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Miocene records of *Entricoplax* Castro and *Exoptheticus* Castro (Decapoda: Brachyura: Goneplacidae) from Japan

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Abstract

Two species belonging to two goneplacid genera from the Miocene of Japan are herein described. *Carcinoplax granulimanus* Karasawa and Inoue, 1992, from the Middle Miocene (Serravallian) Osaki Formation of Tanegashima, is assigned to *Entricoplax* Castro, 2007. The revised diagnosis and description are provided for this species. *Exoptheticus* cf. *hughi* (Rathbun, 1914) is recorded from the Lower Miocene (Burdigalian) Kurosedani Formation of central Honshu. Both genera are recorded for the first time from the Miocene of Japan.

Key words: Eubrachyura, Goneplacoidea, *Entricoplax*, *Exoptheticus*, Cenozoic

1. Introduction

Goneplacidae MacLeay, 1838, consists of 23 extant and four extinct genera (Schweitzer et al., 2022; DecaNet eds., 2025). Most recently, Nyborg et al. (2025) described two extinct genera from the Paleogene of North America. Among extant genera, six genera have the fossil records (Schweitzer et al., 2022). The Japanese Miocene goneplacids are represented by two genera, *Carcinoplax* H. Milne Edwards, 1852, with four species, *C. antiqua* (Ristori, 1889), *C. granulimanus* Karasawa and Inoue, 1992, *C. imperfecta* Karasawa and Inoue, 1992, and *C. prisca* Imaizumi, 1961, and *Psoptheticus* Wood-Mason, 1892, with an unnamed species reported by Imaizumi (1958; 1969).

The purpose of this work is to describe two species belonging to two unrecorded genera of Goneplacidae from the Miocene of Japan, based upon examinations of the paleontological collection in the Mizunami Fossil Museum (MFM).

2. Systematic Paleontology

Family Goneplacidae MacLeay, 1838

Genus *Entricoplax* Castro, 2007

Type species: *Cancer (Curtonotus) vestitus* De Haan, 1833, by original designation.

Diagnosis: Carapace transversely rectangular, much wider than long; widest at anterolateral angle; front concave, not marked by median notch or projection; notch between front and inner edge of upper orbital margin slight; orbits long, wide; upper orbital margins concave, weakly bilobed; suborbital margin long, concave; outer orbital angle with short prominence; anterolateral margins convex with 2 short anterolateral teeth; dorsal surface covered by abundant setae, moderately convex, without clear indication of regions. Thoracic sternum wide; sutures 4/5–7/8 interrupted medially; anterior end of sternopleonal cavity anterior to sternite 4. Pleon of both sexes with 6 freely

movable somites plus telson; somite 2 of male not entirely covered space between coxae, relatively large portion of thoracic sternite 8 visible. Chelipeds subequal largely covered with setae. Pereiopods 2–5 covered with setae. [modified from Castro (2007, p. 745) and Schweitzer et al. (2022, p. 9)].

Included species: Entricoplax granulimana (Karasawa and Inoue, 1992) new combination; *E. vestita*.

Entricoplax granulimana

(Karasawa and Inoue, 1992) new combination

(Figs. 1.1–8)

Carcinoplax granulimanus Karasawa and Inoue, p. 85, pl. 2, figs. 10, 11, 13, 15, 16.

Revised diagnosis: Carapace transversely rectangular, much wider than long; fronto-orbital margin wide; front projected forward, with nearly straight frontal margin; orbits long, wide; upper orbital margin concave, weakly bilobed; inner orbital angle divided from frontal margin by subtle notch; outer orbital angle broadly triangular directed anteriorly; suborbital margin concave, finely dentate; anterolateral margins strongly convex with 2 short spines directed anterolaterally; posterolateral margins longer than anterolateral margins, gently convex; posterior margin straight, rimmed; dorsal surface moderately vaulted transversely, gently convex longitudinally, finely granular, with poorly defined regions. Propodus of cheliped slender, about 1.5 times as long as high; dactylus slightly shorter than palm; dorsal margin finely granular proximally; occlusal margin with irregular, broad teeth; proximal and middle teeth prominent; fixed finger triangular; occlusal margin with irregular, broad teeth; two proximal and median teeth large; ventral margin finely granular on proximal half; palm depressed laterally and mesially; lateral surface with weak ridge running obliquely from base of dactylus to ventral angle of proximal margin; surface behind oblique ridge covered with small granules arranged sparsely; dorsal and ventral margins densely granular.

