

**PERICLIMENAEUS NUFU, A NEW SPECIES OF SHRIMP
(CRUSTACEA: DECAPODA: PONTONIINAE) FROM VIETNAM**

Zdeněk Ďuriš

Department of Biology and Ecology, Faculty of Natural Sciences, University of Ostrava, Chittussiho 10,
710 00 Ostrava, Czech Republic
Email: zdenek.duris@osu.cz

Ivona Horká

Department of Biology and Ecology, Faculty of Natural Sciences, University of Ostrava, Chittussiho 10, 710 00 Ostrava; and Department of Ecology,
Faculty of Natural Sciences, Charles University, Viničná 7, 128 44 Prague, Czech Republic
Email: ivona.horka@osu.cz

Dao Tan Hoc

Institute of Oceanography, Vietnamese Academy of Sciences and Technology, Nhatrang, Vietnam
Email: hoc15145@gmail.com

ABSTRACT. – A new species of the commensal pontoniine shrimp genus *Periclimenaeus*, *P. nufu*, new species, was found in samples from dead coral habitats in shallow Vietnamese waters (Van Phong Bay) of the South China Sea. The new species is placed in the *Periclimenaeus robustus* species group, with a characteristic anteromedian rounded lobe on the first abdominal tergite. It is readily distinguishable from most species of the genus by the unique shape of the widely ovate uropodal exopods; their distolateral margins and unusually rounded distolateral angles are distinctly serrate. Other remarkable features are the produced, movable anteroventral angle of the carapace, ambulatory dactyli with long and slender unguis, and with a markedly reduced additional unguis. The true host of the single specimen available, assumed to be an encrusting sponge, is unknown. The new species is described and illustrated, and a key to distinguish related species is proposed.

KEY WORDS. – South China Sea, Pontoniinae, *Periclimenaeus nufu*, new species.

INTRODUCTION

A Norwegian-Vietnamese research project devoted to studies on the biotic communities of dead coral rubble habitats was held in 2003 and 2006, and included collecting expeditions at various sites of the Van Phong and Nhatrang Bays, Vietnam. Identification of symbiotic shrimps from these collections, deposited in the museum of the Oceanographic Institute, Vietnamese Academy of Sciences and Technology, Nhatrang, yielded the discovery of one new species of the genus *Periclimenaeus* Borradaile, and also several new records of shrimps that will be published in a separate report.

About 69 species of the pontoniine genus *Periclimenaeus*, the second most speciose genus of the palaemonid subfamily Pontoniinae, are currently known, of which at least 56 are distributed throughout the Indo-West Pacific area, including exclusively symbiotic forms. Despite the fact that the hosts

of many of these species remain unreported, most are known as associates of sponges or compound ascidians (Bruce, 1976; Marin, 2007). The dead coral habitat is not typical for shrimps of this genus; however, encrusting or boring sponges and colonial ascidia may often grow within dead bases of live corals and on blocks of coral rubble.

A single specimen of an as-yet undescribed species of the genus *Periclimenaeus* was found in a sample from rather shallow water; the actual host is unknown. This new species, described below, increases the number of congeners known in Vietnamese waters of the South China Sea to ten. This number is evidently underestimated, and further records will surely follow.

The following abbreviations are used: CL, postorbital carapace length; RF, rostral formula; ION, Institute of Oceanography, Academy of Sciences and Technology, Nhatrang, Vietnam.

SYSTEMATICS

Family Palaemonidae Rafinesque, 1815

Subfamily Pontoniinae Kingsley, 1878

Genus *Periclimenaeus* Borradaile, 1915

Periclimenaeus nufu, new species

(Figs. 1–5)

Material examined. – Holotype: female (CL 1.9 mm, TL 6.5 mm), ION R.4254/E.54104, sample n. 10.D2, Bai Tré site, Lon Island, 12°36'25"N, 109°19'58"E, Van Phong Bay, Vietnam, South China Sea, 28 Sep.2003, depth 5m, coral rubble, coll. ION staff (Department of Marine Living Resources).

Diagnosis. – Rostral dentition 4/0; anteroventral angle of carapace produced, movable; telson with two pairs of large dorsal spines at 0.2 and 0.5 of telson length, posterior margin with lateral spines situated anteriorly from remaining spines; first abdominal segment tergite with anterior median lobe; mandibular incisor process normal, distally dentate; first pereopod fingers with cutting edges entire, carpus longer than chela, coxa with distal lobe dorsally and unarmed ventrally; major second pereopod with dactyl almost semicircular dorsally and with low plunger ventrally, palm looks granulate – covered by numerous soft papillae; minor second pereopod fingers with cutting edges simple, straight, shear-like fingers shorter than palm, palm papillose; ambulatory dactyli biunguiculate, with slender unguis subequal to corpus length and distoventral tooth feebly developed, ventral margin of corpus concave, denticulate proximally; uropodal rami broadly ovate, distolateral angle of exopod rounded, serrate.

Etymology. – The abbreviation NUFU (Norwegian Program for Development, Research and Education) is adopted as the specific name for the new species, in reference to the Vietnamese-Norwegian research project under which the type specimen was collected and examined.

Description (based on the female holotype). – A small sized pontoniine shrimp of subcylindrical form belonging to the *Periclimenaeus robustus* species group (Bruce, 2005) (Fig. 1).

Rostrum (Fig. 2B) about 0.35 of CL, reaching distal end of basal segment of antennular peduncle, slightly arched dorsally with four acute teeth, first tooth well in advance of posterior orbital margin, with short interspersed setae, ventral lamina toothless, straight, upturned proximally.

Carapace (Figs 1; 2A,B) smooth, without epigastric, supraorbital or hepatic spines, with a low swollen tubercle in postorbital position; antennal spine well developed, marginal, inferior orbital angle obsolete, anteroventral margin of carapace produced, rounded, forming soft movable plate.

Abdomen smooth, first segment tergite with low, anteriorly directed and flattened median lobe on dorsal surface (Fig. 2E), pleura rounded, fourth and fifth posteriorly produced, rounded, sixth segment median length subequal to fifth segment length, posterolateral and posteroventral angles produced, subacute.

Telson (Fig. 2F) about 1.4 times sixth abdominal segment length, 0.5 of CL, 1.7 times longer than anterior width; lateral margins feebly convex, posteriorly convergent; dorsal telson spines about 0.16–0.18 of telson length, situated at 0.2 and 0.5 of telson length; posterior margin broadly convex without median point, lateral posterior spines half of dorsal spines length, situated in advance of intermediate and submedian spines, intermediate spines subequal to dorsal spines, submedian spines 1.3 times longer than intermediate spines, stout, setulose.

Eyes (Fig. 2A) with globular cornea situated obliquely on stalk, with small accessory pigmented spot dorsally on stalk close to posterior corneal margin; corneal diameter about 0.2 of postorbital CL; stalk short, swollen, medial length about 1.5 of corneal diameter.

Antennule (Figs. 2A,C) of normal form; basal peduncular segment about 2.5 times as long as central width, stylocerite elongate, subtriangular, distally acute and laterally rounded, lateral margin straight, slightly tapering distally, distolateral tooth stout, subtriangular, overreaching anterior margin, reaching almost to distal end of intermediate segment, medial margin with minute ventromedial tooth at about 0.4 of segment length; intermediate segment about 0.2 of proximal segment length, distinctly wider than long, distal segment slightly longer than preceding, length subequal to width; upper flagellum biramous; four proximal segments fused, short ramus with three segments, 6 groups of aesthetascs; longer ramus slender, with about seven segments, lower flagellum similar, slender with about 10 segments.

