An annotated checklist of the alpheid shrimp from the western Indian ocean

Albert H. et Dora M. BANNER

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LISTE COMMENTÉE DES CREVETTES ALPHEIDES DE L'OCÉAN INDIEN OCCIDENTAL

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ORSTOM

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AVANT-PROPOS

Albert H. et Dora BANNER sont bien connus de tous ceux qui ont eu à identifier des Alpheidae. Depuis une trentaine d'années, en effet, ces chercheurs vouent une grande partie de leur temps à l'étude de ce groupe et la liste des publications qu'ils lui ont consacrées est impressionnante.

C'est donc tout naturellement à eux que l'étude de diverses collections rassemblées, depuis une vingtaine d'années, dans l'Océan Indien Occidental par les chercheurs français, appartenant pour la plupart à l'Université d'Aix-Marseille et à l'Office de la Recherche Scientifique et Technique Outre-Mer (ORSTOM) a été proposée. Ces collections, variées et importantes, ayant pu être complétées par d'autres faites en particulier par A.J. BRUCE au Kenya et en Tanzanie et M. VANNINI en Somalie, A.H. et D. BANNER ont décidé de profiter de cet ensemble de récoltes pour faire une mise au point de nos connaissances sur les Alpheidae de l'Océan Indien Occidental qui, depuis les travaux de COUTIERE, dont le dernier date de 1921, n'avaient été l'objet que de courtes notes éparses et de listes partielles.

C'est le résultat de leur travail que l'ORSTOM publie ici.

La zone géographique couverte englobe la côte est de l'Afrique (du cap Guardafui au sud du Mozambique), Madagascar, La Réunion, l'île Maurice, les îles Seychelles avec les Amirantes, l'archipel des Chagos, ainsi que les petites îles éparses de cette région. Sont exclus les îles Maldives et Laquedives, le Sri Lanka et, bien entendu, tout l'Océan Indien Oriental.

La liste commentée qui suit comprend 142 espèces et sous-espèces réparties en 12 genres, alors que jusqu'à présent seules 95 espèces réparties en 10 genres avaient été signalées dans la région. Ces 142 espèces et sous-espèces ne comprennent pas une espèce du genre *Metabetaeus* et une ou deux espèces du genre *Athanas*, qui n'ont pu être identifiées avec certitude, ainsi qu'une espèce du genre *Alpheus* dont la présence dans l'Océan Indien Occidental paraît douteuse.

Quatre espèces sont décrites comme nouvelles : *Alpheus arenicolus*, *Alpheus buchanorum*, *Synalpheus crosnieri* et *Athanas phyllocheles*. Dix synonymies, dont on trouvera la liste dans l'"abstract" publié par A.H. et D. BANNER en tête de leur travail, sont établies. On trouvera également, dans ce même "abstract", la liste des 46 espèces signalées pour la première fois dans la région.

A. CROSNIER

AN ANNOTATED CHECKLIST OF THE ALPHEID SHRIMP FROM THE WESTERN INDIAN OCEAN

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ABSTRACT

The study covers alpheid or snapping shrimp along the coast of Africa from northeastern Somalia through Mozambique and thence eastward covering islands, archipelagoes, some bars and banks to include the Chagos Archipelago, but excluding the Asian mainland, the Maldive and Laccadive Islands, Sri Lanka, and all of the eastern Indian Ocean. In the main text and an addendum we report a total of 142 species and subspecies in 12 genera; of these 95 species in 10 genera were previously reported from the area. In addition and not included in the total is one genus, *Metabetaeus*, which occurs but the form cannot be identified to species; one or possibly two forms in the genus *Athanas* which cannot be identified with certainty to species; and one species of the genus *Alpheus* which is of doubtful record.

We have described four species as new: *Alpheus arenicolus*, *Alpheus buchanorum*, *Athanas phyllocheles* and *Synalpheus crosnieri*. We have placed the following species into synonymy: *Alpheus bucephaloides* Nobili, 1905 (now as *A. longecarinatus bucephaloides*); *Alpheus cloudi* Banner, 1956 (= *A. stanleyi* Coutière, 1908); *Alpheus danae* Coutière, 1905 (= *A. malleodigitus* [Bate], 1888); *Alpheus edmondsoni* (Banner), 1953 (= *A. coetivensis* Coutière, 1908); *Alpheus euchiroides* Nobili, 1906

(= *A. parvirostris* Dana, 1852); *Alpheus eulimene* De Man, 1909 (= *A. stanleyi* Coutière, 1908); *A. providencei* Coutière, 1908 (= *A. paralcyone* Coutière, 1905); *Athanas ghardaqensis* Ramadan, 1936 (= *A. borradailei* [Coutière], 1905); *Athanas polynesia* Banner & Banner, 1966 (= *A. borradailei* [Coutière], 1905); *Synalpheus pachymeris cargadosi* Coutière, 1921 (the nominal variety *cargadosi* is eliminated).

New records of previously unknown species from the area are: *Alpheopsis trispinosus* (Stimpson); *Alpheus acutocarinatus* De Man; *A. amirantei sizou* Banner & Banner; *A. bicostatus* De Man; *A. bidens* (Olivier); *A. brevipes* Dana; *A. chiragricus* H. Milne Edwards; *A. compressus* Banner and Banner; *A. crockeri* (Armstrong); *A. distinguendus* De Man; *A. dolerus* Banner; *A. ehlersii* De Man; *A. euphrosyne euphrosyne* De Man; *A. facetus* De Man; *A. funafutensis* Borradaile; *A. mackayi* Banner & Banner; *A. macrodactylus* Ortmann; *A. maindroni* Coutière; *A. oahuensis* (Banner); *A. perplexus* Banner; *A. polyxo* De Man; *A. serenei* Tiwari: *A. styliceps* Coutière; *A. tenuicarpus* De Man; *A. tungii* Banner & Banner; *Athanas areteformis* Coutière; *A. borradailei* (Coutière); *A. crosslandi* Tattersall; *Leptalpheus pacificus* Banner & Banner; *Neoalpheopsis euryone* (De Man); *Prionalpheus sulu* Banner & Banner; *Salmoneus brevirostris* (Edmondson); *S. cristatus* (Coutière); *S. serratidigitus* (Coutière); *S. tricristatus* Banner; *Synalpheus albatrossi* Coutière; *S. ancistrorhynchus* De Man; *S. bituberculatus* De Man; *S. gambarelloides* (Nardo); *S. gracilirostris* De Man; *S. heroni* Coutière; *S. laticeps* Coutière; *S. quinquedens* Tattersall; *S. septemspinosus* De Man; *S. stimpsonii* (De Man); *S. trispinosus* De Man. Of the 95 species previously reported from the area, 17 are not in our present collection.

The collections came from a number of individuals and institutions, but the numerical bulk came from French workers at Tuléar and the Mascarene Islands, supplemented with collections from ORSTOM. Most specimens came from the intertidal or the immediate subtidal zones; some were collected by dredging or deeper diving. An Addendum has been appended to the paper to include 2 smaller collections received after the paper was typed in final form for photoduplication.

INTRODUCTION

Over the last decade we were able to obtain on loan some large and valuable collections of alpheid shrimp from the western Indian Ocean, principally from the island of Madagascar and the Mascarene Islands, the east African coast, and smaller collections from elsewhere. The collections contain about 5,000 to 6,000 specimens; we list 142 species and subspecies in 12 genera for the region, most of which are represented in our study collections. We have decided to report on these collections in a single paper whose area is delimited by "horn of Africa" (Ras Asir or Cape Guardafui) in northeastern Somalia to southern margin of Mozambique (about 27°S) and eastward through the southern equatorial and subequatorial Indian Ocean to include the Chagos Archipelago. We do not encompass any of continental Asia and Australia or their adjacent islands, including the Maldive and Laccadive Archipelagoes and the island of Ceylon (Sri Lanka). As far as we can determine, no extensive biological collecting has been made on many of the remote islands and banks since they were visited by the Percy Sladen Trust expedition upon the *Sea Lark* in 1905, but we have included the record of species collected by the expedition as reported upon by Coutière (1908, 1909, 1921) in our historical listing.

HISTORY OF ALPHEID RESEARCH IN THE WESTERN INDIAN OCEAN

The first record of an alpheid shrimp from this area was that of H. Milne Edwards (1837) who described *Alpheus ventrosus* (now *A. lottini* Guérin) from Île-de-France and Mauritius. We have used the following systematic works in the preparation of this paper (for full citation, please see the bibliography):

A. Milne Edwards, 1862: two species from Réunion;
Hilgendorf, 1878: a small collection from Mozambique;
Richters, 1880: a small collection from Mauritius and the Seychelles;
Miers, 1884: 4 species collected by the *Alert*;
Lenz, 1905, 1910: a larger collection from East Africa, Madagascar and Sri Lanka;
Coutière, 1908, 1909, 1921: the extensive collection made from the central Indian Ocean archipelagoes, islands and banks by the Percy Sladen Trust Expedition;
Stebbing, 1915: primarily upon crustaceans from South Africa but also including records from Delagoa Bay (Baía de Lourenço Marques), Mozambique;
Balss, 1925: a single specimen from Chagos;
Barnard, 1947, 1950, 1955, 1958, 1962: large collections of specimens mostly from South Africa, but including southern Mozambique and some more northerly locations;
Fourmanoir, 1953, 1955, 1958: collections from Majunga, Nosy Be, and Comores;
Kensley, 1969, 1970, 1978, 1981: collections from Mozambique;
Miya, 1981: a review of specimens reported by Richters, 1880.

In addition to these works, Macnae and Kalk published two handbooks to the biota of Inhaca Island, southern Mozambique (1958, 1969 - we have seen only the second edition) with keys to the species known from the island. Other workers have reported upon alpheids encountered in their broader ecological studies: Macnae and Kalk (1962) on the fauna of the sand flats of Inhaca Island; Jacquotte (2 publications in 1964 and one in 1965 - the latter under the name Hipeau-Jacquotte) on species commensal with corals and with sea urchins from Tuléar, Madagascar; Ledoyer (1968, 1970) on carideans found in sea grass beds and unconsolidated substrate at both Tuléar and Nosy Be, Madagascar. Farrow (1971) discussed burrows made in the substrate of Aldabra, including those made by alpheid shrimp, and Polunin and Lubbock (1977) discussed the alpheid-goby association found on Mahé, Seychelles (without specific identification of the shrimp). Finally, there were the three French doctoral theses, discussed below under "Principal Collections," made for ecological studies in Madagascar and the Mascarene Islands; the results contained in these theses are largely yet unpublished.

SOURCES OF THE PRINCIPAL COLLECTIONS

Somalia: Dr. Marco Vannini, Istituto di Zoologia dell' Università, Florence, made a relatively large collection from the shores of southern Somalia, all inter- and sub-tidal, which he loaned to us for identification. His collections were returned to his institute for permanent storage. We have also listed again the few species that we reported from northeastern Somalia in a previous paper (1980), some of which were dredged.

Kenya and Tanzania: These collections were made by, or under the direction of, Dr. A. J. Bruce when he was working with the East African Fisheries Research Organization at Mombasa, Kenya (presently the Kenya Marine Fisheries Institute). Some were made by shore collections and some were from dredging off both Kenya and Tanzania by the *R/V Manihine*, presently attached to the Institute of Marine Sciences, University of Dar-es-Salaam. Upon Dr. Bruce's departure from Kenya he placed his specimens at the National Museum of Kenya, Nairobi, which in turn loaned them to us. The collection has been returned to the museum.

Madagascar and the Mascarene Islands: The largest collections made available to us were from these islands and were made principally by three students from the Station Marine d'Endoume et Centre d' Oceanographie of the Université d'Aix-Marseille in connection with their doctoral research dealing with broad ecological projects on coral reefs. These were: Dr. Mireille Peyrot-Clausade, who studied the cryptofauna of the coral reef - i.e. the animals inhabiting holes in the substrate, either made by themselves or other animals, or those holes left in the cementation of the substrate - on the Grand Récif at Tuléar with additional studies at Mauritius and Réunion; Dr. Bernard A. Thomassin, who studied the animals in the unconsolidated deposits in the coral reef complex usually sand to muddy and often under sea grass beds at Tuléar with some additional studies at Nosy Be; and Dr. Sonia Ribes who studied the fauna associated with living heads of coral and their dead bases on the island of Réunion (her study was primarily directed at the living portions of the heads, but she listed many species from the dead bases). The alpheid collections of Peyrot-Clausade and Thomassin were examined by us in their entirety, and the numbers of their specimens of each species is added to the total we had from other sources and are listed in the totals reported from each area. However, Ribes sent to us only a small part of her collection for confirmation of her preliminary identification, so we cite for the island of Réunion the number of specimens from her and from others that we actually examined and then insert "(+ Ribes)" to indicate she reported upon additional specimens. In a few cases she reported upon species we had not examined from

Réunion and in those cases we indicated her citation in her thesis as "Ribes only." As we used the theses as the primary source of information on these collections and as the theses are unpublished they are not cited under "Previous records" but the theses are listed in our bibliography. To those who wish to know more about the studies, we recommend the perusal of the theses; however, Dr. Peyrot-Clausade has now started to publish upon her work and her first titles are listed in our bibliography. These collections are to be deposited in the Muséum national d'Histoire naturelle, Paris.

Another source of collections for Madagascar was through the help of Dr. Alain Crosnier who was originally on the staff of the Office de la Recherche Scientifique et Technique Outre-Mer (ORSTOM) at Nosy Be and most recently with the ORSTOM office in Paris. While in Nosy Be he made personal collections from shallow reefs and the ORSTOM made official collections often by dredging and bottom trawls mostly about the coasts of Madagascar but some from adjacent islands such as the Comores. Some of these he shipped directly to us from Madagascar and some were shipped from the Paris Museum. All of these collections will be deposited in the Paris Museum. (See also "Addendum", p. on the new collections from Réunion.)

We also had a small collection from Mauritius forwarded by Dr. Torben Wolff from the Universitetets Zoologiske Museum in Copenhagen that was made during the Java-South African Expedition of 1929-30 under the leadership of Th. Mortensen. These specimens were returned to the museum.

Aldabra: The Royal Society Expedition to Aldabra in 1967-68 under the leadership of John D. Taylor, produced a small collection of alpheids loaned to us by the British Museum (Natural History).

Seychelles: From these islands there are four collections: The first, a small collection, was made by the East African Fisheries Research Station vessel under the direction of A. J. Bruce and loaned to us by the National Museum of Kenya. The second, also small and also made by Dr. Bruce personally, was loaned to us by the British Museum (Natural History). The third was made during two cruises of the French research vessel *Coriolis* on the Seychellian bank in 1980 to assess the pelagic and bottom fisheries potential, the collections being loaned, again through the recommendation of Dr. Crosnier, by the Paris Museum. Fourth was our personal shore and reef collections made in 1975, in part under the support of a grant from the U. S. National Science Foundation. The first three collections will be returned to their respective museums; our collections will be deposited at the Bernice P. Bishop Museum, Honolulu

OTHER COLLECTIONS

We also wish to acknowledge the loan or gift of other more minor collections from the following individuals:

Mr. Kurt Buchanan, formerly with the U. S. Peace Corps, Victoria, Seychelles.

Dr. Patrick Galenon of the Station Marine d'Endoume, Marseille, France.
Dr. Claude Michel of the Mauritius Institute, Port Louis, Mauritius.
Dr. M. Pichon, James Cook University of North Queensland, Townsville, Australia.
Dr. N. V. C. Polunin of the University of Cambridge, Cambridge, England.
Dr. J. R. Randall of the Bernice P. Bishop Museum, Honolulu, Hawaii.

ADEQUACY OF THE COLLECTIONS

We believe that the combined onslaught of the various French workers on the island of Madagascar especially at Tuléar and the Mascarenes, probably gave a most adequate survey of the alpheid fauna there. To judge by the rich and unusual alpheid collections produced by the MUSORSTOM Expedition to the Philippines (B & B, 1981 a), the deeper dredging in these waters was probably inadequate. We would rate the inshore collecting in the Seychelles as only fair, but the deep bottom sampling on the shelf by the *Coriolis* in 25 to 60 m probably was adequate. Especially disturbing is the lack of collections on the numerous banks and islands of the central portion of the Indian Ocean - Coutière listed 10 species from the Percy Sladen Trust Expedition that were not found in any of the collections available to us. As an example, *Synalpheus sladeni* Coutière was described originally from a single specimen from Cargados Carajos and found by us again in the Red Sea collections (B & B, 1981 d, p. 76) but it is not in the collections presently at hand.

ACKNOWLEDGEMENTS

We wish to thank all of the individuals cited above under "Collections" not only for the use of their specimens but also in many cases for their helpful notes and letters on color, ecology and other information. In addition we wish to acknowledge the help of the following institutions and the individuals working in them, either through the loan of specimens or for the courtesy they extended to us while we visited to personally examine their collections:

British Museum (Natural History), London
Instituut voor Taxonomische Zoölogie (Zoölogisch Museum), Universiteit van Amsterdam
Istituto di Zoologia dell'Università, Florence
Museo ed Istituto di Zoologia sistematica della Università, Turin
Muséum national d'Histoire naturelle, Paris
Museum für Naturkunde der Humboldt-Universität, (Zoologisches Museum), [East] Berlin, D.D.R.

National Museums of Kenya, Nairobi
Natur-Museum, Forschungsinstitut Senckenberg, Frankfurt am Main
Naturistorisches Museum Wien (Zoologische Abteilung), Vienna
Office de la Recherche Scientifique et Technique Outre-Mer, Paris
Rijksmuseum van Natuurlijke Historie, Leiden
Smithsonian Institution, Washington, D. C.
Station Marine d'Endoume et Centre d'Océanographie, Université d'Aix-Marseille, Marseille
Universität Hamburg, Zoologisches Institut und Zoologisches Museum, Hamburg
Universitetets Zoologiske Museum, Copenhagen
University Museum of Zoology, Cambridge
Zoologische Staatsammlung, Munich

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NOTES ON FORMAT, BIBLIOGRAPHY AND APPENDIX

The arrangement of the genera and species within the genera is strictly alphabetical, without reference to possible phylogenetic relationship.

We have not offered a full synonymy for each species for we plan to monograph the family in the future, a work which will include full synonymy; instead here we merely cite the original authorship of the species name (together with the author's more full description and figures, if the originally published description was in a shortened preliminary form), and any synonymous names that have been used in the literature of the area under consideration. We have attempted to list under "Previous records" all references to the species within the area, either under the current or previously used names, with an indication as to the collection site. We again have taken the liberty of citing our own work as "B" or "B & B" to save space, and have arranged our own work in the bibliography by strict chronology without reference to senior and junior authorship.

Under many species, we list nothing further than the previous and present records of capture. Because the collecting stations, especially by the French workers at Tuléar, were so numerous, each usually containing only one or a few specimens, to save space we have not listed them individually, but we have summarized their valuable ecological information (see following paragraph). However, for some we have added "Remarks" which entail notes on capture, color notes, possible commensal relationships, etc. For a few we have added a longer "Discussion" which presents a more detailed consideration of morphological characteristics and systematic separations.

Following the taxonomic portion of the study we have appended four additional tables with commentary, one on distribution of the shrimp within the area, the others summarizing the ecological information available to us on the various species.

At the end of the paper we offer an index to the generic and specific names of the alpheids in the work, both those in current usage and those previously used for specimens from the western Indian Ocean. This index does not include the names cited in the tables nor does it list the names of other biota referred to in the text.

Genus ALPHEOPSIS Coutière, 1896

Alpheopsis equalis Coutière

Alpheopsis equalis Coutière, 1896, p. 382; 1905, p. 868, figs. 138, 139.

Previous records. — Coutière, 1921, p. 413 (in error as *Arete equalis*), Coetivy, Amirante.

Specimens examined. — 5 specimens from Kenya; 20, Tuléar; 17, (+ Ribes), Réunion; 6, Mauritius.

Remarks. — This species has been collected from the reef flat to 150 m. Dr. Bruce reported that the specimens from Kenya had a white ground color with transverse red bands starting with the anterior appendages and carapace and continuing to the tail fan. We have found this to be a common color pattern for this species.

Alpheopsis idiocarpus Coutière

Alpheopsis idiocarpus Coutière, 1908, p. 194; 1921, p. 414, pl. 60, fig. 2

Previous record. — Coutière, *loc. cit.*, Providence.

Remarks. — Coutière's specimen was 7 mm in length and collected between 90-140 m. This is the only record of its capture.

Alpheopsis trispinosus (Stimpson)

Betaeus trispinosus Stimpson, 1861, p. 32

Specimen examined. — 1 specimen from near Nosy Be.

Remarks: This specimen was dredged at 18°55'S - 43°56'E, from 205 m.

Genus ALPHEUS Fabricius, 1798

Alpheus acutocarinatus De Man

Alpheus acutocarinatus De Man, 1909a, p. 104; 1911, p. 401, fig. 94.

Specimens examined. — 2 specimens from Nosy Be; 1, SE Madagascar.

Remarks. — In the 26 mm male from SE Madagascar the small chela is unusually thin, 10 times as long as broad. This species is closely related to *A. migrans* Lewinsohn and Holthuis from the Mediterranean. The only difference is in the small male chela which is 15 times as long as broad in *A. migrans*.

Alpheus adamastor Coutière

Alpheus adamastor Coutière, 1908, p. 209; 1921, p. 425, pl. 64, fig. 20.

Previous record. — Coutière, *loc. cit.*, Chagos.

Alpheus alcyone De Man

Alpheus alcyone De Man, 1902, p. 870, pl. 27, fig. 61.

Alpheus aculeipes Coutière, 1905a, p. 892, pl. 79, fig. 31.

Previous records. — Coutière, 1921, p. 424, Amirante; 1921, p. 423 (as *A. aculeipes*), Seychelles, Saya de Malha, Coetivy, Chagos. B & B, 1980, p. 25, NE Somalia.

Specimens examined. — 8 specimens from Somalia; 2, Kenya; 1, Nosy Be; 8, Tuléar; 131, Seychelles; 2, Réunion.

Remarks. — Two of the specimens from the Seychelles were from a sponge, the specimen from Nosy Be was dredged in 170 m.

Alpheus alpheopsides Coutière

Alpheus alpheopsides Coutière, 1905a, p. 901, pl. 83, fig. 40.

Previous record. — Coutière, 1921, p. 427, Chagos.

Alpheus amirantei Coutière

Alpheus amirantei Coutière, 1908, p. 205; 1921, p. 421, pl. 63, fig. 16.

Previous record. — Coutière, *loc. cit.*, Amirante.

Specimens examined. — 3 specimens (+ Ribes), Réunion; 1, Seychelles; 3, Mauritius.

Alpheus amirantei sizou Banner and Banner

Alpheus amirantei sizou Banner and Banner, 1967, p. 265.

Specimen examined. — Ribes only, Réunion.

Alpheus architectus De Man

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

Alpheus bullatus Barnard, 1955, p. 45, fig. 22

Previous records. — Barnard, *loc. cit.*, Mozambique. Macnae & Kalk, 1969, p. 126 (both records as *A. bullatus*), Mozambique. Peyrot-Clausade, 1979, p. 76, Tuléar. Kensley, 1981, p. 25, Mozambique.

Specimens examined. — 2 specimens from Somalia; 7, Kenya; 34, Tuléar; 2, Réunion.

Remarks. — In the adults the lateral tooth of the scaphocerite is strong, but the squamous portion is reduced; however, in a 7 mm specimen from Tuléar the squamous portion is of normal development, indicating that the reduction appears with maturity. Vannini reported this species from the substrate under sea grass beds.

A color transparency* of this species in dorsal view taken by Dr. Vannini shows the body to have a ground color of rich and dark brown, a little lighter in the anterior half of the carapace. A symmetrical well-defined but irregular transverse yellow patch reaches from the posterolateral margins of the orbital hoods laterally and ventrally over the upper branchiostegites. A broad band of somewhat lighter yellow lies transversely across the carapace above the bases of the third legs; the margins of this band as well are discrete but jagged. Each abdominal tergum bears a narrow

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* published on the jacket

yellow-to-white transverse band where it articulates with the somite to the anterior. The telson cannot be seen well, but it appears to carry a slight blue cast. The bases of the antennal peduncle are yellow to red, but the distal portions of the antennules, antennae and third maxillipeds are of the same brown as the body. Both chelae and their carpi are brilliant red, almost scarlet, with the distal portions of the dactyli showing some yellow; the meri are light brown flecked with red. The walking legs are red but more pale than the chelipeds. This is in marked contrast to the color notes of Moulton who found Australian specimens to be dark red with some white (B & B, 1982, p. 56).

Alpheus arenicolus sp. nov.

Figure 1

HOLOTYPE. — 46 mm male from Madagascar. Zoologisches Museum, Berlin, ZMHUB Kat. nr. 17196. No other information available on specimen.

Description: Rostrum acute with tip reaching to near middle of visible part of first antennular article; rostral carina low but definitely angular, reaching to near middle of gastric region, without interruptions or prominences. Orbitorostral grooves deep and narrow, broadening and flattening posterior to eyes. Orbital hoods moderately inflated, frontal margins of orbital hoods hemispherical. Orbitorostral margin flowing as continuous curve from hoods to tip of rostrum, slightly concave mesad to hoods. Second antennular article 3.5 times as long as broad; visible part first article and third article nearly equal, second article 1.8 times longer than third. Stylocerite with small acute tip reaching to last quarter of visible part of first antennular article. Scaphocerite with lateral tooth strong, reaching well past end of antennular peduncle; squamous portion narrow, reaching to just past middle of third antennular article. Carpocerite longer than lateral tooth of scaphocerite and reaching length of third antennular article past that article. Basicerite with acute and slender lateral tooth that is nearly as long as the stylocerite.

Ratio of articles of third maxilliped: 10: 2.5: 5.7. Second article with strong distoinferior shoulder bearing tuft of heavy setae; setae reaching beyond tip of third article. Third article heavy, 4.7 times as long as broad, with tip broad, bluntly rounded and bearing heavy tuft of strong setae, with some somewhat longer than article.

Large chela with dactylus broken proximal to plunger. Large chela strongly compressed, 2.0 as broad as thick, 2.8 times as long as broad and with fingers occupying distal 0.4 (we are presuming the missing dactylus is no longer than the propodus). Superior margin with only slight depression proximal to articulation of dactylus, with no other sculpturing and with all margins rounded. Medial face of chela bearing scattered fine hairs on slightly granular surface,

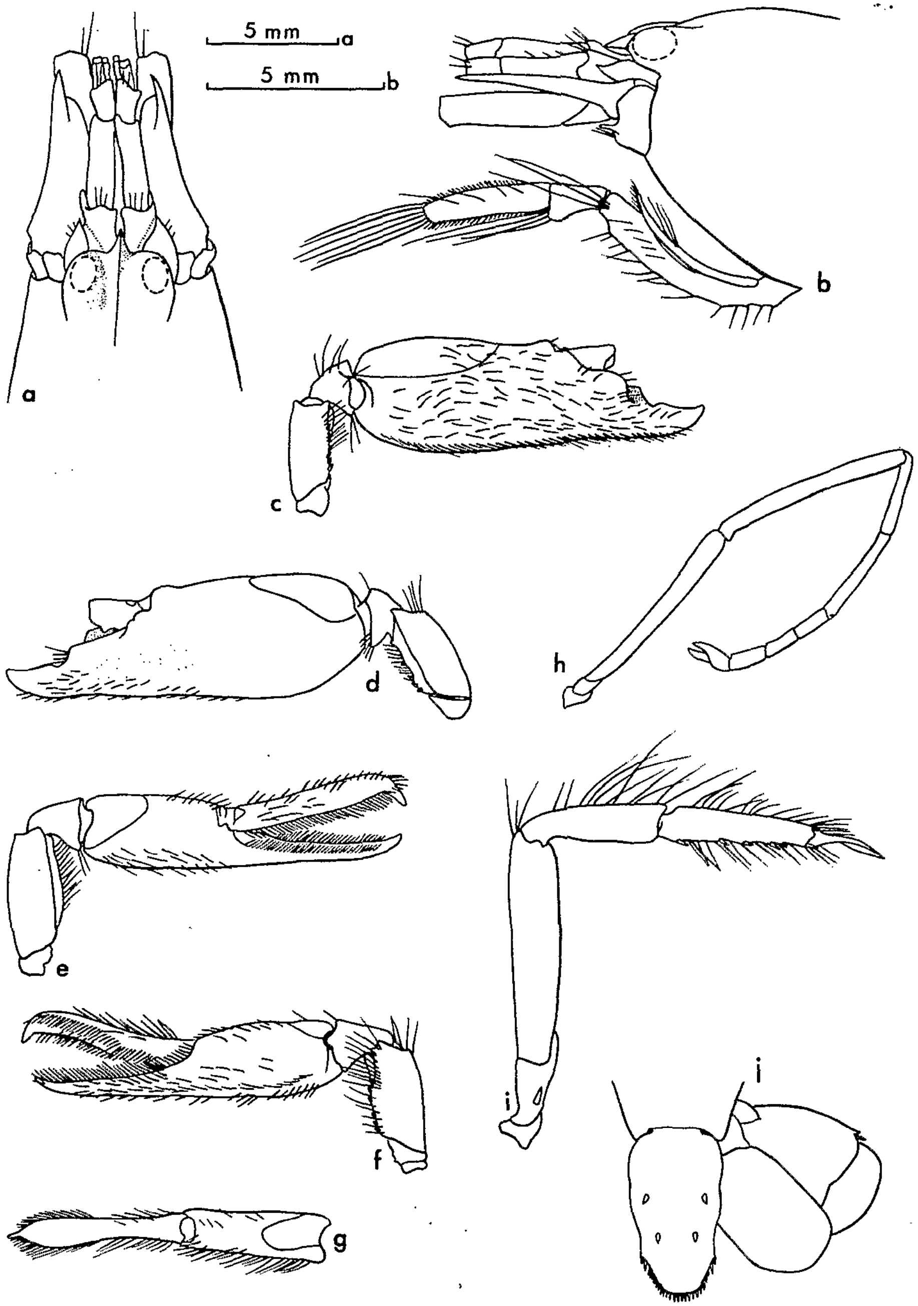

Figure 1. *Alpheus arenicolus sp. nov.* Holotype, 46 mm male from Madagascar. a, b, Anterior region, dorsal and lateral view; c, d, large cheliped, medial and lateral faces (dactylus broken, merus foreshortened); e, f, g, small cheliped, lateral, medial and superior faces; h, second leg; i, third leg; j, telson and uropods. a, b, h, 1, j scale a; c, d, e, f, g, scale b.

and, at rounded inferomedial margin, a definite narrow row of longer stiff forward-directed setae running from near carpal articulation almost to tip of fixed finger. Lateral face glabrous and flattened. Propodal finger with large socket for plunger of dactylus located proximally, distally bearing a shearing edge and slightly curved subacute tip. Merus 2.5 times as long as wide, superodistal margin not projected but bearing long hairs, inferoexternal margin rounded distally and without hairs along margin; inferointernal margin terminating in rounded tooth, bearing 4 small spines and many long hairs.

Small chela of balaeniceps form. Chela slightly more than 4 times as long as broad, fingers 1.2 times longer than palm, palm 1.9 times as broad as thick. Outer face of palm glabrous, inner face with scattered long hairs, mostly distally, inferointernal margin with row of long setae similar to large chela. Propodal finger with tip sharply curved and acute, bearing along either margin dense rows of plumose setae, and with slight ridge on oppositive face with short stiff upright setae regularly placed, more frequent distally than proximally. Dactylus abruptly curved at tip with tip crossing that of fixed finger; seen in superior view, article constricted slightly proximal to middle, 0.6 as broad at constriction as at either end; oppositive face bearing proximally a low rounded cusp. Balaeniceps fringe of dense plumose setae continuing almost as a straight line on either side from near cusp and almost meeting over curvature of finger distally. Merus 2.8 times as long as broad, with superodistal margin rounded and bearing several long hairs; inferomedial margin bearing four short spines proximally and many long setae along entire length, terminating in a small acute tooth distally.

Ratio of articles of second leg: 10: 13: 5: 5: 5.

Ischium of third leg without usual tooth. Merus 4.4 times as long as broad, inermous. Carpus 0.7 as long as merus with superior margin armed with scattered long fine hairs and slightly projecting distally. Propodus 0.6 as long as merus, tapering distally, 4.4 times as long as broad proximally; superior margin bearing many long setae; inferior margin bearing 6 small heavy spines and a pair distally (some broken), flanked by row of many long fine hairs. Dactylus spatulate with low superior carina, 0.4 as long as propodus.

Telson with breadth between small posterolateral spines 0.7 of maximum breadth, lateral margins almost straight and parallel in anterior half, concave to straight in posterior half; tip extending beyond posterolateral spines almost 0.2 length of entire telson, almost semicircular and bearing row of small spines in addition to setae. Spines on dorsal surface of near equal size and small. Anterior pair located anterior to middle. Distolateral tooth and spine of outer uropod weak, distal edge of inner uropod bearing row of slight spines.

Discussion: The general form of the body and especially the highly compressed chelae without sculpture and the spatulate dactyli of the walking legs clearly place this species in the Brevirostris group. Within that group this species can be contrasted to those which are lacking a transverse groove behind the dactylus on the superior surface of the large chela and also have the small chela of the male with a balaeniceps fringe of hairs on the dactylus; these include: *A. acutocarinatus* De Man (1909a, p. 104), *A. macroskeles* Alcock and Anderson (1894, p. 153), *A. nonalter* Kensley (1969, p. 192), *A. pustulosus* B & B (1968, p. 143), and *A. sibogae* De Man (1908, p. 105). The first four species have spatulate dactyli on the third legs like this species, but all five have more slender small chelae in the males - respectively, 9.0, 10, 6.0, and 7.8 times as long as broad in lateral view, in contrast to 4 times as long as broad in this species - and all have the fingers of the chela shorter than the palm instead of longer; there are other differences in proportions and armature as well. Perhaps this species is most closely related to the small species, *A. sibogae* in which an ovigerous female is but 15.5 mm long. The two species can be contrasted on the following points: The dorsal carina of the carapace is longer in *A. sibogae* and bears a small prominence behind the orbital hoods; on the large chela the outer face bears a broad longitudinal groove, demarked by a ridge on the inferior margin, running from near the carpal articulation "almost to the tip of the immobile finger," instead of the flat surface as in *A. arenicolus*; finally, the third legs are more slender - the merus being 8-9 times as long as broad in contrast to 4 times - and the dactylus is simple, not spatulate as in *A. arenicolus*.

The name is derived from the only thing we know about the ecology of the species: it is evidently a sand dweller because it had fine but clean coral sand adhering to some of the setae of the third maxillipeds, the chelae and the uropods. The holotype will be returned to the Zoolgisches Museum, Humboldt Universität, Berlin.

Alpheus barbatus Coutière

Alpheus barbatus Coutière, 1897a, p. 235; 1899, figs. 279, 280.

Previous record. — B & B, 1980, p. 25, Kenya.

Specimens examined. — 2 specimens from Somalia; 2, Nosy Be; 1, Mauritius.

Remarks. — The specimens from Somalia came from "under muddy-sandy carpet among the roots of a prairie of *Syringodium* and *Cymodocea*."

Alpheus bellulus Miya and Miyake

Alpheus bellulus Miya and Miyake, 1969, p. 308, figs. 1, 2.

Previous record. — Polunin and Lubbock, 1977, p. 93, Seychelles (tentative identification, see remarks under *Alpheus djeddensis* Coutière, below).

Alpheus bicostatus De Man

Alpheus bicostatus De Man, 1908, p. 102; 1911, p. 375, fig. 82.

Specimens examined. — 19 specimens from Kenya; 18, Tuléar.

Alpheus bidens (Olivier)

Palaemon bidens Olivier, 1811, p. 663.

Specimen examined. — 1 specimen from Tuléar.

Remarks: This specimen was dredged at 25 m and its collector, Pichon, noted that the bottom had "live crustose coralline nodules. Little sediment (mostly Foraminifera). A few large brown algae."

Alpheus bisincisus De Haan

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

Previous records. — B & B, 1980, p. 26, NE Somalia, Kenya.

Specimens examined. — 35 specimens from Nosy Be; 1, Tuléar; 1, NE Madagascar; 1, SE Madagascar; 56, Seychelles.

Remarks. — These specimens were dredged from 2 m to 90 m.

Alpheus bradypus Coutière

Alpheus bradypus Coutière, 1905a, p. 891, pls. 78, 79, fig. 30.

Previous record. — Coutière, 1921, p. 423, Coetivy.

Specimens examined. — 8 specimens from Réunion; 2, Seychelles.

Remarks. — The Réunion specimens, 6 males and 2 females, are between 12-14 mm in length. In three characteristics they are like the specimens we described from Saipan (1956, p. 355, fig. 17) and differ from Coutière's original description: the dactyli of the small chelae of the males are not broadened and do not carry a fringe of hairs as depicted by Coutière; the basicerites carry a small acute tooth on the inferior margins; the inner rami of the uropods carry a row of small spines along the distolateral margins. The two specimens from the Seychelles, a male and a female of 14 mm, are slightly different: like the Saipan specimens, the small chela of the male is not broadened, but neither specimen has the tooth on the basicerite and only the female bears a few spines on the margin of the inner uropod. This variation in Indian Ocean specimens would seem to rule out a subspecific difference between the Indian and Pacific Ocean stocks of the species.

Alpheus brevipes Stimpson

Alpheus brevipes Stimpson, 1861, p. 30.

Specimens examined. — 10 specimens from Tuléar; 1, Seychelles.

(?) Alpheus brevirostris (Olivier)

Palaemon brevirostris Olivier, 1811, p. 664, pl. 319, fig. 4.*

Previous record. — Lenz, 1905, p. 384, Zanzibar.

Remarks. — Lenz reported his specimen to be without its large chela so its identity is most uncertain. After much study of the records of capture of this species De Man concluded (1911, p. 386) that it was doubtful if this species had ever been collected since the original report, a statement we supported in our Australian work (B & B, 1982, p. 170). Because of our doubts, we are not including this record in any species tally or distributional table.

Alpheus bucephalus Coutière

Alpheus bucephalus Coutière, 1905a, p. 890, pl. 78, fig. 29.

Previous records. — Coutière, 1921, p. 423, Amirante, Chagos, Coetivy, Providence. Peyrot-Clausade, 1979, p. 76, Tuléar.

Specimens examined. — 6 specimens from Somalia; 26, Tuléar; 2, Aldabra; 19, Seychelles; 4 (+ Ribes), Réunion; 18, Mauritius.

Alpheus buchanorum sp. nov.

Figure 2

HOLOTYPE. — 24 mm male from Round Island, off Victoria, Mahé, Seychelles; collected by K. Buchanan, November, 1975 (further data unavailable).

ALLOTYPE. — 23 mm female, ovigerous, same collection.

