OBSERVATIONS UPON SOME PONTONIINE SHRIMPS FROM AQABA, JORDAN

by

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With 15 text-figures and 3 tables

Abstract

Data are presented upon a small collection of eight species of pontoniine shrimp from Aqaba, Jordan, two of which, *Periclimenes longicarpus* and *Hamodactylus aqabai* are new species. Five of the six other species have not been previously recorded from the Red Sea. The pontoniine shrimp fauna of the Red Sea is discussed and keys for the identification of anemone and alcyonarian associated species of *Periclimenes* are provided.

Introduction

The study of the marine fauna of the Red Sea is of particular interest to zoogeographers, as it lies at one of the limits of the Indo-West Pacific region and is conveniently isolated from the main body of that area, and at the same time presents a special array of environmental features. Some of the earliest studies on the Indo-West Pacific fauna were initiated in the Red Sea and one of the first pontoniine shrimps to be described was *Cancer custos* (now *Anchistus custos*), recorded by Forsskål from Loheia in 1775. Subsequently, from material collected during Napoleon's Egyptian Expedition, Savigny (1809) described two species without naming them; later on these were named and illustrated by Audouin (1825) as *Palaemon Petitthouarsi* and *P. beaupressi* (now *Periclimenes petitthouarsi* and *Harpiliopsis beaupresii*). Heller (1861) reported on further crustacean collections from the Red Sea and described *Oedipus nudirostris* (now *Coralliocaris nudirostris*). Paulson (1875) reported upon several species of pontoniine shrimp, unfortunately without any precise details of the localities; these included *A. compressus* Paulson, the type species of the aberrant genus *Anchistioides*.

Nobili (1904, 1906) provided the first detailed account of the decapod fauna of the Red Sea, recognizing eighteen species of pontoniine shrimps belonging to eight different genera. Balss (1915), Tattersall (1921), Ramadan (1936) and Holthuis (1958) have produced reports on the pontoniine shrimps from the northern Red Sea, the Sudanese coast, Ghardaqa and from the Gulf of Aqaba and the Sinai Peninsula respectively.

The present report provides information upon eight species collected from Aqaba, Jordan, by the second author (A.S.), who is also responsible for the sections on hosts, colouration and behaviour/ecology. Only one species, *Periclimenes imperator* Bruce, 1967, has been previously recorded from this region. All species are associates of other marine invertebrates.

Full synonymies for most species are to be found in Holthuis (1952). C.L. refers to the post-orbital carapace length. All measurements are in mm.

If not indicated otherwise, the nos. referred to under "Material examined" are Bruce's file nos. The entire collection, except the paratypes of *Periclimenes longicarpus* nov. spec., has been deposited in the Rijksmuseum van Natuurlijke Historie, Leiden.

SYSTEMATIC ACCOUNT

Periclimenes tenuipes Borradaile
(fig. 1)

Periclimenes tenuipes Borradaile, 1898 : 384; 1899 : 406, pl. 36 fig. 2. Read, 1974 : 15.
Periclimenes (Falciger) kolumadulensis Borradaile, 1917 : 324, 369 (key), 376, pl. 55.
Periclimenes (Ancylocaris) tenuipes — Kemp, 1922 : 171 (key), 173, 220–224, pl. 8 fig. 11.
Periclimenes (Harpilius) tenuipes — Holthuis, 1952 : 13, 84–85, 87.

Material examined.—3 ♂, 1 juvenile (no. 2393) (10–ii–1976, 15 m, Aqaba, Jordan), leg. A. Svoboda.

Description.—The rostra of two specimens are broken and most of the pereiopods are detached, but all second pereiopods are present. The rostra of the two intact specimens have a dentition of 10/7 with one tooth above the orbit and one on the carapace, precisely as in the type specimen of *P. tenuipes*

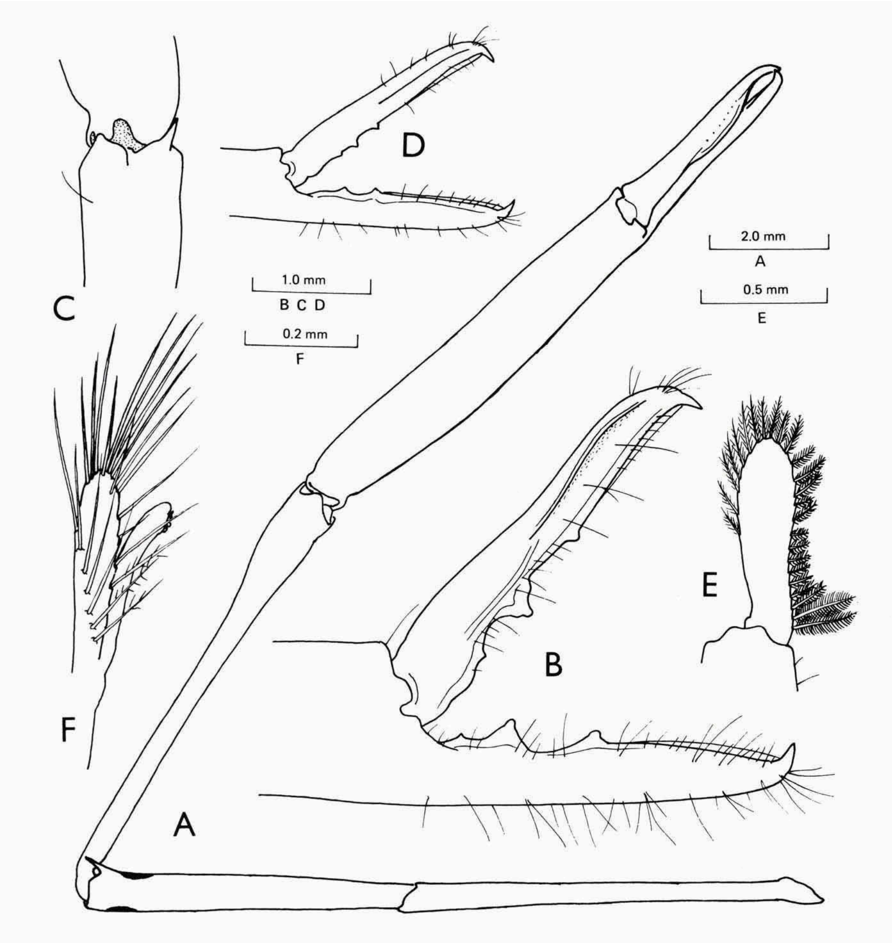

Fig. 1. *Periclimenes tenuipes* Borradaile. A, second pereiopod, male. B, fingers of second pereiopod. C, carpo-propodal joint of second pereiopod. D, fingers of juvenile second pereiopod. E, endopod of male first pleopod. F, appendix masculina and appendix interna.

Borradaile (Bruce, 1978b: fig. 7a). The rostra vary from 2.0 to 2.06 times the carapace length.

The second periopods, although detached, can be safely attributed to individual specimens. In each case the chelae are subequal and similar. All specimens show the same type of dentition on the fingers, although rather less well developed in the juvenile. The dactylus bears a well developed lateral flange and is slightly swollen proximally. The tip is acutely hooked. The cutting edge is distally straight and entire. A small blunt tooth is situated at about 0.6 of the length, separated by a straight edge from a large, irregular, apically blunt tooth at 0.4 of the length. A concave notch separates this tooth from a small acute tooth at 0.25 of the length. The fixed finger is similar but without a lateral flange. A blunt tooth is situated at about 0.5 and a larger blunt tooth at 0.3, with a small acute tooth at about 1.15 of the length. The palm is subcylindrical, about six times longer than wide, and twice the length of the dactylus. The carpus bears an acute inner spine, with a blunt outer lobe. The merus has slender, acute, disto-ventral tooth and the ischium is unarmed. The proportions of the segments, dactylus, palm, carpus, merus, ischium are: 1 : 2.13 : 2.32 : 1.67 : 2.15.

The endopod of the male first pleopod is about 3.7 times longer than wide, slightly expanded distally and without a median lobule; the medial border bears seventeen coarsely plumose setae, of which the first two are distinctly longer than the rest; the distal half of the lateral border bears eight finely plumose setae.

The appendix masculina of the male second pleopod exceeds the appendix interna, which has only four terminal concinni; it bears a group of about eight long, slender, simple setae terminally, with four shorter setae along the medial border; the dorsal aspect bears an obliquely longitudinal row of seven similar setae.

Measurements

	♂	♂	♂	Juv.
C.L.	6.0	4.8	4.0	3.25
P2, chela right	10.4	10.8	9.8	5.2
P2, chela left	10.7	10.8	8.9	5.3

Colouration.—Body transparent, with two brown longitudinal stripes, coalescing on the third abdominal segment, with a single median stripe continuing posteriorly to the telson, which has a white tip. A white median stripe extends along the abdominal segments ventrally. The eye-stalks have a white dorsal band, bordered with black and the cornea is brown, with white bars. The fingers of the second pereiopods are orange and the ischio-meral and mero-carpal joints are blue.

Hosts.—*Megalactis hemprichii* Ehrenberg, 1834, (Actiniaria), 5–30 m. Also occurs, but rarely, on *Cryptodendron adhaesivum* Klunzinger 1877, at 5 m, and has also occasionally been seen on the following hermatypic corals: *Pavona* spp., *Montipora* sp. and *Monastrea* sp., generally in fissures. Specimens have also been seen at Ghardaqa, off Seghir Gaftun Island, on *Cryptodendron adhaesivum* and *Entacmaea quadricolor* Ehrenberg, 1834, at 25 m. (See Table 1).

Behaviour/Ecology.—Groups of up to seven individuals of different size and sex are found on or close to one anemone. Occasionally specimens are seen sitting on the oral disc or on the branched tentacles of *Megalactis*. When disturbed, frightened individuals readily desert the anemone and hide in crevices. No uptake of food was observed, but the presence of swams of small unidentified mysids very close to the *Megalactis* was noted.

Remarks.—*Periclimenes tenuipes* has been recorded in association with the scleractinian coral *Heliofungia actiniformis* (Quoy & Gaimard, 1833) in Palauan waters (Read, 1974 : 15), where it was actually observed feeding on the host's mucus. It has also been recorded in association with an unidentified anemone from Eniwetok atoll (Bruce, 1979 : 210).

The fingers of the chelae of the second pereiopods closely resemble those of the holotype of *P. tenuipes* in the general arrangement of the teeth, which are noticeably more robust in the present material. On the fixed finger the proximal tooth is greatly reduced in comparison with Borradaile's specimen. The Aqaba material differs distinctly from the holotype of *P. kolumadulensis*, in which the chelae are extremely different on the two sides, one with very large teeth and a great diastema and the other with numerous small teeth along two thirds of the cutting edge. The Aqaba specimens also differ from the Eniwetok specimen, which has a pair of large teeth at half the length of the fingers, separated by a gap from a proximal row of four teeth on each finger. In males from Madagascar (Bruce, 1977b : 266), the fingers are similar and resemble those of the minor second pereiopod of the *P. kolumadulensis* holotype. Kemp's material from the Andaman Islands showed males with the dentition resembling the present specimens and also the Madagascar specimens referred to above.

The colouration of the Red Sea specimens differs from those described by Kemp (1922 : 222), which had red and yellow markings on the rostrum, and a sulphur yellow carpus and dull red chela on the second pereiopods. There is a close resemblance to the Eniwetok specimen, in which rostrum and palm of the second pereiopods are colourless, but do not show any white on the fixed finger of the chelae or a distal yellow patch on the carpus of the second pereiopod.

Distribution.—Not previously recorded from the Red Sea. Reported from Kenya, Zanzibar, Maldive and Seychelles Islands, Madagascar, Andaman Islands, Ceylon, Indonesia, New Britain (type locality), Palau and Marshall Islands.

Periclimenes brevicarpalis (Schenkel)

Ancylocaris brevicarpalis Schenkel, 1902 : 653, pl. 13 fig. 21.
Periclimenes (Ancylocaris) brevicarpalis – Kemp, 1922 : 169 (key), 189–191, figs. 40–42, pl. 6 fig. 8. Kubo, 1940 : 46–48, figs. 13–14.
Periclimenes (Harpilius) brevicarpalis – Holthuis, 1952 : 10, 69–73, fig. 27, tab. 1 (full synonymy).

Material examined.—1 ovigerous ♀, C.L. : 7.0 mm (no. 2394) (February 1976, 1–6m, Aqaba, Jordan), leg. A. Svoboda.

Description.—No significant differences from previous descriptions. Rostral dentition is 5/1, with all teeth anterior to the orbital margin. The cutting edges of the fingers of the second pereiopods are unarmed and the dactylus of the third to fifth pereiopods is without an accessory spine. The dorsal telson spines are minute.

Colouration.—Body bluish, transparent, with a white spot on the hepatic region of the carapace; ovary bright white. Base of uropods and of telson white, with conspicuous dark orange-bordered eyespots distally on exopod and endopod of uropod. Females in breeding season have four large white spots on the pleura, bordered with dark blue, with similar patches on the ventral abdomen. Eyes and stalk white. In non-breeding season, females are similar to males and juvenile females, which lack the white pleural patches.

