이학박사학위논문

Systematic study on the Korean pilumnoids and xanthoids (Crustacea: Decapoda: Brachyura) based on morphology and molecular data

한국 애기털보부채게상과와 부채게상과의 계통분류학적 연구

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ABSTRACT

Systematic study on the Korean pilumnoids and xanthoids (Crustacea: Decapoda: Brachyura) based on morphology and molecular data

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A systematic study was conducted on the Korean pilumnoid and xanthoid crabs. The specimens, deposited in the Laboratory of Systematics and Molecular Evolution in Seoul National University since 1950, were examined for the present study. They have been collected from the intertidal and shallow subtidal zones in Republic of Korea. As a result, 18 species of 12 genera and 28 species of 24 genera were identified in the superfamily Pilumnoidea and the superfamily Xanthoidea,

respectively. The updated checklist and the key to species of Korean pilumnoids and xanthoids were provided herein. A total of 46 speceis have been recorded with the specific characters including the pictures, the illustrations. Moreover, their distribution in Korean peninsular and the worldwide was displayed on the map, and their habitats were investigated. Of these, one pilumnoid and 8 xanthoids were first recorded from Korea: *Actaea polyacantha* (Heller, 1861), *Actaeodes hirsutissimus* (Rüppell, 1830), *Atergatopsis germaini* A. Milne-Edwards, 1865, *Danielea noelensis* (Ward, 1934), *Etisus anaglyptus* H. Milne Edwards, 1834, *Gaillardiellus rueppelli* (Krauss, 1843), *Lybia caestifera* (Alcock, 1898), *Neoactumnus convexus* Sakai, 1965, and *Platypodia tomentosa* (De Man, 1902). The mtCOI sequences from 26 species of the Korean pilumnoids and xanthoids were obtained, and examined by DNA barcoding method. The some suspected cryptic species or misidentified specimens were discovered, and then molecular taxonomic relationship among them was inferred by Baysian inferences and Maximum likelihood. According to Baysian inferences tree, a significant taxonomic relationship was found as follows: 1) *Neoliomera insularis* would be questioned their taxonomic status, 2) Based on the relationship between *Leptodius nigromaculatus* and *L. affinis*, the two species were the same species, 3) *Actaea bocki* (Odhner, 1925) would be considered to examined their taxonomic status, 4) Korean *Medaeops granulosus* would be not real *M. granulosus* or a cryptic species. *Zehntneriana villosa* (Zehntner, 1894) were examined and redescribed with illustrations herein with the illustration. *Zehntneriana villosa* from Japan, used to establish the genus *Zehntneriana,* was found out to be a new species. As a result of the revision of the genus *Leptodius* A. Milne-Edward, 1863, the genus *Leptodius* are consisting 10 speices: *L. acutidens* (Stimpson, 1907), *L. affinis* (De Haan, 1835), *L. australis* Ward, 1936, *L. davaoensis* Ward, 1941, *L. exaratus* A. Milne-Edwards, 1834, *L. gracilis* Dana, 1852, *L. planus* Ward, 1834, *L. sanguineus* A. Milne-Edwards, 1834, and *L. nudipes* (Dana, 1853). As regards recorded five species of recent checklist, *Leptodius nigromaculatus* Serène, 1962 would be synonymized as *L. affinis* (De Haan, 1835). *Leptodius philippinensis* Ward, 1941 and *L. hombronii* (Lucas, in Jacquinot & Lucas, 1853) would be synonymized as *L. sanguineus*. *Leptodius efference* Rathbun, 1907 and *L. waialuanus* Rathbun, 1906 would be considered to transfer to the genus

Liocarpilodes Klunzinger, 1913 and the genus *Etisus* H. Milne Edwards, 1834, respectively.

Key words: Xanthoidea, Pilumnoidea, *Leptodius*, *Zehntneriana*, Systematic study, Revision.

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Chapter 2. Taxonomic revision

GENERAL INTRODUCTION

To imagine crustaceans is to imagine crabs due to the crabs may be the best-known group (Poor, 2004). Defined the infraorder Brachyura, as known as true crab, belonging to the order Decapoda, used to describe the absence of a 'tale' or abdomen obvious when viewed on the top. Their abdomen, however, is present but tucked under the rest of the body enclosed in the carapace. The body, hidden beneath a well-developed carapace, is distinctly flattened dorso-ventrally and often expended laterally. Their gills are phyllobranchiate. The first pereopods are chelate and usually enlarged. Pereopods 2 to 5 are typically simple. The eyes are positioned lateral to the antennae. In males, there are almost always only two pairs of pleopods, lacked pleopods 3 to 5, both modified and interacting as gonopods in the transfer of sperm to the female.

The diversity of crab morphology correlated with a diversity of crab ecology. In general, most crabs are benthic and non-swims for more than a brief time, and they are cryptic under stones or other shelters. A few have specialized associations, living associated with corals, sponges, or other symbiotic with mollusks, or worms, or echinoderms. Some crabs burrow in sand on beaches, or other crabs prefer mud, and some spend most of their adult life up trees. Most species and even some families have restricted depth rages, intertidal of shallow subtidal, continental shelf sediments, or deep sea.

Until now, most workers have quoted the key paper of Chace (1951), which cited 4,428 species distributed in 635 genera. It appears Chace (1951) was very close, as according to out present list, by 1950 there had been 4,120 species described. This small difference could perhaps be largely accounted for by species now in synonymy. Since then, no one has attempted to provide an accurate update. Published estimates range from 5,000 to 10,000 (Ng, 1998; Martin & Davis, 2001; von Sternberg & Cumberlidge, 2001; Yeo et al., 2008). Recently, 6,793 species and subspecies, 1,271 genera and subgenera, 93 families, and 38 superfamilies were recognized, and of these, 404 species of 68 genera belonging to 3 families of the superfamily **Pilumnoidea** Samouelle, 1819, and 737 species of 154 genera

belonging to 3 families of the superfamily **Xanthoidea** McLeay, 1838 were listed (Ng et al., 2008). The numbers of crabs, however, are still counting.

The pilumnoids are small cryptic crabs found under rocks, in crevices or in coral. Many members of the pilumnoids are wider than long. Some species are readily recognized as belonging to Pilumnidae because of the dense mat and / or fringe of hair on the carapace and legs. Others are not densely hairy and may seem similar members of Xanthoidea (both superfamilies usually have distinctive black-tipped chelae). Four key adult morphological characters clearly define Pilumnoidea: 1) all male abdominal segments freely articulating, 2) a long sinuous and slender G1, 3) a very short, sigmoidal G2, 4) a penis that protrudes from the condyle of the fifth ambulatory coxa. The known larval evidence strongly supports his classification, the zoeal characters being extremely conservative for the group (See Ng & Clark, 2000; Clark & Ng, 2004; 2005). The male abdomen of pilumnoids has seven somites free (rarely of six) while its of xanthids are only five. Another superfamily confused as pilumnoids is Eriphioidea MacLeay, 1838. The eriphioid crabs have also seven abdominal somites in the male, but the male gonopod 2 of eriphioid crabs is about as long as gonopod 2 while the first gonopod of pilumnoid crabs is slender and sinuous, and the second is very short and sigmoid. The pilumnoids are the most difficult of crabs to identify due to they have very similar structure of the first gonopod (= pleopod 1: hereafter referred to as G1) of male specimens.

Xanthoids are many compact and black-fingered. The members of xanthoid occur more species in the Indo-West Pacific than any other. Typically, xanthoids are found intertidal zone or subtidal zone, and hidden under rocks or in sponges and other sessile invertebrates. Many xanthoids are passive grazers on algae or feed on detritus (Milke & Kennedy, 2001; Poore, 2004). The superfamily Xanthoidea has been treated in the past as a large family. The present composition of Xanthoidea differs markedly from that firs proposed by Guinot (1978) and from other arrangements used by subsequent author. The taxa allied to the Eriphiidae have been moved to their own superfamily, Eriphoidea, while the Carpiliidae is now likewise in the Carpilioidea. All the Pilumnidae and allies are now also in the Pilumnoidea, while the Trapeziidae, Domeciidae and Tetraliidae have been transferred to the Trapezioidea. The family Pseudorobilidae Alcock, 1900, long associated with the

goneplacids and their allies, is referred to the Xanthoidea for the first time. Pseudorhomilids are much close to panopeids in regrads to the form of the male abdomen and gonopods.

These two superfamilies, Pilumnoidea and Xanthoidea, are well represented by diverse species in macrofauna communites of reef habitats, and are studies continuously due to they are shown complicated morphology, undergone substantial re-definition and re-organiztion at many times (cf. Monod, 1956; Balss, 1957; Guinot, 1967, 1968, 1978; Serène, 1984; Davie, 2002; Ng et al., 2008). Unfortunately, All Korean species, belonging to two superfamilies, have not been studied much.

The following general objectives have proposed for this dissertation.

1. To provide an updated and revised checklist of the pilumnoid and xanthoid crabs found within Korean Peninsular, and to suppose their phylogenetic relationship from molecular data based on Korean pilumnoids and xanthoids.
2. During to study of Korean *Zehntneriana amakusae* Takeda & Miyake, 1969, the identification of *Z. villosa* (Zehntner, 1894) was studied.
3. To revised the genus *Leptodius* based on morphological characters with specimens collected from Indo-West Pacific.

MATERIALS AND METHODS

1. Morphology, taxonomic characters study

Collection and Examination

The materials examined in this study have been collected in the littoral zone from 1950 to 2012. Species were collected by hands or using a fish trap or SCUBA diving on the crack between rocks or sponge around seashore. After collection, samples were preserved in 50% ethanol diluted in seawater. In the laboratory, the crabs were sorted out under the stereomicroscope and washed their carapace by the soft brush to remove algae, bryozoan, sponge, etc. and then preserved in 70% ethanol.

The material examined in this species is deposited in the following institutions:

AMNH — American Museum of Natural History, New York City, USA
NHM — Natural History Museum, London, UK (Previously BMNH)
MNHN — Museum national d'Histoire naturalle, Paris, France
NMST — National Museum of Nature & Science, Tokyo, Japan
QM — Queensland Museum, Brisbane, Australia
RMNH — Naturalis, Natinaal Natuurhistorisch Museum, Leiden, the Netherlands
USNM — National Museum of Natural History, Smithsonian, Institution, Washington DC, USA
ZRC — Raffles Museum of Biodiversity Research, National University of Singapore, Singapore

All measurements of the material examined are expressed as carapace width by carapace length, in millimeters. Depth is presented in meters (m). The following contractions are also used: coll. = collected by, Is. = Island; Juv. = juvenile; and ovig. = ovigerous.

Photographs were taken using Nikon D7000 and D300 SLR cameras and

developed with Helicon Focus software (Helicon Soft, Kharkov, Ukraine).

Illustrations were made with a compound microscope fitted with camera lucida. All characters were measured using metric dial calipers (Wiha, Monticello, MN, USA).

The terminology used for adult morphology follows that of Dana (1852), for the carapace regions, and Serène (1984) and Ng (1993, 2002) for the rest (see Figs. 1- 4). The classification follows that of Ng et al. (2008).

The five pairs of pereopods (or ambulatory legs) are also called P1-P5, with P1 as the cheliped, and P2-P5 for the first to fourth ambulatory legs. “CL,” “CW,” and “G1” refer to the carapace length from the front to the posterior dorsal margin of the carapace, to the width of the carapace measured at the widest part, and to the first gonopod of male, respectively.

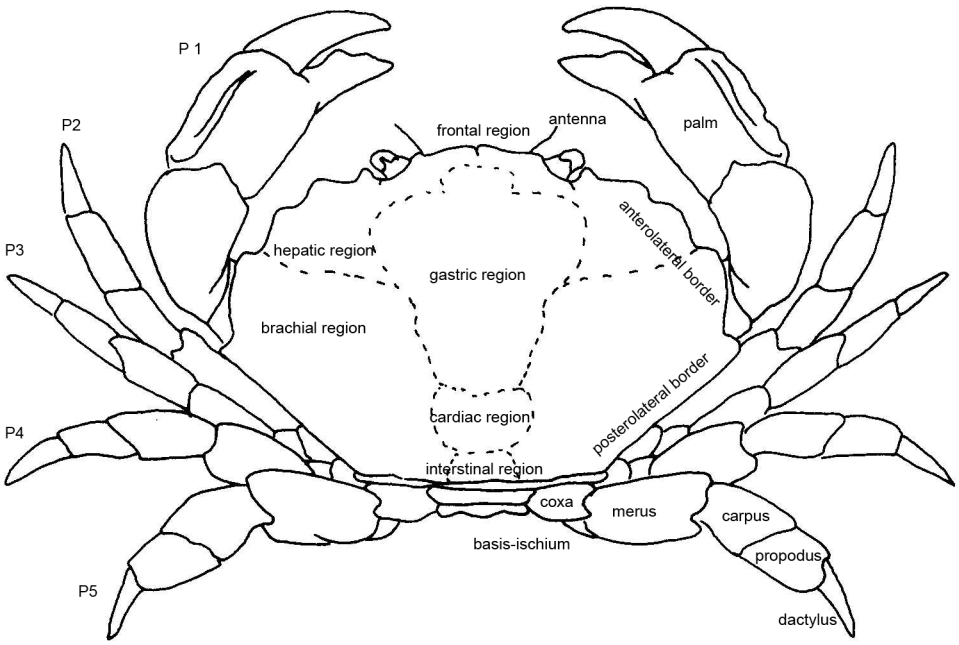

Fig. 1. General anatomy (dorsal), showing the regions of the carapace and associated part. P1– P5 are the pereopods, with P1, cheliped; P2–P5, ambulatory legs. Modified from Serène (1984).

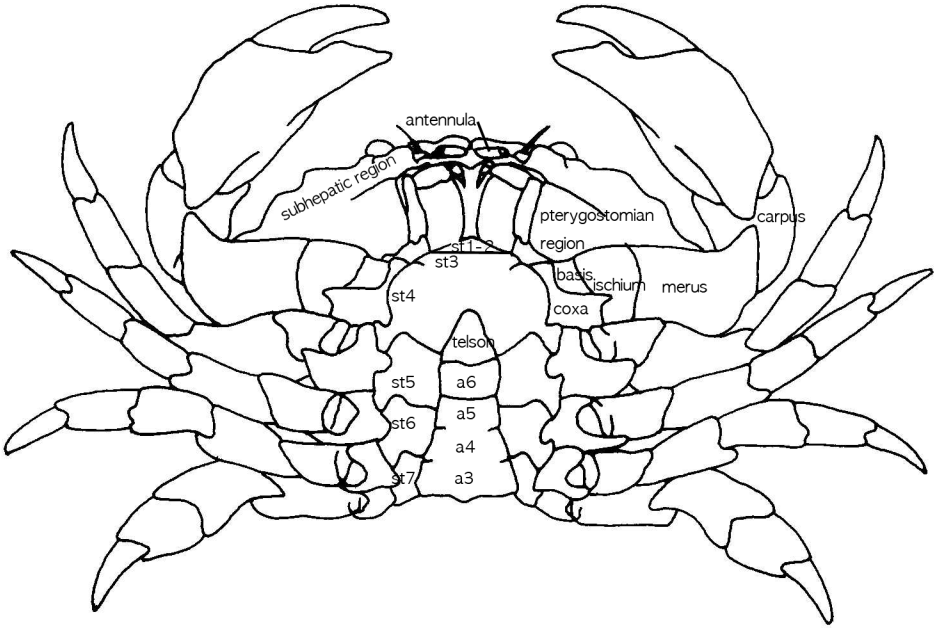

Fig. 2. General anatomy (Venral). a3–a6 are the third to sixth abdominal somites; mxp3 is the third maxillipeds; P1–p5 are the pereopods or ambulatory legs; and st1–7 are the first to seventh thoracic sternites. Modified from Serène (1984).

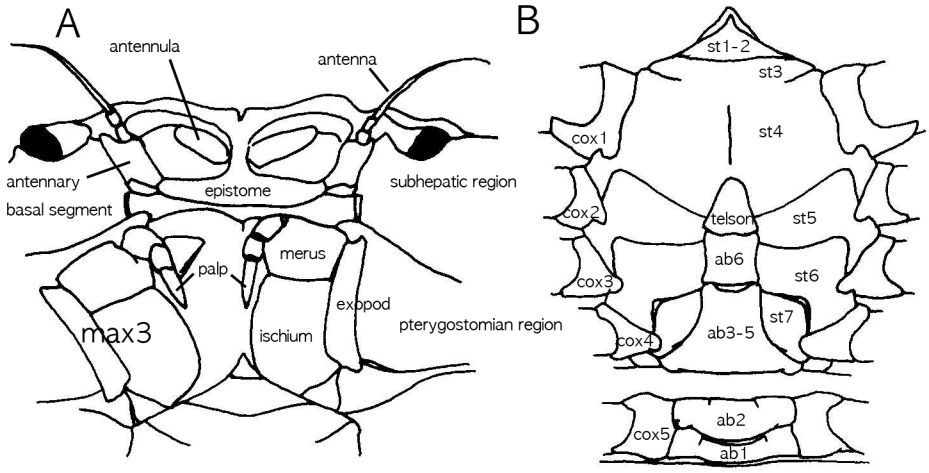

Fig. 3. A, Antero-ventral view of crab; B, Ventral view of crab. a1–a6, abdominal somites; cox1–5, pereopod coxae; mxp1, first maxilliped; mxp3, third maxilliped; st1–7, thoracic sternites. Modified from Guinot (1967).

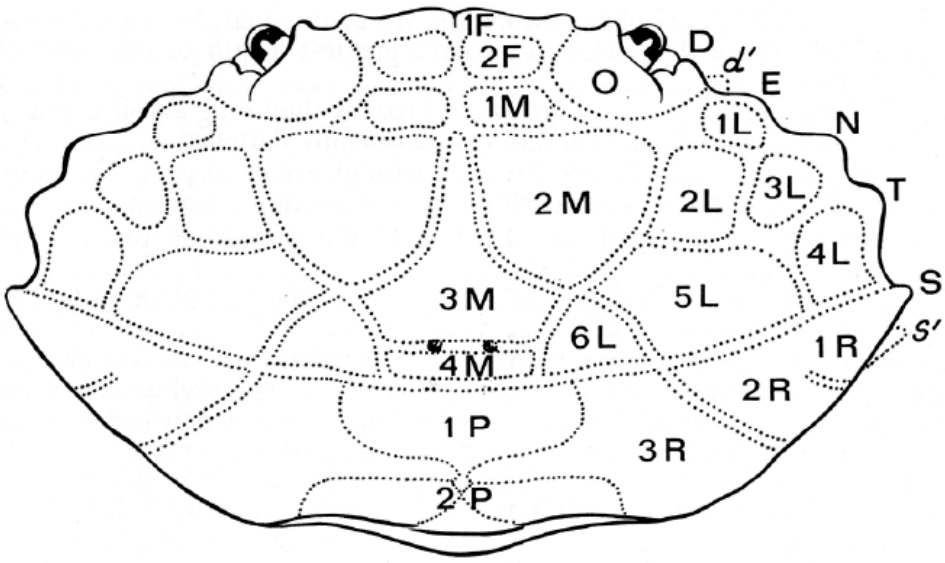

Fig. 4. Carapace regions. Following the nomenclature of Dana (1852).

Chapter. 1.

Faunal and molecular taxonomic study

1-1. Faunal study of Korean pilumnoids and xanthoids.

INTRODUCTION

Mr. E. J. Mier first introduced the Korean crabs in 1879. His article entitled "on a collection of Crustacea made by Capt. H. C. st John, R.N. in the Corean and Japanese Sea" was published in proceeding of the scientific meetings of the Zoological Society of London. In the article, some Korean crabs, collected from Corean Channel and Corean Sea, were examined, and 22 crabs were referred. After the article, Korean crabs had been recorded by Japanese researchers such as Kamita, Yokoya, and Sakai. In 1956, Mr. Jung made "Check list of Crab from Gyeonggi-do" recording 51 species of 32 genera belonging to 12 families and naming Korean species of each crab. His article was the starting point of researching fauna study of the Korean crabs. Some Korean researchers studied morphology, fauna, and distribution of the crabs. Sequentially, the monograph, entitled "Illustrated encyclopedia of fauna & flora of Korea. Vol, 14" was published in 1973 by H. S. Kim. The monograph was included illustrations, Korean descriptions, their distributions, and characteristic keys of 168 species of the18 families. Until now, the Korean Brachyura consists of 223 species of 41 families belonging to 23 superfamilies.

Korean pilumnoids and xanthoids were also begun recording with *Leptodius exaratus* H. Milne Edwards, 1834 and *Pilumnus hirsutus* Stimpson, 1858 (Now, synonymized *L. affinis* (De Haan, 1835) and *P. minutus* De Haan, 1835, respectively) by Mier (1879). After his record, 7 pilumnoids and 9 xanthoids had been recorded until 1973 (Kim, 1973). Just 8 species in the two superfamilies were recorded till 1995. And then, some Korean researchers reported 22 species. Untill now, 18 pilumnoids and 28 xanhoids have been reported in Korea fauna, but there is no revised study of these two families.

Some Korean pilumnoids and xanthoids are found easy under rocks or in cracks of rock of the intertidal zone. The main species of them, however, occur in the subtidal zone on the sponges, holes of sponges, sea anemones, cracks of rocks,

and even on algae in the subtidal zone. Their carapace width is less than 3 cm. The members of two families were known to inhabit around tropical regions (Serène, 1984). The many species of Korean pilumnoids and xanthoids also inhabit in the southern part of Korean peninsular.

In this dissertation, all Korean pilumnoids and xanthoids are reexamined. The author made a checklist and a key of Korean pilumnoids and xanthoids. The checklist presented in this thesis is based partly on a compilation of known records from scientific literatures and partly on identifications made using the newly collected materials or deposited materials of Laboratory of Systematics and Molecular Evolution in Seoul National University during collected materials from 1950 to 2012.

SYSTEMATIC ACCOUNTS

List of Korean Pilumnoids and Xanthoids

Class Crustacea Brünnich, 1772

Order Dacapoda Latreille, 1802

Infraorder Brachyura Linnaeus, 1758

Superfamily Pilumnoidea Samouelle, 1819	애기털보부채게 상과
Family Galenidae Alcock, 1898	다섯모부채게 과
Subfamily Halimedinae Alcock, 1898	다섯모부채게 아과
Genus *Halimede* De Haan, 1833	다섯모부채게 속
1. ***Halimede fragifer*** (De Haan, 1835)	**다섯모부채게**
Subfamily Parapanopinae Ševcic, 2005	얇은니부채게 아과
Genus *Parapanope* De Man, 1895	얇은니부채게 속
2. ***Parapanope eugora*** De Man, 1895	**얇은니부채게**
Family Pilumnidae Samouelle, 1819	애기털보부채게 과
Subfamily Eumedoninae Dana, 1851	갯고사리게 아과
Genus *Echinoecus* Rathbun, 1894	자색오색게 속
3. ***Echinoecus pentagonus*** (A. Milne-Edawards, 1879)	**자색오각게**
4. ***Echinoecus nipponicus*** Miyake, 1939	**자색정오각게**
Genus *Harrovia* Adams & White, 1849	갯고사리게 속
5. ***Harrovia elegans*** De Man, 1887	**갯고사리게**
6. ***Harrovia japonica*** Balss, 1921	**깃갯고사리게**
Subfamily Pilumninae Samouelle, 1819	애기털보부채게 아과
Genus *Actumnus* Dana, 1852	콩알부채게 속

7. ***Actumnus elegans*** De Man, 1888 **직각눈콩알게**

8. ***Actumnus marissinicus*** Takeda and Kim, 1977 **콩알부채게**

Genus *Benthopanope* Davie, 1989 네톱니부채게 속

9. ***Benthopanope indica*** (De Man, 1887) **네톱니부채게**

Genus *Heteropilumnus* De Man, 1895 털보부채게 속

10. ***Heteropilumnus ciliatus*** (Stimpson, 1858) **털보부채게**

Genus *Neoactumnus* Sakai, 1965 민이마부채게 속

*11. ***Neoactumnus convexus*** Sakai, 1965 **민이마부채게**

Genus *Pilumnopeus* A. Milne-Edwards, 1867 털손네톱니부채게 속

12. ***Pilumnopeus granulatus*** Balss, 1933 **털손네톱니부채게**

13. ***Pilumnopeus makianus*** (Rathbun, 1929) **두드러기네톱니부채게**

Genus *Pilumnus* Leach, 1815 애기털보부채게 속

14. ***Pilumnus longicornis*** Hilgendorf, 1878 **긴다리털보부채게**

15. ***Pilumnus minutus*** De Haan, 1833 **애기털보부채게**

16. ***Pilumnus trispinosus*** (Sakai, 1965) **세가시부채게**

Subfamily Rhizopinae Stimpson, 1858 둥글게 아과

Genus *Typhlocarcinops* Rathbun, 1909

17. ***Typhlocarcinops canaliculatus*** Rathbun, 1909

Genus *Zehntneriana* Ng & Takeda, 2010 둥글게 속

18. ***Zehntneriana amakusae*** (Takeda & Miyake, 1969) **긴발둥글게**

Superfamily Xanthoidea MacLeay, 1838 부채게 상과

Family Xanthidae Macleay, 1838 부채게 과

Subfamily Actaeinae Alcock, 1898 옴부채게 아과

Genus *Actaea* De Haan, 1833 옴부채게 속

19. ***Actaea semblatae*** Guinot, 1976 **옴부채게**

*20. ***Actaea polyacantha*** (Heller, 1861) **넓은가시옴부채게**

Genus *Actaeodes* Dana, 1851 다모그물등부채게 속

*21. ***Actaeodes hirsutissimus*** (Rüppell, 1830) **다모그물등부채게**

Genus *Forestia* Guinot, 1976 편평부채게 속

22. ***Forestia depressa*** (White, 1847) **편평부채게**

Genus *Gaillardiellus* Guinot, 1976 털부채게 속

23. ***Gaillardiellus orientalis*** (Odhner, 1925) **털부채게**

*24. ***Gaillardiellus rueppelli*** (Krauss, 1843) **짧은털부채게**

Genus *Novactaea* Guinot, 1976 작은옴부채게 속

25. ***Novactaea pulchella*** (A. Milne-Edwards, 1865) **작은옴부채게**

Subfamily Chlorodiellinae Ng & Holthuis, 2007

Genus *Pilodius* Dana, 1851 털가시부채게 속

26. ***Pilodius nigrocrinitus*** Stimpson, 1858 **털가시부채게**

27. ***Pilodius miersi*** (Ward, 1936) **검은손부채게**

Subfamily Euxanthinae Alcock, 1898 두드러기부채게 아과

Genus *Danielea* Ng & Clark, 2003 잔물결부채게 속

*28. ***Danielea noelensis*** (Ward, 1934) **잔물결부채게**

Genus *Medaeops* Guinot, 1967 두드러기부채게 속

29. ***Medaeops granulosus*** (Haswell, 1882) **두드러기부채게**

Subfamily Etisinae Ortmann, 1893

Genus *Etisus* H. Milne Edwards, 1834 돋음부채게 속

*30. ***Etisus anaglyptus*** H. Milne Edwards, 1834 **돋음부채게**

Subfamily Krausiinae Ng, 1993 접시부채게 아과

Genus *Palapedia* Ng, 1993 접시부채게 속

31. ***Palapedia integra*** (De Haan, 1835) **접시부채게**

Subfamily Liomerinae Sakai, 1976 꼬마매끈이송편게 아과

Genus *Liomera* Dana, 1851 주름부채게속

32. ***Liomera magaritata*** Serène, 1984 **주름부채게**

Genus *Neoliomera* Odhner, 1925 꼬마매끈이송편게 속

33. ***Neoliomera insularis*** (Adams & White, 1849) **꼬마매끈이송편게**

Subfamily Polydectinae Dana, 1851

Genus *Lybia* H. Milne Edwards, 1834 가는손부채게 속

*34. ***Lybia caestifera*** (Alcock, 1898) **가는손부채게**

Subfamily Xanthinae MacLeay, 1838 부채게 아과

Genus *Cycloxanthops* Rathbun, 1897 차양부채게 속

35. ***Cycloxanthops truncatus*** (De Haan, 1837) **차양부채게**

Genus *Leptodius* A. Milne-Edwards, 1863 부채게 속

36. ***Leptodius affinis* (De Haan, 1835) **부채게**

Genus *Macromedaeus* Ward, 1942 꽃부채게 속

37. ***Macromedaeus distinguendus*** (De Haan, 1835) **꽃부채게**

Genus *Microcassiope* Guinot, 1967 작은꽃부채게 속

38. **Microcassiope orientalis** Takeda & Miyake, 1969 **작은꽃부채게**

Genus *Nanocassiope* Guinot, 1967 꼬마부채게 속

39. ***Nanocassiope granulipes*** Sakai, 1939 **꼬마부채게**

Genus *Neoxanthops* Guinot, 1968 줄무늬부채게 속

40. ***Neoxanthops lineatus*** (A. Milne-Edwards, 1867) **줄무늬부채게**

Subfamily Zalasiinae Serène, 1968 반구부채게 아과

Genus *Banareia* A. Milne-Edwards, 1869 반구부채게 속

41. ***Banareia subglobosa*** (Stimpson, 1858) **반구부채게**

Genus *Calvactaea* Ward, 1933 산호숨이부채게 속

42. ***Calvactaea tumida*** Ward, 1933 **산호숨이부채게**

Subfamily Zosiminae Alcock, 1898 송편게 아과

Genus *Atergatis* De Haan, 1833 송편게 속

43. ***Atergatis floridus*** (Linnaeus, 1767) **매끈이송편게**

44. ***Atergatis reticulatus*** De Haan, 1833 **주름송편게**

Genus *Atergatopsis* A, Milne-Edwards, 1862 고운반달게 속

*45. ***Atergatopsis germaini*** A. Milne-Edwards, 1865 **고운반달게**

Genus Platypodia Bell, 1835 납작발부채게 속

*46. ***Platypodia tomentosa*** (De Man, 1902) **납작발부채게**

< A single asterisk (*) indicates newly reported species from Korea by the author, the double asterisk (**) indicated to be synonymized by the author >

A Key to Korean Pilumnoids and Xanthoids

1. Abdomen of male divided into 5 segments ---------- 2 (Xanthoidea)
   Abdomen of male divided into 6 or 7segments ---------- 26 (Pilumnoidea)

2. Chelipeds similar; finger slender with fine teeth, enclose an anemone ---------- ---------- *Lybia caestifera*
   Chelipeds stout. Anemone never enclosed between fingers ---------- 3

3. Antennules folded obliquely ---------- 4
   Antennules folded transversely ---------- 5

4. Dorsal surface of carapace with distinct region, densely covered with long setae ---------- *Banareia subglobosa*
   Dorsal surface of carapace without distinct region; strongly convex both longitudinal; evenly covered with short felt ---------- *Calvactaea tumida*

5. Ambulatory legs having slightly flattened dactylus. Carapace convex; anterolateral margin bearing long seta along its border ---------- ---------- *Palapedia integra*
   Ambulatory legs without special dactyl-propodal articulation. Cheliped fingers rarely enlarged, grooved or spoon-shaped except in *Leptodius* and in some species of *Macromedaeus* ---------- 6
   Ambulatory legs having dactyl-propodal articulation formed by a rounded prolongation of propodal lateral margin shaped to slide against -------- 24

6. Carapace transversely oval, generally much broader than long, with dorsal surface convex, smooth granular or rugose and regions prominent or hardly indicated. Locking mechanism of male abdomen at junction of sternite 4 and 5. Second pleopod of male very short ---------- 7
   Carapce xanthoid-shaped, with antero-lateral margins convex and noticeably separated from the postero-lateral margin ---------- 8

7. Region and sub-region of carapace well delineated. Dorsal surface of carapace convexed longitudinally and transversely ---------- *Liomera magaritata*

   Region of carapace usually poorly defined; carapace little flattened transversely ---------- *Neoliomera insularis*

8. Antero-lateral margins of carapace poorly indicated behind the exorbital angles; feeble crest in a sub-orbital position (Subheparic) directed not towards orbit but wards frame of buccal cavity ---------- 9

   Antero-lateral margins of carapace continued as far as exorbital angles and without traces of predistal ventral crest joining buccal frame ---------- 10

9. Dorsal surface of carapace lamelliform; 4M region distinct ---------- *Madaeops glanulosus*

   Dorsal surface of carapace smooth; 4M region indistinct ---------- *Danielea noelensis*

10. Front bilobed, hardly projecting or spinose; its width about equal to one third of maximum width of carapace. Basal segment of antenna contiguous with ventral prolongation of frontolateral margin and antennal flagellum including within the orbit. Carapace divided into distinct regions, granular, tuberclelate or spinose. Antero-lateral margins three teeth or granular or spinose lobe ---------- 11

    Front bi- or quadrilobed. Basal antennal segment may or may not embrace ventral prolongation of frontolateral margin. Region of carapace having feebly granular, never spinosed. Antero-lateral margin may or may not emarginated with more or less teeth or lobes ---------- 16

11. On sternal plastron of male, suture between sternites 3, 4 absent on the central part and only present as configuration ---------- 12

On sternal plastron of male, suture between sternites 3, 4, marked by transverse line or slightly groove continued from lateral margin to other of sternal plastron ---------- 14

12. Sternite 3,4 without median longitudinal line absent ---------- *Novactaea pulchella*

Sternites 3,4 with median longitudinal line present ---------- *Forest depressa*

Sternites 3,4 with crescent moon-like groove in median ---------- 13

13. Carapace, ambulatory legs with broad spines ---------- *Actaea polyacantha*

Carapace, ambulatory legs with petaliformed tubercles ------- *Actaea semblatae*

14. Sternal plastron with smooth along suture 3/4 ---------- *Actaeodes hirsutissimus*

Sternal plastron with tubercles along suture 3/4 ---------- 15

15. Dorsal surface of carapace with long seta and tufts ---------- *Gaillardiellus orientalis*

Dorsal surface of carapace with tufts ---------- *Gaillardiellus rueppelli*

16. Front with or without marginal crest feebly bilobed. Basal segment of antenna short and completely embraces ventral prolongation of front-lateral margin. Ambulatory legs with crest on anterior margin, particularly on carpus and propodus ---------- 17

Front nearly straight or bilobed, without marginal crest and with median fissure. Basal segment of antenna broad, short, joining front by internal antero-lateral angle. Carapace with four antero-lateral teeth slightly projecting or obliterated. Sternal plastron with large sternite 4 ---------- 19

17. Antero-lateral margins of carapace not emarginated, and sometimes more or less distinctly divided into four rounded lobes. Ambulatory legs subsylindrical and short, without a crest on superior margin ---------- *Atergatopsis germaini*

Antero-lateral margin lobate or dentate, emarinated with more or less broad continuous crest ---------- *Platypodia tomentosa*

Antero-lateral margins of carapace with fine and feeble crest, sometimes obsolete. Ambulatory legs short and flattened or long and thin --------- 18

18. Dorsal surface smooth without any groove. Region of carapace indistinct ---------- *Atergatis floridus*

Carapace, cheliped and legs bearing their surface marked with rugosities forming irregular reticulation ---------- *Atergatis reticulatus*

19. Front noticeably advanced beyond supra-orbital angles ---------- 20

Front not extend beyond supra-orbital angles ---------- 21

20. Antero-lateral margin with 4 lobes ---------- *Neoxanthops lineatus*

Antero-lateral margin with 5 lobes exclusive external orbital angle ---------- *Cycloxanthops truncates*

21. Fingers of larger cheliped rounded extremities which not crossed when they are closed. Antero-lateral margins of carapace with more than four teeth or lobes ---------- 22

Fingers of larger cheliped with more or less pointed extremities that hardly cross each other when closed. Antero-lateral margins of carapace never bearing more than 4theeth or lobes behind exorbital angles ---------- 23

22. Basal segment of antenna short and squat. Fingers of chelipeds with excavated extremities rounded but not enlarge. First gonopod of male bifurcated apex without mushroom-shaped tubercles ---------- *Macromedaeus distinguendus*

Basal segment of antenna elongated. Fingers of chelipeds with strongly hollowed extremities that are enlarged and hoof-shaped. First gonopod of male with elongated apical lobe, bordered by mushroom-shaped tubercles ---------- *Leptodius affinis*

23. Antero-lateral margin with 4 teeth. Dactyli of ambulatory legs with spine on subdistal portion ---------- *Microcassiope orientalis*

Antero-lateral margin with 3 teeth. Dactyli of ambulatory legs without spine on subdistal portion ---------- *Nanocassiope granulipes*

24. Front projected; less than one third of carapace width. Basal segment of antenna with external antero-lateral lobe occupying the obital hiatus antenna flagellum excluded from orbit ---------- *Etisus anaglyptus*

Front hardly projecting and comparatively broader; more than one third of carapace width. Basal segment of antenna with antero-lateral external angle more or less prolonged and lodged in orbital hiatus, often completely closed ---------- 25

25. Dorsal surface of carapace covered with specious tufts -- *Pilodius nigrocrinitus*

Dorsal surface of carapace without tuft ---------- *Pilodius miersi*

26. Carapace pentagonal, moderately broad. Front prominent and square-cut. Abdomen of male with all seven segment distinct; last segment being more than twice as long as any of others. Suture 3 / 4 marked by transverse line or slightly groove continued from lateral margin to other of sternal plastron, and with biased groove from episternite 4 ---------- 27

Carapce hexagonal, transversely rectangular or transversely ovate; dorsal surface convex, smooth or granular. Front not projecting and entire, bilobate or multilobate. Abdomen of male with 7 moveable somites; genital openings coxal or coxal-sternal. Suture 3 / 4 between sternite 3, 4 with or with slightly groove ---------- 28

27. Dorsal surface of carapace with quite broad tubercles; region distinct. ---------- *Helimede fragifer*

Dorsal surface of carapace smooth with fine granules; reagion indistinct --------- *Parapanope eugora*

28. Carapace flat, angular, with spine between anterolateral and posterolateral angles; front projecting ---------- 29

Carapace convex, oval or subquadrate, anterolateral and Posterolateral angles weakly differentiated; front scarcely extended anteriorly ---------- 32

29. Floor of orbital not in contact with front, but leaving hiatus being more or less filled by second joint of antennal peduncle. Rostrum obliquely deflexed, and composed of two lobes or spines being divided by median notch or sinus ---------- 30

Floor of orbit meeting with front so as to completely exclude antennal peduncle from orbit. Lateral rostral spines not prominent and median rostral lobes broad. First pair of ambulatory legs slender and longer than the succeeding pairs, dactylus of former also very slender and long -------- 31

30. Rostrum shorter subtriangular, not elongate. Anterolateral angle of carapace marked with small tooth, not smooth ---------- *Echinoecus nipponicus*

Rostrum subtriangluar. Anterolateral angle of carapace marked without tooth, smooth ---------- *Echinoecus pentagonus*

31. First and second anterolateral lobes separated by narrow fissure, sometimes seemed to be fused; edges of anterolateral margin highly spiniform and directed anteriorly ---------- *Harrovia japonica*

First and second anterolateral lobes separated by a wide cleft; edges of anterolateral margin blunted and directed laterally ----- *Harrovia elegans*

32. Carapace smooth; eyestalks small, immobile in shallow orbits with weak lower margins, eyes reduced or obsolete ---------- 33

Carapace with dense mat of hairs obscuring regions and margins (except *Pilumnopeus* with scattered hairs); eyestalks fully formed in deep orbits ---------- 34

33. Antero- and Posterolateral border bearing seta -- *Typhlocarcinops canaliculatus*
Antero- and Posterolateral border naked with 3 teeth, and bearing slightly shallow concave ---------- *Zehntneriana amakusae*

34. Carapace naked and convex; region indistinct ---------- *Neoactumnus convexus*
Carapace with scattered hairs in anterolateral region (sides and ventral surfaces densely covered with long hairs ---------- 35
Carapace usually well covered with long hairs or felt (at least on anterior and lateral regions) ---------- 36

35. Chelipeds naked; dorsal surface smooth, and without tubercles ---------- *Benthopanope indica*
Chelipeds naked; surface with granules ---------- *Pilumnopeus makianus*
Chelipeds with seta and granules ---------- *Pilumnopeus granulatus*

36. Carapace dorsally with some seta and with dense band of long seta marginally and extending on to front and sides of carapace ---------- *Heteropilumnus ciliates*
Carapace totally covered with even velvet of short thick hairs; psterolateral region of carapace subtly concave ---------- 37
Carapace covered totally, or on anterior and anterolateral region only, with stiff or shaggy longhairs, sometimes mixed with short clubbed hairs; Posterolateral region of carapace subtly convex ---------- 38

37. Surface of cheliped, carapace with tufts; each region ill defined; anterolateral border with 4 spines ---------- *Actumnus elegans*
Surface of cheliped, carapace without tuft; each region well defined; anterolateral border with 4 lobes bearing spines ---- *Actumus marssinicus*

38. Anterolateral margin armed with four acuminate spines: first or external orbital one somewhat smaller and has some additional spines below it. Meri on upper border of ambulatory legs with spines -------- *Pilumnus longicornis*

Anterolateral margin very slightly shorter than postero-lateral; former three spines, longer and sharper in relatively larger specimens, but in some specimens having accessory spinules. Meri on upper border of ambulatory legs without spines ---------- *Pilumnus minutus*

Anterolateral margin armed with four teeth: first mere granulated ridge, less prominent and confluent with external orbital angle; following three teeth capped each by a small but sharp, curved spine, most strongly procurved. Meri on upper border of ambulatory legs without spines ---------- *Pilumnus trispinosus*

Diagnosys and systematic account of species

1. *Halimede fragifer* (De Haan, 1835) 다섯모부채게

Cancer (Halimede) fragifer de Haan, 1833–1849 (1835): 47, pl. 13, fig. 4.

Halimede fragifer Stimpson, 1858: 33; Stimpson, 1907: 50; Odhner, 1925: 81; Kim, 1973: 373, 628, pl. 81, fig. 104; Sakai, 1976: 386, fig. 208a, pl. 136, fig. 2; Takeda et al., 2000: 137; Ng et al., 2008: 138.

Halimede tyche (not Herbst, 1783): Dai & Yang, 1991: 264, fig. 142(1), pl. 32(6).

Previous records of Korean fauna. Busan, Hansan (Kim, 1973).

Material examined. 1 inds, Muchangpo, Boryeong, Chungchunnam-do; 2 inds., Paehang, Sacheon, 26 Oct. 1987.

Diagnosis. Carapace (Fig. 5) pentagonal in outline; surface convex, every region covered with isolated tubercles of various sizes; tubercles on anterior dorsal half flattish, while tubercles on posterior half somewhat cauliflower–like, spaces between tubercles covered with short tomentum. Front (Fig. 6A, 6B) produced, margins elevated; anterior margin truncated, divided into 2 lobes. Dorsal orbital margin slanted postero–laterally, armed with obtuse processes. Anterolateral margin (Fig. 6A) with 3 fairly large flat tubercles or bluntly coniform processes. Posterolateral margin (Fig. 5) bearing a few tubercles, of which the formost is more prominent.

Antennules (Fig. 6C) folding transversely, slightly obliquely. Basal article of antenna sub-rhomboidal, short, broad; antennal flagellum entering orbital hiatus.

Thoracic sternum (Fig. 6D) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture;

Chelipeds (Figs. 5, 6E) symmetrical. Carpus covered with more than 10 flat tubercles or round–blunt processes on the dorsal surface and with a longitudinal granular row composed of fine granules and posterior margins, dactylus slender and elongate.

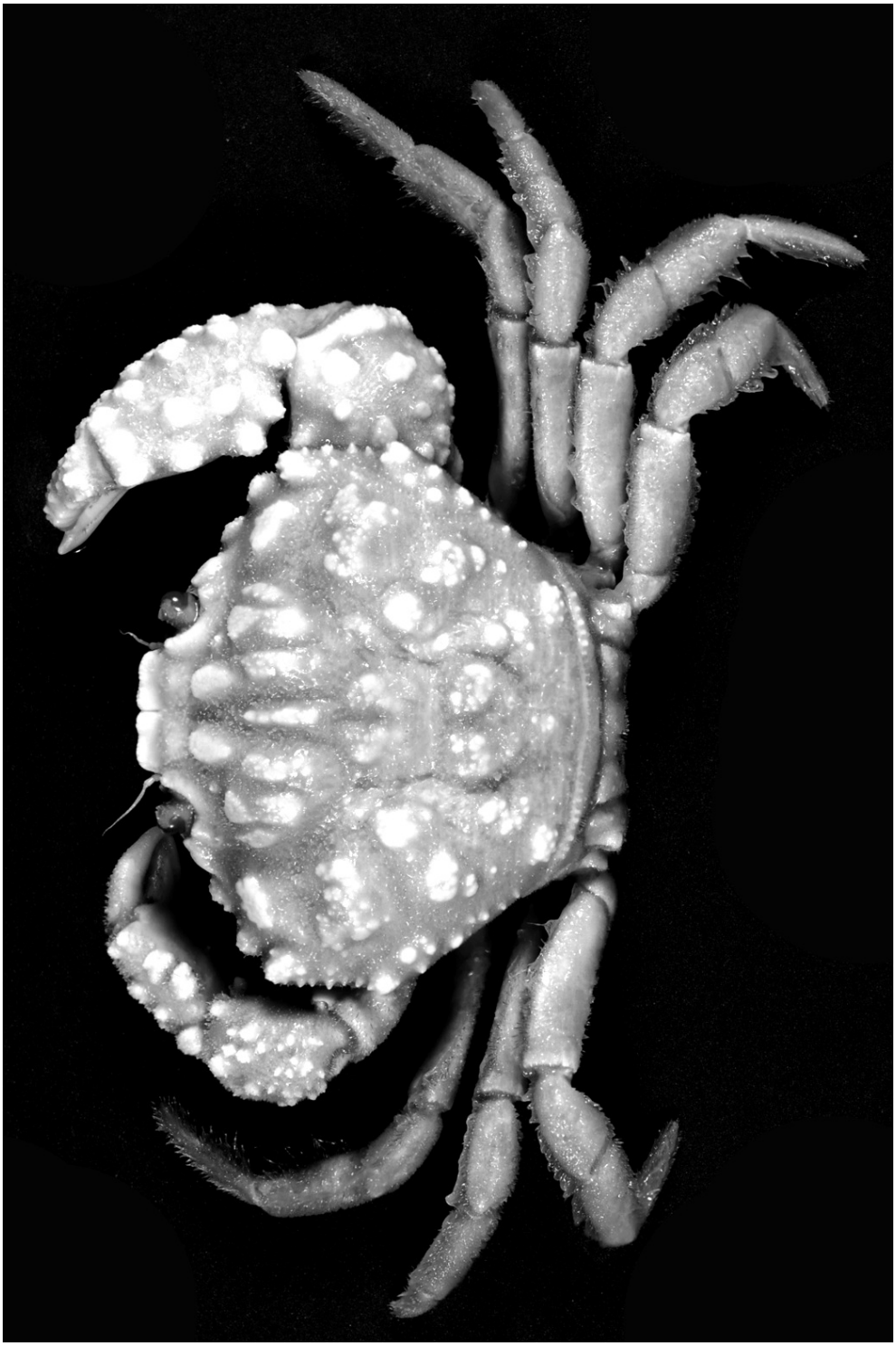

Fig. 5. *Halimede fragifer* (De Haan, 1835), male, 27.3 × 22.5 mm, dorsal view.

