

Two new species of *Gigantione* Kossmann, 1881 (Crustacea: Isopoda: Bopyridae) from Beibu Gulf

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Abstract.—Two new species of the parasitic isopod genus *Gigantione* Kossmann, 1881 are described infesting the goneplacid crab *Notonyx musappocenta* Clark & Ng, 2011. The new species (*G. tuberculata* and *G. notonyxae*) can be distinguished from other described species by their males having mid-ventral projections on the first three pleomeres. *Gigantione tuberculata* differs from *G. rhombos* An, Yu & Markham, 2009, *G. tau*, An, Yu & Markham, 2009, and *G. giardi* Nobili, 1906 in characters of the barbula, shape of the head of the female and uropods and antennae of the male. Females of *G. notonyxae* differ from *G. pratti* Danforth, 1967 in the dorsolateral bosses, oostegite 1 and coxal plates. In addition, females of *G. notonyxae* differ from those of *G. tuberculata* in possessing smooth coxal and lateral plates. This is the first report of *N. musappocenta* bearing any parasitic isopods. The hosts and localities of 18 species of *Gigantione* are summarized and a key to the species is provided.

Keywords: Beibu Gulf, Bopyridae, *Gigantione*, new species

Gigantione Kossmann, 1881 contains 16 previously described species (An et al., 2009). Among them, three species infest axiid hosts whereas the others infest brachyuran hosts from six families: Carpiliidae, Dromiidae, Euryplacidae, Goneplacidae, Pilumnidae, and Xanthidae. Kossmann (1881) erected the genus *Gigantione* with *G. moebii* Kossmann, 1881 from Mauritius infesting *Neoxanthias impressus* (Latreille in Milbert, 1812). Subsequently, Bourdon (1969, 1972) reported this species infesting *Xanthias punctatus* (H. Milne-Edwards, 1834) and unidentified crabs from Africa and Mauritius and provided a detailed redescription. Adkison (1984) and Markham (1994) presented new generic diagnoses of the genus and along

with several other authors (see Table 1) described 15 additional species from localities including the Gulf of Mexico, New Zealand, Solomon Islands, Eniwetok Atoll, Japan, Hawaii, Azores, South China Sea and East China Sea (Table 1).

Taxonomic problems remain among some of the known species, particularly in the descriptions of *G. bouvieri* Bonnier, 1900 (which lacked illustrations to accompany the original description, but the species was briefly figured in Monod, 1932), and *G. giardi* Nobili, 1906 (see remarks by Danforth 1967). Shiino (1952, 1965) and Markham (1974, 1999) speculated that *Gigantione* represents a primitive branchial bopyrid. Markham (1994) and Page (1985) considered the genus most closely related to *Ionella* Bonnier, 1900. However, molecular data is lacking on the phylogenetic position of the genus (Boyko

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Table 1.—Hosts and localities of the 18 species of *Gigantione*Kossmann, 1881.

