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First record of *Menaethius orientalis* (Sakai, 1969) (Decapoda: Brachyura: Epialtidae) from the Ryukyu Archipelago

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Abstract. The first record of the poorly known kelp crab species *Menaethius orientalis* (Sakai, 1969) from the Ryukyu Archipelago is provided based on a full-grown female specimen from Iriomote Island. Comparison with male characters described in previous studies suggested sexual dimorphism in the morphologies of anterolateral carapace part and chelipeds. *Menaethius inornatus* Dana, 1852, which had long been regarded as a junior subjective synonym of *M. monoceros*, is suggested to be treated as a valid species based on distinct morphological differences from the other two extant *Menaethius* species.

Introduction

The Indo-West Pacific kelp crab genus *Menaethius* A. Milne-Edwards, 1834 includes two species, namely, *M. monoceros* (Latreille, 1825) and *M. orientalis* (Sakai, 1969) (Griffin & Tranter 1986; Ng et al. 2008). In contrast to the type species *M. monoceros*, which has been recorded frequently throughout Indo-Pacific waters, Tasman, and Red Sea (e.g. Urita 1926; Sakai 1934, 1938, 1965, 1976; Barnard 1950; Kim & Chang 1985; Griffin & Tranter 1986; Dai & Yang 1991; Komatsu 2011), and recently even from the Tyrrhenian Sea (Falciai 2003), *M. orientalis* is known only from a few published records (Sakai 1969, 1976; Griffin & Tranter 1974, 1986). In Japanese waters, *M. orientalis* has only been recorded from Kii Shirahama, Kii Peninsula and Kozu-shima Island, Izu Islands, each based on one male specimen (Sakai 1969, 1976). This paper provides the first record of *M. orientalis* from the Ryukyu Archpelago on the basis of a specimen from Iriomote Island, Yaeyama Islands, which is also the first female specimen from Japan.

Measurements provided are of postrostral carapace length (PCL) × maximum carapace width excluding epibranchial lobes (CW) in millimeters. The specimens examined in this study are deposited in the Ryukyu University Museum, Fujukan (RUMF), University of the Ryukyus.

Taxonomy

Superfamily Majoidea Samouelle, 1819
Family Epialtidae MacLeay, 1838
***Menaethius orientalis* (Sakai, 1969)**
[Japanese name: Gokaku-mo-gani]
(Figs. 1–4, 6A)

Epialtus orientalis Sakai, 1969: 252–253, text fig. 4a; 1976: 206, text fig. 111.
Huenia proteus — Griffin & Tranter 1974: 169. [Not *Maja (Huenia) proteus* De Haan, 1839, a junior synonym of *Huenia heraldica* (De Haan, 1837)].
Menaethius orientalis — Griffin & Tranter 1986: 90–91, figs. 18c, d, 27; Morgan & Berry 1993: 49 (list); Morgan 2000: 120, tbl. 10; Ng et al. 2008 (list).

Material examined. RUMF-ZC-4745, 1 female (8.8 × 6.4 mm), off Naata-hama Beach, Uehara, Iriomote Island, 24°25'44"N, 123°47'40"E, 13 m, 13 Feb. 2016, SCUBA, coll. R. Yoshida.

Comparative material. *Menaethius monoceros* (Latreille, 1825). RUMF-ZC-4746, 1 ovigerous female (12.9 × 9.3 mm), Nagura Bay, Ishigaki Island, 0.5 m, 3 Jul. 2011, hand, coll. H. Yamada, K. Kon, T. Kawamura & N. Ohtsuchi; RUMF-ZC-4747, 1 male (16.0 × 11.6 mm), 1 ovigerous female (13.0 × 9.5 mm), same locality, 0.5 m, 11 Mar. 2012, hand, coll. H. Yamada, J. Hayakawa, S. Houki; RUMF-ZC-4748, 1 ovigerous female (13.9 × 10.0 mm), same locality, 0.5 m, 11 Mar. 2012, hand, coll. H. Yamada, J. Hayakawa, S. Houki; RUMF-ZC-4749, 1 male (9.3 × 7.6 mm), off Naata-hama Beach, Uehara, Iriomote Island, intertidal, 31 Jul. 2016, hand, coll. R. Yoshida.