Description. — Rostrum acute, 1.5 times as long as broad at base, reaching about 0.7 length of exposed portion of first antennular article. Rostral carina sharp, compressed between orbits and expanding to a rounded prominence slightly behind base of orbits. Orbitorostral grooves moderately deep, extending to base of eyes. Anterior margin of orbital hoods evenly rounded. Second antennular article 2.0 times as long as broad; visible portion of first article 0.7, and third article 0.5, as long as second. Superior surface of

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* This figure appears in Latreille, 1818; as we lack adequate library resources, we cannot determine the relationship between Olivier's description and the often cited figure.

second article moderately hirsute; superodistal margins of all articles also bearing several hairs. Stylocerite with acute tip reaching to end of first antennular article. Scaphocerite with squamous portion narrow and reaching to middle of third antennular article, lateral tooth reaching slightly past end of antennular peduncle; lateral margin markedly concave. Carpocerite stout, 3.5 times as long as broad when viewed laterally. Basicerite with small acute tooth on inferolateral margin.

Ratio of articles of third maxillipeds: 10: 4: 8. Entire maxilliped unusually hirsute, bearing heavy tuft of setae on superodistal end of first article with setae longer than those on tip of third; superior portion of second and superior portion and distal end of third bearing long setae, with those of the tip as long as third article; third article bearing usual rows of short stiff setae on medial face and inferior margin.

Large chela 2 times as long as broad, with fingers occupying the distal 0.4. Plunger of dactylus abrupt and heavy. Superior saddle relatively narrow and deep, with both proximal and distal shoulders approximating right angles to the floor of the groove. Lateral depression quadrangular and extending to *linea impressa*. Superior groove continued on medial face as a vertical depression and proximally as a triangular depression; inferior proximal angle at confluence of the two grooves produced into conspicuous but low rounded boss. Inferior shoulder of lateral face at right angles to margin of palm, but rounded; distal notch moderately deep. Medial face of chela punctate and markedly hirsute in all but proximal quarter. Carpus cup-shaped with sclerite forming inferior third of lateral side seemingly separated from sclerite forming the rest of the carpus by a deep incision. Merus 1.5 times as long as broad, with inferointernal margin bearing a minute but acute tooth distally and several long hairs; superior margin not produced distally but bearing scattered long hairs.

Small cheliped showing slight sexual dimorphism. Male chela 2.5 times as long as broad with fingers occupying 0.5 of total length. Dactylus with slight broadening and flattening proximally. Lateral and medial margins of dactylus bearing crest of hairs in a sub-balaeniceps condition, with crests not meeting distally over top of dactylus; crest on inner face largely obscured by dense long hairs on dactylus and on margin of oppositive face of pollex. Medial margins of oppositive faces of both dactylus and pollex produced into high, sharp cutting ridge; lateral margin of pollex bearing dense fringe of setae; tips of both fingers hooked and crossing. Distal portion of inner face of chela, including about half of palm and both fingers bearing heavy and long setae, obscuring structure. Superior margin of palm bearing shallow transverse groove proximal to dactylar articulation and strong tooth flanking medial side of dactylar articulation.

Small chela of female essentially the same as that of male except slightly smaller (0.85 length of male), more slender (3.3 times as long as broad), with dactylus more slender and with the fringe of

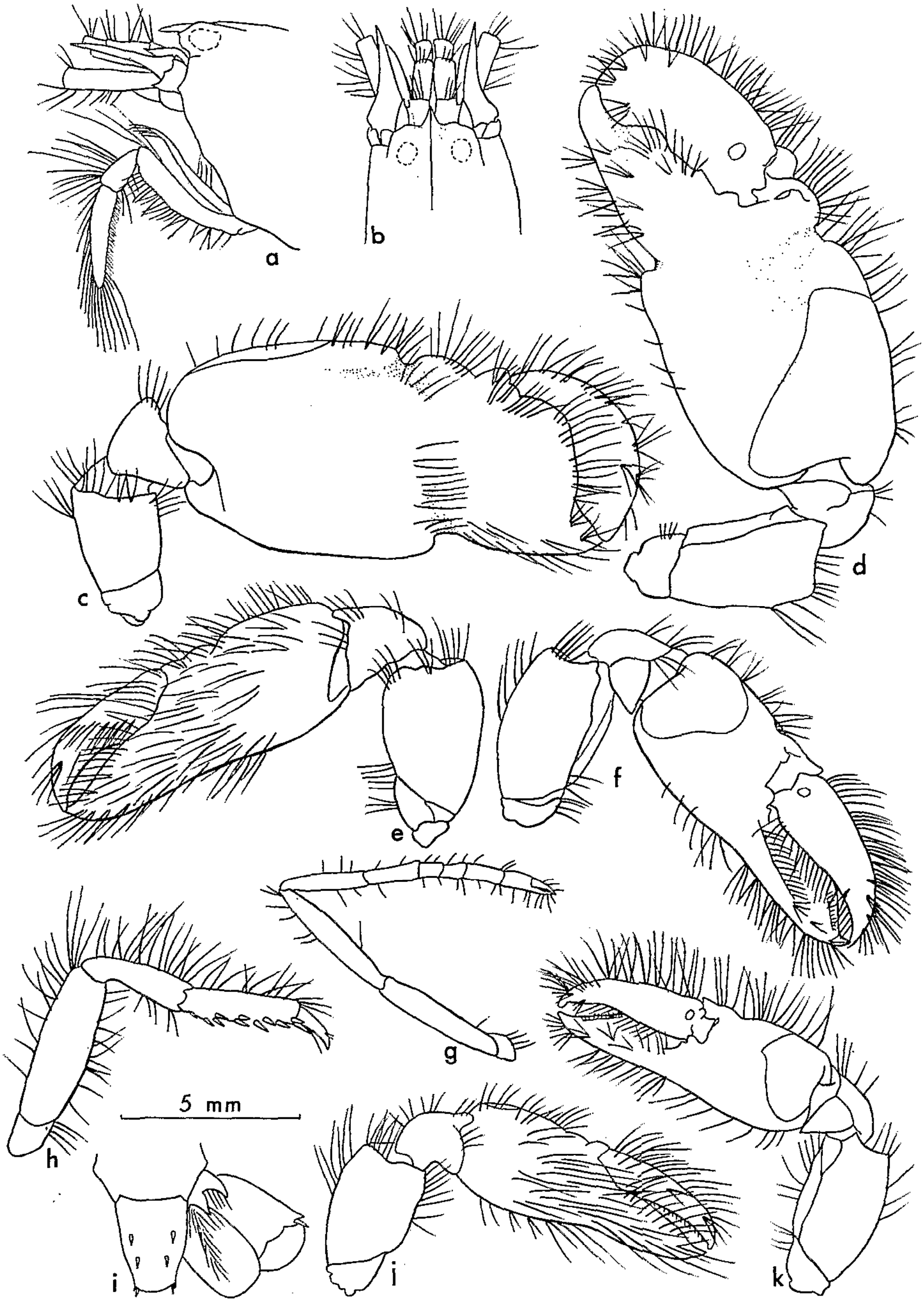

Figure 2. *Alpheus buchanorum sp. nov.* Holotype, 24 mm male from Round Island Mahé. a, b, Anterior region, lateral and dorsal view; c, d, large cheliped, medial and lateral faces; e, f, small cheliped, lateral and medial faces; g, second leg; h, third leg; i, telson and uropods. Paratype, 23 mm female from same location; j, k. small cheliped, medial and lateral faces. All figures same scale.

setae on lateral face not as conspicuous and not reaching quite as far distally. Setae on inner face like those of male.

Ratio of carpal articles of second leg: 10: 6: 3: 3: 6.

Ischium of third leg unarmed. Merus 2.9 times as long as broad, unarmed, bearing a few long setae along superior and inferior margins. Carpus 0.6 as long as merus, distal margins projecting into short but rounded teeth; superior margin bearing many long setae. Propodus a little longer than carpus, bearing on inferior margin 7 spines and a pair distally; both margins bearing scattered long hairs. Dactylus simple, 0.3 as long as propodus.

Telson 2.0 times as long as posterior margin is broad, lateral margins not straight but with double curve; tip broadly arcuate. Dorsal spines prominent, anterior pair placed anterior to middle; inner pair of posterolateral spines twice as long as outer. Sympodite of uropods with 2 tufts of long setae and middle of superior surface of inner uropod bearing longitudinal row of long setae.

Discussion. — The development of the sculpturing on the large chela plainly places this species within the Edwardsii Group. From almost all species in the group it can be separated by the very hirsute condition of the medial side of the large and small chelae and of the third maxillipeds. *A. edamensis* De Man approaches the hairy condition found in *A. buchanorum*, but it can be separated from this new species by the heavy teeth on the meri of the large and small chelipeds and third leg; moreover, in *A. edamensis* the second carpal article of the second leg is 1.2 times the length of the first instead of 0.6. If the heavy growth of setae be ignored, this species can be contrasted to the small group of species in which the small chela in both the males and females is of balaeniceps or sub-balaeniceps condition (see B & B, 1982, p. 225). In *A. pareuchirus imitatrix* De Man, *A. strenuus strenuus* Dana and *A. strenuus cremnus* B & B both the male and the female have full balaeniceps development; in these three the second carpal article is about the same length as the first and the third legs are more slender. In *A. australiensis* B & B the small chela of the male is of full balaeniceps development while the female is sub-balaeniceps, but both lack the transverse groove proximal to the dactylar articulation. The male small chela is unknown in *A. balaenodigitus* B & B where the small chela of the female is of sub-balaeniceps development, but the palm has more extensive sculpturing and the large chela is more slender, being 3.5 times as long as broad instead of 2.2. In *A. hutchingsae* B & B the small chelae of both male and female are unknown, but even if they are similar to the small chelae of *A. buchanorum*, the strong meral tooth on the large cheliped and on the third leg will serve to distinguish it. One other species in which the small chela of the female approaches a sub-balaeniceps condition is *A. heeia* B & B (1975a, p. 433), but in *A. heeia* the second article of the third maxillipeds carried irregular but numerous strong spines and only scattered short setae.

The species is named in honor of Kurt and Janice Buchanan, who, as marine biologists attached to the U. S. Peace Corps, were resident at the marine park established on Round Island off Victoria, Seychelles, and not only collected these two specimens after our return to Hawaii, but also extended to us their help and hospitality during our field work on Round Island. (The final syllable of their name was dropped for euphony.) Both types will be deposited in the Smithsonian Institution, Washington, D. C.

Alpheus chiragricus H. Milne Edwards

Alpheus chiragricus H. Milne Edwards, 1837, p. 354.

Specimens examined. — 7 specimens from Kenya; 2, Tanzania; 5, Mozambique; 5, Nosy Be.

Remarks. — One specimen from Baie d'Ambaro, near Nosy Be, was taken in grey sand in 5 meters from an empty *Pinna* shell.

Alpheus clypeatus Coutière

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

Previous record. — Coutière, 1921, p. 425, Chagos.

Specimens examined. — 50 specimens from Somalia; 1, Kenya; 1, Tuléar; 12, Seychelles; Ribes only, Réunion.

Remarks: A color transparency by Dr. Vannini of a 21 mm female in dorsal view shows the overall color to be green, with oval-shaped area of dark forest green occupying most of the visible surface from behind the eyes to the third abdominal somite; this area carries many spots, mostly circular of pale green. Surrounding the dark green area the ground color is of a more pale green and carries numerous pure white flecks or dots. The chelae are of the darker green ground color and carry less numerous pure white spots; the following legs are variously of white and pale green.

Alpheus coetivensis Coutière

Alpheus coetivensis Coutière, 1908, p. 210; 1921, p. 427, pl. 64, fig. 23.

Crangon edmondsoni Banner, 1953, p. 78, fig. 26.

Previous records. — Coutière, *loc. cit.*, Coetivy, Chagos. B & B, 1980, p. 26, Comores.

Specimens examined — 2 specimens from Somalia.

Remarks. — Our 2 non-ovigerous female specimens from Somalia are without large chelipeds, but since they agree entirely with Coutière's description and figures in every other way we do not hesitate to place them in this species. Field notes with the specimens indicate they were collected from the "reef."

We have been able to contrast the male type specimen of *A. coetivensis* (Coutière did not designate a holotype) at the Muséum national d'Histoire naturelle, Paris (MNHN #2302) with our holotypes and paratypes of *A. edmondsoni* (Bernice P. Bishop Museum, Honolulu, BPBM No. S. 4059) and we are convinced that the two nominal forms are of the same species. There were two possible differences, one in the form of the anterior margin of the carapace and the second in the armature of the merus of the large chela. Coutière's figure of the anterior portion of the carapace shows the base of the rostrum demarked from the orbitorostral area by two short lines (1921, figure 23) that could be interpreted as abrupt shoulders; instead the examination of the type showed the area to be smooth and almost flat, as we described for *A. edmondsoni*. Coutière stated that the merus of the chela was "*inerme*" and showed no spines or teeth on either ischium or merus; his type however, did carry a sole feeble spine on the ischium and four on the inferointernal margin of the merus, similar to the more abundant feeble spines on the ischium and the three margins of the merus in *A. edmondsoni*. We do not regard the difference in count of such spines of importance - indeed, they can easily be broken off in collecting - and we regard the presence or absence of a small tooth on a rounded extension at the meral-carpal articulation to be a potentially variable characteristic. There are also slight differences in proportions in some of the articles of the appendages, but these are minor. We therefore relegate *A. edmondsoni* to synonymy.

We are most perplexed by the record of distribution of this species. As *A. edmondsoni* we originally recorded it from Hawaii where the largest collections occurred (19 specimens), from Raroria in the Tuamotus (it should be noted that the reference to it from the Carolines in B, 1959, p. 141 was in error and was correctly placed in the Tuamotus in B & B, 1964, p. 91), Christmas in the Line Islands and Saipan in the Marianas. To this we now add, from the collections of the Bishop Museum, the record of a single specimen each from isolated Johnston Atoll, lying about 1000 km WSW of the Hawaiian Archipelago, and the even more isolated Marcus Island (Minami-Tori-Shima) 24°18'N, 153°58'E. As *A. coetivensis*, Coutière reported one specimen from the Salomon Atoll, Chagos Archipelago and one from Coetivy; we have reported one specimen from the Comores and now two from Somalia.

The few notes on its ecology offer no clues: In Hawaii we recorded it from intertidal to 150 feet, mostly in areas that seldom are beset by high waves, but the specimens from Raroria and the Tuamotus came from a high surf energy area "from a surge channel, on outer reef beyond Lithothamnion ridge." There are no other ecological data available.

Another aspect to the distributional problem is that this species has been reported from areas where the known number of species is limited and the study collections were often of a small number of specimens. The areas in which it appears with the largest number of species and a large number of specimens were Hawaii, the Marianas and Somalia, each with extensive collections and about 50 known species. Then, in decreasing number of species and usually decreasing size of collections are the Comores, from which we report 21 species in this paper, Salomon Atoll where Coutière reported 17 species, Coetivy where he reported 16 species, Christmas Atoll where we reported only 10 species. The collections from Raroria, Johnston and Marcus had only one to several specimens and species. In none of the large collections that we have examined from the archipelagoes of the Central Pacific, the Philippines, Thailand, Australia, the Red Sea, and now most of the central and western Indian Ocean, with roughly a hundred or so species and often thousands of specimens, does this species appear. This seems to indicate that it is probably absent in these more central areas but that it appears in small numbers in some fringe areas and more abundantly in other, possibly more remote, fringe areas.

One possible explanation is that this is a rather ancient species that once was wide-spread in the entire Indo-Pacific but that it was in ecological competition with a more efficient species that evolved later in the central areas. Through the competition it was eliminated in the central areas but it survived in the isolated fringe areas where the competitor has not yet penetrated. We advance this rather feeble hypothesis with reluctance for not enough is yet known about other fringe areas. It is certain that the consideration of antitropical and antiequatorial distribution as found in fishes would not apply (see Randall, 1982, pp. 197-209), for a few collecting areas would be much closer to the equator than Christmas Island at 1°52'N.

Alpheus collumianus Stimpson

Alpheus collumianus Stimpson, 1861, p. 30.

Alpheus seurati Coutière, 1905a, p. 881, pl. 75, fig. 20.

Alpheus malhaensis Coutière, 1908, p. 205; 1921, p. 419, pl. 62, fig. 14.

Alpheus longecarinatus, Coutière, 1921, p. 426 (*nec* Hilgendorf).

Alpheus dentipes, Fourmanoir, 1958, p. 124, fig. 11 (*nec* Guérin).

Previous records. — (As *A. collumianus*): Coutière, 1921, p. 419, Chagos, Cargados Carajos. Fourmanoir, 1958, p. 124, fig. 12, Nosy Be. Barnard, 1958, p. 8, Delagoa Bay. Macnae & Kalk, 1969, p. 126, Mozambique. Kensley, 1981, p. 25, Mozambique.

(As *A. seurati*): Coutière, 1921, p. 419, Coetivy.

(As *A. malhaensis*): Coutière, *loc. cit.*, Amirante, Saya de Malha.

(As *A. longecarinatus*): Coutière, *loc. cit.*, Providence, Amirante.

(As *A. dentipes*): (in part) Fourmanoir, 1958, *loc. cit.*, Nosy Be.

Specimens examined. — 12 specimens from Somalia; 1, Kenya; 1, Mozambique; 31, Tuléar; 25, Seychelles; 104 (+ Ribes), Réunion; 74, Mauritius.

Remarks. — We have long concerned ourselves with the variation found in this species, once dividing the species into three subspecies based on what we thought were firm differences in morphology and possible differences in ecology (1958, pp. 388 *et seq.*). Most recently, we concluded that there was but one variable species, with an independent assortment of variable traits (i.e. a single specimen might have some characteristics of one subspecies, and some of another) and no differences in ecology - in fact, in cohabiting pairs, one specimen might carry characteristics of one subspecies and its mate of another (B & B, 1982, p. 47). In the same paper we placed *A. malhaensis* into synonymy as it was the same as the form we had previously named *A. collumianus medius*.

We now wish to consider another of Coutière's species, *A. seurati* (*loc. cit.*) with the type locality of Minikoi, Laccadive Islands. The species has been mentioned three times subsequently in the literature. First with additional description by Coutière from the Tuamotus (1905b, p. 22), again by Coutière from Amirante Bank and Coetivy (1921, p. 419) and once by us from Jarvis in the Line Islands (1959, p. 138). In that paper we remarked that *A. seurati* might be considered as an additional subspecies of the *A. collumianus* complex, but we deferred final judgement. From Coutière's original description and figures, the species appears to be intermediate between the forms previously called *A. c. medius* and *A. c. inermis* - thus the orbital teeth are like the former, the third legs are like the latter. Coutière emphasized the short heavy middle article of the antennular peduncle, but this is similar to figure 9*l* in our 1982 publication. He also emphasized in his text and figure that the inferodistal margin of the large chela was "*crénulé*" but examination of the holotype at the Muséum national d'Histoire naturelle, Paris, showed this margin and the adjacent surfaces of the medial face to bear setae with raised bases as is so often found in the *A. collumianus* complex and in other species; in our view his drawings were somewhat exaggerated in this regard. We can find no firm characteristics that would separate this species from the variable *A. collumianus*.

The two specimens Coutière identified as *A. longecarinatus* (MNHN Paris, Na 3018) were first reexamined by Crosnier and Forest (1966, p. 264) and pronounced not to be *A. longecarinatus* as the orbital border carried teeth. We have again reexamined the specimens and found that while they lacked the chelipeds, in all other characteristics they fell within the range of *A. collumianus*. Finally, Fourmanoir divided his specimens into two species, *A. collumianus* and *A. dentipes*. *A. dentipes* is known only from the Atlantic Ocean proper and the Mediterranean Sea and has never been reported from any part of the Indo-Pacific. To judge from Fourmanoir's brief description and four figures, there is nothing about his three specimens that lies outside of the range of variation of *A. collumianus*.

Two of the specimens from the Seychelles were a cohabiting pair associated with the brittle star *Ophiothrix keystonia propinqua* (Lyman) as identified by Dr. Dennis Devaney of the Bishop Museum. One of the specimens from Somalia was reported to be collected "from outside of a *Tridacna* shell."

We also made color notes on a cohabiting pair of this species from the Seychelles. Both sexes were of similar color patterns, but the overall color of the male was more orange pink and the female more rose pink. The gastric region of the carapace was black, but bearing a chalk-white spot posteriorly; running anteriorly from the gastric region to between the eyes and antennular bases were streaks of bright red chromatophores. The abdomen was lightly banded, and the caudal fan was of deeper red. The upper portions of both chelae were olive green with a touch of pink, but the lower portions of the outer face, the inferior surface and the grooves of the medial surface were white with black mottling; the olive spines flanking the dactylar articulation carried white tips; the dactylus was olive with a light orange tip. The second thoracic legs were yellow but all following legs were of pink cast with red chromatophores. The eggs were dark yellow with a touch of green.

Alpheus crockeri (Armstrong)

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

Specimens examined. — 1 specimen (+ Ribes) from Réunion.

Alpheus dasycheles Coutière

Alpheus dasycheles Coutière, 1908, p. 211; 1921, p. 426, pl. 64, fig. 21.

Previous record. — Coutière, *loc. cit.*, Seychelles.

Alpheus deuteropus Hilgendorf

Alpheus deuteropus Hilgendorf, 1879, p. 834, pl. 4, figs. 8-10.

Previous record. — Hilgendorf, *loc cit.*, Zanzibar.

Specimens examined. — 9 specimens from Somalia; 5, Tuléar; 2, Comores; 22, Seychelles.

Remarks. — In a cohabiting pair we collected on the outer face of the Northwest Bay reef front, Mahé, Seychelles, one was of normal color, a rather uniform translucent brownish green on the body, with very small scattered red chromatophores, but in the other the chromatophores dorsally on the cephalothorax and abdomen were greatly expanded when it was collected, giving an overall impression of salmon red.

Alpheus diadema Dana

Alpheus diadema Dana, 1852a, p. 23; 1852b, p. 555, pl. 35, fig. 7.

Alpheus insignis Heller, 1862, p. 269, pl. 3, figs. 17, 18.

Previous records. — Richters, 1880, p. 163, Mauritius [see also Miya, 1981:66]; Coutière, 1921, p. 426, Chagos, Coetivy (all records as *A. insignis*).

Specimens examined. — 11 specimens from Somalia; 15, Kenya; 2, Tanzania; 1, Nosy Be; 6, Seychelles; 4, Réunion; 19, Mauritius; 1, Chagos.

Alpheus distinguendus De Man

Alpheus distinguendus De Man, 1909b, p. 155, pl. 7, figs. 9-14.

Specimens examined. — 12 specimens from Nosy Be.

Remarks. — In one male specimen from Baie d'Ambaro, near Nosy Be, the fingers of the small chela were 3.2 times longer than the palm. This is most unusual but since it agrees with the typical form of the species in every other way we feel it is just an extension of the usual variation.

Alpheus djeddensis Coutière

Alpheus djeddensis Coutière, 1897c, p. 202.

Alpheus djiboutensis De Man, 1909b, p. 160, pl. 8, figs. 17-24.

Previous records. — Polunin and Lubbock, 1977, p. 93 (tentative identification), Seychelles. B & B, 1980, p. 26, Aldabra. (Both records as *A. djiboutensis*.)

Specimens examined. — 1 specimen from Tanzania; 1, Aldabra.

Remarks. — The personal communication from Polunin that accompanied the specimen from Aldabra stated "This species was observed exclusively in symbiosis with *Cryptocentrus aurora* Polunin

& Lubbock". (now *Amblyeleotris aurora* - see B & B, 1981b, p. 404). He goes on to say that "in Baie Ternay, Mahé, Seychelles, this species was seen in association with *Stonogobiops dracula* Polunin & Lubbock and *Cryptocentrus* sp., and it occurred at the base of the reef slope in 20-32 m."

Dr. Polunin supplied color notes on his specimen from Aldabra - it was mottled red, yellow and white, closest to Polunin and Lubbock's "alpheid 2" (1977, p. 93) which they stated to be like the color pattern reported by Miya & Miyake for their *A. bellulus* (1969, fig. 1).

Alpheus dolerus Banner

Alpheus dolerus Banner, 1956, p. 362, fig. 21.

Previous record. — Peyrot-Clausade, 1979, p. 76, Tuléar.

Specimens examined. — 24 specimens from Somalia; 42, Kenya; 2,Nosy Be; 25, Tuléar; 5, Seychelles.

Remarks: — A color transparency in dorsal view by Dr. Vannini shows that the body and appendages to be mostly translucent white tinged with blue or green, with scattered pigment spots of pale brown. The central portion of the thorax is pale green, possibly from the mid-gut gland lying below; the posterior portion of the abdomen is tinged with pale green. The visible appendages of the cephalothorax are all translucent tinged with blue (for example, the stylocerite cannot be seen, but the white coral sand packed inside the statocyst can be seen); the chelae have the same overlay of pale brown chromatophores, but the tips of the fingers of the large chela are pale yellow.

Alpheus edamensis De Man

Alpheus hippothoe edamensis De Man, 1888a, p. 518.

Alpheus edamensis De Man, 1911, p. 437, fig. 107.

Previous record. — Lenz, 1905, p. 383 (as *Alpheus hippothoe edamensis*), Zanzibar.

Specimens examined. — 1 specimen from Nosy Be; 6, Tuléar; 1, NE Madagascar; 1, Seychelles; 2, Réunion; 2, Mauritius.

Alpheus edwardsii (Audouin)

Athanas edwardsii Audouin, 1827, p. 274.

Alpheus crassimanus Heller, 1865, p. 107, pl. 10, fig. 2.

Alpheus audouini Coutière, 1905a, p. 911, fig. 52.

Previous records. — Hilgendorf, 1879, p. 830, Mozambique, Zanzibar. Ortmann, 1894, p. 13, Dar-es-Salaam. Lenz, 1905, p. 383, Zanzibar, Aldabra. Barnard, 1950, p. 759, Mozambique. Fourmanoir, 1955, p. 21; 1958, p. 119, fig. 5 (both as *A. crassimanus*), Madagascar. Macnae & Kalk, 1969, p. 36 *et seq.* (as *A. audouini*), Mozambique. Kensley, 1978, p. 253, Lourenço Marques; 1981, p. 25, Mozambique.

Specimens examined. — 9 specimens from Somalia; 6, Kenya; 1, Nosy Be; 9, Tuléar; 21, Seychelles.

Remarks. — In Fourmanoir's figure of the large chela both the upper and lower proximal shoulders on the palm overhang the groove, a characteristic not of *A. crassimanus* but of *A. edwardsii*. Therefore we have assigned the record to this species.

Alpheus ehlersii De Man

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

Specimens examined. — 1 specimen from Somalia; 4, Tuléar.

Alpheus euphrosyne euphrosyne De Man

Alpheus euphrosyne De Man, 1897, p. 745, figs.64a-d; 1898, p. 317, pl. 4, fig. 2.

Specimen examined. — 1 specimen from Kenya.

Remarks. — The specimen from Kenya came from a mangrove swamp near Mombasa.

Alpheus facetus De Man

Alpheus facetus De Man, 1908, p. 100; 1911, p. 340, fig. 67.

Specimens examined. — 1 specimen from Somalia; 2, Tuléar; 1, Mauritius.

Alpheus frontalis H. Milne Edwards

Alpheus frontalis H. Milne Edwards, 1837, p. 356.

Betaeus utricola Richters, 1880, p. 164, pl. 17, figs. 34, 35.

Previous records. — Richters, *loc. cit.* (as *B. utricola*), Mauritius [see also: Miya, 1981, p. 71]. Coutière, 1921, p. 425, Amirante, Chagos, Seychelles, Coetivy. Balss, 1925, p. 293, Chagos. Barnard, 1950, p. 742, Mauritius. Fourmanoir, 1955, p. 21, Comores. Bruce, 1975, p. 24, fig. 4, E. Africa. Kensley, 1981, p. 25, Mozambique.

Specimens examined. — 14 specimens from Somalia; 13, Kenya; 3, Nosy Be; 1, Tuléar; 2, Comores; 16, Seychelles; 2 (+ Ribes), Réunion; 6, Mauritius.

Remarks. — 7 specimens of *A. frontalis* were dredged from the Seychelles Bank at the depths of 50-55 m by the Seychelles expedition of ORSTOM. This is notable because the species has been reported only as an obligate symbiont living in felted tubes of filamentous blue-green algae (variously identified as *Plectonema*, *Lyngbya*, *Microcoleus*, etc.- see B & B, 1982, p. 93), an alga-shrimp association usually collected in shallow reef areas. However, as the only coral reported by Lewis & Taylor (1966) from the reef platform (as opposed to the shallower reef rim) were ahermatypic (i.e., without zooxanthellae) there was question in our minds as to whether the blue-green alga would be found at this depth. We therefore referred the question to Dr. Crosnier, who in turn referred it to M. Pierre Laboute who has often dived on the bank. Dr. Laboute responded, in part:

> "Je peux vous confirmer qu'en général, sur le plateau seychellois, les formations madréporiques importantes ne dépassent pas 25-30 m de profondeur, et qu'il n'y a que très peu d'algues....Par contre à ces niveaux, il existe de grands herbiers (*Thallasodendron*).
>
> "Au delà de 35 m environ et au moins jusqu'à 60 m sur des fonds sédimentaires, il y a en effet pas mal d' algues bleues ou vertes (dont sans doute *Plectonema*, *Lyngbya* et *Microcoleus*)....L'eau y est en effet excessivement claire et bien souvent de la surface on distingue avec un masque le fond situé à 50 m...."

We were also interested in Kensley's 1981 (p. 25) reference to this species, which, after citing Barnard's 1950 report of the species from Mauritius, then cites his own 1969 report as follows "[Depth] 200 [m], off Mozambique." Yet on p. 154 of the 1969 report, he reports *A. frontalis* as coming from Station 390G made by the *R/V Anton Bruun* at 29°38'S, 31°36'E on a sand and mud bottom at 200 m (station data from p. 150). This dredging will set a new southern distribution record, for it is only 70 km NE of Durban, about 350 km south of the Mozambique-South African border, and also a new depth record. Most marine biologists recognize the ultimate limits of effective photosynthesis in benthic algae to be about 100 m and that 200 m would be well below the euphotic zone. Thus, this record indicates that *A. frontalis* in deeper water may not be an obligate commensal with blue-green algae.*

We have reported the color of *A. frontalis* to be variable (B & B, 1982, p. 102). A color transparency of Dr. Vannini shows in side view that the carapace is a uniform pale brown, the abdomen a pale green of low brilliance, tinged with brown, and the chelae to be pale brown with white flecks.

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* Dr. Kensley, in correspondence, indicates he is suspicious of this record and suggests it may be "a labelling error [that] crept in with the initial sorting of the sample."

Alpheus funafutensis Borradaile

Figure 3

Alpheus funafutensis Borradaile, 1898, p. 1013, pl. 45, fig. 10.

Specimens examined. — 2 specimens from Kenya.

Remarks. — Since the original illustrations for *A. funafutensis* did not emphasize the characteristics useful in separating this species from other members of the Edwardsii Group, we are offering additional drawings.

Our specimens from Kenya and 2 more specimens we have from Indonesia agree well with the type which we have been able to examine at the University Museum, Cambridge, England. The medial and lateral faces of the chelae in our specimens and that of the type appear to be much more pustulate than has been previously indicated. The second antennular article apparently varies from equal to a little longer than the first article. The extra tooth on the outer distal margin of the outer uropod (fig. 3) has not been mentioned before. Dr. C. B. Goodhart of the University Museum kindly reexamined the holotype for us on this specific point, confirming its presence on that specimen.

Alpheus gracilipes Stimpson

Alpheus gracilipes Stimpson, 1861, p. 31.

Previous records. — Ortmann, 1894, p. 15, Tanzania. Lenz, 1905, p. 384, Aldabra.

Specimens examined. — 5 specimens from Somalia; 5, Kenya; 1, Tanzania; 1, Tuléar; 2, Comores; 1, Aldabra; 48, Seychelles; 80 (+ Ribes), Réunion; 28, Mauritius.

Alpheus gracilis Heller

Alpheus gracilis Heller, 1861, p. 27; 1862, p. 271, pl. 3, fig. 19.

Alpheus gracilis alluaudi Coutière, 1905a, p. 882.

Alpheus gracilis simplex Banner, 1953, p. 75, fig. 25.

Previous records. — Coutière, 1921, p. 419, Chagos, Coetivy; 1921, p. 419 (as *A. gracilis alluaudi*), Providence.

Specimens examined. — 3 specimens from Somalia; 4, Kenya; 3, Tuléar; 9, Seychelles; 7 (+ Ribes, as *A. gracilis simplex* Banner), Réunion; 4, Mauritius.

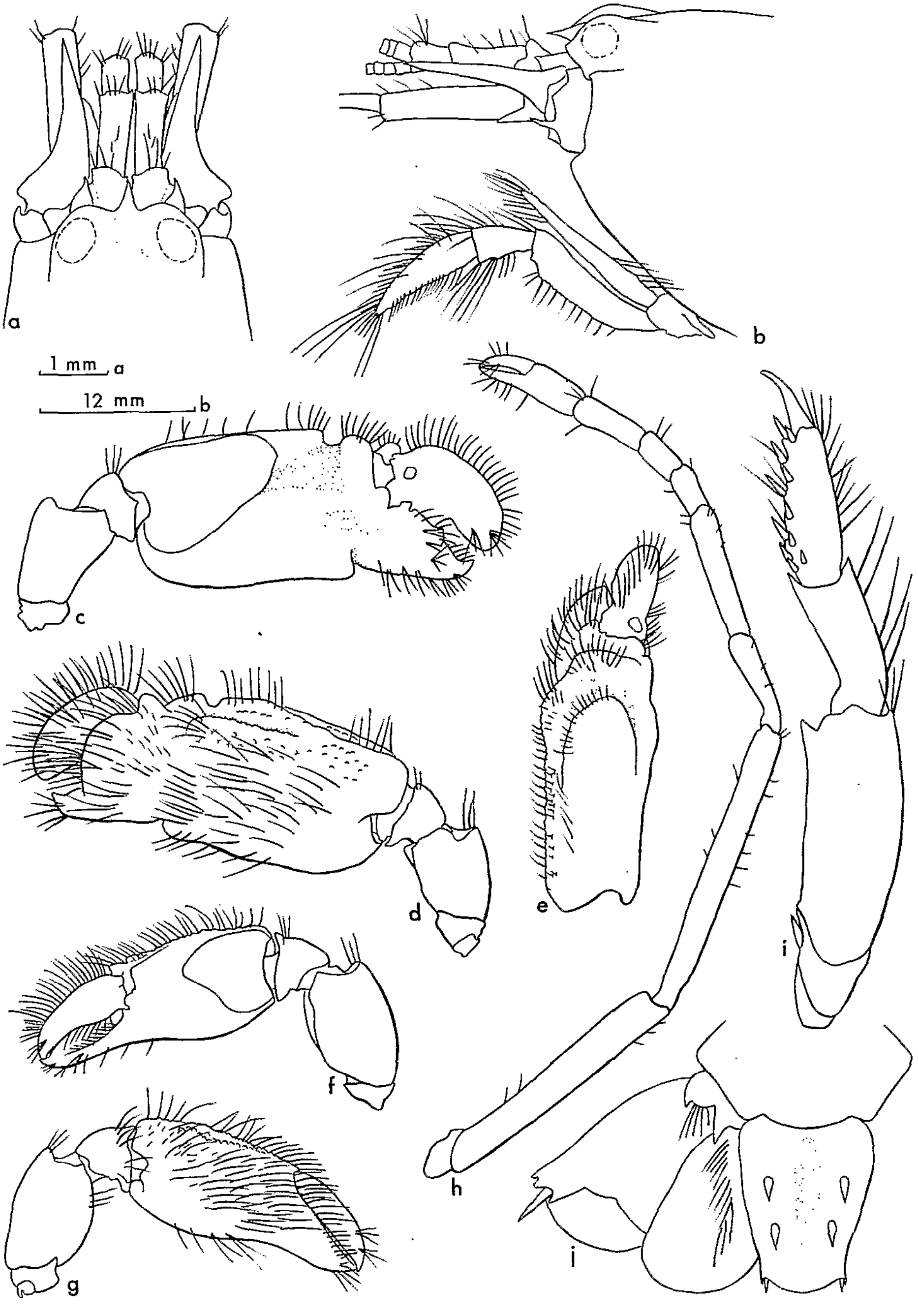

Figure 3. *Alpheus funafutensis* Borradaile. A 22 mm male from near Mombasa, Kenya. a, Anterior region, dorsal view; b, anterior region and third maxilliped, lateral view; c, d, large cheliped lateral and medial faces; e, large chela, superior face; f, g, small cheliped, lateral and medial face; h, second leg, i, third leg; j, telson and uropods. a, b, h, i, j scale a; c, d, e, f, g scale b.

Remarks. — These 30 specimens, collected from the Seychelles to the coasts of Kenya and Somalia extend further the variability that we discussed in our Australia review (1982, p. 60). The stylocerite reaches from the first third of the second antennular article to the middle of that article. The squamous portion of the scaphocerite varies from being narrow and reduced to broader and prominent. The third article of the third maxilliped varies from 3.1 - 5.1 times as long as broad, but the tip is usually truncate. The meri of the large and small chelipeds more often have a series of stiff setae on the inferointernal margin and terminate distally in a small acute tooth but in two of the specimens the inferointernal margins are armed with small spines and the distal margin is rounded. The small chela varies from 3.0 - 4.6 times as long as broad. The spine on the outer uropod in all cases is dark brown or black, even under preservation.

We made the following color notes from a pair of specimens collected in the Seychelles: Body an overall translucent white with 2 dark green broad transverse bands on carapace; each abdominal segment and caudal fan carrying similar bands. Black spine on uropods conspicuous. Chelae of male and thoracic legs light orange-red; chelae of female banded with reddish brown. Coutière has reported a similar coloration from Djibouti (1898c, p. 197) and we have also observed it in Hawaii.

Alpheus hailstonei Coutière

Alpheus hailstonei Coutière, 1905a, p. 879, pl. 74, fig. 18.

Previous records. — Coutière, 1921, p. 419, Seychelles, Saya de Malha.

Specimens examined. — 3 specimens from Kenya; 1, Nosy Be; 1, SE Madagascar; 1, NE Madagascar; Ribes only, Réunion.

Remarks. — One of the specimens from Kenya came from a pool on the outer reef crest. The rest of the specimens in the collection came from at least 20 m.

Alpheus hippothoe De Man

Alpheus hippothoe De Man, 1888b, p. 268, pl. 17, figs. 1-5.

Previous record. — Coutière, 1921, p. 427, Amirante.

Specimens examined. — 4 specimens from Tuléar; 15, Seychelles.

Remarks. — Our field notes for one of the specimens from the Seychelles indicated the color was as follows: Anterior margin of carapace and antennules with red transverse bands. Posterior margin of gastric region and posterior margin of carapace with a similar red band but fading laterally. Abdomen with bright red transverse bands. Uropods and telson almost entirely red but carrying white patches. Medial faces of chelipeds red, with irregular white spots, lateral faces translucent. Pollex and dactylus red except at translucent tip. Coutière (1898c, p. 197) reported a similar banding but of olive green, not red, for specimens from Djibouti.