Antenna (Fig. 2D) of normal form; basicerite short, laterally and dorsally unarmed; carpocerite subcylindrical, reaching about 0.75 of scaphocerite length; scaphocerite about 2.5 times longer than broad, broadest at about 0.6 of length, anterior margin rounded, lateral margin slightly concave, almost straight, with well developed distal tooth reaching level of distal margin of lamella.

Thoracic sternites narrow and unarmed.

Mouthparts (Fig. 3) from left side dissected. Mandible (Fig. 3A,B) without palp; incisor process well developed, with four apical teeth, molar process tapering distally, with four groups of subacute teeth.

Maxillula (Fig. 3C) with bilobed palp (Fig. 3D), lower lobe short, with small spinule; upper lacinia broad, dorsal margin convex, distal margin with about eight strong serrate spines and several slender serrulate setae; lower lacinia short, truncate, with a group of about eight slender

terminal and four subterminal setae, several long setae on ventral margin.

Maxilla (Fig. 3F) with simple palp, tapering, distally rounded, basally setose, slightly shorter than basal endite, basal endite deeply bilobed, upper lobe with about eight slender simple setae and single plumose distal seta, lower lobe slightly more than 3 times longer than central width, anterior lobe about 1.5 times longer than basal width, medial margin slightly angulate proximally, marginal setae plumose; posterior lobe well developed.

First maxilliped (Fig. 3G) with elongate flattened palp, about thrice longer than central width, not reaching anterior margin of basal endite, with single preterminal plumose seta; basal endite with distal margin produced, rounded, medial margin straight with numerous slender setulose setae and one single seta; coxal endite divided from basal endite by shallow emargination, with several long setulose setae medially; exopod with normal flagellum with four plumose terminal setae, caridean lobe large; produced, with lateral margin broadly rounded, marginal setae plumose; epipod well developed, deeply bilobed, lobes elongate, distally rounded.

Second maxilliped (Fig. 3H) with normally developed endopod, dactylar segment broad, about thrice longer than maximum width, distomedial margin straight, with numerous serrulate spines; propodal segment normal, distomedial margin weakly convex with several simple spines; carpus, merus and ischiobasis without special

features; coxa medially angulate with pair of setae; exopod normally developed with four plumose terminal setae; epipod elongate, reaching two-thirds of ischiobasal length, rounded distally, without podobranch.

Third maxilliped (Fig. 3I) stout, with endopod slightly overreaching distal end of carpocerite; coxa with minute ventral tubercle, non-setose, lateral plate semicircular, arthrobranch absent; basis fused with ischiomerus, combined ischio-basal segment about 3.5 times longer than basal width, with series of long and short spiniform setae ventrally and pair of short distolateral setae; penultimate segment about 0.45 of ischio-basal segment length, 2.5 times longer than wide, with ventrolateral and ventromedial rows of long spiniform setae and pair of short distolateral setae - one spiniform; terminal segment about 0.6 of penultimate segment length, with pair of terminal spines longer than segment and scattered shorter spiniform setae ventrally and on sides of ventral margin; exopod normally developed, subequal to ischio-basal segment, with four plumose terminal setae.

First pereopods (Fig. 4A-B) stout, overreaching carpocerite by distal end of merus; chela with palm subcylindrical, compressed, 1.7 times longer than deep, fingers similar, subequal to palm length, broad and high basally and tapering distally, with groups of short stiff setae, subspatulate, with elongate unguis and small adjacent tooth distally (Fig. 4C), cutting edges medial, entire; carpus 1.2 times chela length, thrice longer than distal width, tapering proximally; merus slightly longer than carpus and 5 times longer than central

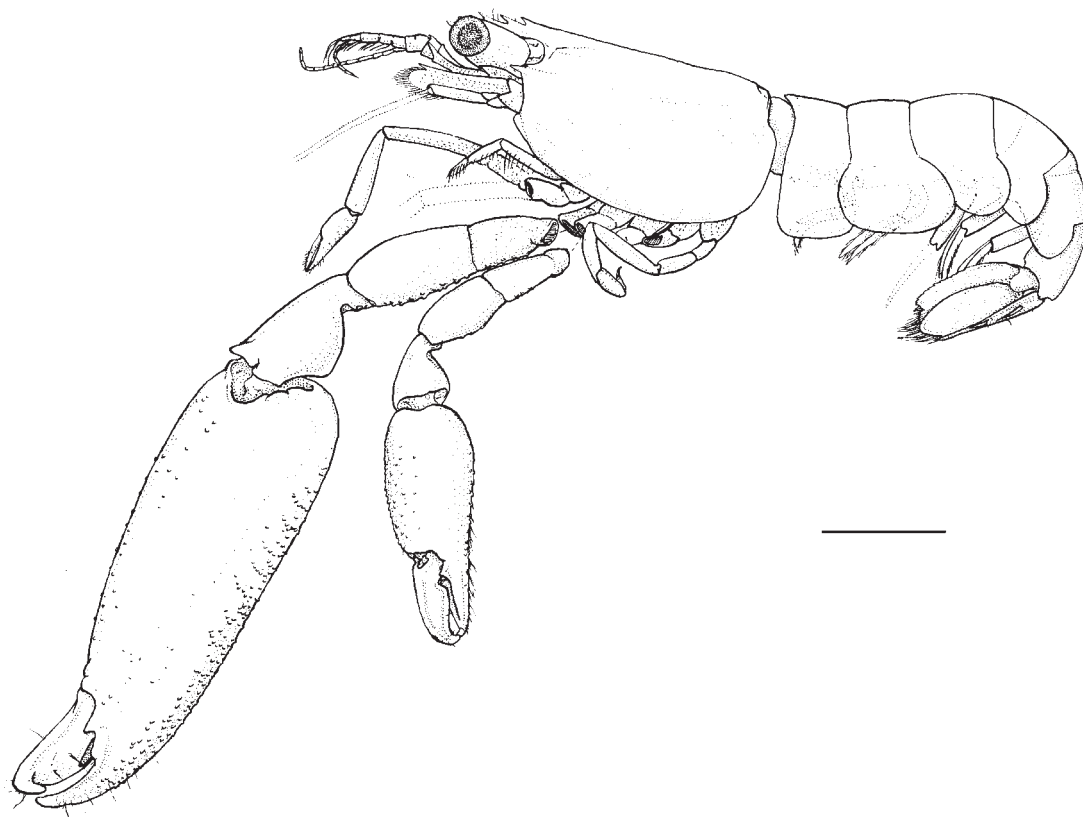


Fig. 1. *Periclimenaeus nufu*, new species, female holotype. Scale bar = 1 mm.

