dr. Moosa was invaluable in his aid in field collections on Ambon and Ujung Pandang and in editing this publication.

Other institutions that have been helpful in this study include:
Allan Hancock Foundation, University of Southern California, Los Angeles
Bernice P. Bishop Museum, Honolulu
Institut voor taxonomische Zoologie (Zoologisch Museum), Universiteit van Amsterdam
Museum national d'Histoire naturelle, Paris
Naturhistorisches Museum Wien (Zoologische Abteilung), Vienna
Office de la Recherche Scientifique et Technique Outre-Mer, (ORS-TOM) Paris
Rijkmuseum van Natuurlijke Historie, Leiden

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Smithsonian Institution, Washington, D.C.
Universitetets Zoologiske Museum, Copenhagen

Genus *ALPHEOPSIS* Coutiere, 1896

Alpheopsis chalciope De Man

Alpheopsis chalciope De Man, 1910: 306.

Previous record: De Man, 1911 : 179, fig. 17.

Alpheopsis equalis Coutiere

Alpheopsis equalis Coutiere, 1896 : 382

Previous record: De Man, 1911 : 178, fig. 16 (as *A. consobrinus* De Man).

Present record: Eastern, 1 specimen.

Remarks: The sole specimen was collected by us at Ambon in 1 meter of water.

Alpheopsis yaldwyni Banner & Banner

Figure 1

Alpheopsis yaldwyni Banner & Banner, 1973 : 344, fig. 17.

Present record: Eastern, 1 specimen.

Remarks: The specimen is a 12 mm male collected from Rumah Tiga, Ambon in a head of overgrown coral in 2 m. of water. Field notes indicate it had "broad red transverse banding on carapace and abdomen." This is the same color pattern described for the holotype and some of the paratypes from Australia (Banner & Banner *loc. cit.*). This is the first time this species has been reported since the original description.

In the mature specimens of the type series, running 19 mm or over in total length, the chelae were nearly symmetrical in size and symmetrical in armature. In this smaller specimen they are dissimilar (see fig. 1, b - e); this is likely to be from immaturity. Similar changes with growth have not been especially remarked upon for other species of this genus, (for example, see Banner 1953 : 15) but are well known in the related genus *Athanas* (see Banner & Banner 1960 : 135).

As our paper describing *A. yaldwyni* was already in the hands of the printer when we received Dr. Chace's publication bearing the description of his new Caribbean species, *Alpheopsis labis* (1972 : 55, fig. 15) we were unable to contrast our species with his. His species is based upon holotype with a carapace length of 2.2 mm (in contrast to this specimen with a

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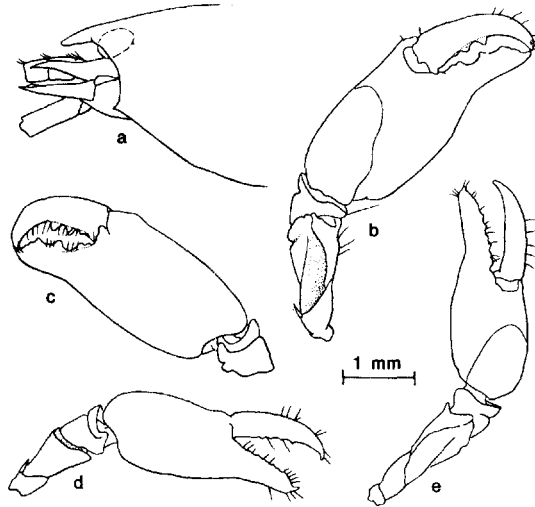


Figure 1. *Alpheopsis yaldwyni* Banner and Banner, 12 mm male from eastern Indonesia. a. Anterior region, lateral view; b, c, large chela, lateral and medial face; d, e, small chela, medial and lateral face. All figures same scale.

carapace length of 4.9 mm), and came from Antigua Island; he gave the additional distribution of Bermudas, Cuba and Hispaniola.

Like the specimen from Ambon, the chelae in *A. labis* are asymmetrical in size and armature with the larger, but not the smaller, bearing strong teeth. However, the larger chela is apparently rounded or ovoid in cross-section, not plano-convex and expanded as in *A. yaldwyni*, and its merus lacks the subterminal transverse indentation. These differences may lie in the maturity of the two specimens. Another strong difference lies in the anterior carapace which gradually slopes laterally posteriorly from the base of the rostrum to the anterolateral margins of the branchiostegite, in contrast to a transverse margin flanking the rostral base that then proceeds ventrally to a strong pterygostomial tooth in *A. yaldwyni*. Other differences between the two species can be found in the armature and proportions of the walking legs, but these differences are slight and, considering the inherent variability within other species of the genus, probably without importance. However, when mature specimens of *A. labis* are found — if indeed, the holotype is immature — they should be contrasted again to the Indo-Pacific *A. yaldwyni*.

Alpheopsis sp. De Man

Alpheopsis sp. De Man, 1922 : 24, fig. 12.

Remarks: De Man did not name this 8.2 mm specimen, in part, be-

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cause it was "still very young", but suggested it might be *Alpheopsis trispinosus* (Stimpson), a species collected from Port Jackson, Australia. We decided when we established a neotype for *A. trispinosus* that De Man's specimen did not belong to the species as redefined (Banner & Banner, 1973 : 337). We have again considered De Man's specimen and believe it is likely to be a new species but one that should be left unnamed until more mature specimens can be described.

Genus *ALPHEUS* Fabricius, 1798.

Alpheus acutocarinatus De Man

Alpheus acutocarinatus De Man, 1909a : 104.

Previous records: De Man, 1911 : 401, fig. 94.

Present records: Eastern, 3 specimens; central, 1 (dredged to 62 m).

Alpheus acutofemoratus Dana

Alpheus acutofemoratus Dana, 1852a : 22.

Previous records: De Man, 1911 : 337; 1922 : 35.

Present records: Eastern, 79 specimens; central, 2; western, 19.

Remarks: We have twice before remarked that *A. acutofemoratus* inhabits the same general type of deep furrow or groove in living heads of massive coral, especially heads of *Porites*, as does *A. deuteropus* Hilgendorf. In our Australian paper (Banner & Banner 1982 : 44) we discussed at length the type of groove inhabited by *A. deuteropus*, based in part on the unpublished observations of R.A. Vaughn; in that paper we made the passing remark that our Indonesian collections showed that the two species occupied similar grooves. In our Philippine study (1979 : 218 — note: while the Philippine paper was published earlier than the Australian, the Australian paper was already in press when this section of the Philippine paper was written) we contrasted habitat preferences of the two species and found that *A. deuteropus* appeared to prefer corals in cleaner, more wave-swept areas while *A. acutofemoratus* preferred quieter waters and corals lying on a substrate at times with silt and organic debris. This contrast of the two habitats was brought about by our field studies in Indonesia in 1975. While in the Seribu Islands ("Thousand Islands") off Jakarta we made a special effort to collect *A. deuteropus* from grooves in massive corals that we immediately identified on the reefs as "A. deuteropus grooves." In all cases they were occupied by *A. acutofemoratus*. Indeed, in contrast to the hundred specimens of *A. acutofemoratus* from all of Indonesia, we have only one specimen of *A. deuteropus* to report (from Ambon Bay — see below), the only one known from Indonesia.

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From our personal collections in Indonesia we see nothing that would void the hypothesis we put forward in the Philippine paper, for none of the collecting sites we visited (except possibly where we obtained the one specimen of *A. deuteropus*) were characteristic of moderate to high wave activity or especially clean waters.

Alpheus alcyone De Man

Alpheus alcyone De Man, 1902 : 870, fig. 61.

Previous records: De Man, 1911 : 351.

Present records: Eastern, 9 specimens; western, 1.

Remarks: These specimens were taken from corals in the intertidal region.

Alpheus amirantei Coutière

Alpheus amirantei Countiere, 1908 : 205.

Present record: Easter, 1 specimen.

Remarks: This specimen was collected intertidally from a sponge.

Alpheus anchistus De Man

Alpheus anchistus De Man, 1908 : 108.

Alpheus sp. De Man, 1911 : 383, fig. 85.

Previous records: De Man, 1911 : 383, fig. 85 (as *Alpheus* sp.) 1920 : 108; 1922 : 37, fig. 16.

Alpheus angustodigitus De Man

Alpheus brevirostris angustodigitus De Man, 1911 : 385, fig. 87.

Previous record: De Man, *loc. cit.*; 1924 : 45, fig. 16.

Remarks: Inasmuch as *Alpheus brevirostris* (Olivier) remains unknown except for the still extant holotype from "New Holland" (= somewhere in the southern or western half of Australia) (see Banner & Banner 1982: 170), it seems rather strange to maintain De Man's well-described form as a variety of this species. Therefore we are following the lead of Johnson (1962 : 53) who raised the variety to specific rank (as *A. angustidigitus*, *lapsis calami*). De Man gives no specific information as to habitat of the species; Johnson reported the species from beaches and mud-flats as well as being dredged from about 12 m in the Singapore area.

Alpheus architectus De Man

Alpheus architectus De Man, 1897 : 726, fig. 60.

Previous records: De Man, *loc. cit.*

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Alpheus arethusa De Man

Alpheus arethusa De Man, 1909a : 100.

Previous records: De Man, 1911 : 352, fig. 72.

Alpheus barbatus Coutière

Alpheus barbatus Coutière, 1897a : 235.

Previous records: De Man, 1911 : 387, fig. 88.

Alpheus bicostatus De Man

Alpheus bicostatus De Man, 1908 : 102.

Previous records: De Man, 1911 : 375, fig. 82.

Present record: Eastern 1 specimen (dredged at 4 m).

Alpheus bidens (Olivier)

Palaemon bidens Olivier, 1811 : 663.

Previous records: De Man, 1911 : 371, fig. 80; *op. cit.* : 373, fig. 81 (as *Alpheus praedator* De Man).

Present record: Eastern, 12 specimens.

Remarks: 11 of these specimens were taken from Banda and one was from Ambon, the type locality for De Man's *A. praedator*. None were collected below 15 m. They all fall within the limits of variation of *A. bidens*, as discussed in our Australian paper (Banner & Banner 1982 : 139).

Alpheus bisincisus De Haan

Alpheus bisincisus De Haan, 1850 : 179, pl. 45, fig. 3

Previous records: De Man, 1911 : 405, fig. 95; *op. cit.*: 406, fig. 95 (as *A. bisincisus variabilis*).

Present records: Eastern, 13 specimens (dredged to 40 m).

Alpheus bucephalus Coutière

Alpheus bucephalus Coutière, 1905 : 890, pl. 78, fig. 29.

Previous record: De Man, 1911 : 360, fig. 75 (as *A. consobrinus* De Man).

Present records: Eastern, 50 specimens; central, 4; western, 3.

Remarks: These specimens were all collected from intertidal heads of coral.

Alpheus chiragricus H. Milne Edwards

Alpheus chiragricus H. Milne Edwards, 1837 : 354.

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Previous records: De Man, 1911 : 415.

Present records: Eastern, 4 specimens; western, 1.

Remarks: While four of the specimens were collected intertidally one came from the Malacca Straits at 40 m.

Alpheus clypeatus Coutière

Alpheus clypeatus Coutière, 1905 : 897, pls, 81 — 82, fig. 36.

Present record: Western, 1 specimen.

Remarks: The specimen was taken from the reef flat.

Alpheus collumianus Stimpson

Alpheus collumianus Stimpson, 1860 : 30.

Previous records: De Man, 1911 : 334, fig. 65: 1924 : 41.

Present records: Eastern, 24 specimens.

Alpheus compressus Banner and Banner

Alpheus compressus Banner & Banner , 1981 : 227, fig. 3.

Present record: Western, 1 specimen.

Remarks: This solitary specimen from Sunda Strait is fragmentary, bearing only one of the second of the five thoracic legs. We assign it to this species with only slight doubts, for it has the high degree of lateral compression found in the type series from the South China Sea and its outer uropod bears the unusual lobe at its distal articulation; like the holotype (and unlike one of the paratypes), it lacks orbital teeth. Our slight doubts arise from the rostrum which is about as broad at its base as long and with its tip reaching only to the end of the first antennular article, instead of being much longer than broad and reaching to the end of that article. The specimen was dredged from a muddy bottom at 27 m in the Sunda Straits.

Alpheus coutierei De Man

Alpheus coutierei De Man, 1909a : 107

Previous records: De Man, 1911 : 409, fig. 97.

Alpheus crockeri (Armstrong)

Crangon crockeri Armstrong, 1941 : 8, figs. 2, 3.

Present record: Eastern, 1 specimen.

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Alpheus deuteropus Hilgendorf

Alpheus deuteropus Hilgendorf, 1879 : 834, pl. 4, figs. 8 — 10.

Present record : Eastern, 1 specimen.

Remarks: This is the only specimen of *A. deuteropus* known from the Indonesian Archipelago. In view of our hypothesis on the habitats of *A. deuteropus* and *A. acutofemoratus* Dana (see above), we cannot explain why we found it in Ambon Bay except to state in that particular collection no specimens of *A. acutofemoratus* were found. We suggest that the species will be better known from the archipelago when sites more on the open sea with greater wave action are sampled.

Alpheus diadema Dana

Alpheus diadema Dana, 1852a : 23.

Previous records: De Man, 1911 : 377 (as *A. insignis* Heller).

Present records: Eastern, 7 specimens; western, 5 (dredged to 10 m).

Alpheus distinguendus De Man.

Alpheus distinguendus De Man, 1909b : 155, figs. 9 — 14.

Present records: Eastern, 1 specimen; western, 1 (dredged to 75 m).

Remarks: DE MAN stated that he did not have this species in the Siboga collections but he reported one specimen as possibly belonging to this species from a river near Pare-Pare, Celebes (1909b : 157; 1911 : 306). One of the above specimens was taken near Krakatoa on a bottom of mud and pumice during the Danish Kei Island expedition.

Alpheus djeddensis Coutière

Alpheus djeddensis Coutière, 1897 : 202.

Present records: Eastern, 2 specimens; western, 29.

Remarks: Most of these specimens were collected burrowing in muddy sand. This species commonly has a goby living in its burrow (see Banner & Banner 1983 : 28), but this association was not remarked upon in the field notes.

Alpheus edamensis De Man.

Alpheus hippothoe edamensis De Man, 1888a : 518.

Previous records: De Man, 1911 : 437, fig. 107.

Present records: Eastern, 25 specimen; western, 19.

Remarks: All of these specimens were collected intertidally.

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Alpheus edwardsii (Audouin)

Athanas edwardsii Audouin, 1827 : 274.

Previous records: Ortmann, 1894 : 13; De Man, 1911 : 414, fig. 100 (as *A. audouini* Coutière). (See also De Man's records under *A. chigragricus* H. Milne Edwards 1911 : 415).

Present records: Eastern, 64 specimens; central, 2; western, 11.

Alpheus ehlersii De Man

Alpheus ehlersii De Man, 1909c : 663, pl. 70.

Previous records: De Man, *loc. cit.* (not collected by the Siboga Exp. — see De Man, 1911 : 320).

Present records: Eastern, 2 specimens; western, 1.

Remarks: Our colour notes on the solitary female specimen from the Seribu Islands indicate that the body and appendages were primarily pale and transparent, with the rostrum and rostral grooves a yellow-brown, the gastric region of similar colour, the posterior margins of the abdominal terga and the tips of the caudal fan approaching black. The antennular and antennal peduncles carried faint touches of yellow brown; the superior and inferior margins of both chela were darker yellow-brown, but with the middle of the lateral faces and the fingers colourless.

Alpheus euphrosyne euphrosyne De Man

Alpheus euphrosyne De Man, 1897 : 745, pl. 36, fig. 64.

Previous records: De Man, 1911 : 413; 1920 : 109; 1924 : 48, fig. 17 (last two records as *A. eurydactylus* De Man).

Present records: Western, 3 specimens.

Remarks: These 3 specimens from the Seribu Islands came from muddy sand in a mangrove swamp.

We wish to withdraw our designation of *A. langi* (Schmitt), (as *Cra-ngon langi* in 1926 : 20) as a subspecies of *A. euphrosyne*. Dr. C. B. Powell of University of Harcourt, Nigeria, in a personal letter has pointed out to us that *A. langi* was reduced to synonymy under the name *A. pontederiae* Rochebrune (1883) by Holthuis in 1951 (p. 85, fig. 17). In our concentration upon Indo-Pacific species we had forgotten this change of status, and had ignored the figures of Holthuis and of Crosnier & Forest (1966 : 278, fig. 23; the latter are the most complete figures of *A. pontederiae* available). Reviewing these descriptions and figures, we still believe that the West African form is related to *A. euphrosyne* of the Indo-Pacific, but we believe the two forms to constitute separate and valid species. However, in view of the variation we have found in stocks of *A. euphrosyne*

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in various parts of the Indo-Pacific and in view of the variation in habitats — from the mud of mangrove swamps to the marl of reef-flats in the Red Sea—we believe some future study should carefully compare the variation found in the two separate ranges to determine the degree of interrelationship.

