Periclimenes kororensis n. sp., An Unusual Shrimp Associate of the Fungiid Coral, *Heliofungia actiniformis*

A. J. BRUCE

Heron Island Research Station, Gladstone, Queensland, 4680, Australia.

Abstract.—A new species of pontoniine shrimp, *Periclimenes kororensis*, from Koror, Western Caroline Islands, is described. The single example, an ovigerous female lacking both second pereiopods, was found in association with a scleractinian host, *Heliofungia actiniformis*. The species appears to be an aberrant member of the "*P. grandis* species-group", and not closely related to any previously described species.

Several shrimps have recently been reported as associates of fungiid corals: *Metapontonia fungiacola* Bruce, *Hamopontonia corallicola* Bruce, *Periclimenes holthuisi* Bruce (Bruce, 1967, 1970, in press), and *P. tenuipes* Borradaile (Read, 1974). The present report describes a further species of the genus *Periclimenes* from the Palau Islands, Western Caroline Islands, which is also associated with the scleractinian coral *Heliofungia actiniformis* (Quoy and Gaimard). In contrast to the previously recorded *Periclimenes* species involved in this association, which have a morphological form typical of several members of the genus, the present species is of unusual morphology, and not closely related to a majority of the commensal species of *Periclimenes* but represents an isolated position, probably most closely related to some of the free-living species.

Periclimenes kororensis n. sp.

Figs. 1–4

MATERIAL EXAMINED: 1 ovigerous ♀, Koror, Palau Islands, 16 November 1972, coll. Hajo Schmidt.

DESCRIPTION: A medium-sized pontoniine shrimp of moderately robust body form but with slender ambulatory pereiopods. The specimen lacks one first pereiopod, both second pereiopods, and three ambulatory pereiopods.

The carapace is smooth, slightly swollen in the cardiac region, and with a distinct fossa at the upper margin of the branchiostegite, posterior to the hepatic spine. The rostrum is elongated, slightly exceeding the postorbital carapace length, and compressed, with a feebly developed lateral carina. The rostrum is slender, slightly upcurved, tapering gradually throughout its length to an acute tip. The dorsal lamina bears five acute teeth anteriorly to the posterior orbital margin: a small subterminal tooth, a slightly longer distal tooth, and an intermediate tooth. The

Micronesica 13(1): 33-43. 1977 (June).

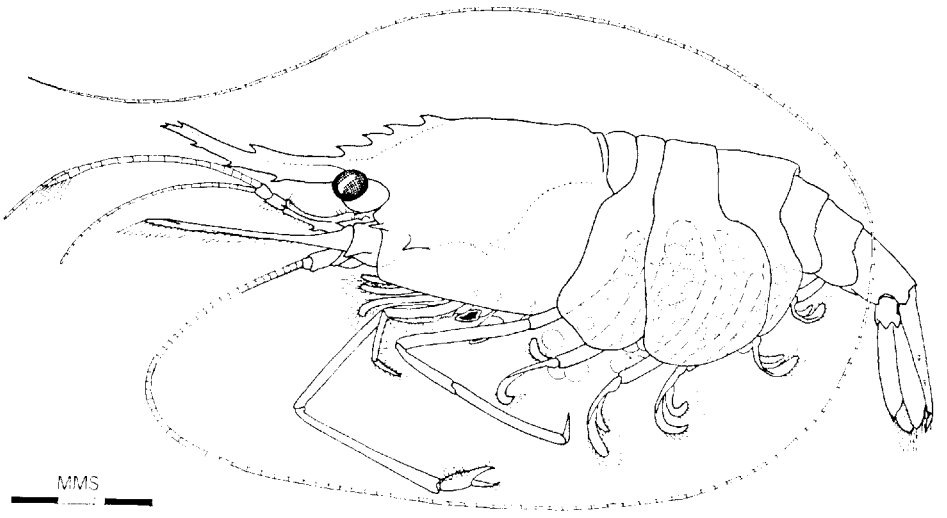

Fig. 1. *Periclimenes kororensis* n. sp., holotype, female. Koror, Palau Islands. Scale in mm.

