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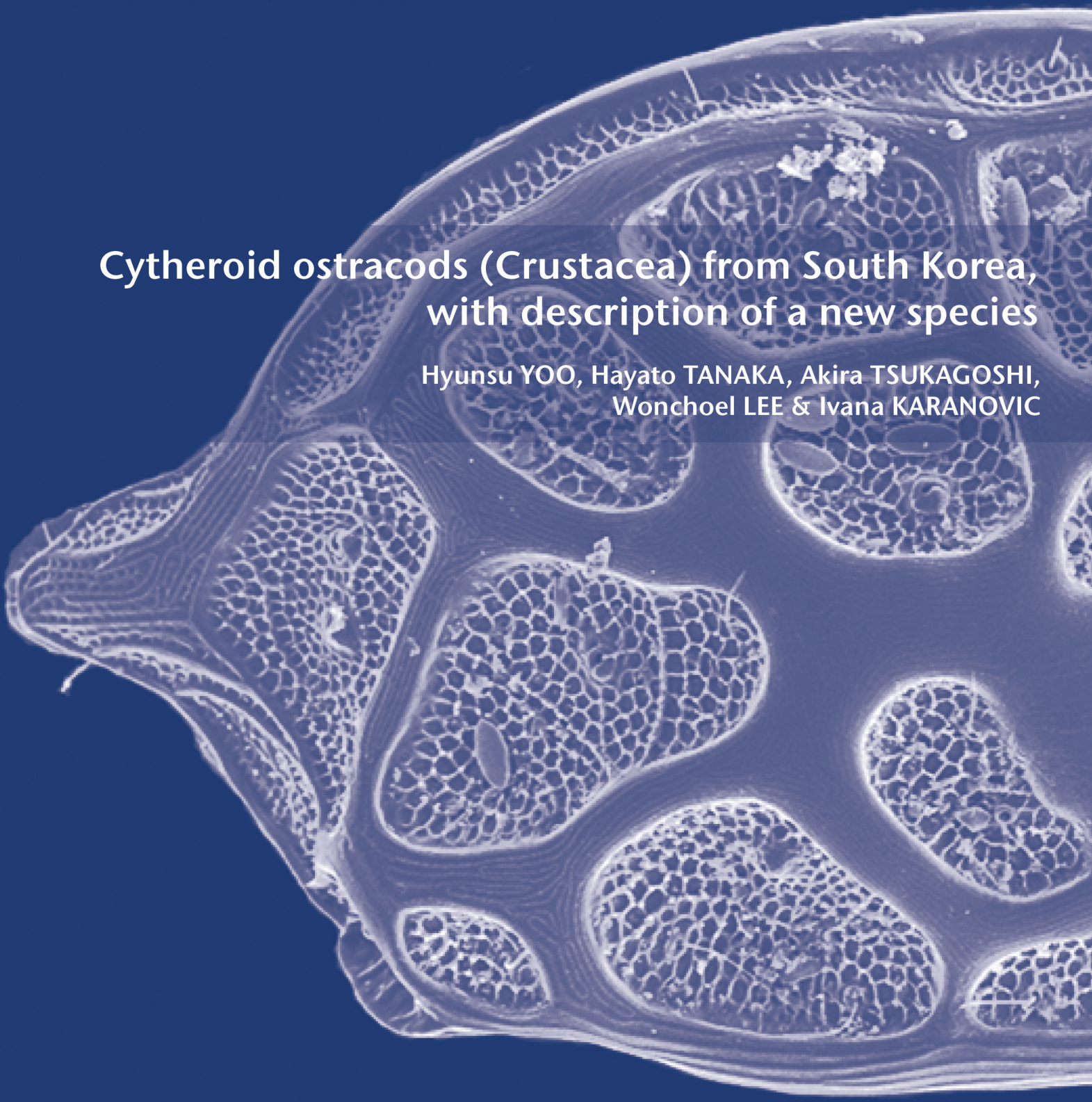

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Couverture / *Cover:*
Detail of *Hemicytherura kajiyamai* Hanai, 1957 SEM photographs; female (NIBRIV0000753777): right valve, external view.

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Cytheroid ostracods (Crustacea) from South Korea, with description of a new species

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ABSTRACT
Living cytheroid ostracod fauna from South Korea is very poorly known, and so far only 12 species have been reported in the taxonomic literature with detail description. We describe one new species, *Xestoleberis hujeongensis* n. sp., and report three other cytheroid ostracods: *X. setouchiensis* Okubo, 1979; *X. sagamiensis* Okubo, 1976; and *Hemicytherura kajiyamai* Hanai, 1957 from the east coast of Korea. The new species is most closely related to *Xestoleberis hanaii* Ishizaki, 1968, a widely distributed and ecologically versatile species. The two species have a very similar carapace shape and soft body parts morphology. Nevertheless, the new species has a distinctively different carapace ornament (presence of wart-like structures on the male carapace), as well as hemipenis morphology. The other three species were known so far only from Japan, and the South Korean populations differ from the Japanese ones only by carapace size, while the carapace shape and all soft body parts are very similar to their original descriptions. This is also the first record of a living representative of the genus *Hemicytherura* Elofson, 1941 from Korea.

KEY WORDS
Cytheroidea,
Ostracoda,
South Korea,
East Asia,
new species.

RÉSUMÉ
Ostracodes cythéroides (Crustacea) de la Corée du Sud, avec la description d'une nouvelle espèce.
La faune actuelle d'ostracodes de Corée est très mal connue et jusqu'à présent seules 12 espèces ont été rapportées dans la littérature taxonomique. Nous décrivons une nouvelle espèce, *Xestoleberis hujeongensis* n. sp., et signalons trois autres ostracodes cythéroides : *X. setouchiensis* Okubo, 1979 , *X. sagamiensis* Okubo, 1976; et *Hemicytherura kajiyamai* Hanai, 1957 de la côte orientale de la Corée. La nouvelle espèce est plus étroitement apparentée à *Xestoleberis hanaii* Ishizaki, 1968, une espèce largement répandue et écologiquement polyvalente. Les deux espèces présentent une forme de carapace et une morphologie des parties molles du corps très semblables. Néanmoins, chez la nouvelle espèce, l'ornementation de la carapace est clairement différente (présence de structures verruqueuses sur la carapace du mâle), de même que la morphologie de l'hémipénis. Les trois autres espèces n'étaient jusqu'ici connues que du Japon, et les populations sud-coréennes ne diffèrent des populations japonaises que par la taille de la carapace, tandis que la forme de la carapace et toutes les parties molles du corps sont très semblables à leurs descriptions originales. Nous signalons également ici pour la première fois un représentant actuel du genre *Hemicytherura* Elofson, 1941 de Corée.

MOTS CLÉS
Cytheroidea,
Ostracoda,
Corée du Sud,
Asie de l'Est,
espèce nouvelle.

INTRODUCTION

The superfamily Cytheroidea has a cosmopolitan distribution, and is the most diverse ostracod group (Horne *et al.* 2002). The carapace is strongly calcified and therefore fossilizes easily. As a consequence, there are more fossil than Recent species described so far (Tanaka 2009). This is an ecologically versatile group that can be found in both marine and freshwater environments, from littoral to deep-sea regions (Benson & Sylvester-Bradley 1971; Danielopol 1977, 1980; Sato & Kamiya 2007; Tanaka *et al.* 2011; Karanovic & Brandão 2012; Karanovic & Humphreys 2014; Karanovic & Brandão 2015; Chand & Kamiya 2016). Of the 44 cytheroid families known so far (Karanovic & Brandão 2015), the following 11 have been recorded from Korea: Cobanocythridae Schornikov, 1975, Cytheruridae Müller, 1894, Cytheridae Baird, 1850, Cushmanideidae Puri, 1974, Hemicytheridae Puri, 1953, Krithidae Mandelstam, 1958, Leptocytheridae Hanai, 1957, Limnocytheridae Klie, 1938, Loxoconchidae Sars, 1925, Paradoxostomatidae Brady & Norman, 1889, Xestoleberididae Sars, 1928. These families are represented in Korea by 52 species (Appendix 1), but only 12 records have been supported by taxonomic descriptions and/or illustrations, while the rest were reported only as names in an environmental monitoring study (Lee *et al.* 2000). In addition, Lee *et al.* (2000) list another 101 unnamed cytheroid species. Here we (re) describe four cytheroids from Korea of which three belong to the genus *Xestoleberis* Sars, 1866 and one to *Hemicytherura* Elofson, 1941.

Xestoleberis has a global distribution, with a preference for intertidal-zone habitats (algae, rocky shore, and intertidal-zone sediments) (Sato & Kamiya 2007; Chand & Kamiya 2016). Sato & Kamiya (2007) divided the genus into three species groups based on the type and distribution of cuticular pores and setae (see figure 3 in Sato & Kamiya 2007). However, this division encompassed only 13 species known from Japan. Nevertheless, the division is congruent with other important morphological characters, such as hingement structure, muscle scar imprints, and hemipenis morphology. According to the world register of marine species – WoRMS, (Brandão *et al.* 2018) there are 219 *Xestoleberis* species described so far. By far, the majority are known only as fossils or subfossils and therefore the morphology of their soft parts is unknown. The East Asian region accounts for 18 Recent species, almost all known only from Japan. Although, the majority of species can be considered as endemic, some as *X. hanai* Ishizaki, 1968, for example, are more widely distributed and have been reported from three East Asian countries: Russia (Schornikov 1974), Korea (Lee *et al.* 2000), and Japan (Sato & Kamiya 2007). No living species are known from China today. Here we describe one new species from Korea and briefly report *X. setouchiensis* Okubo, 1979 and *X. sagamiensis* Kajiyama, 1913, species previously known from Japan only (Okubo 1979; Kajiyama 1913). According to Sato & Kamiya (2007) and Tanaka *et al.* (2011), *X. sagamiensis* was reported from 20 and *X. setouchiensis* from 54 localities from all over Japan (Fig. 1).

The genus *Hemicytherura* Elofson, 1941 is less diverse than *Xestoleberis*, with 74 fossil and Recent species (Brandão *et al.* 2018), but this number is far from complete, since many species are missing from the list, like those described from Japan (Tanaka *et al.* 2011). As for *Xestoleberis*, the majority of the *Hemicytherura* species are known as fossils or subfossils. Soft part morphology has been described for only a few species, some of which are known from Japan, but none from Russian Far East, China or Korea. According to Tanaka *et al.* (2011) *Hemicytherura* can be divided into four species groups: *kajiyamai*-, *cuneata*-, *taiwanensis*-, and *tricarinata*-group. The division is based on the size of pores situated on the fossae (see figure 1C, Tanaka *et al.* 2011). Here we report and redescribe *H. kajiyamai* Hanai, 1957, which is the first record of a Recent representative of the genus from South Korea. One fossil species, *H. yeosuensis* Cheong, Lee, Paik & Chang, 1986 was described from the Ulleung Back-Are basin (Cheong *et al.* 1986) (Sea of Japan).

Hemicytherira kajiyamai Hanai, 1957 was so far known only from its type locality, i.e., the shore of the Imperial villa, Hayamamachi, Kanagawa Prefecture (Fig. 1).

