

Two new species of the genus *Munida* Leach, 1820 (Decapoda: Anomura: Munididae) from Indonesia

Два новых вида рода *Munida* Leach, 1820 (Decapoda: Anomura: Munididae) из Индонезии

Enrique Macpherson¹, Paula C. Rodríguez-Flores^{1,2},
Annie Machordom²
Энрике Макферсон¹, Паула К. Родригес-Флорес^{1,2},
Анни Мачордом²

¹ Centre d'Estudis Avançats de Blanes (CEAB-CSIC), C. acc. Cala Sant Francesc, 14, 17300 Blanes, Girona, Spain.

E-mail: macpherson@ceab.csic.es

² Museo Nacional de Ciencias Naturales (MNCN-CSIC), José Gutiérrez Abascal, 2, 28006 Madrid, Spain.

E-mail: paularodriguezflores@gmail.com

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КЛЮЧЕВЫЕ СЛОВА: Galatheoidea, интегративная таксономия, западная часть Тихого океана, митохондриальные гены.

ABSTRACT. *Munida vassilyi* sp.n. and *M. hastata* sp.n. are described from Kei Islands, Indonesia. *Munida vassilyi* sp.n. is morphologically related to *M. runcinata*, from New Caledonia, Vanuatu, Wallis and Futuna, Fiji and Tonga, whereas *M. hastata* sp.n. is more similar to *M. aurantiaca* from Papua – New Guinea. Pairwise genetic distances estimated using the COI and 16S rRNA gene fragments indicated high levels of sequence divergence between each new species and their most closely related allies.

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РЕЗЮМЕ. *Munida vassilyi* sp.n. и *M. hastata* sp.n. описаны с островов Кей, Индонезия. *Munida vassilyi* sp.n. морфологически близка к *M. runcinata* из Новой Каледонии, Вануату, Уоллиса и Футуны, Фиджи и Тонги, в то время как *M. hastata* sp.n. больше похожа на *M. aurantiaca* из Папуа – Новой Гвинеи. Попарные генетические расстояния, оцененные с использованием фрагментов генных маркеров COI и 16S рРНК, показали высокий уровень расхождения последовательностей между новыми и наиболее близкородственными видами.

Introduction

The genus *Munida* Leach, 1820 is a very diverse and abundant group of anomuran decapods, containing more than 300 species distributed throughout the

world from the coastal area to the abyssal plain [Baba *et al.*, 2008; Schnabel *et al.*, 2011]. This genus has the highest diversity in the western Pacific Ocean, e.g. Coral Sea, Indo-Malay-Philippine Archipelago [Macpherson *et al.*, 2010; Schnabel *et al.*, 2011; Rodríguez-Flores *et al.*, 2019]. Earliest studies by several authors during the last centuries include Henderson [1888] who sampled in the Kei Islands during the HMS Challenger expedition, Ortmann [1894] in Ambon, and De Man [1888, 1902] in Ternate, Moluccas Islands. Since these expeditions, other more recent investigations of Indonesian waters have reported new findings on squat lobsters, including new species of the genus *Munida* (e.g. Baba [1977, 1988]; Baba, Macpherson [1991]; Macpherson, Baba [1993]; Baba, de Saint Laurent [1996]; Macpherson [1993, 1997]). Furthermore, some authors have studied other genera of squat lobsters, e.g., the galatheoids *Leiogalatea*, *Phylladiorhynchus* [Rodríguez-Flores *et al.*, 2019, 2021], or the chirostyloids *Eumunida* [Gordon, 1930; de Saint-Laurent, Poupin, 1996], *Uroptychus* [Baba, 2018]. These studies highlight the existence of a rich fauna in Indonesian waters and that a significant portion of the biodiversity probably still remained to be discovered.

During an expedition to Kei Islands, Indonesia, in October 1991 (KARUBAR) [Macpherson, 1997], specimens of two species of squat lobster of the genus *Munida* Leach, 1820, were collected. The morphological and molecular analyses of these specimens indicate that they have marked morphological and molecular differences from other species of *Munida*. Therefore, the specimens are described and illustrated here.