posterior part of the dorsal lamina is elevated and continued on the anterior carapace as a postrostral carina bearing four large acute teeth, two of which are anterior to the posterior orbital margin and two posterior. The ventral margins of these teeth are smooth and the posterior tooth is epigastric, situated at a level slightly posterior to the hepatic spine. The setose ventral border of the lower rostral lamina is evenly convex with three evenly spaced, acute teeth, situated on the distal three fifths. Supraorbital spines are absent. The orbit is obsolescent. The inferior orbital angle is normally developed, slightly produced, broad in dorsal view. The antennal spine is well developed, submarginal, acute, and strongly projecting, especially in dorsal view. The hepatic spine is particularly robust and acute, projecting ventrolaterally, and situated well behind and at a slightly lower level than the antennal spine. The anterolateral margin of the carapace is bluntly rounded and not projecting.

The abdominal segments are smooth. The third segment is not posteriorly produced in the dorsal midline. The fifth segment is slightly more than half the length of the sixth segment, which is about 0.7 times longer than deep. The pleura of the first three segments are broadly expanded. The fourth and fifth pleura are small, slightly produced posteriorly and bluntly rounded. The posterior ventral angle of the sixth segment is feebly produced and the posterolateral angle is moderately acute.

The telson is about 1.6 times the length of the sixth abdominal segment and 2.7 times longer than broad. The lateral margins are feebly convex and converge posteriorly. The anterior width is about 1.6 times the width immediately anterior to the posterior telson spines. Two pairs of small dorsal spines are present, remote from the lateral borders. The anterior pair lie at 0.5 of the telson length. The