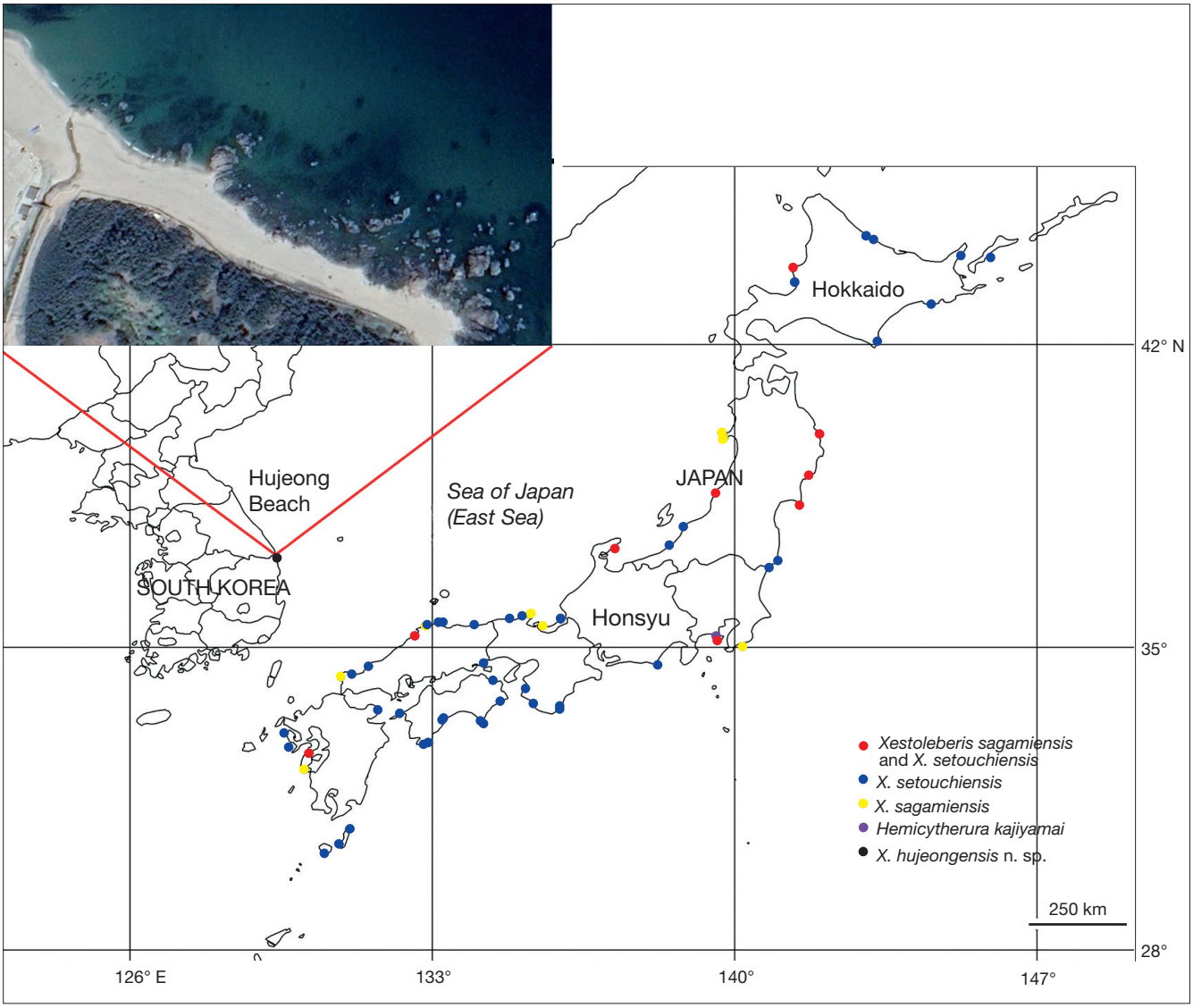

FIG. 1. — Map of sampling station in South Korea and distribution of *Xestoleberis sagamiensis* Kajiyama, 1913, *X. setouchiensis* Okubo, 1979 and *Hemicytherura kajiyamai* Hanai, 1957 in Japan.

The aim of this paper is to contribute to the better understanding of the cytheroid fauna of the Korean Peninsula, and also to add new data about the morphology of the soft parts of this diverse group of ostracods, since overwhelming majority of publications dealing with cytheroids rely on the carapace morphology only.

MATERIAL AND METHODS

COLLECTIONS

Material was collected from intertidal-zone at Hujeong Beach: 37°04'12.3"N, 129°25'01.0"E, 0.1 m depth (Salinity: 32.7 part per thousand, Sediment temperature: 23.6°) (Fig. 1), which is situated in the southeast part of the South Korean east coast about 8 kilometers from Uljin. Samples were collected using rinsing method suggested by Giere (2009): After filling the bucket with algae, seawater was filtered through 38 µm mesh, poured over the algae and stirred by hand. After thoroughly stirring, the algae or sediment will settle down, and the seawater from the bucket was filtered through 63 µm hand-net and placed in a collection bottle. The process was repeated 5-6 times. All samples were fixed in 99% ethanol on site.

DRAWING, SEM AND ANALYSIS

Sorting was done under a stereomicroscope (Olympus SZX12) in the laboratory of Hanyang University. Specimens were dissected on slides in CMC-10 mounting media (Masters Company, Inc., United States). All drawings were prepared using a drawing tube attached to a microscope Olympus BX51. Carapace and hemipenis measurement were performed according to the method presented on Figures 2 and 3. Carapaces were coated with Platinum for the Scanning Electron Microscopy (SEM), which was done at Eulji University with Hitachi S-4700 scan-

Fig. 2. — Method of measurement of carapace H and L. Abbreviations: see Material and methods

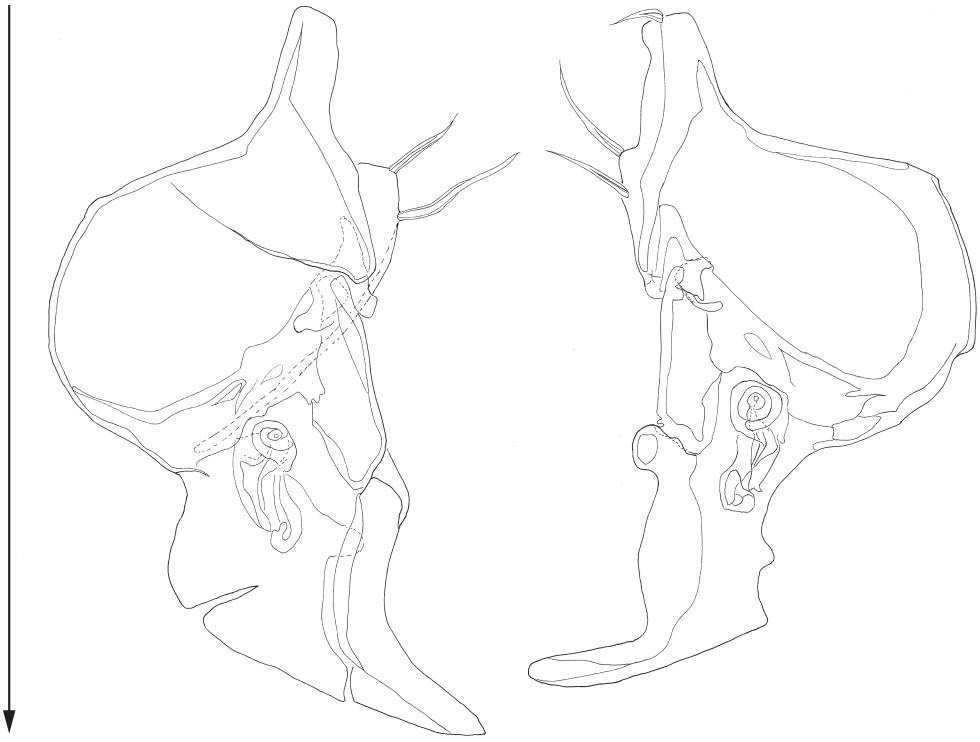

Fig. 3. — Method of measurement of hemipenis length (since pairs of hemipenis are of a different size the longest one was measured).

ning electron microscope. All specimens are deposited in two institutes, the invertebrate collection of the National Institute of the Biological Resources (NIBR) in South Korea and Muséum national d'Histoire naturelle (MNHN) in France.

Abbreviations

A1	antennule;
A2	antenna;
BO	brushed organ;
GF	genital field;
H	height;
Hp	hemipenis;
L	length;
L5-7	leg 5-7;
LV	left valve;
Md	mandibule adjectif mandibular;
Mxl	maxillule, adjectif maxillular;
RV	right valve.

Institutions

MNHN	Muséum national d'Histoire naturelle, Paris;
NIBR	National Institute of the Biological Resources, Seoul.

SYSTEMATICS

Order PODOCOPIDA Sars, 1866
Suborder CYTHEROCOPINA Baird, 1850
Superfamily CYTHEROIDEA Baird, 1850
Family CYTHERURIDAE Müller, 1894
Genus *Hemicytherura* Elofson, 1941

Hemicytherura kajiyamai Hanai, 1957
(Figs 4-8)

Hemicytherura kajiyamai Hanai, 1957: 24, pl. 2, figs 1 (a-d). — Okubo 1980: 15, fig. 5. — Ikeya *et al.* 1985, pl. 5, figs 12, 13, 16. — Ishizaki & Matoba 1985: pl. 4, fig. 8. — Ruan & Hao 1988: 293, pl. 50, fig. 15. — Kamiya 1989: 85, fig. 13 (4). — Ikeya & Suzuki 1992: 128, pl. 5, fig. 3. — Kamiya *et al.* 2001: fig. 13 (5), fig. 17 (7). — Nakao *et al.* 2001: fig. 5 (7). — Yamaguchi 2003: 135, fig. 1(g). — Tanaka et al. 2011: 23-25, fig. 1(a-b), 2(a), 3(a), 4(a), 5. — Schornikov & Zenina 2014: 225 pl. VIII (no.7-8).

Cytheropteron videns – Kajiyama 1913: 4, 5, pl. 1, figs 19-25.

TYPE LOCALITY. — The shore from behind of an Imperial villa, Hayamamachi, Kanagawa Prefecture (beach sand), Japan.

MATERIAL EXAMINED. — **South Korea**. 4 ♀, intertidal-zone algae at Hujeong Beach, Hujeong 2-gil, Jukbyeon-myeon, Uljin-gun, Gyeongsangbuk-do., 37°04'12.3"N, 129°25'01.0"E, 0.1 m depth., dissected on four each slides, NIBRIV0000753777, NIBRIV0000834100, NIBRIV0000834101, NIBRIV0000834102, valves on the micropaleontological slides, NIBRIV0000753777, NIBRIV0000834100, NIBRIV0000834101, NIBRIV0000834102. — 2 ♂, same locality, dissected on two slides, NIBRIV0000834103, NIBRIV0000834104, valves on the micropaleontological slides, NIBRIV0000834103, NIBRIV0000834104. — 6 specimens kept in 2 ml vial in 99% ethanol, NIBRIV0000834105, 5 specimens kept in 2 ml vial in 99% ethanol, MNHN.

DESCRIPTION OF FEMALE

Carapace (Figs 4A-D; 5A; 6A, B)
Relatively small in size, L max = 332 µm, min = 325 µm, average *c*. 329 µm; H max = 198 µm, min = 190 µm, average approximately 193,5 µm, N = 4. Slightly asymmetrical, LV slightly larger than LV, RV hanging over dorsal margin of LV. Dorsal margin highly arched with greatest H in the middle of L, ventral margin almost straight, with setae and thin selvage. Posterior end long and with narrow extension, antero-ventral margin with four crenulations. Valve ornamented consisting of 12 fossae, positioned actiniform started from central part, fossae with thin ridges and setae (Fig. 5A). Muscular scar imprints consisting of a row of four vertical scars and one frontal scar present (Fig. 6E). Only normal pores present. Hinge lophodont (Fig. 4E).

Antennule (Fig. 6F)
Six-segmented. First segment without setae. Second segment with one bare seta situated postero-medially reaching one-third of fourth segment. Third and fourth segments each with one bare seta antero-distally; seta on third segment reaching end of fourth segment and seta on fourth segment reaching half of terminal segment. Fifth segment with two setae antero-distally: one seta more than 2 times longer than terminal segment; other seta 1.5 times longer than same segment. Same segment also with one postero-distal seta 2 times longer than terminal segment. Sixth segment with two short setae distally, one of which 2 times longer than terminal segment and other 2.5 times longer than same segment. Length ratios between six segments: 3: 3.2: 2.5: 2.8: 2.8: 1.