Species	Type host	Type host family	Type locality	Other hosts (family)	Other localities	Reference
<i>G. bouvieri</i> Bonnier, 1900	<i>Pilumnus inermis</i> A. Milne- Edwards & <i>Bouvier, 1894</i>	Pilumnidae	Azores	<i>Hypoconcha</i> sp. (Dromiidae)	Indian	Bonnier, 1900 Nierstrasz & Brender à Brandis, 1931
<i>G. elconaxii</i> Markham, 1994	<i>Eiconaxius</i> sp. Spence Bate, 1888	Axiidae	New Caledonia	-	-	Markham, 1994
<i>G. giardi</i> Nobili, 1906	<i>Juxtaxanthias</i> <i>tetraodon</i> (Heller, 1862)	Xanthidae	Tuamotu Islands	-	-	Nobili, 1906
<i>G. hainanensis</i> An et al., 2009	<i>Atergatis floridus</i> (Linnaeus, 1767)	Xanthidae	Hainan, China	-	-	An et al., 2009
<i>G. hawaiiensis</i> Danforth, 1967	<i>Macromedaeus</i> <i>crassimanus</i> (A. Milne-Edwards, 1867)	Xanthidae	Oahu Island; Hawaii, USA	-	-	Danforth, 1967
<i>G. ishigakiensis</i> Shiino, 1941	<i>Carpilius convexus</i> (Forskål, 1775)	Carpiliidae	Ishigaki-jima, Japan	<i>Liaogore rubromaculata</i> (De Haan, 1835) (Xanthidae)	South China Sea	Shiino, 1941 An et al., 2009
<i>G. moebii</i> Kossmann, 1881	<i>Neoxanthias</i> <i>impressus</i> (Latreille in Milbert, 1812)	Xanthidae	Mauritius	Unidentified crab; <i>Xanthias punctatus</i> (H. Milne-Edwards, 1834) (Xanthidae)	Africa	Kossmann, 1881 Bourdon, 1969 Bourdon, 1972
<i>G. mortensenii</i> Adkison, 1984	<i>Moreiradromia</i> <i>antillensis</i> (Stimpson, 1858)	Dromiidae	Gulf of Mexico	<i>Hypoconcha parasitica</i> (Linnaeus, 1763) (Dromiidae)	-	Adkison, 1984 Rathbun, 1933
<i>G. notonyxae</i> n. sp.	<i>Notomyx</i> <i>musappacenta</i> Clark & Ng, 2011	Goneplacidae	Beibu Gulf	<i>Hypoconcha spinosissima</i> (Dromiidae)	-	Present paper
<i>G. petalomerae</i> Markham, 1999	<i>Petalonera pulchra</i> Miers, 1884	Dromiidae	Chesterfield Islands	-	-	Markham, 1999

Table 1.—Continued.

Species	Type host	Type host family	Type locality	Other hosts (family)	Other localities	Reference
<i>G. pikei</i> Page, 1985	<i>Axiopsis</i> Borradaile, 1903	Axiidae	New Zealand	-	-	Page, 1985
<i>G. pratti</i> Danforth, 1967	<i>Phymodatus</i> <i>ungulatus</i> (H. Milne Edwards, 1834)	Xanthidae	Eniwetok Atoll	-	-	Danforth, 1967
<i>G. rathbunae</i> Siebbing, 1910	<i>Actaea polyacantha</i> (Heller, 1861)	Xanthidae	Solomon Islands	-	-	Siebbing, 1910
<i>G. rhombos</i> An et al., 2009	<i>Eucrate acocki</i> Seïène in Seïène & Lohavanijaya, 1973	Euryplacidae	South China Sea	-	-	An et al., 2009
	<i>Heteroplax</i> <i>dentata</i> Stimpson, 1858	Xanthidae	Sagami Bay, Japan	-	-	Shiino, 1958
<i>G. sagamensis</i> Shiino, 1958	<i>Actiamera</i> <i>bonnensis</i> (Odhner, 1925)	Xanthidae	Sagami Bay, Japan	-	-	Shiino, 1958
<i>G. tau</i> An et al., 2009	<i>Carcinoplax</i> <i>longimanus</i> (De Haan, 1833)	Goneplacidae	East China Sea	-	-	An et al., 2009
<i>G. tuberculata</i> n. sp.	<i>Notonyx</i> <i>musappocenta</i> Clark & Ng, 2011	Goneplacidae	Beibu Gulf	-	-	Present paper
<i>G. uberlackerae</i> Adkison, 1984	<i>Paraxiopsis</i> de Man, 1905	Axiidae	Gulf of Mexico	-	-	Adkison, 1984

et al. 2013). Among the bopyrids that parasitize brachyuran hosts (~330 species), the Keponinae harbor the most diversity; however, *Gigantione* is the most diverse genus parasitizing brachyurans within subfamily Pseudioninae Codreanu, 1967 (Shields et al. 2015).

Following up on previous work on *Gigantione* spp. from Beibu Gulf (An 2009, An et al. 2009), new examination of two specimens of goneplacids has led to the finding of two new species in this genus, *Gigantione* now includes 18 species (Table 1). A key to the species of *Gigantione* is presented to facilitate identification.

