

TWO NEW GENERA AND A NEW SPECIES OF CRINOID-ASSOCIATED PONTONIINE SHRIMPS (DECAPODA: CARIDEA: PALAEMONIDAE)

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ABSTRACT

Two new genera of crinoid-associated pontoniine shrimps, *Brucecaris*, new genus, and *Unguicaris*, new genus, are described and illustrated. *Brucecaris* is established for *Periclimenes tenuis* Bruce. *Unguicaris panglaonis*, new genus, new species, is described from crinoid-associated material collected at Panglao Island, Bohol Sea, The Philippines. Three species, *Periclimenes alegrias* Bruce, *Periclimenes novacaledoniae* Bruce and *Periclimenes pilipes* Bruce and Zmarzly, are transferred to *Unguicaris* since they significantly differ from the diagnosis of the type species of the genus *Periclimenes* Costa, *P. amethysteus* (Risso). Remarks on systematic positions of remaining crinoid-associated species of the genus *Periclimenes* are given.

INTRODUCTION

Recent lists of crinoid-associated fauna consist of more than 25 caridean species including nineteen shallow-water and one, *Periclimenes pectinipes* Bruce, 1991, deep-water species of pontoniine shrimps (Bruce, 1982, 1991; Bruce and Coombes, 1997; Marin, 2006). Some deep-water species, such as *Periclimenes compressus* Borradaile, 1915, are considered as symbionts of deep-water crinoids (Bruce, 1980), but this has not yet been fully confirmed. The real diversity and phylogeny of crinoid-associated species are still unclear. Three of five known pontoniine genera of crinoid associates such as *Araiopontonia* Fujino and Miyake, 1970, *Parapontonia* Bruce, 1968 and *Pontoniopsis* Borradaile, 1915 are monotypic and another genus, *Crinotonia* Marin, 2006 includes two known species. The common occurrence of species-poor genera indicates high level of specialization to host morphology and special ecological niches on the host (Marin, 2006). The remaining 13 crinoid-associated pontoniine species are placed in the genus *Periclimenes* Costa, 1844. However, these species possess very diverse morphology and are obviously polyphyletic.

From field work in Nha Trang Bay, Viet Nam by the first author and the “Panglao 2004” expedition at the Panglao Island, Bohol Sea, in The Philippines participated by the second author, many crinoid-associated pontoniine shrimps were collected. This material allowed us to describe a new species from The Philippines, as well as making a decision to propose two new genera for some crinoid-associated pontoniids previously assigned to the genus *Periclimenes*. Postorbital carapace length (PCL) is used as a standard measurement of size. Specimens are deposited in the Zoological Museum of Moscow State University, Moscow (ZMMU), Philippines National Museum, Manila (PNM), National Taiwan Ocean University, Keelung (NTOU), Raffles Museum of Biodiversity Research, Singapore (ZRC), Muséum national d’Histoire naturelle, Paris

(MNHN) and A. N. Severtzov Institute of Ecology and Evolution RAS, Moscow (LEMMI).

SYSTEMATICS

Brucecaris, new genus

Type Species.—*Periclimenes tenuis* Bruce, 1969.

Diagnosis.—Small sized shrimps associated with feather stars (crinoids). Body slightly compressed and slender (Fig. 1). Carapace smooth, with antennal and hepatic spines, supraorbital and supraocular spines absent (Fig. 2a-c). Rostrum well developed, horizontal, slender, sharply pointed, with 6 dorsal teeth decreasing in size anteriorly, without ventral teeth, extending anteriorly beyond basal segment of antennular peduncle, with feebly developed rostral lamina and postorbital margins (Fig. 2b, c). Orbits feebly developed, inferior orbital angle distinctly produced. Pleomeres smooth; first to fourth pleura rounded, fifth pleuron pointed, posteroventral angle of sixth pleuron slightly produced (Fig. 1). Telson narrow, with 2 pairs of dorsal spines arising near lateral margins at distal half and 3 pairs of posterior spines. Eyes with slightly projecting cornea (Fig. 2d). Antennule with narrow basal segment, with anterior margin produced laterally and bearing long slender distolateral spine, small submarginal ventral spine present at middle of mesial border of basal segment; intermediate and distal segments slender (Fig. 2e, f, h). Antenna with large acute distoventral tooth on basicerite and well-developed scaphocerite more or less reaching tip of antennular peduncle (Fig. 2a, g). Mandible robust, without palp; incisor process very slender, with three small triangular terminal teeth; molar process well developed, robust (Fig. 3a, b). Maxillula and maxilla with well developed palps (Fig. 4a, b). First maxilliped with distinct and well developed endites, large exopod with well-developed caridean lobe bearing plumose setae, and epipod

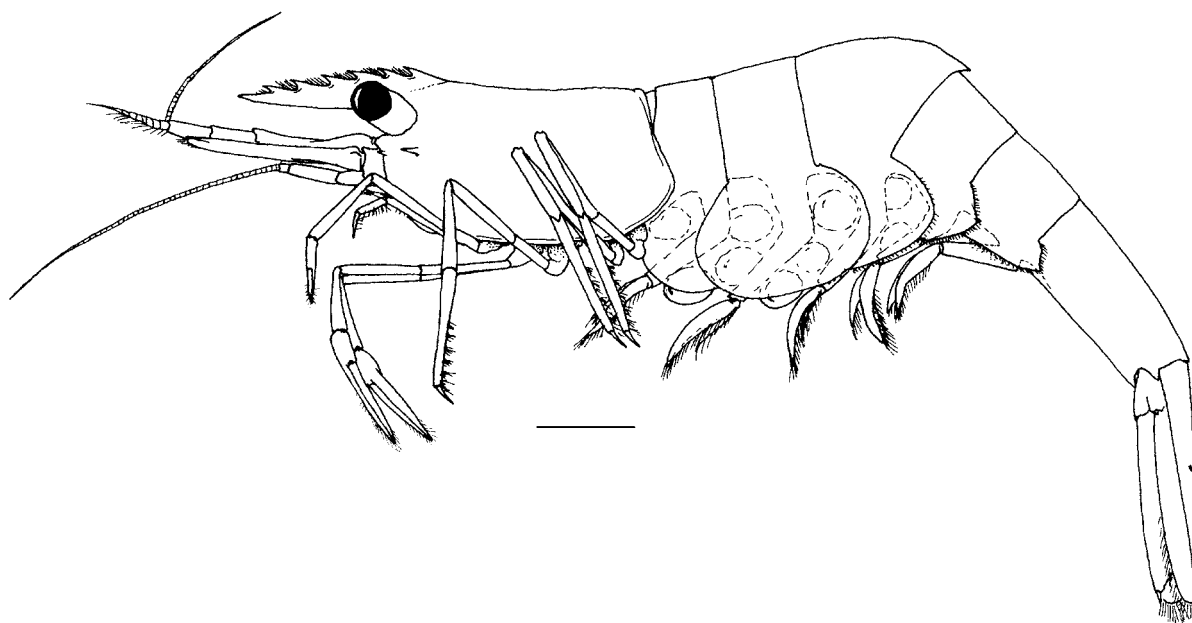


Fig. 1. *Brucecaris tenuis* (Bruce, 1969), ovigerous female (PCL 2.5 mm) from Nha Trang Bay, Viet Nam. Scale = 1 mm.

(Fig. 4c). Second maxilliped well developed, with exopod and epipod, without podobranch (Fig. 4d). Third maxilliped slender and setose, with exopod, triangular epipod and an arthrobranch all well developed (Fig. 3c). First pereiopods slender, chela subcylindrical with slender fingers and subspatulate tips (Fig. 3d, e). Second pereiopods equal in size and shape, with very slender basal segments, subcylindrical short palm and slender scissor-like fingers which are 3 times longer than palm (Fig. 3f, g). Third pereiopods slender, segments unarmed; propodus with tufts of setae along distoventral border, including tufts of long setae at tip of propodus extending to near tip of dactylus excluding unguis; dactylus slender, simple, with elongated and curved unguis (Fig. 5a-c). Pleopods normal. Uropods slender, exceeding telson, lateral border of exopod with small fixed distal tooth and acute mobile spine.

Included Species.—*Periclimenes tenuis* Bruce, 1969

Systematic Position.—The type species of the new genus, *Brucecaris tenuis*, clearly differs from the type species of the genus *Periclimenes*, namely *P. amethysteus* (Risso, 1827), by having very slender body and appendages, acute short rostrum without ventral teeth, absence of podobranch on second maxilliped, equal second pereiopods with the length of fingers three times longer than palm, ambulatory pereiopods with tufts of setae along distoventral margin of propodus, dactylus simple and a unique feature in the subfamily - a row of long setae in distal part of propodus of ambulatory pereiopods extending to the distal part of dactylus. These differences readily exclude this species from the genus *Periclimenes*. Furthermore, none of the known pontoniine genera has the same combination of characters and therefore a separate genus is established for this species.

Brucecaris tenuis is most similar to the crinoid-associated species group including *Periclimenes affinis* (Zehntner, 1894), *P. brockettii* Borradaile, 1915, *P. carinidactylus* Bruce, 1969 and *P. ruber* Bruce, 1982 (see Discussion). The closest species in this group with *B. tenuis* is *P. affinis*, which also has tufts of setae along the distoventral margin of the propodus of the ambulatory pereiopods but clearly differs in having a stout body, rostrum broad and bearing ventral tooth, unequal second pereiopods with fingers considerably shorter than palm, and tip of propodus of ambulatory pereiopods lacking tufts of setae.

Etymology.—The new genus is named in honor of Alexander J. Bruce, leading scientist in caridean shrimp taxonomy and always provided valuable help to our studies on pontoniine shrimps.