Revised description: Carapace transversely rectangular in outline, much wider than long, length about 70 percent maximum carapace width, widest at last anterolateral spine. Fronto-orbital margin about 60% maximum carapace width. Front about 20% maximum carapace width, projected forward, downturned;

frontal margin nearly straight. Orbits long, wide; upper orbital margin concave, weakly bilobed; inner orbital angle divided from frontal margin by subtle notch; outer orbital angle broadly triangular directed anteriorly; suborbital margin concave, finely dentate. Anterolateral margins strongly convex with 2 short spines directed anterolaterally; anterolateral spine longer than anterior one. Posterolateral margins longer than anterolateral margins, gently convex, converging posteriorly. Posterior margin straight, rimmed, narrower than fronto-orbital margin. Dorsal surface moderately vaulted transversely, gently convex longitudinally; surface finely granular if cuticles present; regions poorly defined; anterior mesogastric region separated from protogastric regions by weak groove; subtle cervical groove present medially; cardiac region laterally surrounded by weak grooves.

Thoracic sternum of male wide, broadened posteriorly, widest at sternite 6. Sternites 1 and 2 not preserved. Sternite 4 longest, diverged posteriorly, fused axially, sutured to sternite 3. Sternites 5–7 much wider than long with broadly lobate episternal projections. Sternite 8 narrower than sternite 7. Sternal sutures 4/5 and 5/6 complete. Sternopleonal cavity deep; anterior end rounded reaching sternal suture 3/4.

Male pleonal somites 2 and 3 preserved; somite 2 much narrower than somite 3, not completely covering thoracic sternite 8.

Eyestalk relatively long; cornea small.

Propodus of right cheliped slender, about 1.5 times as long as high. Dactylus slightly shorter than palm, gently curved ventrally; dorsal margin finely granular proximally; occlusal margin with irregular, broad teeth; proximal and middle teeth prominent; lateral surface with weak longitudinal groove along dorsal margin. Fixed finger about as long as dactylus, triangular; occlusal margin with irregular, broad teeth; two proximal and median teeth large; ventral margin finely granular on proximal half; lateral surface keeled ventrally. Palm depressed laterally and mesially; lateral surface with weak ridge running obliquely from base of dactylus to ventral angle of proximal margin; surface behind oblique ridge covered with small granules arranged sparsely; dorsal and ventral margins densely granular. Carpus with dorso-mesial spine.

Some pereiopods preserved, but details not known.

