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NEW KEYS FOR THE IDENTIFICATION OF INDO-WEST PACIFIC CORAL ASSOCIATED PONTONIINE SHRIMPS, WITH OBSERVATIONS ON THEIR ECOLOGY

(Crustacea : Decapoda: Palaemonidae)

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ABSTRACT

Correct identification is the keystone for investigating the ecology of coral reef animals. New keys for the identification of coral-associated Indo-West Pacific pontoniine shrimps are provided to replace those in Bruce (1972). Information on their geographical distribution and host preferences is up-dated and their ecology discussed. The key includes 48 species of 16 genera of obligatory associates, together with 6 species of two genera of less certain ecology.

Key words: Crustacea, Decapoda, Natantia, Palaemonidae, coral associates, Indo-West Pacific, identification keys, hosts, ecology, distributions.

INTRODUCTION

Pontoniine shrimps are the dominant caridean associates of Indo-West Pacific scleractinian corals. The first reported associations were those of *Oedipus graminea* and *O. superba* (now *Coralliocaris graminea* and *C. superba*) by Dana (1852), but as was usual with earlier workers, the host was not even generically identified. Even a century after Dana, there were few records of the coral hosts of these shrimps. In more recent years the intimate relationship, often obligatory and highly specific, has become increasingly recognized, and the host's identities more often reported.

The obligatory association of caridean shrimps in general, and those of the sub-family Pontoniinae in particular, with scleractinian corals seems to be a phenomenon particularly noteworthy in the Indo-West Pacific region. In the eastern Pacific region, both of the pontoniine genera associated with corals, *Harpiliopsis* (2 species) and *Fennera* (1 species), with *Pocillopora* and *Porites* (Holthuis 1951), are probably derived from the Indo-West Pacific by the transportation of planktonic larvae by the Equatorial Counter Current and "island-hopping". In the Atlantic-Caribbean region, they are even less conspicuous and

there appear to be no pontoniine associates of western Atlantic scleractinian corals (P. Castro pers. comm.). Even the large genus *Acropora* appears to be without dedicated pontoniine commensals in that region, in marked contrast to the Indo-West Pacific region, where it has at least 20 species of 6 genera. The absence of *Harpiliopsis* and *Fennera* from the Caribbean suggests that they may have colonised the eastern American seaboard after the development of the Panamanian isthmus.

The information available in 1969 was reviewed in Bruce (1972). General information on the biology of Indo-West Pacific pontoniine and other shrimps can be found in Bruce (1974b, 1976a, 1977b, 1979b). The host corals were reviewed by Bruce (1977a). Further details concerning the taxonomy and distribution of many species are now available but little more is known of their life cycles or trophic relationships with their hosts. Their longevity is particularly obscure. Post-larval specimens may often be found on the host corals but as these are very small and usually nearly transparent, with relatively few chromatophores, they are easily overlooked (Bruce 1985). These have presumably arrived and settled from planktonic larvae. Abbreviated larval development is not known to occur in coral associated pontoniine species. It may be noted that in many pontoniine species, including several from coral hosts, observed under aquarium conditions in Tanzania, Zanzibar), (inclusive of Kenya and the Seychelle Islands, the ova hatched on the night of each spring tide, generally between midnight and 2 am, and a new batch was already in place on the pleopods by the following morning. Field collections made at the time of spring tides throughout the year almost always yielded adult females bearing a full complement of ova, either on the point of hatching or freshly laid. In two weeks these ova were ready to hatch, for the next spring tide, throughout the year. In less equable environments these shrimps may well be expected to show distinct seasonal patterns in their reproductive activities. The first larval stages of the various genera can generally be readily separated on morphological grounds (although the larvae of many genera still remain to be described). Identification of species is much more difficult, although in many cases each species appears to have a distinctive pattern of chromatophores. None have as yet been reared to post-larval stages and host selection by post-larval shrimps remains unstudied.

The identification of pontoniine shrimps from coral hosts presents a number of practical problems, many in common with other caridcans. While many are abundant on appropriate hosts, many are also apparently rare, or at least rarely caught by collectors, and consequently inadequately known and often poorly described by modern standards. Thus, *Coralliocaris macrophthalma*, described by Henri Milne Edwards in 1837, from an indefinite locality, has only been reported on two occasions in the subsequent literature. Some specimens of *C. graminea* may show a close resemblance to the descriptions of *C. macrophthalma* but detailed comparison is not possible as the type material of the latter is no longer

extant. Many species have characteristic colour patterns but the colouration of Milne Edwards' species was not recorded. Further information on these species would be most useful. It should also be kept in mind that abnormal rostra and chelae, through regeneration after injury, are not uncommon in coral associated shrimps (Bruce 1976b), probably due often to intraspecific conflict, and that species that normally have well developed similar subequal chelae may have small dissimilar unequal chelae, for example in *Coralliocaris*. In other species, such as *Jocaste* spp., the chelae are normally asymmetrical.

In making collections of coral associated shrimps, many of which can be quite active, it is fundamentally important that there is no cross contamination between different hosts. Segregation of intertidal coral hosts presents no major problems. From deeper water, smaller corals can be collected by divers and brought to the surface in clip-seal polythene bags. Large corals can be raised in buckets, preferably lidded, and still larger ones in garbage bins also fitted with lids and with small mesh-covered windows cut into the lower sides to allow the outflow of the contained water without losing the catch. Different coral species should not be mixed in the same container. A few drops of rotenone-type chemicals will then dislodge the shrimps, except for *Paratypton siebenrockii,* the only gall-inhabiting species. These shrimps will survive well if transferred quickly to fresh sea-water. The freshly caught shrimps should be quickly sorted by colour pattern. They can be allowed to die, in small containers, by hyperthermia or hypothermia (in tropical sunlight or in containers of iced water or by refrigeration) before preservation to avoid the excessive autotomy of their appendages. Overcrowding should be avoided as this may also result in unnecessary damage to the shrimps. Short term preservation with formaldehyde solution often allows some temporary preservation of the colour pattern, although the shades of colour may change. Subsequent conservation in 50% ethylene glycol also preserves the colour pattern for a further period but final preservation should be in 70% ethanol. A few undamaged, well preserved specimens are preferable to a larger number of poorly preserved bodies with a mass of detached appendages, especially if a mixture of species is represented. Most useful of all are specimens accompanied an authoritative host identification and a description of the colour pattern, or a photograph of the live shrimp.

The importance of colour pattern in the identification of species has only recently become fully apparent. This has been greatly facilitated by the use of scuba diving techniques and underwater photography, although, unfortunately, many photographers do not collect specimens of their subjects. Some of the species that have been photographed on coral and other hosts can not as yet be referred to any known species. Many species of pontoniine shrimp, particularly the commensal species, have striking species-specific colour patterns that are not conspicuous in the free-living species, which tend to be semi-transparent or cryptically coloured. These patterns are generally consistent over wide areas of geographical distribution, although the colour tones may show some variation.