Alpheus facetus De Man

Alpheus facetus De Man, 1908 : 100.

Previous record : De Man, 1911 : 340, fig. 67.

Present records: Eastern, 3 specimens; central, 4.

Remarks: Field notes indicate one of the specimens from Hative Besar, Ambon was collected from an overgrown coral in 2 meters of water and was of basic olive green colour with three darker longitudinal stripes, one down the middle of the body and one stripe on either side.

Alpheus foresti Banner & Banner

Alpheus foresti Banner & Banner. 1982a : 229, fig. 4.

Present record: Western, 4 specimens.

Remarks: This is the first time this species has been reported since its original finding in the Philippines (Banner & Banner *loc. cit.*). These specimens were collected off Ujung Pandang in 134 — 138 m.

Alpheus frontalis H. Milne Edwards

Alpheus frontalis H. Milne Edwards, 1837 : 356.

Previous record: De Man, 1911 : 369, fig. 79.

Present records: Eastern, 17 specimens; western, 3.

Alpheus funafutensis Borradaile

Alpheus funafutensis Borradaile, 1898 : 1013, pl. 65. figs. 10 — 10h.

Previous records: De Man, 1911 : 436.

Present records: Western, 5 specimens.

Remarks: Of the 5 specimen, all from the Seribu Islands, 2 did not have the usual double tooth on the outer margin of the outer uropod. These two specimens are also less pustulate on the inner faces of the chelae than is usual. We feel these differences probably lie within the range of normal variation.

The specimens were collected intertidally from broken overgrown coral. One of the females was almost transparent with greenish cast to the abdomen and brownish cast to the carapace from the brown internal organs; the eggs were blue-green.

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Alpheus georgei Banner & Banner

Alpheus georgei Banner and Banner, 1982 : 200, fig. 61.

Previous record: De Man, 1922 : 42, fig. 18 (as *Alpheus euchirus* Dana see Banner & Banner, 1982 : 197).

Alpheus gracilipes Stimpson

Alpheus gracilipes Stimpson, 1860 : 31.

Previous records: De Man, 1911 : 380; 1924 : 43, fig. 15.

Present records: Eastern, 16 specimens; central, 1; western, 23.

Remarks: Field notes for one of the specimens from the Seribu Islands indicate it had the general colouring typical for this species (see Banner & Banner 1982 : 145) but lacked the usual lateral "eye-spots" on the abdomen.

Alpheus gracilis Heller

Alpheus gracilis Heller, 1862 : 271, pl. 3, figs. 19, 20.

Previous record: De Man, 1911 : 338, fig. 66 (*A. gracilis luciparensis* De Man).

Present records: Eastern, 2 specimens; western, 5.

Alpheus hailstonei Coutière

Alpheus hailstonei Coutière, 1905 : 879, pl. 74, fig. 18.

Previous records: De Man, 1911 : 331, fig. 64 a — c (as *A. h. assimulans* De Man); 1911 : 333, fig. 64 d, e; 1922 : 32 (both records as *A. h. laetabilis* De Man).

Alpheus hippothoe De Man

Alpheus hippothoe De Man, 1888a : 268, pl. 17, figs. 1 — 5.

Previous record: De Man, 1911 : 433.

Present records: Eastern, 52 specimens; central, 11; western, 5 (dredged to 50 m).

Alpheus lepidus De Man

Alpheus lepidus De Man, 1908 : 106.

Previous record: De Man, 1911 : 397, fig. 92.

Alpheus leviusculus leviusculus Dana

Alpheus edwardsii leviusculus Dana, 1852b : 543, pl. 34, figs. 3 a-f.

Previous record: De Man, 1911 : 411, fig. 98.

Present record: Eastern, 1 specimen.

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Alpheus lobidens De Haan

Alpheus lobidens De Haan, 1850 : 179.

Previous records: De Man, 1911 : 417; 1924 : 50 (both records as *A. crassimanus* Heller).

Present records: Eastern, 18 specimens; western, 18.

Alpheus lottini Guérin*

Alpheus lottini Guérin, 1838 : 38.

Previous record: De Man, 1911 : 339 (as *A. ventrosus* Milne Edwards).

Present records: Eastern, 31 specimens; western, 58.

Alpheus mackayi Banner

Alpheus malabaricus mackayi Banner, 1959 : 149, fig. 12.

Alpheus mackayi Banner & Banner, 1975 : 428, fig. 2.

Present record: Eastern, 1 specimen.

Remarks: Field notes indicated this specimen came from a head of *Porites* sp., but we suspect it probably came from dead fronds buried in the substrate.

Alpheus macrodactylus Ortmann

Alpheus macrodactylus Ortmann, 1890 : 473, pl. 36, fig. 10.

Present record: Eastern, 1 specimen.

Alpheus macroskeles Alcock & Anderson

Alpheus macroskeles Alcock & Anderson, 1894 : 153.

Previous record: De Man, 1911 : 403 (as *A. macrosceles* Alcock and Anderson).

Present records: Central, 3 specimens (dredged to 450 m).

Alpheus maindroni Coutière

Alpheus maindroni Coutière, 1898a : 133, figs, 2, 2'.

Present record: Central, 1 specimen.

* Future workers should be warned that the name *Alpheus sublucanus* (Forsk.) 1775, may be substituted for *Alpheus lottini* Guérin, 1829. Holthuis so proposed in 1979, but we challenged his action before the International Commission on Zoological Nomenclature (for bibliographic references, both on original publications and on the challenge, see *Bull. zool. Nom.* 38 (4) : 297, 1981 and 39 (4) : 286, 1982). As this is being written (19 June 1985), no decision has been reached by members of the Commission, but we were informally told that while the majority of the Commission members voting were in favor of *A. lottini*, they did not reach the two-thirds majority required for official action. We offer no time estimate as to when decisive action may be taken by the Commission.

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Alpheus malabaricus leptopus De Man

Alpheus malabaricus leptopus De Man, 1911 : 429, fig. 105.

Previous record: De Man, *loc. cit.*

Alpheus malabaricus malabaricus (Fabricius)

Astacus malabaricus Fabricius, 1775 : 415.

Present records: Eastern, 5 specimens.

Alpheus malleodigitus (Bate)

Betaeus malleodigitus Bate, 1888 : 565, pl. 101, fig. 5.

Previous records: De Man, 1911 : 347, fig. 70.

Present records: Eastern, 65 specimens; western, 8.

Alpheus microrhynchus De Man

Alpheus sp. (*microrhynchus*) De Man, 1897 : 752, pl. 36, fig. 65; *A. microrhynchus* De Man 1898b : 318, pl. 4, fig. 3.

Previous record: De Man, 1911 : 413, fig. 99.

Present record: Western, 4 specimens.

Alpheus microstylus (Bate)

Betaeus microstylus Bate, 1888 : 566, pl. 101, fig. 6.

Previous records: De Man, 1911 : 344; *op. cit.* : 345 (the latter as *A. microstylus* var?).

Present records: Eastern, 1 specimen; western 5.

Alpheus miersi Coutière

Alpheus rapax miersi Coutiere, 1898b : 166.

Previous record: De Man, 1911 : 393.

Present records: Eastern, 1 specimen; central, 1; western, 1.

Remarks: In one 15 mm male specimen dredged at 19 m south of Bali the dactylus of the small chela was not balaeniceps. This probably is the result of immaturity. On this same specimen the large chela has a ridge extending longitudinally from the transverse groove to the *linea impressa*; this may be an artifact from preservation. Inasmuch as the other characteristics of the specimen resemble *A. miersi*, we are placing it in that species with some doubts.

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Alpheus nipa sp. nov.

Figure 2.

Holotype : a 22 mm male.

Allotype : a 15 mm female.

Paratypes : 3 females and 6 males ranging in size from 18 – 22 mm; no specimens with all appendages attached.

Record Of Collection : All specimens from 4°20'N, 98°54'E (Straits of Malacca, roughly 60 km from shore in the vicinity of Medan, Sumatera); water depth 40 m, but specimens collected from a floating frond of nipa palm, retrieved by dip net. Collected by the Danish Galathea Expedition 1950 – 1952, 10 May 1951, Stat. No. 325.

Description : Rostrum short, as long as broad at base, reaching only to first quarter of visible part of first antennular article; lateral margins carrying short bristles, directed upwards; Rostral carina short and rounded. Orbital margins rounded, orbital hoods with only slight depressions adjacent to rostrum. Visible part of first and second antennular articles nearly equal in length; second article 1.8 times as long as broad. Third article only 0.3 as long as second. Stylocerite with acute tip reaching to end of first article. Squamous portion of scaphocerite narrow, reaching well beyond antennular peduncle and with lateral tooth slightly longer; lateral margin slightly concave. Carpocerite longer than lateral tooth of scaphocerite, 6 times as long as broad viewed laterally.

Ratio of articles of third maxilliped beginning at base 10 : 6 : 7. Tip with rosette of short spines.

Large chela 2.3 times as long as broad, with fingers occupying distal 0.4. Superior saddle broad and shallow, with proximal and distal shoulders gently rounded; distal shoulder markedly lower than preceding superior margin. Groove of saddle projecting into lateral face as a shallow depression with rounded margins, not reaching inferiorly to middle of palm, projecting slightly distally towards dactylar articulation and proximally to beyond *linea impressa* with proximal margin somewhat "U" shaped but ill-defined. Inferior to this depression and above inferior notch lies another shallow, rounded depression running from below proximal shoulder to below dactylar articulation. Inferior shoulder heavy but with angle rounded and not projecting; notch distal to shoulder deep but not extending far distally. Superior saddle reaching into medial face with extensive series of connected depressions, all shallow and mostly with gentle margins reaching proximally below superior margin of palm to proximal half of palm as shallow groove; reaching distally below distal shoulder and articular cusp; and reaching inferiorly to be confluent with medial extension of notch distal to inferior shoulder; finally, this lower area of confluence leading to a narrow and better demarked groove along inferior margin of palm that runs proximally to carpal-propodal articulation.

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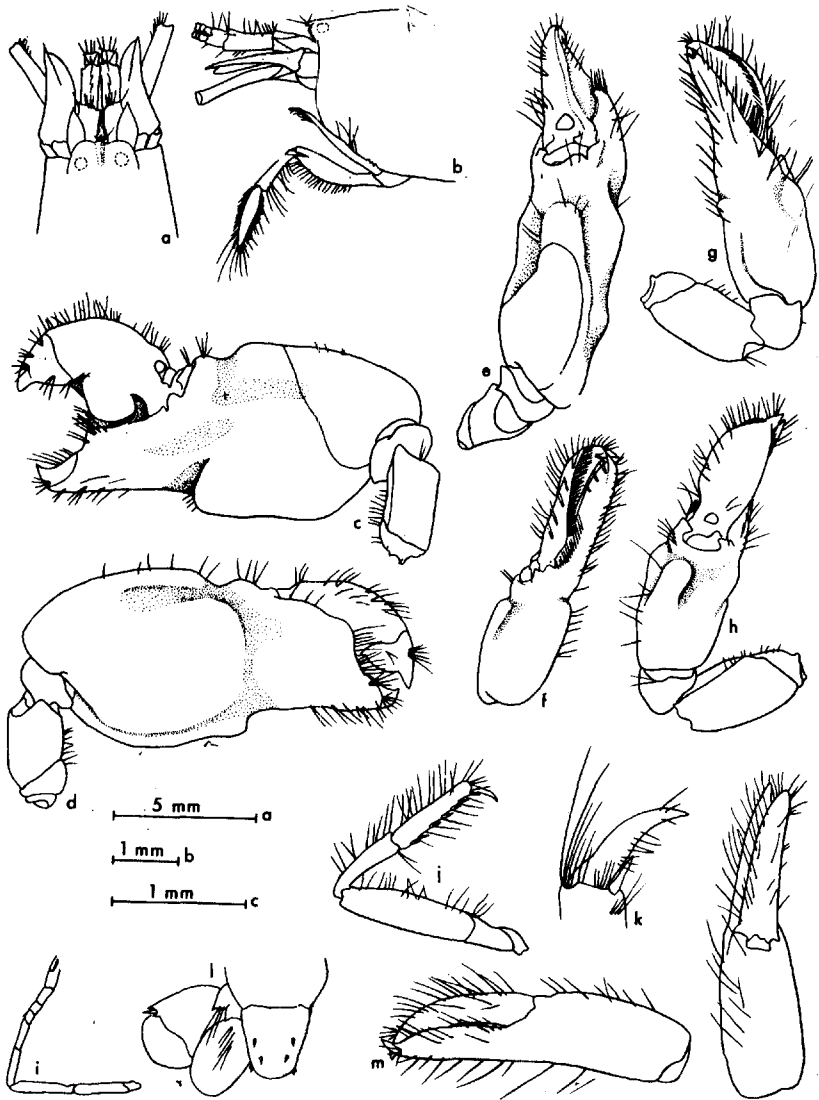


Figure 2. *Alpheus nipa* sp. nov. a, b, Anterior region, dorsal and lateral view; d, c, e, large cheliped lateral, medial and superior face; f, g, h, small cheliped lateral, medial and superior face; i, second leg; j, k, third leg and enlarged dactylus; l, telson and uropod. Allotype. m, n, small chela, lateral and superior face. a, b, c, d, e, f, g, h, i, j, l, scale a; m, n, scale b; k, scale c.

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Palmar area on medial side as demarked by these depressions with superodistal margin projecting as a low but strong prominence (see fig. 2e). Fingers heavy, with tips hardened and white from extra deposits of calcium, hooked and passing. Dactylus with superior margin curved distally to tip; plunger heavy. Chela almost glabrous except for few scattered setae and for usual long setae of fingers; not punctate. Merus unarmed, with outer face 1.3. times as long as broad; middle of inferior face of ischiomerus bearing short row of fine setae.

Small chelae sexually dimorphic. Male chela balaeniceps, 3 times as long as broad with fingers only slightly longer than palm. Sculpturing of palm similar to, but reduced from, large chela. Crest of hairs on margins of dactylus crossing superior surface proximal to curved acute tip; area near dactylar adhesive plaque conspicuously triangular and flattened; inferior margin of finger and distal part of pollex bearing many long hairs, palm with but sparse hairs on medial surface. Merus 2.3 times as long as broad, unarmed and bearing sparse hairs. Small chela of female allotype not balaeniceps, 4 times as long as broad with fingers and palm about equal in length; tips of fingers acute and crossing. Inner face of distal part of palm bearing a few long, forward directed hairs; surface smooth.

Articles of second leg with a ratio: 10 : 8 : 3 : 3 : 5.

Third legs with ischium unarmed. Merus inermous, 3.8 times as long as broad. Carpus 0.6 as long as merus bearing superodistally a slight projection, superior margin bearing several fine hairs; inferior margin glabrous but with 2 setae distally. Propodus only a little longer than carpus and bearing on inferior margin 6 strong spines with a pair distally, interspersed with several long fine setae, superior margin also bearing fine setae along its entire margin. Dactylus one-fourth as long as propodus, simple and curved; not broadened but instead subovate in section and tapering towards narrow inferior margin; bearing in middle a short row of stiff setae.

Telson broad, posterior margin broadly arcuate with curve of tip confluent with sides, without angles, teeth or notches; width at anterior margin equal to total length and 1.7 times width at level of posterolateral spines; posterolateral spines greatly reduced; dorsal spines a little larger, with anterior near mid-length of telson. Uropods broad.

Discussion : The development of the sculpturing of the large chela places this species in the Edwardsii Group. It is most closely related to the species within this group that have a very reduced rostrum and those in which the proximal shoulder of the superior groove of the large chela does not overhang the groove. The four species and subspecies in this group are:

A. euphrosyne euphrosyne De Man, 1897 : 745, fig. 64a-d.

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- A. richardsoni* Yaldwyn, 1971 : 88 (see also *Alpheus* sp., Richardson & Yaldwyn, 1958 : 37, fig. 35)*;
A. microrhynchus De Man, 1897 : 752, pl. 36, fig. 65 and 1898b : 318, pl. 4, fig. 3
A. paludicola Kemp, 1915 : 303, pl. 13, figs. 11 — 13.