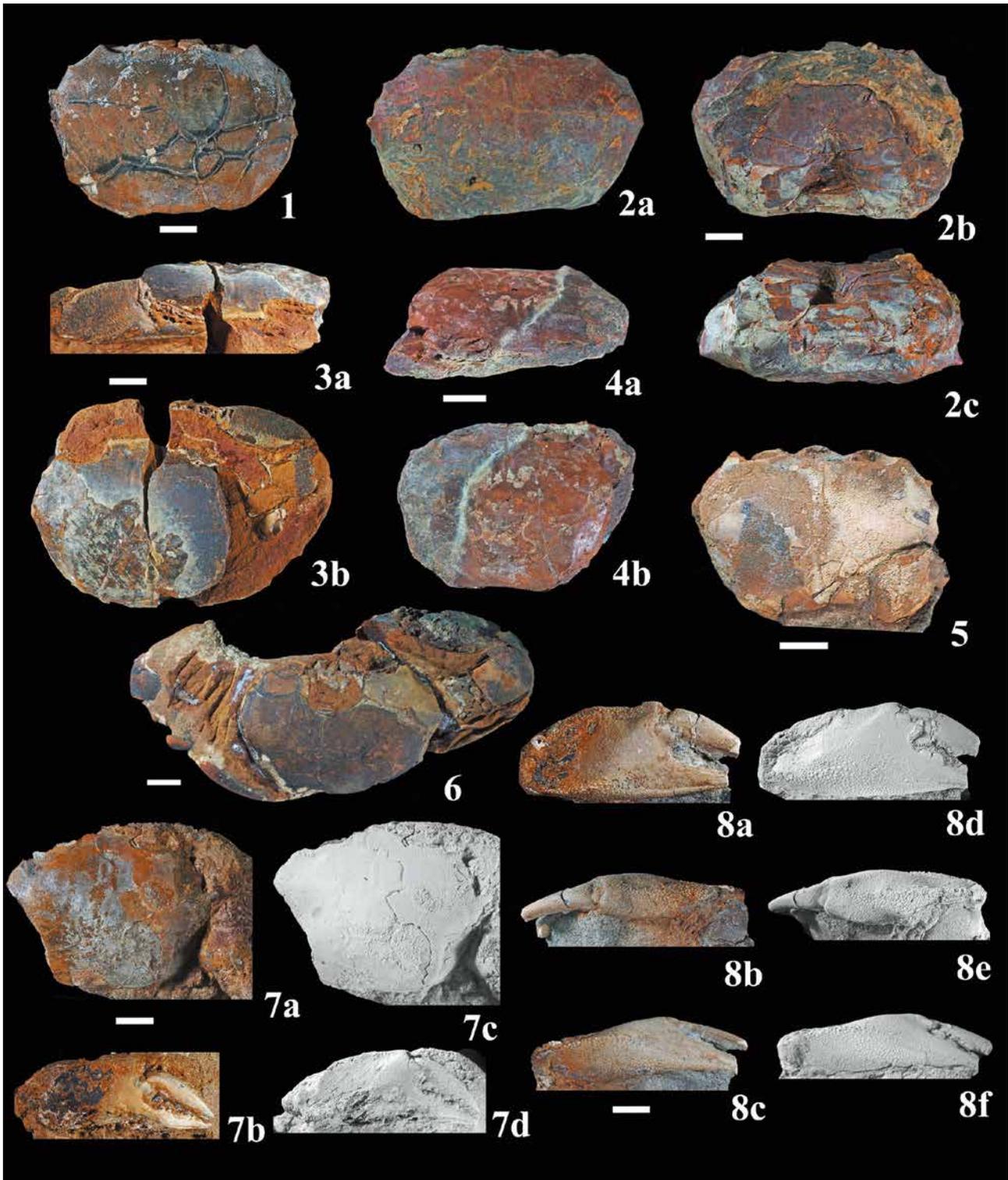


Fig. 1. 1–8. *Entricoplax granulimana* (Karasawa and Inoue, 1992) new combination, Osaki Formation (Middle Miocene: Serravallian). 1, MFM83007, holotype, carapace, dorsal view. 2a–c, MFM84144, carapace and thoracic sternum and male pleon, a, dorsal; b, ventral; c, posterior views. 3a–b, MFM84145, carapace and right cheliped, a, anterior; b, dorsal views. 4a–b, MFM84146, carapace, a, anterior; b, dorsal views. 5, MFM84147, carapace, dorsal view. 6, MFM84148, carapace and chelipeds, dorsal view. 7, MFM83008, paratype, carapace and right cheliped, a, c, dorsal view of carapace; b, d, lateral view of cheliped. 8, MFM83010, paratype, right cheliped, a, d, lateral; b, e, dorsal; e, f, ventral views. 7c–d and 8d–f are whitening images coated with ammonium chloride sublimate. Scale bar = 5 mm.

