

# On a collection of freshwater shrimps (Crustacea Decapoda Caridea) from the Philippines, with descriptions of five new species

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The study deals with a small collection of epigeal and hypogean freshwater shrimps made by an Italian speleological expedition in 1991 in various localities of the Philippine Archipelago, and deposited in the Natural History Museum of the University of Florence, Italy. The collection contains 15 species of caridean shrimps in three families. The Atyidae are represented by nine species from three genera: *Atyopsis* Chace 1983, with one species; *Caridina* H. Milne Edwards 1837, with seven species, including three new species and two new records for the Philippines; and *Parisia* Holthuis 1956, with one new species. The Palaemonidae are represented by five species, all of them belonging to the genus *Macrobrachium* Bate 1868. The Alpheidae are represented only by one new species in the genus *Potamalpheops* Powell 1979. Detailed descriptions are provided for all new and rarely reported species; taxonomic discussions are provided for all species.

KEY WORDS: Caridea, Atyidae, Palaemonidae, Alpheidae, new species, new records, cave shrimps.

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## INTRODUCTION

The freshwater shrimps of the Philippine Archipelago have been studied by several authors (DANA 1852; COWLES 1914; BLANCO 1935, 1939; HOLTHUIS 1950, 1978; JOHNSON 1962; BALETE & HOLTHUIS 1992; CHACE & BRUCE 1993; CHACE 1997; SKET 1997). Up to present, 34 species of freshwater caridean shrimps were reported from the Philippines. The family Atyidae was represented by five genera with 15 species: *Antecaridina* Edmondson 1954, *Atyoida* Randall 1840, *Atyopsis* Chace 1983, and *Edoneus* Holthuis 1978, with one species each, and *Caridina* H. Milne Edwards 1837, with 11 species. The family Palaemonidae was represented by two genera with 19 species: *Macrobrachium* Bate 1868, with 17 species, and *Palaemon* Weber 1795, with two species.

In 1991, an Italian speleological expedition made a small collection of epigeal and hypogean freshwater shrimps in various localities of the island of Palawan, Philippines. The same year, the "Aven Club Valettois", a group of French speleologists, visited several caves on the Philippine islands West Samar and Luzon. This expedition, named "Philippines 1991", collected a small number of interesting cave shrimps, which eventually passed to Dr Roberto Berti (University of Florence, Italy). This material, together with several lots collected 2 years earlier by another Italian expedition (P.L. Tasselli), was deposited in the collection of the Museo Zoologico "La Specola", Sezione del Museo di Storia Naturale dell'Università di Firenze (Natural History Museum of the University of Florence, Zoological Section "La Specola", Florence, Italy).

The examination of the new material from the Philippines resulted in the identification of 15 species of caridean shrimps: nine species in the family Atyidae, including four new species; five species in the family Palaemonidae, and one new species in the family Alpheidae. In this study, detailed descriptions and illustrations are provided for the new and rarely reported species, and brief notes are provided for the more common and widely distributed species.

## MATERIAL AND METHODS

Specimens were collected from various localities of the Philippines (see Fig. 1). Specimens examined are deposited in the Natural History Museum of the University of Florence, Zoological Section "La Specola", Florence, Italy (MZUF); Muséum National d'Histoire

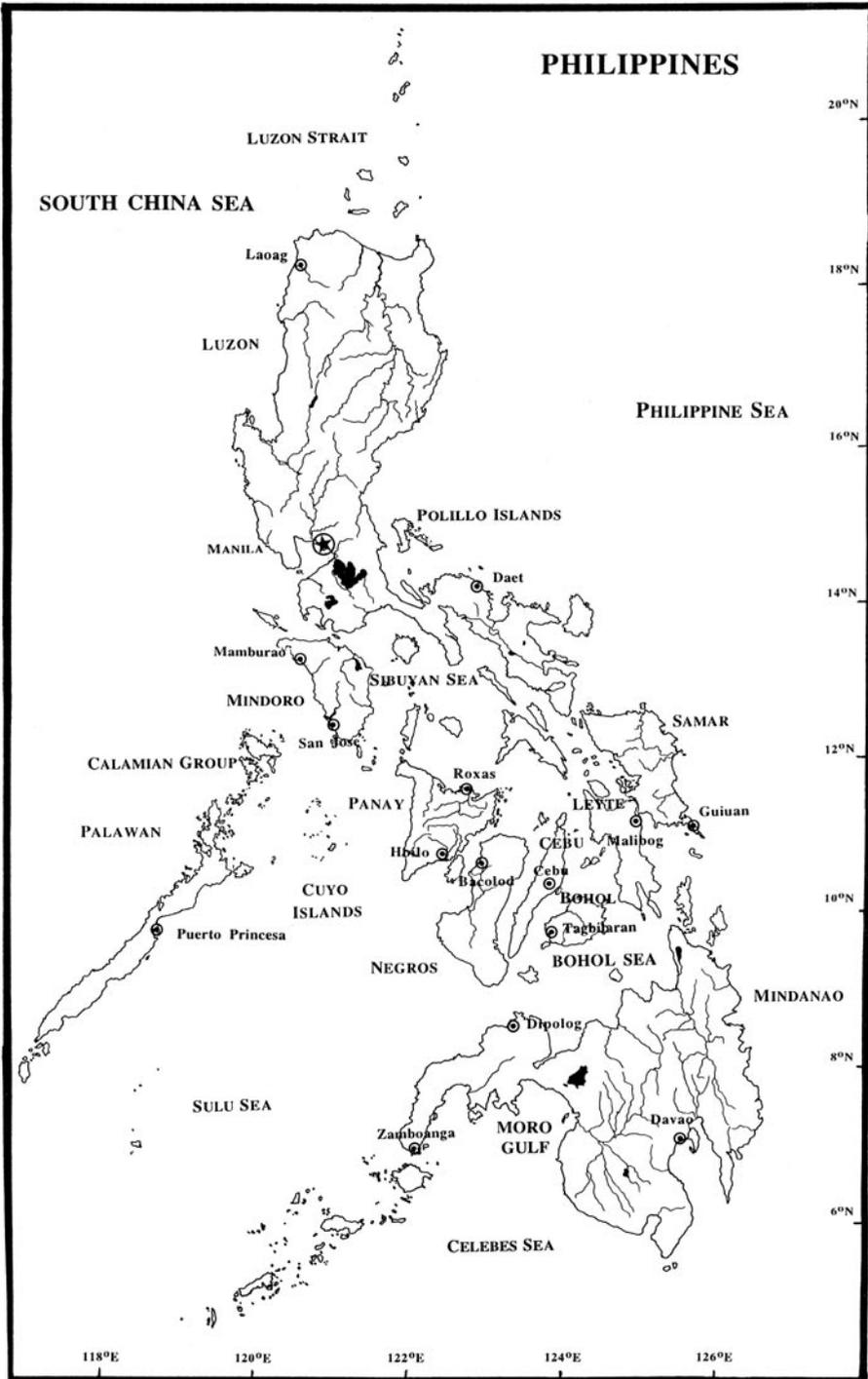


Fig. 1. — Map of the Philippines, showing the collection sites.

Naturelle, Paris, France (MNHN); National Museum of Natural History, Smithsonian Institution, Washington D.C., USA (USNM), and the University of the Ryukyus, Japan (URB). The abbreviation "cl" is used for carapace length measured in mm from the post-orbital margin to the posterior margin of the carapace in the Atyidae and Palaemonidae, and from the tip of the rostrum to the posterior margin of the carapace in the Alpheidae. Other abbreviations used in the text: P, pereopod; Mxp, maxilliped.

## SYSTEMATICS

### Family Atyidae De Haan 1849

#### Genus *Atyopsis* Chace 1983

#### *Atyopsis spinipes* (Newport 1847)

*Atya spinipes* NEWPORT 1847: 159 [type locality: Philippine Islands].

*Atya moluccensis*; DE HAAN 1902: 893 [not *A. moluccensis* (De Haan 1849)].

*Atyopsis spinipes*; CHACE 1983: 35, figs 20-22.

*Material examined.* One ovigerous female, cl 13 mm, MZUF-2460, Jinbajsanjan, Samar, Philippines, coll. C. Ferron, 29 Apr. 1991.

*Remarks.* Only two species are presently known in the genus *Atyopsis*, *A. spinipes* and *A. moluccensis* De Haan (CHACE 1997). The Samar specimen has the rostral formula 0/4, and therefore, clearly belongs to *A. spinipes*. This species occurs from the Philippines and the eastern Lesser Sunda Islands at ca 120°00'E northwards to Taiwan and as far as Tokuno-shima in the Ryukyus, and southeastwards as far as Samoa (CHACE 1983, 1997).

#### Genus *Caridina* H. Milne Edwards 1837

#### *Caridina typus* H. Milne Edwards 1837 (Fig. 9G)

*Caridina typus* H. MILNE EDWARDS 1837: 363 [type locality: unknown]. HOLTHUIS 1965: 10, fig. 3.

CHACE 1997: 21. YEO et al. 1999: 225.

*Caridina typus* form *caledonica* BOUVIER 1925: 253, figs 296-297 [type locality: New Caledonia].

*Caridina typus* form *acuminata*; BOUVIER 1925: 252.

*Caridina typus*; BOUVIER 1905: 77. ROUX 1926: 201. RIEK 1953: 117.

*Caridina typus typica*; BOUVIER 1925: 250.

*Material examined.* One ovigerous female, cl 8.7 mm, egg diameter 0.45 × 0.30 mm, MZUF-2457, Sulpan Cave, 12°02'00"N 124°55'30"E, altitude 100 m, Matalud, West Samar, Philippines, coll. P. Marcel & C. Ferron, 29 Feb. 1991. Two females, cl 4.7-4.8 mm, 1 juvenile, MZUF-2463, St Paul Cave, subterranean river, Palawan Island, Philippines, coll. C. Ferron, 21 Feb. 1991. One male, cl 4.0 mm, 1 female, cl 3.0 mm, MZUF-2464, stream near Coron Town, Balisungan, Busuanga Island, Calamian group, Philippines, coll. R. Berti, 11 Mar. 1991.

*Remarks.* *Caridina typus* is a common freshwater species, widely distributed in the islands of the Indo-Pacific region (CHACE 1997). In one of the Palawan females

(Fig. 9G) the ventral margin of the rostrum is armed with 8 very small teeth, whereas the formula typical for this species is 0/1-4. As no other significant differences were found, this specimen is here regarded as abnormal.

***Caridina peninsularis* Kemp 1918 (Fig. 2)**

*Caridina brachydactyla peninsularis* KEMP 1918: 279, fig. 10a-g [type locality: Patani, southern Thailand and Penang, Malaysia].

*Material examined.* One female, cl 2.6 mm (MZUF-2636), stream near Coron Town, Balisungan, Busuanga Island, Calamian group, Philippines, coll. R. Berti, 11 Mar. 1991.

*Diagnosis.* Rostrum (Fig. 2A) straight, slightly upturned at distal quarter, reaching slightly beyond end of antennular peduncle, not reaching distal margin of scaphocerite blade; rostral formula 3+20/9; three anterior teeth more or less separated from remaining teeth. Antennal spine pointed, situated below inferior orbital angle. Pterygostomian margin broadly rounded. Posterior margin of telson (Fig. 2B) with median projection and 3 pairs of distal spines, lateral spines distinctly longer than intermediate pairs. Preanal carina (Fig. 2I) lacking spine. Antennular peduncle 0.9 times as long as carapace; stylocerite 0.8 length of basal segment. Strap-like epipods present on first four pereopods. First pereopod with carpus 1.7 times as long as high (Fig. 2C), chela 1.4 times longer than carpus, 2.0 times as long as broad, fingers as long as palm. Second pereopod (Fig. 2D) with carpus 5.6 times as long as high, chela 0.8 times as long as carpus, chela 2.4 times as long as broad, fingers 1.2 times as long as palm. Third pereopod (Figs 2E-F) with propodus 5.4 times as long as dactylus; dactylus 3.4 times as long as wide, with 4 spines on flexor margin. Fifth pereopod (Figs 2G-H) with propodus 4.0 times as long as dactylus, dactylus 3.8 times as long as broad, with 39 small spines on flexor margin.

*Distribution.* Peninsular Malaysia, southern Thailand, Philippines.

*Remarks.* The above diagnosis is based on the single Palawan specimen. This specimen agrees rather well with the description provided by KEMP (1918), although there are some notable differences. For instance, the carpus of the first pereopod is stouter (1.7 times vs 2.2-2.6 in the types), while the fingers are shorter (as long as palm vs 1.5 times as long as palm in the types). Further, the dactylus of the fifth pereopod is relatively shorter (propodus 4.0 times as long as dactylus vs 4.8-6.8 times in the types). These differences are tentatively regarded as intra-specific variation, at least until more specimens are collected from the Philippine region. The present specimen represents the first record of *C. peninsularis* outside the Malay Peninsula.

***Caridina laoagensis* Blanco 1939 (Fig. 3)**

*Caridina laoagensis* BLANCO 1939: 390, pl. 2 [type locality: Laoag River, Province of Ilocos Norte, Luzon, Philippines]. CHACE 1997: 12.

*Material examined.* Six females, cl 2.2-2.5 mm, MZUF-2637, stream near Coron Town, Balisungan, Busuanga island, Calamian group, Philippines, coll. R. Berti, 11 Mar. 1991.