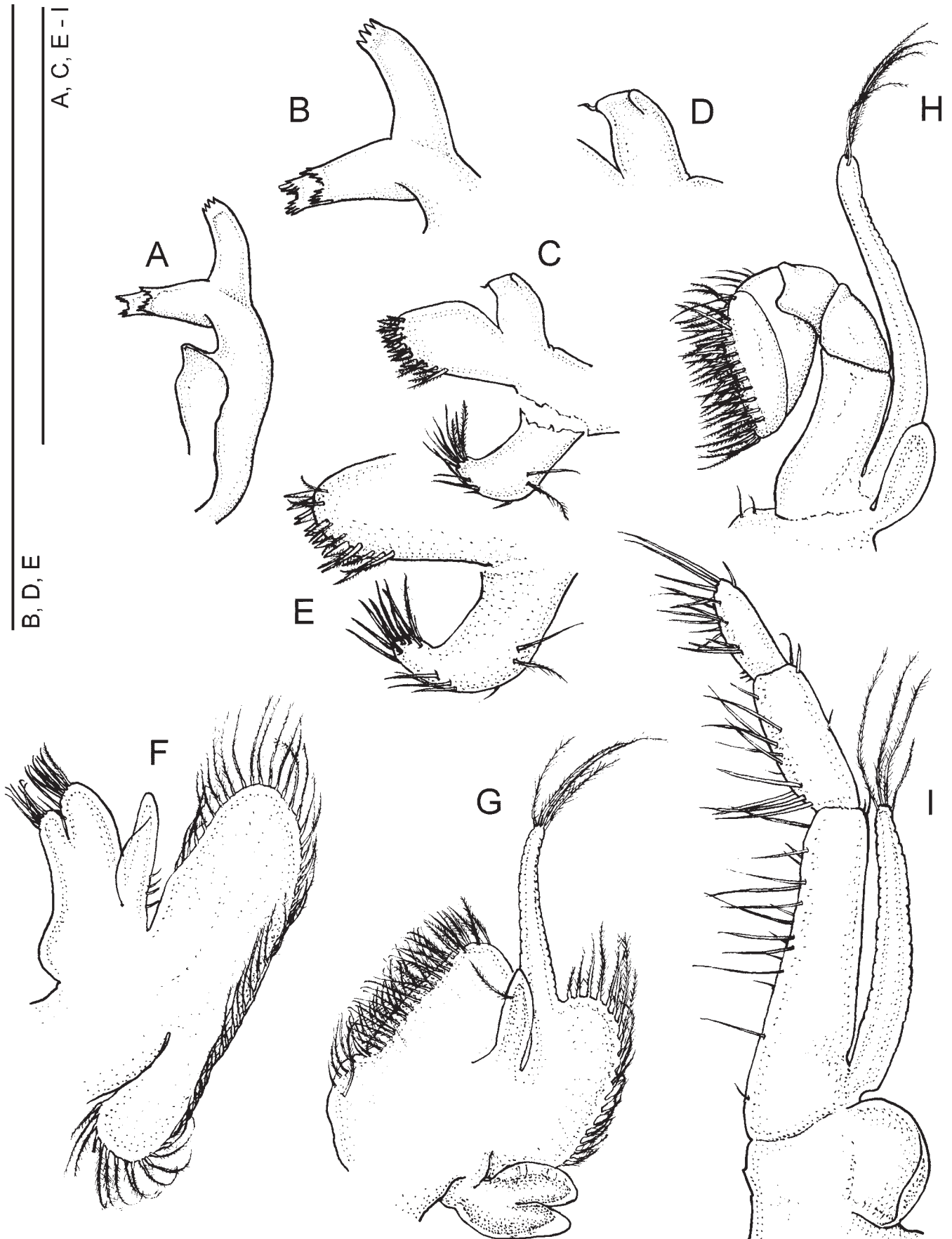


Fig. 2. *Periclimenaeus nufu*, new species, female holotype. A, anterior cephalothorax, eyes and antennae, dorsal. B, anterior carapace, lateral. C, antenna, dorsal. D, antenna, ventral. E, posterior carapace and anterior first abdominal segment, dorsal. F, telson, dorsal. G, same, distal part. H, right uropod, dorsal. I, same, exopod, with distolateral margin enlarged. Scale bars = 0.5 mm.

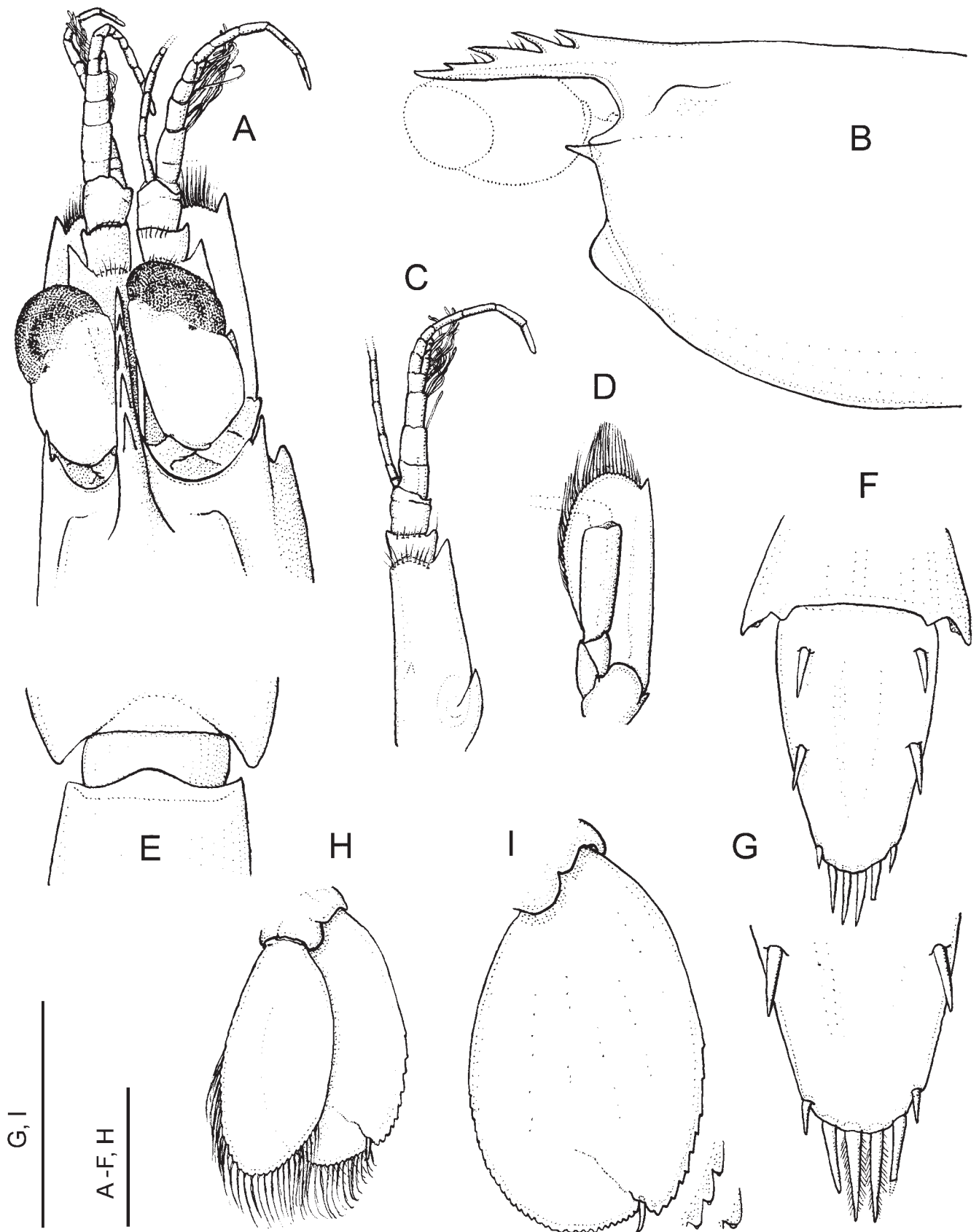


Fig. 3. *Periclimentaenus nufu*, new species, female holotype, mouthparts (from the left side). A, mandible. B, same, molar and incisor processes. C, maxillula. D, same, palp. E, same, laciniae. F, maxilla. G, first maxilliped. H, second maxilliped. I, third maxilliped. Scale bars = 1 mm.

depth; ischium two thirds of merus length; basis without special features; coxa simple ventrally but dorsally produced to distinct lobe with rounded tip.