Material and methods

SAMPLING AND IDENTIFICATION. Specimens were collected using beam trawls. The types are deposited in the collections of the Muséum national d'Histoire naturelle, Paris (MNHN). The general terminology employed in the descriptions largely follows Baba *et al.* [2009] and Macpherson & Baba [2011]. The size of the carapace indicates the postorbital carapace length measured along the dorsal midline from the posterior margin of the orbit to the posterior margin of the carapace. The length of each pereopod article is measured in lateral view along its extensor margin (excluding distal spine), the breadth is measured at its widest portion. Abbreviations used are: Mxp3 — maxilliped 3; P1 — pereopod 1; P2–4 — pereopods 2–4; M — male.

MOLECULAR ANALYSIS. Tissue of each specimen was isolated from the muscle of the fifth pereopods and homogenized overnight with 20 µl proteinase K in 180 µl of buffer ATL (QIAGEN). The extraction was performed using DNeasy Blood and Tissue Kit following manufacturer instructions (QIAGEN). Two molecular markers were amplified: a fragment from the mitochondrial cytochrome oxidase subunit I (COI) using primers LCO1490 [Folmer *et al.*, 1994] and COI-H [Machordom *et al.*, 2003], and a 16S rRNA (16S) fragment, using 16SAR-16SBR from Palumbi *et al.* [2002] pair of primers.

The pre-mixing of the PCR reagents was conducted in 25 µl total volume, which included 2 µl of genomic DNA extract, 0.2 mM of each deoxyribonucleotide triphosphate (dNTP), 0.2 µM of each primer forward and reverse, 2U of MyTaq polymerase (Bioline), 5 µl of 5x buffer solution with MgCl₂ and sterilized H₂O. PCR amplification was performed with a thermal cycle including an initial denaturation at 94–95° for 1–4 min and 40 cycles at 95° for 1 min, annealing at 42–45° for 1 min followed by an extension at 72° for 1 min. A final extension cycle at 72°C was set for 10 min. The amplicons were visualized in agarose 1% gels and purified using ExoSAP-IT™ PCR Product Cleanup Reagent (Thermo Fischer) before sequencing. The purification products were sent to Secugen S.L. (Madrid) for DNA Sanger sequencing.

The nucleotide sequences of both forward and reverse were visualized and assembled with Sequencher 4.10.1 software package (Gene Codes Corp.). Manual alignment for the COI and 16S genes was carried out in MAFFT [Katoh *et al.*, 2002] and revised in AliView [Larsson, 2014]. Genetic distances between species and their closely related species were estimated using uncorrected divergences (p) calculated using PAUP version 4.0 (build 167) [Swofford, 2002]. All the obtained sequences were submitted to GenBank (accession numbers: COI: MZ356538, MZ356539, 16S: MZ357703, MZ357704).

Taxonomy

Superfamily Galatheoidea Samouelle, 1819
Family Munididae Ah Yong, Baba, Macpherson
et Poore, 2010
Genus *Munida* Leach, 1820

Munida hastata sp.n.

Fig. 1.

HOLOTYPE. Indonesia, Kei islands. KARUBAR, Stn DW15, 24/10/1991, 05°17'S, 132°41'E, 212–221 m: M 12.2 mm (MNHN-IU-2016-9655).

ETYMOLOGY. From the Latin, *hastatus*, spear-shaped, in reference to the long chelipeds of the species.

DESCRIPTION. *Carapace:* 1.2 times longer than broad, with some secondary striae and scales between main transverse ridges; dorsal surface moderately convex. Dorsal ridges with dense short non-iridescent setae and a few scattered long iridescent setae. Gastric region with 6 pairs of epigastric spines, longest pair behind supraocular spines, one pair between largest pair of spines. Two minute hepatic spines near margin, one parahepatic, one branchial dorsal on each side and one postcervical spine on left side. Frontal margins transverse. Lateral margins subparallel. First lateral spine at anterolateral angle, long, exceeding level of sinus between rostrum and supraocular spines; one small spine in front of anterior branch of cervical groove; end of anterior branch of cervical groove with tuft of iridescent setae. Branchial margins slightly convex, with five spines. Rostrum spiniform, about 0.6 times length of remaining carapace, slightly upwards directed, dorsally carinate. Supraocular spines reaching midlength of rostrum and end of cornea, slightly divergent, directed slightly upwards. Grooves between rostrum and supraocular spines shallow. Pterygostomian flap unarmed and not visible in dorsal view, ending in one spine. Epistome with ridge arising from marginal ridge of mouth, laterally leading to level of antennal gland aperture.