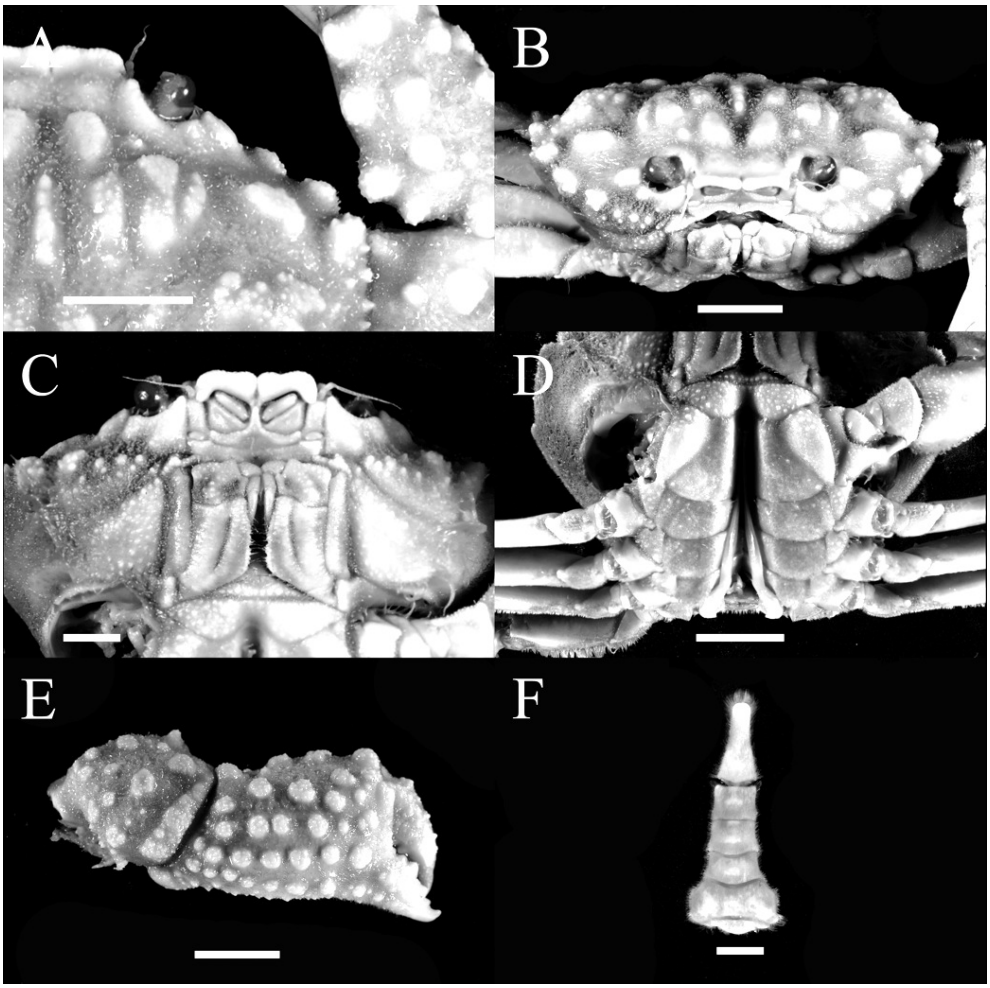

Fig. 6. *Halimede fragifer* (De Haan, 1835). A, Anterolateral margin, dorsal view; B, Front and epistomian region, anterior view; C, Third maxillipeds and pterygostomian region; D, Thoracic sternum, ventral view; E, Right cheliped, outer view; F, Abdomen of male, ventral view. Scale bars: A, B, D, E = 5 mm, C, F = 3 mm

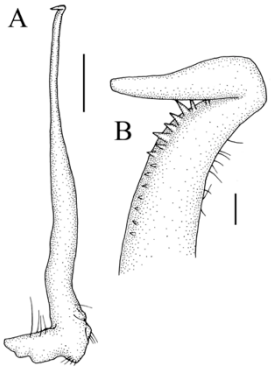

Fig. 7. Male left G1 of *Halimede fragifer* (De Haan, 1835), external view. A, Whole; B, Distal portion. Scale bars: A = 2 mm, B = 0.1 mm.

Male abdomen (Fig. 6F) narrow and long, abdominal segment 6 squarish; terminal segment elongately triangular.

Male first gonopod 1 (Fig. 7) elongate, distal half more slender and distal end curved inner–dorsally.

Habitat. Muddy or sandy–muddy bottom, 20–50 m depth.

Type locality: Japan.

Distribution. Japan, Taiwan, China, Hong Kong, New Caledonia, and Korea

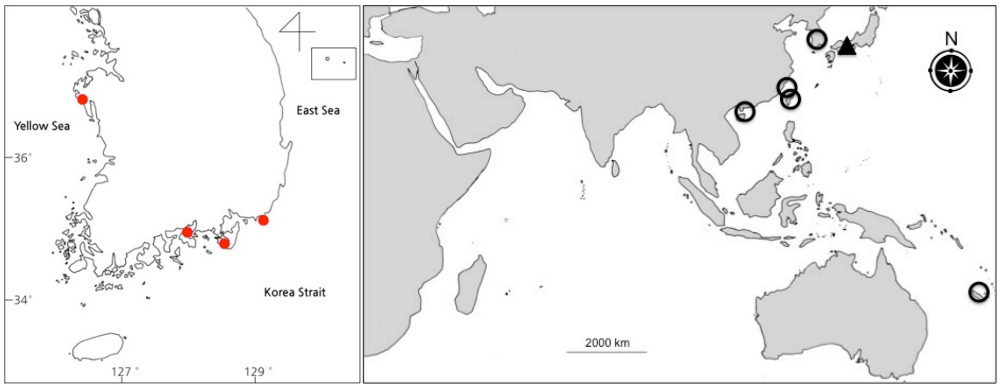

Fig. 8. Distribution of *Halimede fragifer* (De Haan, 1835). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. *Halimede fragifer* (De Haan, 1835) looks like a member of xanthoids due to their carapace and the regions in dorsal surface of this species are similar as those of xanthoids, but the abdomen segment of the present species is consists of 7 somites. Therefore, this species are included in Pilumnoidea.

2. *Parapanope eugora* De Man, 1895 얇은니부채게

Parapanope euagora De Man, 1895: 514; Sakai, 1976: 434, pl. 156, fig. 3; Kim & Kim, 1982: 133; Kim, 1985: 63; Dai & Yang, 1991: 302, fig. 158(1), pl. 39(1), Ng et al., 2008: 138.

Parapanope singaporensis Ng & Guinot, in Guinot, 1985: 694, figs 11–12, pl. 2, fig. 6–8.

Previous records of Korea fauna. Gomso (Kim & Kim, 1982; Kim, 1985)

Material examined. 1 ind., Maryang-ri, Biindo Is., Chungcheongnam-do, 25 Jul. 1971; 1 ind., Daewon-do, Jeollanam-do, 22 Jun. 2002.

Diagnosis. Carapace (Fig. 9) pentagonal, elevated and marked with patches of granules. Front (Figs. 9, 10A) projecting, cut into 2 lobes, each slightly concave and bearing narrow notch on anterior margin, separated from innerorbital angle by notch. Dorsal margin of orbit (Figs. 9, 10A) with 2 fissures. Anterolateral margin sharp, armed with 4 triangular teeth: first small, second slightly larger and with accessory denticle on posterior margin, last sharp and produced. Posterolateral margin straight, converged backwards and granulated.

Antennules (Fig. 10B) folding transversely, slightly obliquely. Basal article of antenna sub-rhomboidal, short, broad; antennal flagellum entering orbital hiatus.

Thoracic sternum (Fig. 10D) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture.

Chelipeds (Fig. 10C) asymmetrical. Merus with granules along dorsal margin. Carpus with obtuse tooth at innerdistal angle. Palm with 2–3 longitudinal granulated carinae on dorsal surface, granules on inner one larger and dentiform in some specimens. Fingers armed with teeth along inner margins and incurved at tips.

Ambulatory legs (Fig. 9) elongate and thin; propodus and dactylus with long setae along anterior and posterior margins; dactylus depressed and tipped with cuticular claw.

Fig. 9. *Parapanope euagora* de Man, 1895, male, 9.8 × 7.2 mm, dorsal view.

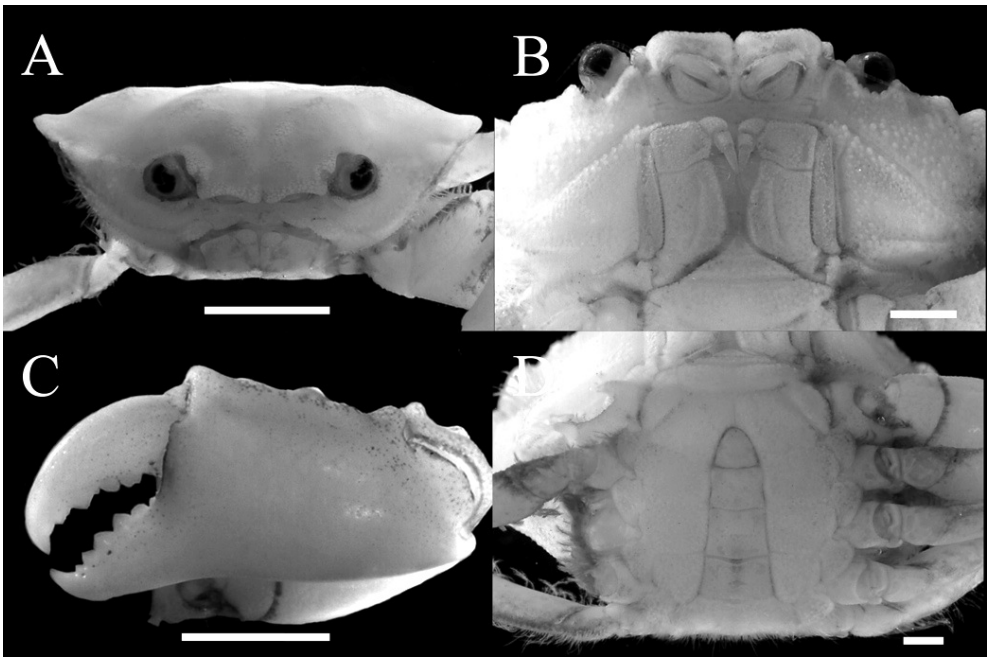

Fig.10. *Parapanope euagora* de Man, 1895. A, Front, anterior view; B, Maxillipedes and pterygostomian region; C, Left cheliped, outer view, D, Thoracic sternum and male abdomen. Scale bars: A = 2.5 mm, B = 1 mm, C = 3 mm, D = 0.5 mm.

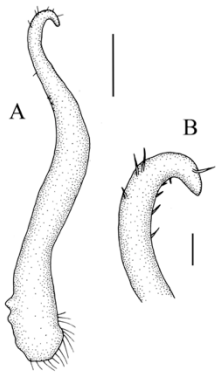

Fig. 11. Male first gonopod of *Parapanope euagora* de Man, 1895, external view. A, Whole; B, Distal portion. Scale bar: A = 0.5 mm, B= 0.1 mm.

Male abdomen (fig. 10D) narrow and long, 7–segmented. Telson acutely triangular.

First pleopod of male (Fig. 11) with its distal half slightly arched dorsally inwards, tip hook–shaped.

Type locality. Java Sea.

Distribution. East coast of India, Nicobar Islands, Malaysia, Japan, China, Singapore, Indonesia, and Korea.

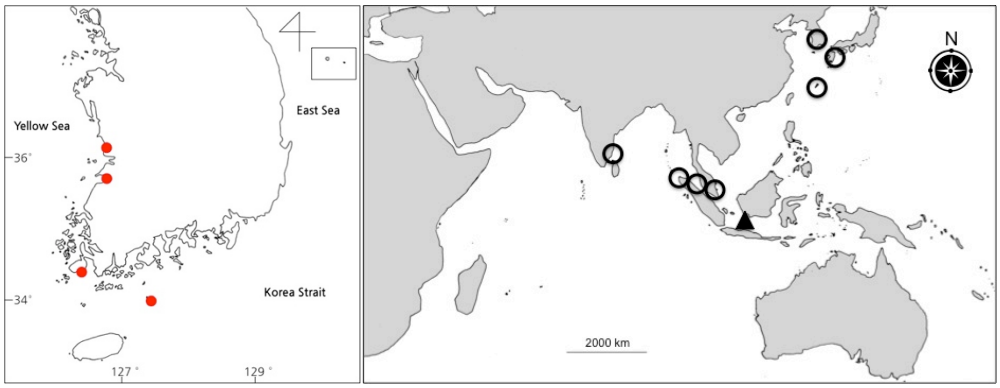

Fig. 12. Distribution of *Parapanope euagora* De Man, 1895. Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. Korean *Parapanope euagora* De Man, 1895 are agrees well with the description of Dai & Yang (1991). This species has been only collected from west-southern part of Korean peninsular.

3. ***Echinoecus pentagonus*** (A. Milne-Edwards, 1879) 자색오각게

Eumedon pentagonus Milne Edwards A., 1879: 104.

Echinoecus pentagonus: Rathbun, 1906: 880, fig. 37; Sakai, 1976: 295, pl. 100, fig. 1; Kim & Chang, 1985: 50, fig. 4; Dai & Yang, 1991: 180, fig. 94.

Previous records of Korean fauna. Seogwipo, Jejudo Is. (Kim & Chang, 1985)

*Material examine*d. 1 ind., Munseom, Jejudo Is., 1 Jul. 1993.

Diagnosis. Carapace of female about as long as broad; dorsal surface smooth and microscopically punctulate; brown in color, but both sides of the intestinal region with shoe–shaped yellow spot. Lateral portions of epigastric region slightly convex, median portion more or less depressed. Rostrum projecting, distal portion divided 2 obtuse teeth by a shallow groove. Orbit small, eye–peduncle stubby. Anterolateral margin with concave in hepatic margin. Posterolateral margin straight, and subequal to anterolateral in length. Conjunctions of anterolateral and posterolateral margins bluntly round.

Chelipeds slightly asymmetrical; right one larger than left. Merus elongate and rhomboid dorsal and ventral margins each with tooth at distal end. Carpus with large tooth and small one at the inner–distal angle. Propodus compressed, about 1.6 times as long as broad.

Ambulatory legs subcylindrical and subequal in length, but last pair a little shorter; surface covered with pits except for dactylus, which is furnished with short pubescene on the ventral surface, tip cuticular.

Female abdomen large and round, 7–segmented; telson with distal margin bluntly round and fringed with short hairs.

Habitat. Commensally attached to the common sea urchin, *Toxopneustes pileolus* (Lamarck)

Distribution. China, Japan, Hawaii, Vietnam, Red Sea, and Madagascar.

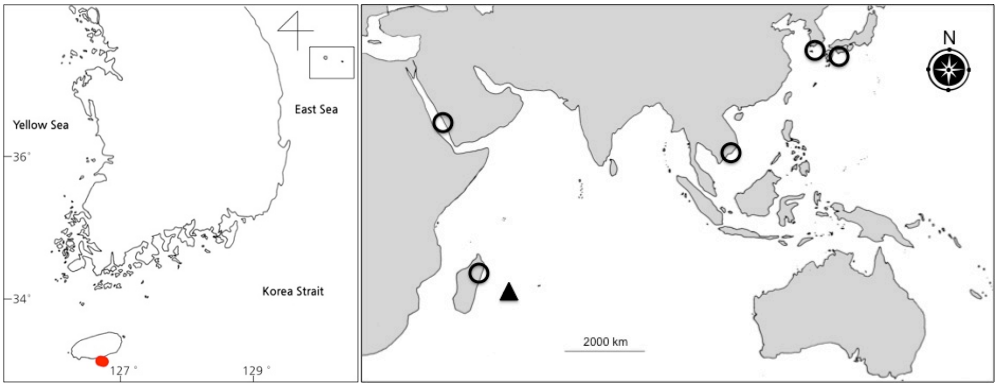

Fig. 13. Distribution of *Echinoecus pentagonus* (A. Milne-Edwards, 1879). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. The author has not been collected and examined *Echinoecus pentagonus* (A. Milne-Edwards, 1879). The description of this species are cited Kim & Chang (1985: 50).

4. ***Echinoecus nipponicus* Miyake, 1939** 자색정오각게

Echinoecus petiti nipponicus Miyake, 1939: 86, 88, 90, textfig. 1-3B.

Echinoecus pentagonus: Sakai, 1976: 295, Pl. 100, fig. 1; Hong et al., 2006: 383.

Echinoecus nipponicus: Ng et al., 2008: 139; Lee et al., 2011: 191.

Previous records of Korean fauna. Jejudo Is. (Lee et al., 2011).

Diagnosis. Carapace 1.1 times broader than long; rostrum subtriangular, length approximately 0.35 width of its base; antero- and posterolateral margins clearly demarcated by small tooth; posterior margin slightly concave medially.

Chelipeds punctuate, subequal; merus with blunt inner and outer teeth; carpus with blunt outer proximal tooth and sharp inner distal tooth; propodus short; cutting margins of each fingers with 3-4 blunt teeth.

Ambulatory legs subcylindrical; anterior margins of merus terminating in small angles; carpus without setae; posterior margins of propodus and dactylus with short setae on legs 1-3, with dense short setae on leg 4.

Color in life. Entire animal generally purple red or pale purple red; carapace with longitudinal whitish purple red stripe on each epibranchial region.

Habitat. These crabs were found on the external surfaces of sea urchins.

Distribution. Japan and Korea.

Remarks. The female specimen reported by Kim & Chang (1985), and as the unnumbered figures by Hong et al. (2006) identified as *E. pentagonus* seems to be *E. nipponicus* (Lee et al., 2011: 193). The author has not examined this species. The description are cited from Lee et al. (2011).

5. ***Harrovia elegans* De Man, 1887** 갯고사리게

Harrovia elegans de Man, 1887b: 21, pl. 1, figs 5-6; Kim, 1970: 26, pl. 5, fig. 4; Kim & Rho, 1972: 86, 100, fig. 5; Kim, 1973: 558, 670, fig. 265, pl. 112, fig. 213a-b.

Previous records of Korean fauna. Upper Chujado Is., (Kim, 1973)

Material examined. 1 ind., Chaguido Is., 16 Sep. 1995; 1 ind., Hyeongje-seom, Jejudo Is., 21 Aug. 1998; 1 ind., Munseom, 7 Nov. 2000; 2 inds, Marado Is., Jejudo-Is., 23 Feb. 2001; 1 ind., Habaekdo Isl. Yeosu-si, Jeollanam-do, 21 Jun. 2001; 1 ind., Sopyongdo, 25, Jun. 2002; 1 ind., Hakdong, Geoje, Gyeongsangnam-do, 29 Aug. 2009.

Diagnosis. Carapace (Fig. 15) broadly hexagonal; dorsal surface with a dense coat of tomentum; gastric region with two large elevations placed side by side; metagastric and branchial regions faintly defined; cardiac and intestinal regions scarcely delimited. Rostrum (Figs. 15, 16A, 16B) composed of two median subtruncate lobes and two lateral acuminate teeth. Anterolateral margin armed with two anterior lobes and two posterior teeth: former subequal, confluent, and granulated; latter salient, well divergent and somewhat project upwards. Posterolateral margin convex. Posterior margin straight. Infraorbital lobe rather prominent and granulated, small tooth, placed between the infraorbital lobe and first anterolateral lobe.

Third maxilliped (Fig. 16C) completely covering buccal orifice

Chelipeds (Fig. 16E) longer than ambulatory legs; palm much longer than merus, and indistinctly sulcated along upper border.

First pair of ambulatory legs (Figs. 15, 16F) slenderer and longer than succeeding pairs, equally thick and subequal in length; merus of all pairs spinulated along anterior border; dactylus of the first pair by far longest of all dactyli of legs.

Male abdomen (Fig. 16D) broad triangular; all somite free segment.

Male first gonopod (Fig. 17) slender; apical lobe curved inward.

Type locality. Elphinstone Island, Mergui Archipelago.

Distribution. Somalia, Pakistan, Gulf of Mannar, Mergui Archipelago, Thailand, Malay Peninsula, Korea, South China Sea, Vietnam, Philippines, Indonesia, and Marshall Islands.

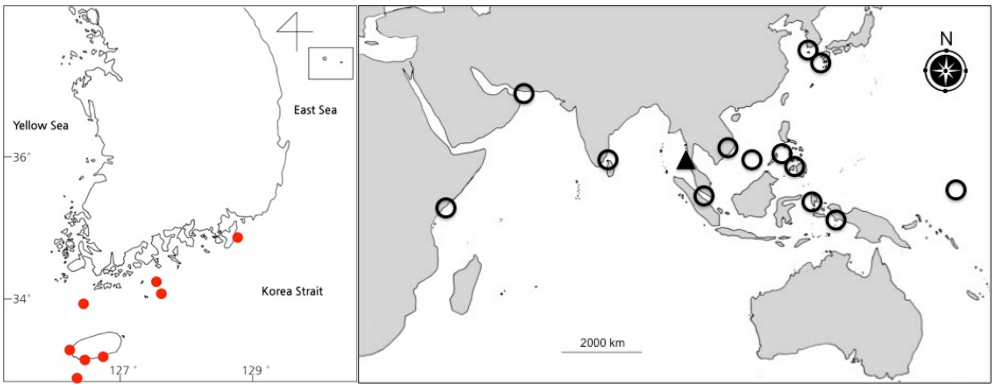

Fig. 14. Distribution of *Harrovia elegans* De Man, 1887. Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. The examined specimens are agreed very well with the original description. But the number of spines on upper margin of merus of ambulatory legs was not mentioned. The examined specimens have 5– 8 spines on there.

Fig. 15. *Harrovia elegans* De Man, 1887, male, 7.8 × 6 mm, dorsal view.

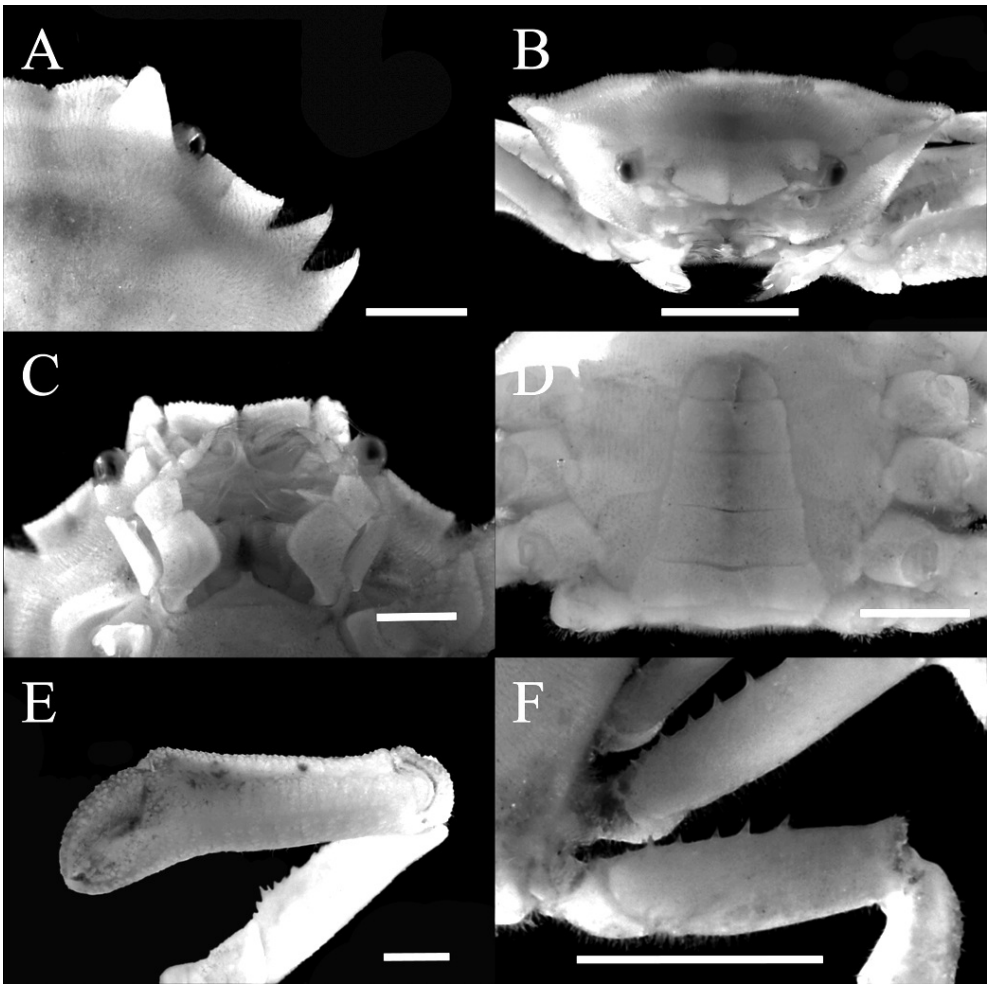

Fig. 16. *Harrovia elegans* De Man, 1887. A, Anterolateral margin, dorsal view; B, Front, anterior view; C, The third maxillipeds, ventral view; D, Male Abdomen, ventral view; E, Left cheliped, outer view; F, Right fourth ambulatory leg, dorsal view. Scale bars: A, C, D, E = 1 mm, B, F= 2 mm.

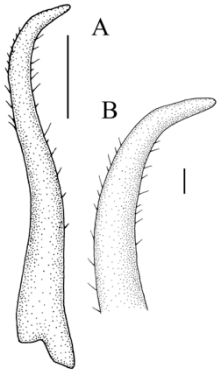

Fig. 17. Male first gonopod of *Harrovia elegans* De Man, 1887, external view. A, Whole; B, Distal portion. Scale bars: A = 0.5mm, B = 0.1 mm.

6. ***Harrovia japonica*** **Balss, 1921** 깃갯고사리게

Harrovia japonica Balss, 1921b: 177; Chia & Ng, 1998: 514(key), 527, figs 16–18; Lee & Ko, 2009: 125.

Harrovia elegans (not de Man, 1887): Sakai, 1976: 298(key), 299, fig. 166d, pl. 100, fig. 3; Kim, 1977: 208; Kim & Kim, 1982: 154.

Previous record of Korean fanua. Geomundo, Jejudo Is. (Kim, 1977; Kim & Kim, 1982; Lee &Ko, 2009)

Diagnosis. Carapace hexagonal; regions not well defined; protogastric regions with two strong tubercles, but sometimes absent. Anterolateral margins separated into four lobes: first and second generally truncate, separated by narrow fissures, usually appearing fused; third and fourth lobes distinctly dentiform. Posterolateral margin mildly tuberculated. Frontal margin with small median fissure, slightly deflexed, appearing straight from dorsal view, shallow median cleft, covered with many tubercles.

Chelipeds cylindrical; carpus without large tubercle or spine on distal inner margin of carpus.

Ambulatory legs short, stout; ratio of length to width of fourth ambulatory merus 2.6–3.4 times; upper margin lined with very strong spinules.

Distal portion of male first gonopod bends approximately 90° or very slightly downwards.

Type locality: Sagami Bay, Japan.

Distribution. Japan; Korea; China.

Remarks. The author has not examined this speices. The description was cited from the description of Lee & Ko (2009).

7. ***Actumnus elegans*** De Man, 1887 직각콩알게

Actumnus elegans De Man, 1887b: 47; Garth & Kim, 1983: 696; Kim, 1985: 63; Kim & Kim, 1986:309.

Previous records of Korean fauna. Guryong-po and upper-Chuja-do (Kim, 1985; Kim & Kim, 1986)

Material examined. 1 ind., near Mt. Songak, Jejudo, 21 Aug. 1998; 4 inds., Ulrung Is., Gyeonsangbuk-do, 20 Oct. 2001; 1 ind., Geomundo Is., Jeollanam-do, 26 Jun. 2002; 1 ind., Munseom, Jejudo Is., 10 Jul. 2003; 1ind., upper Chujado Is., 10 Jul. 1985; 1 ind., Geomundo Is., 26 Jun. 2002; 3 inds., Dokdo Is., 14 Aug. 1995; 1 ind., Chujado Is, Jejudo, 2 Apr., 2009.

Diagnosis. Carapace (Fig. 18) strongly convex anteriorly; surface bears no indication of regions, thickly covered with tufts, and single yellow setae mixed with very scant longish ones: those setae almost uniformly disposed on dorsal surface except for posterolateral surface. Front (Fig. 19B) slightly less than one-third breadth of carapace, deflexed and somewhat produced in middle. Third maxilliped (Fig. 19C) completely filled buccal orifice; merus subquadrate, granular, anterolateral angle slightly produced. Anterolateral border arched, cut ino four lobular teeth by three shallow interruptions; each tooth bordered with four or five granules of good size. Subhepatic region not hairy, minutely granulated without spines or spinules. Posterolateral border equal in length to antero-lateral, and rather strongly convergent just after end of posterior slope of last anterolateral tooth.

Chelipeds (Fig. 19E, 19F) short, heavy, and asymmetrical; merus entirely concealed under carapace; carpus thickly covered with granules and short setae on outer surface, being impressed with shallow furrow parallel to the distal margin; palm of the larger chela thickly covered with granules interspaced with short setae like the carpus on the upper, outer and lower surfaces; its upper border fringed with a row of large granules and long hairs, being somewhat crest-like; smaller palm nearly like larger one, granules and setae on lower surface being more prominent than those on larger chela.

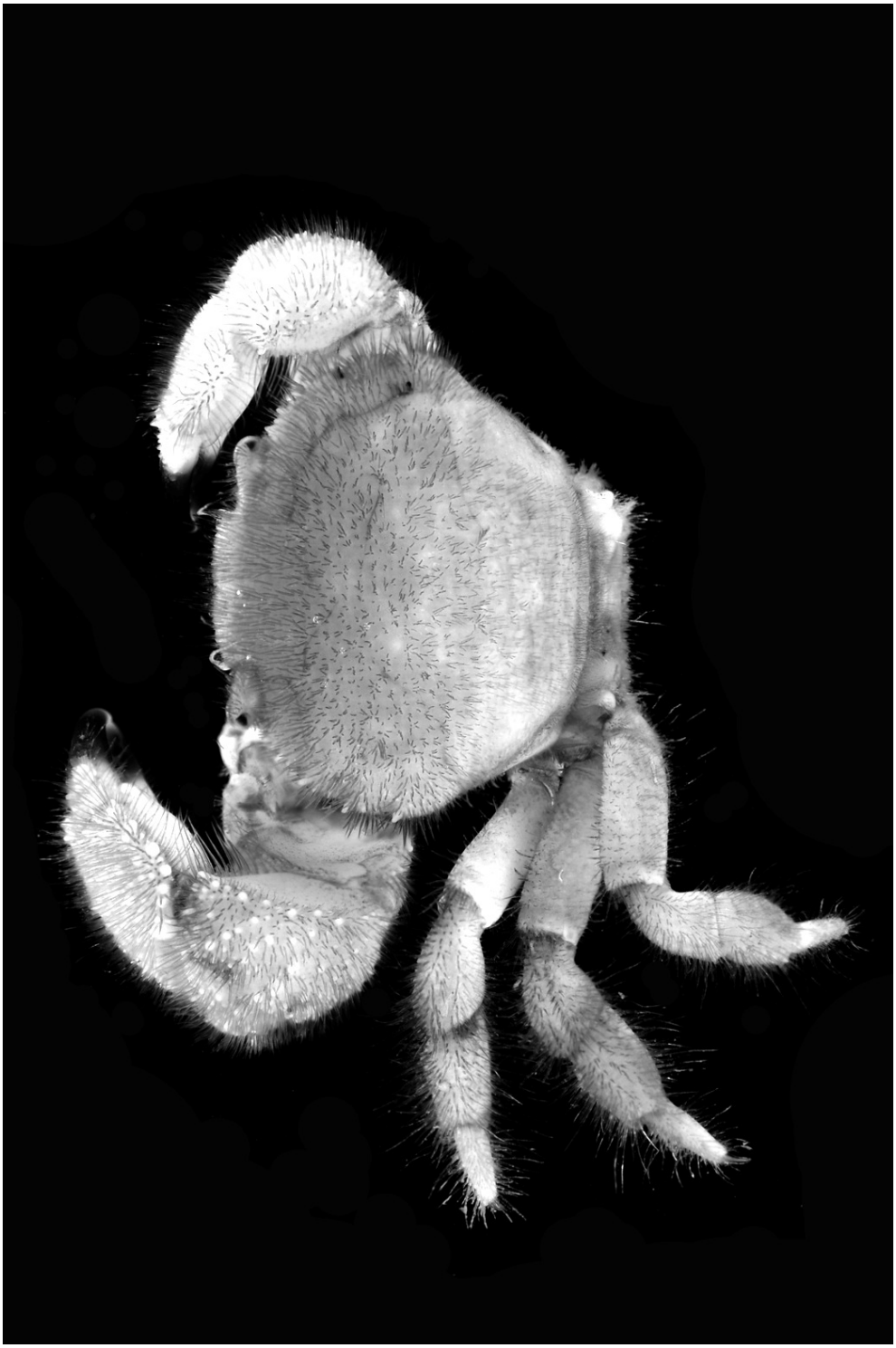

Fig. 18. *Actumnus elegans* De Man, 1887, male, 10.6 × 8.3 mm, dorsal view.

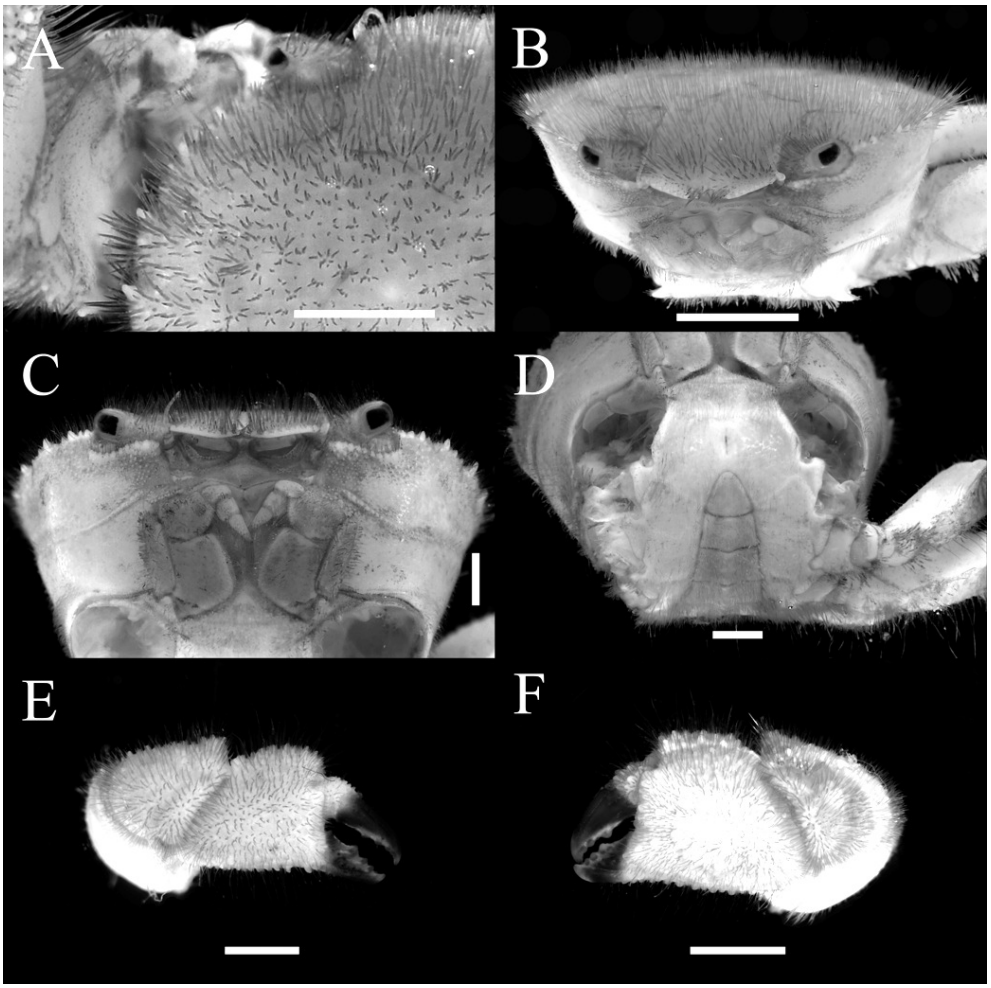

Fig. 19. *Actumnus elegans* De Man, 1887. A, Anterolateral margin, dorsal view; B, Front, anterior view; C, The third maxillipeds and pterygostomian region, ventral view; D, Thoracic sternum and male abdomen, ventral view; E, Right cheliped, outer view; F, Left cheliped, outer view. Scale bars: A, E = 2 mm, B, F = 3 mm, C, D = 1 mm.

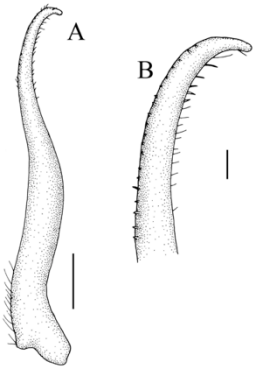

Fig. 20. Male first gonopod of *Actumnus elegans* De Man, 1887, external view.

Scale bars: A = 0.5 mm, B = 0.1 mm.

Ambulatory legs comparatively long, stout and thickly covered with setae mixed with longish ones on entire upper surface; merus very minutely granulated on upper border; each carpus and propodus rather prominently granulated near the upper borders; Dactylus shorter than preceeding segment and ends in sharp terminal claw.

Male abdomen (Fig. 19D) narrow; all somite free; telson subtriangular.

Male first gonopod (Fig. 20) slender; distal portion curved smooth, inward.

Type locality. Sullivan Island, Mergui Archipelago.

Distribution. Burma, Mergui Archipelago, Japan, Philippines, and Korea.

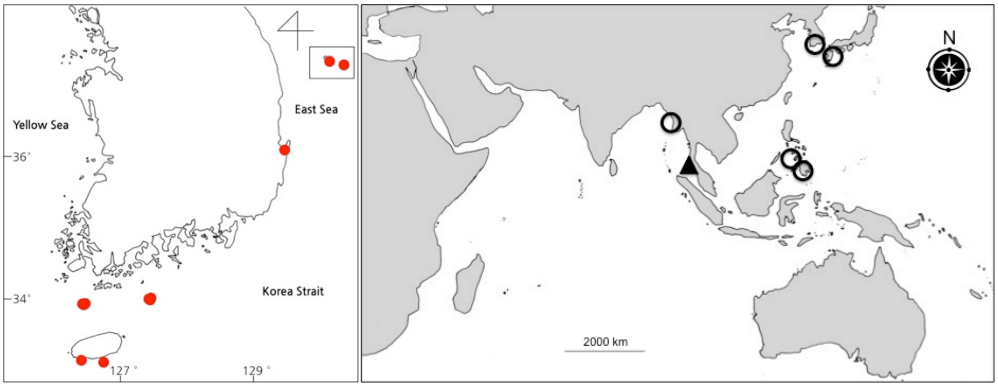

Fig. 21. Distribution of *Actumnus elegans* De Man, 1887. Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. *Actumnus elegans* De Man, 1887 is similar to *Pilumnus longicornis* Higendorf, 1879 in having spicious tuft on dorsal surface of their carapace. *Actumnus elegas* have tubercles on entire outer surface of major cheliped while *P. longicornis* have them on upside of major cheliped.

8. ***Actumnus marissinicus*** Takeda & Kim, 1977 콩알부채게

Actumnus asper (not Rüppell, 1830) Kim & Park, 1972: 61, fig. 5, pl. 1, fig. 4; Kim, 1973: 398, 634, fig. 157, pl. 84, fig. 119.

Actumnus marissinicus Takeda & Kim, 1977: 135, pl. 1, fig. 1B-C; Kim & Chang, 1985: 54.

Previous record of Korean fauna. Seoguipo (Kim, 1973).

Material examined. 1 ind., Moseulpo, Jeju-do, 22 Jul. 1982.

Diagnosis. Carapace (Figs. 22, 23A) extremely convex, very sunken posteriorly and concave postero-laterally; dorsal surface well divided into granulated, depressed areolae by wide but shallow furrows, being everywhere covered with short, erect stiff setae; protogastric region prominently large, regularly convex fore and aft, bearing longitudinal short incision at anterior outer one-third; posterolateral region nearly devoid of granules and markedly concave near inner branchial and cardiac region. Third maxilliped (Fig. 23C) completely filled buccal orifice; merus subquadrate, granular, anterolateral angle slightly produced. Front (Fig. 23B) strongly declivous anteriorly, being cut into two lobes by median small notch.

Chelipeds (Fig. 23D) heavy, quite asymmetirical; merus short, stout and not exerted beyond carapace; its upper border armed with distal and subdistal spine-tipped teeth; carpus large and palm high as usual; outer surface of palm densely covered with conical or rather tuberculated granules.

Ambulatory legs (fig. 22) comparatively slender, especially so in first two pairs. Upper border of merus rather thin. Posterior surface of carpus ornamented with longitudinal shallow furrow, but bears no granules.

Fig. 22. *Actumnus marissinicus* Takeda & Kim, 1977, female, 17 × 13 mm, dorsal view.

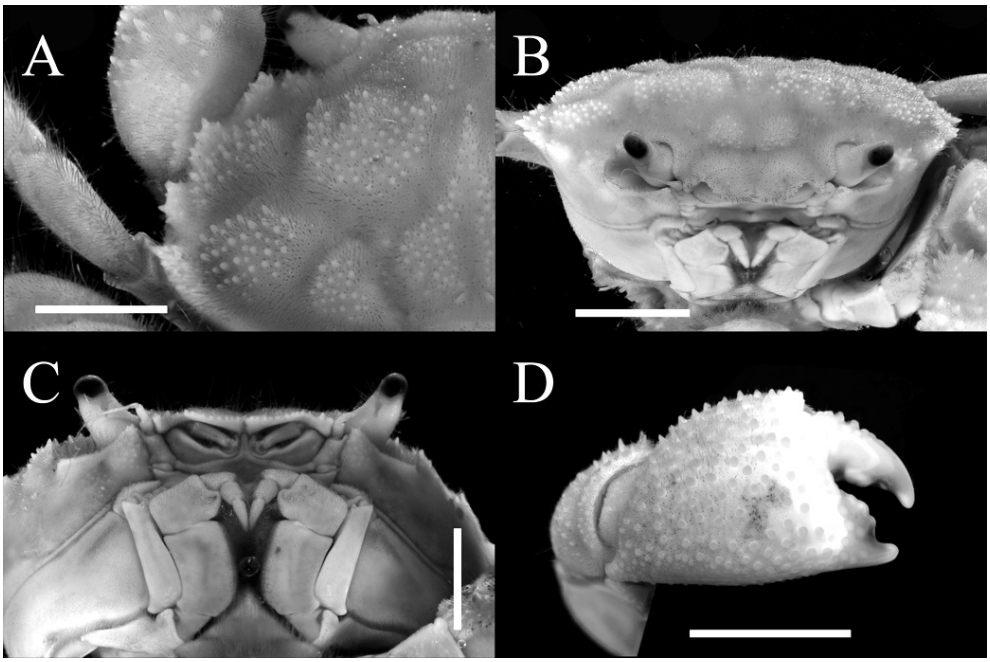

Fig. 23. *Actumnus marissinicus* Takeda & Kim, 1977. A, Anterolateral view, dorsal view; B, Front, anterior view; C, The firth maxillipeds, ventral view; D, Right cheliped, outer view. Scale bars: A, B, C = 3 mm, D = 5 mm.

Type locality. Seogwipo, Cheju-do, Korea.

