

Notonyx kumi, a New Species of Goneplacid Crab (Decapoda: Brachyura) from the Ryukyu Islands, Japan, and Lesser Sunda Islands, Indonesia

Tohru Naruse^{1,2} and Tadafumi Maenosono³

¹Raffles Museum of Biodiversity Research, Department of Biological Sciences, National University of Singapore, 14 Science Drive 4, Singapore 117543, Republic of Singapore

²Present address: Transdisciplinary Research Organization for Subtropical and Island Studies, University of the Ryukyus, 1 Senbaru, Nishihara, Okinawa, 903–0213 Japan
e-mail: naruse@lab.u-ryukyu.ac.jp

³Tsudoi Company, 2–20–5 Gusukuma, Urasoe, Okinawa, 901–2133 Japan
e-mail: maenosono@tsudoi-company.com

Abstract A new species of the goneplacid genus *Notonyx* A. Milne-Edwards, 1873 is described based on material from Oh-jima Island, near Kume Island, Ryukyu Islands, Japan, and Sumbawa, Lesser Sunda Islands, Indonesia. The new species is morphologically most similar to *N. gigacarcinicus* Clark and Ng, 2006. The morphology of the male first gonopod and the relative width of the carapace, however, distinguish the new species from the latter. A possibly undescribed species, represented only by a single female molt from Miyako Island, Ryukyu Islands, is also recorded.

Key words: Decapoda, Brachyura, Goneplacidae, *Notonyx kumi*, new species, Ryukyu Islands, Japan, Lesser Sunda Islands, Indonesia.

The goneplacid genus *Notonyx* A. Milne-Edwards, 1873 is known only from four species, viz. *N. nitidus* A. Milne-Edwards, 1873 (type species of the genus), *N. vitreus* Alcock, 1900, *N. gigacarcinicus* Clark and Ng, 2006, and *N. latus* Ng and Clark, 2008 (Castro, 2007; Ng and Clark, 2008). Their habitats range from the intertidal (*N. gigacarcinicus*) to subtidal (*N. nitidus*, *N. vitreus* and *N. latus*) in the Indo-West Pacific region from the Red Sea to New Caledonia. Clark and Ng (2006) commented that a single male specimen from Oshima Passage, Ryukyu Islands, identified as *N. vitreus* by Takeda (1989: 170, fig. 15A, F, G), differs from *N. vitreus* s. str. in its relatively narrow carapace and the structure of the male first gonopod. Clark and Ng (2006) also indicated that specimens referred to *Notonyx nitidus* from the Philippines (Serene and Umali, 1972: 82, figs. 92–95), and from the Lesser Sunda Islands, Indonesia (Stephensen, 1946: 172, fig. 47A, B), differ markedly from a topotypic specimen of *N. nitidus* (type locality: New Caledonia) (Clark and Ng, 2006: 541, fig. 3) in

the structures of the male first and second gonopods. The specimen used by Stephensen (1946) was recently described as new, *N. latus* (cf. Ng and Clark, 2008). Ng and Clark (2008) commented that the specimens identified as *N. nitidus* by Tesch (1918: 219) represent also an undescribed species. Besides these studies by P. K. L. Ng and P. F. Clark, we have discovered an undescribed species of *Notonyx* from Oh-jima Island, near Kume Island, as well as a large female moult specimen of a species of *Notonyx* from Miyako Island, both in the Ryukyu Islands, Japan. The former species from Oh-jima Island, described as *N. kumi* sp. nov. in this paper, turned out to be the same species as Tesch's (1918) material from Sumbawa, Lesser Sunda Islands, Indonesia (see Ng & Clark, 2008). The possible identity of the moult specimen from Miyako Island is also briefly discussed.

Specimens examined in this study are deposited in the National Museum of Nature and Science, Tokyo (NSMT), the Nationaal Natuurhistorisch Museum–Naturalis, Leiden (formerly

Rijksmuseum van Natuurlijke Historie (RMNH), Ryukyu University Museum, Fujukan, Okinawa (RUMF), and the Zoological Reference Collection of the Raffles Museum of Biodiversity Research, National University of Singapore (ZRC). Measurements provided are of the carapace length and carapace width.

For comparative purposes, the following specimens were examined.