*Diagnosis.* Rostrum (Fig. 3A) straight, reaching to base or near middle of second segment of antennular peduncle, dorsal margin straight, slightly sloping down;

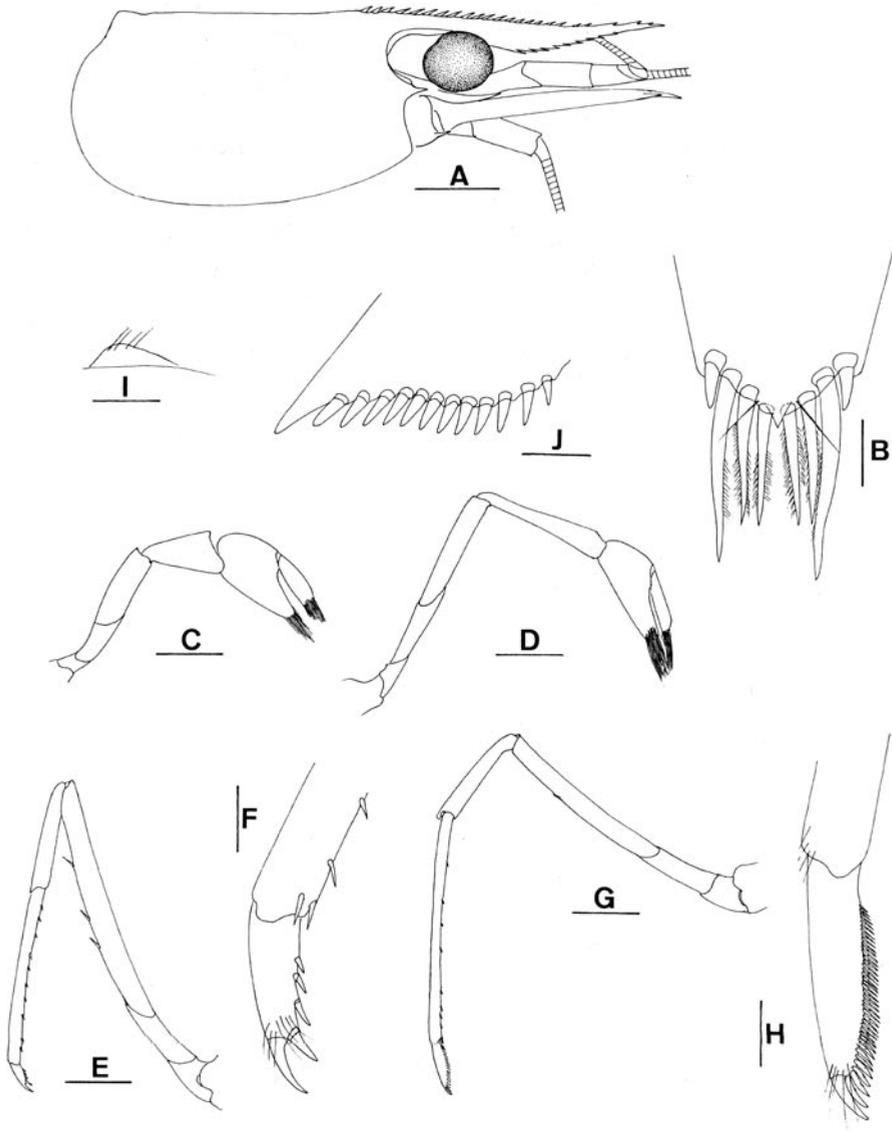


Fig. 2. — *Caridina peninsularis* Kemp 1918 (female, MZUF-2636). (A) cephalothorax and cephalic appendages, lateral view; (B) telson, distal portion; (C) first pereiopod; (D) second pereiopod; (E) third pereiopod; (F) same, dactylus; (G) fifth pereiopod; (H) same, dactylus; (I) preanal carina; (J) uropodal diaeresis. Scales: A = 1 mm; B, F, H, J = 0.1 mm; C-E, G, I = 0.5 mm.

rostral formula 12-15/1-3. Suborbital angle acute, fused with antennal spine. Pterygostomian margin sub-rectangular. Posterior margin of telson (Fig. 3B) with small postero-median projection and 3 elongate, median, plumose setae inserted between 2 pairs of distal spines, sublateral spines shorter than lateral spines. Preanal carina (Fig. 3I) elevated, sub-triangular. Antennular peduncle 0.6 times as long as cara-

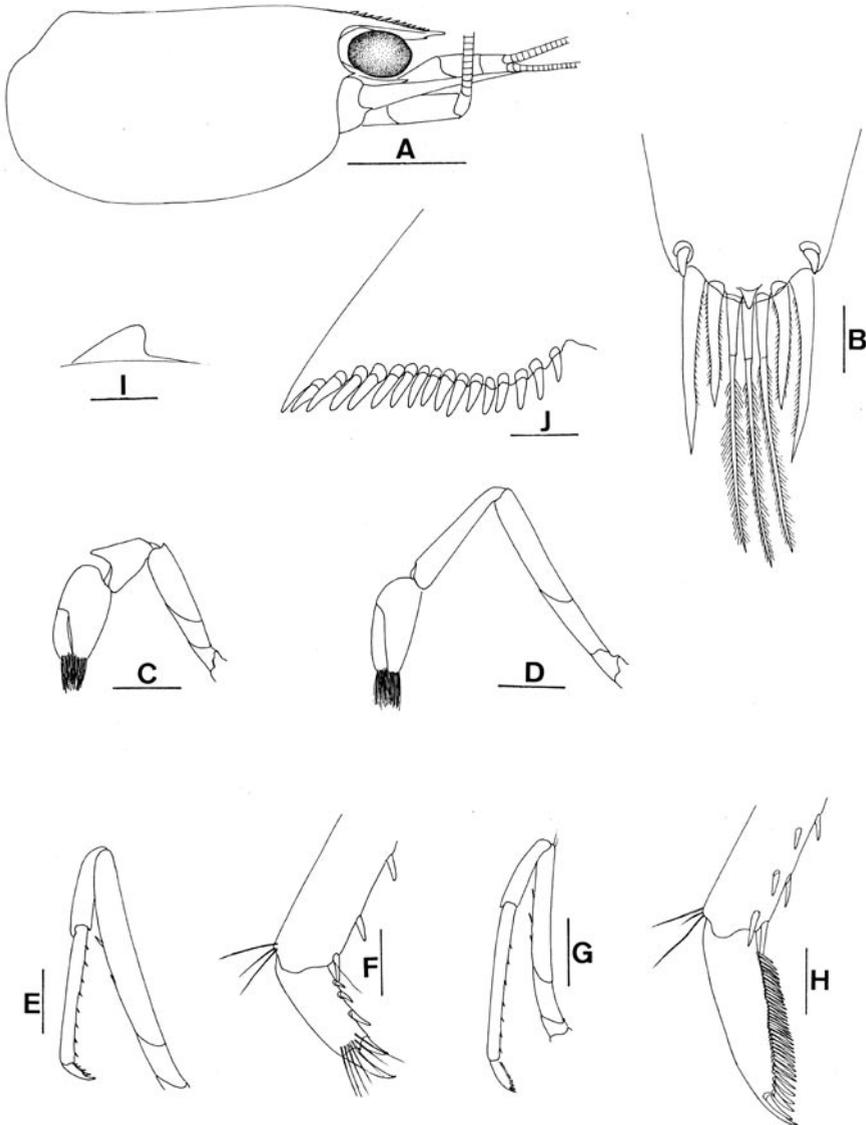


Fig. 3. — *Caridina laoagensis* Blanco 1939 (female, cl 2.5 mm, MZUF-2637). (A) cephalothorax and cephalic appendages, lateral view; (B) telson, distal portion; (C) first pereopod; (D) second pereopod; (E) third pereopod; (F) same, dactylus; (G) fifth pereopod; (H) same, dactylus; (I) preanal carina; (J) uropodal diaeresis. Scales: A = 1 mm; B, F, H, J = 0.1 mm; C-E, G, I = 0.5 mm.

pace. First pereopod (Fig. 3C) with fingers as long as palm; carpus 0.6-0.7 times as long as chela, 1.3 times as long as high; merus 2.4 times as long as wide. Second pereopod (Fig. 3D) with fingers 1.8 times as long as palm, carpus 1.2 times as long as chela, 4.8 times as long as high, merus 5.0 times as long as wide. Third pereopod (Fig. 3E-F) with propodus 4.0 times as long as dactylus; dactylus ending in 2 claws, with 3-4 spines on flexor margin. Fifth pereopod (Fig. 3G-H) slender, with propodus 5.0 times as long as dactylus; dactylus with 28-36 spinules on flexor margin. Endopod of male first pleopod with appendix interna. Uropod with diaeresis (Fig. 3J) bearing 15-18 small spines.

*Distribution.* So far reported only from the Philippine islands Luzon, Leytes and Busuanga, Calamian group, Philippines (BLANCO 1939, CHACE 1997, present study).

*Remarks.* CHACE (1997) recently rediagnosed this species on the basis of specimens from the Philippines, and commented that it "is possible that *C. laoagensis* will eventually fall into synonymy with the variable *C. weberi* from Indonesia". According to the ongoing revision (Y. CAI in prep.), most of the subspecies of *C. weberi* are in fact, distinct species. Among the allied species, *C. laoagensis* is most similar to *C. weberi* De Man 1892, in the form of rostrum, which is straight, pointed at the end. However, *C. laoagensis* can be separated from *C. weberi* by the crest at the base of the rostrum, and the dorsal rostral teeth, which are located considerably anterior to the orbital margin. The distal spine and setae arrangement in the telson of *C. laoagensis* are also different from those in other species. In *C. laoagensis*, there are always two pairs of lateral spines, in which the sublateral pair is much shorter than the lateral pair while in other members of the *C. weberi* group except *C. weberi*, there is only one pair of lateral spine. Both forms appear in *C. weberi*, with the majority of specimens demonstrating the form with only one pair of lateral spine.

### *Caridina samar* n. sp. (Figs 4-5)

*Material examined.* Holotype: 1 male, cl 6.4 mm, MZUF-2638, Sulpan Cave, 12°02'00"N 124°55'30"E, altitude 100 m, Matalud, West Samar, Philippines, coll. P. Marcel & C. Ferron, 29 Feb. 1991.

*Description.* Rostrum (Fig. 4A) incomplete, narrow, slender, slope downwards at posterior half, upturned at anterior half, reaching probably slightly beyond distal margin of scaphocerite, entire dorsal margin armed with more than 22 teeth, anterior half of ventral margin with more than 10 small teeth. Antennal spine fused with sub-orbital angle. Pterygostomian angle rounded.

Sixth abdominal somite 0.6 times as long as carapace, 1.5 times as long as fifth somite, slightly longer than telson. Telson (Fig. 4B-C) 3.1 times as long as wide, with 3 pairs of small dorsal spines, and 1 posterior pair of dorso-lateral spines; posterior margin without posterior projection, with 4 pairs of distal spines, lateral spines slightly longer than intermediate spines, sublateral spines shortest. Preanal carina elevated, triangular, lacking spine (Fig. 5G).

Eyes weakly developed, anterior margin reaching only to 1/3 length of basal segment of antennular peduncle. Antennular peduncle 0.7 times as long as cara-

pace; basal segment shorter than length of second and third segment combined; second segment distinctly longer than third segment; stylocerite 0.7 times length of basal segment. Scaphocerite (Fig. 4D) 3.1 times as long as wide.

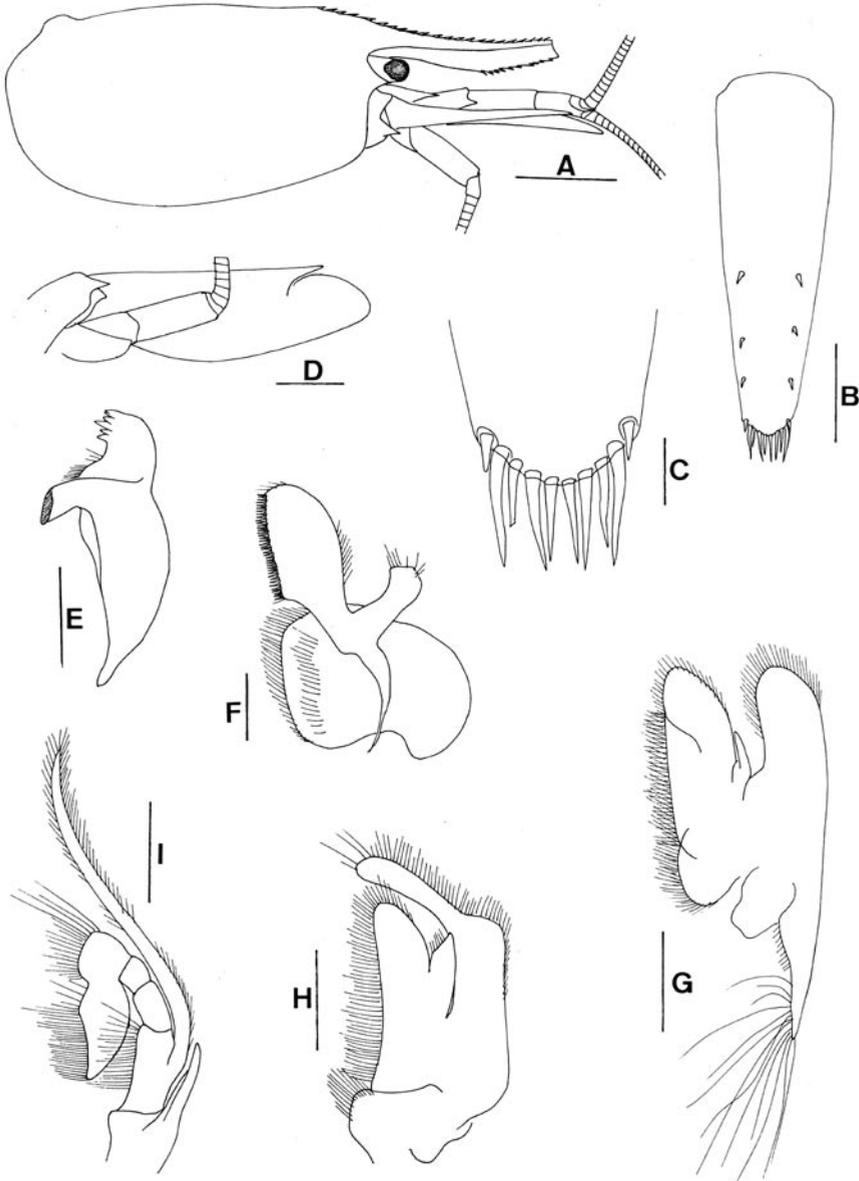


Fig. 4. — *Caridina samar*, n. sp. (male, MZUF-2638). (A) cephalothorax and cephalic appendages, lateral view; (B) telson; (C) same, distal portion; (D) scaphocerite; (E) mandible; (F) maxillula; (G) maxilla; (H) first maxilliped; (I) second maxilliped. Scales: A = 2 mm, B, D, E, G-I = 1 mm; D, F = 0.2 mm; E, G = 0.5 mm.

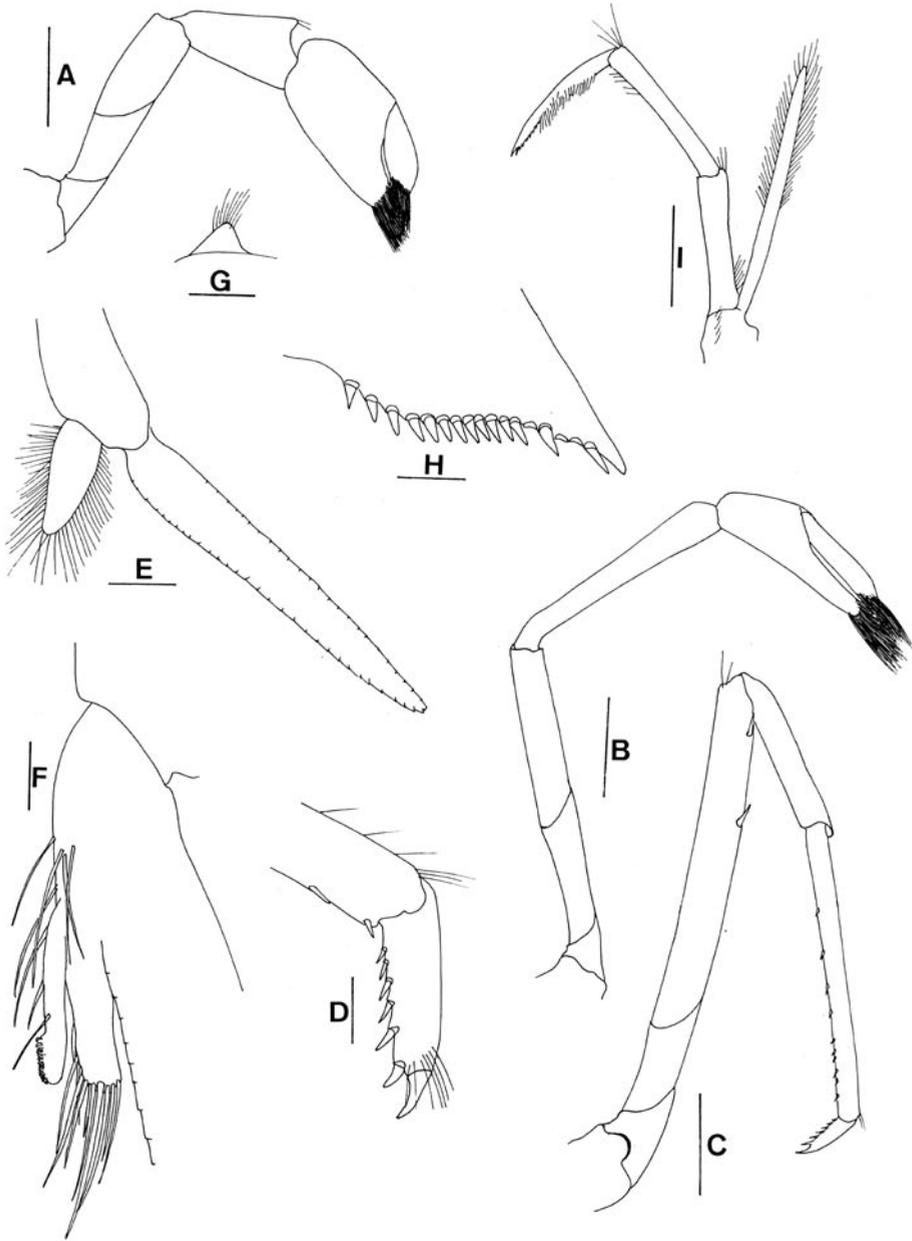


Fig. 5. — *Caridina samar*, n. sp. (male, MZUF-2638). (A) first pereiopod; (B) second pereiopod; (C) third pereiopod; (D) same, dactylus; (E) male first pleopod; (F) male second pleopod, appendix masculina and appendix interna; (G) preanal carina; (H) uropod, diaeresis; (I) third maxilliped. Scales: A-C, I = 1 mm; D, F, H = 0.2 mm; E, G = 0.5 mm.