Alpheus hululensis Coutière

Alpheus bouvieri hululensis Coutière, 1905, p. 908, pl. 85, fig. 46.

Previous record. — Richters, 1880, p. 163 (as *A. strenuus*, see Miya, 1981, p. 69, fig. 3).

Alpheus idiocheles Coutière

Alpheus idiocheles Coutière, 1905a, p. 883, pl. 75, fig. 21.

Alpheus baculifer Coutière, 1908, p. 206; 1921, p. 422, pl. 63, fig. 17.

Previous record. — Coutière, *loc. cit.* (as *A. baculifer*), Chagos.

Specimen examined. — 1 specimen from Mauritius.

Remarks. — We have one 15 mm ovigerous female and an extra male large chela. The female specimen has the typical swollen soft abdomen and entirely agrees with the redescription in which we showed the male of *A. idiocheles* and the female of *A. baculifer* to be a single sexually dimorphic species (B & B, 1967, p. 271). The male cheliped in the collection also agrees with Coutière's original description.

Alpheus lanceloti Coutière

Alpheus lanceloti Coutière, 1905a, p. 900, pl. 83, fig. 39.

Previous records. — Coutière, 1921, p. 426, Amirante. Fourmanoir, 1955, p. 20, Comores.

Specimens examined. — 1 specimen from Comores; 1, Mauritius.

Alpheus leptochirus Coutière

Alpheus leptochirus Coutière, 1905a, p. 914, pl. 87, fig. 54.

Previous records. — Coutière, 1921, p. 427, Chagos, Amirante, Cargados Carajos.

Specimen examined. — 1 specimen from Seychelles; Ribes only, Réunion.

Alpheus leviusculus leviusculus Dana

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

Alpheus bouvieri bastardi Coutière, 1898a, p. 133, figs. 1a, 1'.

Alpheus bastardi Coutière, 1905a, p. 907, pl. 85, fig. 45.

(Note: See B & B, 1982, p. 240 for the full synonymy and discussion of the taxonomy of this species.)

Previous records. — Richters, 1980, p. 163 (as *A. edwardsii leviusculus*, see Miya 1981, p. 66), Mauritius. Coutière, *loc. cit.* (as *A. bouvieri bastardi*), Nosy Be; 1921, p. 427, (as *A. bastardi*), Chagos, Cargados Carajos, Coetivy. Fourmanoir, 1955, p. 20, Comores.

Specimens examined. — 1 specimen from Somalia; 4, Kenya; 7, Nosy Be; 16, Tuléar; 9, Réunion.

Alpheus lobidens De Haan

Figure 4

Alpheus lobidens De Haan, 1850, p. 179.

Alpheus crassimanus Heller, 1865, p. 107, pl. 10, fig. 2.

Previous records. — Lenz, 1905, p. 383, Zanzibar. Fourmanoir, 1953, p. 91, Mozambique. Macnae & Kalk, 1962, p. 117; 1969, p. 80, 126, Mozambique. Ledoyer, 1968, p. 75, pl. 10, figs. 1A-10A, pl. 18B, Tuléar; 1970, p. 127, pls. 12, 23C, Tuléar. Farrow, 1971, p. 482, Aldabra. Thomassin, 1971, p. 381, Tuléar. (All references as *A. crassimanus*). B & B, 1980, p. 26, Aldabra. Kensley, 1981, p. 25 (as *A. crassimanus*).

Specimens examined. — 34 specimens from Somalia; 15, Kenya; 7, Nosy Be; 41, Tuléar; 2, SE Madagascar; 63, Seychelles; 1, Mauritius.

Remarks. — 40 of the specimens collected by Thomassin on the reef top at Tuléar have a tooth on the merus of the third leg similar to the specimens we reported from Aldabra (*loc. cit.*) and the Society Islands (B & B, 1967, p. 283). In a single collection of 6 specimens from Somalia we found one 23 mm female with a strong tooth on the cutting edge at the base of the dactylus of the small chela (fig. 4) and the chela approached the sculpturing and proportions of the form of the species that Holthuis and Gottlieb (1958, p. 42) described as *A. inopinatus*. This specimen appeared in every other way to be a typical *A. lobidens*.

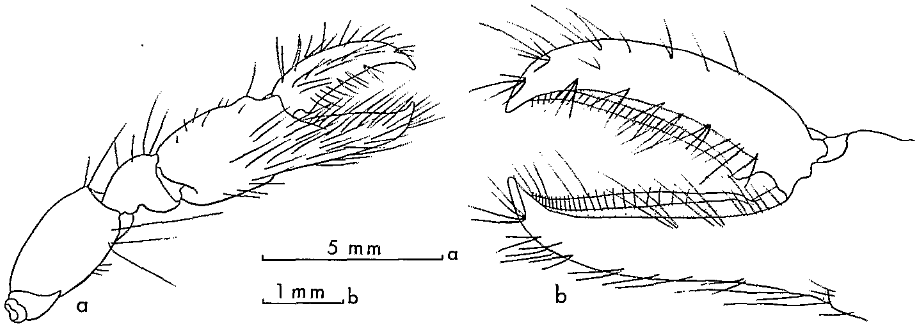

Figure 4. *Alpheus lobidens* De Haan. Aberrant cheliped of 23 mm female from Somalia. a, Medial face; b, distal region, lateral face enlarged. a, scale a; b, scale b.

Alpheus longecarinatus longecarinatus Hilgendorf

Figure 5

Alpheus longecarinatus Hilgendorf, 1879, p. 833, pl. 4, figs. 3-7.

Previous records. — Hilgendorf, *loc. cit.*, Zanzibar. Barnard, 1947, p. 389; 1950, p. 745, figs. 141a-d. Macnae & Kalk, 1969, p. 126. Kensley, 1981, p. 25 (last four records off Mozambique).

Specimens examined. — 5 specimens from Somalia; 8, Kenya; 3, Nosy Be; 5, Tuléar.

HOLOTYPE. — 22.5 mm ovigerous female, total length 22.5 mm, carapace length 8.6 mm. Museum für Naturkunde der Humboldt-Universität (Berlin), Kat. nr. 5956.

REDESCRIPTION OF HOLOTYPE. — The specimen is incomplete, lacks one each of the second, third and fifth legs, the dactylus of one fourth leg, and some denticles around margin of inner uropod and tip of telson; large cheliped and third and fifth legs detached; rostrum slightly bent out of medial line of body.

Anterior portion of carapace broadened and flattened in area of orbital hoods; orbital hoods separated from carapace over antennal base by short, shallow rounded groove. Rostrum short, reaching to middle of visible portion of first antennular article, triangular, slightly longer than base is broad. Rostral carina sharp, high and narrow from tip to behind orbital hoods, continuing over gastric region to about two-thirds length of carapace as slight, low ridge. Orbital hoods continued anteriorly as a low rounded crest turning medially to be confluent with orbitorostral margin. Orbitorostral margin slightly produced before eyes, then almost straight to base of rostrum; anterior margin of orbital hoods bearing a pair of long, slender setae; margins of rostral base bearing pair of shorter setae, both broken. Orbitorostral area anteriorly and at level of eyes almost flat, posterior to eyes slightly depressed until meeting convexity of anterior gastric region; area glabrous.

Antennular peduncle with second article 2.4 times as long as broad, 1.7 times longer than visible portion of first and third articles; superior surface of second article with scattered long setae. Stylocerite broad and rounded except for small acute tooth reaching to near end of first article. Basicerite rounded and unarmed; scaphocerite with strong lateral tooth reaching almost to end of carpocerite, blade moderately broad, reaching to level of end of antennular peduncle; carpocerite in lateral view about 4 times as long as broad distally, reaching beyond antennular peduncle by about half length of distal antennular article.

Ratio of lengths of endopodal articles of third maxilliped: 10: 2.7: 7.0; inferior margins of first article bearing 6 slender spines; second article bearing distally small tuft of long setae; third article broadened, 2.3 times as long as maximum breadth, tip almost rounded and bearing setae about as long as that article.

Large chela with axis of fingers lying at right angles to plane of appendage, subcircular in section, without sculpturing; with some taper from about one-third of length towards fingers. Dactylus heavy, distally rounded, reaching beyond propodal finger, plunger well developed, propodal finger heavy with oppositive face curved to meet dactylus. Chitin of tips of both fingers white from deposition of carbonate; setae few and scattered. Merus with outer face 1.9 times as long as broad in middle; superior margin slightly projecting. Inferoexternal margin unarmed except for a regular series of low rounded cusps on proximal half; inferointernal margin proximally smooth, distally projecting as strong, acute tooth. Ischium also bearing heavy strong tooth on inferodistal margin.

Small chela also with fingers closing laterally; 0.55 length of large chela, over 3.3 times as long as broad at base, with fingers occupying 0.45 of total length. Palm cylindrical in cross-section, tapering from base to tips of fingers. Fingers slightly curved, with low shearing ridge on inner side of both fingers; tips slightly curved and crossing. Carpus two-thirds as long as palm, of the same breadth distally as base of palm. Merus 0.9 as long as chela, almost twice as long as broad in middle with all margins smooth and bearing no projections or teeth distally. Ischium similar to that of large chela except that inferodistal projection more acute. (For small cheliped of male, see below.)

Carpal articles of second leg with the following ratios: 10: 20: 4: 4: 11; chela 1.5 times length of fifth article.

Ischium of third legs bearing strong spine. Merus 3.4 times as long as broad in middle, with sub-terminal heavy acute tooth reaching beyond merocarpal articulation; setae few and scattered. Carpus 0.47

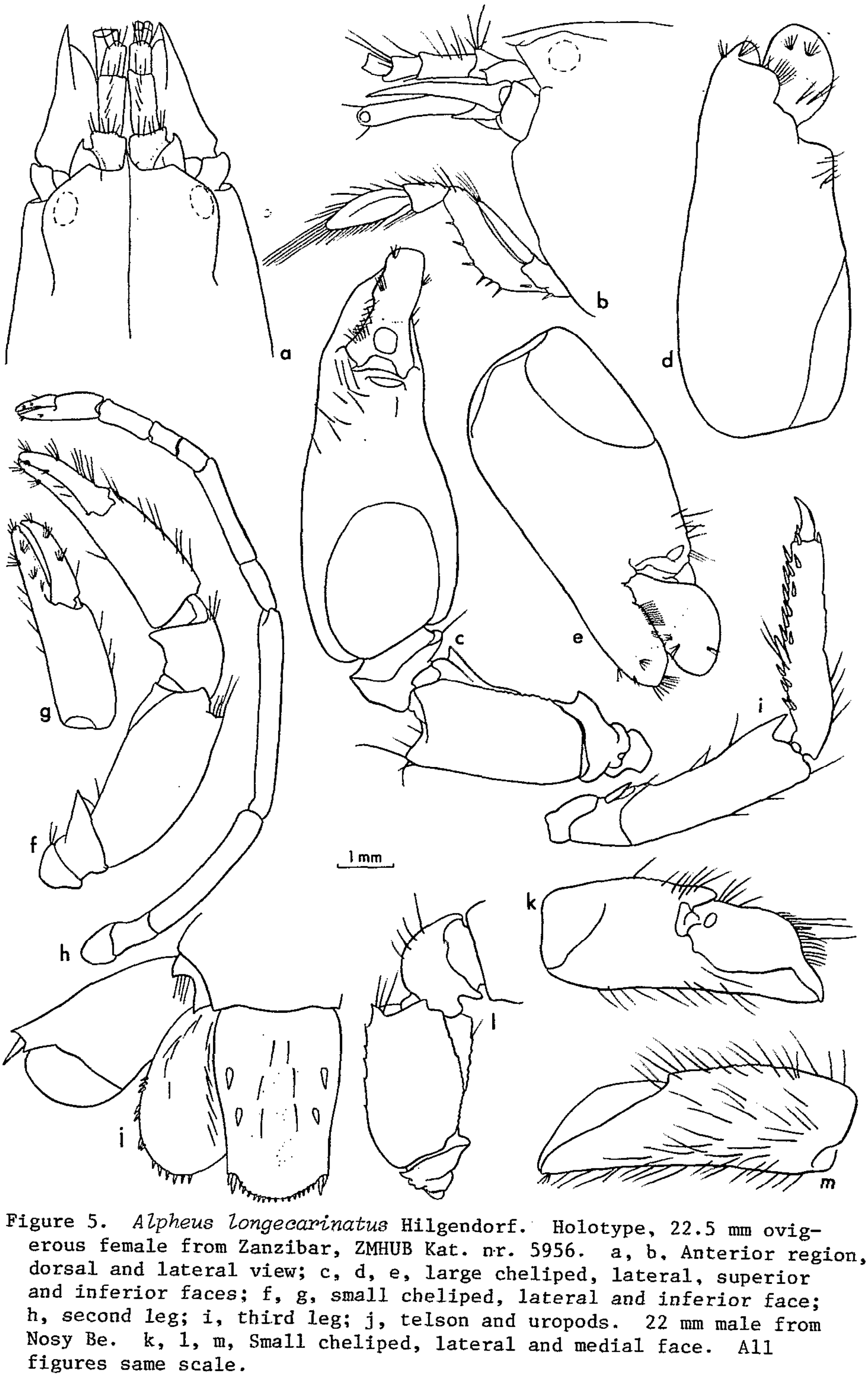

Figure 5. *Alpheus longecarinatus* Hilgendorf. Holotype, 22.5 mm ovigerous female from Zanzibar, ZMHUB Kat. nr. 5956. a, b, Anterior region, dorsal and lateral view; c, d, e, large cheliped, lateral, superior and inferior faces; f, g, small cheliped, lateral and inferior face; h, second leg; i, third leg; j, telson and uropods. 22 mm male from Nosy Be. k, l, m, Small cheliped, lateral and medial face. All figures same scale.

length of merus; inferior margin bearing 5 heavy spines and a strong, acute tooth distally; superior margin with scattered long setae. Propodus 1.35 as long as carpus, 3.2 as long as proximal breadth; inferior margin bearing 10 somewhat irregularly-placed strong spines and a pair distally (last pair in holotype curved and crossing); superior margin bearing long strong setae irregularly placed and small distal spine above dactylar articulation. Dactylus simple, curved, 0.37 as long as propodus; without usual small tuft of setae subterminally. Fourth legs similar but smaller. Fifth legs much smaller than fourth, merus lacking distal tooth, carpus lacking both spines and tooth, propodus with spines reduced in number and size but bearing a well-developed brush distally on inner side.

Lateral spine of outer uropod moderately heavy, extending beyond tip of uropod and flanked by two acute teeth; inner uropod bearing row of small spines from middle to lateral margin to around tip (some spines broken off). Telson with length 1.5 times maximum breadth, with tip 0.8 of maximum breadth; lateral margins initially convex, than concave; tip broadly arcuate and extending beyond tips of inner posterolateral spines and bearing row of spinules similar to those of inner uropod; posterior pair of dorsal spines located about mid-length of telson; dorsal surface from somewhat behind articulation to past tips of last pair of dorsal spines carrying a low, rounded medial concavity or depression.

Small cheliped of male (22 mm male from Nosy Be): Chela subcylindrical, 2.7 as long as broad, with fingers occupying half of total length. Dactylus expanded, subbalaeniceps, bearing dense fringes of setae on medial and lateral margins, but not crossing over tip. Tip slender, acute, occupying about one-third of total length. Inner face of palm with long, scattered hairs. Merus 1.5 times as long as maximum breadth, with all margins slightly irregular but without spines or teeth; superodistal angle slightly projecting.

Discussion. — In the Red Sea paper (1981d, p. 10) we reported upon *A. bucephaloides* Nobili, 1905, both upon collections of the species from the Red Sea and upon the reexamination of Nobili's type series from the Persian Gulf. We found this species to be remarkably similar to the specimens we are now reporting upon in this paper, but we found three possible differences between the two species: First, that the dorsal carina of the carapace extended only to the end of the gastric region in *A. bucephaloides*, but well posterior to the middle in *A. longecarinatus*. Second, that the second article of the carpus of the second leg was 1.6 times the length of the first or shorter than *A. bucephaloides*, but 2.0 times or longer in *A. longecarinatus*. Third, that the merus of the third leg carried only the strong terminal tooth in *A. bucephaloides* but Hilgendorf's figure of *A. longecarinatus* showed what could be interpreted as movable spines proximal to the terminal tooth; this interpretation we considered as unlikely. We also pointed out that Barnard had remarked upon and shown in his figures of specimens of *A. longecarinatus* from Mozambique the presence of long setae on the anterior carapace that did not appear in *A. bucephaloides*. We also considered the presence or absence of a depression ("*Eindruck*") on the dorsal surface of the telson, mentioned by Hilgendorf, but omitted by Nobili, but dismissed it as it was variable in both the Red Sea and Western Indian Ocean specimens.

After the study of the two nominal species, we came to the conclusion that they be left as standing, to be reconsidered "if Hilgendorf's holotype is found or if topotypes from Zanzibar can be studied." We discovered that the Berlin Museum still had Hilgendorf's holotype (and only specimen) which through the courtesy of Dr. H.-E. Gruner we have been able to redescribe and figure. This reexamination of the holotype does indeed show that our suggestion that the merus of the third legs carried movable spineus was in error. We believe that Barnard's long setae on the anterior carapace also is in error, for we found many specimens from Somalia and Tanzania carry in this area a matted hair-like growth that we could not identify. Thinking it perhaps was an epizoic growth of some microscopic form, we sent a specimen carrying it to Dr. R. E. Manning of the U. S. Museum of Natural History who in turn consulted with Dr. Ray Bauer of the Scripps Institution of Oceanography, University of California. They reported it to be "trash: diatoms, blue-green algae and dirt" (in litt.). Barnard's setae therefore could have been algal filaments. Hilgendorf's type also had material adhering to the anterior carapace so thickly that the margins of the orbital region could not be discerned without a prior brushing with a camel's hair brush; it also adhered to other parts of the body, such as the upper surface of the chela, and the "brush" on the fifth legs was also clogged with the "trash."

There remains then the first two characteristics, the length of the dorsal carina and the relative lengths of the first two secondary articles of the carpus of the second legs. We examined every specimen in the present collection on these points:

Somalia: In all the dorsal carina extends definitely behind the middle of the carapace; the second carpal article varies from 2.5 to 3.6 times the length of the first, averaging 3.1.

Kenya: Carina extending from just anterior to well posterior of the middle of the carapace; second carpal article from 1.3 (possibly a regenerating appendage) to 3.3 times the length of the first, averaging 2.5.

Nosy Be: Carina extending always well posterior of middle of carapace; second article 1.9 to 2.4 times length of first, averaging 2.1.

Tuléar: Carina extending well posterior of middle of carapace; second article 1.7 to 2.1 times as long as first, averaging 1.9.

We could find no other characteristic that would separate the two populations. Yet there seems no overlap on these two variable characteristics.

We now propose that these are constant genetic differences between the population from off East Africa and the Red Sea, and we suggest that the genetic separation of the two populations is maintained by oceanographic conditions off the coast of Somalia. According to Stoddart (1971), the coast of Somalia is almost entirely devoid of coral reefs from the area near Djibouti around the "horn of Africa" and down the eastern coast until the equator is approached, a distance of over 2000 km.* The lack of reefs along this length of coast can be explained by a very intense and cold upwelling during the period of southern monsoons (Wyrtki, 1971). Moreover, according to Dr. Wyrtki (personal communication), the Somalia Current during the southern monsoons transports the upper water mass towards the middle of the Arabian Sea, being separated from the continental coast by this broad band of upwelling. When the northern monsoons reverse the currents, it is not water from the Red Sea and Persian Gulf that is transported southward, but again water from the middle of the Arabian Sea. If these oceanographic facts are considered, it is apparent that the populations could be isolated, with neither stepwise diffusion along the coast from one coral reef to another, nor bold "jumps" of the larvae carried by sweeping oceanic currents.

If this hypothesis is correct, then the two populations are separated geographically and genetically, but probably are closely enough related that they could interbreed successfully. Therefore we are relegating Nobili's later named species to subspecific rank, as *A. longecarinatus bucephaloides*.

The specimens that Coutière reported as *A. longecarinatus* from Amirante Bank and from Providence (1921, p. 426) have been reconsidered both by Crosnier and Forest and by us - see above under *A. collumianus*.

Alpheus lottini Guérin

Cancer sublucanus, Forskål, 1775, p. 94.**

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* We reported two species of *Alpheus* and four species of *Synalpheus* from the coast of Somalia, just south of Cape Guardafui (at 11°11'N, 51°14'E, B & B, 1980). These were taken by trawl by the research ship *Anton Bruun* on the continental shelf (depth unspecified). Three of the species of *Synalpheus* are obligate sponge symbionts and two species of *Alpheus* and the last species of *Synalpheus* have also been reported from sponges. In any case, these records do not indicate a continuous distribution of reef-associated alpheids along the coast of Somalia.

** Holthuis (1979, p. 7) proposed the substitution of *A. sublucanus* Forskål 1775 for *A. lottini*. We protested this change to the International Commission on Zoological Nomenclature (1981c, p. 297). As this is being written, we are publishing a compromise we reached with Dr. Holthuis in which Forskål's name is to be retained for the specimens from the Red Sea only if these specimens are considered in the future to be different at the species level from *A. lottini* found elsewhere in the Indo-Pacific. If the populations are considered to be a single species, the name *A. lottini* will be used.

Alpheus lottini Guérin, 1829, pl. 3, fig. 3; 1838, p. 38.

Alpheus ventrosus H. Milne Edwards, 1837, p. 352.

Alpheus laevis Randall, 1839, p. 141.

Previous records. — (As *A. lottini*): Stebbing, 1915, p. 82. Barnard, 1950, p. 748, fig. 141e-j, both records from Mozambique. Fourmanoir, 1955, p. 20, Comores; 1958, p. 119, Nosy Be. Macnae & Kalk, 1969, p. 37 *et seq*, Mozambique. Kensley, 1970, p. 105; 1978, p. 253; 1981, p. 25, all 3 records Mozambique. Bruce, 1975, p. 25, E. Africa. B & B, 1980, p. 26, Kenya, Comores.

(As *A. ventrosus*): H. Milne Edwards, *loc. cit.*, Mauritius. Lenz, 1912, p. 2, E. African Coast. Coutière, 1921, p. 419, Seychelles, Chagos, Coetivy.

(As *A. laevis*): Hilgendorf, 1879, p. 834, Zanzibar. Richters, 1880, p. 163, Mauritius. Miers, 1884, p. 561, Seychelles. Ortmann, 1894, p. 15, Tanzania. Lenz, 1905, p. 384, Aldabra; 1910, p. 568, Mozambique.

(As *A. sublucanus*): Miya, 1981, p. 68. (Richter's specimens).

Specimens examined. — 232 specimens from Somalia; 27, Kenya; 2, Tanzania; 5, Nosy Be; 18, Tuléar; 2, Aldabra; 16, Seychelles; 11, Mauritius; Ribes only, Réunion; 1, Chagos.

Remarks. — While *A. lottini* is considered to be of almost constant coloration throughout the Indo-Pacific, orange-red with darker maculae on the chelae and usually a darker longitudinal stripe down the middle of the carapace that often extends to the abdomen, Dr. Vannini found some in Somalia that were so much lighter in color that he initially thought them to be of a different species. In these, as shown on his color transparencies, in addition to lacking the orange-red color, the longitudinal stripe was discontinuous, being a series of discrete and small black patches.

With this unusual coloration reported from Somalia, we revisited the area in Kaneohe Bay, Hawaii, where we found the very light specimens in 1955 (B, 1959, p. 141) and found the population still existing. As color is so often used as a criterion for species differentiation in shrimp, we have decided to make a more thorough study of color variation in this species, to be reported upon in a future paper. Dr. Vannini has indicated that he, too, plans to study the aberrant colored shrimp on his next visit to Somalia.

Alpheus mackayi Banner

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

Alpheus mackayi Banner and Banner, 1975a, p. 428, figs. 2A-H.

Specimens examined. — 96 specimens from Tuléar.

Alpheus macrodactylus Ortmann

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

Specimens examined. — 20 specimens from Somalia; 1, Kenya; 4, Nosy Be; 3, Tuléar.

Remarks. — The specimens from Somalia were collected in mangrove swamps at Gesira, while those from Tuléar came from white calcareous mud. Since reporting specimens from Guam in our Australian paper (1982, p. 212), we have been told that these came from a mangrove swamp at the mouth of a river. These ecological data support our suggestion (*loc. cit.*) that "the species lives in soft, probably muddy, bottoms," but the Tuléar notes indicate that it is not confined to the black muds of mangrove swamps.

Alpheus maindroni Coutière

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

Specimens examined. — 2 specimens from Tuléar.

Alpheus malabaricus malabaricus (Fabricius)

Astacus malabaricus Fabricius, 1775, p. 415.

Previous records. — Barnard, 1947, p. 390; 1950, p. 761, figs. 142 l-n. Macnae & Kalk, 1962, p. 106. Kensley, 1981, p. 25 (all 4 records off Mozambique).

Alpheus malleodigitus (Bate)

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

Alpheus phyrgianus Coutière, 1905a, p. 886, pl. 77, fig. 25.

Alpheus danae Coutière, 1905a, p. 887, pl. 77, fig. 26.

Previous records. — Coutière, 1921, p. 423, (as *A. phyrgianus*), Chagos, Providence, Amirante.

Specimens examined. — 3 specimens from Somalia; 1, Kenya; 110, Tuléar; 3, Seychelles; 21, Réunion; 34, Mauritius.

Discussion. — In our 1966 review of the species in the Obesomanus Group (1966a, p. 162 *et seq.*; see also footnote under *A. microstylus*, below) we pointed out that *A. danae* was very close to *A. malleodigitus*, as indicated by Coutière in his comparison of the species to *A. phyrgianus* (=*A. malleodigitus*). We then believed that the two species might be separated by the lengths of the carpocerites which were described in *A. danae* as equal in length to the lateral tooth of the scaphocerite, with both reaching before the middle of the second antennular article. In the central Pacific specimens of *A. malleodigitus*, the carpocerite was variable in length, but always longer than the scaphocerite and the length of the scaphocerite was also variable, but in no cases approaching the condition of *A. danae*. We concluded that the described condition of *A. danae* might be "merely an extreme variation [of *A. malleodigitus*] but at present it is not indicated." Coutière's description of 1905a was the only report of specimens under the name of *A. danae*. Since then we have examined Coutière's type of *A. danae* at the British Museum (Natural History) and have confirmed the accuracy of his description and figures.

In the study of the large collections of specimens of the Obesomanus Group from the western Indian Ocean, we again examined the differentiation between these two nominal species. Here we found the missing range of variation that we did not find in the central Pacific: While the carpocerite in the present specimens usually exceeds the length of the scaphocerite by one-quarter to one-half the length of the second antennular article, in a few specimens this difference is reduced to less than one-eighth of the length of the second antennular article, with the tips of both reaching only to near the middle of that article. We therefore are putting the name *A. danae* into synonymy.

We think that our species *A. samoa* (B & B, 1966, p. 174) may be a further variation of *A. malleodigitus*. It has a vestigial scaphocerite, with the tooth reaching only to near the end of the first antennular article and no trace of the squame, and the carpocerite reaches only to the level of the middle of the second antennular article. However, as there are no specimens in any of the collections we have examined that bridge this gap, we are permitting the name to stand, with reservations.

Alpheus microstylus (Bate)

Figure 6a-f

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

Previous records. — Coutière, 1921, p. 423, Coetivy. Fourmanoir, 1958, p. 120, figs. 7, 8, Nosy Be. Peyrot-Clausade, 1979, p. 76, Tuléar. B & B, 1980, p. 26, Aldabra.

Specimens examined. — 1 specimen from Somalia; 11, Kenya; 4, Tanzania; 80, Tuléar; 1, Aldabra; 76, Seychelles; 13, Réunion; 4, Mauritius.

Discussion.—We have considered the separation of species in the Obesomanus Group in 3 previous papers (1966a, p. 162; 1966b, p. 99; 1982, p. 87). The first study was based on the measurements of characteristics used in the separation of the species of this group in over 150 specimens, principally of *A. obesomanus* Dana and *A. malleodigitus* (Bate) with a few specimens of *A. microstylus.** While the study permitted us to place a number of species into synonymy, it also showed that the separation of these three nominal species was clouded. The two other studies added a bit to the separation of the species and to their ecology and distribution, but they did not clarify the separation amongst the species.

In these previous studies *A. microstylus* was found only in small numbers. It was not until we undertook the study of the Indian Ocean areas that we found *A. microstylus* to predominate (1981d, p. 36, and the present study). We decided to utilize this study on the western Indian Ocean to see if we could resolve the question of species separation, especially in reference to *A. microstylus*. For this we took enough specimens at random from the various areas, usually 10-20, for careful measurement to see if trends could be found that would warrant a more detailed study such as we made in 1966. As the preliminary work merely showed a continuing variation in the characteristics as previously reported, we will not present our measurements, but merely our conclusions:

1. The separation of the three species in question is other than firm.

2. *A. malleodigitus* appears to be the most distinct species, with the longest and thinnest second article of the antennules, the most reduced scaphocerite and carpocerite (relative to the antennular articles), and the shortest second carpal article of the second leg, with the average ratio of 14 specimens being 10: 12.6.

3. *A. obesomanus* is usually characterized as having the lateral tooth of the scaphocerite not greatly reduced, but with the squamous portion reaching only to near the middle of the second antennular article, and as having the tip of the telson straight, narrow and bearing 2 pairs of long spines, the length of the inner pair usually exceeding half the breadth of the tip (fig. 6g,h).

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* We wish to call attention to an error in one of the captions of the graphs we presented in the 1966a study, an error that may have appeared when we attempted to reconstruct the paper from our burned original notes (see the introduction to the 1966a paper): In figure 14, p. 167, dealing with the relative lengths of the fingers of the small chelae, the ratios expressed are not for the length of the palm divided by the length of the fingers, as stated in the caption, but rather for the total length of the chela divided by the length of the fingers (to obtain the palm/finger ratio, the figures given can be reduced by 1, as 3.2 for the total length to 2.2 for the palmar length). In our reexamination of this characteristic in the three accepted species, we found the specimens from the Indian Ocean to overlap and extend the ranges reported from the central Pacific, rendering this characteristic yet more unreliable for differentiation.

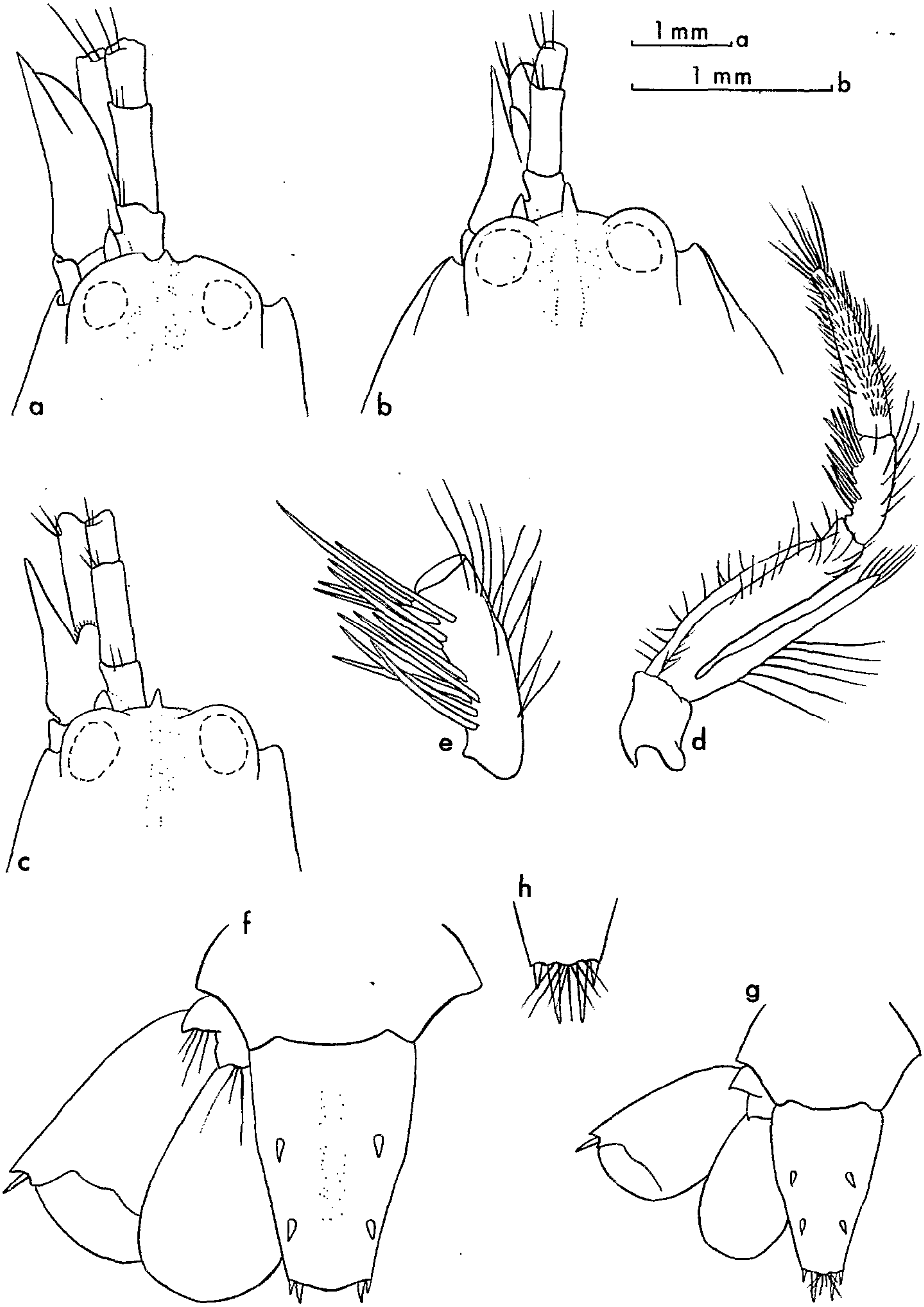


Figure 6. *Alpheus microstylus* (Bate). Anterior region of 3 specimens showing variation in scaphocerite. a, 20 mm male, Tuléar; b, 23 mm female, Seychelles; c, 20 mm male, Seychelles. 20 mm male, Seychelles, d, e, third maxilliped, medial face and second article enlarged; f, telson and uropods. *Alpheus obesomanus* Dana. 15 mm male, Tuléar, g, h, telson and uropods with tip enlarged. a, b, c, d, f, g scale a; e, h scale b.

4. The separation of *A. microstylus* from *A. obesomanus* is questionable but usually specimens of *A. microstylus* have neither the tooth nor the squame of the scaphocerite reduced (however, see number 5, below) and have the tip of the telson broad, arcuate, with the posterolateral spines short (fig. 6f).

5. Within the species *A. microstylus* we found two populations, one from Tuléar and the other parts of Madagascar and the east African coast, the second from the Seychelles (with smaller collections from Mauritius and Réunion). The Tuléar specimens were more constant in all characteristics, the Seychelles specimens were more variable. This was especially noticeable in the scaphocerite, with the tooth in all the Tuléar specimens reaching to, or just beyond the end of the third antennular article, but in 17 specimens from the Seychelles it reached from the end of the second article to beyond the end of the third; the scale, correspondingly, reached from the middle to the end of the third antennular article in specimens from Tuléar, but from the middle of the second article to the end of the third in those from the Seychelles (contrast figs 6b,c). In a few from the Seychelles, the carpocerite was shorter as well.

6. Individual specimens would occasionally vary markedly from the norm on one or two characteristics, but be normal for the species in other criteria. Thus a specimen identified as *A. obesomanus* from Tuléar on the basis of the length/breadth ratio of the second antennular article (2.0), the long second carpal article of the second leg (3 times the length of the first), had the reduced tooth of the scaphocerite (to three-quarters the length of the second antennular article), the reduced carpocerite (to slightly beyond end of second antennular article), and the broad arcuate telson of *A. malleodigitus*. Again, a specimen of *A. microstylus* from Tuléar with a relatively narrow tip of the telson (4.7 times as long as broad) was at modal proportions for *A. microstylus* in other characteristics.

7. Other characteristics, not amenable to measurement, were also found to vary, such as the rostrum which varied from a well-formed equilateral triangle to being completely absent or even having the middle of the anterior margin of the carapace marked by a slight U-shaped depression. The orbital hoods, normally not greatly inflated in all 3 species, were markedly inflated in most of the specimens of *A. microstylus* from the Seychelles. Finally, in all three species the lower margin of the middle article of the third maxilliped bore a group of long and heavy setae near the tip. However at times some specimens of *A. microstylus* and a few specimens of *A. obesomanus* had the heavy setae extending proximally for almost the entire length of the article.

The color of living specimens, a characteristic that is helpful in other species such as *A. gracilipes* Stimpson, added more to the confusion:

A. obesomanus: "Sulphur yellow color with the ovary green through the transparent carapace" (B & B, 1982, p. 89).

A. malleodigitus: "Sulphur yellow color" (B & B, 1982, p. 82). This color was also remarked upon by Coutière in specimens from Djibouti (1898c, p. 197). However, in one pair we collected in Australia "the female was an 'off-pinkish' red and the male was tan," and Holthuis described one specimen from the Red Sea as carrying pink transverse bands on the abdomen, with the appendages yellow to orange (B & B, 1981d, p. 35).

A. microstylus: Color notes from the Red Sea indicated that specimens in 9 collections were bright to lemon yellow; Holthuis noted that in one specimen the fingers of the large chela were white and the small chela was greenish; the eggs were green. In the present collection two specimens from Kenya were reported to be bright yellow. However, our color notes on a cohabiting pair from the Seychelles described the male as having the dorsal parts of the carapace, abdomen and caudal fan "royal blue (almost purple)," with the branchiostegites paler blue and with a pale blue transverse band on the anterior margin of each abdominal tergum, and with pale blue mottling on both faces of the large chela. In the female the carapace was a light blue green dorsally, but the branchiostegites were translucent tinged with orange; the abdomen was darker, almost olive, with each tergum carrying a broad translucent band of blue cast, caudal fan was similar to the abdomen but with scattered red chromatophores; superior portions of large chela were olive, the dactylus was white, while inferior surface of the chela was translucent white. Thoracic legs were pale translucent blue with scattered red chromatophores. Eggs were pale green.

Further confusion is added when the distribution of the three species is considered. We present the actual numbers of specimens that we have personally examined and have reported upon or will be reporting in Table 1a,b, the first by broad regions, the second for the more specific areas reported in this paper. Figures 7a,b correspondingly give the percentage that each species contributes of the total collection of the three species in each area.