Distribution. Korea - Seogwipo, Cheju-do (Kim, 1973, Takeda & Kim, 1977), Mosulpo (Kim & Chang, 1985).

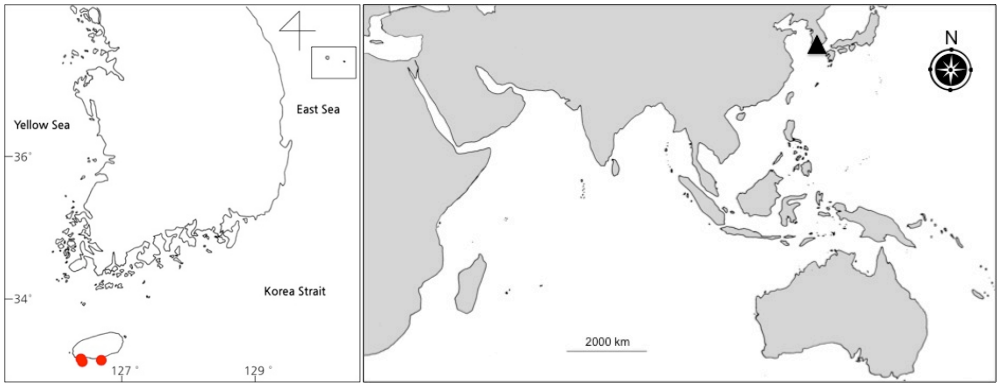

Fig. 24. Distribution of *Actumnus marissinicus* Takeda & Kim, 1977. Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. This species were reported by Takeda & Kim (1977). But only the female of this species was recorded as new species. Since then, the male have not been reported until now.

9. ***Benthopanope indica*** (De Man, 1887) 네톱니부채게

Heteropanope indica de Man, 1887b: 53, pl. 3, figs 1-2.

Pilumnopeus indica: Balss, 1933: 33; Kim, 1970: 16; Sakai, 1976: 500, pl. 178, fig. 2; Dai & Yang, 1991: 374, fig. 182(1), pl. 50(4); Muraoka, 1998: 45.

Pilumnopeus indicus: Takeda & Miyake, 1969: 125, fig. 12a-b; Kim & Chang, 1985: 54; 이, 2000: 54; 전, 2001a: 238, 250; 전, 2001b: 54.

Heteropanope (Pilumnopeus) indica: Kim, 1973: 400, 634, fig. 158, pl. 84, fig. 120a-d; Kim & Kim, 1998: 299.

Previous records of Korean fauna. Guryong-po, Mijori, Sinan, Taean, Haenam, Geojedo, Pusan, Wando, upper Jujado, Baekdo, Halim; Seogui-po; Sungsan-po; Udo; Buphwan; Beayan-do — Jejudo (Kim, 1973; 전, 2001a; , 2001b; Lee et al, 2000; Kim, 1985; Kim & Chang, 1985; Kim & Kim, 1998)

Material examined. 1 ind., lower Baekdo, 12 Jul. 1984; 1 ind., Marado Is., 4 Nov. 2000; 2 inds, Marado Is., 16 Aug. 2001; 6 inds., Seodori, Geomun-do, Jeollanam-do, 16 Oct. 2001; 1 ind., Namhae-do, 19 Jul. 1967; 1 ind., Seogui-po, Jejudo, 13 Oct. 1963; 2 inds., Chagui-do, Jejudo, 16 Jun. 2008; 1 ind. Homigot, Pohang-si, 13 Jul. 2009.

Fig. 25. *Benthopanope indica* (De Man, 1887), male, 9.3 × 7 mm, dorsal view.

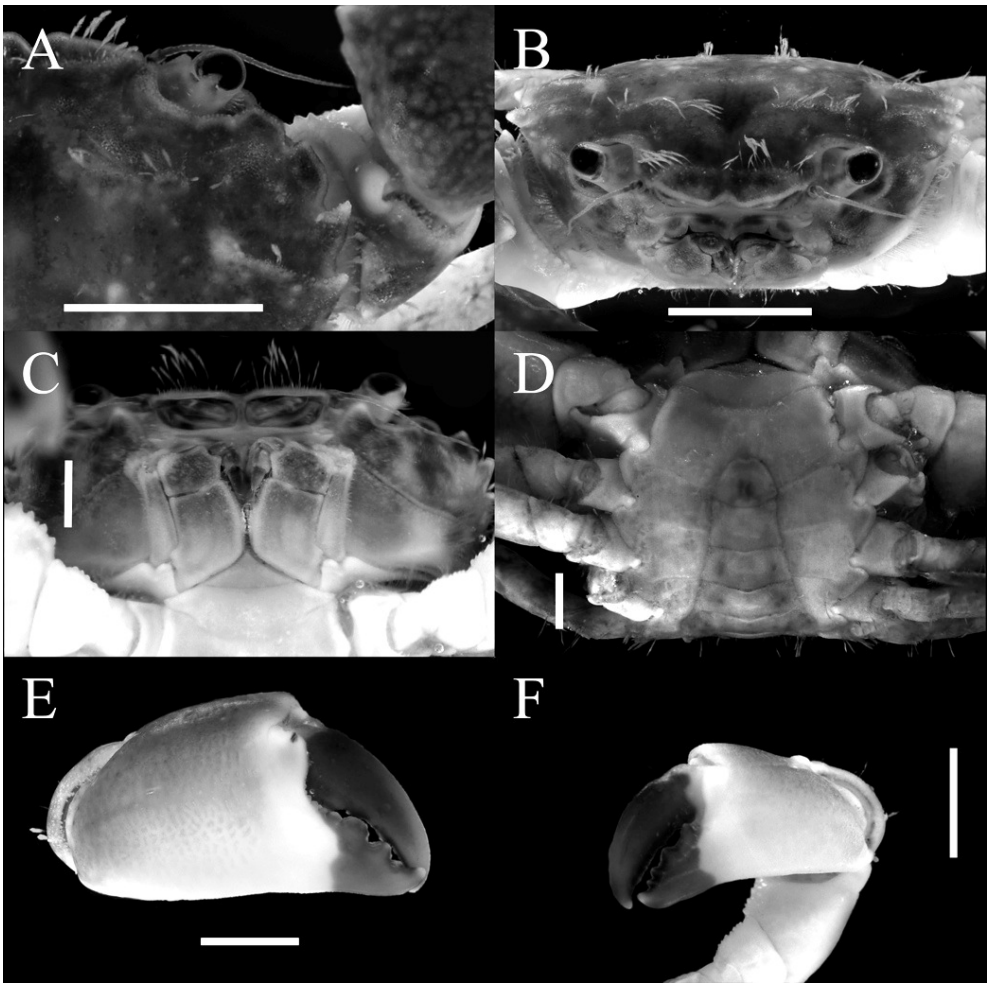

Fig. 26. *Benthopanope indica* (De Man, 1887). A, Anterolateral view, dorsal view; B, Front, anterior view; C, The third maxillipeds, ventral view; D, Thoracic sternum and male Abdomen, ventral view; E, Right cheliped, outer view; F, Left cheliped, outer view. Scale bars: A, E, F = 2mm, B = 3 mm, C, D = 1 mm.

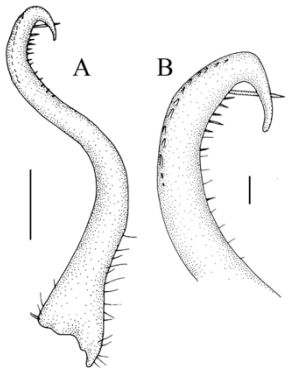

Fig. 27. Male first gonopod of *Benthopanope indica* (De Man, 1887), external view. A, Whole; B, Distal portion. Scale bars: A = 0.5 mm, B = 0.1 mm.

Diagnosis. Carapace (Figs. 25, 26A) about 1.35 times as broad as long; dorsal surface naked, smooth, moderately convex in both directions; regions ill-defined; dorsal surface with two parallel transverse ridges on lateral: one on hepatic region and other on epibranchial, latter arising from last anterolateral tooth; epibranchial region with pair of ridges (very often obliterated) and also on frontal surface parallel to frontal margin; ridges beaded with fine granules and usually furnished with several hairs. Front (Fig. 26B) bilobate; median frontal sinus broadly V-shaped. Anterolateral margin with four-toothed: first or the external orbital angle broad and its anterior border almost transverse; second largest and also subtruncate on external border, third acuminate and little smaller, last one very small and also salient; margins of these teeth and also the frontal lobes bordered with fine flat granules.

The third maxilliped (Fig. 26C) completely covering buccal orifice.

Thoracic sternum (Fig. 26D) glabrous, sternite 1,2 completely fused, separated from sternite 3 by distinct suture.

Chelipeds (Fig. 26E, 26F) extremely asymmetirical, each segment is naked and glabrous, not at all tuberculated or granulated.

Ambulatory legs are very slender and sparingly haired.

Male abdomen (Fig. 26D) broad triangular.

Male first gonopod (Fig. 27) slender, quite twist; median portion curved outward; distal portion curved inward with one long setae.

Type locality. Mergui Archipelago.

Distribution. Mergui Archipelago, Japan, Korea, Taiwan, China.

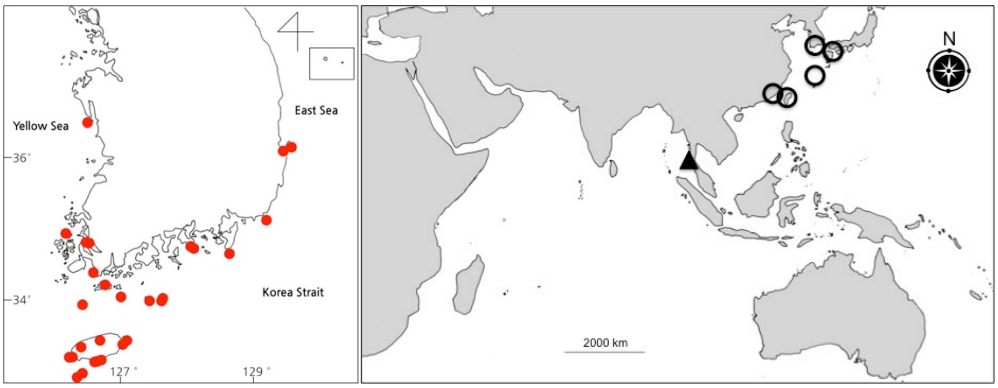

Fig. 28. Distribution *Benthopanope indica* (De Man, 1887). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. The exmined samples are agrees well with the original description. The size of these crabs collected from Korea is mainly under 1 cm. In Kim (1973), this species was associated with species of the genus *Sargussum* spp., and the author collected this species between ascides.

10. ***Heteropilumnus ciliatus*** (Stimpson, 1858) 털보부채게

Pilumnoplax ciliata Stimpson, 1858: 94; Stimpson, 1907: 92.

Lithocheira ciliate: Tesch, 1918: 163(key).

Heteropilumnus ciliatus: Balss, 1933b: 42; Sakai, 1939: 539, pl. 66, fig. 3; Kim, 1973: 396, 634, fig. 156, pl. 30, fig. 118; Kim & Chang, 1985: 54; Dai & Yang, 1991: 373, pl. 50(2).

Previous records of Korean fauna. Incheon, Pusan, Jacak-do, Sinchang, Juk-do, Jejudo Is. (Kim, 1973; Kim & Chang, 1985)

Material examined. 1 ind., Haeundae, Pusan, 29 Jun. 1971; 1 ind. Seogui-po, Jejudo, 18 Apr. 2002; 1 ind. Seungsan-po, Jejudo, 10 Oct. 2002; Jacak-do, Incheon, 15 Oct. 1967; 1 ind. Sinchang, Jejudo, 3 May 1985; 1 ind., Geomundo Is., Jeollanam-do, 17 Oct. 2001; 1 ind. Sunjaedo, Gyonggi-do, 19 Nov. 2005; 1 ind. Uljin, Gyeongsangbuk-do, 27 Mar. 2009; 1 ind. Uljin, Gyeongsangbuk-do, 25 Mar. 2009.

Diagnosis. Carapace (Figs. 29, 30A) subquadrilateral; dorsal surface depressed on posterior half but markedly vaulted down in anterior third; regions are almost obliterated excepting usual groove extending from median frontal sinus toward gastric region and also small depression on either side of cardiac region. Frontal and antero-lateral borders furnished with very long silky hairs; remainder of surface also covered with velvety tomentum. Front (Fig. 30B) rather straight; median sinus very shallow; lateral angle not markedly lobulated; not distinctly separated from supraorbital angle. Anterolateral tooth broad and truncate: first usually bordered by few granules; second and third teeth obtusely pointed and bearing one or two granules; last tooth very small. Third maxilliped (Fig. 30C) completely covering buccal orifice

Thoracic sternum (Fig. 30D) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture

Chelipeds (Fig. 31E) thickly fringed with long silky hairs; carpus sparingly granular on dorsal surface; outer surface of propodus covered with fine granules.

Ambulatory legs very thickly fringed with long silky hairs; Merus of ambulatory legs crested along anterior border; carpus sparingly granular on dorsal surface; outer surface of propodus covered with fine granules.

Male abodomen (Fig. 30F) subtringular, consisted 7 segments; width of telson as long; telson triangular.

Male first gonopod (Fig. 31) slender, with seta along the inner border and external border; distal portion curved inward; apical lobe benting 90º to rest of whole.

Type locality. Shimoda, Japan.

*Distribution***.** Japan; Korea; China.

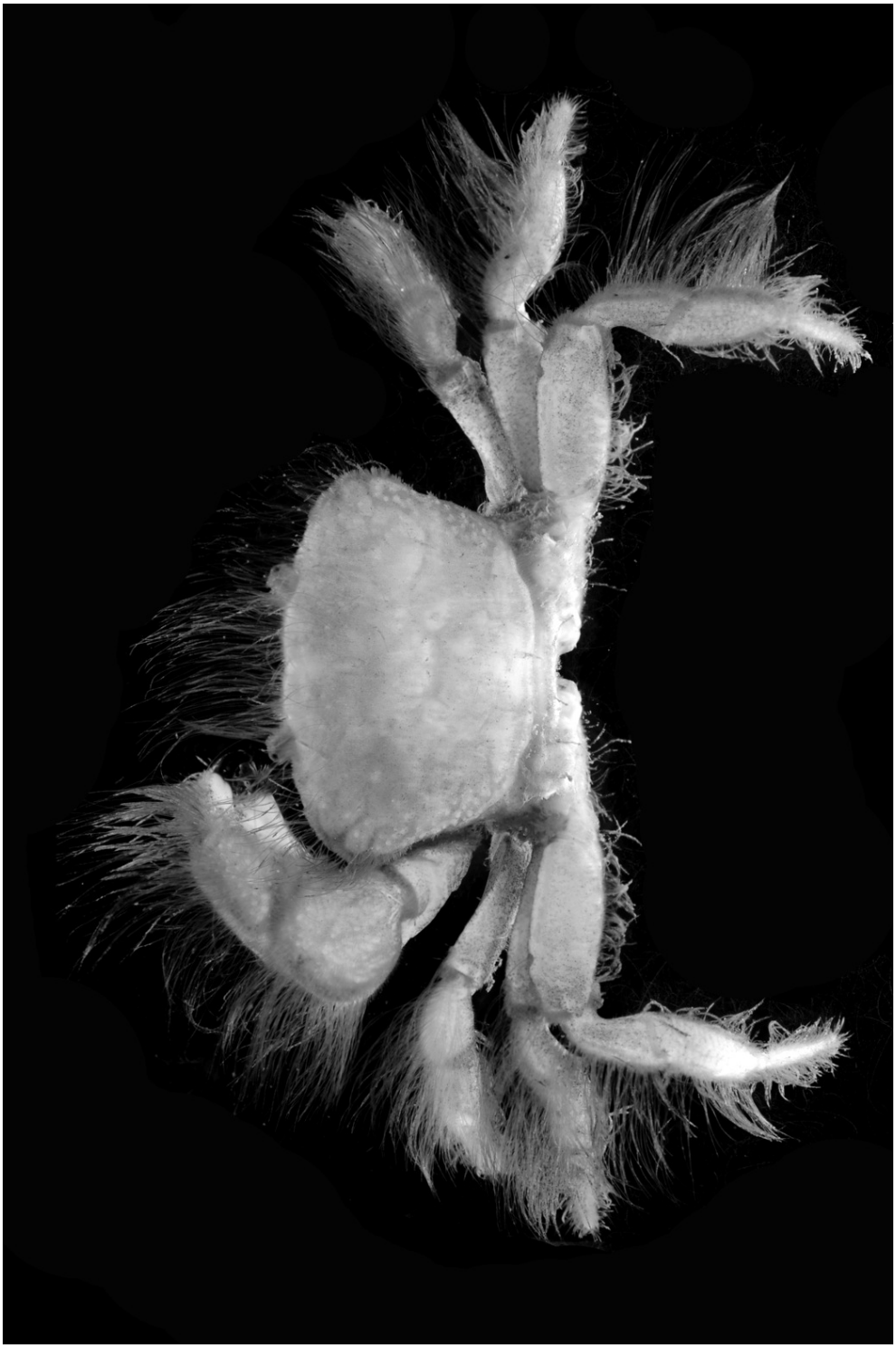

Fig. 29. *Heteropilumnus ciliatus* (Stimpson, 1858), male, 12 × 8.7 mm, dorsal view.

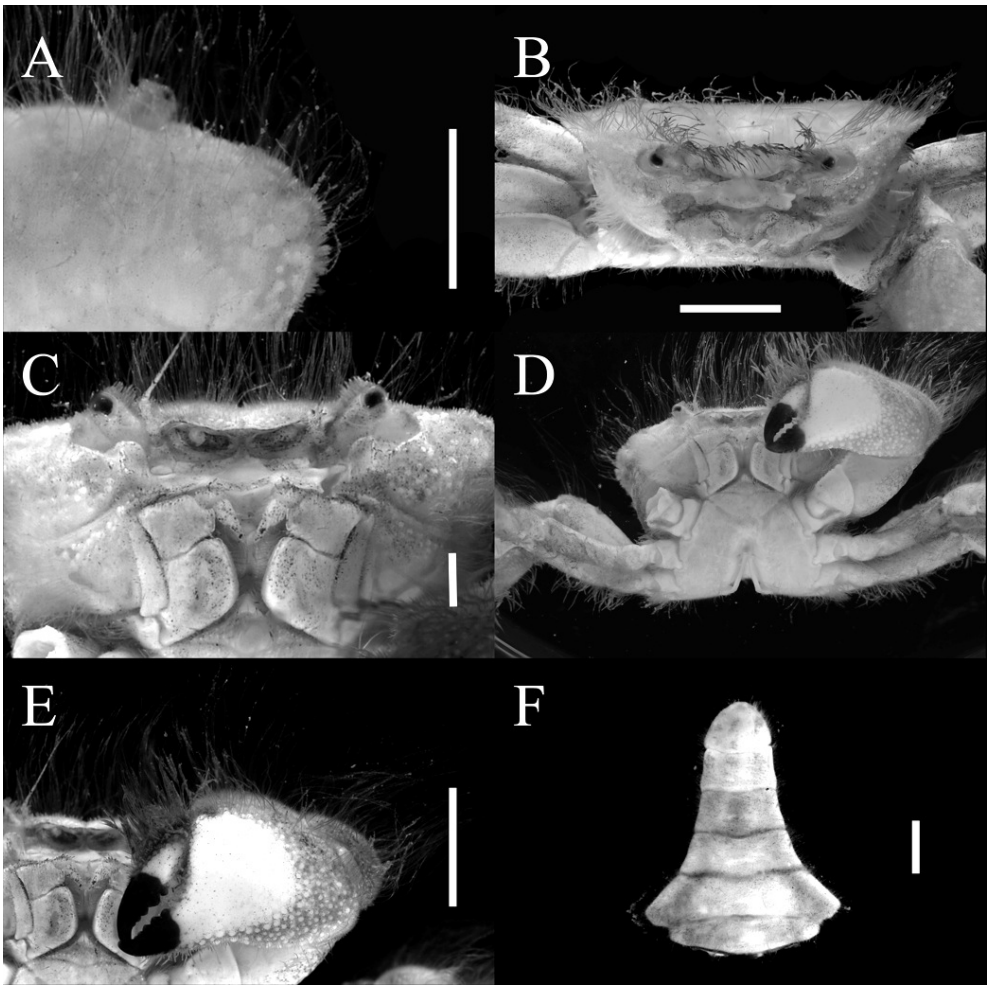

Fig. 30. *Heteropilumnus ciliatus* (Stimpson, 1858). A, Anterolateral margin, dorsal view; B, Front, anterior view; C, The third maxillipeds, ventral view; D, Thoracic sternum, ventral view; E, Left cheliped, outer view; F, male Abdomen. Scale bars: A, B, E = 3 mm, C, D, F = 1 mm.

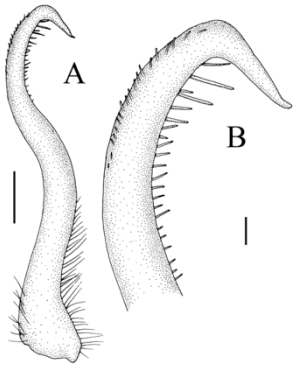

Fig. 31. Male first gonopod of *Heteropilumnus ciliatus* (Stimpson, 1858), external view. A, Whole; B, Distal portion. Scale bars: A = 0.5 mm, B = 0.1 mm.

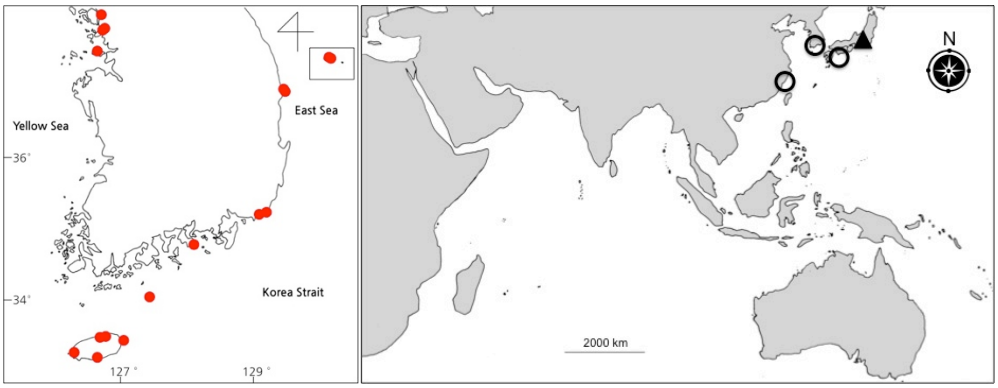

Fig. 32. Distribution of *Heteropilumnus ciliatus* (Stimpson, 1858). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. *Heteropilumnus ciliatus* (Stimpson, 1858) can be found near subtidal mudflats. As mention by Kim (1973), their ambulatory legs and body were smeared with mud.

11. ***Neoactumnus convexus*** Sakai, 1965 민이마부채게

Neoactumnus convexus Sakai, 1965, p. 105, fig. 4; Sakai, 1976, p. 498, figs. 267a-c; Muraoka, 1998, p. 45, Lee et al., 2008: 292.

Material examined. 1 ind, Munseum, Jejudo, 19 Sept. 1995, coll. H. S. Kim.

Diagnosis. Carapace (Figs. 33, 34A) nearly as long as wide; dorsal surface strikingly convex in middle, smooth, with indistinct grooves, and covered with velvety tomentums; front (Fig. 34 B) wide without median emargination and lateral lobule; frontal margin with transverse row of sparse hairs interrupted medially; anterolateral border (Fig. 34A) with four lobes including postorbital one; these lobes low-triangular in shape, each separated by very shallow sinus; posterolateral border almost as long as anterolateral one, slightly concave, with no accommodate concavity for fourth ambulatory leg. Orbits circular; preobital and supraorbital margin entirely continuous with frontal margin, without preorbital hiatus, bearing indistinct notch near outer orbital tooth. Basal antennal segment not touching ventral prolongation from lateral front; antennal hiatus thin, loosely filling.

Fig. 33. *Neoactumnus convexus* Sakai, 1965, female, 12.5 × 9.5 mm, dorsal view.

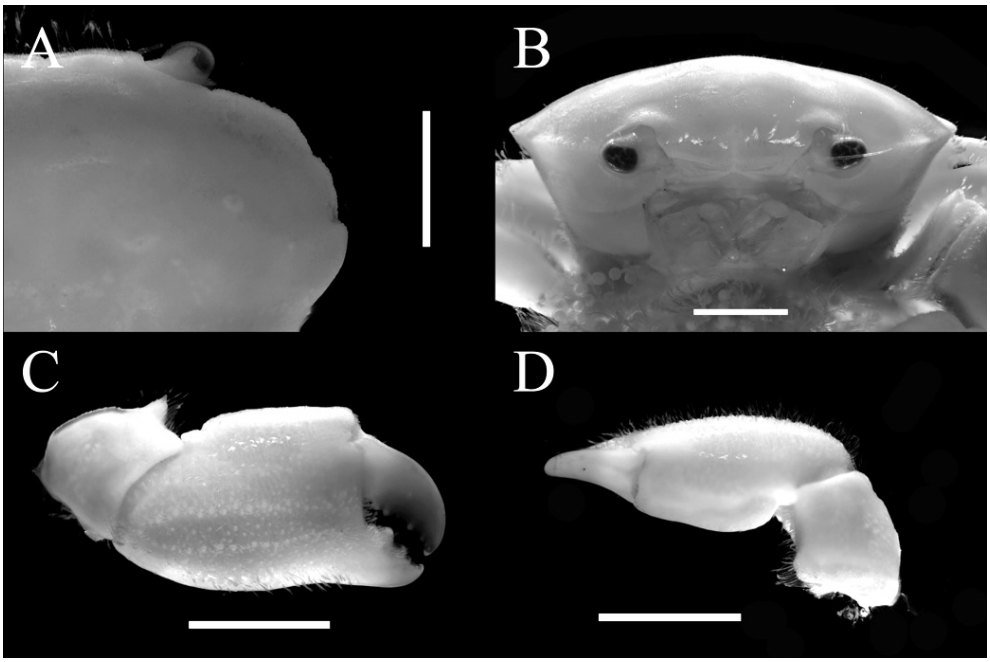

Fig. 34. *Neoactumnus convexus* Sakai, 1965. A, Anterolateral margin, dorsal view; B, Front, anterior view; C, Right cheliped, outer view; D, Right cheliped, upper view. Scale bars: A, B, C, D = 3 mm.

Chelipeds (Fig. 34C, 34D) slightly asymmetrical; carpus and propodus massive; inner corner of carpus armed with tooth and accessory lower tooth; propodus with longitudinal rows of tiny granules on upper and outer surfaces; fingers not gaping very much, not hallowed at tip.

Ambulatory legs slender; merus, carpus and propodus not much depressed; dactylus sharply hooked at tip.

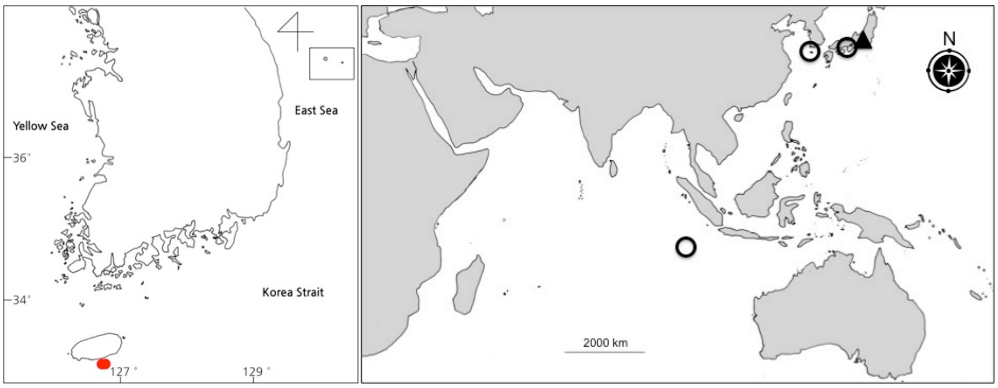

Fig. 35. Distribution of *Neoactumnus convexus* Sakai, 1965 in Korea. Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. The carapace of this species is smooth, convex and with no furrows. However, Korean specimen is strikingly convex with indistinct grooves in the middle. The teeth on anterolateral borders are very low triangular in shape so it looks like more circular. *Neoactumnus convexus* Sakai, 1965 is very similar to *N. unispira* Garth and Kim, 1983. However, *N. convexus* differs from *N. unispira* in having two fissures on supraobital border and having a spine at the inner angle of the carpus. *N. convexus* has been only recorded in southern coast of Japan (Sakai, 2004). This species is newly reported from Korean fauna and discovered outside the Japanese waters.

12. ***Pilumnopeus granulatus*** Balss, 1933 털손네톱니부채게

Pilumnopeus serratifrons granulatus Balss, 1933: 34.

Pilumnopeus granulatus: Takeda & Miyake, 1969: 127, fig. 12c-f; Garth & Kim, 1983: 704; Ko & Takeda, 2000: 34.

Previous records of Korean fauna. Moseul-po (Ko & Takeda, 2000)

Material examined. 1 ind., Gimnyong, Jejudo, 27 Oct. 2005; 1 ind., Udo Is., Jejudo, 27 Oct. 2005; 1 ind., Gwakji, Jejudo, 27 Oct. 2008; 2 inds., Udo Is., Jejudo, 31 May 2007.

Diagnosis. Carapace (Figs. 36, 37A) covered with scant short hairs, with some rows and tufts of longish plumose hairs; surface very smooth except for some minute granules or pits and granular ridges, around which hairs arises; regions being only slightly define. Front (Fig. 37B) slightly deflexed, cut into two truncated lobes by small median sinus; each lobe bearing small lateral lobule. The eye large; supraorbital border nearly entire and bordered with granules of good size, whereas infraorbital border more sharply granulated and bears a distinct notch near the external orbital angle. Anterolateral margin well arched and provided with short granulated ridge and following three teeth; first ridge is confluent with less prominent external orbital angle; first tooth most prominent, subtruncated and

Fig. 36. *Pilumnopeus granulatus* Balss, 1933, female, 15.3 × 9.8 mm, dorsal view.

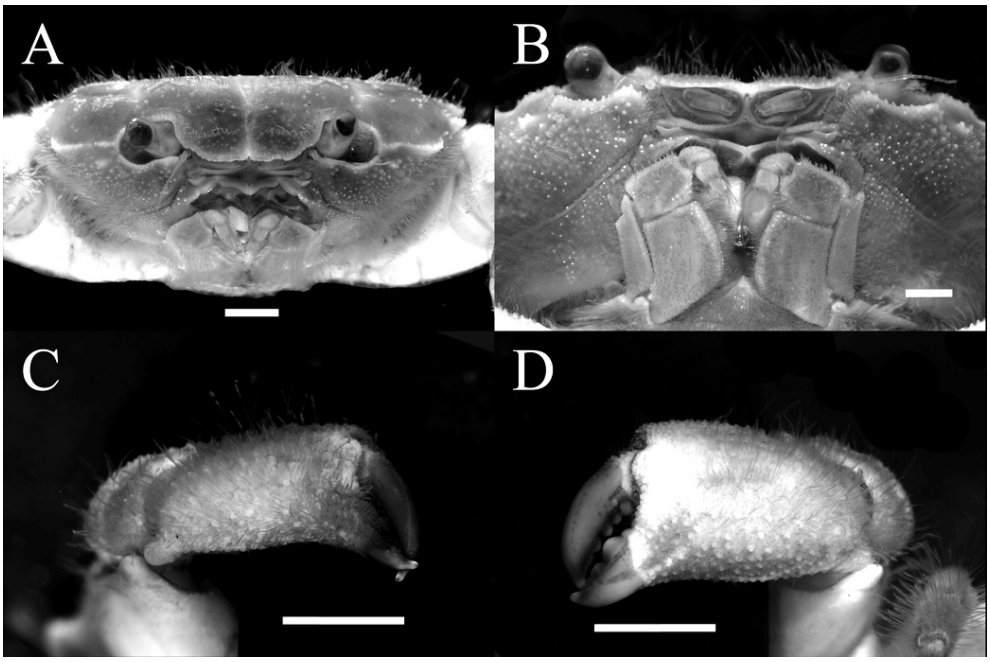

Fig. 37. *Pilumnopeus granulatus* Balss, 1933. A, Front, anterior view; B, The third maxillipeds, ventral view; C, Left cheliped, outer view; D, Right cheliped, outer view. Scale bars: A = 2 mm, B = 1 mm, C, D = 3 mm.

bordered with granules, being depresssed and bearing its tip anteriorly; second and third teeth acute, but not spine-tipped, latter being smallest of series. Posterolateral margin little longer than anterolateral; dorsal margin slightly concave for reception of last ambulatory leg. Third maxillipeds (Fig. 37B) filled buccal; merus subquadrate, granular, anterior margin without concave.

Chelipeds (Fig. 37C, 37D) distinctly asymmentry; carpus of the larger cheliped covered with sharp granules interspaced with short plumose hairs mainly on upper distal surface; smaller carpus is nearly like larger one. Fingers of larger chela rather short, stout and bluntly toothed on cutting edges, whereas those of smaller one more sharply and irregularly toothed each immovable finger formes straight line with lower border of palm.

Ambulatory legs rather slender, smooth. Those segments are covered with fine plumose hairs mainly along the borders, but not armed with any spines.

Type locality. Fiji.

Distribution. Japan, Philippines, Indonesia, New Caledonia, Fiji, Korea

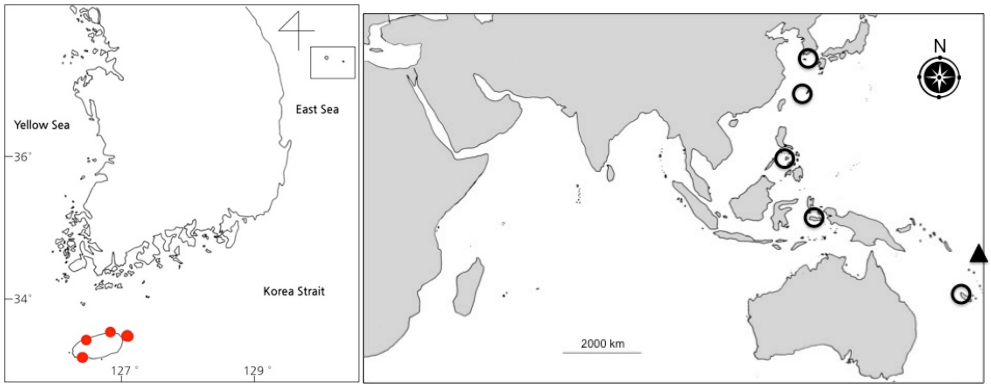

Fig. 38. Distribution of *Pilumnopeus granulatus* Balss, 1933. Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. The present samples are agrees well with the description of Takeda & Miyake (1969). In Korean peninsular, this species occurs only in Jejudo Island.

13. ***Pilumnopeus makianus*** (Rathbun, 1931) 두드러기네톱니부채게

Heteropanope makiana Rathbun, 1931: 80, pl. 11, figs 31-32; Sakai, 1934: 306, fig. 18; Shen, 1940: 86.

Pilumnopeus makiana: Balss, 1933: 33; Kim, 1970: 16; Sakai, 1976: 501, pl. 178, fig. 3; Dai & Yang, 1991: 375, fig. 182(2), pl. 50(5).

Pilumnopeus makianus: Serène & Moosa, 1971: 4; Kim & Chang, 1985: 55; Kim & Kim, 1995: 497; 전, 2001a: 238, 250; 전, 2001b: 54, 87, 110, 145; Rho & Kim, 2004: 456.

Heteropanope (*Pilumnopeus*) *makiana*: Kim, 1973: 402, 635, fig. 159, pl. 30, fig. 121;

Previous records of Korean fauna. Incheon, Daehang-ri, Gyokpo-ri, Daecheon, Youngjong-do, Sorho-do, Sinan, Taean, Seosan, Youngjong-do, Jacak-do, Biin-do, Byong-do, Jindo, Sinsi-do, Jejudo is (Kim, 1970; Kim, 1973; Kim & Kim, 1995; 전, 2001a; 전, 2001b; Kim & Kim, 1982; Kim & Chang, 1985; Rho & Kim, 2004)

Material examined. 1 ind., Youngjongdo Is., 9 Mar. 1955, coll. H. S. Kim; 1 ind., Daecheon, 15 Aug. 1957, coll. H. S. Kim; 3 inds., Jacakdo Is., 14 Apr. 1968; 2 inds., Iho-ri, 11 Aug. 1969; 2 inds., Sorokdo Is., Jeollanam-do, 19 Aug. 1972; 1 ind., Jacakdo Is., 25 Apr. 1990; 13 inds., Uiido Is., Sinan, Jeollanam-do, 15 Aug. 1998; 1 ind., Geoje, Gyeongsangnam-do, 6 Jul. 1999; 2 inds., Jodo Is., Taean, Chungcheongnam-do, 20 Jun. 2000; 32 inds., Munho, Taean, Chungcheongnam-do, 1 Jul. 2000; 1 ind., Dadaepo, Pusan, 29 Jul. 2000; 1 ind., Hogok-ri, Gyeonggi-do, 30 Sep. 2000; 1 ind., Munseum, Jejudo, 6 Jun. 2001; 10 inds., outer Narodo Is., Jeollanam-do, 20 Oct. 2001; 7 inds., Sinsido Is, Jeollabuk-do, 5 Aug. 2003; 5 inds., Jindo Is, Jeollanam-do, 29 Jun. 2004; 1 ind., Seongsanpo, Jejudo, 18 Jan. 1985, coll. H. S. Kim; 1 ind, Jangsu-ri, Yeosu-si, Gyengsangnam-do, 19 Jun. 2010; 4 inds., Jindo, Jeollanam-do, 25 Jul. 1994, coll. S. H. Kim; 1 ind., Sanyang-eup, Tongyoung-si, Gyeongsangnam-do, 10 May 2006; 1 ind., Geomundo Is., Jeollanam-do, 20 Sep. 2006; 1 ind., Happo, Jinhae-si, Jeollanam-do, 29 Jun. 2006; 2 inds., Hamo-ri, Jejudo, 30 May 2007; 1 ind., Younggi-ri, Namhaedo, Gyeongsangnam-do, 1 Mar. 2006; 1 ind., Shinji-myeon, Jeollanam-do, 9 Oct. 2008; 1 ind., Jebudo, Gyeonggi-do, 28, Nov. 2008.

Diagnosis. Carapace (Figs, 39, 40A) transversely oval; Surface usually covered with short pubescence and long bristles, densely situated on the transverse ridges in the anterior and median portion; sometimes also with long bristles, scattered in small bundles, posterior portion usually smooth. Front (Fig. 40B) produced, deflected and devided into 2 lobes by a deep V-shaped notch, each lobe with anterior margin slanting laterally and denticulate. Anterolateral margin armed with 4 tiangular teeth behind the outerorbital tooth, each with its margin spinulosusly denticulated: the first one very low; the second the latgest, but blunt; third and fourth sharper. Posterolateral margin straight. Third maxilliped (Fig. 40C) glabrous, smooth; merus subquadrate, granular; ischium subrectangular with submedian sulcus.

Thoracic sternum (Fig. 40D) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture

Chelipeds (Fig. 40E, 40F) quite asymmetrical; merus short, stout and trigonous. carpus nearly as broad as long, its dorsal surface convex and coarsely granulated, inner-distal angle armed with short spinous tip; propodus longer than high, covered with large conical tubercles on dorsal two-thirds of its outer surface and dorsal one-third of its inner surface; dactylus stout, with obtuse teeth along the inner margins.

Ambulatory legs long and slender, armed with long pubescence along anterior and posterior margins of every joint.

Male abdomen (Fig. 40D) narrow and elongate: telson triangular.

Male first gonopod of the male (Fig. 41) somewhat S-shaped and with tapering distal portion; apical lobe opened on external region.

Habitat. under stones or on muddy and weedy bottoms, inertidal zone.

Distribution. Taiwan, China, Japan, Korea.

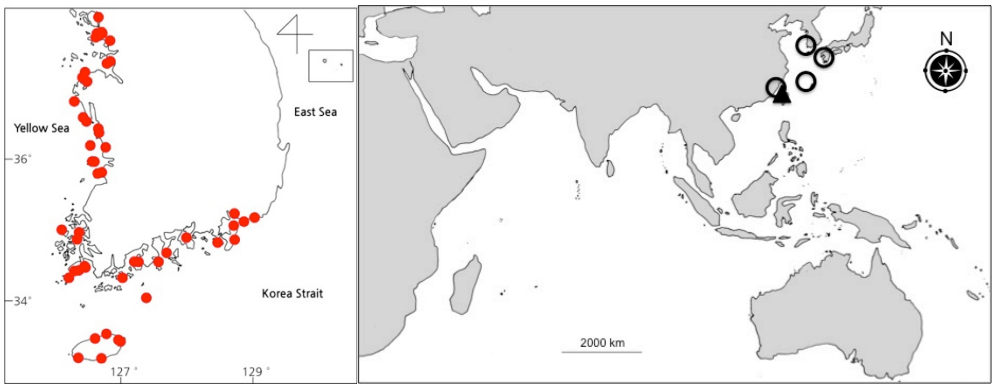

Fig. 39. Distribution of *Pilumnopeus makianus* (Rathbun, 1931). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remark. *Pilumnopeus makianus* (Rathbun, 1931) is common in Korean fauna. Their distribution in Korea, however, is quite interesting limited in West-Southern part of Korean peninsula.

Fig. 40. *Pilumnopeus makianus* (Rathbun, 1931), male, 15.5 × 11.4 mm, dorsal view.

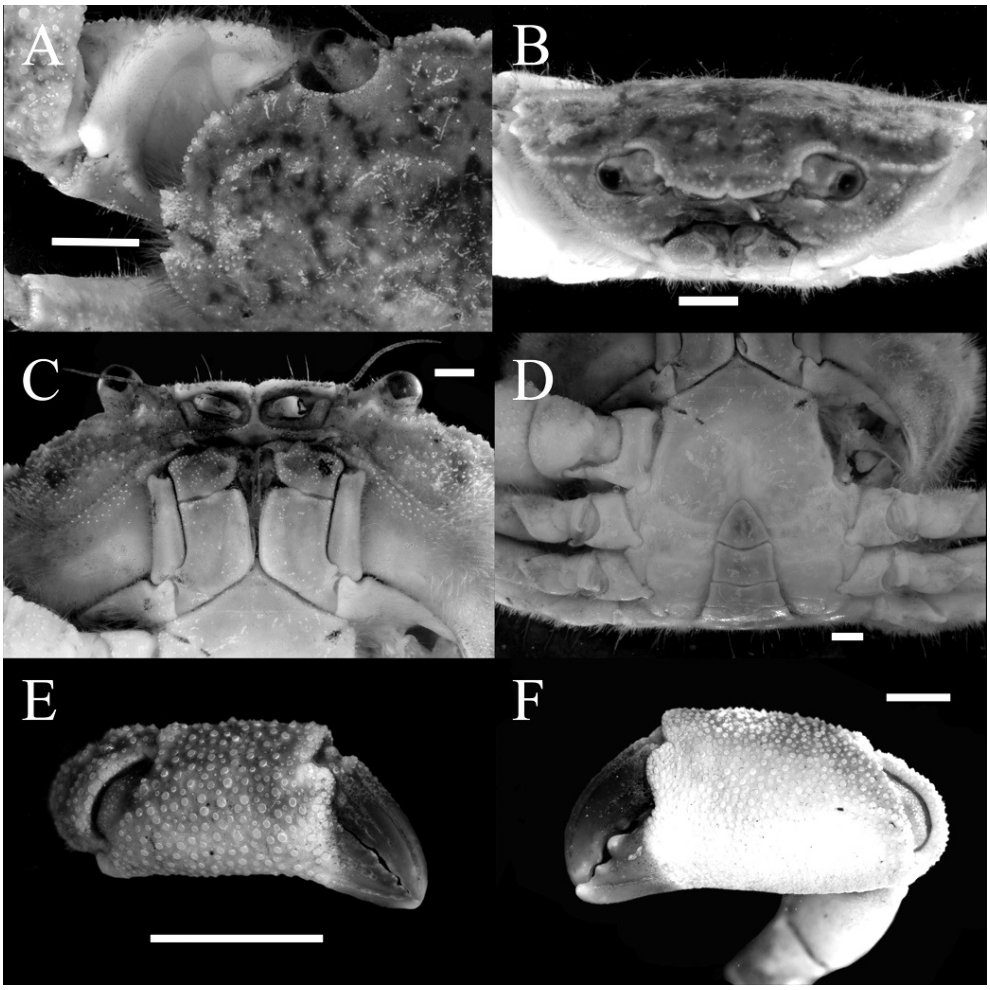

Fig. 41. *Pilumnopeus makianus* (Rathbun, 1931). A, Anterolateral margin, dorsal margin; B, Front, anterior view; C, The third maxilliped, ventral view; D, Thoracic sternum and male Abdomen; E, Right cheliped, outer view; F, Left cheliped, outer view. Scale bars: A, B = 2 mm, C, D = 1 mm, E = 5 mm, F = 3 mm.