Sternum: 0.8 times longer than broad; maximum width at sternite 7. Lateral parts of posterior sternites never with carinae or granules. Surface of thoracic sternites 4–5 with scales. Sternite 3 3.5 times wider than long, as wide as anterior margin of sternite 4. Sternite 4 trapezoidal, anterior margin wide and contiguous to sternite 3 along entire length; 3.1 times wider than long, and 2.5 times wider than sternite 3.

Abdomen: Anterior ridge of somite 2 with 1–2 small lateral spines on each side; somites 2–4 each with 5–7 uninterrupted or scale-like transverse ridges on tergite behind anterior ridge; some iridescent setae on each side of anterior ridges of somites 2–3; posteromedian margin of somite 6 straight. Posterior plates of telson moderately wide, each plate with length-breadth ratio 0.7.

Eyes: Ocular peduncles as long as broad. Cornea dilated, maximum diameter 0.4 distance between bases of anterolateral spines.

Antennule: Article 1 (distal spines excluded) very long, about 0.3 times carapace length, 2.2 times longer than wide (excluding spines), slightly overreaching end of cornea, with 2 subequal distal spines; 2 spines on lateral margin, proximal one short, located at midlength of segment, distal one long, reaching end of distal spines.

Antenna: Article 1 not fused with cephalothorax, with strong distomesial spine reaching distal margin of article 4. Article 2 with distomesial spine exceeding antennal peduncle, additional small spine along mesial margin; distolateral spine slightly reaching end of article 4. Article 3 and 4 unarmed.

Mxp3: Ischium with strong distal spine on flexor margin. Merus shorter than ischium; flexor margin with 2 spines, proximal stronger than distal; extensor margin with small distal spine. Carpus unarmed.

P1: Long, 7.0 times carapace length, covered with scales, dense short plumose setae on each scale. Merus 2.5 length of carapace, 1.8 times as long as carpus, with some dorsal and mesial spines; distal spines short. Carpus 0.7 length of palm, 5.5 times as long as broad, with a few small spines along mesial and dorsal sides. Palm 5.5 times longer than broad, with some minute dorsal spines. Fingers 0.6 palm length; 1–2 small marginal spines on each fingers.