One possible explanation for the strange distributional pattern could be that the collectors in the various areas favored one type of habitat over another, thus prejudicing the total collection in favor or one species over the other two. We do not believe this explanation to be plausible for three reasons: First, as pointed out in previous papers, the species occupy similar ecological niches and all three have even been found in the same overgrown coral head (B & B, 1966b, p. 101). Second, we personally collected almost all of the specimens from the central Pacific where *A. obesomanus* and *A. malleodigitus* were in near equal numbers; from the Philippines (not the South China Sea) where all specimens were *A. obesomanus*; most of the specimens from Indonesia where *A. malleodigitus* was dominant; and all specimens reported from the Seychelles where *A. microstylus* was in great excess. Third, the Red Sea collections, showing again a dominance of *A. microstylus*, were made by many collectors who were often working in ecological transects.

TABLE 1

Distribution of *Alpheus obesomanus*, *A. malleodigitus* and *A. microstylus* indicated by total number of specimens examined

1a. Number of specimens examined by us from various major areas.

Area	*A. obesomanus*	*A. malleodigitus*	*A. microstylus*	Total	As Reported in:
Central Pacific	80	87	9	176[1]	B&B, 1966a:162
Philippines	233	11	0	244	B&B, 1979:266
Thailand	138	104	9	251	B&B, 1966b:99
Indonesia	11	70	7	88	(2)
Australia	273	30	0	303	B&B, 1982:87
Western Indian Ocean	66	172	190	428	This paper
Red Sea	1	10	50	61	B&B, 1981d:35

1. Not total number collected, but number of reasonably intact specimens studied.
2. Study still in progress; the numbers represent those studied until April, 1981.

1b. Number of specimens examined by us from localities in the Western Indian Ocean.[1]

Area	*A. obesomanus*	*A. malleodigitus*	*A. microstylus*	Total
Somalia	0	3	1	4[2]
Kenya	4	1	11	16
Tanzania			4	4[2]
Tuléar	19	110	80	209
Aldabra			1	1[2]
Seychelles	1	3	76	80
Réunion	41	21	13	75
Mauritius	1	34	4	39

1. These localities not listed lacking specimens of these species.
2. Samples too small to be significant for graphing (figure 7b).

Fig. 7 - Distribution of the species *Alpheus obesomanus* (Dana), *A. malleodigitus* (Bate) and *A. microstylus* (Bate) shown as a percentage of the total collections of the three species.

Figure 7a - In the Indo-Pacific realm

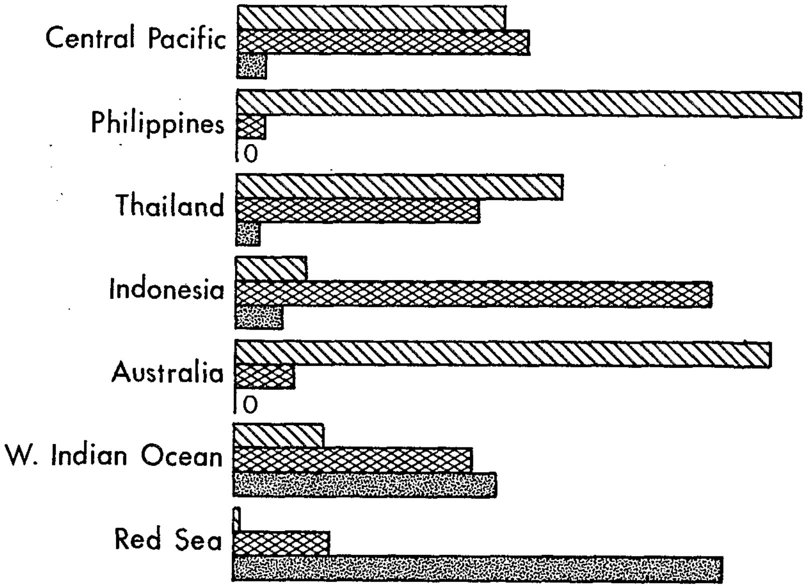
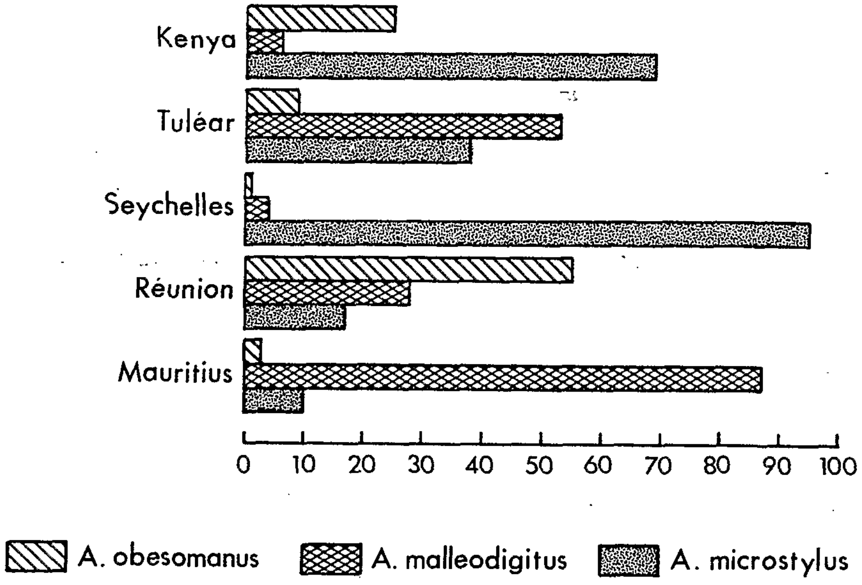


Figure 7b - In the western Indian Ocean



The most instructive contrast presented is between Mauritius and Réunion, islands only a little over 100 km apart: In Mauritius 87 percent of the collections were of *A. malleodigitus*, 1 percent were of *A. obesomanus*, while in Réunion the same species represent 28 to 55 percent, respectively. In Australia we found that all collections of *A. obesomanus* were confined to the region of the Great Barrier Reef from Torres Straits southward but *A. malleodigitus* was represented in collections from northern and western Australia as well as the Great Barrier Reef.

A. microstylus, dominant in the Red Sea and other areas in the western Indian Ocean, was not found in any of the extensive Australian collections in spite of the fact that Cape York is the type locality; in the Thai collections, it was found only on the Indian Ocean coast of Peninsular Thailand, not in the Gulf of Thailand; it is not common in the Indonesian collections so far examined, and we reported it only from the Marianas and Samoas in the central Pacific.

To a taxonomist and a zoogeographer, this complex may be considered in two possible ways: First, these collections represent a single species widespread and variable, with geographically separated populations harboring different gene pools that apparently have no particular adaptive significance for survival. Or, second, three basic species, again with different gene pools in different areas and possibly with some isolated subspecific groups, but with enough in common genetically that interspecific hybrids might at times occur, producing the specimens remarked upon under paragraphs 6 and 7 above.

The resolution of the problem might be attained through the measurement of morphological characteristics in large populations throughout the range of the Indo-Pacific with subsequent multivariate analysis by computer. The analysis of the "racial stocks" by serum electrophoresis might also help resolve the problem. Biologically, the problem might be resolved through studies of microecology of the three species, studies of their behavior, or even by attempting crossbreeding and the observation of the resulting larvae and adults. We are certain that further studies such as those we have made with preserved specimens, supplemented with crude field observations, will not resolve the question posed. Although we are inclined towards the concept of a single variable species, we have no proof and we therefore leave the three nominal species standing.

Alpheus miersi Coutière

Alpheus rapax miersi Coutière, 1898b, p. 166, fig. 1.

Alpheus miersi Coutière, 1905a, p. 903, pls. 83, 84, fig. 42.

Previous records. — Fournanoir, 1955, p. 20, Comores. B & B, 1980, p. 26, Kenya.

Specimens examined. — 4 specimens from Somalia; 7, Tuléar; 23, Seychelles.

Remarks. — One of the specimens from Somalia was entirely lacking the tooth distally on the merus of the third leg and 5 specimens from Tuléar had only a small angle. Three of the specimens from Somalia were taken from "rocky-sandy" tide pools on the coastal intertidal platform near shore, while one was collected in the muddy-sandy carpet among the roots of "a prairie" of *Syringodium* and *Cymodocea.*

Alpheus nonalter Kensley

Alpheus nonalter Kensley, 1969, p. 172, fig. 15.

Previous records. — Kensley, *loc. cit.*; 1981, p. 25 (both records off Mozambique).

Specimen examined. — 1 specimen from Nosy Be.

Remarks. — The specimen from Nosy Be was dredged at 210 m.

Alpheus notabilis Stebbing

Alpheus notabilis Stebbing, 1915, p. 80, pls. 84, 85.

Previous records. — Stebbing, *loc. cit.* Barnard, 1950, p. 747. Kensley, 1981, p. 25 (all references Mozambique).

Alpheus oahuensis (Banner)

Crangon oahuensis Banner, 1953, p. 64, fig. 20.

Specimens examined. — 1 specimen from Somalia; 2, Tuléar; 2, Mauritius.

Remarks. — In the specimen from Somalia the second article of the antennular peduncle is 1.5 times as long as broad instead of twice, as reported for the holotype. However, in the paratypic series from Hawaii some smaller specimens had the second antennular articles that were only 1.7 times as long as broad.

Alpheus obesomanus Dana

Figure 6g,h

Alpheus obesomanus Dana, 1852a, p. 21; 1852b, p. 547, pl. 34, fig. 7.

Alpheus lutini Coutière, 1905a, p. 885, pl. 76, fig. 24.

Previous records. — Richters, 1880, p. 163, Mauritius. Miers, 1884, p. 561, Seychelles. Lenz, 1905, p. 383, Aldabra; 1910, p. 568, Madagascar. Coutière, 1921, p. 423 (as *A. lutini*), Coetivy. Peyrot-Clausade, 1979, p. 76, Tuléar. Miya, 1979, p. 68 (Richter's specimens).

Specimens examined. — 4 specimens from Kenya; 19, Tuléar; 1, Seychelles; 41 (+ Ribes), Réunion; 1, Mauritius.

Remarks. — Collection notes on a specimen from Kenya state: "...in hole in coral block, reef flat at low water spring. Pale yellowish transparent with dark olive green ovary and ova." (See also discussions under *A. microstylus*).

Alpheus ovaliceps Coutière

Alpheus ovaliceps Coutière, 1905a, p. 888, pl. 77, fig. 27.

Previous record. — Coutière, 1921, p. 423, Chagos.

Specimen examined. — 1 specimen from Kenya.

Alpheus pachychirus Stimpson

Alpheus pachychirus Stimpson, 1861, p. 30.

Previous records. — Coutière, 1921, p. 425, Chagos, Coetivy.

Specimens examined. — 25 specimens from Somalia; 1, Kenya; 3, Tuléar; 1, Aldabra; 3, Seychelles; 1, Réunion; 38, Mauritius.

Remarks. — None of the field notes from this large collection indicated that any of the specimens were living in algal tubes, the usual habitat for this species.

Alpheus pacificus Dana

Alpheus pacificus Dana, 1852a, p. 21; 1852b, p. 544, pl. 34, fig. 5a-g.

Previous records. — Hilgendorf, 1879, p. 832, Zanzibar. Richters, 1880, p. 163, Mauritius (in part, see Miya, 1979, p. 66). Coutière, 1921, p. 427, Chagos. Fourmanoir, 1955, p. 20, Comores. B & B, 1980, p. 28, Comores.

Specimens examined. — 68 specimens from Somalia; 58, Kenya; 5, Tanzania; 4, Nosy Be; 85, Tuléar; 3, S. E. Madagascar; 3, Aldabra; 48, Seychelles; 4, Mauritius.

Remarks. — We remarked upon the habitat preferences of *A. pacificus* and *A. lobidens* De Haan (the latter under the name *A. lobidens polynesica* Banner and Banner) in Hawaii (1975a, p. 435), pointing out that while both species tunnel under rocks in the substrate in the lower intertidal or deeper, *A. pacificus* prefers well-washed sands of beaches exposed to wave action while *A. lobidens* prefers mixtures of sand and silt in more protected areas, and often with some fresh water discharge. We reviewed the records of capture of these two species about Mahé, Seychelles, and found the 4 collections of *A. lobidens* were usually in a somewhat muddy area or near the mouth of a stream, while 2 of the 3 collections of *A. pacificus* were from cleaner wave-swept beaches. The third collection, however, was of a pair of *A. pacificus* found at the edge of an area near the mouth of an intermittent stream with fresh water seepage through the beach where 18 specimens of *A. lobidens* were also collected, so the division between their habitats is not completely firm. Moreover, one of the specimens from Somalia was reported to be found on "a muddy-sandy carpet among the roots of the prairie of *Syringodium* and *Cymodocea*," a most unusual habitat.

Alpheus paracrinitus Miers

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

Alpheus mitis, Banner and Banner, 1979, p. 226; 1982, p. 134 (*nec* Dana).

Previous record. — B & B *loc. cit.*, Madagascar (as *A. mitis*).

Specimens examined. — 1 specimen from Somalia; 1, Tanzania; 19, Tuléar; 14, Seychelles; 5 (+ Ribes), Réunion; 3, Mauritius.

Discussion. — There is a serious question in our minds about the separation of *A. paracrinitus* and *A. mitis* Dana, 1852 (1852a, p. 22; 1852b, p. 549, pl. 35, fig. 1). Dana's species was described on the basis of a 19 mm specimen, sex unspecified, from Balabac Straits between the Philippines and Borneo. Miers' species was on the basis of 2 females of 15 mm from Senegambia off the west coast of Africa. Coutière (1905, p. 901) described a form he named *A. paracrinitus bengalensis* from the Maldive Archipelago, thus putting the species in the Indo-Pacific. Holthuis (1958, p. 25) separated the Indo-Pacific form from the Atlantic form by raising Coutière's varietal name to specific rank. This separation was reviewed by Chace (1962, p. 609) on the basis of some west African specimens and he came to the conclusion that there was but a single circumtropical species. This was supported by Crosnier and Forest (1966, p. 253). We have discussed variation in *A. paracrinitus* or its variety in our rather large central Pacific collections (1953, p. 110; 1956, p. 358; 1967, p. 278); in the last we supported Chace's conclusion, pointing out the range of variation we found exceeded the morphological differences reported by Coutière.

The name *A. mitis*, on the other hand, has been used only 4 times since the original description, once each by Nobili (1907, p. 355) and Sendler (1923, p. 46) for specimens from the Tuamotus in the Pacific, and by us for a single specimen each from the Philippines (1979, p. 226) and from Australia (1982, p. 134).

The principal characteristics that we were using to separate the two nominal species were found in the orbitorostral grooves and margin, the shape of the rostrum and its carina. *A. mitis* was shown as having a straight orbitorostral margin with the rostrum elongate and slender and with "the surface between the eyes carinate," thus implying that there were orbitorostral grooves. *A. paracrinitus*, on the other hand, had "sinuate" orbitorostral margins, the grooves were described as "somewhat concave" and the rostrum shown as shorter and broader than the figure of Dana, and Miers specified that the rostrum was "not prolonged backward as a dorsal carina." While most of the specimens in the present collections have a sinuate margin, in some it is as straight as that shown by Dana; the shape and length of the rostrum is similarly variable, and in most specimens the orbitorostral grooves are shallow and the rostral carina is low and rounded, but in a few the interorbital area is almost flat.

We have pointed out before that the relative lengths of the antennular peduncle, the scaphocerite and the carpocerite are variable (1956); that the armature at the articulation of the finger of the small chela and that the teeth on the meri of both chelipeds may be strong, weak or absent (1967); in this study we have discovered that the teeth, when present, may be terminal or subterminal. We have previously remarked upon specimens with a balaeniceps condition of the dactylus of the small chela of some of the males, but without any great broadening of the dactylus (1966b, p. 117). The balaeniceps condition is uncommon in these specimens from the Indian Ocean. The second article of the second leg may be slightly shorter than to almost twice of the length of the first (1967). The third legs were also found to vary in proportion (1967).

Thus there is variability in almost all characteristics that could have been used for separation. However, there may be differences in the chelae that may be valid. In the large chela, Dana depicted a rather thick chela with the height of the palm 0.6 of its length, and with the fingers also 0.6 the length of the palm; moreover, the dactylus in profile has an almost straight superior margin. Miers did not draw the large chela of his specimen but stated that the palm was "rather more" than twice as long as broad, that the fingers were "nearly half" as long as the palm and that the superior surface of the dactylus was "arcuated." In almost all of the specimens we have examined the chela is like that shown by Crosnier and Forest from the Gulf of Guinea (1966) where the chela is definitely more slender than Miers specification, the fingers running about one-third the length of the palm and the superior surface of the dactylus plainly arcuate in profile, not slightly bowed. Dana showed the small chela to be relatively heavy with the fingers shorter than the palm and glabrous; Miers only remarked that this chela was "very slender" with hairy fingers (it was a female specimen). In most of the specimens we have seen the small chela is slender, the fingers are longer than the palm and, at least in the male, the dactylus may or may not be balaeniceps. If these criteria are reliable, then all of the specimens we have examined are *A. paracrinitus*, but the question of the reliability of the characteristics remains. The figures of Dana are usually quite accurate, but the large chela he drew may be one that is in the process of regeneration, and the small chela may be somewhat distorted. Miers' description is, of course, not complete enough for any subtle judgements. Unfortunately, we cannot reexamine the type specimens for that of Dana is missing and the syntypes of Miers are in "*mauvais état*" (Crosnier & Forest, 1966, p. 254). Therefore the question of the separation of the two species must at present be left unanswered, and we continue to use the name *A. paracrinitus*. We also reassign our Australian and Philippine specimens to this species.

Alpheus paradentipes Coutière

Alpheus paradentipes Coutière, 1905a, p. 880, pl. 74, fig. 17.

Previous records. — Coutière, 1921, p. 419, Amirante, Providence.

Specimens examined. — 6 specimens from Kenya; 4, Tuléar; 8, Aldabra.

Remarks. — The specimens from Aldabra were from a sponge collected at 22 m; the association of this species with sponges has only been reported once before (Banner, 1953, p. 75).

Alpheus paralcyone Coutière

Figure 8.

Alpheus paralcyone Coutière, 1905a, p. 895, pls. 80, 81, fig. 34.

Alpheus providencei Coutière, 1908, p. 208; 1921, p. 424, pl. 63, fig. 19.

Previous records. — Coutière, 1921, p. 424, Amirante, Seychelles. Peyrot-Clausade, 1979, p. 76, Tuléar.

Specimens examined. — 7 specimens from Nosy Be; 13, Tuléar; 2, SE Madagascar; 1, Comores; 56, Seychelles; 5, Réunion; 11, Mauritius.

Discussion. — This species is related to *Alpheus spongiarum* Coutière 1897a (syn. *A. paraculeipes* Coutière 1905a) and *A. alcyone* De Man, 1902 (syn. *A. aculeipes* Coutière 1905a). *A. spongiarum* may be an obligate sponge-dweller and the other two species has been reported from sponges. All three have been reported as variable in their proportions and their armature (see B & B, 1982, p. 110 *et seq*. and earlier authors). The most firm characteristics that can be used to separate the trio are the development of the squame, almost vestigial in *A. spongiarum* and of normal development in the other two, and the row of movable spines along the inferointernal margin of the merus of the third legs, present in *A. alcyone* and replaced by regular or irregular bristles or setae in the other two species. At least for the present, these separations appear to be valid.

Into this species complex also falls *A. providencei* Coutière, known only from a single specimen dredged from 50-78 fathoms off Providence by the Percy Sladen Trust Expedition (Station D.4). Because its status was somewhat questionable, we have examined Coutière's type through the courtesy of Dr. Jacques Forest of the Muséum national d'Histoire naturelle, Paris (no catalog number assigned). It is a 13 mm female, slightly dessicated and lacking a number of appendages, and in only fair condition.

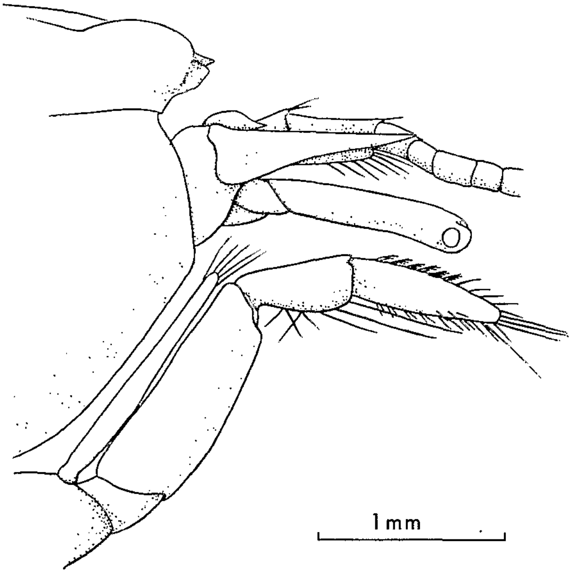


Figure 8. Holotype of *Alpheus providencei* Coutière, 1908 (= *A. paralcyone* Coutière, 1905a), a 13 mm female from Providence, MNHN (Paris); anterior region, lateral view.

Like *A. paralcyone*, it has a normal squame on the scaphocerite reaching to the end of the second antennular article, and the merus of the third legs bears a series of fine, short setae (it is not "absolument nu" as described by Coutière). These hairs are smaller and finer than those usually found in *A. paralcyone*, but in that species they are variable. With what is known now of the range of variation in *A. paralcyone*, almost none of the characteristics that Coutière gave to separate *A. providencei* from *A. alcyone* (under the name of *A. aculeipes*) and *A. spongiarum* (under the name of *A. paraculeipes*) would serve for reliable separation. Thus the proportions of the chelipeds are known to be variable; the palm of the small chela of the females is somewhat bulbous in mature females, as is shown by Coutière (1921, fig. 19b), but in more immature females tapers like the female chela shown by Coutière for *A. paralcyone* (1905a, fig. 34d); the second carpal article of the second leg was specified as 1.95 times the length of the first and 2.45 in *A. paralcyone* - in 17 measured specimens of *A. paralcyone* in this collection it ranged from 1.9 to over 3.0 times the length of the first.

However, there were four possible characteristics that might have had some potential for the separation of the two nominal species. They were:

1. The tooth on the basicerite, present in *A. paralcyone* and absent in *A. providencei* (see fig. 8). In the 17 specimens examined these teeth varied from large and prominent to very small and difficult to discern; in one the tooth was small and acute on one side, but even further reduced and rounded on the other, and in two specimens there was no trace of a tooth at all on one side.

2. The shape of the last article of the third maxilliped, not mentioned or illustrated by Coutière, but shown by us to be ovate, almost paddle-shaped in specimens of *A. paralcyone* from Australia (1982, fig. 30c). In most of the 17 specimens the shape like that illustrated in fig. 8; however, in some the taper of the article was almost uniform from the proximal articulation to the truncate tip. In one specimen the right maxilliped was definitely ovate, with the maximal breadth occurring at about one-third of the length, the whole article being slightly less that 3 times as long as broad, but on the other side the article was of uniform taper, broadest at the articulation and 3.5 times as long as broad (the broader article was also 1.25 times as long as the one opposite).

3. The spine on the ischium of the third legs, present in *A. paracylone* and absent in *A. providencei*. These spines are difficult to discern on the smaller specimens, but appear to be variable in size and may be absent.

4. The development of the distolateral spine on the outer uropod and the spinules of the inner uropod. Coutière's drawings (1905a, fig. 34h; 1922, fig. 19f) suggested that the spine reached considerably beyond the distal margin of the outer uropod and that the inner uropod carried a series of spinules in *A. paralcyone*, while in *A. providencei* the outer spine was shorter than the margin and the inner uropod carried only two larger spinules. Coutière's holotype for *A. providencei* was as it was illustrated for *A. paralcyone*, and in the 17 specimens this spine exceeded the almost truncate tip of the uropod by variously one-quarter to one-half of its length; similarly the spines of the inner uropod varied in number and size.

Therefore we place *A. providencei* into synonymy under Coutière's earlier described *A. paralcyone*.

Alpheus paralpheopsides Coutière

Alpheus paralpheopsides Coutière, 1905a, p. 902, pl. 83, fig. 41.

Previous record. — Coutière, 1921, p. 427, Chagos.

Alpheus pareuchirus pareuchirus Coutière

Alpheus pareuchirus Coutière, 1905a, p. 906, pl. 84, fig. 43.

Previous record. — Fourmanoir, 1958, p. 124, fig. 10, Nosy Be.

Specimens examined. — 1 specimen from Tuléar; 1, SE Madagascar; 8, Seychelles.

Remarks. — The specimen from southeast Madagascar was dredged at 90 m.

Alpheus parvirostris Dana

Figure 9

Alpheus parvirostris Dana, 1852a, p. 22; 1852b, p. 551, pl. 35, fig. 3a-f.

Alpheus euchiroides Nobili, 1906, p. 257; 1907, p. 356, pl. 1, fig. 6.

Previous records. — Coutière, 1921, p. 427, Chagos, Seychelles, Coetivy. Barnard, 1947, p. 389; 1950, p. 753, both records Mozambique. Fourmanoir, 1958, p. 121, fig. 9, Nosy Be. Ledoyer, 1970, p. 127, pls. 14, 15, Nosy Be. Peyrot-Clausade, 1979, p. 76, Tuléar. B & B, 1980, p. 28, Madagascar. Kensley, 1981, p. 25, Mozambique.

Specimens examined. — 32 specimens from Somalia; 14, Kenya; 2, Tanzania; 348, Tuléar; 369, Seychelles; 65 (+ Ribes), Réunion; 55, Mauritius; 1, Chagos.

Discussion. — A specimen from Somalia came from a head of the coral *Tubipora musica* Linnaeus; previously we remarked on a specimen collected by Dr. Bruce from a head of *Galaxea* on the Great Barrier Reef. Normally the species lives in dead coral heads.

Through the courtesy of the Muséum national d'Histoire naturelle, Paris, we were able to examine Nobili's types for *Alpheus euchiroides* from Marutea (geographically the easternmost of the Tuamotus but administratively under the Gambiers) (NMNH No. 2362). There were two specimens in the vial, both females, one of 11 the other of 13 mm total length, and both in bad condition. Neither had any thoracic legs attached although there were two large chelipeds and one small cheliped in the vial, unattached; on the smaller female the last several segments of the abdomen were broken and separate; the larger specimen had its orbital hoods somewhat crushed and its rostrum and antennules displaced, but the smaller carried only a slight indentation on the hoods. We have drawn the anterior region of the smaller specimen, both large chelipeds and the small cheliped.

The two specimens plainly lie within the range of variation of *A. parvirostris*. The primary characteristic that Nobili used to separate the two species was the lateral tooth of the basicerite, present and strong in *A. parvirostris*, but lacking, as he stated both in the French original description and the subsequent Italian redescription, in *A. euchiroides*. In this he was plainly in error, for both sides of the smaller specimen and on the right side of the larger the spine is present with its tip reaching the level somewhat beyond the middle of the second antennular article. Perhaps Nobili looked at

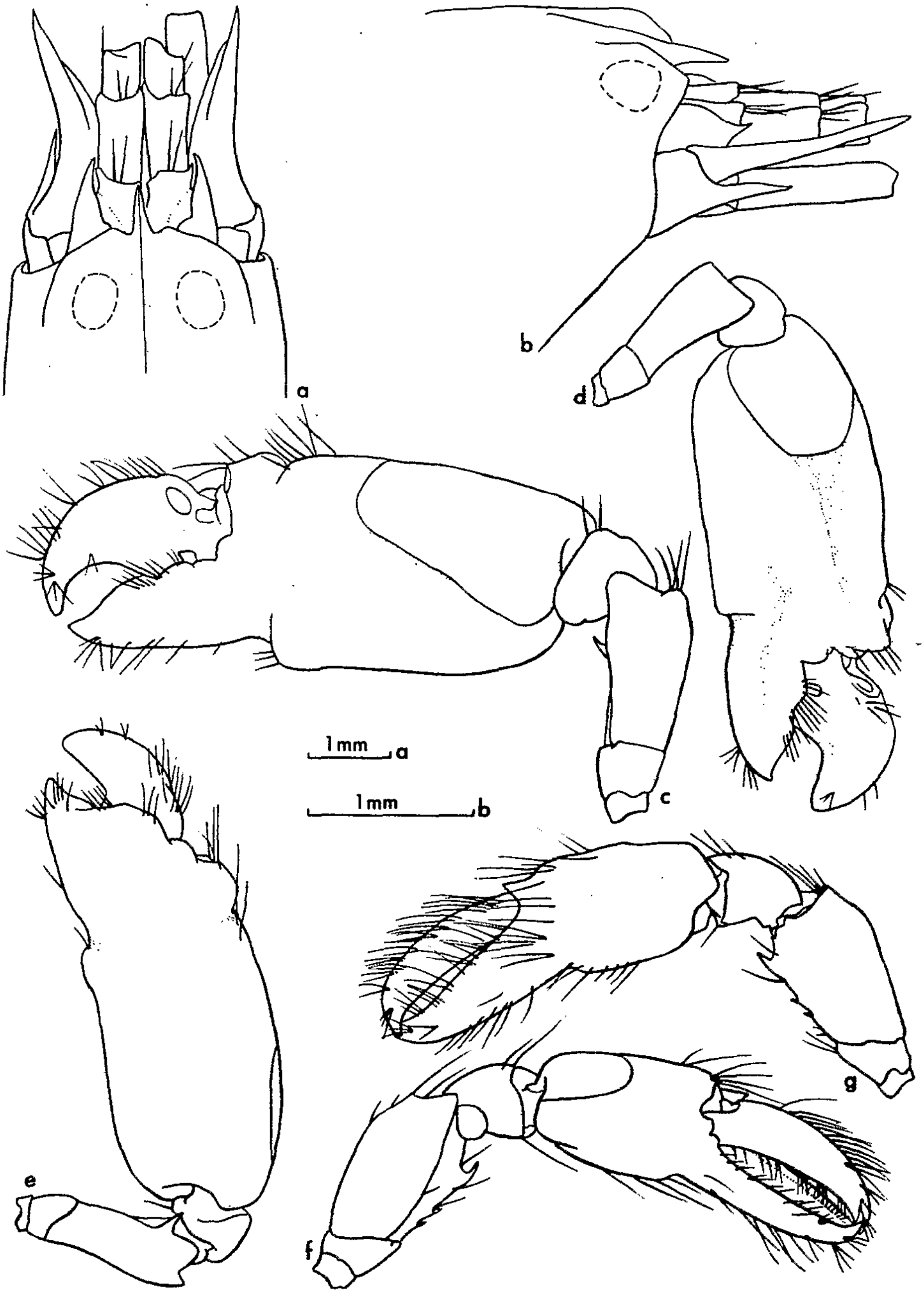


Figure 9. *Alpheus euchiroides* Nobili 1906 (= *Alpheus parvirostris* Dana, 1852). Types (see text), 11 and 13 mm females from Marutea, French Polynesia, MNHN (Paris), cat. no. 2362. a, b, Anterior region, dorsal and lateral view; c, larger of the large chelipeds; d, e, smaller of the large chelipeds; f, g, small cheliped. a, b scale b; c-g, scale a.

only the left side of the larger specimen where the tooth was broken off near its base, possibly by the same action that crushed the orbital hoods and displaced the rostrum and antennules. Otherwise, the parts that remain are characteristic of *A. parvirostris*, including the small flat extension of the anterior margin between the rostral base and the orbital hoods, the peculiar sculpturing of the large chela, unlike most of those in the Edwardsii Group, the heavy small chela and merus, etc. The subterminal tooth on the merus of the large cheliped is possibly larger and more acute than the norm for *A. parvirostris*, but this is variable. We therefore place Nobili's name into synonymy.

In the two large chelipeds the dactyli are of different development, with the larger curved in the distal portion of its oppositive face and acute at its tip, and with the smaller straight and blunt at its tip. Similar conditions have been noted for other species, especially those in the genus *Metalpheus*. The oppositive face of the propodal finger of the small chela is flat and carrying a low but definite ridge extending as a rim along both medial and lateral margins.

We did note that the mouth parts are somewhat protruding, approaching the condition found in the genus *Metalpheus*. However the basal article of the third maxillipeds is not expanded and enclosing the anterior mouthparts and, more important, the second pleopods of the males (in our study collection) are of the development typical of *Alpheus*, not of the highly modified development found in *Metalpheus*.

Alpheus percyi Coutière

Alpheus percyi Coutière, 1908, p. 21; 1921, p. 426, pl. 54, fig. 22.

Previous records. — Coutière, *loc. cit.*, Cargados Carajos, Amirante, Coetivy.

Alpheus perplexus Banner

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

Specimens examined. — 2 specimens from Tuléar.

Remarks. — Our specimens agree well with the original specimen from Saipan except they both have a tiny rostrum. However, in the holotype the frontal margin was straight, in the allotype the margin concave, and in *Alpheus* sp. of De Man (1911, p. 349) which we placed under this species (*loc. cit.*) the rostrum was "extremely short, broadly triangular, obtuse, hardly projecting beyond the frontal margin...".

Alpheus polyxo De Man

Alpheus polyxo De Man, 1909a, p. 108; 1911, p. 423, fig. 104.

Specimen examined. — 1 specimen from Tuléar.

Remarks. — Our sole specimen was dredged at 190 m off the Tuléar Grand Récif from a "grey-yellow, sticky mud" according to Dr. Pichon, the collector.

Alpheus rapacida De Man

Alpheus rapacida De Man, 1908, p. 105; 1911, p. 394, fig. 91.

Alpheus rapax, Ledoyer, 1970, p. 126, pls. 12, 23B (*nec* Fabricius).

Previous records. — Barnard, 1950, p. 750, figs. 142a-p. Macnae & Kalk, 1962, p. 117; 1969, p. 43 *et seq.* (All 3 records, Mozambique). Ledoyer, *loc. cit.* (as *A. rapax*), Nosy Be. Polunin and Lubbock, 1977, p. 93, Seychelles. Kensley, 1981, p. 26, Mozambique.

Specimens examined. — 1 specimen from Somalia; 4, Nosy Be; 6, Tuléar; 2, Seychelles.

Remarks. — Macnae and Kalk report *Alpheus rapacida* living symbiotically with *Cryptocentrus octofasciatus* and *Gobius delagoa* on the sand flats of Inhaca Island, Mozambique. This species has been reported in association with other species of gobies (Polunin and Lubbock, *loc. cit.*; B & B, 1981d, p. 38; 1982, p. 162). One of the specimens from Nosy Be was collected at 5 m.

We feel the 15 mm specimen Ledoyer figured (*loc. cit.*, pl. 12) is probably *A. rapacida* as it lacks the usual transverse groove superodistally on the palm of the large chela. Ledoyer remarked that he thought the lack of transverse groove was probably characteristic of the small specimens, but in our collections we have not found this to be true.

Alpheus rapax Fabricius

Alpheus rapax Fabricius, 1798, p. 405.

Alpheus malabaricus, Hilgendorf, 1879, p. 832 (*nec* Fabricius).

Previous records. — Hilgendorf, *loc. cit.* (as *A. malabaricus*), Zanzibar. Barnard, 1950, p. 752, figs. 142g-k, Mozambique. Fourmanoir, 1958, p. 119, fig. 6, Nosy Be. Macnae and Kalk, 1962, p. 117; 1969, p. 126, both records Mozambique. Polunin and Lubbock, 1977, p. 93, Seychelles. Kensley, 1981, p. 26, Mozambique.

Specimens examined. — 1 specimen from Somalia; 3, Kenya; 2, Tanzania; 1, Nosy Be; 26, Tuléar.

Remarks. — Macnae and Kalk reported (1962, p. 117) that *Alpheus rapax* was in the same areas and associated with the same gobies as *A. rapacida.*

In 1888 (p. 261) De Man placed the specimens Hilgendorf had reported as *A. malabaricus* from Zanzibar under the species *A. brevirostris* (Olivier). However, upon reconsideration in 1909b, (p. 147) he decided Hilgendorf's species was actually *A. rapax.*

Alpheus serenei Tiwari

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

Specimens examined. — 1 specimen from Somalia; 2, Nosy Be; 1, NE Madagascar.

Remarks. — One of the specimens from Nosy Be was dredged at 54 m. The other specimens, like those previously reported, were collected at most only a few meters below the intertidal zone.

Alpheus splendidus Coutière

Alpheus splendidus Coutière, 1897a, p. 236.

Previous records. — Coutière, 1921, p. 426, Seychelles.

Specimens examined. — 8 specimens from Somalia.

Remarks. — A color transparency of this species in dorsal view made by Dr. Vannini showed the same general pattern described by Coutière but quite different colors (1897a, p. 235). The longitudinal stripe running from rostrum to telson is white with a yellow tinge rather than being "jaune vif;" it is flanked by two blue-grey, not brown, stripes that carry minute red chromatophores. The pattern on the sides of the body, as best it can be seen in dorsal view, appears to be patches of the same off-white and blue-grey, certainly not "rougeâtre." The chelae of the first pair have alternating broad transverse bands of the off-white and blue-grey, not "orange clair." The meri of the chelae and the following legs are blue-grey. Dr. Holthuis reported yet a third color pattern (in B & B, 1981d, p. 39).

Alpheus spongiarum Coutière

Alpheus spongiarum Coutière, 1897a, p. 236.

Alpheus paraculeipes Coutière, 1905a, p. 894, pls. 79, 80, fig. 32.

Previous record. — Coutière, 1921, p. 423 (as *A. paraculeipes*), Amirante.

Specimens examined. — 5 specimens from Nosy Be; 51, Tuléar; 1, Comores; 6, Seychelles; Ribes only, Réunion.

Remarks. — The specimens from Nosy Be were reported to be dredged from 20-115 m; if they came from below 42 m, this would constitute a depth record.

In this series of specimens we found that while the carpus of the third legs usually have only setae, no spines, some specimens carry one or two spines as Coutière described for *A. paraculeipes*. This variation renders unreliable dichotomy 30 in our key to the genus *Alpheus* for Australia (B & B, 1982, p. 28).

Alpheus stanleyi Coutière

Alpheus stanleyi Coutière, 1908, p. 207; 1921, p. 423, pl. 63, fig. 18.

Alpheus cloudi Banner, 1956, p. 352, fig. 16.

Previous record. — Coutière, *loc. cit.*, Amirante.

Specimens examined. — 1 specimen from Nosy Be; 2, Comores; 17, Seychelles.

Discussion. — Coutière's only specimen, a male, was dredged from 30 fathoms off Amirante; the only subsequent reports were from Johnson (1962, p. 32) from near Singapore at 10 m, and by us from the southern Philippines (1979, p. 230) where we collected 10 specimens in water less than 5 m deep. *A. cloudi* was based upon a single female lacking the small chela, collected at 15 ft. or less off Saipan in the Marianas, and subsequently reported by us from Fiji and from Ifaluk in the Carolines; these specimens, also, came from shallow inshore waters (B & B, 1966a, p. 177, and 1968, p. 284).

It should be noted that the pair of specimens from Ifaluk came from "the large chambers of a sponge;" two in our Philippines collection came from "a white sponge;" and one pair of specimens in the present collection are also noted as being collected from a sponge. All other collections had at most only notes on the general ecology.