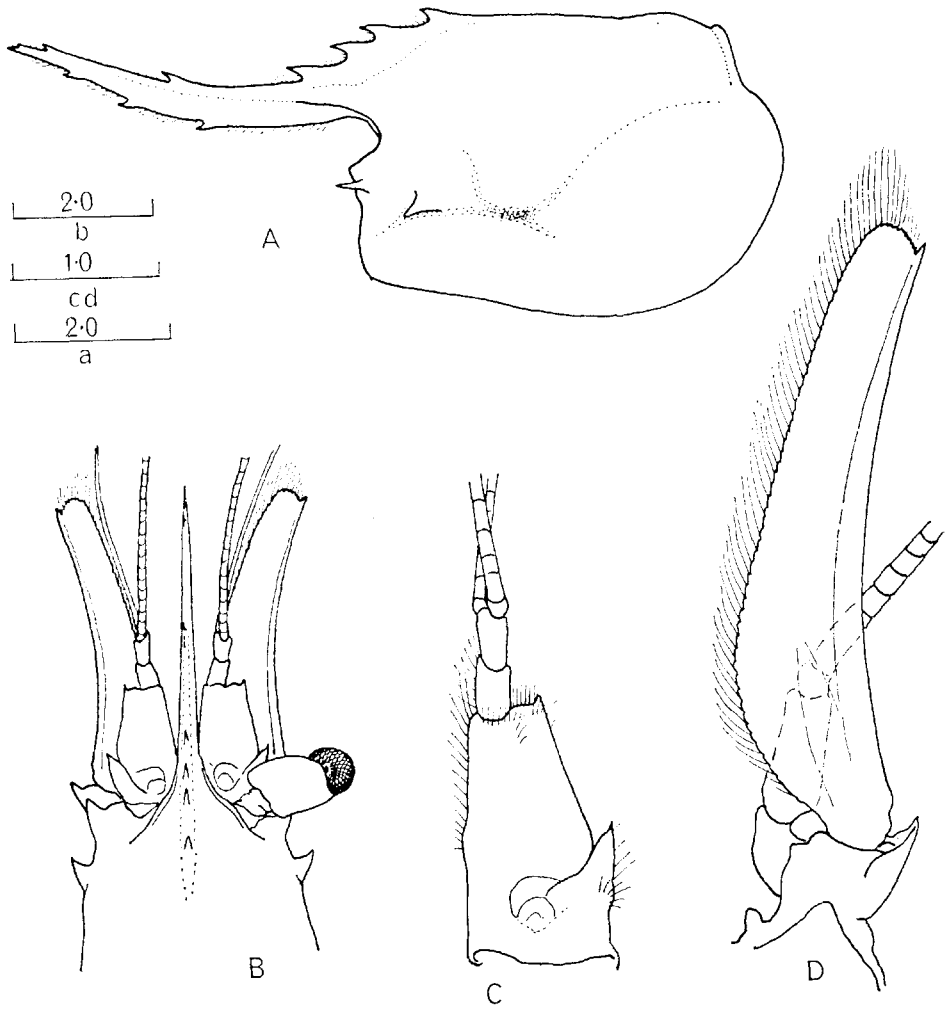

Fig. 2. *Periclimenes kororensis* n. sp., holotype. A, carapace and rostrum. B, anterior carapace, rostrum and antennae, dorsal aspect. C, antennular peduncle. D, antennal peduncle, Scale in mm.

posterior pair are slightly asymmetrical and are at about 0.75 of the telson length. The posterior margin of the telson is angularly tapered with three pairs of spines. The lateral spines are small and short, similar to the dorsal spines. The intermediate spines are large, stout and distally blunt, equal to about 0.14 of the telson length. The submedian spines are slender, about 0.6 of the length of the intermediate spines, and finely plumose.

The eyes are normally developed. The cornea is large and globular, slightly oblique and with a distinct accessory pigment spot dorsally. The stalk is slightly swollen proximally and feebly compressed dorsoventrally, the greatest breadth being subequal to the length of the posterior margin. The ophthalmic somite is

rounded and without a median process dorsally.

The antennules are normal and the peduncle reaches to about the middle of the length of the rostrum. The proximal segment is about 1.7 times longer than the width at its base. The medial border is straight, setose, with a strong acute spine ventrally at its midpoint. The stylocerite is moderately broad and acute, reaching to half the length of the segment, and projecting from the lateral border. The distal lateral border is straight and convergent distally, ending in a small acute tooth. The lateral distal border is narrow and feebly convex, with numerous plumose setae. The intermediate and distal segments are of similar length, each equal to about 0.28 of the length of the proximal segment. The intermediate segment has the lateral lobe obsolescent, but the medial border bears numerous plumose setae. The distal segment is distinctly more slender than the intermediate segment. The statocyst is normally developed with an oval statolith. The upper flagellum is long and slender, biramous, with the proximal 16 segments fused. The shorter ramus consists of only two or three segments, with five groups of aesthetascs and the longer ramus with seven segments. The lower flagellum is very slender and with indistinguishable segments.

The antenna has a robust basicerite with a particularly large and acute laterally projecting tooth. The ischiocerite and merocerite are normal. The carpocerite is short, only reaching to about 0.25 of the length of the scaphocerite, and about 2.25 times longer than wide. The scaphocerite is elongated and moderately broad, reaching to about the tip of the rostrum and about 4.6 times longer than broad. The lateral border is distinctly concave, with a small distolateral tooth, which is slightly exceeded by the rounded tip of the lamella, which tapers distally to half its greatest width, that lies at about one third of its length. The flagellum is particularly long and slender, equal to 9.5 times the postorbital carapace length.

The epistome is normal and without horns. The labrum is deeply divided. The second and third thoracic sternites are unarmed. The fourth bears a long slender median spine. The fifth bears a low transverse ridge posteriorly. The sixth somite is very narrow, the seventh and eighth increasing in width; all three are unarmed.

The mouthparts present no special features. The mandible is robust and is without a palp. The molar process is stout and expanded distally, with large blunt teeth and a dense group of short stout setae ventrally. A more acute tooth is present dorsally. The incisor process is rather short, tapering with 2–3 stout teeth distally.

The maxillula has a distinctly bilobed palp. The upper lobe is long, slender with a few simple setae distally. The lower lobe is short, with a single hooked seta. The upper lacinia is rather narrow with about 10 short spines, some simple and some feebly dentate, and a few setae distally. The lower lacinia is short and stout, tapering distally to terminate with a few slender finely setulose spines and setae, with plumose setae along the ventral border.