Host.—*Cryptodendron adhaesivum* (Actiniaria).

Behaviour/Ecology.—This species is an obligatory associate of anemones, normally found in pairs (Svoboda & Svoboda, unpubl.) but frequently accompanied by juveniles which are not chased away. The female is often hidden below the surface of the disc while the male is on the upper surface. Approach by a diver causes the second pereiopods to be extended with the fingers of the chela opened. When chased, individuals of the same species are attacked when introduced into an occupied host anemone, the large chelae of the second pairs of pereiopods being locked together. The weaker animal is usually chased off the host. These engagements may result in autotomy of one of the appendages. The reduced size of the chela found in some individuals may be the result of autotomy of this appendage. During encounters the individuals often exhibit a swinging movement of the body, twisting the body along the longitudinal axis of the cephalothorax, thereby conspicuously displaying the white patches of the abdomen and the eyespots of the tail fan.

Periclimenes brevicarpalis feeds on the tentacles of the host anemone. Several tentacles are touched by the fingers of the chelae of the second pereiopods before one is cut off by a rapid movement and consumed. Mucus with trapped food particles is also ingested after collection by the chelae of the first pair of pereiopods.

Aquarium observations (A.S., unpubl.) show that adult females supplied with adequate quantities of food, do not show ovarian development unless they are in contact with the host. Eggs are laid when the environmental temperature rises above 22°C in summer at Mombasa, Kenya.

Remarks.—This species has been previously reported in association with

Cryptodendron adhaesivum, by Hipeau–Jacquotte (1973 : 105). The species recorded by Fricke (1976 : 53; 1973 : 114) as *P. affinis*, in association with anemones, is also clearly an example of *P. brevicarpalis* on account of the diagnostic colour pattern. There are no traces of minute accessory teeth on the dactyls of the third to fifth ambulatory pereiopods, which may occasionally be present in some specimens, i.e. from Eniwetok Atoll (Bruce, 1979 : 211, pl. 1a).

P. brevicarpalis has been previously reported in association with: *Actinodendron* sp., *Cryptodendron adhaesivum, Entacmaea quadricolor* (Rüppell & Leuckart), ?*Heteractis* sp., *Heteractis magnifica* (Quoy & Gaimard, 1833), *H. malu* (Haddon & Shackleton, 1893), *Stichodactyla gigantea* (Forskål, 1775), *S. martensi* Brandt, 1835 and *Thalassianthus hypnoides* (Saville-Kent, 1893). (See Table 1).

Distribution.—Not previously recorded from the Red Sea. Type locality: Makassar, Celebes. Reported from Djibuti, Gulf of Aden and Bahrein, Persian Gulf. Also known extensively throughout the Indian Ocean and western and central Pacific Ocean as far as Santa Cruz and Palau Islands.

Periclimenes imperator Bruce
(fig. 2)

Periclimenes imperator Bruce, 1967 : 62–63, figs. 23–25. Schumacher, 1973 : 260–355, fig. 1.

Material examined.— 1 ovigerous ♀, C.L. 4.2 mm (no. 2395) (February 1976, 40m, Aqaba, Jordan), leg. A. Svoboda.

Description.—Agrees precisely with previous reports. Rostral dentition 31/0. The proximal segment of each antennular peduncle bears two disto-lateral teeth. The dentitions of the fingers of the second pereiopods are similar to those of the type material but the teeth are rather stronger and the proximal teeth of the fixed finger are crowned with a series of six small denticles. The dactyls of the ambulatory pereiopods are without accessory teeth.

Colouration.—Body brown-orange, with a broad white dorsal stripe from rostrum to telson, distinctly expanded laterally over the branchial region and on the central parts of the anterior abdominal segments. The tips of the scaphocerite are blue. The fingers of the second pereiopods are blue, the palm white, the carpus and merus ochraceous with blue joint. Remaining pereiopods bluish violet. Dark-adapted animals contract the white chromatophores and become completely orange.

Host.—*Stichopus variegatus* (Semper, 1868) (Holothuroidea).

Behaviour/Ecology.—On small hosts, single specimens usually occur, with

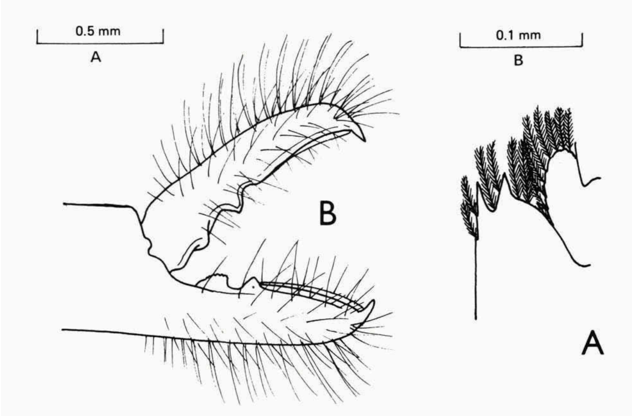

Fig. 2. *Periclimenes imperator* Bruce. A, disto-lateral angle of proximal segment of antennular peduncle. B, fingers of chela of second periopod.

pairs or even two pairs on larger hosts. They occur invariably on the ventral aspect of the host, and only move onto the dorsal surface under provocation. They will not voluntarily leave their host.

In choice experiments, the shrimps from *Stichopus variegatus*, if placed on the nudibranch *Hexabranchus sanguineus* (Rüppell & Leuckart, 1828), will desert the new host and return to their original host over a distance of 20 m. *Hexabranchus sanguineus* was observed on several occasions at Aqaba, but always without shrimps.

Periclimenes imperator was only found on *Stichopus variegatus* occurring on coarse gravel substrates and was absent from those found on finer substrates.

Remarks.—This species was originally found in association with the nudibranch *Hexabranchus marginatus* Quoy & Gaimard, 1833, and has since been found in association with other nudibranchs and also with a wide variety of holothurians, including *Euapta godeffroyi* (Semper, 1868) and *Actinopyge bannwarthi* Panning, 1944, in the Gulf of Aqaba, where specimens were also found on *Hexabranchus sanguineus* (cf. Schumacher, 1973). *P. imperator* has also been previously recorded in association with *Stichopus chloronotus*, Brandt, 1835.

Distribution.—Type locality: Zanzibar. Widespread throughout the Indo-West Pacific region from the Red Sea and Moçambique as far east as the Hawaiian Islands.

Periclimenes holthuisi Bruce
(fig. 3)

Periclimenes (Periclimenes) aesopius — Holthuis, 1952 : 8, 32, 34—37, 39, figs. 1—6.
Periclimenes holthuisi Bruce, 1969b : 258—59.

Material examined.—1 ovigerous ♀, 2 ♀, C.L. : 5.2, 4.5, 3.8 mm (no. 2396) (2–iii–1976, 35–45m, Aqaba, Jordan), leg. A. Svoboda.

Description.—As previously described. The rostrum is distincly arched and extends to about the middle of the second segment of the antennular peduncle. The dentition is 10–13 / 3–4, with the two posterior teeth situated on the carapace.

The eye is relatively short and stout with a globular cornea that is wider than the distal podophthalmite, which is about 1.4 times longer than the maximum width.

The second pereiopods are subequal and similar. The palm of the chela is subcylindrical, slightly compressed and about 3.5 times longer than the central width. The fingers are slightly angled to the palm axis, with the dactylus equal to 1.4 of the palm length, about six times longer than deep. The distal half of the cutting edge is sharp and entire, the proximal half blunt, with a small acute distal tooth, and a still smaller proximal tooth. The fixed finger bears four small acute teeth on the proximal portion, the largest tooth situated distally, opposing in advance of the distal dactylar tooth. The teeth are all slightly recurved. The tips of the fingers are acutely hooked. The carpus is unarmed, and slightly exceeds the palm length. The ischium is slender, about 1.4 times the palm length.

The ambulatory pereiopods have slender propods, about seventeen times longer than wide. The ventral border usually bears five sets of spines, a distoventral pair of long slender spines, with single spines of decreasing size at 0.10, 0.30, 0.54 and 0.62 from the distal end. The dactylus is slender, equal to one fifth of the propod length. The corpus bears an acute disto-ventral accessory tooth. The unguis is distinct, slender, equal to 0.7 of the corpus length.

Colouration.—Body transparent; abdomen spotted with white and red, with a white V-shaped mark dorsally on the third abdominal segment. Scaphocerite and eyestalk are red spotted. Telson white. First and second pereiopods with fingers and joints red-violet. Uropods with white blue-bordered eyespot on exopod; endopod yellow.

Host.—*Cassiopeia andromeda* (Forskål, 1755) (Scyphozoa).

Behaviour/Ecology.—Up to eight individuals, of both sexes, may be found in association on a single host. Usually they are around the host, but also may occur on it. In the latter case they apparently are not stung and show no discomfort. If disturbed, they readily leave the host and conceal themselves among eel grass, etc. The host has a depth range of 40–50 m, but the shrimp was only found from 34–45m.

Remarks.—*Periclimenes holthuisi* has been previously reported in associa-

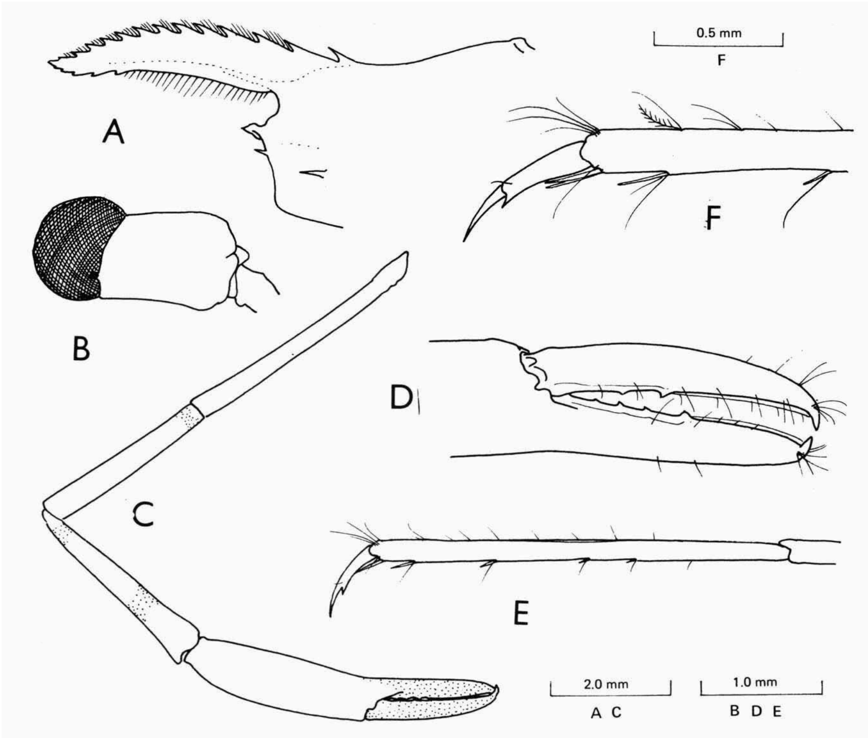

Fig. 3. *Periclimenes holthuisi* Bruce. A, anterior carapace and rostrum. B, eye. C, second pereiopod. D, fingers of second pereiopod. E, propod and dactylus of third pereiopod. F, dactlylus and distal propod of third pereiopod.

tion with scyphozoans from Zanzibar (Bruce, 1972). It has also been reported in association with fungiid corals and anemones (Read, 1974 : 16). Suzuki & Hayashi (1977 : 200) record its association with *Entacmaea quadricolor* Ehrenberg, ?*Heteractis* sp. and *Dofleinia armata* Wassilieff (See Table 1).

Distribution.—Not previously recorded from the Red Sea. Reported from Zanzibar, Seychelles Islands, Maldive Islands, Ceylon, Indonesia, New Guinea, Hong Kong (type locality), South China Sea, Japan, Palau Islands, New Caledonia and Queensland, Australia.

Periclimenes ornatus Bruce

Periclimenes ornatus Bruce, 1969c : 266–267.

Material examined.—2 ♂, 3 ovigerous ♀, C.L. ♂ : 3.1, 2.9, ♀ : 4.7, 4.0, 3.8 mm (no. 2391) (11–ii–76, 5–15m, Aqaba, Jordan), leg. A. Svoboda.

Description.—The specimens agree closely with the preliminary description. The two males have a rostral dentition of 7/1 and the females 7/2, 6/1 and 7/1 respectively. In all specimens the first rostral tooth is situated on the carapace.

Colouration.—Body transparent, intestines covered by fine brownish longitudinal stripes. Eyes dark pink; eyestalks white, connected by white band. Antennae, pereiopods and caudal fan spotted by alternating black and white chromatophores. Ovary opaque, eggs bright orange.