Mandible with incisor process (Fig. 4E) ending in irregular teeth, molar process truncate. Maxillula with lower lacinia (Fig. 4F) broadly rounded; upper lacinia elongate, with a number of distinct teeth on inner margin; palp slender. Maxilla with upper endites (Fig. 4G) subdivided; palp short; scaphognathite posteriorly tapering, with several long, curved setae at posterior end. First maxilliped with palp (Fig. 4H) broadly triangular. Second maxilliped (Fig. 4I) without specific features, typical for genus. Third maxilliped (Fig. 5I) reaching to end of antennular peduncle, with ultimate segment as long as penultimate segment.

Strap-like epipods present on first four pereopods. First pereopod (Fig. 5A) reaching to end of basal segment of antennular peduncle; ischium as long as merus; merus 2.0 times as long as broad, slightly longer than carpus; carpus excavated anteriorly, shorter than chela, 1.7 times as long as high; chela 2.0 time as long as broad; fingers distinctly shorter than palm. Second pereopod (Fig. 5B) reaching to third segment of antennular peduncle; ischium as long as merus; merus shorter than carpus, 5.0 times as long as broad; carpus 1.3 times as long as chela, 6.1 times as long as high; chela 3.0 times as long as broad; fingers 1.2 times as long as palm. Third pereopod (Fig. 5C-D) reaching end of scaphocerite, propodus distinctly shorter than merus, 13 times as long as broad, 4.0 times as long as dactylus; dactylus 4.5 times as long as wide (spines included), with 6 accessory spines on flexor margin. Fifth pereopod unknown (lacking in holotype).

Endopod of first male pleopod (Fig. 5E) triangular, about 0.25 length of exopod, without appendix interna. Second male pleopod with appendix masculina (Fig. 5F) about 1/2 length of endopod, appendix interna reaching distal end of appendix masculina.

Diaeresis of uropod (Fig. 5H) bearing 17 small movable spines.

*Habitat.* Freshwater rivers in caves.

*Distribution.* Presently known only from the type-locality, Sulpan Cave, 12°02'00"N 124°55'30"E, altitude 100 m, near Matalud, West Samar, Philippines.

*Etymology.* Named after the island of West Samar, Philippines, the type-locality of the new species. The name is used as a noun in apposition.

*Remarks.* *C. samar* n. sp., is very close to *C. peninsularis* from the Malay Peninsula (KEMP 1918) and the Philippines (present study) in the arrangement of rostral teeth. However, the new species can be distinguished from *C. peninsularis* by the less developed eyes; the stouter first pereopod; the larger number of post-orbital teeth on the carapace (5 vs 1-3 in *C. peninsularis*); the absence of appendix interna on the endopod of the first male pleopod; the much higher preanal carina; and the telson lacking a posteromedian projection.

### ***Caridina rubella*** Fujino & Shokita 1975 (Figs 6-7)

*Caridina rubella* FUJINO & SHOKITA 1975: 102, fig. 6a-o [type locality: Izaga Cave, Morikaga Cave and a well near Hirara city of Miyako Island, Ryukyus, Japan]. SHOKITA 1979: 203.

*Material examined.* Five females, cl 2.6-6.4 mm, MZUF-2462, Palawan, coll. G. Messana, 25 Feb. 1991.

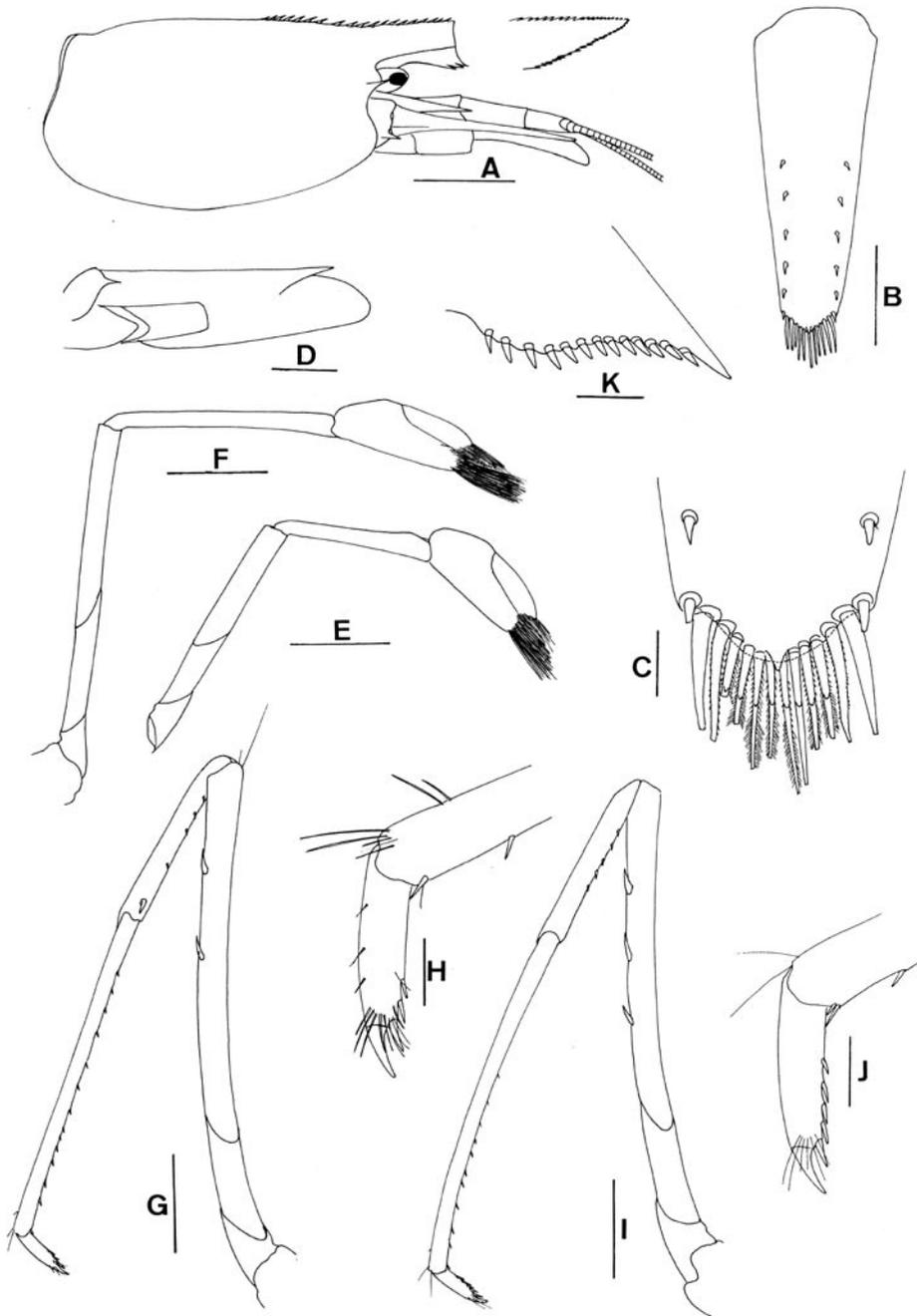


Fig. 6. — *Caridina rubella* Fujino & Shokita 1975 (female, MZUF-2462). (A) cephalothorax and cephalic appendages, lateral view; (B) telson; (C) same, distal portion; (D) scaphocerite; (E) first pereiopod; (F) second pereiopod; (G) third pereiopod; (H) same, dactylus; (I) fourth pereiopod; (J) same, dactylus; (K) uropodal diaeresis. Scales: A = 2 mm; B, D-G, I = 1 mm, C, H, J, K = 0.2 mm.

*Comparative material.* Holotype: 1 female, cl 6.1 mm, (dry), URB-495, Izaga Cave, coll. S. Shokita, 19 Sept. 1964. Paratype: 1 female, cl 5.4 mm (dry), URB-496, same data as for the holotype.

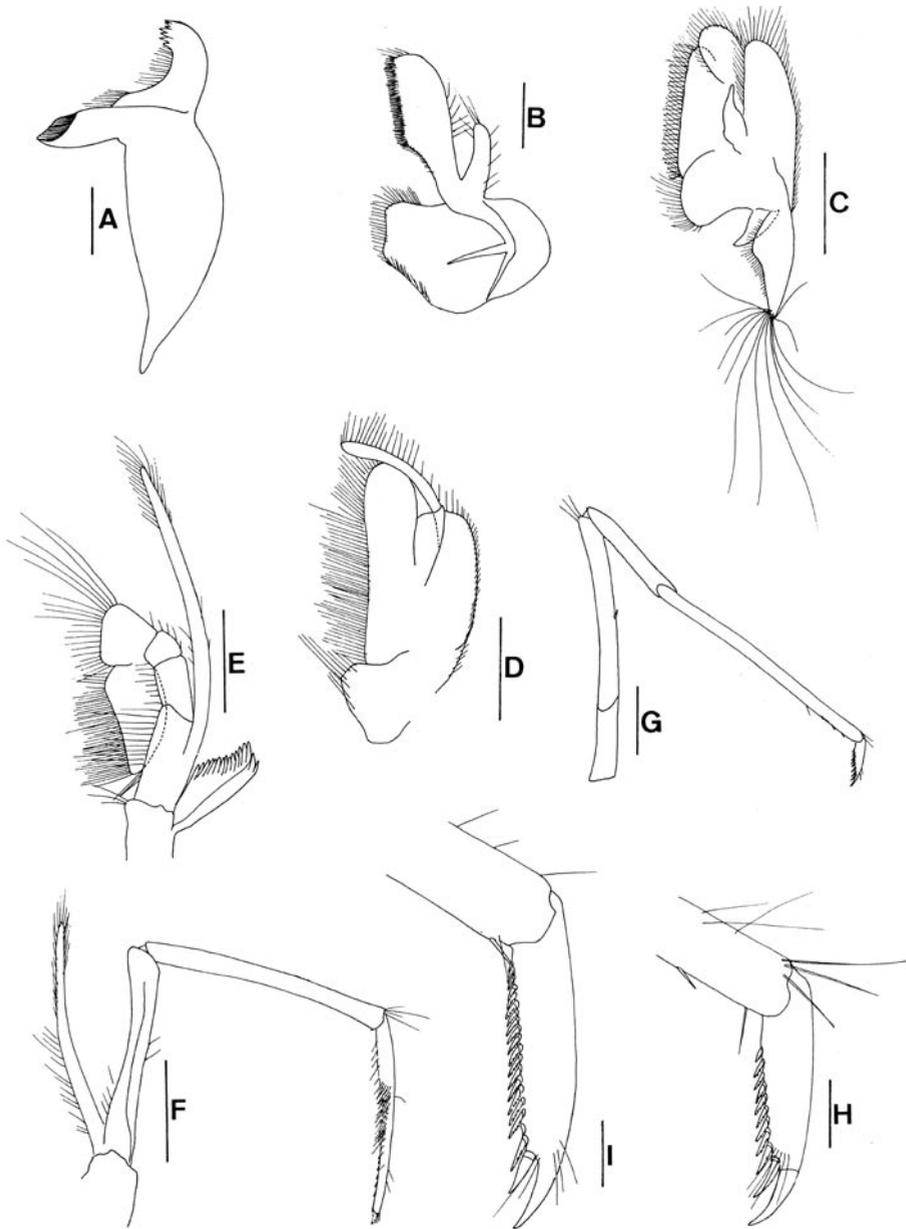


Fig. 7. — *Caridina rubella* Fujino & Shokita 1975 (A-H, female, cl 6.0 mm; I, female, cl unknown; MZUF-2462). (A) mandible; (B) maxillula; (C) maxilla; (D) first maxilliped; (E) second maxilliped; (F) third maxilliped; (G) fifth pereopod; (H), (I) same, dactylus. Scales: A-B = 0.5 mm; C-G = 1 mm; H-I = 0.2 mm.

*Description.* Rostrum (Fig. 6A) straight, elevated, reaching to about end of antennular peduncle, rostral formula: 7-9+14+26/8-17, dorsal teeth throughout dorsal margin. Antennal spine distinct, situated at inferior orbital angle. Pterygostomian margin broadly rounded.

Sixth abdominal somite 0.6 times as long as carapace, 2.0 times as long as fifth somite, slightly longer than telson. Telson (Fig. 6B-C) 2.7 times as long as wide, with 5 pairs of small dorsal spines and 1 posterior pair of dorso-lateral spines; posterior margin with median projection and several pairs of spines and spiniform setae (Fig. 6C), lateral spines simple, more stout and slightly shorter than sublateral spines and intermediate plumose setae. Preanal carina elevated, triangular, lacking spine.

Eyes reduced, oval, with cornea visible dorsally as small, black spot, with diameter slightly larger than 1/2 of eyestalk; anterior margin of eye reaching only to 1/3 length of basal segment of antennular peduncle. Antennular peduncle 0.65 times as long as carapace; basal segment shorter than 1/2 of antennular peduncle length; second segment distinctly longer than third segment; stylocerite very long, reaching far beyond distal margin of basal segment. Scaphocerite (Fig. 6D) 3.4 times as long as wide.

Mandible with incisor process (Fig. 7A) bearing distally irregular teeth; molar process truncate. Maxillula with lower lacinia (Fig. 7B) broadly rounded; upper lacinia elongate, with distinct teeth on inner margin; palp slender. Maxilla with upper endites (Fig. 7C) subdivided; palp short; scaphognathite posteriorly tapering, with several long, curved setae at posterior end. First maxilliped (Fig. 7D) with palp broadly triangular, ending in short, stout process. Second maxilliped (Fig. 7E) without specific features, typical for genus. Third maxilliped (Fig. 7F) slender, reaching to end of antennular peduncle, with ultimate segment shorter than penultimate segment.