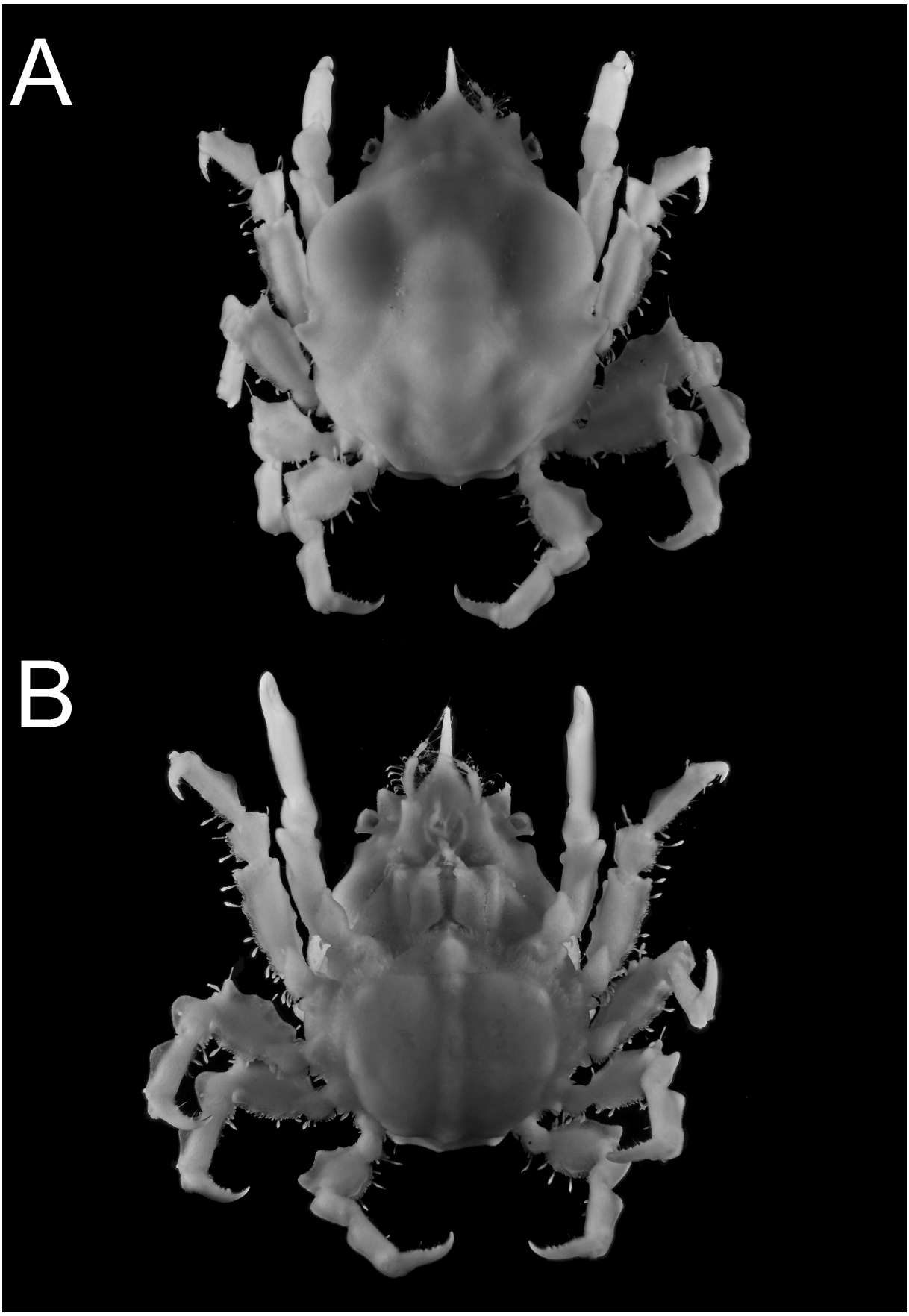

Fig. 1. *Menaethius orientalis* (Sakai, 1969) (female, 8.8 × 6.4 mm, RUMF-ZC-4745). A, B, habitus in dorsal view (A) and ventral view (B).
図 1. ゴカクモガニ (雌 , 8.8 × 6.4 mm, RUMF-ZC-4745). A, B, 全体 , 背面観 (A) および腹面観 (B).