Distinctive colour patterns within a morphological "species" may be the first indication of the existence of a group of sibling species or, at least, species with minimal morphological differences. These may also be associated with different host animals. Once preserved in alcohol, this valuable clue is rapidly lost, often for ever. In East Africa, some specimens of "*Periclimenes lutescens*" were noticed to consist of two distinct colour patterns, one associated with *Acropora* and the other with *Stylophora* (Bruce 1972). The former proved eventually to be *P. lutescens* (Dana) s.str., while the other was resurrected as *P. consobrinus* De Man, a very closely related species separable by only small morphological differences, whose author (De Man 1902) had himself originally (De Man 1888) identified his specimens as *P. lutescens*, the hosts and colour patterns of both being then unknown. Holthuis (1952) synonymized the two species, although Kemp (1922) had treated them as distinct, although for inadequate reasons.

The importance of sibling species in marine animals has been reviewed by Knowlton (1986, 1993). It appears probable that the frequency of sibling species in the marine environment has been much underestimated until recently and that in many groups of coral reef animals, including both corals and decapod crustaceans, the species diversity may be underestimated by a factor of three to five times (Knowlton & Jackson 1994). Duffey (1996) has shown that the sponge-associated alpheid shrimp "*Synalpheus rathbunae*" Coutière, 1909 consists of three sympatric species, separable by their allozyme genotypes and with minimal host overlap. It is likely that some of the "species" dealt with in this report consist of similar sibling species. This is well exemplified by the *Coralliocaris venusta* taxa, where shrimps with two characteristic colour patterns of conspicuous white patches live and behave like distinct species (Bruce 1974b), but without any consistent morphological differences having as yet been detected. Both are associated with *Acropora* hosts, but it is not clear if they associate with different species. On any particular coral host the shrimp population always consists of examples sharing the same colour pattern. The original description of *C. venusta*, by Kemp (1922), did not provide any indication of the colour pattern of his specimens, which are not available for study, so that it cannot be determined which of the two taxa is *C. venusta* Kemp *s str.* However, a third pattern, without conspicuous white patches also occurs (Bruce 1977b) and may represent a further sibling species.

Similarly, atypical colour patterns have been noted in *C. superba* (Dana), which may also represent sibling species, but these are relatively rare, whereas both colour patterns of *C. venusta* seem quite common. Unfortunately, detailed information on the host preferences of these taxa, if any, is not readily available. *Coralliocaris viridis* has recently been separated from the closely related *C. graminea* (Dana) by Bruce (1974a, 1976b). It may be noted that while these two species are very easily and consistently separated by their colour patterns and morphological features in the western Indian Ocean, some specimens are much less easily distinguished in Great Barrier Reef material. Similar situations

may be expected to occur in other species or species groups. The group represented by *Periclimenes holthuisi* and related species, some of which also associate with actinians and scyphozoans, show particularly characteristic colour patterns on the dorsum of the third abdominal segment (Bruce 1990), but the number of colour patterns as reflected in the underwater photographic literature seems to greatly exceed the number of presently recognized taxa. The genus *Hamopontonia* contains at present only two recognized species, one of which, *H. corallicola*, has been reported to associate with actinarians as well as corals in Japanese waters (Suzuki & Hayashi 1977; Nomura 1989). Nomura concludes that "the colour patterns may be affected by the host species". The actinarian associates would be likely candidates for a sibling species. It also seems probable that the various monospecific pontoniine genera that are associated with a diversity of host genera may dissolve into complexes of sibling species.

Although pontoniine shrimps have been reported in asscociation with a wide variety of coral hosts, they are most frequently found on close-branching coral species, such as many *Acropora, Pocillopora, Stylophora*, etc., or in species in which the tentacles of the polyps are fully expanded by day, such as *Galaxea, Euphyllia*, etc. Many coral species that appear to be suitable as potential hosts, such as *Aorehelia*, have not so far provided the expected pontoniine or other associates. Coral hosts in this report are identified only to genus. Most pontoniine shrimps are associated with hosts at a generic level and many of the species level host identifications, particularly the more ancient ones, should be verified in terms of modern scleractinian taxonomy. This may be particularly important in view of the recent recognition of sibling species in some corals such as *Stylophora pistillata* (Esper 1797) (Gattuso et al. 1991) and indications that *Pocillopora damicornis* (L., 1758) also not a single species (Knowlton & Jackson 1994). It seems likely that many of the other "well known" common and widespread coral species may also be polyspecific. These two coral genera, *Stylophora* and *Pocillopora*, have a long history of being studied in the Indo-West Pacific for their decapod commensals but are referred to at species level in numerous papers only from 1966, when Patton reported the association of several shrimp species with a variety of coral hosts, including species of these two genera. The situation of the numerous *Acropora* "species" appears even more complex, possibly due to the existance of hybrids as well as "pseudo-species" (Wallace & Willis 1994). There are numerous records of pontoniine shrimps (*Anapontonia, Ischnopontonia* and *Platycaris*) from *Galaxea fascicularis* (L. 1758), some of which should perhaps be referred to the closely related *G. alta*, until recently overlooked on the Great Barrier Reef (Harrison 1988), and possibly elsewhere also.

The distributions of many coral-associated pontoniine shrimp species are still not well known, due largely to the haphazard nature of collecting activities. It is apparent that some common species are very widely distributed, ranging, for example, from the Red Sea or East Africa to Mexico or Panama (*Harpiliopsis depressa* and *H. spinigera, Fennera chacei*, the latter first described from the eastern

Pacific region). However, some species do appear to have genuine rarity or very restricted distributions. The recently discovered *Yemenicaris trullicauda*, found in Yemen in *Stylophora* and *Pocillopora* spp, would surely have been found elsewhere in these hosts if it occurred commonly in the western Indian Ocean or Red Sea. Similarly, *Tectopontonia maziwiae* is still known only from the holotype specimen, from Maziwi Island, Tanzania, collected in 1970, although its host is a common *Acropora* species, reported as *A. surculosa* (Dana 1846), now *A. hyacinthus* (Dana 1846), ranging from the Indian Ocean east to Tahiti. However, rarity may be more apparent than real, as is illustrated by the example of the alpheid shrimp *Racilius compressus*, first described from the Red Sea by Paulson (1875). It was not reported again until 1958, 70 years after its discovery, when a further, but incomplete, specimen was found in Moçambique (Barnard 1958). The species was apparently of great rarity. Once its host, the oculinid coral *Galaxea fascicularis*, where it is often found with pontoniine shrimps of the genera *Anapontonia, Ischnopontonia* and *Platycaris*, had been identified, the shrimp was found to be abundant and widespread throughout most of the Indo-West Pacific region, whereever the host coral occurred.. Some of the "rare" pontoniines may be rare for similar reasons. There are still many genera and species of corals, particularly those from greater depths, that appear potentially suitable as hosts from which no shrimp associates have yet been reported.

