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A New Species of the Stenopodid Genus *Richardina* A. Milne-Edwards (Crustacea: Decapoda: Stenopodidea) from Uraga Strait, Central Japan

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Abstract A new species of the stenopodid genus *Richardina* A. Milne-Edwards, 1881 is described and illustrated on the basis of a single ovigerous female specimen collected from Uraga Strait, central Japan, at depths of 200-250 m. *Richardina rupicola* sp. nov. appears closest to *R. ohtsukai* Saito and Komatsu, 2009, described from the Ryukyu Islands, southwestern Japan, in sharing a slender spine on the extensor margin of each ambulatory dactyli, but is the only species in the genus having anterolateral teeth on the lateral surface of the carapace. Different armature of the postorbital to postrostral regions of the carapace and of the third pereopod, the relatively stout second to fifth pereopods also distinguish the new species from *R. ohtsukai*. This is the fifth species in the genus and the third known from the Pacific Ocean.

Key words: Crustacea, Decapoda, Stenopodidea, Stenopodidae, *Richardina*, new species, Japan.

The stenopodid genus *Richardina* A. Milne-Edwards, 1881 had long been represented only by two species known from the Atlantic Ocean and Mediterranean Sea, viz. *R. spinicincta* A. Milne-Edwards, 1881 (type species of the genus) and *R. fredericii* Lo Bianco, 1903, until Saito and Komatsu (2009) recently described two new species from Japanese waters (*R. ohtsukai* Saito and Komatsu, 2009 and *R. parvioculata* Saito and Komatsu, 2009), representing the first discovery of the genus from the Pacific Ocean. All the known species are deep-water inhabitants, collected at depths of 400-1230 m (Saito and Komatsu, 2009).

During a continuous marine faunal survey in waters around Boso Peninsula, carried out by the Natural History Museum and Institute, Chiba, a single ovigerous female specimen of an unusual stenopodid shrimp was collected from deepwater off Kyonan, Uraga Strait. Detailed examination has revealed that this specimen represents an undescribed species of *Richardina*, closely related to *R. ohtsukai*, described from the Ryukyu Islands. In this study, a new species, *R. rupicola* sp. nov. is described and illustrated on the basis of this specimen. Differentiating characters between the new species and *R. ohtsukai* are discussed.

The material examined in this study is deposited in the Natural History Museum and Institute, Chiba (CBM). The postorbital carapace length (cl) is used as an indication of the specimen size.

Taxonomy

Family **Stenopodidae**
Genus ***Richardina*** A. Milne-Edwards, 1881
Richardina rupicola sp. nov.
[New Japanese name: Gankutsu-ryujin-ebi]
(Figs. 1-5)

Material examined. Holotype: ovigerous female (cl 4.7 mm), Uraga Strait, SW of Katsuyama Ukishima Islet, Kyonan, Boso Peninsula, 200-250 m, commercial gill net for scampi, 6 December 2009, coll. T. Komai, CBM-ZC 10138.

Description. Body (Figs. 1, 2A, D) moderately robust, subcylindrical. Rostrum (Figs. 2A, B, 5A) 0.35 times as long as carapace, directed forward, reaching midlength of second segment of antennular peduncle, somewhat compressed laterally, narrowly triangular in dorsal view; dorsal margin slightly sloping anteriorly, armed with 12 small teeth, including 3 on carapace posterior to orbital margin (posteriormost tooth smallest, arising at anterior 0.10 of carapace length); ventral margin with 2 subdistal teeth, these teeth larger than those in dorsal series; ventrolateral ridge sharply delimited, baring 1 minute acute denticle located at midlength. Carapace (Fig. 2A, B) with postrostral median ridge low, extending to midway between rostral base and cervical groove; postrostral to postorbital region with about 10 slender, spiniform teeth arranged in irregular 2 or 3 oblique rows; orbital margin evenly concave, infraorbital lobe rounded; antennal tooth small, acuminate; antero-