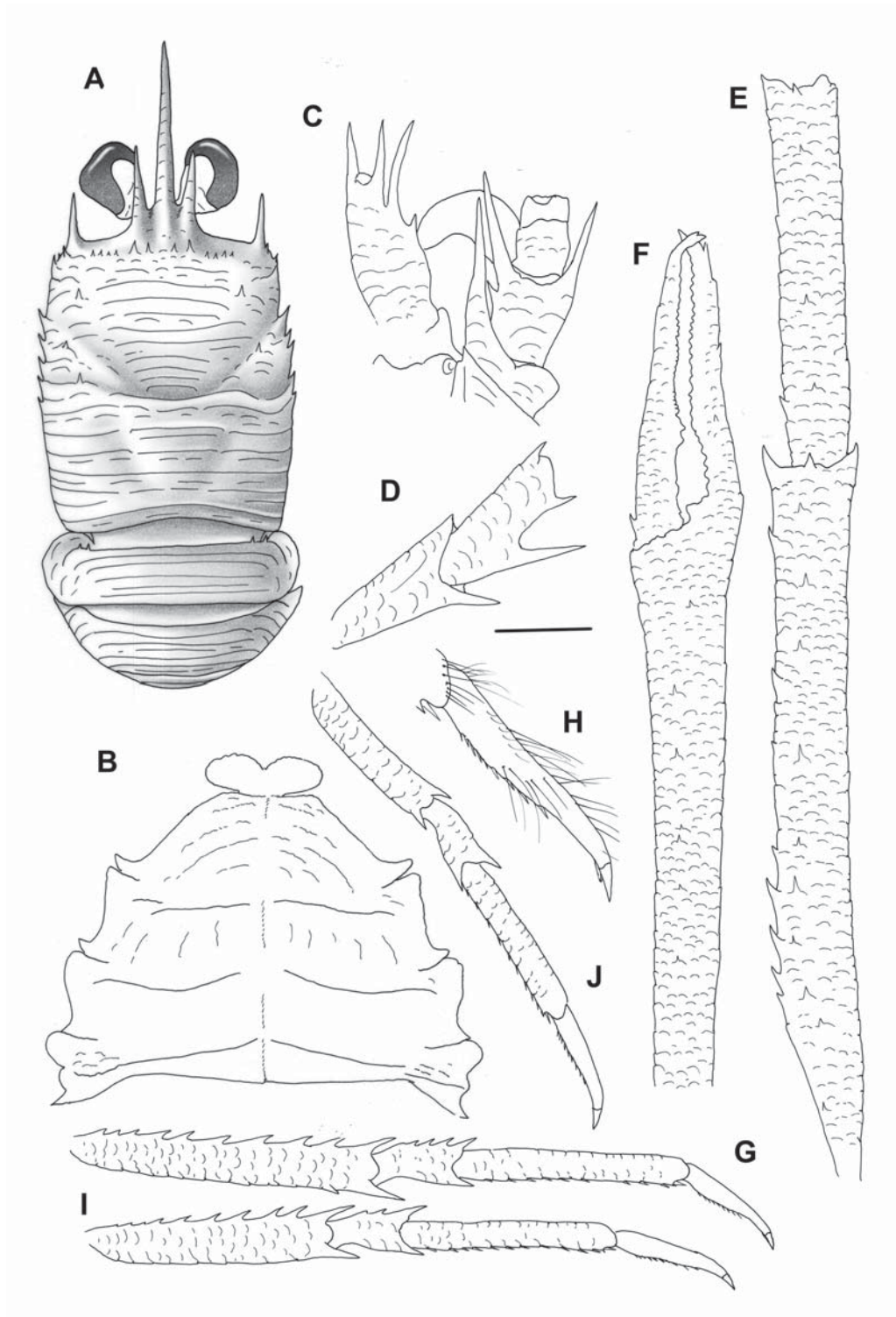


Fig. 1. *Munida hastata* sp.n., ♂, 12.2 mm (MNHN-IU-2016-9655): A — carapace and pleon, dorsal; B — sternal plastron; C — cephalic region, showing left antennular and antennal peduncles, ventral; D — right Mxp3, lateral; E — right P1, merus and carpus, lateral; F — right P1, propodus and dactylus, lateral; G — right P2, lateral; H — right P2 dactylus, lateral; I — right P3, lateral; J — right P4, lateral. Scale: A, E, F, G, I, J — 4.0 mm; B, C, D, H — 2.0 mm.

Рис. 1. *Munida hastata* sp.n., ♂, 12,2 мм (MNHN-IU-2016-9655): A — карапакс и плеон, дорсально; B — стернальный пластрон; C — головная область, показаны левые антеннуальные и антеннальные стебельки, вентрально; D — правый Mxp3, латерально; E — правый P1, мерус и карпус, латерально; F — правый P1, проподус и дактилус, латерально; G — правый P2, латерально; H — правый P2 дактилус, латерально; I — правый P3, латерально; J — правый P4, латерально. Масштаб: A, E, F, G, I, J — 4,0 мм; B, C, D, H — 2,0 мм.

P2-4: Moderately long and slender, with numerous long plumose setae and some long iridescent setae along extensor margin of articles. *P2* 2.5 times carapace length. Meri shorter posteriorly (*P3* merus 0.8 length of *P2* merus, *P4* merus 0.7 length of *P3* merus). *P2* merus thicker than those of *P3* and *P4*; *P2* merus 1.1 length of carapace, 7 times as long as broad, 1.4 times longer than *P2* propodus; *P3* merus 6 times longer than broad, 1.2 times longer than *P3* propodus; *P4* merus 4 times as long as broad, 1.1 times length of *P4* propodus. Extensor margins of *P2-3* meri with row of 9–10 proximally diminishing spines, and one distal spine on *P4*; flexor margins distally with 1–2 spines followed proximally by several eminences; lateral sides unarmed. Carpi with 3–5 spines on extensor margin of *P2-3*, one distal spine on *P4*; lateral surface with several granules sub-parallel to extensor margin on *P2-4*; flexor margin with distal spine. Propodi 6.5–6.8 (*P2-3*), 5.1 (*P4*) times as long as broad; extensor margin unarmed; flexor margin with 10–11 slender movable spines on *P2-4*, distal end with one fixed spine. Dactyli slender, length 0.5–0.7 that of propodi; flexor margin with 9–10 movable spinules, with spinule at base of unguis, wide unarmed gap between penultimate and ultimate spine; *P2* dactylus 7.0 times longer than wide. *P4* moderately long and slender, merocarpal articulation reaching anterior branchial margin of carapace.