Almost all the shrimps included in the following key are obligate associates of scleractinian corals. Other pontoniine shrimps may also often be found in collections of coral associates. These include particularly *Periclimenella petitthouarsi* and *P. spinifera*, which are probably free-living browsers and frequently found in coral free intertidal pools. This genus is therefore included in the key, together with the similar genus *Exoclimenella*. The associations of the latter genus must be considered as tentative only as they are based on very limited information and the various species may be also free-living browsers. Further information on these two genera can be found in Duris & Bruce (1995). Not included are the species of the free-living, micropredatory *Periclimenes grandis* (Stimpson, 1860) species-group or the ubiquitous *Palaemonella rotumana* (Borradaile, 1898). Keys for the identification of the species of these taxa can be found in Bruce (1987, 1991). Some of the already described but rarer pontoniine species, such as *Eupontonia noctalbata* Bruce, not as yet known to be of commensal life-styles, may eventually prove to be commensally associated with coral hosts. Some other species may be accidentally associated with corals due to the vagaries of collection. Others that have been attributed to coral hosts, such as some *Periclimenaeus* species, are probably always associated with encrusting sponges or colonial tunicates attached to the coral. Such species have been omitted from the present key. The key is intended for use with adult specimens, preferably ovigerous females. Further details for most species are to be found in Kemp (1922), Holthuis (1952, 1993), Chace & Bruce (1993). Müller (1993) also gives full details of their coral hosts.

Abbreviations used: R., rostral dentition, dorsal teeth/ventral teeth; pocl, post-orbital carapace length. Further details of the species marked with an asterisk in the keys are to be found in the similarly marked items listed in the references.

KEY TO GENERA

1. First pereiopod chelae with strongly spatulate, pectinate fingers 2
– First pereipod chelae with simple, non-pectinate fingers 3
2. Major second pereiopod with phonogenic fossae on opposing cutting edges of fingers ..... ***Periclimenella***
– Phonogenic fossae absent from second pereiopod fingers ..... ***Exoclimenella***
3. Mandibles with palp ..... ***Vir***
– Mandibles without palp 4
4. Dactyls of ambulatory pereiopods with hoof-shaped basal process 5
– Dactyls of ambulatory pereiopods without hoof-shaped basal process 6
5. Hepatic spine present, second pereiopod chelae markedly unequal, dissimilar ..... ***Jocaste***
– Hepatic spine absent, second pereiopod chelae subequal, similar ..... ***Coralliocaris***
6. Dactyls of ambulatory pereiopods simple 7
– Dactyls of ambulatory pereiopods twisted laterally, carinate ..... ***Harpiliopsis***
7. Posterior margin of telson normally armed with three pairs of spines 10
– Posterior border of telson not normally armed with three pairs of spines 8
8. Posterior border of telson without marginal spines in adults 9
– Posterior telson expanded scoop-shaped, margin with lateral and intermediate spines only ..... ***Yemenicaris***
9. Posterior margin of telson narrow, with paired of curved hook-like processes, rostrum well developed ..... ***Hamopontonia***
– Posterior margin of telson broadly rounded, unarmed; rostrum obsolete, gall inhabiting ..... ***Paratypton***
10. Body form depressed 11
– Body subcylindrical or compressed 13
11. Body strongly depressed; rostrum short, broadly expanded laterally, unarmed ..... ***Platycaris***
– Body moderately depressed only, rostrum compressed, dentate 12
12. Carapace with hepatic, antennal and post-antennal spines ..... ***Fennera***
– Carapace with hepatic and antennal spines only ..... ***Tectopontonia***
13. Body subcylindrical; rostrum well developed, dorsally and ventrally dentate; second pereiopods with large subequal similar chelae; caudal fan without special armament 14
– Body compressed, rostrum feebly developed, ventrally unarmed 15
14. Hepatic spine present ..... ***Periclimenes***
– Hepatic spine absent ..... ***Philarius***

15. Body strongly compressed; rostrum dorsally dentate, caudal fan strongly armed 16
– Body moderately compressed, rostrum unarmed, caudal fan normal 17
16. Distolateral margin of uropodal exopod strongly multidentate, without articulated spine ..... ***Anapontonia***
– Distolateral margin of uropodal exopod not multidentate, unarmed, with strong hamate spine distally ..... ***Ischnopontonia***
17. Orbital margin non-pectinate ..... ***Metapontonia***
– Orbital margin strongly pectinate, inhabiting grooves on host's surface ..... ***Ctenopontonia***

KEYS TO SPECIES

Anapontonia Bruce, 1966

Single species only ..... ***A. denticauda*** Bruce, 1966
[**Host genus**: *Galaxea*. **Distribution:** Type locality: Pange Reef, Zanzibar. Also known from Comoro Islands, Singapore, Malaysia, Great Barrier Reef.].

Coralliocaris Stimpson, 1860

– Chela of second pereiopods with molar process on fixed finger 2
1. Chela of second pereiopods without molar process on fixed finger 4
2. Rostrum short, with one dorsal and no ventral teeth ..... ***C. macrophthalma*** (H. Milne-Edw., 1857)
[**Host genus**: *Acropora*. **Distribution:** Type locality; Red Sea. Also reported from Israel, Saya de Malha and Great Barrier Reef (?)].
– Rostrum with numerous dorsal and ventral teeth 3
3 Rostral dentition normally 5/2, dorsal teeth large, lamina relatively deep, colour pattern with red striae ..... ***C. graminea*** (Dana, 1852)
[**Host genera**: *Acropora*, rarely *Pocillopora*, *Seriatopora*, *Stylophora*. **Distribution:** Type locality: Fijian Islands. Also known from Egypt, Saudi Arabia, Sudan, Kenya, Zanzibar, Moçambique, Tanganyika, Moçambique, Madagascar, Seychelle Islands, Sri Lanka, Andaman Islands, Nicobar Islands, Christmas Island, Singapore, Indonesia, Vietnam, Hong Kong, China, Japan, Philippines, Australia, New Caledonia, Loyalty Islands, Fijian Islands, Samoan Islands, Caroline Islands, Marshall Islands, Johnson Island, Palmyra Island and Wake Island. N.B., some of the earlier records may refer to specimens of *C. viridis*].
– Rostral dentition normally 4/1, dorsal teeth small, lamina shallow, colour pattern not red striate ..... ***C. viridis*** Bruce, 1974
[**Host genus**: *Acropora*. **Distribution:** Type locality: Mombasa Island, Kenya. Also known from Moçambique, Seychelle Islands, Maldive Islands, Sri Lanka, Indonesia, Vietnam, Ryukyu Islands, Northern Territory, Queensland and Papua-New Guinea].
4. Dactyl of second pereiopod laterally carinate or with proximal swelling ... 5
– Dactyl of second pereiopod not laterally carinate, without proximal swelling 8
5. Fixed finger of second pereiopod with distinct oval fossa on proximal cutting edge; R. 4-5/0 ..... ***C. pavonae*** Bruce, 1972

*See addendum

[**Host genus**: *Pavona*. **Distribution:** Type locality: Sigatoka, Viti Levu, Fijian Islands. Also known from Taiwan].