Major second pereiopod (Fig. 4D) well developed, length about twice CL, palm about twice longer than maximal depth, slightly swollen proximally, oval in section, covered with small soft papillose tubercles (Fig. 4) dorsally and ventrally, ventral tubercles aligned to transversal rows (Fig. 4F); fingers (Fig. 4E) 0.4 of palm length, sparsely setose; dactyl twice longer than maximal depth, dorsal margin strongly convex, with stout obtuse hooked tip, cutting edge with low elongate molar process proximally, distal cutting edge convex, entire; fixed finger tapering distally, tip hooked; carpus about 0.35 of palm length, narrow proximally, broadly expanded distally, several tubercles ventrally; merus about 0.4 of palm length, robust, twice longer than central depth, tuberculate ventrally; ischium 0.8 of meral length, twice longer than distal depth, tapering proximally, without ventral denticles; basis and coxa normal, without special features.

Minor second pereiopod (Fig. 4H) chela length subequal to CL, with palm (Fig. 4I) tuberculate dorsally and ventrally, oval in section, 1.5 times longer than central depth, tapering

slightly proximally, ventral margin convex; with series of long setae along ventral margin of palm and fixed finger; fingers about two thirds of palm length, dactylus compressed, slightly exceeding fixed finger, about 2.4 times longer than maximal depth, dorsal margin convex, tip blunt, cutting edge simple; fixed finger basal width subequal to dactylus width, rather straight, tapering distally to upturned subacute tip, cutting edge grooved proximally; carpus short, less than 0.4 of palm length, stout, distally excavate, length subequal to distal depth, ventral margin simple; merus short and stout, slightly longer than both carpus length and half of palm length, about 1.7 times longer than central depth, ventral margin tuberculate; ischium subequal to merus length, ventral margin with distomesial rounded lobe; basis and coxa short, robust, without special features.

Ambulatory legs robust; third pereiopods (Fig. 5A, C) with dactyli (Fig. 5B, D) 0.4 of propod length, feebly biunguiculate; unguis distinctly demarcated, slender, 5 times longer than basal width, slightly curved, corpus compressed, about twice longer than proximal depth, tapering distally, dorsal margin slightly convex, ventral margin sinuate, with minute but acute distal accessory tooth somewhat separated from base of unguis, three minute sharp denticles proximally on corpus; propod about 0.55 of CL,

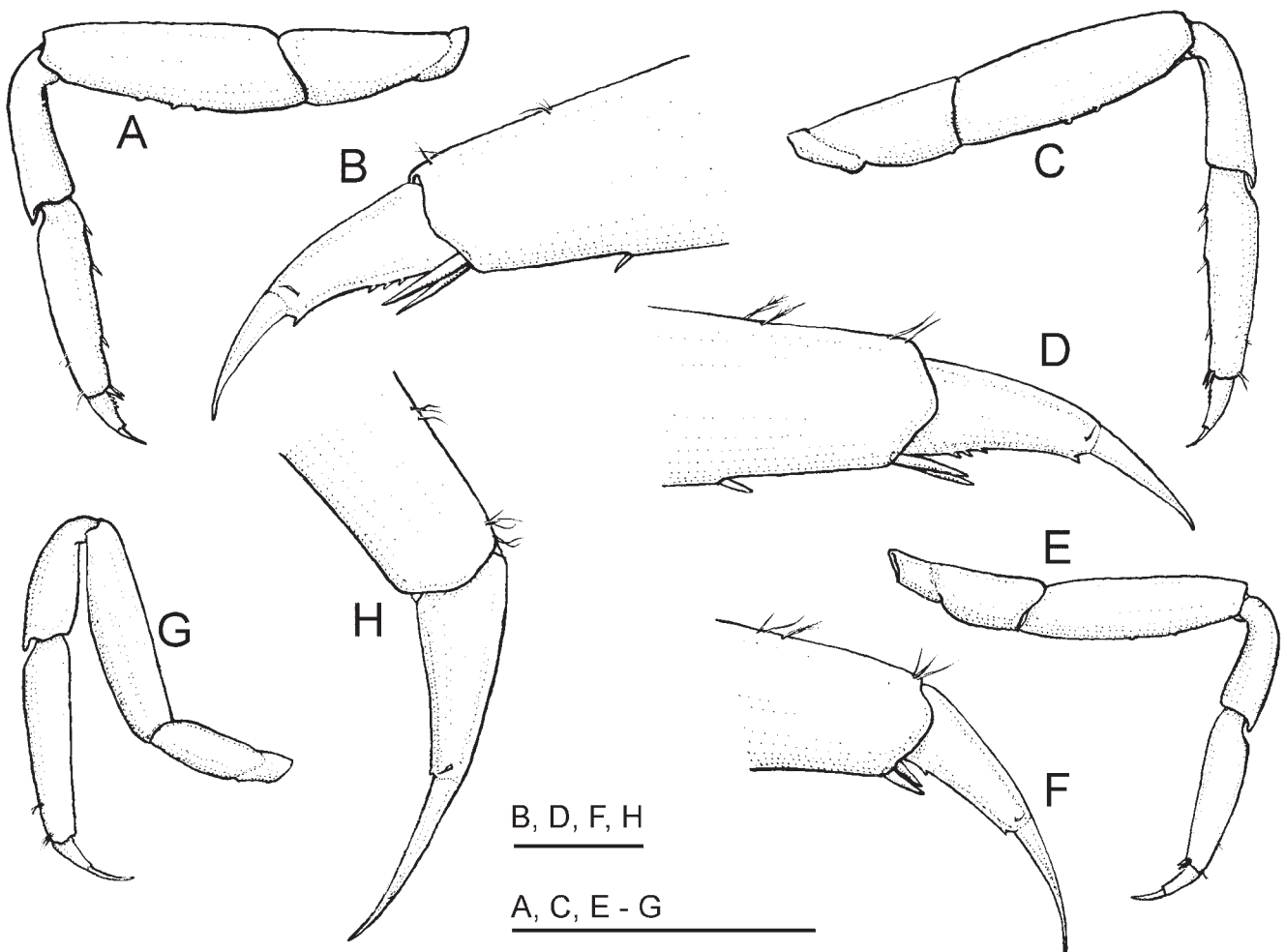


Fig. 4. *Periclimenaeus nufu*, new species, female holotype. A, right first pereiopod, lateral. B, same, distal segments, lateral. C, same, tips of fingers. D, major second pereiopod, lateral. E, same, distal palm and fingers, mesial. F, same, ventral margin of palm. G, same, tubercle from ventral palm. H, minor second pereiopod, lateral. I, same, chela. Scale bars = 1 mm.