Antenna (Fig. 6H)
Five-segmented. Exopod transformed into three-segmented spinneret seta. First endopodal segment without setae. Second segment with one bare and one plumose seta situated postero-distally; bare seta reaching half of third segment and plumose seta reaching two-third of the same segment. Third segment with two plumose setae postero-distally reaching half of fourth segment, and several setulae antero-proximally. Fourth segment with one bare seta situated medially reaching half L of the fourth segment; one plumose seta postero-medially not reaching distal margin of the fourth segment, and one short plumose seta antero-distally. Terminal segment with two strong, serrated claws and one short seta situated between claws. Appendage with several stiff seatulae groups along posterior margin of the first endopodal segment and on the anterior margin of the second endopodal segment. Length ratios between four segments: 1.9: 1.2: 1: 2.1.

Mandibule (Fig. 6G)
Coxa with one row of setula on distal margin, and with one seta. Palp 3 segmented. First segment with one bare seta antero-medially, and three bare setae on antero distal margin. Second segment with four setae postero-distally, and two setae antero-distally, all bare. Terminal segment with three setae on distal margin. Setae on all segments very strong, almost claw-like. Length ratio between three segments: 5.5: 1.5: 1.

Maxillule (Fig. 7D)
Palp present and 2-segmented. First segment with four bare setae on distal margin. Second segment with two bare setae on distal margin. Masticatory organ with three endites. First endite with four bare setae on distal margin. Second endite with four bare setae on distal margin. Third endite with two bare setae on distal margin. Exopodite with 12 plumose and two bare setae ("aberrant" setae) in vibratory plate.

Leg 5 (Fig. 7A)
Four-segmented. First segment with one plumose seta antero-medially reaching distal end of the same segment, two plumose setae on antero-distal margin reaching half L of the second segment, one plumose and one bare seta on posterior margin not reaching end of the first segment. Second segment with one plumose seta antero-distally not reaching end of the third segment; row of setulae present medially along anterior to distal margin. Third segment with one row of setulae medially along anterior to distal margin. Terminal segment with setulae medially along anterior to distal margin, and most distally with one claw. Length ratio between four segments: 2.7: 1.4: 1: 1.2.

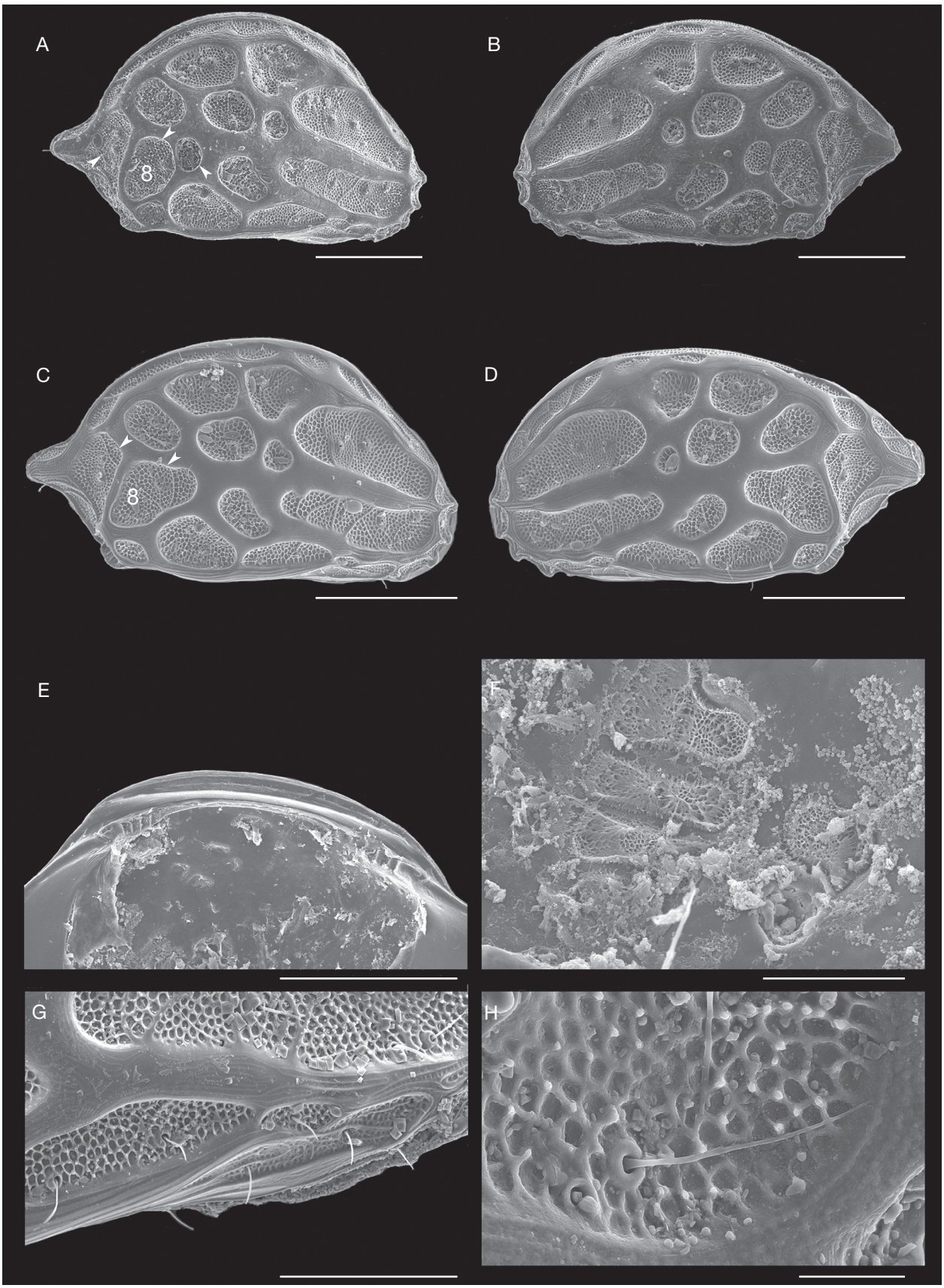

FIG. 4. — *Hemicytherura kajiyamai* Hanai, 1957 SEM photographs; female NIBRIV0000753777: **A**, RV external view; **B**, LV external view; male NIBRIV0000834103; **C**, RV external view; **D**, LV external view; **E**, hingement (lophodont); **F**, muscular scar; **G**, posterior ventral margin; **H**, seta pore type; no. 8 fossa divided in 3 parts on female RV (**A**) and in 2 parts on male RV (**C**). Abbreviations: see Material and methods. Scale bars: A-E, 100 µm; F, 20 µm; G, 50 µm; H, 10 µm.

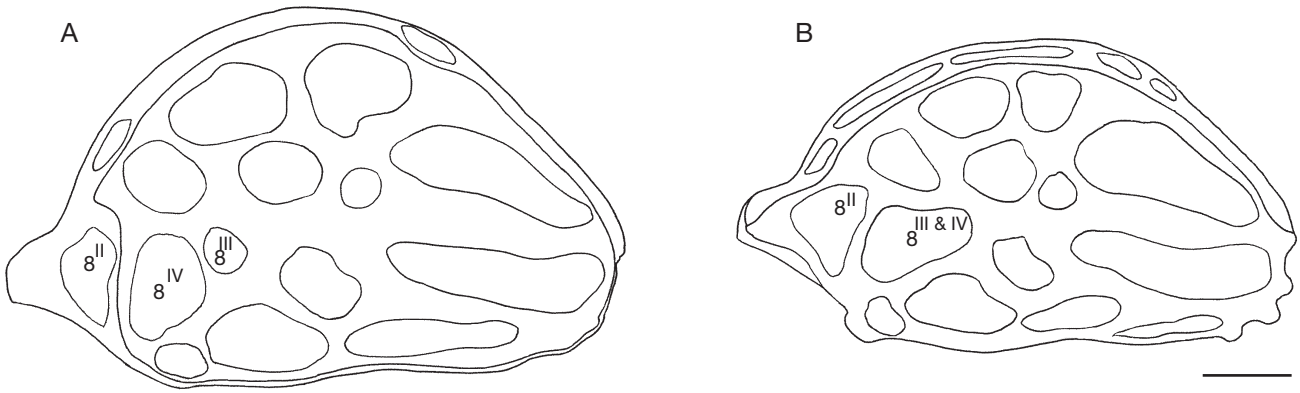

FIG. 5. — *Hemicytherura kajiyamai* Hanai, 1957: **A**, female NIBRIV0000753777: RV external view; **B**, male NIBRIV0000834103), RV external view; no. 8 fossa divided in 3 parts on female RV (**A**) and in 2 parts on male RV (**B**). Abbreviations: see Material and methods. Scale bar: 50 µm.

Leg 6 (Fig. 7B)
Four-segmented. First segment with one plumose and one bare seta situated antero-medially reaching end of the first segment; one bare seta antero-distally reaching one-third of second segment, one plumose seta postero-medially reaching one-third of the same segment and setulae on distal margin. Second segment with one bare seta antero-distal margin reaching ¾ of the third segment. Third segment without seta and setulae. Terminal segment with one claw on distal margin. Length ratios between four segments: 2.3: 1.7: 1: 1.2.

Leg 7 (Fig. 7C)
Four-segmented. First segment with one plumose seta antero-distally reaching ⅕ of the second segment. Second segment with one plumose seta antero-distally reaching ¼ of terminal segment, setulae present along anterior margin. Third segment with setulae along anterior margin to distal margin. Terminal segment with setulae along antero-medial and distal margins, claw present on distal margin. Length ratios between four segments: 2.3: 2.3: 1: 1.3.

Genital field (Fig. 7E)
Ellipsoidal. Setulae positioned on distal margin. Two bare setae positioned on antero-distal margin.

DESCRIPTION OF MALE
Antennule, antenna, mandibular, maxilular same as in female.

Carapace (Fig. 4C, D; 5B)
Smaller than female, L max = 309 µm, L min = 303 µm, L average = 306 µm; H max = 172 µm, H min = 168 µm, H average = 170 µm, N = 2 specimens.. Ornamentation slightly different than in female, i.e., fossa no. 8 in male divided into two parts (Fig. 4C arrow and 5B).

Leg 5 (Fig. 8A)
Four-segmented. First segment with one plumose seta antero-proximally reaching end of the first segment, two plumose setae antero-distally reaching half of the second segment; one plumose and one bare seta on posterior margin not reaching end of the first segment. Second segment with one plumose seta antero-distally not reaching end of the third segment; setulae present medially along anterior margin. Third segment with setulae situated medially along anterior and distal margins. Terminal segment with setulae antero-medially and one claw on distal margin. Length ratios between four segments: 2.1: 1.5: 1: 1.

Leg 6 (Fig. 8B)
Four-segmented. First segment with two plumose setae antero-medially reaching slightly beyond the first segment, one plumose seta antero-distally reaching one-third of the second segment; one bare and one plumose seta postero-proximally reaching end of the first segment. Second segment with one plumose seta antero-distally reaching half of terminal segment, setulae present along antero-medial and distal margins. Third segment with setulae along anterior margin. Terminal segment with setulae along anterior margin, one strong claw on distal margin. Length ratios between four segments: 2.3: 1.7: 1: 1.3.

Leg 7 (Fig. 8C)
Four-segmented. First segment with one plumose seta antero-distally reaching ⅙ of the second segment, one bare seta postero-distally also reaching ⅙ of the same segment. Second segment with one plumose seta antero-distally reaching one-third of terminal segment; setulae present along antero-medial and distal margins. Third segment with setulae on antero-medial and distal margins. Terminal segment with claw on distal margin, setulae present on antero-medial and distal margins. Length ratios between four segments: 1.9: 2.1: 1: 1.3.

Brushed organ (Fig. 8D)
With more than 15 setae on distal margin. Positioned behind L7 and below hemipenis.