Key to 18 species of *Gigantione* Kossmann, 1881 (Characters from females and males)

- 1a. Head extended laterally into anterolateral flaps 2
- 1b. Head not extended into anterolateral flaps 14
- 2a. Lateral plates of the pleon bilaterally symmetrical 3
- 2b. Lateral plates of the pleon bilaterally asymmetrical 4
- 3a. Male with biramous uropods *G. bouvieri* Bonnier, 1900
- 3b. Male with uniramous uropods *G. petalomerae* Markham, 1999
- 4a. Lateral plates with tuberculate or serrate margins 5
- 4b. Lateral plates with smooth margins 8
- 5a. Head with "T" shaped pigmentation on dorsal surface *G. tau* An, Yu & Markham, 2009
- 5b. Head without pigmentation on dorsal surface 6
- 6a. Barbula with rhombic projection in center *G. rhombos* An, Yu & Markham, 2009
- 6b. Barbula without rhombic projection in center 7
- 7a. All pereomeres distinct *G. tuberculata* n. sp.
- 7b. Pereomeres 2–4 fused medially *G. giardi* Nobili, 1906
- 8a. Posterior margin of the head bilobed... *G. hawaiiensis* Danforth, 1967
- 8b. Posterior margin of the head entire... 9
- 9a. Barbula with one pair of lateral projections *G. moebii* Kossmann, 1881
- 9b. Barbula with one pair of lateral projections and some smaller extensions 10
- 10a. Uropods of male terminally pointed, male with uniramous pleopods 11
- 10b. Uropods of male terminally bifid, male with biramous pleopods.... 12
- 11a. Bases of lateral plates of short side wider than those of long side *G. hainanensis* An, Yu & Markham, 2009
- 11b. Bases of lateral plates of two sides equal *G. ishigakiensis* Shiino, 1941
- 12a. Male with complex spine on the pereopods *G. mortensenii* Adkison, 1984
- 12b. Male without complex spine on the pereopods 13
- 13a. Oostegite 1 with round posterior margin *G. notonyxae* n. sp.
- 13b. Oostegite 1 with flat and concave posterior margin..... *G. pratti* Danforth, 1967
- 14a. Body almost symmetrical 15
- 14b. Body asymmetrical 17
- 15a. Head trapezoidal, nearly equal in length and width *G. elconaxii* Markham, 1994
- 15b. Head rectangular or suboval, wider than long 16
- 16a. Head with anteromedial notch *G. uberlackerae* Adkison, 1984
- 16b. Head with entire anterior margin *G. pikei* Page, 1985
- 17a. Female with black eyes, lateral plates smooth *G. rathbunae* Stebbing, 1910
- 17b. Female without eyes, lateral plates tuberculate..... *G. sagamiensis* Shiino, 1958

Material and Methods

Materials for this study originated from the China/Vietnam Comprehensive Oceanographic Survey of Beibu Gulf (1962). All materials examined have been deposited in the Institute of Oceanology, Chinese Academy of Sciences, Qingdao, China (IOCAS). Animals were viewed and drawn using a Zeiss Stemi SV Apo microscope. Taxonomic authorities and dates for hosts are provided in text but not cited in References. This work has been registered in ZooBank with the registration number [EE21E659-254F-47C0-9AB6-A635D8368A93]

Systematic account

Family BOPYRIDAE Rafinesque, 1815
Subfamily Pseudioninae Codreanu, 1967

Genus *Gigantione* Kossmann, 1881

Type species: *Gigantione moebii*
Kossmann, 1881, original designation

Gigantione tuberculata n. sp.

Fig. 1

Material examined.—Infesting right branchial chamber of *Notonyx musappunctata* Clark & Ng, 2011. Det. of host, Wei Jiang. Holotype: CIEG750201, 1♀, Beibu Gulf, Stn. 7502, 19°30'N, 106°30'E, 32 m, 15Apr.1962. Allotype: CIEG750202, 1♂, same data as holotype.

Description of holotype.—Length 4.28 mm, maximal width 3.74 mm, head length 1.14 mm, head width 1.33 mm, pleon length 1.43 mm. All body regions and segments distinct, no pigmentation (Fig. 1A).