Strap-like epipods present on first four pereopods. First pereopod (Fig. 6E) slender, reaching to end of third segment of antennular peduncle; merus 2.0 times as long as ischium, 5.7 times as long as broad, slightly shorter than carpus; carpus not excavate anteriorly, 1.1 times as long as chela, 6.4 times as long as high; chela 2.5 times as long as broad; fingers slightly longer than palm. Second pereopod (Fig. 6F) very slender, reaching beyond end of antennular peduncle; merus 1.9 times as long as ischium, shorter than carpus, 7.8 times as long as broad; carpus 1.5 times as long as chela, 10 times as long as high; chela 3.0 times as long as broad; fingers 1.2 times longer than palm. Third pereopod (Fig. 6G-H) reaching beyond end of scaphocerite; propodus distinctly shorter than merus, 17 times as long as broad, 5.0 times as long as dactylus; dactylus 4.0 times as long as wide (spines included), with accessory spines on flexor margin. Fifth pereopod (Fig. 6I-J) reaching to end of antennular peduncle, with propodus 20 times as long as broad, 5.0 times as long as dactylus; dactylus 5.0 times as long as broad, terminating in very strong claw, with 10-19 very small, articulated spines.

Uropod with diaeresis (Fig. 6K) bearing 11-13 small movable spines.

*Habitat.* Freshwater rivers in caves.

*Distribution.* Ryukyu Islands and Palawan, Philippines.

*Remarks.* *C. rubella*, is closely related to *C. troglodytes* Holthuis 1978, a subterranean species from New Ireland (Bismarck Archipelago, Papua New Guinea),

especially in the features of the rostrum, the eyes, the stylocerite and the telson. It can be distinguished from *C. troglodytes* (cf. HOLTHUIS 1978) by the slender scaphocerite (3.4 times as long as broad vs 2.7 times in *C. troglodytes*); more numerous ventral teeth on the rostrum (8-17 vs 2-10 in *C. troglodytes*); and the stouter second pereopod (chela 3.0 times as long as broad vs 4.0 times in *C. troglodytes*; fingers 1.2 times as long as palm vs 3-4 times in *C. troglodytes*). The present specimens represent the first record of *C. rubella* outside the Ryukyu Islands, and a new record for the Philippines.

***Caridina gortio*** n. sp. (Figs 8, 9A-F)

*Material examined.* Holotype: 1 female, 4.5 mm, MZUF-2459, Can Gortio Cave, 11°59'00"N 124°53'00"E, altitude ca 200 m, Matalud, West Samar, Philippines, coll. C. Ferron, 20 Mar. 1991. Paratype: 1 female, cl 3.7 mm, MZUF-2639, same data as for holotype.

*Description.* Rostrum (Fig. 8A) short, reaching to middle of second segment of antennular peduncle; dorsal margin slightly sloping down, rostral formula: 4+15/7. Antennal spine fused with inferior orbital angle. Pterygostomian margin broadly rounded.

Sixth abdominal somite 0.46 times as long as carapace, 1.5 times as long as fifth somite, slightly shorter than telson. Telson (Fig. 8B) 3.0 times as long as wide, with 4 pairs of small dorsal spines and 1 posterior pair of dorso-lateral spines; posterior margin without median projection, with 4 pairs of spines, lateral spines slightly longer than intermediate spines, sublateral spines shortest, and 2 slender, oblique setae. Preanal carina (Fig. 8J) triangular, lacking spine.

Eyes well developed and pigmented. Antennular peduncle 0.65 times as long as carapace; basal segment of antennular peduncle longer than combined length of second and third segments; stylocerite reaching 0.8 length of basal segment. Scaphocerite (Fig. 8C) 3.2 times as long as wide.

Mouthparts generally similar to those of *C. samar*, new species (see above). First maxilliped (Fig. 8G) with palp ending in a finger-like process. Third maxilliped (Fig. 8I) reaching to end of antennular peduncle, with ultimate segment as long as penultimate segment.

Strap-like epipods present on first four pereopods. First pereopod (Fig. 9A) almost reaching end of basal segment of antennular peduncle; ischium as long as merus; merus 2.0 times as long as broad; carpus excavate anteriorly, shorter than chela, 1.6 times as long as high; chela 2.0 times as long as broad; fingers slightly shorter than palm. Second pereopod (Fig. 9B) reaching slightly beyond end of antennular peduncle; ischium as long as merus, merus 4.0 times as long as broad; carpus 1.4 times as long as merus, 1.3 times as long as chela, 5.4 times as long as high; chela 3.0 times as long as broad; fingers 1.4 times as long as palm. Third pereopod (Fig. 9C-D) reaching distal margin of scaphocerite; propodus shorter than merus, 13 times as long as broad, 4.4 times as long as dactylus; dactylus 3.3 times as long as wide (spines included), with 5 accessory spines on flexor margin. Fifth pereopod (Fig. 9E-F) reaching end of antennular peduncle; propodus distinctly longer than merus, 15 times as long as broad, 3.5 times as long as dactylus; dactylus 3.4 times as long as wide, with 54 spinules on flexor margin.

Uropod with diaeresis (Fig. 8K) bearing 17 small, movable spines.

*Habitat.* Freshwater rivers in caves.

*Distribution.* Presently known only from the type-locality, Can Gortio Cave, near Matalud, West Samar, Philippines.

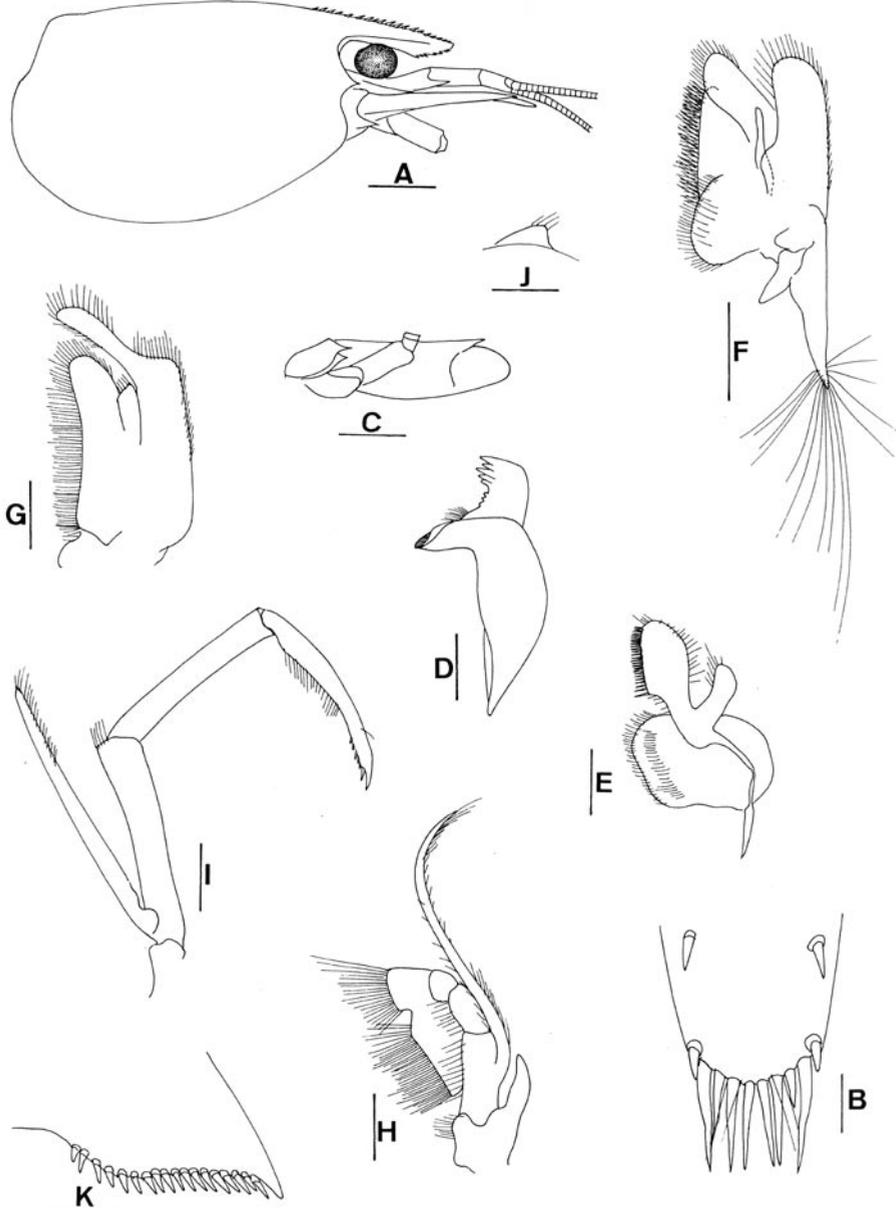


Fig. 8. — *Caridina gortio* n. sp. (female, MZUF-2459). (A) cephalothorax and cephalic appendages, lateral view; (B) telson, distal portion; (C) scaphocerite; (D) mandible; (E) maxillula; (F) maxilla; (G) first maxilliped; (H) second maxilliped; (I) third maxilliped; (J) preanal carina; (K) uropod, diaeresis. Scales: A, C, F = 1 mm; B, K = 0.2 mm; D-E, G-J = 0.5 mm.

*Etymology.* The new species name, *gortio*, refers to the type-locality of this species, Can Gortio Cave, used as a noun in apposition.

*Remarks.* In the general shape of the rostrum and the rostral formula, *C. gortio* n. sp. is similar to *C. weberi sumatrensis* De Man 1892, from Sumatra and the

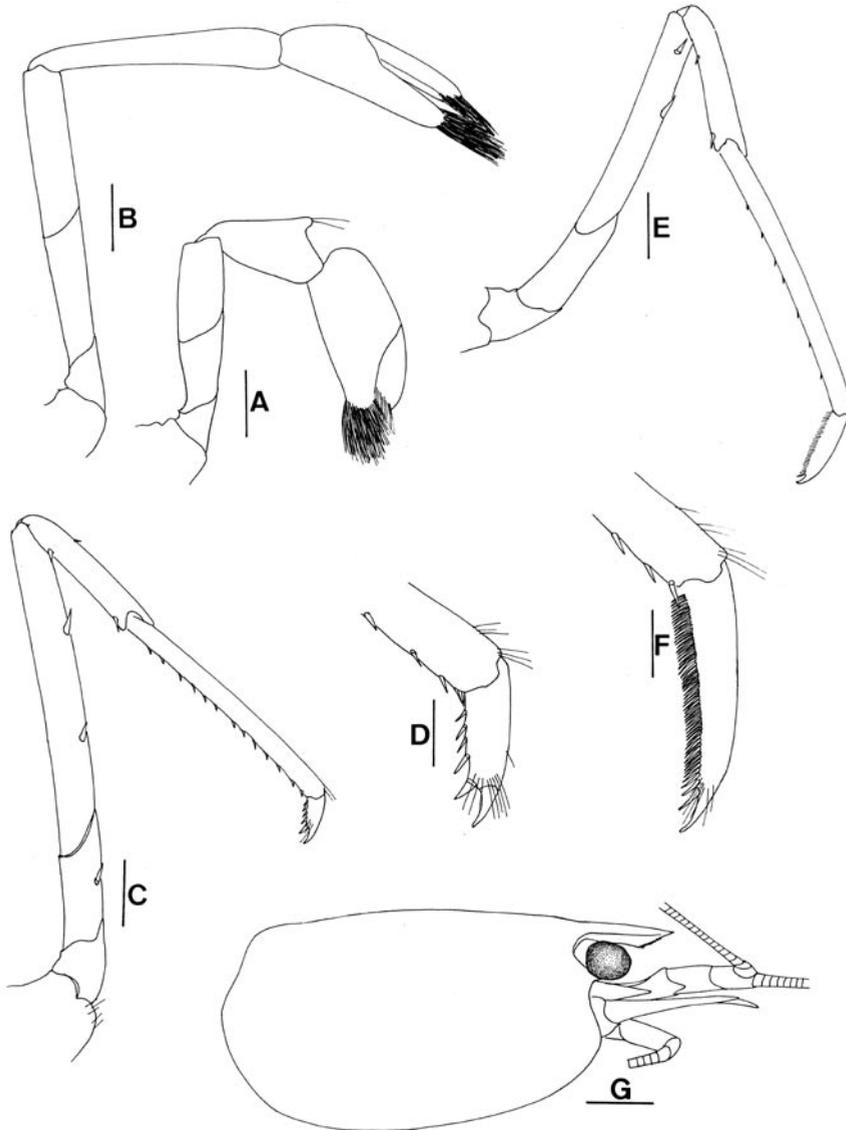


Fig. 9. — *Caridina gortio* n. sp. (A-F, female, MZUF-2459) and *Caridina typus* H. Milne Edwards, 1837 (G, female, MZUF-2463). (A) first pereiopod; (B) second pereiopod; (C) third pereiopod; (D) same, dactylus; (E) fifth pereiopod; (F) same, dactylus; (G) cephalothorax and cephalic appendages, lateral view. Scales: A-C, E = 0.5 mm; D, F = 0.2 mm; G = 1 mm.

Malay Peninsula, and *C. sundanella* Holthuis 1978, from the Lesser Sunda Islands. However, the new species differs from *C. w. sumatrensis* by having the rostrum sloping down (vs straight in *C. w. sumatrensis*); the fewer number of the post-orbital rostral teeth (4 vs 5-6 in *C. w. sumatrensis*); and the posterior margin of the telson lacking a median projection (vs with such a projection in *C. w. sumatrensis*), and with intermediate spines or setae being shorter than lateral spines (vs longer in *C. w. sumatrensis*). The new species can be distinguished from *C. sundanella* by the relatively narrow rostrum (vs high in *C. sundanella*); the shorter fingers of the first pereopod (shorter than palm vs 1.4 times longer than palm in *C. sundanella*); and the shorter fingers of the second pereopod (1.4 times as long as palm vs 2.0 times in *C. sundanella*).

***Caridina minidentata* n. sp.** (Figs 10-11)

*Material examined.* Holotype: 1 female, cl 4.1 mm, MZUF-2461, Can Gortio Cave, 11°59'00"N 124°53'00"E, altitude ca 200 m, Matalud, West Samar, coll. C. Ferron, 19 Mar. 1991. Paratype: 1 female, cl 4.0 mm, MZUF-2640, same data as for holotype.

*Description.* Rostrum (Fig. 10A-B) short, straight, reaching about 0.8 length of basal segment of antennular peduncle; dorsal margin sloping, with 3-10 very small teeth; ventral margin horizontal, unarmed. Antennal tooth fused entirely with inferior angle. Pterygostomian margin broadly rounded.

Abdomen with sixth somite about 1/2 length of carapace, as long as telson and 1.7 times as long as fifth somite. Telson (Fig. 10C) with 1 pair of dorso-lateral spines proximal to posterior margin; posterior margin without postero-median projection, with 4 pairs of slender, simple spines, lateral spines longer than intermediate spines. Preanal carina (Fig. 11H) triangular, without spine.