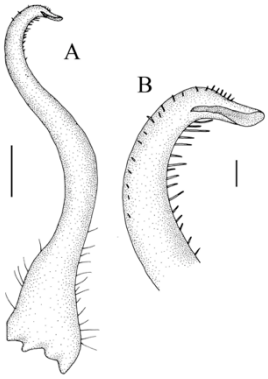

Fig. 42. Male first gonopod of *Pilumnopeus makianus* (Rathbun, 1931), external view. A, Whole; B, Distal portion. A = 0.5 mm, B = 0.1 mm.

14. ***Pilumnus longicornis*** Hilgendorf, 1879 긴다리털보부채게

Pilumnus longicornis Hilgendorf, 1879: 794, pl. 1, figs 8–9; Chopra & Das, 1937: 406, pl. 6, fig. 3; Kim, 1970: 21; Kim & Rho, 1971: 7; Kim, 1973: 393, 633, fig. 154, pl. 84, fig. 116; Sakai, 1976: 486, pl. 175, fig. 1; Garth & Kim, 1983: 692; Kim & Chang, 1985: 54; Kim & Lee, 1992: 203.

Previous records of Korean fauna. Seogui-po, Marado Is. (Kim, 1973; Kim & Chang, 1985; Kim, 1970; Kim & Rho, 1971; Kim & Lee, 1992)

Material examined. 4 inds., Beomseom Is., Jejudo, 21 Feb. 2001; 1 ind., Seogui-po, Jejudo, 8 Mar. 2002; 1 ind., Chaguido Is., Jejudo, 17 Aug. 2001; 1 ind., Seogui-po, Jejudo, 15 Aug. 1969; 2 inds., Dokdo,Ulreung, Gyeogsangbuk-do, 21 Jun. 2006; 1 ind., Jelmyeong-ye, Chujado Is., Jejudo, 2 Apr. 2009.

Diagnosis. Carapace (Figs. 43, 44A) covered with long flexible hairs; regions weakly defined; surface near anterolateral borders being covered with very fine granules. Front (Fig. 44B) with two lobes, well convex; median region with sinus deeply V–shaped. Anterolateral margin armed with four acuminate spines: first or external orbital one somewhat smaller and has some additional spines below it. Surface of third maxilliped (Fig. 44C) glabrous; merus subquadrate, granular; ischium subrectangular, smooth, punctuate.

Thoracic sternum (Fig. 44D) finely granular, glabrous, sternites 1,2 compoletely fused, separated from sternite 3 by distinct suture.

Cheliped (Fig. 44E, 44F) quite asymmentrical; palm of major tuberculated only on superior surface and on the proximal portion of outer surface; those surface being smooth and glabrous; palm of minor cheliped with rather erect tubercles arranged in longitudinal series.

Ambulatory legs (Fig. 44G, 44H) slender, long; merus bearing spinule at distal end of anterior border; distal half of anterior border of the three anterior pairs also armed with three to five slender spines.

Male abdomen (Fig. 44D) narrow and long, consisting of 7 segments.

Male first gonopod (Fig. 45) slender, S-shaped; apical lobe bented over 90º to rest of G1.

Fig. 43. *Pilumnus longicornis* Hilgendorf, 1879, male, 9.8 × 7.4 mm, dorsal view.

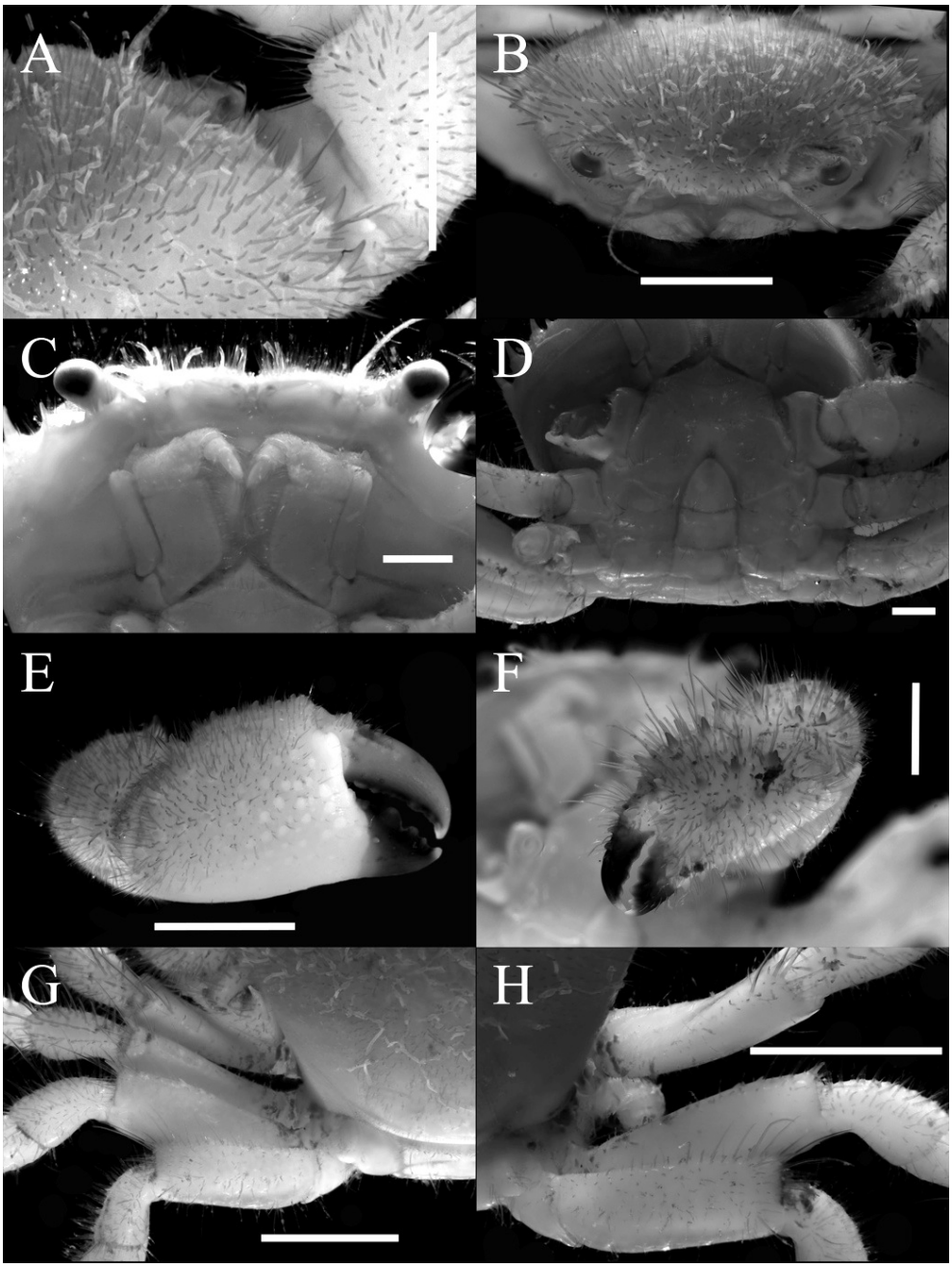

Fig. 44. *Pilumnus longicornis* Hilgendorf, 1879. A, Anterolateral margin, dorsal view; B, Front, anterior view; C, The third maxillipeds, ventral view; D, Thoracic sternum, ventral view; E, Major cheliped, outer view; F, Minor cheliped, outer view; G, Left ambulatory legs, dorsal view; H, Right ambulatory legs, dorsal view. Scale bars: A, B, E, G, H = 3 mm, C, D = 1 mm, F = 2.

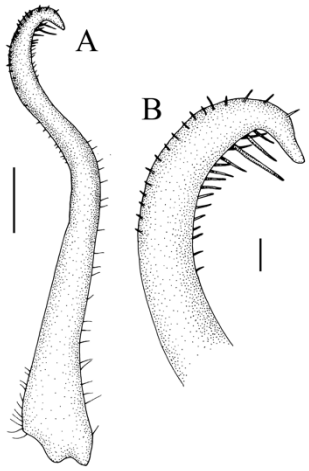

Fig. 45. Male first gonopod of *Pilumnus longicornis* Hilgendorf, 1879, external view. Scale bars: A = 0.5 mm, B = 0.1 mm.

Type locality. Inhambane, Mozambique.

Distribution. Mozambique, Mauritius, Persian Gulf, Pakistan, India, Sri Lanka, Mergui Archipelago, Sumatra, Japan, Korea, Taiwan, Gulf of Thailand, Singapore, Philippines, Indonesia, Caroline Islands, Australia, Hawaiian Islands, Line Islands, New Zealand.

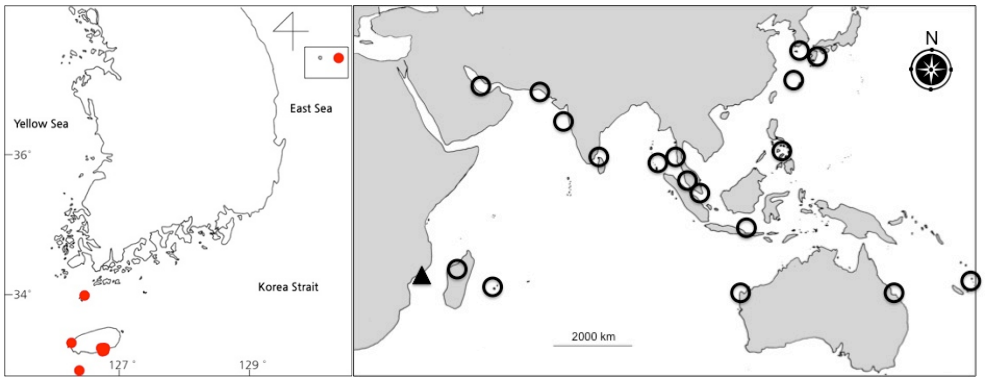

Fig. 46. Distribution of *Pilumnus longicornis* Hilgendorf, 1879. Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. *Pilumnus longicornis* Hilgendorf, 1879 is rare in Korean fauna and closed to *P. minutus* (De Haan, 1833). Its differences from *P. longicornis* and closeness with *P. minutus*, will be discussed under the Remarks of *P. minutus*.

15. ***Pilumnus minutus*** **(**De Haan, 1833) 애기털보부채게

Cancer (Pilumnus) minutus De Haan, 1833-1849 (1833): pl. 3, fig. 2, pl. B

Pilumnus hirsutus Stimpson, 1858: 37; Stimpson, 1907: 69, pl. 9, fig. 1; Chopra & Das, 1937: 407, fig. 11.

Pilumnus minutus Milne Edwards A., 1872: 250; Kim, 1973: 395, 633, fig. 155, pl. 83, fig. 117a-d; Sakai, 1976: 487, fig. 260, pl. 174, fig. 2; Garth & Kim, 1983: 693; Kim & Chang, 1985: 54; Dai & Yang, 1991: 367, fig. 178, pl. 49(5); 이 등, 2000: 47; 전 등, 2001a: 17, 21, 35, 49, 145; Kim & Chang, 1985: 54; Kim & Rho, 1971: 27; Kim & Rho, 1972: 100; 김 등, 1979a: 103; Kim et al., 1979b: 287; 김 과 최, 1981: 193; Kim & Kim, 1982: 133; Rho & Kim, 2004.

Previous records of Korean fauna. Ulreung, Hansando, Jejudo Is., Mijo-ri, Janggundo, Bangjukpo, Wando Is., Seogui-po, Hwanggando Is., Geoje, Gaduckdo Is., Dolsando, Manripo, Guryong-po, Haeundae, Udo Is., Geomundo, Upper-Baekdo Is., Sasudo, Upper Jujado, Heuksando, Jindo, Baekryoungdo Is., Dokdo Is., Bogildo Is., Yejakdo (Kim, 1973; 이 등, 2000, 전 등, 2001a; Kim & Chang, 1985; Kim & Rho, 1971; Kim & Rho, 1972; 김 등, 1979a; 김 등, 1979b; 김 과 최, 1981; Kim & Kim, 1982; Rho & Kim, 2004)

Material examined. 2 inds., Namhaedo, Gyeongsangnam-do, 19 Jul. 1967; 14 inds., Ijo-ri, Namhaedo, Gyeongsangnam-do, 21 Jul, 1967; 8 inds., Hanggando, 9 Aug. 1969; 1 inds., Haeundae, Pusan, Gyeongsangnam-do, 9 Jul. 1970; 13 inds., Guryoungpo, Gyeongsangnam-do,17 Jul. 1972; 7 inds., Mipo, 14 Jul. 1974; 2 inds., Gaduckdo, 22 May 1978; 2 inds., Seoguipo, Jejudo, 20 Aug. 1982; 16 inds., Upper Chujado Is., Jejudo, 18 Jul. 1985; 1 ind., Jeopdo Is., Jindo, Jeollanam-do, 23 Jul. 1994; 2 inds., Janggundo Is., Yeosu-si, Jeollanam-do, 21 Apr. 1996; 1 ind., Port. Nokdong, Jeollanam-do, 7 Jul. 1996; 1 ind., Geojedo, Gyeongsangnam-do, 9 Jul. 1996; 1 ind., Geojedo, Gyeongsangnam-do, 9 Jul. 1996; 11 inds., Heungnam, Geojedo, Gyeongsangnam-do, 29 Jan. 1997; 29 inds., Namhaedo, Gyeongsangnam-do, 29 Jun. 1998; 2 inds., Geojedo, Gyeongsangnam-do, 29 Jun. 1998; 1 ind., near Mt. Songak, Jejudo, 21 Aug. 1998; 1 ind., Chaguido Is., Jejudo, 6 Nov. 2000

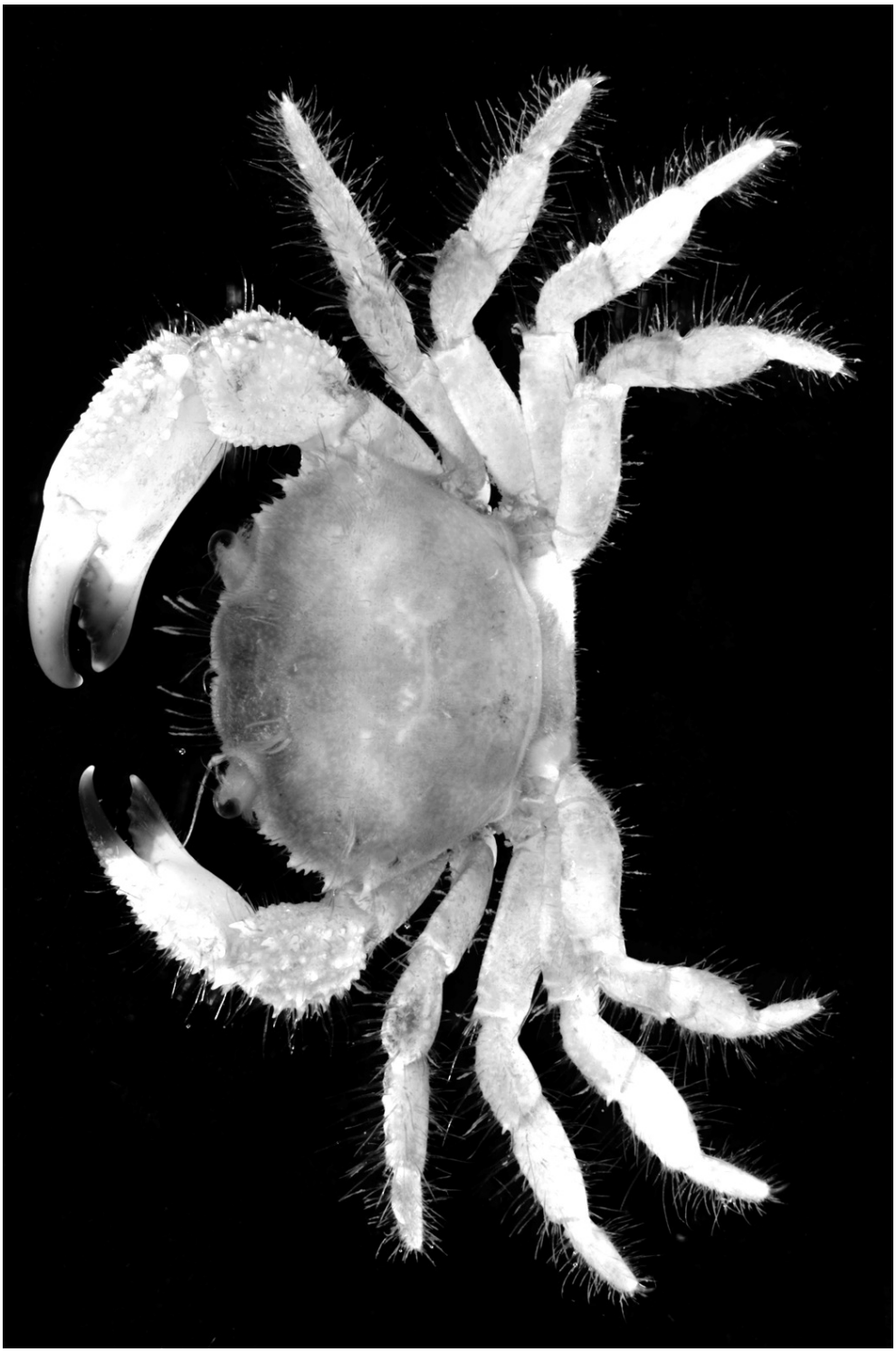

Fig. 47. *Pilumnus minutus* De Haan, 1833, male, 10.00 × 7.5 mm, dorsal view.

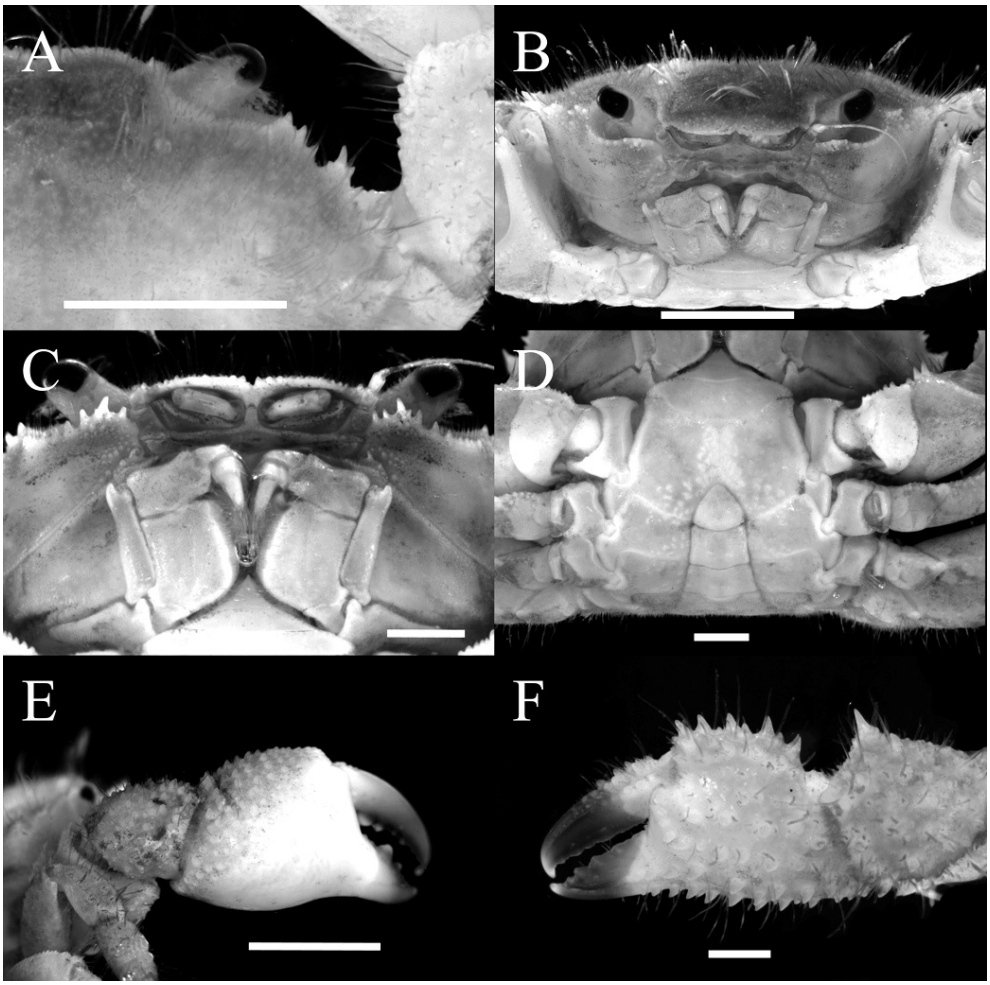

Fig. 48. *Pilumnus minutus* De Haan, 1833. A, Anterolateral maring, dorsal view; B, Frontal and Epistome, anterior view; C, The third maxillipeds, ventral view; D, Thoracic sternum and male Abdomen, ventral view; E, Right cheliped, outerview; F, Left cheliped, outer view. Scale bars: A, B, E = 3 mm, C, D, F = 1 mm.

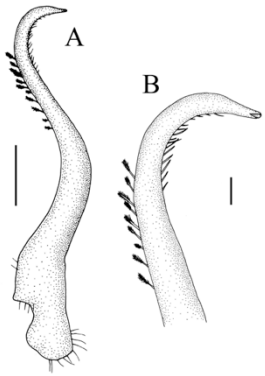

Fig. 49. Male first gonopod of *Pilumnus minutus* De Haan, 1833, external view. Scale bars: A = 0.5 mm, B = 0.1 mm.

; 3 inds., Geomundo Is., Jeollanam-do, 16 Oct, 2001; 3 inds., Lighthouse, Geomundo Is., Jeollanam-do, 16 Oct. 2001; 11 inds., Galquiseom Is., Geomudo, Jeollanam-do, 26 Jun. 2002; 2 inds., Pungwha-ri., Gyeonsangnam-do., 10 May 2006; 9 inds., lower Baekdo Is., Geomudo, Jeollanam-do, 12 Jul. 1984; 1 ind., Bangjukpo, Dosando, Jeollanam-do, 13 Jun. 1969; 2 inds., Boryung, Chungcheongnam-do, 25 Feb. 2004; 2 inds., Port Jukjin, Uljin-eup, Gyeongsanbuk-do, 21 Oct. 2008; 25 inds., Chujado Is., Jejudo, 2 Apr. 2009; 8 inds., Songjiho, Gangwon-do, 24 Jun. 2010; 1 ind., Beomseom Is., Jejudo, 26 Aug. 2007; 14 inds., Taean, Chungcheongnam-do, 28 Jun. 2006.

Diagnosis. Carapace (Figs. 47, 48A) transversely oval; dorsal surface strongly convex from before backward but slightly so from side to side, covered with short fur but in some specimens with some additional long and feathered hairs disposed in tufts.

Front (Fig. 47B) bilobate; lobules being conve, finely denticulated, externally divide from orbital border by shallow notch. Anterolateral margin very slightly shorter than postero-lateral; former three spines, longer and sharper in relatively larger specimens, but in some specimens having accessory spinules. Posterolateral margin less concave. Surface of third maxilliped (Fig. 48C) glabrous; merus subquadrate, granular; ischium subrectangular, smooth, punctuate.

Thoracic sternum (Fig. 48D) finely granular, glabrous, sternites 1,2 compoletely fused, separated from sternite 3 by distinct suture.

Chelipeds (Fig. 48E, 48F) extremely asymmetrical. Palm of the larger cheliped dorsally granulated; external surface only granular near upper border and proximal end; remainder of surface glabrous; between these granules disposed long hairs. Smaller cheliped has the wrist and palm armed with numerous sharp spinules, interspersed with long setae.

Ambulatory legs thin and slender; merus unarmed while carpus with sharp spinule at distal end of anterior border.

Male abdomen (Fig. 48D) narrow and long, consisting of 7 segments.

Male first gonopod (Fig. 49) slender, S-shaped, having bristle setae on madian region of male first gonopod; apical lobe bented over 90º to rest of G1.

Type locality. Japan.

Distribution. Red Sea, Persian Gulf, Maldives, Mergui Archipelago, Strait of Malacca, Japan, Korea, Northern China Sea, China, Taiwan Strait, Macclesfield Bank, Gulf of Thailand, Singapore, Philippines, Indonesia, Australia, New Caledonia.

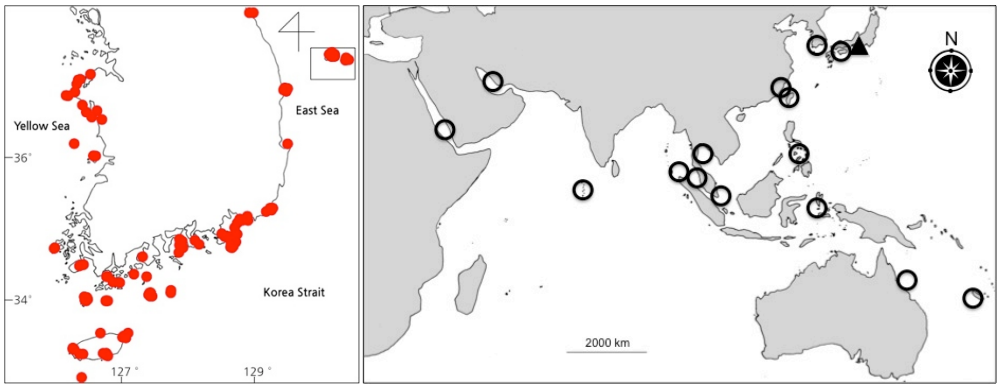

Fig. 50. Distribution of *Pilumnus minutus* (De Haan, 1833). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. *Pilumnus minutus* (De Haan, 1833) is common species in Korea. The differentiation between *P. longicornis* and *P. minutus* is as follows: 1) having slender spines on upper margin of merus of ambulatory legs, 2) having dorsal surface of the carapace covered with long turfts, and 3) having bristle setae on median region of male first gonopod.

16. ***Pilumnus trispinosus*** **(**Sakai, 1965) 세가시부채게

Parapilumnus pearsei (not *Heteropanope pearsei* Rathbun, 1932) Sakai, 1939: 544, fig. 58.

Parapilumnus trispinosus Sakai, 1965: 160, pl. 79, fig. 5; Sakai, 1976a: 502, fig. 268; Kim &Kim 1982: 140; Kim & Chang, 1985: 55;Kim & Kim, 1985: 55; Dai & Yang, 1991: 376, fig. 182(2), pl. 50(7).

Pilumnus trispinosus: Ng et al., 2008: 142.

Previous records of Korean fauna. Seongsanpo, Seoguipo (Kim & Kim, 1982; Kim & Chang, 1985; Kim & Kim, 1985)

Material examined. 3 inds. (NIBRIV0000114099), Samsan-myeoun., Jeollanam-do, 2 Apr. 2007, coll. H. S. Ko; 1 ind., Daecheon, Seogui-po, Jejudo, 30 May 2007.

Diagnosis. Carapace (Figs. 51, 52A) rather strongly convex antero-posteriorly, provided with some tufts and rows of plumose hairs, with sparse short pubescence; surface ill-defined and slightly roughened near anterolateral borders by minute granules and granular ridges; remainder of surface being smooth and glossy. Front (Fig. 52B) declivous, truncated, with small median sinus but no lateral lobule. Anterolateral margin armed with four teeth: first mere granulated ridge, less prominent and confluent with external orbital angle; following three teeth capped each by a small but sharp, curved spine, most strongly procurved. Surface of third maxilliped (Fig. 52C) glabrous; merus subquadrate, granular; ischium subrectangular, smooth, punctuate.

Thoracic sternum (Fig. 52D)finely granular, glabrous, sternites 1,2 compoletely fused, separated from sternite 3 by distinct suture.

Chelipeds (Fig. 52E, 52F) distinctly asymmetrical. Outer surface of larger cheliped of carpus and merus thickly covered with small granules, and with short tomentum mixed with sparse longish hairs. Lower and outer greater surfaces of larger propodus glossy. Smaller cheliped clothed with a dense tomentum mixed with some longish hairs on outer surfaces of carpus and propodus.

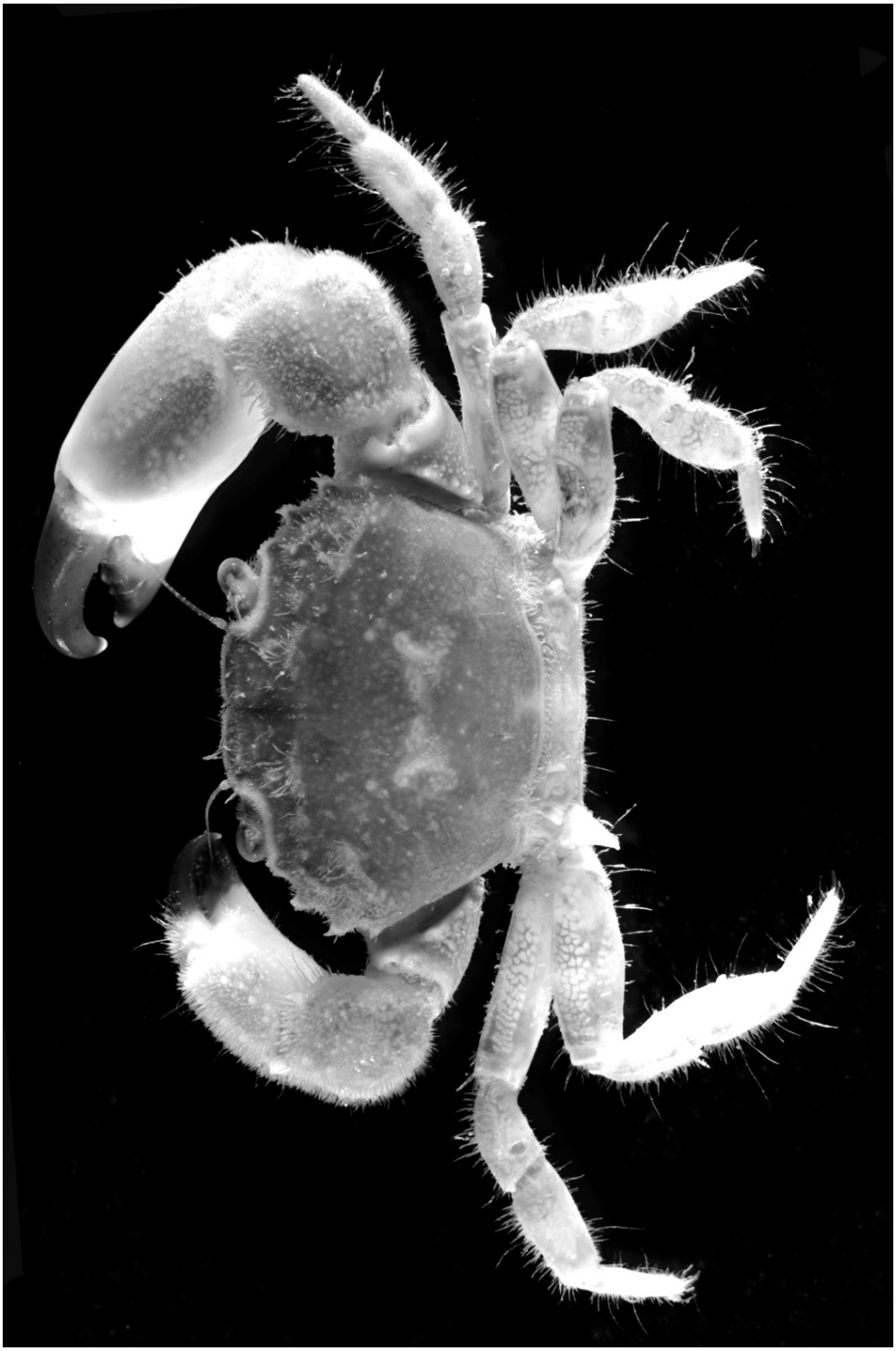

Fig. 51. *Pilumnus trispinosus* Sakai, 1965, male, 9.5 × 7 mm, dorsal view.

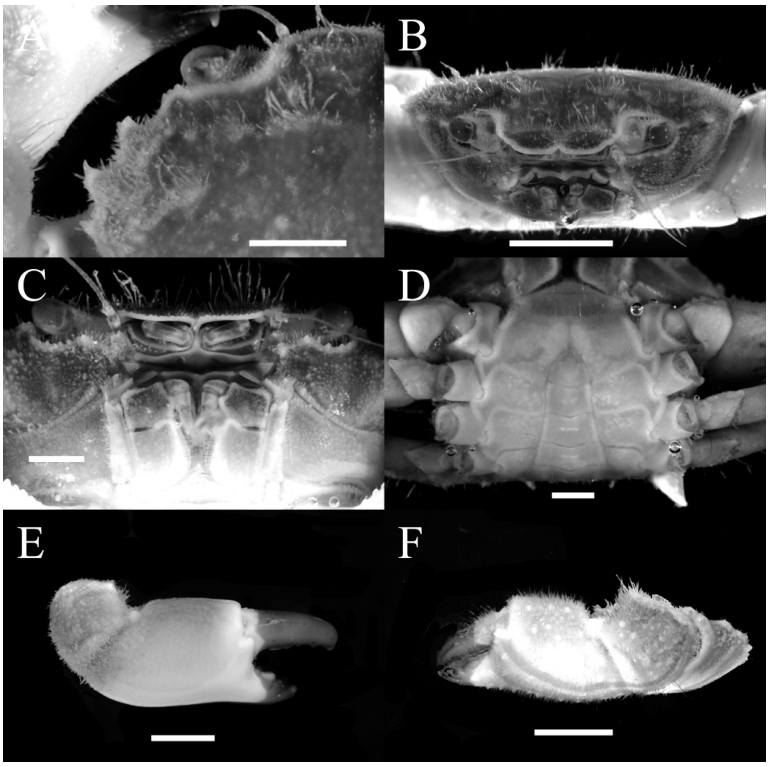

Fig. 52. *Pilumnus trispinosus* Sakai, 1965. A, Anterolateral margin, dorsal view; B, Front, anterior view; C, The third maxilliped, ventral view; D, Thoracic sternum and male Abdomen; E, Right cheliped, outer view; F, Left cheliped, outer view. Scale bars: A = 2 mm, B, E, F = 3 mm, C, D = 1 mm.

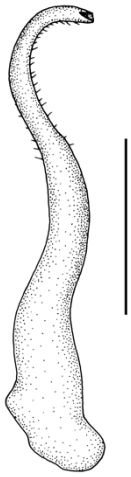

Fig. 53. Male first gonopod of *Pilumnus trispinosus* Sakai, 1965, external view. Scale bar: 1 mm.

Ambulatory legs comparatively long and unarmed. Each merus sparsely covered with hairs. Other segments more densely clothed than the merus.

Male abdomen (Fig. 52D) narrow and long, consisting of 7 segments.

Male first gonopod (Fig. 53) slender, smooth S-shaped

Type locality. Sagami Bay, Japan.

Distribution. Japan, Korea, China, Palau, Solomon Islands, Vanuatu – Santo, and Fiji.

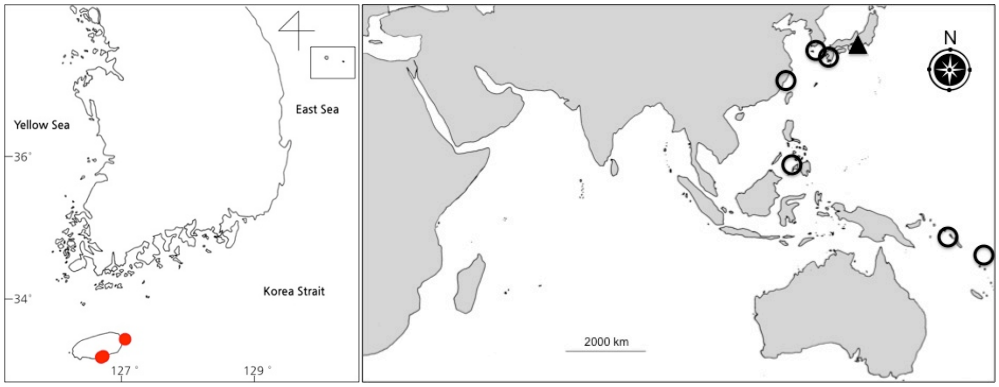

Fig. 54. Distribution of *Pilumnus trispinosus* (Sakai, 1965). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. Korean *Parapilumnus trispinosus* (Sakai, 1965) occurs from only Jejudo-Island (Fig. 54). *P. trispinosus* is similar to Pilumnus minutus (De Haan, 1833), but *Pilumnus minutes* has produced and sharp external obit spines while Parapilumnus trispinosus has broad spines.

17. ***Typhlocarcinops canaliculata*** **Rathbun, 1909**

Typhlocarcinops canaliculata Rathbun, 1909: 112; Sakai, 1976: 545, figs 292a–b, pl. 195, fig. 1; Dai & Yang, 1991: 413, fig. 202(1), pl. 55(6); Takeda et al., 2000: 138.

Material examined. 2 inds., boryeong, Chungcheongnam-do, 14 Nov. 2006.

Diagnosis. Carapace (Fig. 55, 56A) cylindrical; lateral borders only slightly divergent posteriorly; dorsal surface markedly convex from before backward but almost flat from side to side. Front medially marked by shallow sinus; free margin of each lobe being rounded and well convex and projecting downwards. Anterior half of lateral border furnished with some hairs but never lobulate or dentate. Surface of third maxilliped (Fig. 56B) glabrous; merus subquadrate, granular; ischium subrectangular, smooth, punctuate.

Thoracic sternum finely granular, glabrous, sternites 1,2 compoletely fused, separated from sternite 3 by distinct suture

Cheliped (Figs. 55, 56C) slightly asymmetrical; right side slightly heavier than that of opposite side; carpus with obtuse tooth at inner angle; propodus covered with fine granules and tomentum near superior and inferior borders but middle portion of outer surface smooth.

Ambulatory legs subequal; second and third pairs shorter than fist and fourth.

The first somite of male abdomen (Fig. 56D) extremely broad, extends along the posterior border, covers whole extent of last sternal segment.

Male first gonopod (Fig. 57) slender, strogly S-shaped; apical lobes bented 90º to rest of G1.

Type locality. Gulf of Thailand.

Distribution. Gulf of Thailand, Japan, China, Philippines, Indonesia, Korea.

Remarks. Korean *Typhlocarcinops canaliculata* Rathbun, 1909 was collected by dradge in Yellow sea. The carapace of this species is quite convex like a lodge in lateral view, and their colour in life is dark brown.

Fig. 55. *Typhlocarcinops canaliculata* Rathbun, 1909, male, 13.3 × 10 mm, dorsal view.

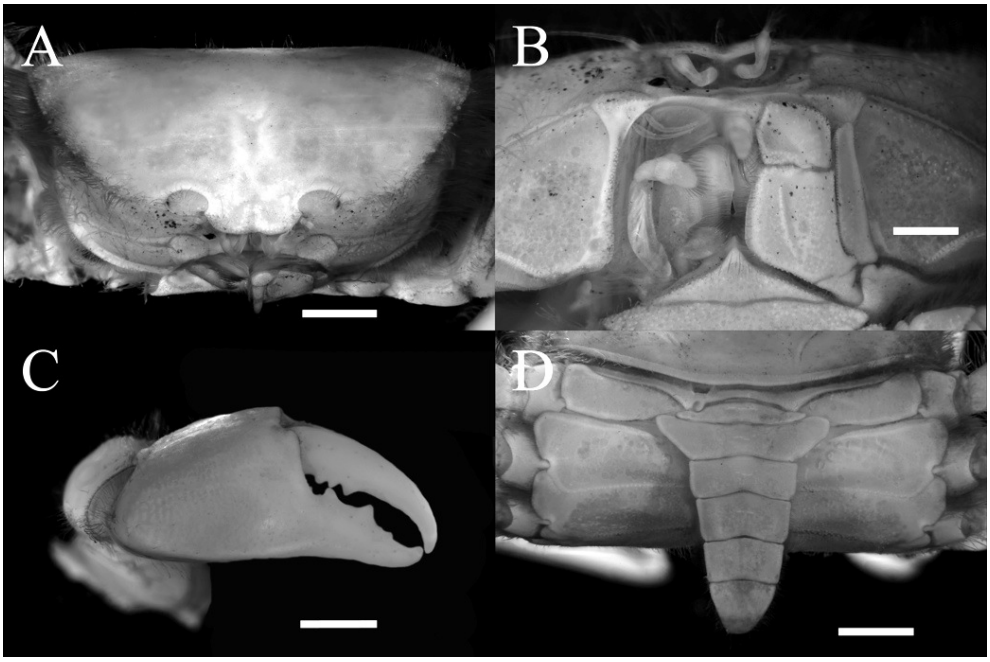

Fig. 56. *Typhlocarcinops canaliculata* Rathbun, 1909. A, Front, anterior view; B, The third maxilliped, ventral view; C, Right cheliped, outer view; D, male abdomen, posterior view. Scale bars: A, C, D = 2 mm, B = 1 mm.

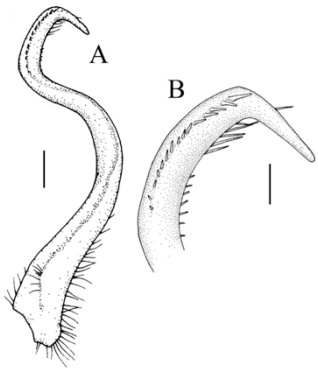

Fig. 57. Male first gonopod of *Typhlocarcinops canaliculata* Rathbun, 1909, external view. A, Whole; B, Distal portion. Scale bars: A = 0.5 mm, B = 0.25 mm.

18. ***Zehntneriana amakusae*** (Takeda & Miyake, 1969) 긴발등글게

Lithocheira amakusae Takeda & Miyake, 1969a: 10, fig. 1.

Zehntneriana amakusae: Takeda, 1972: 35; Lee et al., 2011: 193.

Previous records of Korean Fauna. Munseom (Lee et al., 2011)

Material examined. 1 ind., Chujado Is., Jejudo., 31 Mar. 2009, coll. S. K. Lee.

Diagnosis. Carapace (Fig. 58, 59A, 59B) transverse, weakly declivous anteriorly; dorsal surface naked for its greater part, ill–defined only with a short thick felt along frontal and anterolateral borders. Front about one–third breadth of carapace. Anterolateral martin cut into three distinct but low teeth; very small tooth produced on posterior slope of third tooth; first tooth indicated as a weakly arched ridge; second tooth more or less conical with a tip near its anterior end, its posterior slope arched; third tooth bearing tip at its anterior end, generally arched at outer border; small fourth tooth obscurely demarcated as small granule. Posterolateral border weakly convergent, longer than anterolateral border, dorsally covered with pubescence, with small rounded granules. Posterior border wide, rimmed along whole length, weakly concave at its middle.

Third maxilliped (Fig. 59E) completely covering buccal orfice; merus subquadrate, granular.

Thoracic sternum (Fig. 60A) glabrous. Sternites 1 and 2 completely fused, separated from sternite 3 by distinct suture.

Chelipeds (Fig. 59C, 59D) nearly equal; merus unarmed only with crest of upper border; carpus nearly naked, glabrous; distal inner margin coarsely granules with short, dense brush–like hairs; inner angle pronounced, tipped with spiniform granules, fringed with row of several long simple hairs long its inner slope; larger palm entirely smooth, naked, smaller palm provided with some long hairs and rounded granules near upper border; movable finger somewhat vertical due to stout, rather short immovable finger.

Fig. 58. *Zehntneriana amakusae* (Takeda & Miyake, 1969), male, 6.3 mm × 4.5 mm, dorsal view.

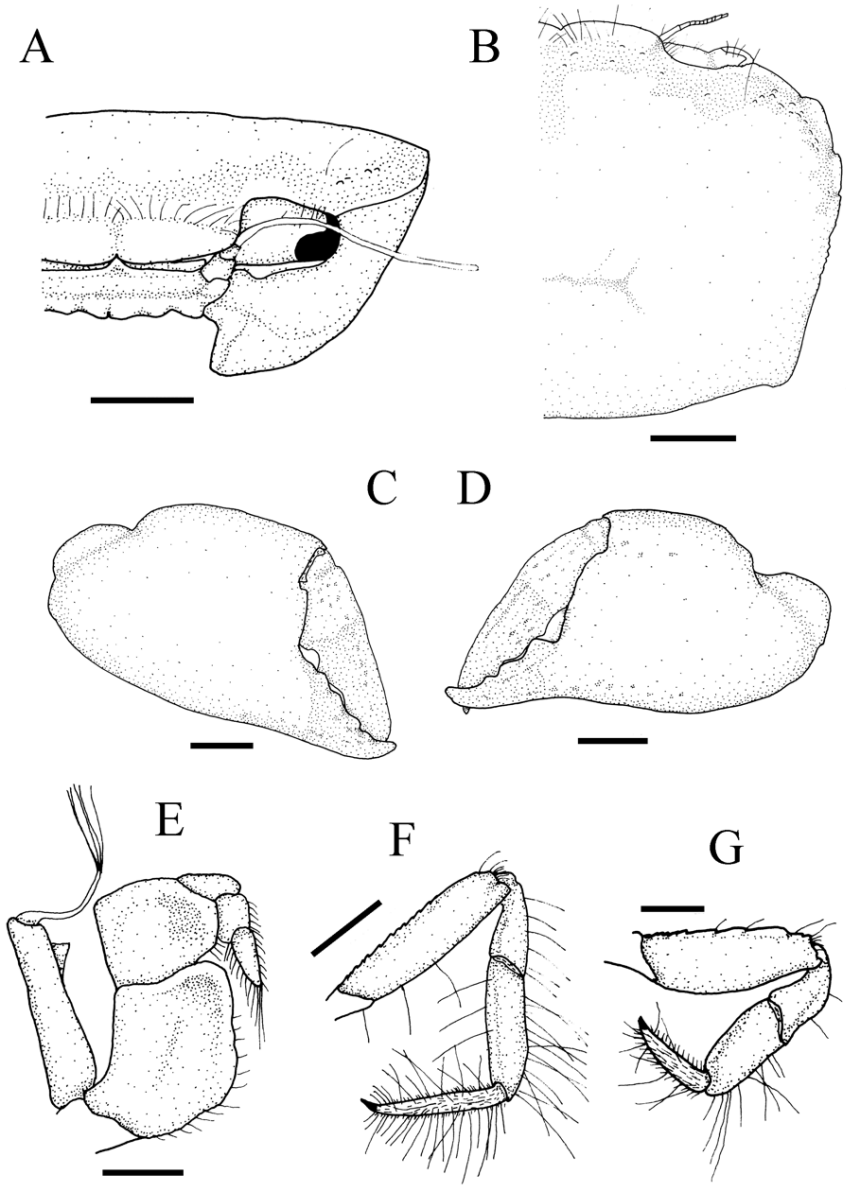

Fig. 59. *Zehntneriana amakusae* (Takeda & Miyake, 1969). A, Front and Pterygostomian region; B, Anterolater margin, dorsal view; C, Right cheliped, outer view; D, Left cheliped, outer view; E, Right third maxilliped, ventral view; F, The third ambulatory leg, posterior view; G, The fourth ambulatory leg, posterior leg. Scale bars: A, B, C, D = 1 mm, F = 2 mm, G = 1mm, E = 0.5 mm.