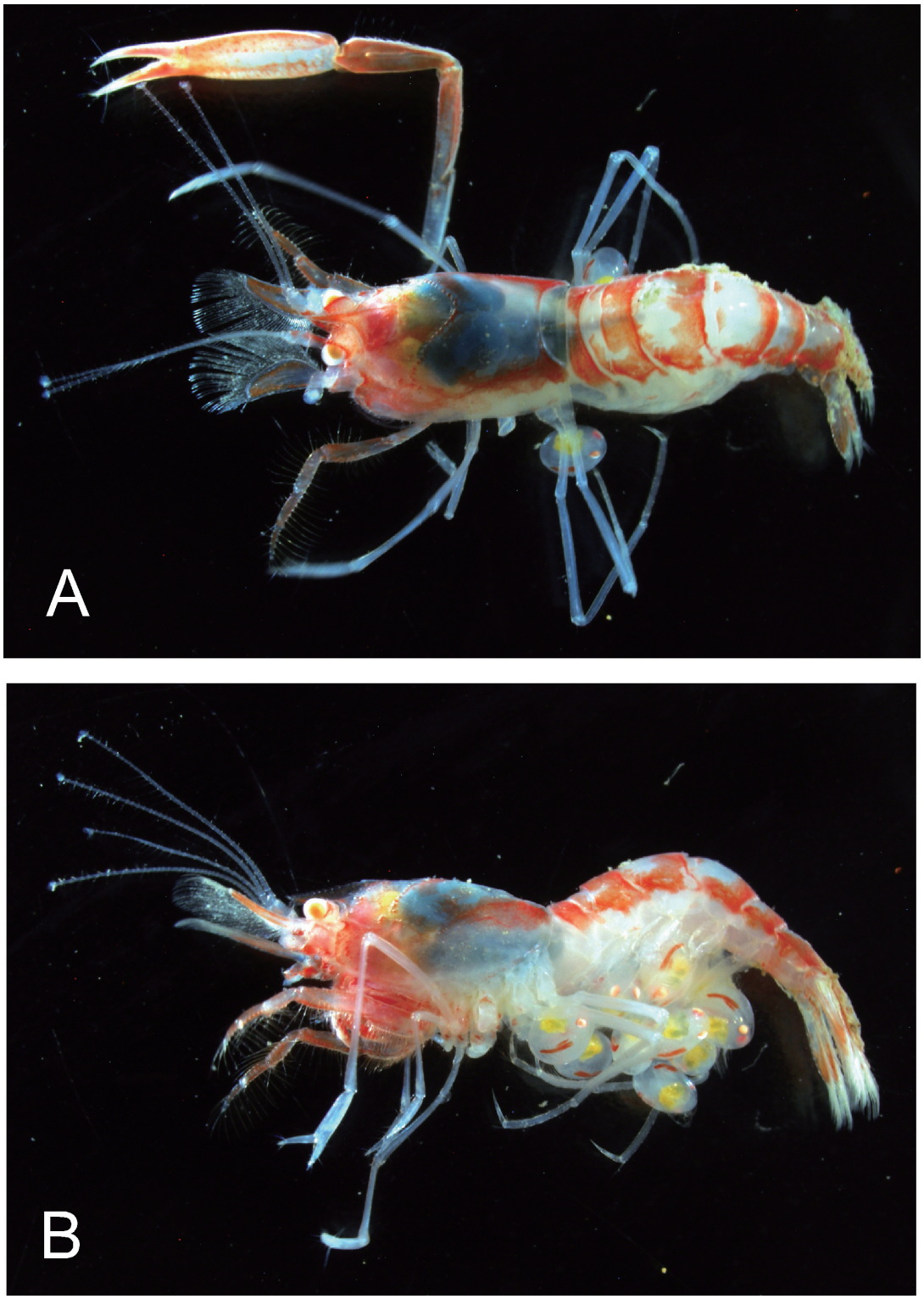

Fig. 1. *Richardina rupicola* sp. nov., holotype, ovigerous female (cl 4.7 mm), CBM-ZC 10138. A, entire animal, dorsal view (left third pereopod missing); B, same, lateral, right third pereopod removed.