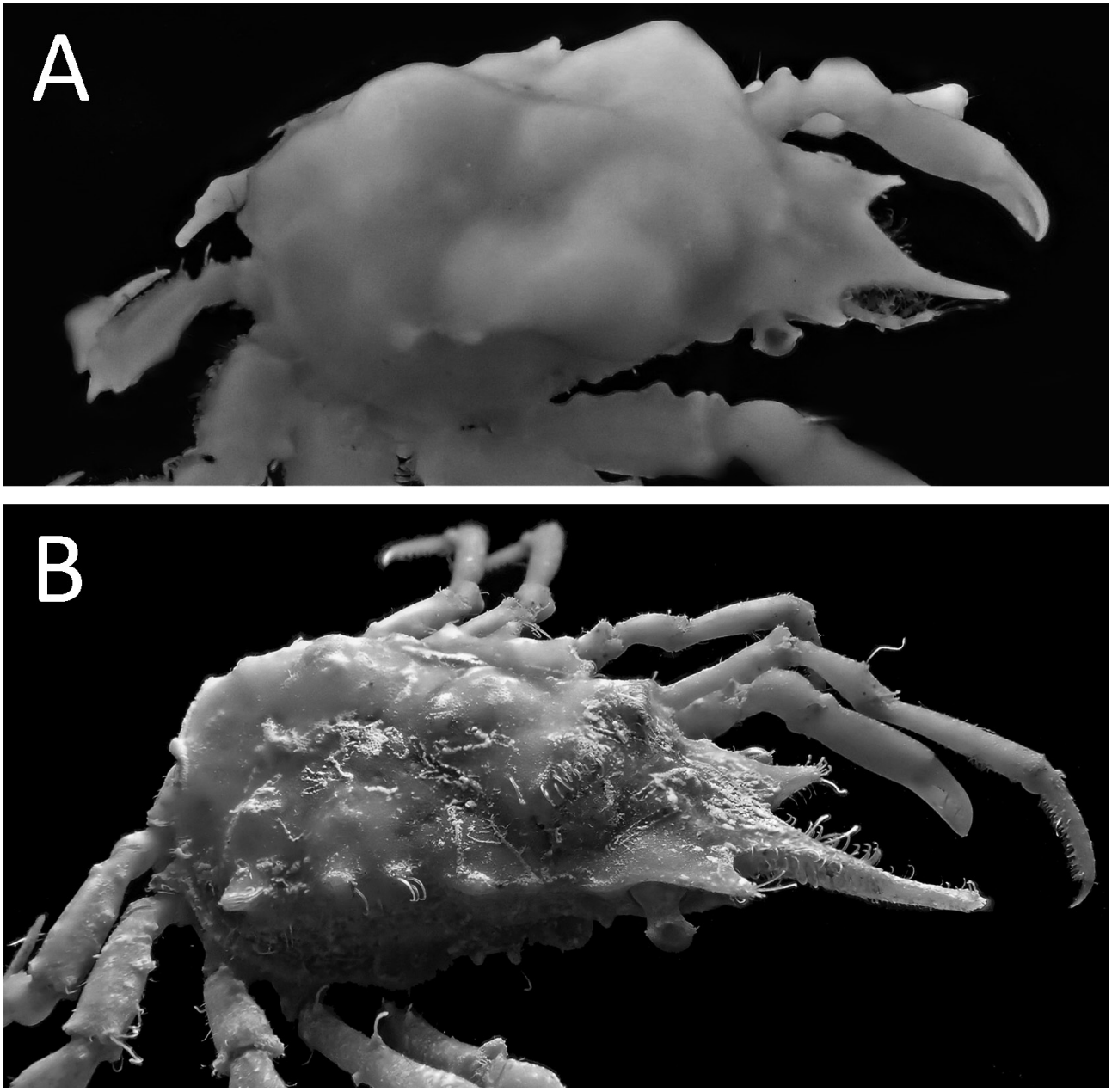

Fig. 2. Anterolateral view of carapace of *Menaethius* species. A, *Menaethius orientalis* (Sakai, 1969) (female, 8.8 × 6.4 mm, RUMF-ZC-4745), off Naata-hama Beach, Iriomote Island; B, *Menaethius monoceros* (Latreille, 1825) (ovigerous female, 13.0 × 9.5 mm, RUMF-ZC-4747), Nagura Bay, Ishigaki Island.
図2. イッカクガニ属の甲の前側面観. A, ゴカクモガニ (雌 , 8.8 × 6.4 mm, RUMF-ZC-4745), 西表島ナータ浜沖; B, イッカクガニ (抱卵雌 , 13.0 × 9.5 mm, RUMF-ZC-4747), 石垣島名蔵湾 .

Description on a female specimen from the Ryukyus. Carapace (Figs. 1A, 2A) sub-pentagonal, width 0.7 times length, dorsal surface smooth; width between both supraorbital eaves more than 0.5 times broader than carapace width. Pseudorostrum (Figs. 1A, 2A) short, 0.24 times longer than postrostral carapace length, broad triangular basally, immediately narrowed in distal half, with pointed apex; lateral margins with long, hooked setae. Supraorbital spine (Figs. 1A, 2A) triangular, compressed dorsoventrally. Eyestalk short, anterior, posterior apex each with cluster of short setae, cornea truncate on distal margin (Figs. 1A, 3A). Postorbital lobe (Figs. 1A, 3A) low, rounded triangular. Gastric region (Figs. 1A, 2A) broadened anteriorly, weakly elevated, distinctly separated from hepatic regions by deep, broad grooves on both sides; protogastric, mesogastric, epigastric regions unclearly defined. Hepatic region (Figs. 1A, 2A) dilated anterolaterally, lobate, thickened dorsoventrally; lateral margin rounded. Cardiac region (Figs. 1A, 2A) more elevated than gastric region, apically with pair of