The maxilla has a rather broad, tapering nonsetose palp. The basal endite

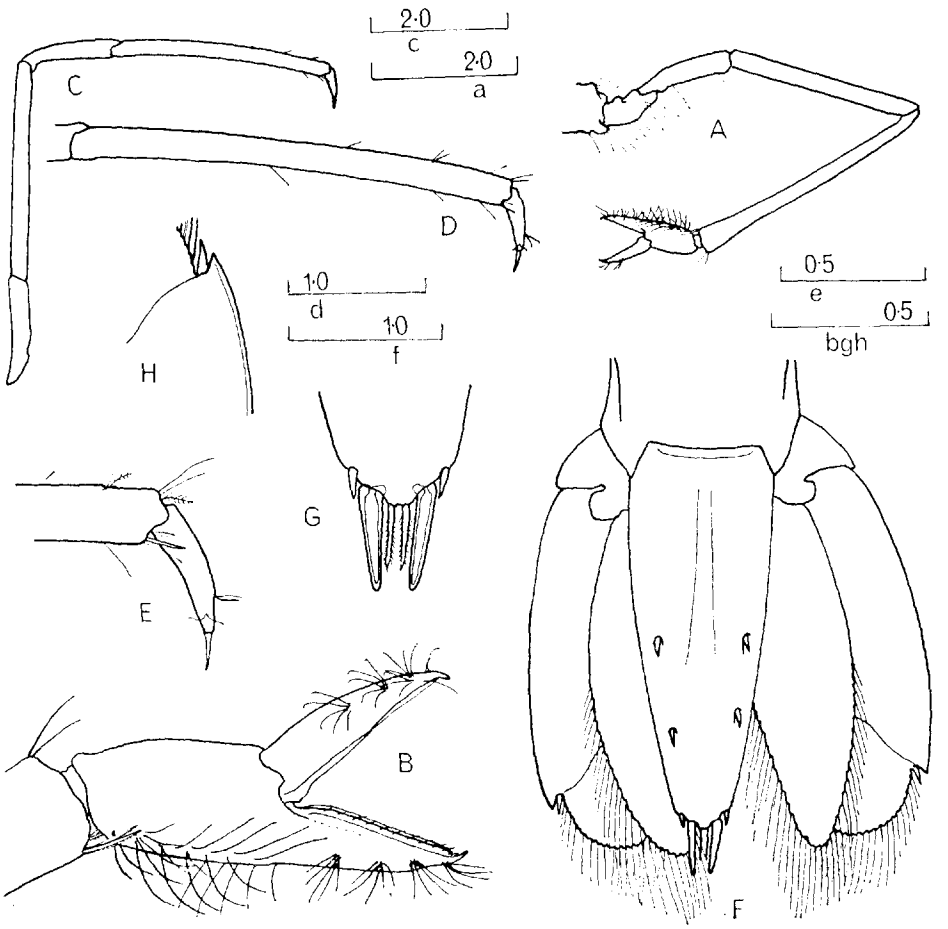

Fig. 3. *Periclimenes kororensis* n. sp., holotype. A, first pereiopod. B, chela of first pereiopod. C, ambulatory pereiopod. D, propod and dactyl of ambulatory pereiopod. E, dactyl of ambulatory pereiopod, F, telson and uropods. G, posterior telson spines. H, distolateral angle of exopod of uropod. Scale in mm.

is distinctly bifid with the distal lobe slightly longer and more slender than the proximal, each bearing 15 and 11 sparsely setulose setae respectively. The coxal endite is absent, the region being slightly produced medially. The scaphognathite is normally developed, about 2.2 times longer than broad with the anteromedial margin feebly emarginate.

The first maxilliped has a short, stout palp, bearing a longer distal plumose seta and a simple shorter proximal seta on the distomedial border. The basal endite is well developed, evenly produced, with numerous long slender setae along its medial and distal borders. The setae arising distally are sparsely setulose, those arising proximally are densely setulose. The coxal endite is distinct from the basal