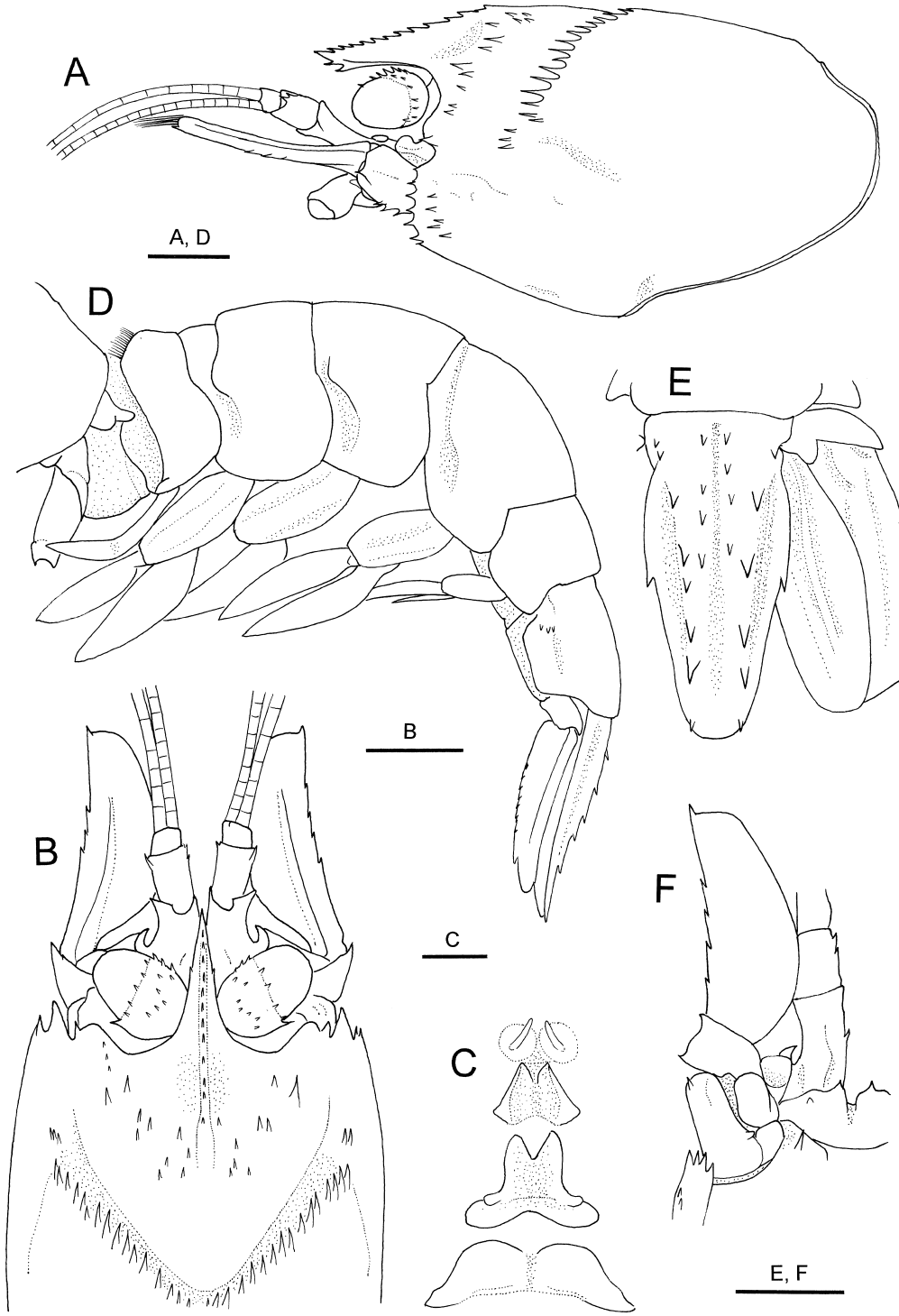

Fig. 2. *Richardina rupicola* sp. nov., holotype, ovigerous female (cl 4.7 mm), CBM-ZC 10138. A, carapace and cephalic appendages, lateral view; B, anterior part of carapace and cephalic appendages, dorsal view; C, prominences on fourth to seventh thoracic sternites, ventral view; D, abdomen, lateral view (setae mostly omitted); E, telson and right uropod, dorsal view; F, proximal two segments of antennular peduncle and antenna, right side, ventral view (antennal flagellum missing). Scale bars: 1 mm for A, B, D-F; 0.5 mm for C.

lateral margin with distinct U-shaped notch just inferior to antennal tooth, and remaining part subtruncate, armed with row of small, slender teeth (inferiormost tooth located at pterygostomial angle); cervical groove distinct, its posterior margin bearing cincture of slender teeth (16 teeth on either side of midline), these teeth increasing in size laterally; set of 2 (right) or 3 (left) small spiniform teeth on hepatic region adjacent to lateral end of cervical groove; 5 anterolateral teeth arranged in vertical row; shallow hepatic groove discernible.

Thoracic sternum (Fig. 2C) moderately narrow. Fourth thoracic sternite with paired laterally compressed prominence. Fifth sternite with paired triangular prominence with raised lateral margins. Sixth sternite with paired subtriangular lobes, separated by V-shaped notch. Seventh sternite with broad, rounded lobes, separated by small median notch. Eighth sternite also with broad, rounded, lobes (not figured).

First abdominal somite (Fig. 2D) with distinct transverse carina clearly dividing somite in two sections, anterior section deeply depressed; pleuron with weak anteroventral angle, otherwise rounded. Second somite with distinct, sinuously transverse carina. Second to fifth pleura generally rounded, without armature. Sixth somite slightly widened posteriorly; tergum unarmed, posterodorsal margin also unarmed; pleuron subtruncate ventrally, armed with 3 minute teeth arranged in vertical row adjacent to junction with fifth somite. Telson (Fig. 2E) lanceolate, about 2.20 times longer than broad; dorsal surface with two rather broad submedian ridges separated by deep median groove, each ridge bearing mesial row of 4 small teeth in proximal half and lateral row of 5 (right) or 7 (left) small to moderately large teeth almost over entire length; lateral margin constricted proximally, bearing 1 tooth at about midlength, anterior part between constriction and lateral tooth convex; posterior margin flanked by small posterolateral teeth, convex, unarmed.

Cornea (Fig. 2A, B) not particularly reduced in size, but non-pigmented or faceted, as wide as eyestalk at base, but slightly narrowing distally; corneal width 0.14 of carapace length; eyestalk armed with row of minute, sharp denticles along base of cornea and several scattered minute denticles on dorsal surface.

Antennular peduncle (Fig. 2A, B, F) reaching midlength of antennal scale. First segment longer than distal two segments combined, with subrectangular process on dorsolateral distal margin and with few small teeth on ventromesial margin; stylocerite very short, strongly curved mesially, terminating in acute tooth. Second segment armed with 1 slender tooth at dorsolateral distal angle and few minute teeth on ventromesial margin distally. Antennular flagella subequal in length, slightly longer than carapace.