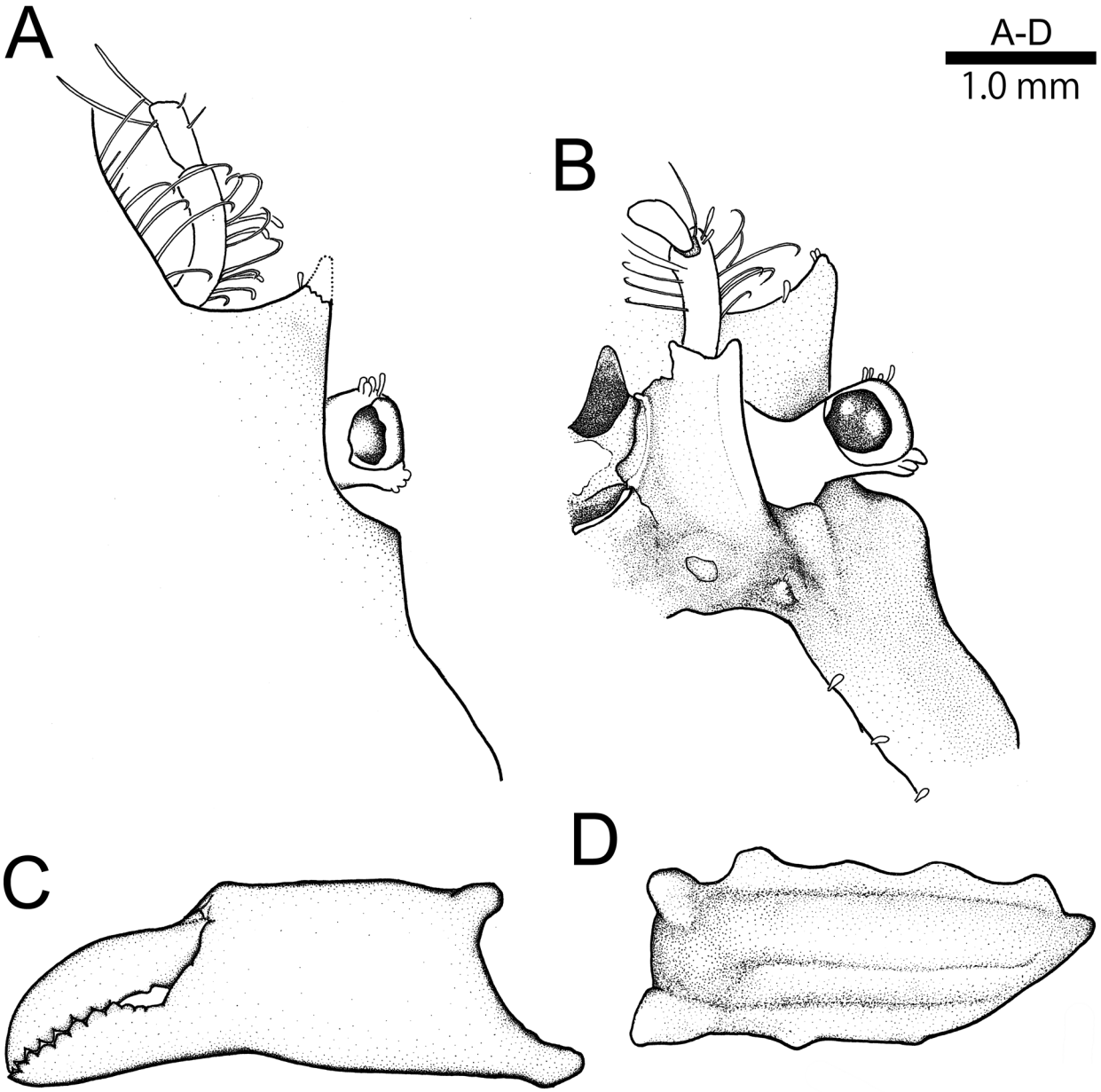

Fig. 3. *Menaethius orientalis* (Sakai, 1969) (female, 8.8 × 6.4 mm, RUMF-ZC-4745). A, B, anterolateral part of carapace in dorsal view (A) and ventral view (B), C, left chela in outer view, D, left cheliped merus in lateral view.
図3. ゴカクモガニ (雌, 8.8 × 6.4 mm, RUMF-ZC-4745). A, B, 甲前側部, 背面観 (A) および腹面観 (B), C, 左鉗部, 外面観 , D, 左鉗脚長節 , 外側面観 .

indistinct tubercle. Branchial region (Figs. 1A, 2A) flattened, unarmed; epibranchial region weakly elevated, with two, flattened, triangular lobes on each lateral margin. Intestinal region (Figs. 1A, 2A) weakly elevated medially. Posterior margin projected medially, with low, triangular carina on both sides (Fig. 1A).

Basal antennal article (Fig. 3B) smooth, nearly fused with carapace; distolateral angle produced into small subacute spine, directed anterolaterally; lateral margin shallowly concave, proximally with low protuberance. Penultimate article of antennal peduncle twice as long as ultimate article, mesial margin lined with long hooked setae, lateral margin with long setae, distal half of which bent posteriorly; ultimate article slightly broadened distally; tip of flagellum reaching tip of pseudorostrum.

Third maxilliped (Fig. 1B) unarmed; merus with rounded anterodistal angle; ischium with shallow, longitudinal groove medially. Pterygostomian region (Fig. 1B) smooth, with two, low teeth on pleural suture.

Cheliped (Figs. 1, 2A, 3C, D) merus generally subcylindrical, dorsal surface with carinate