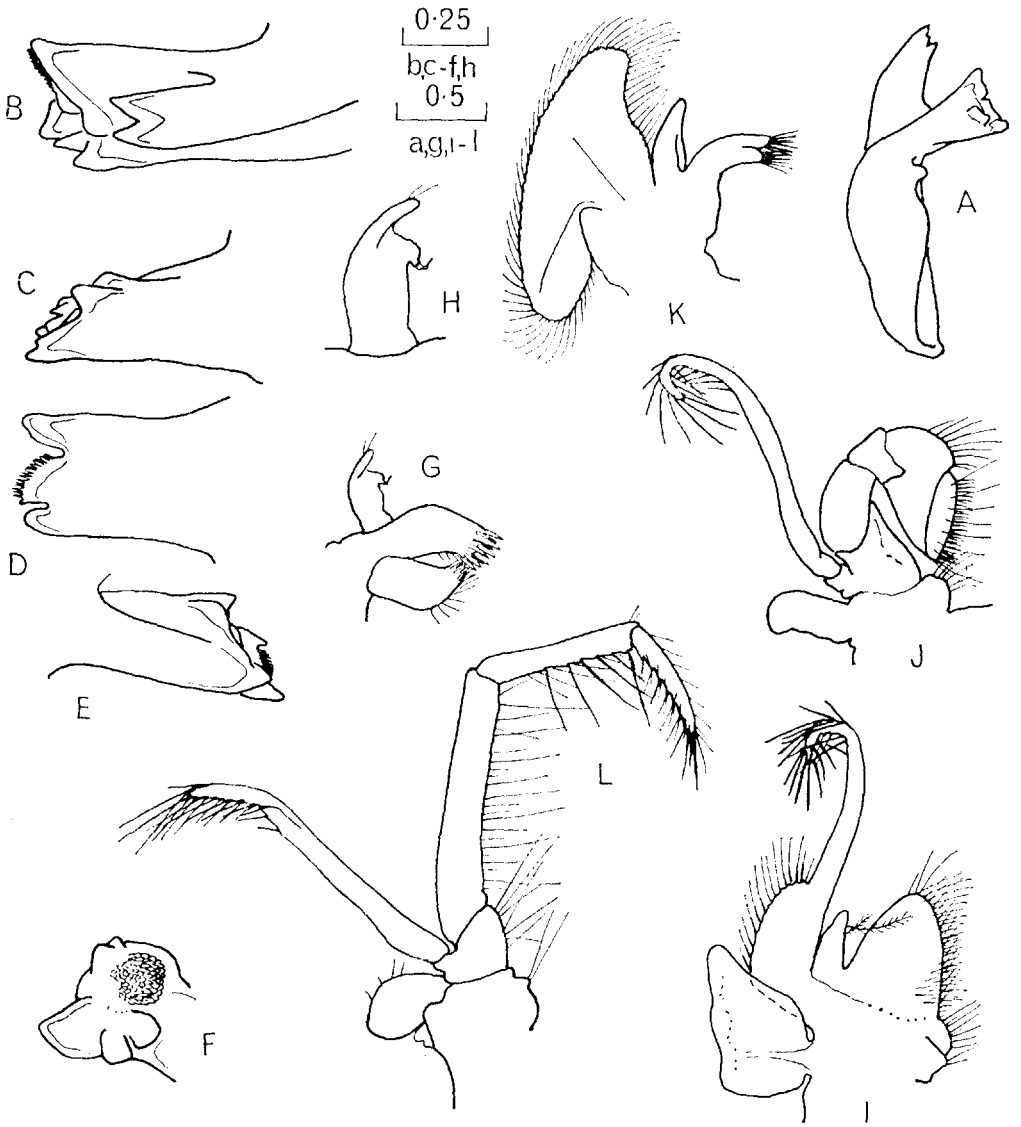

Fig. 4. *Periclimenes kororensis* n. sp., holotype. A, mandible. Molar process: B, dorsal; C, anterior; D, ventral; E, posterior; F, occlusal aspect. G, maxillula. H, palp of maxillula. I, first maxilliped. J, second maxilliped. K, third maxilliped. Scale in mm.

endite and is produced with a larger rounded distal lobe bearing about a dozen long, sparsely setulose setae and a smaller proximal lobe with a single seta. The exopod is well developed, with a robust flagellum bearing about 15 long plumose setae on the distal portion. The caridean lobe is distinct but narrow with numerous plumose setae laterally. The epipod is large, simple and triangularly produced

distally, the proximal border being truncated.