Hosts.—*Entacmaea quadricolor* Ehrenberg (Actiniaria), 10—20 m. (See Table 1).

Behaviour/Ecology.—*Periclimenes ornatus* occurs most commonly in pairs on *Entacmaea quadricolor* and less commonly on *G. helianthus*, hidden between the tentacles of the host. When the anemone is disturbed it contracts and withdraws down a fissure in the reef substrate. The shrimps do not leave their hosts and remain hidden between the tentacles.

The clownfish *Amphiprion bicinctus* Rüppell, 1828, is frequently found in association with the shrimps and anemones, but shows no aggressive behaviour towards the shrimps.

Remarks.—This species has been previously found in association with *Entacmaea quadricolor* by Suzuki & Hayashi (1977: 200) who also recorded its association with a ?*Heteractis* sp. It has also been found in association with *Heteractis malu* (Haddon & Shackleton). (See Table 1). It also occurs on *Heterodactyla hemprichi* Ehrenberg.

Distribution.—Not previously recorded from the Red Sea. Known only from the type locality (Hong Kong), Kenya, Japan and the Marshall Islands.

Periclimenes longicarpus nov. spec.
(figs. 4—8)

Material examined.—3 ♀, 1 juvenile (no. 2392) (10—ii—76, 15 m, Aqaba, Jordan), leg. A. Svoboda. The holotype, ♀, C.L. 4.8 mm, is deposited in the collections of the Rijksmuseum van Natuurlijke Historie, Leiden, catalogue no. D 33228. A paratype, ♀, C.L. 5.1 mm is in the collection of the British Museum (Natural History) London, catalogue no. 1981 : 47 and two paratypes, 1 ♂ and the juvenile, are in the U.S. National Museum of Natural History, catalogue no. USNM 184107.

Description.—A medium sized, slenderly built pontoniine shrimp. The four specimens have many of the pereiopods detached, and in two of the specimens the rostrum is also detached.

The carapace is smooth, with a well developed rostrum that extends anteriorly to the level of the distal margin of the proximal segment of the antennular peduncle. The rostrum is compressed, with a feeble lateral carina situated

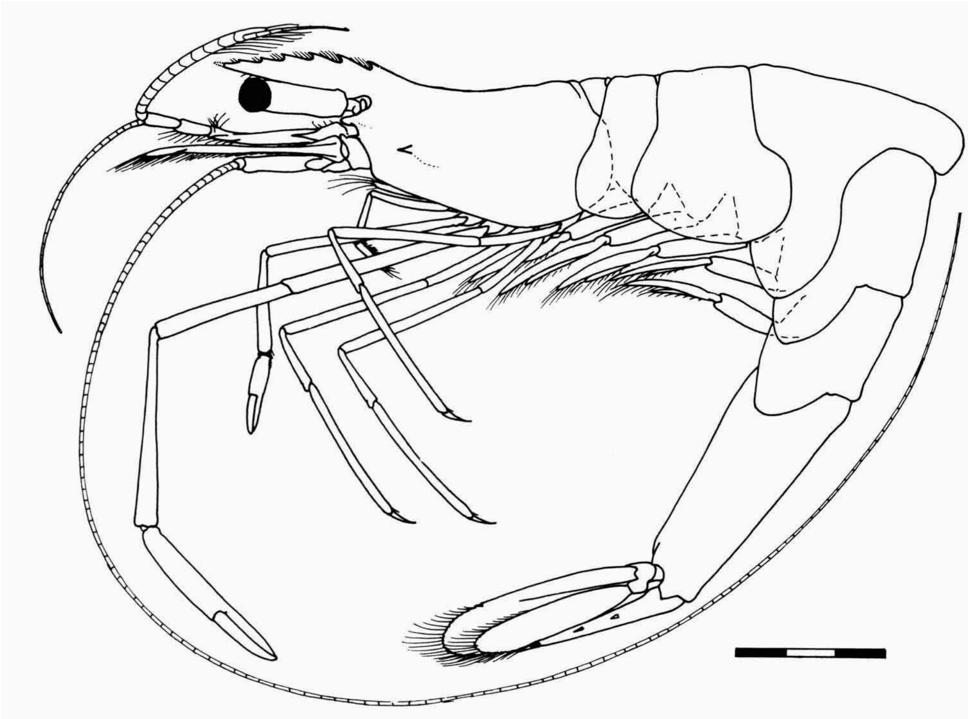

Fig. 4. *Periclimenes longicarpus* nov. spec. Holotype, Aqaba, Jordan.

close to the lower margin and is horizontal, tapering to a slender acute point distally. The dorsal lamina is elevated and bears 5–6 acute teeth; the first is situated over the orbit. The first four teeth are subequal in size and without denticulations on the ventral margin, the more distal teeth are distinctly smaller. The ventral lamina is obsolescent but two minute acute denticles may be present on the distal fourth of the rostrum. The proximal three quarters of the ventral margin is feebly convex with plumose setae. Epigastric and supraorbital spines are absent. The orbit is feebly developed. The inferior orbital angle is well developed, stout and bluntly produced, with an inner flange. The antennal spine is slender and marginal, well below the level of the inferior orbital angle and slightly above that of the hepatic spine, which is more robust and situated at 0.2 of the carapace length. The antero-lateral angle of the branchiostegite is bluntly obtuse.

The abdomen is large in comparison with the cephalothorax, and the segments are smooth. The third segment is conspicuously produced into a large, rounded, compressed, postero-medial hump. The fifth segment is about 0.45 of the length of the sixth, which exceeds the carapace length, about 2.5 times longer than deep, and is strongly bilaterally compressed. The postero-ventral angle is small and blunt and the postero-lateral angle large and more acute. The first three pleura are broadly rounded, the fourth and fifth bluntly produced posteriorly.

The telson is about 0.75 of the carapace length, 2.5 times longer than wide anteriorly, the lateral margin almost straight, slightly convergent to a transverse posterior margin equal to 0.29 of the anterior width. Two pairs of small, subequal dorsal spines are present at 0.62 and 0.83 of the telson length. Three pairs of posterior telson spines are present. The lateral spines are slightly larger than the dorsal spines. The intermediate spines are stout, about three times the length of the lateral spines, equal to about 0.075 of the telson length and four times longer than broad. The submedian spines are short and simple, about half the length of the intermediate spines.

The eyes are well developed. The cornea is globular, slightly oblique, with a small accessory pigment spot. The podophthalmite is subcylindrical and about three times longer than wide. The basiophthalmite bears a distinct lateral flange that articulates with the ventral margin of the orbit.

The antennules are slender and the peduncle exceeds the tip of the rostrum by two distal segments. The proximal segment is about 3.4 times longer than wide, tapering slightly distally. The lateral border is straight and bears a slender acute distal tooth, that does not exceed the antero-lateral margin, which is produced as a setose lobe. The medial margin is straight, setose and without a ventral tooth. The stylocerite is slender and acute, extending to about 0.8 of the length of the proximal segment. The statocyst is normal, with a subcircular statolith. The intermediate and distal segments are subequal, together equal to a little less than half the length of the proximal segment. The segments are about three times longer than wide. The upper flagellum is biramous with the rami fused for the first ten segments. The shorter free ramus consists of 1–2 segments and there are nine groups of aesthetascs present. The longer free ramus has about eight slender segments. The lower ramus is filiform, with about thirty slender segments.

The antenna has a robust basicerite, with a small, short lateral spine. The ischiocerite and merocerite are normal. The carpocerite is slender, about 4–5 times longer than wide, and reaching to about the middle of the scaphognathite, which is 3–4 times longer than broad. The lateral border is straight, with a slender acute distal tooth, that is far exceeded by the broadly rounded anterior margin of the lamella. The greatest width is situated distally, at about the level of the lateral spine. The flagellum is long and slender, equal to about eight times the carapace length.

The fourth thoracic sternite is narrow and unarmed. The following somites broaden progressively posteriorly and are also unarmed.

The mandible is moderately robust and without a palp. The molar process is stout, obliquely truncated distally, with a few large blunt teeth and a small group of short setae anteriorly. The incisor process is short, broad, tapering distally to end with three acute teeth of which the central is the smallest and the lateral the largest. The distal medial margin also bears two minute denticles.

The maxillula is normal, with a feebly bilobed palp, on which the small lower lobe bears a rather stout subconical spine. The upper lacinia bears about seven simple spines distally, with several finely serrulate setae. The lower lacinia is normal, tapering distally to terminate with a couple of slender spines and several serrulate setae.

The maxilla has a slender non-setose palp. The basal endite is short, tapering, with a single terminal seta. The coxal region is feebly produced, convex. The scaphognathite is slender, about 3.7 times longer than wide. The anterior lobe is narrow and the posterior lobe well developed.

The first maxilliped has an elongated subcylindrical non-setose palp. The basal endite is broad, round distally with a straight medial border, with numerous short, finely setulose setae. A small notch separates the basal endite from the coxal endite, which is sparsely provided with setae. The exopod is well developed, the flagellum bearing four plumose terminal setae, with a few shorter setae proximally. The caridean lobe is well developed, narrow and elongated, extending beyond the end of the palp. The epipod is small, rounded, feebly notched laterally.

The second maxilliped is normal. The dactylar segment is about 4.3 times longer than wide and densely fringed medially with stout, coarsely serrulate spines. The propodal segment is rounded antero-medially, bearing about 7–8 long slender serrulate spines. The coxa is angularly produced medially, with a few simple setae. The exopod is normal and a small subrectangular epipod is present.

The endopod of the third maxilliped is slender, extending anteriorly to about one third of the length of the carpocerite. The ischio-merus and basis are fused, the junction being indicated by a small protuberance on the medial border. The combined segment is about 13 times longer than its central width, slightly wider proximally and sparsely fringed with simple setae along its medial border. The penultimate segment is about 0.7 of the length of the antepenultimate, about twelve times longer than the central width, with almost subparallel sides. The medial border bears numerous grouped, serrulate, slender spines. The terminal segment is about half the length of the antepenultimate, about eight times longer than the central width, and with about eight groups

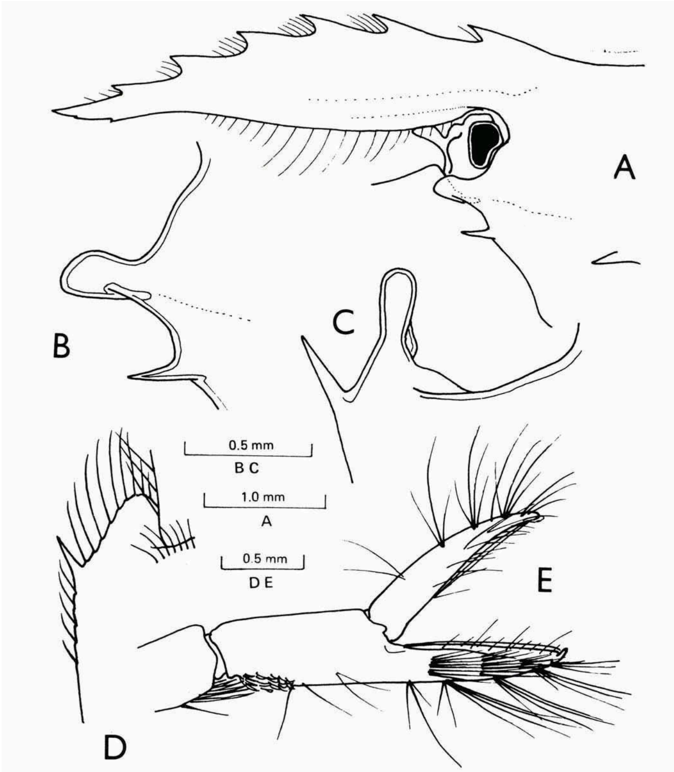

Fig. 5. *Periclimenes longicarpus* nov. spec. A, anterior carapace, rostrum and ophthalmic somite. B, inferior orbital angle, lateral. C, inferior orbital angle, dorsal. D, disto-lateral angle of proximal segment of antennular peduncle. E, chela of first pereiopod.

of robust serrulate spines along the medial and lateral margins and with 2—7 slender terminal spines. The exopod is similar to that of the second maxilliped. A small rounded epipod is present on the coxa laterally, and a unilamellar arthrobranch. The medial margin of the coxa is very feebly produced and sparsely setose.

