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Species of the Genus *Ericthonius* (Crustacea: Amphipoda: Ischyroceridae) from Western Japan with Description of a New Species

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Abstract Two species of the genus *Ericthonius* Milne Edwards, 1830 (Amphipoda: Ischyroceridae), *E. convexus* sp. nov. and *E. pugnax* Dana, 1852, are reported from western Japan. Both species share a posterodistal lobe on the article 2 in male pereopod 5, which only *E. pugnax* possesses in all the *Ericthonius* species described. The new species is very similar to the latter species in the morphological characters and the general coloration in life. However, the new species is distinguishable from the latter species by the relatively larger eyes, the relatively slender peduncles of antennae, the convex posterior edge of telson between spinulose lobes (straight or concave in *E. pugnax*), and the distal edge of article 6 of gnathopod 2 in the hyper-adult male having a distinct incision (such an incision is absent in *E. pugnax*). In addition, the habitat preference is also different between the two species; *E. convexus* occurs on sandy-mud bottom, whereas *E. pugnax* inhabits under rocks in the intertidal zone and among seaweeds in the shallow sea.

Key words : Amphipoda, Ischyroceridae, *Ericthonius*, new species, Japan.

The ischyrocerid genus *Ericthonius* was established by Milne Edwards (1830) with *E. difformis* Milne Edwards, 1830 as its type species and 19 species of the genus are known so far (Moore, 1988; Barnard and Karaman, 1991; Krapp-Schickel, 1994; Vader and Myers, 1996; Hughes and Lowry, 2006). In Japan, several species of the genus have been recorded (Ishimaru, 1994); but only *Ericthonius pugnax* Dana, 1852 is recognized with certainty (Nagata, 1960, 1965b; Hirayama, 1985). During my survey of amphipod fauna of Japan, two species of the genus, including an undescribed species, were recognized. In the present paper, I describe a new species, *E. convexus*, and a detailed description is given for *E. pugnax*, closely allied to the new species, in order to make adequate comparison with the new species.

Materials and Methods

Samples were collected from the coasts of Osaka and Mie Prefectures, and the bottoms of Suo-nada in the Seto Inland Sea and Ariake Sea, Kyushu. Thirty individuals were dissected. Drawings were made with the aid of drawing tube mounted a phase-contrast microscope. Body length was measured from the apex of rostrum along the dorsal margin to the distal end of telson. The examined specimens, including the type series of the new species, are deposited in the National Museum of Nature and Science, Tokyo (NSMT) and the Osaka Museum of Natural History (OMNH).

Systematics

Ericthonius convexus sp. nov.

[New Japanese name: Soko-hoso-yokoebi]

(Figs. 1–8)

Ericthonius pugnax: Hirayama, 1985: 52, fig. 160 (map) (in part ?); Ishimaru, 1994: 36 (in part); ?Myers, 1995: 80, figs. 40–42.

Material examined. Holotype: NSMT-Cr 18218, male (6.7 mm), Suo-nada, off Otsu Island,

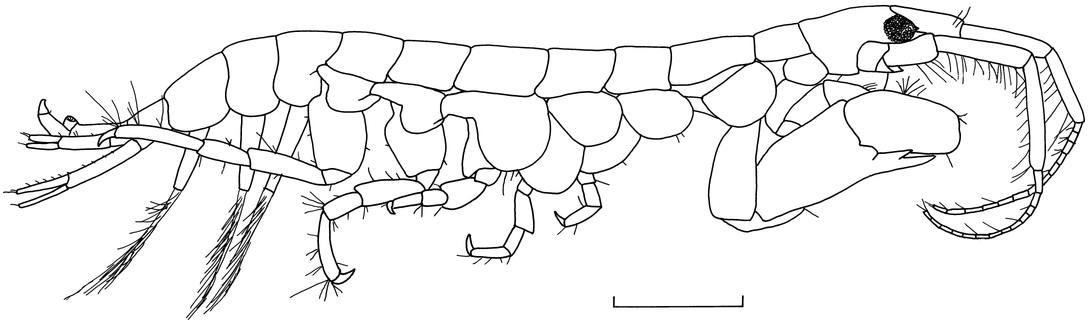

Fig. 1. *Ericthonius convexus* sp. nov., holotype, male (6.7 mm), NSMT-Cr 18218. Habitus, right lateral view. Scale: 1 mm.

Shunan City, Yamaguchi Prefecture (33°58′N, 131°42′E), ca. 40 m deep, sandy-mud bottom, commercial otter trawl, 26 February 2007, coll. Y. Uchida.

Allotype: NSMT-Cr 18219, ovigerous female (7.6 mm), same data as holotype.

Paratypes: NSMT-Cr 18220–18223, 4 males (7.6, 6.1, 5.2, 4.0 mm), same data as holotype; NSMT-Cr 18224, 1 ovigerous female (7.7 mm), same data as holotype; OMNH-Ar 7662, 10 males and 10 females (not dissected), same data as holotype; NSMT-Cr 18225, 1 male (6.4 mm), Ariake Sea (32°33′N, 130°23′E), 7.2 m deep, dredge, 15 May 2006, coll. K. Mori; NSMT-Cr 18226, 1 ovigerous female (7.1 mm), same data; NSMT-Cr 18227, 18228, 2 males (5.6, 5.2 mm), Ariake Sea (32°31′N, 130°20′E), 15 m deep, sandy-mud bottom, dredge, 12 May 2006, coll. K. Mori; NSMT-Cr 18229, 1 female (6.2 mm), same data; NSMT-Cr 18230, 1 male (4.0 mm), Tanigawa in Misaki, Osaka Prefecture (34°19′N, 135°07′E), 6 m deep, sandy-mud bottom, snorkeling, 18 August 1995, coll. H. Ariyama; NSMT-Cr 18231, 1 female (4.8 mm), same data.

Description. Holotype male. Body (Fig. 1) slender, relatively depressed. Rostrum short; ocular lobes projected, with pointed tip; antennal sinus deep. Eyes large, width about 1/3 of dorsal length of head. Antenna 1 (Fig. 2A) slender; ratio of lengths of peduncular articles 1–3 1 : 1.3 : 1.1, posterodistal part of peduncular article 1 with 2 robust setae, peduncular articles 2 and 3 setose posteriorly; accessory flagellum (Fig. 2A1) vestigial, with 3 short setae; flagellum with 14 articles, posterior surface bearing long and short setae, articles 2 and 4–11 each with aesthetasc posterodistally and article 3 with 2 aesthetascs posteriorly. Antenna 2 (Fig. 2B) subequal in length to antenna 1, with ratio of lengths of peduncular articles 3–5 1 : 1.9 : 2.3, article 3 with posterodistal robust seta, articles 4 and 5 setose posteriorly; flagellum with 12 articles.

Upper lip (Fig. 2C) rounded, with many short, thin setae ventrally; epistome strongly projected anteriorly. Mandible (Fig. 2D, E) each with 5 cusps on incisor, left and right laciniae mobilis with 4 and 5 cusps, respectively; palp strong, article length ratio 1 : 3.6 : 2.9, ventral surfaces of articles 2 and 3 and distal edge of article 3 heavily setose. Lower lip (Fig. 2F) with inner and outer lobes covered with thin setae on distal margins, mandibular lobes short. Maxilla 1 (Fig. 2G) with inner plate pointed ventrally, bearing 3 normal and many thin setae; outer plate bearing 11 robust setae distally; tip of article 2 of palp with 6 robust and 7 normal setae. Maxilla 2 (Fig. 2H) with both plates heavily setose. Maxilliped (Fig. 2I) with inner plate bearing 3 anterior and 1 ventral robust setae; outer plate with 6 medial robust setae; palp with 4 articles, article 2 long, article 4 with long spine apically.

Gnathopod 1 (Fig. 3A) small, subchelate; coxal plate bearing a few short setae on anteroventral corner; article 2 slightly broadened distally, anterior margin without setae; anterodistal corner of article 3 roundly protruded; article 4

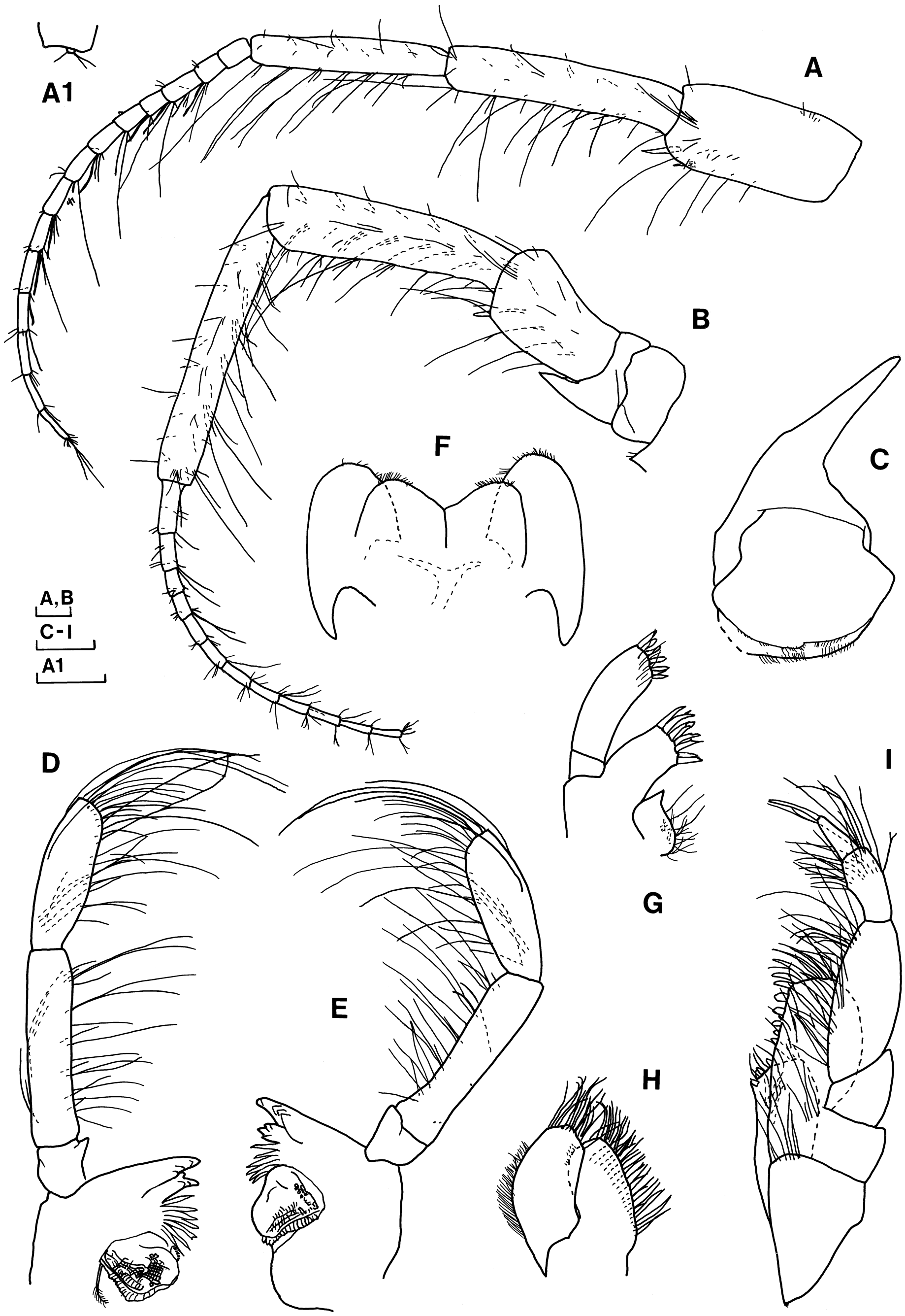

Fig. 2. *Ericthonius convexus* sp. nov., holotype, male (6.7 mm), NSMT-Cr 18218. A, left antenna 1, lateral view; A1, left accessory flagellum, medial view; B, left antenna 2, lateral view; C, upper lip, anteroventral view; D, left mandible, medial view; E, right mandible, medial view; F, lower lip, ventral view; G, left maxilla 1, dorsal view; H, right maxilla 2, ventral view; I, left maxilliped, ventral view. Scales: 0.1 mm.