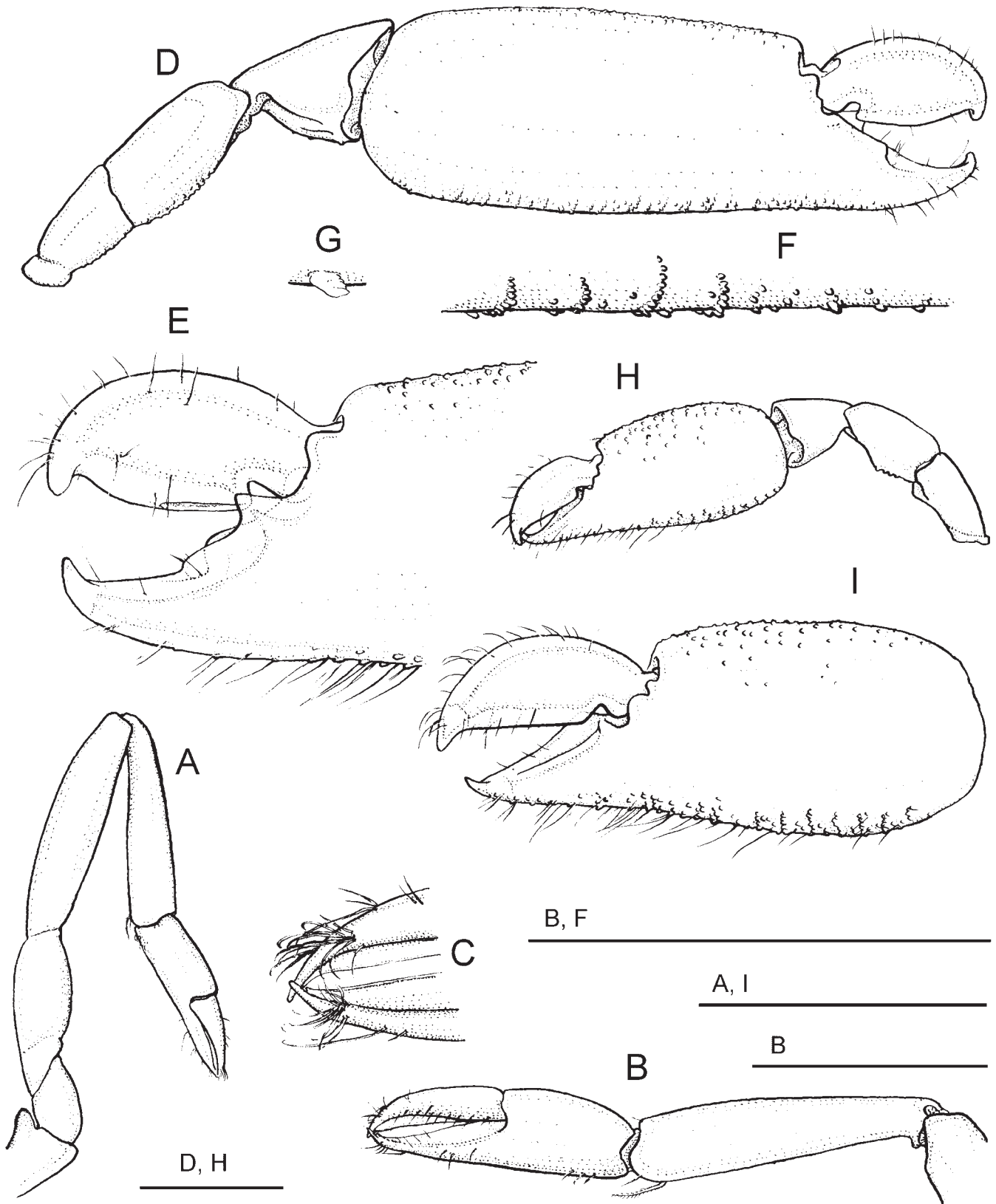


Fig. 5. *Periclimenaeus nufu*, new species, female holotype. A, left third pereiopod, lateral. B, same, distal propodus and dactylus. C, right third pereiopod, lateral. D, same, distal propodus and dactylus. E, right fourth or fifth pereiopod, lateral. F, same, distal propodus and dactylus. G, left fifth pereiopod, lateral. H, same, distal propodus and dactylus, mesial. Scale bars: A, C, E-G = 1 mm; B, D, F, H = 0.1 mm.

3.8 times longer than proximal width, tapering distally, distoventral angle armed with two stout spines about 0.5 of dorsal corpus length, three to four additional smaller single spines irregularly spaced on ventral margin, with proximal one smallest and close to preceding spine; carpus subequal and as stout as propod, about 3.5 times longer than distal width, tapering proximally, unarmed; merus subequal to propod length but stouter, about 3 times longer than proximal width, several sharp tubercles ventrally; ischium two thirds of propod length, slightly more slender than merus, tapering proximally; basis and coxa robust, without special features.

Fourth and fifth pereopods (Fig. 5E, G, respectively) generally similar and subequal to third pereopods, with dactyli (Fig. 5F, H, respectively) gradually slightly slender and longer than third dactylus; fourth dactylus with accessory tooth vestigial, corpus with only single proximal denticle on ventral margin; fourth propodus with distoventral pair of spines short, 0.25 of dactylar corpus dorsal length; fifth dactylus with unguis unusually long, nine times longer than basal width, additional unguis inconspicuous, corpus unarmed; additional ventral spines lacking; fifth propod totally unarmed.

Uropods (Fig. 2H) with protopodite posterolaterally unarmed; exopod (Fig. 2I) broadly ovate, subequal to telson length, 1.6 times longer than broad, lateral margin convex with distal half serrate, non-setose, distolateral angle produced to rounded serrate lobe, serration with vestigial terminal denticles (Fig. 2I-detail), distolateral lobe medially with slender acute spine with incurved tip, spine far exceeding distal end of lobe and reaching level of distal end of exopod; endopod slightly shorter than exopod, ovate, 2.2 times longer than broad.

Color. – Specimen preserved, no traces on color.

Host. – The specimen was collected during an examination of coral rubble. No host animal was recorded. All species of *Periclimenaeus*, if their host is reported, live in association with host animals, sponges or compound ascidians.

Distribution. – Known only from the type locality, Van Phong Bay, south of Nhatrang Bay, Vietnam (South China Sea).

DISCUSSION

About 69 species of the pantropical genus *Periclimenaeus* are actually known, with 12 Atlantic species and the remaining majority of species distributed through the Indo-West Pacific and Western American areas. *Periclimenaeus nufu*, new species, is easily distinguishable from all other species of the genus by the unique shape of the broadly ovate uropodal exopod with a serrate distolateral lobe outside of a single movable spine. A serrate lateral margin of uropodal exopod is known only in *P. gorgonidarum* (Balss, 1913)

and *P. uropodialis* Barnard, 1958. In both these species the margin is deeply serrate and the distolateral angle terminates in a row of four to six spines; these species also possess a supraorbital spine that is lacking in the present new species, and differ also (see the key below) in the rostral armament, dorsal and terminal telson spines, and ventral spination of ambulatory propodi (Kubo, 1940; Barnard, 1958; Miyake & Fujino, 1967). In other congeners, the lateral margin of the uropodal exopod is straight or moderately convex and terminates with a more or less distinct tooth and a movable spine medially. This movable spine is also well developed in the present species. A similar lobate distolateral angle of the uropodal exopod was described for all three species of the related genus *Paraclimenaeus* Bruce, *P. fimbriatus* (Borradaile, 1915), *P. spinicauda* (Bruce, 1969) and *P. seticauda* (Bruce, 2008) but the marginal serration of these species is equipped with long spines (Bruce, 1969, 1988, 2009). In the present new species only inconspicuous denticles are present on the distal serrations. *Paraclimenaeus* differs from *Periclimenaeus* in the specific setation of the first chelae, in the sound-producing structure on the second pereopods with the plunger situated on the fixed finger and the fossa on dactyl, and other characters listed in the original generic diagnosis (Bruce, 1988).