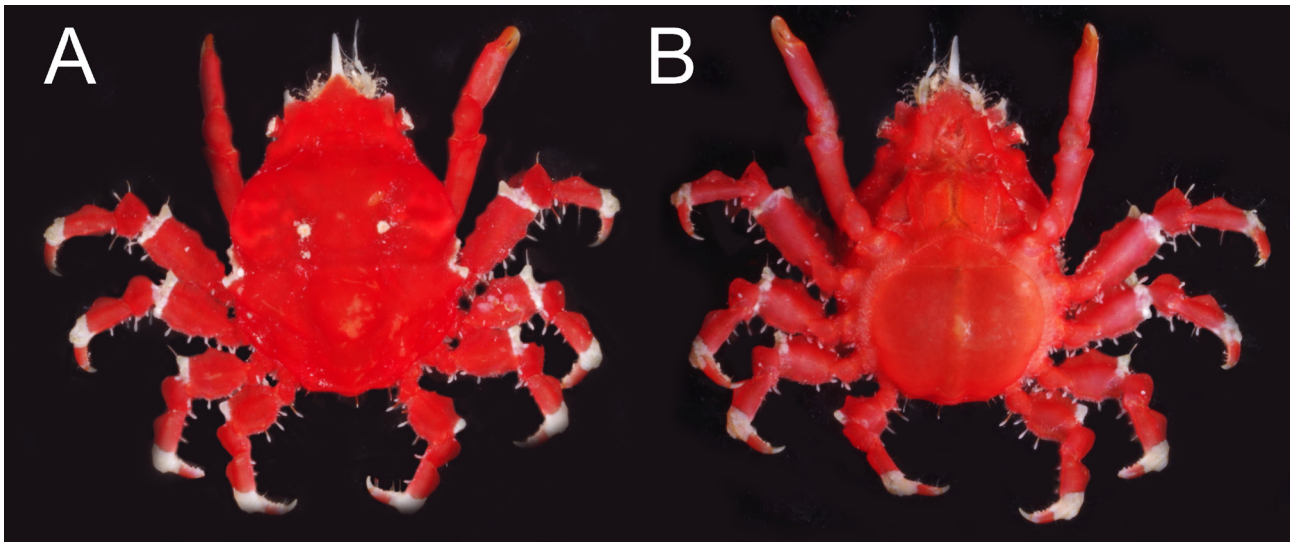

Fig. 4. *Menaethius orientalis* (Sakai, 1969). Live colouration (female, 8.8 × 6.4 mm, RUMF-ZC-4745), off Naata-hama Beach, Iriomote Island.
図 4. ゴカクモガニ . 解凍後の標本 (雌 , 8.8 × 6.4 mm, RUMF-ZC-4745, 西表島ナータ浜沖) に基づく色彩 .

longitudinal ridge with four teeth (Fig. 3D). Carpus moderately inflated, smooth. Chela (Figs. 2A, 3C) moderately compressed, three times as long as height; cutting margin of movable finger dentate uniformly in distal two-thirds, with minute, isolated tooth proximally; both fingers contact in distal two-thirds, gaped proximally when closed.

Ambulatory legs (Fig. 1A) decreased in length posteriorly. Merus carinate on both extensor, flexor margins with 3–4 teeth; carpus short, extensor margin with rounded carina, flexor margin with low, dentate carina; propodus carinate on extensor margin, carina with broad 2 teeth, proximal one larger, strongly extended; dactylus with 2 rows of 5–7 small calcareous spines on flexor surface, spines longer distally. Row of mainly short, sparsely long setae on flexor margin in entire length in merus, carpus, in proximal half in propodus.

Pleon (Figs. 1B, 4B, 6A) strongly expanded, smooth, four-segmented, fused pleomeres third to sixth, with blunt keel medially. Gonopore oblong.

Coloration in life. Based on defrosted specimen (Fig. 4). Carapace generally dark red with white spots on deep groove which separates hepatic and gastric regions (Fig. 4A); elongated part of pseudorostrum, distal part of supraorbital spine, base of cornea, lateral margin of concavity in between two epibranchial lobes white (Fig. 4A). Pleon deep red (Fig. 4B). Thoracic sternites pale red (Fig. 4B). Penultimate article of antennae white in distal one-third (Fig. 4B), visible dorsally (Fig. 3A). Chelipeds, each ambulatory leg generally deep red (Fig. 4); first, second ambulatory legs with two white broad bands: proximal one covering distal part of merus to proximal pat of carpus, distal one covering distal part of propodus to proximal part of dactylus; third, fourth legs with white patches on distal end of extensor carina of merus and on distal part of propodus to proximal part of dactylus.

Distribution. Tasman Sea, Australia, Timor, Molucca, Sulu Archipelago, Mauritius, Red Sea, and Japan (Griffin & Tranter 1986). In Japan, Kozu-shima Island, Kii Shirahama (type locality), and Iriomote Island (Sakai 1969, 1976; this study). Morgan & Berry (1993) and Morgan (2000) listed several records from Ashmore and Cartier Islands and Christmas Island (both in Timor Sea), respectively, though they did not provide any further information on their specimens.

Ecological notes. Our specimen was collected from coral rubble from a depth of 13 m. Known habitats include: seafloor of sand or gravel (Kozu-shima Island), mud and hard bottom (Molucca Sea), coral (north of Mauritius), coral blocks (Queensland), coralline red algae of *Lithothamnion* (Sulu Archipelago, Timor Sea, and Flores Sea) at 13–72 m depth (Sakai 1969, 1976; Griffin & Tranter 1986).

Remarks. Sakai (1969) described *Menaethius orientalis* (as *Epialtus*) based on a male specimen (PCL (confirmed from drawing) 9.1 × 7.2 mm, text-fig. 4a) from Kii Shirahama, Japan. Judging from its proportionally short chelipeds (Sakai 1969: text-fig. 4a), the male holotype had not experienced terminal molt (cf. Hartnoll 1963). Soon after, Sakai (1976) recorded a male from Kozu-shima Island, southeast Japan (as *Epialtus*) but its size was not recorded. The first record of this species from outside Japan was of Griffin & Tranter (1974) from the Red Sea (2