The first pereipods are moderately slender and extend beyond the antennular peduncle and the tip of the scaphocerite by the fingers of the chela. The palm of the chela is subcylindrical, slightly compressed, about 2.5 times longer than deep, with 5—6 transverse rows of cleaning setae proximally. The fingers are slender, with entire, laterally situated cutting edges and small, hooked tips. Numerous groups of simple and longer serrulate setae are present on the fingers. The carpus is about 1.7 times the length of the chela, about nine times longer than the distal width, which is about twice the proximal width. The merus is subequal to the carpus and of uniform width, freely articulated with

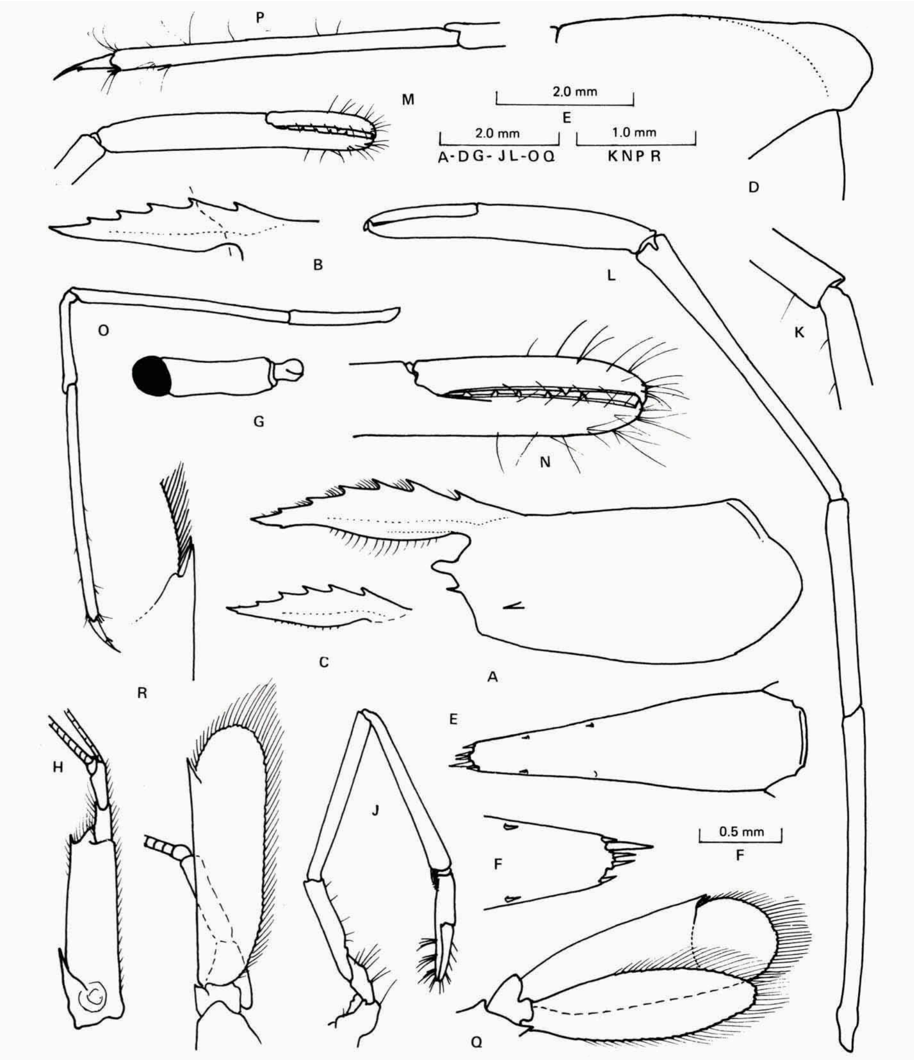

Fig. 6. *Periclimenes longicarpus* nov. spec. A, carapace and rostrum. B, rostrum of female. C, rostrum of juvenile. D, third abdominal segment, lateral. E, telson. F, posterior telson spines. G, eye. H, antennule, I, antenna. J, first pereiopod. K, ischio-meral joint of first pereiopod. L, second pereiopod. M, chela of second pereiopod. N, fingers of second pereiopod. O, fifth pereiopod. P, propod and dactylus of ambulatory pereiopod. Q, uropod.

the ischium, which is 5.5 times longer than wide, and subequal to the length of the chela. The basis is half the length of the ischium, with a sparsely setulose medial border. The coxa is short and without a medial process.

The second pereiopods are elongated and slender, similar and sub-equal, exceeding the antennular peduncle by the distal third of the merus in one

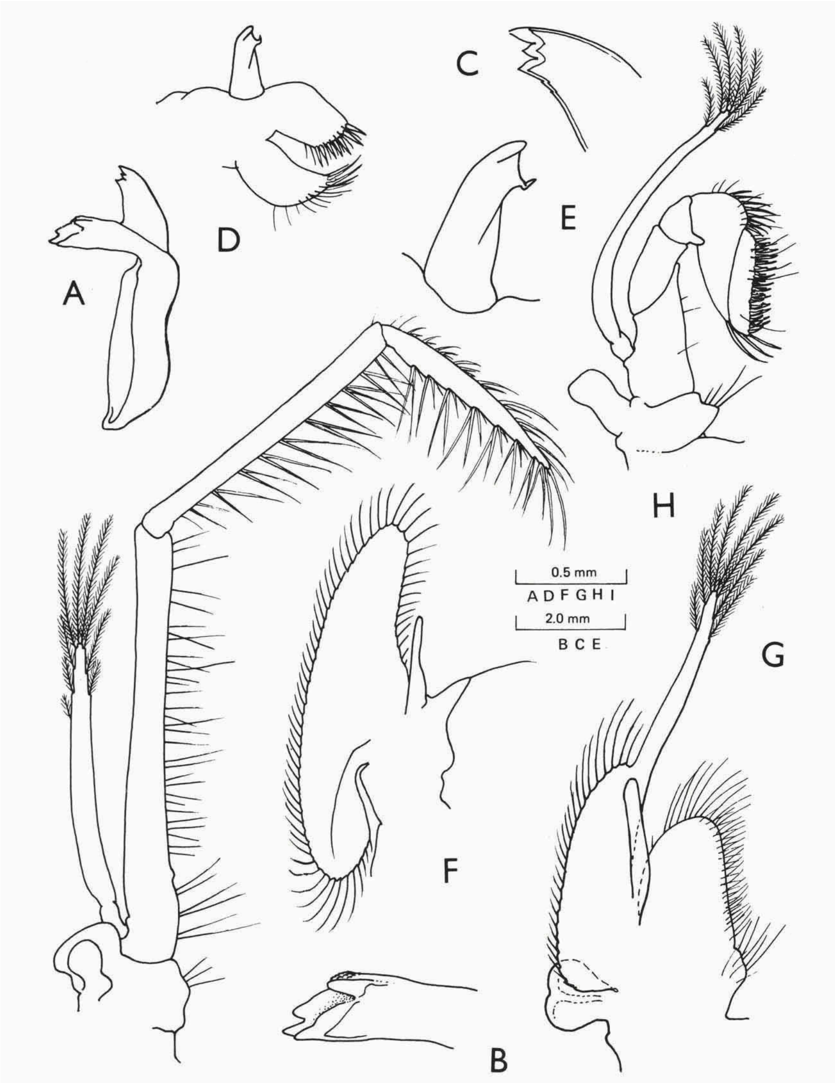

Fig. 7. *Periclimenes longicarpus* nov. spec. A, mandible. B, molar process. C, incisor process. D, maxillula. E, palp of maxillula. F, maxilla. G, first maxilliped. H, second maxilliped. I, third maxilliped.

specimen, slightly shorter in others. The palm is subcylindrical, smooth, about five times longer than deep. The fingers are equal to 0.7 of the palm length, straight, feebly tapering, with small hooked tips. The cutting edge of the dactylus bears a single small acute, slightly recurved tooth at two thirds of its length. The fixed finger bears five similar small teeth, approximately equally spaced, with the single tooth on the dactylus opposing centrally between the

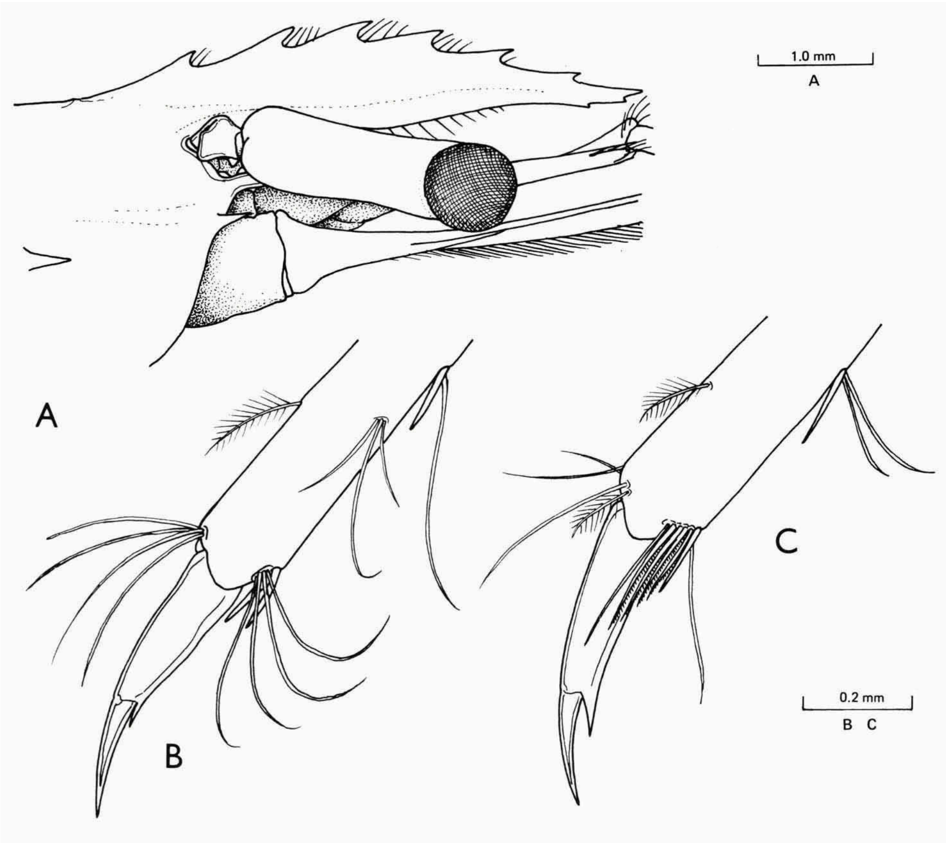

Fig. 8. *Periclimenes longicarpus* nov. spec. A, orbital region. B, dactylus of third pereiopod. C, dactylus of fifth pereiopod.

fourth and fifth teeth. The cutting edges are otherwise entire. The fingers are sparsely setose. The carpus, merus and ischium are unarmed. The carpus is slightly broadened distally, about 21 times longer than its central width, 2—3 times wider distally than proximally and 1.2 of the length of the chela. The merus is 0.66 of the length of the carpus, which is slightly exceeded by the length of the ischium. The basis and coxa are normal.

The ambulatory pereiopods are slender. The third pereiopod exceeds the scaphocerite by the dactylus and the distal third of the propod. The dactylus is slender, with a distinct unguis, equal to about 0.6 of the corpus, which is about three times longer than deep, and bears a very slender accessory spine distoventrally. The propod is about five times the length of the dactylus, 17 times longer than wide distally, with a pair of disto-ventral spines and a single distal ventral spine. The carpus is unarmed, about 2.3 times the propod length. The merus is slender, slightly shorter than the propod, and the ischium is subequal to the carpus. The fourth and fifth pereiopods are similar, but the propod and meri are slightly longer. The propod of the fifth pereiopod has several coarsely serrulate setae disto-ventrally and only a disto-ventral spine, and the accessory spine of the dactylus is more strongly developed.

The pleopods are normal. The uropods are well developed and extend well beyond the tip of the telson. The protopodite is postero-laterally rounded. The endopod is about three times longer than wide, widest and broadly rounded distally, with a well marked diaeresis. The lateral border is feebly convex, with an acute tooth distally, adjacent to a larger slender mobile spine. The endopod is shorter than the exopod, about 3.3 times longer than wide, with the greatest width centrally.

Measurements

	Holotype	Paratype i	Paratype ii	Juvenile
C.L.	4.8	5.1	5.0	3.7
P2, right chela	5.2	4.0	5.0	3.0
P2, right carpus	5.6	4.2	5.2	2.9
P2, left chela	5.1	4.0	4.5	3.0
P2, left carpus	5.7	4.2	5.2	2.9

Colouration.—Body transparent, with V-shaped white patch dorsally on the third abdominal segment, bordered anteriorly by violet-blue dots. A median white line extends throughout the length of the abdomen. Sixth abdominal segment with white spots anterior to margin of telson, which has a white tip. Eyestalks white, connected by a white band. First and second pereiopods white, with dactylar hinge dark blue, with other joints of a similar dark blue. Exopod of uropod with vivid blue eyespots; tip of endopod with white patch.

Host.—*Entacmaea quadricolor* Ehrenberg (Actiniaria). Also observed at Al Ghardaqa on *Entacmaea quadricolor, Heteractis aurora* (Quoy 8 Gaimard, 1833) and rarely on *Megalactis hemprichi* Ehrenberg, 1834, at similar depths. (See Table 1).

Behaviour/Ecology.—Up to six individuals may occur amongst the tentacles of a single large specimen of *Entacmaea quadricolor* with fewer specimens on smaller examples. Occasionally the clownfish *Amphiprion bicinctus* may be found on the same host but no antagonistic behaviour has been observed.