In the original descriptions of the 2 nominal species there were marked differences, for in *A. stanleyi* the entire anterior carapace between the orbital hoods was produced and almost straight across except for a small rostrum, while in *A. cloudi* the rostrum was produced by regularly concave margin arising in front of the orbital hoods. In *A. stanleyi* the antennular peduncles were longer and more slender than those of *A. cloudi* and the lateral tooth of the scaphocerite reached to near the end of the second, not the third, antennular article. On the large cheliped in *A. stanleyi* the merus was heavy and carried only a slight rounded protrusion distally on the inferointernal margin while the chela itself was heavy, approaching twice as long as broad; in *A. cloudi* the merus was more slender, armed with an acute tooth distally and the chela itself was 3.1 times as long as broad. In the third legs in *A. stanleyi* the articles were quite slender, the propodal spines short, the dactylus was simple and extending well beyond the terminal propodal spines, while in *A. cloudi* the articles were much heavier, the propodal spines more numerous and the terminal spines almost as long as the biunguiculate dactylus, thereby largely masking the dactylus which carried a slight secondary unguis.

In our comparison of our Fiji and Ifaluk specimens with the Saipan specimen we pointed out that the shape of the rostral front was variable, approaching the condition of *A. stanleyi* (although we did not make that specific comparison), that the proportions of the antennular articles were variable, that there was a strong sexual dimorphism in the size and shape of the large chela and its merus, that the proportions of the third legs were also variable and that dactyli of these legs did or did not have an accessory hook. We also described the condition of the small chela which we found not to show any sexual dimorphism.

On the basis of the present collections we now wish to relegate *A. cloudi* to synonymy. Our primary consideration is the development of the small chela which we discussed in the 1966a paper under the name of *A. cloudi* and in 1979 under the name of *A. stanleyi*. The form of this chela is unique within the genus, but is reminiscent of a sponge-dwelling group within the genus *Synalpheus* (B & B, 1979, p. 232; *cf.* 1975, pp. 297-313), for the fingers are broadened, excavate, bearing cutting edges on the medial side, stiff setae on the lateral side and have tips that are developed into teeth that mesh. Probably of lesser importance but none-the-less interesting is that the rather large chelae of the second legs have gaping fingers that bear short stiff setae (see B & B, 1956, fig. 16f).

Almost all of the apparent differences between the two species, as listed above, were bridged by variation we reported for the relatively small collection of *A. cloudi* from Fiji (1966a, p. 177). Only three possible differences remained, but those criteria are removed by this study collection. They were: First, the relative lengths of the first two carpal articles of the second leg, shown to have the ratio of 10:6 by Coutière and reported by us to be 10:9 for *A. cloudi*; in these specimens the ratio reaches from 10:7 to 10:9. Second, the relative development of the distal propodal spines on the third legs, normal in *A. stanleyi* (1921, fig. 18f) and the gross elongation of these spines in *A. cloudi* (1956, figs. 18g,h); in one specimen in these collections one of the third pair of legs has normal spines on one side but on the other the terminal spines reach to the point of bifurcation of the dactylus. Finally, the depth range with *A. stanleyi* described from 30 fathom (55 m) and *A. cloudi* probably no more than 5 m; however, the shallow water specimens we identified as *A. stanleyi* from the Philippines show no differences from the present specimens that were dredged from 33 to 60 m.

In the Philippine paper (1979) we discussed the possible reliability of De Man's use of the presence or absence of a tooth on the merus of the fourth leg to separate his variety, *A. stanleyi* *dearmatus*, from the nominal species. We pointed out that that characteristic was variable in the Philippines, but that if the Indonesian form of the species always lacked the tooth while the Indian Ocean form always had the tooth, it might be a valid criterion for a geographically separated subspecies. None of the specimens in this collection had such a tooth, so De Man's variety cannot be considered as a subspecies.

The form of the small chela will easily separate this species from the two related nominal species, *A. styliceps* Coutière (1905a, p. 889) and *A. arethusa* De Man (1909a, p. 100), for they have bulbous palms and relatively longer fingers (see also under *A. styliceps*, below).

We remarked on the striking sexual dimorphism in the proportions of the large chela in the Samoan paper, but we did not give the actual proportions. In two apparently cohabiting pairs dredged in the Seychelles these measurements were taken:

Sex	Carapace length	Chela length/ carapace length	Chela length/ chela breadth
Female	7.7 mm	0.9	3.3
Male	6.1	1.2	2.4
Female	6.8	1.0	4.1
Male	6.4	1.6	2.3

We suggest that this may be an obligate sponge symbiont, with the variability often found in alpheids living in specialized and protected habitats, and with the sexual dimorphism similar to those species of the Obesomanus Group that live in galleries in encrusting coralline algae. The host sponge may be one of those often found between the branches of dead coral heads so that the association would not be apparent when the head is broken up.

Alpheus staphylinus Coutière

Alpheus staphylinus Coutière, 1908, p. 204; 1921, p. 418, pl. 62, fig. 13.

Previous record. — Coutière, *loc. cit.*, Chagos.

Specimens examined. — 3 specimen from Somalia; 1, Kenya.

Remarks. — Field notes for the specimen from Kenya state its color was "yellow."

Alpheus strenuus strenuus Dana

Alpheus strenuus Dana, 1852a, p. 21; 1852b, p. 543, pl. 34, figs. 4a-e.

Alpheus strenuus angulatus Coutière, 1905a, p. 914.

Previous records. — Hilgendorf, 1879, p. 831, Mozambique. Richters, 1880, p. 163 (in part), Mauritius.* Lenz, 1905, p. 383, Zanzibar; 1912, p. 2, E. Africa. Coutière, 1921, p. 427, Chagos; 1921, p. 427 (as *A. strenuus angulatus*), Chagos, Amirante. Barnard, 1950, p. 760, Mozambique (repeat of Hilgendorf). B & B, 1980, p. 28, Kenya, Aldabra. Kensley, 1981, p. 26, Mozambique.

Specimens examined. — 37 specimens from Somalia; 11, Kenya; 4, Nosy Be; 27, Tuléar; 2, Aldabra; 14, Seychelles, 2, Mauritius; 1, Chagos.

Discussion. — This species is normally found in the central Pacific and in Australia in burrows under large rocks on sandy beaches low in the intertidal zone (B & B, 1966a, p. 181; 1982, p. 228), on the more protected flats of the atoll lagoon beaches, or, in Tongatabu, Tonga, on similarly protected sand flats near the capital city of Nukualofa (this was probably the type location). However at Onotoa in the Gilbert Islands it was believed to inhabit the wave-swept windward reef flat, a structure of consolidated coral and coralline algae so hard that "a geologist's pick would scarcely penetrate" (it was impossible to collect any from this habitat). In the Seychelles we found it in a unique set of "burrows" or tubes associated with the large, wave-rounded granitic boulders in two shoreline areas of Mahé: On the northeastern side of Round Island off Victoria, the tubes were found between massive boulders, some a meter or more in diameter, with smaller boulders firmly packed around their bases; the burrows mouth was well above the 0.0 tide level and its base possibly below that level. This area was evidently wave-swept in times of northerly monsoons, and little sand was found. The other location was on Northwest Bay, at about the same tide level, and on a granitic outcrop with piled boulders resting on the bedrock of the island; surrounding the area were sand flats with sea grass beds. This area, too, probably was subjected to wave activity in the times of the northerly monsoons, but the sea grass beds and the north-south orientation of the beach might abate the wave energy.

Four sets of tubes were investigated, the first on Round Island and the other 3 on Northwest Bay. Each set of tubes inhabited by one pair, male and female, of *A. s. strenuus* of large size, ranging from about 40 to 60 mm in total length; no connections could be found between the tubes of adjacent pairs. The tubes were constructed of very dense coralline algae somewhat shaped like a low, broad and

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* Miya (1981, p. 66) examined 8 of the 30 specimens of *A. s. strenuus* that Richters had identified from Mauritius and found 6 of them to be *A. s. strenuus*; one was *A. hululensis* Coutière, and the other was *A. pacificus* Dana.

inverted "U" with the open end of the "U" applied to the face of the rock. The tube was large enough for the large body of the shrimp to traverse, and it ran irregularly upwards in the space between the adjacent boulders that were securely wedged and cemented together. Where space was available between the boulders the basic tube would be expanded laterally into one or a series of galleries, more or less horizontally oriented that ranged from 5 to 10 cm long and which were quite broad. Both the upward tube and the lateral galleries communicated to the outside by a series of "portholes" which ranged from 3 to 6 mm in diameter, far too small for the shrimp to use as an exit. The top of the tube, however, was open and large enough for the shrimp to emerge. The tubes on Northwest Bay extended through a layer of sand, but this sand may have been seasonal and swept away by the northerly monsoons; on Round Island only the very base of the gallery-tube system lay in a thin layer of sand and rock rubble. All tube systems ended in a relatively large chamber cleared in the sand under the largest boulder in the complex with its shape determined in part by the larger unmovable rocks, but possibly 20 cm or more in the longest diameter and 5 to 10 cm deep; this chamber was low enough intertidally that it probably had standing water at all stages of the tide. The size of the complex system was large, with the top at Round Island extending about 50 cm above the basal chamber, and with the galleries of the largest pair at Northwest Bay reaching up about 40 cm and with the maximum distance that the branch galleries reached out from the vertical tube being at least 10 cm.

Living in the same basal chamber were always very large fireworms (genus *Eurythoe*) up to 10-12 cm long, and at times brittle stars (one we returned from Northwest Bay was identified by Dr. Dennis Devaney of the Bishop Museum as *Ophiocoma scolopendrina* [Lamarck]). We were also able to capture one specimen each of *Salmoneus tricristatus* Banner and *Metalpheus paragracilis* (Coutière), but more of the orange-red *Salmoneus* were seen. It should be noted that the association with *S. tricristatus* and *S. sibogae* De Man, (now *S. serratidigitus* [Coutière]), was remarked upon at Enewetak (B & B, 1968, p. 271) where *Athanas marshallensis* Chace was also found in possible association. In Australia *A. s. strenuus* was found in association with the brittle star, *Macrophiothrix longipeda* (Lamark) (B & B, 1982, p. 229). The shrimp's association with *Eurythoe* has been remarked upon both from Enewetak and Australia.

Immediately shoreward from the granitic outcrop at Northwest Bay at a slightly higher tide level was a sand beach with scattered boulders partially imbedded in sand. Under these were found not *A. s. strenuus* but *A. pacificus* Dana. This was the type of area where *A. s. strenuus* might be found in the Pacific. However, we could find no morphological characteristic that would distinguish between the sand-burrowing Pacific *A. s. strenuus* and the tube constructing *A. s. strenuus* of the Seychelles.

Dr. Vannini's color transparency of this species shows much the same color as Dr. Holthuis described from the Red Sea (in B & B, 1981, p. 40) a basic greyish-green with white flecks and patches; the chelae are pale green on the palm, more yellow-green distally, with the tips of the fingers of the large chela white. This specimen also shows two pair of small irregular black spots on the tergum of the first and one pair on the tergum of the third abdominal somite; these evidently were not on the specimen described by Dr. Holthuis.

Alpheus styliceps Coutière

Alpheus styliceps Coutière, 1905a, p. 889, pl. 78, fig. 28.

Alpheus eulimene De Man, 1909a, p. 101; 1911, p. 364, fig. 76.

Specimens examined. — 3 specimens from Somalia; 5, Kenya; 4 (+ Ribes), Réunion; 4, Mauritius.

Discussion. — In our Australian study (1982, p. 107) we discussed the separation of 3 closely related species, *A. styliceps*, *A. eulimene* and *A. arethusa* De Man, and came to the conclusion that the latter 2 species may be junior synonyms. These 9 specimens permit us to reduce the status of *A. eulimene* at least. Four of the specimens have the anterior region of the carapace flowing from the orbital hoods to the rostrum and 5 specimens have the anterior margin produced but transverse. In some the squame reaches only to the middle, in others to the end, of the second antennular article. The ratio of the first 2 carpal articles of the second legs varies from 10:13 to 10:16 (not as broad a range as the specimens from Australia). The merus of the third leg varies from 3.8 to 4.6 times as long as broad, encompassing the supposed difference between the 2 species. Four of the specimens have a tooth on the merus of the third legs, a characteristic supposedly of *A. arethusa*, and a characteristic that was also found in some of the Australian specimens. All of the specimens lack a tooth on the merus of the fourth legs and a spine on the inferior margin of the carpus. All of the males have the pleura of the first abdominal segment hooked. The variation we have found in these and the Australian specimens together with the variation found in the related *A. stanleyi* (discussed above) have lead us to conclude that *A. eulimene* is a junior synonym of *A. styliceps*. However, we believe that *A. arethusa* may be a distinct species for we have found no specimens in which the medial projection of the tergum of the sixth abdominal segment reaches over the base of the telson, nor males in which the four anterior abdominal pleura bear hooks.

Alpheus sulcatus Kinsley

Alpheus sulcatus Kingsley, 1878, p. 193.

Alpheus macrochirus Richters, 1880, p. 164, pl. 17, figs. 31-33.

Alpheus luciae Barnard, 1947, p. 389.

Previous records. — Richters, 1880, p. 164, Mauritius (see also: Miya, 1981, p. 69). Ortmann, 1894, p. 15, Tanzania. Lenz, 1905, p. 384, Aldabra. Coutière, 1921, p. 419, Chagos, Coetivy. (All records as *A. macrochirus*). Kensley, 1970 (as *A. luciae*), p. 118, figs. 13a,b, Mozambique. B & B, 1980, p. 28, Kenya, Tanzania, Comores, Amirante. Kensley, 1981, p. 26, Mozambique.

Specimens examined. — 38 specimens from Somalia; 50, Kenya; 5, Nosy Be; 1, Tuléar; 3, Aldabra; 7, Seychelles; 6, Mauritius.

Remarks. — The color pattern for one of the females we collected from the Seychelles was as follows: Overall color olive green with maxilliped bluish-green. Tip of telson dark orange, tip of large chela brownish orange. Body and chelae with minute brown chromatophores.

Alpheus superciliaris Coutière

Alpheus superciliaris Coutière, 1905a, p. 896, pl. 81, fig. 35.

Previous record. — Coutière, 1921, p. 425, Amirante.

Specimens examined. — Ribes only, Réunion; 4, Mauritius.

Alpheus tungii Banner and Banner

Alpheus tungii Banner and Banner, 1966a, p. 160, table 2.

Alpheus villosus, Richters, 1880 p. 163, (*nec A. villosus* [Olivier]).

Previous record. — Richters, 1880, p. 163, Mauritius (as *A. villosus*) (see Miya, 1981, p. 66, fig. 1).

Specimens examined. — 3 specimens from Mauritius.

Discussion. — By the time our original publication on the species had appeared both the holotype (the only specimen) and the drawings of it had been destroyed by fire. We therefore are grateful to Dr. Miya for his amplification of our description and for his presentation of drawings of specimens of *A. tungii* from the Möbius collection and elsewhere (1981, p. 66). Miya also reviewed the criteria we used to separate our new species from *A. villosus* (Olivier) (our Table 2). We agree that variation within *A. villosus* in the armature of the merus and carpus of the third leg (B & B, 1982, p. 53) has destroyed the fourth point in our table, and that our fifth point, dealing with lack of spines on the inner uropod in *A. villosus* arose from Coutière's incorrect figure (1899, fig. 383). Miya also emphasized a difference in the projection of the inner crest of the large chela flanking the dactylar articulation, slight in *A. villosus* and conspicuous and heavy in *A. tungii*.

The body color for *A. villosus* in the Australia specimens, where noted, was basically orange to yellow, at times with red and white striping; Michel noted that his specimens from Mauritius which are plainly *A. tungii* were golden yellow with the chelipeds and abdominal terga bearing a green tinge. However, in Michel's alcoholic specimens, the corneas of the eyes were pale yellow, depigmented as we found for all of the Australian specimens of *A. villosus*, while in our type of *A. tungii* the corneas were "black, of normal size and development." It may be that *A. tungii*, if living in cryptic environments with little light, may either change or reduce the normal optical pigments, while those that live under conditions of brighter light will develop the normal melanism.

Thinking that we may have overlooked the distinction between *A. villosus* and *A. tungii* in our large Australian (B & B, 1982, p. 51) collection, we reexamined samples from all areas represented. All were *A. villosus*, however Miya did report *A. tungii* from Melville Island, Northern Territory, Australia.

Inasmuch as the Möbius collection reported upon by Richters (*loc. cit.*) is available in European museums and Miya's Ryukyu and Australian specimens are available in Japan (see Miya *loc. cit.*), we are depositing the Mauritius specimens listed above in the Bernice P. Bishop Museum, Honolulu (BPBM cat. no. S10185). It should be noted that none of the specimens can be considered as neotypes as none came from the central Pacific.

Genus ARETOPSIS De Man, 1910

Aretopsis amabilis De Man

Aretopsis amabilis De Man, 1910, p. 311; 1911, p. 171, fig. 14.

Aretopsis aegyptiaca Ramadan, 1936, p. 16.

Previous records. — Ledoyer, 1968, p. 74, pl. 11, figs. 1-13, pl. 18A (as *A. aegyptiaca*), Tuléar. Bruce, 1969, p. 175, figs. 1-4, Mahé, Seychelles. B & B, 1980, p. 28, Nosy Be.

Specimens examined. — 4 specimens from Somalia; 1, Kenya; 3, Tuléar; 5, Nosy Be; 2, Seychelles.

Remarks. — As reported initially by Bruce (1969, p. 180 - see also B & B, 1973, p. 333) this species appears to be an obligate symbiont, living principally in the shells occupied by hermit crabs of the genus *Dardanus*. Of the collections listed above the four specimens from Somalia, two from Tuléar, one from Nosy Be and our two specimens from the Seychelles were noted as coming from hermit crab shells, but for the other specimens there were no notes as to the specific habitat.

We made color notes on the cohabiting pair we collected from the upper whorls of a shell occupied by a large *Dardanus* sp. from Northwest Bay, Mahé. We regarded the basic color to be white with a dark, but brilliant, red "trim" (Bruce, *op. cit.*, regarded the color to be red with white stripes). Running from the antennules and anterior carapace through the length of the carapace and the abdomen was a broad white band, with a longitudinal oblong white patch on the side of the branchiostegites from the level of the anterior gastric region to near the end of the carapace; the third maxillipeds, the superior and medial faces of the chela as it is held in an inverted position, and the following thoracic legs were white; the posterior portion of the telson was also white. The lateral portions of the cephalothorax, except for the white patch, a narrow band along the abdominal pleura and the anterior telson were red, as was the lateral tooth of the scaphocerite and the inferior and lateral faces of both chelae. The gastric region of these specimens was dark purple, possibly from ingested food. There was no difference in color pattern between the sexes. Our color notes in general agree with those of Bruce except for the difference in emphasis of red vs. white, and the fact that he found the red and white areas separated by "a narrow zone of orange," with orange also appearing on the uppermost edge of the chelae and on all of the following thoracic legs. A color slide made by Dr. Vannini shows a similar color pattern except that the broad red bands on the chelae,carapace and abdomen were flecked with round white spots of various diameters, mostly small.

Genus ATHANAS Leach, 1814

Athanas areteformis Coutière

Athanas areteformis Coutière, 1903, p. 79, figs. 17, 18; 1905, p. 860, fig. 132.

Previous record. — Jacquotte, 1964, p. 180, Madagascar.

Specimens examined. — 1 specimen from Tuléar; 20 (+ Ribes), Réunion; 9, Mauritius.

Remarks. — We found in these specimens of *A. areteformis* considerable variation in the length of the supracorneal and infracorneal teeth. In a few specimens the supracorneal teeth were of such minimal development they were difficult to see, particularly in the small specimens. While the infracorneal teeth were usually lacking as in the typical specimen, in some there was a definite tooth. We have remarked upon this previously (B & B, 1960a, p. 139).

Athanas borradailei (Coutière)

Arete borradailei Coutière, 1903, p. 80, figs. 19-24; 1905a, p. 861, fig. 133.

Arete ghardaqensis Ramadan, 1936, p. 15, pl. 1, fig. 208.

Athanas polynesia Banner and Banner, 1966a, p. 152, fig. 7.

Specimens examined. — 2 specimens from Somalia; 1, Nosy Be; 56, Tuléar; 11 (+ Ribes), Réunion; 2, Mauritius.

Discussion. — This large number of specimens of both sexes and the reexamination of the holotype of Coutière, through the courtesy of Dr. Forest of the Muséum national d'Histoire naturelle, Paris (MNHN, N.A. 1725), has enabled us to place *A. ghardaqensis* and *A. polynesia* in synonymy.

Only five collections of specimens of this species under its three names have been reported in the literature, the three cited above, Jacquotte of four specimens from Madagascar (1964b, p. 180, as *A. borradailei*, but only with notes on symbiotic association), and our record from Australia (B & B, 1982, p. 302, as *A. polynesia*, with redescription and new figures). Coutière based his description upon a sole ovigerous female from the Maldives; Ramadan had one female and 4 males from the head of the Red Sea; we had 3 males from American Samoa and subsequently had one complete and 7 damaged specimens from Lizard Island on the Great Barrier Reef.

When Ramadan established his species, he listed 6 differences between *A. ghardaqensis* and *A. borradailei*; after indicating his criteria we will set forth our comments:

"(1) The ventral side of the rostrum is not convex...." Here, the reexamination of the holotype showed that Coutière's figure 133b was in error and that the rostrum more closely resembled our figure 7b in 1966a.

"(2) Below the extra-corneal spine the anterior edge of the carapace is not so concave...." Again on this characteristic Coutière's figure of the holotype was in error; moreover, the characteristic is somewhat variable.

"(3) The external filament of the antennule is made of more than 4 segments and they are much shorter than in *A. borradailei*." In the holotype the external filament is entirely lacking on one side and has only the 2 basal articles remaining on the other, so the condition of the specimen when examined by Coutière cannot be postulated except through his drawing. However, in these collections the number of articles runs from 5 to 8 and they are of varying length.

"(4) The basicerite is of different shape and does not carry any lateral spines." We found the general shape and the presence of a rounded projection to vary from specimen to specimen.

"(5)...[the second article of the carpus of the second leg is longer than the third]...." In Coutière's holotype and in all specimens in these collections the second article, while variable, is always slightly longer than the third.

"(6) The tooth of the basal segment of the uropod is bifid...." On the holotype the sympodite of the uropods projects into 2 acute teeth, not shown in Coutière's figure because the drawing was in lateral, not dorsal view.

We separated *A. polynesia* from *A. borradailei* primarily upon the basis of the chelipeds, slender and symmetrical without armature on the ischium in *A. borradailei*, expanded, flattened, with an excavate carpus and armed ischium in *A. polynesia*; these were somewhat symmetrical in form but not in size. Ramadan pointed out that his sole female carried chelae similar to Coutière's figure, but that the chelae of the males were markedly different, very similar to our later *A. polynesia*, but he had drawn them with smooth margins. We indicated in our Australia paper that there appeared to be sexual dimorphism in the chelae, but it was not certain because the sole cheliped of the female form was not attached to the specimen. From this extensive series we now conclude: 1, that the chelae of the females are of the form drawn by Coutière (1905a, fig. 133c; B & B, 1982, fig. 93k), slender and symmetrical with few or no spines on the ischium; 2, that the chelipeds of the males are of the form depicted for *A. polynesia* (1966a, figs. 7e,f,g, and B & B, 1982, figs. 93c,d,e), with varying armature of spines on the ischium, and with both the margins of the chelae proper as they approach the dactylar articulation showing varying degrees of rugosity; 3, that in the male the two chelae may be equal in size or may differ by a factor as large as 25 percent. These findings remove all criteria for the differentiation between the nominal species.

The large collection from Tuléar was the result of the studies performed by Dr. Peyrot-Clausade (1979) on the motile cryptofauna of the reefs. Her studies give a firm indication of the habitat of this species. For the study she removed the substrate with hammer and chisel from various sections of the reef in blocks with a a volume of about 1 dm^3; these were wrapped and returned to the laboratory where they were first treated with fresh water to encourage the more motile forms to flee the cavities, and then with a dilute formalin solution to preserve those animals still within the cavities. Finally the block of coral was completely fragmented and all animals remaining in it were picked out. The large number of specimens she obtained thus was because she was actually sampling the cavities in the hard substrate. Similarly, the specimens from Lizard Island on the Great Barrier Reef were from the reef substrate that was covered with coralline algae. Peyrot-Clausade reported the collection of specimens in her blocks from the groove and spur system of the outer reef edge (to 25 m) from sections of the reef flat and from a pinnacle on the inner slope. This, too, would agree with most previous records, with the original records of *A. polynesia* from Samoa coming from a dead and overgrown head of coral on the outer slope of the fringing reef. However, the specimens from Somalia were reported as coming from heads of *Acropora variabilis* and *Stylophora mordax* and Jacquotte (*loc. cit.*) reported collecting 4 specimens of this species in the cavity in the reef made by the sea urchin, *Stomopneustes variolaris* (Lamark). It should be noted that the related *Athanas verrucosus* B & B was collected from a block of reef cemented with coralline algae on the raised outermost ridge at reef edge at Enewetak, Marshall Islands.

Athanas crosslandi Tattersall

Athanas crosslandi Tattersall, 1921, p. 372, pl. 27, figs. 13-17.

Specimens examined. — 1 specimen from Somalia; 1, Tuléar.

Remarks. — *A crosslandi* can best be separated from the otherwise closely related *A. areteformis* Coutière only by the absence of supracorneal teeth which are usually present and well-developed in the latter species. There may be differences in the form of the female chelipeds as well, for in Tattersall's figure the proportions of the merus:propodus:chela are 10:6:12, the same as this specimen from Tuléar, while the specimen from Somalia has the proportions of 10:5.5:12 and in all the ischium is unarmed; on the other hand, in *A. areteformis* from Australia (B & B, 1973, p. 304) the proportions are 10:4:15, with the distal end of the carpus enveloping the proximal end of the chela and the ischium bearing about 4 strong spines. However, with such polymorphism from growth and sex as is known for members of this genus, and without the knowledge of the chelipeds of any males, let alone mature males, this characteristic should not be relied upon. Our 2 specimens with lengths of 8 to 9 mm are slightly larger than the two females of Tattersall from the Red Sea with lengths of 6 and 7 mm.

We regard the separation of *A. crosslandi* from *A. areteformis* as questionable, but we do not have enough intact specimens to resolve the question.

The specimen from Somalia came from a coral on the reef top and that came from Tuléar from a coral taken from the pinnacle of the inner slope. This is the first time this species has been reported since the original description. Ramadan (1936, p. 12) merely repeated Tattersall's record.

Athanas dimorphus Ortmann

Athanas dimorphus Ortmann, 1894, p. 12, pl. 1, figs. 1-4.

Previous records. — Ortmann, *loc. cit.*, Dar-es-Salaam. Balss, 1927, p. 222 (repeat of original record).

Specimens examined. — 3 specimens from Somalia; 46, Kenya; 4, Tanzania; 19, Nosy Be; 2, Tuléar; 1, SE Madagascar; 1, Comores; 12, Seychelles; 9, Réunion; 3, Mauritius.

Remarks. — In many of the specimens from Kenya the infracorneal tooth is acute instead of the usual rounded form. One specimen from Kenya was dredged at 63 fathoms (115 m). This is the deepest so far recorded for it is usually taken from the detritus on the shallow reef flat.

Athanas djiboutensis Coutière

Athanas djiboutensis Coutière, 1897a, p. 233; 1905a, p. 856, fig. 129.

(?) *Athanas nitescens*, Fourmanoir, 1958, p. 126, fig. 14. *Nec* Leach, 1814.

Previous records. — Coutière, 1921, p. 413, Chagos. Barnard, 1947, p. 388; 1950, p. 732, figs. 137e-f, both records Mozambique (identity questioned by author). Fourmanoir, 1955, p. 22, Comores. Ledoyer, 1968, p. 74, pl. 10, figs. 1-10, 18C; 1970, p. 126, pl. 10, both references Tuléar. Peyrot-Clausade, 1979, p. 76, Tuléar. B & B, 1980, p. 29, Aldabra. Kensley, 1981, p. 26, Mozambique.

Specimens examined. — 1 specimen from Somalia; 7, Kenya; 1, Mozambique; 22, Tuléar; 1, Comores; 67, Seychelles; 42 (+ Ribes) Réunion; 69, Mauritius.

Remarks. — While Barnard indicated some doubts about the identity of his specimen from Mozambique, possibly because it was incomplete, there is nothing in his brief description or in his two figures that would indicate it is other than *A. djiboutensis*.

We question the identity of the specimens that Fourmanoir identified as "*à la série nitescens* Leach." In the first place *A. nitescens* is positively known only from the Atlantic coast of Europe and the Mediterranean (see Holthuis and Gottlieb, 1958, p. 27 *et seq.* for the distribution and the variation in this species). It is true that a form that may be *A. nitescens* is known from South Africa as far up the eastern coast as Durban, but Stebbing originally identified this form as *Athanas* sp., next as *A. grimaldii* (Stebbing, 1915, p. 88; 1921, p. 18) and Barnard as "*Athanas*, *cf. nitescens* Leach or *grimaldii* Cout.," but aside from Fourmanoir's record, *A. nitescens* has never been reported from the tropical Indo-Pacific, even from the Red Sea. Like *A. nitescens*, both *A. areteformis* and *A. djiboutensis* in the Indo-Pacific have supracorneal teeth. While Fourmanoir remarks that the extracorneal tooth is "*nettement plus longue que l'infra-orbitaire*," his figure 14 is other than clear, but it apparently does not reach beyond the eye itself as does the extracorneal spine in *A. areteformis*. However, the cheliped that he figures has the long merus, the short carpus and the long slender chela proper that is characteristic of the large cheliped of the females of *A djiboutensis* (see B & B, 1973, fig. 3c) in contrast to the shorter, heavier cheliped of the female in *A. areteformis* (*op. cit.*, fig. 2f). We believe therefore that Fourmanoir's specimen may have been *A. djiboutensis*, but we cannot be certain.

In his field notes Dr. Bruce described a specimen of *A. djiboutensis* from Mombasa, Kenya with a "Broad white irregular dorsal stripe, red transparent with fair red-brown patches."

Athanas dorsalis (Stimpson)

Arete dorsalis Stimpson, 1861, p. 32.

Previous records. — Richters, 1880, p. 164 (as *Athanas mascarenicus*), Mauritius (see also, Miya, 1981, p. 71, fig. 3). Fourmanoir, 1955, p. 22 (as *Arete dorsalis* and *A. dorsalis maruteensis*), Comores. Jacquotte, 1964b, p. 179, Tuléar. Hipeau-Jacquotte, 1965, p. 247, Tuléar.

Specimens examined. — 2 specimens from Somalia; 12, Kenya; 11, Tuléar; 1, Comores; 4, Seychelles; 15, Mauritius.

Remarks. — This species and *A. indicus* (following) appear to be obligate commensals living with sea urchins of various genera (see B & B, 1975, pp. 326-329). Jacquotte (1964, *loc. cit.*) reported this species in association with *Stomopneustes variolaris* (Lamarck) in Tuléar. Two of the specimens from Mauritius were found with *Heterocentrotus mammillatus*. Field notes on the specimens from Kenya indicated that all specimens were associated with echinoids.

Athanas indicus (Coutière)

Arete dorsalis indicus Coutière, 1903, p. 84, figs. 25-30.

Arete indicus Coutière, 1905a, p. 863, figs. 134, 135.

Previous records. — Coutière, 1921, p. 413 (as *Arete indicus*), Seychelles. Barnard, 1958b, p. 7 (as *Arete indica*), Delagoa Bay. Jacquotte, 1964b, p. 180, Tuléar; Hipeau-Jacquotte, 1965, p. 247, Tuléar. Macnae and Kalk, 1969, p. 75 *et seq.* (as *Arete indica*), Mozambique. B & B, 1980, p. 28, Tuléar. Kensley, 1981, p. 26, (as *Arete indica*), Mozambique.

Specimens examined. — 5 specimens from Somalia; 3, Kenya; 5, Tanzania; 7, Tuléar; 3, Seychelles; 1 (+ Ribes), Réunion; 2, Mauritius.

Remarks. — Jacquotte found this species living among the spines of *Stomopneustes variolaris* and *Echinometra mathei*. Previous collections have indicated this species may have a preference for *E. mathei*.

Athanas marshallensis Chace

and/or

Athanas rhothionastes Banner and Banner

Athanas marshallensis Chace, 1955, p. 17, fig. 8.

Athanas rhothionastes Banner and Banner, 1960, p. 142, fig. 3.

Specimens examined. — 1 specimen from Nosy Be; 2, Tuléar; 20, Seychelles; 1, Réunion; 2, Mauritius.

Discussion. — When we described *Athanas rhothionastes* from Canton, Phoenix Islands and other areas of the central Pacific, including the Marshalls, we could find only one morphological characteristic that separated it from *A. marshallensis*, also from Marshalls. That was in the carpal length of the chelipeds of mature females, 0.2 the palmar length in *A. rhothionastes* and usually over 0.5 palmar length in *A. marshallensis*, the shortest carpi in the latter species being 0.4 the length of the palm. We knew that the relative proportions of the articles of the chelipeds in the genus *Athanas* and in these 2 species depended upon sex, maturity and even bilateral symmetry (see 1960b, figs. 2a-d, 3c-f, j-o). However, we also found what appeared to be a clear ecological separation in our central Pacific collections especially at Enewetak, Marshall Islands. *A. rhothionastes* appeared to be confined to the edge of the reef in the surf zone, often in the coralline algal ridge or at the heads of surge channels. We had collected it evidently from similar habitats in the entire collection (our original notes were lost - see B & B, 1962). On the other hand, the specimens we identified as *A. marshallensis* at Enewetak came from "under rocks on a sandy bottom in a somewhat protected cove on the lagoon side of one of the islets." Thus one was living in coral or coralline rocks in the surge or surf zone, the other living under dead coral on sand flats in areas of relatively low wave energy.

Neither we nor anyone else have recorded *A. rhothionastes* since the original report (our reference in our 1968 paper, p. 270 to both species was a repeat of our 1960 reference). *A. marshallensis* was reported by Miya and Miyake (1968, p. 147) but with only geographical location, not habitat (Kikuchi and Miyake, 1978, p. 22 [in Japanese] may be a repetition of the 1968 reference), and by us from the Philippines (1979, p. 237), where none of the reefs from which we obtained specimens were of the formation found in high wave energy areas with reef crests and groove-and-spur systems.

When we were in the Seychelles we were able to collect some species of *Athanas* from overgrown heads of coral on the outer margins of reefs where we think there could be heavy surf during the periods of northern monsoons, and others from under heads of coral resting on sandy beaches that should have been somewhat to quite protected from surf during both northerly and southerly monsoons. Unfortunately, our optical equipment and illumination did not permit the identification of these small specimens to species while we were in the field; had we realized that these collections represented *A. marshallensis* and *A. rhothionastes*, we would have made an effort to collect a greater number of specimens and to annotate better the conditions of their habitats.

The data on the ten females in the collections (of which two are definitely immature) is presented in Table 2, together with notes on their collection localities and their probably ecology. The sample

TABLE 2. *Athanas marshallensis* and/or *A. rhothionastes*: Data on female cheliped carpus/palm ratios and habitats.

Island & Collector	Locality and Habitat; species to be expected from this habitat in parentheses.	Carapace Length, mm.	Maturity	Carpus/ Palm*
Mahé, Seychelles** B & B	Northwest Bay, (4°36'17", 55°25'54"); coral heads, subtidal, outer reef face; probably area of high surf, northerly monsoons. (*A. rhothionastes*)	3.8	Ovigerous	0.60 0.28
	Same, but intertidal, outer reef edge (*A. rhothionastes*)	3.6	Ovigerous	0.32 0.36
	Northwest Bay (4°35'51", 55°25'54"); burrowing into sand and rubble near 0.0 tide - no reef formation; probable area of high surf, northerly monsoons. (*A. rhothionastes*)	3.7	Ovigerous	1.0 0.34
	Anse Gaulettes, Baie Lazare (4°45'41", 55°29'10"); under coral heads, intertidal, lying on clean sand; probably protected from all heavy monsoonal swells. (*A. marshallensis*)	2.6	Immature	0.86
		3.0	Ovigerous	0.32
Seychelles Bruce	Intertidal fish poison station, locality not specified. (Not enough ecological data to predict species expected.)	3.0	Ovigerous	1.0 1.0
		3.1	Ovigerous	0.35 0.90
		4.0	Ovigerous	1.05 1.12
Tuléar, Madag. Peyrot-Clausade	In coral, outer reef flat, Grand Recif. (*A. rhothionastes*)	3.0	Ovigerous	0.80 0.47
	In resettlement block, inner reef flat, Grand Récif. (*A. marshallensis*)	2.1	Immature	1.0

* Ratios of both chelae recorded for specimens where both were present.

** These localities on Mahé estimated from Mahé sheet, series Y752 (D.O.S. 404), 3rd Ed., 1974, Br. Gov't. Overseas Dev. Adm., 1-50,000. Localities with possible ± 0.5 km error.

is too small to draw any conclusions except that the differentiation between the two forms and its correlations with habitat preferences is clouded. At this point one cannot either state that the two species are valid or that they represent a single polymorphic species. However, we have a serious doubt about the separation of the two forms as distinct species.

We did make color notes on one of the specimens from Anse Gaulettes, a specimen with a 4 mm carapace length that may be *A. marshallensis*: Basic body color a translucent white. Carapace with red-brown chromatophores posterior to eyes, patch of red and blue chromatophores at base of chelipeds. Mid-dorsal saddle over gastric region of light green and blue, also with white stellate chromatophores and with anterior and posterior corners extending to upper branchiostegites as narrow bands; similar saddle of white chromatophores over anterior cardiac region. Branchiostegites bearing a patch of red chromatophores. Posterior end of carapace and anterior abdominal segments with transverse bands of red and blue chromatophores, separated by bands of white chromatophores and extending to the pleura; sixth abdominal segment bearing but a single band of red and blue. Scattered red chromatophores on antennular and antennal peduncles and on superior margins of chelipeds; otherwise appendages mostly transparent with a touch of faint transparent green. Other specimens in the same collection showing banding and patches of varying intensity, some more red, some more blue.

Athanas minikoensis Coutière

Athanas minikoensis Coutière, 1903, p. 76, figs. 9-11; 1905a, p. 858, fig. 130.

Previous records. — Barnard, 1950, p. 731, figs. 137a-d, (identity questioned by author), Mozambique. Fourmanoir, 1958, p. 126, fig. 15, Madagascar (identity questionable). Macnae and Kalk, 1969, p. 43 *et seq.* Kensley, 1970, p. 118, figs. 12a-e; 1981, p. 26; last 3 records Mozambique.

Athanas sibogae De Man

Athanas sibogae De Man, 1910, p. 314; 1911, p. 151, fig. 6.

Athanas parvus De Man, 1910, p. 315; 1911, p. 148, fig. 4.