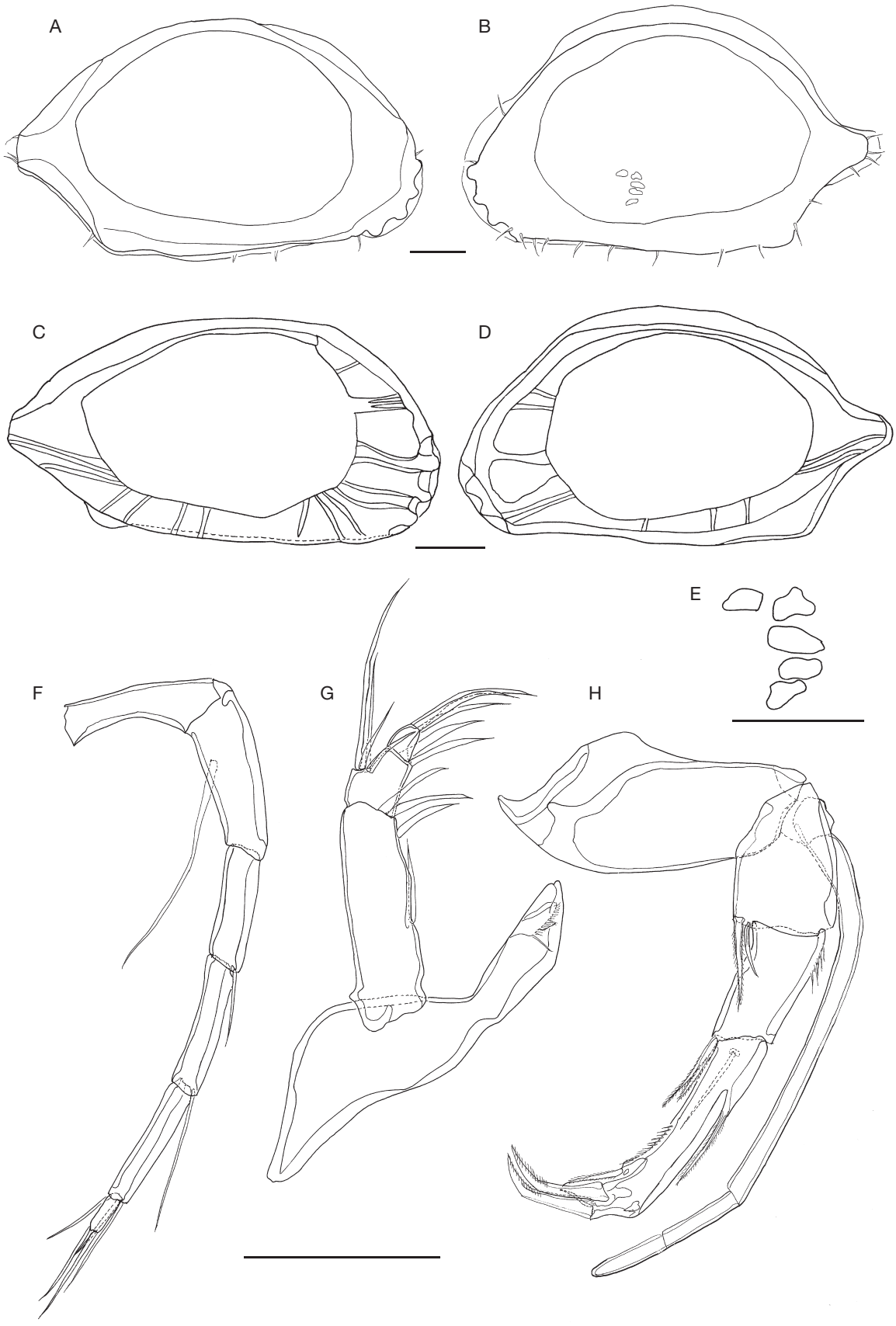

FIG. 6. — *Hemicytherura kajiyamai* Hanai, 1957: **A**, **B**, **E**-**H**, female NIBRIV0000753777: LV internal view (**A**), RV internal view (**B**), muscular scar (right valve) (**E**), A1 (**F**), Md (**G**); A2 (**H**); **C**, **D**, male NIBRIV0000834103: LV internal view (**C**); RV internal view (**D**). Abbreviations: see Material and methods. Scale bars: 50 µm.

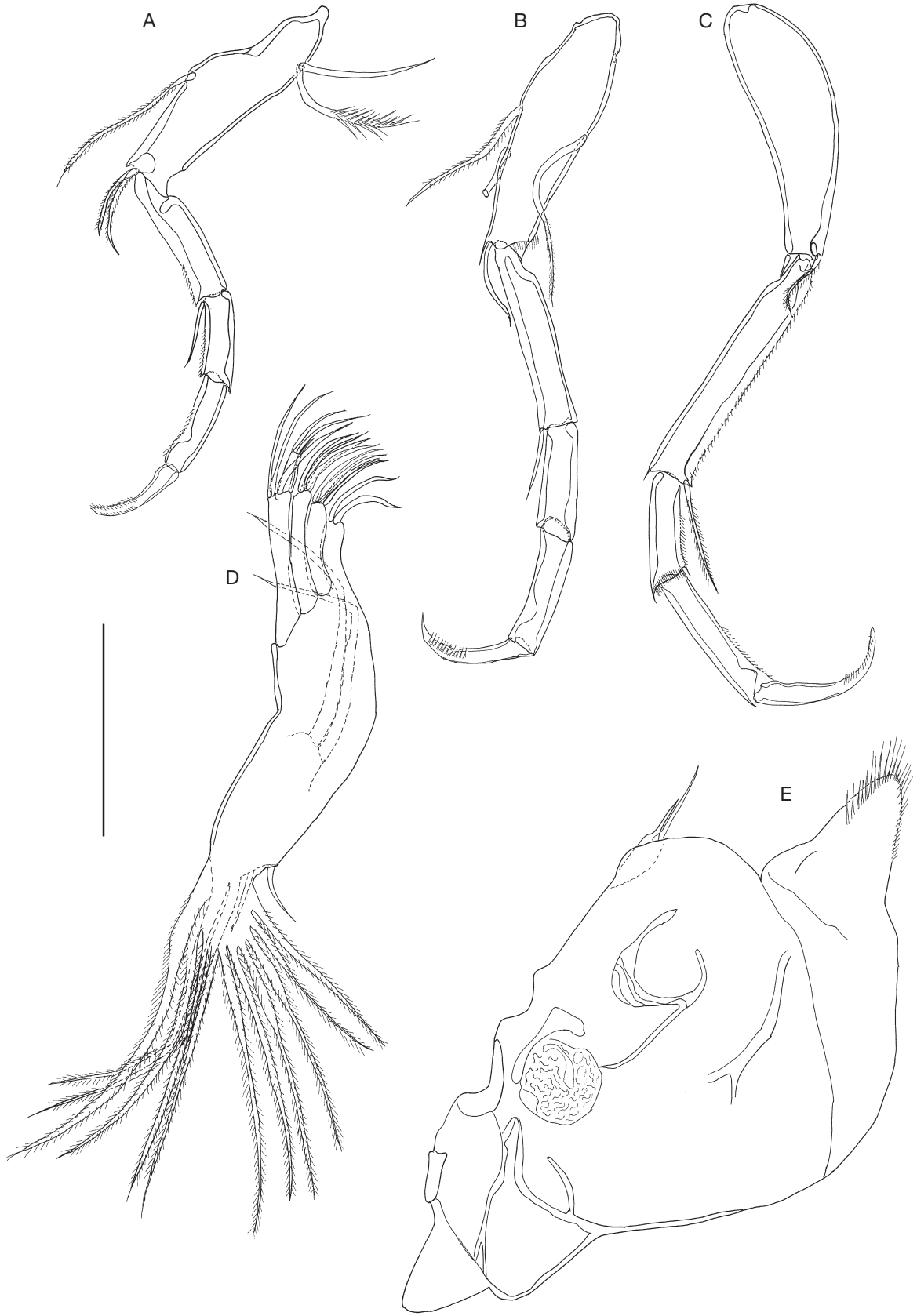

FIG. 7. — *Hemicytherura kajiyamai* Hanai, 1957, female NIBRIV0000753777: **A**, L5; **B**, L6; **C**, L7; **D**, MxIr; **E**, GF. Abbreviations: see Material and methods. Scale bar: 50 µm.

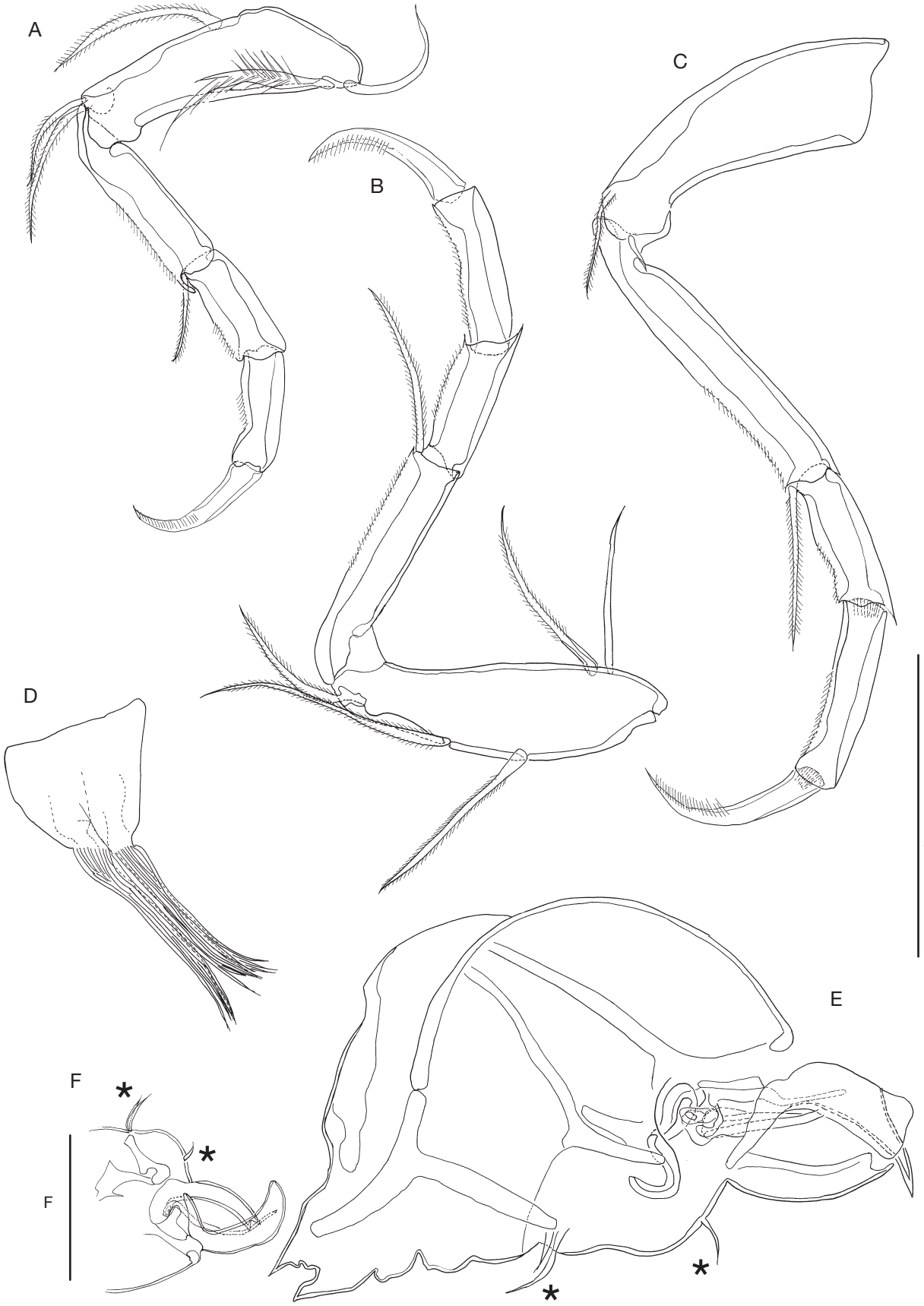

FIG. 8. — *Hemicytherura kajiyamai* Hanai, 1957, male NIBRIV0000834103: **A**, L5; **B**, L6; **C**, L7; **D**, BO; **E**, heft Hp, ventral view; **F**, lobe of Hemipenis, NIBRIV0000834104 (2nd male right Hp, ventral view), ✱, reduced caudal rami. Abbreviations: see Material and methods. Scale bars: 50 µm.