These previously described species and one subspecies are all characterized by having the dactyli of the third and fourth legs not conical in lateral view and ovoid in section but rather trigonal and slightly curved, with the inferior surface flattened and somewhat broadened, or spatulate.** In *A. nipa* the dactyli of these legs are curved and tapering, with a sub-ovoid cross-section, not triangular, and with the inferior margin of the ovoid much narrower than the superior; the row of short, stiff bristles as shown in the drawing is carried along the rounded face — not the edge — of the article. On the second leg the second carpal article is about half the length of the first in *A. microrhynchus* and *A. paludicola*, while it is subequal to the first in *A. euphrosyne* and *A. nipa*. In the three species, none of the small chelae of the males have the marked sculpturing of the palm that is found in *A. nipa*, but perhaps the described males were more immature. Other differences occur in the relative length of the rostrum, the development of the scaphocerite, the sculpturing of the large chela, the spines and hairs on the propodus of the third leg, and the shape and armature of the telson — some of these characteristics may be variable and some may be reliable, but we believe that in this complex the single most reliable characteristic is the form of the dactyli of the third and fourth legs.

* For the placement of *A. richardsoni* as a subspecies, see Banner & Banner 1982 : 235; for *A. e. langi* (Schmitt) also reduced to a subspecies in the same paper, see *A. euphrosyne*, this paper, above.

** This condition was not always fully described by the original authors; De Man (1897 : 750) described *A. euphrosyne* as having the dactylus "ein wenig gebogen, von oben nach unten etwas zusammengedrückt, an der Vorderseite schwach gekielt" He does not describe the shape of the dactyli at all for *A. microrhynchus* except to state (1911 : 414) that the third and fourth legs "much resemble those of *A. euphrosyne*." Kemp does state that the dactylus in *A. paludicola* "is spatulate . . . and is externally ridged."

All of the specimens of *A. euphrosyne* we have examined do have the spatulate dactyli; we also examined topotypes of *A. paludicola* in the museum of the Zoological Survey of India and found them to be as Kemp described. We were in error in our Thai paper (1966b : 133) when we described our sole specimen of *A. microrhynchus* having a conical dactylus. We have reexamined this specimen, now stored at the Bernice P. Bishop Museum (Cat. no. S7466), and determined that the dactyli of the third and fourth legs are trigonal, with the inferior surface broad and somewhat twisted from the axis of the propodi.

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We do not believe that any importance should be attached to the type locality — the Straits of Malacca, 60 km from the closest shore of Sumatra and floating in 40 m of water. We do, however, attach significance to the fact these 11 specimens were being rafted at sea on a frond of a nipa palm.

The nipa palm, *Nipa fruticans* Wurmd (the genus *Nipa* is monotypic) is endemic to southeast Asia and adjacent waters, extending from the Bay of Bengal to Queensland to the south, to the Solomons on the east and to the Marianas on the north. It is a swamp-dwelling species with recumbent trunks lying in or above the bottom silt of the swamp as they are buoyed by air sacks in the trunk. The crowns bear long fronds that are also buoyed by airsacks. The younger fronds upward vertically; as they are displaced by yet younger fronds, they eventually lie horizontally on the surface of the water; presumably later they are detached from the trunk to either float away or to sink to the bottom. While the palms apparently have a tolerance for somewhat brackish salt water, they are always found inland and upstream from the more salt-tolerant mangroves that line the outer parts of stream deltas and brackish shorelines. They occur in fairly pure stands in suitable locations. (Data from personal observation, observation of colleagues, and from Whitmore, 1977 : 80 — 81.).

The related species and subspecies of *Alpheus* listed are all tolerant of waters of low salinity. *A. euphrosyne* may occur on reef-flats where there is "fresh-water leakage" but more commonly occurs in mangrove swamps where violent changes in salinity occur with changes of the tide. *A.e. richardsoni* was found in environments in which the salinities varied between 14 ‰ and 35 ‰ but were found to tolerate an even greater range of salinity in the laboratory (see principally Banner & Banner, 1966b : 130 — 135 and 1982; 232 — 241). *A. microrhynchus* was reported by De Man as being dredged up to 32 m off Makassar (Ujung Pandang) but also as being found in Bangkok, some 18 — 20 km up the Chaophya River from the Gulf of Thailand (as we also did, 1966b, *loc. cit.*) and by Johnson (1965 : 9) in mangrove swamps in Malaya. *A. paludicola* was described from Chilka Lake, India where it can tolerate "changes in specific gravity varying from 1.000 to 1.0265 water as salt as that of the sea in the neighborhood of the lake-mouth." We have no data whatsoever on the salinity tolerance of *A. nipa* except that the Straits of Malacca probably are more or less of normal tropical salinity, around 35 ‰.

In conclusion, we would like to suggest that *A. nipa* is derived from one of these euryhaline mud-or soft sediment-dwelling species, possibly from the most common and widespread *A. euphrosyne*. We further suggest that *A. nipa*, however, has left the mud and silt where the other three species dwell and has invaded a unique habitat, the nipa palms. In so doing, it has lost the spatulate dactyli on the walking legs, so necessary for digging

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in soft sediments, and has reverted to the ancestral hooked and pointed dactyli which are far better adapted for holding and even penetrating the leaflets of the fronds of the nipa. Here *A. nipa* would find a rich food source, not only in the leaflets themselves, but in the microscopic flora and fauna of the dead and decaying leaflets and perhaps in some of the large fauna that may be found on the floating or sinking fronds. The individual shrimp could easily forsake a dead frond and move to another that is in the process of dying. Only seldom would a storm flood carry the frond away from the nipa swamp and out to sea where it could be found by passing biologists, but such a transport could account for the concentration of the shrimp on this fragment of a frond collected by the Danes. We further suggest that the distribution of *A. nipa* may be found to be parallel to that of *Nipa fruticans*, although possibly not quite as broad.

The specific name is obviously derived from the name of the palm, which in turn is derived (according to Webster's Third New International Dictionary . . . Unabridged, 1965) "prob, fr. It., fr. Malaya *nipah*, an East Indian palm."

The holotype and allotype and 8 paratypes will be returned to the Zoologisk Museum in Copenhagen, one paratype will be placed in the Bernice P. Bishop Museum, Honolulu.

Alpheus obesomanus Dana

Alpheus obesomanus Dana, 1852a : 21.

Previous record: De Man, 1911 : 346, fig. 69 (as *A. lutini*)

Present records: Eastern, 12 specimens; western, 2.

Alpheus pachychirus Stimpson

Alpheus pachychirus Stimpson, 1860 : 30.

Previous record: De Man, 1911 : 366, fig. 77.

Present records: Eastern, 4 specimens; central, 1; western, 1.

Alpheus pacificus Dana

Alpheus pacificus Dana, 1852a : 21.

Previous record : De Man, 1911 : 427

Present records: Eastern, 22 specimens; western, 1.

Alpheus paracrinitus Miers

Alpheus paracrinitus Miers, 1881 : 365, pl. 16, fig. 6.

Present record: Eastern, 5 specimens.

Remarks: This is the first record from Indonesia of this circum tro-

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pical species.

Alpheus pararentipes Coutière

Alpheus pararentipes Coutière, 1905 : 880, pl. 74, fig. 17.

Previous record: De Man, 1911 : 336.

Present record : Eastern 2 specimens (dredged to 11 m).

Alpheus paralcione Coutière

Alpheus paralcione Coutière, 1905 : 895, pl. 80 and 81, fig. 34.

Previous record: De Man, 1911 : 354, fig. 73.

Present records: Eastern, 10 specimens; western, 20 (dredged to 55 m).

Alpheus pareuchirus imitatrix De Man

Alpheus pareuchirus imitatrix De Man, 1909a : 106.

Previous record : De Man, 1911 : 426.

Present record: Eastern, 1 specimen (dredged at 290 m).

Alpheus pareuchirus pareuchirus Coutière

Alpheus pareuchirus Coutière, 1905 : 906, pl. 84, fig. 43.

Previous records: De Man, 1911 : 418, fig. 101; *loc. cit.* : 420, fig. 102
(as *A. p. leucothea*).

Present record: Eastern, 2 specimens.

Alpheus parvirostris Dana

Alpheus parvirostris Dana, 1852a : 22.

Previous records: De Man, 1911 : 432, fig. 106; 1924 : 51.

Present records: Eastern, 255 specimens; central, 2, western, 43.

Alpheus parvus De Man

Alpheus parvus De Man, 1909a : 102.

Previous record: De Man, 1911 : 358, fig. 74.

Alpheus perplexus Banner

Figure 3.

Alpheus perplexus Banner, 1956 : 347, fig. 13.

Previous record: De Man, 1911 : 349, fig. 71 (as *Alpheus* sp.).

Present record: Eastern, 3 specimens.

Remarks: As this species has so rarely been reported in the literature

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we wish to add a few comments. This species is based upon a pair, probably cohabiting, from Saipan collected by Cloud; at the time of its description, the fragmentary specimen reported by De Man from south of Saleyer Is. (7°S ; 120°E) was also placed under the species. Since then a single specimen was reported from Tahiti. (Banner & Banner 1967 : 270) and two from Tulear in Madagascar (Banner & Banner 1983 : 62). The three specimens listed above were collected under the direction of Dr. M. Kasim Moosa, assisted by staff members Lisapally and Duma (for a discussion on of the habitat of the three specimens, see under *Metabetaeus lohena* Banner & Banner below).

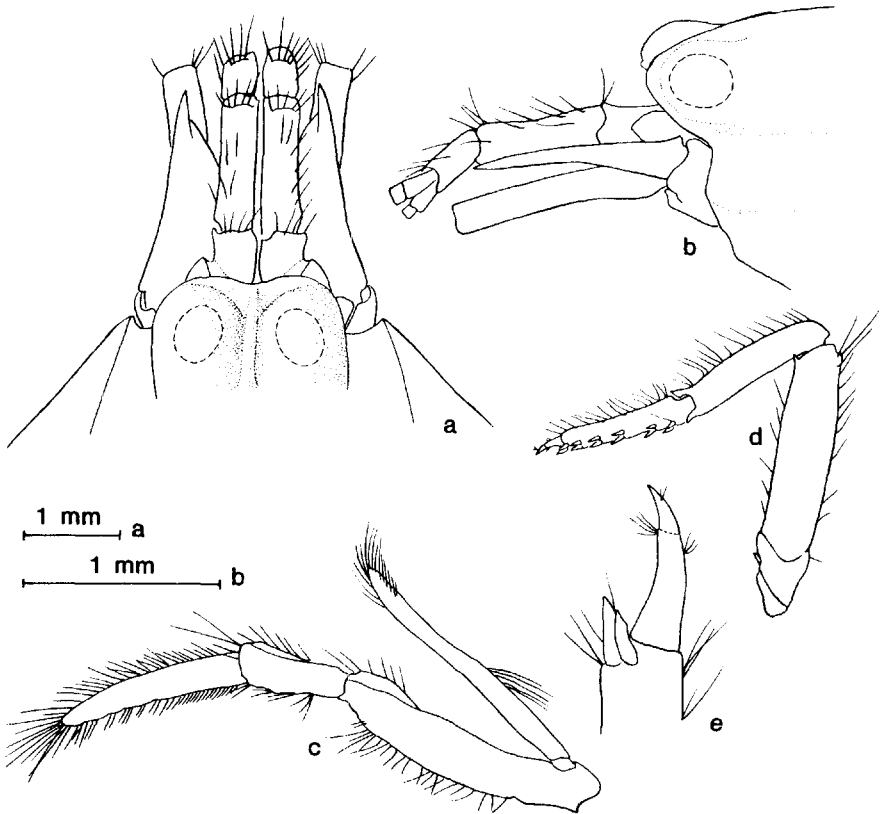


Figure 3. *Alpheus perplexus* Banner. A 26 mm male from Ambon. A, b, anterior region, dorsal and lateral view; c, third maxilliped, lateral face; d, e, third leg with enlarged dactylus. All figures except scale a.

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In the nine specimens there appears to be some variation in the interorbital margin of the carapace, with De Man's specimen and those from Tulear showing a straight front with a vestigial rostrum; the holotype, a male, had a straight front without any rostrum, and the others, including the allotype, were also without any rostrum but showed varying degrees of concavity of the interorbital margin. Similar variation in a near straight interorbital margin has been recorded for other species, as in *A. clypeatus* Coutière (Banner 1953, figs. 38, 39).

The nature of the biunguiculation of the dactylus of the third leg has not been previously discussed or depicted. Close examination shows that at about two-thirds of its length the dactylus bears a slight thickening, terminating in a transverse ridge; it is the inferior extension of this ridge that forms the small biunguiculation which may be either rounded or projecting as an acute tooth (see also De Man, 1911, fig. 71c).

The specific name reflected the inability to assign this species clearly to a subgeneric group which, at best, are not precisely defined. Again we are perplexed by the problem with one of us (DMB) holding that the form and sculpture of the large chela plainly places the species in the Macrocheles Group (previously the Megacheles Group) for the distal ridge and groove and the heavy dactylus that closes terminally is so similar to species like *A. collumianus* Stimpson and *A. hailstonei* Coutière. On the other hand, AHB, while admitting that the chela is like those in the Macrocheles Group, points out that the species in that group have strong rostrums, strong orbital teeth, and strong spines on the stylocerite, all of which are reduced in the Obesomanus Group. We leave it to future workers to decide which set of characteristics is more reliable to determine basic relationships.

These specimens from Ambon Bay were collected from the usual living and dead coral at a shallow depth near shore, but 2 of the specimens were in the same collection as *Metabetaeus lohena* Banner & Banner, a species known to be "anchialine" or "hypogean" (see discussion under that species below). This, coupled with the rarity of the species in the collections we have studied has caused us to review what is known from the collection data about its particular habitat. First, the Station A-7 on Saipan from which the type specimens came was not as we reported, from "Even to slightly undulating sand of fine-to coarse-grained limesand"; Dr. P. E. Cloud Jr. described the collection area in the western shallow lagoon of Saipan as follows: (in litt., 1983 — basic printed reference is Cloud, 1959 ("a mound of cavernous and mostly dead coral rock about 16 feet long, 8 feet wide and extending about 5 feet above the surrounding limesands" at 24' deep. The specimens were collected by breaking pieces off the mass with a geological hammer which then were examined in the accompanying boat.

Otherwise, the habitats from which specimens were collected were not outstanding — living and dead coral, mostly within simple diving depth

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from the surface and in lagoonal or bay waters of low wave energy. The associated species of alpheids also were not noteworthy and included such often-collected species as *A. collumianus*, *A. gracilis*, species of the Obesomanus Group, *A. gracilipes*, *A. paracrinitus*, etc. In none of the collection sites was there an indication of brackish water or a deep loose substrate as might be required for *M. lohena*.*

Alpheus philocetes De Man

Alpheus philocetes De Man, 1909a : 103.

Previous record: De Man, 1911 : 378, fig. 83.

Alpheus polyxo De Man

Alpheus polyxo De Man, 1909a : 108.

Previous record: De Man, 1911 : 423, fig. 104.

Present records: Eastern, 1 specimen; central, 3; western, 3.

Remarks: The specimens from Indonesia, including De Man's types, do not have the long hairs on the crest of the rostrum as did the specimens from Australia (Banner & Banner, fig. 84b).

Alpheus proseuchirus De Man

Alpheus proseuchirus De Man, 1908 : 111.

Previous record: De Man, 1911 : 407, fig. 96.

Present record: Eastern, 1 specimen (dredged from 68 m).

Alpheus pubescens De Man

Alpheus pubescens De Man, 1908 : 109.

Previous record: De Man, 1911 : 389, fig. 89.

Alpheus rapacida De Man

Alpheus rapacida De Man, 1908 : 105.

* After the acceptance of this paper for publication, Mr. Roy K. Kropp, Department of Zoology, University of Maryland, told us of his observation on the habitat of *A. perplexus* on Guam while studying the role of decapod crustaceans in the biodegradation of coral reefs. He reported finding extensive colonies of this species in obesomanus-like burrows on the level bottom of encrusting coralline algae at various shallow depth (about 5-8 m). The burrows were marked by a series of lineally-arranged ports at the surface and extended down some distance into the coralline substrate. He also remarked that when the ports were observed closely one could see the elongate and chelate second legs extending from the ports and picking material off the adjacent substrate, presumably for food. Mr. Kropp has granted us permission to publish this preliminary note and has informed us that he plans to make further observations on this ecology and to publish upon it in the future.