Brucecaris tenuis (Bruce, 1969), new combination
Figs. 1-5

Periclimenes tenuis Bruce, 1969: 272 [type-locality: Zanzibar]; 1982: 195, fig. 8c; 1983: 886; Chace and Bruce, 1993: 123; Müller, 1993: 112; Li, 2000: 242.

Material Examined.—Viet Nam, 3 ovigerous females (PCL 2.3, 2.5, 2.5 mm)(ZMMU Ma 5467), Nha Trang Bay, Mun Island, 15 m, collected from *Zygotetra comata*, *Oxycomanthus* aff. *pinguis* and unidentified crinoid, 21 July 2004.- 1 ovigerous female (PCL 2.8 mm)(LEMMI), same locality, 8-10 m, from *Comaster* sp. 5 November 2003.

Philippines, 1 ovigerous female (PCL 2.2 mm)(NTOUM00695), "Panglao 2004", stn JD1, 9°55.25'N, 123°80.50'E, 12-17 m, hand diving, from a crinoid not determined, 01 June 2004.

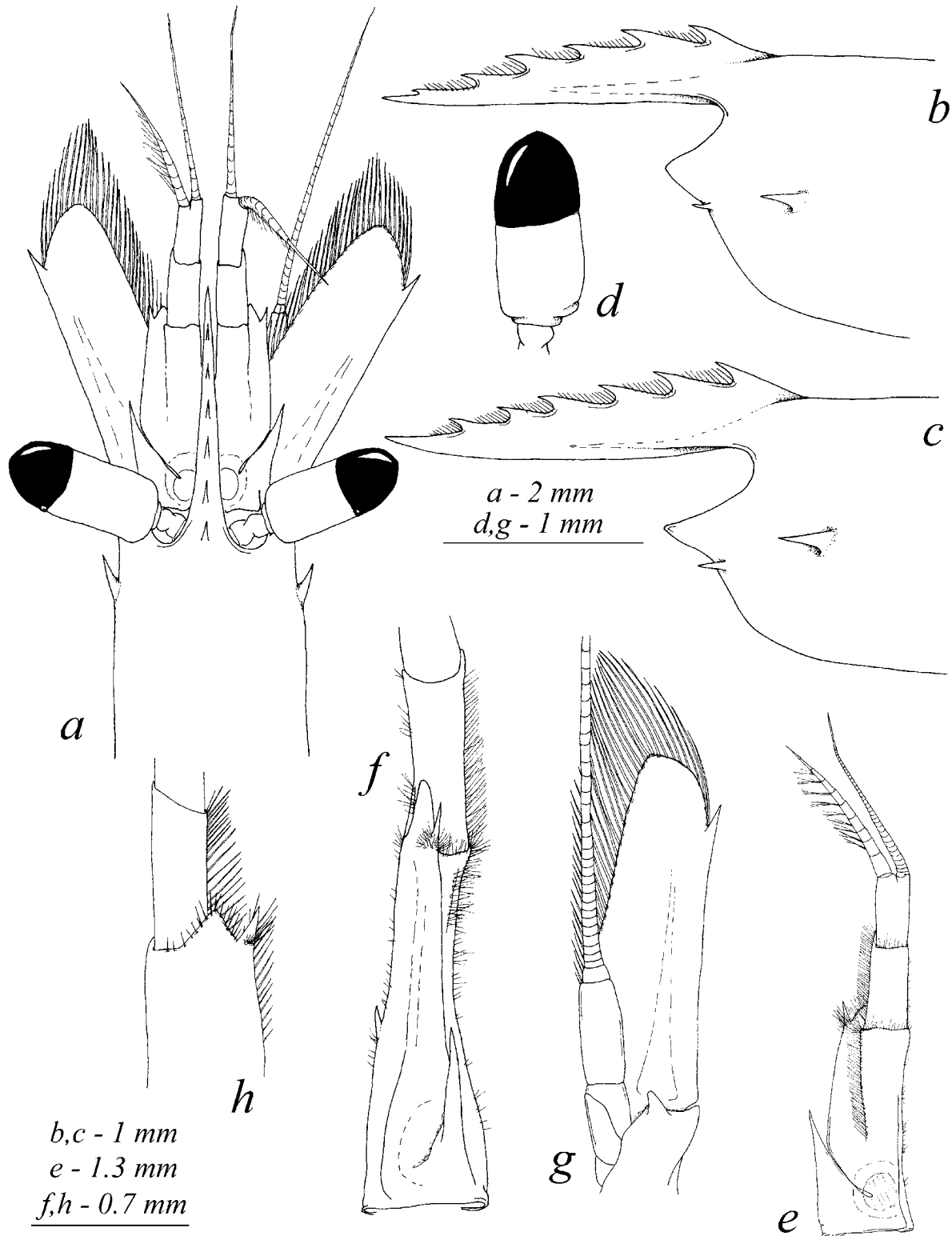


Fig. 2. *Brucecaris tenuis* (Bruce, 1969), ovigerous female (PCL 2.5 mm) (a, c-h), ovigerous female (PCL 2.3 mm) (b) from Nha Trang Bay, Viet Nam: a, anterior carapace, dorsal view; b, c, rostrum; d, eye; e, f, antennule; g, antenna; h, distolateral part of basal segment of antennule.

Color.—Body translucent with black margined narrow yellowish longitudinal bands. Eyes with golden reflection and thin blackish stripes. Rostrum and scaphocerite bearing black margined yellow stripes. Uropods transparent

with distal part goldish on endopods and whitish on exopods. Color photos in Colin and Arnesson (1995) and Kawamoto and Okuno (2003) show color polymorphism of this species correlated with the host coloration.

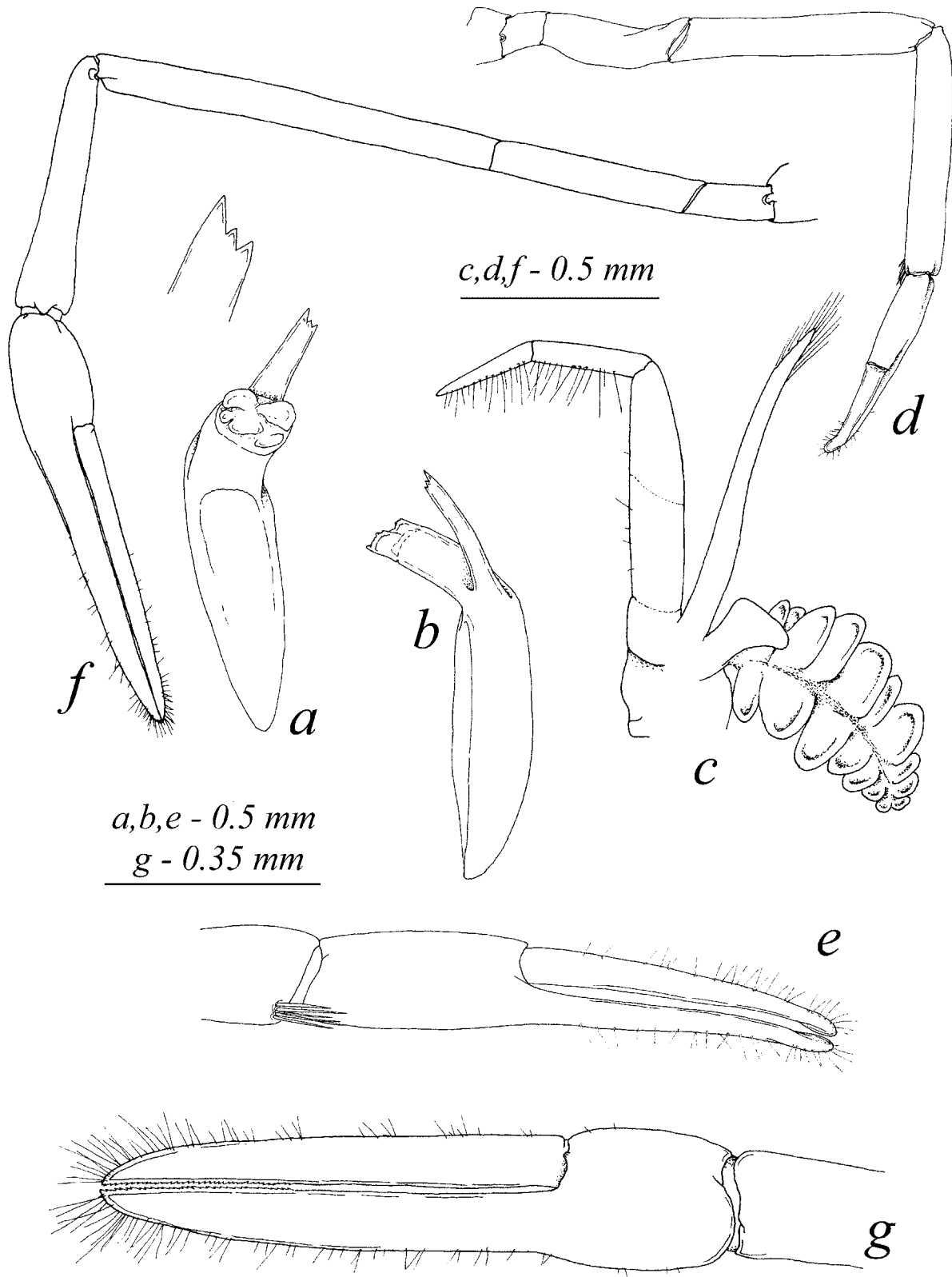


Fig. 3. *Brucecaris tenuis* (Bruce, 1969), ovigerous female (PCL 2.5 mm) from Nha Trang Bay, Viet Nam: a, b, mandible; c, third maxilliped; d, first pereiopod; e, chela of first pereiopod; f, second pereiopod; g, chela of second pereiopod.