GENETIC DATA. COI, 16S.

REMARKS. *Munida hastata* belongs to the group of species having five spines on the branchial lateral margins of the carapace, thoracic sternites without granules or carinae, anterior ridge of the second abdominal somite with 1–2 small spines on each side, article 1 of antennule with subequal distal spines, extensor margin of *Mxp3* merus with small distal spine and terminal third of flexor margin of *P2-4* dactyli unarmed between ultimate and penultimate spines. The new species is closely related to *M. aurantiaca* Macpherson, Rodríguez-Flores et Machordom, 2020, from Papua-New Guinea [Macpherson *et al.*, 2020]. Both species are morphologically very similar and only differ by the length and shape of *P1*: *P1* are longer in males of the new species (7.0 times longer than carapace) than in *M. aurantiaca* (3.5 times); the carpus is 2.2 times longer than wide in *M. aurantiaca*, whereas it is 5.5 times in *M. hastata*.

Genetically both species are different. *Munida hastata* showed high divergence values with *M. aurantiaca* (4.7% COI, 2.0% 16S).

DISTRIBUTION. Indonesia, Kei islands, between 212 and 221 m.

Munida vassilyi sp.n.

Fig. 2.

HOLOTYPE. Indonesia, Kei islands, KARUBAR, Stn CP06, 22/10/1991, 05°49'S, 132°21'E, 287–298 m: M 10.3 mm (MNHN-IU-2016-9654).

ETYMOLOGY. The species is named for our friend and colleague, the late Vassily Spiridonov, for his important contributions to carcinology.

DESCRIPTION. *Carapace*: As long as broad, with some secondary striae and scales between main transverse ridges, dorsal surface moderately convex. Dorsal ridges with dense short plumose setae, non-iridescent, and a few scattered long iridescent setae. Gastric region with 4–5 epigastric spines on either side, dorsal carapace surface otherwise unarmed. Frontal margins transverse. Lateral margins subparallel and slightly convex. First lateral spine at anterolateral

angle, long, reaching level of sinus between rostrum and supraocular spines; two small spines in front of anterior branch of cervical groove; end of anterior branch of cervical groove with tuft of iridescent setae. Branchial margins with five spines. Rostrum spiniform, about 0.7 times length of remaining carapace, slightly upwards directed, dorsally not carinate. Supraocular spines not reaching midlength of rostrum and end of corneae, slightly divergent, directed slightly upwards. Grooves between rostrum and supraocular spines shallow. Pterygostomian region not visible in dorsal view, unarmed, ending in blunt angle. Epistome with ridge arising from marginal ridge of mouth, laterally leading to level of antennal gland aperture.

Sternum: 0.8 times longer than broad; maximum width at sternite 7. Surface of thoracic sternites 4–6 with numerous scales. Sternite 3 2.8 times wider than long, slightly wider than anterior margin of sternite 4. Sternite 4 trapezoidal, anterior margin wide and subparallel to sternite 3 along entire border; 2.5 times wider than long, and 2.5 times wider than sternite 3. Lateral parts of posterior sternites without carinae or granules.

Abdomen: Anterior ridge of somites unarmed; somites 2–4 each with 7–9 uninterrupted or scale-like transverse ridges on tergite behind anterior ridge; some iridescent setae on each side of anterior ridges of somites; posteromedian margin of somite 6 straight. Posterior plates of telson moderately wide, each plate with length-breadth ratio 0.7.

Eyes: Ocular peduncles as long as broad. Corneae dilated, maximum diameter 0.5 distance between bases of anterolateral spines.

Antennule: Article 1 (distal spines excluded) very long, about 0.3 times carapace length, twice longer than wide (excluding spines), slightly exceeding end of corneae, with 2 distal spines, distomesial slightly longer than distolateral; 2 spines on lateral margin, proximal one short, located at midlength of segment, distal one long, nearly reaching end of distolateral spine.

Antenna: Article 1 not fused with cephalothorax, with distomesial spine nearly reaching distal margin of article 2. Article 2 with distomesial spine exceeding antennal peduncle, additional small spine along mesial margin; distolateral spine slightly reaching end of article 3. Article 3 and 4 unarmed.