So far, all specimens obtained from anemones have been females. On one occasion, at dawn at 30 m, two specimens were observed without any anemo-

TABLE 1

The hosts of the Indo-West Pacific Anemone-associated species of *Periclimenes*

P. tenuipes Borradaile	*Cryptodendron adhaesivum* Klunzinger, 1877		This report
	Entacmaea quadricolor Ehrenberg, 1834		This report
	Megalactis hemprichii Ehrenberg, 1834		This report
P. brevicarpalis (Schenkel)	*Actinodendron* sp.		Jacquotte, 1964
	Cryptodendron adhaesivum Klunzinger, 1877		Hipeau-Jacquotte, 1973
	Entacmaea quadricolor (Rüppel & Leuckart, 1828)	as *Parasicyonis actinostroides* and *P. maxima*	Suzuki & Hayashi, 1977
		as *Physobranchia* sp.	Bruce, 1974
	? *Heteractis* sp.	as *Radianthus "maculata"**	Suzuki & Hayashi, 1977
	Heteractis magnifica (Quoy & Gaimard, 1833)	as *Radianthus ritteri*	Bruce, 1971
	Heteractis malu (Haddon & Shackleton, 1893)	as *Radianthus malu*	Bruce, 1979
	Stichodactyla haddoni (Saville-Kent, 1893)	as *Stoichactis haddoni*	Saville-Kent, 1893
	Stichodactyla gigantea (Forskål, 1775)	as *Stoichactis kenti*	Stephenson et al, 1931; Kubo, 1940
	? *Stichodactyla mertensii* Brandt, 1836 (possibly *S. gigantea*)	as *Stoichactis giganteum*	Coutière, 1898; Nobili, 1906; Gravely, 1927; Nayar, 1947; Saville-Kent, 1893
	Thalassanthius hypnoides (Saville-Kent, 1893)		Stephenson, et al, 1931
P. indicus (Kemp)	*Macrodactyla aspera* (Haddon & Shackleton, 1893)		Bruce, 1977a
P. inornatus Kemp	*Heteractis magnifica* (Quoy & Gaimard, 1833)	as *Radianthus ritteri*	Bruce, 1971, 1976

P. holthuisi Bruce	*Dofleinia armata* Wassilieff, 1908		Suzuki & Hayashi, 1977
	Entacmaea quadricolor (Rüppell & Leuckart 1828)		This report
	Entacmaea quadricolor (Rüppell & Leuckart, 1828)	as *Parasicyonis actinostroides*	Suzuki & Hayashi, 1977
	? Heteractis sp.	as *Radianthus "maculata"**	Suzuki & Hayashi, 1977
P. ornatus Bruce	*Entacmaea quadricolor* (Rüppell & Leuckart, 1828)		This report
	Entacmaea quadricolor (Rüppell & Leuckart, 1828)	as *Radianthus malu*	Suzuki & Hayashi, 1977
	Heteractis malu (Haddon & Shackleton, 1893)	as *Parasicyonis actinostroides* and *P. maxima*	Bruce, 1979
	Heterodactyla hemprichi Ehrenberg, 1834		Bruce, (unpubl.)
P. ornatellus Bruce	*Heteractis malu* (Haddon & Shackleton, 1893)	as *Radianthus malu*	Bruce, 1979
P. magnificus Bruce	*Dofleinia armata* Wassilieff, 1908		Bruce, 1979a
P. longicarpus nov. sp.	*Entacmaea quadricolor* (Rüppell & Leuckart, 1828)		This report
	Heteractis aurora (Quoy & Gaimard, 1833)		This report

* Reported by Suzuki & Hayashi as *Radianthus maculata* Klunzinger, but this author did not describe a species *"maculata"* in any genus (D. F. Dunn, pers. comm.).

nes being seen. The shrimps do not occur on hosts exposed to wave action.

Systematic position.—*Periclimenes longicarpus* is most closely related to *P. holthuisi* and to a lesser extent to *P. aesopius* (Bate, 1863) and *P. tosaensis* Kubo, 1951. *P. longicarpus* may be readily distinguished from *P. holthuisi* principally by the morphology of the rostrum, inferior orbital angle, eye and ophthalmic somite and the second pereiopods. From *P. aesopius, P. longicarpus* differs in the absence of post-rostral teeth on the carapace, and from *P. tosaensis* by the presence of accessory spines on the dactyls of the ambulatory pereiopods. The differences between *P. longicarpus* and *P. holthuisi* are summarized below:

P. longicarpus

i. rostral dentition 5–6 / 0–2 (minute), without post-orbital teeth.
ii. inferior orbital angle strongly produced, stout and blunt, with feeble inner flange.
iii. ophthalmic somite with large "bec ocellaire" extending to contact lower border of rostrum in some specimens.
iv. elongated eyestalk, podophthalmite three times longer than wide.
v. second pereiopod elongated, with carpus distincly longer than chela. Fingers of second pereiopod with a single small acute tooth on dactylus and five small equally spaced teeth on proximal three fourths of fixed finger.
vi. conspicuous development of dorsal hump on third abdominal segment.

P. holthuisi

i. rostral dentition 8–13 / 1–4 (minute), with 1–2 post-orbital teeth.
ii. inferior orbital angle strongly produced, compressed, distally acute, with strong inner flange.
iii. ophthalmic somite with small "bec ocellaire" only.
iv. eyestalk normal, podophthalmite about twice as long as wide.
v. second pereiopod not conspicuously elongated, carpus distinctly shorter than chela. Fingers of chela unarmed or with two small teeth proximally on dactylus and three larger ones on the fixed finger.
vi. moderate dorsal hump on third abdominal segment.

Both species may also be readily distinguished by their characteristic colour pattern.

Remarks.—The discovery of *P. longicarpus* at Aqaba, on an actinarian host, confirms the association of the "*P. aesopius* species group" with coelenterates, particularly sea anemones. The species is particularly remarkable for the development of the "bec ocellaire". This was originally described by Coutière (1899 : 108) in alpheid shrimps and is of rare occurrence in palaemonid shrimps. Its presence has been recorded in *P. aesopius* (Bruce, 1977a : 221, 222). Its function remains obscure.

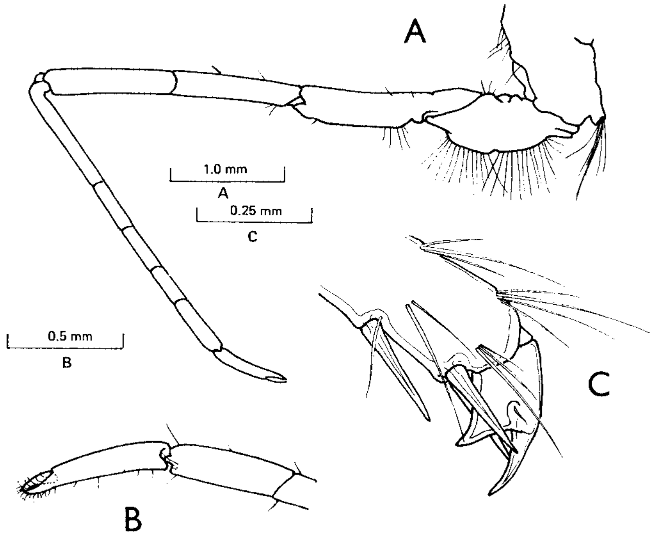

Fig. 9. *Thaumastocaris streptopus* Kemp. A, first pereiopod. B, chela and distal carpus of first pereiopod. C, dactylus of third pereiopod.

Thaumastocaris streptopus Kemp
(fig. 9)

Thaumastocaris streptopus Kemp, 1922 : 244–247, figs. 78–80. Holthuis, 1952 : 13, 111–114, figs. 46–47. Bruce, 1975 : 61, figs. 8, 12, 17–fig.; 1978a : 206, 255–256; 1979 : 227–228, fig. 3 c–d.

Material examined.—1 ovigerous ♀, C.L. 6.5 mm (no. 2555), (11 –iv– 77, 20 m, Aqaba, Jordan), leg. M. Mastaller.

Description.—Agrees closely with previously published descriptions. The rostral dentition is 9/4, with three teeth situated posteriorly to the orbital margin. The tip of the rostrum reaches the distal border of the intermediate segment of the antennular peduncle.

The first pereiopods are similar and slender, with five segments on each carpus, and when extended exceed the scaphocerite by the chela and distal segment of the carpus. The merus consists of two subequal segments, and is equal in length to the four proximal segments of the carpus. The ischium has the ventral border equal to about half the length of the merus. The basis has the ventral border semi-carinate and bears two longitudinal rows of simple setae, its total length slightly exceeding the ventral length of the ischium. The coxa is stout and has a small ventro-medial setiferous process. The chela is only slightly longer than the distal segment of the carpus, and its fingers are equal to less than one third of the palm length. The tips of the fingers are feebly bifid.

The second pereiopods are both present, large, strongly tuberculate on the palm and markedly unequal.

The ambulatory pereiopods are robust, with a short dactylus bearing a very robust accessory spine, which is distinctly stouter than the feebly demarkated, slender unguis. Small sensory setae are present disto-laterally on the corpus. The propods bear a pair of particularly large distoventral spines, which lie on either side of the partly flexed dactylus.

The ova are numberous and about 0.6 mm in length.

Colouration.—Pale pinkish.

Host.—*Siphonochalina siphonella* Levi, 1965 (Porifera).

Behaviour/Ecology.—This species lives within the spongocoel of the host, which occurs on reef slopes exposed to weak currents only, generally below fans of *Acropora scandens*, Klunzinger, 1879.

Remarks.—This species has been previously reported in association with sponges of the genera *Siphonochalina, Haliclone, Callyspongia, Petrosia* and *Acarnus*.

The form of the first pereiopods closely resembles the details reported by Kemp (1922: 246) of the holotype specimen from Noumea, New Caledonia, and differs markedly from the Indonesian specimens described by Holthuis (1952 : 114) in which these limbs were noticeably asymmetrical, one long and slender and the other shorter and robust, the latter with the carpus only feebly segmented.

Distribution.—Not previously recorded from the Red Sea. Type locality: Noumea, New Caledonia. Also recorded from Somalia, Kenya, Zanzibar, Madagascar, Indonesia, Caroline and Marshall Islands.

Hamodactylus aqabai nov. spec.
(figs. 10–14)

Material examined.—1 ovigerous ♀ (no. 2398), 6 m, (24–ii–76, Aqaba, Jordan), leg. A. Svoboda. The holotype, an ovigerous female, with dissected appendages, is deposited in the collections of the Rijksmuseum van Natuurlijke Historie, Leiden, catalogue no. D33233.

Description.—A small sized, rather slender pontoniine shrimp, with slender pereiopods. The specimen is complete, with all appendages.

The carapace is smooth, distinctly swollen in the cardiac region. The rostrum is well developed, reaching to the middle of the intermediate segment of the antennular peduncle. The lamina is deep, with the lateral carina situated near to the convex, setose, toothless ventral margin. The dorsal margin is con-

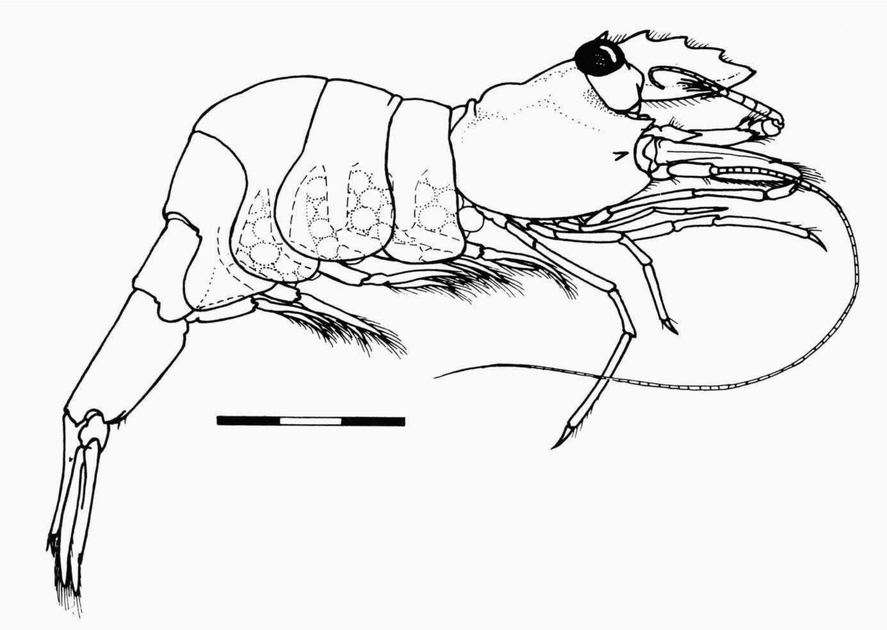

Fig. 10. *Hamodactylus aqabai* nov. spec. Holotype, female. Aqaba, Jordan.

vex and elevated, strongly compressed, with four large subequal teeth, of which the first is situated posteriorly to the level of the posterior margin of the orbit. A rudimentary preterminal tooth is also present. Supra-orbital spines are absent. The orbit is obsolescent. The inferior orbital angle is well developed, acutely produced in lateral view. The antennal spine is small and slender, marginal, situated closely below the inferior orbital angle. The hepatic spine is larger and more robust than the antennal, situated just behind the level of the posterior orbital margin and well below the level of the antennal spine. The antero-lateral angle is moderately produced.