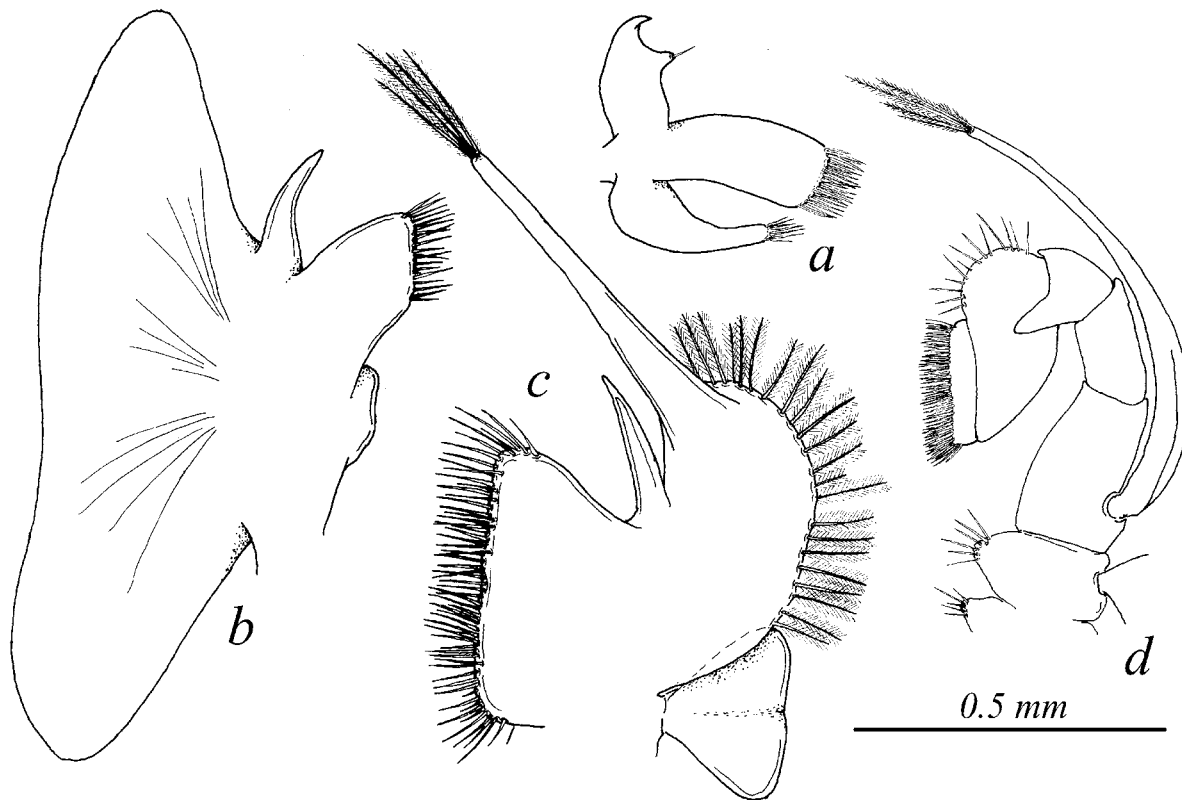


Fig. 4. *Brucecaris tenuis* (Bruce, 1969), ovigerous female (PCL 2.5 mm) from Nha Trang Bay, Viet Nam: a, maxillula; b, maxilla; c, first maxilliped; d, second maxilliped.

Remarks.—Observed specimens show no difference with the original descriptions given by Bruce (1969).

Distribution.—Red Sea, Zanzibar, Indonesia, Japan, Papua New Guinea, Queensland and Marshall Islands; *Zygometra comata* Clark, *Oxycomanthus* sp. and *Comaster* sp. show new host records. Also known in associations with crinoids *Heterometra africana* (Clark), *H. savignyi* (Müller), *Oxy-metra* sp., *Amphimetra* sp., *Himerometra robustipinna* (Carpenter), *Laprometra klunzingeri* (Hartlaub), *Decametra chadwicki* (Clark), and *Tropiometra carinata* (Lamarck).

Unguicaris, new genus

Type Species.—*Unguicaris panglaonis*, new species

Diagnosis.—Medium-sized shrimps associated with feather stars (crinoids). Body slightly compressed and slender. Carapace smooth, with antennal and hepatic spines, supraorbital and supraocular spines absent. Rostrum well developed, with 6-8 dorsal and 0-2 ventral teeth, extending anteriorly beyond antennular peduncle, slender, with well-developed rostral lamina and postorbital margins. Orbits feebly developed, inferior orbital angle acutely produced. Pterygostomial margin bluntly angular. Pleomeres smooth; pleura of first to fourth rounded, pleura of fifth pointed, posteroventral angle of sixth slightly projected. Telson narrow, with 2 pairs of dorsal spines arising from close to lateral margins at distal half and 3 pairs of posterior spines.

Eyes with globular or conoidally produced cornea; accessory pigment well marked. Antennule with 1 large disto-lateral and 1 small teeth on distomedial lobe, small submarginal ventral spine at middle of medial border of basal segment. Antenna with large acute distoventral tooth on basicerite, scaphocerite well developed and extending far beyond antennular peduncle. Mandible robust, without palp; incisor process well developed, broad, shovel-like, with 7 stout triangular terminal teeth; molar process well developed, robust, with 5 stout teeth distally. Maxilla and maxillula with well developed palps. First maxilliped with well-developed endites, exopod large with well-developed caridean lobe bearing plumose setae, epipod present. Second maxilliped well developed, exopod and epipod present, without podobranch. Third maxilliped with segments slender and setose, exopod well developed, epipod and arthrobranch small. First pereiopod slender, chela subcylindrical and well developed, fingers slender with curved tips; coxa with distoventral lobe. Second pereiopods equal or unequal in size, robust, palm long and subcylindrical, fingers slender. Third pereiopod with segments unarmed; propodus with tufts of thick setae distally; dactylus robust, with acute accessory spine on posterior border and 3 acute stout spinules on anterior margin. Pleopods normal. Uropods slender, exceeding telson, lateral border of exopod with acute fixed distal tooth accompanied with acute mobile spine.

Included Species.—*Unguicaris panglaonis*, new species; *Periclimenes aegrius* Bruce, 1968 (known from Northern

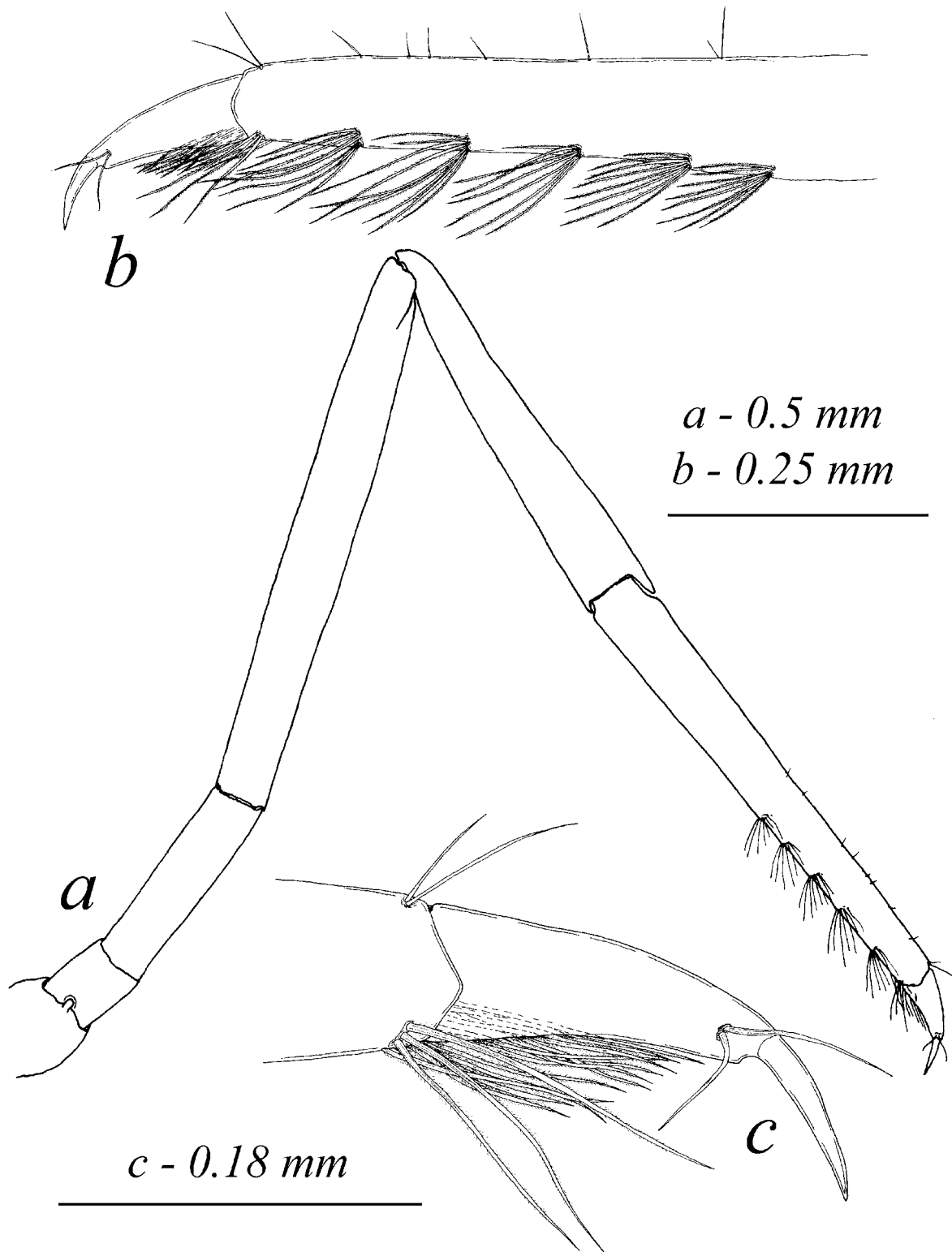


Fig. 5. *Brucecaris tenuis* (Bruce, 1969), ovigerous female (PCL 2.5 mm) from Nha Trang Bay, Viet Nam: a, third pereopod; b, same, ventral margin of propodus; c, dactylus of third pereopod.