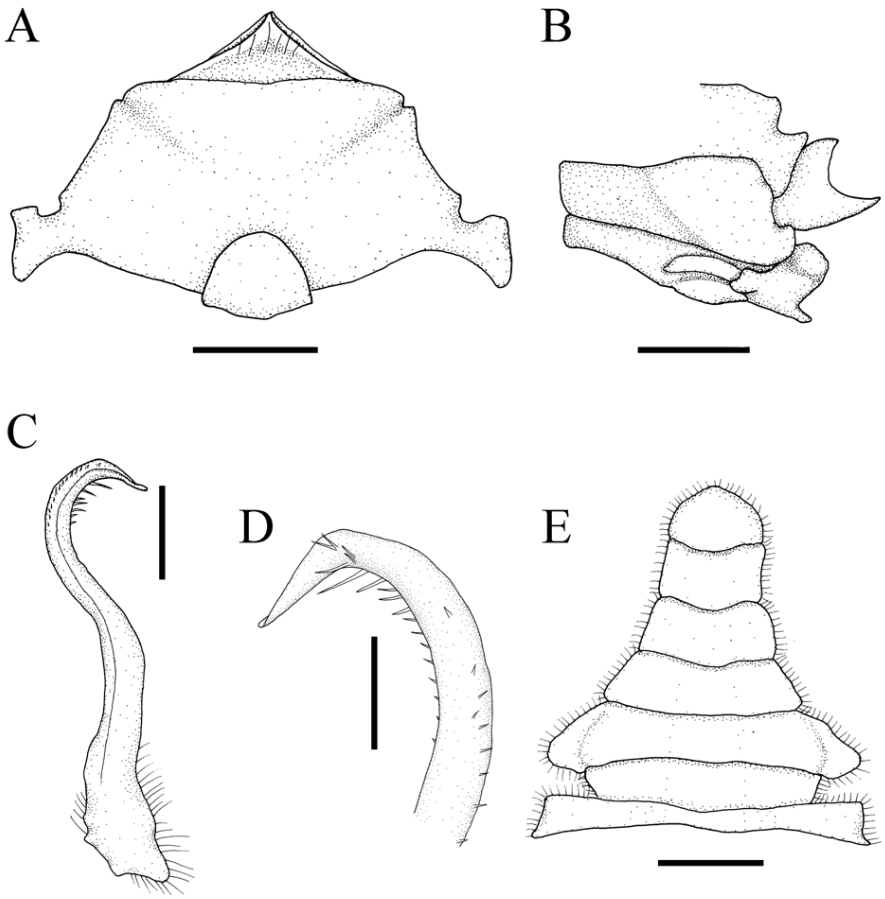

Fig. 60. *Zehntneriana amakusae* (Takeda & Miyake, 1969). A, Sternites 1 to 4, vental view; B, Sternite 7, 8 and male genital opening cavity, ventral view; C, male first gonopod, whole, external view; D, Distal portion of male first gonopod, internal view; E, male abdomen, ventral view. Scale bars: A, B, E = 1 mm, C = 0.5 mm, D = 0.2 mm.

Ambulatory legs (Fig. 59F, 59G) long, stout; upper border of merus thin, minutely serrated, with prominent subterminal interruption; upper border of carpus fringed with short setae and some long hairs; propodus also fringed with short thick setae and long hairs along both borders; dactylus as long as propodus, densely covered with short setae and long hairs; in last pair dactylus weakly curved upward near tip.

Abdomen (Fig. 60E) narrow and rather long subtriangular, consisting of 7 segments, bearing fur on ventral surface. Width of first segment subequaled to third segment. Telson triangular.

Male first pleopod (Fir. 60C, 60D) generally curved with row of small and picky spine ornaments on distal region

Male penis (Fig. 60B) attached fifth coxo-condyle.

Colour in life. Generally bright red on the body and legs.

Type locality. Uze, Tomioka, Amakusa–shoto, Japan.

Distribution. Japan and Korea.

Remarks. The genus *Zehntneriana* contained four species: *Z. villsa* Zehntner, 1894, *Z. amakusae* Takeda & Miyake, 1969, *Z. miyakei* Takeda, 1972, and *Z. novaeinsulicola* Takeda & Kurata, 1977. In Korea, Lee et al. (2011) recorded *Z. amakusae* with the short comments. The author examined Korean *Z. amakusae*, and *Z. villosa* collected from Japan compared holotype of *Z. villosa*. The author found that *Z. villosa* from Japan differred from holotype of *Z. villosa*. The differentation between them will be discussed in Chapter 2.

19. *Actaea semblatae* Guinot, 1976 옴부채게

Cancer (*Actaea*) *granulatus* (not Linnaeus, 1758) de Haan, 1833-1849 (1835): 47, pl. D.

Actaea granulata carcharias Sakai, 1934: 309.

Actaea savignyi (not H. Milne Edwards, 1834) Sakai, 1935: 70; Kim, 1970: 20; Kim, 1973: 383, 631, fig. 147, pl. 83, fig. 111a-b; Sakai, 1976: 442, pl. 158, fig. 2.

Actaea semblatae Guinot, 1976: 225, fig. 39c, pl. 11, figs 4, 4a, 5, 6; Serène, 1984: 109(key), 112(key); 김 등, 1979a: 103; Kim & Kim, 1982:133; Kim & Chang, 1985: 54; Kim & Kim, 1998: 293; Muraoka, 1998: 41; 전 등, 2000c: 108.

Fig. 61. *Actaea semblartae* Guinot, 1976, male, 16.3 × 11.3 mm, dorsal view.

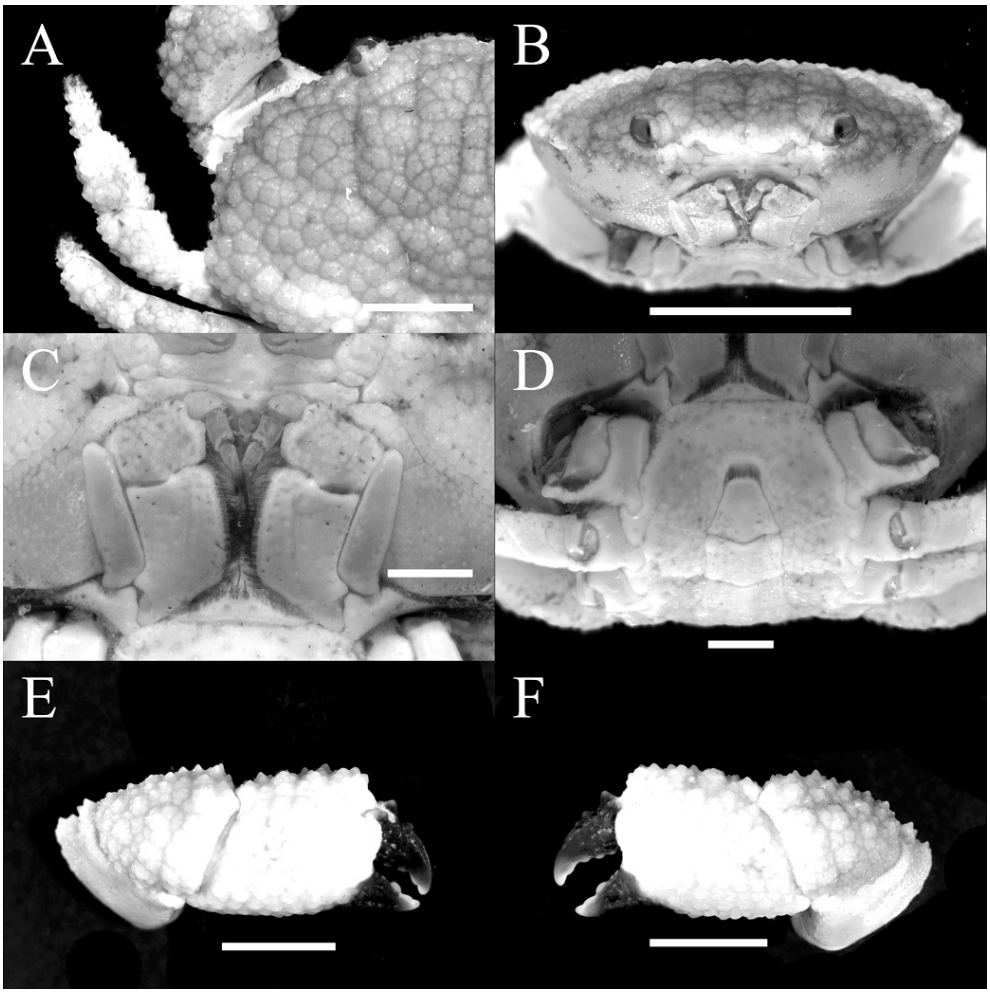

Fig. 62. *Actaea semblartae* Guinot, 1976. A, Anterolateral margin, dorsal view; B, Front, anterior view; C, The third maxillipeds, ventral view; D, Thoracic sternum and male abdomen, ventral view; E, Right cheliped, outer view; F, Left cheliped, outer view. Scale bars: B = 5 mm, A, E, F = 3 mm, D = 2 mm, C = 1 mm.

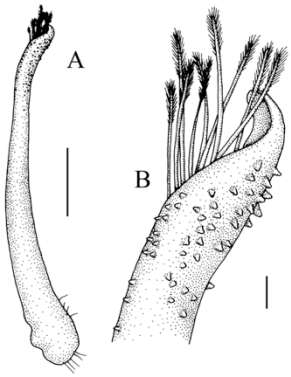

Fig. 63. Male first gonopod of *Actaea semblartae* Guinot, 1976, external view. A, Whole; B, Distal portion. A = 1 mm, B = 0.1 mm.

Previous record of Korean fauna. Ulreungdo Is., Pusan, Hansando, Mijo-ri, Namhaedo, Geojedo Is., Geomundo Is., upper Baekdo Is., Jejudo Is. (Kim, 1973; 전 등, 2000c; Kim & Chang, 1985; Kim, 1970; 김 등, 1979a; Kim & Kim, 1982; Kim & Kim, 1998)

Material examined. 2 inds., Bangjuk-po, Dolsando, Jeollanam-do, 13 Jun. 1969, coll. H. S. Kim; 1 ind., Haeundae, Pusan, Gyeongsangnam-do, 30 Jun. 1970; 1 ind., Beomseom Is., Jejudo, 17 Jun. 1985; 1 ind., Geojedo Is., Gyeongsangnam-do, 29 Jul. 1996; 1 ind., Hongnam, Geojedo Is., Gyeongsangnam-do, 29 Jan. 1997; 4 inds., Munseom Is., Jejudo, 7 Nov. 2000; 1 ind., Marado Is., Jejudo, 7 Jun. 2001; 1 ind., Chaguido Is., Jejudo, 8 Jun. 2001; 2 inds., Geomundo Is., Jeollanam-do, 22 Jun. 2002.

Diagnosis. Carapace (Figs. 61, 62A) moderately wide; dorsal surface distinctly areolated in prominent areas, entirely covered by tubercles very coalescent and forming paving, facetted, petaloid, with many pores on their circumferences. Front (Fig. 62B) with two lobes separated by a distinct median notch. Spinose tubercles on the antero-lateral and frontal borders. Third maxilliped (Fig. 62C) completely filled buccal orifice; merus subquadrate, granular, anterolateral angle slightly produced; ischium subrectangular with submedian sulcus, smooth, punctuate.

Sternal plastron (Fig. 62D) nearly smooth in front of sternite 4, elsewhere with facetted tubercles, small but numerous; same tubercles on male abdomen.

Male chelipeds (Fig. 62E, 62F) with black colouration on fixed finger not extending onto palm. Same ornamentation of petaloid tubercles on outer surface of carpus and palm, becoming spiniform on margins.

Ambulatory legs with numerous same tubercles shown more spinose appearance on margins, more noticeably on propodus and dactylus.

Male abdomen (Fig. 62D) narrow and long; somites 3-5 fused, sutures vaguely discernible; distal half slightly broader than proximal half, lateral margins slightly concave.

Male first gonopod (Fig. 63) slightly smooth, little tick; Apical lobe twisted; center of distal portion with 9 bristle seta

Type locality. Japan.

Distribution. Japan, Korea, East China Sea.

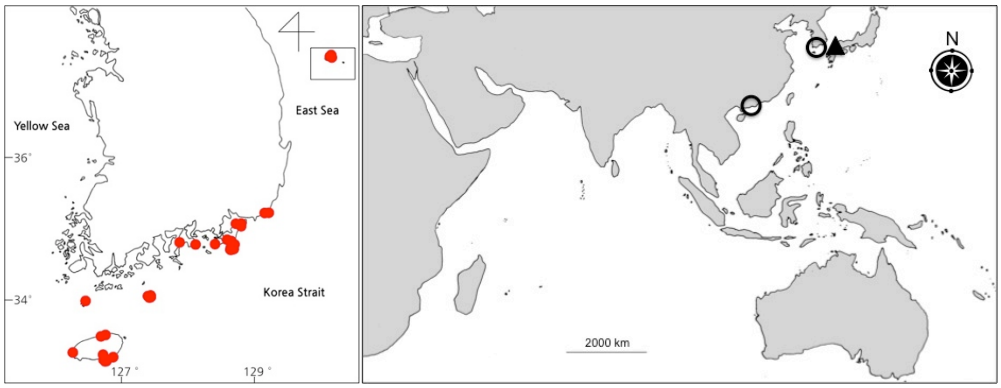

Fig. 64. Distribution of *Actaea semblartae* Guinot, 1976. Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. Korean *Actaea semblatae* Guinot, 1976 has been recorded or collected in sourther part of Korean peninsular. Some individuals of this species occur from Ulreungdo Island in East Sea (Fig. 64).

20. *Actaea polyacantha* (Heller, 1861) 넓은가시옴부채게

Chlorodius polyacantha Heller, 1861: 11.

Actaeodes polyacanthus: Miers, 1884, p. 206.

Actaea polyacantha: Rathbun, 1911, p. 222, pl. 18, figs. 5-6; Serène, 1984, p. 109 (key), p. 112 (key), p. 114, fig. 67, pl. 14E; Dai and Yang, 1991, p. 309, fig. 160A; Lee et al., 2012: 87.

Materials examined. 1 ind., 16 × 11 mm, Beomseom Is., Jejudo, 26 Aug. 2007, coll. S.K. Lee; 1 ind., 13 × 8 mm, Munseom Is., Jejudo, 3 Mar. 2009, coll. T.S. Park.

Diagnosis. Carapace (Fig. 65, 66A) naked, oval; dorsal surface covered with flat-topped black brown tubercles, of which those on 3M, 4M, 2R, 3R, 1P, and 2P somewhat obscure, while those near lateral margins erect and distinct; regions ill-defined except for 2M and 3M well demarcated by deep intervening grooves; frontal border rather obscurely bilobated with broad v-shaped median notch; antero-lateral borders with six sharp and slightly curved tubercles including external orbital angle; postero-lateral borders shorter than antero-lateral borders and deeply concave. Supraorbit composed of five tubercles. Eye-stalks short, thick, bearing four to five tubercles. Basal antennal joint entered inner orbital hiatus, but not so deeply. Third maxilliped (Fig. 66C) flatted; ischium longer than broad; merus produced at antero-external angle.

Chelipeds (Fig. 66A, 66D) symmetrical, stout, covered with rather erect and distinct tubercles; outer surface of propodus and carpus bearing tubercles as those on carapace disposed in longitudinal series. Fingers black, stout, without gaping; cutting edges with 3 teeth.

Ambulatory legs (Fig. 66A) bearing long and spine-formtubercles colored black brown distantly along superior borders; merus smooth and glabrous on posterior surface, with 3 to 4 small tubercles on superior borders; dactylus slender, sharp at tip.

Female abdomen (Fig. 66B) composed of seven segments; telson coniform, longer than broad.

Male first gonopod (Fig. 67) slightly straight; subdistal portion with bristled seta.

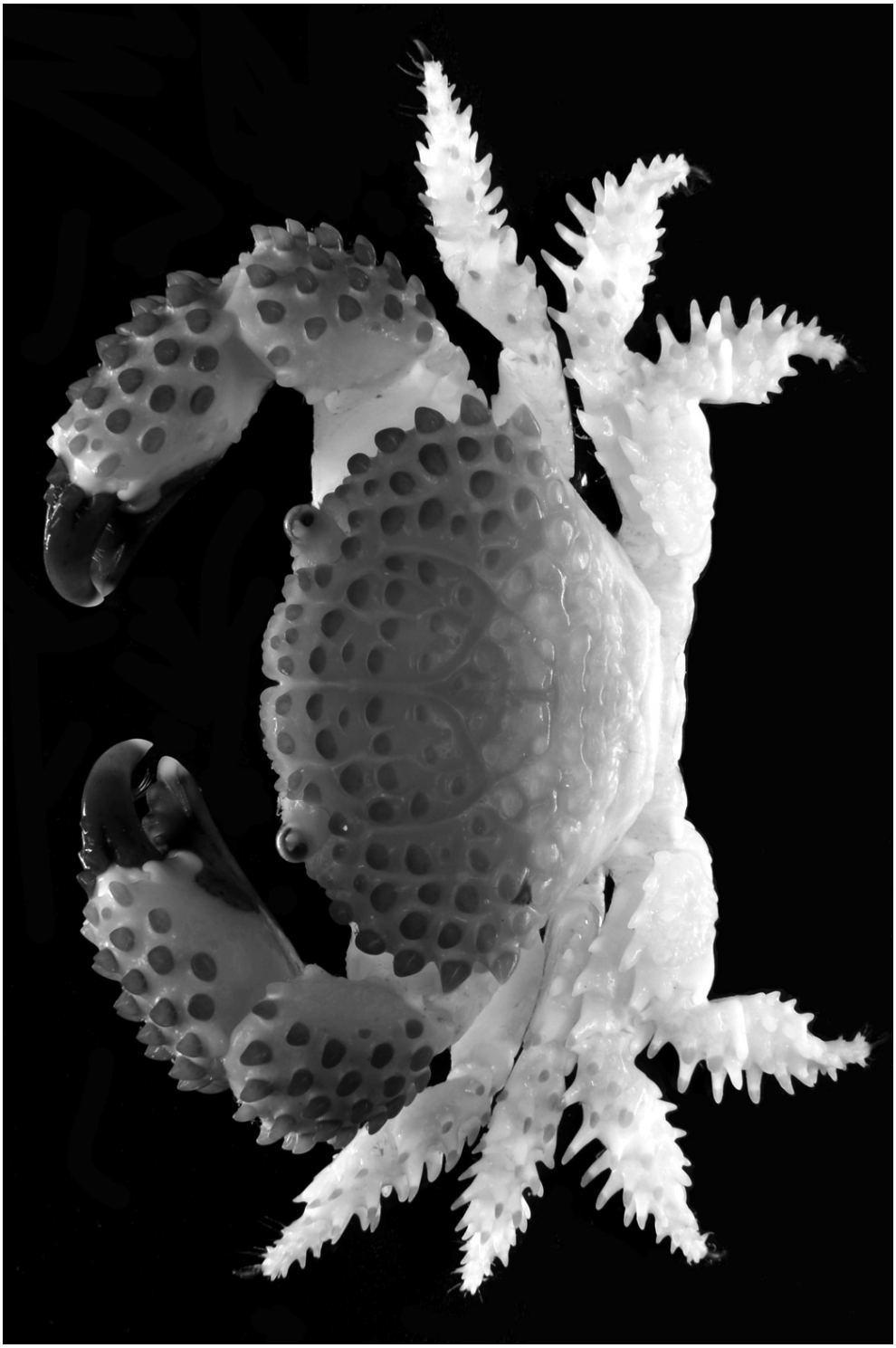

Fig. 65. *Actaea polyacantha* (Heller, 1861), male, 11.5 × 8 mm, dorsal view.

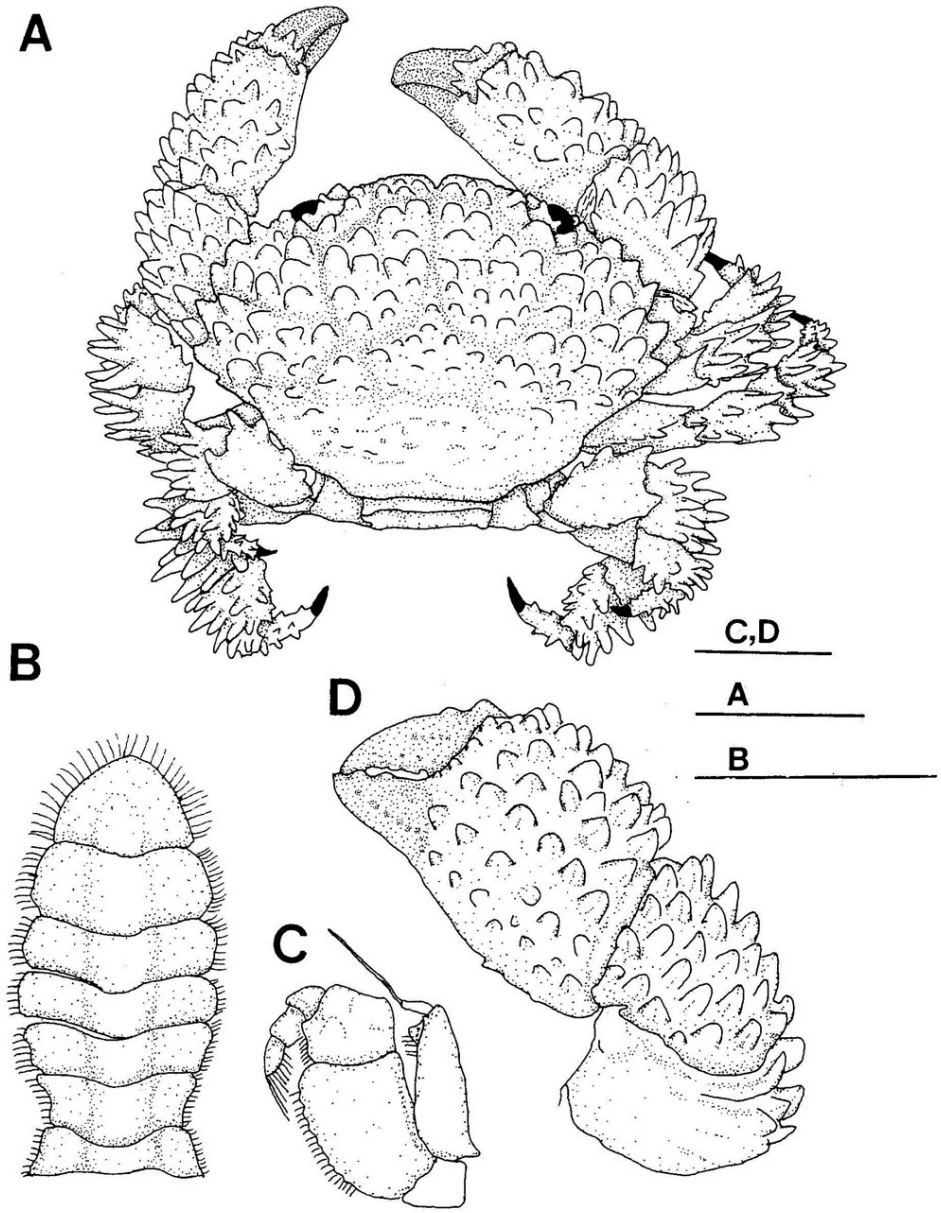

Fig. 66. *Actaea polyacantha* (Heller, 1861), female, 16 × 11 mm. A, whole animal, dorsal view; B, Abdomen of female, ventral view; C, The third maxilliped, ventral view; D, Left cheliped, outer view. Scale bars=0.5mm(C), 2mm(B), 5mm(A, D, E). Note=Seta on the right part of whole animal are omitted.

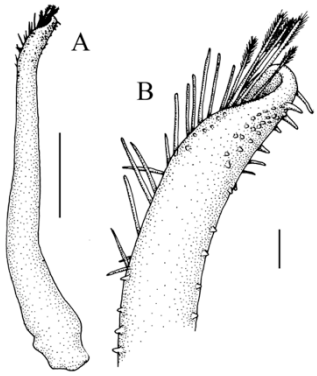

Fig. 67. Male first gonopod of *Actaea polyacantha* (Heller, 1861), external view. A, Whole; B, Distal portion. Scale bars: A = 1 mm, B = 0.1 mm.

Habitat. Crevices of rocks at low-tide mark.

Distribution. Red Sea, Gulf of Aden, Japan, South China Sea, Australia, Fiji, Korea (new record).

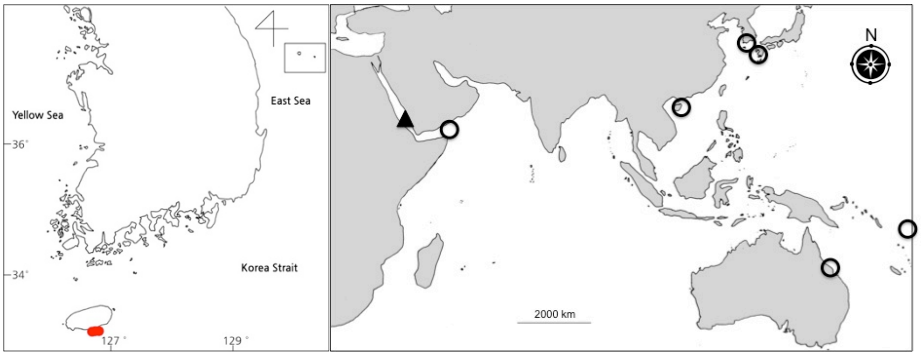

Fig. 68. Distribution of *Actaea polyacantha* (Heller, 1861). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. According to the descriptions by Rathbun (1911), Serène (1984), and Dai & Yang (1991), *Actaea polyacantha* (Heller, 1861) has the following characteristics: dorsal surface of carapace covered with flat-topped tubercles; posterior dorsal region without tubercles; median sinus of front narrow; ambulatory legs with long spines on the superior borders (particularly on carpus and propodus). The present specimens agree well with these descriptions but show that the tubercles on 2R, 3R, 1P, and 2P are very small or irregular in shape, and the median sinus of the front margin is not narrow.

21. *Actaeodes hirsutissimus* (Rüppell, 1830)　다모그물등부채게

Xantho hirsutissimus Rüppell, 1830, p. 26, pl. 5, fig. 6.

Actaea hirsutissimus: Forest and Guinot, 1961, p.78.

Actaeodes hirsutissimus: Sakai, 1976, p. 488, pl. 159, fig. 3; Lee et al., 2010: 90.

Materials examined. 1 ind., 14 × 9 mm, Beomseom Is., Jejudo, 2 Oct. 1995, coll. J. Lee; 1 ind., 12 × 8 mm, 7 Jun. 2001, coll. S.H. Kim.

Description. Carapace (Figs. 69, 70A, 71A) 1.5 to 1.6 times broader than long, furnished with short and stiff setae implanted only on beaded granules; surface convex in anterior half and depressed in posterior half; regions separated into lobules by deep and smooth grooves; 2M entirely divided longitudinally into two parts; each external branch of 2M with only outline of division on anterior margin; 3M tripartite; anterior lobe of 3M long, narrow, hardly developed; frontal borderslightly produced and deflected, separated into 2 bluntly round lobes by broad V-shaped notch; antero-lateral borders composed of 4 shallow lobes with tubercles: first to third broadened, last subequal to first; postero-lateral borders very concave, shorter than antero-lateral borders.

Third maxilliped (Fig. 70C) completely covering buccal orifice.

Thoracic sternum (Fig. 70D) finely granular with seta. Sternite 1, 2 completley fused, seaparted form sternite 3 by distict sutre.

Cheliped (Fig. 70E, 70F, 71E) asymmetrical; merus triquetrous, covered with granules; black pigmentation on fixed finger entirely encircled palm; dactylus black, with triangular teeth on cutting edges; tip of fingers sharp.

Ambulatory legs (Fig. 69) flat, covered with granules and short hairs on porsterior surface; carpus bearing longitudinal groove in median of superior surface; dactylus short, armed with short claw.

Male first pleopod (Fig. 71B, 71C) slender and long, with distal portion slightly curved laterally and with tip bluntly spoonshaped.

Male abdomen (Fig. 71D) narrow and long; third to fifth segments fused; sixth segment longer than broad; telson elongated triangle.

Fig. 69. *Actaeodes hirsutissimus* (Rüppell, 1830), male, 10.7 × 8.1 mm, dorsal view.

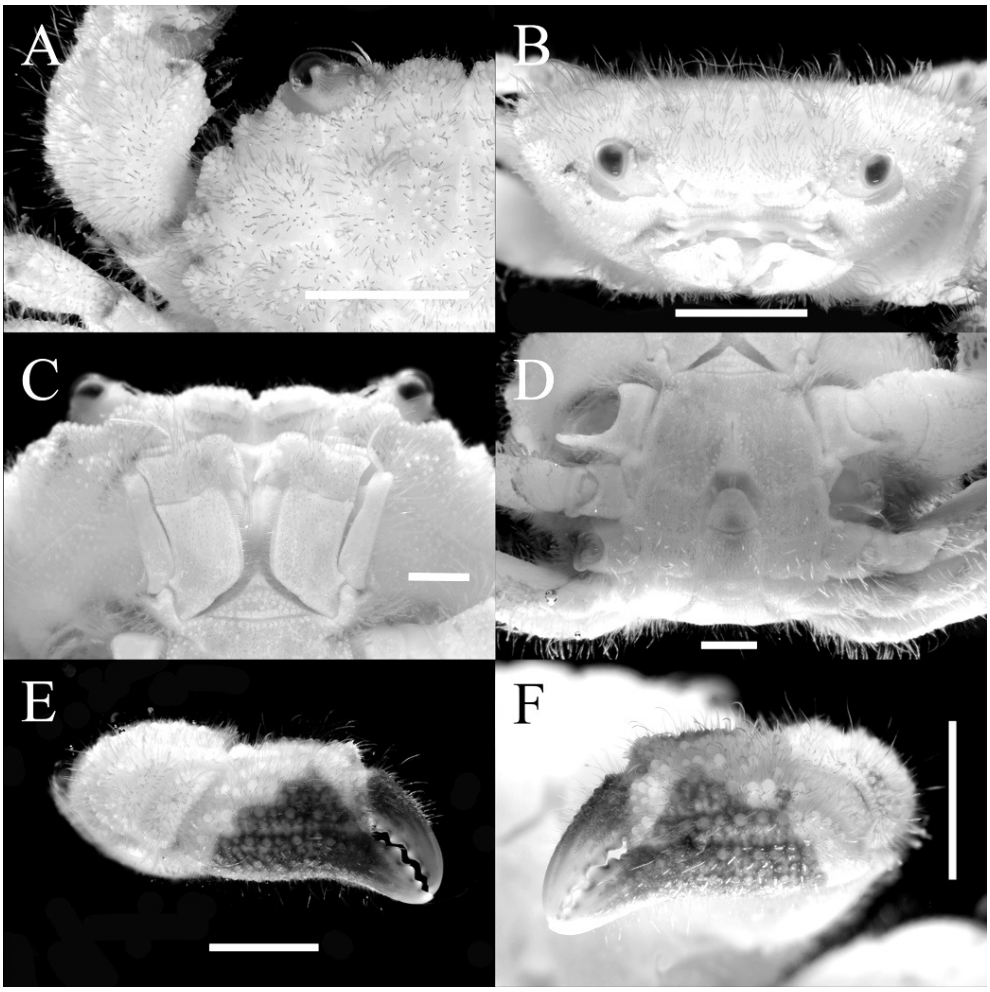

Fig. 70. *Actaeodes hirsutissimus* (Rüppell, 1830). A, Anterolateral margin, dorsal margin; B, Front, anterior view; C, Third maxillipeds, verntraly view; D, Thoracic sternum and male Abdomen, ventral view; E, Right cheliped, outer view; F, Left chelipeds, outer view. Scale bars: A, B = 3 mm, C, D = 1 mm, E, F = 2 mm.

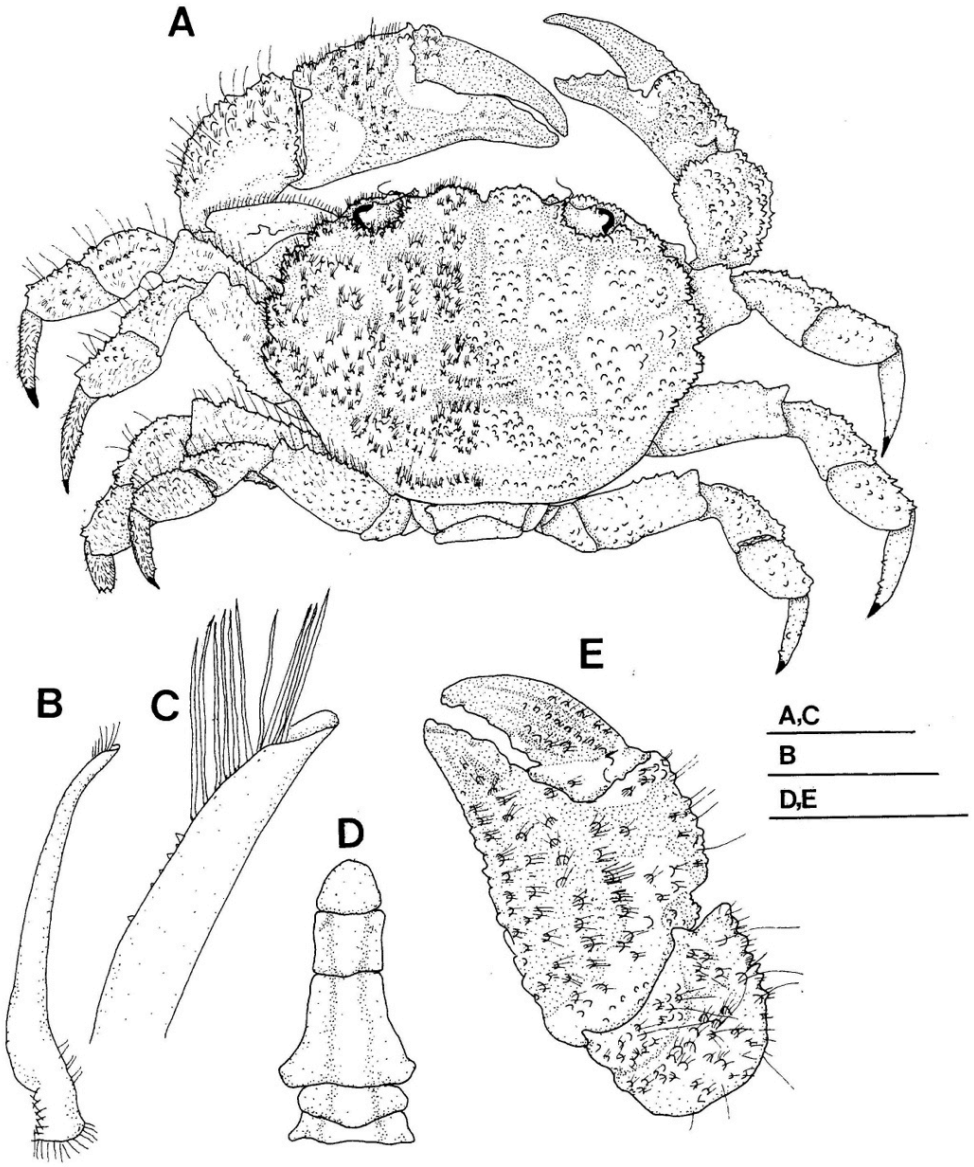

Fig. 71. *Actaeodes hirsutissimus* (Rüppell, 1830), male. A, whole animal, dorsal view; B, left first pleopod, ventral view; C, tip of left first pleopod; D, abdomen; left cheliped, outer view. Scale bars=0.5 mm (C), 2 mm (B), 5 mm (A, D, E). Note=Seta on the right part of whole animal are omitted.

Habitat. Shallow waters on coral reefs.

Distribution. China, Japan, Samoa Is., Australia, Philipine, Red Sea, Korea.

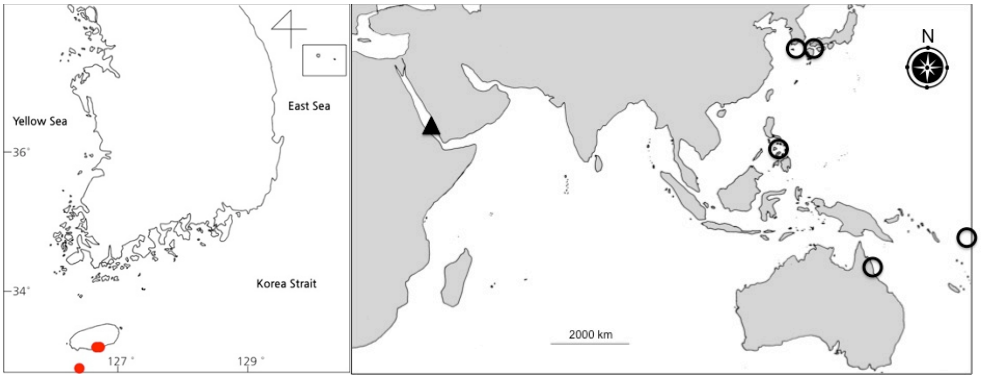

Fig. 72. Distribution of *Actaeodes hirsutissimus* (Rüppell, 1830). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. The areolas on the regions of the carapace of *Actaeodes hirsutissimus* (Rüppell, 1830) are very similar to those of *A. consobrinus* (A. Milne Edwards, 1873). The external branch of 2M of *A. hirsutissimus* has only an outline of division on anterior margin, whereas that of *A. consobrinus* has whole. The examined specimens have indistinct division of anterior margin on the external branch of 2M. The chelipeds of *A. hirsutissimus* are symmetrical (Serène, 1984; Dai and Yang, 1991) but those of the illustrated specimen in the present study are asymmetrical. However, the characteristics of the present specimnes, such as the shape of the first pleopod, the black pigmentation on the palm, and the carapace furnished with short and stiff setae implanted only on beaded granules agree well with the characteristics of *A. hirsutissimus*.

22. *Forestia depressa* (White, 1847) 편평부채게

Xantho depressa White, 1847: 17.

Actaea depressa: Odhner, 1925: 38, pl. 2, fig. 19; Sakai, 1976: 446, fig. 237; Kensley, 1981: 43.

Forestia depressa: Guinot, 1976: 262, fig. 42B, 44A, 45B, b, b', c, pl. 18, fig. 1; Muraoka, 1998: 42; Ko & Takeda, 1999: 76.

Previous records of Korean fauna. Udo Is. (Ko & Takeda, 1999)

Description. Carapace about 1.4 times as broad as long, much depress on posterior region; dorsal surface very flat, with granules; surface near the fronto-orbital border extremely vaulted down, covered with coarse granules.

Front lobes much produced near median notch; free margin being beaded with granules. Anterolateral margin shorter than Posterolateral, with markedly arcuate and obscurely 4 lobes. Posterior margin bearing characteristic median V-shaped invagination.

Chelipeds extremely asymmetrical, covered with coarse granules and short yellowish hairs.

Abdomen 7 segmented; telson semitriangular,

Type locality. Corregidor Island, Philippines.

Distribution. South Africa, Madagascar, Sri Lanka, Mergui Archipelago, Japan, Taiwan, Philippines, Korea.

Remark. The author does not examine this species. The description of this speices is cited from Sakai (1939) and Ko & Takeda (1999).

23. *Gaillardiellus orientalis* (Odhner, 1925) 털부채게

Actaea ruppelli var. *orientalis* Odhner, 1925: 46, pl. 3, fig. 7.

Paractaea ruppelli orientalis: Kim, 1960: 343; Park, 1964: 17; Kim & Rho, 1971: 12; Sakai, 1976: 452, pl. 159, fig. 2.

Actaea rueppelli orientalis: Kim, 1973: 385, 631, fig. 148, pl. 27, fig. 112.

Gaillardiellus orientalis: Guinot, 1976: 255, figs 43B, b, pl. 16, fig. 2; Kim & Chang, 1985: 54; 전 등, 2001a: 145; Rho & Kim, 2004; 459.

Paractaea orientalis: Dai & Yang, 1991: 315, pl. 40(7).

Previous records of Korean fauna. Ulreung, Pusan, Yeosu, Seogui-po, Mijo-ri, Dolsando, Chujado Is., Jejudo Is., Taean, Tongyuong, Impo, Geojedo, Gaduckdo Is., Guryong-po, Haeundae, Geomundo Is., Dokdo Is. (Kim & Rho, 1971; Kim, 1973; Kim & Chang, 1985; 전 등, 2001a; Rho & Kim, 2004)

Material examined. 8 inds., Haeundae, Gyeongsangnam-do, 10 Jul. 1967; 1 ind., Mijo-ri, Namhaedo, Gyeongsangnam-do, 18 Jul. 1967; 1 ind., Dolsando, Gyeongsangnam-do, 8 Jun. 1968; 3 inds., Pusan, Gyeongsangnam-do, 10 Jul. 1968; 4 inds., Chujado Is, Jejudo, 9 Aug. 1969; 1 ind., Gaduckdo Is., Pusan, Gyeongsangnam-do, 22 May 1978; 1 ind., Munseom Is., Jejudo, 12 Au. 1996; 1 ind., Daecheon, Chungcheongnam-do, 13 Jun. 1999; 2 inds., Galquiseom Is., Geomundo, Jeollanam-do, 26 Jun. 2002; 1 inds., upper Baekdo Is., Geomundo, Jeollanam-do, 21 Jun. 2002; 1 ind., Jukdo Is., Ulreung, Gyeongsangnam-do, 21 Jun. 2006; 1 ind., Songji, Gosung, Gangwon-do, 24 Jun. 2010.

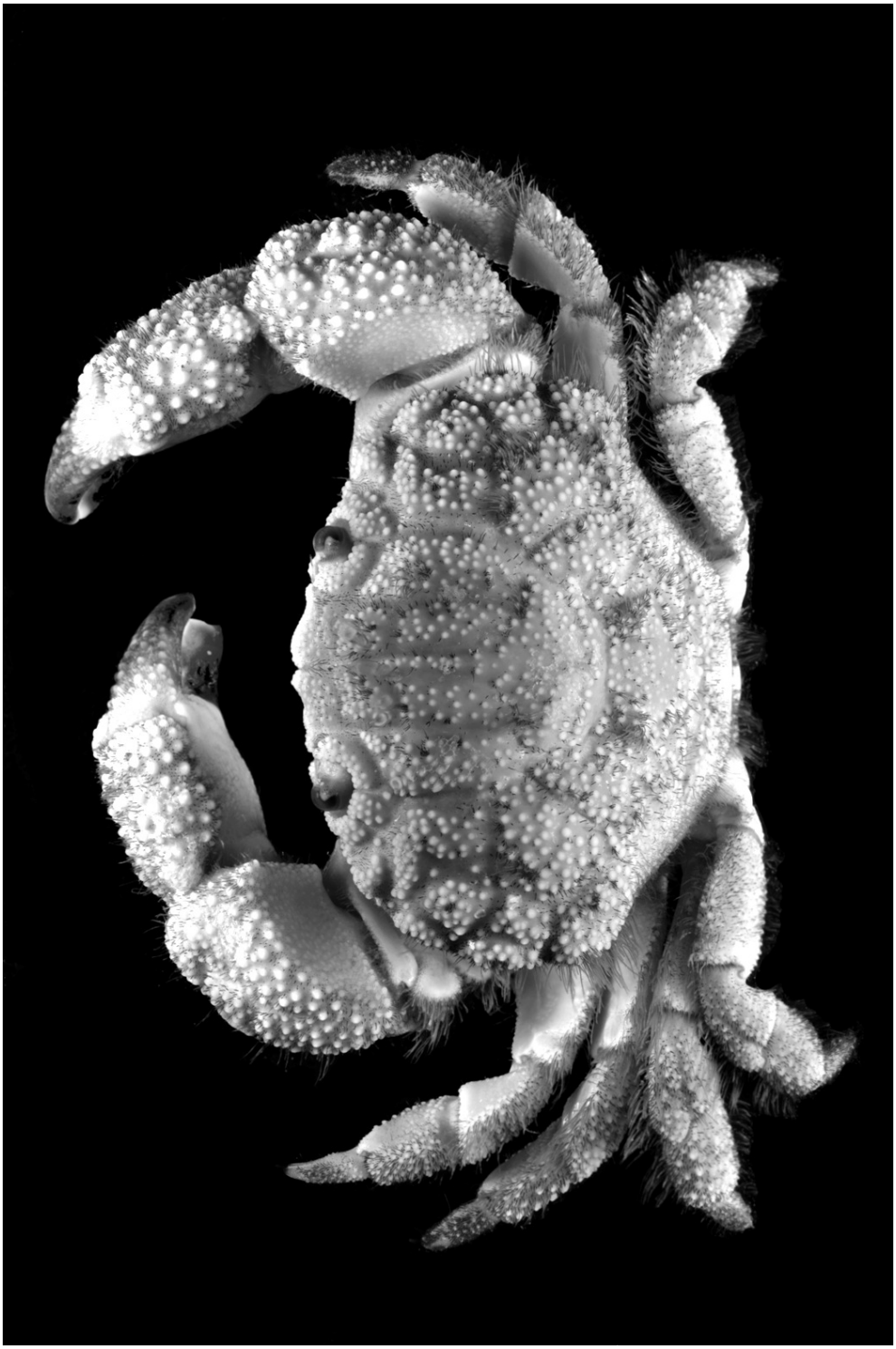

Fig. 73. *Gaillardiellus orientalis* (Odhner, 1925), male, 26.3 × 19.8 mm, dorsal view.