– Fixed finger lacking fossa on proximal cutting edge 6

6. Rostral dentition 4-5/2; dactyl of second pereiopod with proximal inflation with angulated carina; R. 4-5/2 ..... ***C. superba*** (Dana, 1852)
[**Host genus**: *Acropora*. **Distribution:** Type locality: Tongatabu, Tonga Islands. Also known from Red Sea, Egypt, Sudan, Jibuti, Kenya, Zanzibar, Moçambique, Comoro Islands, Madagascar, La Réunion, Seychelle Islands, Maldive Islands, Andaman Islands, Nicobar Islands, Indonesia, Vietnam, Nansha Islands, Philippines, Japan, Queensland, New Caledonia, Ogasawara Islands, Caroline Islands, Marshall Islands, Marianas Islands, Samoan Islands, Tonga, Fijian Islands and Society Islands].

– Rostral dentition 0-4/0-2 7

7. Colour pattern with large white patches ..... ***C. venusta* a**

– Colour pattern lacking large white patches ..... ***C. venusta* b**
[**Host genus**: *Acropora*. *C. venusta* Kemp, 1922, s. lat., type locality, Tholayiram Paar, Gulf of Manaar, India, has been reported from Egypt, Kenya, Zanzibar, Moçambique, Comoro Islands, La Réunion, Seychelle Islands, Sri Lanka, Indonesia, South China Sea, Japan, Great Barrier Reef, Solomon Islands and Marshall Islands].

8. Proximal segment of antennular peduncle as long as wide, with well developed distolateral lobe with acute distolateral tooth; rostrum reaching to middle of intermediate peduncular segment; R. 0/0 ..... ***C. nudirostris*** (Heller, 1861)
[**Host genus**: *Acropora*. **Distribution:** Type locality: Red Sea. Also known from Kenya, Zanzibar, Tanganyika, La Réunion, Seychelle Islands, Mauritius, Maldive Islands, Japan, Marshall Islands, Kiribati and Society Islands].

– Proximal segment of antennular peduncle wider than long, with poorly developed distolateral lobe bearing obsolescent distolateral tooth; rostrum reaching only to middle of proximal peduncular segment; R. 0/0 ..... ***C. brevirostris*** Borradaile, 1898
[**Host genus**: *Acropora*. **Distribution:** Type locality: Tuvalu. Also known from Coral Sea and Marshall Islands].

Ctenopontonia Bruce, 1979

One species only ..... ***C. cyphastreophila*** Bruce, 1979*
[**Host genus**: *Cyphastrea*. **Distribution:** Type locality: Eniwetak Atoll, Marshall Islands. Known only from the type locality].

Exoclimenella Bruce, 1994

1. Supraorbital spines present; R. 7/4 ..... ***E. sudanensis*** Duris & Bruce, 1995
[**Host genus**: *Stylophora*. **Distribution:** Type locality: Port Sudan, Sudan. Known only from the type material].

– Supraorbital spines absent 2

2. Carpus of second pereiopod with two small distal teeth; R. 6-7/2 ..... ***E. maldivensis*** Duris & Bruce, 1995
[**Host genus**: *Seriatopora*. **Distribution:** Type locality: Genego Islet, North Nilandu Atoll, Maldive Islands. Also known from Cartier Reef, Timor Sea].

– Carpus of second pereiopod with three distal teeth 3
3. Merus of second pereiopods with several distoventral spines; mandibular palp present; R. 1+6-7/3 ..... ***E. denticulata*** (Nobili, 1906)
[**Host genus**: *Acropora*. **Distribution:** Type locality: Gatavake, Mangareva Atoll, Gambier Islands. Also known from Great Barrier Reef, South China Sea, Marshall Islands and Tuamotu Islands].
– Merus of second pereiopod unarmed; mandibular palp absent; R. 6/2..... ..... ***E. sibogae*** (Holthuis, 1952)
[**Host genera**: ? **Distribution:** Type locality: Banda, Indonesia, 9-36m. Known from type specimen only].

Fennera Holthuis, 1951

One species only ..... ***F. chacei*** Holthius, 1951
[**Host genera**: *Pocillopora, Porites, Stylophora*. **Distribution:** Type locality: Secas Islands, Panama Also known from Kenya, La Réunion, Seychelle Islands, Maldive Islands, Marshall Islands and Hawai'ian Islands. Also known from Galapagos Islands, Mexico, Costa Rica and Colombia].

Hamopontonia Bruce, 1970

1. Larger species, posterior margin of telson bifurcate; R. 7/2..... ..... ***H. corallicola*** Bruce, 1970
[**Host genera**: *Catalaphyllia, Euphyllia, Fungia, Goniopora, Heliofungia*. **Distribution:** Type locality: Kat O Chau, Hong Kong. Also known from Indonesia, Hong Kong, Ryukyu Islands, Japan, Northern Territory and Queensland. Also reported from anemones].
– Smaller species, pocl to *ca* 2mm, posterior margin of telson with additional small median tooth; R. 4-6/0 ..... ***H. essingtoni*** Bruce, 1986
[**Host genus**: *Stylophora*. **Distribution:** Type locality: Port Essington, Northern Territory, Australia. Known only from the type locality].

Harpiliopsis Borradaile, 1915

1. Dactyl of second pereiopods with lateral carina; R. 4-7/2-4 .... ***H. beaupresii*** (Audouin, 1825)
[**Host genera**: *Pocillopora, Seriatopora, Stylophora*, rarely *Acropora*. **Distribution:** Type locality: Egypt. Also known from Israel, Eritrea, Sudan, Yemen, Kenya, Zanzibar, Tanganyika, Moçambique, Madagascar, La Réunion, Seychelle Islands, Maldive Islands, Chagos Islands, Sri Lanka, Andaman Islands, Singapore, Indonesia, Thailand, South China Sea, Japan, Philippines, Australia, Coral Sea, Mariana Islands, Marshall Islands, Fijian Islands, Hawai'ian Islands, French Frigate Shoal and Johnson Atoll. Also Easter Island].
– Dactyl of second pereiopods without lateral carina 2
2. Palm of chela of second pereiopod robust, about 3.0 times longer than central width; R. 5-7/2-3 ..... ***H. depressa*** (Stimpson, 1860)
[**Host genera**: *Pocillopora, Seriatopora, Stylophora*, rarely *Acropora, Porites*. **Distribution:** Type locality: Hawai'i. Also known from Egypt, Israel, Saudi Arabia, Sudan, Yemen, Kenya, Zanzibar, Comoro Islands, Madagascar, Moçambique, La Réunion, Seychelle Islands, Maldive Islands, Chagos Islands, Sri Lanka, Andaman Islands, Nicobar Islands, Indonesia, Papua New-Guinea, South China Sea, Japan, Philippines, Western Australia, Queensland, New Caledonia, Loyalty Islands, Samoan Islands, Fijian Islands, Mariana Islands, Marshall Islands, Kiribati, Rotuma

Island, Palmyra Island, Johnson Atoll and Hawaiian Islands. Also Galapagos Islands, Mexico, Costa Rica, Panama, Colombia and Ecuador].