Australia; associated with shallow water crinoids *Lamprometra palmate* (Müller), *L. klunzingeri* (Harlaub) and *Stephanometra spicata* (Carpenter) (Bruce, 1986; Bruce and Coombes, 1995); *Periclimenes novaecaledoniae* Bruce,

1968 (known from New Caledonia and Northern Australia; associated with shallow water crinoids *Tropiometra afra* (Hartlaub), *Lamprometra klunzingeri* (Harlaub) and *Comanthus* sp. (Bruce, 1968, 1980; Bruce and Coombes,

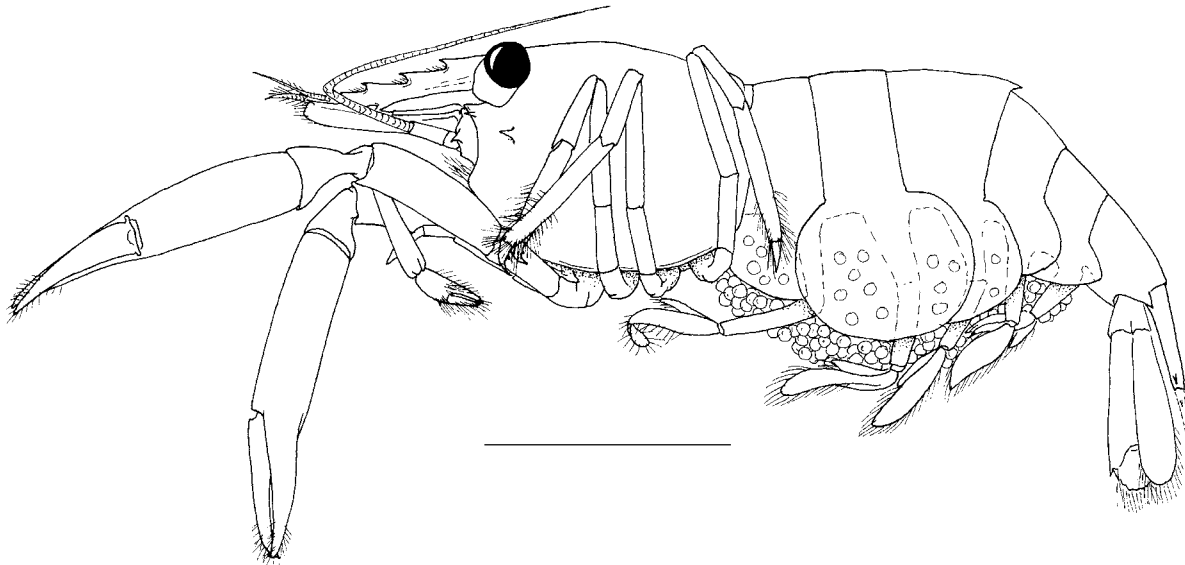


Fig. 6. *Unguicaris panglaonis*, new genus, new species, holotype ovigerous female (PCL 5.1 mm), general view. Scale = 1 mm.

1995); *Periclimenes pilipes* Bruce and Zmarzly, 1983 (known from Philippines and Marshall Islands; associated with shallow water crinoid *Comanthina schlegeli* (Carpenter) (Bruce and Zmarzly, 1983; Bruce, 1989). All three species clearly belong to *Unguicaris* by their possession of the mandible with a shovel-like incisor processor and the dactyli of ambulatory pereiopods bearing acute stout spinules on anterior margin.

Systematic Position.—The new genus is most closely related to the monotypic genus *Araiopontonia* Fujino and Miyake, 1970 by the highly developed shovel-like incisor processor at the mandible and the presence of acute accessory spinules on the anterior margin of the dactyli of ambulatory pereiopods. Both characters are not found in other pontoniine genera. On the other hand, *Araiopontonia* can be readily separated from *Unguicaris* by lacking an antennal spine, the lateral margins of rostrum well developed and bearing triangular supraocular spines and the external part of the incisor process of mandible bearing an enlarged first marginal tooth.

Etymology.—The first part “*Ungui-*” is derived from Latin *unguis*, talon, claw, and is in reference to the special shape of the dactylus in this genus, and the second part “*-caris*” means shrimp.

Unguicaris panglaonis, new species

Figs. 6-13

Material Examined.—Philippines, “Panglao 2004”, stn R38, 9°29.4'N, 123°56.0'E, 6-37 m, reef slope, hand diving, from crinoids not determined, 11 June 2004, ovigerous female holotype (PCL 5.1 mm)(PNM), 1 ovigerous female paratype (PCL 3.8 mm)(NTOUM00696), 1 ovigerous female paratype (PCL 4.8 mm) (MNHN), 1 ovigerous female paratype (PCL 4.3 mm)(ZRC).- stn S22, 9°29.4'N, 123°56.0'E, 15-20 m, hard ground covered with sand,

suction pump, 21 June 2004, 1 male paratype (PCL 3.5 mm)(MNHN).

Description.—Holotype female. Carapace swollen, smooth, with antennal and prominent hepatic spines (Fig. 7a-c). Hepatic spine triangular and larger than antennal spine; antennal spine long and slender (Fig. 7b). Rostrum long, slender, straight, tapering and slightly compressed, with feebly developed dorsal carina bearing 7 conspicuous teeth, ventral margin convex and bearing 2 teeth, ventral teeth smaller than dorsal teeth and situated close together at about level of intermediate segment of antennular peduncle (Fig. 7b, c); lateral lamina feebly developed and continuous with orbital margin (Fig. 7a). Orbit feebly developed, inferior orbital angle acutely produced. Pterygostomial angle projected but rounded.

Pleomeres smooth; pleura of first to fourth pelomeres rounded, pleuron of fifth pointed; posterolateral angle of sixth pointed, posteroventral angle projecting and rounded (Fig. 6). Telson about 3 times as long as width in proximal part (Fig. 11a), gradually narrowing posteriorly, with 2 pairs of small dorsal spines arising from close to lateral margins and situated at 0.55 and 0.75 of telson length; 3 pairs of posterior spines containing short stout lateral, long slender intermediate and slender submedial spines slightly longer than half length of former spines (Fig. 11c).

Eyes large and well developed, with slightly projecting cornea. Central cornea without papilla. Well-marked accessory pigmented spot present posterodorsally.

Antennules (Fig. 7d) well developed; basal segment about 2 times longer than width, lateral border bearing acute distolateral tooth, distomedial lobe with acute long medial tooth, small setae present between teeth; submarginal ventral tooth small but distinct, situated near medial border of basal segment (Fig. 7e). Stylocerite well developed. Intermediate segment slender, as long as width; distolateral border produced distally. Distal segment about 2 times as

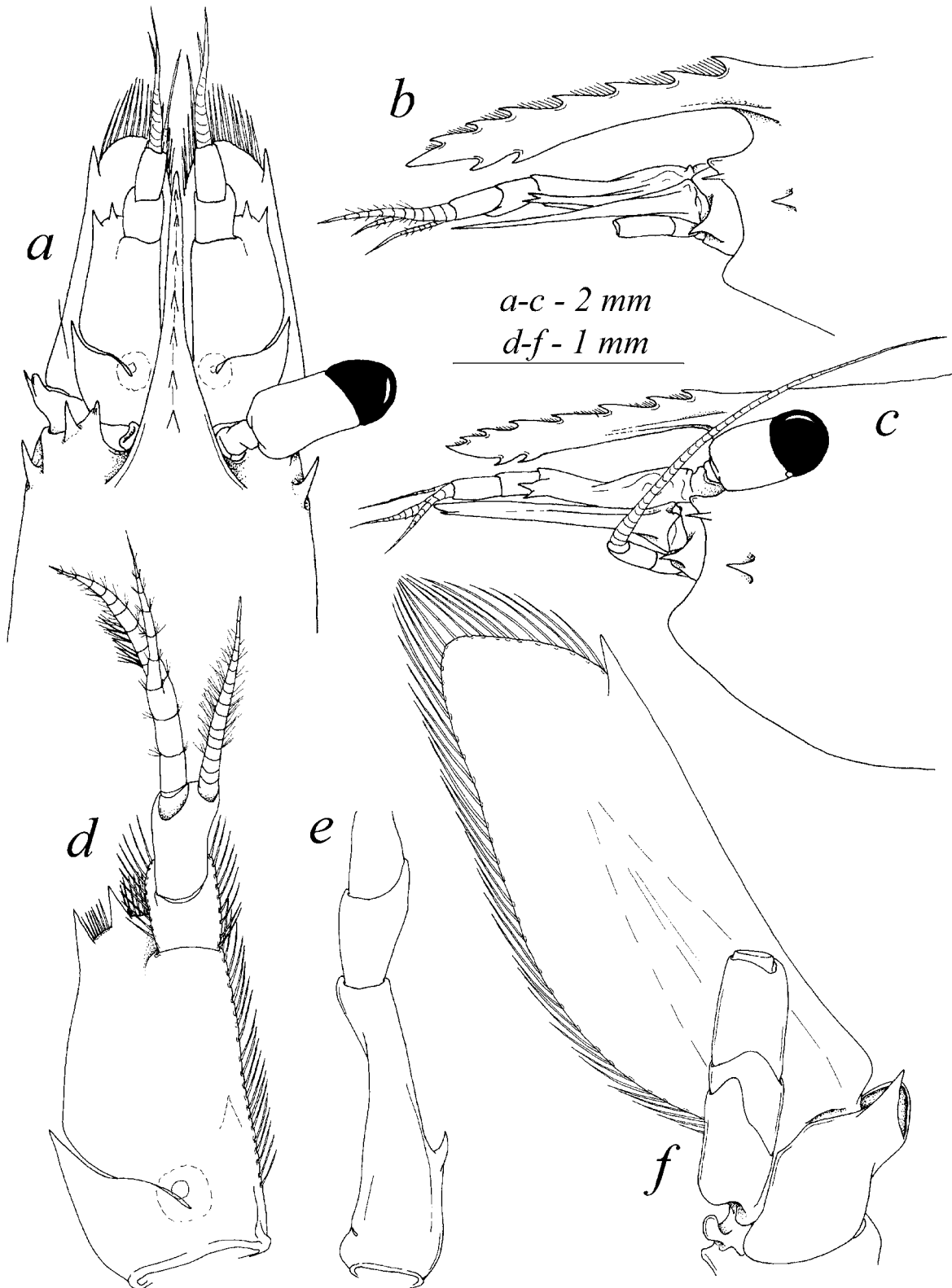


Fig. 7. *Unguicaris panglaonis*, new genus, new species, holotype ovigerous female (c), paratype ovig. female (PCL 3.8 mm) (a-b, d-f): a, anterior carapace, dorsal view; b, c, rostrum; d, antennule, dorsal view; e, same, lateral view; f, antenna.