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Previous record: De Man, 1911 : 394, fig. 91.

Present record: Eastern, 3 specimens (dredged from 49 — 53).

Alpheus rapax Fabricius

Alpheus rapax Fabricius, 1798 : 405.

Previous record: De Man, 1911 : 385.

Alpheus savuensis De Man

Alpheus savuensis De Man, 1908 : 110.

Previous record: De Man, 1911 : 392, fig. 90.

Alpheus serenei Tiwari

Alpheus serenei Tiwari, 1963 : 310, figs, 27, 28.

Previous records: De Man, 1911 : 434; 1922 : 42, fig. 18 (both as *Alpheus euchirus* Dana).

Present records: Eastern, 15 specimens; central, 9; western, 22.

Alpheus sibogae De Man

Alpheus sibogae De Man, 1908 : 107.

Previous record: De Man, 1911 : 398, fig. 93.

Alpheus splendidus Coutière

Alpheus splendidus Coutière, 1897a : 235.

Previous records: De Man, 1924 : 41, fig. 14; 1929 : 23, pl. 3, fig. 8.

Present record: Eastern, 1 specimen.

Remarks: As we have previously stated (1982 : 56) we have examined the specimen from the Malacca Straits that was the basis of De Man's report (1929) through the courtesy of the Zoologisch Museum, Amsterdam. We concluded that the specimen was indeed *A. splendidus*, but that the large chela, lying loose in the storage bottle and the basis for De Man's fig. 8c, was not from the specimen, but probably from a specimen of *A. parvirostris* Dana.

Alpheus spongiarum Coutière

Alpheus spongiarum Coutière, 1897a : 236

Previous records: De Man, 1911 : 362; *op. cit.* : 356 (as *A. paraculeipes* Coutière).

Present record: Eastern, 8 specimens (dredged to 50 m).

Alpheus stanleyi Coutière

Alpheus stanleyi Coutière, 1908 : 207.

Previous record: De Man, 1911 : 367, fig. 78 (as *Alpheus stanleyi dear-*

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matus De Man).

Present record: Eastern, 1 specimen.

Alpheus staphylinus Coutière

Alpheus staphylinus Coutière, 1908 : 204.

Present record: Eastern, 1 specimen.

Alpheus strenuus strenuus Dana

Alpheus strenuus Dana, 1852a : 21.

Previous records: Schenkel, 1902 : 566; De Man, 1911 : 425.

Present records: Eastern, 73 specimens; western, 23.

Remarks: We have 16 specimens from the Seribu Islands, and 10 specimens from Ceram, both male and female, in which the orbitorostral grooves are usually deep, similar to those described for *A. strenuus cremnus* Banner & Banner (1982 : 229, fig. 72). In the latter subspecies the small chela was also markedly different from *A. strenuus strenuus*, but in the Indonesian specimens the small chela is identical with *A. strenuus strenuus*. Since we have other specimens of *A. s. strenuus* from both Seribu and Ceram in which the orbitorostral grooves are as usual for the species we believe the deeper grooves to be a mere variation.

Alpheus styliceps Coutière

Alpheus styliceps Coutière, 1905 : 889, pl. 78, fig. 28.

Previous record: De Man, 1911 : 364, fig. 76 (as *A. eulimene* De Man).

Present record: Eastern, 3 specimens.

Alpheus sulcatus Kingsley

Alpheus sulcatus Kingsley, 1878 : 193.

Previous record: De Man, 1911 : 343 (as *Alpheus macrochirus* Richters).

Present records: Eastern, 4 specimens; western, 2.

Alpheus tenuicarpus De Man

Alpheus tenuicarpus De Man, 1908 : 104.

Previous record: De Man, 1911 : 381, fig. 84.

Present record: Eastern, 2 specimens.

Remarks: The complete 17 mm male from Ambon resembles De Man's but the chelipeds are thinner. The large chela is 3.7 times as long as broad (3.0 in De Man); the small chela is 6.9 times as long as broad (5.7 in De Man) and the merus of the third leg is 6.3 times as long as broad (8.0 in De Man). We found a similar type of variation in our spe-

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cimens from the Gulf of Aqaba (Banner & Banner 1981b : 40).

Alpheus tenuipes De Man

Alpheus tenuipes De Man, 1910 : 288.

Previous record: De Man, 1911 : 383, fig. 86.

Genus *ARETOPSIS* De Man 1910

Aretopsis amabilis De Man

Aretopsis amabilis De Man, 1910 : 311.

Previous record: De Man, 1911 : 171, fig. 14.

Present record: Eastern, 8 specimens, central, 1.

Remarks: The 6 specimens from Ceram were collected by Dr. A. Hume of Boston University. His field notes states that they were blue and white and were taken from the apex of a shell that housed *Dardanus lagapodes* (Forskål). In one of the male specimens from Ceram the usual bifurcate tooth distally on the inferointernal margin of the merus of the large chela is fused, forming a single short broad tooth. The 2 specimens from Banda collected by E. Ball were also taken from a shell with *D. lagapodes*. A specimen from Ujung Pandang was dredged from 50 m.

Genus *ATHANAS* Leach, 1814

Athanas areteformis Coutière

Athanas areteformis Coutière, 1903 : 79, figs. 17 — 18.

Previous record: De Man, 1922 : 16, pl. 2, fig. 9 (as *Athanas naifaroensis* Coutière).

Athanas djiboutensis Coutière

Athanas djiboutensis Coutière, 1905 : 856, fig. 129.

Previous records: De Man, 1922 : 21; Holthuis, 1978 : 49.

Athanas dorsalis (Stimpson)

Arete dorsalis Stimpson, 1860 : 32.

Previous records: De Man, 1911 : 167, fig. 12 (as *Arete dorsalis*); *op. cit.*: 169, fig. 13 (as *Arete maruteensis salibabuensis* De Man).

Athanas indicus (Coutière)

Arete dorsalis indicus Coutière, 1903 : 84, figs. 25 — 30.

Previous records: De Man, 1911 : 164, fig. 11; 1922 : 22, fig. 11 (both references as *Arete iphianassa* De Man).

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Athanas jedanensis De Man

Athanas jedanensis De Man, 1910 : 313.

Previous record: De Man, 1911 : 154, fig. 7.

Athanas minikoensis Coutière

Athanas minikoensis Coutière, 1905 : 858, fig. 130.

Previous record: De Man, 1911 : 149, fig. 5.

Athanas sibogae De Man

Athanas sibogae De Man, 1910 : 314.

Previous records: De Man, 1911 : 151, fig. 6; *op. cit.*: 148, fig. 4; 1922 : 16
(last two records as *Athanas parvus* De Man).

Present records: Eastern, 18 specimens; western, 8 (dredged to 54 meters).

Athanas stebbingi De Man

Athanas stebbingi De Man, 1920 : 106.

Previous record: De Man, 1922 : 18, fig. 10.

Athanas tenuipes De Man

Athanas tenuipes De Man, 1910 : 316.

Previous record: De Man, 1911 : 157, fig. 8.

Genus *AUTOMATE* De Man, 1888

Automate anacanthopus De Man

Automate anacanthopus De Man, 1910 : 317.

Previous record: De Man, 1911 : 142, fig. 3.

Automate dolichognatha De Man

Automate dolichognatha De Man, 1888a : 529, pl. 22, fig. 5.

Previous record: De Man, 1911 : 140, fig. 2 (as *Automate* sp.)

Present records: Eastern, 2 specimens; central, 2.

Remarks: The 2 specimens from Ambon were collected at low tide in a location where there was much organic matter and some oil pollution; the beach was characterized by the outflow of fresh water from the land, both in superficial streamlets and seeping through the sandy substrate. A specimen from South Bali, however, was collected in 19 meters from an unspecified bottom substrate.

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Genus *BETAEOPSIS* Yaldwyn, 1971

Betaeopsis indicus (De Man)

Betaeus indicus De Man, 1910 : 309.

Previous record: De Man, 1911 : 173, fig. 15 (as *Betaeus indicus*).

Genus *METABETAEUS* Borradaile 1898

Metabetaeus lohena Banner & Banner

Metabetaeus lohena Banner and Banner, 1960 : 299, fig. 1.

Present record: Eastern, 1 specimen.

Discussion: This species has previously been known only from "anchialine ponds" — brackish water ponds separated from the sea by a substrate previous to smaller living forms — in two of the Hawaiian Islands. The collection of this specimen from Indonesia we have mentioned in passing in our discussion of the collection of *Metabetaeus* sp. from Madagascar (1983 : 83) and its relationship to the "anchialine ponds" of Holthuis (1973) and "hypogeal distribution" of Maciolek (1983).

Unfortunately the capture of this sole specimen adds nothing to the knowledge of the habitat preferences of the species nor to its likely method of distribution. On the particular day the collection was made, both authors were afflicted by a severe but transient respiratory disease with the senior author staying ashore and the junior author staying a-bed. The collection was actually made under the supervision of Dr. M. Kasim Moosa, assisted by staff members Lisapally and Duma. It was made near shore in the area known as Rumah Tiga on Ambon Bay (roughly opposite Ambon City); here the bottom was silty-sand, the coral heads scattered, the sponges common and the sea water diluted both by direct land runoff and by fresh water seeping through the substrate. The partially living or dead heads of corals (and associated sponges) were presumably collected in the immediate sub-tidal zone (possibly a meter or two below mean low water). The other alpheids in this collection were quite usual — *Alpheus lottini* Guerin, *A. malleodigitus* (Bate), *A. collumianus* Stimpson, *A. parvirostris* Dana, etc. except for the rather rare *A. perplexus* Banner (discussed above). How and why *M. lohena* should appear in such a collection we can offer no explanation.

Field notes indicated a red band on each abdominal segment and across the carapace, the latter broken along the branchiostegites. The telson and uropods were tinged with red blotches. The chelipeds carried uneven red striping distally, but with the fingers white. The characteristic dark mandibular spot was not observed in the field but it is clearly visible in the preserved specimen. Specimens from Hawaii were uniformly pale pink to salmon-red

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Genus *NENNALPHEUS* Banner & Banner, 1981

Nennalpheus sibogae (De Man)

Alpheopsis sibogae De Man, 1910 : 307.

Previous record: De Man, 1911 : 181, fig. 18 (as *A. sibogae*).

Present record: Central, 1 specimen.

Remarks: This specimen was discussed in Banner & Banner 1981a : 219.

Genus *NEOALPHEOPSIS* Banner 1953

Neopalpheopsis euryone (De Man)

Alpheopsis (?) *euryone* De Man, 1910 : 308; 1911 : 184, fig. 19.

Alpheopsis hummelincki Schmitt, 1936 : 364, pl. 11, fig. 1.

Neopalpheopsis hiatti Banner, 1953 : 21, fig. 6.

Compare: *Parabetaeus culliereti* Coutière, 1896 : 383.

Previous records: De Man, *loc. cit.*

Specimen examined: Eastern, 1 specimen from Rumah Tiga, Ambon, at about 2 m, in coral.

Discussion: In this paper we wish to discuss the three nominal species of the genus *Neopalpheopsis* and their possible separation from the form Coutiere named *Parabetaeus culliereti*. For discussion we have examined (or reexamined) the following specimens (a-d identified as *N. euryone*; e and f, *N. hiatti*; most of the earlier specimens reported upon were lost — see Banner & Banner 1962 : 238):

- a. The specimen listed above, a 16 mm male.
- b. The specimen we reported from Zamboanga, Philippines (Banner & Banner, 1979 : 238), a 14 mm male (Bishop Mus. Cat. No. S7864).
- c. The specimen we reported from Hawaii (Banner 1953 : 25, fig. 7), a 20 mm male (USNM No. 93452).
- d. Seven specimens from shore collecting about the Galapagos, ranging from 18.5 to 27 mm, both sexes, all fragmentary to varying degrees, loaned by the Smithsonian Institution (USNM Acc. No. 122445); all identified for the Smithsonian by M.K. Wicksten.
- e. The holotype for *N. hiatti*, a 13.5 mm male from Hawaii (USNM No. 93452).
- f. A pair of specimens, a 15.4 mm male and a 12.6 mm female, both from Kaneohe Bay, Oahu, Hawaii, not previously reported. (Bishop Museum Cat. No. S10600).

We have reviewed these specimens to determine the extent of variation in the first two nominal species, especially in view of the criteria established for their separation in the description of *N. hiatti*. In our

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tabulation of measurements the differences between the two disappears:

- A. *Length and shape of rostrum.* Reaching from about half the visible portion of the first antennular article to the middle of the second article; often, but not always shorter than the base is broad. ((It should be remembered that the anterior carapace is attached only to the cephalothorax without an orbitorostral process so that it can be displaced, leaving the ocular peduncles partially exposed).
- B. *Orbital teeth:* Usually the orbital front is straight in dorsal view from the base of the rostrum to the outer margins of the orbital hoods; however, at times the orbitorostral margins of the hoods slant forward, making a pair of low, rounded teeth (see Banner 1953, fig. 6a, b).
- C. *Length of stylocerite:* Reaching from three-quarters the length of the second antennular article to the middle of the third.
- D. *Outer margin of scaphocerite:* Almost straight to slightly convex (the figured convexity of the scaphocerite in De Man's fig. 19 (1911) may have been because the delineator was overly impressed by the terminal setae of the blade which curve strongly towards the midline of the anterior appendages, giving the viewer an impression of greater convexity of the margin of the scaphocerite itself).
- E. *The development of the chelae of the first pair:* Variable with sex and maturity, usually with a slight asymmetry; both males and females developing heavier teeth on the larger chela and smaller and more regular teeth on the smaller chela. On the larger chelae in the larger specimens from the Galapagos the fixed fingers develop into a conspicuous flange bearing low but regular teeth on its distal margin against which the curved tip of the dactylar finger closes (see Banner 1953 fig. 6 i, although in this small specimen the row of teeth is not well developed).
- F. *The secondary articles of the carpus of the second legs:* The first article may be somewhat shorter to somewhat longer than the sum of the following four; the articles vary also in length/breadth ratios.
- G. *The proportions and armature of the third legs:* The merus itself may be 3.5 to 7 times as long as broad, and its inferior margin may bear 0 to 2 movable spines (these spines may be erected to an angle of about 60° or may be folded into a recess on the margin making them difficult to see). The merus also varies when compared to the length of the other articles — thus, it may measure from slightly over twice to almost 5 times the length of the dactylus.
- H. *The proportions of the triangular projections of the posterior margin of the telson:* The length of the telson from its base to the postero-lateral spines varies from 7 to almost 14 times the length of the ter-

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minimal triangle; the triangle may be markedly shorter than, to almost as long as, the inner pair of posterolateral spines (contrast Banner 1953, figs, 6l end 7g).

Thus the given differences between *N. euryone* and *N. hiatti* disappear within the range of observed variation. We cautioned in 1979 (*loc. cit.*) that Schmitt's *N. hummelincki* was very similar to *N. euryone*, but then held that *N. hummelincki* was 'likely to be a separate species, especially in view of the great geographical separation of the two forms' (from the Dutch East Indies to the Dutch West Indies or from 127°E to 80°W). Now, with *N. euryone* known not only from central and western Pacific, but also from beyond the Eastern Pacific Barrier, the distance does not seem as great and certainly Schmitt's criteria for separation — the size and shape of both the rostrum and the telson projection, and minor differences in proportions of the second and third legs — do not appear to be valid. We apparently may have in this species another form with circumtropical distribution.

Coutière's genus and species *Parabetaeus culliereti*, presents an interesting problem in taxonomy. The genus and species were established in 1896 on the basis of a single specimen from Papeete (Society Islands) without either of the large chelae. While the original description was brief and far from exhaustive, much more was added to both the generic and specific descriptions, together with figures of the holotype, in his 1899 Thesis (for a complete listing of the scattered page and figure references, see the index prepared by Chace & Forest, 1970 : 1479). The holotype cannot be found in the *Museum national d'Histoire naturelle*, Paris according to Dr. Jacques Forest (in litt., 1984). (Dr. Forest suggests that the specimen may be in the uncataloged Sollaud collection at the University of Lyon). No further records of either genus or species have appeared in the literature.

In all characteristics except for the frontal region of the carapace *Parabetaeus* agrees well with *Neoalpheopsis*, and the characteristics of *P. culliereti* as given in Coutière's 1899 work lie within the variations for *N. euryone* as noted above. This includes the angular and setiferous dentiform extension of the posterior margin of the telson.