The second maxilliped is normal. The dactylar segment is narrow, about 5.0 times longer than broad ventrally, with numerous finely dentate spines along the medial border, with further long slender spines arising from the ventral aspect. The distomedial border of the propodal segment is rounded, with about 10–12 long slender, sparsely setulose setae. The carpus, merus and ischiobasis present no special features. The coxa is angularly produced medially with six slender setae. The flagellum of the exopod is similar to that of the first maxilliped. A subrectangular epipod, without a podobranch, is present.

The third maxilliped has a slender endopod, extending anteriorly beyond the end of the carpocerite by about half the length of the merus. The ischiomerus is distinct from the basis, obliquely jointed with it, with a small rounded knob at the proximal end of the medial margin. The segment is about 5.2 times longer than its greatest width and tapers slightly distally.

The median margin is sparsely provided with slender simple setae. The penultimate segment is 7.0 times longer than wide, about 0.6 of the length of the antepenultimate, with subparallel margins, the medial border bearing about 6 stout, coarsely dentate setae, with a row of simple setae dorsomedially. The terminal segment is robust, slightly tapering, with a stout simple seta distally. It is about half the length of the antepenultimate segment and about 5.5 times longer than the proximal width. The ventromedial aspect is provided with 6–7 groups of short, stout, serrulate setae. The basis has a rounded medial margin that bears 4–5 long simple setae. The exopod is similar to the anterior exopods, with about 20 setae on the distal fourth. The coxa bears a small rounded setose medial process and a large rounded epipod is present laterally. A small fleshy lobe that may be a vestigial arthrobranch is also present laterally.

The first pereiopod is slender, the distal end of the merus distinctly exceeding the carpocerite. The palm of the chela is about 1.8 times longer than deep and is moderately compressed. The ventral border bears about seven transverse rows of setae that are finely pectinate along their anterior aspects. The ventrolateral palm bears a longitudinal row of setae with a double row of fine serrulations. The fingers are about subequal to the palm length, slender, tapering, with simple cutting edges and small hooked tips. The fingers bear several groups of coarsely serrulate setae. The carpus is slender, about 2.5 times longer than the chela, gradually increasing in width distally, where it is about 10 times longer than wide. The distoventral angle bears four or five serrated cleaning spines. The merus is 0.75 of the length of the carpus, of uniform width and about 9.5 times longer than wide. The ischium is more robust than the merus and equal to half its length. The basis is normal with a few simple ventral setae. The coxa is stouter, with a small ventral process bearing four slender simple setae.

The ambulatory pereiopods are slender. The dactylus is equal to about 0.2 of the length of the propod. The corpus is slender and moderately compressed, tapering gradually distally with a feebly concave sinuous lower margin, with antero-

distal and lateral setae. The unguis is very slender, equal to slightly less than one third of the length of corpus, and about 5 times longer than wide at the base. The propod is slender, feebly bowed, of rather uniform width, and 15 times longer than wide. A single distoventral spine is present, the propod otherwise bearing only a few sparse simple setae, with some short plumose setae distally on the dorsal margin. The carpus is 0.4 of the propod length and unarmed. The merus is subequal to the propod length, feebly tapering distally, about 12 times longer than wide and unarmed. The ischium, basis and coxa show no special features.

The uropods are normal and slightly exceed the tip of the telson. The protopodite is without an acute distolateral tooth. The endopod is broad, about 2.5 times longer than wide, broadly rounded distally with a well marked diaeresis; the lateral broader is moderately convex, entire, with a small acute tooth distally and a larger mobile spine medially. The endopod is more slender, about 3.4 times longer than broad, and slightly exceeds the exopod.

TYPE: The single specimen, an adult ovigerous female, is designated as the holotype and is deposited in the collection of the Smithsonian Institution, National Museum of Natural History, registration number 168474.

MEASUREMENTS: (in millimeters) Total length, 192; carapace and rostrum, 97; postorbital carapace length, 42; diameter of ovum, 0.45.

COLORATION: No data.

HOST: *Heliofungia actiniformis* (Quoy and Gaimard, 1833) [Fungiidae: Scleractinia].