Hemipenis (Fig. 8E, F)
Distal lobe subdivided into two rectangular parts: dorsal with almost straight distal margin and ventral with v-shaped distal margin. Dorsal part with folded and one distally pointed extension. Reduced caudal rami on ventral margin. Copulatory duct very simple.

Family XESTOLEBERIDIDAE Sars, 1928
Genus *Xestoleberis* Sars, 1866

Xestoleberis hujeongensis n. sp.
(Figs 9-12)

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TYPE MATERIAL. — **Holotype**. ♂, South Korea, intertidal-zone algae at Hujeong Beach, Hujeong 2-gil, Jukbyeon-myeon, Uljin-gun, Gyeongsangbuk-do. 37°04'12.3"N, 129°25'01.0"E, 0.1 m depth, dissected on one slide, NIBRIV0000753780, and valves mounted on the micropaleontological slide, NIBRIV0000753780.
Allotype. ♀, same locality as holotype, dissected on one slide, NIBRIV0000834106, valves on the micropaleontological slides NIBRIV0000834106.
Paratypes. 3 ♂ and 3 ♀, same locality as holotype, dissected on two slide each, NIBRIV0000834107, NIBRIV0000834333, NIBRIV0000834334, NIBRIV0000834107, NIBRIV0000834335, NIBRIV0000834336, valves on the micropaleontological slides, NIBRIV0000834333, NIBRIV0000834334, NIBRIV0000834107, NIBRIV0000834335, NIBRIV0000834336. — 6 specimens kept in 2 ml vial in 99% ethanol, NIBRIV0000834109. — 4 specimens kept in 2 ml vial in 99% ethanol, MNHN.

TYPE LOCALITY. — Intertidal-zone algae at Hujeong Beach, Hujeong 2-gil, Jukbyeon-myeon, Uljin-gun, Gyeongsangbuk-do, 37°04'12.3"N, 129°25'01.0"E, 0.1 m depth.

ETYMOLOGY. — The species is named after the beach from where it was collected.

DESCRIPTION OF MALE
Carapace (Figs 9A, B, E, F; 10A, B)
L max = 512 µm, L min = 480 µm, L average = 492 µm, H max = 309 µm; H average = 289 µm, H min = 268 µm, N = 4 specimens. Elongate to subovate in lateral view, dorsal margin arched, with the greatest H behind middle, equaling 57% *c.* 61% of L, ventral margin slightly sinusoid. Posterior margin rounded, anterior margin almost semi-circle. Carapace smooth, except for anterior end which carries one patch of wart like ornament (Fig. 9A). Carapace with setae arising from pore canals along anterior and ventral margins. Pore canals visible along anterior and ventral margins (Fig. 10A, B), relatively long and not branching. Outer lamella with a crack postero-ventrally (Fig. 9F). Muscular scar imprints consisting of a row of four vertical scars and one frontal scar present (Fig. 11I). Hinge antimerodont (Fig. 9B).

Antennule (Fig. 10E)
Six-segmented. First segment with setulae on postero-proximal margin. Second segment with setulae antero-medially and antero-distally, one bare seta postero-distally not reaching end of third segment. Third segment with one plumose seta antero-distally not reaching end of fourth segment. Fourth segment with two bare setae antero-distally, twice longer than fifth segment, and one bare seta on distal margin not reaching end of fifth segment. Fifth segment with three bare setae on distal margin, twice longer than fifth segment. Terminal segment with two setae on distal margin, twice longer than same segment. Length ratios between six segments: 4.8: 4.1: 1.7: 1.9: 2.1: 1.

Antenna (Fig. 10C)
Four-segmented. Exopod transformed into two-segmented spinneret seta. First endopodal segment with setulae postero-medially. Second segment with setulae present on anterior margin and with one plumose seta posterior-distally reaching half of the third segment. Third segment with two bare setae antero-medially not reaching end of the same segment, two plumose setae postero-medially not reaching end of the same segment, and one strong plumose seta postero-distally; setulae present on antero-proximal margin and postero-distal margin. Fourth segment with two claw-like setae on distal margin, setulae present on distal margin. Length ratios between four segments: 13.3: 3: 10.6: 1

Mandibule (Fig. 10F, F', H)
Coxa with five teeth on distal margin, one bare seta postero-distally, and two bare setae antero-distally. Palp 4-segmented. First segment bearing exopodite composed of two long setae, with one plumose seta antero-medially reaching end of the second segment, and one plumose seta on central margin reaching end of terminal segment. Second segment with two plumose setae medio-distally exceeding distal margin of the third segment; one long plumose seta antero-distally, and one bare seta postero-distally. Third segment with two sub-equally long plumose setae antero-distally, accompanied by one half of long bare seta; same segment with one claw-like seta medio-distally. Terminal segment with three claw-like setae, all serrated.

Maxillule (Fig. 10G)
Palp present, 2-segmented. First segment with two setae, second segment with two claws, one fused with segment. First and second endites with three to four teeth-like setae respectively. Vibratory plate with 16 setae.

Leg 5 (Fig. 11E)
Four-segmented. First segment with one plumose seta postero-proximally not reaching end of the same segment, two plumose setae antero-distally reaching half of the second segment, and two plumose setae antero-medially: one plumose seta reaching end of the first segment, another not reaching end of the same segment. Second segment with setulae along anterior margin and one plumose seta antero-distally reaching ⅓ of the terminal segment. Third segment with setulae on distal margin. Terminal segment with setulae along anterior and distal margins, one claw on distal margin. Length ratios between four segments: 3.4: 2.1: 1: 1.2.

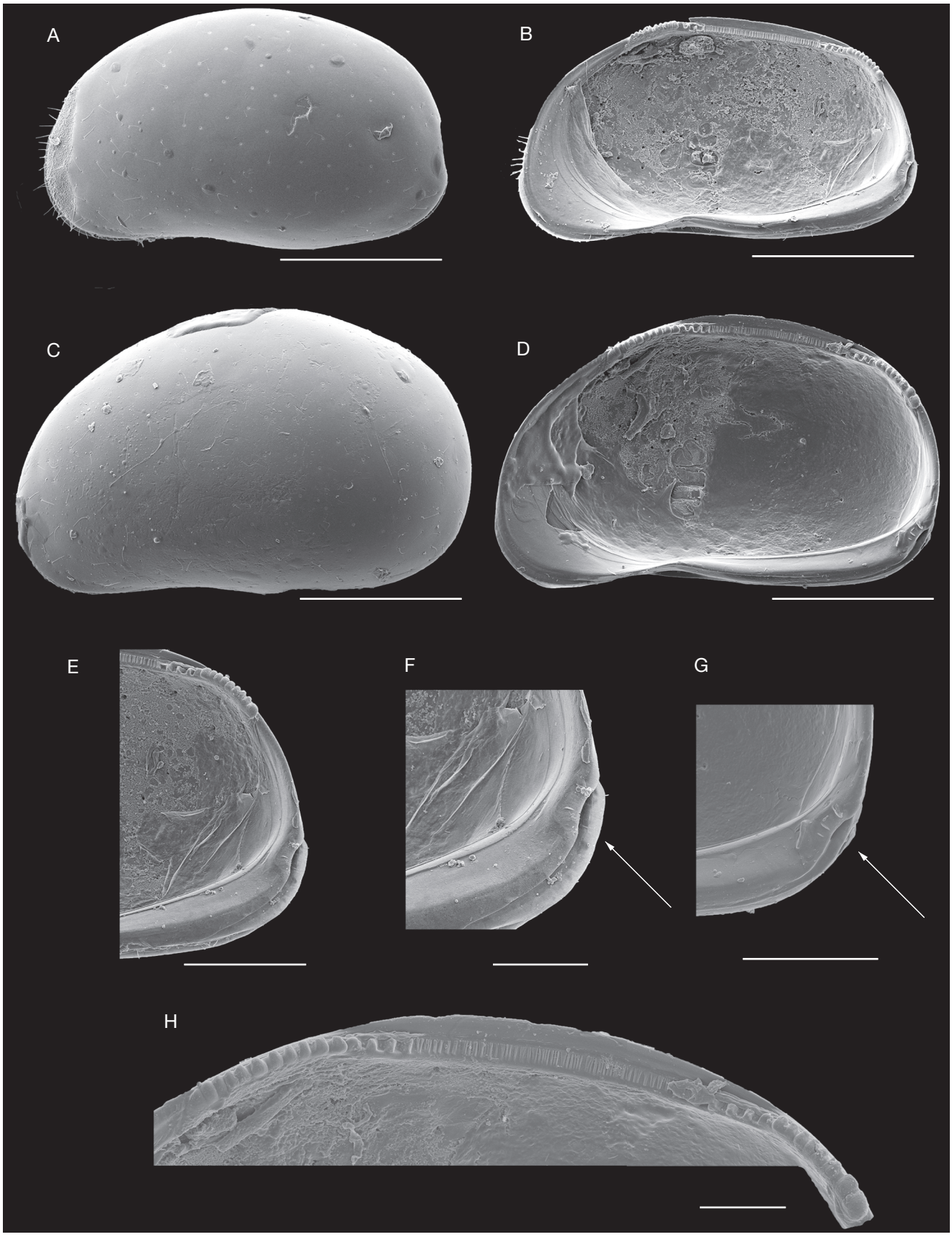

Fig. 9. — *Xestoleberis hujeongensis* n. sp., male NIBRIV0000753780: **A**, LV external view; **B**, RV internal view; **E**, posterior part of RV; **F**, postero-ventral part of RV; female NIBRIV0000834106; **C**, LV external view; **D**, RV internal view; **G**, postero-ventral part of RV; **H**, hingement structure (antimerodont). Arrows: point of divided outer lamella. Abbreviations: see Material and methods. Scale bars: A-D, 200 µm; E, G, 100 µm; F, H, 50 µm.