However, instead of small to medium sized triangular rostrum between the orbital hoods, as found in *Neoalpheopsis*, the anterior margin of the carapace in *Parabetaeus* is straight and lies somewhat posterior to the protruding orbital teeth (Coutière, 1988 : 69, fig. 16). This complete absence of a rostrum would certainly be of great importance at the generic level were it a constant characteristic. However, we have seen an occasional specimen of species in another genera that either had the rostrum extremely reduced or entirely lacking, yet that were firmly identi-

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fiable to their genus and species by other characteristics. Thus, in the months before this discussion was originally written, we found in a single Indonesian collection of the sponge-dwelling species, *Synalpheus streptodactylus* Coutière, a single specimen completely lacking its rostrum but that was otherwise indistinguishable from the other dozen or more specimens in the collection (data on this collection not noted at the time and the specimens have now been returned either to Jakarta or Copenhagen). We suspect that these rare aberrations may perhaps be due to some accident during growth, but are more likely to be the result of a sublethal genetic defect of sufficient gravity to prevent it from becoming more wide-spread, but that may permit an occasional individual bearing it to reach maturity. Another example of defective growth in the region of the anterior carapace is illustrated for *S. iocasta* (fig. 4).

We therefore strongly suspect that this characteristic of *Parabetaeus culliereti* is a genetic defect; if so, *Neolpheopsis* and *N. euryone* are junior synonyms of Coutière's genus and species. However, this is merely a learned guess and cannot be supported by reexamination of the holotype nor can it be supported by the characteristics of the large chelae which also may be important. Therefore we rather reluctantly leave both genera and species standing as separate in the hope that in some future collections of this rather rare form (or these forms) the question may be resolved

Field notes on the Ambon specimen indicate that the body was red, the carapace extension over the eyes was transparent and the chelipeds were red with white tips.

Genus *PTEROCARIS* Heller, 1862

Pterocaris typica Heller

Pterocaris typica Heller, 1862 : 395, pl. 1, fig. 7 — 18.

Previous record: Heller, *loc. cit.*

Remarks: The type for this species, a female from Ambon, is apparently lost. We searched the shelves of the Naturhistorisches Museum in Vienna not only among the Caridea but also among the collections of other crustacean families with which it might be confused such as the phyllosoma larvae of the spiny lobster, and could not find it. Nor could we find any reference to the genus or species in the records of the museum. No additional records of the genus or species have ever been reported. From the extreme dorsoventral compression as reported by Heller, we suspect that if additional specimens are found they will be discovered to be living as symbionts where the flattened shape would be an advantage as within the mantle cavity of bivalves.

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Genus *RACILIUS* Paulson, 1875

Racilius compressus Paulson

Racilius compressus Paulson, 1875 : 107, pl. 14, fig. 2.

Present records: Eastern, 6 specimens; central, 5.

Remarks: These specimens were all taken from the coral, *Galaxia* sp.

Genus *SALMONEUS* Hothuis, 1955

Salmoneus brevirostris (Edmondson)

Jousseamea brevirostris Edmondson, 1930 : 7, fig. 3

Previous record: De Man, 1911 : 158, fig. 9 (as *J. sibogae* De Man).

Salmoneus hilarulus (De man)

Jousseamea hilarula De Man, 1910 : 304.

Previous record: De Man, 1911 : 160, fig. 10 (as *J. hilarula* De Man).

Salmoneus serratidigitus (Coutiere)

Jousseamea serratidigitus Coutière, 1896 : 382.

Present record: central, 4 specimens;

Genus *SYNALPEHUS* Bate, 1888

Synalpheus amabilis De Man

Synalpheus amabilis De Man, 1910 : 295.

Previous record: De Man, 1911 : 275, fig. 52.

Synalpheus ancistrorhynchus De Man

Synalpheus ancistrorhynchus De Man, 1909a : 124.

Previous record: De Man, 1911 : 267, fig. 47.

Synalpheus antenor De Man

Synalpheus antenor De Man, 1910 : 293.

Previous record: De Man, 1911 : 294, fig. 62.

Present record: Eastern, 6 specimens (dredged to 70 meters).

Synalpheus bispinosus De Man

Synalpheus bispinosus De Man, 1910 : 302.

Previous record: De Man, 1911 : 280, fig. 54.

Present record: Eastern, 1 specimen (dredged at 20 m).

Synalpheus bituberculatus De Man

Synalpheus bituberculatus De Man, 1910 : 294.

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Previous record: De Man, 1911 : 276, fig. 53.

Present records: Eastern, 10 specimens; western, 1 (dredged to 15 m).

Synalpheus carinatus (De Man)

Alpheus carinatus De Man, 1888a : 508, pl. 22, fig. 2.

Previous records: Schenkel, 1902 : 566, pl. 13, fig. 23 (as *Alpheus carinatus*); De Man, 1911 : 210, fig. 23; *op. cit.*: 211, fig. 23a (as *S. carinatus* var. *binongcensis*); *op. cit.*: 212 (as *S. carinatus* var. *ubianensis*).

Present record: Eastern, 12 specimens.

Remarks: Seven of these specimens were collected by the Danish Kei Island Expedition at Ambon from crinoids.

Synalpheus charon (Heller)

Alpheus charon Heller, 1862 : 272, pl. 3, fig. 21, 22.

Previous record: De Man, 1911 : 245, fig. 37.

Synalpheus coutierei Banner

Synalpheus coutierei Banner, 1953 : 36.

Previous record: De Man, 1911 : 273, fig. 51 (as *S. biunguiculatus* (Stimpson)).

Present records: Eastern 3, western, 1.

Remarks: The specimen from the Seribu Islands carried a row of setae on the superior margin of the dactylus of the small chela similar to those reported from the South China Sea (Banner & Banner 1979 : 242) and Kenya (Banner & Banner 1983 : 91, fig. 10e); also the posterolateral angles of the telson are projecting as in those from Kenya.

Synalpheus demani Borradaile

Synalpheus demani Borradaile, 1899 : 416.

Previous record: De Man, 1911 : 257, fig. 42.

Present records: Eastern, 12 specimens; western, 15 (dredged to 75 m).

Remarks: Many of these specimens were reported to be attached to crinoids or crinoids were in the dredged material in which the shrimps were found.

Synalpheus fossor (Paulson)

Alpheus fossor Paulson, 1875 : 103, pl. 13, fig. 5.

Previous records: De Man, 1911 : 250, fig. 39 (as *Synalpheus fossor propinqua*); *op. cit.*: 253, fig. 40 (as *S. bakeri stormi*).

Present records: Eastern, 18; western, 1 (dredged to 38 m).

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Synalpheus gracilirostris De Man

Synalpheus gracilirostris De Man, 1910 : 291.

Previous record: De Man, 1911 : 269, fig. 49.

Present records: Eastern, 5 specimens; western, 8 (dredged to 91 m).

Remarks : Three of the specimens carried an acute superior tooth on the basicerite, an acute tooth on the superior margin proximal to the dactylus of the large chela and the posterolateral angles of the telson were projected and acute. These 3 specimens are similar to those we found in Australia (1975 : 372, fig. 26). The rest of the specimens agree with those of De Man from Indonesia .

Synalpheus hastilicrassus Coutière

Synalpheus hastilicrassus Coutière, 1905 : 875, pl. 72, fig. 12.

Previous records: De Man, 1911 : 263, fig. 45; *op. cit.*: 264, fig. 45b (as *S. hastilicrassus* Coutière var.?); *op. cit.*: 265, fig. 46 (as *S. acanthitelsonis* Coutière); 1920 : 108; 1922 : 29, fig. 14 (last two reference as *S. hastilicrassus acanthitelsoniformis* De Man).

Present records: Eastern, 16 specimens; central, 2; western, 11 (dredged to 90 m).

Synalpheus heroni Coutière.

Synalpheus heroni Coutière, 1909 : 42, fig. 24.

Previous record: De Man, 1911 : 251, fig. 41.

Synalpheus hilarulus De Man

Synalpheus hilarulus De Man, 1910 : 290.

Previous record: De Man, 1911 : 271, fig. 50.

Synalpheus iocosta De Man

Figure 4.

Synalpheus iocosta De Man, 1909a : 119.

Previous record: De Man, 1911 : 235, fig. 33.

Present records: Eastern, 40 specimens; central, 7; western, 3 (dredged to 90 m).

Remarks: Figure 4 illustrates a most aberrant development of the rostrum in a single specimen from Banda. We do not speculate whether this defective development is from basic genetic error or from the effects of some teratogenic agent in the environment.

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Synalpheus iphinoe De Man

Synalpheus iphinoe De Man, 1909a : 116.

Synalpheus jedanensis De Man, 1909a : 117.

Previous records: De Man, 1911 : 219, fig. 26; *loc. cit.*: 222, fig. 27; 1922 : 27 (last two references as *S. jedanensis*).

Present records: Eastern specimens, 21; central, 4; western, 9 (dredged to 128 m).

Discussion: De Man described 3 new species from Siboga Expedition as closely related to *S. neomeris* (De Man), of which he had 35 specimens, all dredged. These were *S. iphinoe*, of which he had 7 specimens, *S. jedanensis*, 6 specimens and *S. miscellaneous*, 1 specimen. All had the characteristic third legs with spines on the merus and the very reduced superior unguis on the biunguiculate dactylus. Four other nominal species and subspecies have also been considered as within the *S. neomeris* complex: *S. gravieri* Coutière, now considered a synonym of *S. neomeris*; *S. neomeris streptodactylus* Coutière, now raised to *S. streptodactylus*; *S. streptodactyloides* De Man and *S. modestus* De Man. The first two names are not further considered in this paper: *S. streptodactyloides* has been reduced to a synonym of *S. streptodactylus* in this paper and is reviewed under that name; and *S. modestus* is still accepted in this paper and reviewed under its own name, below.

From the present collections we have selected 56 specimens of the complex, all dredged and mostly from the Danish Kei Islands Expedition, for the review of four species under consideration. Our primary separation of the group was on the basis of the most obvious and perhaps the most constant characteristic set forth by De Man, whether the frontal teeth (rostrum and orbital hoods) were straight, as in *S. neomeris*, or slightly upturned, as in *S. miscellaneous*, or markedly upturned, as in the remaining two species. Through the use of these criteria 23 of the selected specimens belonged to *S. neomeris*, 31 to the other subcomplex and 2 that will be considered separately as *S. miscellaneous*. The *S. neomeris* specimens ranged from less than 10 mm to 26 mm long, the other group was smaller, reaching a maximum of only 14 mm. We tried also to use the shape of the small chela, with those of *S. neomeris* with slender curved fingers subequal in length to the palm, and the other three species with heavy straight fingers about 0.6 to 0.8 the length of the palm; however, we found the smaller specimens of what we judged to be *S. neomeris* carrying short and heavy fingers.

With the group of the 31 specimens and the group we judge to be *S. neomeris* we examined the variation in the characteristics set forth by De Man for the separation of the three species.

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1. *S. iphinoe* was reported by De Man as lacking the setae on the tips of the frontal teeth. We found these setae to be variable in number and often asymmetrical on the orbital teeth (see Banner & Banner 1975; figs. 22a. h. for *S. neomeris*), but in none were they entirely lacking. While the presence of a variable number of these setae is usually fairly constant within a species possessing them, we consider that their variable presence or complete absence is a rather weak characteristic for the separation of a species.

2. De Man discussed the differences in proportions in articles of the antennular and antennal bases, however, these are somewhat variable in most species of alpheids, and have been found to be variable in the related *S. neomeris* (Banner & Banner, 1975 : 360). These 31 specimens showed similar variations that encompassed the supposed differences between the three species and paralleled the range of *S. neomeris*.

3. De Man used the proportions of the small chela; we found the length: breadth relationship to vary between 2.1 to 3.8 in the 31 specimens; in the Australian study *S. neomeris* was found to range from 3.4 to 4.4. The range of the ratios we found in the 31 specimens more than covered the variation in the 3 species as reported by De Man. None, however, approached the proportions of the large specimens of *S. neomeris*.

4. The number of spines on the merus of the third legs was also used by De Man. In *S. neomeris* from Australia we found this number to vary from 3 — 7; in this series, from 2 — 6. This covered *S. iphinoe* and *S. jedanensis*. *S. miscellaneus* will be discussed below.

5. De Man reported that in *S. neomeris*, *S. iphinoe* and *S. jedanensis* the posterolateral corners of the telson were neither angular nor projecting, and in *S. neomeris* the anterior pair of dorsal spines were placed posterior to the middle, while in the other two they were located anterior to the middle. In *S. miscellaneus* the corners were reported to be acute and slightly projecting and the anterior spines were similar to *S. neomeris*. In this series of 31 specimens, 12 specimens had projecting posterolateral angles and in all the anterior pair of dorsal spines were placed anterior to the middle. Obviously these characteristics should not be relied upon.

The two specimens not included in the above enumeration were females, 13.0 and 13.5 mm in total length, dredged from 100 m in the western Bali Sea (7°34'S, 114°18'E) by the Danish Java-South African Expedition of 1929 — 1930. The tips of the frontal teeth were not upturned (in De Man's specimen they were "very slightly upturned"). Their unique characteristic was that, like *S. miscellaneus*, they had one feeble spine on the meri of each of the third and fourth legs. Their telsons were somewhat distinctive, for the anterior dorsal spines were placed on the midline, neither before, as in the series of 31, nor posterior, as in *S. neomeris*. The posterolateral corners of the telson were angular and somewhat protruding.

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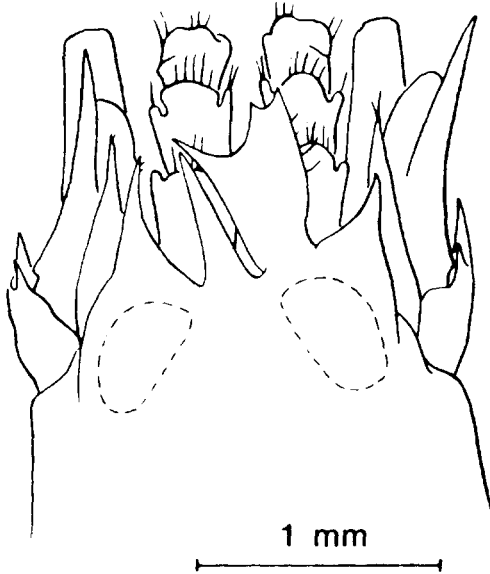


Figure 4. *Synalpheus iocosta* De Man. 9 mm female from Banda, illustrating abnormal rostral front.

Their small chelae were short and heavy, 3.2 times as long as broad and with the fingers in both 0.7 the length of the palm.

These four named species present, therefore, a dilemma: is there but a single variable species involved, or are there two or even more species? Considering that the complex is likely to be symbiotic on various sponges, alcyonarians, bryzoans (see Banner & Banner 1975 : 361), the slight and often overlapping differences in form may represent specific adaptations for a specific type of host — or they may represent a single, plastic species that can modify itself according to the host upon which it settles. It may even be that if the species has settled on a particularly favourable host, it grows larger with longer and thinner fingers on the small chela, but does not so develop on other hosts. Or, again, it may be that the species is not an obligate but a chance symbiont, and is merely variable.

Certainly nothing in the collection notes that are available to us even indicates the specimens may have a symbiotic relationship with any fixed benthic form — indeed, on most of the labels only the coordinates (or location), the maximum depth and type of bottom are given. So we must proceed solely on morphology and a knowledge of variation as it is found in other members of the genus *Synalpheus*. Until more definitive studies are possible we recommend the following:

1. That *S. iphinoe* and *S. jedanensis* be separated from *S. neomeris*

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on the basis of the smaller size, the probable heavier small chela, and the upturned tips to the frontal teeth.

2. That as the differences between *S. iphinoe* and *S. jedanensis* are slight and variable, they be considered as single species under the name *S. iphinoe* on the basis of page priority.

3. That *S. miscellaneus*, being separated primarily by the presence of a single spine on the merus of the third leg rather than 3 – 7 in *S. neomeris* and 2 – 6 in *S. iphinoe*, appears to be a mere extension of the range found in those two species and therefore, on the basis of the straight, rather than upturned, frontal teeth, be considered a junior synonym of *S. neomeris*.

Synalpheus laticeps Coutière

Synalpheus laticeps Coutière, 1905 : 874, pl. 72, fig. 11.

Present records: Eastern, 2 specimens.

Synalpheus modestus De Man

Synalpheus modestus De Man, 1909a : 115.

Previous record: De Man, 1911 : 232, figs. 31, 31b.

Remarks: This species was described by De Man on the basis of a single specimen, and, like *S. streptodactyloides* De Man, it was considered to be "closely related to *S. streptodactylus* Cout". In almost all characteristics given by De Man, the specimen falls within the range of variation known for *S. streptodactylus* and its related *S. neomeris* (De Man).