Another peculiar structure is the ‘movable’ anteroventral (pterygostomial) angle of the carapace. In the present species, the angle, much softer than the remaining carapace, is well produced and divided from the carapace by a distinct suture. It is possible that the latter is not unique, but has just gone unmentioned in previous reports. A similar anteroventral lobe, subdivided from the carapace, was illustrated by Bruce (1989: Fig. 3A) in his original description of *Periclimenaeus storchi*. A more or less pronounced anteroventral angle is known from some other *Periclimenaeus* species, e.g., *P. ascidiarum* Holthuis, 1951, as well as some other American species (Holthuis, 1951), and *P. gorgonidarum*, *P. garthi* Bruce, 1974a, *P. serrula* Bruce & Coombes, 1995, or *P. stylirostris* Bruce, 1969, among Indo-West Pacific congeners (Miyake & Fujino, 1967; Bruce, 1972, 1974a; Bruce & Coombes, 1995). This feature, however, needs confirmation in these species; basing on recently examined specimens, the pterygostomial region of the carapace is not produced or articulated in *P. gorgonidarum* (A.J. Bruce, pers. comm.).

The carapace of the new species has a low swollen tubercle on the postorbital position which is similar, to some extent, to that in another Vietnamese species, *P. pachyspinosus* Marin, 2007, and also in *P. bidentatus* Bruce, 1970, *P. nielbrucei* Bruce, 2006, or *P. tuamotae* Bruce, 1969 (Bruce, 1969, 1970, 2006; Marin, 2007). In these, however, the tubercles are more distinct, subacute, not broadly swollen. More feebly developed, obtusely rounded, supraorbital areas are described or figured in several other species, e.g., *P. leptodactylus* Fujino & Miyake, 1968, *P. rastrifer* Bruce, 1980, *P. spinimanus* Bruce, 1969, *P. tchesunovi* Đuriš, 1990, *P. tridentatus* Bruce, 2002, or *P. zarenkovi* Đuriš, 1990 (Fujino & Miyake, 1968; Bruce, 1969, 1980, 2002; Đuriš,

1990). The present new species differs from all these by the shape of the uropodal exopods noted above, and also by combination of characters on the first and second chelae, and of the ventral armament of the ambulatory dactyli.

Periclimenaeus nufu, new species, belongs to the *P. robustus*-group of species that now includes at least nine other species: *P. ardeae* Bruce, 1970, *P. djiboutensis*, *P. gorgonidarum*, *P. lobiferus*, Bruce 1978a, *P. orontes*, Bruce 1986, *P. palauensis* Miyake & Fujino, 1968, *P. spinimanus*, *P. robustus* Borradaile, 1915, and *P. uropodialis* Barnard, 1958 (Barnard, 1958; Bruce, 2005). These species have an abdomen with a semicircular anteromedian dorsal lobe on the first abdominal tergite, usually fitting beneath the flat, shallow posteromedian depression dorsally on the carapace. A key for distinguishing these species was provided by Bruce (2005).

Together with the unique uropodal exopod, the present new species also differs by a produced distodorsal lobe on the first pereopod coxa, and an articulated anteroventral angle of the carapace. Within this species group, a produced anteroventral angle of the carapace is present in *P. djiboutensis* (Bruce, 1970, 1974b). That species has a distinct dorsolateral lobe on the antennal basicerite - a unique character among congeners; the palm of the first pereopod chela is elongate, about thrice longer than fingers, the minor second pereopod dactyl is distally bidentate, and the dorsal telson spines are all situated on the proximal fifth of the telson (Bruce, 1986). The first pereopod finger: palm lengths ratio, similar to those of *P. djiboutensis*, is also close to that in *P. spinimanus*. Both the former species are generally quite similar; the latter species, however, differs in the normal shape of the antennal basicerite and the dorsal telson armament, and in the dense spinulation of the second pereopod chelae (see below).

Periclimenaeus lobiferus has a longer rostrum reaching almost to the end of the antennular peduncle, and with nine, mostly long, slender and erect dorsal teeth. The mandibular incisor process is reduced (Bruce, 1978a). The new species possess a short rostrum not overreaching the basal segment of the antennular article, five dorsal teeth, the incisor process is well developed, dentate distally. *Periclimenaeus lobiferus* is the only representative of the *robustus* group with a denticulate ventral margin of the ambulatory dactyli that it shares with the present new species. The dactyli are long and slender, however, with ungui subequal to the corpus, and with an indistinct distoventral tooth, in *P. nufu*, new species. *Periclimenaeus ardeae*, a sponge associated shrimp, and *P. palauensis*, whose host remains unknown, bear a unique (among pontoniines) tuft of long setae dorsally on the first pereopod dactyli (Miyake & Fujino, 1968; Bruce, 1970, 1978a). *Periclimenaeus ardeae* is similar to *P. robustus* and may prove to be synonymous with the latter (Bruce, 2005). Nothing is still known about a host animal, or about the presence or absence of the tuft of setae in *P. robustus*. Well developed tufts, rather dorsolateral, are also present on the first pereopod fingers in *P. djiboutensis* and *P. spinimanus* (Bruce, 1974b, 1978b).

Periclimenaeus ardeae has 8-9 dorsal teeth on the laterally lanceolate rostrum, hooked tips of the first pereopod fingers, and the chelae of the second pereopods covered with long slender spinules on dorsomedial aspects (Bruce, 1970). The rostrum and first pereopod chelae of *P. nufu*, new species, are different from those of the former species, but the second pereopod chelae are similarly covered by tubercles which are soft and papillose in the new species. Spinulose chelae are widely reported in many *Periclimenaeus* species from all main tropical marine areas. Together with *P. ardeae* and *P. nufu*, new species, that character is also present in all known species of the *P. robustus* group (Bruce, 1974b, 1978a,b, 1986, 2005), excluding *P. palauensis* (Miyake & Fujino, 1968). Dense spinulation of the upper surfaces of the second pereopod chelae, with long slender spines, are especially developed in *P. spinimanus* (Bruce, 1969, 2005). We have also observed distinct subquadrate tubercles in an undescribed sponge-dwelling species from Caribbean waters (Đuriš et al., manuscript), not of *P. robustus* group. For scanning electron microscopy, we prepared a single chela of another Caribbean species, possibly *P. brucei* Cardoso & Young, 2007. Curiously, the chela lost these spinules, leaving only minute oval membranous fields at their positions after drying procedures. The function of these soft spiniform structures remain unknown; we only can suggest on a soft molting stage of the chelae covers in the described cases. The host remains unknown in *P. lobiferus*, *P. nufu*, new species, *P. palauensis* and *P. spinimanus*; all other species of this group are sponge associates (Bruce, 1970, 1981, 1986; Marin, 2007).

In *P. palauensis* the palm and dactyl of the first pereopod are compressed and expanded basally (Bruce, 1970, 2005), characters not found in *P. nufu*, new species. The second pereopod chelae are smooth in *P. palauensis*. The dorsal rostral armament of the latter species is similar to those of *P. ardeae*, *P. djiboutensis*, *P. lobiferus*, *P. orontes* and *P. robustus*, bearing 5-9 slender and well erected teeth on the laterally lanceolate rostrum. Within the *P. robustus* group, *P. nufu*, new species, occupies an isolated position in possessing a rather styliform rostrum with 4 depressed dorsal teeth.

In most species of the group discussed, the dactyl of the minor second pereopod is semicircular (unknown in *P. palauensis*), not elongate as in *P. lobiferus* and *P. nufu*, new species. In *P. orontes*, and to some extent also in *P. stylirostris*, the dactyl has a distodorsal edge which is produced into a sharp carina (Bruce, 1986, 2005; Bruce & Coombes, 1995). The accessory tooth of the ambulatory dactyli is minute in both *P. orontes* and *P. nufu*, new species, but the dactyli are more robust and not spinulate ventrally in *P. orontes*. Both pairs of dorsal telson spines are situated on the anterior third of the telson in the latter species, a character shared only with *P. djiboutensis*.