Rectangular head, wider than long, with prominent frontal lamina. Head extending into pair of anterolateral flaps; eyes absent (Fig. 1A). Antennule of three articles, antenna of six articles, terminally setose (Fig. 1B). Maxilliped subrectangular, without palp, anterior article much larger than posterior, with minute setae on margin (Fig. 1C). Barbula with pair of long

pointed falcate lateral projections on each side, two small projections encircled by lateral projections, and low rounded projection in center (Fig. 1D).

Pereon broadest across third pereomere (Fig. 1A). Coxal plates of left side much longer than those on right side. Dorsal surface of coxal plates with small tubercles, margin somewhat dentate. Round dorsolateral bosses on first six pereomeres of right side, only on first four pereomeres of left side. Oostegites completely enclosing brood pouch. First oostegite (Fig. 1E, F) with subequal anterior and posterior articles, deep groove separating articles externally, internal ridge bearing 5 projections, posterolateral point absent. Pereopods with blunt dactyli (Fig. 1G, H), all pereopods of same structure but slightly larger posteriorly.

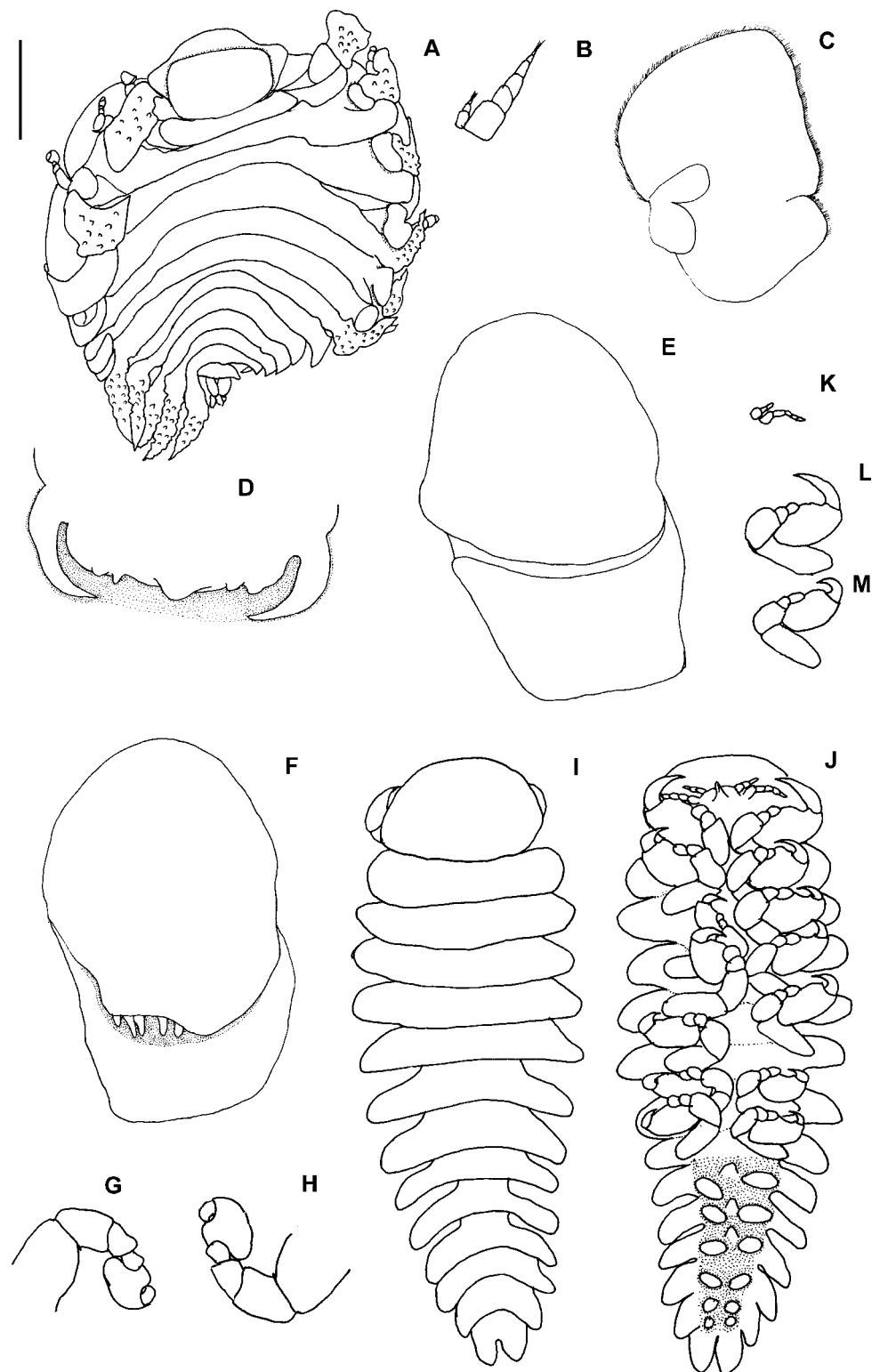
Pleon of six pleomeres, all bearing biramous pleopods and lateral plates, sixth pleomere with short lateral plates. Pleon asymmetrical with lateral plates on left side tuberculate on the dorsal surface, and much longer than those on the right side. Lateral plates on the right side smooth and short. Pleopods tuberculate, asymmetrical, those on left side much longer than those on right side, and exopodite larger than endopodite. Biramous uropods with cylindrical protopodite and two rod-shaped rami.