However, its long, slender rostrum appears to be unique within the genus *Synalpheus* (species of the Comatularum Group may have longer rostrum but they are not as narrow at their bases). Other species approaching the length and slimness of *S. modestus* include the Indo-Pacific *S. gracilirostris* De Man (1911 : 269, fig. 49) and the Atlantic *S. townsendi* Coutiere (1909 : 32, figs. 14 – 17). Both of these species can easily be distinguished from *S. modestus* by a series of characteristics, especially the lack of spines on the merus and the form of the dactylus of the third legs. Within the well over 100 specimens of *S. streptodactylus* that we have examined we have found only minor variation in the length of the rostrum, with the tip reaching from near the middle of the visible portion of the first antennular article to slightly exceeding the end of the same article, yet in *S. modestus* the tip reaches to middle of the second article.

We feel that possible the form represented by *S. modestus* may be some genetic aberration of the typical *S. streptodactylus*, but certainly we have no specimens that show a transition between the long rostrum of *S. modestus* and the normal range in *S. streptodactylus*. Therefore

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we continue to recognize *S. modestus* as a valid species in spite of the fact that no specimen other than the holotype has ever been reported.

Synalpheus mortenseni sp. nov.

Figure 5.

HOLOTYPE : 1 ♂ 15 mm ovigerous collected by the Danish Expedition to Kei Islands. Ambon, 13 — 18 m (7 — 10 fathoms), in sand, 28/2/22.

Allotype : 1 ♂ , 10.5 mm from same location as type.

Paratypes : 3 ♀♀ , 9.5 — 11 mm, from same location as type.

1 ♀ ,13 mm , off Ambon, 15 — 20 m.

1 ♂ ,10 mm , off Ambon, 30 m.

1 ♂ .13 mm , off Ambon, 90 m.

1 ♂ .10 mm , off Tone, Kei Islands, 20 m.

1 ♀ ,12 mm , off Toeal, Kei Islands, 20 m.

2 ♀♀ ,11 — 15 mm , off Doelah, Kei Islands, 20 m.

1 ♂ ,12 mm , off Noehoe Roa, Kei Islands, 32 m.

Description : Rostrum and orbital teeth of equal length, reaching to middle of visible part of first antennular article; tips curved upward and bearing a few short bristles. Rostrum 2 times as long as broad at base. Orbital teeth triangular and as long as broad. Pterygostomial angle projecting but with tip round. Rostral base with orbitorostral process.

Visible part of first antennular article 1.4 times as long as second and 2 times as long as third article; second article 1.5 times as long as broad. Stylocerite acute, reaching to near middle of second antennular article. Squamous portion of scaphocerite narrow, reaching just past end of second antennular article; lateral tooth reaching to end of third antennular article ; carpocerite 5 times as long as broad in lateral view. Inferior tooth of basicerite acute, tip reaching near end of first antennular article, superior tooth acute, slightly longer than orbital teeth.

Third maxillipeds extending well beyond carpocerite, with articles bearing ratio: 10 : 4 : 11; tip bearing cirlet of short stiff spines.

Large chela rounded, somewhat compressed, 2.5 times as long as broad with fingers accuyping the distal 0.3. Termination of palm above dactylar articulation extended as swollen tubercle, bearing in turn a smaller distinct and acute tooth. Inner face of chela and dactylus bearing few setae. Dactylus with rounded carina along superior margin, tip ending in subacute tooth overhanging pollex. Merus short, only 0.7 times as long as

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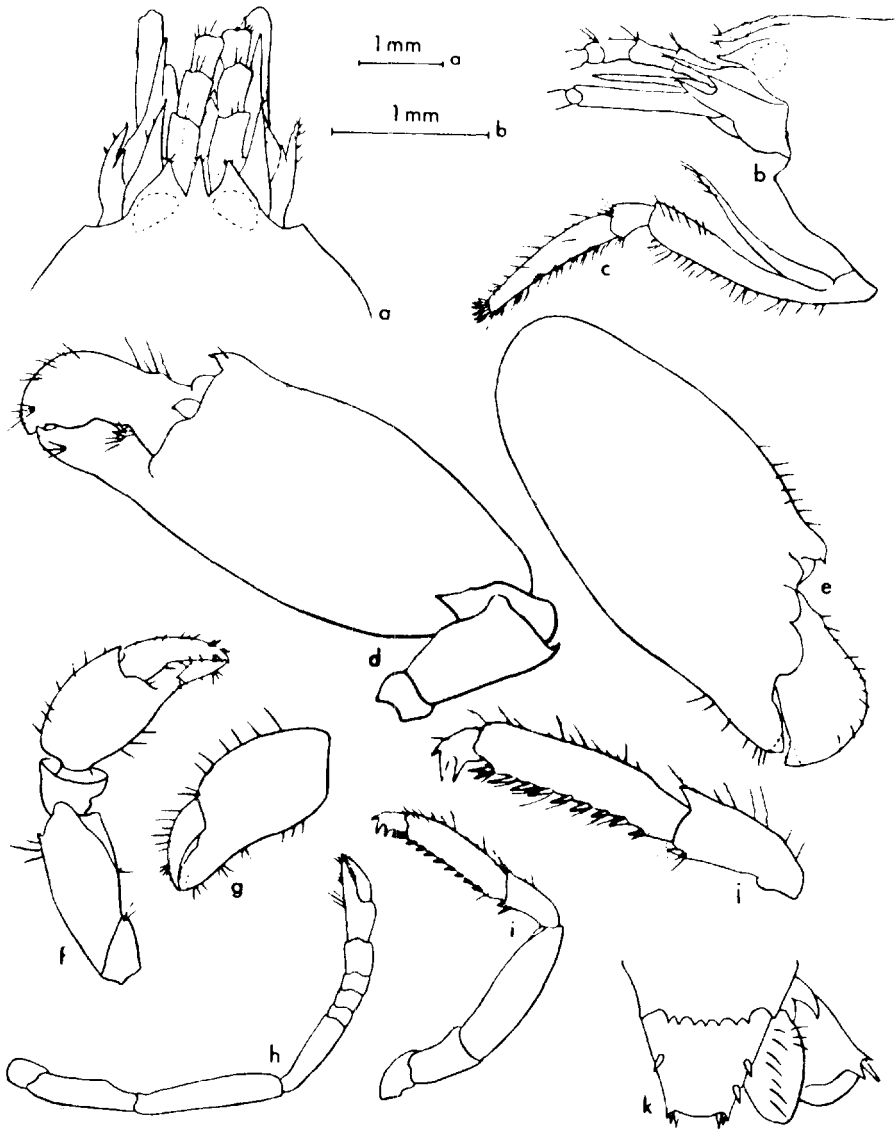


Figure 5. *Synalpheus mortenseni* sp. nov. a, b, anterior region, dorsal and lateral view; c, third maxilliped, outer face; d, e, large cheliped, lateral and medial face; f, g, small cheliped, lateral and medial face; h, second leg; i, j, third leg and enlarged carpus, propodus and dactylus; k, telson and uropods. All figures except j, scale a.

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palm is wide, 1.9 times as long as broad (merus foreshortened in drawing); superior margin terminating with incurving acute tooth, inferoexternal margin rounded distally and inferointernal margin bearing small acute tooth and a few short setae.

Small chela about 2.4 times as long as broad with fingers approaching length of palm, tips of fingers crossing when closed. Chela with sparse hairs on superior and inferior border. Merus 2.0 times as long as broad and bearing short acute tooth distally on superior margin, other distal margins rounded.

Ratio of articles of second leg: 10 : 2 : 2 : 2 : 4; middle articles broader than long.

Ischium of third legs almost 0.4 length of merus, inermous. Merus also inermous, 3.8 times as long as broad. Carpus one third length of merus, superodistal margin projecting as a tooth, inferodistal margin rounded and bearing 2 short spines and a pair of stiff setae. Propodus 0.8 as long as merus with superior margin bearing slender setae and on inferior margin 8 stout spines, interspersed with fine setae, and pair of longer thinner spines distally. Dactylus 0.3 as long as propodus, heavy, triunguiculate. Superior unguis smallest, slender and awl-like, slightly curved and following contour of superior margin; middle unguis heavy, 2 times length of superior, with length approaching 2 times breadth at base, curved so tip lies perpendicular to axis of dactylus; inferior unguis strongly projecting, equal in length and parallel to middle unguis, but with base markedly less broad.

Posterior margin of sixth abdominal tergum bearing triangular lateral teeth; margin between these teeth bearing 7 smaller subacute teeth.

Posterior margin of telson 0.5 breadth of anterior margin; length 1.6 times breadth of posterior margin. Posterolateral angles produced into short, acute teeth; length of adjacent spines equal to about half of the breadth between their bases; margin between spines rounded and somewhat projecting. Spines of superior surface heavy and lying near lateral margins, with anterior pair situated slightly before middle (one spine of posterior pair lacking in holotype).

Discussion: Little variation was noted in the type series except for minor variation in proportions. At times the bristles on the tips of the rostrum and orbital hoods reached 3 or 4 on a side, at times the number was reduced to one or even were lacking, especially on the rostrum — but this may be from handling; all tips were up-turned. On all large chelae the bulb above the dactylar articulation carried the awl-shaped projection. On the distinctive dactyli of the third on fifth legs, all had the slender superior unguis and the projecting and hooked inferior unguis, although in some the ungui were heavier and in some lighter than the holotype. The number of teeth along the posterior margin of the sixth abdominal segment varied from 7 to 10 and also varied in size and spacing. The dorsal

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spines of the telson were always heavy, but some were even stronger than the depicted holotype; in all the posterolateral angles of the telson were projecting and acute.

Only a small group of species within the genus *Synalpheus* have a more or less triunguiculate dactylis on the pereopods. These are (in the order of discussion):

S. triunguiculatus (Paulson), 1875 : 103, pl. 14, fig. 1.

[= *S. physocheles* Coutière, 1908 : 10; see below under *S. triunguiculatus*].

S. demani Borradaile, 1899 : 416.

S. trionyx Coutière, 1908 : 196; also 1921 : 416, pl. 61, fig. 9.

S. nilandensis Coutière, 1905 : 871, pl. 70, fig. 4.

S. fossor (Paulson, 1875); 103, pl. 13, fig. 1.

S. heroni Coutière, 1909 : 43, fig. 21.

From all in this group of species, *S. mortenseni* is separated by the rounded tubercle bearing the awl-like extension above the dactylar articulation of the large chela and the 7 — 10 teeth on the posterior margin of the sixth abdominal segment between the posterolateral teeth. Of the group, *S. mortenseni* is most closely related to *S. triunguiculatus*. In *S. triunguiculatus* the palm of the large chela carries a strong tooth above the dactylar articulation but it is tapering to its hooked tip instead of having a bulbous base; as the possible armature of the sixth abdominal segment has never been mentioned we have reexamined specimens from Red Sea, topotypes in a broad sense, and found the teeth to be lacking. *S. demani* is shown by De Man (1911, pl. 9, fig. 42) as having a dactylus almost identical to *S. mortenseni*, but the propodi of these pereopods bear only a few distal spines on their inferior borders; moreover, the spines of the telson, both posterolateral and dorsal, are markedly reduced. *S. trionyx* bears a small tooth above the articulation of the dactylus of the large chela, but it does not have a bulbous base and the dactylus of the third leg has the superior unguis much larger than in *S. mortenseni*, the middle unguis lying at an angle of about 45° to the axis of the article, and the inferior unguis much smaller and almost a continuation of the inferior curve of the dactylus. In *S. nilandensis* the superior unguis is always longer and heavier than in *S. mortenseni* and the inferior unguis is variable both in size and angle, running from a slightly extended projection to a definitely separate unguis, but when so developed its angle is like that of *S. trionyx* and it is always smaller than the one found in *S. mortenseni*. Finally, in both *S. fossor* and *S. heroni* the inferior unguis varies from a simple right angle to a slightly projected angle and is never developed as a well-developed unguis as is found in *S. mortenseni* and *S. demani*.

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The two other species with teeth originating from the posterior margin of sixth abdominal segment, *S. septemspinus* De Man (1910 : 297, 1911 : 289, fig. 59) and *S. quinquedens* Tattersall (1921 : 376, pl. 38, fig. 1 - 5), are both with only two very short ungui on the dactyli of the third legs. Their numerical specific names refer to the total number of teeth on the posterior margin of the sixth tergum, not the number lying between the projecting posterolateral angles, so both have less teeth on these margins than does *S. mortenseni*.

We wish to note, in passing, that the species *S. bougainvillei* that Coutière compared to both *S. gravieri* and *S. nilandensis* in his 1905 publication (p. 871) was neither mentioned by him again or any other author in any publication that we could find; it must be regarded as a *nomen nudum*.

The habitat of *S. mortenseni* cannot be well defined by the station information of the Danish Kei Islands Expedition; the depth of capture ranged from 7 - 10 m to about 90 m (50 fathoms) and all were dredged from sand to shell bottoms. The remarks on the stations by Mortensen (1923 : 91 - 99) supply only the names of genera in which Mortensen was interested, principally of echinoids and holothuroids. All specimens came from off the Kei Islands or Ambon. However, we suspect from the shape of the dactylii on the pereopods that this species possibly may be found to be a symbiont on crinoids, as is *S. demani* which has a similar development of the ungui (see Banner & Banner 1975 : 326).

The species is named in honor of Dr. Th. Mortensen, 1868 - 1952, the leader of the Danish Kei Islands Expedition that collected all of these specimens as well as other Danish expeditions to the Indo-Pacific and who was a world authority on echinoderms. The holotype and allotype and most of the paratypes will be returned to Universitetets Zoologiske Museum, Copenhagen; some paratypes will be placed in the B. P. Bishop Museum, Honolulu.

Synalpheus neomeris (De Man)

Alpheus neomeris De Man, 1897 : 734, fig. 61a, d, e.

Synalpheus miscellaneus De Man, 1909a : 118.

Previous records: De Man, 1911 : 212, fig. 24; *op. cit.*: 216, fig. 25 (as *Synalpheus gravieri* Coutière); *op. cit.*: 224, fig. 28 (as *S. miscellaneus* De Man).

Present records: Eastern, 31 specimens; central, 5; western, 9 (dredged to 100 m).

Remarks: For the placement of *S. miscellaneus* into synonymy, see discussion under *S. iphinoe*, above.

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Synalpheus neptunus neptunus (Dana)

Alpheus neptunus Dana, 1852a : 22.

Previous record: De Man, 1911 : 291, fig. 60.

Present records: Eastern, 1 specimen; western, 2 (dredged to 50 m).

Synalpheus nilandensis Coutière

Synalpheus nilandensis Coutière, 1905 : 871, pl. 70, fig. 4.

Previous records: De Man, 1911 : 246, fig. 38; *op. cit.* : 248, fig. 38 a, b (as *S. nilandensis* var. *bandaensis* De Man); *op. cit.* : 249, fig. 38c, (as *S. nilandensis* var. *oxyceros* Coutière).

Present records: Eastern, 56 specimens; western, 4 (dredged to 128 m).

Remarks: The specimens of this species are variable, as to be expected. Most fell within the forms *alpha* and *beta* (Banner & Banner 1975 : 328), and at times both forms were found within the same collection.

Synalpheus nobilii Coutière

Synalpheus nobilii Coutière, 1909 : 40, fig. 22.

Present record: Eastern, 1 specimen (intertidal).

Remarks: This specimen came from a head of *Acropora* sp. Records of this species until now have been confined to the Eastern Pacific Region and it has never been reported further west than Clipperton Island. However, the specimen shows no differences from the description and figures of Coutière's type specimen from Ecuador (1909: *loc. cit.*) and those of Abele's from Mapelo Island (1975 : 75, fig. 30). The protuberance proximal to the inferior unguis on the dactyli of the thoracic legs as depicted by the previous authors is also present in this specimen.

Synalpheus odontophorus De Man

Synalpheus odontophorus De Man, 1909a : 113.

Previous record: De Man, 1911 : 208, fig. 22.

Synalpheus paraneomeris Coutière

Synalpheus paraneomeris Coutière, 1905 : 872, pl. 71, fig. 7.

Synalpheus sluiteri De Man, 1920 : 107; 1924 : 35, fig. 12.

Previous records: De Man, 1911 : 240, fig. 34; 1922 : 28 (both references as *S. p.* var. *praedabundus*); 1911 : 241 (as *S. p.* var. *prolatus*); 1911 : 243 (as *S. p.* var. *halmaherensis*).