Mxp3: Ischium with strong distal spine on flexor margin. Merus shorter than ischium; flexor margin with 2 spines, proximal stronger than distal; extensor margin with small distal spine. Carpus unarmed.

P1: 4.0 times carapace length, covered with scales, dense short plumose setae on each scale, and some scattered long spines. Merus 1.3 length of carapace, 1.8 times as long as carpus, with some dorsal and mesial spines; distomesial spine strong, not reaching first quarter of carpus. Carpus 0.8 length of palm, 2.3 times as long as broad, with a few small spines along mesial and dorsal sides. Palm 2.5 times longer than broad, with some minute dorsal spines; row of small spines along mesial and lateral margins. Fingers as long as palm; movable and fixed fingers with proximal and distal spines.

P2-4: Moderately long and slender, covered with setose scales, with numerous long plumose setae and some long iridescent setae along extensor margin of articles. *P2* 2.3 times carapace length. Meri shorter posteriorly (*P3* merus 0.8 length of *P2* merus, *P4* merus 0.7 length of *P3* merus); *P2* merus thicker than those of *P3* and *P4*. *P2* merus 0.9 length of carapace, 5.5 times as long as broad, 1.5 times

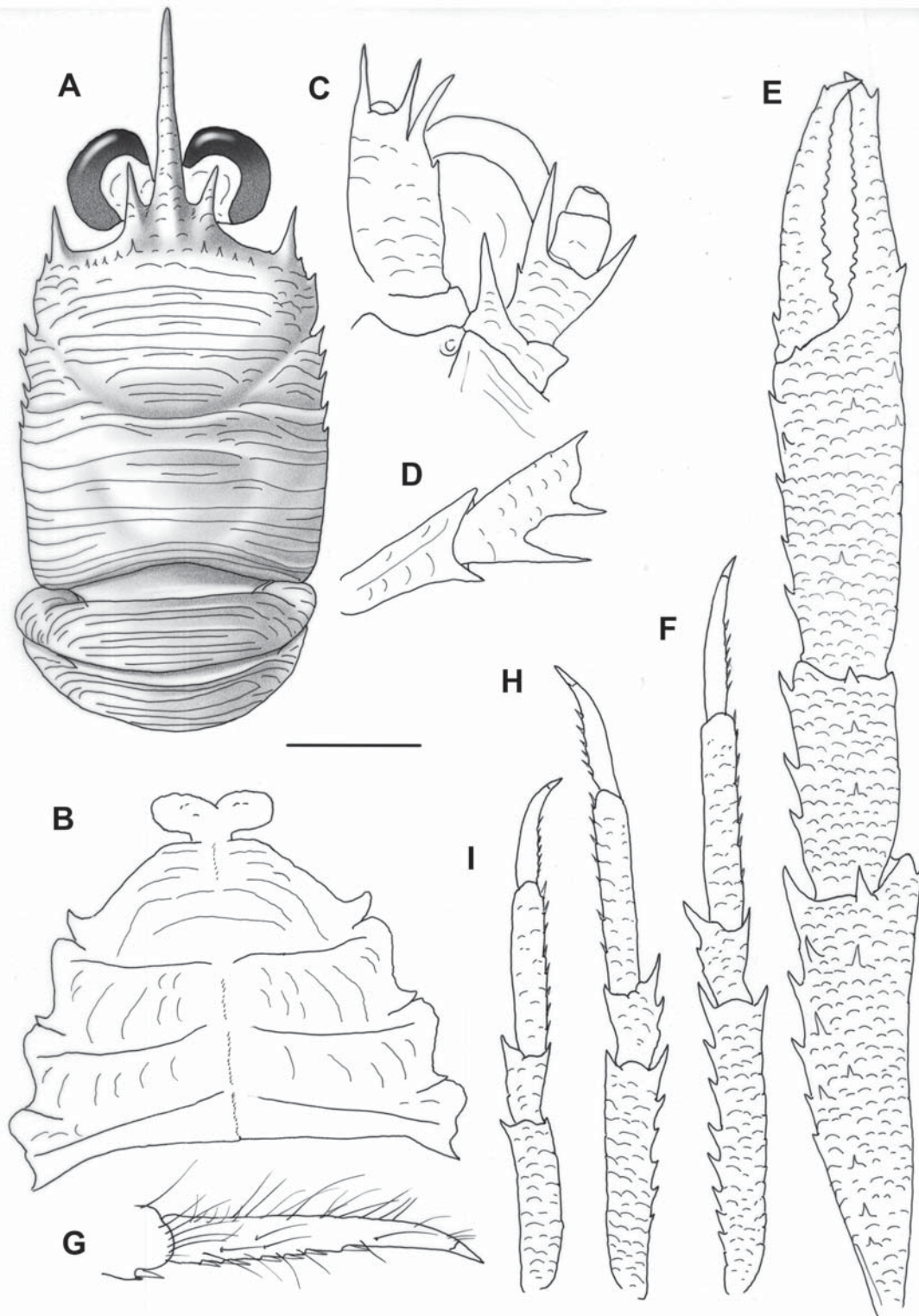


Fig. 2. *Munida vassilyi* sp.n., ♂, 10.3 mm (MNHN-IU-2016-9654): A — carapace and pleon, dorsal; B — sternal plastron; C — cephalic region, showing left antennular and antennal peduncles, ventral; D — right Mxp3, lateral; E — right P1, lateral; F — right P2, lateral; G — right P2 dactylus, lateral; H — left P3, lateral; I — right P4, lateral. Scale: A, E, F, H, I — 4.0 mm; B, C, D, G — 2.0 mm.

Рис. 2. *Munida vassilyi* sp.n., ♂, 10,3 мм (MNHN-IU-2016-9654): А — карапакс и плеон, дорсально; В — стеральный пластрон; С — головная область, показаны левый антеннуальный и антеннальный стебельки, вентрально; D — правый Mxp3, латерально; E — правый P1, латерально; F — правый P2, латерально; G — правый P2 дактилус, латерально; H — левый P3, латерально; I — правый P4, латерально. Масштаб: А, E, F, H, I — 4,0 мм; B, C, D, G — 2,0 мм.