Previous record. — Ledoyer, 1970, p. 126, pl. 11 (as *A. parvus*), Nosy Be.

Specimen examined. — 1 specimen from Kenya.

Remarks. — Collection notes indicated the specimen from Kenya was "deep purple." Miya and Miyake (1968, p. 136) however reported Japanese specimens of this species to be pale blue ground color with a mid-dorsal longitudinal stripe free of color.

Genus AUTOMATE De Man 1888a

Automate anacanthopus De Man

Automate anacanthopus De Man, 1910, p. 317; 1911, p. 142, fig. 3.

Previous record. — Ledoyer, 1970, p. 127, pls. 17, 24A, Tuléar.

Specimens examined. — 7 specimens from Tuléar.

Remarks. — De Man's specimens were dredged from 75 m from a hard sand bottom and from a 22 m mud bottom; 5 of Ledoyer's specimens came from mud and muddy gravel bottoms from 4-38 m in depth, but one came from a microatoll on the reef flat (microatolls occur only in immediate subtidal zone). Ledoyer suggested that they are burrowers in the loose substrate. Similarly, the 7 identifiable specimens from Tuléar were collected by Dr. Thomassin from mud or muddy sand at 17 to 18 m. His collections also contained a large number of specimens that we could report neither as *A. anacanthopus* or as *A. dolichognatha* as they had lost their chelipeds which are required for the separation of the two species.

Automate dolichognatha De Man

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

Previous record. — Ledoyer, 1970, p. 127, pls. 18, 24B, Tuléar.

Specimens examined. — 1 specimen from Kenya; 2, Zanzibar; 1, Nosy Be; 15, Tuléar; 1, Réunion.

Automate salomoni Coutière

Automate salomoni Coutière, 1908, p. 192; 1921, p. 413, pl. 60, fig. 1.

Previous record. — Coutière, *loc. cit.*, Chagos.

Genus LEPTALPHEUS Williams 1965

Leptalpheus pacificus Banner and Banner

Leptalpheus pacificus Banner and Banner, 1975a, p. 424, fig. 1.

Specimen examined. — 1 specimen from Tuléar.

Remarks. — This 7 mm female is similar to the original 14 and 23 mm females that we described from Hawaii except for the chelipeds. They are more slender, the large cheliped being 6.3 times as long as broad instead of 4.4 and the small chela is 5.6 times as long as broad instead of 5.0. The small size of the specimen probably accounts for the different proportions.

The type species, *L. forceps* Williams is known to live as a commensal in burrows of callianassid shrimp in sandy substrate; *L. pacificus* probably also has a similar association. This specimen was collected by Thomassin from a sand bank where callianassids might occur.

Genus METABETAEUS Borradaile 1898

Metabetaeus sp. (?)

Two species of this genus have been described, *M. minutus* (as *Betaeus minutus* by Whitelegge, 1897, p. 147, subsequently put into the new genus *Metabetaeus*, by Borradaile, 1898, p. 1014) and *M. lohena* B & B (1960a, p. 299). The type locality for *M. minutus* is Funafuti in the Ellice Group (now Tuvalu) and it has subsequently been reported from Arno and Jaluit in the Marshall Islands (B, 1957, p. 193; B & B, 1960a, p. 302) and from Fakaofo Atoll, Tokelaus by Holthuis (1963, p. 269). *M. lohena* was originally described from a pool on the southern tip of the island of Hawaii (*loc. cit.*); it has subsequently been reported from the shoreside pools in the drier portion of the islands of Hawaii and Maui in the Hawaiian Archipelago, but not from beyond these locations (Holthuis, 1973, p. 36).

In the present collections are 5 specimens collected by Dr. Thomassin off Tuléar. All plainly belong to this genus, even to bearing the characteristic brown-to-black spots on the lateral sides of the mandibles that do not fade in preservation (for discussion, see Coutière, 1899, p. 374 and B & B, *loc. cit.*). However, all 5 have lost their large chelipeds, and differences in this appendage provided the principle separation between the two known species. *M. minutus* bears quite symmetrical but small chelipeds in both sexes with the palm straight, relatively heavy, subcylindrical and definitely longer than the fingers, and with the fingers unarmed except for bristles. In *M. lohena* the chelipeds may be asymmetrical, at least in immature females, but are symmetrical in adults; in this species the fingers are about 1.5 the length of the somewhat bulbous and tapering palm and are thin, slightly curved and bearing small cusps in the proximal third - the chelae are raptorial in appearance and in use.

Two other characteristics to separate the 2 species were given in the original description for *M. lohena*: The stylocerite reached only to the end of the first antennular article and the scaphocerite reached beyond the end of the third antennular article in *M. lohena*, while in *M. minutus* the stylocerite was longer, reaching to the middle of the second article and the scaphocerite was shorter, reaching only to the middle of the third article. In the Tuléar specimens both characteristics are variable, with the stylocerite reaching from a quarter to half the length of the second article, and the scaphocerite reaching from the middle to the end of the third. Accordingly, we reexamined 5 specimens in our collections from the island of Hawaii (not the original type material) and 15 topotypes of *M. minutus* from Funafuti. With this larger series of specimens we found that the two characteristics are variable in both species and that the only reliable characteristic for their separation would be in their chelae.

We thought that we discovered one other possible differentiating characteristic that might separate the Tuléar specimens from those of the central Pacific for the Tuléar specimens all carried on the third legs one or two spines of moderate development on the ischium and two similar spines on the merus, a characteristic that was not mentioned in the description of either named species. However, reexamination of the specimens from Hawaii and Funafuti revealed that this, too, is a variable characteristic, with some bearing 3 or 4 spines and some being completely unarmed (*cf.* B & B, 1960, fig. 1n).

The possible ecology of the Tuléar specimens is challenging. The two known species are from "anchialine pools," brackish water pools that are separated from the adjacent sea by a superficially dry but porous substrate, such as fragmented lava or coral rubble, that permits the water level in the pools to rise and fall with the tides, or even with the broad rhythm of the waves on the adjacent coastline (for a description of this type of pool and its crustacean fauna see Holthuis, 1973). For *M. minutus* the probable exact site from which the type series was collected was separated from the atoll lagoon by a wall of coral rubble (for a description, see Holthuis, *op. cit.* p. 7). On Arno, it came from a "brackish pond;" on Jaluit from a brackish mangrove swamp and from a World War II bomb crater that almost completely drained at low tide (for a description see B & B, 1960, p. 302); on Fakaofo they came from "brackish pond." In Hawaii, *M. lohena* is found in ponds isolated from the sea by fields of rough (or "a-a") lava; these have been described in B & B, 1960, Holthuis, 1963 and Maciolek and Brock, 1974.

In contrast, the specimens from Tuléar were taken by airlift (a submarine suction device using compressed air) from a "gravely sedimentary accumulation at the foot of a vertical cliff along the edges of an outer creed (outer re-entrant) of the outer reef front...at 7 m deep...." (Thomassin, personal communication). When we asked Dr. Thomassin for confirmation of this anomalous collecting site, he wrote further: "At first view this biotope is completely opposed to the inland-enclosed pools or brackish water ponds where the Pacific members of this genus were collected. This because, at Tuléar, we are in open sea on the outer barrier reef front. But since a time I expect that the "Grand Récif" is built near or upon a karstic system. Moreover, I have recorded a discontinuity at 8-10 m deep, in the building of this barrier reef, so I think that the bottom of these creeks are the top of an old level (the famous 10 meter terrace of most of the Indo-Pacific coral reefs). So, if this hypothesis is true, the phenomena of reappearance of subterranean waters could occur here at this place." We initially regarded Dr. Thomassin's hypothesis as somewhat preposterous, but his analysis of the geology of the area appears to present a reasonable explanation for the occurrence of an anchialine, brackish water species in the substrate of a reef front. We only hope that at some time in the future some worker may explore the geology and hydrology of this area, known to the French workers as "Crique en V" or in Malagasyan as "Ankolatsy-Kely" (see also Thomassin's doctoral thesis, 1978, pp. 93, 94).

Dr. John A. Maciolek, of the cited Maciolek and Brock paper (1974) and currently with the Aquatic Ecology Research Section of the U. S. National Fishery Research Center in Seattle, Washington, has written of another approach to the problem of distribution of the "insular hypogeal shrimps" that he presented to a meeting of the Western Society of Naturalists (USA) in Sydney, Australia in July, 1982 (the paper is to be published later this year). His theory, in brief review, rests on the fact that he has found the species inhabiting the anchialine pools to be broadly euryhaline, tolerating all mixtures of sea and fresh water. Therefore, he does not believe the salinity of the water would inhibit their distribution. Rather, he believes that anchialine species to be confined to those waters, salt or fresh, that penetrate loosely packed aggregates of rocks in hypogeal or subterranean substrates, whether they be shore-side loose lava beds with exposed pools or the coarse submarine detritus associated with coral reefs. An evidence of adaptation to this stygean habitat is the reduction of the eyes found in many of these hypogeal species. As the collection of the infauna of coral rubble found beyond the outer reef is difficult and seldom done, these species are most often found in the isolated brackish ponds surrounded by the loose substrate on land.

Incidentally, we are not wagering upon what species this *Metabateus* may prove to be in view of the fact that the new genus and species of Holthuis, *Calliasmata pholidota*, was collected within a year's time from anchialine pools in the Sinai Peninsula, Funafuti and Hawaii (Holthuis, *loc. cit.*) - and nowhere else - and that we will report in a future paper on the "endemic Hawaiian species," *M. lohena*, from a collection made in Indonesia.

Genus METALPHEUS Coutière 1908

Metalpheus paragracilis (Coutière)

Alpheus paragracilis Coutière, 1897b, p. 303; 1905a, p. 883, pl. 76, fig. 22.

Previous records. — Coutière, *loc. cit.*, Nosy Be; 1921, p. 419, Coetivy. Ledoyer, 1970, p. 127, pl. 16, Tuléar. Kensley, 1970, p. 120, figs. 14a-e, Mozambique (all records as *Alpheus paragracilis*). Kensley, 1981, p. 26, Mozambique.

Specimens examined. — 11 specimens from Somalia; 7, Kenya; 200, Tuléar; 1, Comores; 39, Seychelles; 70 (+ Ribes), Réunion; 29, Mauritius.

Metalpheus rostratipes (Pocock)

Alpheus rostratipes Pocock, 1890, p. 522.

Previous records. — Peyrot-Clausade, 1979, p. 76, Tuléar.

Specimens examined. — 58 specimens from Tuléar; 8, Seychelles; 49 (+ Ribes), Réunion; 72, Mauritius.

Remarks. — The specimens from the Seychelles and Mauritius were from the bases of dead coral collected at the reef face while the specimens from Tuléar were collected from the reef surface.

Genus NEOALPHEOPSIS Banner 1953

Neoalpheopsis euryone (De Man)

Alpheopsis? euryone De Man, 1910, p. 308; 1911, p. 184, fig. 19.

Specimens examined. — 3 specimens from Kenya.

Remarks. — One of the specimens was collected intertidally under rocks by Dr. A. J. Bruce. He supplied the following color note: "Marked red bar across each abdominal segment dorsally, pink with white palm. With white and orange ovaries."

Genus PRIONALPHEUS Banner and Banner 1960

Prionalpheus fissipes (Coutière)

Alpheopsis fissipes Coutière, 1908, p. 193; 1921, p. 414, pl. 60, fig. 3.

Previous record. —Coutière, *loc. cit.*, Providence (both references to the single holotype; no other specimens known).

Prionalpheus sulu Banner and Banner

Prionalpheus sulu Banner and Banner, 1971, p. 268, fig. 2.

Specimens examined. — 5 specimens from Tuléar; 2, Seychelles.

Remarks. — Only the 2 specimens from the Seychelles had any thoracic legs. Since the mouthparts on the specimens from Tuléar were the same as those for the typical *P. sulu* we are assigning them to this species. We made color notes on a specimen collected in the Seychelles from a dead head of coral found in a sea grass beds (in sand): Body transparent to whitish (only slight opacity); scattered red chromatophores on lateral abdominal terga and anterior branchiostegites, eggs red-orange.

Genus RACILIUS Paulson 1875

Racilius compressus Paulson

Racilius compressus Paulson, 1875, p. 107, pl. 14, figs. 2a-g.

Previous records. — Barnard, 1958a, p. 752, Mozambique; 1958b, p. 9, Delagoa Bay. Jacquotte, 1964a, p. 175, Tuléar. Macnae and Kalk, 1969, p. 126 (as *Racilius* sp.) Mozambique. Bruce, 1972, p. 92, Aldabra, Seychelles, Kenya, Zanzibar; 1974, p. 1 (larval development), Kenya.

Specimens examined. — 4 specimens from Somalia; 87, Kenya; 2, Tanzania; 2, Mozambique; 19, Seychelles; Ribes only, Réunion; 1, Mauritius.

Remarks. — The field notes indicate all of the specimens from the African coast were collected from *Galaxea fascicularis* (Linnaeus) and *G. clavus* (Dana). The specimens from Somalia were reported as coming from *Galaxea irregularis* (Edwards and Haime). Veron & Pichon, 1980, list *G. irregularis* as a synonym for *G. fascicularis* (p. 204) and *G. clavus* as a synonym for *G. astreata* (Lamarck) (p. 201).

Dr. Vannini's color transparency of this species shows a specimen almost completely translucent with a pale yellow-green gastric region visible through the carapace and bearing yellow-green eggs. The transparency of the body has previously been remarked upon (B & B, 1979, p. 239); Yaldwyn (in B & B, 1973, p. 352) added that his specimens had a scattering of minute red chromatophores.

Genus SALMONEUS Holthuis 1955

Salmoneus brevirostris (Edmondson)

Jousseaumea brevirostris Edmondson, 1930, p. 7, figs. 2a-e.

Specimens examined. — 1 specimen from Iles Glorieuses, northwestern Madagascar.

Remarks. — We have recently collected a specimen of this species intertidally in Hawaii. The specimen was entirely yellow-orange with the gastric region a darker orange. In collecting members of this genus we have found this to be a common color (see 1981d, p. 52).

We wish to correct errors in the listing of this species and *S. serratidigitus* (Coutière) in our Red Sea paper (1981d). On page 54 the second line under *Specimens examined* should read "Acc. No. Na 2778 [not 2788]. The *Remarks* following should be eliminated. On page 58, the fourth line under *Specimens examined* should read "4 [not 2], Na. 2778, Red Sea;...."

Salmoneus cristatus (Coutière)

Jousseaumea cristata Coutière, 1897a, p. 234.

Specimens examined. — 3 specimens from Kenya; 3, Tuléar; 2, Seychelles.

Remarks. — We were able to make the following color notes from a living specimen collected on Mahé, Seychelles: Ground color of body translucent white. Transverse red to orange-red bands at rostral base, posterior region of carapace and posterior part of each abdominal terga; caudal fan translucent white. Gastric region orange-red with narrow longitudinal stripe extending posteriorly to tip of telson. Appendages colorless, eyes black, eggs orange. This agrees with Coutière's original notes (*loc. cit.*) except he described the color as "*rouge vif*," and with the color notes of Dr. Holthuis on specimens from the Red Sea (B & B, 1981d, p. 57).

Salmoneus rostratus Barnard

Salmoneus rostratus Barnard, 1962, p. 240, fig. 1.

Previous record. — Barnard, *loc. cit.*, Nosy Be.

Specimen examined. — 1 specimen from Nosy Be.

Salmoneus serratidigitus (Coutière)

Jousseaumea serratidigitus Coutière, 1896, p. 382.

Specimens examined. — 2 specimens from Kenya; 1, Nosy Be; 9, Tuléar; 1, NE Madagascar; 1, Aldabra; 1, Seychelles.

Remarks. — One of the specimens from Kenya was reported to be "bright yellow." This is similar to some reported from the Red Sea (B & B, 1981d, p. 63).

Salmoneus tricristatus Banner

Salmoneus tricristata Banner, 1959, p. 131, fig. 1.

Specimens examined. — 1 specimen from Kenya; 2, Tuléar; 1, Seychelles.

Remarks. — The large cheliped was missing from the holotype from the Marshall Islands (*loc. cit.*) but was subsequently described from other specimens from the Marshalls (B & B, 1968, p. 270) as having the palm roughly square in section with an additional groove to accommodate the merus when the chela was flexed against the body. We found a somewhat similar shape in the single specimen we reported from Australia (B & B, 1973, p. 334) but there we cautioned that the shape might be the result of the shrinkage of the muscle distorting the weak chitin of the palm. On the other hand, Miya (1972, p. 42) reported that in his specimen from the Ryukyus the palm was swollen and nearly cylindrical in section. In one specimen in this collection from Tuléar, the "sculpturing" on the palm is intermediate, the palm itself being somewhat oval in section, and with the only flattened area in the proximal half on the side of the dactylar articulation; the flattened area is not well defined. The groove to accommodate the merus is well defined at the proximal end of the palm but gradually fades out in mid-palm. The side of the chela on which the propodal finger lies carries proximally a heavy rounded "heel" somewhat distal to the carpal-propodal articulation (this is shown somewhat poorly in 1973, fig. 13d, and better for related species in Red Sea (B & B, 1981d, figs. 6e, 8e, 8j). We believe that the squarish palm is from distortion but that the groove for the merus and heel are constant features.

The specimen we collected from Mahé was either living in, or found near, the large cemented burrows of *Alpheus strenuus strenuus* Dana - see under that species for the description of the burrows.

Dr. A. J. Bruce supplied the following color notes on his specimen from Kenya: "White, fairly speckled with small red dots over posterior carapace and first and second abdominal tergites."

Genus SYNALPHEUS Bate, 1888

Synalpheus albatrossi Coutière

Synalpheus albatrossi Coutière, 1909, p. 89, fig. 54. (See also: Banner, 1953, p. 30, fig. 9).

Specimens examined. — 3 specimens from Réunion; 3, Mauritius.

Remarks. — These 6 specimens, running from 7-8 mm in total length, agree well with the 1953 (p. 30) redescription and figures of 8 mm specimens from the Hawaiian Islands that we placed under *S. albatrossi*, except for 2 minor details: First, the carpus of the third leg bears a single relatively strong spine on its inferodistal angle instead of a pair of weaker spines. Second, the tip of the telson is about one-half the breadth of the base rather than one-third. The specimens also agree well with the two deeper water specimens we reported from the MUSORSTOM collections from the Philippines (1981a, p. 223). While most species of the Comatularum Group of the genus *Synalpheus* are associated with comatulid crinoids, this species does not appear to have such an association - certainly, as it does occur in shallow water in Hawaii where there are no crinoids, it cannot require that association.

As we reviewed Coutière's description and figures and our redescription of 1953, some doubts occurred to us about the correctness of our identification. The principal difference is in the form of the rostrum and orbital teeth which are markedly different in the two forms. We have examined Coutière's holotype - the only specimen known - at the Smithsonian Institution and have determined that his drawings and description are accurate. For the present with so few specimens known, we have decided to leave the species designation unchanged but should more specimens resembling Coutière's holotype be found without specimens transitional in form between the two types we suggest that the taxonomic status of this form be again considered.

The species appears to be wide-ranging in depth. The Waikiki specimens (1953) and those listed above came from the shallow subtidal, the MUSORSTOM specimens came from 150 and 194 m, and Coutière's from off Laysan came from 18 to 35 m.

Synalpheus ancistrorhynchus De Man

Synalpheus ancistrorhynchus De Man, 1909a, p. 124; 1911, p. 267, fig. 47.

Specimens examined. — 4 specimens from Tuléar; 4, Nosy Be; 3, SE Madagascar.

Remarks. — One of the specimens from Tuléar was dredged from 100-200 meters; the deepest previous report was 38 m and the species also occurs in the intertidal zone.

Synalpheus bituberculatus De Man

Synalpheus bituberculatus De Man, 1910, p. 294; 1911, p. 276, fig. 53.

Specimens examined. — Ribes only, Réunion; 4, Mauritius.

Synalpheus charon (Heller)

Alpheus charon Heller, 1861, p. 27; 1862, p. 272, pl. 3, figs. 21, 23.

Previous records. — Coutière, 1921, p. 416, Chagos, Coetivy. Barnard, 1947, p. 389; 1950, p. 738, figs. 139j,k, both references, Mozambique. Macnae and Kalk, 1969, p. 126, Mozambique. Bruce, 1975, p. 25, fig. 8, E. Africa. Kensley, 1981, p. 26, Mozambique.

Specimens examined. — 211 specimens from Somalia; 20, Kenya; 3, Nosy Be; 15, Tuléar; 27, Seychelles; 2 (+ Ribes), Réunion; 7, Mauritius; 1, Chagos.

Remarks. — This species, as previously remarked upon, appears to be an obligate symbiont of living coral, mostly with the family Pociloporidae (B & B, 1975b, p. 370). The very large collections from Somalia were made from many heads of the genera *Pocillopora* and *Stylophora*, mostly as a cohabiting pair in each head, although one collection had 3 pairs in one head. However, 2 pairs came from heads identified as *Porites andrewsi* Vaughan and one came from *P. nigrescens* Dana. According to notes available to us, six lots came from corals yet to be identified.

Dr. A. J. Bruce mentioned that 2 specimens from Mombasa, Kenya were "bright red" (see also Bruce, 1975, fig. 8); a color transparency by Dr. Vannini showed a similar color, uniform in distribution on the body and appendages. This is the color we have found elsewhere in the Indo-Pacific.

Synalpheus coutierei Banner

Figure 10

Synalpheus coutierei Banner, 1953, p. 36.

Alpheus biunguiculatus, De Man, 1888a, p. 502, pl. 21, fig. 6 (*nec Alpheus biunguiculatus* Stimpson, 1861).

Previous records. — Lenz, 1905, p. 384 (as *Alpheus biunguiculatus*), Aldabra. Coutière, 1921, p. 416 (as *S. biunguiculatus*), Chagos, Amirante.

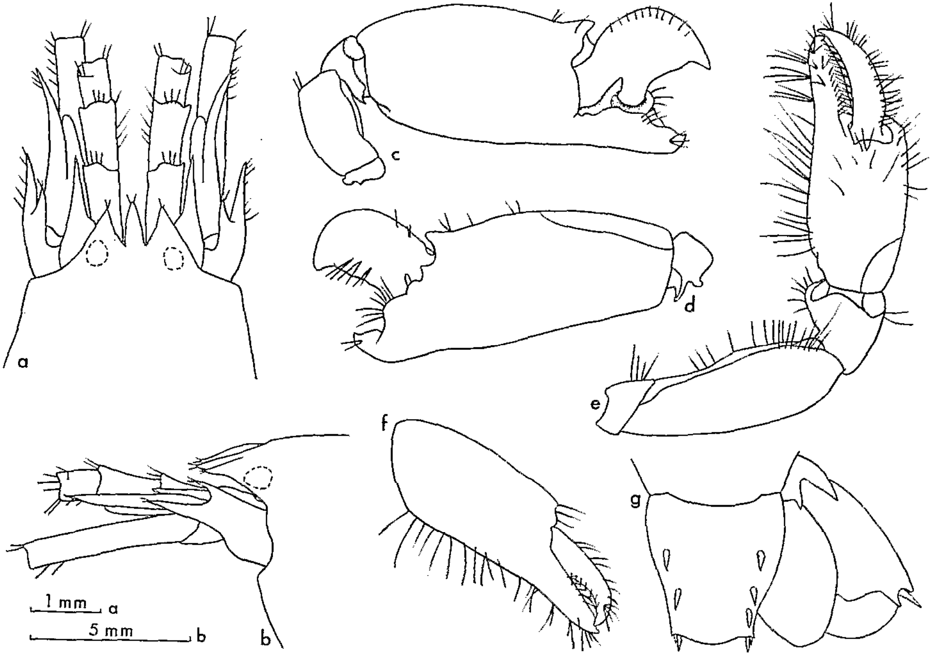

Figure 10. *Synalpheus coutierei* Banner. 21 mm male from Kenya. a, b, Anterior region, dorsal and lateral view; c, d, large cheliped, lateral and medial faces; e, f, small cheliped, lateral and medial faces; g, telson and uropods. a, b, e, f, g scale a; c, d scale b.

Specimens examined. — 7 specimens from Somalia; 14, Kenya; 1 Aldabra; 30, Seychelles; 2, Réunion.

Remarks. — The 14 specimens from Kenya show some characteristics of both *S. coutierei* and *S. hastilicrassus* Coutière, both variable species. In general they are most like *S. coutierei*, especially in that the tooth above the dactylar articulation of the large chela points upward from the curvature of the superior surface of the palm rather than following the curvature. However, the posterolateral corners of the telson are in the form of slightly projected right angles, approaching the minimal condition we reported for the posterolateral teeth for *S. hastilicrassus* from Australia (1975b, fig. 21q). Furthermore, like the single male from the South China Sea that we identified as *S. coutierei* (1979, p. 242), these specimens carry a row of hairs on the superior surface of the dactylus of the small chela, similar to *S. hastilicrassus* and unlike the usual *S. coutierei*. However, because of the other similarities to *S. coutierei*, we continue to classify this form under that name, but we are appending figures of the form for future workers.

Synalpheus crosnieri sp. nov.

Figure 11

HOLOTYPE. — 10 mm male from northwest coast of Madagascar (12°44'S; 48°25.2'E). Dredged at 73 m. Coll. A. Crosnier, 2/8/73.

ALLOTYPE. — 12 mm ovigerous female from same location as type.

PARATYPES. — 110 specimens from 9-12 mm from off northwestern Madagascar (including type locality), dredged from 55-130 m; 24 specimens of similar size dredged from off Mombasa, Kenya; 9 specimens of similar size from off northern Kenya, dredged as 46 m; 2 specimens of 10 mm from the Seychelles, dredged at 50 m.

Description. — Rostrum triangular with tip acute, 1.7 times as long as broad at base and reaching 0.4 length of visible part of first antennular article. Orbital teeth much longer than broad at base, tips rounded and reaching as far forward as rostrum. Rostral base with orbitorostral process.

Visible part of first antennular article 1.5 times as long as second; second article only a little longer than broad and slightly shorter than third article. Stylocerite with tip rounded, reaching slightly past middle of visible part of first antennular article. Scaphocerite with squamous portion absent, lateral tooth reaching to near middle of third antennular article. Carpocerite 5 times as long as wide when viewed laterally, reaching a little less than length of third antennular article past that article. Inferior tooth of basicerite reaching to first quarter of second antennular article, superior tooth short and subacute.

Ratio of articles of third maxilliped: 10:2:7. Superodistal margin of second article bearing two heavy setae as well as several fine hairs; third article bearing circlet of short heavy spines on tip.

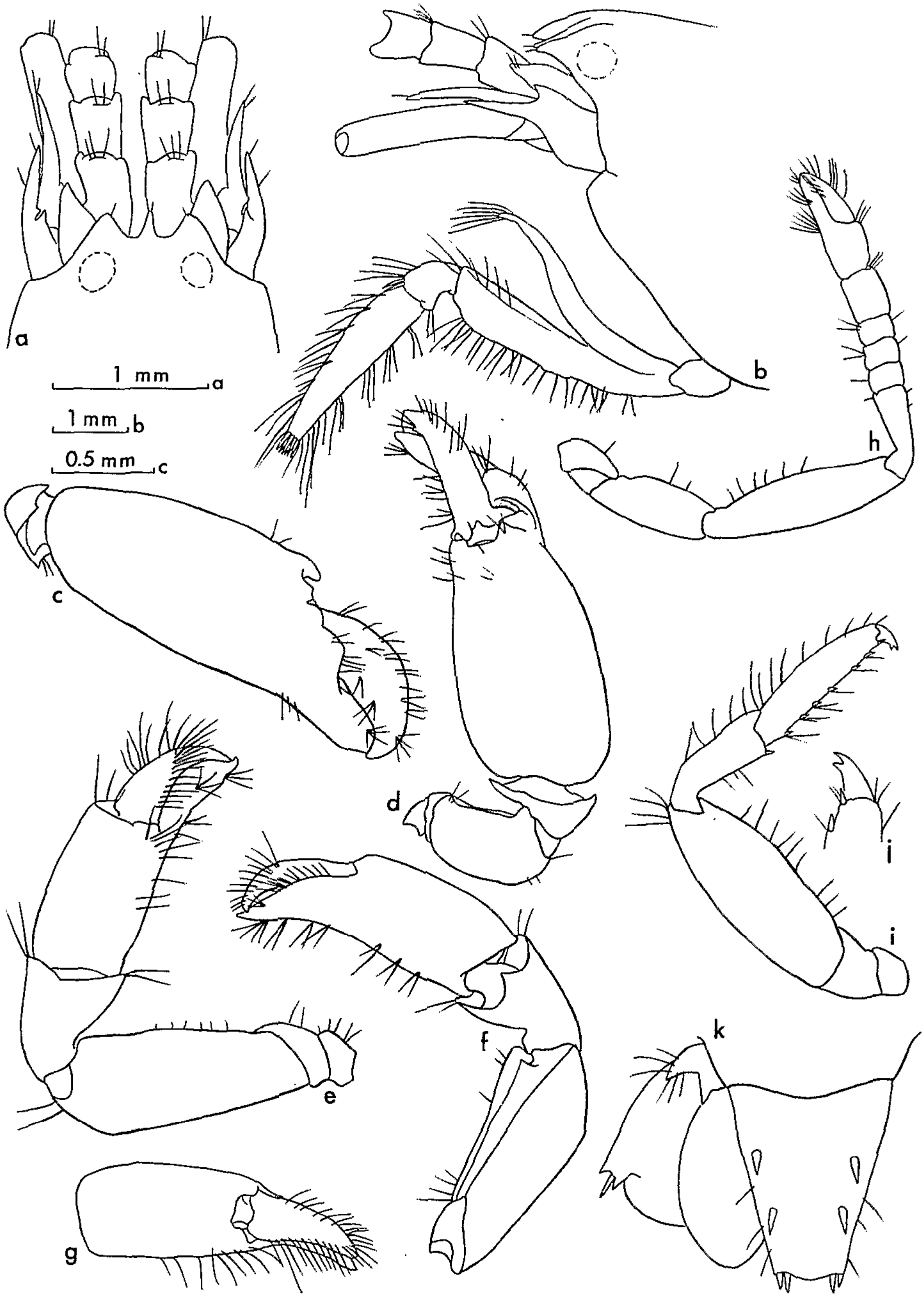

Figure 11. *Synalpheus crosnieri sp. nov.* Holotype, 10 mm male from NW Madagascar. a, b, Anterior region, dorsal and lateral view; c, d, large cheliped, medial and superior faces; e, f, small cheliped superolateral and superomedial face; g, small chela, superior face; h, second leg; i, j, third leg and dactylus; k, telson and uropods. a, b, e, f, g, h, i, k scale a; c, d scale b; j, scale c.

Large chela 2.7 times as long as broad with fingers occupying distal third. Superior margin of palm terminating in prominent rounded tooth. Palm carrying heavy swelling at medial side of dactylar articulation; when viewed in profile swelling conspicuous beyond condoyler surface. In lateral view swelling not as visible but finger slightly depressed from axis of palm. Fingers of large chela with strong lateral twist. Merus with superodistal margin rounded.

Small chela 2.4 times as long as broad with fingers occupying distal 0.5 and not twisted laterally as in large chela; palm cylindrical. Superior margin of dactylus bearing brush of hairs directed laterally, typical of the Gambarelloides Group, oppositional margins of fingers bearing a few sparse hairs with more on medial face than lateral. Carpus cup-shaped, 0.4 as long as chela; both superodistal and inferodistal margins projected, that of inferodistal margin as a strong but rounded tooth. Merus 2.5 times as long as broad distally, distal margins rounded, not projected.

Carpal articles of second leg with ratio: 10: 2.7: 2.7: 2.7: 5.6; middle articles broader than long.

Ischium of third leg unarmed. Merus 3.0 times as long as broad, lacking spines on inferior margin and distal tooth. Carpus 0.4 times as long as merus; superodistal margin projected as heavy rounded tooth, inferodistal margin not projected but bearing small spines. Propodus 0.7 as long as merus, bearing on inferior margin 5 small spines and a pair distally; inferior and superior margin sparsely hairy. Dactylus 0.2 as long as propodus, gradually curved and with 2 ungui equal in length, separated by a U-shaped notch.

Telson 2.0 times as long as posterior margin is broad. Posterolateral corners angular but not projected, bearing 2 pairs of moderately stout spines, outer spine about 0.7 length of inner. Posterolateral margin only slightly arcuate between spines. Dorsal spines prominent, same size as medial pair of posterior spines, anterior pair placed well anterior to midline. Outer uropod without transverse articulation.

Discussion. — As this species bears a brush of hairs on the dactylus of the small chela and lacks the squame on the scaphocerite we are assigning it to the Gambarelloides Group. This group, prominent in the Atlanto-East Pacific realm of Ekman (1953, p. 30), has only 3 other species known in the Indo-Pacific, all confined to the western Indian Ocean and Red Sea: *S. sladeni* Coutière (see below), *S. gambarelloides* (Nardo) (see below), and *S. spongicola* B & B (1981d, p. 78). The first two species lack the orbitorostral process found in *S. crosnieri*; further, in *S. sladeni* the exopods of the second and third maxillipeds are swollen and the scaphocerite bears a well-developed squame, while in *S. gambarelloides* the blade of the scaphocerite is reduced, that species bears a tooth with a swollen base and an acute tip above the dactylar articulation on the large chela. *S. spongicola* is like *S. crosnieri* in bearing an orbitorostral process, but can easily be distinguished by the well-developed squame of the scaphocerite, a longer and acute stylocerite and by the large chela bearing an acute tooth instead of a rounded tooth above the dactylar articulation. We have been unable to check all of the species of the Gambarelloides Group from the Atlanto-East Pacific for orbitorostral processes, but, of the 17 species we have examined, only three species had the process. These were *S. goodei* Coutière and *S. goodei occidentalis* Coutière, but these two can be separated from *S. crosnieri* by the presence of many serrate teeth on the outer margin of the outer uropod. *S. rathbunae* Coutière has only partial development of the orbitorostral process and it differs otherwise from *S. crosnieri* by having only 4 articles on the carpus of the second leg.

Dr. Crosnier has told us that all of the specimens he collected including the holotype, allotype and the paratypes coming from northwestern Madagascar came from sponges; one lot of 9 specimens dredged off Kenya by Dr. A. J. Bruce came from an "orange sponge;" we have no data on the habitat of the other specimens from Kenya and the 2 specimens from the Seychelles. However, we suspect all may have come from sponges.

Of the 147 specimens in the collections only 3 are female, 2 of which are ovigerous. The allotype carries only 3 eggs, all located on the last 2 abdominal segments. The ova are of large size, 1.0 x 0.6 mm in diameter and are near hatching with the appendages formed and the eyes pigmented; while the embryos were not dissected out of the egg membrane, they appear to be in the mysis stage. We believe that more eggs may have been carried on the anterior abdominal segments but they had hatched. Two of the females have both chelipeds, the third has one, but all of the chelipeds are of the form of the smaller cheliped of the male. Even the smallest of the 144 males has hooked pleura on the first abdominal segment and angular pleura on subsequent segments; the pleura of the females are expanded and rounded. In both sexes the outer uropod is usually without a trace of a distal articulation, but in a few a faint and incomplete articulation is seen.

Twice before we have discussed abnormal sex ratios and extremely low reproductive potentials found in species of *Synalpheus* inhabiting sponges, once for *S. neptunus* (Dana) and *S. n. germanus* B & B from Australia (1975b, pp. 317-322), and one for *S. paradoxus* B & B (1981d, p. 68); in the latter paper we also reviewed unusual sex ratios reported by Coutière and Chace for species of the genus from the Atlantic.

Fundamental to all considerations of these sex ratios is the fact that the sponges elaborate a variety of unusual "natural products." "In the last few years, about a hundred different species belonging to the class Desmospongia have been investigated for their secondary metabolites, which has lead to the discovery of about two hundred new molecules, most of them possessing unique structural features without parallel in terrestrial sources." (Minale, 1978, p. 176). These "secondary metabolites" are often the toxins that protect the sponges from being invaded by pathogens and parasites, and from being eaten by most browsers, invertebrate and vertebrate; the marine biologist in the tropics is also aware of the dermatitis that sponges may produce upon being handled. The type of toxins produced by the sponges vary from species to species.

It is obvious that many species of animals from protozoans to brittle stars have been able to develop chemodefenses against toxins of specific sponges. Among the alpheids, *Synalpheus streptodactylus* Coutière inhabits the brown sponge *Zygomycale parishei* (Bowerbank) in Hawaii (B & B, 1966a, p. 158) but a different orange-red sponge in Australia (B & B, 1975b, p. 364); it is found in normal sex ratios and reproductively active in the large populations found in the spongocoels. Similarly, *S. gambarelloides* (Nardo) (below) is found in large numbers in other unspecified sponges and populations are normal. However, while *S. neptunus* (Dana) is found possibly free in dead coral heads (or in sponges between the fronds of dead coral), and large and reproductive individuals are found in some unidentified sponges, in other sponges the populations (which we named *S. n. germanus*) are largely homosexual, stunted and not reproductive (B & B, 1975b, p. 322).

It is for this reason we have been concerned about describing populations as new species which either show no signs of effective reproduction, as in *S. n. germanus* and *S. paradoxus*, or this species which may be only feebly reproductive. Such populations must be supported by reproductive populations, either in other sponges or free-living. In the case of *S. neptunus* the reproductive population can be identified and separated from the sterile population only by minor morphological characteristics. But with this species and *S. paradoxus* we can recognize no reproductive populations.

We suggest that if the larvae or juveniles produced by the normal populations settle in the "correct" sponges, they will grow to normal reproductive adults but if they settle in the "wrong" sponges, a sponge whose toxins cannot be fully combatted by the chemodefenses of the species, the normal physical and sexual growth of the offspring will be inhibited. Further, the toxins of some sponges may even alter morphological growth of characteristics used by taxonomists for the separation of the species so that we cannot recognize the altered form as belonging to the parent species. If this be so, it would be possible that *S. paradoxus* and *S. crosnieri* are actually offspring from some widespread species already named.

This species has been named after Dr. Alain Crosnier of the Office de la Recherche Scientifique et Technique Outre-Mer, Paris, who not only has done excellent work upon the decapod crustaceans but who also has made available to us the extensive collections of alpheids made by ORSTOM in the western Indian Ocean. This species is part of those collections and the type series from Madagascar and Seychelles will be deposited in the Muséum national d'Histoire naturelle, Paris; the paratypes from Kenya will be returned to the National Museum of Kenya, Nairobi.

Synalpheus fossor (Paulson)

Alpheus fossor Paulson, 1875, p. 103, pl. 13, figs. 5a-g.

Synalpheus trionyx Coutière, 1908, p. 196; 1921, p. 416, pl. 61, fig. 9.

Synalpheus trionychis Coutière, 1909, p. 91 (*lapsus calami*).