– Palm of chela of second pereiopod slender, about 6.0 times longer than central width; R. 5-7/2-3 ..... ***H. spinigera*** (Ortmann, 1890)
[**Host genera**: *Pocillopora, Stylophora.* **Distribution:** Type locality: Samoa. Also known from Kenya, Zanzibar, Comoro Islands, La Réunion, Seychelle Islands, Maldive Islands, Andaman Islands, Indonesia, Philippines, Great Barrier Reef, Marshall Islands and Fijian Islands. Also Panama and Colombia].

Ischnopontonia Bruce, 1966

One species only ..... ***I. lophos*** (Barnard, 1962)
[**Host genus**: *Galaxea.* **Distribution:** Type locality: Inhaça Island, Moçambique. Also known from Kenya, Zanzibar, Tanganyika, Moçambique, Comoro Islands, Madagascar, La Réunion, Seychelle Islands, Singapore, Malaya, Northern Territory, Queensland, Mariana Islands, Caroline Islands, Fijian Islands, and Ryukyu Islands].

Jocaste Holthuis, 1952

1. Rostrum distinctly shorter than antennular peduncle, with 2-3 dorsal teeth, no ventral teeth ..... ***J. platysoma*** Fransen, 1994
[**Host genus**: *Acropora.* **Distribution:** Type locality: St Joseph Atoll, Seychelle Islands. Also known only from Poivre Island, Seychelle Islands].

– Rostrum exceeding antennular peduncle, with 3-7 dorsal and 1-4 ventral teeth 2

2. Dactyl of major second pereiopod bidentate; supraorbital margins of carapace angular; R. 4-7/1-2 ..... ***J. lucina*** (Nobili, 1901)
[**Host genera**: *Acropora,* rarely *Pocillopora, Stylophora.* **Distribution:** Type locality: Eritrea. Also known from (Red Sea), Egypt, Israel, Sudan, Yemen, Oman, Kenya, Zanzibar, Tanganyika, Moçambique, Comoro Islands, Madagascar, La Réunion, Seychelle Islands, Maldive Islands, Sri Lanka, Andaman Islands, Nicobar Islands, Singapore, Indonesia, Vietnam, South China Sea, Western Australia, Queensland, Papua New-Guinea, Coral Sea, New Caledonia, Marianas Islands, Marshall Islands, Cook Islands, Fijian Islands and Johnson Atoll].

– Dactyl of major second pereiopod unidentate; supraorbital margin convex; R. 3-5/1-2 ..... ***J. japonica*** (Ortmann, 1890)
[**Host genus**: *Acropora.* **Distribution:** Type locality: Kagoshima, Japan. Also known from Kenya, Zanzibar, Tanganyika, Moçambique, Comoro Islands, Madagascar, La Réunion, Mauritius, Seychelle Islands, Maldive Islands, Chagos Islands, Indonesia, Vietnam, Japan, South China Sea, Philippines, Western Australia, Queensland, Papua New-Guinea, New Caledonia, Cook Islands, Caroline Islands, Mariana Islands, Marshall Islands and Fijian Islands].

Metapontonia Bruce, 1967

One species only ..... ***M. fungiacola*** Bruce, 1967
[**Host genera**: *Fungia, Halomitra, Herpolitha, Hydnophora, Goniastrea.* **Distribution:** Type locality: Pamanzi, Mayotte, Comoro Islands. Also known from Kenya, Tanganyika, La Réunion, Seychelle Islands and Japan].

Paratypton Balss, 1914

One species only ..... ***P. siebenrocki*** Balss, 1914

[**Host genus:** *Acropora*. **Distribution:** Type localities: Koseir; Mersa Sheik, Egypt; Jaluit, Marshall Islands; Samoa. Also known from Kenya , Zanzibar, Tanganyika, La Réunion, Seychelle Islands, Indonesia, Japan, Great Barrier Reed, Marshall Islands and Fijian Islands].

Periclimenella Bruce, 1994

1. Supraorbital spines absent; R. 1+5-8/3-5 .. ***P. petitthouarsii*** (Audouin, 1826)
[**Host genera**: various. **Distribution:** Type locality: Egypt. Also known from Israel, Sudan, Eritrea, Saudi Arabia, Jibuti, Yemen, Persian Gulf, Kenya, Zanzibar, Tanganyika, Comoro Islands and Madagascar].
- Supraorbital spines present; R. 1+5-8/3-4 ..... ***P. spinifera*** (De Man, 1902)
[**Host genera**: various. **Distribution:** Type localities: Ternate, Ambon, Indonesia; Tahiti, Society Islands. Also known from Madagascar to Tahiti and Wake Island, to southern Great Barrier Reef, north to the Ryukyu Islands, but absent from the north west Indian Ocean and Red Sea].

Periclimenes Costa, 1844

1. Fourth thoracic sternite with distinct finger-like median process..... 2
- Fourth thoracic sternite without finger-like median process 6
2. Supraorbital spines present; R. 1+5-7/2-4..... ***P. amymone*** De Man, 1902
[**Host genera:** *Acropora, Pocillopora, Seriatopora, Stylophora*. **Distribution:** Type locality: Ternate, Indonesia. Also known from Nicobar Islands, Singapore, Philippines, Northern Territory, Great Barrier Reef, Papua New Guinea, Solomon Islands and New Caledonia].
- Supraorbital spines absent..... 3
3. Carapace usually with four relatively large teeth closely grouped over orbit dorsally, three smaller smaller teeth spaced out over distal rostrum; R. 1+ 6-7/3-4..... ***P. kororensis*** Bruce, 1977
[**Host genus:** *Heliofungia*. **Distribution:** Type locality: Koror, Palau Islands. Also known from Philippines and Great Barrier Reef].
- Rostrum with teeth evenly distributed along dorsal carina..... 4
4. Medial margins of terminal and preterminal segments of second maxilliped endopod forming straight medial border; R.1+ 6-7/2-3 ..... ***P. lutescens*** (Dana, 1852)
[**Host genera:** *Acropora*, rarely *Pocillopora, Seriatopora*. **Distribution:** Type locality: Tongatabu, Tonga Islands. Also known from Egypt, Israel, Eritrea, Sa'udi Arabia, Kenya, Zanzibar, Tanganyika, Moçambique, Comoro Islands, Madagascar, Seychelle Islands, Maldive Islands, Nicobar Islands, Singapore. Indonesia, Nansha Islands, Japan, Great Barrier Reef, Coral Sea, Solomon Islands, Samoan Islands, Society Islands (?) and Marquesas Islands (?)].
- Medial margins of terminal and preterminal segment of second maxilliped endopod not forming continuous straight border 5
5. Rostrum slender, distinctly exceeding scaphocerite, upcurved; R.1+ 6-7/3-5 ..... ***P. bayeri*** Holthuis, 1973
[**Host genus:** *Pocillopora*, (??) *Pavona*. **Distribution:** Type locality: Arno Atoll, Marshall Islands. Also known from Kapingamarangi, Rongerik and Eniwetak Atolls, Marshall Islands].
- Rostrum deep, not as scarcely exceeding scaphocerite, straight; R.1+ 7/1-3 ..... ***P. consobrinus*** (De Man, 1902)
[**Host genus:** *Pocillopora*. **Distribution:** Type locality: Ternate, Indonesia. Also known from

Kenya, Tanganyika, Comoro Islands, La Réunion, Thailand, Philippines and Great Barrier Reef].