Notonyx gigacarcinicus Clark and Ng, 2006. Holotype: ZRC 2000.0981, male (9.0×12.1 mm), Ao Tang Khen Bay, Phuket, Thailand, in reef rubble, coll. P. F. Clark and P. K. L. Ng, 3–6 May 2000. Paratype: ZRC 2000.0981, 1 female (10.7×14.0 mm), same data as holotype.

Notonyx nitidus A. Milne-Edwards, 1873. ZRC 2005.0139, 1 male (5.6×7.0 mm), 1 female (6.1×7.6 mm), LAGON 6, stn 322, Grand Récif Sud, New Caledonia, 22°30'S, 166°58'E, 71 m, coll. B. Richer de Forges/ORSTOM, 27 November 1984.

Notonyx sp.: RUMF-ZC-864, 1 female moult (13.8×19.0 mm), intertidal flat at Yonaha Bay, off Hisamatsu, Miyako Island, Ryukyu Islands, Japan, coll. J. Nawa, H. Osada and T. Naruse, 2 May 2005.

Taxonomy

Family Goneplacidae

Genus *Notonyx* A. Milne-Edwards, 1873

Notonyx kumi sp. nov.

[New Japanese name: Ryukyu-kaku-enkou-gani]

(Figs. 1–3)

Material examined. Holotype: RUMF-ZC-863, male (9.5×13.0 mm), Oh-jima Island, near Kume-jima Island, Ryukyu Islands, Japan, 0 m at low tide, 1 April 2008, coll. T. Maenosono.

Paratypes: ZRC 2008.0022, 1 male (6.8×9.3 mm), same data as holotype; NSMT-Cr 19553, 1 female (8.2×11.2 mm), 1 juvenile (3.7×4.9 mm), same data as holotype.

Other material. RMNH, male (4.6×6.0 mm), stn 47, Bay of Bima, north coast of Sumbawa,

Lesser Sunda Islands, Indonesia, 13–31 m deep.

Description. Carapace (Figs. 1a, 3) rectangular, widest at posterolateral angle of epimera, width 1.36–1.37 (mean 1.37, n=3) times length; dorsal surface smooth, glabrous, convex longitudinally, anterior third of carapace including front sloping anteroventrally, H-shaped gastric groove distinct; cardiac region laterally demarcated, cervical groove shallow; 2 pairs of short, low ridges present, 1 mesial pair mesial to orbit and 1 outer pair just posterior to orbit. Margins of front, orbit and carapace proper weakly cristate, not granulated. Frontal margin slightly concave medially, frontal width 0.45–0.46 (mean 0.46, n=3) times fronto-orbital width, fronto-orbital width 0.71–0.74 (mean 0.72, n=3) times carapace width. Orbital margins entire; infraorbital margin sinuous, concave at inferior to base of cornea, inner orbital tooth blunt, low, leaving gape for antenna. External orbital angle blunt; anterolateral margin weakly convex, without epibranchial tooth; posterolateral margin concave. Epistome trilobed; median lobe with small median notch; lateral lobes shorter than median lobe, directed anteriorly.

Eyes long, gradually narrowed distally, slightly constricted near base. Antennule relatively long, basal antennular article accommodated in transverse fossa. Antenna with long flagellum, exceeding beyond external orbital angle by two-fifths length of flagellum when stretched laterally.

Third maxillipeds (Fig. 1b) relatively broad, but leaving narrow median gape when closed; ischium, merus subquadrate, subequal in length, mesial margin of ischium crenulate, with short stiff setae; palp 3-segmented, tip of dactylus reaching beyond distomesial angle of ischium when folded, with stiff setae distally. Exopod broad, about half width of ischium, mesial margin with subdistal triangular projection, flagellum long.

Thoracic sternite 3 demarcated from sternite 2 by transverse groove, hardly demarcated from sternite 4; male sternal cavity relatively wide; sternal condyle near distal end of sternite 5; border between sternites 7 and 8 forming sheltered groove for penis; penis emerging from lateral end