Previous records. — All records of *S. trionyx* were those of Coutière (1908, 1909, 1921) of the same three specimens from Saya de Malha. He also cited *S. fossor* from Chagos (1921, p. 416).

Specimens examined. — 2 specimens from Nosy Be; 1, NE Madagascar; 3, Tuléar; 1, Comores; 16, Seychelles; 16, Mauritius.

Discussion. — In Coutière's description of *S. trionyx*, he compared it to the closely related *S. fossor*. In our Australian paper (1975b, p. 335) with over 80 specimens of *S. fossor* from Australia, Red Sea, Philippines and Thailand we compared them with the criteria used to separate *S. fossor*, *S. fossor propinqua* De Man and the closely related *S. bakeri* Coutière and *S. bakeri stormi* De Man. We were able to place in synonymy the last 3 species and subspecies. We now believe *S. trionyx* is a synonym as well. The slight differences in the relationship of the scaphocerite to the carpocerite, the length-breadth ratio of the carpocerite are well within the range of normal variation for *S. fossor*. Coutière stated that in *S. trionyx* the superodistal margin of the palm of the large chela and the merus terminated in an acute tooth but that "*l'un et l' autre sont inermes chez le* S. fossor, *surtout la paume de la grande pince*." This plainly is in error as we found both the superodistal margin of the palm and the merus bearing teeth in *S. fossor* with that of the palm often rounded. Paulson's figure (5b) also shows an acute tooth distally on the palm of the large chela. The differences in the small chela and its meropodite are within a normal range of variation. In the second leg of *S. trionyx* the first carpal article is described as slightly longer than the sum of the 4 following while in *S. fossor* it is supposed to be slightly shorter. However, we commonly find this variable in the genus *Synalpheus* (see *S. paraneomeris*, below). The dactylus of the third leg is similar to that described by De Man for *S. bakeri stormi* which we have already placed in synonymy.

Synalpheus gambarelloides (Nardo)

Alpheus gambarelloides Nardo, 1847, p. 6; 1869, p. 107, pl. 3, fig. 3. [See also Holthuis and Gottlieb, 1958, p. 48.]

Specimens examined. — 113 specimens from Tuléar.

Discussion. — As these specimens were clearly of the Gambarelloides Group as shown by the tuft of setae on the upper surface of the dactylus of the small cheliped, and as they were unlike the two species previously reported from the Indo-Pacific, *S. sladeni*

Coutière from Cargados Carajos and the Gulf of Aqaba, and *S. spongicola* B & B from the Red Sea, we initially started to describe the form as a new species. However, in our comparison of the specimens with the description of *S. gambarelloides* we became convinced it was either the same species or one that was closely related. Accordingly we sent representative specimens to Dr. Lipke Holthuis of the Rijksmuseum van Natuurlijke Historie, Leiden, for comparison. He kindly responded, "I have not been able to find a good difference [between the Tuléar and Mediterranean specimens]."

S. gambarelloides has been known only from the Mediterranean where it occurs in sponges dredged from waters between 4-60 m deep (Zariquiey, 1968, p. 143). Dr. Bernard Thomassin, who made this collection at Tuléar, did not report these specimens as coming from sponges but only from "dunes hydraulique post récifales. Tous les niveaux mélangés." We suspect that they may have come from a sponge because only in such a restricted habitat would one be able to collect so many specimens of a single species. We have previously pointed out that species from sponges often exhibit an abnormal sex ratio (see *S. crosnieri*, above). In this collection the ratio is very close to normal, with 46 males (even the smallest male, 9 mm long, bearing the hook on the first abdominal pleura and a normal *appendix interna*) and 67 females (of which 51 were ovigerous).

These specimens exhibit the variation that is often found in aggregations of *Synalpheus* living in spongocoels (B & B, 1972, p. 24). The rostrum and orbital teeth vary from one-fourth the length of the visible part of the first antennular article to slightly past middle. The lateral tooth of the scaphocerite varies from the end of the second article to the end of the third, and the squamous portion varies from being greatly reduced to being entirely absent. The inferior tooth of the basicerite varies relative to the lateral tooth of the scaphocerite. The carpocerite is always longer than the antennular peduncle but also varies in the relative length. In the telson, the arcuate portion between the posterolateral spines also varies in its width in relation to the total width of the tip.

It is surprising to find a typical Mediterranean species so far from its previously reported distribution, especially since it was not found in the extensive collections made in the Red Sea. Steinitz (1967, pp. 166-169) and Por (1971) have pointed out that while many species have evidently entered the eastern Mediterranean through the Suez Canal from the Red Sea, few species have gone in the opposite way. Thus, in addition going the "wrong way" and skipping the Red Sea where one would expect it to be established, the species would also have had to pass through the area of cold upwelling along the coast of Somalia (see discussion under *Alpheus longecarinatus* Hilgendorf, above).

Yet we have found it in these extensive collections only at Tuléar on the Tropic of Capricorn. We offer a tentative suggestion for its seeming discontinuous distribution. Perhaps a ship's hull, fouled with a sponge and its symbiotic *S. gambarelloides* in the Mediterranean, sailed to Madagascar where the sponge could have been accidentally knocked off or intentionally scraped off.

While this may have happened in classic Egyptian or Roman times when the existence of small canals combined with eustatic rise of sea level in linking the Mediterranean with the Red Sea (see Por, *op. cit.*), or during the spice trade following the circumnavigation of Africa by the Portuguese, the ships of those times were slow and travelled with many coastal stops. If they were carrying the host sponge and the alpheid, one would expect to find the pair at other ports along the coast, or, in the many centuries for subsequent diffusion, more widespread than the port of Tuléar. Instead, we suggest that during the period of French dominance of the island (they established their protectorate in 1855) and subsequent to the opening of the Suez Canal in 1861, some ship sailed from its home port in southern France, traversed the Suez Canal with sufficient speed to avoid serious harm from the hypersaline lakes to the Mediterranean fauna fouling its bottom and reached Tuléar where its bottom was cleaned for the return trip, thus introducing *S. gambarelloides* and the host sponge to which it was adapted. Bergquist (1977, p. 54) reports 4 species of sponges occurring in Hawaii as members of the fouling community, and "all...can be considered [as] accidental introductions to Hawaii." Similarly, Doty (1961, p. 547-551) has suggested that the transportation of certain species of algae from the far western Pacific to Hawaii could have been on the fouled bottoms of barges after World War II.

Synalpheus gracilirostris De Man

Synalpheus gracilirostris De Man, 1910, p. 291; 1911, p. 269, fig. 49.

Specimens examined. — 2 specimens from Somalia; 3, Tuléar; Ribes only, Réunion; 7, Maritius.

Synalpheus hastilicrassus Coutière

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

Previous records. — Coutière, 1921, p. 417, Amirante, Providence. B & B, 1980, p. 31, NE Somalia.

Specimens examined. — 8 specimens from Somalia; 2, Kenya; 10, Nosy Be; 5, Tuléar; 3, NE Madagascar; 3, Seychelles; 3, Réunion; 6, Mauritius.

Remarks. — One of the specimens from Somalia was reported as coming from the organpipe coral, *Tubipora musica* L.

Synalpheus heroni Coutière

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

Specimens examined. — 1 specimen from Kenya; 43, Tuléar; 1, Chagos.

Remarks. — These specimens have the usual variations for this species: 1. The squame of the scaphocerite is at times asymmetrical of development and it may be absent. 2. On the large chela, the usual cusp on the lateral face of the propodal finger near the socket is at times lacking. 3. Finally, the most proximal unguis of the dactylus of the thoracic legs varies from being a mere right angle to a definitely projecting unguis.

Synalpheus laticeps Coutière

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

Specimens examined. — 4 specimens from Tuléar; 1, Comores; 5, Mauritius.

Remarks. — This species has the orbitorostral process on the ventral side of the rostral base. The dactylus of the small chela has in these specimens 3 teeth distally and 2 teeth on the opposing margin of the propodus as Coutière described for the species (we found this variable in the Philippines, B & B, 1979, p. 243). In one specimen the telson is slightly constricted at the distal one-sixth.

Synalpheus lophodactylus Coutière

Synalpheus lophodactylus Coutière, 1908, p. 197; 1921, p. 417, pl. 61, fig. 11.

Previous records. — Coutière, 1908, *loc. cit.*; 1909, p. 93; 1921, *loc. cit.* [All references to a single specimen from Chagos.]

Specimens examined. — 122 specimens from off SE Madagascar.

Remarks. — The examination of the large collection of specimens of *S. lophodactylus* confirms the criteria we set forth for the separation of this species from the closely related *S. hastilicrassus* Coutière (B & B, 1975b, p. 352) with the exception that in many of the specimens the teeth on the posterolateral angle of the telson were as long in relation to the adjacent spines as they are in *S. hastilicrassus*. We feel this species is most readily recognized by the longitudinal row of hairs on the superior surface of the dactylus of the small chela, by the upward tilt of the tooth that terminates the superior margin of the palm of the large chela, and by the lack of transverse articulation of the outer uropod. We have specimens ranging in size from 10-18 mm. The specimens were dredged in sand and shells at 90 m.

Synalpheus merospiniger Coutière

Synalpheus merospiniger Coutière, 1908, p. 195; 1921, p. 415, pl. 60, fig. 4.

Previous records. — Coutière, 1908, *loc. cit.*; 1909, p. 90; 1921, *loc. cit.* [All references to a single specimen from Amirante.]

Synalpheus neomeris (De Man)

Alpheus neomeris De Man, 1897, p. 734, figs. 61a,d,e.

Synalpheus gravieri Coutière, 1905, p. 870, fig. 2.

Previous records. — Coutière, 1921, p. 414 (as *S. gravieri*). Amirante, Providence. B & B, 1980, p. 31, NE Somalia.

Specimens examined. — 3 specimens from Somalia; 1, Mozambique; 18, Tuléar; 1, NE Madagascar; 1, Comores; 1, Mauritius.

Remarks. — The specimen from Mautitius was dredged from 250 m and 10 specimens from Tuléar were dredged from 150 m. Two were reported in association with an alcyonarian, a host which we have also reported from the South China Sea (B & B, 1979, p. 244).

Synalpheus neptunus neptunus (Dana)

Alpheus neptunus Dana, 1852a, p. 22; 1852b, p. 553, pl. 35, fig. 5.

Previous records. — Miers, 1884, p. 562 (as *Alpheus minor neptunus*) Darros Is., Iles des Neufs (Amirante), Iles Glorieuses.

Specimens examined. — Ribes only, Réunion; 1 specimen from Mauritius.

Synalpheus nilandensis Coutière

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

Synalpheus nilandensis oxyceros Coutière, 1905, p. 871, fig. 5.

Previous records. — Coutière, 1921, p. 415, Seychelles; 1921, p. 416 (as *S. nilandensis oxyceros*), Chagos.

Specimens examined. — 1 specimen from Somalia; 2, Kenya; 17, Nosy Be; 8, Seychelles.

Remarks. — The specimen from Somalia was of the "*forma beta*," the others were of the "*forma alpha*" that we tentatively erected (1975b, p. 330). The specimens from Nosy Be were taken from alcyonarians, but the other had no commensal associations noted. The specimens from Nosy Be were dredged from 12-18 m.

Synalpheus otiosus Coutière

Synalpheus otiosus Coutière, 1908, p. 195; 1921, p. 415, pl. 61, fig. 8.

Previous records. — Coutière *loc. cit.* [Both references to a single specimen from Coetivy. We searched for this holotype in both the museums of Cambridge and Paris and could not find it.]

Synalpheus pachymeris Coutière

Figure 12

Synalpheus biunguiculatus pachymeris Coutière, 1905, p. 873, pl. 71, fig. 9.

Synalpheus pachymeris cargadosi Coutière, 1921, p. 417, pl. 61, fig. 10.

Previous records. — Coutière, 1921, *loc. cit.*, as *S. pachymeris*, Providence; also as *S. p. cargadosi*, Cargados Carajos.

Specimens examined. — 4 specimens from Tuléar; 243, Seychelles; 2, Réunion.

Remarks. — On the basis of a single female from the Maldives Coutière erected his new variety of *S. biunguiculatus pachymeris*, subsequently changed by De Man (1911, p. 199) and by Coutière (*loc. cit.*) to specific rank; on the basis of another female from Cargados Carajos he erected the variety *cargadosi*. He separated the variety from the nominal form on the basis of three differences found in *S. p. cargadosi*. 1. The superior angle of the basicerite is "*a peine épineux*." 2. The merus of the third leg bears 3 spines (and some long bristles) instead of 5. 3. The propodus of the same leg has only 5 instead of 8 spines and is only 1.33 instead of 1.47 times as long as the carpus. In this series of specimens we found the superior tooth of the basicerite to be variable, at times reduced but never absent. On the merus of the third leg there were always long bristles with some shorter and thicker; at times none could be considered to be true short, acute spines, but on others 1-3 of the outgrowths could be considered as slender, needle-like spines. The propodus of the third legs had variously 5-8 spines, and in 10 measured specimens the propodus ranged from 1.1 to 1.6 times the length of the carpus, the average being 1.38 times as long. We therefore can see no valid distinction between the nominal species and the variety.

In a collection of 33 specimens from a single sponge dredged at 50 m in the Seychelles by ORSTOM, all were males ranging from 8-11 mm in total length. All had hooked pleura of the first abdominal segment and the *appendix interna* of the second pleopod was carried in the "male position;" all had a transverse articulation of the outer uropod. For a discussion of unisexual populations, see under *S. crosnieri*, above.

Coutière figured the telson of what he considered to be *S. biunguiculatus* (Stimpson) (now known as *S. coutierei* Banner) in the Maldive and Laccadive report (1905, fig. 8d). This showed the tip between the lateral spines projecting as a half-circle. As he did not mention or figure the telson for either his initial variety *pachymeris* or later variety *cargadosi*, one might presume the telson in these 2 varieties was similar. In these collections the margin of the telson between the spines is at most only slightly projected with a gradual, not an 180° circle.

Figure 12. *Synalpheus pachymeris* Coutière. 17 mm female from Réunion. a, b, Aberrantly inflated large cheliped.

Of the 2 female specimens from Réunion one has a grossly inflated chela, almost circular in section, only twice as long as broad, with fingers about 0.2 the length and 0.3 the breadth of the chela. Otherwise the specimen is normal for the species, with the characteristic configuration of the heavy orbital teeth and short, blunt rostrum. In our collections from the Marshall Islands we found a similarly inflated chela on a specimen of *S. charon* (Heller), a species whose identity is clearly established by the unique modification of the dactyli of the pereiopods (B, 1957, p. 194, fig. 3b). In the same paper we discussed a similarly enlarged chela that was the basis of the description by Edmondson of his *S. macromanus* (1925, p. 9, fig. 1); we concluded that it was likely that *S. macromanus* was a deformed *S. paraneomeris* Coutière and assigned it to synonymy. This inflated chela in the Réunion specimen we hold also to be a growth anomaly, and place it under *S. pachymeris*.

Synalpheus paraneomeris Coutière

Synalpheus paraneomeris Coutière, 1905, p. 872, fig. 7 (*cf.* B & B, 1975b, p. 383).

Synalpheus paraneomeris praslini Coutière, 1921, p. 415, pl. 61, fig. 6.

Synalpheus paraneomeris seychellensis Coutière, 1921, p. 415, pl. 61, fig. 7.

Previous records. — Coutière, *loc. cit.* (as *S. p. praslini*), Seychelles; Coutière, *loc. cit.* (as *S. p. seychellensis*), Seychelles.

Specimens examined. — This is the most common species of the genus in these collections and is represented by approximately 500 specimens. It was found in all major areas upon which we are reporting, but, of course, not in all individual collections.

Remarks. — The wide variation found in this species in characteristics commonly used for the separation of the species of the genus *Synalpheus* has been previously discussed at length (see, for example, B, 1953, p. 41 and B & B, 1975b, p. 383); this variation has completely spanned the number of subspecies or varieties erected by previous authors.

Strangely enough, in the approximately 270 specimens in these collections from the Seychelles we find most specimens can be roughly divided into one of two forms that are parallel to the two varieties that Coutière described from the archipelago, and their characteristics are as he contrasted them:

	S. p. praslini		*S. p. seychellensis*
1.	On the basicerite, the superior margin projects as an acute tooth.	1.	On the basicerite, the superior margin is either rounded or angular, but not projecting.
2.	In the carpus of the second leg, the first article is longer than the sum of the following four.	2.	In the carpus of the second leg, the first article is shorter than or equal to the sum of the following four.
3.	In the dactylus of the third legs, a) the two ungui are of approximately the same length; b) the inferior unguis is thicker at its base than the superior.	3.	In the dactylus of the third legs, a) the inferior unguis is shorter than the superior; b) the two ungui are of approximately the same thickness at their bases.

However, the distinction between the two forms is not clear cut with some independent assortment of the four characteristics found in all larger collections. Moreover, in a single collection both forms may appear indicating there is no major ecological distinction between them. Our field observations did not indicate whether the two forms were cohabiting or not. Thus with only 2 specimens of each form that were available to Coutière, he was justified in their separation, but with our larger collections showing an overlap of characteristics the nominal separation is no longer acceptable.

Synalpheus pescadorensis Coutière

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

Previous record. — Peyrot-Clausade, 1979, p. 76, Tuléar.

Specimens examined. — 3 specimens from Somalia; 21 from Tuléar; 6, Seychelles; 5 (+ Ribes), Réunion; 12, Mauritius.

Remarks. — In a 14 mm female specimen from the reef at Gesira, Somalia the rostrum is entirely lacking and the orbital teeth are slight rounded projections; otherwise the specimen is normal for the species. We believe this to be merely a growth anomaly.

Synalpheus quinquedens Tattersall

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

Specimens examined. — 8 specimens from Kenya; 8, Nosy Be; 4, Tuléar.

Remarks. — These specimens were collected from the intertidal zone to 64 *m*.

Synalpheus septemspinosus De Man

Synalpheus septemspinosus De Man, 1910, p. 297; 1911, p. 289, fig. 59.

Specimens examined. — 6 specimens from Nosy Be.

Remarks. — These specimens were collected in 28 m. De Man's holotype was collected "in depths of 36 m."

Synalpheus sladeni Coutière

Synalpheus sladeni Coutière, 1908, p. 198; 1921, p. 417, pl. 62, fig. 12.

Previous record. — Coutière, *loc. cit.*, Cargados Carajos.

Synalpheus somalia Banner and Banner

Synalpheus somalia Banner and Banner, 1980, p. 31, fig. 3.

Previous record. — Banner and Banner, *loc. cit.*, NE Somalia.

Synalpheus stimpsonii (De Man)

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

Specimens examined. — 32 specimens from Kenya; 2, Tanzania; 8, Nosy Be; 2, SE Madagascar; Ribes only, Réunion.

Remarks. — The specimens from southeastern Madagascar, two from Nosy Be and some of the specimens from the African coast were reported as living on crinoids. Four specimens dredged at 155 m off the northern coast of Kenya were reported as living on a gorgonian. The gorgonian that was collected with this species in one of the Manihine Cruises (2°42.5'S, 40°42.5'E at 65 fathoms) was identified by Dr. Fred Bayer of the Smithsonian Institution as belonging to the family Melithaeidae and the genus *Acabaria*, but specific identification could not be made as the fragment was too small.

Synalpheus streptodactylus Coutière

Synalpheus neomeris streptodactylus Coutière, 1905a, p. 870, pl. 70, fig. 1.

Synalpheus metaneomeris streptodactylus Coutière, 1921, p. 414, pl. 60, fig. 4.

Synalpheus jedanensis, Barnard, 1947, p. 389 (and others) (*nec S. jedanensis* De Man, 1909a).

Previous records. — Coutière, 1921, *loc. cit.* (as *S. metaneomeris streptodactylus*) Amirante, Saya de Malha, Cargados Carajos, Providence. Barnard, 1947 *loc. cit.*; 1950, p. 738, figs. 139s-k, Mozambique. Fourmanoir, 1958, p. 115, figs. 2,3, Madagascar. Macnae & Kalk, 1969, p. 126, Mozambique. Ledoyer, 1970, p. 128, pl. 19, Madagascar. Kensley, 1981, p. 26, Mozambique (last 6 references as *S. jedanensis* De Man). B & B, 1980, p. 34, NE Somalia.

Specimens examined. — 17 specimens from Kenya; 3, Tanzania; 295, Nosy Be; 20, Tuléar; 5, NE Madagascar; 25, SE Madagascar; 78, Seychelles; 7, Mauritius.

Remarks. — The principal difference between *S. streptodactylus* and the related species, *S. jedanensis* De Man and *S. neomeris* (De Man), lies in the dactylus of the third legs. In *S. streptodactylus* the superior unguis is at least half as long and may be subequal to the inferior unguis, and about half as broad at its base as the inferior (B & B, 1975b, p. 363); in both *S. jedanensis* and *S. neomeris* the superior unguis is about one-third as long and one-third as thick at its base as the inferior. In Barnard's 1950 figure and Ledoyer's 1970 figure, they show the superior unguis to be about two-thirds as long as the inferior. For this reason we believe that the specimens identified by those authors as *S. jedanensis* were actually

S. streptodactylus. Kensley's 1981 report is apparently based also on Barnard's identification. As Macnae and Kalk (1969, *loc. cit.*) in general followed Barnard's identification it is likely that their reference is also *S. streptodactylus*.

We have commented on a seemingly normal sex ratio and reproductive rate in a collection of 130 specimens of this species from a sponge from Nosy Be under *S. paradoxus* in a previous paper (B & B, 1981d, p. 72). One of the collections of this species was dredged from 30 m on the Seychelles bank.

Synalpheus trispinosus De Man

Synalpheus trispinosus De Man, 1910, p. 300; 1911, p. 288, fig. 58.

Specimens examined. — 3 specimens from Kenya; 1, Nosy Be; 3, SE Madagascar.

Remarks. — These specimens were collected from 50-72 m.

Synalpheus tumidomanus (Paulson)

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

Synalpheus anisocheir Stebbing, 1915, p. 86, pl. 23.

Previous records. — Coutière, 1921, p. 417, Cargados Carajos. Macnae and Kalk, 1969, p. 75 *et seq.* (as *S. anisocheir*), Mozambique. Peyrot-Clausade, 1979, p. 76, Tuléar.

Specimens examined. — 10 specimens from Somalia; 6, Mozambique; 13, Tuléar; 128, Seychelles; 2 (+ Ribes), Réunion; 1, Mauritius.

Remarks. — Fourmanoir (1958, p. 116) reported specimens he identified as *S. anisocheir* from Nosy Be. These are not *S. tumidomanus* but they cannot be further identified (see B & B, 1975b, p. 377).

INFORMATION ON TABLES OF DISTRIBUTION

Tables 3 to 6

TABLE 3. ZOOGEOGRAPHIC DISTRIBUTION IN THE WESTERN INDIAN OCEAN.

This table represents a compilation of all capture records within the study area (see Introduction p. 3) from the literature and from the present study collections. For more exact data, see under the individual species. The areas about Madagascar (NW, SW, etc.), are divided into the east-west sectors by the northern and southern capes and into the north-south sectors by 19° south latitude; the off-shore islands were included in the adjacent coastal areas. The group term "Seychelles" includes those islands under the government of the Seychelles, while the single column under "Seychelles" includes the Seychelles Bank and the islands grouped upon it - however, most of the shallow water collections were made about the island of Mahé. Mauritius and Réunion are listed separately in spite of their close proximity as we had collections from different sources for the two islands that must have used differing techniques of collection, but we suspect their alpheid fauna would be almost identical if similar habitats had been studied with similar techniques.

TABLE 4. ECOLOGICAL DISTRIBUTION, MADAGASCAR, MAURITIUS AND RÉUNION, based on collections made by Peyrot-Clausade and Thomassin.

This table and Table 5 attempt to give ecological zonation; this table is separated from Table 5 because the two collectors largely followed the standard ecological nomenclature set forth by the French workers in *Tethys* (Battistini *et al.*, 1975, pp. 1-111) whereas those who contributed to Table 5 used a variety of terms. Where no specific mention of an ecological zone was made, we could often locate the zone from the geographical designation on the label when compared to the appropriate aerial photograph or diagram in the *Tethys* article. Dr. Thomassin's studies were largely confined to sea grass beds, sand bars and banks, but these ranged from intertidal to rather deep beds on the floors of lagoons, and at times must have included scattered heads of living and dead corals found on such sea grass beds, for many of the species he lists are not known to occur free upon fine bottom sediments. He also investigated species living under rocks on sandy substrate on various other portions of the reef. The sediments he surveyed appeared to run from mud to coarse sand and coral gravel. The studies of Peyrot-Clausade were on the in-fauna of hard reef sediments and appeared to be confined to the more solid portions of the reef; she also investigated the invasion of newly exposed coral blocks from which all previously dwelling animals were removed.

The last column, "Association, as noted," is obviously incomplete for the obligate association of *Alpheus lottini* and *Synalpheus charon* with living pocilloporid corals and of *A. frontalis* with blue-green algae (it lives only in felted tubes of its own construction) were not mentioned. In some cases where known symbiotic associations are mentioned in the main text, the reader is referred to them by

"See Discussion." The associations mentioned were with the coralline algae *Porolithon* and "Mélobésieés" (the latter "en feuilletés," or layered); sea grasses (for conservation of space, we have listed these by the following numbers: 1. *Cymodocea serrulata*; 2. *Halodule uninervis*; 3. *Halophila decipiens*; 4. *H. ovalis*; 5. *Thalassia hemprichii*; 6. *Thalassodendron ciliatum*); and the invertebrates ocurring in banks, *Idanthyrsus pennatus* (a tubeworm) and *Dendropoma* sp. (a sessile tubiculous vermetid gastropod). At times unidentified sponges were also mentioned.

TABLE 5. ECOLOGICAL DISTRIBUTION, as determined from field notes of Banner and Banner, Bruce, Crosnier, Michel, Vannini and others.

We present this table with some hesitancy, for we do not know for sure what the other collectors meant by their terms - thus, we do not know whether Dr. Vannini's "tide pools" are the same as Dr. Bruce's "reef flat at low water springs." With these reservations, our ecological categories may be explained as follows:

Mangroves: Brackish, sluggish water with mangroves and a silty substrate.

Intertidal, under rocks: We presume these will be rocks of various sizes lying partially bedded in a sand to silt substrate; if low enough in the intertidal, the "rocks" may be of living coral.

Tide pools: These may be either the conventional pools found at low water along rocky coasts, or perhaps pools found in the flat of inner parts of coral reefs.

Sea grass beds with associated coral: We presume that most of these, if not all, are true sea grasses (spermatophytes, not algae) at various depths. As with Dr. Thomassin's collections from Tuléar, (Table 4), in some cases living and dead heads of coral scattered in the bed must have been collected, for some of the alpheids in the collections are cryptic forms living in coral heads, not burrowing in the substrate.

Low (wave) energy reefs: In this category we have attempted to place reefs that lack the steady or seasonal onslaught of high energy oceanic waves breaking on their fronts. These would include those in lagoons or bays and some that are protected by headlands. Instead of having an outer ridge or crest and having the outer face cut by grooves and spurs, they go in gradual transition from a more-or-less consolidated reef flat with little living coral to an ill-defined zone of intermittant but vigorously growing heads separated by small, shallow channels, which in turn changes to the irregular and abruptly sloping reef front with abundant living coral. In this category are most of the better developed reefs we were able to visit about Mahé in the Seychelles, and into this category also we place the "lagoon" reefs of Dr. Bruce, which according to his sketch of East African reefs (in litt.) were found lying to the shoreward of the energy-absorbing reef crest. However, Dr. Bruce's "lagoon" was not the same lagoon in an atoll or one lying behind a barrier reef. Dr. Vannini has written us that many of his collections were made in a "lagoon" similar to Dr. Bruce, but that the reef crest was not well developed. He characterized these collections as coming from a low energy reef. Because these low energy reefs have no abrupt transition between the outer and growing reef top and the reef front, we have included in the category any depths on the front that could be reached by normal diving without the use of SCUBA.

Reef flat, reef crest and outer reef slope: These three developments are typical of a high wave energy reef, especially characterized by the presence of a reef crest; although not noted in any of the collecting notes, these usually have the outer slope or front cut by the groove-and-spur system. In Dr. Bruce's notes he uses the three categories.

TABLE 6. ECOLOGICAL DISTRIBUTION: Data from specimens taken from deeper water by diving, dredging and trawling.

The data in this table excludes those specimens taken from deeper water that are listed in Table 4. The area designations in the third column are the abbreviations used in Table 3 with M for Madagascar added for clarity to NW, SW, etc. Dr. Bruce's dredging depths were converted from fathoms to meters. Many of the dredge hauls did not designate the type of substrate, and in some cases did not indicate the depths sampled. The comments on notes on association were rather random, and obviously incomplete as was noted for the corresponding Table 4.

TABLE 3. GEOGRAPHIC DISTRIBUTION IN THE WESTERN INDIAN OCEAN

Species					Madagascar						Seychelles								
	Somalia	Kenya	Tanzania	Mozambique	NW Coast	SW Coast	NE Coast	SE Coast	Comores	Aldabra	Providence	Amirante	Coetivy	Seychelles	Saya de Malha	Cargados Carajos	Réunion	Mauritius	Chagos
ALPHEOPSIS																			
equalis		x				x						x	x				x	x	
idiocarpus											x								
trispinosus					x														
ALPHEUS																			
acutocarinatus							x	x											
adamastor																			x
alcyone	x	x			x	x						x	x	x	x		x		x
alpheopsides																			x
amirantei												x		x			x	x	
amirantei sizou																	x		
architectus	x	x		x		x											x		
arenicolus					[loc.unspec.]														
barbatus	x	x			x													x	
bellulus														x					
bicostatus		x				x													
bidens						x													
bisincisus	x	x			x	x	x	x						x					
bradypus													x	x			x		
brevipes						x								x					

TABLE 3. GEOGRAPHIC DISTRIBUTION (continued)

	Som.	Ken.	Tan.	Moz.	NW	SW	NE	SE	Com.	Ald.	Pro.	Ami.	Coe.	Sey.	Saya	Car.	Réu.	Mau.	Cha.
ALPHEUS-cont.																			
bucephalus	x					x					x	x	x	x			x	x	x
buchanorum														x					
chiragricus		x	x	x			x												
clypeatus	x	x				x								x			x		x
coetivensis	x								x				x						x
collumianus	x	x		x	x	x			x		x	x		x	x	x	x	x	x
crockeri																	x		
dasycheles														x					
deuteropus	x		x			x			x					x					
diadema	x	x	x		x								x	x			x	x	x
distinguendus					x														
djeddensis			x							x				x					
dolerus	x	x			x	x								x					
edamensis			x		x	x	x							x			x	x	
edwardsii	x	x	x	x	x	x				x				x					
ehlersii	x					x													
e. euphrosyne		x																	
facetus	x					x												x	
frontalis	x	x			x	x			x			x	x	x			x	x	x
funafutensis		x																	
gracilipes	x	x	x			x			x	x				x			x	x	

TABLE 3. GEOGRAPHIC DISTRIBUTION (continued)

	Som.	Ken.	Tan.	Moz.	NW	SW	NE	SE	Com.	Ald.	Pro.	Ami.	Coe.	Sey.	Saya	Car.	Réu.	Mau.	Cha.
ALPHEUS-cont.																			
gracilis		x				x					x		x	x			x	x	x
hailstonei		x			x		x	x				x			x		x		
hippothoe						x						x		x					
hululensis																		x	
idiocheles																		x	x
lanceloti									x			x						x	
leptochirus													x	x		x		x	x
l. leviusculus	x	x			x	x				x			x	x		x	x	x	x
lobidens	x	x	x	x	x	x		x		x				x				x	
longecarinatus	x	x	x	x	x	x													
lottini	x	x	x	x	x	x		x	x	x			x	x				x	x
mackayi						x													
macrodactylus	x	x			x	x													
maindroni						x													
m. malabaricus				x															
malleodigitus	x	x				x					x	x		x			x	x	x
microstylus	x	x	x		x	x				x			x	x			x	x	
miersi	x	x				x			x					x					
nonalter				x	x														
notabilis				x															
oahuensis	x					x												x	

TABLE 3. GEOGRAPHIC DISTRIBUTION (continued)

	Som.	Ken.	Tan.	Moz.	NW	SW	NE	SE	Com.	Ald.	Pro.	Ami.	Coe.	Sey.	Saya	Car.	Réu.	Mau.	Cha.
ALPHEUS-cont.																			
obesomanus		x					x			x				x			x	x	
ovaliceps		x																	x
pachychirus	x	x				x				x			x	x			x	x	x
pacificus	x	x	x		x	x		x	x	x				x				x	
paracrinitus	x		x			x								x			x	x	
paradentipes		x				x				x	x	x							
paralcyone					x	x		x	x			x		x			x	x	
paralpheopsides																			x
p. pareuchirus					x	x		x						x					
parvirostris	x	x	x	x	x	x							x	x			x	x	x
percyi												x	x			x			
perplexus						x													
polyxo						x													
rapacida	x			x	x	x								x					
rapax	x	x	x	x	x	x													
serenei	x				x		x												
splendidus	x													x					
spongiarum					x	x			x			x		x			x		
stanleyi					x				x			x		x					
staphylinus	x	x																	x

TABLE 3. GEOGRAPHIC DISTRIBUTION (continued)

	Som.	Ken.	Tan.	Moz.	NW	SW	NE	SE	Com.	Ald.	Pro.	Ami.	Coe.	Sey.	Saya	Car.	Réu.	Mau.	Cha.
ALPHEUS-cont.																			
s. strenuus	x	x	x	x	x	x				x		x		x				x	x
styliceps	x	x															x	x	
sulcatus	x	x	x	x	x	x			x	x		x	x	x				x	x
superciliaris												x					x	x	
tungii																		x	
ARETOPSIS																			
amabilis	x	x			x	x								x					
ATHANAS																			
areteformis						x											x	x	
borradailei	x				x	x											x	x	
crosslandi	x					x													
dimorphus	x	x	x		x	x		x	x					x			x	x	
djiboutensis	x	x	x	x		x			x	x				x			x	x	x
dorsalis	x	x				x			x					x				x	
indicus	x	x	x	x		x								x			x	x	
marshallensis and/or rhothionastes					x	x								x			x	x	
minikoensis				x															
sibogae		x			x														
AUTOMATE																			
anacanthopus						x													
dolichognatha		x	x		x	x											x		
salomoni																			x

TABLE 3. GEOGRAPHIC DISTRIBUTION (continued)

	Som.	Ken.	Tan.	Moz.	NW	SW	NE	SE	Com.	Ald.	Pro.	Ami.	Coe.	Sey.	Saya	Car.	Réu.	Mau.	Cha.
LEPTALPHEUS																			
pacificus						x													
METABETAEUS																			
species						x													
METALPHEUS																			
paragracilis	x	x		x	x	x			x				x	x			x	x	
rostratipes						x								x			x	x	
NEOALPHEOPSIS																			
euryone		x																	
PRIONALPHEUS																			
fissipes											x								
sulu						x								x					
RACILIUS																			
compressus	x	x	x	x						x				x			x	x	
SALMONEUS																			
brevirostris					x														
cristatus		x				x								x					
rostratus					x														
serratidigitus		x			x	x			x					x					
tricristatus		x				x								x					

TABLE 3. GEOGRAPHIC DISTRIBUTION (continued)

	Som.	Ken.	Tan.	Moz.	NW	SW	NE	SE	Com.	Ald.	Pro.	Ami.	Coe.	Sey.	Saya	Car.	Réu.	Mau.	Cha.
SYNALPHEUS																			
albatrossi																	x	x	
ancistrorhynchus					x	x		x											
bituberculatus																		x	x
charon	x	x		x	x	x							x	x			x	x	x
coutierei	x	x								x		x		x			x		x
crosnieri					x									x					
fossor					x		x		x					x	x			x	
gambarelloides						x													
gracilirostris	x					x											x	x	
hastilicrassus	x	x			x	x	x				x	x		x			x	x	
heroni		x				x													x
laticeps						x			x									x	
lophodactylus								x											x
merospiniger												x							
neomeris	x			x		x	x		x		x	x						x	
n. neptunus																	x	x	
nilandensis	x	x			x									x					x
otiosus													x						
pachymeris						x					x			x		x	x		
paraneomeris	x	x	x	x	x	x	x	x	x					x			x	x	
pescadorensis	x					x								x			x	x	

TABLE 3. GEOGRAPHIC DISTRIBUTION (continued)

	Som.	Ken.	Tan.	Moz.	NW	SW	NE	SE	Com.	Ald.	Pro.	Ami.	Coe.	Sey.	Saya	Car.	Réu.	Mau.	Cha.
SYNALPHEUS-cont.																			
quinquedens		x			x	x													
septemspinosus					x														
sladeni																x			
somalia	x																		
stimpsonii		x	x		x			x									x		
streptodactylus	x	x	x	x	x	x	x	x			x	x		x	x	x		x	
trispinosus					x			x											
tumidomanus	x			x		x								x		x	x	x	

TABLE 4 - ECOLOGICAL DISTRIBUTION, MADAGASCAR, MAURITIUS AND RÉUNION, collected by Peyrot-Clausade and Thomassin

Species	Lagoon	Sea grass beds and sand banks	Inner slope	Inner reef flat	Boulder zone or reef crest	Outer reef flat	Outer reef slope		Comments or associations, as noted
							Present	Depth, m	
ALPHEOPSIS									
equalis	x		x	x	x	x	x	15-32	Pools; *Porolithon*
ALPHEUS									
alcyone			x				x	14-32	
amirantei							x	23	Melobesiae
architectus				x	x	x	x		*Idanthyrsus*; *Dendropoma*
bicostatus		x							
bradypus				x		x			
brevipes				x					
bucephalus	x		x	x	x	x	x	25	
clypeatus					x				
collumianus	x		x	x	x	x	x	5-25	*Dendropoma*
crockeri							x	14	
deuteropus			x	x		x	x		
diadema				x			x	20	
dolerus	x	x	x	x	x	x	x		*Porolithon*; Melobesiae
edamensis		x			x	x			
edwardsii				x	x	x	x		Melobesiae
ehlersii						x			
facetus						x			
frontalis	x						x	32	[See Discussion]
gracilipes	x		x						
gracilis	x				x	x	x	1-5	*Idanthyrsus*
hippothoe			x						
l. leviusculus	x			x	x	x			
lobidens	x	x		x	x				*Idanthyrsus*
longecarinatus				x	x				*Idanthyrsus*
lottini	x			x			x	9-27	
mackayi	x	x							1,2,4,5
macrodactylus	x	x							
maindroni					x		x	5	
malleodigitus	x		x	x	x	x	x	5-28	*Porolithon*
microstylus		x	x	x	x	x	x	4	Melobesiae
miersi		x							2
oahuensis						x	x		
obesomanus	x		x	x	x	x	x	1-27	Melobesiae
pachychirus			x		x	x	x	28	Melobesiae

TABLE 4, cont. Species	Lagoon	Sea grass beds and sand banks	Inner slope	Inner reef flat	Boulder zone or reef crest	Outer reef flat	Outer reef slope		Comments or associations, as noted
							Present	Depth, m	
ALPHEUS, cont.									
pacificus					x				Melobesiae
paracrinitus	x	x	x	x	x	x	x	32	Pools
paradentipes							x	27	
paralcyone		x	x	x		x	x	5-27	Pools
p. pareuchirus							x	27	
parvirostris	x	x	x	x	x	x	x	25	*Porolithon*; Melobesiae
perplexus			x				x	22	
rapacida	x	x							2
rapax	x	x							1,2,3,4,5
spongiarum			x	x		x	x		Sponges, pools
s. strenuus		x		x	x				*Idanthyrsus*; Melobesiae
styliceps							x	10-20	
sulcatus		x							
superciliaris							x	10-15	
ARETOPSIS									
amabilis		x							[See Discussion]
ATHANAS									
areteformis	x			x		x	x	14-25	
borradailei			x	x		x	x	1-20	
crosslandi			x						
dimorphus					x				
djiboutensis	x	x	x	x	x	x	x	4-20	Melobesiae
indicus	x								[See Discussion]
marshallensis or rhothionastes						x			
AUTOMATE									
anacanthopus		x							Mud
dolichognatha	x	x			x				
LEPTALPHEUS									
pacificus		x							
METABETAEUS									
species							x	7	(See Discussion]
METALPHEUS									
paragracilis	x		x	x	x	x	x	1-20	*Porolithon*; Melobesiae
rostratipes				x	x	x	x	1-40	

TABLE 4, cont.