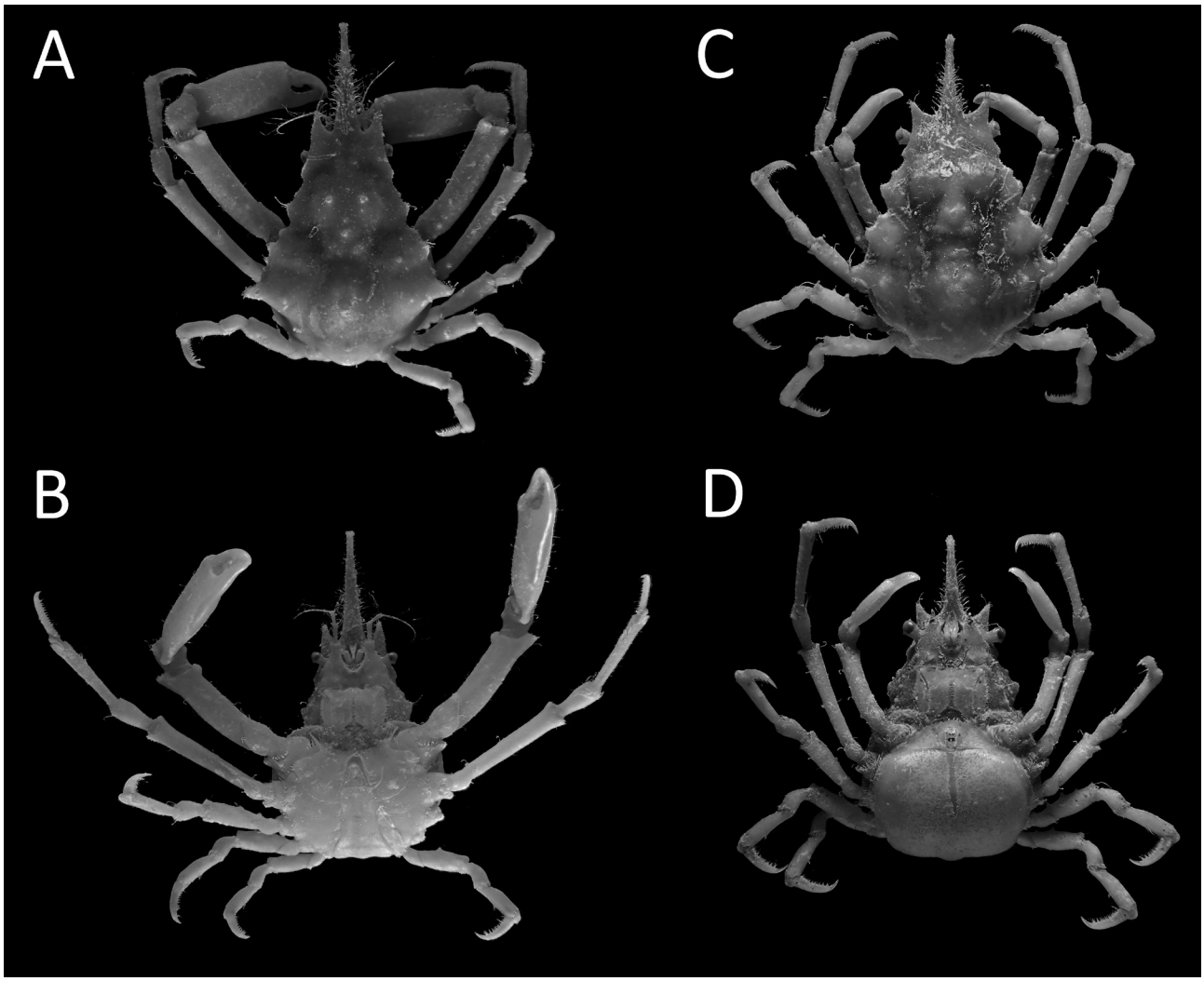

Fig. 5. *Menaethius monoceros* (Latreille, 1825), habitus in dorsal view (A, C) and ventral view (B, D). A, B, male (16.0 × 11.6 mm, RUMF-ZC-4747), C, D, ovigerous female (13.0 × 9.5 mm, RUMF-ZC-4747), Nagura Bay, Ishigaki Island.
図 5. イッカクガニ , 全体 , 背面観 (A) および腹面観 (B). A, B, 雄 (16.0 × 11.6 mm, RUMF-ZC-4747), C, D, 雌 (13.0 × 9.5 mm, RUMF-ZC-4747), 石垣島名蔵湾 .

ovigerous females with 7, 12 mm PCL, respectively, as *Huenia proteus*; see Griffin & Tranter 1986: 91). They later examined 10 specimens of both sexes (5.5–11 mm PCL) from various localities of Indo-West Pacific waters and redescribed this species as *Menaethius* with a short note on female characters and some drawings based on a male (8.5 mm PCL) (Griffin & Tranter 1986: figs. 18c, d, 27).

Judging from strongly expanded pleon, our female specimen had experienced terminal molt. Its morphological characters essentially agreed with descriptions of the previous studies (Sakai 1969; Griffin & Tranter 1986) but differed in the following presumable secondary sexual characters.