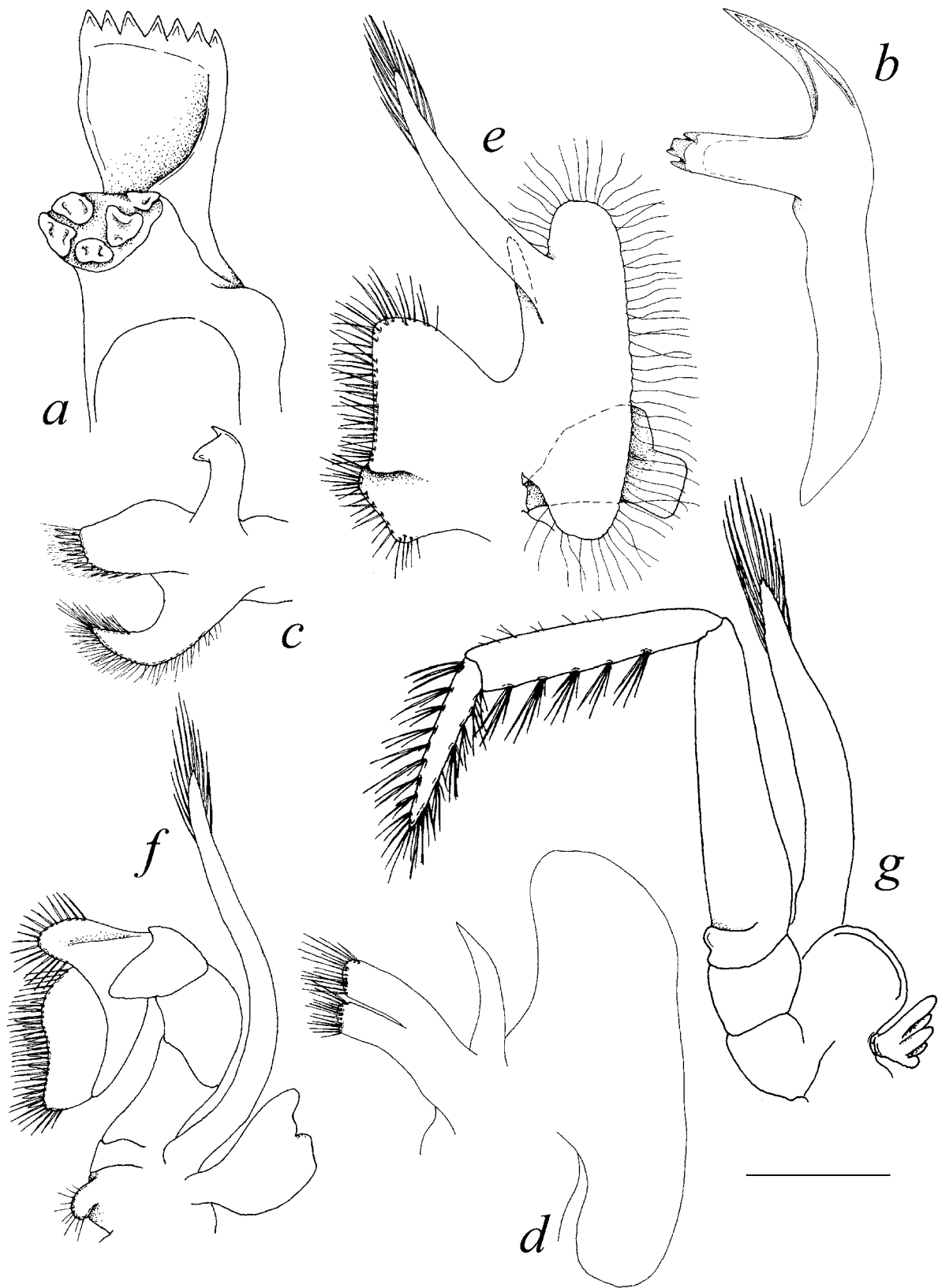


Fig. 8. *Unguicaris panglaonis*, new genus, new species, paratype ovigerous female (PCL 3.8 mm): a, b, mandible; c, maxillula; d, maxilla; e, first maxilliped; f, second maxilliped; g, third maxilliped. Scale = 1.5 mm (a,b), 1 mm (c-g).

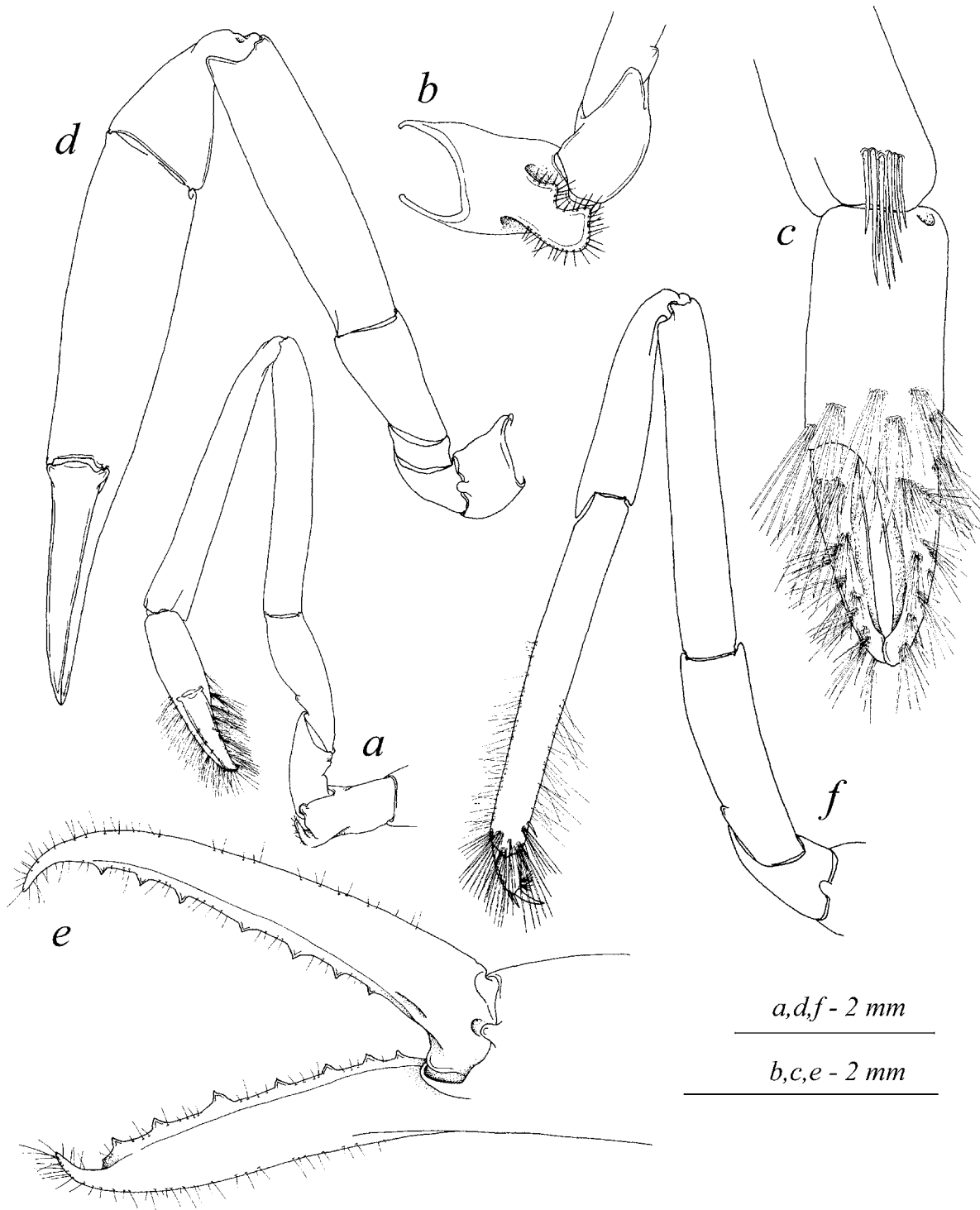


Fig. 9. *Unguicaris panglaonis*, new genus, new species, paratype ovigerous female (PCL 3.8 mm): a, first pereopod; b, coxal and basal segments of first pereopod; c, chela of first pereopod; d, second pereopod; e, chela of second pereopod; f, third pereopod.

long as width. Upper flagellum with rami of 2 proximal segments fused, shorter ramus consists of 5-7 segments with groups of aesthetascs, longer ramus free and consisting of more than 10 segments. Lower flagellum filiform with more than 15 segments.