Species	Lagoon	Sea grass beds and sand banks	Inner slope	Inner reef flat	Boulder zone or reef crest	Outer reef flat	Outer reef slope		Comments or associations, as noted
							Present	Depth, m	
PRIONALPHEUS									
sulu						x			
RACILIUS									
compressus						x			
SALMONEUS									
cristatus				x					
serratidigitus	x				x	x	x		
tricristatus	x								
SYNALPHEUS									
albatrossi				x			x	10-32	
bituberculatus				x					
charon				x		x	x	8-15	[See Discussion]
coutierei							x	14-25	
fossor				x		x	x	32	
gambarelloides		x							[See Discussion]
gracilirostris			x				x	8-27	
hastilicrassus			x				x	15-27	
heroni				x	x	x	x		
laticeps	x			x	x	x	x	5	
n. neptunus							x	10	
pachymeris				x			x	25-32	
paraneomeris	x	x	x	x	x	x	x	1-18	*Idanthyrsus*; *Dendropoma*; Melobesiae
pescadorensis		x	x	x	x	x	x	27-34	*Idanthyrsus*; *Porolithon*; pools
quinquedens				x			x	27	
streptodactylus			x	x	x		x	14-27	
tumidomanus				x	x	x	x	1-5	

TABLE 5 - ECOLOGICAL DATA from the collections of Banner & Banner, Bruce, Crosnier, Michel, Vannini and others.

Species	Mangroves	Intertidal, under rocks	Tide pools	Sea grass beds w/assoc. coral	Low energy reefs	Reef flat	Reef crest	Outer reef slope	Comments or associations, as noted
ALPHEOPSIS									
equalis			x			x			
ALPHEUS									
alcyone				x	x			x	
architectus		x			x				
barbatus					x	x			
bicostatus			x	x		x	x		
brevipes					x				
bucephalus				x	x	x		x	
buchanorum		x							
chiragricus	x				x				
clypeatus					x	x		x	In felted algal tube
coetivensis					x				
collumianus			x		x	x		x	With *Ophiothrix keystonia*
deuteropus					x			x	
diadema		x	x	x	x	x	x		
dolerus			x	x	x	x	x	x	
edamensis						x			
edwardsii		x		x	x	x		x	
ehlersii								x	
facetus					x				
frontalis		x	x		x	x	x		In felted algal tube
funafutensis						x			
gracilipes		x		x	x	x		x	
gracilis				x	x			x	
hailstonei			x						
hippothoe					x				
l. leviusculus		x		x			x		
lobidens	x	x	x	x		x			
longecarinatus			x			x		x	
lottini					x	x		x	
macrodactylus	x					x		x	
maindroni			x						
malleodigitus					x		x		
microstylus				x	x	x		x	In burrows in coral
miersi		x	x	x					
nonalter						x			
obesomanus		x		x	x	x	x	x	

TABLE 5, cont. Species	Mangroves	Intertidal, under rocks	Tide pools	Sea grass beds w/assoc. coral	Low energy reefs	Reef flat	Reef crest	Outer reef slope	Comments or associations, as noted
ALPHEUS, cont.									
ovaliceps							x		
pachychirus					x	x			
pacificus		x	x	x	x	x	x	x	
paracrinitus			x	x				x	
paralcyone			x		x	x			From a sponge
parvirostris		x		x	x	x	x	x	
rapacida	x	x				x			
rapax	x	x		x		x	x		With a goby
splendidus					x				
staphylinus					x			x	
s. strenuus		x	x	x	x	x	x		
styliceps								x	
sulcatus		x	x	x	x	x	x	x	
ARETOPSIS									
amabilis					x				In *Dardanus* shell
ATHANAS									
borradailei								x	
crosslandi								x	
dimorphus		x	x	x		x	x		
djiboutensis		x	x		x	x	x	x	
dorsalis			x			x			
indicus			x			x		x	With *Echinometra*
marshallensis or rhothionastes		x		x	x			x	[See Discussion]
AUTOMATE									
dolichognatha	x				x			x	
METALPHEUS									
paragracilis		x	x	x	x	x	x	x	With *Ophiocoma*
rostratipes					x			x	
NEOALPHEOPSIS									
euryone						x		x	
PRIONALPHEUS									
sulu				x					
RACILIUS									
compressus					x	x		x	

TABLE 5, cont. Species	Mangroves	Intertidal, under rocks	Tide pools	Sea grass beds w/assoc. coral	Low energy reefs	Reef flat	Reef crest	Outer reef slope	Comments or associations, as noted
SALMONEUS									
cristatus					x	x			
serratidigitus		x		x		x			
tricristatus		x							
SYNALPHEUS									
charon					x	x		x	From pocilloporid
coutierei		x	x		x				From a sponge
fossor						x		x	
gracilirostris					x				
hastilicrassus					x			x	
heroni								x	
nilandensis					x			x	
pachymeris					x	x			
paraneomeris				x	x		x	x	
pescadorensis					x				
quinquedens						x			
stimpsonii						x			
streptodactylus					x	x			
tumidomanus					x	x			

TABLE 6 - ECOLOGICAL DISTRIBUTION: Data from specimens taken from deeper water by diving, dredging and trawling

SPECIES	Number of hauls	Areas	Range in depths, in meters	Type of bottom, where noted	Comments and associations, as noted
ALPHEOPSIS					
trispinosus	1	NWM.			
ALPHEUS					
acutocarinatus	2	NWM, SWM.	27-70		
alcyone	20	NWM, Ken, Sey.	3-80	Coral & sand marl; sand & shells; hard blocks	In sponges
amirantei	1	Sey.	50	Marl	
bidens	1	SWM.			(See discussion)
bicostatus	1	Ken.	60		
bisincisus	17	NWM, NEM, SEM, Sey.	18-41	Sand & sponges	In sponges
bucephalus	1	Ken.	9-10		
chiragricus	6	Ken, Tan, NWM.	3-35	Grey mud; sea grass; lithothamnion; gravel	In empty Pinna shell; sea grass beds
clypeatus	1	Ken.	25		In coral
collumianus	10	Sey.	32-70	Marl; algae & marl; coral & sand; hard blocks	From coral
deuteropus	2	Sey.	32-70	Sand & coral	
diadema	1	Ken.	60		
distinguendus	3	NWM.	5-35	Muddy sand	
dolerus	2	Sey.	44	Sand & shells; coral & sand; hard blocks	
edamensis	1	NEM.	21		
frontalis	5	Com, Sey.	22-55	Marl & sand; sand & shells; coral & sand	(See discussion)
hailstonei	4	Ken, NWM.	33-130		In coral rock

TABLE 6, cont. SPECIES	Number of hauls	Areas	Range in depths, in meters	Type of bottom, where noted	Comments and associations, as noted
hippothoe	5	Sey.	25-40	Marl; marl & sand; coral & sand	In sponges
l. leviusculus	1	NWM.	25	Mud & sponges	
lobidens	1	NWM.	15	Sand	
longecarinatus	2	NWM, SWM.	17-30		
lottini	1	Sey.	25	Coral	
nonalter	1	NWM.	210		
pachychirus	2	Ken, Sey.	44-185	Coral & sand	
paracrinitus	1	Zan.	16		In coral
paradentipes	3	Ken, SWM, Ald.	12-30		In sponges
paralcyone	27	NWM, SWM, SEM, Com, Sey.	32-90	Marl & sand; sand; coral heads on sand	In sponges; in corals
p. pareuchirus	3	Sey.	40-55	Marl & sand	
polyxo	1	SWM	190	Grey yellow sticky mud	
rapacida	1	NWM	5	mud	
serenei	2	NWM.	25-45	Sand & mud; sand & shells	
spongiarum	9	NWM, SWM, Com, Sey.	7-117	Marl; hard blocks	
stanleyi	6	NWM, Sey.	23-60	Muddy sand; sand & shells	In sponges
s. strenuus	3	Sey.	32-44	Coral & sand	
ATHANAS					
dimorphus	1	Ken.	115		
dorsalis	1	Sey.	60		Under coral
indicus	2	Sey.	60		From <u>Echinothrix</u>
METALPHEUS					
paragracilis	1	NWM			In coral

TABLE 6, cont. SPECIES	Number of hauls	Areas	Range in depths, in meters	Type of bottom, where noted	Comments and associations, as noted
SYNALPHEUS					
ancistrorhynchus	3	NWM, SWM.	28-200		
charon	1	Ken.	22		
coutierei	6	Sey, Ald.	25-60	Marl; sand & shells; coral & sand	In sponges
crosnieri	6	Ken, NWM, Sey.	53-72	Sand & shells	In orange sponge
fossor	8	NWM, SWM, Com, Sey.	32-40	Algal marl; sandy mud; coral; hard block	In coral
hastilicrassus	3	NEM, Sey, Com.	33-60	Sand & shells	
laticeps	1	Com.	30		In coral
lophodactylus	1	SEM	80	Sand & shells	
neomeris	8	Ken, Tan, NWM, Mau, Com.	20-250	Mud & coral	In sponge; on alcyonarian
nilandensis	6	NWM, Sey.	18-60	Marl; sand	On alcyonarian
pachymeris	13	Sey.	32-57	Muddy sand; sand & shells	
paraneomeris	1	Sey.	70	Coral rubble	
pescadorensis	4	Sey, Mau.	40-59	Marl; coral & sand	
quinquedens	3	Ken, NWM	10-64	Muddy sand	In sponge
septemspinosus	1	NWM.	28	Sand & sponges	
stimpsonii	10	Ken, Tan, NWM.	13-146	Sand	In crinoid & gorgonian hosts

TABLE 6, cont. SPECIES	Number of hauls	Areas	Range in depths, in meters	Type of bottom, where noted	Comments and associations, as noted
streptodactylus	50	Ken, NWM, SWM, NEM, SEM, Sey.	10-90	Brown mud, marl; sand & marl; sand & shells; coral heads on sand	In sponges in coral
trispinosus	3	NWM, SEM.	50-72	Sand & shells	In coral
tumidomanus	12	Sey.	25-70	Coral	In coral rubble

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ADDENDUM

ADDITIONAL SPECIMENS FROM REUNION, MASCARENE ISLANDS

After the preceding paper was typed for photoduplication in its entirety we received two relatively small collections made on the island of Réunion and its surrounding waters. The first collection was made by biological dredging from the MARION DUFRESNE, a ship of the Territoire des Terres Australes et Antarctiques Françaises which carried on oceanographic research in the waters about the island from diving depths to deeper trawling and dredging (the deepest alpheid was from 680 m, but was too fragmentary for identification). The expedition was from 11 August to 10 September, 1982 ; the collections were loaned by Dr Alain Crosnier. All of the informative field notes cited in the text below, except those specifically attributed to Dr de Saint Laurent, were made by Dr Sonia Ribes ; we have also used for color notes the colored sketches she made in the field from fresh specimens. The second collection was made on the shores and reefs at low tide at St Gilles, Réunion by Dr Michèle de Saint Laurent while she stayed on the island for a few days after the departure of the MARION DUFRESNE.

The two collections contained 190 specimens identified to be in 35 species. One species, *Athanas phyllocheles*, is being described as new and *Alpheus compressus* Banner and Banner and *A. tenuicarpus* De Man constitute new records for this portion of the Indian Ocean ; all three of these species were obtained from deeper water by dredging. Of the 32 species previously reported from the western Indian Ocean only 5 are new records for Réunion.

The species are listed alphabetically by genus and species and are cross-referenced to the page on which they are found in the main text. For each species the additional records are given and, where appropriate, the additional remarks. The new species and the two new records are included in the totals given in the Abstract and in the Introduction, but none of those listed in this addendum is incorporated in the final tables at the end of the text. They are, however, listed in the index.

We have listed only the depths from the MARION DUFRESNE as further data are not now available to us (the prefix DS listed on specimens of the type series of *Athanas phyllocheles* indicates a station made by a Sander's dredge). All specimens will be returned to the Muséum national d'Histoire naturelle, Paris.

Genus ALPHEOPSIS Coutière, 1896

Alpheopsis equalis Coutière [p. 11]

Additional record. — 1 specimen, 50-70 m.

Additional remarks. — Field notes state that the specimen was completely transparent, but with some red chromatophores at end of each abdominal pleuron.

Alpheopsis trispinosus Stimpson [p. 12]

Additional record. — 1 specimen, 302 m [new record for Réunion].

Genus ALPHEUS Fabricius 1798

Alpheus amirantei Coutière [p. 13]

Additional record. — 1 specimen, 58-70 m.

Alpheus collumianus Stimpson [p. 25]

Additional record. — 6 specimens, 55 m.

Alpheus compressus Banner and Banner

Alpheus compressus Banner and Banner, 1981a, p. 227, fig. 3.

Specimens examined. — 4 specimens.

Remarks. — These specimens were collected from 280-340 m on a clayey-silt bottom. Field notes state that the cephalothorax carried a reddish spot and the abdomen was transparent with red stripes. This species has been reported previously only from the South China Sea from near Manila and Hong Kong in depths ranging from 84 to 192 m (B & B, *loc. cit.*).

Alpheus dolerus Banner [p. 29]

Additional record — 2 specimens, 45 m [new record for Réunion].

Alpheus frontalis Milne Edwards [p. 30]

Additional record. — 1 specimen, 55 m.

Alpheus hailstonei Coutière [p. 34]

Additional record. — 1 specimen, 225-227 m.

Additional remarks. — A color sketch in the field notes shows that the body carried longitudinal red stripes on a yellow groundcolor, the telson was a light yellow and the large cheliped had transverse red bands.

Alpheus lottini Guérin [p. 42]

Additional records. — 4 specimens, 55 m; 3, low tide.

Alpheus nonalter Kensley [p. 53]

Additional record. — 15 specimens, 290-352 m (new record for Réunion].

Additional remarks. — Field notes indicate these specimens were collected from a clayey-silt substrate and that "all the body [carried] red and white stripes."

Alpheus obesomanus Dana [p. 53]

Additional record. — 1 specimen, 2-5 m.

Alpheus pachychirus Stimpson [p. 54]

Additional record. — 2 specimens, low tide.

Alpheus pacificus Dana [p. 54]

Additional record. — 2 specimens, low tide [new record for Réunion].

Alpheus paracrinitus Miers [p. 55]

Additional record. — 5 specimens, 55-70 m.

Alpheus paralcyone Coutière [p. 57]

Additional record. — 1 specimen, 58-70 m.

Alpheus parvirostris Dana [p. 60]

Additional records. — 7 specimens, 2-5 m; 2, low tide.

Alpheus spongiarum Coutière [p. 64]

Additional record. — 2 specimens, 73-77 m.

Additional remarks. — Field notes on these specimens state they were transparent pinkish with a black longitudinal stripe along the body.

Alpheus staphylinus Coutière [p. 67]

Additional record. — 3 specimens, 55 m [new record for Réunion].

Alpheus styliceps Coutière [p. 70]

Additional record. — 2 specimens, 55-80 m.

Alpheus tenuicarpus De Man

Alpheus tenuicarpus De Man, 1908, p. 104; 1911, p. 381, fig. 84.

Specimen examined. — 1 specimen, 45 m.

Remarks. — Field notes indicate that the specimen was "transparent white." This species has been previously reported from Indonesia (De Man) and the Red Sea (B & B, 1981d, p. 40)

Genus ATHANAS Leach, 1814

Athanas djiboutensis Coutière [p. 77]

Additional record. — 1 specimen, low tide.

Athanas dorsalis (Stimpson) [p. 78]

Additional record. — 6 specimens, low tide [new record for Réunion].

Remarks. — Field notes of Dr. de Saint Laurent indicate the specimens were black in life.

Athanas indicus (Coutière) [p. 78]

Additional record. — 1 specimen, low tide.

Remarks. — Field notes of Dr. de Saint Laurent indicate the specimens were "avec des bandes longitudinales rouges".

Athanas marshallensis Chace [p. 78]

Additional record. — 46 specimens, intertidal.

Additional remarks. — All of these specimens came from a single collection by Dr. de Saint Laurent at St. Gilles. It was the "typical habitat" for *A. marshallensis*. They came from pools and under rocks at the foot of the gravel beach at low tide; she reported that the zone was sheltered. ("...il s'agit d'une zone abritée et non de la zone très battue du récif externe.")

These additional specimens have caused us to reconsider our discussion in the main text on the possible separation of *A. marshallensis* and *A. rhothionastes* B & B, a separation based upon the ratio of the length of the carpus to the palm in the first chelipeds of mature females and upon the environmental requirements of the two nominal species.

In the de Saint Laurent collection were 20 ovigerous females with carapace lengths ranging from 4.1 to 5.0 mm and two additional non-ovigerous females with carapace lengths of 4.3 and 4.6 mm that were also presumed to be mature. Only one was lacking a cheliped, so there were 43 mature female chelipeds available, by far the largest collection that we have yet seen. Moreover, they came from a single locality so they should give a reasonable indication of the inherent variation in a single population of the species.

We measured the carpal-palmer ratios on all of these chelipeds and found all but two to lie within the range from 0.5 to 1.4, with the average of 0.93. In general the right and left chelipeds were somewhat symmetrical in their ratios (to the first decimal point). Again, in general the larger specimens had the shorter carpi, the smaller the longer - but one of 4.1 mm carapace length had one cheliped with a 0.7 ratio and two of 5.0 mm carapace length each had one cheliped with a ratio of 1.0.

The two chelipeds not included in the above figures were far beyond the "normal" limits set by the rest of the measured chelipeds, one carried by a female of 4.5 mm carapace length had a carpal-palmar ratio of 0.32, the second carried by a female of 4.3 mm had the ratio of 1.60. As the opposite chelipeds of these two specimens were within the "normal range," these ratios were regarded as somewhat aberrant. (The addition of these two ratios do not change the overall average of 0.93.)

The smallest recognizable female in the collection was non-ovigerous and had the carapace length of 3.7 mm; its carpal-palmer ratios were 0.35 and 0.36. We did not include it with the specimens above as it appeared to be immature.

The range of these ratios, then, extend beyond almost all of the ratios we give in our Table 2 of the main text (p. 80). Moreover, almost none of those specimens listed in the table approach the carapace lengths found in this collection, and therefore may be immature. None here measured or given in the main table closely approach the 0.2 carpal/palmar ratio found in the *A. rhothionastes* from the central Pacific (B & B, 1960, p. 145, Table 3). We conclude therefore on the basis of morphology that all of the specimens we have studied from the western Indian Ocean are *A. marshallensis*.

In the question of ecology of the specimens listed in the main text we could well have been wrong about the degree of potential wave action which could be found at our various collecting sites on the island of Mahé in the Seychelles, for during the time of our short visit, the island was subjected to incessant southerly monsoons. Under those wind and sea conditions, our collecting sites were all quite calm. In our earlier discussion we had merely projected what the waves might be like when the monsoons reversed and became northerly, and our conjectures may well be entirely in error (and this may also hold for first specimen listed from Tuléar as well).

We reluctantly conclude, therefore, that despite the large collections of this species available to us from the western Indian Ocean, in no way have we resolved the question of the validity of *A. rhothionastes* as a separate species. The question can only be resolved by similar large collections made from the outer ramparts of high wave-energy reef fronts in the central Pacific or possibly elsewhere.

Dr. de Saint Laurent did not observe color patterns under magnification, but remarked that the species is "...peu colorée et le corps est en grande partie transparent."

Athanas phyllocheles sp. nov.

Figures 13, 14

HOLOTYPE. — 11 mm male (carapace length 4.5 mm), from off Réunion, (DS 178), 450 m.

ALLOTYPE. — 11.4 mm ovigerous female (carapace length 4.1 mm), from same station as type.

PARATYPES. — All from off Réunion. 1, 10 mm male (DS 121), 345 m; 2, 6.5 and 8.7 mm males (DS 131), 345 m; 9, 8-13 mm males from same station as holotype; 1, 10 mm ovigerous female from same station as holotype (most paratypes with some appendages detached).

Description. — Rostrum reaching to end of first antennular article, with strong rostral carina on anterior half disappearing completely at base of eyes. Supracorneal teeth lacking; extracorneal teeth acute, reaching to end of cornea; infracorneal teeth lacking. Visible part of first antennular article longer than second or third which are sub-equal, second article 1.6 times as long as wide. Stylocerite acute, extending beyond first antennular article. Scaphocerite extending to end of antennular peduncle, squamous portion broad and projecting beyond tip of lateral tooth. Carpocerite

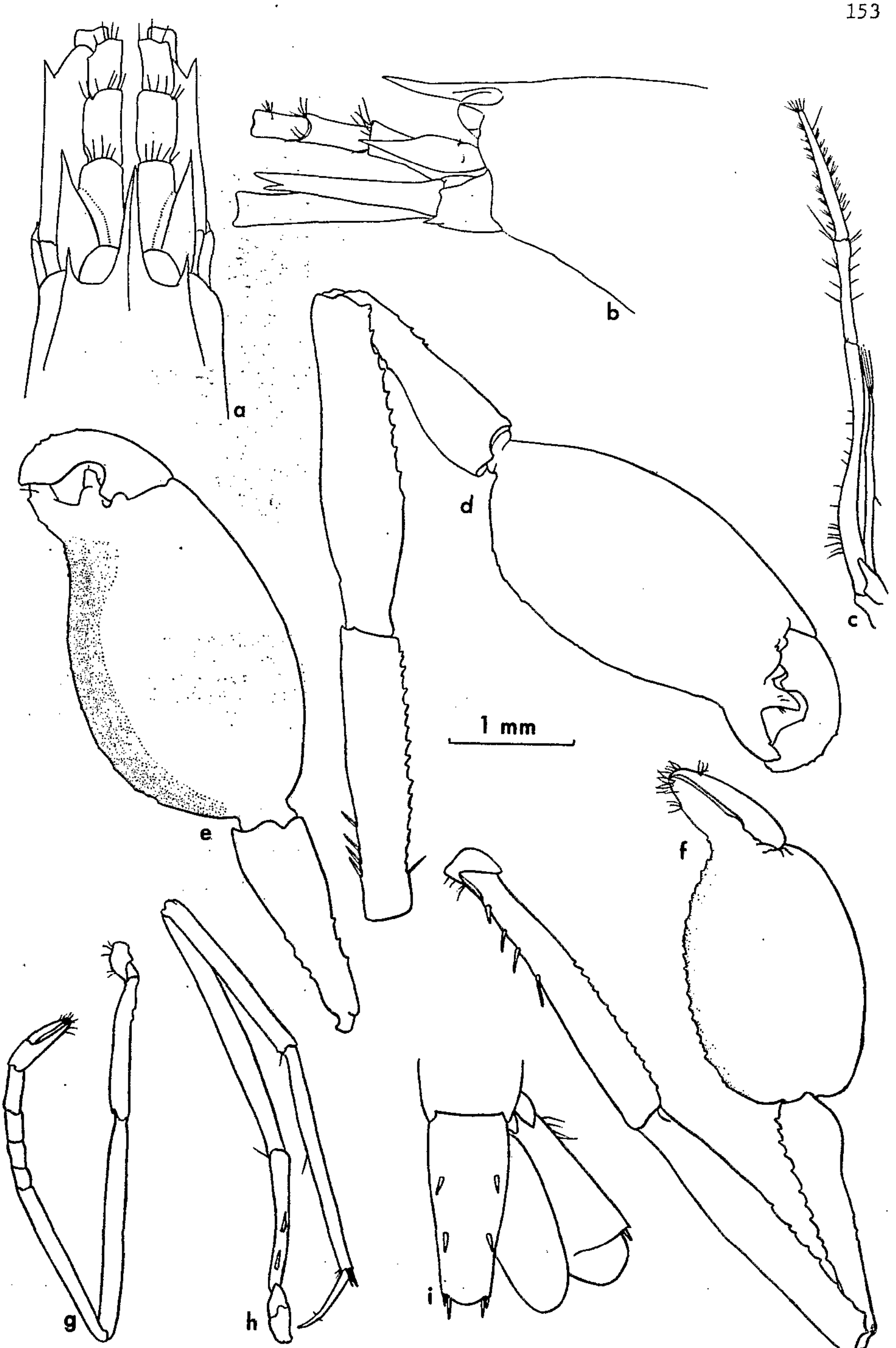

Figure 13. *Athanas phyllocheles sp. nov.*, Réunion. Holotype, 11 mm male. a,b, Anterior region, dorsal and lateral view; c, third maxilliped; d, large cheliped, lateral face; e, large chela and carpus, medial face; f, small cheliped, lateral face; g, second leg; h, third leg; i, telson and uropods.

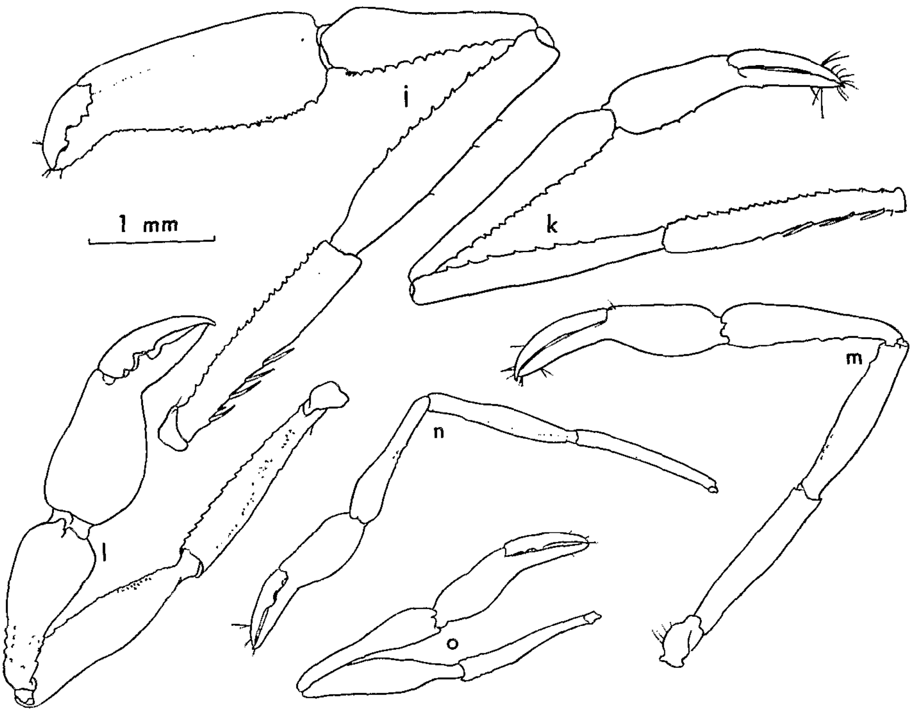

Figure 14. *Athanas phyllocheles sp. nov.*, type series from Réunion. Allotype, 11.4 mm ovigerous female. j, k, Large and small chelipeds. Paratype, 8.7 mm male from DS 131. l, m, Large and small chelipeds. Paratype, 6.5 mm specimen (sex uncertain) from DS 131. n, o, Chelipeds. All drawings in figs. 13 and 14 same scale.

extending one-fourth length of third article past that article. Inferolateral tooth of basicerite acute and small; superior margin rounded.

Third maxilliped long, with tip reaching to end of basicerite, slender with middle article 9 times as long as broad in lateral view. Ratio of length of articles starting at basal article: 10:3:5. Last article bearing fine setae on medial face and with a tuft of short setae at tip.

Chelipeds of the first pair carried flexed back at meral-carpal articulation, asymmetrical in development and somewhat in size, showing sexual dimorphism and marked changes with increasing maturity.

Large chela of holotype highly compressed, 2.0 times as long as wide, with fingers occupying distal 0.2. Fingers curved with tips crossing; dactylus bearing heavy rounded tooth just distal to articulation, followed by deeply concave but smooth margin, tip heavy and obliquely truncate; propodal finger bearing heavy rounded tooth distal to that of dactylus, margin distal to tooth slightly concave to tip. Palm greatly broadened, laterally compressed, almost leaf-like with region of dactylar muscles only slightly thickened. Superior margin entire and gradually curved; inferior margin projected as a thin lamella curved medially to almost 90° from plane of palm and bearing on margin a series of low irregular and often obtuse teeth that, because of rolling of margin, are not visible in medial or lateral view. (Note: the rolling of the lamella and possibly the lamella itself may be an artifact caused by preservation.) When cheliped is flexed, tip of fingers reach posterior to base of ischium. Inferior surface of carpus and distal portion of merus flattened to accommodate flexure. Carpus 0.44 as long as chela, 3.0 times as long as broad at broadest point, tapering proximally; superior margin with 3, inferior margin with 6 or 7 rounded teeth similar to those on inferior margin of palm. Merus about 1.5 times length of carpus, 4.4 times as long as broad, inferodistal margin bearing teeth similar to carpus. Ischium 0.8 as long as merus, almost 5 times as long as broad and bearing rounded teeth on inferior margin, 4 heavy articulated spines proximally on superior margin, one on inferior.

Small chela about 0.9 as long as large chela, but thinner, more leaf-like. Chela 2.1 as long as broad with slender, slightly curved fingers occupying distal 0.3. Fingers with tips acute and crossing and bearing only low flattened (on dactylus) or rounded (on propodus) protrusions corresponding to teeth of large chela; oppositive face on medial side of propodal finger bearing low cutting edge distal to protrusion. Palm greatly flattened like that of large chela but without inferior lamella. Inferior margin of all articles from ischium to propodus bearing rounded teeth similar to those of large cheliped; all articles with same relative lengths as those of large chela, but all more slender - carpus, for example, 3.8 times as long as broad.

Chelipeds of allotype in general similar to those of holotype, but more slender and of different armature of the fingers. Large chela 2.8 times as long as broad, flattened ovate in section, without marked lamellar flanges; fingers occupying 0.25 of total length. Fingers with only slight curvature; propodal finger bearing low truncate tooth, similar in position to heavy tooth of holotype; dactylus bearing two heavy truncate teeth, one proximal, one distal to propodal tooth; tips acute but meeting, not crossing. Carpus 0.73 as long as chela, 3.2 times as long as broad. Merus as long as chela, 5.4 times as long as broad. Ischium 0.8 as long as chela, 5.0 times as long as broad. Small chela 4.3 times as long as broad with almost straight fingers occupying almost half of total length; both fingers without teeth but bearing low cutting flange on oppositive faces, tips acute, slightly curved and crossing. Carpus 1.15 times as long as chela, 5.7 times as long as broad. Merus equal in length to carpus, 8.8 times as long as broad. Ischium only slightly longer than chela, 6.6 times as long as broad. On both large and small chelipeds inferior surface of carpus and merus flattened to accommodate flexure, inferior margin of chela and proximal articles bearing low but heavy teeth and spines similar to holotype (only 3 teeth on small chela, superior margins of ischia bearing 3 and 4 strong articulated spines proximally.

Two pairs of chelipeds of immature paratypes also illustrated in fig. 14.

Second leg with first carpal article 0.8 length of merus. Carpal articles with ratio: 10 : 1.4 : 1.4 : 1.4 : 2.7. Chela about twice length of preceding article, with fingers twice length of palm.

Third leg slender, with merus over 15 times as long as broad, inermous. Ischium 0.5 as long as merus, bearing on inferior margin 2 strong spines, one on superior margin. Carpus 0.7 as long as merus and 11.5 times as long as broad, distal margins not projecting. Propodus 0.8 as long as merus 15 times longer than broad, without spines on inferior margin but with one stiff seta near middle. Dactylus simple, long and slender, 0.36 length of propodus.

Telson 2.3 times as long as broad at anterior end; lateral margins gradually tapering; posterolateral corners not projecting. Length of medial pair of posterolateral spines one-half width of tip; posterior margin somewhat arcuate. Anterior pair of dorsal spines located anterior to middle. Uropod with strong diaeresis.

Discussion. — This species is within the group in the genus *Athanas* that carry the chelipeds flexed back towards the body; it can be further differentiated within that group by the simple dactylus on the third legs, by the lack of supracorneal and infracorneal teeth (although the last may not be a reliable characteristic) and a relatively short rostrum. However, within the group it is best characterized by relatively long carpus in the mature chelipeds. In all but one of the species within the group so defined the flexion of the mature cheliped in the males and usually in the females is obtained by both the meral-carpal and carpal-propodal articulations, each being bent to approximately 90° with the carpus itself being very short, usually 0.2 or 0.3 as long as chela. In *A. phyllocheles* the entire 180° flexion is at the meral-carpal articulation and the carpi are 0.5 as long as the chelae in males and 0.7 to 1.15 (large and small chelae) in the females.

The species within the group that carries a chela somewhat similar to that of *A. phyllocheles* is *A. amazone* Holthuis (1951, p. 111). Holthuis's holotype and sole original specimen, a female 7 mm long, came from off Nigeria at 52 m. Subsequently, Holthuis and Gottlieb (1958, p. 32) reported the capture of 18 specimens from off the Mediterranean coast of Israel at depths ranging from 45 to 92 m. The last specimens reported were four from near Pointe Noire, Congo Republic at 104 and 130 m (Crosnier and Forest, 1973, p. 162). All three publications carried illustrations.

We are not convinced that the specimens of *A. amazone* described and depicted are as mature as our holo- and allotype, for even sexually mature males and females may not have yet developed the proportions and shape of ultimate condition of the chelipeds - see B & B, 1960a, throughout ;B and B, 1973, p.306-329 ; and especially Miya and Miyake, 1968, p. 139-147. It is possible that the 7 mm holotype of Holthuis, in spite of its ovigerous condition, carried immature large and small chelipeds; certainly the carpus on the large cheliped, about equal in length to the chela itself, is relatively much longer than that of our allotype of 11.4 mm. The male cheliped illustrated by Holthuis and Gottlieb in their figure 4 (size of specimen not specified) appears to be markedly immature by the standards of *A. phyllocheles*. The male of 3.0 mm carapace length shown by Crosnier and Forest in figure 48 (we estimate it to be approximately 7.0 ± 0.5 mm total length if the body proportions are comparable to *A. phyllocheles*) shows what appears to be an immature pair of chelipeds, with the smaller chela definitely of immature proportions and the larger without fully developed fingers and teeth. However, this cheliped shows a much longer carpus than in *A. phyllocheles* and, more important, a greatly expanded merus to accommodate the chela. None of the authors and none of their illustrations show the extreme flattened condition found in mature chelae of *A. phyllocheles* and only the larger chela of Holthuis' holotype and the figure of the male of Crosnier and Forest show the characteristic denticles on the margins of the carpus, merus and ischium found in this species. While the chelipeds are being considered it should be mentioned that some of the chelipeds illustrated in figure 5 for *A. japonicus* Kubo by Miya and Miyake (*op. cit.*) appear to show denticulations on the lower margin of the palm and merus somewhat similar to this species, but there can be no confusion between the chelipeds of the adult specimens of the two species. On another characteristic, we also note that unlike the holotype of Holthuis and unlike this species, the carpocerite illustrated by Crosnier and Forest extends beyond the end of the antennular peduncle for over half its length.

When enough mature specimens from the tropical Atlantic and Mediterranean are studied, it may be found that their forms show such variation that *A. phyllocheles* may be considered to be a synonym. However, the flattened chelae in both sexes when mature, the lack of expansion of the merus, the proportions of the palm to carpus, at least in the mature males, appear to be different enough in this species to warrant its description as new. Indeed, perhaps the Mediterranean specimens may be found to be a different species on the basis of their chelipeds, and the specimens described by Crosnier and Forest different enough on the basis of their carpocerites that they may in the future be considered to be three separate species. Only the study of more specimens will answer these questions.

The name is derived from the Greek and indicates the leaf-like expansion of the palm of the large chela. All of the specimens will be placed in the Muséum national d'Histoire naturelle, Paris.

Genus AUTOMATE De Man 1888

Automate anacanthopus [p. 82]

Additional record. — 1 specimen, 55 m.

Genus METALPHEUS Coutière 1908

Metalpheus paragracilis (Coutière) [p. 85]

Additional record. — 6 specimens, low tide.

Metalpheus rostratipes (Pocock) [p. 86]

Additional record. — 5 specimens, low tide.

Genus SYNALPHEUS Bate, 1888

Synalpheus charon (Heller) [p. 90]

Additional record. — 8 specimens, low tide.

Synalpheus coutierei Banner [p. 91]

Additional record. — 8 specimens, 55-73 m.

Additional remarks. — Field notes state that these specimens were transparent yellowish, internal organs green.

Synalpheus hastilicrassus Coutière [p. 99]

Additional record. — 1 specimen, 73-77 m.

Additional remarks. — Field notes state this specimen was "transparent-yellowish."

Synalpheus neomeris (De Man) [p. 99]

Additional record . — 24 specimens, 70-90 m [new record for Réunion].

Additional remarks. — Color notes from the field state that the specimens were completely transparent and were found on an alcyonarian.

Synalpheus pachymeris Coutière [p. 102]

Additional record . — 2 specimens, 50-60 m.

Synalpheus paraneomeris Coutière [p. 103]

Additional record. — 2 specimens, low tide.

Synalpheus pescadorensis Coutière [p. 105]

Additional record. — 2 specimens, 58-83 m.

Additional remarks. — According to the field notes these specimens were uniformly yellowish and found in sponges.

ADDITIONAL BIBLIOGRAPHY

CROSNIER (A.), FOREST (J.), 1973. — Les crevettes profondes de l'Atlantique oriental tropical. *Faune tropicale*, 19, 409p. 121 figs.

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SYSTEMATIC INDEX TO THE ALPHEIDAE

The specific and generic names are in roman with the generic names in capitals; the synonyms are in italic. The species listed in the addendum are also included in this index.

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