The abdominal segments are smooth. The third segment is not produced postero-dorsally. The first segment is about 0.55 of the length of the sixth, which is twice as long as deep. The pleura are all broadly rounded, that of the fifth segment being rather small. The postero-ventral angle is feebly produced and the postero-lateral angle feebly acute.

The telson is 0.85 of the length of the sixth abdominal segment and 3.1 times longer than wide anteriorly. The lateral margins converge posteriorly, feebly over the anterior half and more strongly over the posterior half. A pair of very small marginal dorsal spines is present at the middele of the telson length. The posterior margin is feebly angular, about one third of the anterior width, with three pairs of spines. The lateral spines are short, but distinctly

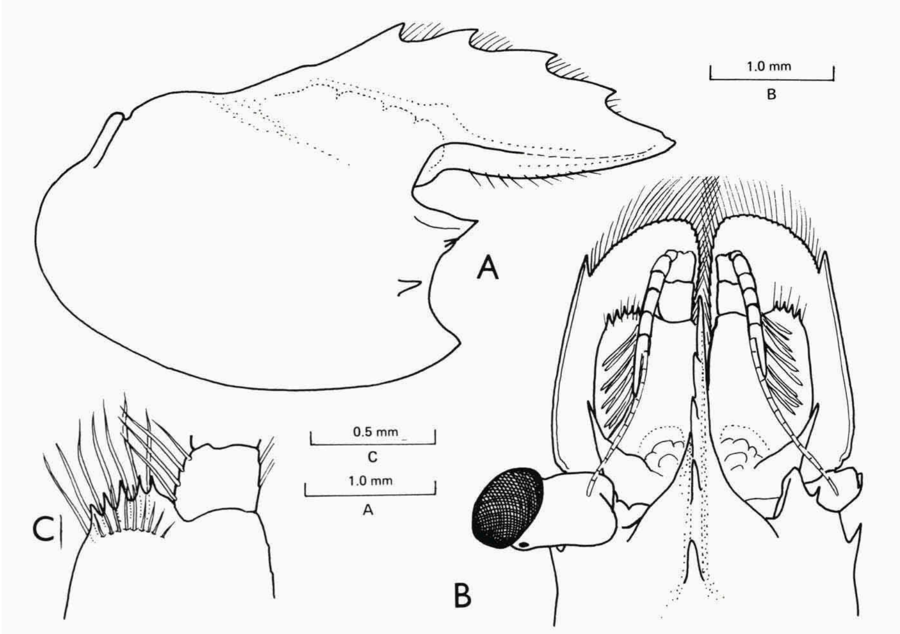

Fig. 11. *Hamodactylus aqabai* nov. spec. Holotype. A, carapace and rostrum. B, anterior carapace, rostrum and antennae, dorsal aspect.

longer than the dorsal spines. The intermediate spines are well developed, 1.16 of the telson length and 1.3 times the length of the more slender submedian spines, which are finely plumose proximally.

The eyes are well developed. The cornea is globular and very obliquely set on the stalks, which are swollen proximally and have a distinct accessory pigment spot posteriorly.

The antennular peduncle is normal and exceeds the tip of the rostrum by half the length of the intermediate segment. The proximal segment is broad, 1.7 times longer than wide. The stylocerite is slender and acute and reaches almost to the middle of the segment. The lateral border is feebly convex and the antero-lateral margin is slightly produced, bearing 3—5 small acute teeth and numerous setae. The medial ventral margin is without a tooth. The statocyst is normally developed and contains a granular statolith. The intermediate and distal segments are short, together equal to 0.37 of the proximal segment length. The upper flagellum is biramous, with the first four segments of each ramus fused. The shorter free ramus is indistinctly segmented and the longer ramus consists of 10—11 slender segments. There are five groups of aesthetascs present. The lower flagellum is missing.

The antennule has a robust basicerite, without a lateral tooth. The ischiocerite and merocerite are normal. The carpocerite is slender, reaching to the middle of the scaphocerite. The scaphocerite is large and broad, and the lamella extends well beyond the antennular peduncle. The lateral border is almost straight and ends in an acute distal tooth. The lamella extends far beyond the tooth and is feebly angulated disto-medially, about 2.2 times longer than broad, with the greatest width at about one third of its length.

The fourth thoracic sternite is unarmed.

The mandible is rather feeble, with a small, cylindrical molar process bearing a few setae distally. The incisor process is of normal size and has four well developed teeth distally, of which the most lateral is enlarged. The mandible is without a palp.

The maxillula has a slender feebly bilobed palp, the lower lobe bearing a small seta distally. The upper lacinia is rather short and stout, with robust simple spines and spinose setae distally. The lower lacinia is slender with numerous slender simple setae distally.

The maxilla has a short tapering non-setose palp. The basal endite is also short, stout and blunt, with two simple setae distally. The coxal endite is absent, the medial region being slightly convex. The scapho-gnathite is normal, widest centrally, about 2.2 times longer than broad, with a slender posterior lobe. The marginal plumose setae are well developed with especially coarse setules.

The first maxilliped has a short, slender, tapering non-setose palp. The basal region is broad and round and not distinctly separated from the coxal region. The median margin is sparsely provided with slender setulose setae. The caridean lobe is large, with coarsely setulose plumose marginal setae. The flagellum of the endopod is greatly reduced and devoid of setae. A small rounded epipod is present.

The second maxilliped has a small dactylar segment, about 1.6 times longer than wide, convex medially, bearing 14 stout biserrulate spines. The propodal segment is large, twice as long as the dactylar segment, twice as long as wide, with a subrectangular disto-medial angle. The medial margin is almost straight and bears about 20–22 coarsely serrulate spines. The carpus and merus are normal. The ischium is completely fused to the basis, which lacks any trace of an exopod. The coxa is not produced medially and bears a small, suboval epipod laterally.

The third maxilliped has a broad antepenultimate segment, about three times longer than wide centrally. The basis is completely fused with the ischiomerus, the junction being indicated medially by a small knob. The median margin is sparsely provided with simple setae over the proximal two thirds. A row of five long setulose setae is present distally submarginally. The

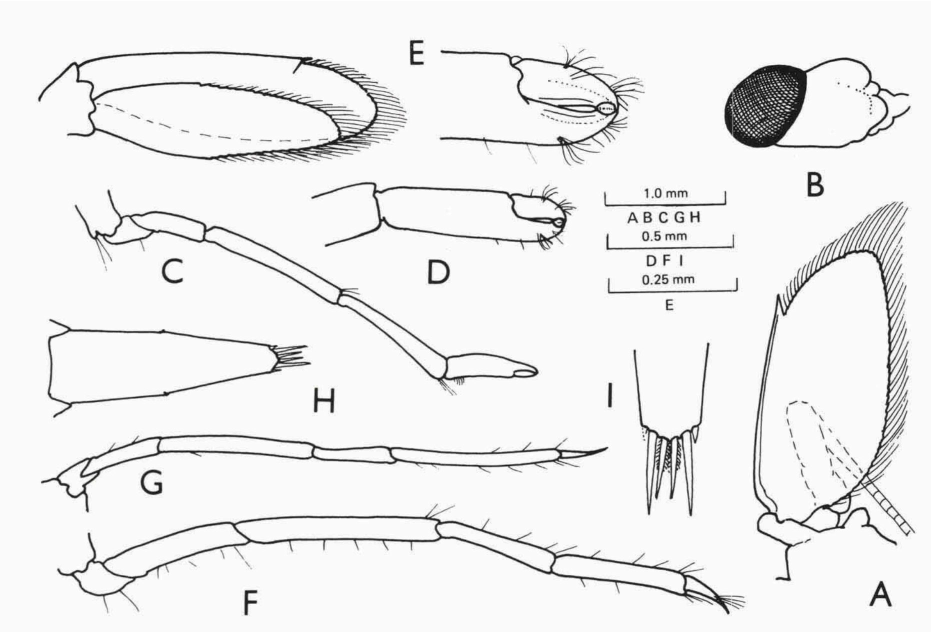

Fig. 12. *Hamodactylus aqabai* nov. spec. Holotype. A, antennal peduncle. B, eye. C, first pereiopod. D, chela of first pereiopod. E, fingers of chela of first pereiopod. F, second pereiopod. G, third pereiopod. H, telson. I, posterior telson spines. J, uropod.

penultimate segment is slender, 3.2 times longer than wide, 0.33 of the length of the antepenultimate segment and with four slender setulose setae distally on the medial border. The terminal segment is five times longer than wide, 1.2 times the length of the penultimate segment, with nine groups of short serrulate setae medially and slender simple terminal setae. There is no trace of any exopod. The coxa is feebly produced medially and bears a rounded epipod laterally. A small multilamellar arthrobranch is present laterally.

The first pereiopod is slender and reaches to the end of the scaphocerite. The chela has the palm subcylindrical, slightly bowed and compressed, about 2.8 times longer than wide. The fingers are short, 0.27 of the palm length, feebly subspatulate. The cutting edges gape proximally and bear a small blunt tooth at about 0.6 of the length. A deep notch separates this tooth from the tip, which is provided with a very thin denticulate lamella laterally. The tip of the dactylus bears a distinct spine and a smaller spine is also present medially. Cleaning setae are present proximally on the palm and on the disto-ventral end of the carpus, which is 1.4 times the length of the chela, 5.4 times longer than wide, and moderately wider distally. The merus is about 1.15 times longer than the carpus and twice the length of the ischium. The basis is normal.

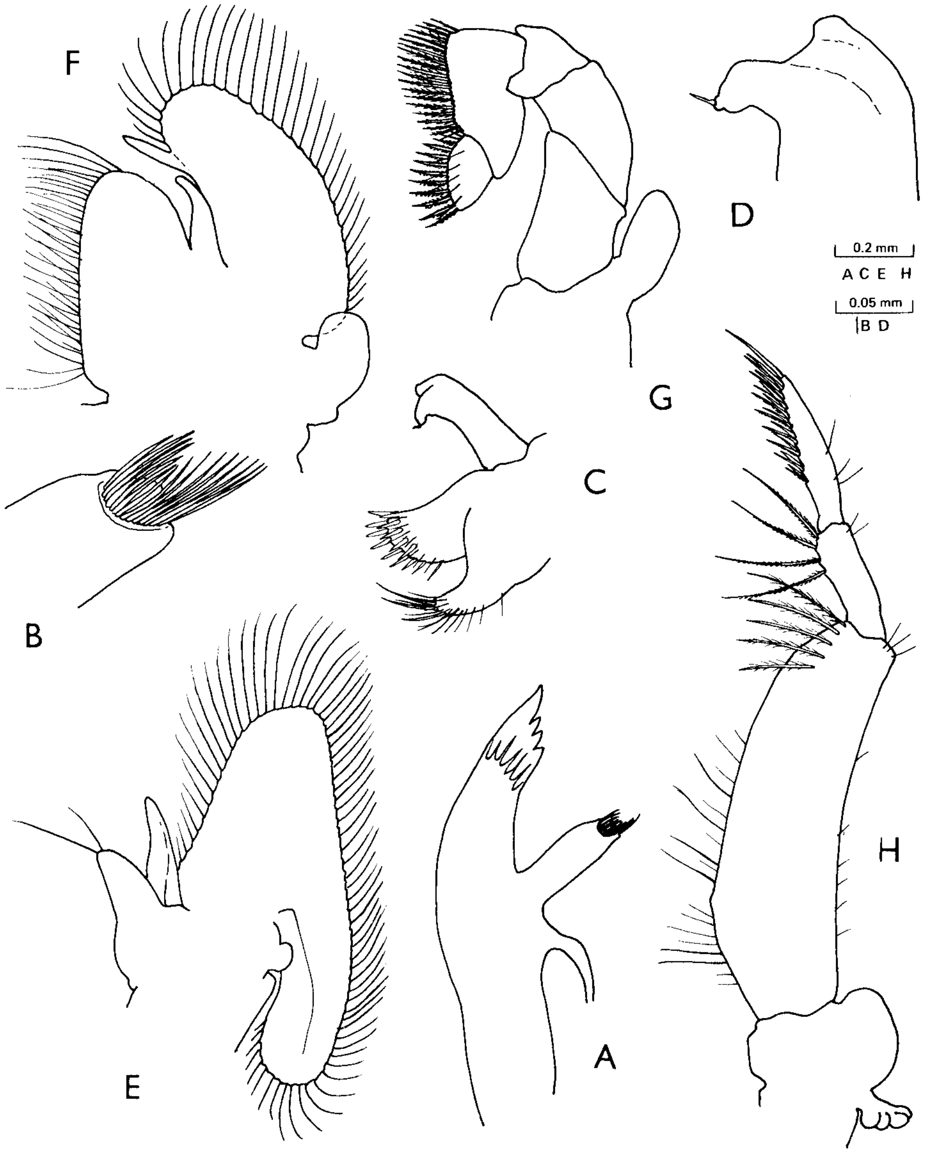

Fig. 13. *Hamodactylus aqabai.* nov. spec. Holotype. A, mandible. B, distal molar process. C, maxillula. D, distal part of maxillular palp. E, maxilla. F, first maxilliped. G, second maxilliped. H, third maxilliped.