Eyes well developed and pigmented. Antennular peduncle 0.6 times as long as carapace; basal segment as long as 1/2 length of peduncle, third segment shortest; stylocerite reaching 0.7-0.8 times length of basal segment. Scaphocerite slender, reaching beyond distal end of antennular peduncle, about 4.0 times as long as broad.

Mouthparts (Fig. 10D-F) generally similar to those of *C. samar*, new species (see above). First maxilliped (Fig. 10H) with palp ending in a stout finger-like process. Second maxilliped with podobrach (Fig. 10G) reduced to one lamella. Third maxilliped (Fig. 11A) reaching slightly beyond distal end of antennular peduncle, ending in single terminal claw; ultimate segment slightly longer than penultimate segment.

Strap-like epipods present on first four pereopods. First pereopod (Fig. 11B) reaching distal margin of eye; ischium slightly shorter than merus; merus shorter than carpus; 2.0 times as long as broad; carpus excavated anteriorly, about 2.0 times as long as high, shorter than chela; chela 2.2 times as long as broad, fingers slightly longer than palm. Second pereopod (Fig. 11C) long, slender, reaching to end of antennular peduncle; ischium distinctly shorter than merus, shorter than chela, 4.3 times as long as broad; carpus about 6.7 times as long as high, 1.3 times as long as chela; chela 4.3 times as long as broad, fingers 1.3 times as long as palm. Third pereopod (Fig. 11D-E) slender, elongate, reaching beyond end of antennular peduncle by entire dactylus; propodus 12 times as long as wide, 4.3 times as long as dacty-

lus; dactylus terminating in one spine, and bearing 4 small spines on flexor margin. Fifth pereopod (Fig. 11F-G) long and slender, reaching to end of second segment of antennular peduncle; propodus 12 times as long as broad, 2.8 times as long as dactylus; dactylus terminating in a strong claw, with 52-59 spinules on flexor margin.

Uropod with diaeresis (Fig. 11I) bearing 14 or 15 spines.

*Habitat.* Freshwater rivers in caves.

*Distribution.* Presently known only from the type-locality, Can Gortio Cave, near Matalud, West Samar, Philippines.

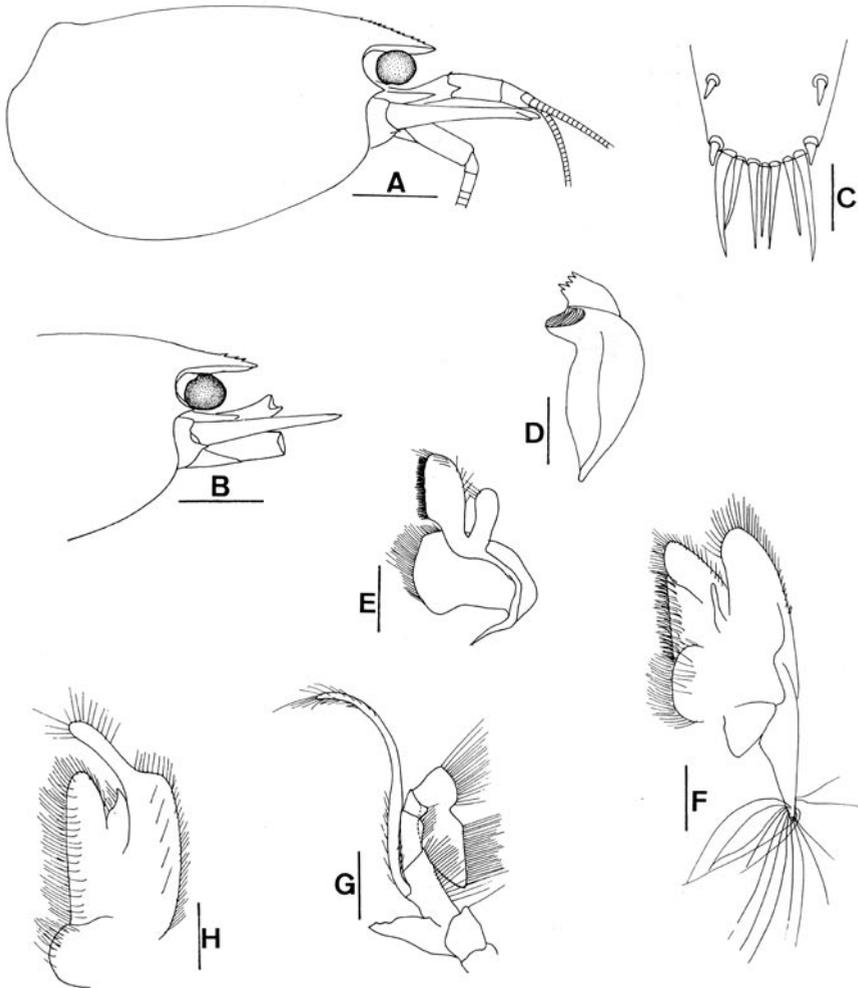


Fig. 10. — *Caridina minidentata* n. sp. (A, C-H, female, MZUF-2640; B, female, MZUF-2461). (A-B) cephalothorax and cephalic appendages, lateral view; (C) telson, distal portion; (D) mandible; (E) maxillula; (F) maxilla; (G) second maxilliped; (H) first maxilliped. Scales: A-B = 1 mm; C = 0.2 mm; D-H = 0.5 mm.

*Etymology.* The new species name, *minidentata*, is the combination of two Latin words, minus, small, and dentata, toothed, alluding to the very small rostral teeth in this species.

*Remarks.* Based on rostral features, *C. minidentata* n. sp., appears to be similar to the Taiwanese *C. formosae* Hung, Chan & Yu 1993, but can be distinguished from the latter by the slender carpus on the first pereiopod (2.0 times as long as high vs 1.5 times in *C. formosae*); and the smaller number of teeth on the uropodal diaeresis (15 vs 19-22 in *C. formosae*). Further, *C. minidentata* n. sp., resembles *C.*

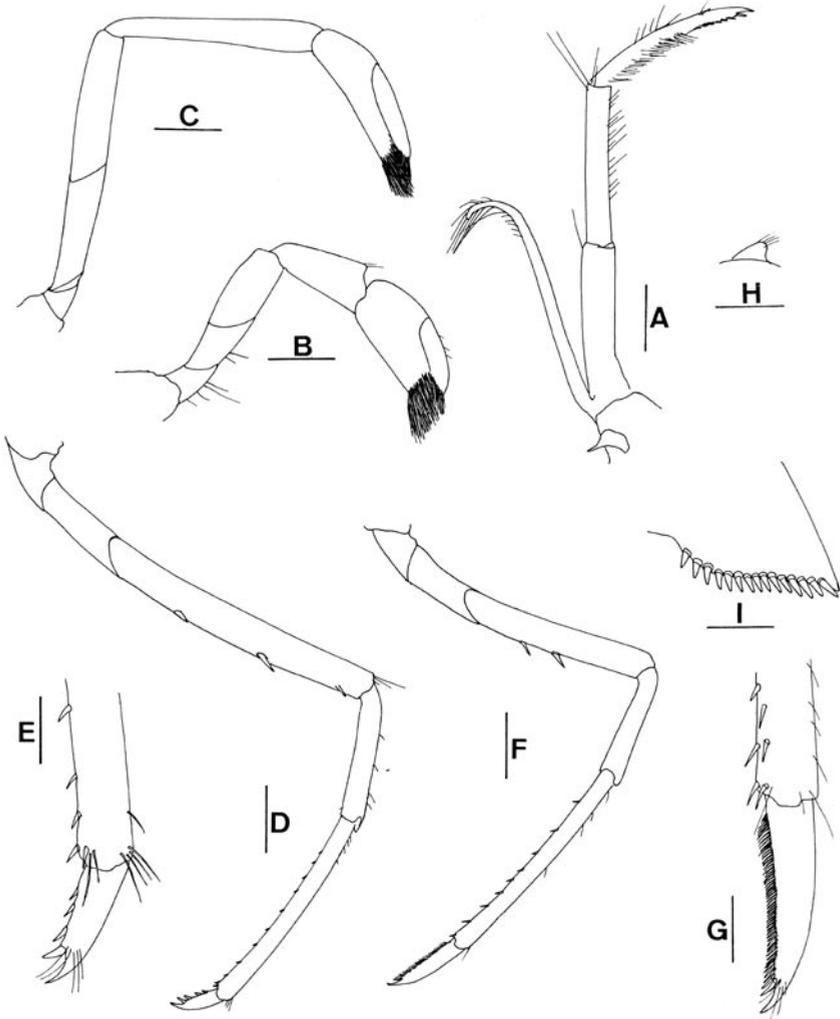


Fig. 11. — *Caridina minidentata* n. sp. (female, MZUF-2640). (A) third maxilliped; (B) first pereiopod; (C) second pereiopod; (D) third pereiopod; (E) same, dactylus; (F) fifth pereiopod; (G) same, dactylus; (H) preanal carina; (I) uropod, diaeresis. Scales: A-D, F, H = 0.5 mm; E, G, I = 0.2 mm.

*leytensis* Blanco 1939, and *C. celestinoi* Blanco 1939, both described from Leyte, Philippines. The new species differs from *C. leytensis* (cf. BLANCO 1939) by the shorter rostrum (failing to reach the end of the basal segment of the antennular peduncle vs reaching the middle of the second segment in *C. leytensis*), and the excavated carpus on the first pereopod (not excavated in *C. leytensis*). *C. minidentata* n. sp., can be separated from *C. celestinoi* (cf. BLANCO 1939) by the stouter carpus of the first pereopod (2.0 times as long as high vs 2.7 times in *C. celestinoi*) and by the anterior margin of being distinctly excavated (vs not excavated in *C. celestinoi*).

### Genus *Parisia* Holthuis 1956

#### *Parisia macrophora* n. sp. (Figs 12-14)

*Material examined.* Holotype: ovigerous female, cl 3.7 mm, MZUF-2458, Nalubog Cave, Quezon Province, Luzon, Philippines, coll. C. Ferron, 12 Apr. 1991. Paratypes: 4 males, cl 2.7-3.3 mm, MZUF-2641, same data as for holotype.

*Description.* Rostrum (Fig. 12A-D) very short, triangular, unarmed, reaching 2/3 of basal segment of antennular peduncle, antennal spine small, fused with inferior orbital angle. Pterygostomial margin broadly rounded.

Sixth abdominal somite 0.44 times as long as carapace, 1.5 times as long as fifth somite, slightly longer than telson. Telson (Fig. 13A) 2.4 times as long as wide, with 4 pairs of small dorsal spines and 1 posterior pair of dorso-lateral spines; posterior margin broadly convex, without median projection, with 5 pairs of simple spines or spiniform setae; lateral spines longer than intermediate spines, median spiniform setae and sublateral spines shortest. Preanal carina low, triangular, lacking spine (Fig. 13I).

Eyes reduced, with tiny cornea at anterior end, reaching only to 1/2 length of basal segment of antennular peduncle. Antennular peduncle (Fig. 12E) short, 0.4 times as long as carapace; basal segment of antennular peduncle as long as combined length of second and third segments; second segment distinctly longer than third segment; stylocerite reaching 0.6 length of basal segment of antennular peduncle. Scaphocerite (Fig. 12F) 2.2 times as long as wide.

Mandible (Fig. 12G) with incisor process bearing distally irregular teeth; molar process truncated. Maxillula (Fig. 12H) with lower lacinia broadly rounded; upper lacinia elongate, with distinct teeth on inner margin; palp slender. Maxilla (Fig. 12I) with upper endites subdivided; palp short, scaphognathite tapering, posteriorly with long, curved setae. First maxilliped (Fig. 12J) with palp terminating in short finger-like process. Second maxilliped (Fig. 12K) with ultimate segment of endopod attaching to lateral margin of penultimate segment. Third maxilliped (Fig. 12L) reaching to end of antennular peduncle; ultimate segment as long as penultimate segment.

Branchial formula as summarized in Table 1, with podobranch reduced to a simple lamella (r).

First pereopod (Fig. 13B) reaching to end of second segment of antennular peduncle; merus 3.6 times as long as broad, slightly shorter than carpus; carpus not excavated anteriorly, shorter than chela, 1.7 times as long as high; chela 2.0 time as long as broad; fingers distinctly longer than palm. Second pereopod (Fig.

Table 1.  
Branchial formula of *Parisia macrophora* n. sp.

	Maxillipeds			Pereiopods				
	1	2	3	1	2	3	4	5
Pleurobranch	-	-	-	+	+	+	+	+
Arthrobranch	-	-	+	-	-	-	-	-
Podobranch	-	r	-	-	-	-	-	-
Epipod	-	-	+	+	+	+	+	-
Exopod	+	+	+	-	-	-	-	-

r, podobranch reduced to a simple lamella.

13C) reaching to end of antennular peduncle; merus shorter than carpus, 6.6 times as long as broad; carpus 1.6 times as long as chela, 8.0 times as long as high; chela 3.0 times as long as broad; fingers 2.5 times as long as palm. Third pereiopod (Fig. 13D-E) reaching beyond end of scaphocerite, propodus distinctly longer than merus, 12 times as long as broad, 3.7 times as long as dactylus; dactylus 3.5 times as long as wide (spines included), with 5 accessory spines on flexor margin. Fifth pereiopod (Figs. 13F, 14B-D) reaching end of scaphocerite; propodus 4.4 times as long as dactylus; dactylus with 18-34 spinules on flexor margin.

First pleopod of male with endopod (Fig. 13G) rounded distally, 2.3 times as long as wide, reaching 0.25 length of exopod, without appendix interna. Second pleopod of male with appendix masculina (Fig. 13H) about 1/2 length of endopod; appendix interna reaching distal end of appendix masculina.

Uropod with diaeresis (Fig. 13J) bearing 9 small, movable spines. Ovigerous females with few eggs (8 in holotype, 0.9 × 0.6 mm in diameter, cf. Fig. 14A).

*Habitat.* Freshwater rivers in caves.

*Distribution.* Presently known only from the type-locality, Nalubog Cave, Quezon Province, Luzon, Philippines.

*Etymology.* The new species name, *macrophora*, is the combination of two Greek words, macro, large, and phora, bear or carry, alluding to the large-sized eggs carried by females of this species.

*Remarks.* The new species is placed to the genus *Parisia* on the basis of the branchial formula and the pleopods. HOLTHUIS (1956) established the genus *Parisia* for *Caridina*-like species lacking an arthrobranch on the first pereiopod. So far, six species of *Parisia*, have been reported from subterranean waters of Madagascar and Australia. The three species from Madagascar, originally assigned to *Parisia* by HOLTHUIS (1956): *P. microphthalmalma* (Fage 1946), the type-species, *P. edentata* Holthuis 1956, and *P. macrophthalmalma* Holthuis 1956, all occur in subterranean waters in total darkness. Their eyes are reduced; the cornea remains well pigmented in *P. macrophthalmalma*, but is reduced to a very small spot in *P. microphthalmalma* and *P. edentata*. Two more species, *P. gracilis* Williams 1964, and *P. unguis* Williams 1964, were described from a cave in the Northern Territory, Australia (WILLIAMS

1964), and GURNEY (1984) added one more species, *P. dentata*, to the subterranean fauna of Madagascar.

Because of the reduced eyes and the extremely short rostrum, *P. macrophora* appears to be closest to *P. edentata*, but differs by the slender carpus of the first pereiopod (1.7 times as long as high vs as long as high in *P. edentata*).