Antennal peduncle (Fig. 2A, B, F) short, stout. Basicerite with small distolateral tooth and few ventral spiniform teeth; ventromesial distal angle strongly produced in rounded process, bearing large antennal gland opening. Carpocerite unarmed. Antennal scale 0.50 times as long as carapace, 2.90 times longer than wide; lateral margin slightly concave, bearing 3 (left) or 4 (right) small teeth in proximal 0.75, terminating in small distal tooth overreaching subtruncate distal lamella; dorsal surface with 1 obtuse longitudinal ridge.

Epistome (Fig. 5B) with 3 spiniform denticles at each anterolateral angle, ventralmost denticle directed ventrally; anterior margin obtusely angular.

Mandible (Fig. 3A) considerably robust; palp consisting of 3 articles, distal article oval, longest, furnished with numerous stiff setae, second article also with several stiff setae; molar and incisor processes clearly separated in outer view, but separation distinct in inner view, molar surface oval, without distinct tooth, distal margin of incisor process truncated, armed with low, blunt teeth, edges of teeth chitinous. Maxillule (Fig. 3B, C) with coxal endite rounded, tapering distally, bearing marginal stiff setae; basial endite moderately broad, distal margin truncated, bearing double row of slender spines and sparse, stiff setae; endopod articulated at inner side of basial endite, tapering distally, with some stiff setae. Maxilla (Fig. 3D) with coxal and basial endites both deeply bilobed, each lobes rounded distally; scaphognathite well developed, posterior lobe short rounded, bearing elongate stiff setae; endopod slender, curved, slightly tapering distally, reaching distal margin of anterior lobe of scaphognathite,. First maxilliped (Fig. 3E) with generally rounded basial endite bearing numerous setae on mesial to distal margins; coxal endite broken off; endopod consisting of 2 articles, bearing dense long setae on lateral to terminal margins, distal article distinctly shorter than basal article, not markedly tapering distally, exopod long, flagellum-like, distally multiarticulated; epipod large, divided in 2 slender lobes. Second maxilliped (Fig. 3F) composed of 7 segments; dactylus tapering distally to rounded apex; propodus slightly widened distally, about 0.8 times as long as dactylus; carpus cup-shaped, shorter than propodus; merus longest, mesial half strongly compressed, forming thin lobe, mesial margin slightly convex; ischium very short, mesial angle slightly produced; basis also very short, bearing small but distinct papilla-like tubercle on outer face, mesial angle somewhat produced; exopod well-developed, flagellum-like, multiarticulated distally; epipod small, slender, podobranch small, having few rudimentary filaments.

Third maxilliped (Fig. 4A, B) overreaching antennal scale by length of dactylus. Dactylus shorter than propodus, bearing 4 pairs of long stiff setae on margins and 3 terminal stiff setae. Propodus subequal in length to carpus, with row