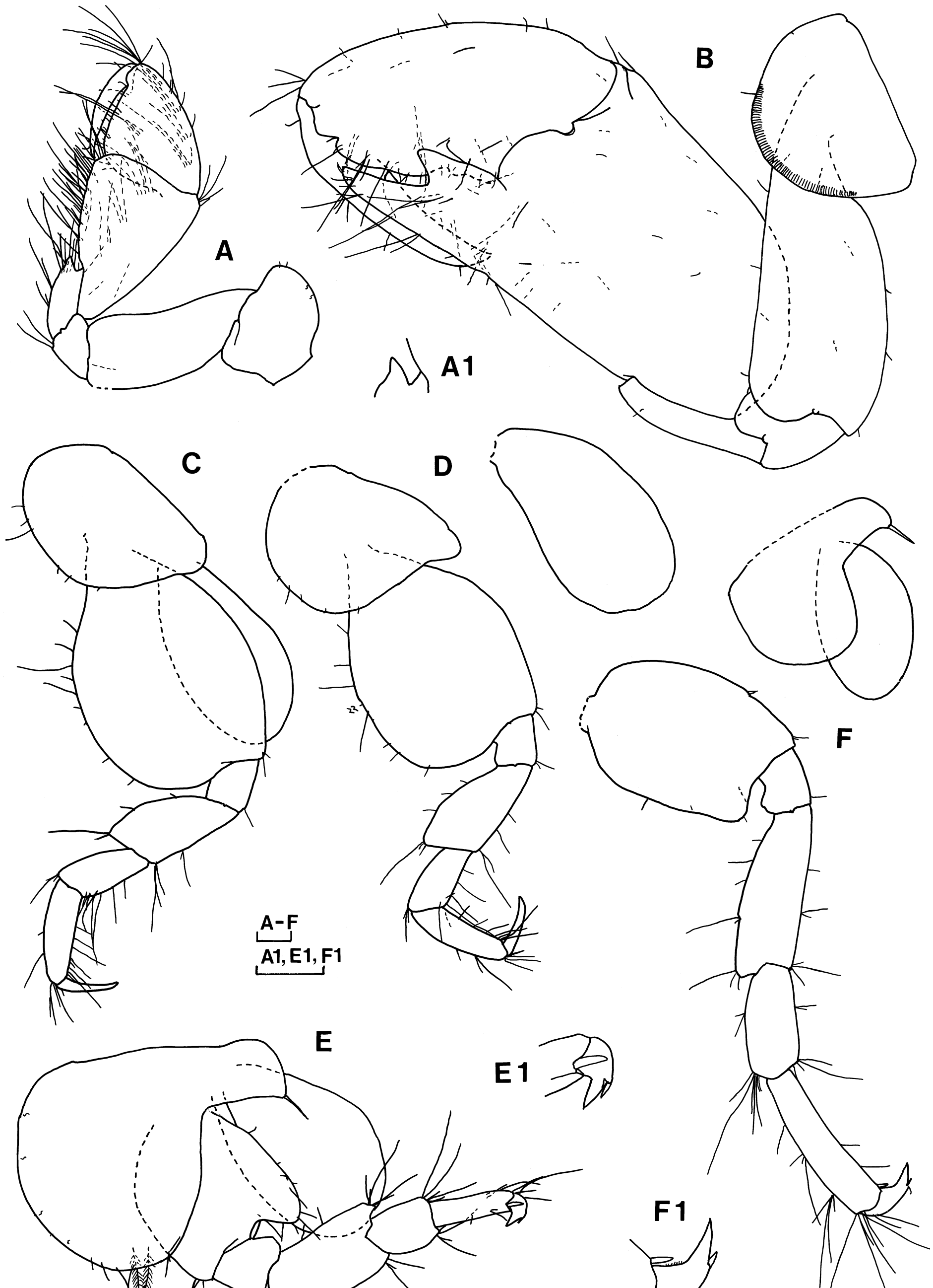

Fig. 3. *Ericthonius convexus* sp. nov., holotype, male (6.7 mm), NSMT-Cr 18218. A, left gnathopod 1, lateral view; A1, distal process of left gnathopod 1 article 4, lateral view, setae omitted; B, left gnathopod 2, lateral view; C–E, left pereopods 3–5, lateral views; E1, distal part of left pereopod 5, lateral view, setae omitted; F, left coxa 6 and articles 2–7 of right pereopod 6, lateral views; F1, distal part of right pereopod 6, lateral view, setae omitted. Scales: 0.1 mm.

with acute process on posterodistal corner (Fig. 3A1), distal edge setose; article 5 longish triangular, posterior edge heavily setose, posterior half of medial surface with many setae; article 6 short, rounded, posterior margin with small robust seta and many normal setae, anterodistal corner and medial surface setose. Gnathopod 2 (Fig. 3B) extremely large, carpochelate; coxal plate rounded, bearing short seta anteroventrally, ventral margin with many (>60) stridulating ridges, gill absent; article 2 relatively wide, broadened distally, anterior and posterior margins with sparse short setae; anterodistal corner of article 3 roundly protruded; article 4 narrow, extended along posterior margin of article 5, with short seta on posterior margin; article 5 greatly enlarged, posterodistal corner bearing large process (about 42% length of article 5 proper) with 2 teeth, separated by a V-shaped incision, posterior margin of outer tooth setose, middle part of distal margin roundly inflated; article 6 wide, posterior margin undulate and setose; article 7 stout, gradually curved posteriorly, tip with a few setae, posterior margin with several short setae.

Pereopods 3 and 4 (Fig. 3C, D) similar; coxal plates protruded posterodorsally, each bearing several ventral setae, gill present; articles 2 wide, ovoid, anterior margins with several setae; articles 4 projected anterodistally; articles 5 with many long setae on posterodistal corners; articles 6 setose posteriorly; articles 7 narrow, almost straight. Pereopod 5 (Fig. 3E) short; coxal plate wide, anterior lobe broad, with 2 plumose long setae and several short setae ventrally, posteroventral corner of posterior lobe with robust seta, gill present; article 2 roundish, posterodistal corner produced distal lobe, anterodistal corner setose, posterior and posterodistal margins with sparse setae; article 4 relatively long, posterodistal corner acutely projected; anterodistal and posterodistal corners of article 5 setose; article 6 with 2 robust setae and several long setae on distal edge; article 7 short, strongly curved, with 2 accessory spines on outer margin (Fig. 3E1). Pereopod 6 (Fig. 3F) about 1.3 times as long as pereopod 5; coxal plate smaller than coxa 5, posterodistal corner with robust seta, gill present; posterior margin of article 2 with a few setae; article 4 long; article 5 setose on posterodistal corner; article 6 with robust seta and several long setae on distal edge; article 7 short, strongly curved, with accessory spine on outer margin and several denticles on inner margin (Fig. 3F1). Pereopod 7 (Fig. 4A, A1) about 1.3 times as long as pereopod 6; almost similar to pereopod 6, but article 6 with 2 robust setae on distal edge, gill absent.

Pleopods (Fig. 4B–D) long, pleopod 3 shortest; peduncles each with 2 coupling hooks, peduncles of pleopods 1 and 2 with 1 and 2 setae, respectively; outer rami shorter than inner, both rami of pleopods 1–3 each with 11 articles, inner basal margins of inner rami each with 4 clothespin setae. Uropod 1 (Fig. 4E) long; peduncle bearing 8 robust setae on lateral margin and normal seta on laterodistal corner, medial margin pectinate, with 3 robust setae; both rami subequal in length, outer ramus with 5 lateral, 3 medial and 4 terminal robust setae, inner ramus with 5 lateral and 2 terminal robust setae. Uropod 2 (Fig. 4F) short; lateral margin of peduncle bearing 3 robust setae, mediodistal corner with long robust seta; both rami subequal in length, outer ramus with 2 marginal and 4 terminal robust setae, inner ramus with 3 marginal and 2 terminal robust setae, margins of both rami pectinate. Uropod 3 (Fig. 4G) small, uniramous; peduncle stout, with 1 lateral, 2 laterodistal, 1 mediodistal and 1 dorsal setae; single ramus short, about 1/3 length of peduncle, tip with 3 minute protuberances and 2 short setae (Fig. 4G1). Telson (Fig. 4G) entire, short, with a pair of densely spinulose lobes each bearing 2 penicillate setae and forked seta; posterior edge between lobes convex.

Allotype female. Gnathopod 1 (Fig. 5A) almost similar to that of male, but article 2 proportionally narrower. Gnathopod 2 (Fig. 5B, B1) proportionally smaller than that of male, subchelate; coxal plate inflated posteriorly, ventral margin with many (>50) stridulating ridges, gill absent; article 2 broadened medianly; anterodis-

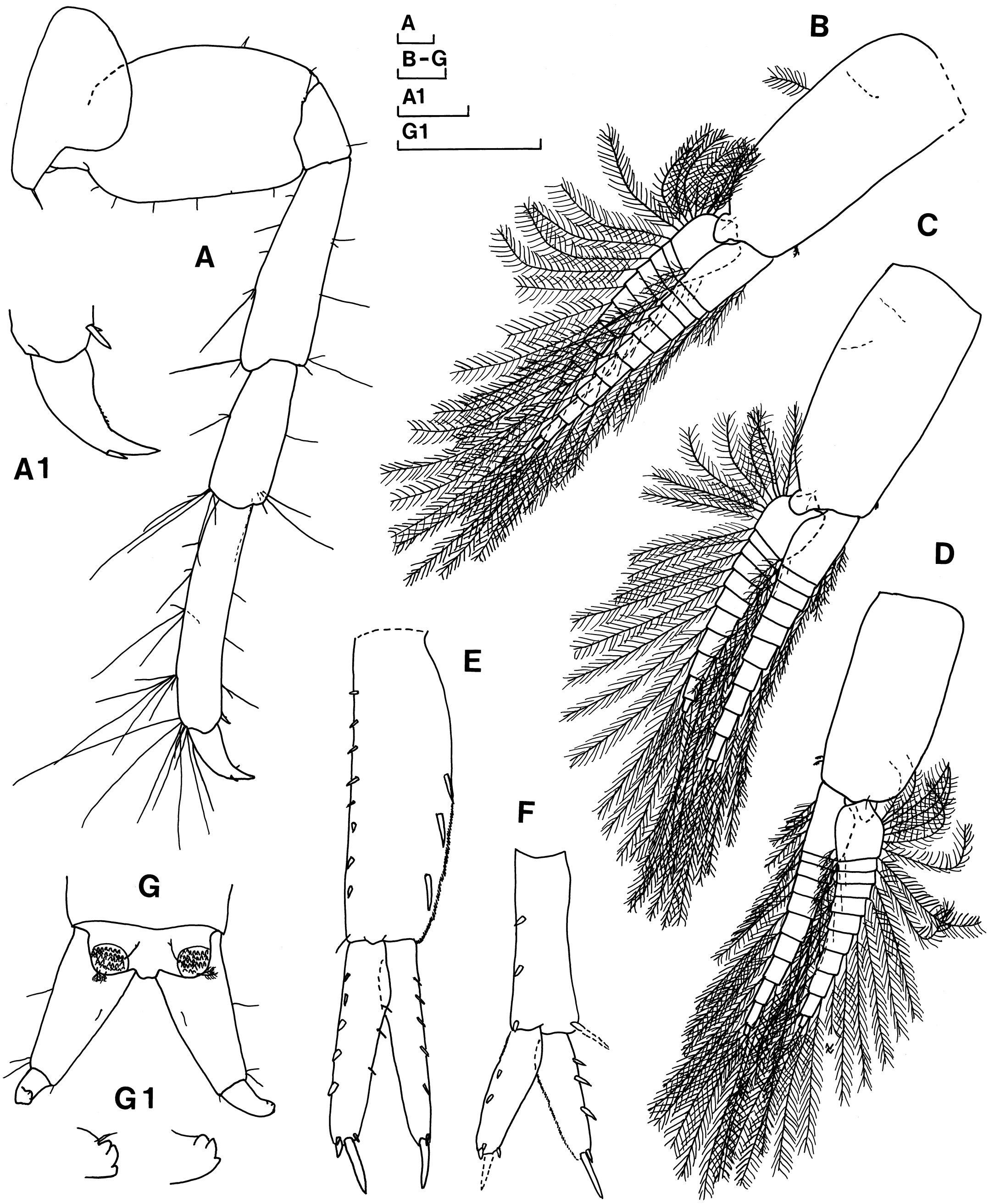

Fig. 4. *Ericthonius convexus* sp. nov., holotype, male (6.7 mm), NSMT-Cr 18218. A, right pereopod 7, lateral view; A1, distal part of right pereopod 7, lateral view, setae omitted; B, C, left pleopods 1, 2, posterior views; D, left pleopod 3, anterior view; E, F, left uropods 1, 2, dorsal views; G, uropods 3 and telson, dorsal view; G1, tips of uropods 3, dorsal view. Scales: 0.1 mm.