First, the chela is proportionally shorter, less gaped between fingers in our specimens (Fig. 3C) than in Griffin & Tranter (1986: fig. 27a). In addition, the isolated tooth on the cutting margin of movable finger is less developed in our specimen (Fig. 3C) than in Griffin & Tranter (1986: fig. 27a). On the other hand, “fingers are short and unarmed” in the holotype male (Sakai 1969: 253). The differences between Griffin & Tranter (1986) and this study are explained by sexual dimorphism in *M. orientalis*, and the differences between two previous studies are due to different ontogenetic stages (cf. Ohtsuchi et al. 2016, 2018) in males.

Second, Griffin & Tranter (1986: 90) described a large proximal tubercle on the dorsal surface of cheliped merus in a large male (Griffin & Tranter 1986: fig. 27b), but our female specimen has a carinate longitudinal ridge instead (Fig. 3D). In addition, the cheliped merus of the male of Griffin & Tranter (1986) is proportionally longer (4.7 times longer than height, estimated based on their fig. 27b) than that of our female specimen (2.7 times longer

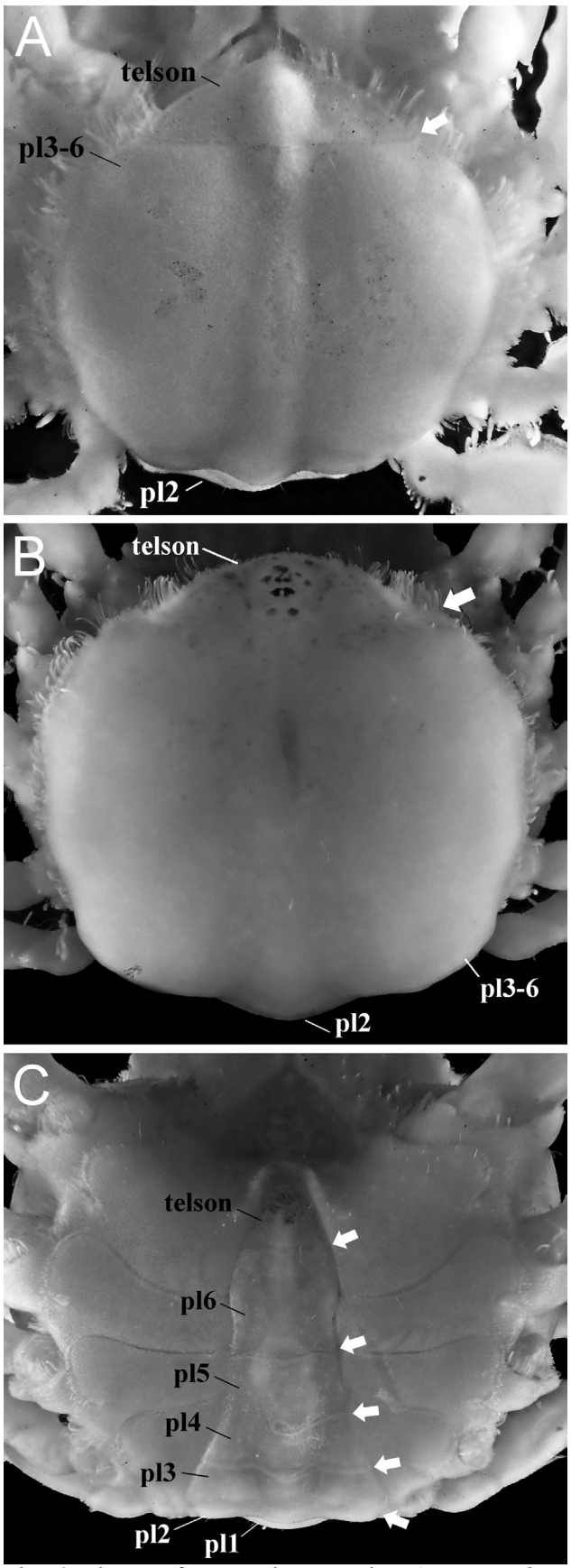

Fig. 6. Pleons of *Menaethius* species. A, *Menaethius orientalis* (Sakai, 1969) (female, 8.8 × 6.4 mm, RUMF-ZC-4745), off Naata-hama Beach, Iriomote Island; B, C, *Menaethius monoceros* (Latreille, 1825) (B, ovigerous female, 13.0 × 9.5 mm, RUMF-ZC-4747; C, male, 16.0 × 11.6 mm, RUMF-ZC-4747), Nagura Bay, Ishigaki Island. pl1–6 indicate the first to sixth abdominal pleomeres. White arrows indicate sutures between each pleomere.

図 6. イッカクガニ属の腹部 . A, ゴカクモガニ (雌 , 8.8 × 6.4 mm, RUMF-ZC-4745), 西表島ナータ浜沖 ; B, C, イッカクガニ (B, 抱卵雌 , 13.0 × 9.5 mm, RUMF-ZC-4747; C, 雄 , 16.0 × 11.6 mm, RUMF-ZC-4747), 石垣島名蔵湾 . pl1–6 は第 1–6 腹節を示す . 白矢印は各腹節間の溝の位置を示す .

than height, Fig. 3D). It is highly possible that a simple, slender, dorsally tuberculate cheliped merus is one of the male secondary sexual characteristics of *M. orientalis*. Unfortunately, Sakai (1969) did not describe the armatures on the cheliped merus of holotype in detail.