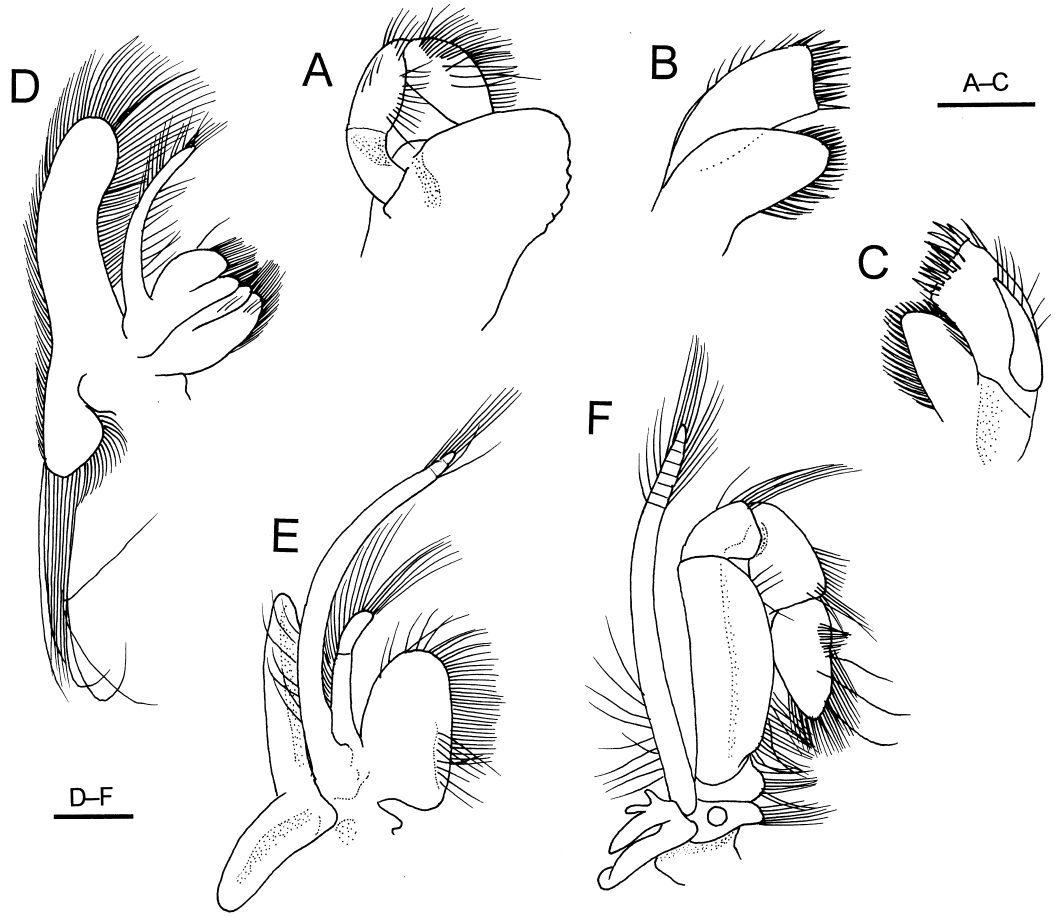

Fig. 3. *Richardina rupicola* sp. nov., holotype, ovigerous female (cl 4.7 mm), CBM-ZC 10138, right mouthparts. A, mandible, ventral (outer) view; B, maxillule, ventral (outer) view; C, same, dorsal (outer) view; D, maxilla, ventral (outer) view; E, first maxilliped, ventral (outer) view; F, second maxilliped, ventral (outer) view. Scale bars: 0.5 mm.

of stiff setae on ventrolateral margin and small patch of grooming setae distally followed by row of stiff setae on mesial face. Carpus broader than distal two segments, much shorter than merus, bearing row of stiff setae only on ventromesial margin, ventrodistal margin not produced. Merus not particularly twisted, subequal in length to ischium, armed with strong distolateral tooth, row of 4 spiniform teeth on lateral face and 3 small spiniform teeth on ventrolateral margin distally; ventral margin slightly convex. Ischium with row of 8 spiniform teeth increasing in size distally on lateral face adjacent to dorsal margin; ventral margin slightly convex, unarmed. Exopod well developed, flagellum-like, distinctly overreaching dorsodistal margin of ischium, distal part multiarticulated.

First pereopod (Fig. 4C, D) small, moderately slender, unarmed, overreaching antennal scale by half-length of chela. Dactylus 0.80 times as long as palm. Palm with small patch of grooming setae proximally. Carpus longest, 1.6 times longer than chela, with small grooming apparatus consisting of patch of short setae and some longer setae on distal portion of ventromesial face. Merus 0.70 times as long as carpus. Ischium distinctly shorter than merus.

Second pereopod (Fig. 4E, F) distinctly longer than first pereopod, overreaching tip of antennal scale by length of chela and half of carpus. Dactylus 0.60 times as long as palm. Palm subcylindrical, without grooming apparatus. Carpus 1.7 times longer than chela, without grooming apparatus. Merus slightly shorter than carpus. Ischium about half length of merus.

Third pereopod (only right side preserved) (Figs. 4G, 5C-F) largest, overreaching antennal scale by length of chela and carpus. Chela somewhat compressed laterally, about 1.4 times longer than carapace; lateral margin slightly sinuous. Dactylus 0.65 times as long as palm, very slightly curving, terminating in acute tip; mesial face with row of minute spiniform denticles on extensor side; cutting edge with