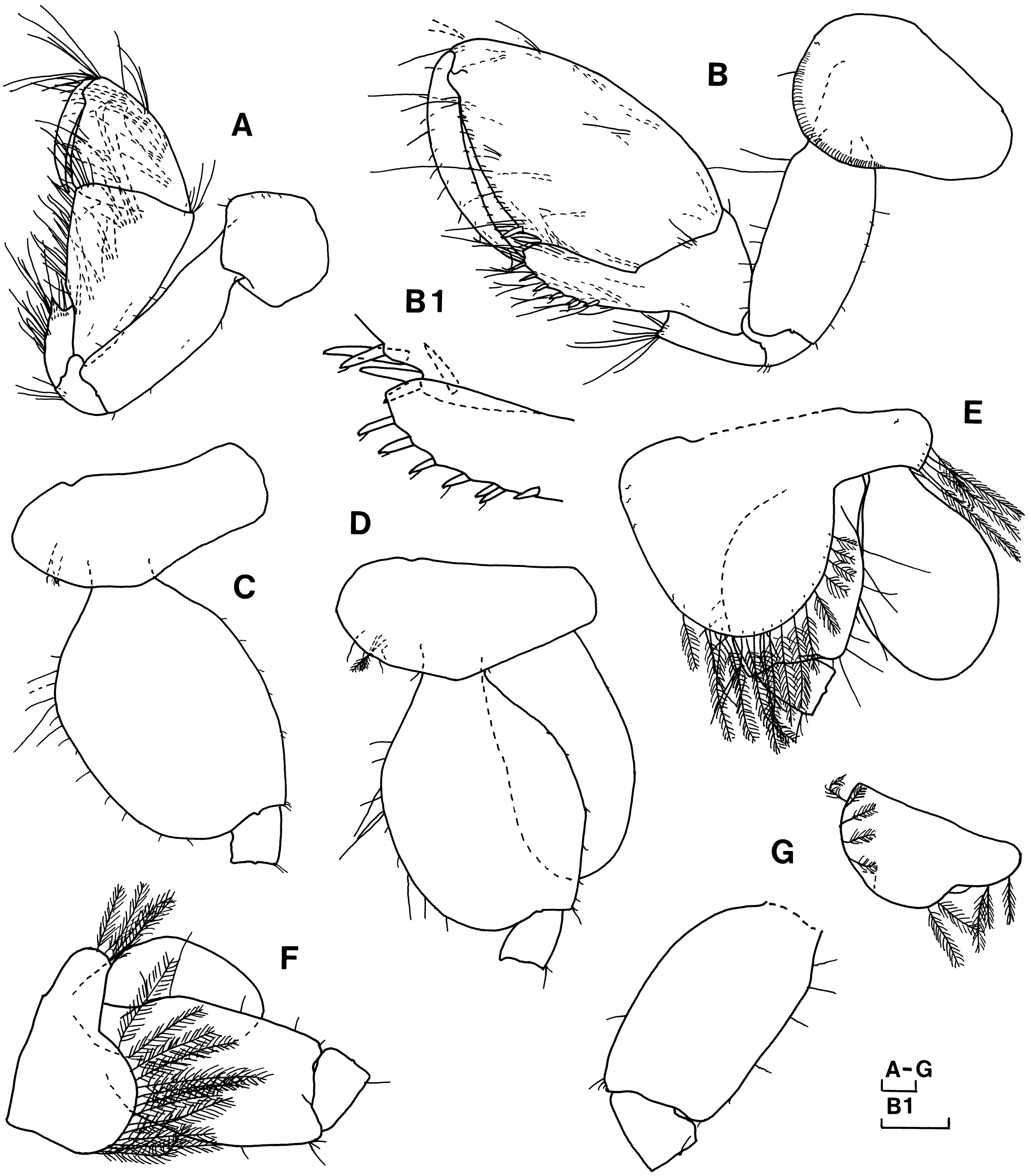

Fig. 5. *Ericthonius convexus* sp. nov., allotype, ovigerous female (7.6 mm), NSMT-Cr 18219. A, left gnathopod 1, lateral view; B, left gnathopod 2, lateral view, oostegite omitted; B1, posterior parts of articles 5, 6 of left gnathopod 2, lateral view, setae omitted; C–G, articles 1–3 of left pereopods 3–7, lateral views, gill lost in C, oostegites omitted. Scales: 0.1 mm.

tal corner of article 3 slightly protruded; article 4 narrow, posterodistal corner projected, distal margin setose; article 5 with large posterodistal lobe bearing 7 robust and many normal setae posteriorly; article 6 enlarged, posterior margin with 5 robust and several normal setae; article 7 stout, gradually curved posteriorly. Pereopods 3, 4 (Fig. 5C, D) each with short coxal plate bearing several plumose and simple setae on ventral margin. Pereopods 5–7 (Fig. 5E–G) each with coxal plate bearing many plumose setae, but lucking robust seta; posterodistal lobe of pereopod 5 article 2 absent, posterior edge of pereopod 6 article 2 almost straight. Oostegites broad, present on pereopods 2–5.

Variation of male gnathopod 2 and pereopod 5 with growth. NSMT-Cr 18223, 4.0 mm (Fig. 6A, B): article 5 of gnathopod 2 short, inner tooth on posterodistal process small; posterodistal lobe of pereopod 5 article 2 absent. NSMT-Cr 18228, 5.2 mm (Fig. 6C, D): articles 5 and 6 of gnathopod 2 more slender than those of holotype, posterodistal process of article 5 short (about 32% length of article 5 proper), proximal part of article 7 strongly curved posteriorly, posterior margin with many short setae, tip with bundle of long setae; proximal part of pereopod 5 article 2 narrower, and posterodistal lobe of article 2 longer than those of holotype, article 4 curved posteriorly. NSMT-Cr 18225, 6.4 mm (Fig. 6E, F): gnathopod 2 enlarged, articles 2 and 5–7 more slender than those of holotype, posterodistal process of article 5 long (about 52% length of article 5 proper), inner tooth on process lucking, posterior margin of article 6 almost smooth, distal edge with distinct incision, article 7 curved posteriorly, tip with bundle of long setae; pereopod 5 small, proximal part of article 2 narrower, posterodistal lobe of article 2 longer, and article 4 longer than those of NSMT-Cr 18228.

Coloration in life (Fig. 7A–C). Eyes red; head, pereonites 1–7, pleonites 1–3 and urosomites 1–3 mottled brown and white, occupancy ratio of brown part higher in female, dorsal surfaces of pereonite 3 and pleonites 1 and 2 in male each with distinct dark brown spot medially; peduncular article 1 of antenna 1 brown and white, peduncular article 4 of antenna 2 light orange, peduncular article 5 of antenna 2 white with orange mark medianly, other parts of antennae orange; whole of gnathopods, coxal plates and articles 2 of pereopods 3–7, and peduncles of pleopods brown and white, other parts of pereopods and pleopods white, uropods brown.

Remarks. This new species is very similar to *Ericthonius pugnax* particularly in the male pereopod 5 with a posterodistal lobe on the article 2, which the other species of the genus do not possess. However, *E. convexus* sp. nov. can be distinguished from *E. pugnax* in the following points: (1) the eyes are relatively larger than in *E. pugnax* (Figs. 1, 9); (2) the peduncles of antennae are relatively more slender than in *E. pugnax* (Fig. 8); (3) the posterior edge of telson between spinulose lobes is convex, rather than straight or concave as in *E. pugnax* (Figs. 4G, 12G, H); (4) the distal edge of article 6 of gnathopod 2 in the hyper-adult male has a distinct incision, whereas such an incision is absent in *E. pugnax* (Figs. 6E, 14G); and (5) the dorsal surface of body in the male bears a median dark brown spot on each of pereonite 3 and pleonites 1 and 2, while there is only an indistinct marking each on pereonite 3 and pleonite 1 in *E. pugnax* (Figs. 7B, D, 15B).

Ledoyer (1969) and Myers and McGrath (1984) indicated the existence of hyper-adult males in the genus *Ericthonius*, which lose the inner tooth on the posterodistal process of article 5 of gnathopod 2 with growth. Hyper-adult males of this new species and *E. pugnax* were also observed in the present study.

Hirayama (1985) recorded *E. pugnax* from western Kyushu. Although he did not give any description and figure of the material, his specimens were mainly collected with a Smith-McIntyre grab sampler from the bottom of the Ariake Sea, Tomioka Bay and Shijiki Bay (Hirayama, 1983). Because only *E. convexus* occurs on the bottom of the Ariake Sea (Ariyama and Mori, unpublished data), Hirayama's (1985) specimens from the Ariake Sea is most probably *E. convexus*. The identity of the specimens from Tomioka Bay and Shijiki Bay is uncertain.

Myers (1995) recorded *E. pugnax* from various habitats in Papua New Guinea (e.g. in mud, among dead coral and seagrasses; 1–30 m deep). His specimens resemble *E. convexus* sp. nov., because they have three of the five the diagnostic characters mentioned above, i.e. (1), (2) and (4). There is no description on the telson in his paper; therefore, detailed observation including the telson is needed for accurate identification of his specimens.