Third, although Griffin & Tranter (1986: 91) noted that "the carapace shape is similar in both sexes", the female specimen at hand is partly but clearly different from males in the structure of anterolateral part of carapace. As already noted by Sakai (1969: 252), "the posterior half [of anterolateral border] bears three teeth, of which middle one is the smallest and set little closer to the third" in males, whereas in female, the first anterolateral lobe is more dilated than the other posterior lobes, and thickened dorsoventrally, and its lateral margin is more projected and rounded than in males (Figs. 1A, 2A) (cf. Sakai 1969: text fig. 4a; Griffin & Tranter 1986: fig. 27g). Probably, Griffin & Tranter (1986) over-simplified their description of female characters.

Griffin & Tranter (1986) noted that the female pleon of *Menaethius orientalis* is fused in fourth to sixth pleomeres in their description, but the fusion is commonly described as third to sixth (Griffin & Tranter 1986: 91). Our examination confirmed that the female pleon of *M. orientalis* is four-segmented, and fused in third to sixth pleomeres (Figs. 1B, 6A). Sakai (1969) recognized "six segments" in the male pleon of the holotype, but Griffin & Tranter (1986) confirmed it is seven-segmented, with six pleomeres and telson (Griffin & Tranter 1986: fig. 27f). Our additional examination of the only congener *M. monoceros* based on specimens from the Yaeyama Group confirmed that their pleon is functionally fused in third to sixth pleomeres but each defined by distinct sutures in males (seven-segmented) (Figs. 5A, 6C), whereas they are fused without sutures in third to sixth pleomeres (four-segmented) in females (Figs. 5B, 6B). Dai & Yang (1991: 133) noted that the female pleon of *M. monoceros* is fused in fourth to sixth pleomeres.

Menaethius orientalis is readily distinguished from *M. monoceros* by a subpentagonal carapace (elongate triangular in *M. monoceros*) (Figs. 1 vs. 5); absence of a pair of hooked setae on anterior slope of gastric region (present in *M. monoceros*) (Fig. 2A vs. 2B); pseudorostrum being narrowed immediately in distal half, with unarmed, pointed apex (narrow throughout, triangular, with bifid tip in *M. monoceros*) (Figs. 1 vs. 5); dilated, lobate anterolateral carapace margin in female (dentate in both sexes in *M. monoceros*) (Figs.1A, 2A vs. 2B, 5A); and distinctly carinate ambulatory legs (subcyrindrical in *M. monoceros*) (Figs. 1 vs. 5).

As already noted by Griffin & Tranter (1986), *M. orientalis* resembles *M. inornatus* Dana, 1852, which was described based on one male specimen from Lahaina, Hawaii. Though being synonymous with *M. monoceros* by A. Milne-Edwards (1872) [not by Sakai (1976) as noted in Griffin & Tranter (1986)], *M. inornatus* shares more characters with *M. orientalis* than with *M. monoceros*. The following characters are shared between *M. orientalis* and *M. inornatus* but not with *M. monoceros*: relatively broad frontal region (ca. 0.5 CW) (Fig. 1A); proportionally short pseudorostrum (0.2–0.3 PCL) (Fig. 1A); lack of constriction behind the postorbital lobes (Fig. 1A); elongate, simple basal antennal article with shallowly concave lateral margin (Fig. 3B); mesially ciliated antennae (Fig. 3A, B); truncated cornea on eyestalk with tumid anterior and posterior apex (Fig. 3A, B) (cf. Dana 1852, 125: 1855: pl. 5 fig. 3). Although A. Milne-Edwards (1872) regarded *M. monoceros* as greatly variable in the length and width of pseudorostrum, and in the development of anterolateral dentation and dorsal tuberculation of carapace, the differences in relatively constant characters in Epialtidae, such as the shape of basal antennal article, suggest it is reasonable to differentiate *M. inornatus* from *M. monoceros*.

Despite many shared characters, *Menaethius orientalis* is different from *M. inornatus* in the following characters: pseudorostrum is longer and more elongate than in *M. inornatus*, narrower than preorbital spines, and its tip is exceeding distal end of the penultimate antennal articles (Fig. 3A, B) (acute, subtriangular, as broad as preorbital spines, tip not exceeding or as long as in *M. inornatus*); three lobes on anterolateral carapace margin are not tipped with setae, and the first lobe is much broader than the others (Fig. 1A) (tipped with setae, the first lobe subequal in size and shape to the others in *M. inornatus*) (cf. Dana 1855: pl. 5 fig. 3a, b, d, d'; Griffin & Tranter 1986: 27g). These significant morphological differences of *M. inornatus* from both *M. monoceros* and *M. inornatus* suggest that *M. inor*natus should be treated as a valid species.

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琉球列島初記録のゴカクモガニ（十脚目：短尾下目：モガニ科）

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要旨. 西表島より採集された 1 雌個体に基づき，ゴカクモガニ *Menaethius orientalis* (Sakai, 1969) の琉球列島初記録を報告し，既往研究において記載されていた雄の形態的特徴との比較から，甲前側部や鉗脚長節の形態に性的二型があることを指摘した．また，イッカクガニ *M. monoceros* (Latreille, 1825) の新参異名とされてきた *M. inornatus* Dana, 1852 について，イッカクガニ属の既知 2 種との間に明瞭な形態的差異が認められることから，正当な種と見なすことを提案した．

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