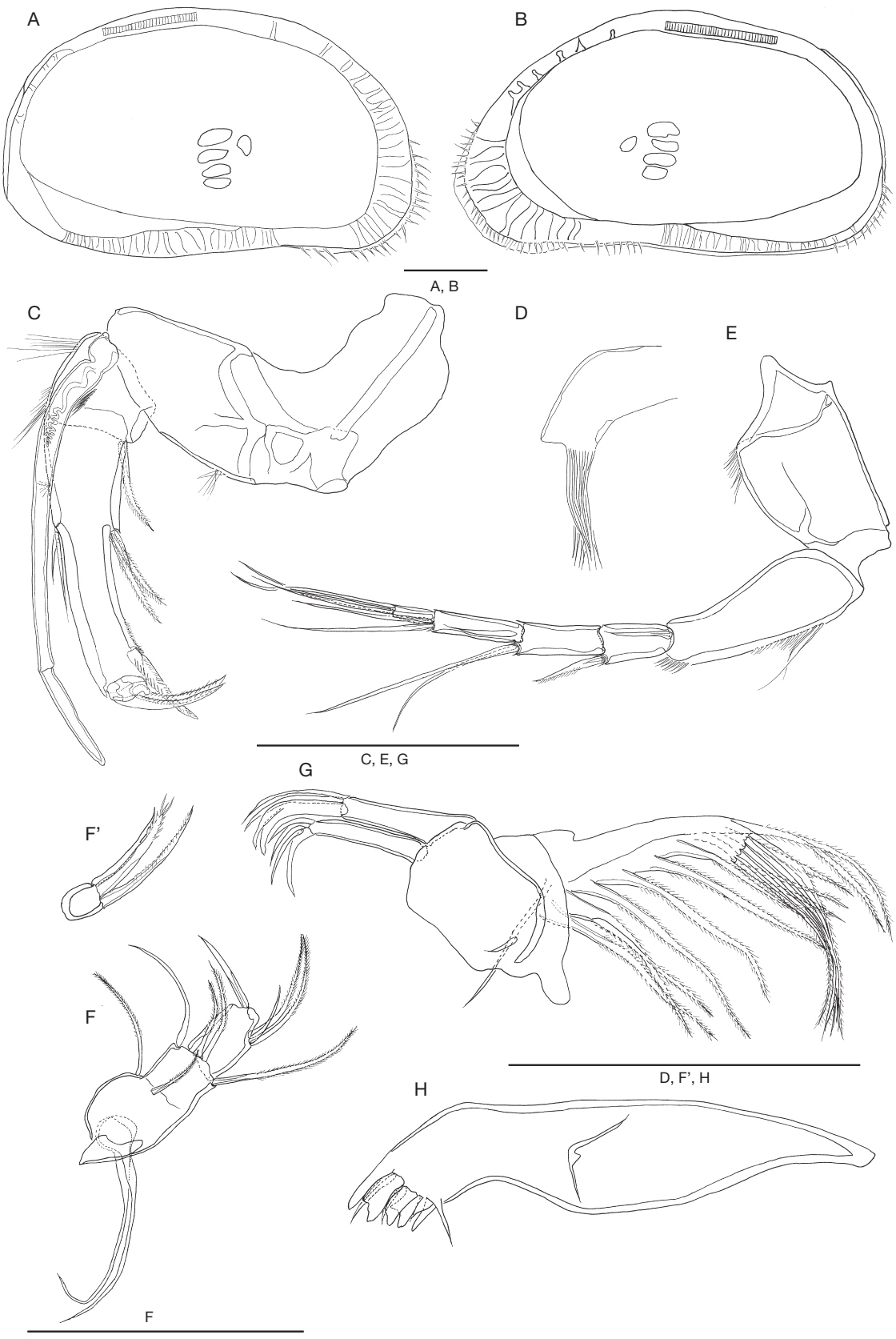

FIG. 10. — *Xestoleberis hujeongensis* n. sp., male NIBRIV0000753780: **A**, left Valve internal view; **B**, RV internal view; **C**, A2; **D**, BO; **E**, A1; **F**, first to third segments of Md palp; **F'**, terminal segment of Md palp; **G**, MxI; **H**, coxa of Md. Abbreviations: see Material and methods. Scale bars: 100 µm.

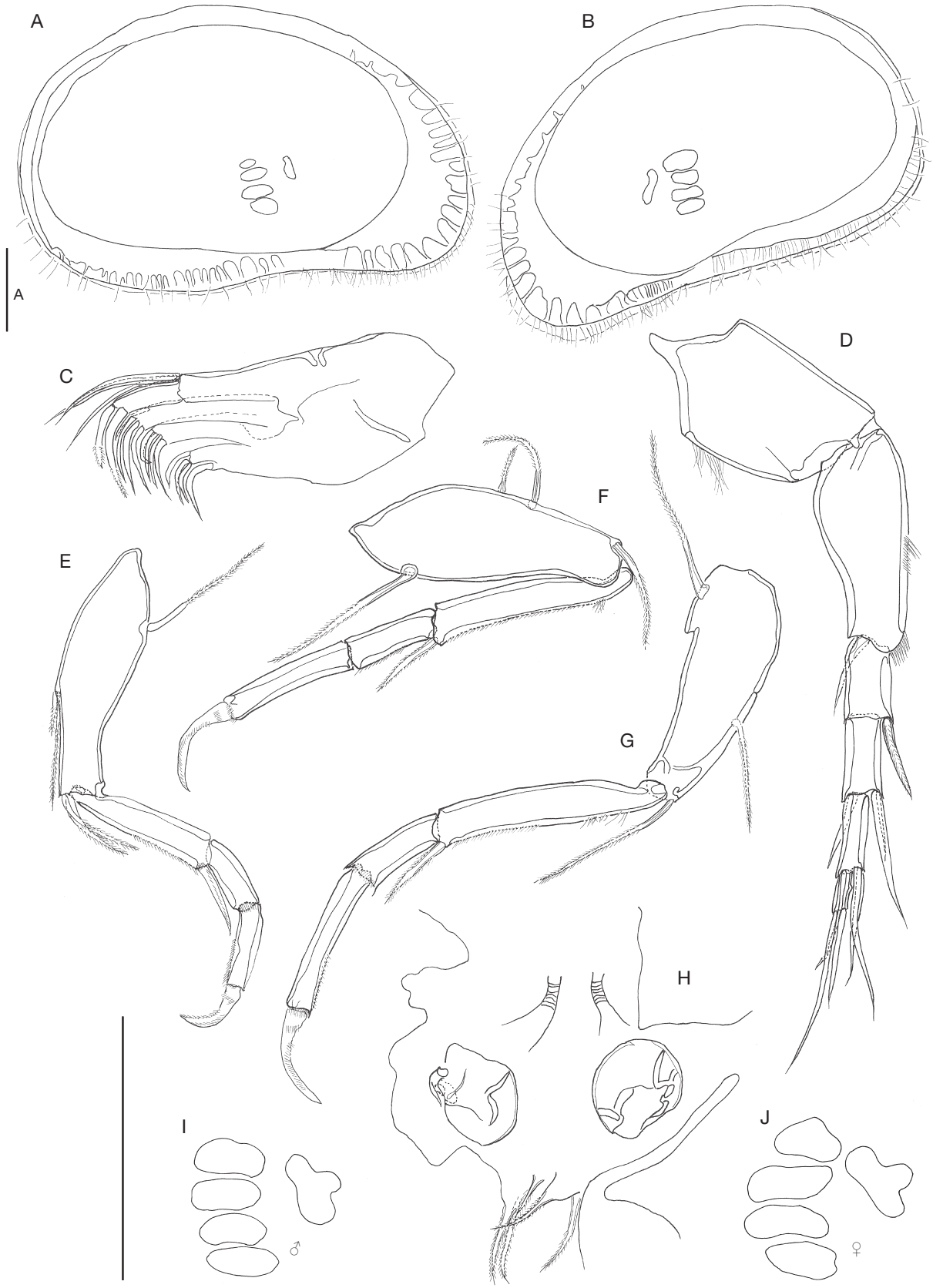

FIG. 11. — *Xestoleberis hujeongensis* n. sp.: **A**-**D**, **H**, **J**, female NIBRIV0000834106: LV internal view (**A**), RV internal view (**B**), endites of MxI (**C**), A1 (**D**); GF (**H**); muscular scar (LV) (**J**); **E**-**G**, **I**, male NIBRIV0000753780: L5 (**E**); L6 (**F**); L7 (**G**); muscular scar (LV) (**I**). Abbreviations: see Material and methods. Scale bars: A-H 100 µm, I, J 50 µm.

FIG. 12. — *Xestoleberis hujeongensis* n. sp. Male. **A**, Hp, NIBRIV0000753780; **B**, number of setae at central part, NIBRIV0000834333. Arrows point central part of Hp. Abbreviations: see Material and methods. Scale bar: 100 µm.

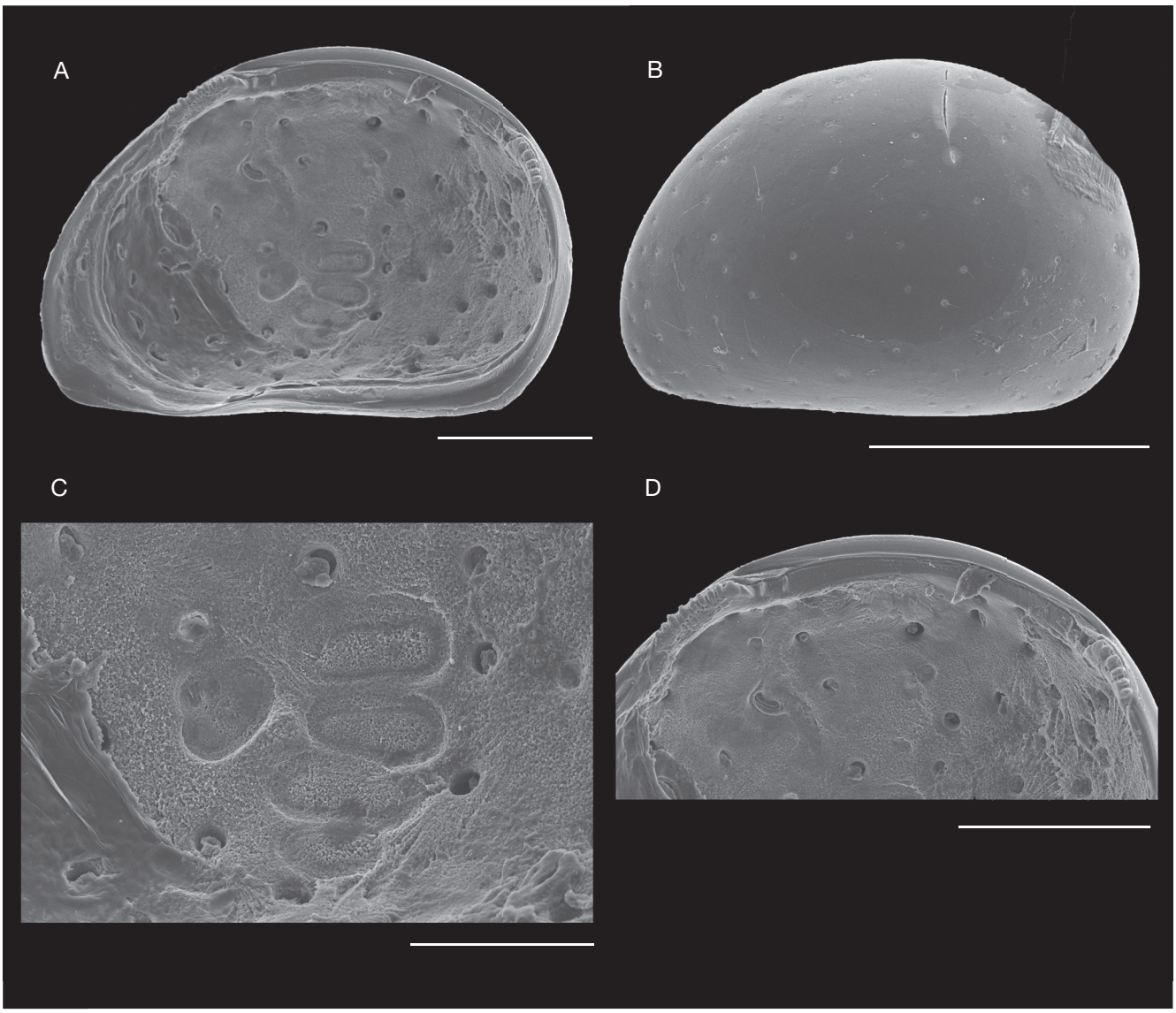

Fig. 13. — *Xestoleberis sagamiensis* Kajiyama, 1913, male NIBRIV0000753781: **A**, RV internal view, **B**, LV external view, **C**, Muscular scar (RV), **D**, Hingement (Hemimerodont). Abbreviations: see Material and methods. Scale bars: A, D, 100 µm; B, 200 µm; C, 50 µm.

Leg 6 (Fig. 11F)
Four-segmented. First segment with one plumose seta postero-proximally not reaching end of first segment; two plumose setae antero-medially not reaching end of the same segment; one plumose seta antero-distally reaching half of the second segment. Second segment with one plumose seta antero-distally not reaching end of the third segment, setulae present along anterior margin. Third segment with setulae along anterior margin. Terminal segment with one claw on distal margin and setulae present on distal margin. Length ratios between four segments: 2.9: 2.2: 1: 1.5.

Leg 7 (Fig. 11G)
Four-segmented. First segment with one plumose seta postero-proximally not reaching end of the first segment; one plumose seta antero-medially reaching end of the same segment and one plumose seta antero-distally reaching ⅔ of the second segment. Second segment with one plumose seta antero-distally reaching end of the third segment and setulae present along anterior margin. Third segment with setulae present on distal margin. Terminal segment with one claw on distal margin and setulae present along anterior margin and distal margin. Length ratios between four segments: 2.6: 2.5: 1: 1.6.

Hemipenis (Fig. 12A, B)
Conspicuous cuticle present along the rim. Hemipenis with strongly asymmetrical lobes. Lobes foot-like, but more robust on right than on left Hp. Ejaculatory duct terminated on distal lobe. Three bare setae present near the upper central margin and one small seta called caudal process on between left and right (Fig. 12B).