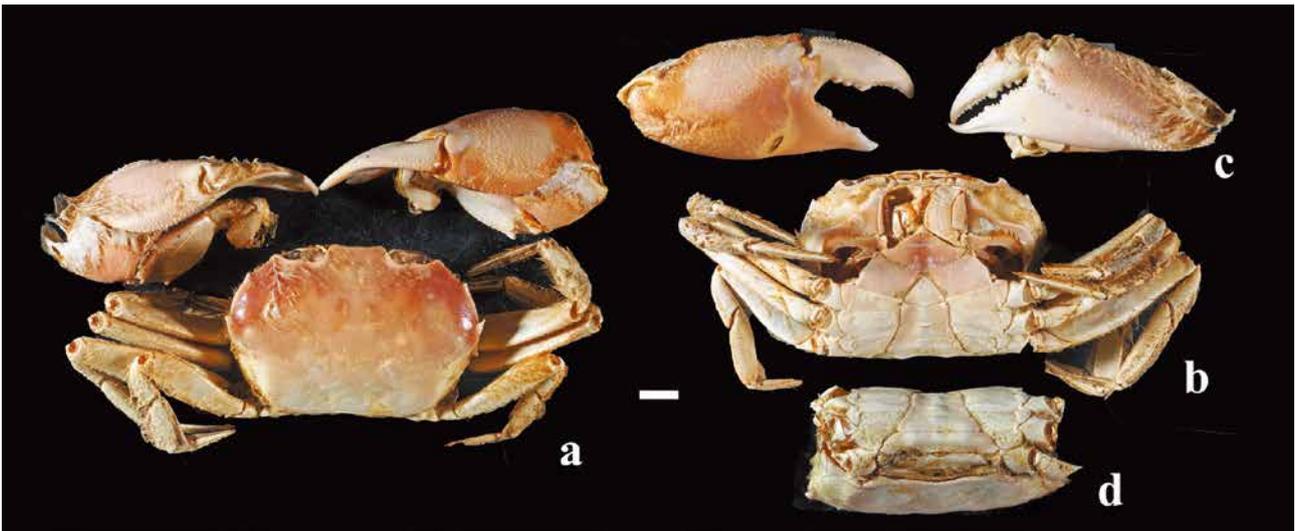


Fig. 2. *Entricoplax vestita* (De Haan, 1833), MFM129117-2, extant dry specimen from Mikawa Bay (setae were omitted), a, dorsal view; b, ventral view; c, lateral view of chelipeds; d, posterior view. Scale bar = 5 mm.

Remarks: Karasawa and Inoue (1992) described *Carcinoplax granulimanus*, a new species of *Carcinoplax* H. Milne Edwards, 1852, resembling the Japanese Miocene species, *Carcinoplax antiqua* (Ristori, 1889). This species is only known from the Middle Miocene (Serravallian) Osaki Formation of the Kuki-naga Group.

Entricoplax is a monotypic genus with *E. vestita* (De Haan, 1833) and it is characterized by the carapace, chelipeds and pereopods covered with conspicuous setae within Goneplacidae (Castro, 2007, p. 621, 656). Additionally, examinations of *Entricoplax vestita* with setae removed (Fig. 2) give the following characters for the species: the carapace is finely granular dorsally; the cheliped palm is depressed laterally and mesially; a granular lateral surface of the palm has a weak ridge running obliquely from the base of the dactylus to a ventral angle of the proximal margin. Although some species among *Carcinoplax* have the dorsal carapace and chelae covered with conspicuous granules (i.e., Ng and Castro, 2020; Ng et al., 2022), they do not have the bilobed upper orbital margins, the cheliped lateral surface lacks an oblique ridge, and the pleonal somite 2 of male is much narrower than the somites 1 and 2.

Carcinoplax granulimanus shares the carapace and cheliped characters with those of *E. vestita* and, therefore, it is herein moved from *Carcinoplax* to *Entricoplax*. A

nearly straight frontal margin of the carapace and cheliped fingers with broad teeth distinguish *E. granulimana* (Karasawa and Inoue, 1992) new combination from *E. vestita*.

The oldest fossil record of *E. vestita* is reported from the Middle Pleistocene Hamamatsu Formation (Kato and Kitamura, 2020). Therefore, the occurrence of *E. granulimana* from the Osaki Formation extends the geologic range for the genus back to Middle Miocene (Serravallian).

Material examined: MFM83007, holotype; MFM83008–MFM83010, paratypes; MFM84144–MFM84148, topotypes. All from Loc. KO-2 of Karasawa and Inoue (1992), southwest of Osaki launching pad, Kuki-naga, Minamitane-cho, Kagoshima Prefecture; Hirota alternation Member of the Osaki Formation, Kuki-naga Group; Middle Miocene (Serravallian).

Genus *Exoptheticus* Castro, 2007

Type species: *Psoptheticus hughi* Rathbun, 1914, by original designation.

Diagnosis: Carapace subcircular to transversely sub-hexagonal, wider than long; front straight or slightly concave without median notch or projection; notch between front and inner edge of upper orbital margin absent; orbits wide; upper orbital margins sinuous; outer orbital teeth flattened, triangular; anterolateral margins convex with sharp anterolateral spine; dorsal surface smooth,

slightly convex, without clear indication of regions. Thoracic sternum wide; sutures 4/5, 5/6, and 7/8 interrupted medially, 6/7 complete; anterior end of sternopleonal cavity anterior to sternite 4. Pleon of male and female with 6 freely movable somites plus telson. Eyes reniform, dorso-ventrally flattened, cornea greatly expanded distally; eye peduncles relatively short to moderately long, shorter than front. Cheliped fingers slender, shorter than propodus. Stridulating mechanism of subocular, elliptical pterygostomial crest rubbing against proximal portion of cheliped merus [modified from Castro (2007, p. 745)].