Systematic Position of *P. kororensis*

The lack of the second pereiopods from the only available specimen of *P. kororensis* prevents a detailed assessment of its exact systematic position in relation to the other species of the genus *Periclimenes* Kingsley, which present a very wide spectrum of morphological variation. *P. kororensis* does not show any close affinity to any of the known Indo-West Pacific species of the genus and occupies a rather isolated systematic situation.

The features of particular importance in assessing its relationships are (1) the moderately well developed dentate rostrum, (2) the well developed median spine on the fourth thoracic sternite, (3) the rounded posteroventral angles of the fourth and fifth abdominal pleura and (4) the slender ambulatory pereiopods with slender simple dactyls. A median thoracic spine on the fourth thoracic somite is only found in the genera *Palaemonella* Dana, *Vir* Holthuis, *Eupontonia* Bruce, *Philarius* Holthuis, and in some species of *Periclimenes*. In these features it shows most affinity to the species of the "*P. grandis* group" (Kemp, 1922). These species of *Periclimenes* appear to be basically free-living micropredators. Most of these species have well developed slender second pereiopods with large, similar, subequal chelae. In addition, the ventral borders of the propods of the pereiopods bear numerous spines and the posteroventral angles of the fourth and fifth abdominal pleura are acute.

Also, the rostrum usually has a deeper lamina and is more heavily dentate, and the spinulation of the telson is more strongly developed. *P. tenuipes* Borradaile, reported as an associate of *Heliofungia actiniformis* (=*Fungia actiniformis*) by Read (1974), is also a member of the "*P. grandis* group" but differs most noticeably from *P. kororensis* in the particularly long, slender rostrum, with a dentition of (9–12)/(6–9) (Kemp, 1922), which extends well beyond the tip of the scaphocerite.

The mouthparts of *P. tenuipes* have not been described in detail, but the mouthparts of *P. kororensis* show a close resemblance to those of *P. grandis* (Stimpson) (Bruce, 1976). The principal differences, in *P. kororensis*, are (1) the more slender incisor process of the mandible, (2) the presence of setae on the upper lobe of the maxillular palp, (3) the absence of a podobranch on the second maxilliped, and (4) the absence of spines on the lateral border of the antepenultimate segment of the third maxilliped, which is also without an arthrobranch. Noteworthy similarities are: (1) the robust molar process of the mandible, with large blunt teeth, (2) the bilobed maxillular palp, (3) the unbroadened laciniae of the maxillula, (4) the bifid basal endites of the maxilla, with a nonsetiferous palp, (5) the distinct basal and coxal endites of the first maxilliped, with the former slightly bilobed, (6) the triquetral shape of the endite, and (7) the setiferous palp; (8) the large rounded epipod of the third maxilliped, with (9) distinct ischiomeral and basal segments of the endopod and (10) the well developed flagella of the maxillipedal exopods, with numerous plumose setae over the distal portion.

Periclimenes kororensis may be readily separated from all the other species of the "*P. grandis* group" by the characteristic form of the rostrum, the absence of supraorbital spines, the presence of the remarkably large and robust hepatic spine, together with the particularly strong antennal spine and distolateral spine on the basicerite. The first pereiopod presents no special features, but the ambulatory pereiopods are unusual in the absence of ventral spines on the propod. The dorsal spines and posterior spines of the telson are also unusually small in comparison with those of other members of the "*P. grandis* group".

The rostrum in species of the "*P. grandis* group" is always well developed. Although the numbers of dorsal and ventral teeth on the lamina show considerable variation, the typical formula is (7–8)/(2–3) most often 7/3. These often show a slight tendency for the four posterior dorsal teeth to be grouped together over the orbital region, with the more distal teeth fairly evenly spaced along the length of the lamina. The ventral teeth are usually grouped over the middle third of the lamina. This arrangement is accentuated in *P. kororensis*, in which the interspace between the fourth and fifth dorsal teeth is exaggerated, giving the rostrum its characteristic appearance, with four large acute teeth over the orbital region, with a slender, feebly dentate distal lamina.