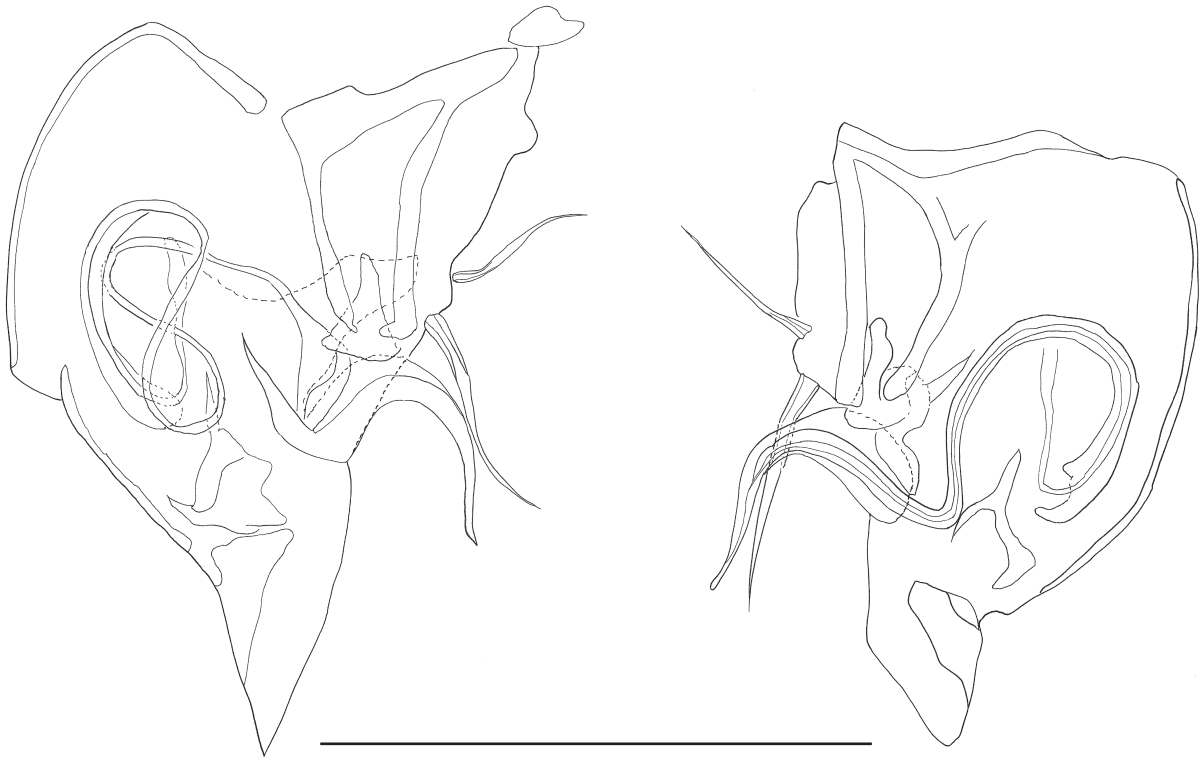

FIG. 14. — Hemipenis of *Xestoleberis sagamiensis* Kajiyama, 1913, male NIBRIV0000753781. Scale bar: 100 µm.

DESCRIPTION OF FEMALE

Carapace (Figs 9C, D, G, H; 11A, B)

Slightly larger than male, L approximately 546 µm H approximately 336 µm, number of specimens = 5, notable pore canals and setae present anteriorly and postero-distally (Fig. 11A, B). Carapace ornamentation same as in male, but without wart like feature on anterior margin (Fig. 9C). Outer lamella with crack on postero-ventral margin (Fig. 9G) Muscular scar imprints consisting of a row of four vertical scars and one frontal scar (Fig. 11J). Hinge antimerodont (Fig. 9H).

Antennule (Fig. 11D)

Same as in male, with exception that all setae are thicker than in male.

Antenna, Mandibule

Same as in male.

Maxillule (Fig. 11C)

Palp present. 2-segmented. First segment with three bare setae antero-distally. Second segment with two plumose setae distal margin. Masticatory process with three endites. First to third endites with four bare setae on distal margin. Vibratory plate same as in male.

Legs 5, 6, 7

Same as in male.

Genital field (Fig. 11H)

Bean-shaped ovary. Genital lobes with total of five plumose setae situated on distal margin.

Xestoleberis sagamiensis Kajiyama, 1913 (Figs 13, 14)

Xestoleberis sagamiensis Kajiyama, 1913: 8, pl. 1, figs 26-29. — Ishizaki 1968: 42, pl. 9, figs 3, 4; 1971: 95, pl. 4, fig. 11. — Kamiya & Nakagawa 1993: 133, fig. 6 (12). — Sato & Kamiya 2007: figs 2, 4, 6, 25-26. — Ozawa & Domitsu 2010: 6, fig. 5 (21).

TYPE LOCALITY. — Misaki, Miura City, Kanagawa Prefecture, Japan.

MATERIAL EXAMINED. — **South Korea**. 1 ♂, intertidal-zone algae at Hujeong Beach, Hujeong 2-gil, Jukbyeon-myeon, Uljin-gun, Gyeongsangbuk-do, 37°04'12.3"N, 129°25'01.0"E, 0.1 m depth dissected on one slide, NIBRIV0000753781, valves on the micropaleontological slide, NIBRIV0000753781. — 4 specimens kept in 2 ml vial in 99% ethanol, NIBRIV0000834110. — 3 specimens kept in 2 ml vial in 99% ethanol.

BRIEF DESCRIPTION

Carapace (Fig. 13A-D)

L max = 563 µm, L min = 530 µm, L average = 546.6 µm; H max = 345 µm, H min = 327 µm, H average = 336 µm, N = 5 specimens. With highly arched dorsal margin, and greatest H situated slightly posterior to middle L. In dorsal view spherical egg shaped. Hemimerodont hingement type

TABLE 1. — Carapace and hemipenis size of males from Korea and Japan species. All sizes are mean values: *Xestoleberis hujeongensis* n. sp. (4 specimens), *X. sagamiensis* Kajiyama, 1913 (2 specimens), *X. setouchiensis* Okubo, 1979 (2 specimens), *Hemicytherura kajiyamai* Hanai, 1957 (2 specimens). Size measurement of Japanese specimens followed Sato & Kamiya (2007) and Tanaka (2011).

Country	Species	Carapace (L)	Carapace (H)	Hemipenis (longest one)
Korea	*X. hujeongensis* n. sp.	492	289	200
	X. sagamiensis	367	253	134
	X. setouchiensis	372	180	122
	H. kajiyamai	306	170	89
Japan	*X. sagamiensis*	360	272	150
	X. setouchiensis	430	220	137
	H. kajiyamai	303	164	88

(Fig. 13D). Ventral margin straight. Ornament smooth with few sieve type setae. Scar print consisting of four prints in vertical row and one situated in front of vertical row (Fig. 13C).

Hemipenis (Fig. 14)
Subreniform, with asymmetrical distal lobes, right distal lobe inverted triangle shaped and left distal lobe dented and strawberry shaped. Sperm tube situated on central margin, with four bare setae near exit of sperm.

Xestoleberis setouchiensis Okubo, 1979
(Figs 15; 16)

Xestoleberis setouchiensis Okubo, 1979: 10-14, pl.1, figs 2, 3. — Ozawa *et al.* 2004: 44, pl. 2 (14). — Sato & Kamiya 2007, figs 2 (5), 4 (5), 6 (5). — Ozawa 2010: 35, pl. 4 (20). — Ozawa & Domitsu 2010: 6, fig. 5 (22). — Tanaka *et al.* 2018: 130, figs 5, 7.

TYPE LOCALITY. — Intertidal zone of rocky shore, Inland Sea of Seto, Japan.

MATERIAL EXAMINED. — **South Korea**. 2 ♂, Intertidal-zone algae at Hujeong Beach, Hujeong 2-gil, Jukbyeon-myeon, Uljin-gun, Gyeongsangbuk-do. 37°04'12.3"N, 129°25'01.0"E, dissected on two slides, NIBRIV0000753788, NIBRIV0000834111, valves on the micropaleontological slides, NIBRIV0000753788, NIBRIV0000834111. — 2 specimens kept in 2 ml vial in 99% ethanol, NIBRIV0000834112. — 2 specimens kept in 2 ml vial in 99% ethanol, MNHN.

BRIEF DESCRIPTION
Carapace (Fig. 15A-D)
L max = 374 µm, L min = 370 µm, L average = 372 µm, H max = 182 µm; H min = 178 µm, H average = 180 µm, N = 2 specimens. Elongated ellipsoidal in lateral view, inflated in dorsal view, slightly arched dorsal margin, almost straight ventral margin, smooth ornament with setae. Four adductor muscle scars in vertical row with 1 front scar.

Hemipenis (Fig. 16)
Same as in original description (Okubo 1979).

DISCUSSION

Until this study, there were only 12 ostracod species reported from Korean marine intertidal zone. This is an indication of the lack of research on intertidal zone ostracods in Korean since the same habitats in Japan harbor a much higher diversity, i.e., over 200 species (Hanai *et al.* 1977; Okubo 1979; Sato & Kamiya 2007; Watanabe *et al.* 2008). In this study, we report four cytheroid species: *Hemicytherura kajiyamai* Hanai, 1957, *Xestoleberis hujeongensis* n. sp., *X. sagamiensis* Kajiyama, 1913 and *X. setouchiensis* Okubo, 1979. The main characteristic of the genus *Hemicytherura* is the presence of fossae as a part of the valve ornamentation. Although the morphology of appendages of the Korean population is the same as the original description (Hanai 1957), there is a slight difference in the male fossae pattern. Namely, fossa no. 8 is divided into two parts (Fig. 4C, 5B), while in the Japanese population, the no. 8 fossa is divided into three parts (Tanaka *et al.* 2011: figs 3A, 5,). However, females of both populations have the same fossae patterns (Figs 4A, 5A). Interestingly, male carapace fossae pattern of *H. kajiyamai* from Peter the Great Bay (see Schornikov & Zenina 2014), in Russia, is same as in the Korean population. Unfortunately, Schornikov & Zenina (2014) did not provide any drawings of the soft parts. The hemipenis of the Korean male specimens are very similar to those reported by Kajiyama (1913), but there are slight differences from those reported by Tanaka *et al.* (2011): in the Korean populations, and in species reported by Kajiyama (1913) the lobe end on the hemipenis is flat, but in species reported by Tanaka *et al.* (2011) the shape is different. This might indicate a species complex of *H. kajiyamai* in East Asia. According to the division of the genus into species groups (Tanaka *et al.* 2011), *H. kajiyamai* belongs to *kajiyamai*-group and therefore is similar with the following Japanese species: *H. huangi* Tanaka, Kaseda & Ikeya, 2011; *H. notoense* Tanaka, Kaseda & Ikeya, 2011; *H. okuboi* Tanaka, Kaseda & Ikeya, 2011.
Xestoleberis hujeongensis n. sp. is most closely related to *X. hanaii* Ishizaki, 1968, one of the most widely distributed recent species of the genus. The shape of the carapace is almost identical between the two species, and the differences are very subtle. The major difference is presence of the wart-like structures on the anterior end of the male carapace in the new species (Fig. 9A), the shape of the distal lobe and the number of setae at the central part of Hp. Left lobe in the new species has a less pointed distal lobe while the right lobe has longer most distal extension and the entire distal lobe is more rectangular than in *X. hanaii*. The new species also has three bare setae at the central part (Fig. 12B) but *X. hanaii* has four (Schornikov 1974: fig. 26). Other soft parts are very similar between the two species, with the exception of the expodite of the Md. Namely there are two long bare setae (Fig. 10F) in the new species, and in *X. hanaii* three (Schornikov 1974: fig. 26).