Description of allotype.—Length 1.96 mm, maximal width across pereomere 4, 0.78 mm, head length 0.37 mm, head width 0.63 mm. All body regions and segments distinctly (Fig. 1I, J).

Ellipsoidal head, without eyes. Short antennule of 3 articles, not observable dorsally, antenna of 5 articles (Fig. 1K).

Pereomeres without midventral projections (Fig. 1J). Dactyli of first pereopod about twice as long as those of subsequent pereopods (Fig. 1L, M).

Pleon of six pleomeres, first five with conspicuous uniramous pleopods, first three pleomeres with midventral projec-



tions (Fig. 1J). Sixth pleomere with broad uniramous uropods.

Etymology.—The specific name *tuberculata* refers to the allotype male with mid-ventral projections on the first three pleomeres.

Remarks

Among the 16 previously described species, only three have tuberculate coxa- and lateral plates. An et al. (2009) reported *G. rhombos* An, Yu & Markham, 2009 and *G. tau* An, Yu & Markham, 2009 from South China Sea and East China Sea also infesting members of Gonoplacidae. Nobili (1906) described *G. giardi* from Tuamotu infesting a xanthid host.

The new species, *G. tuberculata*, is distinguished from the other 16 species by the male having mid-ventral projections on first three pleomeres. *Gigantione tuberculata* appears to be closely related to *G. rhombos*, *G. tau* and *G. giardi*. The new species differs from *G. rhombos* in the female having a barbula with a low rounded projection in the middle region and two small projections encircled by the large falcate projections and the male possessing uniramous pleopods. According to An et al. (2009), females of *G. rhombos* have a prominent rhombic projection in the center of the barbula and multiple small medial projections while the males have biramous pleopods on pleomeres 2–4. Females of *G. tuberculata* differ from those of *G. tau* in the head lacking pigmentation, and the male lacking eyes. An et al. (2009) described *G. tau* with “T”-shaped pigmentation on the female’s head and males with yellow eyes. The new

species differs from females of *G. giardi* in having all segments distinct and an asymmetrical pleon while the males have short antennae that cannot be seen in dorsal view. Nobili (1906) reported the females of *G. giardi* as having pereomeres 2–4 fused medially and with an almost symmetrical pleon and the males with very long antennae extending beyond the margin of the head, observable from the dorsal view.

Gigantione notonyxae n. sp.

Fig. 2

Material examined.—Infesting left branchial chamber of *Notonyx musappocenta* Clark & Ng, 2011. Det. of host, Wei Jiang. Holotype: CIEG740501, 1♀, Beibu Gulf, Stn. 7405, 19°30'N, 108°00'E, 63 m, 12Oct.1962. Allotype: CIEG740502, 1♂, same data as holotype.

Description of holotype.—Length 2.99 mm, maximal width 2.02 mm, head length 0.79 mm, head width 1.04 mm, pleon length 0.99 mm. All segments distinct (Fig. 2A).