Distribution. Known with certainty from

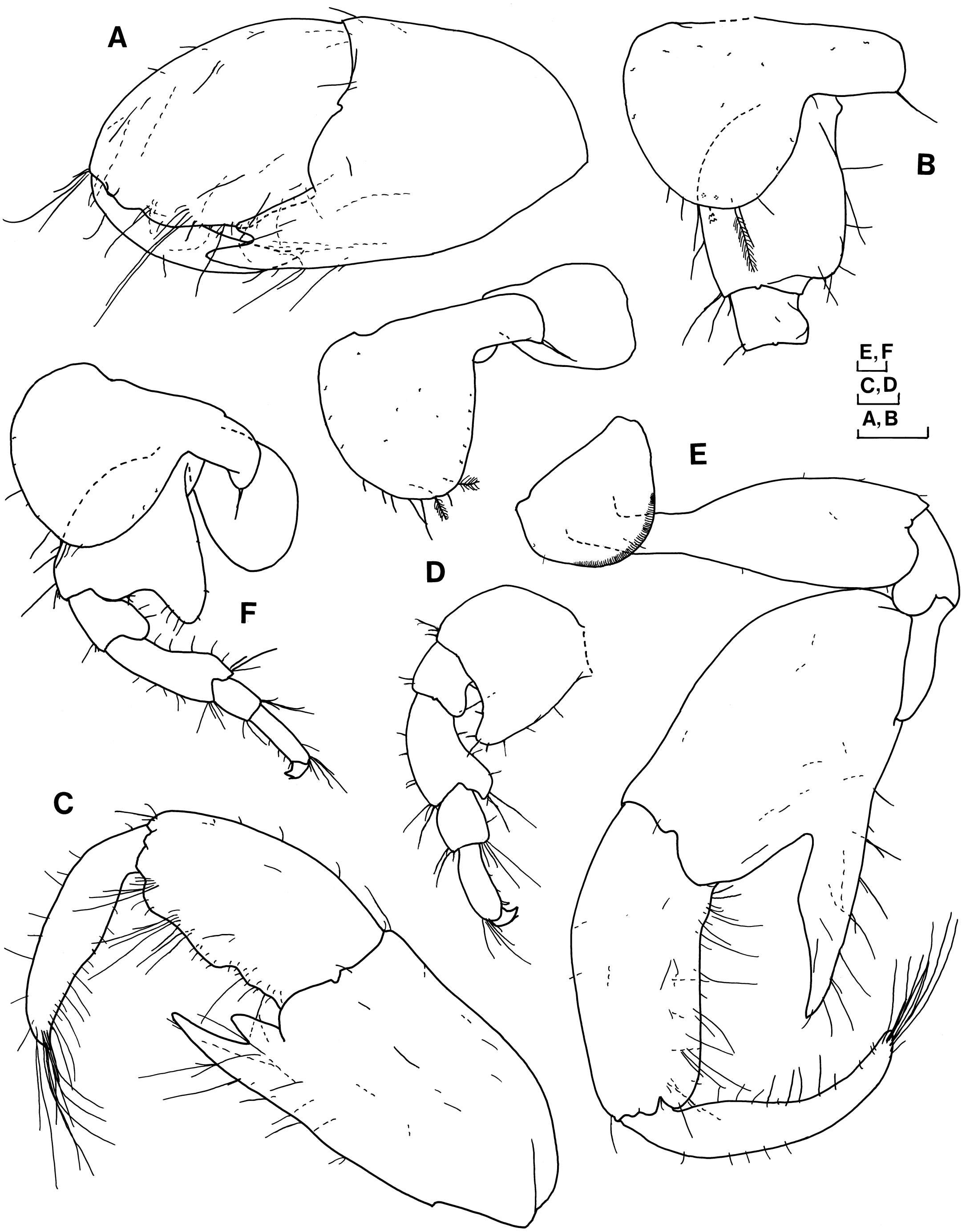

Fig. 6. *Ericthonius convexus* sp. nov. A, B, paratype, male (4.0 mm), NSMT-Cr 18223; C, D, paratype, male (5.2 mm), NSMT-Cr 18228; E, F, paratype, male (6.4 mm), NSMT-Cr 18225. A, C, articles 5–7 of left gnathopods 2, lateral views; B, articles 1–3 of left pereopod 5, lateral view, gill omitted; E, left gnathopod 2, lateral view; D, F, left pereopods 5, lateral views. Scales: 0.1 mm.

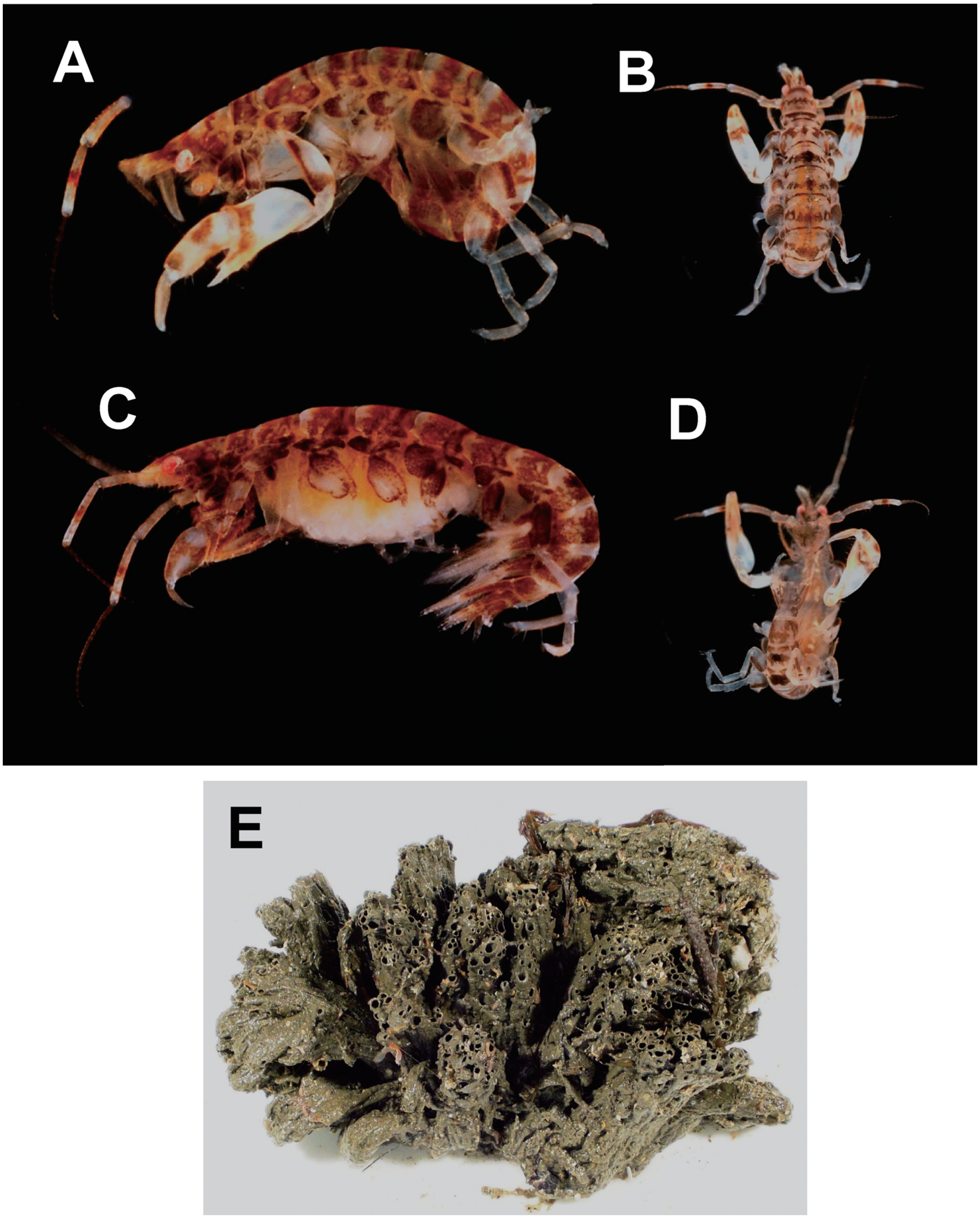

Fig. 7. *Ericthonius convexus* sp. nov. A, male (collected on 15 January 2008), left lateral view; B, male (same date), dorsal view; C, ovigerous female (same date), left lateral view; D, male (same date), ventral view; E, nests (26 February 2007). Photography by Y. Uchida. All specimens were collected from the bottom of Suo-nada off Yamaguchi Prefecture.

Osaka Bay, Suo-nada in the Seto Inland Sea, and Ariake Sea.

Habitat. This species builds nests (Fig. 7D) on sandy-mud bottom at depths of 6–40 m.

Etymology. From the Latin *convexus*, referring to the shape of telson.

Ericthonius pugnax Dana, 1852

[New Japanese name: Iso-hoso-yokoebi]

(Figs. 8–15)

Erichthonius [sic] (*Pyctilus*?) *macrodactylus* Dana, 1852: 218.

Erichthonius [sic] (*Pyctilus*?) *pugnax* Dana, 1852: 218.

Pyctilus macrodactylus: Dana, 1853: 974; Dana, 1855: pl. 67, fig. 3a–c.

Pyctilus pugnax: Dana, 1853: 975; Dana, 1855: pl. 67, fig. 4a–d.

Ericthonius macrodactylus: Walker, 1904: 292, fig. 48; Stebbing, 1906: 672; Pirlot, 1938: 352; Nayar, 1967: 162, fig. 17c.

Ericthonius brasiliensis: Chilton, 1923: 242, figs. 1–5; Irie, 1955: 4, figs. 5-1, 5-2: Hong, 1983: 147, figs. 9, 10. Not *Ericthonius brasiliensis* Dana, 1853.

Ericthonius pugnax: Stebbing, 1906: 672; Pirlot, 1938: 352; Hurley, 1954: 445, figs. 4, 5; Nagata, 1960: 179, pl. 17, figs. 99–102; Nagata, 1965b: 320, fig. 40 (in part ?); Ledoyer, 1969: 179, pl. 1, figs. 1–12; Ledoyer, 1986: 628, fig. 239; Moore, 1988: 727, fig. 14; Kim and Kim, 1991: 246, figs. 13, 14; Ishimaru, 1994: 36 (in part); Appadoo and Myers, 2004: 357.

Material examined. NSMT-Cr 18202–18206, 5 males (8.8, 8.9, 6.5, 5.1, 3.9 mm), lower intertidal zone of Nagasaki coast in Misaki, Osaka Prefecture (34°20′N, 135°09′E), under rock, 4 April 2007, coll. H. Ariyama; NSMT-Cr 18207, 18208, 2 females (9.5, 8.2 mm), same data; OMNH-Ar 7661, 10 males, 10 females (not dissected), same data; NSMT-Cr 18209, 1 male (5.4 mm), Gokasho Bay, Mie Prefecture (34°20′N, 136°42′E), 3 m deep, among a brown alga *Sargassum piluliferum*, SCUBA, 15 March 1999, coll. H. Yokoyama; NSMT-Cr 18210, 1 ovigerous female (5.0 mm), same data; NSMT-Cr 18211, 18212, 2 males (6.1, 5.3 mm), Gokasho Bay, Mie Prefecture, 2 m deep, among a brown alga *Sargassum yamamotoi*, SCUBA, 15 March 1999, coll. H. Yokoyama; NSMT-Cr 18213, 1 ovigerous female (5.2 mm), same data; NSMT-Cr 18214, 18215, 2 males (6.8, 5.4 mm), tapered seawall of Kansai International Airport in Izumisano, Osaka Prefecture (34°26′N, 135°15′E), 0.5 m deep, among a red alga *Chondrus giganteus*, SCUBA, 18 December 1998, coll. H. Ariyama; NSMT-Cr 18216, 1 ovigerous female (7.0 mm), same data; NSMT-Cr 18217, 1 male (8.1 mm), same locality, 16 April 1999, coll. H. Ariyama.

Description. Male [based on NSMT-Cr 18202, and NSMT-Cr 18203 (only for antenna 2 and telson)]. Body (Fig. 9) slender, slightly depressed. Rostrum short; ocular lobes projected, with pointed small tip; antennal sinus deep. Eyes relatively small, width about quarter of dorsal length of head. Antenna 1 (Fig. 10A) with ratio of

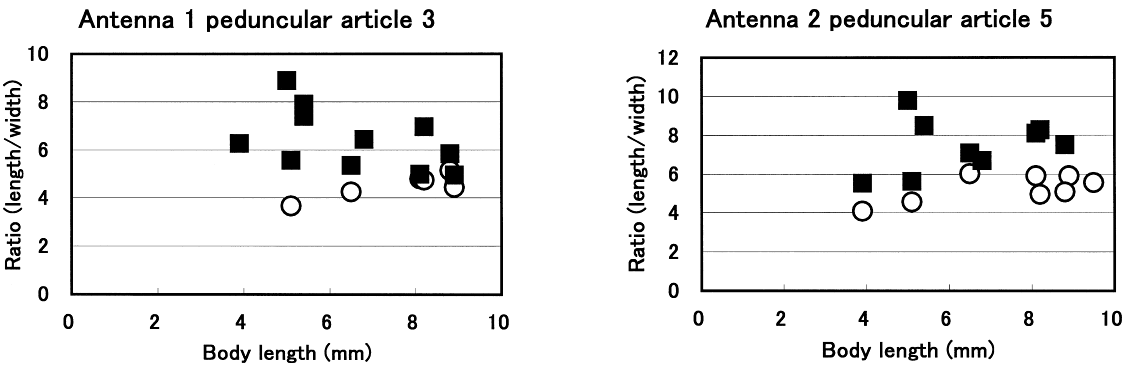

Fig. 8. Relationships between body length and length-width ratio of peduncular article 3 of antenna 1 and between body length and length-width ratio of peduncular article 5 of antenna 2 in *Ericthonius convexus* sp. nov. (■) and *E. pugnax* Dana, 1852 (○).