Discussion

The association between pontoniine shrimps and coral hosts have been recently reviewed (Bruce, in press) and several species are now known to associate with

fungiid corals. *Metapontonia fungiacola* is known only from the western Indian Ocean and associates with several other coral host genera. *Hamopontonia corallicola* was first described from a Hong Kong faviid coral, but has since been found on *Heliofungia actiniformis*. *Periclimenes holthuisi* is most commonly found on actinarians but has also been found on scyphozoans (Bruce, 1972) and in New Guinean and Australian waters, it also occurs on *H. actiniformis*. In Palauan waters, Read (1974) has recorded the association of *P. tenuipes* with *H. actiniformis*.

The association of some of these shrimps with *H. actiniformis* is of particular interest as it is one of the few coral species in which the polyps are fully expanded in daylight. A full color photograph of a living *H. actiniformis* with expanded tentacles can be seen in Johannes and Faulkner (1976: 49). When fully expanded *H. actiniformis* presents a distinctly anemone-like appearance. Similarly, the scyphozoan host for *P. holthuisi*, *Cassiopeia andromeda* (Forskål), rests upon the sea floor in an inverted position, again presenting an anemone-like appearance. The host of *H. corallicola* in Hong Kong, is *Goniopora stokesi*, which also opens its polyps in daylight. In contrast to these hosts, the very small *Metapontonia fungiacola* is found in association with *Fungia* species, other than *H. actiniformis*, and also *Halomitra*, *Hydnophora* and *Goniastrea*.

Periclimenes kororensis is more closely related to *P. tenuipes* than to *P. holthuisi*, which is not a member of the " *P. grandis* group". *P. holthuisi* is one of a group of closely related species, without a median sternal spine on the fourth thoracic sternite and typically with biunguiculate dactyls on the ambulatory pereiopods which are frequently associated with anemones and may often be involved in fish-cleaning symbioses. *P. tenuipes* is reported by Read (1974) to be a mucus feeder.

In an earlier paper, Bruce (1973) remarked that the differences between *Dasycaris* and *Periclimenes* was quite small in some species. In the case of *P. kororensis*, there is a distinct similarity to some *Dasycaris* species in the form of the carapace and rostrum. The grouping of four large acute teeth over the orbital region of the rostrum, the very strong antennal spine and the even larger and more projecting hepatic spine are features that are found in *Dasycaris* to a more extreme degree, as is also the lateral spine of the basicerite. In *Dasycaris* species, ventral rostral teeth are absent and the distal dorsal teeth are reduced in number, six or fewer being present. In *Dasycaris*, in contrast to *P. kororensis*, the ambulatory pereiopods are short and robust, and also the exopods of the maxillipeds are comparatively feebly developed, with slender flagella and sparse distal plumose setae.

ACKNOWLEDGEMENT

I am most grateful to Dr. Hajo Schmidt, Heidelberg University, for the opportunity to examine and report upon this specimen.

References Cited

Bruce, A. J. 1967. Notes on some Indo-West Pacific Pontoniinae, III–IX. Descriptions of

some new genera and species from the western Indian Ocean and South China Sea. Zool. Verhand., Leiden 87: 1–73.

———. 1970. Notes on some Indo-Pacific Pontoniine, XV, *Hamopontomia corallicola* gen. nov., sp. nov., a new pontoniid shrimp from Hong-Kong. Crustaceana 18 (1): 37–48.

———. 1972. An association between a pontoniinid shrimp and a rhizostomatous scyphozoan. Crustaceana 23 (3): 300–302.

———. 1973. Notes on some Indo-Pacific Pontoniine, XXLV, *Dasycaris zanzibarica* sp. nov., from the western Indian Ocean, with remarks on other species of *Dasycaris* Kemp, 1922 (Decapoda Natantia). Crustaceana 24 (3): 247–260.

———. 1976. A report on a small collection of shrimps from the Kenya National Marine Parks at Malindi, with notes on selected species. Zool. Verhand., Leiden 145: 1–72.

———. (in press). The hosts of coral-associated Indo-West Pacific pontoniine shrimps. Atoll Res. Bull.

Johannes, R. E., and D. Faulkner. 1976. Life and death of the reef. Audubon 78 (5): 36–55,

Kemp, S. 1922. Notes on the Crustacea Decapoda in the Indian Museum. XV. Pontoniinae. Rec. Indian Mus. 24: 113–288.

Read, K. R. H. 1974. The rock islands of Palau. Oceans 7 (6): 10–17.