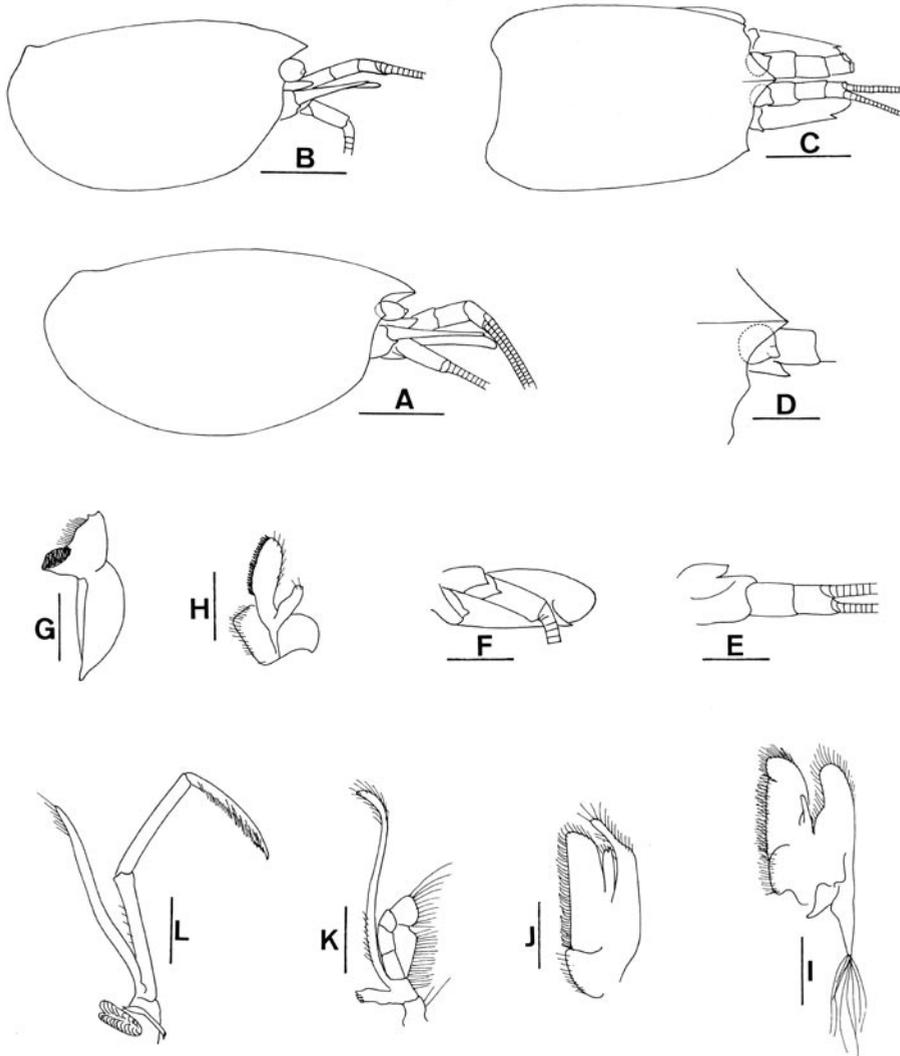


Fig. 12. — *Parisia macrophora* n. sp. (A, female, MZUF-2458; B-L, male, cl 3.3 mm, MZUF-2641). (A-C) cephalothorax and cephalic appendages, lateral view; (D) cephalothorax, anterior portion; (E) antennular peduncle; (F) scaphocerite; (G) mandible; (H) maxillula; (I) maxilla; (J) first maxilliped; (K) second maxilliped; (L) third maxilliped. Scales: A-C = 1 mm; D-L = 0.5 mm.

## Family Palaemonidae Rafinesque 1815

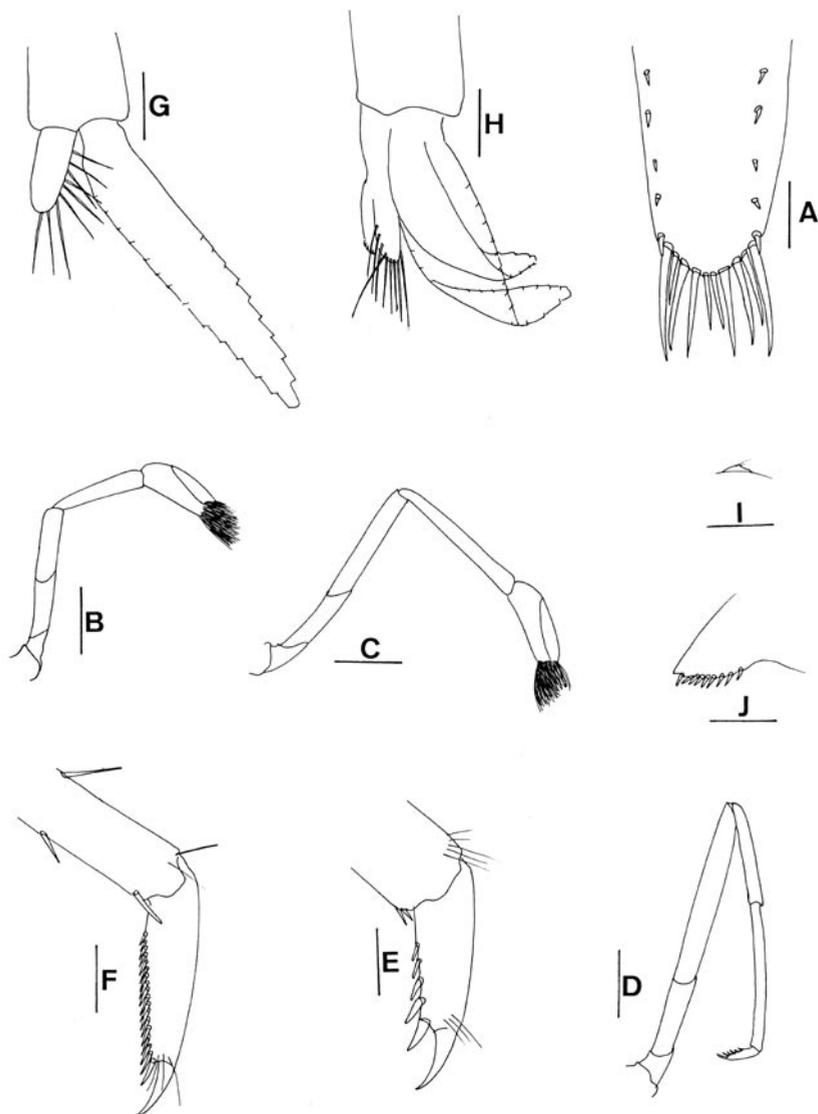
Genus *Macrobrachium* Bate 1868*Macrobrachium lar* (Fabricius 1798)*Palaemon Lar* WEBER 1795: 94 [nomen nudum].

Fig. 13. — *Parisia macrophora* n. sp. (male, cl 3.3 mm, MZUF-2641). (A) telson, distal portion; (B) first pereopod; (C) second pereopod; (D) third pereopod; (E) same, dactylus; (F) fifth pereopod, dactylus; (G) male first pleopod; (H) male second pleopod; (I) preanal carina; (J) uropod, diaeresis. Scales: A, E-H, J = 0.2 mm; B-D = 0.5 mm; I = 0.5 mm.

*Palaemon Lar* FABRICIUS 1798: 402 [type locality: in India Dom. Daldorf]. COWLES 1914: 380, pl. 2, fig. 7.

*Palaemon (Eupalaemon) lar*; DE MAN 1902: 774; 1905: 205, pl. 15, fig. 5; 1915: 415.

*Macrobrachium lar*; HOLTHUIS 1950: 176, fig. 37. CHACE & BRUCE 1993: 30, fig. 9. YEO et al. 1999: 236. CAI & NG 2001: 683, fig. 14e.

*Material examined.* One male, cl 10 mm, MZUF-2642, stream near Coron Town, Balisungan, Busuanga Island, Calamian group, Philippines, coll. R. Berti, 11 Mar. 1991.

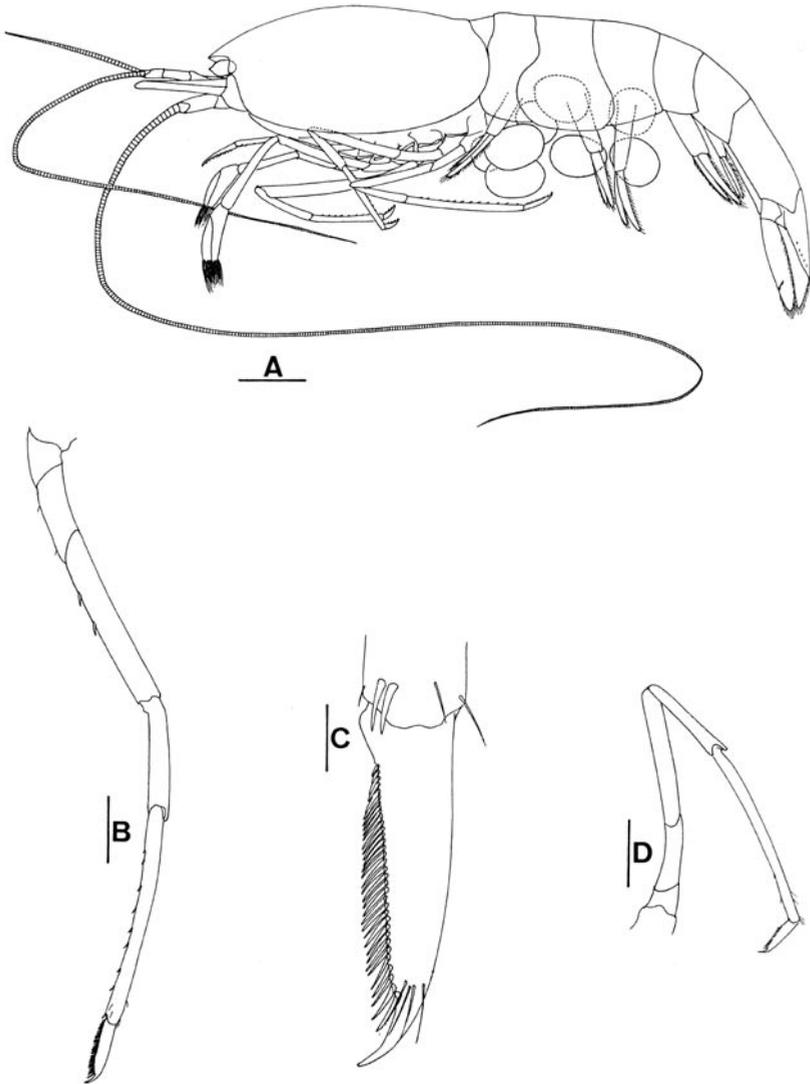


Fig. 14. — *Parisia macrophora* n. sp. (A-C, female, MZUF-2458; D, male, cl 3.3 mm, MZUF-2641). (A) whole body, lateral view; (B, D) fifth pereopod; (C) same as B, dactylus. Scales: A = 1 mm, B, D = 0.5 mm, C = 0.2 mm.

*Remarks.* *M. lar* is a well known species, widely distributed throughout the Indo-West Pacific (CHACE & BRUCE 1993).

***Macrobrachium equidens*** (Dana 1852)

*Palaemon equidens* DANA 1852: 26 [type locality: Singapore].

*Palaemon sundaicus*; COWLES 1914: 355, pl. 2, fig.3.

*Macrobrachium equidens*; HOLTHUIS 1950: 162, fig. 36; 1980: 90. CHACE & BRUCE 1993: 25, fig. 4. YEO et al. 1999: 226. CAI et al. 2004: 589.

*Material examined.* One male, cl 15.5 mm, 1 female, cl 15.8 mm. MZUF-2467, Pukaway Cave, Coron, Island, Philippines, coll. G. Messana, 24 Mar. 1991.

*Remarks.* *M. equidens* is a common brackish water species, widely distributed in the Indo-West Pacific, from Madagascar to the Solomon Islands (cf. CHACE & BRUCE 1993). Juveniles and younger adults are often found in mangrove creeks.

***Macrobrachium latidactylus*** (Thallwitz 1891)

*Palaemon latidactylus* THALLWITZ 1891: 97 [type locality: Sulawesi, Indonesia]; 1892: 17, fig. 3. COWLES 1914: 392, pl. 3, fig. 10.

*Palaemon (Macrobrachium) latidactylus*; DE MAN 1902: 805.

*Macrobrachium latidactylus*; HOLTHUIS 1950: 239, fig. 50. SHOKITA 1979: 275. CHACE & BRUCE 1993: 31, fig. 10. YEO et al. 1999: 236. CAI & NG 2001: 683, fig. 15a-i.

*Material examined.* Four males, cl 11.2-14.2 mm, 1 female, cl 14.0 mm, 2 ovigerous females, cl 10.0-12.0 mm, MZUF-2645, Tahabang River, Palawan Island, Philippines, coll. P.L. Tasselli, Aug. 1989.

*Remarks.* This species is widely distributed throughout the Indo-West Pacific, and has been reported from Sri Lanka, Indonesia, Malaysia, Thailand, Philippines, southern China, Taiwan and Ryukyu Islands (CHACE & BRUCE 1993).

***Macrobrachium australe*** (Guérin-Méneville 1838)

*Palaemon australis* GUÉRIN-MÉNEVILLE 1838: 37 [type locality: Tahiti, French Polynesia].

*Palaemon sundaicus* HELLER 1862: 415, pl. 2, figs 38-39 [type locality: Java, Indonesia].

*Palaemon dispar* VON MARTENS 1868: 41 [type locality: Pulau Adonara, east of Flores, Indonesia].

*Palaemon (Eupalaemon) dispar*; DE MAN 1902: 766.

*Macrobrachium australe*; HOLTHUIS 1950: 124, figs 27-30. CHACE & BRUCE 1993: 23, fig. 2. CAI & NG 2001: 683, figs 14a-d.

*Material examined.* Two ovigerous females, cl 12.8 mm, MZUF-2468, Tahabang River, Palawan Island, Philippines, coll. P.L. Tasselli, Aug. 1989.

*Remarks.* This species has a wide distribution range in the Indo-West Pacific, reaching from Madagascar to French Polynesia (CHACE & BRUCE 1993).

***Macrobrachium lepidactyloides*** (De Man 1892)

*Palaemon (Macrobrachium) lepidactyloides* DE MAN 1892: 497, pl. 29, fig. 51 [type locality: "Rakambaha", W Flores, Indonesia].

*Palaemon lepidactylus*; COWLES 1914: 389, pl. 3, fig. 9.

*Macrobrachium hirtimanus*; HOLTHUIS 1950: 245 (part), fig. 51a. SHY & YU, 1998: 29.

*Macrobrachium lepidactyloides* HOLTHUIS 1952: 210, pl. 15, fig. 2.

*Material examined.* One ovigerous female, cl 9.2 mm, 2 males, cl 10.2-17.2 mm, MZUF-2643, Tahabang River, Palawan Island, Philippines, coll. P.L. Tasselli, Aug. 1989.

*Remarks.* The larger male specimen, with a strongly inflated palm of the major second cheliped, clearly confirms the identity of the present specimens as *M. lepidactyloides*. So far this species has been reported from Taiwan, Philippines, Indonesia and Fiji.