Present records: Eastern, 3 specimens; central, 1.

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Remarks: De Man described *S. sluiteri* (*loc. cit.*) from 2 specimens from the Bay of Batavia (= Jakarta Bay) as "closely related to *Syn. paraneomeris* Cout. and its varieties". We find this species falls well within the range of variations that have been described for *S. paraneomeris* many times (Coutière, 1905; Banner, 1953, 1956; Banner & Banner, 1964, 1975). We do not wish to reiterate these discussions here, but are reducing *S. sluiteri* to the status of a junior synonym of *S. paraneomeris*.

Synalpheus paulsoni rameswarensis Coutière

Synalpheus paulsoni var. *Rameswarensis* Coutière, 1908 : 201.

Previous record: De Man, 1911 : 269, fig. 48.

Synalpheus pescadorensis Coutière

Synalpheus pescadorensis Coutière, 1905 : 877, pl. 73, fig. 15.

Previous record: De Man, 1911 : 298, fig. 63.

Present records: Eastern, 7 specimens; western, 1 (dredged to 128 m).

Synalpheus pococki Coutière

Synalpheus neomeris pococki Coutière, 1898b : 167, fig. 2.

Previous record: De Man, 1911 : 234, fig. 32.

Synalpheus quadrispinosus De Man

Synalpheus quadrispinosus De Man, 1910 : 298.

Previous records: De Man 1911 : 284, fig. 56 (as *quadridens*); *of. cit.* : 285, fig. 57.

Present records: Eastern, 6 specimens; western, 1 (dredged to 128 m).

Synalpheus quinquedens Tattersall

Synalpheus quinquedens Tattersall, 1921 : 376, pl. 28, figs. 1 - 5.

Present record: Eastern, 1 specimen (dredged to 50 m).

Synalpheus readi Banner & Banner

Synalpheus readi Banner & Banner, 1972b : 137, fig. 1.

Present record: Eastern, 7 specimens.

Remarks: This is the first time this species has been reported since the original specimen from Palau in the western Pacific. After publishing the original description we learned that specimen had come from the sponge *Asteropus sarasinorum* (Thiele). The sponge was identified by Dr. W. Hartman of Yale University. All of the present specimens were reported as coming from sponges.

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Synalpheus septemspinosus De Man

Synalpheus septemspinosus De Man, 1910 : 297.

Previous record: De Man, 1911 : 289, fig. 59.

Synalpheus species De Man

Synalpheus Sp. De Man, 1922 : 30, pl. 3, fig. 15.

Previous record: De Man, *loc. cit.*

Remarks: We have not reexamined this specimen so we have no further comments about it.

Synalpheus stimpsonii (De Man)

Alpheus stimpsonii De Man, 1888a : 513, pl. 22, fig. 3.

Synalpheus stimpsonii maldivensis Coutière, 1905 : 878, pl. 73, fig. 16.

Previous records: Schenkel, 1902 : 567, pl. 13, fig. 22 (as *A. stimpsonii* var?). De Man, 1911 : 203, fig. 20 (as *S. amboinae* (Zehntner)); *op. cit.* : 204, fig. 21 (as *S. consobrinus* De Man); 1922 : 26, pl. 3, figs. 13, 13a (as *S. amboinae*).

Present records: Eastern, 54 specimens; central, 5; western, 9 (dredged to 128 m).

Discussion: When we reviewed the variation found in *S. stimpsonii* and the synonymy caused by this inherent variation (Banner & Banner 1975: 292, fig. 4), we did not consider Coutière's variety (or subspecies) *S. stimpsonii maldivensis* based on a single specimen (1905) : 878, fig. 16) because the rostrum and orbital hoods were so grossly reduced and the normal tooth on the merus of the third leg was also reduced.

However, the 68 specimens in the present collection show further variation beyond that reported in 1975. The end of the rostrum, normally reaching towards the distal end of the second antennular article, in a few specimens these reached barely to the end of the first article. The tooth on the merus, normally not excessively heavy but always protruding and acute, in some of these approached a slightly projecting right angle. Thus the further reduced rostrum and orbital hoods and the reduction of the meral tooth to a mere right angle is but a further extension of the range of variation and we place the varietal name into synonymy under *S. stimpsonii*.

The symbiotic vs. free-living status of the species cannot be further resolved from the field notes for these collections, for while many species were noted as "living on a crinoid" for others we merely have the data on depth and type of bottom for a dredge haul. One specimen that Dr. A. J. Bruce loaned us from his personal collection was reported from a crinoid

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together with the pontoniid shrimp, *Periclimenes commensalis* Borradaile.

Synalpheus streptodactylus Coutière

Synalpheus neomeris streptodactylus Coutière, 1905 : 870, pl. 70, fig. 1.
Synalpheus streptodactyloides De Man, 1909a : 114.

Previous records: De Man, 1911 : 226, fig. 29; *op. cit.* : 230, fig. 30 (as *S. streptodactyloides*).

Present records: Eastern, 12 specimens; central, 34; western, 52.

Discussion: When De Man described the species *S. streptodactyloides* on the basis of a single specimen, he stated that it was "closely related to *Syn. streptodactylus* Cout." Indeed, most of the differences in proportions in the appendages he sets forth as criteria for the separation we have discovered to be quite variable in both *S. streptodactylus* and the closely related *S. neomeris* (De Man) (see Banner & Banner 1975 : 357, 362, and above under *S. neomeris*). We have found the telson, both in its proportions and armature, to be quite variable in these as well as other species of *Synalpheus*. Possibly the most outstanding characteristic of *S. streptodactyloides* is the presence of a single spine on the merus of the third leg, but inasmuch as the number of spines in *S. streptodactylus* varies from 2 – 5, too much importance should not be attached to this further reduction.

However, De Man did emphasize one difference between *S. streptodactyloides* and *S. streptodactylus*, for he stated that the "anterior wall of the front [of the carapace]" was visible in *S. streptodactylus*, *S. neomeris* and *S. gravieri*, but was "not visible at all" in *S. streptodactyloides*. To our knowledge, this characteristic has not previously, or since, been used as a criterion for separation of the species. An examination of a number of species of the genus show that in most (except for those of the Comatularum Group) the rostrum extending beyond the front of the carapace is broadly awl-shaped, round to oval in section, without any flattening or groove on the ventral side. The orbitorostral margin, making a gradual, almost hyperbolic, curve between the tips of the orbital teeth, extends under the protruding portion of the rostrum. However, in *S. streptodactylus* and related species under consideration, immediately under the base of the rostrum the two lateral curves of the margin turn abruptly upward to unite with the ventral side of the base of the rostrum, forming a narrow groove. Posterior from the frontal margin the space under rostrum broadens, approaching the curvature of the orbitorostral grooves. Where the curvature of the upper surface of the rostrum becomes confluent with the surface of the orbitorostral grooves or the convexity of the anterior portion of the carapace itself it forms the ultimate posterior "base" of the rostrum. Evidently, this section of the anterior carapace where the lateral margins of the rostrum overhung the adjacent carapace was the area that

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De Man designated as the "anterior wall", present in *S. streptodactylus* but absent in *S. streptodactyloides* — in other words, in the latter species the curvature of the rostrum joined the curvature of the orbitorostral grooves without an overhang.

However, the molding of this area of the carapace is difficult to discern in routine examination with alcohol-bleached specimens and the usual flat lighting under a binocular dissection microscope. Witness to this lack of discernment is the lack of indication of sculpturing shown in most drawing of species of *Synalpheus*. To view the exact nature of the attachment between the orbitorostral margins and the ventral side of the rostrum demands an anterior view of the entire animal, a view that is demanding both in the positioning of the body and its illumination.

With these difficulties, we have no idea of the possible variations in the manner of attachment of the rostrum to the anterior carapace or the variations in the amount of overhang of the rostrum of the interorbital area. Certainly, the length and breadth of the rostrum, the extent of the rostral "base" and the degree of overhang does vary. Even the presence or absence of the rostrum itself varies within the limits of the species within *Synalpheus* and other genera. Therefore, we suspect the condition described by De Man for *S. streptodactyloides* is a variation from the normal for the species *S. streptodactylus*, and we are placing *S. streptodactyloides* into synonymy under the older name.

Synalpheus thai Banner & Banner

Synalpheus thai Banner & Banner, 1966b : 61, fig. 19.

Present record: Central, 1 specimen (dredged at 24 m).

Remarks: Field notes state that this specimen was taken from a sponge.

Synalpheus theano De Man

Synalpheus theano De Man, 1910 : 296.

Previous record: De Man, 1911 : 293, fig. 61.

Synalpheus tijou Banner & Banner

Synalpheus tijou Banner & Banner, 1982 : 296, fig. 91.

Previous record: Eastern, 1 specimen.

Remarks: This is the second time this species has been reported. It is a 11.6 mm female, collected in 10 meters near Banda by the Danish Kei Islands Expedition. The holotype was living commensally with a crinoid, but the field notes for this specimen only indicate it was on a sandy bot-

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tom. As in the holotype this specimen lacks usual pairs of spines on the dorsal surface of the telson.

We still have reservations about the maturity of the two specimens described under this name. While we have no evidence, we suggest it may be newly settled postlarval stage of one of the larger crinoid symbionts and that our named species *S. tropidodactylus* (Banner & Banner 1975 : 286, fig. 2) might also be a later developmental stage of a large species such as *S. comatularum* (Haswell) that reaches 30 mm in the adult female (Miers 1884 : 289).

Synalpheus triacanthus De Man

Synalpheus triacanthus De Man, 1910 : 301.

Previous record: De Man, 1911 : 282, fig. 55.

Synalpheus trispinosus De Man

Synalpheus trispinosus De Man, 1910 : 300.

Previous record: De Man, 1911 : 288, fig. 58.

Present records: Eastern, 1 specimen; central, 1 (dredged to 90 m).

Synalpheus triunguiculatus (Paulson)

Figure 6.

Alpheus triunguiculatus Paulson, 1875 : 103, pl. 14, fig. 1.

Nec. A. triunguiculatus De Man, 1888 : 504, pl. 22, fig. 1.

Alpheus tricuspидatus Heller, 1861 : 26. (*Nec. Alpheus tricuspидatus* Paulson *op. cit.* : 105, pl. 13, fig. 1).

Synalpheus physocheles CoutiÈre, 1908 : 200.

Confer: *S. demani* Borradaile, 1900 : 416 (= *A. triunguiculatus* De Man *loc. cit.*, *nec.* Paulson.) *S. paulsoni* Nobili, 1906 : 28, fig. 1. (= *A. tricuspидatus* Paulson, *loc. cit.*, *nec.* Heller.).

Present record: Eastern, 1 specimen.

Discussion: This 10 mm specimen collected off Doelah, Kei Islands at 50 m lacks both chelipeds. However it has the characteristic dactyli on the third legs. Finally it lacks any posterior projections on the sixth abdominal somite as found in *S. mortenseni*, described above, a closely related species.

In 1981 (p. 82) we briefly considered the validity of the name *S. tricuspидatus* and deferred judgement until the type specimens could be reexamined. We now wish to report upon our attempt to examine Heller's

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Figure 6. *Synalpheus triunguiculatus* (Paulson), from lot no. 486, Naturhistorische Museum, Wien, Labelled "Type, *Alpheus tricuspидatus* Heller" (see text). a, anterior region, dorsal view, specimen lacking left antennular and antennal bases, and with rostrum distorted; b, large cheliped, chela rotated so tooth above dactylus is not outstanding; c, d, third leg and dactylus; e, sketch of posterolateral margin of telson, not to scale. a, c, scale a; b, scale b; d, scale c.

type specimen (s). However, to partially clarify the last almost 120 years of confusion about the species, it would be well to give a historical review of the use of the names *Alpheus tricuspидatus* Heller and *Alpheus triunguiculatus* Paulson. (Since 1899 both have been recognized as belonging to the genus *Synalpheus* as redefined by Coutière).

Heller's original description of this species from the Red Sea (1861) was brief and generalized. However, he did specify some proportions and the fact that his specimen carried a biunguiculate dactylus on the third legs and was 10 lines long (22.6 mm if a French ligne, 21.2 mm if an English line). His much longer description in German in 1862 unfortunately did not emphasize many of the characteristics that are now used for the

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separation of the species in the genus *Synalpheus*. He depicted only the third leg of his species but that drawing was small and not clear as to its detailed structure. (Heller, 1862 : 267, contributed to the original confusion about the name of his new species by his initial statement: "Von dieser Art befindet sich ebenfalls in der Descript. de l'Egypte par M. Savigny' Crust., pl. 9, Fig. 4, eine sehr gute Abbildung, mit welcher die mir vorliegenden Exemplare ganz übereinstimmen." We have pointed out (1981 : 75) that the rather handsome but unnamed figure of Savigny, subsequently named *Alpheus savigny* by Guérin, is sufficiently lacking in details so that all names applied to it must be regarded as *nomen dubia*.)

In 1875 Paulson, also working on crustaceans from the Red Sea, listed specimens under the name *A. tricuspидatus* Heller with a short description and then fully described *Alpheus triunguiculatus* as new; for both he gave an adequate series of figures. In 1906 (p. 28) Nobili renamed the species Paulson described under *A. tricuspидatus* as *S. paulsoni*; *A.* (or *S.*) *triunguiculatus* of Heller has been accepted by all subsequent workers.

In 1888a (p. 504) De Man named a new species from Amboina as *Alpheus triunguiculatus*; he evidently was unaware of Paulson's rather rare work in Russian. This species, definitely distinct from Paulson's, was renamed *Synalpheus demani* by Borradaile (1899 : 416).

In 1897 (p. 738) De Man was concerned with the identity of 6 specimens from Atjeh (Sumatra) and obtained for comparison "2 Originalexemplare von *A. tricuspидatus* Heller aus dem Rothen Meer" from the "k. k. Naturhistorischen Hofmuseum" in Vienna (the latter quotation from the legend for figure 62d). He remarked that the larger example, a 17 mm ovigerous female, agreed fully with Heller's description, but the two specimens did not agree one with the other in details of the last two articles of the walking legs. He offered some description of both specimens and a drawing (pl. 35, fig. 62d, dd) of the third leg of the smaller specimen. He did not select either to be the "type." He also did not apply names to the specimens from Atjeh, although later (1911) he designated the specimen depicted in fig. 62a, aa to be *S. paulsoni rameswarensis* Coutiere and the one in 62c, cc to be *S. bakeri stormi* De Man.

In 1894 (p. 204) Zehntner reported "plusieurs individuals" from Amboina under the name *A. tricuspидatus*, pointing out they were in "concordent parfaitement" with the description of Heller.

Coutière, in the historical review of his Thesis (1899 : 20) stated that "Les types de Heller [of *A. tricuspидatus*] ne sont point rigoureusement semblables: les uns representent probablement l'espece de Savigny et sont synonymes de *A. Neptunus*, Dana, mais un autre est un specimen de l'espece que Paulson (nec de Man) nommera plus tard *A. triunguiculatus*." Thereafter in his long work Coutière seldom referred to *S. tricuspидatus*

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and when he referred to *S. triunguiculatus* he would specify "Paulson, nec De Man" or "De Man, nec Paulson." At times he would repeat his earlier suggestions of Synonymy, as on p. 455: ". . . *S. triunguiculatus* Paulson, Cette derniere forme represente, come je l'ai dit, l'un des types de *A. tricuspидatus*, Heller = *A. neptunus*, Dana." In Coutière's subsequent publications we cannot find any use by him of the name *tricuspидatus* but he did list *S. triunguiculatus* in his 1909 paper as belonging to the "Neomeris Group" (p. 9) and in 1921 he reported it from the central Indian Ocean (p. 416).

Nobili in 1901 (p. 2) placed 4 specimens in *S. tricuspидatus* (Heller) without comment on the characteristics and used *S. triunguiculatus* Paulson) for other specimens, based upon Coutière's 1899 remarks and figures. In 1906 (p. 25) he reported upon *S. triunguiculatus* (Paulson), giving a French translation of Paulson's Russian description; as remarked upon above, he also named as *S. paulsoni* the specimens described by Paulson as *A. tricuspидatus*. As far as we have been able to determine, Nobili (1901) was the last to name any actual specimens as *Synalpheus tricuspидatus* (Bedot's 1909 reference to this species was merely a relisting of Zehntner's 1894 reference.).