The coxa bears a very small medial setose process.

The second pereiopods are greatly reduced, subequal and similar, only extending slightly beyond the carpocerite. The chela is obsolescent. The dactylus

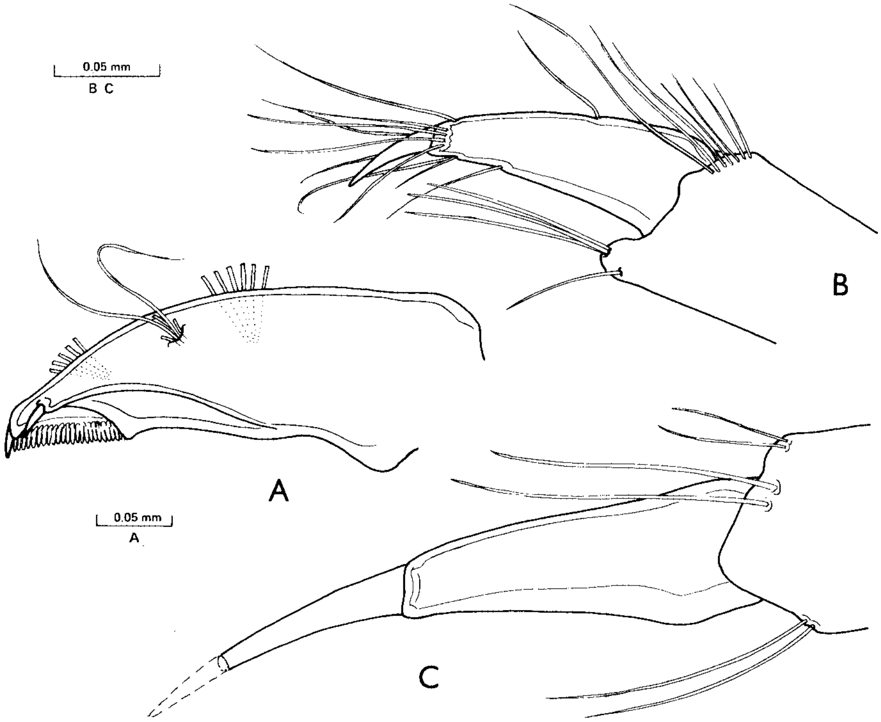

Fig. 14. *Hamodactylus aqabai* nov. spec. Holotype. A, dactylus of first pereiopod. B, fingers of second pereiopod. C, dactylus of third pereiopod.

resembles that of an ambulatory pereiopod. The unguis is distinct and the corpus without accessory spines or teeth. Setae arise from the anterior, disto-ventral and extreme disto-lateral aspects of the corpus, which is about 2.6 times longer than wide and 2.5 times longer than the unguis. The propod is subcylindrical, about 6.5 times longer than wide centrally and 2.3 times the length of the dactyl, with the disto-ventral angle produced as a small rounded knob, bearing three simple setae. The propod is without spines. The carpus, merus and ischium are also unarmed, their lengths in the ratio of 0.9, 1.5 and 1.1 times the length of the propod. The basis and coxa are normal.

The ambulatory pereiopods are normal but slender, distinctly more robust than the second pereiopods. The third pereiopod exceeds the tip of the scaphocerite by the distal third of the propod. The dactyl is slender, uniformly tapering, unarmed and with a distinct unguis. The total length is about five times the width near the base. The propod is about twelve times longer than wide, 3.6 times the length of the dactyl, and devoid of spines. The carpus, merus and ischium are 0.50, 0.92 and 0.52 of the propod length and are also unarmed. The fourth and fifth pereiopods are similar.

The pleopods are well developed. The marginal plumose setae of the exopod and endopod are coarsely serrulate.

The uropods are slender and extend well beyond the tip of the telson. The protopodite is unarmed laterally. The exopod has the lateral border almost straight, entire, terminating in a small mobile spine. The exopod is about 3.6 times longer than wide and extends well beyond the endopod, which is 3.3 times longer than wide.

Measurements

Total length, (approx.)	15.0 mm
Carapace and rostrum	4.7 mm
Post-orbital carapace	2.5 mm
Diameter of ova	2.5 mm

Colouration.—Transparent, with ochraceous-green spots.

Host.—*Litophyton arboreum* Forsskål, 1775 (Alcyonacea).

Behaviour/Ecology.—On account of its cryptic colouration and the densely tufted form of the host, the shrimp is almost invisible *in situ*. The single example was caught when wiping off the host with both hands. *Litophyton* is extremely common from 1—40 m, but the shrimps appear to be extremely rare. A small goby, *Cottogobius* sp., also occurs on this host in small numbers.

Systematic position.—*Hamodactylus aqabai* is most closely related to *H. noumeae* Bruce, 1970, which it resembles in the absence of a supra-orbital spine, a character present in *H. boschmai* Holthuis, 1952. Both *H. aqabai* and *H. noumeae* also have a multidentate disto-lateral lobe on the proximal segment of the antennular peduncle. *H. aqabai* can be readily distinguished from *H. noumeae* by (1) the dentition of the fingers of the first pereiopods and (2) the non-chelate second pereiopods.

Remarks.—The three known species of *Hamodactylus* present a series in the degree of reduction of the chelae of the second pereiopod. In *H. noumeae* the chela is small but of normal form (Bruce, 1970), in *H. boschmai*, the dactylus is hypertrophied and strongly hooked but the fixed finger is greatly reduced and in *H. aqabai* the fixed finger is obsolescent and the dactyl is similar in form to those of the ambulatory pereiopods.

The mouthparts of *H. noumeae* have not been described. Those of *H. boschmai* are reported as lacking an arthropod on the third maxilliped (Holthuis, 1952 : 211), but a small arthrobranch is present in *H. aqabai* so that its

TABLE 2

The hosts of the Indo-West Pacific Alcyonarian-associated Pontoniine Shrimps

Periclimenes	*psamathe* (De Man)	*Morchellana gilva* (Henderson, 1909)	Bruce, 1978a
	investigatoris Kemp	Alcyonarian indet.	Kemp, 1922
	jugalis Holthuis	*Morchellana dollfusi* Tixier-Durivault & Prevorsk, 1962	Bruce, 1977a
	kempi Bruce	*Sarcophyton elegans* Moser, 1919	Bruce, 1977a
	sinensis Bruce	*Morchellana planoregularis* Burchardt, 1898	Bruce, unpubl.
	setoensis Fujino & Miyake	*Dendronephytha disciformis* Kukenthal, 1905	Fujino & Miyake, 1969
	lepidus Bruce	*Morchellana gilva* (Henderson, 1909)	Bruce, 1978a
	perlucidus Bruce	*Morchellana gilva* (Henderson, 1909)	Bruce, 1978a
	perturbans Bruce	*Morchellana gilva* (Henderson, 1909)	Bruce, 1978a
	magnificus Bruce	*Lobophyton* sp.	Bruce, unpubl.
	sp.	*Litophyton viridis* (May, 1898)	Bruce, 1977a
Hamodactylus	*boschmai* Holthuis	*Morchellana gilva* (Henderson, 1909)	Bruce, 1978a
	noumeae Bruce	Nephtheidae, indet.	Bruce, 1978a
	aqabai nov. spec.	*Litophyton arboreus* Forskål, 1775	This report
Propontonia	*pellucida*	*Lemnalia* sp.	Bruce, 1974
		Cladiella sp. (as *Macrospicularia*)	Bruce, 1974
		Nephthea sp.	Bruce, 1974
		Sarcophyton crassicaule Moser, 1919	Bruce, 1969a
		Sarcophyton elegans Moser, 1919	Bruce, 1976
		Sarcophyton acutangulatus (Maranzeller, 1886)	Bruce, 1974
		Sarcophyton trocheliophorum Marenzeller, 1886	Bruce, 1974

absence is not a valid generic character. The mouthparts of the two species agree closely in general but *H. boschmai* differs from *H. aqabai* in having a bifid basal endite on the maxilla and a large bilobed epipod on the first maxilliped.

Discussion

The pontoniine shrimp fauna of the Red Sea

Details of the pontoniine shrimps at present known to occur in the Red Sea are outlined in the final section of this paper (Table 3). For the purposes of this table the Red Sea is considered to be north of the Bab el Mandeb Strait.

A total of some 45 species are recorded. Undoubtedly many more remain to be reported as many regions have not yet been adequately examined and little study of species from deeper waters has yet been carried out. Although the provisional list counts 45 species, the exact status of some of these is open to doubt. *Periclimenes grandis* (Stimpson, 1860) and *P. elegans* (Paulson, 1895) may prove to be synonymous, and the status of *P. edwardsi* (Paulson, 1875) and *P. ensifrons* (Dana, 1852) is also dubious. Both of these could also be possibly synonymous with *P. grandis*, the apparent difference being due to change in the morphology of the second pereiopods following regeneration after autotomy. The record of *Periclimenes consobrinus* (De Man, 1902) by Balss (1915) needs confirmation. *Coralliocaris graminea* (Dana, 1852) and *C. macrophthalma* (H. Milne Edwards, 1857) (Bruce, 1977c) may also be synonymous. If this should prove to be the case a total of 42 distinct species are known from the Red Sea.

The fauna present consists of typical Indo-West Pacific species, and most are well known throughout that region, with several extending as far east as Hawaii. The only species that may prove to be a true endemic is *Periclimenes calmani*, (Tattersall, 1921) which has not yet been recorded with certainty from outside the Red Sea, but *Hamodactylus aqabai* nov. spec. has already been found in the western Pacific Ocean (A. J. B., personal observation). Several groups of commensal shrimps appear to be very poorly represented, i.e. the associates of sponges, gorgonians, antipatharians and echinoids. This is probably due only to lack of study, and the examination of some of these hosts would probably quickly augment the present list.

TABLE 3

Pontoniine Shrimp Fauna of the Red Sea

1.	*Anchistioides compressus* Paulson	Red Sea	Paulson, 1875
2.	*Anchistus custos* Forskål	Loheia, Suakin	Forskål, 1775; Nobili, 1906
3.	*Anchistus miersi* (De Man)	Suakin, Ghardaqa	Nobili, 1906; Tattersall, 1921; Ramadan, 1936
4.	*Conchodytes biunguiculatus* (Paulson)	"Red Sea", Tor, Sinai	Paulson, 1875; Balss, 1915
5.	*Conchodytes meleagrinae* Peters	Massawah, Ras Abu Somer, Hasani Is., Suakin; Ghardaqa	Nobili 1906; Balss, 1915; Tattersall 1921; Ramadan, 1936
6.	*Conchodytes tridacnae* Peters	Jeddah	Hilgendorf, 1879
7.	*Coralliocaris graminea* (Dana)	Suez, Ghardaqa, Senafir, Koseir, Habban, Zebirget, Yenbo Raveiya, El Lith, Massawa	Balss, 1915; Ramadan, 1936; Gurney, 1938
8.	*Coralliocaris macrophthalma* (M-Edwards)	Massawa, Eilat	Nobili, 1901; Holthuis, 1958
9.	*Coralliocaris nudirostris* (Heller)	"Red Sea"	Heller, 1861
10.	*Coralliocaris superba* (Dana)	Numerous localities	Paulson, 1875; Nobili, 1901; Balss, 1915; Tattersall, 1921; Ramadan, 1936; Holthuis, 1958
11.	*Coralliocaris venusta* (Kemp)	Ghardaqa	Ramadan, 1936
12.	*Hamodactyloides incompletus* (Holthuis)	Sharm el Sheik	Holthuis, 1958
13.	*Hamodactylus aqabai* sp. nov.	Aqaba	Present report
14.	*Harpiliopsis beaupresii* (Audouin)	Numerous localities	Savigny, 1809; Audouin, 1826, 1827; Paulson, 1875; Nobili, 1901, 1906; Balss, 1915, 1927; Tattersall, 1921; Kemp, 1922; Ramadan, 1936; Gurney, 1938, Holthuis, 1958