Family Alpheidae Rafinesque 1815

Genus ***Potamalpheops*** Powell 1979

***Potamalpheops palawanensis*** n. sp. (Figs 15-16)

*Material examined.* Holotype: one female, cl 3.2 mm, MZUF-2465, St Paul Cave subterranean river, near cave entrance, Palawan, coll. G. Messana, 21 Feb. 1991. Paratype: female, cl 3.7 mm, MZUF-2644, same data as for holotype.

*Comparative material examined.* *Potamalpheops monodi* (Sollaud 1932): 3 specimens, MNHN-Na 13636, Porto Novo, Benin (labeled "Dahomey"), West Africa, Waterlot, 1910; *Potamalpheops amnicus* Yeo & Ng 1997: 1 male, MNHN-Na 13757, Sungai Kahang, Johore, Malaysia, in fresh water, Tar et al. coll., 11 Mar. 1998; *Potamalpheops johnsoni* Anker 2003: 1 specimen, MNHN-Na 13638, Sungei Mandai Kechil, Singapore, mangrove, D.C.J. Yeo & D.L. Rahayu, 10 Oct. 1999; *Potamalpheops tigger* Yeo & Ng 1997: 4 specimens, MNHN-Na 13642, Lim Chu Kang, Singapore, mangrove, coll. A. Anker, 16 Jan. 2001; *Potamalpheops pininsulae* Bruce & Iliffe 1992: 2 specimens, MNHN-Na 14249, Pindai Peninsula, west coast of New Caledonia, GPS 21°21,010'S 164°57,778'E, calcareous cave near the sea, in salt water, coll. L. Lemaire, May 2001; *Potamalpheops stygicola* (Hobbs 1973): 1 specimen, paratype, USNM 143630, Cueva del Nacimiento del Río San Antonio, 10 km SSW Acatlán, Oaxaca, Mexico, coll. J.R. Reddell et al. coll., 26 Dec. 1972 / 9 Mar. 1973; *Potamalpheops miyai* Yeo & Ng 1997: 1 male, cl 3.0 mm, URB, Surigao mangrove, Mindanao Island, Philippines, 25 Jul. 1985.

*Description.* Body laterally slightly compressed. Carapace smooth, dorsally somewhat inflated, glabrous, except for some sparse setae on post-rostral region. Rostrum (Fig. 15A-B) narrow, acute, moderately long, not reaching middle of basal segment of antennular peduncle, with a few inconspicuous setae on inferior margin. Extra-corneal teeth well developed, acute, infra-corneal angle anteriorly produced, rounded. Pterygostomian region rounded-angular; branchiostegial margin with several setae proximal to pterygostomian angle (Fig. 15A).

Major portion of eyes exposed in dorsal and lateral views; cornea well pigmented, occupying entire anterior and lateral portion of eyestalk (Fig. 15B). Antennular peduncle (Fig. 15D) relatively slender, elongate; stylocerite slightly exceeding

or not reaching distal margin of basal segment of antennular peduncle, tip acute; mesio-ventral carina with acute tooth (Fig. 15D); second segment approximately equal to first segment, about 1.5 times length of distal segment; outer flagellum biramous (Fig. 15D). Antenna slightly less robust than antennule; basicerite with strong, acute, ventro-lateral tooth (Fig. 15E); scaphocerite not reaching distal end of antennular peduncle, anterior margin convex, antero-lateral spine strong; car-pocerite shorter than scaphocerite and antennular peduncle.

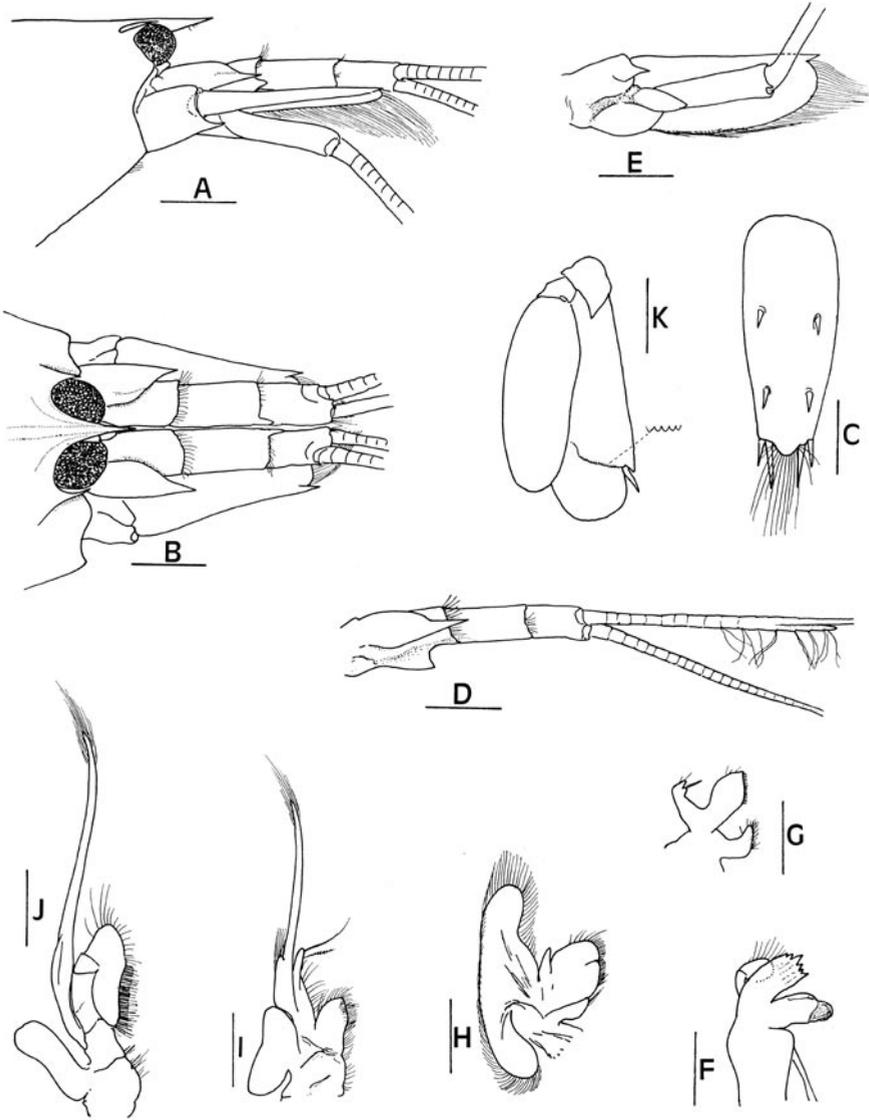


Fig. 15. — *Patamalpheops palawanensis* n. sp. (female, MZUF-2644). (A) frontal region, lateral view; (B) same, dorsal view; (C) telson; (D) antennular peduncle; (E) scaphocerite; (F) mandible; (G) maxillula; (H) maxilla; (I) first maxilliped; (J) second maxilliped; (L) uropod. Scales: A-K = 0.5 mm.

Mouthparts typical for *Potamalpheops*. Mandible (Fig. 15F) with 2-segmented palp; incisor process distally with 6 teeth. Maxillula, maxilla, first and second maxillipeds without specific features, as illustrated (Fig. 15G-J). Third maxilliped (Fig. 16A) slender; coxa with strap-like epipod and triangular lateral plate; ultimate segment setose, distally with 2-3 small spines; arthrobranch present.

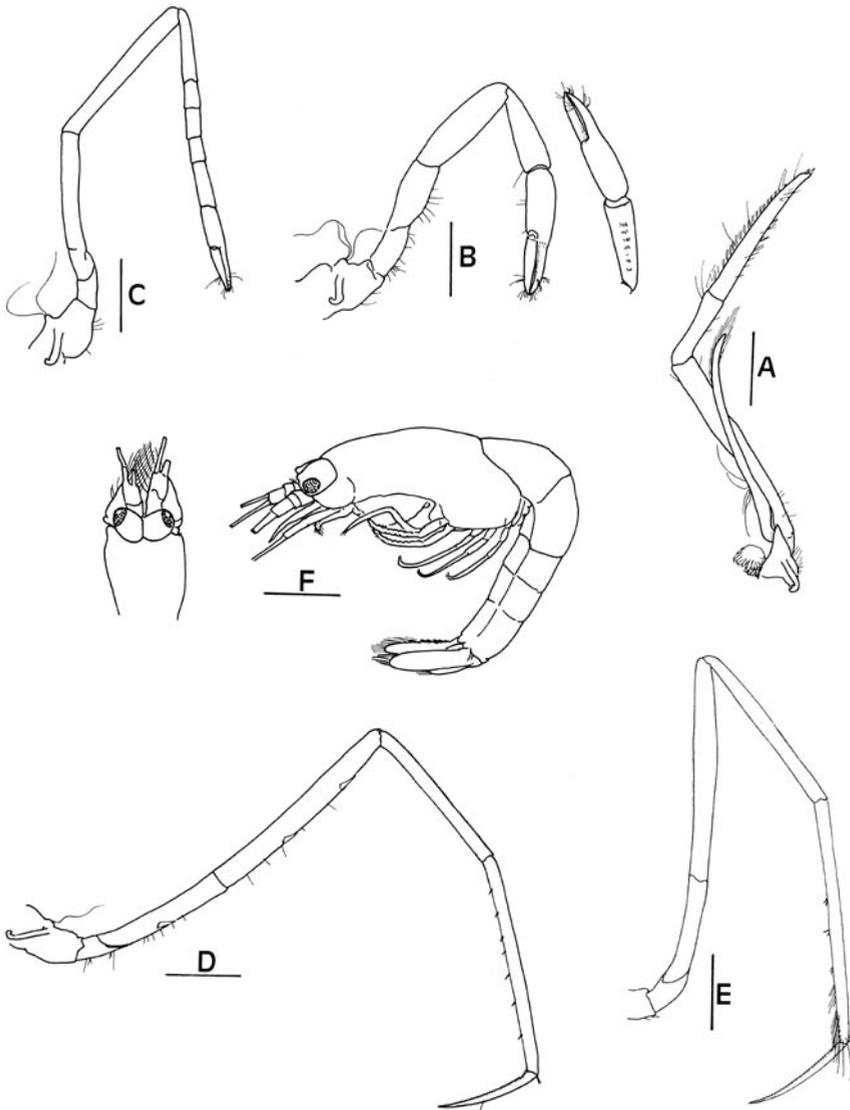


Fig. 16. — *Potamalpheops palawanensis* n. sp. (A-E, female, MZUF-2644; F, hatchling, same lot). (A) third maxilliped; (B) first pereiopod; (C) second pereiopod; (D) third pereiopod; (E) fifth pereiopod; (F) hatchling, lateral view. Scales: A-F = 0.5 mm.

First pereiopods (chelipeds, Fig. 16B) not enlarged, symmetrical in shape, equal in size; merus slightly longer than carpus; carpus cylindrical, mesially with several rows of setae (Fig. 16B); chela slender, slightly longer than carpus; fingers slightly shorter than palm, with cutting edges unarmed. Second pereiopod (Fig. 16C) slender; ischium and merus elongated; carpus 5-articulated, ratio of carpal articles approximately equal to (from proximal to distal): 3-1-1.2-1-2; chela slender, simple, as long as first carpal article.

Third pereiopod (Fig. 16D) slender; ischium armed with 1 spine, merus armed with 2 spines; carpus unarmed; propodus bearing 7 small spines on inferior margin and 1 distal pair of spines; dactylus simple, very slender, slightly curved, about 0.4 length of propodus. Fourth pereiopod similar to third. Fifth pereiopod (Fig. 16E) with ischium and merus unarmed; propodus bearing about 4 small spines or pairs of spines, distal portion with several rows of elongate setae; dactylus very slender, about 0.45 length of propodus.

Abdominal somites without specific features, sixth segment with articulated triangular plate at postero-ventral angle. Uropod with finely toothed diaeresis (at least 15 min teeth, Fig. 15K); lateral spine well developed. Telson (Fig. 15C) slightly less than 3.0 times as long as wide, with 2 pairs of dorsal spines; posterior margin with central portion convex, with 2 strong lateral spines at each angle, mesial spines much longer than lateral spines. Branchial formula typical for genus (cf. POWELL 1979): 5 pleurobranchs (P1-P5); 0 podobranch; 1 arthrobranch (Mxp3); 2 lobe-shaped epipods (Mxp1 and Mxp2); 5 strap-like epipods (mastigobranchs, Mxp3 + P1-P4); 5 sets of setobranchs (P1-P5), 3 exopods (Mxp1-Mxp3). Colour in life unknown.

*Habitat.* Subterranean freshwater river, near cave entrance. The former "St. Paul's Underground River National Park", now Puerto Princessa Subterranean River National Park, features spectacular limestone formations, estimated to be 16-20 million years old, with an underground river traversing the network of caves flowing out to the sea. The water chemistry of the St Paul Cave underwater river is complicated by tidal influence going up to 5 km inside the St Paul Cave (G. MESSANA pers. comm.). Thus the water salinity varies from pure freshwater to oligohaline or brackish. The Palawan cave biology and geology, including the complex water chemistry of several underground rivers, is described in MESSANA (1994) and PICCINI & ROSSI (1994).

*Distribution.* Presently known only from the type-locality, St Paul Cave, Palawan, Philippines.

*Etymology.* The new species name refers to the island of Palawan, where is situated the type-locality of this species.

*Remarks.* *P. palawanensis* n. sp. clearly belongs to *P. monodi* (Sollaud 1932) species group, characterized by the posterior margin of the telson bearing four spines (a pair at each postero-lateral angle) (POWELL 1979, YEO & NG 1997), the carapace lacking conspicuous grooves; the corneas well pigmented; and the mesial face of the carpus of the first pereiopod bearing rows of setae (A. ANKER pers. obs.). Within this group, the new species shows more or less strong affinities to seven species characterized by the "primitive" chelipeds that are not especially modified or enlarged, and have an elongate, cylindrical carpus. These species are: *P. miyai*

Yeo & Ng 1997, from mangroves of Pulau Bintan, Indonesia and Mindanao, Philippines (YEO & NG 1997, and present study); *P. pininsulae* Bruce & Iliffe 1992, from anchialine limestone caves of Île des Pins and Pindai, New Caledonia (BRUCE & ILIFFE 1992, A. ANKER pers. obs.); *P. tigger* Yeo & Ng 1997, from mangrove forests of Singapore and the Northern Territory, Australia (YEO & NG 1997, ANKER 2003); *P. johnsoni* Anker 2003, presently known only from mangrove forests of Singapore (ANKER 2003); *P. monodi* (Sollaud 1932), from tidal freshwater and mangrove habitats of West Africa (POWELL 1979); *P. amnicus* Yeo & Ng 1997, known only from freshwater streams in Singapore, Pulau Bintan, Indonesia and Johor, Malaysia (YEO & NG 1997); and *P. hanleyi* Bruce, 1991, from mangroves of the Northern Territory (BRUCE 1991).