Included species: Exoptheticus hughi (Rathbun, 1914); *E. insignis* (Alcock, 1900).

***Exoptheticus cf. hughi* (Rathbun, 1914)**

(Figs. 3.1–4)

Description: Carapace transversely subhexagonal in outline, much wider than long, length 72–80 percent maximum carapace width, widest at last anterolateral spine. Fronto-orbital margin 80–90% maximum carapace width. Front about 30% maximum carapace width, projected forward, downturned; frontal margin straight without median sulcus; Orbits long, wide; upper orbital margin concave, rimmed, with low, broadly triangular projection shallowly grooved dorsally; inner orbital angle not divided from frontal margin; outer orbital angle broadly triangular directed anterolaterally; suborbital margin concave. Anterolateral margins gently convex with sharp anterolateral spine directed laterally; anterolateral spine longer than outer orbital tooth. Posterolateral margins longer than anterolateral margins, gently convex, converging posteriorly. Posterior margin straight, rimmed, 40–50% maximum carapace width. Dorsal surface gently vaulted transversely and longitudinally; surface smooth if cuticles present; regions poorly defined; anterior mesogastric and protogastric regions bordered by weak groove; weak cervical groove present medially; epibranchial regions raised transversely.

Thoracic sternum of male wide, broadened posteriorly, widest at sternite 6. Sternites 1, 2, and 8 not preserved. Sternite 4 longest, diverged posteriorly, sutured to sternite 3; anterior end of sternopleonal cavity reaching sternal suture 3/4.

Male pleonal somites 2–6 and telson preserved; telson triangular, slightly wider than long; somite 6 longest of somites 3–5; somites 3–6 decreasing in length and increasing in width posteriorly; somite 2 shorter than somite 3, slightly narrower than somite 3.

Eyestalk preserved, long.

Chelipeds elongate, heterochely. Propodus of major cheliped about 3 times as long as high; dactylus slender, about 45 percent propodus length, gently curved ventrally and mesially; dorsal margin smooth; occlusal margin with irregular, broad teeth of which proximal one are prominent; lateral surface smooth; fixed finger slender, slightly shorter than dactylus, triangular, gently curved mesially, with upturned tip; occlusal margin with irregular, broad teeth; ventral margin smooth; lateral surface smooth, medially grooved; palm converged proximally, inflated laterally, smooth on dorsal and ventral margins and lateral surface; carpus with dorso-lateral and dorso-mesial spines. Minor cheliped similar to major one; propodus of minor cheliped about 85 percent major propodus length; teeth of occludent margins of both fingers fine rather than those of major one.

Some pereopods poorly preserved; dorsal margin not fringed with spines.

Remarks: The present specimens fit the main diagnostic characters of *Exoptheticus*, based upon the diagnosis and description provided by Castro (2007). This genus is represented by two extant species, *E. hughi* (Rathbun, 1914) from the West Pacific from Japan to the Philippines, and *E. insignis* (Alcock, 1900) from the Andaman Sea to the Western Pacific from Taiwan to Fiji (Castro, 2007). *Exoptheticus hughi* differs from *E. insignis* in that the dorsal carapace lacks the well-defined color spot, the chelipeds do not become long in adult with the merus bearing some distal spines, and the pleonal somite 2 of male is slightly narrower than the somite 3 (Castro, 2007). Although the detailed characters of the cheliped merus are not observed, the specimens are likely to be referable to *E. hughi* by having the male pleonal somite 2 slightly narrower than the somite 3.

Imaizumi (1958; 1969) reported *Psoptheticus* sp. from the Lower Miocene (Burdigalian) Higashi-innai Formation and Katsuta Group of Southwest Honshu. Species of *Psoptheticus* Wood-Mason, 1892,

have a transversely rectangular carapace, whereas his figured specimens have a transversely subhexagonal carapace, characteristic of *Exoptheticus*.

Although his specimens can be compared with *Exoptheticus*, more completed specimens are needed for species identification.