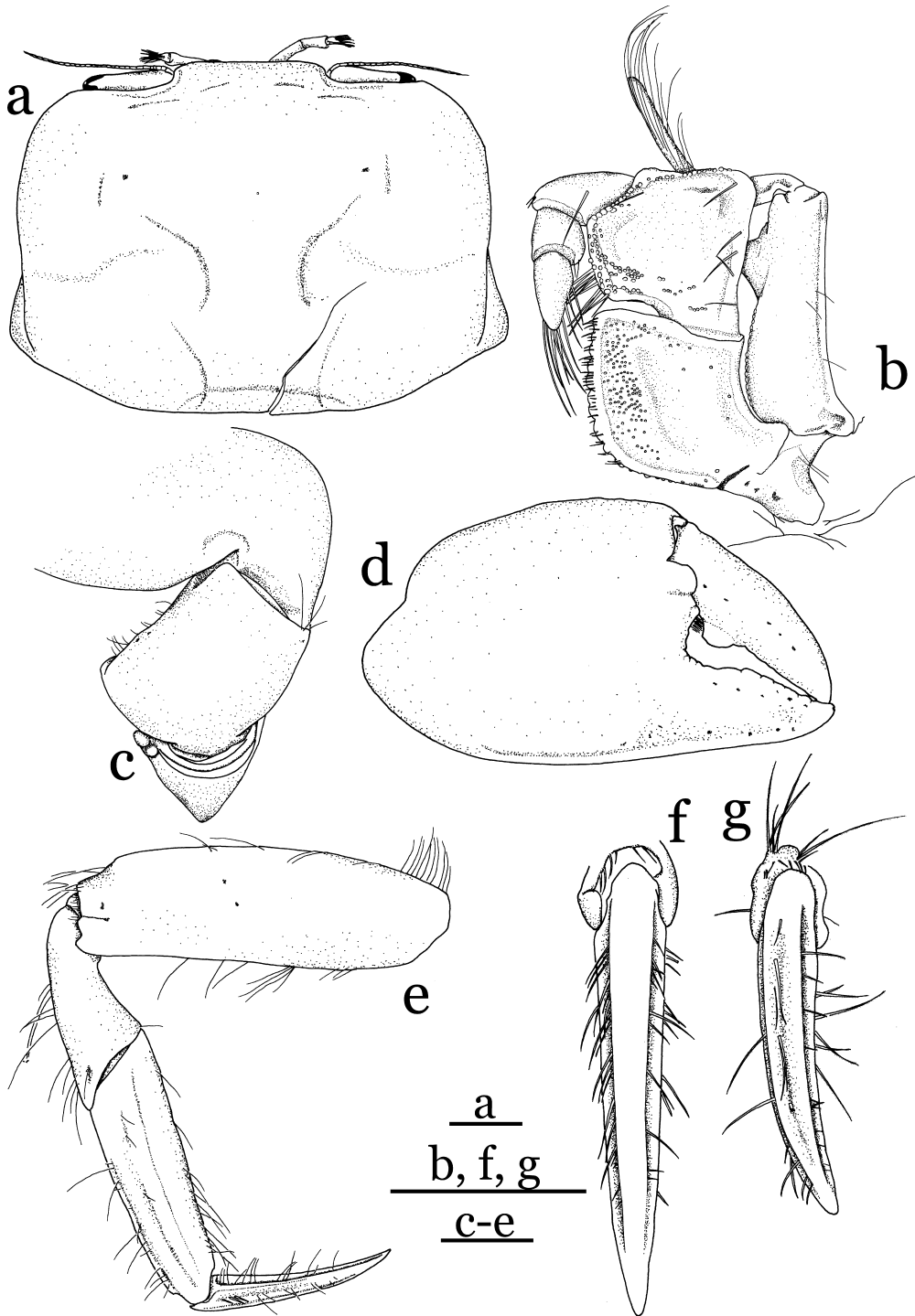


Fig. 1. *Notonyx kumi* sp. nov., holotype male (9.5×13.0 mm), RUMF-ZC-863. a, carapace, dorsal view; b, left third maxilliped, outer view; c, carpus of major cheliped, dorsal view; d, major chela, outer view; e, left fourth pereopod, dorsal view; f, dactylus of left fourth pereopod, extensor view; g, dactylus of left fifth pereopod, extensor view. Scale bars: 1 mm.

of sternal cavity. Vulva large, semicircular, covered with operculum, distal half of vulva being embraced by anterior margin of thoracic sternite 6.

Chelipeds subequal (holotype male) or equal (paratype male and female). Male cheliped with merus short, stout, ventral outer margin with clearly delimited distal angle; carpus (Fig. 1c) short, wide, rhomboidal in shape, inner angle very low, rounded, as blunt as outer angle; chela (Fig. 1d) smooth on surfaces, palm rather compressed distoventrally, more swollen dorsally, with weak ventral ridge on outer surface, extending onto fixed finger (in holotype, outer ventral ridge more distinct in minor chela than in major chela), dorsal margin lacking tooth, exceeding twice length of immovable finger; fingers weakly compressed, cutting edge of immovable finger with proximal concavity, corresponding to large proximal tooth of dactylus. Female chela lower and more compressed, ventral ridge on outer surface of palm more distinct than in that of holotype.