The *Periclimenaeus robustus* group now consists, together with the present new species, of ten species. It is possible that some other previously-described *Periclimenaeus* species

will be added to this group after future revisions, since that character may have been overlooked or unmentioned (Bruce, 1986). The actual species group, first mentioned by Bruce (1986) but formally named by that author later (Bruce, 2005), is a rather heterogeneous assemblage of small species with an irregular distribution of the main diagnostic characters for each species, but sharing only a single unique character – the anteromedian lobe on the first abdominal tergite. The group is not regarded as necessarily monophyletic, but rather more as a useful basket for sorting species (A.J. Bruce – pers. comm.). Molecular analyses would yield needed insight into the phylogenetic relations within this group. However, all species mentioned above are rare, and, except for *P. ardeae*, *P. djiboutensis*, *P. gorgonidarum* and *P. robustus*, are known only from their unique type specimens. This constrains the possibilities of proceeding with adequate methods. The true systematic relation of *P. robustus* to other congeners is also highly important since it is the type species of the genus *Periclimenaeus* Borradaile (Bruce, 2005).

Nine species of the genus *Periclimenaeus* are now known from the South China Sea (Bruce, 1979; Li et al., 2004). All of them, i.e., *P. arabicus* (Calman, 1939), *P. djiboutensis* Bruce, 1970, *P. hecate* (Nobili, 1904), *P. pachyspinosus*, *P. rastrifer* Bruce, 1980, *P. rhodope* (Nobili, 1904), *P. storchi* Bruce, 1969, *P. stylirostris* Bruce, 1969, and *P. tridentatus* (Miers, 1884), are also reported from Vietnamese waters (Bruce, 1993; Marin, 2007; Marin & Savinkin, 2007). The present new species increases the number of Vietnamese *Periclimenaeus* species to ten.

KEY TO THE KNOWN INDO WEST-PACIFIC SPECIES OF THE PERICLIMENAEUS ROBUSTUS GROUP

(after Bruce, 2005, modified):

- 1 Lateral margin of uropodal exopods serrate on distal half 2
 - Lateral margin of uropodal exopods entire 4
- 2 Swollen supraorbital tubercles present, not spines; ventral margin of 3rd and 4th pereopod propodus feebly spinulate (not more than six spines including terminal pair); distolateral angle of uropodal exopod terminating with serrate lobe and a single spine on diaeresis; RF 4/0
 - P. nufu* Đuriš, Horká & Hoc, new species [South China Sea]
 - Supraorbital spines present; ventral margin of 3rd and 4th pereopod propodus heavily spinulate (about 12-20 spinules); distolateral angle of uropodal exopod with about 4 spines 3
- 3 Dorsal telson spines all distinctly on anterior half of telson; ambulatory dactyls with corpus and unguis ventrally entire; RF 1+6/1 *P. gorgonidarum* (Balss, 1913) [East Africa, Seychelles, Japan, Australia]
 - Posterior pair of dorsal telson spines distinctly on posterior half of telson; ambulatory dactyls with corpus and unguis ventrally serrate; RF 1+6/3 *P. uropodialis* Barnard, 1958 [western Indian Ocean]
- 4 Dorsal telson spines all distinctly on anterior half of telson .. 5
 - Dorsal telson spines distinctly not all on anterior half of telson, second pair at about midlength of telson 6

- 5 Basicerite with well developed dorsolateral lobe; anteroventral angle of carapace produced; first pereopod fingers about 1/3 of palm length; RF 7-9/0 *P. djiboutensis* Bruce, 1970 [western Indian Ocean, Great Barrier Reef]
 - Basicerite without developed dorsolateral lobe; anteroventral angle of carapace not produced; first pereopod fingers subequal to palm length; RF 6/0 *P. orontes* Bruce, 1986 [northern Australia]
- 6 Third and fourth pereopods dactyls with corpus ventrally denticulate; RF 9/0 *P. lobiferus* Bruce [western Indian Ocean]
 - Third and fourth pereopods dactyls with corpus ventrally entire 7
- 7 Second pereopod chelae smooth, not spinulate or tuberculate; RF 7/0 *P. palauensis* Miyake & Fujino [Philippine Sea]
 - Second pereopod chelae spinulate or tuberculate 8
- 8 Dorsal surfaces of second pereopod chelae densely covered with long slender spinules, including dorsal margin of dactylus; RF 9/1 *P. spinimanus* Bruce [western Indian Ocean]
 - Dorsal surfaces of second pereopod chelae with small short acute tubercles 9
- 9 Rostral midrib slender, lanceolate, dorsal carina shallow, tip slenderly acute, ventral margin smoothly convex, RF 8-9/0 .. *P. ardeae* Bruce [Great Barrier Reef]
 - Rostrum midrib robust, deep, tip broadly acute, ventral margin straight, RF. 9/0 *P. robustus* Borradaile [western Indian Ocean]

ACKNOWLEDGMENTS

This study was supported by the Vietnam-Norwegian research project funded by the Norwegian Program for Development, Research and Education (NUFU). The Czech authors are very grateful to the management of the Institute of Oceanography, Vietnamese Academy of Sciences and Technology, Nhatrang, for kindly providing us with facilities and material for our studies, especially to Mr. Nguyen Van Long, the Vietnamese project manager, for ensuring our access to interesting NUFU specimens. The authors are also indebted to Dr. A.J. Bruce (Queensland Museum, South Brisbane), and to anonymous reviewers, for reading the manuscript and valuable comments, and Mr. D. Hardekopf (Charles University, Prague) for final language corrections. The study was partly supported by the Czech National Committee for cooperation with IOC UNESCO (ĐURIŠ), by the Moravian-Silesian Government from the program “Mobility of students and young researchers”, projects VAV4/06 and VAV11/07 (IH), and by the NUFU project Marine Biodiversity within the framework of the project “Aquaculture and Coastal Management in Vietnam: Modeling – Biodiversity – Fish health”, 2003-2007 (DTH).

LITERATURE CITED

Balss, H., 1913. Diagnosen neuer ostasiatischer Macruren. *Zoologischer Anzeiger*, **42**: 234–239.
 Barnard, K. H., 1958. Further additions to the crustacean fauna-list of Portuguese East Africa. *Memórias do Museu Dr. Álvaro de Castro*, **4**: 3–23.