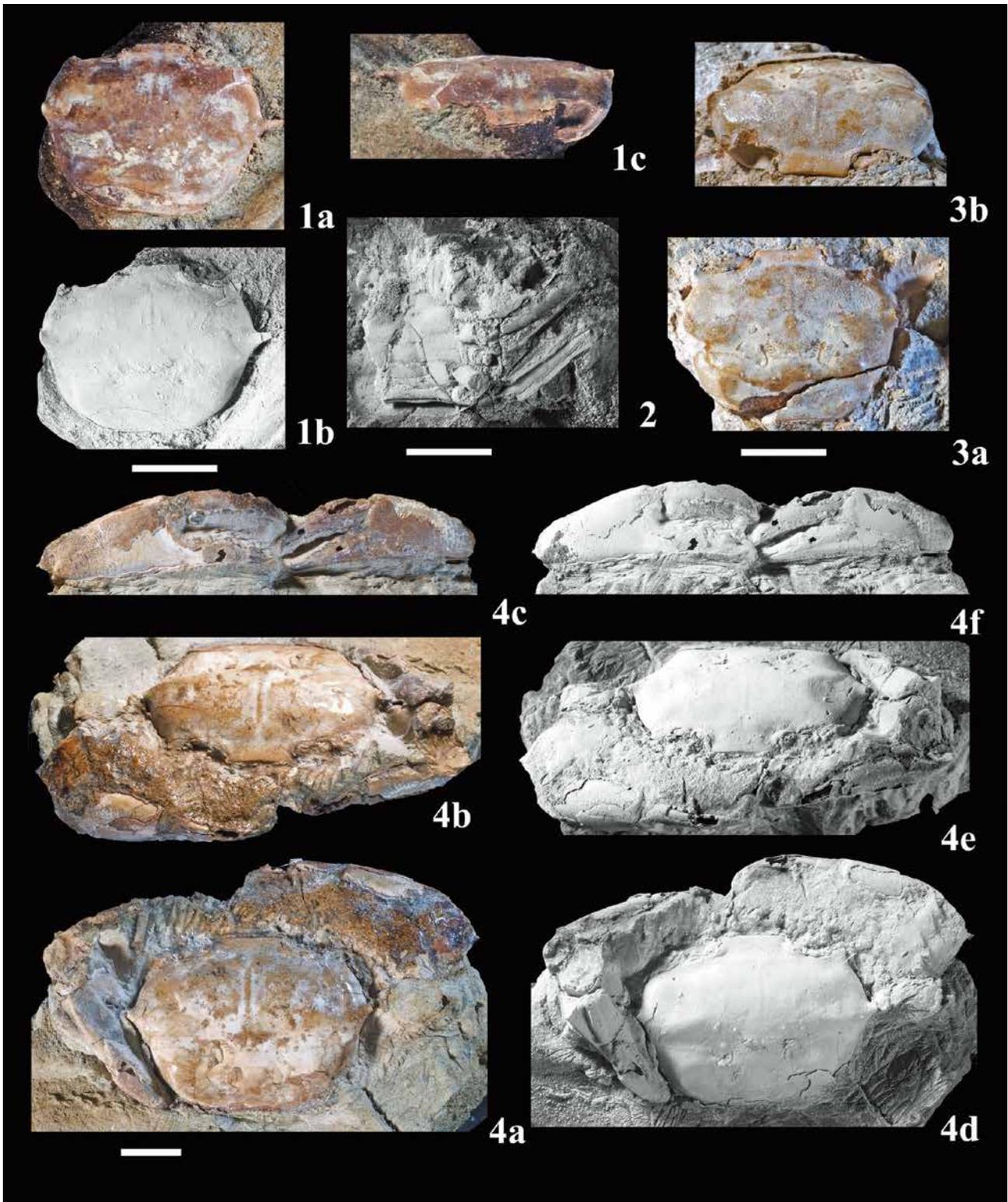


Fig. 3. 1–4. *Exoptheticus cf. hughi* (Rathbun, 1914), Kurosedani Formation (Lower Miocene: Burdigalian). 1, MFM84150, carapace, a, b, dorsal; c, anterior views. 2, MFM84151, ventral view of maxilliped 3, thoracic sternum, male pleon, and some pereiopods. 3, MFM84152, carapace, a, anterior; b, dorsal views. 4, MFM84153, carapace, chelipeds, and some pereiopods, a, d, dorsal; b, e, anterior; c, f, lateral views. 1b, 2, and 4d–f are whitening images coated with ammonium chloride sublimate. Scale bar = 5 mm.

Exophteticus is reported for the first time from the Early Miocene (Burdigalian) of Japan.

Material examined: MFM84150–MFM84153. All from Shimosasahara (southwest of locality of Amano et al. (2004)), Yatsuo-cho, Toyama City, Toyama Prefecture; Kurosedani Formation of the Yatsuo Group; Lower Miocene (Burdigalian).

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