De Man in his comprehensive work on the Siboga specimens (1911 : 194, 202) placed *S. triunguiculatus* (Paulson) in his key to the Neomeris Group, but he evidently was too uncertain about the characteristics of *S. tricuspидatus* to put it in any of his comprehensive keys in spite of having studied earlier "Heller's types." Instead, he discussed its possible separation from several species in the Paulsoni Group without further defining it as a separate species.

Thereafter all references have been made to *Synalpheus triunguiculatus* except for ours (1981 : 82) which was merely the historical citation of the use of *S. tricuspидatus* by Heller and Nobili.

Other reference to species under either of these names by other authors from Paulson to the present contributed to neither the clarification nor the confusion established by these major workers.

It was then with considerable interest we sought our Heller's type series in the Naturhistorische Museum in Vienna where we were permitted to work through the courtesy of the museum officials. In the museum's *Detail-Inventar* Nr. 476 — 500, we found listed under the following columns: "Laufende Nr., 486; Name, *Alpheus tricuspидatus* Heller; Fundort, Rotes Meer; Collector, Frauenfeld; Stück-Zahl, 4; Anmerkung, Vermutlich Heller'sche Typen"; it should be noted that this ledger was not written in Heller's time, for an "earlier" item, No. 443, recorded *Alpheus gracilis* Heller that was collected in Hawaii in 1928. The small museum jar for No. 486 carried the label "*Alpheus tricuspидatus* Heller"

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and the additional label, "TYPE"; within it were 5, not 4 specimens.

Three of the specimens lay loose within the jar itself, together with numerous detached appendages; all of them appeared to be of the genus *Synalpheus*, but only one was complete enough for tentative identification. This appeared to be, on the basis of the third leg and a few other characteristics, the form now recognized as *S. fossor* (Paulson), and the leg was similar to the one drawn by De Man in 1897 in figure 62d, dd, and identified by him as the smaller of the two of Heller's original types of *S. tricuspидatus*.

Within the larger jar was a smaller vial stoppered with cotton-wool and without additional labels; it contained two specimens. One was represented by a broken body, without major appendages, but it plainly was of the genus *Alpheus*, not *Synalpheus*. The second specimen, an ovigerous female 2 x 2 mm long, was a *Synalpheus* and in surprisingly good condition except it had the left antennule and antennae dissected away and was lacking the small chela and one fifth leg; the rostrum was slightly distorted, possibly during the dissection. We have attached some drawings made from this specimen (fig. 6).

The specimen was an almost perfect *S. triunguiculatus* (Paulson) except for some inconsequential variation in a few proportions. The triunguiculate condition of the dactylity of the walking legs was most conspicuous, as was the tooth above the dactylar articulation of the large chela (not shown well in the drawing (fig. 6b) because of the angle of rotation of the palm), and the projecting and acute posterolateral angles of the telson. In none of these characteristics was it like Heller's description of *A. tricuspидatus*.

In view of the historical background and what remains of Heller's "type series" in Vienna, we offer the following hypotheses and suggestions:

1. That Heller's original "types" — the exact number of specimens is unknown, but possibly it was the 4 recorded on the ledger — contained two or possibly three species now recognized as separate: 1) the form he described as *A. tricuspидatus*, 2) the form now recognized as *S. triunguiculatus*, and 3) probably the form now recognized as *S. fossor*. We doubt that the *Alpheus* sp. we found in museum Lot No. 486 was in the series as sorted by Heller, but think that it was added at some time after his study.

2. That of the two "types" sent to De Man for his 1897 study, probably neither was Heller's "type", on the basis of size, but the larger may have been of the same species as Heller's "type"; it was the form redescribed in part by De Man on p. 742. The second smaller specimen he viewed and drew the dactylus of the third leg in figure 62d, dd. It may have

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been the specimen loose in the jar that we could tentatively identify (but not confirm) to be *S. fossor* (Paulson). We believe that De Man's confusion about the identity of *S. tricuspидatus* in 1911 was in part due to his failure to make definitive notes and drawings of the larger specimen when it was in his possession.

3. That Coutière, before writing his Thesis, must have seen at least some of Heller's type series, although we could find no place in his writing that he mentioned actually viewing the series. If he had not seen the specimens, there is no way he could have known of the specimen identical to *S. triunguiculatus* Paulson (*nec* De Man) (of course, he could have been told about the specimen with a triunguiculate dactylus by a colleague, but he almost always acknowledged such input, as that of Faxon on p. 13, footnote 3). Yet it is strange that he, like De Man, did not attempt to characterize *S. tricuspидatus* more perfectly.

4. That the specimen upon which Heller based his description for *S. tricuspидatus* no longer exists in a recognizable form, but that it was plainly different from *S. triunguiculatus* and *S. fossor* found in Lot No. 486.

We conclude:

1. That, based on Heller's description, the species named as *S. tricuspидatus* is not identical to any species subsequently described and named, but that its characteristics might fall within the range of variation of one of several species such as *S. paraneomeris* Coutière, or *S. tumidomanus* (Paulson);

2. That the characteristics of the species cannot be established by the reexamination of the original specimen — "type" — of Heller:

3. That *S. tricuspидatus* cannot be a junior synonym of *S. neptunus* (Dana), as suggested by Coutière — we established and described a neotype for *S. neptunus* (1972 : 20 — 27) in which the squamous portion of the scaphocerite was variable and reduced, and always much smaller than that described by Heller;

4. That therefore the name *S. tricuspидatus* should be considered as a *nomen dubium* and that its application to specimens from the time of its original publication through Nobili's 1901 publication should be regarded as questionable;

5. That the species *S. triunguiculatus* (Paulson), on the other hand, was well-defined and well-drawn and should be recognized as a valid species in spite of the fact that it probably occurred in Heller's original "type series".

6. That the species named, as outlined above, *S. paulsoni* Nobili and *S. demani* Borradaile, are valid and untouched by any confusion over

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S. tricuspидatus. As we have seen no specimens that we could identify as *S. paulsoni*, we take no stand on the validity of Coutiëre's named four "varieties."

Coutiëre described *S. physocheles* from Djibouti on the basis of one female specimen, size not stated. We have examined the type at the Paris Museum and found it had been dessicated at some time in the past and the characters were impossible to make out. Coutiere stated it was "tres voisine egalement" to *S. triungiculatus* except for slight differences in the ratios of the merus and propodus of the third leg. The principal differentiating characteristic was the large chela. The palm was "tres fortement renflée" and the fingers were short (fingers 1; total length 5 . 33). We have found this type of chela with a swollen palm and short fingers in specimens of *S. charon* (Heller), *S. paraneomeris* Coutiere and *S. pachymeris* Coutiere, and believe it to be an aberrancy (see Banner & Banner 1983 : 103). On this basis we place *S. physocheles* under synonymy to *S. triungiculatus*.

Synalpheus tumidomanus (Paulson)

Alpheus tumidomanus Paulson, 1875 : 101, pl. 13, fig. 2.

Previous records: De Man, 1911 : 258, fig. 43; *op. cit.* : 261, fig. 44 (as *S. theophane*); 1924 : 38, fig. 13 (as *S. theophane*).

Present records: Eastern, 9 specimens; central, 11; western, 6 (dredged to 91 m).

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APPENDIX

List of synonymous names used for Indonesian
alpheids in De Man, 1911, and subsequently

Original name	Present name	Reference to change
<i>Alpheopsis consobrinus</i> De Man	<i>Alpheopsis equalis</i> Coutière	Armstrong, 1941 : 5
<i>Alpheopsis? euryone</i> De Man	<i>Neopalpheopsis euryone</i> (De Man)	Banner 1953 : 25
<i>Alpheopsis sibogae</i> De Man	<i>Nennalpheus sibogae</i> (De Man)	Banner & Banner 1981a : 221
<i>Alpheus</i> sp. De Man, 1911 : 349	<i>Alpheus perplexus</i> Banner	Banner 1956 : 347
<i>Alpheus audouini</i> Coutière	<i>Alpheus edwardsii</i> (Audouin) in part	Banner & Banner 1972 : 1142
<i>Alpheus bisincisus</i> var. <i>variabilis</i> De Man	<i>Alpheus bisincisus</i> De Haan	Banner & Banner 1982 : 263
<i>Alpheus djiboutensis</i> De Man	<i>Alpheus djeddensis</i> Coutière	Banner & Banner 1981 : 17
<i>Alpheus brevirostris</i> var. <i>angustodigitus</i> De Man	<i>Alpheus angustodigitus</i> De Man	Johnson, 1962 : 53
<i>Alpheus consobrinus</i> De Man	<i>Alpheus bucephalus</i> Coutière	Banner & Banner 1957 : 201
<i>Alpheus crassimanus</i> Heller	<i>Alpheus lobidens</i> De Haan	Banner & Banner 1975a : 429
<i>Alpheus euchirus</i> Dana	In part: <i>Alpheus serenei</i> Tiwari <i>Alpheus georgei</i> Banner & Banner	Banner & Banner 1982 : 199 Banner & Banner 1982 : 200
<i>Alpheus eulimene</i> De Man	<i>Alpheus styliceps</i> Coutière	Banner & Banner 1983 : 70.
<i>Alpheus eurydactylus</i> De Man	<i>Alpheus euphrosyne</i> <i>euphrosyne</i> De Man	Banner & Banner 1982 : 232
<i>Alpheus gracilis</i> var. <i>luciparensis</i> De Man	<i>Alpheus gracilis</i> Heller	Banner & Banner 1982 : 60
<i>Alpheus hailstonei</i> var. <i>assimulans</i> De Man	<i>Alpheus hailstonei</i> Coutière	Banner & Banner 1982 : 38

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<i>Alpheus hailstonei</i> var. <i>laetabilis</i> De Man	<i>Alpheus hailstonei</i> Coutière	Banner & Banner 1982 : 38
<i>Alpheus insignis</i> Heller	<i>Alpheus diadema</i> Dana	Banner 1953 : 118
<i>Alpheus lutini</i> Coutière	<i>Alpheus obesomanus</i> Dana	Banner & Banner 1966 : 173
<i>Alpheus macrochirus</i> Richters	<i>Alpheus sulcatus</i> Kingsley	Banner & Banner 1982 & 79
<i>Alpheus macroscelus</i> Alcock & Anderson	<i>Alpheus macroscelus</i> Alcock & Anderson	(see Banner & Banner 1979 : 224)
<i>Alpheus microstylus</i> var. De Man	<i>Alpheus microstylus</i> (Bate)	Banner & Banner 1966 : 173
<i>Alpheus paraculeipes</i> Coutière	<i>Alpheus spongiarum</i> Coutière	Miya, 1974 : 150
<i>Alpheus pareuchirus</i> var. <i>leucothea</i> De Man	<i>Alpheus pareuchirus</i> <i>pareuchirus</i> Coutière	Banner & Banner 1982 : 276
<i>Alpheus praedator</i> De Man	<i>Alpheus bidens</i> (Olivier)	Banner & Banner 1982 : 136
<i>Alpheus stanleyi</i> var. <i>dearmatus</i> De Man	<i>Alpheus stanleyi</i> Coutière	Banner & Banner 1979 : 230
<i>Alpheus ventrosus</i> Milne Edwards	<i>Alpheus lottini</i> Guérin	Holthuis, 1958 : 22
<i>Arete amboinensis</i> De Man 1910 (not found by Siboga Exp. but listed in key)	<i>Athanas dorsalis</i> (Stimpson)	Suzuki, 1970 : 12
<i>Arete dorsalis</i> Stimpson	<i>Athanas dorsalis</i> (Stimpson)	Banner & Banner 1960a : 151
<i>Arete iphianassa</i> De Man	<i>Athanas indicus</i> (Coutière)	Banner & Banner 1960a : 149
<i>Arete maruteensis</i> var. <i>salibabuensis</i> De Man	<i>Athanas dorsalis</i> (Stimpson)	Banner & Banner 1960a : 151
<i>Athanas najaroensis</i> Coutière	<i>Athanas areteformis</i> Coutière	Banner & Banner 1960a : 138
<i>Athanas parvus</i> De Man	<i>Athanas sibogae</i> De Man	Miya & Miyake, 1968: 134
<i>Automate</i> sp. De Man	<i>Automate dolichognatha</i> De Man	Banner & Banner 1973 : 299
<i>Betaeus indicus</i> De Man	<i>Betaeopsis indicus</i> (De Man)	Yaldwyn, 1971 : 88

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<i>Jousseamea hilarula</i> De Man	<i>Salmoneus hilarulus</i> (De Man)	Holthuis, 1955 : 88
<i>Jousseamea sibogae</i> De Man	<i>Salmoneus serratidigitus</i> (Coutière)	Banner & Banner 1981b : 58
<i>Synalpheus acanthitelsonis</i> Coutière	<i>Synalpheus hastilicrassus</i> Coutière	Banner & Banner 1975 : 353
<i>Synalpheus amboinæ</i> (Zehntner)	<i>Synalpheus stimpsonii</i> (De Man)	Banner & Banner 1975 : 292
<i>Synalpheus bakeri</i> var. <i>starmi</i> De Man	<i>Synalpheus fossor</i> (Paulson)	Banner & Banner 1975 : 335
<i>Synalpheus biunguiculatus</i> (Stimpson)	<i>Synalpheus coutierei</i> Banner	Banner 1953 : 37
<i>Synalpheus carinatus</i> var. <i>binongcensis</i> De Man	<i>Synalpheus carinatus</i> (De Man)	Banner & Banner 1968 : 272
<i>Synalpheus consobrinus</i> De Man	<i>Synalpheus stimpsonii</i> (De Man)	Banner & Banner 1968 : 274
<i>Synalpheus fossor</i> var. <i>propinqua</i> De Man	<i>Synalpheus fossor</i> (Paulson)	Banner & Banner 1975 : 335
<i>Synalpheus gravieri</i> Coutière	<i>Synalpheus neomeris</i> (De Man)	Banner & Banner 1975 : 357
<i>Synalpheus hastilicrassus</i> var? De Man	<i>Synalpheus hastilicrassus</i> Coutière	Banner & Banner 1975 : 353
<i>Synalpheus hastilicrassus</i> var: <i>acanthitelsoni-</i> <i>formis</i> De Man	<i>Synalpheus hastilicrassus</i> Coutière	Banner & Banner 1975 : 153
<i>Synalpheus helleri</i> De Man*	<i>Synalpheus charon</i> (Heller)	Banner & Banner 1967 : 262
<i>Synalpheus jedanensis</i> De Man	<i>Synalpheus iphinoe</i> De Man	[text]
<i>Synalpheus miscellaneous</i> De Man	<i>Synalpheus neomeris</i> (De Man)	[text]
<i>Synalpheus nilandensis</i> var. <i>bandaensis</i> De Man	<i>Synalpheus nilandensis</i> Coutière	Banner & Banner 1975 : 327
<i>Synalpheus nilandensis</i> var. <i>oxyceros</i> Coutière	<i>Synalpheus nilandensis</i> Coutière	Banner & Banner 1975 : 327

* While *S. helleri* was named by De Man in the Siboga Report (1911 : 246), it was not reported by him from Indonesian waters.

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<i>Synalpheus paraneomeris</i> var. <i>halmaherensis</i> De Man	<i>Synalpheus paraneomeris</i> Coutière	Banner & Banner 1975 : 383
<i>Synalpheus paraneomeris</i> <i>praedabundus</i> De Man	<i>Synalpheus paraneomeris</i>	Banner & Banner 1975 : 383
<i>Synalpheus paraneomeris</i> var. <i>prolatus</i> De Man	<i>Synalpheus</i> <i>paraneomeris</i>	Banner & Banner 1975 : 383
<i>Synalpheus physoscheles</i> Coutière (not collected Siboga Exp. but listed De Man 1911)	<i>Synalpheus triunguiculatus</i> (Paulson)	[text]
<i>Synalpheus quadridens</i> De Man	<i>Synalpheus quadrispi-</i> <i>nosus</i> De Man	Banner & Banner 1958 : 161
<i>Synalpheus sluiteri</i> De Man	<i>Synalpheus paraneomeris</i> Coutière	[text]
<i>Synalpheus stimpsoni</i> var. ? Schenkel	<i>Synalpheus stimpsonii</i> (De Man)	Banner & Banner 1975 : 292
<i>Synalpheus stimpsonii</i> var. <i>maldivensis</i> Coutière	<i>Synalpheus stimpsonii</i> (De Man)	[text]
<i>Synalpheus streptodacty-</i> <i>loides</i> De Man	<i>Synalpheus strepto-</i> <i>dactylus</i> Coutière	[text]
<i>Synalpheus theophane</i> De Man	<i>Synalpheus tumido-</i> <i>manus</i> (Paulson)	Banner & Banner 1968 : 275

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