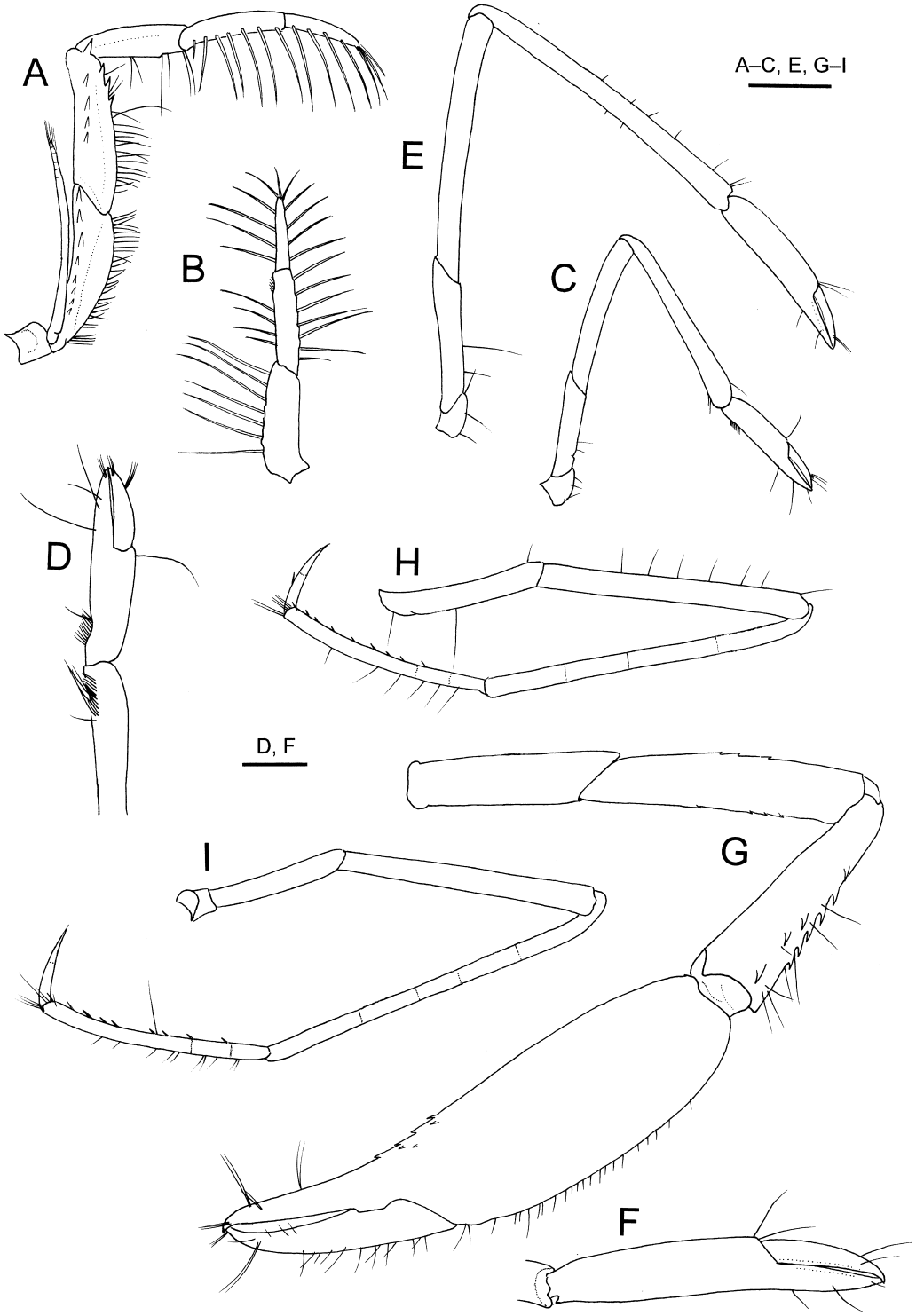

Fig. 4. *Richardina rupicola* sp. nov., holotype, ovigerous female (cl 4.7 mm), CBM-ZC 10138, right thoracic appendages. A, third maxilliped, lateral view; B, same, distal three segments, extensor view; C, first pereopod, lateral view; D, same, chela and distal part of carpus, mesial view; E, second pereopod, lateral view; F, same, chela, lateral view; G, third pereopod, lateral view; H, fourth pereopod, lateral view; I, fifth pereopod, lateral view. Scale bars: 1 mm for A-C, E, G-I; 0.5 mm for D, F.