Head pentagonal, wider than long, without frontal lamina and extended laterally into pair of rounded anterolateral flaps. Eyes absent (Fig. 2A). Antennule of three articles and antenna of five articles, setose terminally (Fig. 2B). Maxilliped with large rounded anterior article, with minute setae on margin; small rounded posterior article, without palp, internal margin of posterior article with minute setae (Fig. 2C). Barbula with one pair of long pointed falcate lateral projections on each side, three small projections encircled by lateral projections, round projection in center (Fig. 2D).



Fig. 1. *Gigantione tuberculata* n. sp., holotype female (CIEG750201) (A–H). A, dorsal view. B, left antennule and antenna. C, right maxilliped, external view. D, barbula. E, left oostegite 1, external view. F, left oostegite 1, internal view. G, left pereopod 1. H, left pereopod 7. Allotype male (CIEG750202) (I–M). I, dorsal view. J, ventral view. K, left antennule and antenna. L, left pereopod 1. M, left pereopod 7. Scale: A, 1 mm for A; B, 0.33 mm; C, 0.50 mm; D, 0.45 mm; E, F, 0.41 mm; G–M, 0.33 mm.

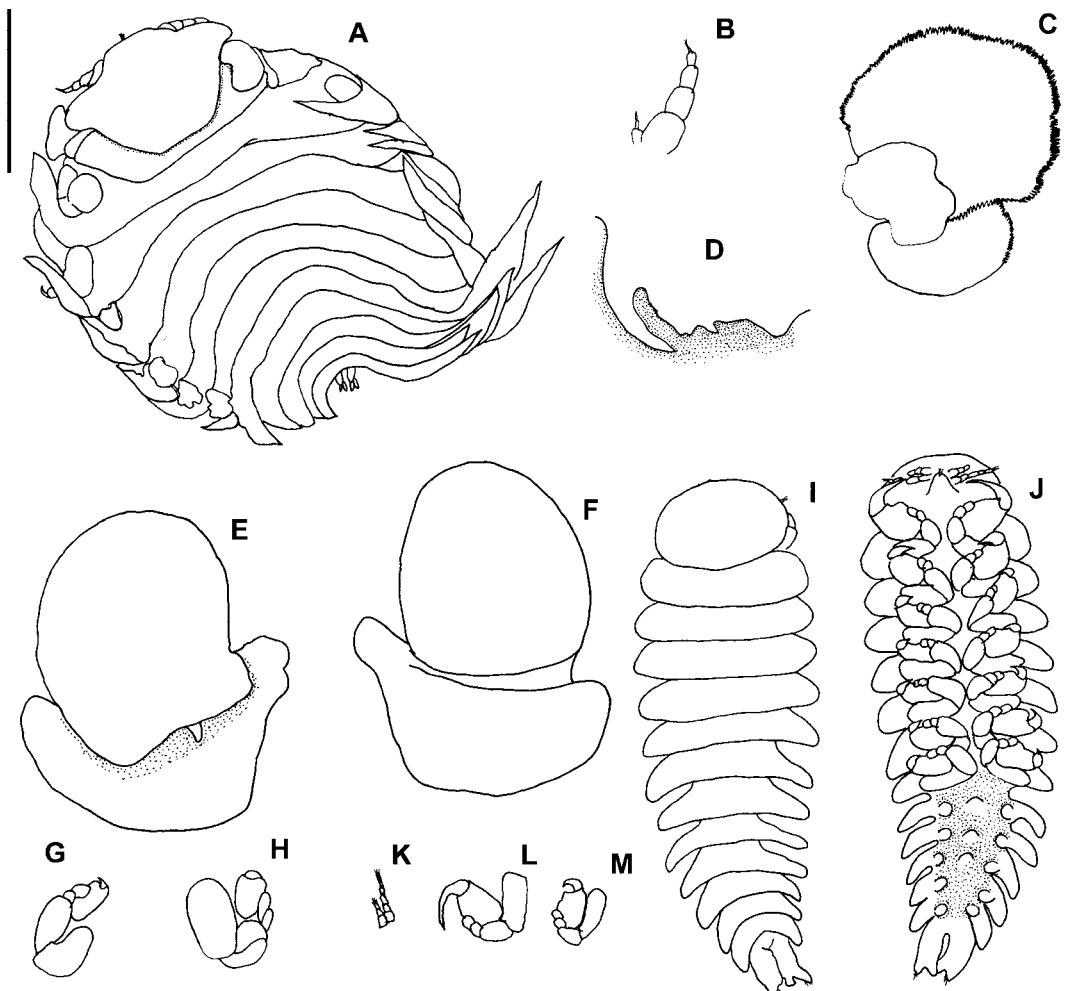


Fig. 2. *Gigantione notonyxae* n. sp., holotype female (CIEG740501) (A–H), A, dorsal view. B, left antennule and antenna. C, left maxilliped, external view. D, right side of barbula. E, right oostegite 1, internal view. F, right oostegite 1, external view. G, left pereopod 3. H, left pereopod 4. Allotype male (CIEG740502) (I–M). I, dorsal view. J, ventral view. K, left antennule and antenna. L, left pereopod 1. M, left pereopod 7. Scale: A, 1 mm; B, 0.48 mm; C, 0.65 mm; D, 0.48 mm; E, F, 0.55 mm; G–M, 0.47 mm.

Pereon broadest across third pereomere (Fig. 2A). Smooth coxal plates of right side longer than those on left side. Dorsolateral bosses only on first four pereomeres of right side, bosses on all pereomeres of left side. Oostegites incompletely enclosing brood pouch. First oostegite (Fig. 2E, F) with two articles, anterior article elongate and rounded, posterior article compressed, wider than anterior article. Internal ridge of first oostegite bearing one medial

projection. Posterior margin of oostegite 1 straight and without posterolateral point. All pereopods of approximately the same size and structure (Fig. 2G, H), with short pointed dactyli.

Pleon of six pleomeres, sixth pleomere not visible in dorsal view. First five pleomeres bearing biramous pleopods and lateral plates, sixth pleomere without lateral plates but with biramous uropods extended on peduncles. Pleon asymmetrical with lateral plates on right side much