15. *Harpiliopsis depressa* (Stimpson)	Numerous localities	Balss, 1915; Ramadan, 1936; Holthuis, 1951, 1958
16. *Jocaste lucina* (Nobili)	Numerous localities	Nobili, 1906; Balss, 1915; Tattersall, 1921
17. *Palaemonella rotumana* (Borradaile)	Gulf of Suez; S. Red Sea	Kemp, 1922; Calman, 1939, Holthuis, 1958
18. *Palaemonella tenuipes* Dana	Several localities	Nobili, 1901; Balss, 1915; Tattersall, 1921; Gurney, 1938
19. *Paratypton siebenrocki* Balss	Senafir, Koseir, Sharm el Sheik	Balss, 1914, 1915; Bruce, 1969b
20. *Periclimenaeus djiboutensis* Bruce	Eilat	Fichelson, 1974
21. *Periclimenes agag* Kemp	Ghardaqa	Gurney, 1938
22. *Periclimenes brevicarpalis* (Schenkel)	Aqaba	Present report
23. *Periclimenes calmani* Tattersall	Sudan coast; Suez canal	Tattersall, 1921; Balss, 1927
24. *Periclimenes consobrinus* (De Man)	Several localities	Balss, 1915
25. *Periclimenes diversipes* Kemp	Ghardaqa	Gurney, 1938
26. *Periclimenes edwardsi* (Paulson)	Red Sea	Paulson, 1875
27. *Periclimenes elegans* (Paulson)	"Red Sea"; St John Is.; Tor.	Paulson, 1875; Balss, 1915; Kemp, 1922
28. *Periclimenes ensifrons* (Dana)	"Red Sea"; Obock; Dahab.	Paulson, 1875; Nobili, 1906; Balss, 1915
29. *Periclimenes grandis* (Stimpson)	Ghardaqa	Ramadan, 1936
30. *Periclimenes holthuisi* Bruce	Aqaba	Present report
31. *Periclimenes imperator* Bruce	Eilat; Aqaba	Bruce, 1967; Schumacher, 1973
32. *Periclimenes kempi* Bruce	Ghardaqa	Bruce, 1969b
33. *Periclimenes longicarpus* sp. nov.	Aqaba	Present report
34. *Periclimenes longirostris* Borradaile	Eilat	Holthuis, 1958
35. *Periclimenes lutescens* auct.	Tor; Ras Abu Somer; Yenbo, Suakin	Balss, 1915; Tattersall, 1921
36. *Periclimenes ornatus* Bruce	Aqaba	Present report
37. *Periclimenes petitthouarsi* (Audouin)	Numerous localities	Nobili, 1906; Balss, 1915; Tattersall, 1921;

		Kemp, 1922; Ramadan, 1936; Holthuis, 1958
38. *Periclimenes soror* Nobili	Jeddah	Bruce, 1976
39. *Periclimenes tenuipes* Borradaile	Aqaba	Present report
40. *Periclimenes tenuis* Bruce	Eilat	Fichelson, 1974
41. *Philarius gerlachei* (Nobili)	Several localities	Balss, 1915; Tattersall, 1921; Ramadan, 1936; Gurney, 1938
42. *Philarius imperialis* (Kubo)	Eilat	Holthuis, 1959
43. *Pontoniopsis comanthi* Borradaile	Eilat	Holthuis, 1958; Fichelson, 1974
44. *Thaumastocaris streptopus* Kemp	Aqaba	Present report

COMMENSALISM IN RED SEA PONTONIINE SHRIMPS

Of the present fauna, 34 (75%) species are known commensals of other marine organisms and only 7 (16%) are considered to be truly free-living species. One species (2.4%) (*Periclimenes tenuipes* Borradaile), appears to be a facultative commensal. The distribution of hosts is: sponges, 3 species (6.6%); coelenterates, 21 species (46.6%); molluscs, 6 species (13.3%); echinoderms, 3 species (6.6%) and tunicates, 1 species (2.4%). The distribution of coelenterate hosts is: Scleractinia, 14 species (31.1%); Actinaria, 4 (or 5) species (8.9 or 11.1%); Alcyonaria, 2 species (4.4%) and Hydroida, 1 species (2.4%).

PONTONIINE ASSOCIATES OF ACTINARIANS

Numerous species of the subfamily Pontoniinae have now been described as associates of sea anemones. So far, in the Indo-West Pacific region, except for *Hamopontonia coralliocola* Bruce, 1970, these are all members of the genus *Periclimenes* Costa. *P. tenuipes* appears to be a facultative associate only and can frequently be found not in association with anemones. Eight other species of *Periclimenes* are known to associate with anemones, two of which, *P. magnificus* Bruce, 1979, and *P. holthuisi* may also be found in association with other coelenterates belonging to the Scleractinia and Scyphozoa. Juveniles of *P. brevicarpalis* have also been found occasionally on alcyonarians (Bruce, 1974 : 475) but no adults have been recorded in this association, which is considered to be abnormal. *P. brevicarpalis, P. inornatus* Kemp, 1922, *P. ornatus* and *P. ornatellus* Bruce, 1979, constitute one group of closely related species, and *P. indicus* (Kemp, 1915), *P. holthuisi, P. longicarpus* and *P. magnificus* another group.

A list of the shrimp-sea anemone associations is provided by Suzuki & Hayashi (1977). The *Periclimenes* species associated with actinarians may be identified by the following keys; the hosts known at present are listed in table 1.

KEYS FOR THE IDENTIFICATION OF THE ANEMONE ASSOCIATED SPECIES OF THE GENUS *PERICLIMENES*

(i) Morphological

1. Inferior orbital angle obsolescent; rostral dentition 9—12 / 6—9 merus of second pereiopod with strong disto-ventral spine .... *P. tenuipes*
   Inferior orbital angle distinct; generally acutely produced; adult rostral dentition not more than 5—13 / 0—4; merus of second pereiopod unarmed 2
2. Dactyls of ambulatory pereiopods simple 3
   Dactyls of ambulatory pereiopods biunguiculate 6

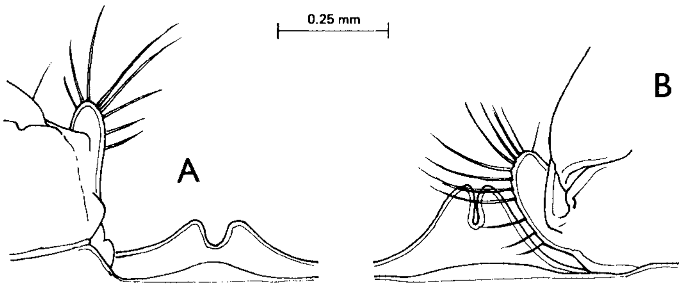

Fig. 15. Fourth thoracic sternites. A, *Periclimenes inornatus* Kemp, female, C.L. 2.2 mm, Heron Island, Australia. B, *Periclimenes ornatus* Bruce, female, C.L. 2.6 mm, Heron Island, Australia.

3. Dorsal telson spines minute .... *P. brevicarpalis*
   Dorsal telson spines normal 4
4. Dactyls of ambulatory pereiopods minutely spinulate around base of unguis .... *P. ornatellus*
   Dactyls of ambulatory pereiopods with simple unguis 5
5. Fourth thoracic sternite with broad low transverse ridge, with an open median notch (fig. 15a) .... *P. inornatus*
   Fourth thoracic sternite with a centrally elongated transverse ridge, with a deep close median notch (fig. 15b) .... *P. ornatus*
6. Carpus of second pereiopod shorter than chela 7
   Carpus of second pereiopod longer than chela; rostral dentition 5–6 / 1–3 .... *P. longicarpus*
7. Third abdominal segment with conspicuous dorsal hump 8
   Third abdominal segment without conspicuous dorsal hump, rostral dentition 9–11 / 1–3, isolated epigastric spine present .... *P. indicus*
8. Rostral dentition 8/1; propod of ambulatory pereiopod with pair of spines on distal fourth of propod .... *P. magnificus*
   Rostral dentition 8–13 / 1–4; propod of ambulatory pereiopod with one pair of disto-ventral spines on propod with four simple spines along distal two thirds of ventral border .. *P. holthuisi*

(ii) Colouration (Adult females)

1. Caudal fan inconspicuously coloured; third abdominal segment also without conspicuous colour markings 2
   Caudal fan conspicuously coloured; third abdominal segment generally also with conspicuous colour markings 6
2. Almost completely transparent, apart from white dorsal eye stripe .... *P. inornatus*
   Numerous chromatophores present, at least on body 3
3. Generally mottled all over body and appendages with brown and white .... *P. indicus*
   Largely transparent body with scattered chromatophores 4
4. Caudal fan spotted with small red/blue and white chromatophores; antennal peduncles, pereiopods similarly coloured .... *P. ornatus*
   Caudal fan mainly transparent 5
5. Second pereiopods colourless; stomach white, with broad longitudinal band of white extending posteriorly to fifth abdominal segment .... *P. ornatellus*
   Fingers of second pereiopods orange red, palm white or transparent; carpus yellow or transparent; abdomen with fine longitudinal dorso-lateral red line .... *P. tenuipes*

6. Rami of uropods with conspicuous yellow ocelli ringed with purple .... *P. brevicarpalis*
   Uropod with exopod distally purple and white; endopod distally white 7
7. Carapace sparsely spotted with well separated red and white chromatophores; second pereiopods white, conspicuously banded with purple at fingers and hinges ....*P. holthuisi*
   Carapace transparent, spotted with red and white 8
8. Carapace transparent with thin transverse bar of white across posterior dorsal margin; rostrum and scaphocerite transparent .... *P. longicarpus*
   Carapace transparent with broad transverse central band of white, bordered anteriorly and posteriorly by narrow lines of purple; rostrum and scaphocerite white .... *P. magnificus*

PONTONIINE ASSOCIATES OF ALCYONACEA

Comparatively few pontoniine shrimps are found in association with alcyonarians, although the phenomenon has as yet not been adequately investigated. At present only three Indo-West pacific genera are known to contain species that associate with alcyonarians. The genus *Periclimenes* contains several species, but *Periclimenes setoensis* Fujino & Miyake, 1969, is probably synonymous with *P. sinensis* Bruce, 1969; *Hamodactlylus* now contains three species and the genus *Propontonia* Bruce is monospecific. *Propontonia* may be distinguished from *Periclimenes* by the absence of an exopod on the third maxilliped, and from *Hamodactylus* by the presence of well developed instead of greatly reduced, chelae on the second pereiopods. The species *H. boschmai* and *H. noumeae* may also be found in association with gorgonians, as may *Periclimenes psamathe* (De Man, 1902). It appears that nephtheid alcyonarians are particularly favoured as hosts by pontoniine shrimps, but this is probably largely due to the chances of collecting. The alcyonarian-associated species of *Periclimenes* may be identified by the following key; the hosts known at present are listed in table 2. As mentioned above, juveniles of *Periclimenes brevicarpalis* may also be found on alcyonarians, but are not included in the key.

A KEY TO THE ALCYONARIAN ASSOCIATED SPECIES OF THE GENUS *PERICLIMENES*

1. Dactyls of ambulatory pereiopods simple 2
   Dactyls of ambulatory pereiopods biunguiculate 6
2. Major second pereiopod greatly elongated; post-rostral teeth with minute ventral serrations, R. 6–7 / 0 .... *P. psamathe* (De Man, 1902)
   Major second pereiopod not greatly elongated; post-rostral teeth (if present) without ventral serrations; ventral rostral teeth present 3
3. Chelae of second pereiopods short and stout, fingers subspatulate R. ♂ 6 / 1–2; ♀ 7–8 / 0–1 .... *P. kempi* Bruce, 1969
   Chelae of second pereiopod slender, finger not subspatulate 4

4. Carpus of first pereiopod distincly shorter than chela, second pereiopods very small and slender, R.7/1 .... *P. perturbans* Bruce, 1978
Carpus of first pereiopod longer than chela 5
5. Major second pereiopod with robust chela; fingers of first pereiopod only slightly shorter than palm; two post-rostral teeth present, rostrum feebly depressed, R.9/2 .... *P. jugalis* Holthuis, 1952
Major second pereiopod feeble; chela of first pereiopod about half length of palm, single epigastric spine present, rostrum slightly elevated, R. 7–8 / 1–2 .... *P. lepidus* Bruce, 1978
6. Rostrum long and slender; dactyl of major chela with well developed lateral carina, R. ♂ 7–8 / 0–2, ♀ 8–10 / 2–3 .... *P. perlucidus* Bruce, 1969
Rostrum short and deep; dactyl of major second pereiopod without lateral flange 7
7. Stylocerite reaching level of proximal border of first segment of antennular peduncle, R.9/1 .... *P. investigatoris*Kemp, 1922
Stylocerite reaching level of middle of procimal peduncular segment only 8
8. Posterior rostral teeth mobile; first pereiopod with fingers subequal to palm, carpus subequal to chela, R. 9–10 / 2 .... *P. sinensis* Bruce, 1969
Posterior rostral teeth fixed; first pereiopod with fingers shorter than palm, carpus shorter than chela, R.9/2 .... *P. setoensis* Fujino & Miyake, 1969

Acknowledgment

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