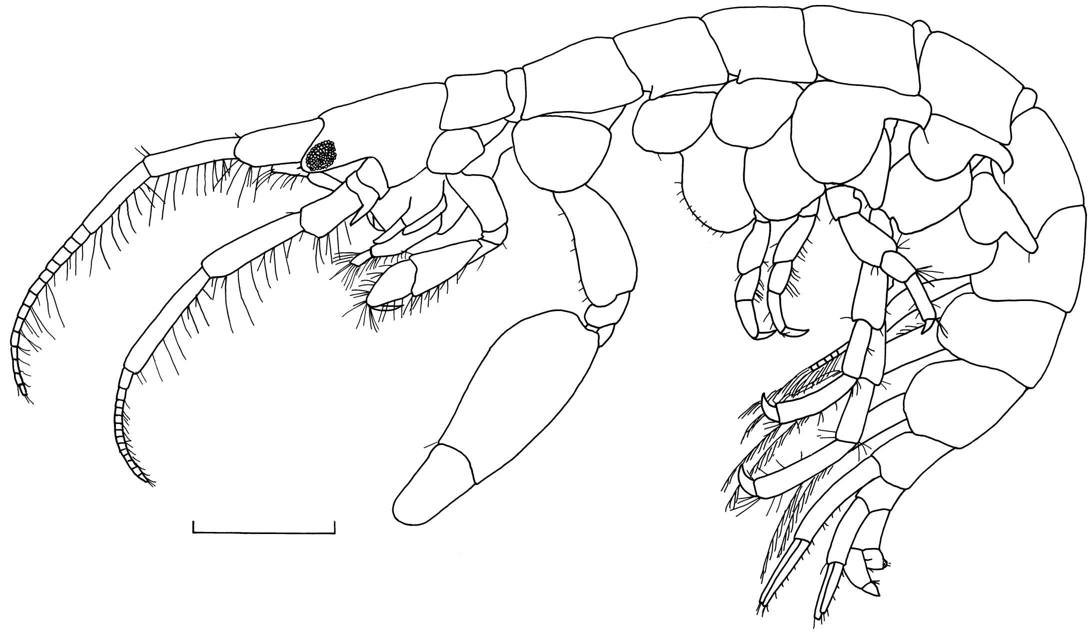

Fig. 9. *Ericthonius pugnax* Dana, 1852, male (8.8 mm), NSMT-Cr 18202. Habitus, left lateral view. Scale: 1 mm.

lengths of peduncular articles 1–3 1 : 1.2 : 1, posterodistal part of peduncular article 1 with 3 robust setae, peduncular articles 2 and 3 heavily setose posteriorly; accessory flagellum (Fig. 10A1) vestigial, with 3 short setae; flagellum with 14 articles, posterior surface bearing long and short setae, all articles except tip article each with aesthetasc posterodistally. Antenna 2 (Fig. 10B) subequal in length to antenna 1, with ratio of lengths of peduncular articles 3–5 1 : 1.7 : 2.2, article 3 with 1 posterodistal and 3 medial robust setae, articles 4 and 5 setose posteriorly; flagellum with 11 articles.

Upper lip (Fig. 10C) rounded, with many short, thin setae ventrally; epistome strongly projected anteriorly. Mandible (Fig. 10D, E) each with 4 cusps on incisor, lacinia mobilis trifid in the left and bifid in the right; palp strong, article length ratio 1 : 3.3 : 2.5, ventral surfaces of articles 2 and 3 and distal edge of article 3 heavily setose. Lower lip (Fig. 10F) with inner and outer lobes covered with thin setae on distal margins, mandibular lobes short, pointed. Maxilla 1 (Fig. 10G) with inner plate pointed ventrally, bearing 3 normal and a few thin setae; outer plate bearing 10 robust setae distally and several thin setae medially; tip of article 2 of palp with 6 robust and 9 normal setae. Maxilla 2 (Fig. 10H) with both plates heavily setose. Maxilliped (Fig. 10I) with inner plate bearing 3 anterior and 1 ventral robust setae; outer plate with 10 medial robust setae; palp with 4 articles, article 2 long, article 4 with long spine apically.

Gnathopod 1 (Fig. 11A) small, subchelate; coxal plate bearing a few short setae on anteroventral corner; article 2 with middle to distal parts broad, anterior margin with 4 short setae, posterodistal corner with a few setae; anterodistal corner of article 3 roundly protruded; article 4 with acute process on posterodistal corner (Fig. 11A1), distal edge setose; article 5 longish triangular, posterior edge heavily setose, posterior half of medial surface with many setae; article 6 short, rounded, posterior margin with small robust seta and many normal setae, anterodistal corner and medial surface setose. Gnathopod 2 (Fig. 11B) extremely large, carpochelate; coxal plate rounded, bearing a few short setae an-

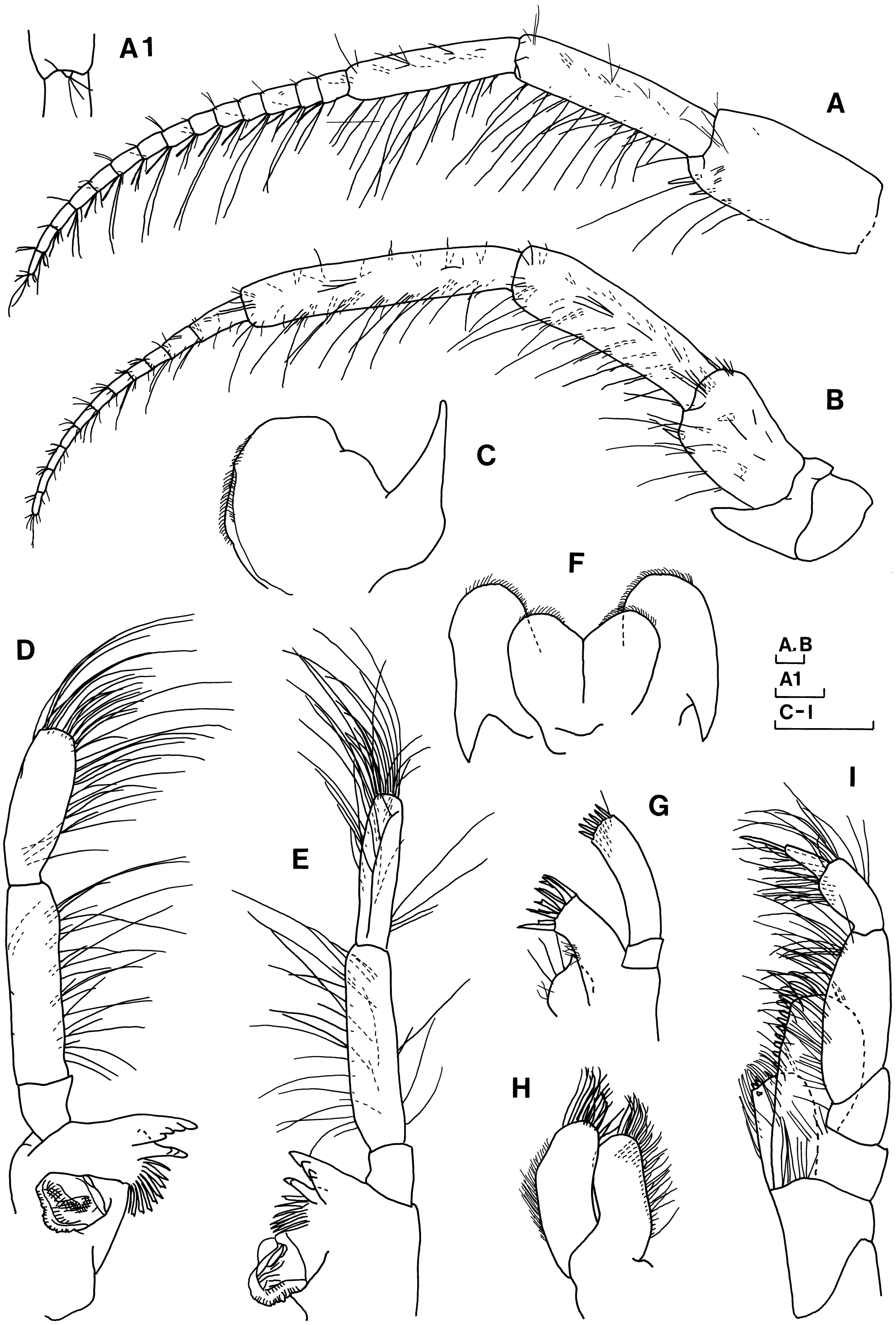

Fig. 10. *Ericthonius pugnax* Dana, 1852. A, A1, C–I, male (8.8 mm), NSMT-Cr 18202; B, male (8.9 mm), NSMT-Cr 18203. A, left antenna 1, lateral view; A1, left accessory flagellum, medial view; B, left antenna 2, lateral view; C, upper lip, anterolateral view; D, left mandible, medial view; E, right mandible, medial view; F, lower lip, ventral view; G, left maxilla 1, ventral view; H, right maxilla 2, ventral view; I, left maxilliped, ventral view. Scales: 0.1 mm.