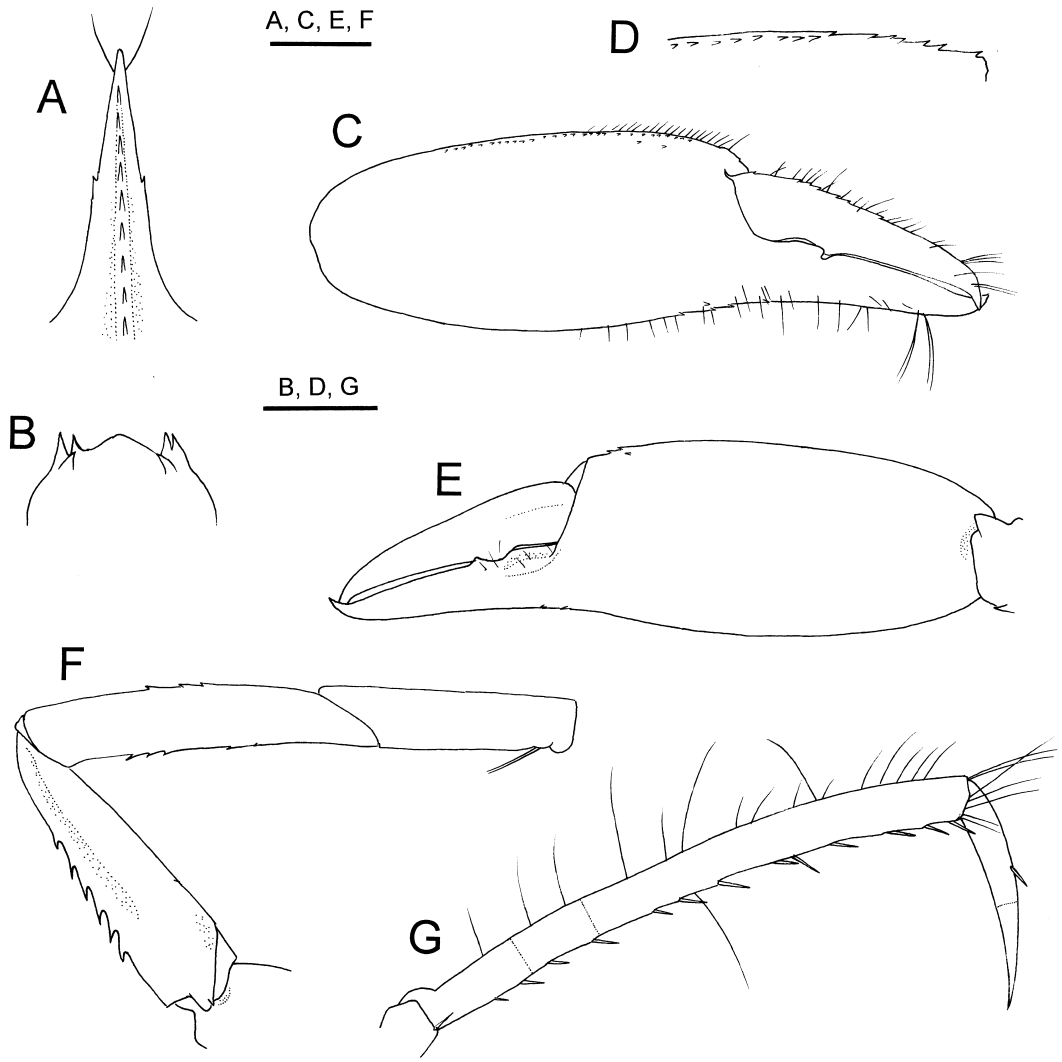

Fig. 5. *Richardina rupicola* sp. nov., holotype, ovigerous female (cl 4.7 mm), CBM-ZC 10138. A, rostrum, dorsal view; B, epistome, ventral view; C, chela of right third pereopod, extensor view; D, same, mesial margin of palm, extensor view; E, chela of right third pereopod, flexor view (setae omitted); F, carpus to ischium of right third pereopod, mesial view; G, dactylus and propodus of right fourth pereopod, lateral view. Scale bars: 1 mm for C, E, F; 0.5 mm for A, B, D, G.

low, triangular teeth proximal to midlength. Fixed finger curving in distal portion, terminating in acute tip; cutting edge bearing shallow concavity receiving tooth on dactylus and small triangular tooth just distal to it, otherwise nearly smooth. Palm 2.20 times longer than wide, with sparse setae on lateral and mesial faces; lateral face rounded, bearing some minute denticles around base of fixed finger; extensor surface with row of numerous, minute denticles adjacent to mesial margin; mesial margin sharply carinate, with row of short setae; flexor surface nearly smooth. Carpus somewhat elongate, widened distally, with triangular process on distolateral margin, with prominent lobe on dorsal margin subdistally; extensor surface with 2 rows of spiniform teeth; lateral, mesial and flexor surfaces unarmed. Merus with 3 minute denticles on dorsal margin; ventral margin with 5 minute denticles; surfaces and margins otherwise unarmed. Ischium unarmed.

Fourth pereopod (Figs. 4H, 5G) moderately long and slender, overreaching antennal scale by length of distal three segments. Dactylus 0.40 times as long as propodus, 7.30 times longer than high, simple, armed with 1 slender spinule at midlength of extensor margin; unguis demarcated, occupying about half-length of entire dactylus. Propodus 0.60 times as long as carpus, subdivided into 2 short

proximal articles and 1 long distal article (articulation rather obscure), bearing 13 slender spinules on flexor margin. Carpus longest, subdivided in 4 articles, unarmed. Merus shorter than carpus, 11.2 times longer than wide. Ischium much shorter than merus.

Fifth pereopod (Fig. 4I) similar to fourth pereopod. Propodus bearing 9 spinules on flexor margin. Carpus subdivided into 5 articles.

Gill formula summarized in Table 1. All gills well lamellate. Epipods on pereopods simple, rod-like.

Table 1. *Richardina rupicolasp*. nov.
Gill formula. r: rudimentary.

Thoracis somites	1	2	3	4	5	6	7	8
	Maxillipeds				Pereopods			
Appendages	1	2	3	1	2	3	4	5
Pleurobranchs	0	0	1	1	1	1	1	1
Arthrobranchs	1	1	2	2	2	2	2	0
Podobranchs	0	r	0	0	0	0	0	0
Epipods	1	1	1	1	1	1	1	0
Exopods	1	1	1	0	0	0	0	0

Pleopods (Fig. 2D) without appendices. First pleopod uniramous, shortest. Second to fifth pleopods each with broad rami; protopods flattened, unarmed.

Uropod (Fig. 2E) not reaching posterior margin of telson. Endopod unarmed, dorsal surface with 1 longitudinal ridge medially. Exopod with serration of 7 teeth on lateral margin (including one tooth at posterolateral angle), dorsal surface with trace of longitudinal ridge on midline. Protopod unarmed.

Eggs (Fig. 1) large, about 1.9 mm measured along longer axis (about 0.4 times of carapace length), 12 in number.