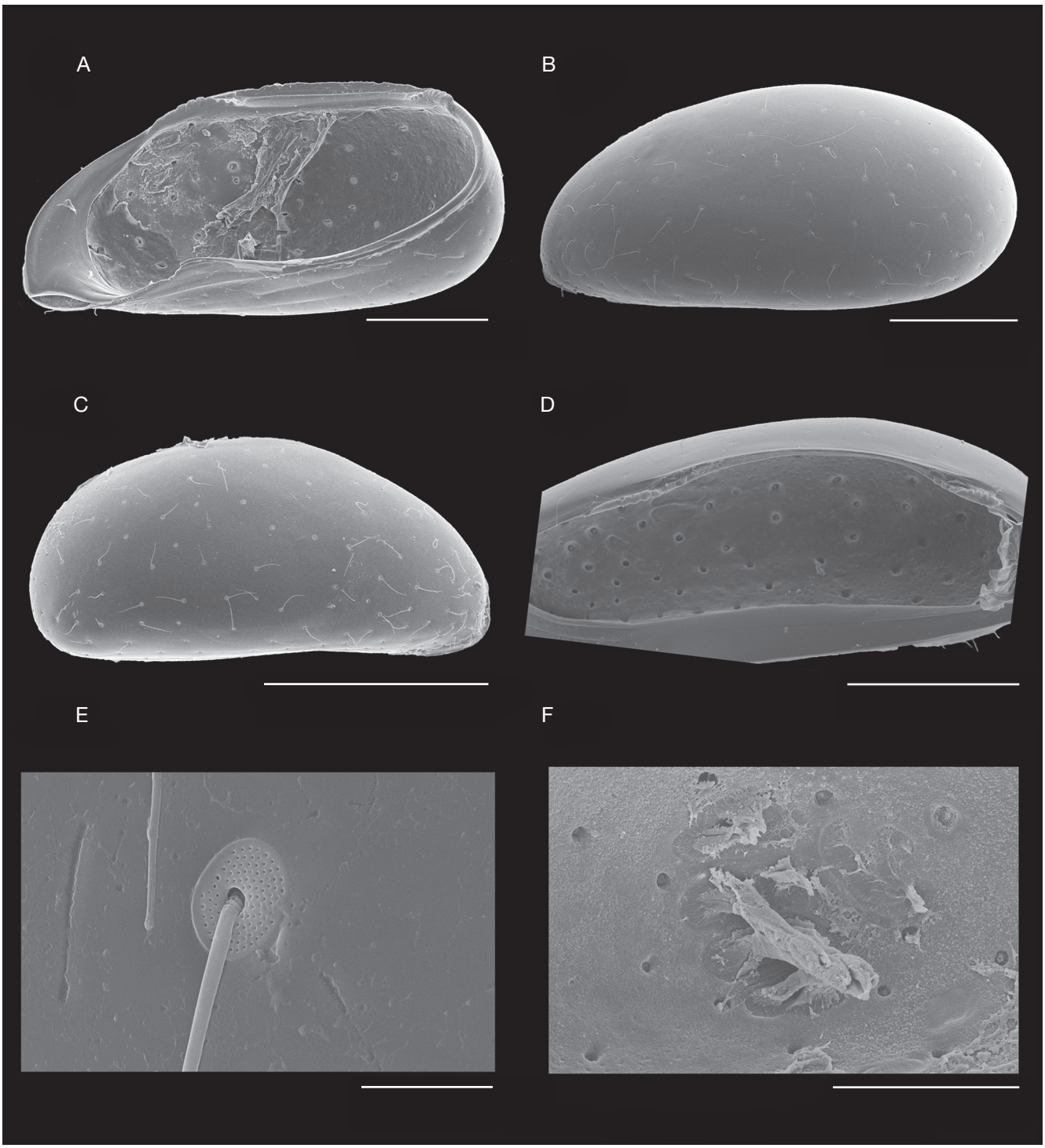

FIG. 15. — *Xestoleberis setouchiensis* Okubo, 1979: **A**-**D**, male NIBRIV0000753788: RV internal view (**A**), LV external view (**B**), RV external view (**C**), **D**, male NIBRIV0000834111, RV internal view; **E**, **F**, male NIBRIV0000753788, normal pores on the surface of carapace (LV) (**E**), muscular scar (RV) (**F**). Abbreviations: see Material and methods. Scale bars: A, B, D, 100 µm; C, 200 µm; E, F, 50 µm.

Hemicytherura kajiyamai, *X. sagamiensis* and *X. setouchiensis* collected from South Korea are very similar to the Japanese populations. Korean and Japanese populations of *Hemicytherura kajiyamai*, *X. sagamiensis* are of a similar size, but Korean individuals of *X. setouchiensis* are slightly smaller than the Japanese ones (see Table 1).

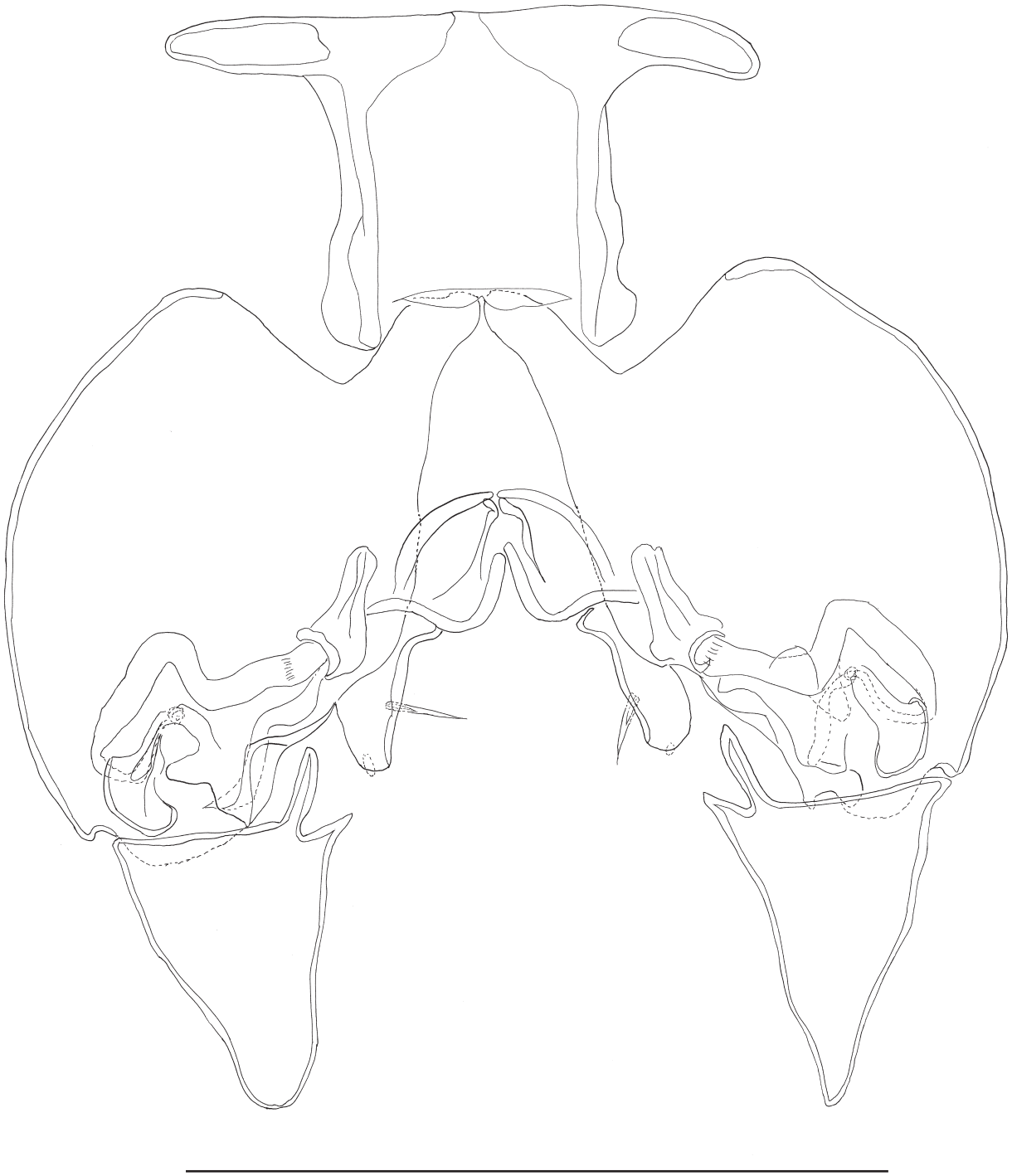

Fig. 16. — Hemipenis of *Xestoleberis setouchiensis* Okubo, 1979, male NIBRIV0000753788. Scale bar: 100 µm.

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APPENDIX

APPENDIX 1. — List of cytheroid ostracod species recorded from South Korea (* species reported in Lee *et al.* 2000).

1. *Angulicytherura miii** (Ishizaki, 1968)
2. *Aurila acostata** Schornikov & Tsareva, 1995
3. *Aurila corniculata** Okubo, 1980
4. *Aurila disparata** Okubo, 1980
5. *Aurila elongata** Schornikov & Tsareva, 1995
6. *Aurila inabai** Okubo, 1980
7. *Aurila kiritsubo** Yajima, 1982
8. *Aurila munechikai** Ishizaki, 1968
9. *Aurila tosaensis** Ishizaki, 1968
10. *Cythere nishinipponica* Okubo, 1976
11. *Frambocythere relicta* Smith, Lee, Choi, Chang & Colin, 2012
12. *Hemicytherura cuneata** Hanai, 1957
13. *Hemicytherura kajiyamai** Hanai, 1957
14. *Hemicytherura tricarinata** Hanai, 1957
15. *Hemicytherura clathrata** (Sars, 1865)
16. *Hemicytherura choeae** Tanaka, Kaseda & Ikeya, 2011
17. *Ishizakiella miurensis* (Hanai, 1957)
18. *Ishizakiella ryukyuensis** Tsukagoshi, 1994
19. *Ishizakiella supralittoralis* (Schornikov, 1974)
20. *Krithe japonica** Ishizaki, 1971
21. *Limnocythere stationis** Vavra, 1891
22. *Loxoconcha chinzeii** Ikeya & Zhou, 1992
23. *Loxoconcha harimensis** Okubo, 1980
24. *Loxoconcha hattorii** Ishizaki, 1971
25. *Loxoconcha japonica** Ishizaki, 1968
26. *Loxoconcha laeta** Ishizaki, 1968
27. *Loxoconcha pulchra* Ishizaki, 1968
28. *Loxoconcha uranouchiensis* Ishizaki, 1968
29. *Paradoxostoma assimile** Okubo, 1978
30. *Paradoxostoma bingoense** Okubo, 1975
31. *Paradoxostoma brunneum* Schornikov, 1974
32. *Paradoxostoma flaccidum* Schornikov, 1975
33. *Paradoxostoma koreana* Karanovic, Yoo, Tanaka & Tsukagoshi, 2017
34. *Paradoxostoma oshoroense** Hiruta, 1975
35. *Paradoxostoma rhomboideum** Okubo, 1977
36. *Paradoxostoma setoense* Schornikov, 1975
37. *Paradoxostoma sokchoensis* Yoo, Lee & Karanovic, 2014
38. *Paradoxostoma vandenboldi** Okubo, 1980
39. *Paradoxostoma yatsui** Kajiyama, 1913
40. *Parakrithella pseudadonta** Hanai, 1959
41. *Pontocythere japonica** (Hanai, 1959)
42. *Pontocythere kashiwarensis** (Hanai, 1959)
43. *Pontocythere minuta** Ikeya & Hanai, 1982
44. *Pontocythere sekiguchii** Ikeya & Hanai, 1982
45. *Pontocythere subjaponica** (Hanai, 1959)
46. *Robustaurila ishizakii** (Okubo, 1980)
47. *Xestoleberis hujeongensis* n. sp
48. *Xestoleberis hanaii** Ishizaki, 1968
49. *Xestoleberis iturupica** Schornikov, 1974
50. *Xestoleberis opalescenta** Schornikov, 1974
51. *Xestoleberis sagamiensis** Kajiyama, 1913
52. *Xestoleberis setouchiensis* Okubo, 1979