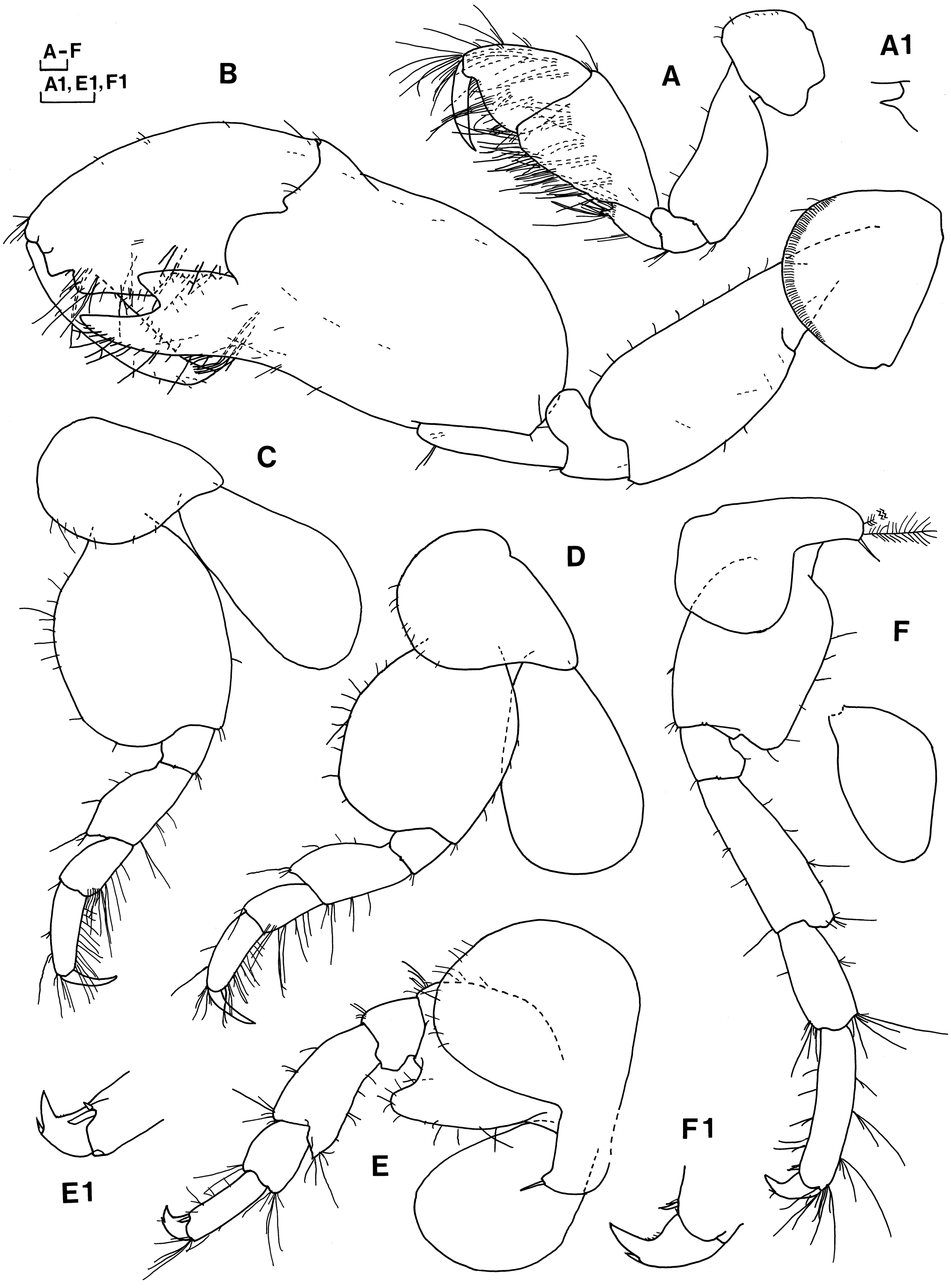

Fig. 11. *Ericthonius pugnax* Dana, 1852, male (8.8 mm), NSMT-Cr 18202. A, left gnathopod 1, lateral view; A1, distal process of left gnathopod 1 article 4, lateral view, setae omitted; B, left gnathopod 2, lateral view; C–F, left pereopods 3–6, lateral views; E1, F1, distal parts of left pereopods 5, 6, lateral views, setae omitted. Scales: 0.1 mm.

teroventrally, ventral margin with many (>60) stridulating ridges, gill absent; article 2 relatively wide, broadened distally, anterior and posterior margins with sparse short setae; anterodistal corner of article 3 roundly protruded; article 4 narrow, extended along posterior margin of article 5, with a few short setae on posterodistal corner; article 5 greatly enlarged, posterodistal corner bearing large process (about 42% length of article 5 proper) with 2 teeth, separated by a V-shaped incision, posterior margin of outer tooth setose, middle part of distal margin roundly inflated; article 6 wide, posterior margin undulate and setose; article 7 stout, almost straight, tip with bundle of setae, posterior margin with several short setae.

Pereopods 3 and 4 (Fig. 11C, D) similar; coxal plates protruded posterodorsally, each bearing several ventral setae, gill present; articles 2 wide, ovoid, anterior margins with several setae; articles 4 projected anterodistally; articles 5 with many long setae on posterodistal corners; articles 6 setose posteriorly; articles 7 narrow, almost straight. Pereopod 5 (Fig. 11E) short; coxal plate wide, anterior lobe broad, with several short setae ventrally, posteroventral corner of posterior lobe with robust seta, gill present; article 2 roundish, posterodistal corner produced distal lobe, anterodistal corner setose, posterior and posterodistal margins with sparse setae; article 4 relatively long, gradually curved posteriorly, posterodistal corner acutely projected; posterodistal corner of article 5 setose; article 6 with 2 robust setae and several long setae on distal edge; article 7 short, strongly curved, with accessory spine on outer margin and a few denticles on inner margin (Fig. 11E1). Pereopod 6 (Fig. 11F) about 1.3 times as long as pereopod 5; coxal plate smaller than coxa 5, posterior margin with 2 plumose and 1 robust setae, gill present; posterior margin of article 2 with sparse setae; article 4 long; article 5 setose on anterodistal and posterodistal corners; article 6 with 2 robust setae and several long setae on distal edge; article 7 short, strongly curved, with accessory spine on outer margin and several denticles on inner margin (Fig. 11F1). Pereopod 7 (Fig. 12A, A1) about 1.1 times as long as pereopod 6; almost similar to pereopod 6, but coxal plate with robust seta only, gill absent.

Pleopods (Fig. 12B–D) relatively long, pleopod 3 shortest; peduncles each with 2 coupling hooks, peduncle of pleopods 1 and 2 with 1 and 4 setae, respectively; outer rami shorter than inner, outer rami of pleopods 1–3 each with 14 articles, inner rami with 14, 13, 13 articles, respectively, inner basal margins of inner rami each with 4 clothespin setae. Uropod 1 (Fig. 12E) long; peduncle bearing 6 robust setae on lateral margin and normal seta on laterodistal corner, medial margin pectinate, with 4 robust setae; outer ramus about 1.1 times as long as inner ramus, outer ramus with 6 lateral, 3 medial and 5 terminal robust setae, inner ramus with 4 lateral and 2 terminal robust setae, margin of inner ramus pectinate. Uropod 2 (Fig. 12F) short; lateral margin of peduncle bearing 3 robust setae, mediodistal corner with long robust seta; both rami subequal in length, outer ramus with 3 marginal and 4 terminal robust setae, inner ramus with 3 marginal and 2 terminal robust setae, margins of both rami pectinate. Uropod 3 (Fig. 12G) small, uniramous; peduncle stout, slightly curved laterally, with 2 lateral, 3 laterodistal, 1 mediodistal and 1 dorsal setae; single ramus short, about 1/3 length of peduncle, tip with 5 minute protuberances and 2 short setae (Fig. 12G1). Telson (Fig. 12G, H) short, with a pair of densely spinulose lobes each bearing 2 penicillate setae and forked seta; posterior edge between lobes straight or concave.

Female (NSMT-Cr 18207). Gnathopod 1 (Fig. 13A) almost similar to that of male, but article 2 proportionally narrower. Gnathopod 2 (Fig. 13B, B1) proportionally smaller than that of male, subchelate; coxal plate slightly inflated posteriorly, ventral margin with many (>50) stridulating ridges, gill absent; article 2 broadened medianly, with several setae on anterior margin; anterodistal corner of article 3 slightly protruded; article 4 narrow, posterodistal corner projected, distal margin setose; article 5 with large posterodistal lobe bearing 5 robust and many normal setae

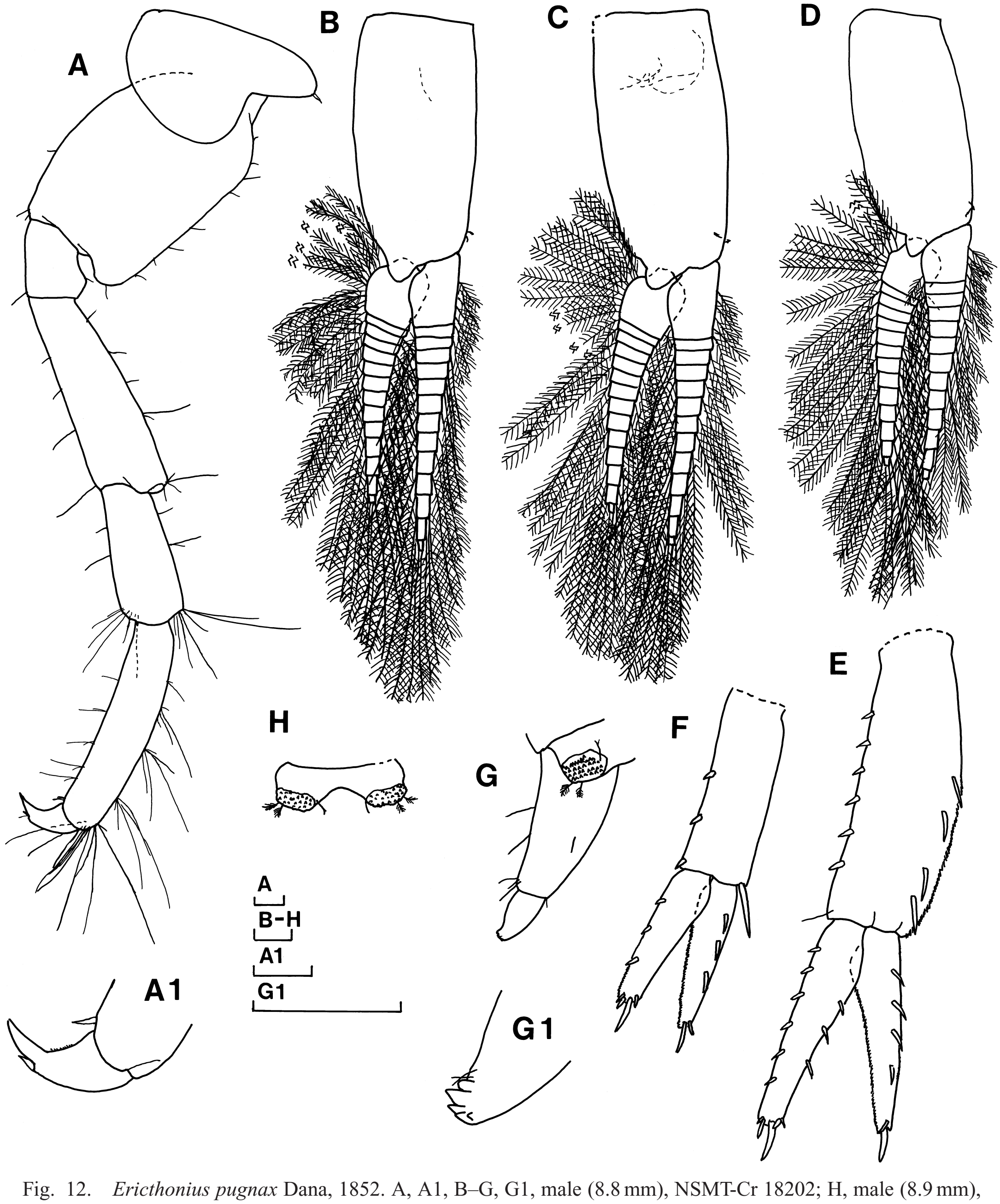

Fig. 12. *Ericthonius pugnax* Dana, 1852. A, A1, B–G, G1, male (8.8 mm), NSMT-Cr 18202; H, male (8.9 mm), NSMT-Cr 18203. A, left pereopod 7, lateral view; A1, distal part of left pereopod 7, lateral view, setae omitted; B–D, left pleopods 1–3, posterior views; E, F, left uropods 1, 2, dorsal views; G, left uropod 3 and left part of telson, dorsal view; G1, tip of left uropod 3, dorsal view; H, telson, dorsal view. Scales: 0.1 mm.