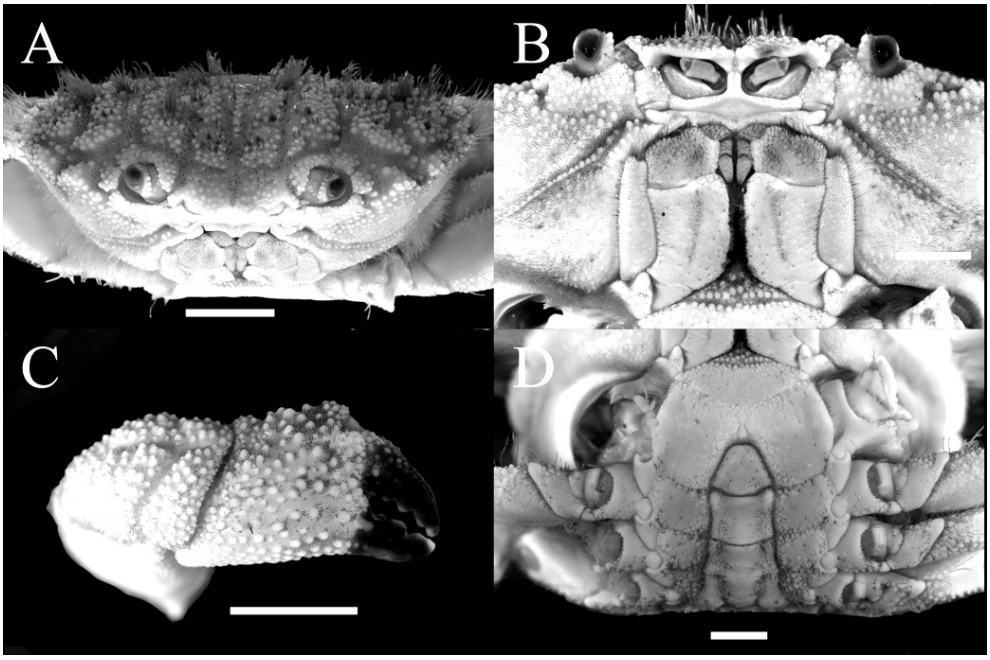

Fig. 74. *Gaillardiellus orientalis* (Odhner, 1925). A, Front, anterior view; B, The third maxillipeds, ventral view; C, Left cheliped, outer view; D, Thoracic sternum and male Abdomen, ventral view. Scale bars: A, D = 3 mm, B = 2 mm, C = 5 mm.

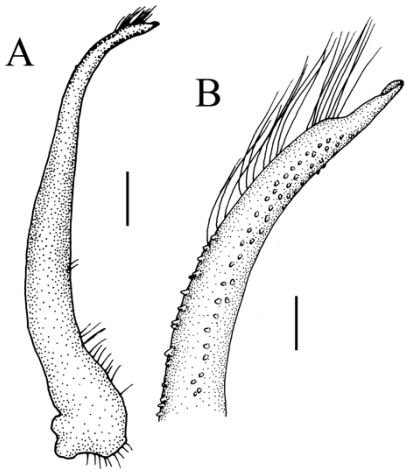

Fig. 75. Male first gonopod of *Gaillardiellus orientalis* (Odhner, 1925), external view. A, Whole; B, Distal portion. Scale bars: A = 10 mm, B = 0.2 mm.

Diagnosis. Carapace (Figs. 73) convex, convered with coarse granules and slump of long hairs, well areolated by deep and smooth grooves. 2M longitudinally divided into 2 lobes, 3M entire, 4M absent; 1P entire and circular. Front (Fig. 74A) deflected downwards, divided into 2 lobes. Orbit with dorsal margin slightly convex, bearing 2 fissures and covered with granules. Anterolateral margin composed of 4 round lobes: first small, last three large, of with third largest. Posterolateral margin shorter than anterolateral one and slightly concave. Third maxilliped (Fig. 74B) completely filled buccal orifice; merus subquadrate, granular, anterolateral angle slightly produced, anterior margin with wide v-shape notch medially; ischium subrectangular with submedian sulcus, smooth, punctuate; exopod stout, length about 4 times width.

Thoracic sternum (Fig. 74D) finely granular, glabrous. Sternites 1,2 completely fuse, separated from sternite 3 by distinct suture

Chelipeds (Fig. 74C) with granules on outer surface and smooth on inner surface. Meurs short, triquetrous. Carpus slightly massive and separated into a few lobules by fine grooves on outer surface. Female chelipeds faintly small and thin and separated into few lobules. The movables finger with 4—5 obtuse teeth on inner margins; immovable finger with 3—4 obtuse teeth, both with bluntly round, spoon-shaped tip.

Ambulatory legs (Fig. 74D) covered with granules on dorsal surface, and long hairs along anterior and posterior margins. Female abdomen oblong.

Male abdomen (Fig. 74D) narrow and long; somites 3-5 fused, sutures vaguely discernible

Male first gonopod (Fig. 75) smooth curved, inwards; distal portion with long seta.

Type locality. Hong Kong.

Distribution. Japan, Korea, China, Hong Kong.

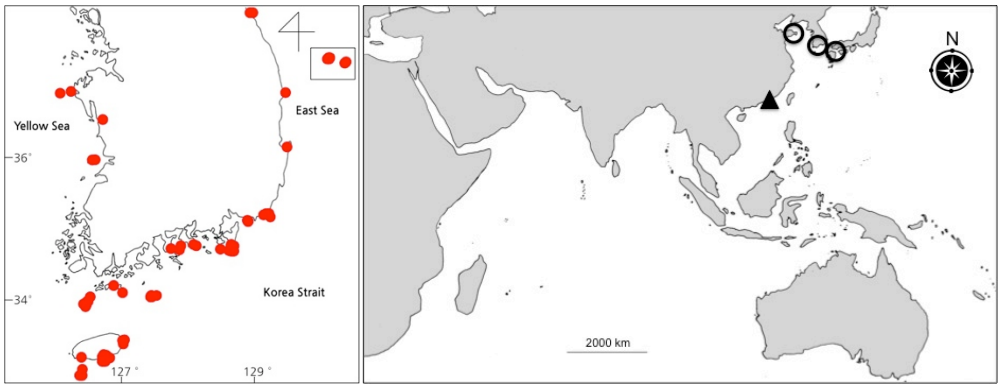

Fig. 76. Distribution of *Gaillardiellus orientalis* (Odhner, 1925). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. *Gaillardiellus orientalis* (Odhner, 1925) is common species in Korean fauna, and very similar to *G. rueppelli* (Krauss, 1843). The differentiation of them will note to remarks of *G. rueppelli*.

24. *Gaillardiellus rueppelli* (Krauss, 1843) 짧은털부채게

Cancer (*Aegle*) *rüppelli* Krauss, 1843: 28, Pl. 1, fig. 1.

Paractaea ruppelli: Sakai, 1976: 451, fig. 242; Dai & Yang, 1991: 314, Pl. 40(6), fig. 162(1).

Gaillardiellus rueppelli: Guinot, 1976: 254, figs. 42A, 43A, 43a, 44B, 44b, Pl. 16, figs. 1, 1a; Serène, 1984: 118, Pl. 15F, fig. 71; Ng et al., 2008: 195; Lee et al., 2012: 118.

Material examined. 1ind., Munseom Is., Jejudo, 21 Jan 1997. *Gaillardiellus orientalis* (Odhner, 1925): 1 ind., Hongdo Is., Geoje-si, 17 Oct 2010; 1ind., Ulleung Isl., Gyeongsangbuk- do, 24 Jun 2007.

Gaillardiellus rueppelli (Krauss, 1843): 1ind., Ifaty, Madagascar.

Diagnosis. Carapace (Figs. 77, 78A) transversely oval; surface thickly covered with granules and short setae, interspersed with long setae; all regions divided into lobules by deep smooth grooves; 2M completely divided into two lobules; outer lobule convex and broader; 1P also well convex and circular. Front

(Figs. 77, 78A) divided into two lobes by median V-shaped notch. Orbit with dorsal margin convex. Anterolateral border composed of four convex lobes excluding external orbital angle: first and last smaller, second and third broader. Posterolateral border shorter than anterolateral one, and slightly concave. Third maxilliped (Fig. 78C) completely covering buccal orifice, bearing seta on surface; ischium subrectagular; merus subquadrate with seta, and angled on anterolateral border.

Chelipeds (Fig. 78B) symmetrical, and covered with granules and long setae. Carpus massive, larger than propodus, and covered with tubercles separating by shallow grooves on upper surface. Propodus short and small, with 3 tubercles on dorsal surface, marked with transverse granulated carinae. Dactylus with tip bluntly round.

Ambulatory legs (Fig. 78D, 78E) stout. Merus with long setae along anterior margin and granules on dorsal surface; first to third pairs relatively smooth. Carpus with longitudinal groove. Dactylus with tip claw-shaped.

Distribution. Australia, China, Indonesia, Japan, Kenya, Madagascar, Mauritius, Mergui Archipelago, Papua New Guinea, Persian Gulf, Philippines, Samoa, Singapore, South Africa, Tahiti, and Korea.

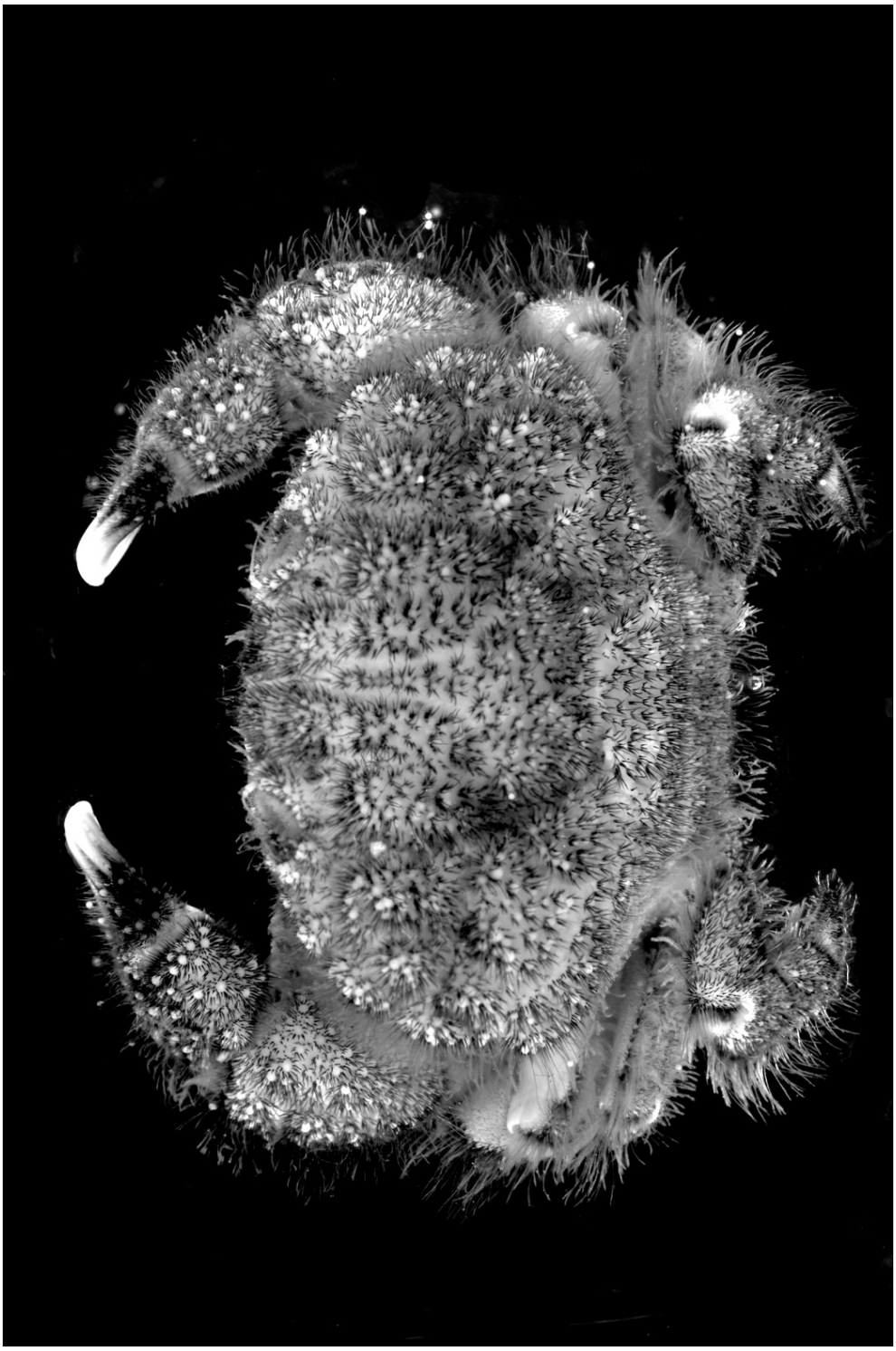

Fig. 77. *Gaillardiellus rueppelli* (Krauss, 1843), female, 32 × 25.4 mm, dorsal view.

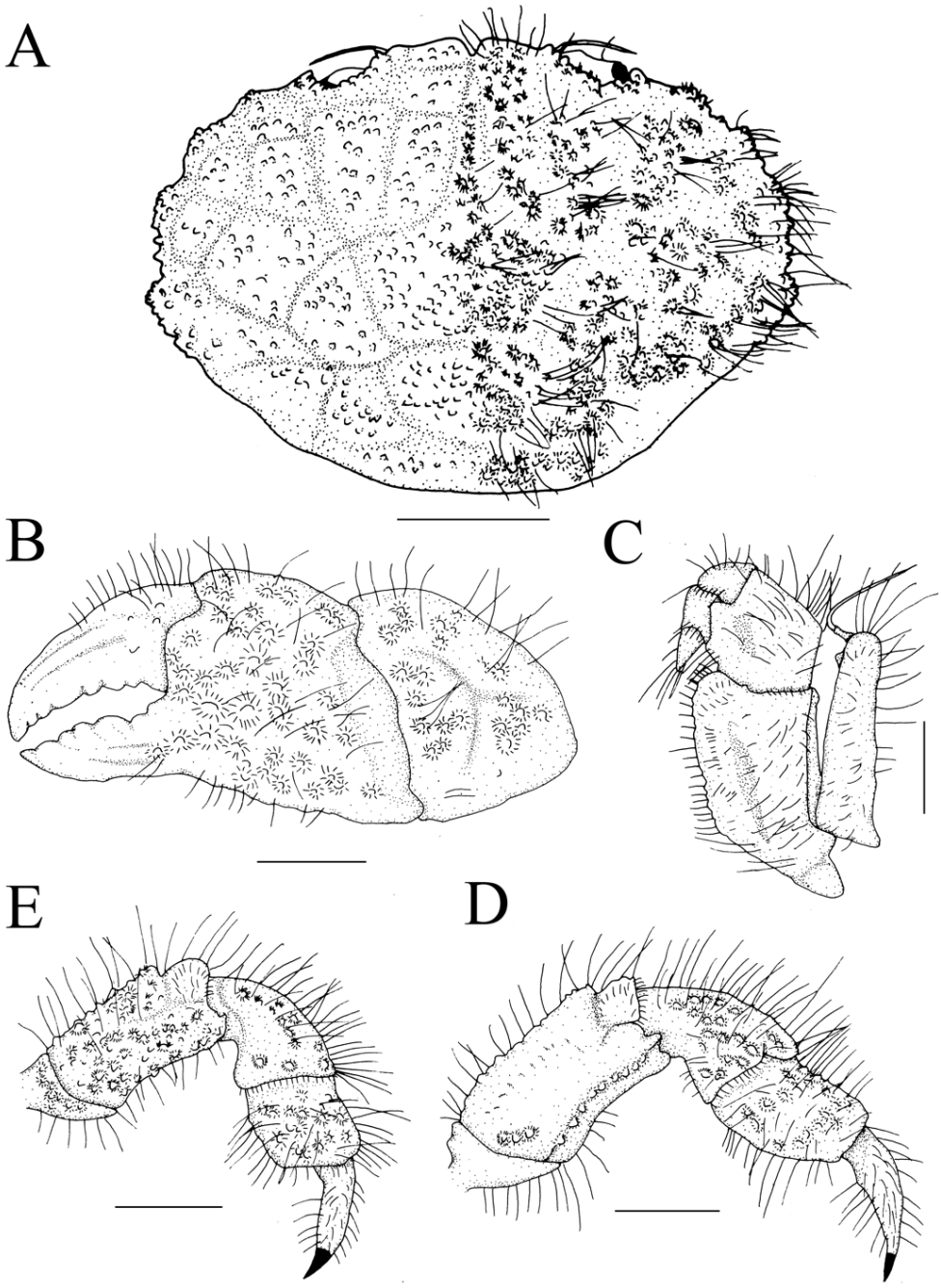

Fig. 78. *Gaillardiellus rueppelli* (Krauss, 1834). A, Carapace, dorsal view; B, Left cheliped, outer view; C, Left 3rd maxilliped; D, Third ambulatory leg, dorsal view; E, Fourth ambulatory leg, dorsal view. Note: seta on the left part of the carapace are omitted. Scale bars: A = 10 mm, B, D, E = 5 mm, C = 3 mm.

Remarks. The present specimen (Fig. 77, 78) agrees with the description by Dai and Yang (1991). In Korean fauna, only *Gaillardiellus orientalis* (Odhner, 1925) has been recorded in the genus Gaillardiellus. These two species are distinguished from each other in characters: presence or absence of tufts of long and plumose setae distributed on regions of their carapace (Serène, 1984) and shapes of G1 (Guinot, 1976). In the present study, *G. orientalis* has tufts of long setae on their carapace while *G. rueppelli* does not have. Identification using G1 is difficult because their G1 are quite similar.

The distribution of setae on the carapace of *G. rueppelli* is similar to that those of previously recorded Pilodius nigrocrinitus Stimpson, 1858 and *Actaeodes hirsutissimus* (Rüppell, 1830) from Korean fauna. *G. rueppelli*, however, is distinguished from previous two species because the genus *Gaillardiellus* has the deep and broader suture between sternite 3 and 4 (fig. 42A in Guinot, 1976; fig. 54D in Serène, 1984).

25. *Novactaea pulchella* A. Milne-Edwards, 1865 작은옴부채게

Actaea pulchella A. Milne-Edwards, 1865: 237, Pl. 17, Fig. 5b

Novactaea pulchella: Guinot, 1976, P. 269, pl. 18, fig. 6; Serène, 1984, P. 105, pl. 14, fig. A; Ko & Takeda, 2000:38; Ko, 2006: 7.

Previous records of Korean fauna. Jejudo Is. (Ko & Takeda, 2000; Ko, 2006)

Material examined. 1 ind., Iho-ri, Jejudo, 11 Aug. 1969; 1 ind., Gujo-ri, Geoje, Gyeongsangnam-do, 6 Jul. 1999; 1 ind., Munseom Is., Jejudo, 10 Jul. 2003; 1 ind., Gujo-ri, Geojedo, Gyeongsangnam-do, 6 Jul. 1999.

Diagnosis. Carapace (Fig. 79) transversely ovate, about 1.5 times as broad as long. Surface densely covered with granules and short setae; anterior half convex and regions well defined, and with larger granules and denser and longer setae, while the posterior half depressed and regions ill defined, 2M divided downwards,

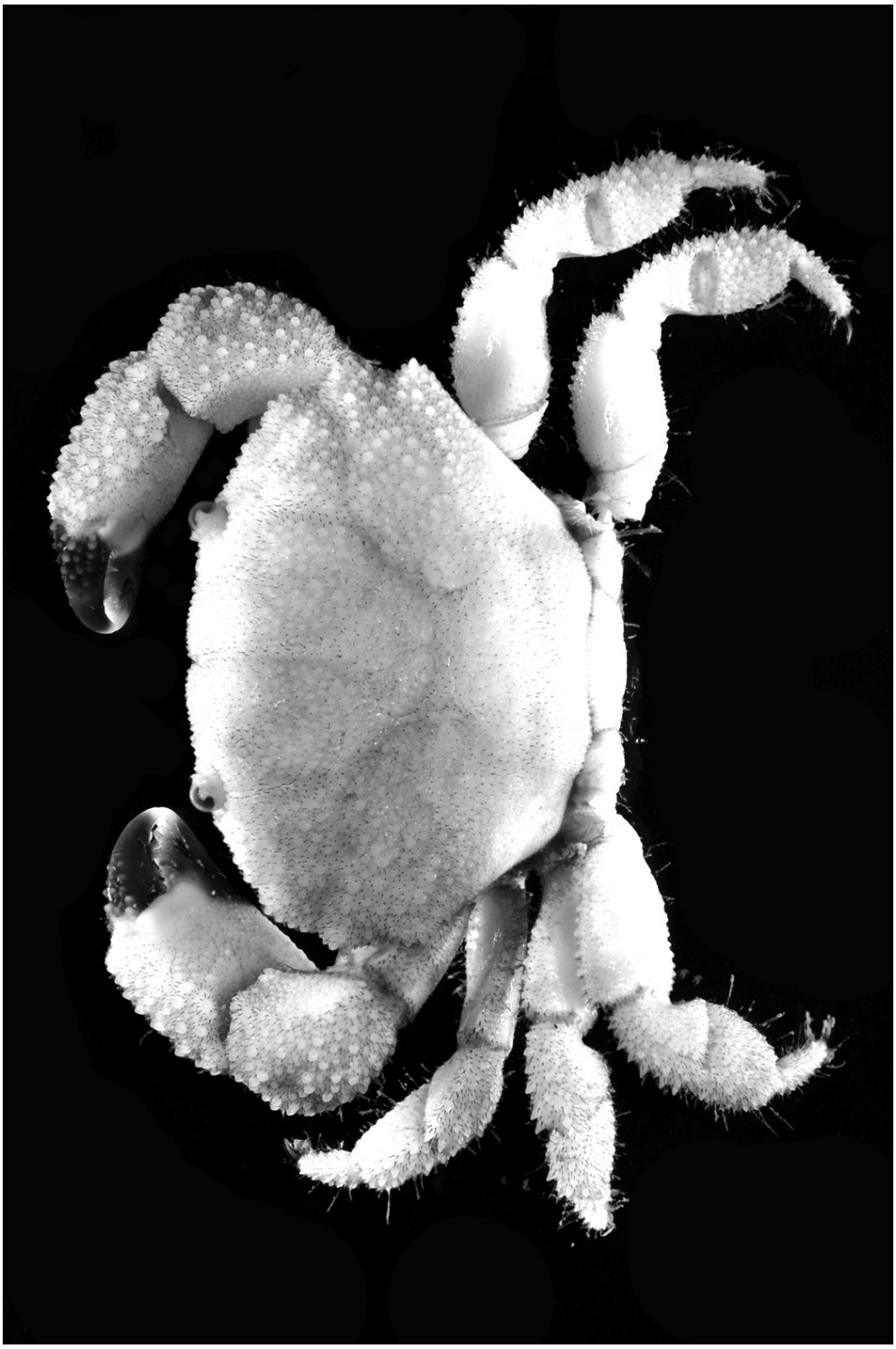

Fig. 79. *Novactaea pulchella* A. Milne-Edwards, 1865, female, 17 × 11 mm, dorsal view.

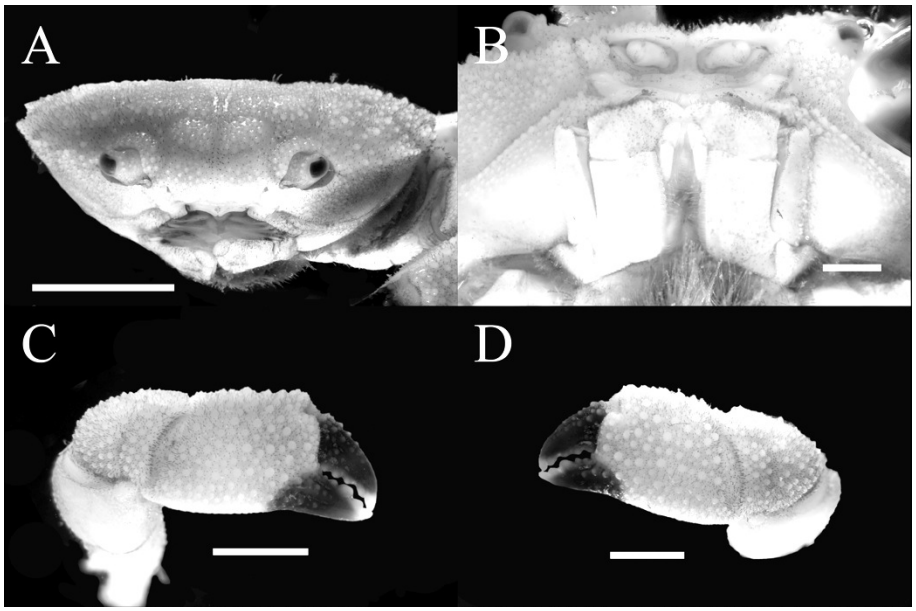

Fig. 80. *Novactaea pulchella* A. Milne-Edwards, 1865. A, Front, anterior view; B, The third maxillipeds, ventral view; C, Right cheliped, outer view, D, Left cheliped, outer view. Scale bars: A = 5 mm, B = 1 mm, C, D = 3 mm.

anterior margin serrated and with a broad median notch. Anterolateral margin bearing 4 lobes besides the outerorbital angle: the first depressed, posterior three subequal in shape; margin of each lobe beaded, with a few acute granules.

Third maxillipeds (Fig. 80B) completely covering buccal orfice; Merus subquadrate, granular, anterolateral angle not produced.

Chelipeds (Fig. 80C, 80 D) symmetrical, thickly covered with larger granules and interspersed with setae of carious lengths. Carpus with a short longitudinal groove near distal end of the outer surface, also with a transverse groove parallel to the outer-distal margin. Fingers stubby, bearing acute granules and longitudinal grooves on the dorsal surface and in proximal half of the outer surface; armed with 4 strong teeth on each inner edge; spoon-shaped at the tip.

Ambulatory legs short and stout, finely granulated and interspersed with long setae. Merus serrated along its anterior margin; carpus with a longitudinal groove on the upper surface.

Habitat. Crevices of rocks at low-tide mark.

Distribution. China, Japan, Singapore, Korea.

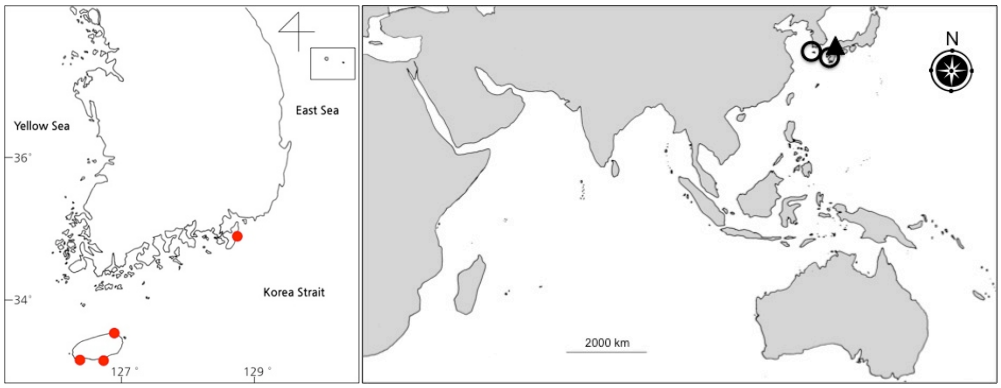

Fig. 81. Distribution of *Novactaea pulchella* A. Milne-Edwards, 1865. Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

26. *Pilodius nigrocrinitus* Stimpson, 1858 털가시부채게

Pilodius nigrocrinitus Stimpson, 1858, p. 34; Sakai, 1976, P. 461, fig. 248; Serène, 1984, p. 235; Dai & Yang, 1991, p. 330, pl. 43, fig. 166; Ko, 1999: 77.

Previous records of Korean fauna. Mosulpo (Ko, 1999)

Material examined. 3 inds., Hamo-ri, Seoguipo-si, Jejudo, 12 Aug. 2010, coll. H. S. Ko.

Diagnosis. Carapace (Figs. 83, 84A) approximately 1.6 times as broad as long; dorsal surface covered with black short setae and yellow long hairs. Front (Fig. 84B) broad, with 2 lobes, and U-shaped median notch. Anterolateral margin (Fig. 84A) composed of four lobes except for external outerorbital angle; tip of each lobe with 24 short spines.

Third maxilliped (Fig. 84C) without concave on anterior border of merus.

Chelipeds (Fig. 84E, 84F) asymmetrical; dorsal outer surfaces of carpus and palm with spines. Basal half of outer surface of movable finger armed with two rows

of spines; black pigmentation of immovable finger extending onto palm; tip of fingers deeply excavated, white.

Ambulatory legs (fig. 83) serrated on anterior margins of meri, propodi and carpi, thickly armed with long hairs, back short short setae, and acute granules.

Fifth and sixth, segments of male abdomen (Fig. 84D) rectangular; telson coniform.

First pleopod (Fig. 85) of male with hook-shaped end distally.

Type locality. Shimoda, Japan.

Distribution. Japan, Society Island, eastern Australia, and Korea.

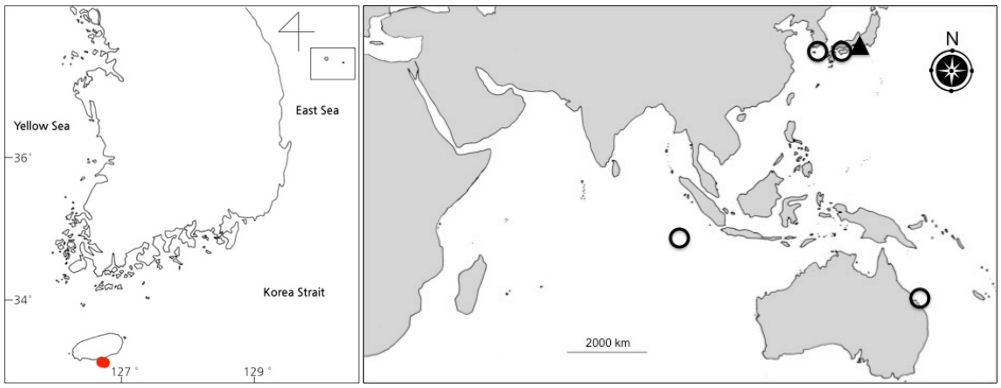

Fig. 82. Distibution of *Pilodius nigrocrinitus* Stimpson, 1858. Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

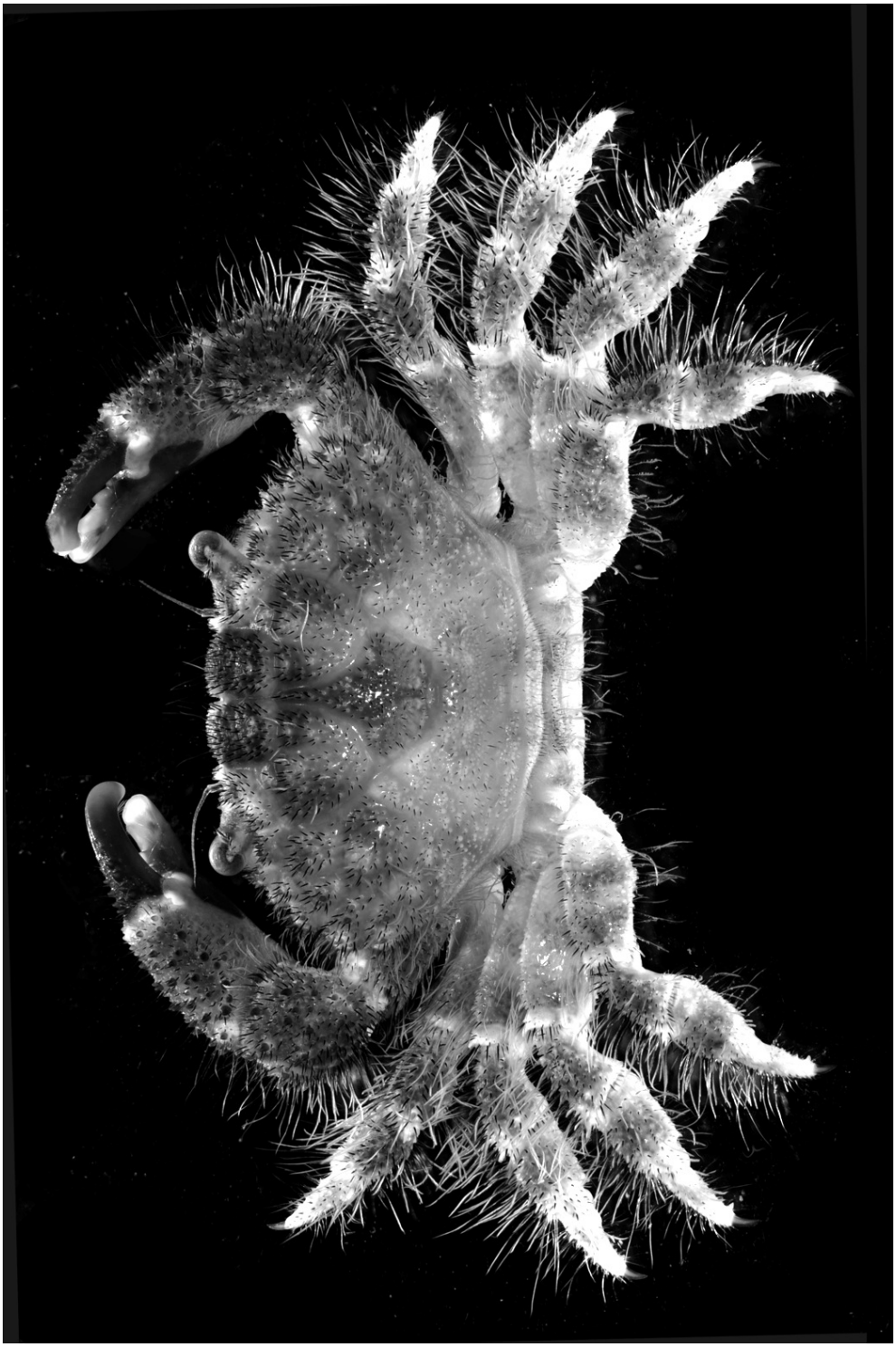

Fig. 83. *Pilodius nigrocrinitus* Stimpson, 1858, male, 13.8 × 8.8 mm, dorsal view.

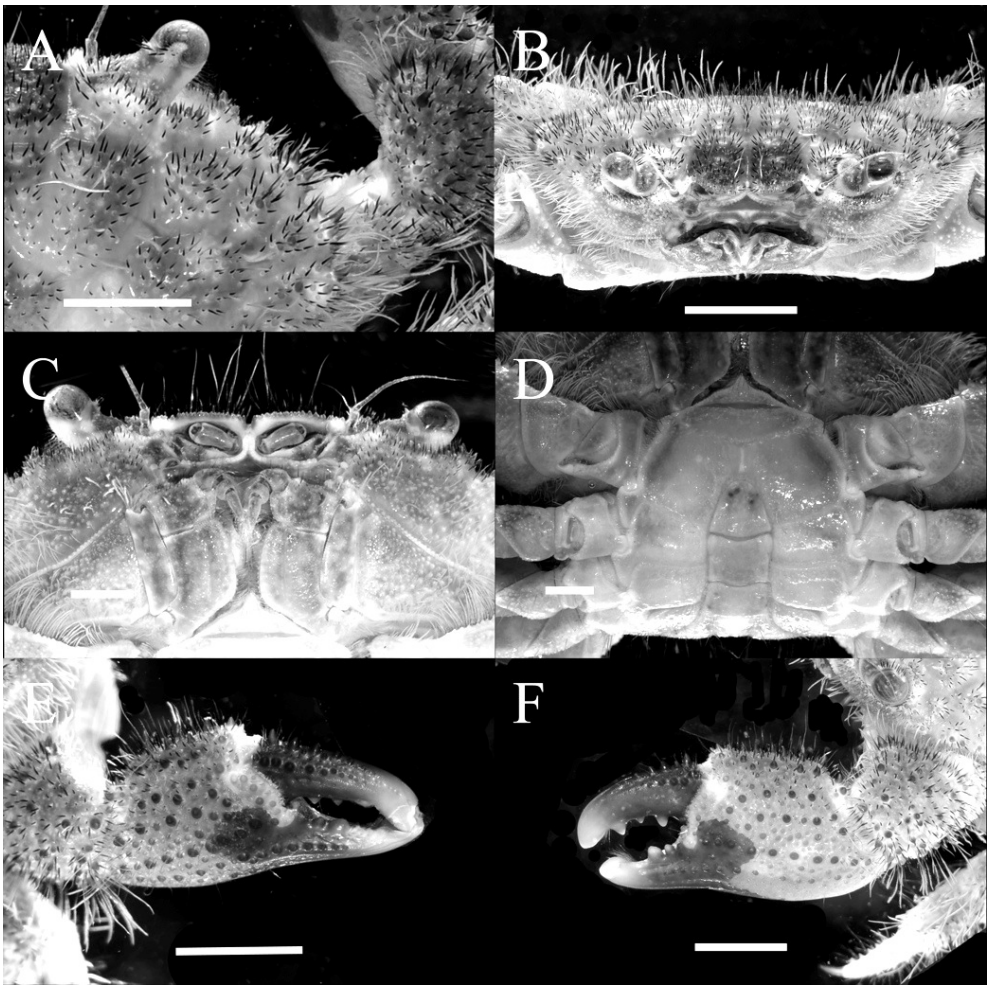

Fig. 84. *Pilodius nigrocrinitus* Stimpson, 1858. A, Anterolateral margin, dorsal view; B, Front, anterior view; C, The third maxillipeds, ventral view; D, Thoracic sternum and male Abdomen, ventral view; E, Right cheliped, outer view; F, Left cheliped, outer view. Scale bars: B, E, F = 3 mm, A = 2 mm, C, D = 1 mm.

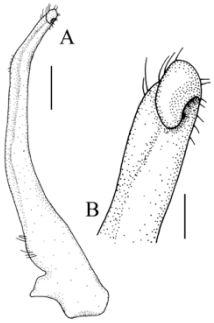

Fig. 85. Male gonopod of *Pilodius nigrocrinitus* Stimpson, 1858, external view. A, Whole; B, Distal portion. Scale bars: A = 1 mm, B = 0.2 mm.

Remarks. The genus *Pilodius* was extensively revised by Clark and Galil (1993) with description and illustrations of 43 species assigned to the genus. They stated that the genus Pilodius is at present composed of 15 species in Indo-West Pacific. The first pleopod of male is a very important criterion to distinguish the *Pilodius* species. The male pleopod of examined specimen have strongly recurved toward the base on distal portion, with a row of strong setae like cockscomb, as clearly figured by Sakai (1939), Serène & Luom (1958, 1959), Dai & Yang (1991), Clark & Galil (1993).

27. *Pilodius miersi* (Ward, 1936) 검은손부채게

Chlorodopsis miersi Ward, 1936: 4, Pl. 2, figs. 1-3.

Pilodius granulatus (not Stimpson, 1859): Sakai, 1976: 460, Pl. 164, fig. 3; Serène, 1984: 239 (key); Dai & Yang, 1991: 329, Pl. 43(3), fig. 165B.

Pilodius miersi: Clark & Galil, 1993: 1136, figs. 7A-G, 34A, 41D; Lee & Ko, 2011: 187.

Previous records of Korean fauna. Hyeongjeseom Is. (Lee & Ko, 2011)

Materials examined. 1 ind., Hyeongjeseom Is., 16 Jun 2009, Ko HS, SCUBA at 25 m depth. 1 ind., Andeok-myeon, Gyeongsangbuk-do, 17 Jan. 2009.

Diagnosis. Carapace (Figs. 86, 87A) convex, approximately 1.7 times broader than long; regions well defined, separated by strong furrows, covered with irregularly granules and setae. 1M produced, with 3 spines anteriorly. 2M divided into longitudinally. Anterolateral margins with 4 spines, tuberculated. Posterolateral margins oblique, somewhat straight. Frontal (Fig. 87B) margin arched, cut into 2 lobes by U-shape notch. Third maxilliped (Fig. 87C) punctuated on surface; Ischium subrectangular; merus with setae on inner margin; antero-external angle produced.

Thoracic sternum (Fig. 87D). Sternites 1,2 completely fused, separated from sternit 3 by distinct suture.

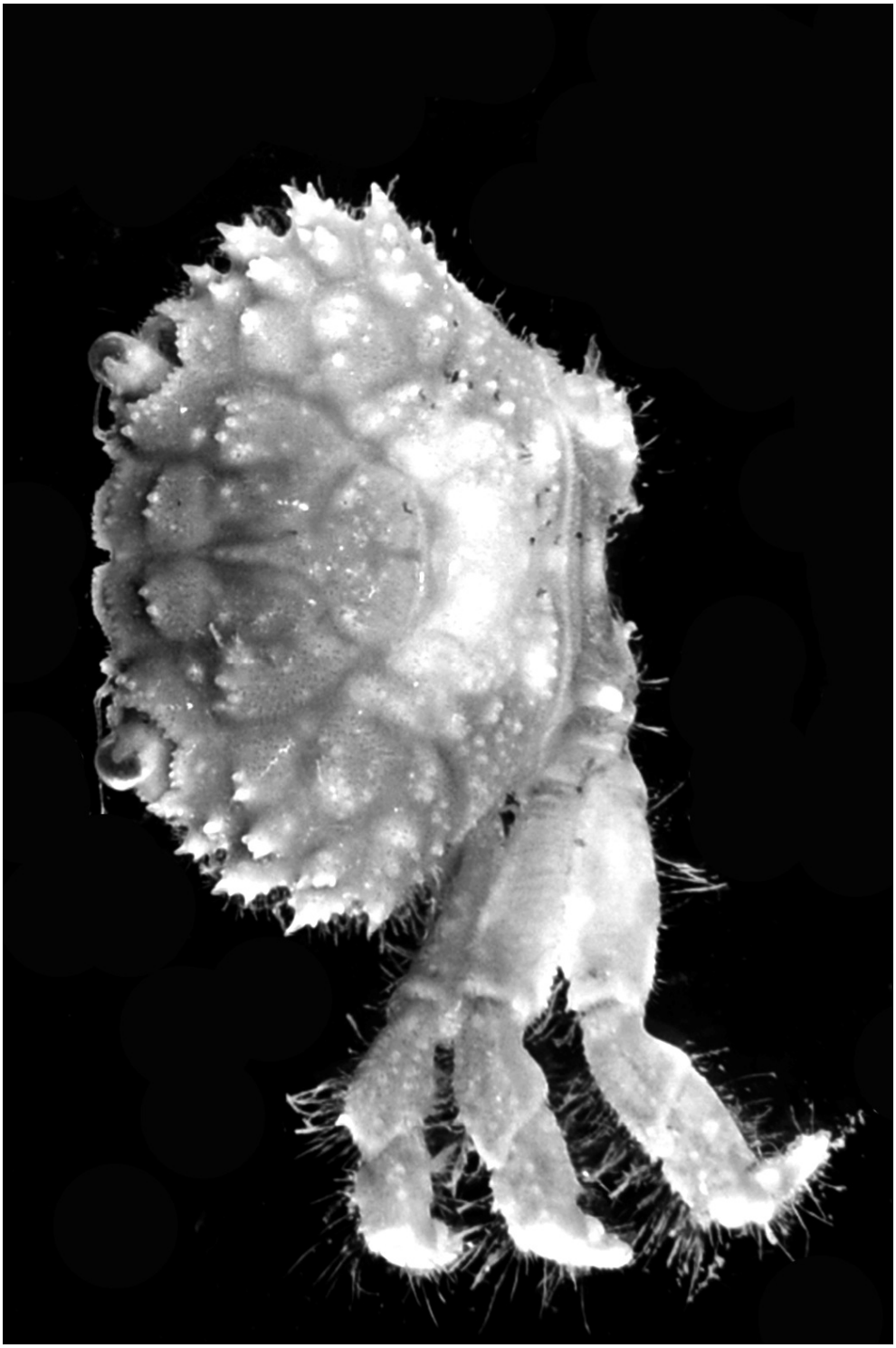

Fig. 86. *Pilodius miersi* (Ward, 1936), male, 14.2 × 9.3 mm, dorsal view.