Ambulatory legs (second to fifth pereopods) (Fig. 1e) moderately long, third and fourth pereopods longest. Meri, carpi and propodi rather compressed dorsoventrally, inner and outer margins with sparse setae (setae denser in fifth pereopod). Propodi with submarginal rows of soft setae along inner and outer margins of dorsal surfaces of all ambulatory legs and outer margin of ventral surface of second and third pereopods. Dactyli acicular, flexor and extensor surfaces flat, dorsal and ventral surfaces carinate medially, with rows of setae flanking median carina; tips curved ventrally in extensor view in second pereopod, straight in third and fourth pereopods (Fig. 1f), curved dorsally in fifth pereopod (Fig. 1g).

Male abdomen (Fig. 2a) 6-segmented; first segment completely concealed under carapace, wider than second segment; third segment widest, lateral projections covering suture between thoracic sternites 7 and 8 *in situ*. Telson (Fig. 2a) slightly longer than sixth abdominal segment. Female abdomen not fully widened in available largest specimen (NSMT-Cr 19553;

8.2×11.2 mm), first segment only partially covered under posterior margin of carapace.

Male first gonopod (Fig. 2b, c) relatively long, stout, curved dorsomesially in distal two-fifths; distomesial portion weakly expanded, covered with proximally-directed spinules; distolateral portion tube-like, exceeding beyond distomesial angle; proximolateral angle with squarish lobe, lobe projecting halfway to penis *in situ*. Male second gonopod (Fig. 2d, e) slender, sinuous, longer than first gonopod, inserted into first gonopod in holotype (Fig. 2c, d), divided into two parts by submedian flap bearing short oblique row of spinules; distal part thinner and longer than proximal part, apical portion bent outwards almost perpendicularly, terminating in subacute tip.

Coloration. Adults. Carapace and ambulatory legs with maroon patterns on beige to light orange background (Fig. 3); single short longitudinal line on cardiac region and one pair of continuous stripes extending from epimeron through sides of progastric regions to front most distinct.

Juvenile (NSMT-Cr 19553; 3.7×4.9 mm). Maroon patterns less clearly defined, only disjunct lines on outer sides of progastric regions and single short line on gastric region distinct.

Ecological notes. In Oh-jima Islands, the present specimens were collected from under stones near the low-tide line of an intertidal flat with a sandy-muddy sediment. *Notonyx kumi* sp. nov. seems to be a burrower. When the stone was turned over, they tried to hide in a transverse burrow. The entrance of the burrow was similar to that of *Macrophthalmus* species, but it is uncertain whether it is a simple straight burrow with a single entrance. *Etisus laevimanus* Randall, 1840 (Xanthidae) and *Libystes villosus* Rathbun, 1924 (Portunidae) were collected from the same habitat.

Remarks. *Notonyx kumi* sp. nov. is most similar to *N. gigacarcinicus* in the structure of the male first gonopod, but it is clearly more slender than that of the latter species. In the new species, the distomesial expansion of the male first gonopod is relatively small, and forming a distomesial