*P. palawanensis* n. sp. may be distinguished from *P. miyai* by the much longer rostrum; the slightly different proportions of carpal articles of the second pereopod (3-1-1.2-1-2 vs 4.5-1-1-1-2.2 in *P. miyai*); the more slender dactylus on the third to fifth pereopods; and the narrower telson. Furthermore, *P. miyai* was collected from isolated brackish or saltwater pools on mangrove mud, left behind by receding tidal waters (YEO & NG 1997), while *P. palawanensis* n. sp. was found in freshwater, in a small river near the entrance to a cave. *P. palawanensis* n. sp. differs from *P. pininsulae* by the much smaller size (cl 3.2-3.7 mm vs cl around 7 mm in *P. pininsulae*); the carapace dorsally much less inflated; the rostrum shorter, not reaching distal 2/3 of the basal segment of the antennular peduncle, and without a small subapical tooth on the inferior margin (vs almost reaching distal margin of the basal segment and usually with such a subapical tooth in *P. pininsulae*); and the distal margin of the first segment of the antennular peduncle straight, not toothed (vs furnished with small teeth in *P. pininsulae*).

Among other species, *P. tigger* is immediately recognized by the straight, long rostrum, reaching almost to the middle of the second segment of the antennular peduncle, and the much more elongate stylocerite, overreaching the distal margin of the second segment of the antennular peduncle. These two features clearly separate *P. palawanensis* n. sp. from *P. tigger*. *P. johnsoni*, differs from most other species of *Potamalpheops*, including *P. palawanensis* n. sp. by the long, elevated rostrum bearing subdistally one or several teeth on the inferior margin. Both *P. amnicus* and *P. monodi* differ from *P. palawanensis*, n. sp., by the very short, broadly triangular rostrum, and the eyestalks bearing conspicuous, elongate setae on the mesio-anterior margin. Finally, *P. hanleyi* differs from the new species by the presence of small anal tubercles on the telson, the shorter scaphocerite, and the less slender dactylus on the third to fifth pereopods.

The lot with the two *Potamalpheops* specimens also contained about 15 hatchlings, which obviously belong to the same species (Fig. 16F). Similar-looking zoeal stages were described for *Athanas dimorphus* Ortmann 1894 (BHUTI et al. 1977). Therefore, these hatchlings could represent a fourth or fifth zoeal stage of *P. palawanensis* n. sp.

With the new species described above, the genus *Potamalpheops* now contains 12 species (cf. POWELL 1979; HOBBS 1983; BRUCE 1991, 1993; YEO & NG 1997; ANKER 2003); one West African species remains undescribed (see addendum in POWELL 1979), and a further undescribed species has been collected in Sri Lanka (A. ANKER in prep.).

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## REFERENCES

- ANKER A. 2003. Alpheid shrimps from the mangroves and mudflats of Singapore. Part 1. Genera *Salmoneus*, *Athanas* and *Potamalpheops*, with the description of two new species (Crustacea; Decapoda; Caridea). *Raffles Bulletin of Zoology* 51 (2): 283-314.
- BALETE D.S. & HOLTHUIS L.B. 1992. Notes on the cave shrimp *Edoneus atheatus* Holthuis, 1978, with an account of its type locality and habits (Decapoda, Caridea, Atyidae). *Crustaceana* 62 (1): 98-101.
- BATE C.S. 1868. On a new genus, with four new species of freshwater prawns. *Proceedings of the Zoological Society of London*, 363-368, pls 30-31.
- BHUTI G.S., SHAKUNTALA S. & SANKOLLI K.N. 1977. Laboratory reared alpheid larvae of the genera *Automate*, *Athanas* and *Synalpheus* (Crustacea, Decapoda, Alpheidae). *Proceedings, Symposium on Warm Water Zooplankton (Special Publication) UNESCO/NIO*: 588-600.
- BLANCO G.J. 1935. The Atyidae of the Philippines Islands. *Philippine Journal of Science* 56 (1): 29-39, pls 1-3.
- BLANCO G.J. 1939. Four new Philippine species of fresh-water shrimps of the genus *Caridina*. *Philippine Journal of Science* 70 (4): 389-395, pls 1-3.
- BOUVIER E.L. 1905. Observations nouvelles sur les (crevettes de la famille des Atyidés). *Bulletin Scientifique de la France et de la Belgique* 39: 55-134.
- BOUVIER E.L. 1925. Recherches sur la morphologie, les variations, la distribution géographique des crevettes de la famille des Atyidés. *Encyclopédie Entomologique* 4 (A): 1-370, figs 1-761.
- BRUCE A.J. 1991. The "African" shrimp genus *Potamalpheops* in Australia, with the description of *P. hanleyi*, new species (Decapoda: Alpheidae). *Journal of Crustacean Biology* 11 (4): 629-638.
- BRUCE A.J. 1993. *Potamalpheops darwiniensis* (Crustacea, Decapoda, Alpheidae), the third Indo-West Pacific species. *Proceedings of the Biological Society of Washington* 106 (4): 698-704.
- BRUCE A.J. & ILIFFE T.M. 1992. *Potamalpheops pininsulae* sp. nov., a new stygophilic shrimp from New Caledonia (Crustacea: Decapoda: Alpheidae). *Stylogia* 87 (4): 231-242.
- CAI Y. & NG P.K.L. 2001. Freshwater decapods of Halmahera, Indonesia. *Journal of Crustacean Biology* 21 (3): 665-695.
- CAI Y., NAIYANTR P. & NG P.K.L. 2004. The Freshwater Prawns of the genus *Macrobrachium* Bate, 1868 (Crustacea: Decapoda: Palaemonidae) of Thailand. *Journal of Natural History* 38: 581-649.

- CHACE F.A. JR 1983. The *Atya*-like shrimps of the Indo-Pacific Region (Decapoda: Atyidae). *Smithsonian Contributions to Zoology* 384: i-iii, 1-54.
- CHACE F.A., JR 1997. The Caridean shrimps (Crustacea: Decapoda) of the Albatross Philippine expedition 1907-1910. Part 7: Families Atyidae, Eugonatonotidae, Rhynchocinetidae, Bathypalaemonellidae, Processidae, and Hippolytidae. *Smithsonian Contributions to Zoology* 587: I-V, 1-106.
- CHACE F.A. JR & BRUCE A.J. 1993. The Caridean shrimps (Crustacea: Decapoda) of the Albatross Philippine expedition 1907-1910. Part 6: Superfamily Palaemonoidea. *Smithsonian Contributions to Zoology* 543: I-VII + 1-152.
- COWLES R.P. 1914. Palaemons of the Philippine Islands. *Philippine Journal of Sciences* (D) 9 (4): 319-403, pls 1-3.
- DANA J.D. 1852. Crustacea, Part 1. In: United States Exploring Expedition during the years 1838, 1839, 1840, 1841, 1842, under the Command of Charles Wilkes, U.S.N., 13: 1-685. Atlas (1855): 1-27, pls 1-96. *Philadelphia*.
- DE MAN J.G. 1892. Decapoden des Indischen Archipels. In: Weber M., Edit. *Zoologische Ergebnisse einer Reise in Niederländisch Ost-Indien* 2: 265-527, pls 15-29.
- DE MAN J.G. 1902. Die von Herrn Professor Kükenthal in Indischen Archipel gesammelten Dekapoden und Stomatopoden. In: W. Kükenthal, Ergebnisse einer zoologischen Forschungsreise in den Molukken und Borneo. *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft* 25 (3): 467-929, pls 18-20.
- DE MAN J.G. 1905. Synonymical remarks about *Palaemon neglectus* nov. nom. and *Palaemon reunionnensis* Hoffm. *Notes from the Leyden Museum* 26: 201-205, pl. 15.
- DE MAN J.G. 1915. Macrura. In: Zur Fauna von Nord-Neuguinea, nach den Sammlungen von Dr. P.N. van Kampen und K. Gjellerup in den Jahren 1910-1911. *Zoologische Jahrbücher Abteilung für Systematik, Geographie und Biologie der Tiere* 38 (6): 385-458, pls 27-29.
- EDMONDSON C.H. 1954. Substitute for an invalid generic name in the Crustacea. *Pacific Science*, 8: 368.
- FABRICIUS J.C. 1798. Supplementum Entomologiae Systematicae. *Hafniae*, 527 pp.
- FAGE L. 1946. Sur une Caridine nouvelle cavernicole de Madagascar, *Caridina microphthalma* nov. sp. *Bulletin du Muséum National d'Histoire Naturelle, Paris* 18: 324-327.
- FUJINO T. & SHOKITA S. 1975. Report on some new atyid shrimps (Crustacea, Decapoda, Caridea) from the Ryukyu Islands. *Bulletin of Science & Engineering Division, University of the Ryukyus, Mathematics & Natural Sciences* 18: 93-113.
- GUÉRIN-MÉNEVILLE F.E. 1829-1838. Crustacés, Arachnides et Insectes. In: Duperrey L.J., Edit. Voyage autour du monde, exécuté par ordre du Roi, sur la corvette de Sa Majesté, La Coquille, pendant les années 1822, 1823, 1824 et 1825. *Zoologie* 2 (n. 2, sect. 1): 1-47 (Crustacés), 48-319 (Arachnides et Insectes); pls 1-5 (Crustacés), 1-21 (Insectes). *Paris: Arthus Bertrand*.
- GURNEY A.R. 1984. Freshwater shrimps genera *Caridina* and *Parisia* (Decapoda: Caridea: Atyidae) of Madagascar, with description of four new species. *Journal of Natural History* 18: 567-590.
- HELLER C. 1862. Beiträge zur näheren Kenntniss der Macrouren. *Sitzungsberichte der Akademie der Wissenschaften in Wien* 45 (1): 389-426, pls 1-2.
- HOBBS H.H. JR 1983. The African shrimp genus *Potamalpheops* in Mexico (Decapoda: Alpheidae). *Crustaceana* 44 (2): 221-224.
- HOLTHUIS L.B. 1950. Subfamily Palaemonidae. The Palaemonidae collected by the Siboga and Snellius Expeditions with remarks on other species. I. The Decapoda of the Siboga Expedition. Part X. *Siboga Expeditie* 39 (a9): 1-268.
- HOLTHUIS L.B. 1952. On some Indo-West Pacific Palaemonidae (Crustacea Decapoda Caridea). *Zoologische Mededelingen, Leiden* 31 (18): 201-211, pl. 15.
- HOLTHUIS L.B. 1965. The Atyidae of Madagascar. *Mémoires du Muséum National d'Histoire Naturelle (A, Zoologie)* 33 (1): 1-48.
- HOLTHUIS L.B. 1978. Zoological results of the British speleological expedition to Papua New Guinea 1975. 7. Cavernicolous shrimps (Crustacea, Decapoda, Natantia) from New Ireland and the Philippines. *Zoologische Mededelingen* 53 (19): 209-224.

- HOLTHUIS L.B. 1980. FAO species catalogue, vol. Shrimps and prawns of the world, an annotated catalogue of species of interest to fisheries. *FAO Fisheries Synopsis* 125 (1): 1-271.
- JOHNSON D.S. 1962. On a new species of *Macrobrachium* (Decapoda, Caridea). *Crustaceana* 4 (4): 307-310.
- KEMP S. 1918. Decapod and Stomatopod Crustacea. In: Annandale N. Zoological Results of a Tour in the Far East. *Memoirs of the Asiatic Society of Bengal* 6: 217-297.
- MESSANA G. 1994. Cap. 6 — Biologia / Chapter 6 — Biology, pp. 56-60. In: Piccini L. & Rossi G., Edits. Le esplorazioni speleologiche italiane nell'isola di Palawan, Filippine. / Italian caving exploration in the island of Palawan, Philippines. *Speleologia* 31: 5-61.
- MILNE EDWARDS H. 1837. Histoire naturelle des Crustacés, comprenant l'anatomie, la physiologie et la classification de ces animaux. *Paris*, 2: 1-532, Atlas, pls 1-14, 14bis, 15-25, 25bis, 26-42.
- NEWPORT G. 1847. Note on the genus *Atya* of Leach, with descriptions of four apparently new species, in the cabinets of the British Museum. *Annals and Magazine of Natural History* 19: 158-160, pl. 8.
- PICCINI L. & ROSSI G. 1994. Le esplorazioni speleologiche italiane nell'isola di Palawan, Filippine. / Italian caving exploration in the island of Palawan, Philippines. *Speleologia* 31: 5-61.
- POWELL C.B. 1979. Three Alpheid shrimps of a new genus from West African fresh and brackish waters: taxonomy and ecological zonations (Crustacea Decapoda Natantia). *Revue de Zoologie Africaine* 93 (1): 116-150.
- RANDALL J.W. 1840. Catalogue of the Crustacea brought by Thomas Nuttall and J.K. Townsend, from West Coast of north America and the Sandwich islands, with descriptions of such species as are apparently new, among which are included several species of different localities, previously existing in the collection of academy. *Journal of the Academy of Natural Science, Philadelphia*, 8: 106-147, pls 3-7.
- RIEK E.F. 1953. The Australian freshwater prawns of the family Atyidae. *Records of the Australian Museum* 23 (3): 111-121.
- ROUX J. 1926. Crustacés décapodes d'eau douce de la Nouvelle-Calédonie. In: Sarasin F. & Roux J., Edits. Nova Caledonia, Zoologie, 4 (2): 181-240. *München: C.W. Kreidel's Verlag*.
- SHOKITA S. 1979. The distribution and speciation of the inland water shrimps and prawns from the Ryukyu Islands II. *Bulletin of the College of Science, University of the Ryukyus* 28: 193-278.
- SHY J.Y. & YU H.P. 1998. Freshwater shrimps of Taiwan. *National Museum of Marine Biology and Aquarium*, 103 pp.
- SKET B. 1997. Hypogean aquatic fauna in Bohol Island, Philippines. Our Caves. *Bulletin of Speleological Association of Slovenia* 39: 62-67.
- SOLLAUD E. 1932. Sur un alphéidé d'eau douce, *Alpheopsis monodi* n. sp., recueilli par M.Th. Monod au Cameroun. *Bulletin de la Société Zoologique de France* 57: 375-386.
- THALLWITZ J. 1891. Ueber einige neue indo-pacifische Crustaceen (vorläufige Mittheilung). *Zoologischer Anzeiger* 14: 96-103.
- THALLWITZ J. 1892. Decapoden-Studien, insbesondere basiert auf A.B. Meyers Sammlungen im Ostindischen Archipel, nebst einer Aufzählung der Decapoden und Stomatopoden des Dresdener Museums. *Abhandlungen und Berichte des Königlichen Zoologischen und Anthropologisch-Ethnographischen Museums zu Dresden* 1890-91 (3): 1-55, pl. 1.
- VON MARTENS E. 1868. Ueber einige ostasiatische Süßwasserthiere. *Archiv für Naturgeschichte* 34 (1): 1-67, pl. 1.
- WEBER F. 1795. Nomenclator entomologicus secundum Entomologiam systematicam ill. Fabricii adjectis speciebus recens detectis et varietatibus, I-VIII, 1-171.
- WILLIAMS W.D. 1964. Subterranean freshwater prawns (Crustacea: Decapoda: Atyidae) in Australia. *Australian Journal of Marine and Freshwater Research*, 15: 93-106.
- YEO D.C.J. & NG P.K.L. 1997. The alpheid shrimp genus *Potamalpheops* Powell, 1979, (Crustacea: Decapoda: Caridea: Alpheidae) from Southeast Asia, with descriptions of three new species. *Journal of Natural History* 31 (2): 163-190.
- YEO D.C.J., CAI Y. & NG P.K.L. 1999. The freshwater and terrestrial Decapod Crustacea of Pulau Tioman, Peninsular Malaysia. *Raffles Bulletin of Zoology (Suppl.)* 6: 190-244.