6. Rostrum generally arched, inferior orbital angle strongly produced, with reflected inner flange; bec ocellaire conspicuously developed; third abdominal segment usually posterodorsally produced; second pereiopods subequal and similar 7
– Rostrum generally straight, inferior orbital angle without reflected inner flange, not strongly produced; without distinct bec ocellaire; third abdominal segment not strongly posterodorsally produced; second pereiopods equal, unequal, similar or dissimilar 9
7. Second pereiopod chela with fingers bearing series (5-7) of small acute recurved denticules along both cutting edges; R. 1+ 5-7/0-2. Third abdominal tergite typically with large oval pink patch, outlined in white ..... ***P. venustus*** Bruce, 1990
[**Host genus:** *Heliofungia*. **Distribution:** Type locality: Port Essington, Northern Territory, Australia. Also known from Japan, Philippines and Western Australia].
– Fingers of second pereiopods with few (1-3) larger, acute, proximal teeth... 8
8. Second pereiopods with chelae bowed, carpus distinctly shorter than palm, length; R. 1+ 7-8/1-2. Third abdominal tergite typically with large white patch margined anteriorly in red ..... ***P. magnificus*** Bruce, 1979
[**Host genus:** *Catalaphyllia, Fungia*. **Distribution:** Type locality: Heron Island, Queensland, Australia. Also known from Indonesia, Japan and Philippines].
– Second pereiopod with chelae straight, carpus subequal to palm length; R. 1+ 10-13/2-4. Third abdominal tergite typically with posteriorly directed white chevron margined anteriorly in red ..... ***P. holthuisi*** Bruce, 1969
[**Host genera:** *Catalaphyllia, Euphyllia, Heliofungia, Plerogyra*. **Distribution:** Type locality: Lung Ha Wan, Hong Kong. Also reported from Jordan, Zanzibar, Seychelle Islands, Maldive Islands, Sri Lanka, Malaya, Singapore, Vietnam, Hong Kong, South China Sea, Japan, Philippines, Indonesia, Northern Territory, Queensland, Papua New-Guinea, Lord Howe Island, New Caledonia, Solomon Islands, Caroline Islands and Marshall Islands. Some reports, particularly those of early date, probably require re-evaluation as they may refer to related species].
9. Fourth thoracic sternite with transverse linguiform median plate; ambulatory propods with well developed spines, R. 5-6/1 ... ***P. difficilis*** Bruce, 1976
[**Host genus:** *Porites*. **Distribution:** Type locality: Baie Ste Anne, Praslin, Seychelle Islands. Known only from the type locality, and Bird Island, also some on alcyonaria].
– Fourth thoracic sternite without linguiform plate, ambulatory propods feebly spinose 10
10 Second pereiopods with fingers shallowly subspatulate, unarmed, longer than palm, R. 5-6/0-1 ..... ***P. watamuae*** Bruce, 1976
[**Host genus:** *Fungia*. **Distribution:** Type locality: Watamu, Kenya. Also known from Seychelle Islands].
– Second pereiopods with fingers not shallowly subspatulate, dentate, shorter than palm 11
11. Major second pereiopod dactyl with single small acute tooth proximally,

opposing two small teeth on fixed finger, without distinct distal diastema, major chela robust; ambulatory pereiopods without ventral spines; ambulatory dactyl more than 0.25 of propod length; R. 1+ 6-7/1 ..... ***P. madreporae*** Bruce, 1969
[**Host genera:** *Acropora, Pocillopora, Seriatopora, Stylophora, Turbinaria.* **Distribution:** Type locality: Erskine Island, Queensland, Australia. Also known from La Réunion, Indonesia, Philippines, Coral Sea, Caroline Islands (?) and Solomon Islands].

– Major second pereiopod dactyl with very small or obsolete tooth, fixed fingers with large tooth and distinct distal diastema 12

12. Major second pereiopod with fixed finger tooth at less than 0.8 of fingers length 13

– Major second pereiopod with fixed finger tooth at 0.8 of length, separated by deep notch from tip; dactylar tooth obsolete; R. 5-7/0-2..... ***P. diversipes*** Kemp, 1922
[**Host genera:** *Acropora, Galaxea, Goniopora, Montipora, Pavona, Pocillopora, Porites, Psammocora, Seriatopora, Stylophora.*. **Distribution:** Type locality: Kilakarai, Gulf of Manaar, India. Also known from Egypt, Yemen, Kenya, Zanzibar, Tanganyika, Comoro Islands, Madagascar, La Réunion, Seychelle Islands, Singapore, Thailand, Northern Territory, Great Barrier Reef and Coral Sea].

13. Major second pereiopod with fixed finger tooth large, acute, at about 0.6 of finger length, with large gap proximally; dactylar tooth obsolete, distal cutting edge more or less straight; R. 5-7/0-1..... ***P. gonioporae*** Bruce, 1989*
[**Host genera:** *Galaxea, Goniopora Lobophyllia, Montipora, Porites.* **Distribution:** Type locality: Ras Iwatine, Kenya. Also known from La Réunion and Great Barrier Reef].

– Major second pereiopod with fixed finger tooth at 0.5 of finger length blunt, with large gap proximally; dactylar tooth distinct, blunt distal cutting edge concave; R. 5/1 ..... ***P. mahei*** Bruce, 1969
[**Host genera:** *Acropora, Pocillopora, Seriatopora.* **Distribution:** Type locality: Northwest Bay, Mahé, Seychelle Islands. Also known from Zanzibar, Comoro Islands and Western Australia].

Philarius Holthuis, 1952

1. Supraorbital spines present; R 7-10/1 ..... ***P. lifuensis*** (Borradaile, 1898)
[**Host genus**: *Acropora.* **Distribution:** Type locality: Lifu, Loyalty Islands, New Caledonia. Also known from the Great Barrier Reef].

– Supraorbital spines absent 2

2. Carpus of second pereiopod with strong medial spine distally; postrostral teeth present on carapace; R. 7-9/1 ..... ***P. imperialis*** (Kubo, 1940)
[**Host genus**: *Acropora.* **Distribution:** Type locality: Haha-jima, Ogasawara-Islands. Also known from Israel, Kenya, Zanzibar, Tanganyika, Comoro Islands, La Réunion, Singapore, Nansha Islands, Northern Territory, Great Barrier Reef, Coral Sea, Marshall Islands and Caroline Islands].