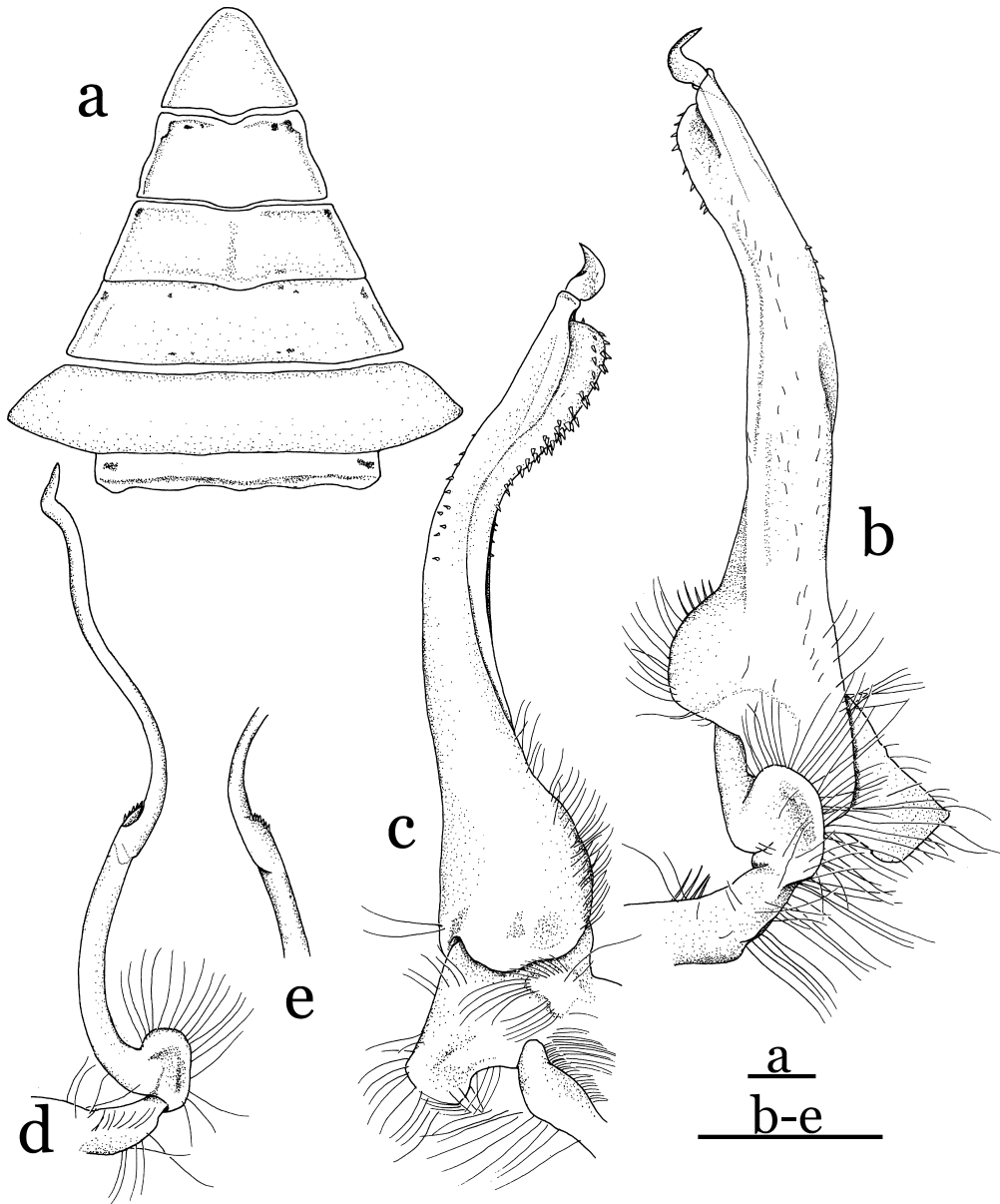


Fig. 2. *Notonyx kumi* sp. nov. a–c, holotype, male (9.5×13.0 mm), RUMF-ZC-863; d, e, paratype, male (6.8×9.3 mm), ZRC 2008.0022. a, second to sixth abdominal segments and telson, outer view; b, first gonopod with inserted second gonopod, ventral view; c, first gonopod with inserted second gonopod, dorsal view; d, second gonopod, ventral view; e, central part of male second gonopod, dorsal view. Scale bars: a, 2 mm; b–e, 1 mm.

angle of the gonopod; the tube-like structure of the distolateral angle is long and thin, exceeding beyond the distomesial angle. In contrast, the expansion in *N. gigacarcinicus* is more prominent, but not reaching the distomesial angle; and the

tube-like structure of the distolateral angle is shorter and broader, just reaching the level of distomesial angle. Furthermore, the carapace of the new species appears to be proportionally wider than that of *N. gigacarcinicus* [carapace



Fig. 3. *Notonyx kumi* sp. nov. Entire animals in dorsal view, showing coloration in life. a, b, holotype, male (9.5×13.0 mm), RUMF-ZC-863; c, paratype, female (8.2×11.2 mm), NSMT-Cr 19553.