Antenna (Fig. 7f) well developed, basicerite with well-developed lobe and large acute distoventral tooth; carpo-

cerite stout, about 1.5-2 times as long as width; flagellum well developed, as long as body length; scaphocerite exceeding intermediate antennular segment, about 3 times as long as maximum width, with well developed acute distolateral tooth.

Mandible robust (Fig. 8a, b), without palp; incisor process well developed, broad, shovel-like, with 7 terminal teeth;

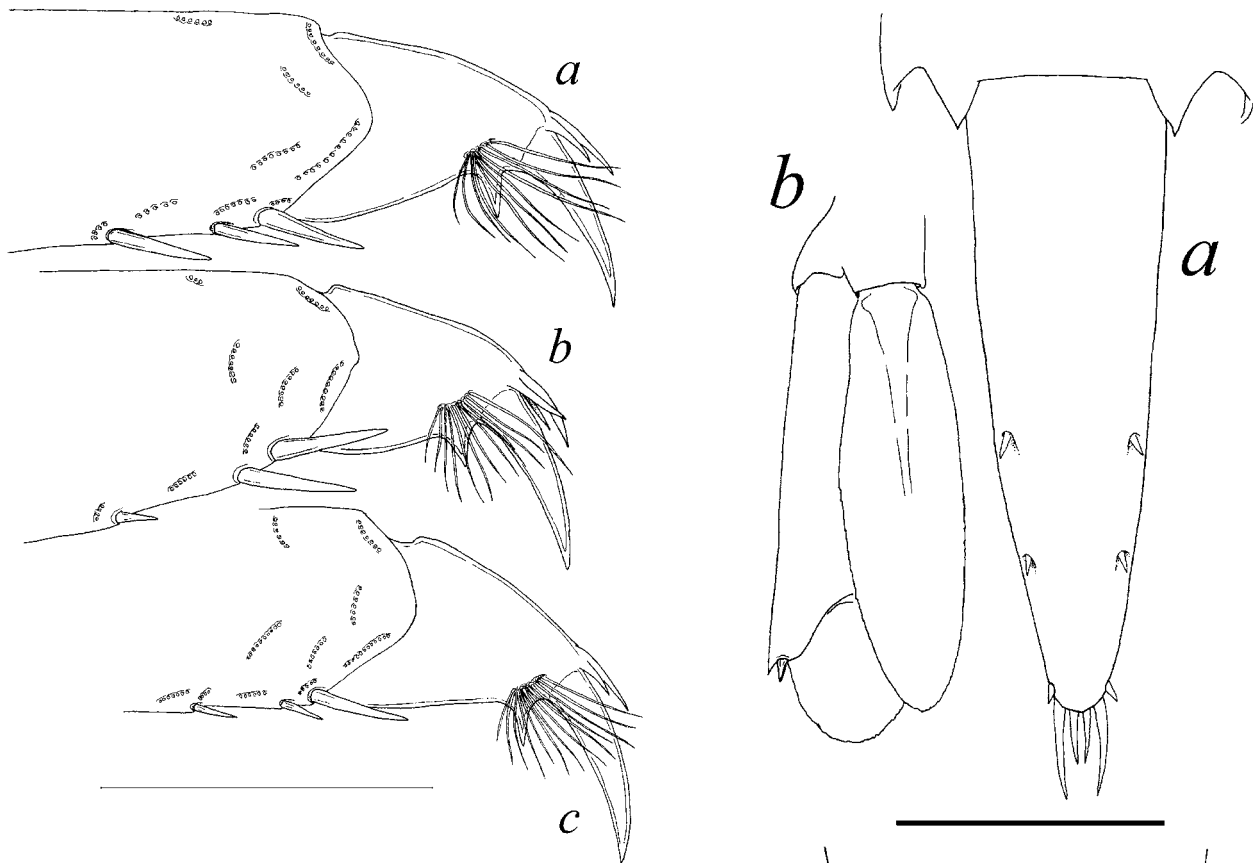


Fig. 10. *Unguicaris panglaonis*, new genus, new species, paratype ovig. female (PCL 3.8 mm), dactyli of ambulatory pereiopods: a, third; b, fourth; c, fifth. Scale = 1 mm.

molar process well developed, robust, with 5 stout tooth distally.

Maxillula (Fig. 8c) normal, with well-developed bilobed palp; upper lacinia slightly curved, flaring distally, with strong setae distally; lower lacinia slender, tapering distally.

Maxilla (Fig. 8d) with well-developed simple palp; endites well developed, basal endite feebly bilobed, distal lobes subequal, furnished with stiff, elongated setae; scaphognathite well developed, with plumose setae.

First maxilliped (Fig. 8e) with distinct and well-developed endites, basal endite significantly larger, with setae along lateral margin; exopod well developed with large caridean lobe bearing plumose setae; epipod triangular in shape, well developed.

Second maxilliped (Fig. 8f) with exopod well developed; distolateral margin of propodus broadly rounded, with slender setae, situated angularly to dactylar segment; dactylus about 1.5 times longer than broad, with numerous spines along distal margin; epipod triangular; podobranch absent.

Third maxilliped (Fig. 8g) with segments slender, exopod well developed and exceeding ischiomerus; ischiomerus about 4 times as long as maximum width, slightly tapering distally, penultimate segment slender, about 5 times as long as width; terminal segment also slender, about 5 times as

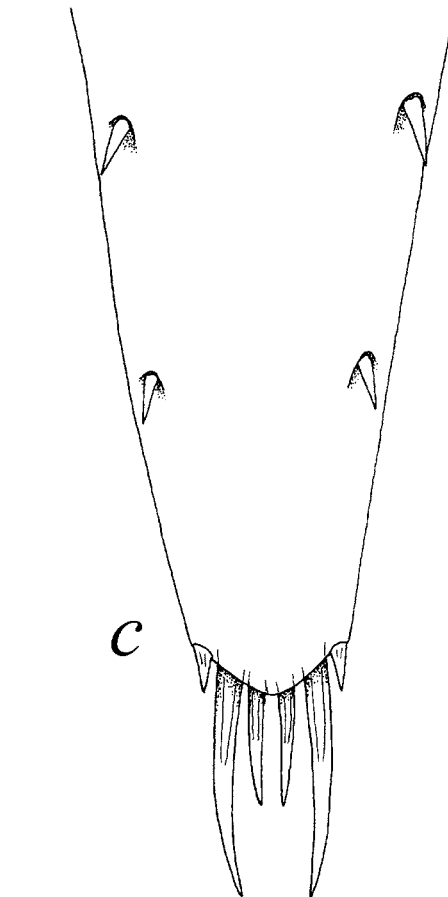


Fig. 11. *Unguicaris panglaonis*, new genus, new species, paratype ovigerous female (PCL 3.8 mm): a, telson; b, uropods; c, distal margin of telson. Scale = 2 mm (a), 4 mm (b), 1 mm (c).

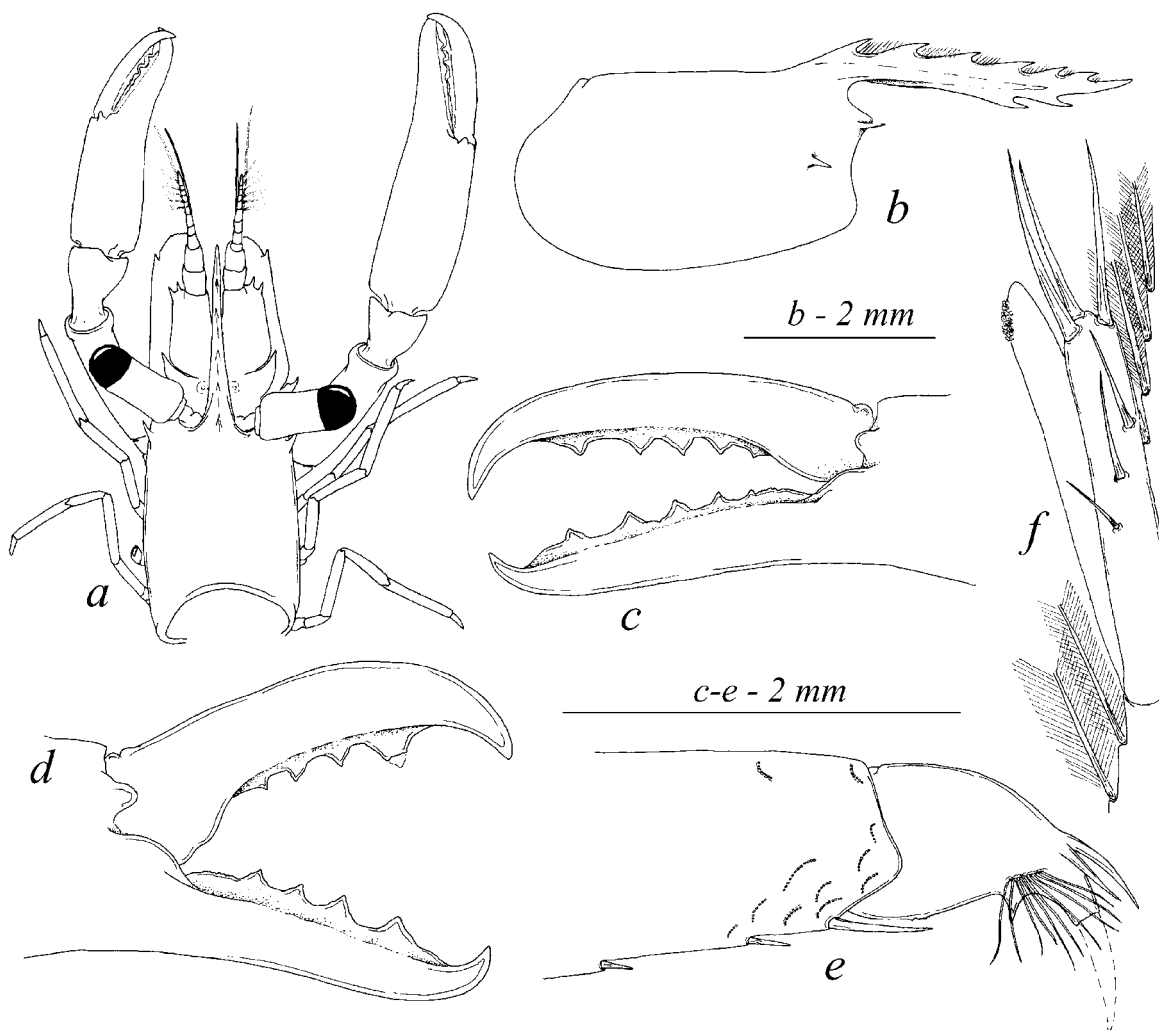


Fig. 12. *Unguicaris panglaonis*, new genus, new species, paratype male (PCL 3.5 mm): a, anterior part of cephalothorax, dorsal view; b, carapace and rostrum; c, d, fingers of second cheliped; e, distal part of propodus and dactylus of third pereiopod; f, appendix masculina and appendix interna of second pleopod. (a, f, without scale).

long as width, with tufts of sparse long setae along border; epipod triangular, lobed; small arthrobranch present.