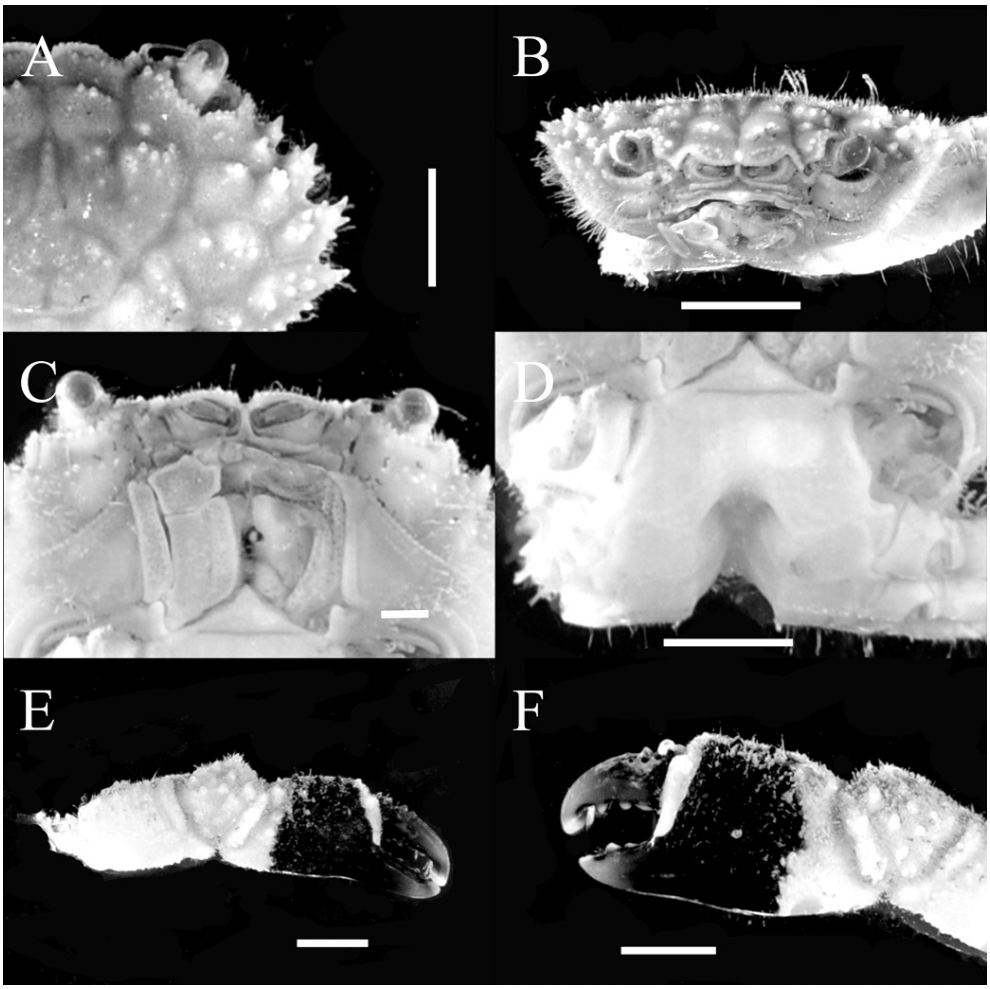

Fig. 87. *Pilodius miersi* (Ward, 1936). A, Anterolateral margin, dorsal view; B, Front, anterior view; C, The third maxillipeds, ventral view; D, Thoracic sternum; E, Right cheliped, outer view, F, Left cheliped, outer view. Scale bars: A, B, F = 3 mm, D, E = 2 mm, C = 1 mm.

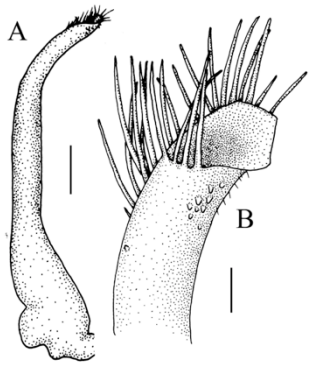

Fig. 88. Male first gonopod of *Pilodius miersi* (Ward, 1936), external view. A, Whole; B, Distal portion. Scale bars: A = 0.5 mm, B = 0.1 mm.

Chelipeds (Fig. 87E, 87 F) asymmetrical; propodus long, slender, conical tubercles over upper surfaces while lower surfaces naked, black colored band encircled except distal margins; dactylus massive, tips bluntly pointed, black colored.

Ambulatory legs generally short, robust, covered with granules and setae; meri with spines on anterior margins; dactyli with spines on both margins, dactyls pointed end, tips curved, black colored.

Male abdomen relatively narrow; segments 3 to 5 fused; lateral margins slightly concaved. Telson coniform.

Male first gonopod (Fig. 88) slender; proximal parts of both margins with setae; spoon-shaped tip, setose, with spines disto-medially.

Habitat. Crevices of coral reef.

Distribution. Australia, China, Japan, Singapore, Korea.

Remarks. The exmamined specimen agrees well with the description of Clark & Galil (1993), and has a dactyl-propodal articulation on distal propodus of ambulatory legs and coxal genital openings. These two character is represented by subfamily Chlorodiellinae Ng & Holthuis, 2007.

28. *Danielea noelensis* (Ward, 1934) 잔물결부채게

Medaeus noelensis Ward, 1934: 17, Pl. 1, fig. 1.

Paramedaeus noelensis: Sakai, 1976: 426, fig. 224; Serène, 1984: 90, Pl. 12F, fig. 51.

Danielea noelensis: Ng & Clark, 2003: 142, fig. 4; Ng et al., 2008: 198; Lee et al., 2012; 121.

Material examined. 1 ind., Beomseom Is., Jejudo, 6 Jun 2001.

Diagnosis. Carapace (Figs. 89, 90A) transversely oval; dorsal surface gently

convex; regions densely covered with small, evenly sized rounded granules. Front (Figs. 89, 90A) weakly produced, divided into two broad lobes by small, narrow fissure. Orbits (Figs. 89, 90A) subparallel with frontal margin; inner supraobital tooth low and rounded; external orbital tooth low and undiscernible. Eyestalk granulated. Anterolateral border (Figs. 80, 90A) with four broad teeth; first tooth very low; next three teeth low, each with median prominence. Posterolateral border (Fig. 90A) gently convex to almost straight, wider than frontal margin. Basal antennal segment subrectangular, free but filling orbital hiatus. Surface of third maxilliped (Fig. 90D) densely covered with evenly sized small rounded granules; merus squarish and rather projecting on anteroexternal angle. Thoracic sternum (Fig. 90E) relatively broad, surface entirely; suture between sternites 2 and 3 welldeveloped, complete; suture between sternites 3 and 4 prominent but becoming shallow medially.

Chelipeds (Fig. 90B, 90C) elongate; outer surfaces densely covered with evenly sized granules. Dorsal margin of merus granular. Carpus rounded rugose on dorsal surface, inner angle with one prominent rounded tooth and several tubercles anteriorly. Propodus with prominent uneven, almost subpetaloid crest on subdorsal inner surface. Right cheliped with two teeth and pronounced curved basal cutting tooth on cutting edge of dactylus. Left cheliped with fingers more slender, cutting edges blade-like, each with two or three teeth and two or three denticles.

Ambulatory legs (Fig. 90F, 90G) with all segments unarmed, almost glabrous; surfaces densely covered with evenly sized small rounded granules. Merus entirely cristate on anterior margin. Carpus with distal part of dorsal margin subcristate, produced into rounded tooth.

Abdomen of male (Fig. 90I) with segments 3-5 completely fused, sutures separating segments not discernible, lateral margins entire, without clefts; segments 1-3 trapezoidal, segment 6 rectangular, lateral margins gently concave, subparallel; telson semicircular, lateral margins distinctly convex, tip rounded; surfaces of all segments covered with numerous small evenly sized granules.

Fig. 89. *Danielea noelensis* (Ward, 1934), male, 14.3 × 9.5 mm, dorsal view.

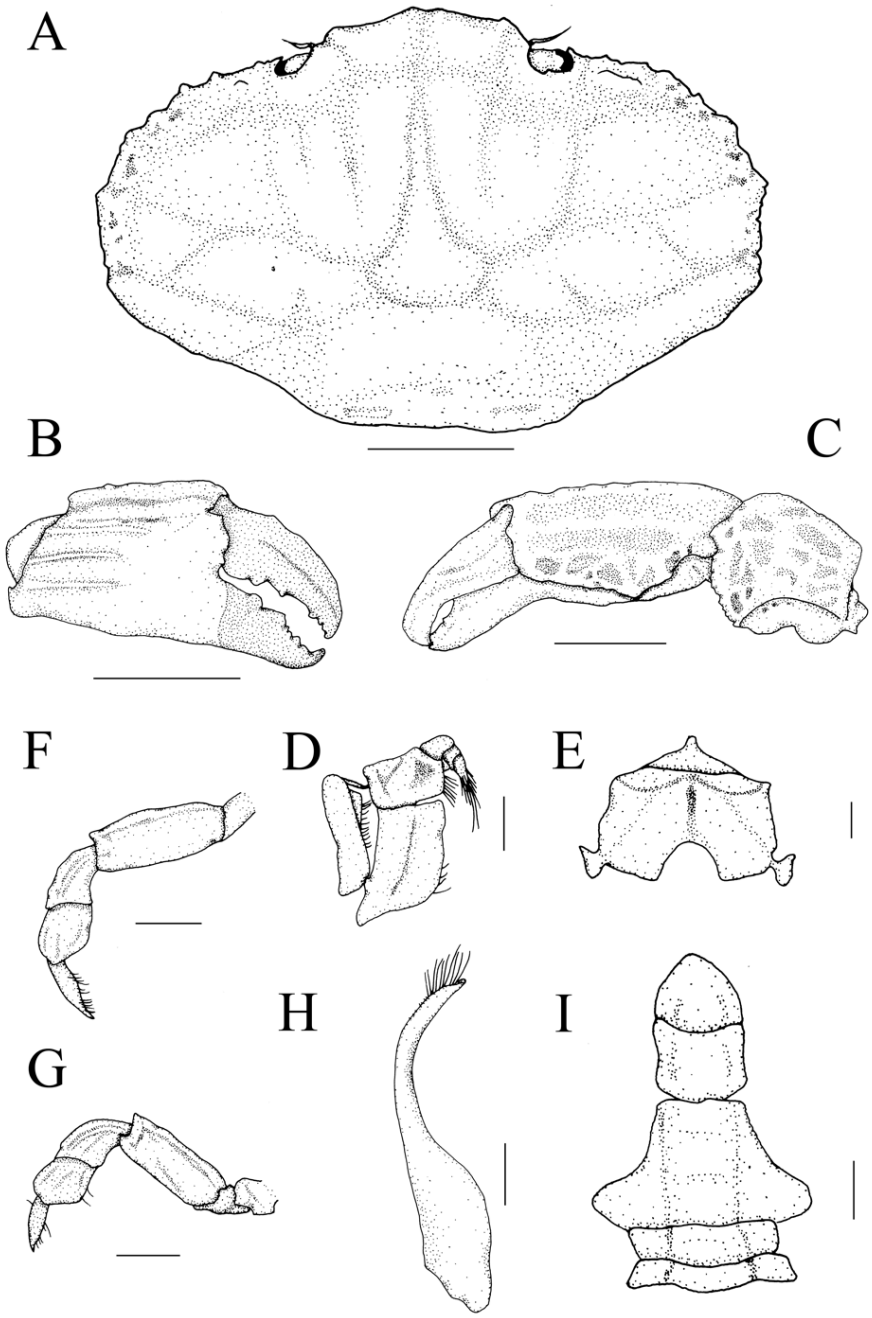

Fig. 90. *Danielea noelensis* (Ward, 1934). A, Carapace, dorsal view; B, Right cheliped, outer view; C, Right cheliped, dorsal view; D, Right 3rd maxilliped; E, Sternites 1-4; F, 3rd ambulatory leg, dorsal view; G, 4th ambulatory leg, dorsal view; H, Left first gonopod, ventral view; I, Abdomen of male. Scale bars: A, C=3 mm, B=5mm, D, E, I=1 mm, F, G=2 mm, H=0.5 mm.

First gonopod of male (Fig. 90H) relatively stout, gently curved, tip blunt; lateral margins lined with short spines and long plumose setae on disto-dorsal margin.

Distribution. Christmas Island, Japan, Madagascar, Mauritius, Philippines, Red Sea, Samoa, Tahiti, and Korea.

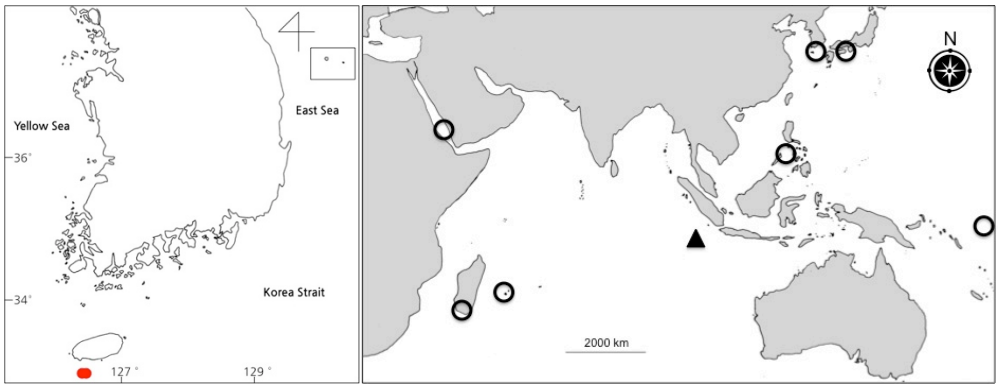

Fig. 91. Distribution of *Danielea noelensis* (Ward, 1934). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. The present specimen agrees well with the description of Ng & Clark (2003) except for antero-external angle of merus of third maxilliped (Fig. 90D). In their *Danielea noelensis*, antero-external angle is not projecting but that of the present specimen is rather projecting. *Danielea noelesis* is similar to *Medaeops granulosus* (Haswell, 1882) in Korean fauna. These two species have lamelliform surfaces of the carapace and the upper margins of the chelipeds, and cristiform on the anterior margin of the merus of each ambulatory leg. However, *D. noelensis* bears almost subpetaloid crest on subdorsal inner surface of the right cheliped while *M. granulosus* does not have this crest.

29. *Medaeops granulosus* (Haswell, 1882) 두드러기부채게

Leptodius granulosus Haswell, 1882: 61.

Medaeus granulosus: Odhner, 1925: 81; Forest & Guinot, 1961: fig. 45; Kim, 1970: 14.

Medaeops granulosus Guinot, 1967: Kim, 1973: 382; Sakai, 1976: 425, pl. 153, fig. 3; 전 등, 2001a: 238, 250; Kim & Kim, 1982: 133; Serène, 1984: 91(key); Dai & Yang, 1991: 295, fig. 155B(3), pl. 37(7); Takeda et al., 2000: 137; Rho & Kim, 2004:456.

Previous records of Korean fauna. Incheon, Yeosu, Duckjeukdo Is., Sinan, Jindo (Kim, 1973; 전 등, 2001a; Kim & Kim, 1982; Rho & Kim, 2004)

Material examined. 15 inds., Geojedo, Gyeongsangnam-do, 7 Jul. 1996; 1 ind., Namhaedo, Gyeongsangnam-do, 30 Jun. 1998; 4 inds., Taean, Chungcheongnam-do, 15 Jun. 2000; 4 inds., Sopyuong-do, 26 Jun. 2002; 1 inds., Geomundo, Jeollanam-do, 27 Jun. 2002; 1 ind., Yeonpyeongdo Is., Gyeonggi-do, 30 Mar. 2001; 1 ind., Ulreungdo Is., Gyeongsangbuk-do, 27 Mar. 2009; 4 inds., Port Jukjin, Gyeongsangbuk-do, 26 Mar. 2009.

Diagnosis. Carapace (Figs. 92, 93A) hexagonal, about 1.5 times as broad as long; surface convex in anterior two-thirds; regions well defined. Front (Fig. 93B) markedly produced beyond inner-orbital tooth cut into 2 truncated lobes by median notch, separated from inner-orbital tooth by notch. Anterolateral margin with 4 teeth beside outer-orbital tooth; first and fourth short and small, second and third broader; all teeth covered with granules. Antennal flagellum set in orbital hiatus. Merus of third maxilliped (Fig. 93C) covered with granules, outer-distal angle produced laterally.

Thoracic sternum (Fig. 93D) finely granular, glabrous.

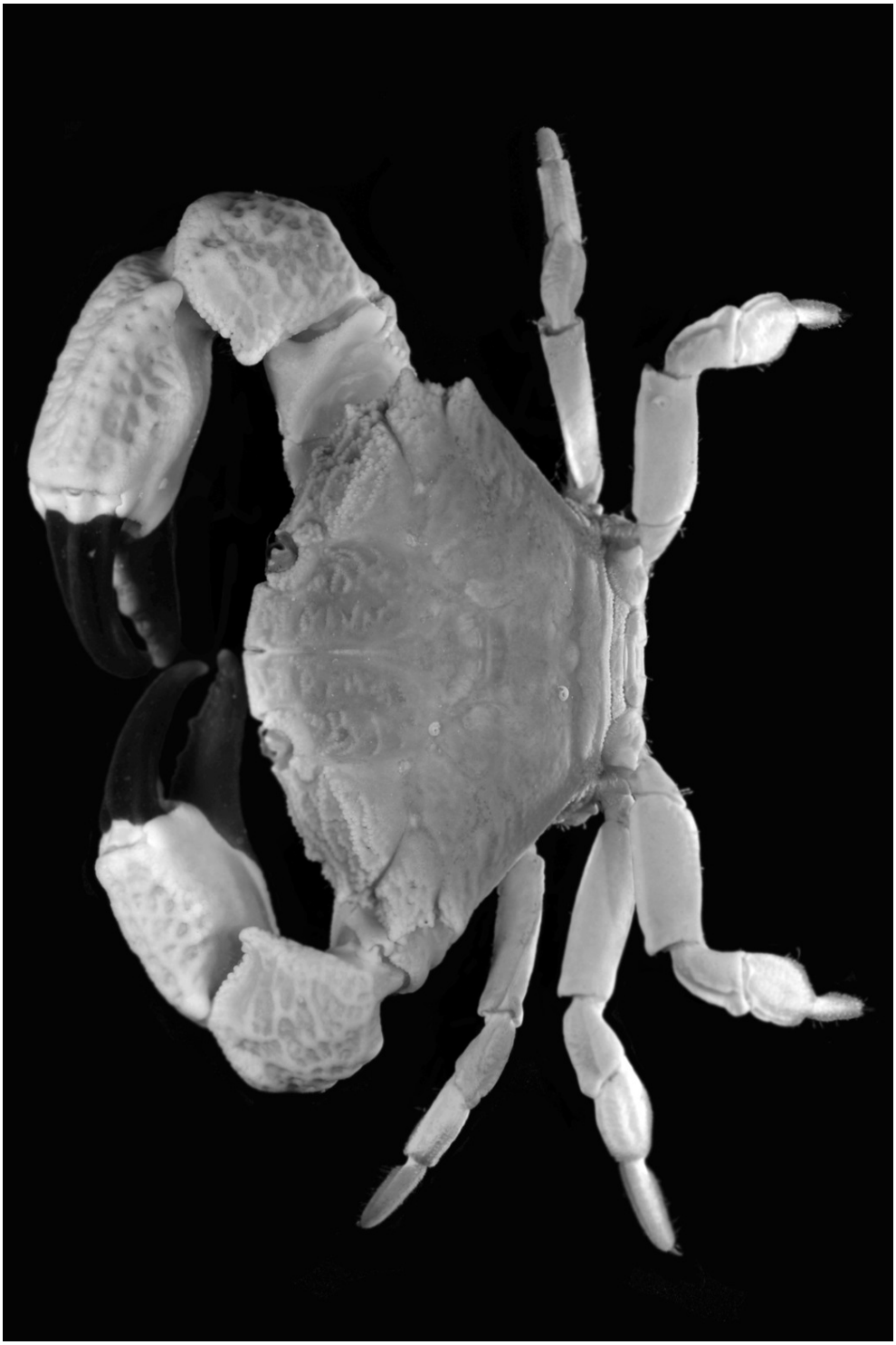

Fig. 92. *Medaeops granulosus* (Haswell, 1882), male, 25.5 × 16.8 mm, dorsal view.

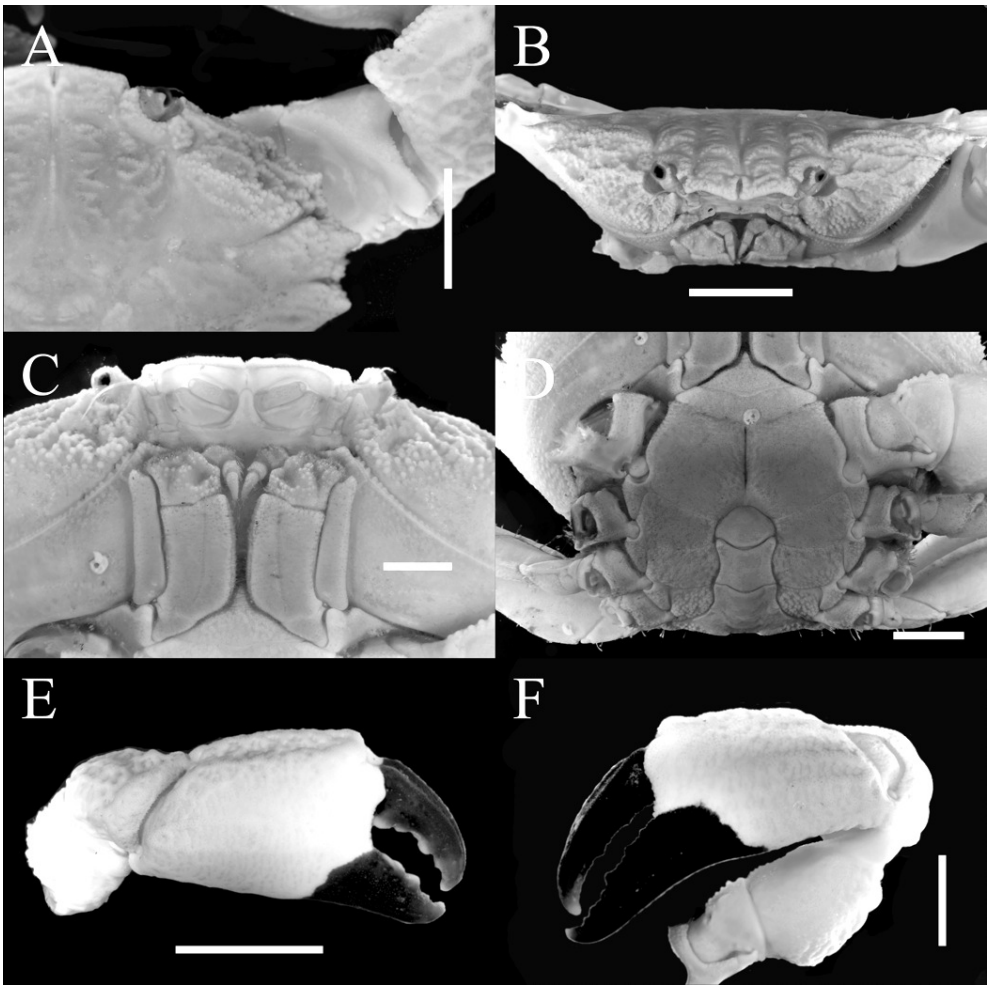

Fig. 93. *Medaeops granulosus* (Haswell, 1882). A, anterolateral margin, dorsal view; B, Front, anterior view; C, The third maxillipeds, ventral view; D, Thoracic sternum and male abdomen, ventral view; E, Right cheliped, outer view; F, Left cheliped, outer view. Scale bars: A, B, E = 5 mm, C = 2 mm, D = 3, F = 4 mm.

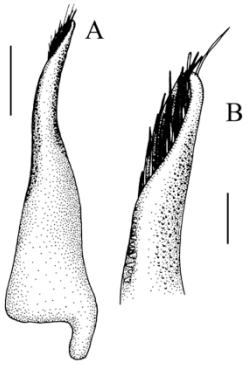

Fig. 94. Male first gonopod of *Medaeops granulosus* (Haswell, 1882), external view. A, Whole; B, Distal portion. Scale bars: A = 1 mm, B = 0.3 mm.

Chelipeds (Fig. 93E, 93F) asymmetrical. Merus with granulated ridges on dorsal margin. Carpus also covered with granules and pits except for inner surface. Propodus with dorsal surface similar to that of carpus, but outer surface with granules, of which those in middle arranged in 2 obscure carinae. Dactylus stout, armed with stout teeth of various sizes in inner margins, tip pointed.

Ambulatory legs with anterior margin crestiform; merus not serrated on dorsal margin; carpus and propodus with longitudinal granular carinae.

Male abdomen (Fig. 93D) pagoda-shaped; sixth segment slightly broader than long; telson subtriquetrous.

First pleopod of male (Fig. 94) stout; distal half with numerous inverse hook-shaped spines, distal end obtuse and armed with long feathered hairs.

Habitat. rocky or stony shore, at and below the tide-mark

Distribution. China; Japan; Korea; Australia; Mergui Arch.; Red Sea; and South Coast of Africa.

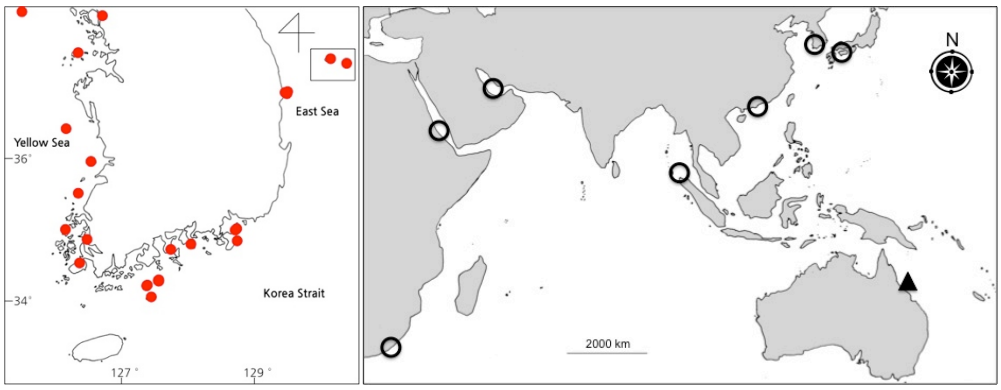

Fig. 95. Distribution of *Medaeops granulosus* (Haswell, 1882). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

***30. Etisus anaglyptus* H. Milne Edwards, 1834 돋음부채게**

Etisus anaglyptus H. Milne Edwards, 1834: 411; Sakai, 1976: 456, fig. 246; Serène, 1984: 219(key), 223(key), 228, Pl. 32A, fig. 137; Dai and Yang, 1991: 324, Pl. 42(3); Ng et al., 2008: 198; Lee et al., 2012: 120.

Material examined. 1 ind., Deokcheon-ri, Uljin-gun, Gyeongsangbuk-do, 25 Aug 2010, coll. T. S. Park, by SCUBA diving.

Diagnosis. Carapace (Figs. 96, 97A) transversely oval, about 1.46 times as broad as long; surface not smooth, slight rugose with sparse pits; regions well defined by grooves: gastriccardiac regions with H-shaped groove distinct. Front (Fig. 97A) narrow, produced, 0.15 times as broad as carapace width, divided into two lobes by V-shaped median notch. Orbital (Fig. 97A, 97B) complete, very narrow orbital hiatus being completely filled up by prolonged lobule from basal antennal segment; inner angle obtuse and outer angle tubercular; inner angle of ventral margin very produced and visible from above. Third maxilliped (Fig. 97C) completely covering buccal orifice; ischium subrectagular; merus subquadrate. Anterolateral border armed with four teeth exclusive of external orbital angle; first two obtuse, last two obtusely pointed and curved forward; transverse groove deepbehind last teeth.

Chelipeds (Figs. 96, 97D) covered with fine granules except for ventral surface. Carpus with three tubercles on dorsal surface, six tubercles on outer surface, and two tubercles on inner surface. Propodus weakly compressed and bearing four or five tubercles on superior border and about six smaller ones on outer surface. Dactylus with four teeth on either inner margin; tip spoon-shaped, with a tuft of setae.

Ambulatory legs (Fig. 97E, 97F) stubby, with long hairs along both margins; merus and carpus with granular spines on anterior margins; carpus with granulated ridge on dorsal surface; propodus and dactylus also covered with granular spines.

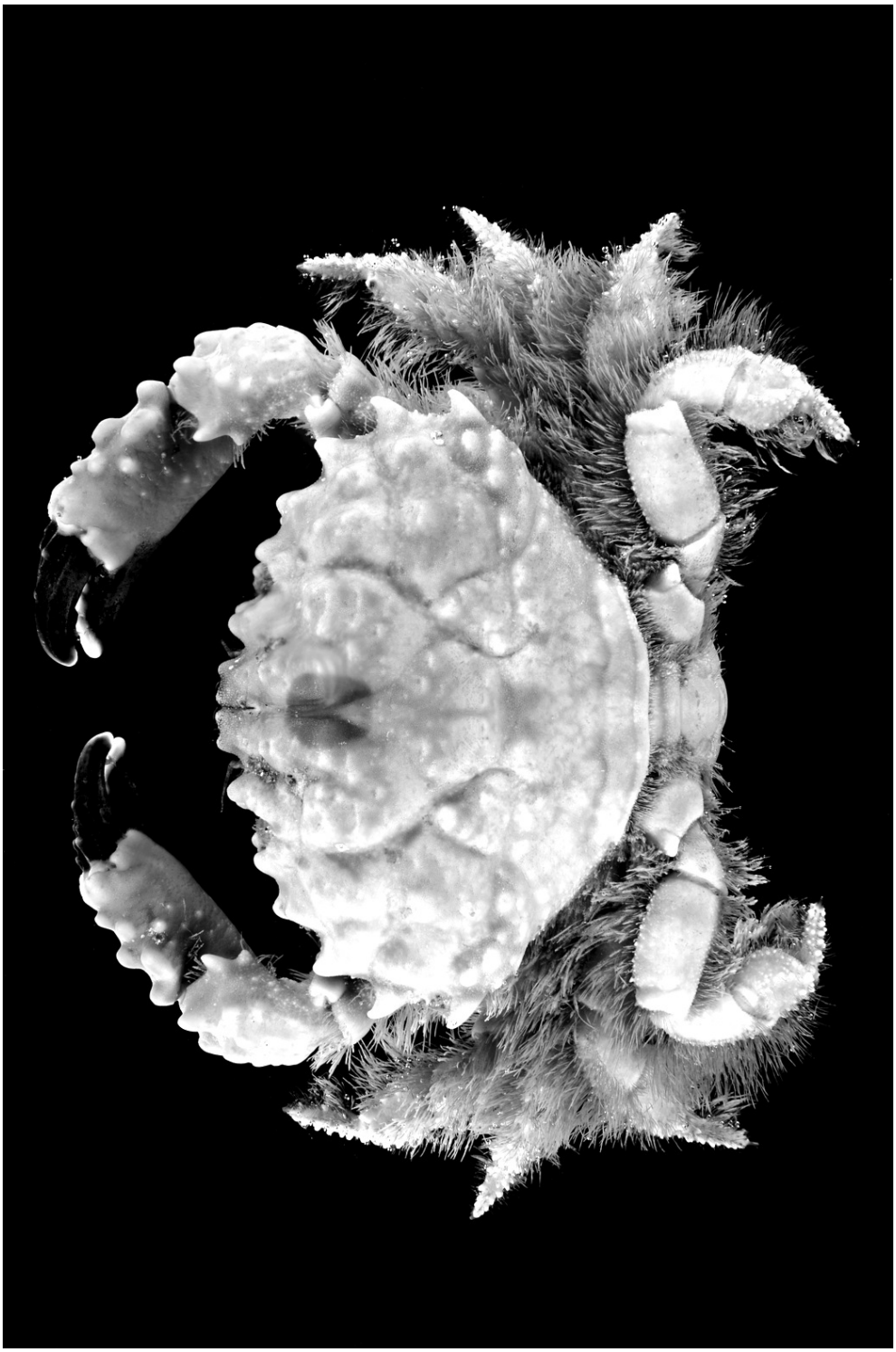

Fig. 96. *Etisus anaglyptus* H. Milne Edwards, 1834, female, 37.5 × 25.6 mm, dorsal view.

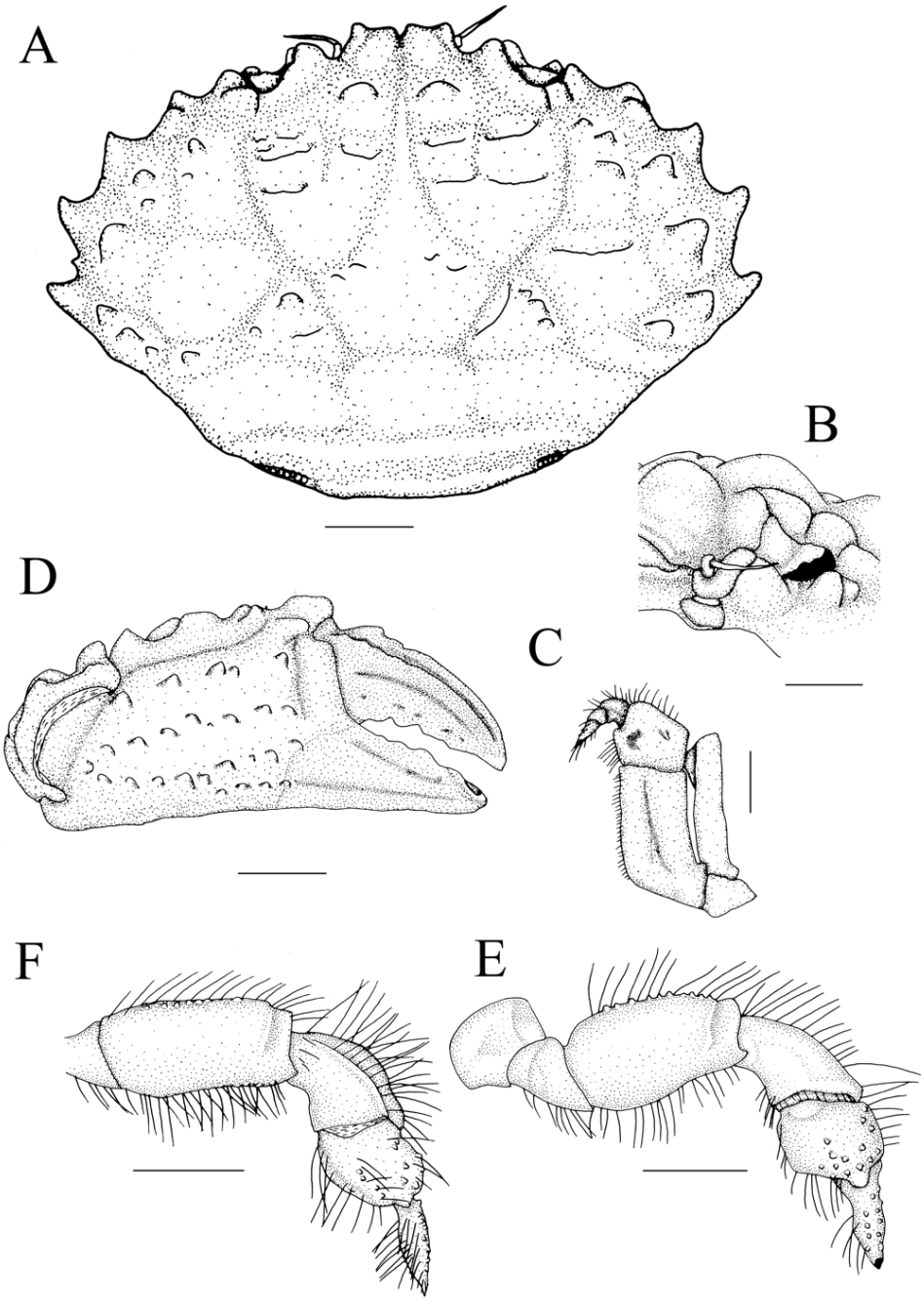

Fig. 97. *Etisus anaglyptus* H. Milne Edwards, 1834. A, Carapace, dorsal view; B, Basal antenna segment, frontal view; C, Left third maxilliped; D, Right cheliped, outer view; E, Third ambulatory leg, dorsal view; F, Fourth ambulatory leg, dorsal view. Scale bars: A, D, F = 5 mm, B, C = 3 mm.

Habitat. Rocky or stony beaches, under stones or in crevices of rocks, shallow waters.

Distribution. Australia, China, India, Japan, Madagascar, Red Sea, Samoa, Taiwan, Vietnam, and Korea.

Remarks. According to Dai and Yang (1991), and Sakai (1976), E. anaglyptus has an elongated basal antennal segment occupying the orbital hiatus, feebly developed frontal margin from the supra-orbital angles, and numerous long setae and granular spines on ambulatory legs. The characteristics of the present specimen agree well with their description.

31. *Palapedia integra* (De Haan, 1835) 접시부채게

Cancer (*Xantho*) *integra* de Haan, 1833-1849 (1837): 66, pl. 18, fig. 6.
Kraussia integra: Sakai, 1976a: 308, fig. 172a; Dai & Yang, 1991: 191, fig. 103(1), pl. 23(5); Muraoka, 1998: 31.
Palapedia integra: Ng, 1993: 141; Ko & Takeda, 1999: 78.

Previous records of Korean fauna. Udo Is., Moseul-po (Ko & Takeda, 1999)

Material examined. 2 inds., Sungsan-po, Jejudo, 22 Jun. 1905; 1 ind., Beomseom Is., Jejudo, 6 Jun. 2001; 1 ind., Ulreungdo Is., Gyeongsangbuk-do, 25 Jul. 2001; 1 ind., Seoguipo, Jejudo, 17 Apr. 2002; 4 inds., Munseom Is., Jejudo, 10 Jul. 2003.

Diagnosis. Carapace (Fig. 98, 99A) transversely oval, convex; dorsal surface smooth; regions faintly recognizable. Frontal (Fig. 99B) margin with acute teeth, cut into 4 lobes by 3 shallow notches, the median one narrower and the lateral one broader, confluent with inner dorsal orbital tooth. Dorsal margin of orbital with

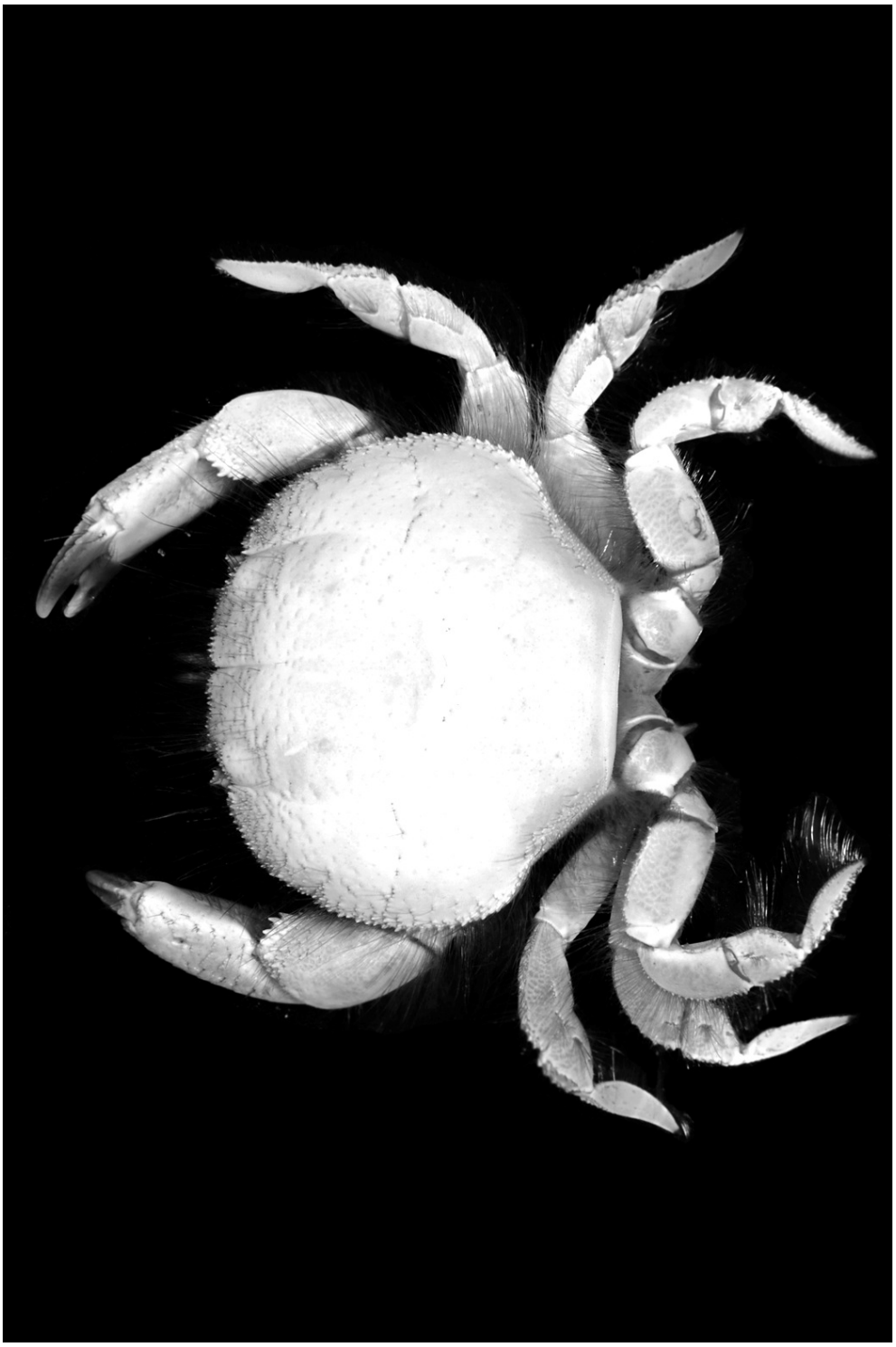

Fig. 98. *Palapedia integra* (De Haan, 1835), male, 14.4 × 11.9 mm, dorsal view.

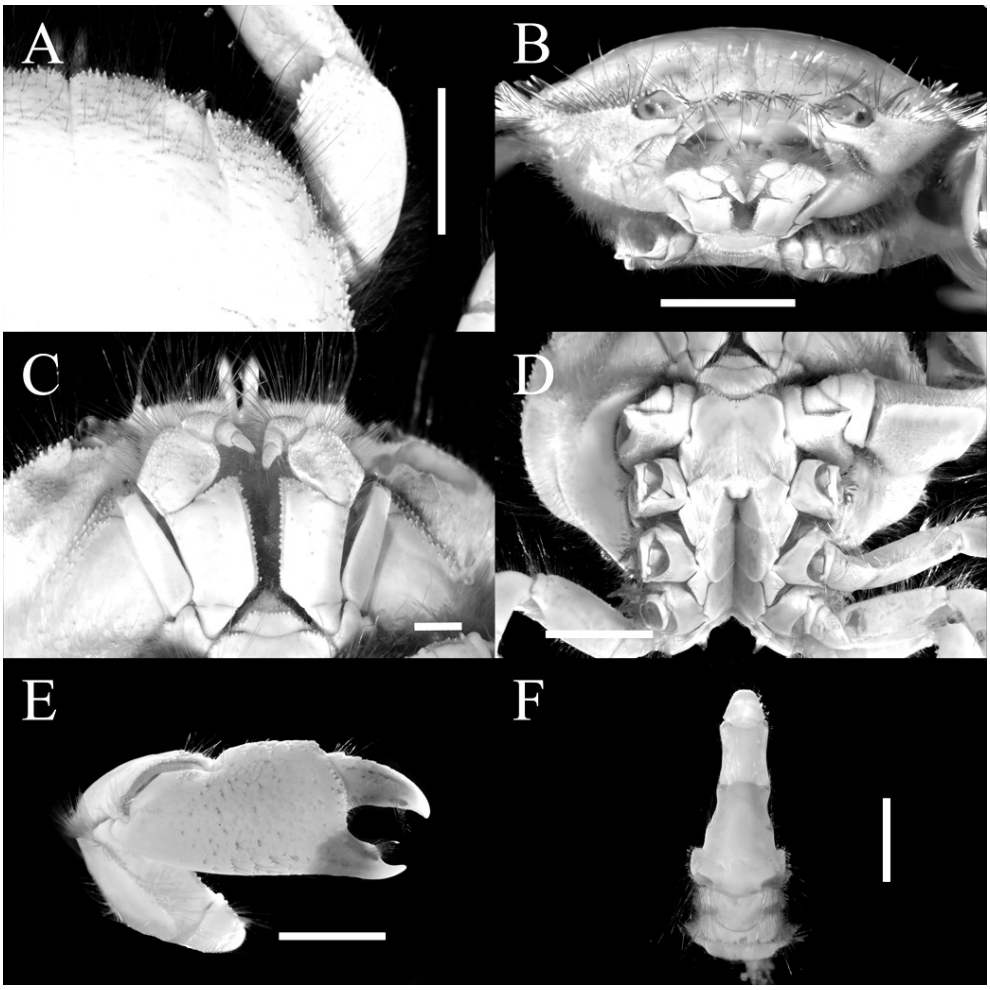

Fig. 99. *Palapedia integra* (De Haan, 1835). A, Anterolateral margin, dorsal view; B, Front, Epistome, and Pterygostomian region; C, The third maxillipeds, ventral view; D, Thoracic sternum, ventral view; E, Right cheliped, outer view; F, Male abdomen, ventral view. Scale bars: B = 4 mm, A, D, E = 3 mm, F = 2 mm, C = 1 mm.