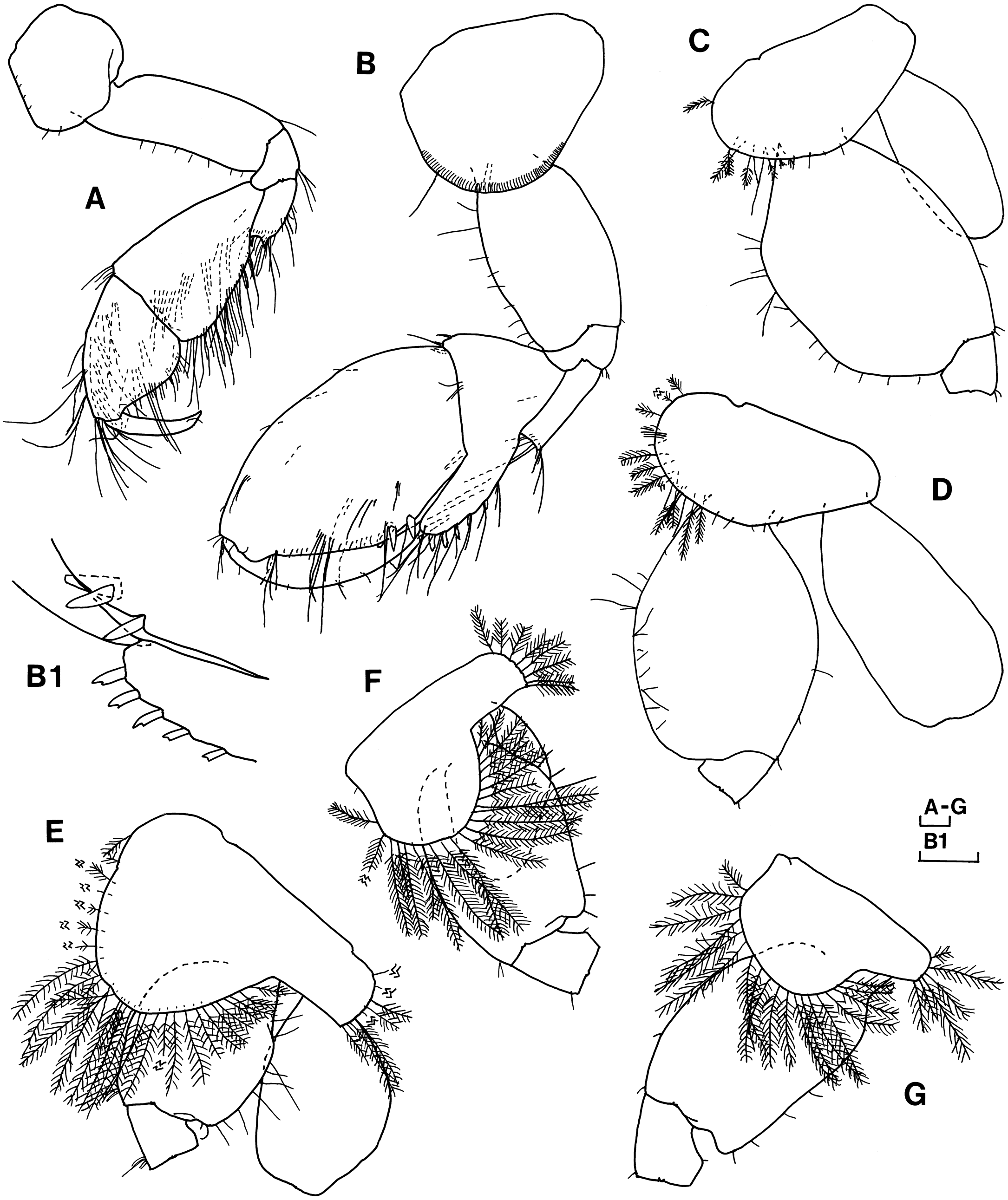

Fig. 13. *Ericthonius pugnax* Dana, 1852, female (9.5 mm), NSMT-Cr 18207. A, left gnathopod 1, lateral view; B, left gnathopod 2, lateral view, oostegite omitted; B1, posterior parts of articles 5, 6 of left gnathopod 2, lateral view, setae omitted; C–G, articles 1–3 of left pereopods 3–7, lateral views, oostegites omitted. Scales: 0.1 mm.

posteriorly; article 6 enlarged, posterior margin with 3 robust setae and long and short normal setae; article 7 stout, gradually curved posteriorly. Pereopods 3, 4 (Fig. 13C, D) each with short coxal plate bearing several plumose setae on anterior and ventral margins. Pereopods 5–7 (Fig. 13E–G) each with coxal plate bearing many plumose setae, but lucking robust seta; posterodistal lobe of pereopod 5 article 2 absent, posterior margin of pereopod 6 article 2 roundish. Oostegites broad, present on pereopods 2–5.

Variation of male gnathopod 2 and pereopod 5 with growth. NSMT-Cr 18206, 3.9 mm (Fig. 14A, B): article 5 of gnathopod 2 short, inner tooth on posterodistal process indistinct, bundle of setae on tip of article 7 lucking; posterodistal lobe of pereopod 5 article 2 absent. NSMT-Cr 18204, 6.5 mm (Fig. 14C, D): shape of gnathopod 2 intermediate between NSMT-Cr 18202 and NSMT-Cr 18206; posterodistal lobe of pereopod 5 article 2 small. NSMT-Cr 18214, 6.8 mm (Fig. 14E, F): articles 5 and 7 of gnathopod 2 slightly shorter than those of NSMT-Cr 18202, incision on posterodistal process of article 5 shallow; posterodistal lobe of pereopod 5 article 2 slightly smaller than that of NSMT-Cr 18202. NSMT-Cr 18209, 5.4 mm (Fig. 14G, H): gnathopod 2 extremely enlarged, articles 2 and 5–7 more slender than those of NSMT-Cr 18202, posterodistal process of article 5 about 51% length of article 5 proper, inner tooth on process lucking, bundle of setae on tip of article 7 well-developed; pereopod 5 small, anterior lobe of coxal plate wider, proximal part of article 2 narrower, posterodistal lobe of article 2 longer, and article 4 longer than those of NSMT-Cr 18202.

Coloration in life (Fig. 15A–C). Eyes red; head entirely light brown, pereonites 1–7, pleonites 1–3 and urosomites 1–3 mottled light brown and white, dorsal surfaces of pereonite 3 and pleonite 1 in male each with indistinct dark brown marking medially; medial surface of peduncular article 1 of antenna 1 white, peduncular article 5 of antenna 2 white with distinct dark red mark medianly, other parts of antennae orange; whole of gnathopods, coxal plates and articles 2 of pereopods 3–7 light brown and white, other parts of pereopods and pleopods white, uropods light brown.

Remarks. The male pereopod 5 of this species has a posterodistal lobe on the article 2. In all the *Ericthonius* species described, only *E. pugnax* and *E. convexus* sp. nov. have such pereopod 5. Although Dana (1852, 1853, 1855) did not describe in detail *E. pugnax*, the morphological characters of the present specimens generally agree with descriptions and figures of Chilton (1923), Hurley (1954), Ledoyer (1969, 1986) and Moore (1988). Especially in Hurley (1954), the concave posterior edge of telson was clearly described.

In Japan, only *Ericthonius pugnax* is recognized with certainty as a member of the genus, as mentioned above (Nagata, 1960, 1965b; Hirayama 1985). Specimens used by Nagata (1960) were collected from *Zostera* belts in shallow sublittoral water (<3 m). Because the gnathopod 2 of the hyper-adult male illustrated by Nagata (1960) agrees well with that of *E. pugnax* (Fig. 14G), Nagata's (1960) identification seems to be correct. Later Nagata (1965b) reported *Ericthonius pugnax* from various localities. He wrote "from depth of 2 m in low water" about the collecting site; however, his specimens were collected actually from the depth with wide range (up to 25 m; Nagata, 1965a). In addition, his figure shows intermediate condition between *E. pugnax* and *E. convexus* in the small eyes and slender antennae. Although Nagata's (1965b) material included the specimens used by Nagata (1960), it is difficult to fully assess the identification of Nagata (1965b) without reexamination of his specimens. There is a possibility that his material is mixture of the two species reported in this paper. Hirayama (1985) referred the record of *E. brasiliensis* (Dana, 1853) by Irie (1955) to *E. pugnax*. It has been confirmed that Hirayama's identification is correct, because Irie's specimens had a concave posterior edge of the telson.

Hong (1983) and Kim and Kim (1991) recorded *E. brasiliensis* and *E. pugnax*, respectively,

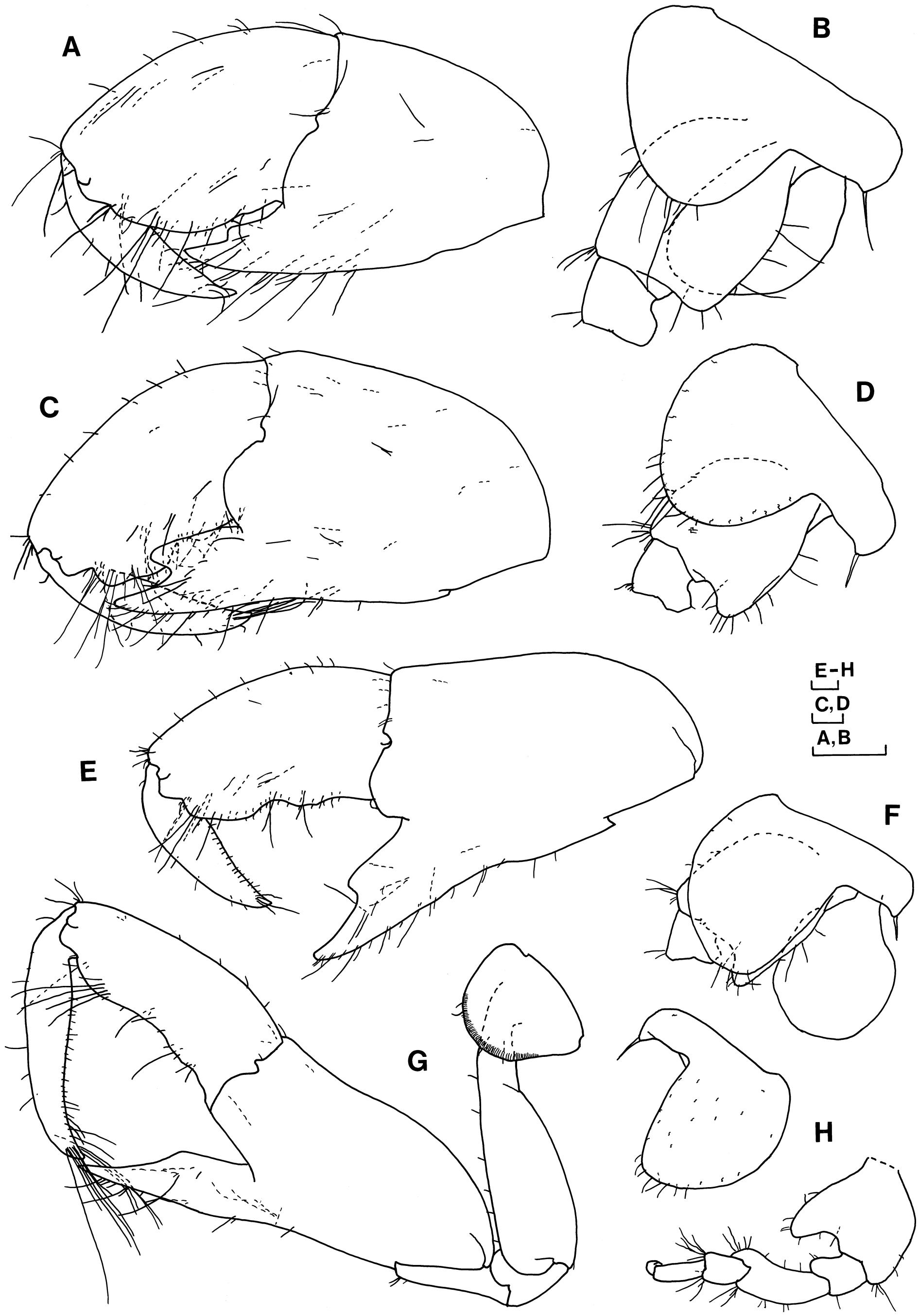

Fig. 14. *Ericthonius pugnax* Dana, 1852. A, B, male (3.9 mm), NSMT-Cr 18206; C, D, male (6.5 mm), NSMT-Cr 18204; E, F, male (6.8 mm), NSMT-Cr 18214; G, H, male (5.4 mm), NSMT-Cr 18209. A, C, E, articles 5–7 of left gnathopods 2, lateral views; B, D, F, articles 1–3 of left pereopods 5, lateral views, gill omitted in D; G, left gnathopod 2, lateral view; H, right pereopod 5, lateral view, gill omitted. Scales: 0.1 mm.