longer than those on the left side. Pleopods tuberculate, asymmetrical, those on right side longer than those on left side.

Description of allotype.—Length 1.58 mm, maximal width across pereomere 4, 0.53 mm, head length 0.20 mm, head width 0.36 mm. All body segments distinctly (Fig. 2I, J).

Head ellipsoidal, eyes absent. Antennule of 3 articles, antenna of 5 articles (Fig. 2K).

Pereomeres without mid-ventral projections (Fig. 2J). First pereopods much larger than others, pereopods 2–6 of approximately same morphology, progressively smaller posteriorly (Fig. 2L, M).

Pleon of six segments, first five with small rounded uniramous pleopods, first three pleomeres with small mid-ventral projections (Fig. 2J). Sixth pleomere with long uropods, distal end produced into two distally biramous extensions, lateral extensions with terminal setae.

Etymology.—The specific name *notonyxae* refers to its host genus.

Remarks

The new species, *G. notonyxae*, is distinguished from previously described species by the female having dorsolateral bosses on the left side of all pereomeres and the male with mid-ventral projections on the first three pleomeres. *Gigantione notonyxae* appears to be most closely related to *G. pratti* Danforth, 1967 which is known to infest *Phymodius ungulates* (H. Milne Edwards, 1834) from Eniwetok Atoll, Marshall Islands, in the Pacific. The new species differs from *G. pratti* in possessing dorsolateral bosses on all pereomeres of the left side, oostegite 1 with a rounded posterior margin, prominent coxal plates on the left side of pereomeres 4–7, and an asymmetrical pleon with the sixth pleomere not observable in dorsal view. In addition, the male has uniramous pleopods and mid-ventral projections on the first

three pleomeres. According to Danforth (1967), females of *G. pratti* have dorsolateral bosses on the left side of the first five pereomeres, oostegite 1 has a flat and concave posterior margin, coxal plates are present only on the first four pereomeres of left side, and the sixth pleomere is distinct and is visible in dorsal view. Males of *G. pratti* have biramous pleopods and lack mid-ventral projections on the pleon. Females of *Gigantione notonyxae* differs from those of *G. tuberculata* in possessing smooth coxal and lateral plates, whereas those of *G. tuberculata* have tuberculated coxal and lateral plates.

Acknowledgements

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