First pereiopod (Fig. 9a) slender, with slender chela and fingers; coxal segment with well-developed curved lobe situated distoventrally (Fig. 9b); carpus slender, considerably flaring distally; palm about 2 times as long as width, compressed laterally; fingers robust and with numerous terminal setae, cutting edge entire, tip spatulate (Fig. 9c).

Second pereiopods equal in size and shape; segments robust (Fig. 9d); ischium about 2 times as long as width; merus about 4 times as long as maximal width, with straight margins; carpus flared distally, as long as maximal width, palm cylindrical, about 3 times as long as maximal width; fingers pointed, with acute, curved tips; fixed fingers slender, cutting edge bearing 7 distinct triangular teeth; dactylus slender, about 7 times as long as width, cutting edge bearing 7 distinct triangular teeth along entire length (Fig. 9e).

Third-fifth pereiopods similar. Third pereiopod (Fig. 9f) slender, with segments unarmed; ischium about 3.5 times as

long as width; merus about 7 times as long as width; carpus about 4 times as long as maximum width, tapering proximally; propodus about 9 times as long as width, with straight and smooth margins; propodus with 3 distoventral teeth, with tufts of long slender setae distally; dactylus (Fig. 10a-c) robust, as long as maximum width, unguis well developed, long, curve and acute, accessory spine well developed at posterior border, anterior margin with 3 acute stout spines; tufts of long slender setae present at middle of dactylus.

Pleopods normal. Uropods (Fig. 11b) slender, exceeding telson; lateral border of uropodal exopod with small distal tooth accompanied with mobile spine.

Male generally similar to holotype female and with rostral formula 6/2 (Fig. 12b), second pereiopods subequal (Fig. 12a), appendix interna slightly longer than appendix masculina and with numerous subterminal cincinnuli, appendix masculine bearing 3 long terminal setae and lateral border with 3 well-developed spines distomedially (Fig. 12f).



Fig. 13. *Unguicaris panglaonis*, new genus, new species, fresh color: a, holotype ovigerous female; b, paratype ovigerous female. Both specimens from "Panglao 2004" stn R 38.

Color.—Holotype with body and appendages mostly violet and bearing some yellowish markings (Fig. 13a), fourth to sixth pleomeres slightly lighter in color than carapace. Small yellow spot at mid-dorsal carapace and 2 large oval spots along ventral border of carapace. Ventral part of rostrum and dorsal part of eyes, distal part of scaphocerite, distal part of fingers and carpomeral articulation of second pereiopods, distal half of propodus, carpus and distal part of merus of ambulatory pereiopods, and distal half of tail-fan yellowish. Pleon with yellow spot at distal part of first and third pleura, and broad yellow vertical stripe on second pleuron. Eyes dark grey. Pleopods and eggs violet. Another ovigerous female paratype from the same station (Fig. 13b) with body mainly yellowish and only few violet stripes remained on

ventral carapace and first two pleomere pleura. Dorsal parts of carapace and pleon even paler in color and with some yellow margined short transverse violet stripes.

Host.—The specimens were collected from a shallow-water unidentified crinoid.

Remarks.—By most of the features the new species is most similar to *Unguicaris novaecaledoniae* (see Bruce, 1968, 1977, 1980). The main differences are the feeble development of rostral lamina, presence of teeth along the entire cutting edge of the fingers of the second pereiopods and the better development of the spines on the dactyli of the ambulatory pereiopods in *U. panglaonis*. *Unguicaris*

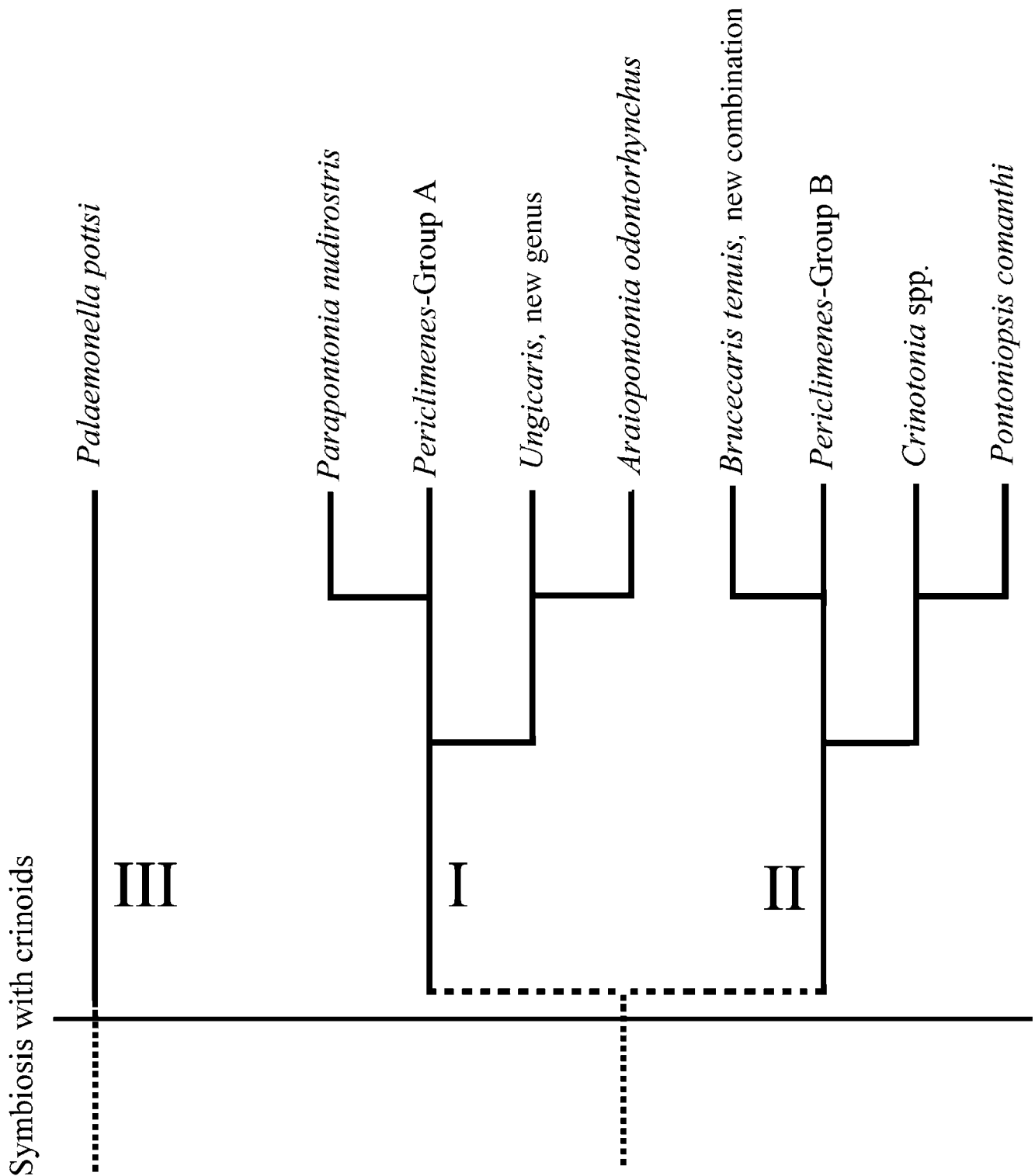


Fig. 14. Schematic relationships among shallow-water crinoid-associated pontoniine shrimps.

pilipes clearly differs from the new species by a much smaller size, rostrum with deep lamina and unequal second pereiopods (see Bruce and Zmarzly, 1983; Bruce, 1989). On the other hand, *U. alegrias* is unique in the

genus by the conoidally produced cornea, absence of ventral rostral teeth, highly unequal second pereiopods, and cutting edge of fingers of second pereiopods only bearing distinct teeth at proximal half (see Bruce, 1986).

The four species in the genus can be readily separated by the following key:

Key for identification of the species of *Unguicaris*:

1. Eyes with conoidally produced cornea, ventral rostral teeth absent *U. alegrias*
- Eyes with globular cornea, ventral rostral teeth presented 2
2. Second pereopods unequal *U. pilipes*
- Second pereopods equal 3
3. Dactyli of ambulatory pereopods with weak accessory spines; fingers of second pereopods without teeth at distal half of cutting edges *U. novaecaledoniae*
- Dactyli of ambulatory pereopods with well-developed accessory spines; fingers of second pereopods with teeth along entire cutting edge *U. panglaonis*, new species

Etymology.—The name is given in reference to the type-locality of the species, Panglao Island.

Distribution.—Known only from the type-locality, Panglao Island, Philippines.