longer than P2 propodus; P3 merus 4.5 times longer than broad, 1.3 times longer than P3 propodus; P4 merus 3.8 times as long as broad, 1.1 times length of P4 propodus. Extensor margins of P2–3 meri with row of 7–8 proximally diminishing spines, one distal spine on P4; flexor margins distally with 1–2 spines followed proximally by several eminences; lateral sides unarmed. Carpi with 3 spines on extensor margin of P2–3, one distal spine on P4; lateral surface with several granules sub-parallel to extensor margin on P2–4; flexor margin with distal spine. Propodi 5.0–5.5 (P2–3), 4.7 (P4) times as long as broad; extensor margin unarmed; flexor margin with 7–8 slender movable spines on P2–4, distal end with one fixed spine. Dactyli slender, length 0.7–0.8 that of propodi; flexor margin with 6–7 movable spinules, without spinule at base of unguis, distal third unarmed; P2 dactylus 7.0 times longer than wide. P4 moderately long and slender, merocarpal articulation reaching anterior branchial margin of carapace.

GENETIC DATA. COI, 16S.

REMARKS. *Munida vassilyi* belongs to the group of species having five spines on the branchial lateral margins of the carapace, dorsal surface of the carapace with epigastric spines only, thoracic sternites without granules or carinae, anterior ridge of the abdominal somites unarmed, extensor margin of Mxp3 merus with small distal spine and terminal third of flexor margin of P2–4 dactyli unarmed. The new species is closely related to *M. runcinata* Macpherson, 1994, from New Caledonia, Vanuatu, Wallis and Futuna, Fiji and Tonga [Macpherson, 1994]. However, both species can be distinguished by the following characters:

- Thoracic sternites with numerous scales in the new species, whereas the sternites are smooth and there are only a few scales in the sternite 4 in *M. runcinata*.

- The antennular article 1 has the distomesial spine slightly longer than the distolateral in *M. vassilyi*, whereas they are subequal in *M. runcinata*.

- The distomesial spine of the antennal article 1 clearly exceeds the article 2 in *M. runcinata*, whereas this spine nearly reaches the distal margin of this article in the new species.

Genetically both species are different. *Munida vassilyi* showed high divergence values with *M. runcinata* (5.9% COI, no data of 16S for *M. runcinata*).

DISTRIBUTION. Indonesia, Kei islands, between 287 and 298 m.

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