- Borradaile, L. A., 1915. Notes on Carides. *Annals and Magazine of Natural History*, series 8, **15**: 205–213.
- Bruce, A. J., 1969. Preliminary descriptions of ten new species of the genus *Periclimenaeus* Borradaile, 1915 (Crustacea, Decapoda, Natantia, Pontoniinae). *Zoologische Mededelingen, Leiden*, **44**: 159–176.
- Bruce, A. J., 1970. Further preliminary descriptions of new species of the genus *Periclimenaeus* Borradaile, 1915 (Crustacea, Decapoda, Natantia, Pontoniinae). *Zoologische Mededelingen, Leiden*, **44**: 305–315.
- Bruce, A. J., 1972. A report on a small collection of pontoniid shrimps from Fiji, with the description of a new species of *Coralliocaris* Stimpson (Crustacea, Decapoda, Natantia, Pontoniinae). *Pacific Science*, **26**: 63–86.
- Bruce, A. J., 1974a. A report on a small collection of pontoniine shrimps from the northern Indian Ocean. *Journal of the Marine Biological Association of India*, **16**: 437–454.
- Bruce, A. J., 1974b. Observations upon some specimens of the genus *Periclimenaeus* Borradaile (Decapoda Natantia, Pontoniinae) originally described by G. Nobili. *Bulletin du Muséum National d'Histoire Naturelle, Paris* (3), **258**: 1557–1583.
- Bruce, A. J., 1976. Shrimps and prawns of coral reefs, with special reference to commensalism. In: Jones, O.A. & R. Endean (eds), *Biology and Ecology of Coral Reefs, Vol 3*. Academic Press, New York. Pp. 37–94.
- Bruce, A. J., 1978a. A report on a collection of pontoniine shrimps from Madagascar and adjacent Seas. *Zoological Journal of the Linnean Society*, **62**: 205–290.
- Bruce, A. J., 1978b. Pontoniinid shrimps from the ninth cruise of R/V *Anton Bruun*, IIOE, 1964, II: The remaining genera. *Bulletin of Marine Science*, **28**: 18–136.
- Bruce, A. J., 1979. Records of some pontoniine shrimps from the South China Sea. *Cahiers de l'Indo-Pacifique*, **1**: 215–248.
- Bruce, A. J., 1980. On some pontoniine shrimps from Nouméa, New Caledonia. *Cahiers de l'Indo-Pacifique*, **2**(10): 1–39.
- Bruce, A. J., 1981. Pontoniine shrimps of Heron Island. *Atoll Research Bulletin*, **245**: 1–33.
- Bruce, A. J., 1986. Three new species of commensal shrimps from Port Essington, Arnhem Land, Northern Australia (Crustacea: Decapoda: Palaemonidae). *The Beagle, Occasional Papers of The Northern Territory Museum of Arts and Sciences*, **3**: 143–166.
- Bruce, A. J., 1988. A redescription of *Periclimenaeus fimbriatus* Borradaile, 1915, with the designation of a new genus (Crustacea: Decapoda: Palaemonidae). *Zoological Journal of the Linnean Society*, **94**: 219–232.
- Bruce, A. J., 1989. A report on some coral reef shrimps from the Philippine Islands. *Asian Marine Biology*, **6**: 173–192.
- Bruce, A. J., 1993. Some coral reef pontoniine shrimps from Vietnam. *Asian Marine Biology*, **10**: 55–75.
- Bruce, A. J., 2002. A redescription of *Periclimenaeus tridentatus* (Miers, 1884), based on specimens from Port Essington, Northern Territory, and a note on *P. hecate* (Nobili, 1904) (Crustacea: Decapoda: Pontoniinae), with a key for the preliminary identification of the tunicate-associated species of *Periclimenaeus* Borradaile. *Journal of Natural History*, **36**: 565–584.
- Bruce, A. J., 2005. A re-description of *Periclimenaeus robustus* Borradaile, the type species of the genus *Periclimenaeus* Borradaile, 1915 (Crustacea: Decapoda: Pontoniinae). *Cahiers de Biologie Marine*, **46**: 389–398.
- Bruce, A. J., 2006. *Periclimenaeus nielbrucei* sp. nov. (Crustacea: Decapoda: Pontoniinae), a new sponge associate from the Capricorn Islands, Queensland, with notes on related *Periclimenaeus* species. *Zootaxa*, **1224**: 1–22.
- Bruce, A. J., 2008. Palaemonoid shrimps from the Australian North West Shelf. *Zootaxa*, **1815**: 1–24.
- Bruce, A. J., 2009. Notes on some Indo-Pacific Pontoniinae, XLVII. Re-evaluation of the genera *Apopontonia* Bruce, 1976, *Paraclimenaeus* Bruce, 1988 and *Climeniperæus* Bruce, 1996. *Crustaceana*, **82**: 493–504.
- Bruce, A. J. & K. E. Coombes, 1995. The palaemonoid shrimp fauna (Crustacea: Decapoda: Caridea) of the Cobourg Peninsula, Northern Territory. *The Beagle, Records of the Museums and Art Galleries of the Northern Territory*, **12**: 101–144.
- Calman, W. T., 1939. Crustacea: Caridea. *Scientific Report of the John Murray Expedition*, **6** (4): 183–224.
- Cardoso, I. A. & P. S. Young, 2007. Caridea (Crustacea, Decapoda: Disciadidae, Palaemonidae, Processidae, Rhynchocinetidae) from Rocas Atoll including two new species of *Periclimenaeus* Borradaile, 1915. *Arquivos do Museu Nacional, Rio de Janeiro*, **65**: 277–337.
- Đuriš, Z., 1990. Two new species of the commensal shrimp genus *Periclimenaeus* Borradaile, 1915 (Decapoda, Palaemonidae) from the Maldive Islands. *Journal of Natural History*, **24**: 615–625.
- Đuriš, Z., I. Horká & F. Sandford, submitted. *Periclimenaeus pectinidactylus* n. sp. (Crustacea: Decapoda: Pontoniinae) from the Belizean Barrier Reef, Caribbean Sea. *Zootaxa*.
- Fujino, T. & S. Miyake, 1968. Description of two new species of pontoniid shrimps (Crustacea, Decapoda, Palaemonidae) commensal with sponges. *OHMU*, **1** (3): 85–96.
- Holthuis, L. B., 1951. A general revision of the Palaemonidae (Crustacea Decapoda Natantia) of the Americas. I. The subfamilies Euryrhynchinae and Pontoniinae. *Allan Hancock Foundation, Occasional Paper*, **11**: 1–332, pls 1–63.
- Kingsley, J. S., 1878. List of the North American Crustacea belonging to the sub-order Caridea. *Bulletin of the Essex Institute*, **10**: 53–71.
- Kubo, I., 1940. Studies on Japanese palaemonoid shrimps. II. Pontoniinae. *Journal of the Imperial Fisheries Institute*, **34**: 31–75.
- Li, X., A. J. Bruce & R. B. Manning, 2004. Some palaemonid shrimps (Crustacea: Decapoda) from northern South China Sea, with descriptions of two new species. *The Raffles Bulletin of Zoology*, **52**: 513–553.
- Marin, I., 2007. Pontoniine shrimps (Decapoda: Caridea: Palaemonidae) inhabiting boring sponges (Porifera: Demospongia) from Nhatrang Bay, Vietnam, with description of three new species. *Zoologische Mededelingen, Leiden*, **81**: 217–240.
- Marin, I. & O. Savinkin, 2007. Further records and preliminary list of pontoniine (Caridea: Palaemonidae: Pontoniinae) and hymenocerid (Caridea: Hymenoceridae) shrimps from Nhatrang Bay. In: Britayev, T. & D. Pavlov (eds), *Benthic Fauna of the Bay of Nhatrang, Southern Vietnam*. IPEE, Moscow. Pp.176–208, Pls. 83–96.

- Miers, E. J. (1884) *Crustacea. Report of the Zoological Collections made in the Indo-Pacific Ocean during the Voyage of H.M.S. "Alert" 1881–2*. Pp. 178–322, 513–575.
- Miyake, S. & T. Fujino, 1967. On four species of Pontoniinae (Crustacea, Decapoda, Palaemonidae) found in Porifera inhabiting the coast regions of Kyushu, Japan. *Journal of the Faculty of Agriculture, Kyushu University*, **14**: 225–291, Pl. 3.
- Miyake, S. & T. Fujino, 1968. Pontoniinid shrimps from the Palau Islands (Crustacea, Decapoda, Palaemonidae). *Journal of the Faculty of Agriculture, Kyushu Imperial University*, **10**: 339–431.
- Nobili, G., 1904. Diagnoses préliminaires de vingt-huit espèces nouvelles de Stomatopodes et Décapodes Macroures de la Mer Rouge. *Bulletin du Muséum d'Histoire naturelle, Paris*, **10**: 228–238.
- Rafinesque, C. S., 1815. *Analyse de la Nature ou Tableau de l'Univers et des Corps organisés*. Palermo. 224 pp.