– Carpus of second pereiopod without any strong distal teeth, post-rostral teeth absent; R. 3-5/1 ..... ***P. gerlachei*** (Nobili, 1905)
[**Host genus**: *Acropora.* **Distribution:** Type locality: Arzana Island, United Arab Emirates. Also known from Egypt, Sudan, Oman, Kenya, Zanzibar, Tanganyika, Comoro Islands, Moçambique Channel, Madagascar, La Réunion, Seychelle Islands, Sri Lanka, Singapore, In-

donesia, Nansha Islands, Thailand, Japan, Philippines, Northern Territory, Great Barrier Reef, Coral Sea, Solomon Islands, Fijian Islands, Samoan Islands, Marshall Islands and Kiribati].

Platycaris Holthius, 1952

One species only ..... ***P. latirostris*** Holthuis, 1952
[**Host genus**: *Galaxea*. **Distribution:** Type locality: Ende, Flores, Indonesia. Also known from Kenya, Zanzibar, Tanganyika, Comoro Islands, Madagascar, Moçambique, La Réunion, Seychelle Islands, Singapore, Indonesia, Japan, Queensland, Fijian Islands and Marshall Islands.].

Pontonides Borradaile, 1917

1. Margin of lateral rostral carina smoothly convex; proximal lateral aspect of antepenultimate segment of third maxillipeds without blunt flattened setae; R. 0/0..... ***P. maldivensis*** (Borradaile, 1915)
[**Host genus**: *Dendrophyllia*. **Distribution:** Type locality: Fadiffolu Atoll, Maldive Islands. Also known from Kenya].
– Margin of lateral rostral carina rectangular; proximal lateral aspect of antepenultimate segment of third maxillipeds with blunt flattened setae; R. 0/0 ..... ***Pontonides*** sp. α*
[**Host genus**: *Dendrophyllia*. **Distribution:** Tomioka, Amakusa Islands, Japan only, Fujino and Miyake, 1969, *as P. unciger* Calman].

Tectopontonia Bruce, 1973

One species only ..... ***T. maziwiae*** Bruce, 1973
[**Host genus**: *Acropora*. **Distribution:** Type locality: Maziwi Island, Tanganyika. Known from the type locality only].

Vir Holthuis, 1952

1. Second pereiopods relatively long and slender, chela about 3.5 times longer than broad; R. 7-8/1 2
– Second pereiopods relatively short and stout, chela about 2.5 times longer than broad; R. 7/1 ..... ***V. orientalis*** (Dana, 1852)
[**Host genera**: *Acropora, Pocillopora, Stylophora*. **Distribution:** Type locality: Sulu Sea. Also known from Kenya, Zanzibar, Seychelle Islands, Maldive Islands, Andaman Islands, Indonesia, South China Sea, Mariana Islands, Coral Sea, Fijian Islands and Hawai'ian Islands].
2. Merus of second pereiopods without distoventral tooth; R. 5-8/1 .... ***V. philippinensis*** Bruce & Svoboda, 1984
[**Host genera**: *Plerogyra, Fungia*. **Distribution:** Type locality: Cebu, Philippines. Also known from Japan and the Great Barrier Reef].
– Merus of second pereiopods with well developed distoventral tooth; R. 8/ .....***Vir*** sp. α
[**Host genus**: *Pocillopora*. **Distribution:** Mururoa Atoll, Tuamotu Islands].

Yemenicaris Bruce, 1997

One species only ..... ***Y. trullicauda*** Bruce, 1997*
[**Host genus**: *Stylophora Pucillopora*. **Distribution:** Type locality: Bir Ali, Yemen. Also known only from other Yemeni localities].

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REFERENCES

Barnard, K.H. 1958. Further additions to the crustacea fauna list of Portuguese East Africa. – *Memorias do Museu Dr. Alvaro de Castro* **4**: 3-23, figs 1-7.

Bruce, A.J. 1972. A review of information upon the coral hosts of commensal shrimps of the subfamily Pontoniinae, Kingsley, 1878 (Crustacea, Decapoda, Palaemonidae) – In *Proceedings of the Symposium on Corals and Coral Reefs, 1969, Cochin* pp. 399-418, figs 1-2. Marine Biological Association of India.

Bruce, A.J. 1974a. *Coralliocaris viridis* sp. nov., a preliminary note (Decapoda Natantia, Pontoniinae). – *Crustaceana* **26**(2): 222-224, fig. 1.

Bruce, A.J. 1974b. Hidden shrimps of the coral reefs. – *Wildlife* **16**(6): 260-263, figs 1-6.

Bruce, A.J. 1975. Coral reef shrimps and their colour patterns. – *Endeavour* **34**: 23-27, figs 1-16.

Bruce, A.J. 1976a. Shrimps and Prawns of Coral Reefs, with special reference to commensalism. In O. Jones & R. Endean (eds): – *Biology and Geology of Coral Reefs* **3**(2): 37-94, figs 1-21, tab. 1.

Bruce, A.J. 1976b. A report on some pontoniinid shrimps collected from the Seychelle Islands by the F.R.V. *Manihine,* 1972, with a review of the Seychelles pontoniinid shrimp fauna. – *Journal of the Linnean Society of London, Zoology* **59:** 89-153, tabs. 1-8, figs 1-30.

Bruce, A.J. 1977a. The hosts of the coral-associated Indo-West Pacific pontoniine shrimps. – *Atoll Research Bulletin* **205**: 1-19, fig. 1.

Bruce. A. J. 1977b. Shrimps that live on corals. – *Oceans* **1**(2): 70-75, figs 1-16.

*Bruce, A.J. 1979a. *Ctenopontonia cyphastreophila,* a new genus and species of coral associated pontoniine shrimp from Eniwetok Atoll. – *Bulletin Marine Science* **29**(3): 423-435, figs 1-7.

Bruce, A.J. 1979b. The evolution and zoogeography of shallow-water tropical shrimps. – Proceedings of the International Symposium on Marine Biogeography and Evolution in the Southern Hemisphere, Auckland, 1978. N.Z. – *DSIR Information Series* **137**: 337-355, figs 1-4.

Bruce, A.J. 1985. Some caridean associates of scleractinian corals in the Ryukyu Islands. – *Galaxea* **4**: 1-21, figs 1-12, pl. 1.

Bruce, A.J. 1987. Re-descriptions of two little-known Indo-West Pacific palaemonid shrimps, *Periclimenes calmani* Tattersall and *P. delagoae* Barnard. – *Journal of Natural History* **21**(6): 1415-1432, figs 1-9.

Bruce, A.J. 1989. *Periclimenes gonioporae* sp. nov. (Crustacea: Decapoda: Palaemonidae), a new coelenterate – associated shrimp. – The Beagle, Records of the Northern Territory Museum of Arts & Sciences **6**: 149-156, figs 1-4.

Bruce, A.J. 1990. A new cnidarian associated palaemonid shrimp from Port Essington, Cobourg Peninsula, Australia. – *Indo-Malayan Zoology* **6**; 229-234, figs 1-8.