Coloration in life. Carapace generally reddish translucent, with darker longitudinal band on branchial region; grayish blue ovary visible through integument. Tergites of anterior three abdominal somites red (median part of second and third somites translucent), pleura of those somites translucent; fourth to sixth somites with red broad longitudinal band on lateral face connected with posterior transverse band on dorsal surface. Telson and uropods with reddish transverse band across midlength. Cornea opaque. Antennular peduncle colorless. Antenna and third maxilliped reddish. All but third pereopod colorless. Third pereopod generally reddish. Eggs pale yellow.

Distribution. Known only from the type locality, Uraga Strait off Kyonan, Boso Peninsula, 200-250 m deep.

Habitat. The holotype was collected from a deeply located chamber on a clay rock entangled by gill net at depths of 200-250 m. At the time of capture it was still alive, but no evidence of association with other invertebrates was observed.

Remarks. Saito and Komatsu (2009) noted that *Richardina ohtsukai* is unique among the known species of the genus in having a single spine on the extensor margin of the dactyli of the fourth and fifth pereopod. This presumably apomorphic character is also present in this new species, suggesting that these two species are phylogenetically closely related. Indeed, the new species is similar to *R. ohtsukai* in many features. However, *R. rupicola* sp. nov. appears unique in the genus in having anterolateral teeth posterior to the anterolateral margin of the carapace. No other species of the genus have such an armature (A. Milne-Edwards, 1881; Lo Bianco, 1903; Kemp, 1910; Forest and Holthuis, 1997; Saito and Komatsu, 2009). Furthermore, *R. rupicola* differs from *R. ohtsukai* in several features, as follows: (1) the postrostral to postorbital regions of the carapace bear more numerous spines in *R. rupicola* than in *R. ohtsukai* (more than 10 versus four); (2) teeth on the anterolateral margin of the carapace are stronger in the new species than in *R. ohtsukai*; (3) the dorsal surface of the telson bears one or two lateral teeth proximal to the lateral constriction in *R. rupicola*, but such teeth are absent in *R. ohtsukai*; (4) the cornea slightly tapers in *R. rupicola*, rather than spherical in *R. ohtsukai*; (5) the ventrodistal margin of the carpus of the third maxilliped is non-produced in the new species, rather than slightly produced in *R. ohtsukai*; (6) the ischium of the third maxilliped bears a row of spiniform teeth on the lateral face adjacent to the dorsal margin while unarmed on the ventral margin in *R. rupicola*, whereas there are no teeth on the lateral face but armed with a row of small teeth on the ventral margin in *R. ohtsukai*; (7) the pereopods are generally more stout in *R. rupicola* than in *R. ohtsukai* (for example, the merus of the third pereopod is 4.70 times longer than high when measured along the dorsal margin in the new species versus 7.10 in *R. ohtsukai*); (8) the carpus of the third pereopod is unarmed on the flexor surface in *R. rupicola*, rather than having minute denticles arranged in irregular rows on that surface in *R. ohtsukai*. In addition, *R. rupicola* seems to be a free-living species, but *R. ohtsukai* is an associate of hexactinellid sponges (Saito and Komatsu, 2009).

The recent discovery of the two new species by Saito and Komatsu (2009) and this new species suggest that *Richardina* is more diverse than we have expected. The four known congeneric species have been recorded from depths greater than 400 m (Saito and Komatsu, 2009), and thus the present new species extends slightly the bathymetric range of the genus to 200-250 m. As noted above, the habitat of this new species is cryptic, and thus it is difficult to collect specimens. Perhaps this is one of the reasons why this species remained unknown until now, although the type locality is involved in well-surveyed area. It is suggested that

documentation of the deep-water cryptic fauna is far from complete even in the macrobenthos.

Etymology. From the Latin *rupes* (rock) and *cola* (living), in reference to the habitat of this new species. Used as a noun in apposition.

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浦賀水道の深海から発見されたリュウジンエビ属（十脚目：オトヒメエビ下目：オトヒメエビ科）の１新種

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千葉県鋸南町沖の浦賀水道，水深 200 ～ 250 m の深海から採集された１抱卵個体に基づき，オトヒメエビ下目オトヒメエビ科リュウジンエビ属 *Richardina* A. Milne-Edwards, 1881 の新種 *R. rupicola*（新称：ガンクツリュウジンエビ）を記載した．本新種は，琉球諸島から記載された *Richardina ohtsukai* Saito and Komatsu, 2009 に形態的に類似し，特に歩脚（第４，５胸脚）の指節の上縁に１本の可動小棘を具えるという派生的形質を共有する．しかし，本新種は頭胸甲上の小棘の数と配列や胸脚のプロポーションなどの明瞭な相違により *R. ohtsukai* とは識別される．本種はリュウジンエビ属としては５番目に知られる種であり，日本近海からは３種目となる．本種の発見された浦賀水道は海洋生物相の調査が比較的進んでいる海域であるが，深海の隠蔽的な環境にはマクロベントスにも未発見の生物種が多く存在することが示唆される．