Fig. 4. *Notonyx* sp., female moult (13.8×19.0 mm), RUMF-ZC-864, entire animal in dorsal view, showing coloration in life.

width 1.36–1.37 (mean 1.37, $n=3$) times length versus 1.30–1.33 (mean 1.32, $n=2$) times]. The color pattern of the carapace differs between the new species and *N. gigacarcinicus*. The maroon stripes in the large individuals of *N. kumi* are connected each other, showing a more intricate pattern, while those of *N. gigacarcinicus* are restricted to the posterolateral, the outer sides of the progastric and the cardiac regions (Clark and Ng, 2006, fig. 7). The juvenile specimen of *N. kumi* (3.7×4.9 mm, NSMT-Cr 19553), however, shows a color pattern similar to that of *N. gigacarcinicus* (see Clark and Ng, 2006).

A large female moult of an unidentified species of *Notonyx*, the largest known specimen referred to the genus (13.8×19.0 mm; RUMF-ZC-864) (cf. Clark and Ng, 2006), was collected from an intertidal flat of Miyako Island, the Ryukyu Islands (Fig. 4). The carapace of this moult is proportionally much higher than that of the largest specimen of *N. kumi* (male holotype, 9.5×13.0 mm, RUMF-ZC-863) even considering their size difference. The anterolateral margin of the carapace of the moult appears to be more squarish and more produced anterolaterally, and the fronto-orbital width is slightly narrower in the moult than that of the available specimens of *N. kumi* [fronto-orbital width 0.67 times ($n=1$) carapace width versus 0.71–0.74 times (mean 0.72, $n=3$) carapace width]. Furthermore, the vulva of the moult is placed close to the anterior margin of thoracic sternite 6, but the vulva is only partially pushing away the anterior margin of the thoracic sternite 6. In contrast, the anterior half of the vulva is surrounded by the anterior margin of thoracic sternite 6 in *N. kumi*. Examination of additional male specimens of this unidentified species may eventually corroborate that this moult represents an undescribed species of the genus.

Etymology. The species name “*kumi*” is derived from an Okinawa dialect, “Kumi” (=Kume Island). The name is used as a noun in apposition.

Acknowledgments

We thank Dr. Tomoyuki Komai (Natural History Museum and Institute, Chiba) and two anonymous reviewers for their valuable comments, which improved the paper greatly; Dr. Ng Ngan Kee (National University of Singapore) for reviewing a first draft of the manuscript, and to Mr. J. Nawa and Mr. H. Osada for helping in the field. The first author also thanks Prof. Peter K. L. Ng (Raffles Museum of Biodiversity Research, National University of Singapore) for access to museum facilities.

References

- Castro, P. 2007. A reappraisal of the family Goneplacidae MacLeay, 1838 (Crustacea, Decapoda, Brachyura) and revision of the subfamily Goneplacinae, with the description of 10 new genera and 18 new species. *Zoosystema*, **29**: 609–774.
- Clark, P. F. and P. K. L. Ng. 2006. A new species of *Notonyx* A. Milne-Edwards, 1873 (Crustacea, Brachyura, Goneplacidae) from the intertidal zone of Phuket, Thailand. *Zoosystema*, **28**: 539–551.
- Milne-Edwards, A. 1873. Recherches sur la faune carcinologique de la Nouvelle-Calédonie, deuxième partie. *Nouvelles Archives du Muséum d'Histoire naturelle, Paris*, **9**: 155–332, pls. 4–18.
- Ng, P. K. L. and P. F. Clark. 2008. A new species of *Notonyx* A. Milne-Edwards, 1873 (Crustacea: Decapoda: Brachyura: Goneplacidae) from Indonesia. *Zootaxa*, (1897): 20–26.
- Serène R. and A. F. Umali. 1972. The family Raninidae and other new and rare species of brachyuran decapods from the Philippines and adjacent regions. *Philippine Journal of Science*, **99**: 21–105, pls. 1–9.
- Stephensen, K. 1946. The Brachyura of the Iranian Gulf with an appendix: the male pleopoda of the Brachyura. *Danish Scientific Investigations in Iran*, **4**: 57–237.
- Takeda, M. 1989. Shallow-water crabs from the Oshima Passage between Amami-Oshima and Kakeroma-jima Islands, the northern Ryukyu Islands. *Memoirs of the National Science Museum*, (22): 135–184, pl. 4.
- Tesch, J. 1918. The Decapoda Brachyura of the Siboga-Expedition. II. Goneplacidae and Pinnotheridae. *Siboga-Expedition*, **39c**¹: 149–295, pls. 1–12.

Manuscript received 15 May 2008; revised 23 December 2008; accepted 25 December 2008.

Associate editor: T. Komai