Bruce, A.J. 1991. Shallow-water Palaemonoid shrimps from New Caledonia (Crustacea: Decapoda). – In B. Richer de Forges (ed.): *Le benthos des fonds meubles des lagons de Nouvelle-Calédonie, 1.* – Études et Thèses; Paris, ORSTOM: 211-279, figs 1-31.

*Bruce, A.J. 1997. A new pontoniine shrimp from the Yemen, with a note on other species. – *Journal of Natural History* **31**(11): 1213-1222, figs 1-3.

Chace, F.A., Jr. & A.J. Bruce 1993. The Caridean Shrimps (Crustacea: Decapoda) of the *Albatross* Philippine Expedition 1907-1910, Part 6: Superfamily Palaemonoidea. – *Smithsonian Contributions to Zoology* **543**: i-vii, 1-252, figs 1-23.

Dana, J.D. 1852. Conspectus Crustaceorum quae in Orbis Terrarum circumnavigatione, Carolo Wilkes e Classe Republicae Foederatae e Duce, lexit et descripsit. – *Proceedings of the Academy of Natural Sciences of Philadelphia* **1852**: 10-28.

Duffey, J. E. 1996. Species boundaries, specialization, and the radiation of sponge-dwelling alpheid shrimp. – *Biological Journal of the Linnean Society* **58**: 307-324, figs 1-4.

Duris, Z. & A.J. Bruce 1995. A revision of the "petitthouarsi" species-group of the genus *Periclimenes* Costa, 1884 (Crustacea: Decapoda: Palaemonidae). – *Journal of Natural History* **29**: 619-671, figs 1-22.

*Fujino, T. & S. Miyake 1969. Sexual dimorphism and variation in the second pereiopods of *Pontonides unciger* Calman (Crustacea, Decapoda, Palaemonidae). – *Ohmu* **2**: 87-92, fig. 1.

Gattuso, J.-P., M. Pichon & J. Jaubert 1991. Physiology and taxonomy of scleractinian corals: a case study in the genus *Stylophora*. – *Coral Reefs* **9**: 173-182.

Harrison, P.L. 1988. Pseudo-gynodioecy: an unusual breeding system in the scleractinian coral *Galaxea fascicularis*. – *Proceedings of the Sixth International Coral Reef Symposium, Townsville, 1988* **2**: 699-705.

Holthuis, L.B. 1951. A general Revision of the Palaemonidae (Crustacea Decapoda Natantia) of the Americas. I. The Subfamilies Euryrhynchinae and Pontoniinae. – *Occasional Papers of the Allan Hancock Foundation* **11**: 1-332, pls 1-63.

Holthuis, L.B. 1952. The Decapoda of the Siboga Expedition. Part XI. The Palaemonidae collected by the Siboga and Snellius Expeditions with remarks on other species. II. Subfamily Pontoniinae. – *Siboga Expeditie Mon.* **39a 10**: 1-252, figs 1-110, tab. 1.

Holthuis, L. B. 1993. *The recent genera of the caridean and stenopodidean shrimps (Crustacea, Decapoda) with an appendix on the order Amphionidacea.* – Nationaal Natuurhistorisch Museum, Leiden, 1-328, figs 1-312.

Kemp, S. 1922. Notes on Crustacea Decapoda in the Indian Museum. XV. Pontoniinae. – *Records of the Indian Museum* **24**: 113-288, figs 1-105, pls 3-9.

Knowlton, N. 1986. Cryptic and sibling species among the decapod Crustacea. – *Journal of Crustacean Biology* **6**: 356-363.

Knowlton, N. 1993. Sibling species in the sea. – *Annual Review of Ecology and Systematics* **24**: 189-216.

Knowlton, N. & J.B.C. Jackson 1994. New taxonomy and niche partitioning on coral reefs: jack of all trades or master of none? – *Trends in Evolution and Ecology* **9**(1): 7-9.

Man, J. G. de 1888. Bericht über die von Herrn Dr. J. Brock im indischen Archipel gesammelten Decapoden und Stomatopoden. – *Archiv für Naturgeschichte* **53**(1): 215-600, pls 7-22a.

Man, J.G. de 1902. Die von Herrn Professor Kükenthal im Indischen Archipel gesammelten Dekapoden und Stomatopoden. – In W. Kükenthal (ed): *Ergebnisse einer zoologischen Forschungsreise in den Molukken und Borneo. – Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft* **25**: 467-929, pls 19-27.

Milne-Edwards H. 1837. *Histoire Naturelle des Crustacés Comprenant l'Anatomie, la Physiologie et la Classification de ces Animaux* **2**: 1-532; atlas, pls 1-42. – Librairie encyclopédique de Roret, Paris.

Mitsuhashi, M. &. M. Takeda 1998. *Coralliocaris taiwanensis* Fujino & Miyake, 1972 (Crustacea, Decapoda, Natantia, Palaemonidae), a pontaniine shrimp associated with a coral, as a senior synonym of *C. pavonae* Bruce, 1972. – *Bull. Natn. Sc. Mus.*, A. (Zoology) **24**: 1-6, figs 1-3.

Müller, H.-G. 1993. *Catalogue of the Indo-West Pacific Shrimps*, pp. 1-159. Wissenschaftlicher Verlag H.-G. Müller, Research and Information Service, Wetzlar.

Nomura, K. 1989. Host and colour pattern of commensal shrimp, *Hamopontonia corallicola* Bruce (Decapoda: Palaemonidae) at Kushimoto, Wakayama Prefecture. – *Nankiseibato: The Nanki Biological Society* **31**(1): 19-24, figs 1-4.

Patton, W.K. 1966. Decapod crustacea commensal with Queensland branching corals. – *Crustaceana* **10**: 271-295, figs 1-3.

Paulson, O. 1875. Podophthalmata i Edriophthalmata (Cumacea). – *Izsledovaniya Rakoobraznykh Krasnago Morya s Otnositsl' no Rakoobraznykh Drudikh Morie,* xiv, + pp. 144, pls 21, Kiev. [Investigations on the Crustacea of the Red Sea with Notes on Crustacea of the adjacent Seas. Part I. Podophthalmata and Edriophthalmata (Cumacea), pp. i-xiv, 1-144, pls 1-21, Kiev].

Suzuki, K. & K.-I. Hayashi 1977. Five caridean shrimps associated with sea anemones in central Japan. – *Publications of the Seto Marine Biological Laboratory* **24**(1-3): 193-208, figs 1-5, pls 1-2.

Wallace, C.C. & B.L. Willis 1994. Systematics of the coral genus *Acropora*: Implications of New Biological Findings for Species Concepts. – *Annual Review of Ecology and Systematics* **25**: 237-262.

Addendum: It has recently been shown by Mitsuhashi & Takeda (1998) that *C. pavonae* Bruce, 1972 is a junior synonym of *C. taiwanensis* Fujimo & Miyake, 1972 which is therefore the correct name for this species.

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