DISCUSSION

The number of known species of shallow-water crinoid-associated pontoniines of Indo-Pacific is increased to 20 with the present study. All of them, excluding *Palaemonella pottsi* Borradaile, 1915 which was also recorded in association with sea urchin (Marin, 2006), are obligate and specific symbionts of crinoids and has never been observed in association with other hosts (Bruce, 1982).

The origin and phylogeny of shallow-water, crinoid-associated fauna are still unclear. Nevertheless, crinoid-associated *Periclimenes* species probably can be divided into two groups. Group A (“*P. amboinensis*”-group) includes *P. amboinensis* (De Man, 1888), *P. cornutus* Borradaile, 1915, *P. ceratophthalmus* Borradaile, 1915, *P. commensalis* Borradaile, 1915, and is characterized by the globular or conoidally produced cornea, well-developed rostral lateral margins with triangular supraocular spines, equal or slightly unequal second pereopods, and biunguiculate dactylus with long acute unguis and small acute accessory spine. Group B (“*P. affinis*”-group) includes *P. affinis* (Zehntner, 1894), *P. brockettii* Borradaile, 1915, *P. carinidactylus* Bruce, 1969, *P. novaffinis* Bruce and Coombes, 1997 and *P. ruber*, that are characterized by globular cornea, feebly-developed rostral lateral margins, absence of supraocular and supraorbital spines, antennules without accessory spine on distomedial margin, second pereopods greatly unequal with fingers subspatulate and as long as palm, and simple dactyli of ambulatory pereopods.

The above two groups of the genus *Periclimenes* seem to be more primitive than the more specialized *Araiopontonia odontorhyncha* Fujino and Miyake, 1970, *Brucecaris tenuis*, *Crinotonia*, *Parapontonia nudirostris* Bruce, 1968, *Pontoniopsis comanthi* Borradaile, 1915 and *Unguicaris*. It is possible to consider *B. tenuis* as a highly specialized species in comparison with the above mentioned Group A. The same is also true for *Pontoniopsis comanthi*, which is close to *Crinotonia* and even more highly adapted to a special, but

unfortunately unknown, ecological niche (Marin, 2006b). *Parapontonia nudirostris* Bruce, 1968 is a specialized species and closer to crinoid-associated species of Group B, while *A. odontorhyncha* is also highly specialized and closer to the genus *Unguicaris*. The presence of small dorsal subapical teeth in juveniles of *Parapontonia nudirostris* (see Bruce, 1992: fig. 27B) emphasizes its close relationship with the genus *Periclimenes*. A preliminary scheme of the relationships of the shallow-water crinoid-associated pontoniine shrimps is proposed (Fig. 14). Branch I includes species of medium sized shrimps with a stout body and appendages, biunguiculate dactyli of ambulatory pereopods, rostral midrib well developed and with supraocular spines best developed in *Parapontonia nudirostris* and *A. odontorhyncha*. Branch II includes species with a simple dactylus, second pereopod highly specialized, size becoming smaller and more slender such as in *B. tenuis*, *Pontoniopsis comanthi* and *Crinotonia*. Nonetheless, branches I and II are closely related to each other and likely arose from a common ancestor. Branch III, including *Palaemonella pottsi*, clearly differs from other branches and contains the only species in the genus *Palaemonella* associated with crinoids (Bruce, 2002).

Some morphological characters such as the shape of cornea (globular or protruded), reduction of rostral teeth, symmetry of the second pereopods, ratio of palm/fingers and subspatulate fingers of chelae vary among species inside the *Periclimenes* groups and the genus *Unguicaris*. These characters likely evolved independently in different branches. Unfortunately, it is impossible to conclude the trends of specialization in the different branches since the food and behavior of all these species are still unknown.

Pontoniine shrimps associated with other echinoderms such as sea urchins, brittle stars, holothurians and sea stars are likely to be unrelated to those crinoid-associated species. The absence of any pontoniine genus with species inhabiting more than one echinoderm groups seems to support this hypothesis. The only exception is the genus *Periclimenes*, which still needs revision. Similar morphological adaptations in the associated shrimps from different echinoderm groups, in our opinion, are analogous but not homologous and most likely have resulted from similar morphology of the hosts.

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REFERENCES

- Borradaile, L. A. 1915. Notes on Carides. *Annals and Magazine of Natural History* (8)15: 205-213.
- Bruce, A. J. 1968. A report on some pontoniid shrimps from New Caledonia. *Bulletin du Muséum National d'Histoire Naturelle* 39(6): 1148-1171.
- . 1969. Preliminary descriptions of sixteen new species of the genus *Periclimenes* Costa, 1844 (Crustacea, Decapoda, Natantia, Pontoniinae). *Zoologische Mededelingen* 43: 253-278.
- . 1977. Pontoniine shrimps in the collections of the Australian Museum. *Records of the Australian Museum* 31: 39-81.
- . 1980. Some pontoniine shrimps from Nouméa, New Caledonia. *Cahiers de l'Indo-Pacifique* 1(2): 215-248.
- . 1982. The shrimps associated with Indo-Pacific echinoderms, with the description of a new species in the genus *Periclimenes* Costa (Crustacea, Pontoniinae). *Australian Museum Memoir* 16: 192-216.
- . 1983. Expédition Rumphius II (1975) Crustacés parasites, commensaux, etc. (Th. Monod éd.). IX: Crustacés Décapodes (1^{ère} partie: Natantia Pontoniinae). *Bulletin du Muséum National d'Histoire Naturelle*, Paris, 4e sér. 5, section A(3): 871-902.
- . 1986. Three new species of commensal shrimps from Port Essington, Arnhem Land, Northern Australia (Crustacea: Decapoda: Palaemonidae). *The Beagle* 3: 143-166.
- . 1989. A report on some coral reef shrimps from the Philippine Islands. *Asian Marine Biology* 6: 173-192.
- . 1991. Crustacea Decapoda: Further Deep-sea Palaemonid Shrimps from New Caledonian Waters. pp. 221-279. In, A. Crosnier, ed. *Résultats des Fonds Meubles des Lagoons de Nouvelle-Calédonie*, 1. Etudes et Theses, Paris, ORSTOM.
- . 1992. Two New Species of *Periclimenes* (Crustacea: Decapoda: Palaemonidae) from Lizard Island, Queensland, with Notes on Some Related Taxa. *Records of the Australian Museum* 44: 45-84.
- . 2002. Notes on some Indo-Pacific Pontoniinae, XLVI *Palaemonella foresti* sp. nov., a new pontoniine shrimp from western Australia (Decapoda, Palaemonidae), with a review of the Indo-West Pacific species of the genus *Palaemonella* Dana, 1852. *Crustaceana* 75: 277-298.
- , and K. E. Coombes. 1995. The palaemonoid shrimp fauna (Crustacea: Decapoda: Caridea) of the Cobourg Peninsula, Northern Territory. *The Beagle* 12: 101-144.
- , and ———. 1997. An annotated check-list of the caridean shrimps (Crustacea: Decapoda) of Darwin Harbour, with descriptions of three new species of *Periclimenes* (Palaemonidae: Pontoniinae). pp. 301-337. In, J. R. Hanley et al. (eds.), *The Marine Flora and Fauna of Darwin Harbour, Northern Territory, Australia*.
- , and D. L. Zmarzly. 1983. *Periclimenes pilipes*, new species, a crinoid associate from Enewetak Atoll, Marshall Islands (Crustacea: Decapoda: Pontoniinae). *Journal of Crustacean Biology* 3: 644-654.
- Chace, F. A. Jr., and A. J. Bruce. 1993. The caridean shrimps (Crustacea: Decapoda) of the Albatross Philippine Expedition 1907-1910, (Part 6: Superfamily Palaemonoidea). *Smithsonian Contributions to Zoology* 543: 1-152.
- Colin, P. L., and C. Arneson. 1995. *Tropical Pacific Invertebrates*. The Coral Reef Press, California. 296 pp.
- Costa, O. G. 1844. Su due nuovi generi di Crostacei decapodi Macrouri Nota. *Annali delle Accademia degli Aspiranti Naturalisti*, Napoli 2: 285-290.
- Fujino, T., and S. Miyake. 1970. *Araiopontonia odontorhyncha* gen. et sp. nov., a new shrimp from the Ryukyu Islands, Japan (Decapoda, Palaemonidae, Pontoniinae). *OHMU* 3 (1): 1-10.
- Kawamoto, T., and J. Okuno. 2003. Shrimps and crabs of Kume Island, Okinawa. *Hankyu Communications*, Tokyo. 173 pp. [In Japanese.]
- Li, X. 2000. *Catalog of the Genera and Species of Pontoniinae* Kingsley, 1878. Xueyuan Press, Beijing. 319 pp.
- Man, J. G., de. 1888. Bericht über die von Herrn Dr. J. Brock im Indischen Archipel gesammelten Decapoden und Stomatopoden. *Archiv für Naturgeschichte* 53: 215-600.
- Marin, I. N. 2006. Description of *Crinotonia anastasiae*, new genus, new species, a new crinoid associated pontoniine shrimp (Crustacea: Caridea) from Nha Trang Bay, Viet Nam, with inclusion of *Periclimenes attenuatus* Bruce, 1971 in the new genus. *The Raffles Bulletin of Zoology* 154: 321-340.
- Müller, H. G. 1993. *Catalogue of the Indo-Pacific Pontoniine Shrimps*. Wetzlar, Germany. 159 pp.
- Risso, A. 1827. *Histoire naturelle des principales productions de l'Europe méridionale et particulièrement de celles des environs de Nice et des Alpes Maritimes*, 5 : i-viii + 1-403, pls. 1-10.
- Zehnter, L. 1894. Crustacés de l'Archipel Malais. *Revue Suisse de Zoologie et Annales du Musée d'Histoire Naturelle de Genève* 2: 135-214.

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