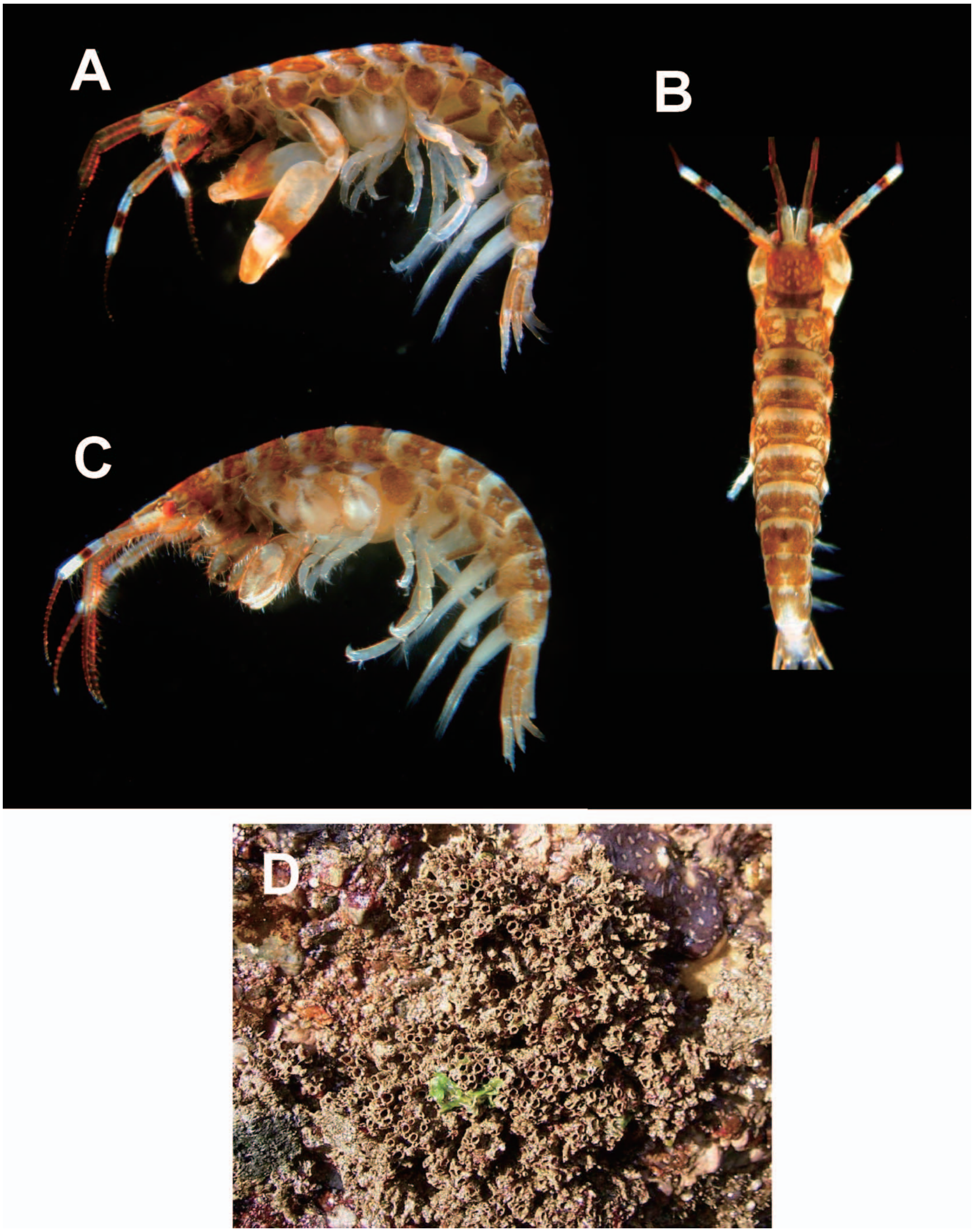

Fig. 15. *Ericthonius pugnax* Dana, 1852. A, male (collected on 6 April 2008), left lateral view; B, male (same date), dorsal view; C, ovigerous female (same date), left lateral view; D, nests (4 April 2007). All specimens were collected from Nagasaki coast, Misaki, Osaka Prefecture.

from Korea. These two species are similar in the posterodistal lobe on the article 2 of male pereopod 5 and the concave or straight telson; therefore, both of them are probably *E. pugnax*.

Ericthonius pugnax is distributed very widely in the tropical and temperate waters in the Indo-West Pacific (see below), and there are subtle morphological differences among the populations (e.g. length of the posterodistal lobe on the article 2 of male pereopod 5). Future study may eventually reveal that more than one species are confounded under this name.

Distribution. Japan: Gokasho Bay in Mie Prefecture, Misaki and Izumisano in Osaka Prefecture (present study), Seto Inland Sea (Nagata, 1960, 1965b), Simabara in Nagasaki Prefecture (Irie, 1955). Korea (Hong, 1983; Kim and Kim, 1991). Other localities: Sulu Sea (Dana, 1853); Ambon, Manipa Island, Banda (Pirlot, 1938); New Zealand (Chilton, 1923; Hurley, 1954); Australia (Moore, 1988); South India (Nayar, 1967); Sri Lanka (Walker, 1904); Mauritius (Appadoo and Myers, 2004); Madagascar (Ledoyer, 1969, 1986).

Habitat. This species builds nests (Fig. 15D) under rocks in the intertidal zone, and inhabits among seaweeds or seagrasses in shallow water at depth less than 3 m.

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References

Appadoo, C. and A. A. Myers. 2004. Corophiidea (Crustacea: Amphipoda) from Mauritius. *Records of the Australian Museum*, **56**: 331–362.

Barnard, J. L. and G. S. Karaman. 1991. The families and genera of marine gammaridean Amphipoda (except marine gammaroids). *Records of the Australian Museum*, Supplement, (13) (Part 1 and Part 2): 1–866.

Chilton, C. 1923. Some New Zealand Amphipoda: No. 3. *Transactions and Proceedings of the New Zealand Institute*, **54**: 240–245.

Dana, J. D. 1852. Conspectus crustaceorum quae in orbis terrarum circumnavigatione, Carolo Wilkes e classe republicae faederatae duce, lexit et descripsit Jaconus D. Dana. Pars III. *Proceedings of the American Academy of Arts and Sciences*, **2**: 201–220.

Dana, J. D. 1853. Crustacea. Part II. *United States Exploring Expedition during the Years 1838, 1839, 1840, 1841, 1842, under the Command of Charles Wilkes, U.S.N.*, **14**: 689–1618.

Dana, J. D. 1855. Crustacea. *United States Exploring Expedition during the Years 1838, 1839, 1840, 1841, 1842, under the Command of Charles Wilkes, U.S.N.*, Atlas, **13/14**: 1–27, pls. 1–96.

Hirayama, A. 1983. Taxonomic studies on the shallow water gammaridean Amphipoda of west Kyushu, Japan. I. Acanthonotozomatidae, Ampeliscidae, Ampithoidae, Amphilochidae, Anamixidae, Argissidae, Atylidae and Colomastigidae. *Publications of the Seto Marine Biological Laboratory*, **28**: 75–150.

Hirayama, A. 1985. Taxonomic studies on the shallow water gammaridean Amphipoda of west Kyushu, Japan. IV. Dexaminidae (*Guernea*), Eophiliantidae, Eusiridae, Haustoriidae, Hyalidae, Ischyroceridae. *Publications of the Seto Marine Biological Laboratory*, **30**: 1–53.

Hong, J. S. 1983. Three tube-building amphipods from experimental plates in Deukryang Bay in the southern coast of Korea. *Korean Journal of Zoology*, **26**: 135–153.

Hughes, L. and J. K. Lowry. 2006. New species of Amphipoda (Crustacea: Peracarida) from the Solitary Islands, New South Wales, Australia. *Zootaxa*, (1222): 1–52.

Hurley, D. E. 1954. Studies on the New Zealand amphipodan fauna. No. 7. The family Corophiidae, including a new species of *Paracorophium*. *Transactions of the Royal Society of New Zealand*, **82**: 431–460.

Irie, H. 1955. Tube-building amphipods occurring at the “wakame” (a species of brown algae: *Undaria pinnati-*

fida) grounds of Simabara, Nagasaki Prefecture. *Bulletin of the Faculty of Fisheries, Nagasaki University*, **4**: 1–6.

Ishimaru, S. 1994. A catalogue of gammaridean and ingolfiellidean Amphipoda recorded from the vicinity of Japan. *Report of the Sado Marine Biological Station, Niigata University*, **24**: 29–86.

Kim, W. and C. B. Kim. 1991. The marine amphipod crustaceans of Ulreung Island, Korea: Part I. *Korean Journal of Zoology*, **34**: 232–252.

Krapp-Schickel, G. 1994. *Ericthonius argenteus* n. sp. (Amphipoda, Corophiidae) aus Kreta. *Zoologischer Anzeiger*, **232**: 129–136.

Ledoyer, M. 1969. Amphipodes tubicoles des feuilles des herbiers de phanérogames marines de la région de Tuléar (Madagascar). *Receuil des travaux de la Station Marine d'Endoume*, Supplement, (9): 179–182.

Ledoyer, M. 1986. Crustacés amphipodes gammariens: familles des Haustoriidae à Vitjazianidae. *Faune de Madagascar*, **59**: 599–1112.

Milne Edwards, H. 1830. Extrait de recherches pour servir à l'histoire naturelle des Crustacés amphipodes. *Annales des Sciences Naturelles*, **20**: 353–399, pls. 10, 11.

Moore, P. G. 1988. Taxonomic observations on the genera *Xenocheira* Haswell and *Ericthonius* Milne Edwards (Crustacea: Amphipoda) from Australian coastal waters. *Journal of Natural History*, **22**: 705–732.

Myers, A. A. 1995. The Amphipoda (Crustacea) of Madang Lagoon: Aoridae, Isaeidae, Ischyroceridae and Neomegamphopidae. *Records of the Australian Museum*, Supplement, (22): 25–95.

Myers, A.A. and D. McGrath. 1984. A revision of the north-east Atlantic species of *Ericthonius* (Crustacea, Amphipoda). *Journal of the Marine Biological Association of the United Kingdom*, **64**: 379–400.

Nagata, K. 1960. Preliminary notes on benthic gammaridean Amphipoda from the *Zostera* region of Mihara Bay, Seto Inland Sea, Japan. *Publications of the Seto Marine Biological Laboratory*, **8**: 163–182, pls. 13–17.

Nagata, K. 1965a. Studies on marine gammaridean Amphipoda of the Seto Inland Sea. I. *Publications of the Seto Marine Biological Laboratory*, **13**: 131–170.

Nagata, K. 1965b. Studies on marine gammaridean Amphipoda of the Seto Inland Sea. III. *Publications of the Seto Marine Biological Laboratory*, **13**: 291–326.

Nayar, K. N. 1967. On the gammaridean Amphipoda of the Gulf of Mannar, with special reference to those of the pearl and chank beds. *Proceedings of the Symposium on Crustacea, Ernakulam*, **1**: 133–168.

Pirlot, J. M. 1938. Les amphipodes de l'expédition du Siboga. Deuxième partie. Les amphipodes gammarides. III.–Les amphipodes littoraux. 2. Familles des Dexaminidae, Talitridae, Aoridae, Photidae, Ampithoidae, Corophiidae, Jassidae, Cheluridae et Podoceridae. *Siboga-Expeditie, Monographie*, **33f**: 329–359.

Stebbing, T. R. R. 1906. Amphipoda. I. Gammaridea. *Das Tierreich*, **21**: 1–806.

Vader, W. and A. A. Myers. 1996. Amphipods living in association with hermit crabs in S.E. Australia. I. Five new Ischyroceridae. *Bollettino del Museo Civico di Storia Naturale di Verona*, **20**: 263–292.

Walker, A. O. 1904. Report on the Amphipoda collected by Professor Herdman, at Ceylon, in 1902. *Ceylon Pearl Oyster Fisheries—1904—Supplementary Reports*, (17): 229–300, pls. 1–8.

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