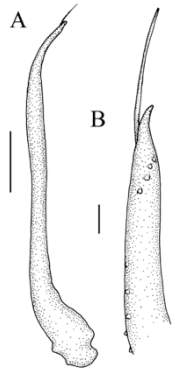

Fig. 100. Male first gonopod of *Palapedia integra* (De Haan, 1835), external view. A, Whole; B, Distal portion. Scale bars: A = 10 mm, B = 0.1 mm

acute teeth and a hiatus at the median. Anterolateral margin obtusely serrated, bearing a shallow notch at the anterior one-third fringed with filiform setae.

Third maxillipeds (Fig. 99C). Merus subquadrate, granular. Ischium subrectabular without submedian sulcus.

Thoracic sternum (Fig. 99 D) narrow. Sternite 3, 4 not fused.

Chelipeds (Fig. 99E) stout. Carpus with granules in distal portion of dorsal surface. Manus smooth on inner side, but covered with pits and patches of setae in basal half. Movable finger of major cheliped with stout tooth at base of inner margin; immovable finger with 2 mortal-shaped teeth in basal half of inner margin, of which basal one indistinct.

Ambulatory legs stout, with obtuse granules on anterior margin of the propodus and carpus; anterior margins of dactylus blade-shaped, slightly concave on anterior margin.

Male abdomen (Fig. 99F) narrow and elongate, third to fifth segments fused; sixth segment subcylindrical; telson subconiform.

First pleopod of male (Fig. 100) slender and elongate, distal one curved, distal end tapering and venterally directed, dorsal surface armed with one long setae at subdistal end and the ventral surface covered with granular denticles.

Habitat. Sand or under stones, intertidal zone.

Distribution. China, Japan, Solomon Is., Philippines, and Andaman Is., Korea.

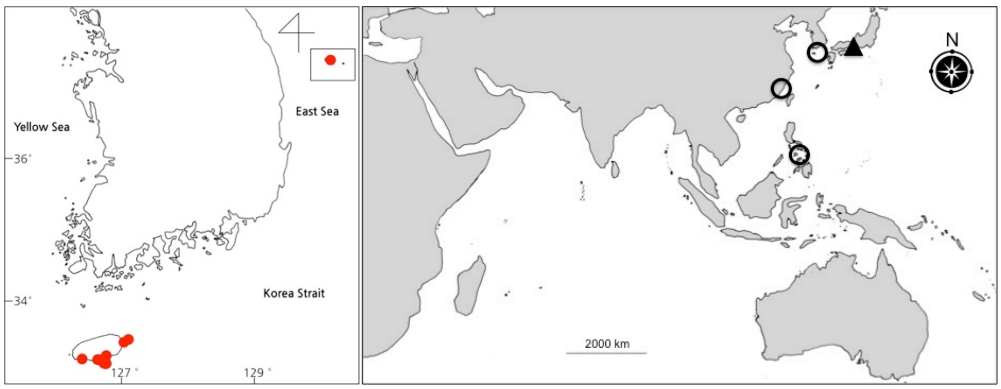

Fig. 101. Distribution of *Palapedia integra* (De Haan, 1835). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. The examined specimens agree well the description of De Haan (1835), Sakai (1976), Serène (1972), and Dai & Yang (1991). The male first pleopod is referred to Saki (1939), Buitendijk (1960) and Serène (1972). In Korea, this species have been mainly occurred Jejudo Island, but just one specimen was collected from Ulreung Island. The author examined again this specimen collected from Ulreungdo Island, but the specimen has not any variation with others collected from Jejedo Island.

32. *Liomera magaritata* (A. Milne-Edwards, 1873) 주름부채게

Carpilodes margaritatus Milne Edwards A., 1873: 182, pl. 5, fig. 2; McNeill, 1968: 74.

Liomera margaritata: Sakai, 1976: 396, fig. 211; Dai & Yang, 1991: 271, fig. 145(2), pl. 34(2); Lee & Ko, 2011: 185.

Liomera (*Liomera*) *margaritata* Serène, 1984: 63, fig. 23, pl. 7A.

Chlorodius exiguus Targioni: Odhner, 1925: pl. 5, figs 8, 8a.

Material examined. 1 ind., Andeok-myeon, Gyeongsangbuk-do, 17 Jun. 2009, coll. H. S. Ko.

Diagnosis. Carapace (Fig. 102, 103A) about 1.7 times as broad as long; dorsal surface covered with pearl-shaped grnules on anterior half; regions well defined, longitudinally divided into 2 lobules. Front (Fig. 103B) with granules on margins, divided into 2 lobules by median V-shaped notch; each lobule with lateral side dentiform, separated by fine furrow from innerorbital tooth. Anterolateral margin cut into 4 lobules: first two obtuse, last two more prominent. Third maxillipeds (Fig. 103C) with the merus distinctly shorter than ischium.

Thoracic sternum (Fig. 103D). Sternite 3, 4 almost completely fused except for short notch laterally.

Chelipeds (Fig. 103E) short, symmetrical, covered with dense pearl-shaped granules. Carpus with 2 teeth at inner angle. Manus smaller and thinner than carpus,

bearing 2 longitudinal granular carinae and longitudinal groove on outer surface. Finger with distinct grooves and carinae on surface, armed with stout teeth on cutting edges, tip slightly hollow.

Ambulatory legs also covered with pearl-shaped granules. Merus and carpus with anterior margin sharp, latter marked with indistinct longitudinal grooves; dactylus relatively long.

Male abdomen(Fig. 103F) narrowly triangular; sixth segment square, shorter than of telson, latter coniform

First pleopod of male (Fig. 104) with slantingly truncated tip, outer-distal and pointed; armed with long feathery hairs on inner-side and with small acute granules on outer side.

Habitat. crevices of coral reef or under stones, just below low-tide mark.

Distribution. China, Japan, New Caledonia, Samoa, New Guinea, Sumatura, Amboina Is., Red Sea, and Madagasca.

Remarks. The genus *Liomera* is characterized with smooth or granular or stippled of the carapace, chelipeds, sterna plastron and abdomen. It differs from Genus *Actiomera* bearing finely granular and punctuate on those of them. *L. magaritata* is very similar with *Actiomera erythra* by the shape of carapace. *L. magaritata* has fused 1F and 2F while *A. erythra* shows divided 1F and 2F.

Fig. 102. *Liomera magaritata* (A. Milne-Edwards, 1873), male, 26.2 × 15.6 mm, dorsal view.

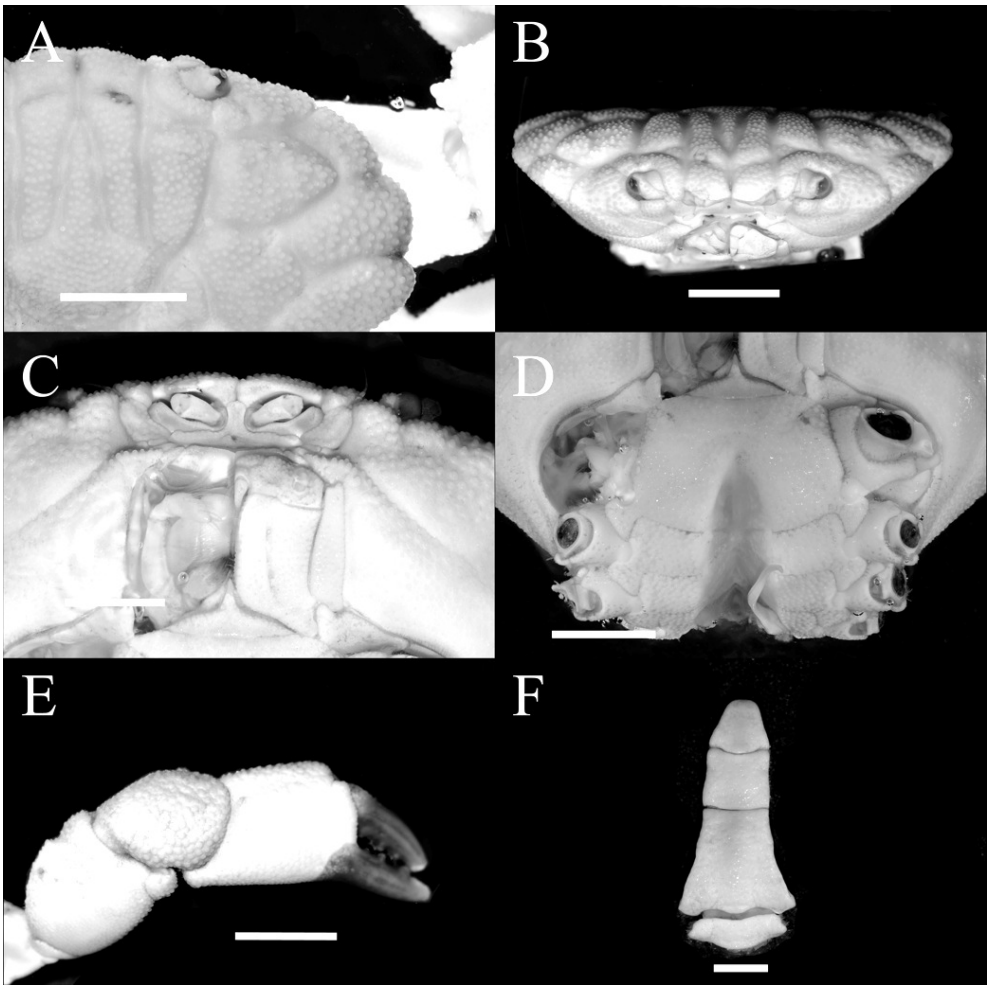

Fig. 103. *Liomera magaritata* (A. Milne-Edwards, 1873). A, Anterolateral margin, dorsal view; B, Front, anterior view; C, The third maxilliped, ventral view; D, Thoracic sternum, ventral view; E, Right cheliped, outer view; F, male abdomen, ventral view. Scale bars: A, B = 5 mm, E = 6 mm, C, D = 3 mm, F = 2 mm.

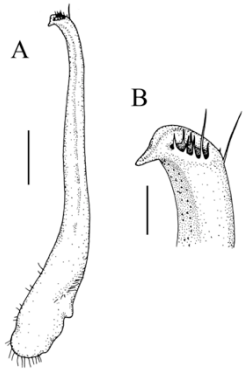

Fig. 104. Male first gonopod of *Liomera magaritata* (A. Milne-Edwards, 1873), external view. A, Whole; B, Distal portion. Scale bars: A = 10 mm, B = 0.25 mm.

33. *Neoliomera insularis* (Adams & White, 1848) 꼬마매끈이송편게

Atergatis insularis Adams & White, 1848: 38, pl. 8, fig. 2.

Neoliomera insularis: Odhner, 1925: 32, pl. 2, fig. 14; Kim & Park, 1972: 57; Kim, 1973: 374, 629, fig. 139, pl. 82, fig. 105a-b; Sakai, 1976: 398, pl. 141, fig. 2; 김 등, 1979a: 103; Serène, 1984: 67(key), 68(key); Kim & Chang, 1985: 53; Kim, 1992: 256; 김 등, 1996: 413; Kim & Kim, 1998: 299.

Previous records of Korean fauna. Seogui-po, Geojedo, Ulreungdo Is., Hongdo Is., Hyun-po (Kim 1973; Kim & Chang, 1985; Kim & Park, 1972; Kim et al., 1979a; Kim, 1992; 김 등, 1996; Kim & Kim, 1998)

Material examined. 1 ind., Ulreungdo Is., Gyeongsangbuk-do, 15 Jul. 1989; 1 ind., Gwanuemdo Is., Ulreung-gun, Gyeongsangbuk-do, 16 Nov. 1990; 1 ind., Chaguido Is., Jejudo, 22 Oct. 1991; 3 inds., Rock Mulsae, Ulreung-gun, Gyeongsangbuk-do, 26 Sep. 2000; 1 ind., Munseom Is., Jejudo, 7 Nov. 2000; 1 ind., Seogui-po, Jejudo, 6 Aug. 1970; 1 ind., Seogui-po, Jejudo, 1 Jul. 1993.

Diagnosis. Carapace (Fig. 105) transversely ovate; dorsal surface almost smooth; regions obliterated with two indistinct shallow grooves each extending inward from 2nd and 3rd antero-lateral notches. Frontal (Fig. 106A) lobes weakly sinuate, bearing lobular lateral angle; supraorbital border very faintly separated. Antero-lateral borders crested cut into four lobules by very obscure notches. Third maxilliped (Fig. 106B) completely filled buccal orifice; merus subquadrate, granular, anterolateral angle slightly produced; ischium subrectangular with submedian sulcus, smooth, punctuate.

Thoracic sternum finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture

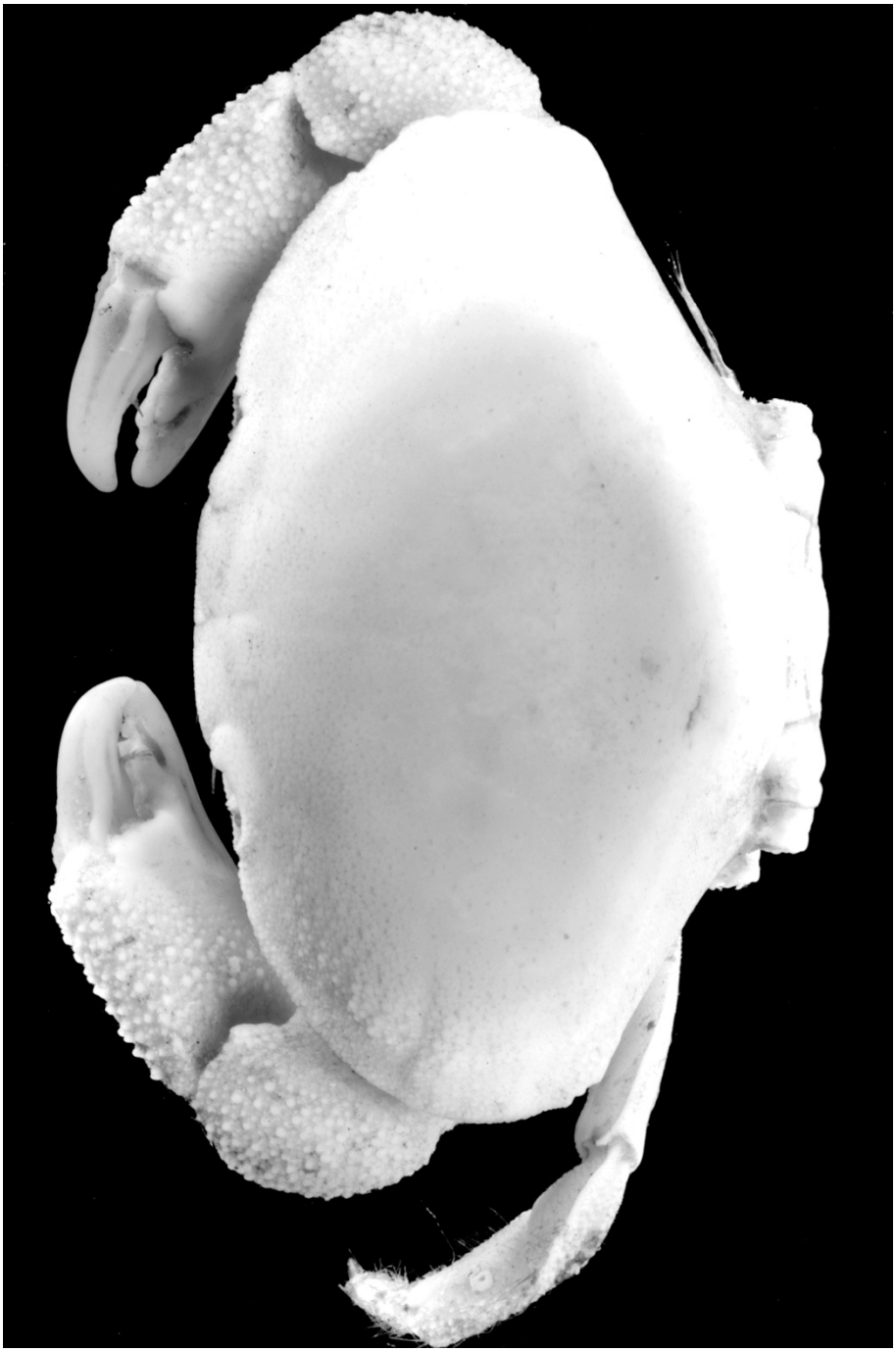

Fig. 105. *Neoliomera insularis* (Adams & White, 1848), female, 26.4 × 15.5 mm, dorsal view.

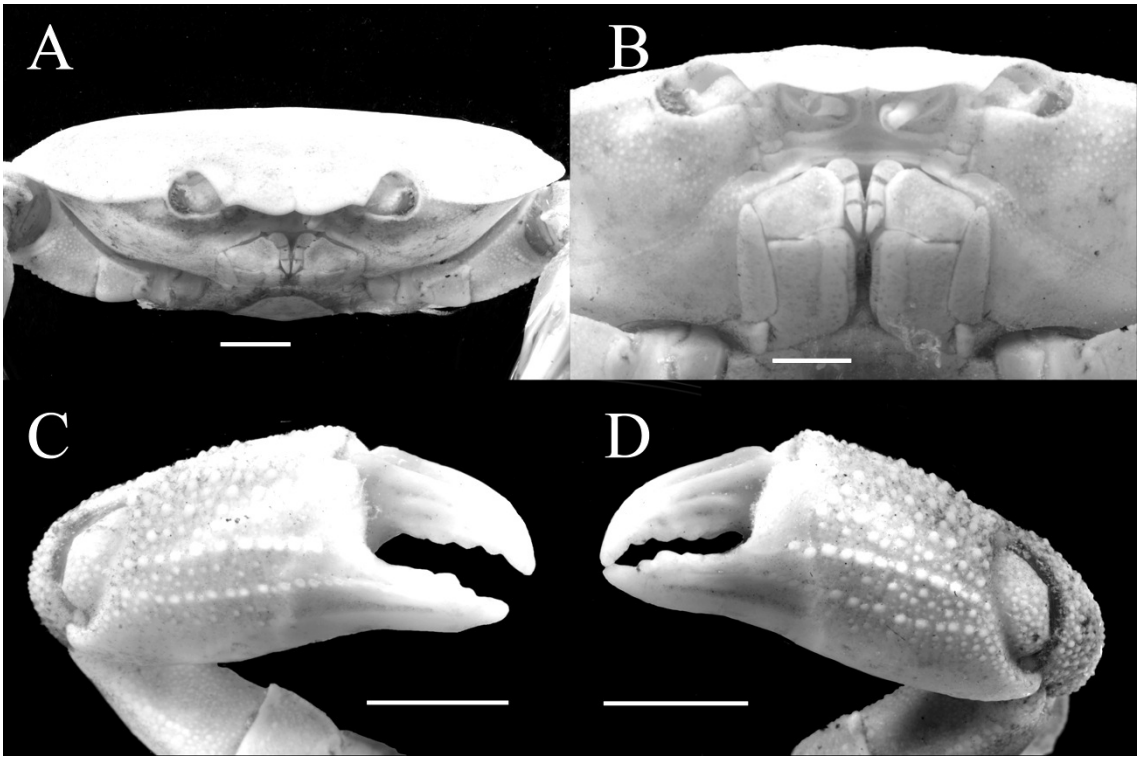

Fig. 106. *Neoliomera insularis* (Adams & White, 1848). A, Anterolateral margin, anterior view; B, Third and fourth ambulatory leg, dorsal view; C, Right cheliped, outer view; D, Left cheliped, outer view. Scale bars: A, C, D = 4 mm, B= 3 mm.

Chelipeds (Fig. 106C, 106D) symmentrical. Merus crested along superior edge. Carpus bearing two obscure teeth at inner angle; outer surface very finely granular; Propodus weakly crested in proximal half of superior border; outer surface covered with vesiculous granules, having two longitudinal ridges of granules, one near middle and other immediately below it.

Ambulatory legs with sharply crested on anterior border of Merus and propodus.

Type locality. Philippines.

Distribution. Japan, Korea, Taiwan, Philippines, Sulu Sea, Singapore, Palau, New Guinea, Australia, New Caledonia.

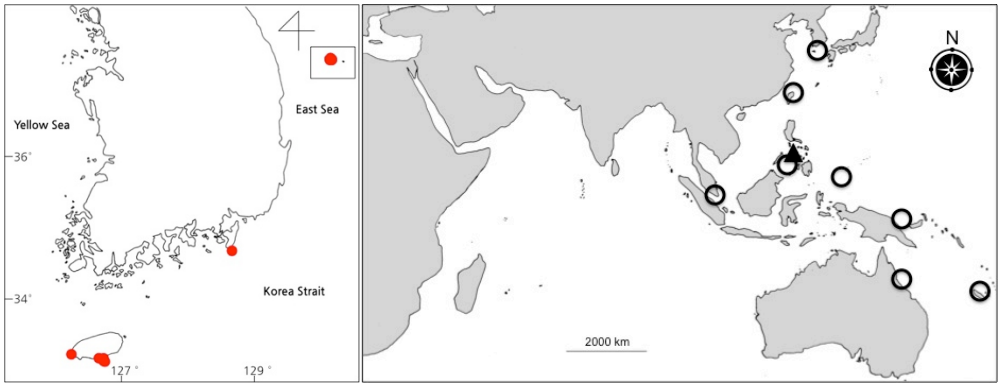

Fig. 107. Distribution of *Neoliomera insularis* (Adams & White, 1848). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. The carapace width of Korean *Neoliomera insularis* (Adams & White, 1848) is less 2 centimetres. They have been collected Jejudo Island, Geojedo, and Ulreungdo Island. They are shown no variation of their morphology. But this species have not occurred from Yellow Sea.

34. *Lybia caestifera* (Alcock, 1898) 가는손부채게

Melia caesifer Alcock, 1898, p. 231.

Lybia caestifera: Sakai, 1976, p. 504, pl. 180, fig. 2; Serène, 1984, p. 25 (list); Dai & Yang, 1991, p. 379, pl. 51 (2); Lee et al., 2008: 294.

Material examined. 1 ind., Munseum, Jejudo Is. 6 June 2001, coll. S. H. Kim.

Diagnosis. Carapce (Fig. 108, 109A) subhexangular, uneven, and less areolated; front (Fig. 109B) broad, relatively straight anterior margin without median notch, cutting into 2 lobes by longitudinal median trace with each lobes separated from inner–orbital tooth by slanting mark; anterolateral border armed with no serrated, triangular three teeth; third tooth rudimentary. Both sides of 1F, 2M, and 4L of carapace with small bundles of setae. Third maxilliped (Fig. 109C) completely filled buccal orifice.

Thoracic sternum (Fig. 109D) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture.

Chelipeds (Fig. 109E, 109F) very slender and small; fingers quite slim with tip curved and claw-shaped, bearing acute on teeth both inner margins.

Ambulatory legs (Fig. 108) relatively stouter than chelipeds, with few setae on upper and inner borders; dactyli with small, few teeth, and quite sharp at tip. Forth pair of ambulatory leg shorter and smaller than others.

Female abdomen (Fig. 109D) elongated.

Habitat. Coral reefs in shallow waters.

Distribution. Red Sea, Indo-West pacific, Japan, Taiwan, Hawaii, Tahiti, Korea.

Remarks. The Korean specimen agrees well with Dai & Yang (1991)'s description but the carapace of the Korean specimen has relatively small lobes on the frontal margin and no small bundles of setae on both sides of 2P region.

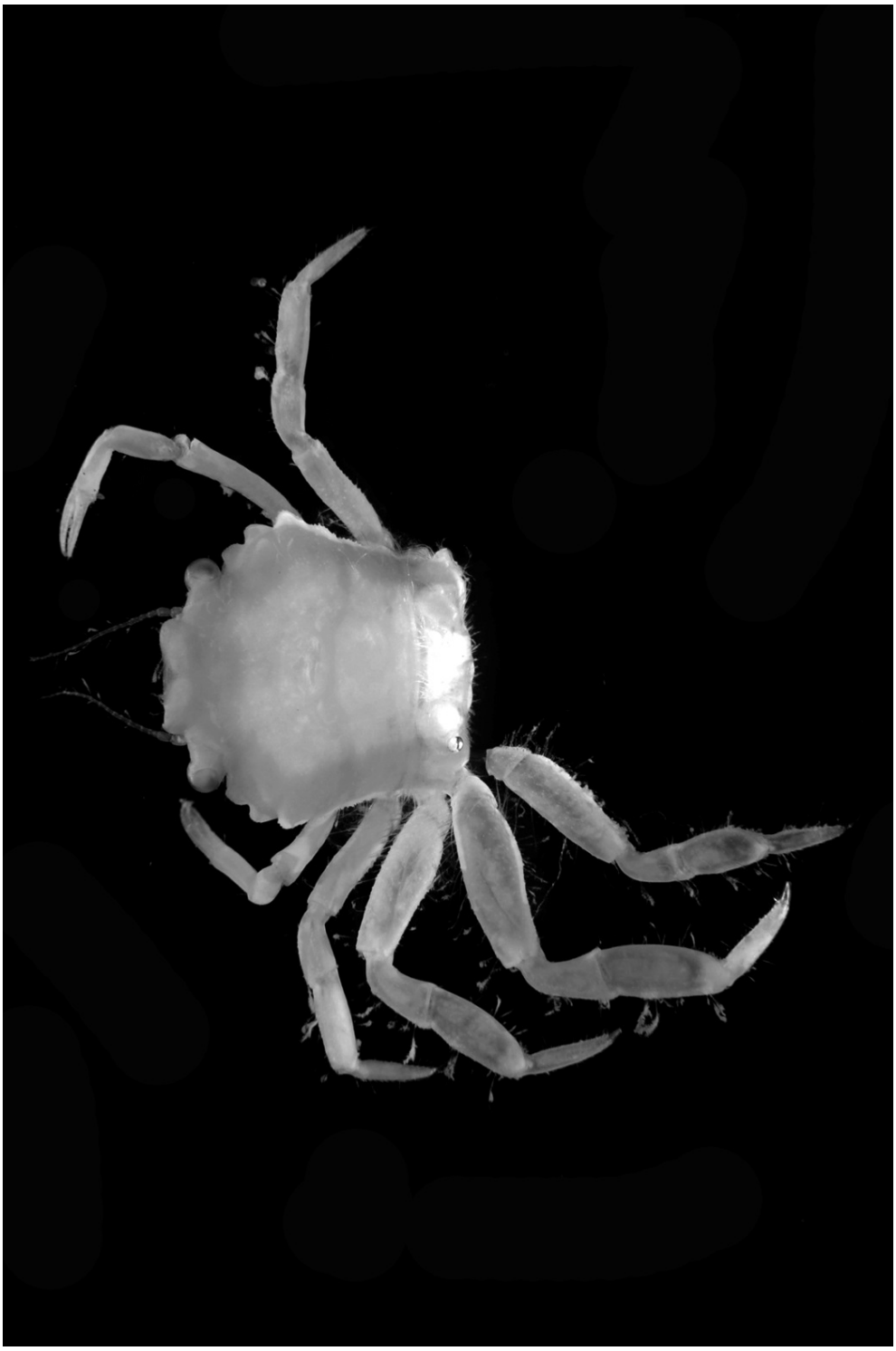

Fig. 108. *Lybia caestifera* (Alcock, 1898), female, 3.7 × 3.1 mm, dorsal view.

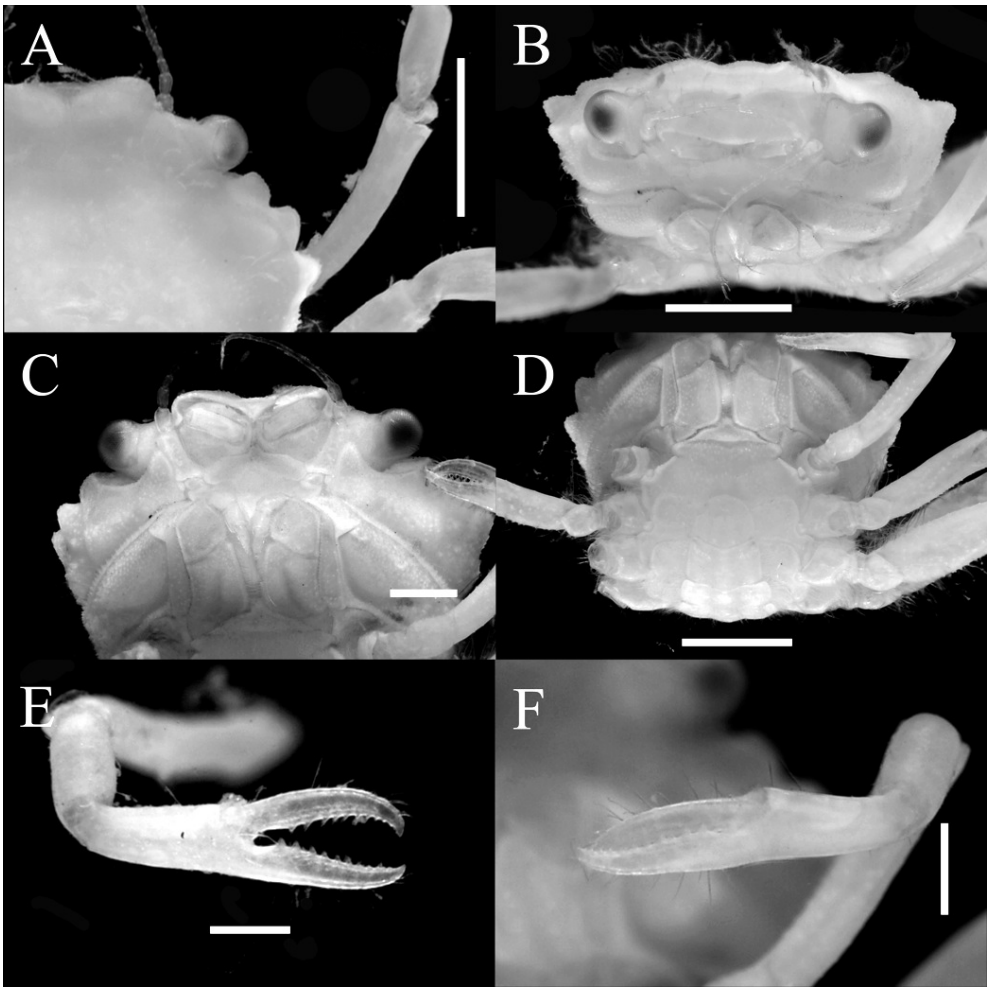

Fig. 109. *Lybia caestifera* (Alcock, 1898). A, Anterolateral view, dorsal view; B, Front, anterior view; C, The third maxilliped, ventral view; D, Thoracic sternum and male Abdomen; E, Right cheliped, outer view; F, Left cheliped, outer view. Scale bars: A, B, D = 1 mm, C, E, F = 0.5 mm.

35. *Cycloxanthops truncatus* (De Haan, 1837) 차양부채게

Cancer (*Xantho*) *truncatus* de Haan, 1833-1849 (1837): 66, pl. 18, fig. 4.

Xantho truncata Stimpson, 1907: 46; Sakai, 1939: 460, pl. 58, fig. 2, pl. 90, fig. 4.

Cycloxanthops truncates: Guinot, 1968: 700, fig. 15; Sakai, 1976: 435, fig. 229; Kim & Kim, 1982:135; Kim, 1985: 65; Kim & Chang, 1985: 54; 김 등, 1996: 413.

Previous records of Korean fauna. Seoguipo, Sinchang — Jejudo, Yeosu, Songjung, Pusan, Dokdo (Kim & Chang, 1985; Kim & Kim, 1982; Kim, 1985; Kim & Chang, 1987; 김 등, 1996)

Material examined. 1 ind., Dongbaekseom Is., Yeosu-si, Jeollanam-do, 26 Sep. 1976; 1 ind., Sinchang, Jejudo, 3 May 1985; 1 ind., Supseom Is., Jejudo, 2 Jul. 1993; 1 ind., Munseom Is., Jejudo, 19 Jan. 1997; 3 inds., Sungsan-po, Jejudo, 24 Feb. 2001; 1 ind. Gosan, Jejudo, 8 Jun. 2001; 2 inds., Gongam, Ulreungdo Is., 28 Jul. 2001; 1 inds., Munseom Is., Jejudo, 25 Aug. 2001; 1 ind., Upper Baekdo, Jeollanam-do, 21 Jul. 2002; 1 ind., Seoguipo, Jejudo, 2 Aug. 1970; 1 ind., Port Jukjin, Uljin-gun, Gyeongsangbuk-do, 22 Oct. 2008.

Diagnosis. Carapace (Fig. 110, 111A) transversely ovate; regions moderately defined. Front (Fig. 111B) cut into 2 lobes, extremely produced beyond general outline of carapace; anterior edge of each frontal lobe being subtruncate and slightly oblique outwards. Anterolateral margin obscurely divided into five lobes exclusive of external orbital angle, each lobe ending in tuberculiform tooth, first one being on lower level. Third maxilliped (Fig. 111C) completely filled buccal orifice; merus subquadrate, granular, anterolateral angle slightly produced; ischium subrectangular with submedian sulcus, smooth, punctuate.

Thoracic sternum (Fig. 111D) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture.

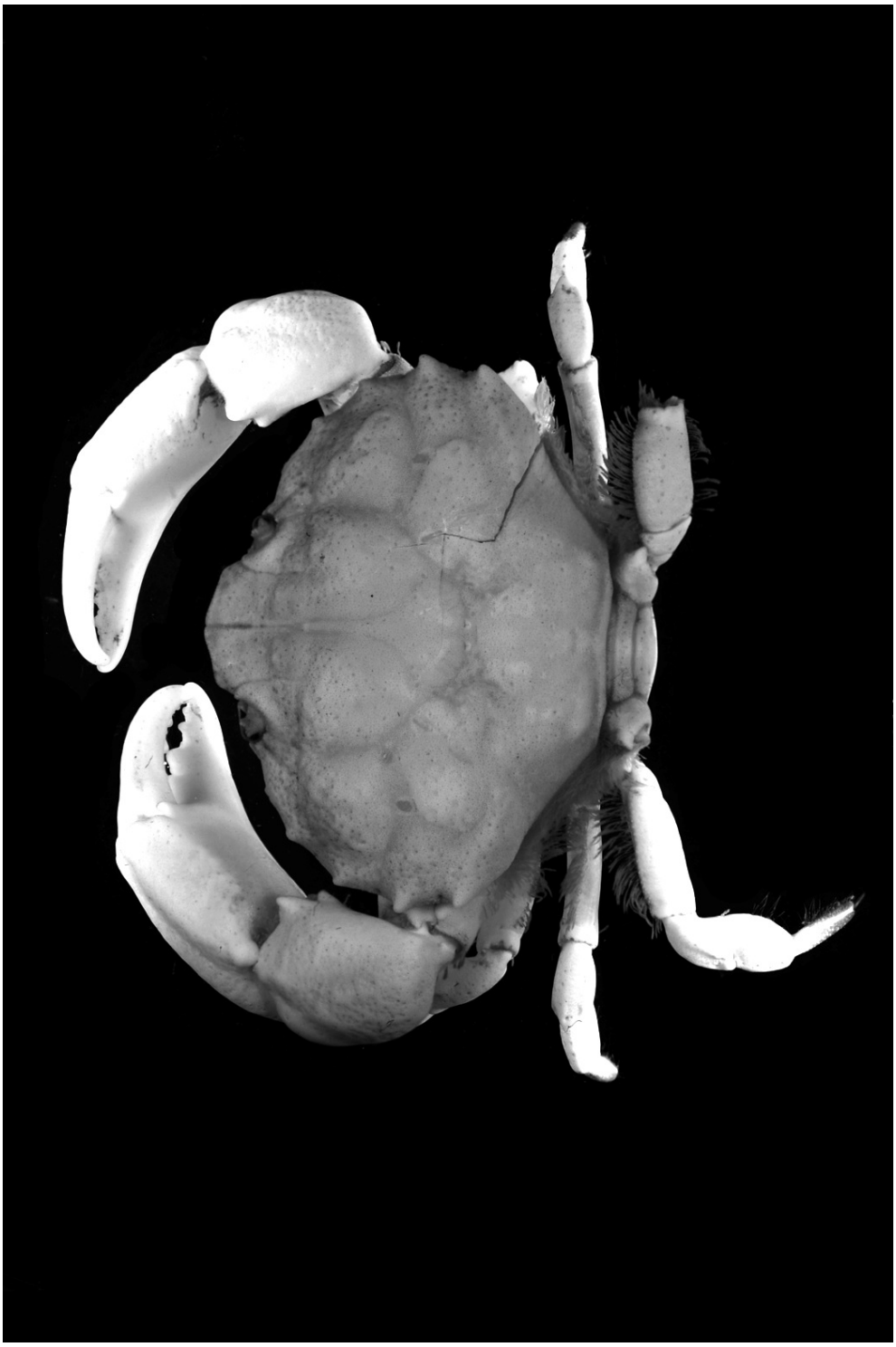

Fig. 110. *Cycloxanthops truncatus* (De Haan, 1837), male, 25.7 × 16.4 mm, dorsal view.

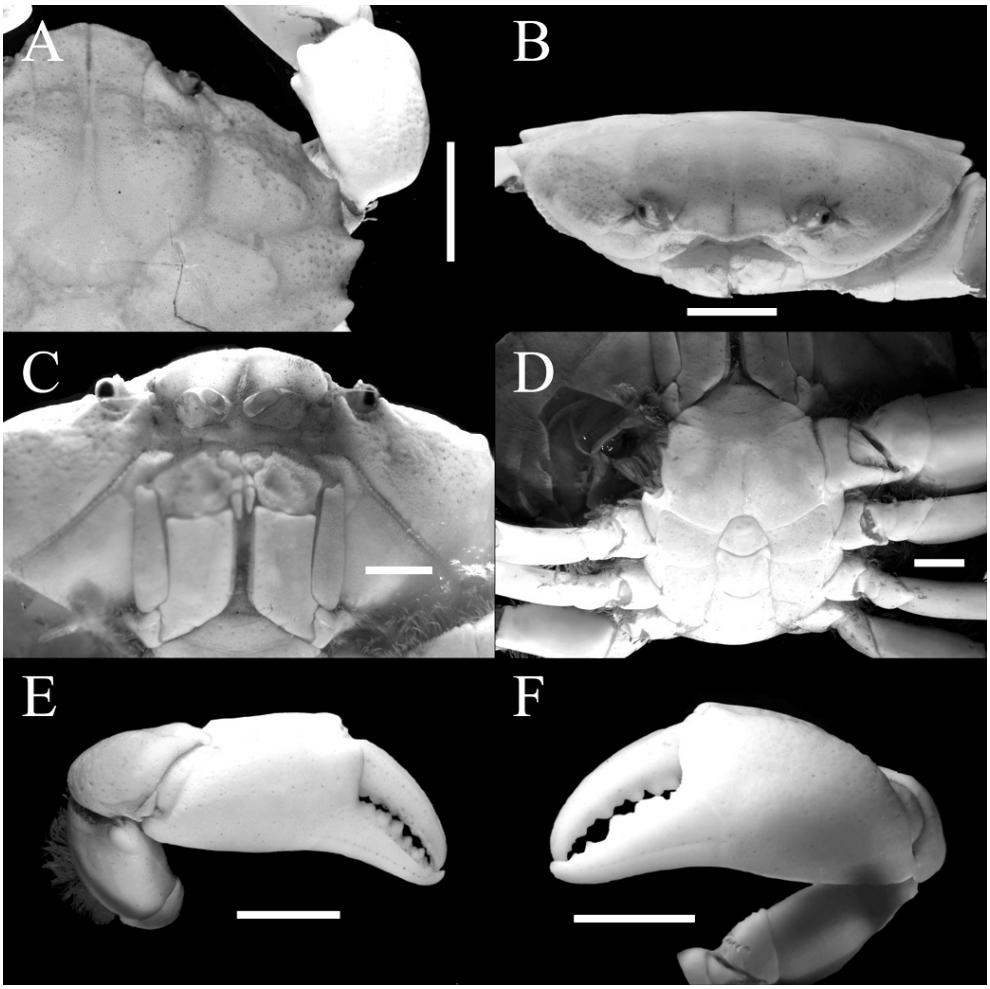

Fig. 111. *Cycloxanthops truncatus* (De Haan, 1837). A, Anterolateral margin, dorsal view; B, Front, anterior view; C, The third maxillipeds, ventral view; D, Thoracic sternum and male abdomen, ventral view; E, Right cheliped, outer view; F, Left cheliped, outer view. Scale bars: A, B, E, F = 5 mm, C, D = 2 mm.

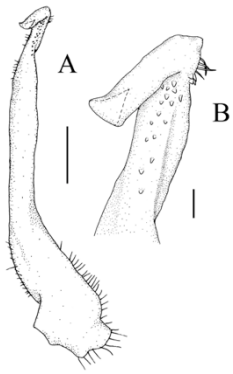

Fig. 112. Male first gonopod of *Cycloxanthops truncatus* (De Haan, 1837), external view. Scale bars: A = 1 mm, B = 0.1 mm

Cheliped (Fig. 111E, 111F) slightly asymmetrical; superior and lower edges of merus crested and fringed with hairs; carpus enlarged and rugose; propodus with very shallow and indistinct groove along upper outer border and fingers usually obtusely pointed at tip.

Ambulatory legs rather short, naked; merus thickly fringed with hairs along anterior border; upper border of propodus and both borders of dactylus also fringed with hair.

Male abdomen (Fig. 111F) narrow and long; somites 3–5 fused, sutures vaguely discernible

Male first gonopod (Fig. 112) somewhat thick, short; apical lobe opening at tip, fold inward on subdistal portion.

Type locality. Japan.

Distribution. Japan, Korea.

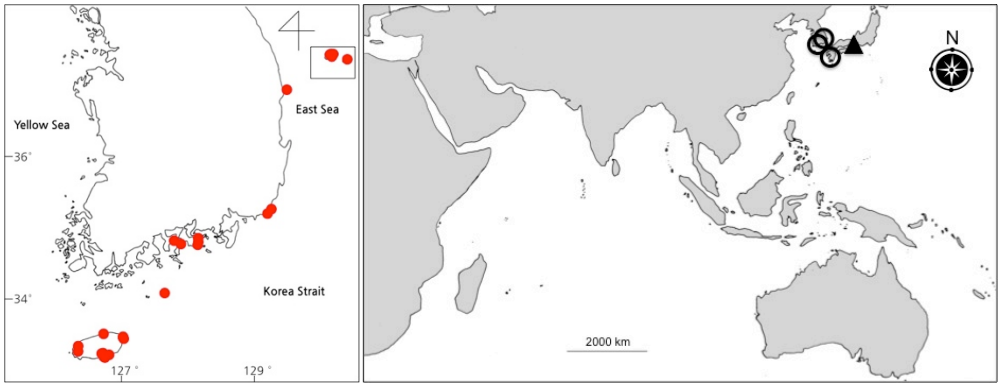

Fig. 113. Distribution of *Cycloxanthops truncatus* (De Haan, 1837) in Korea.
Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. *Cycloxanhops truncates* (De Haan, 1837) is one of the common species in Korean fauna. They can be easily found with their carapace being damaged. For example, their front looks like 3- 4 lobes, or having small sternite 4, or with a hole near the buccal, and so on. This species would be easily harmed by environmental demages.

36. *Leptodius affinis* (De Haan, 1835) 부채게

Cancer (*Xantho*) *affinis* De Haan, 1835: 48, pl. 13 fig. 8.

Cancer (*Xantho*) *lividus* De Haan, 1835: 48, pl. 13 fig. 6.

Chlorodius exaratus, Dana, 1852: 208.

Leptodius exaratus, A. Milne-Edwards, 1873: 222; Sakai, 1976: 423, pl. 153, fig. 1; Kim, 1970: 14; 1973: 380, fig. 144, pl. 82, fig. 109; Dai & Yang, 1991: 292, pl. 37(4), fig. 154(3); 전 등, 2000a: 118; 이 등, 2000: 36; Kim & Chang, 1985: 53; 김 등, 1979a: 110; Poore, 2004: 472, fig. 150b.

Xantho exaratus var. *typica* Ortmann, 1893: 445 (in part) [not *Chlorodius exaratus* H. Milne Edwards, 1834].

Chlorodius exaratus var. *pictus* Stimpson, 1907: 54, fig. 6 [not *Chlorodius exaratus* H. Milne Edwards, 1834].

Chlorodius exaratus var. *typicus* Stimpson, 1907: 55 [not *Chlorodius exaratus* H. Milne Edwards, 1834].

Xantho (*Leptodius*) *exaratus*, Alcock, 1898: 118; Balss, 1938: 41[not *Chlorodius exaratus* H. Milne Edwards, 1834].

Xantho exaratus, Holthuis, 1953: 27 [not *Chlorodius exaratus* H. Milne Edwards, 1834].

Leptodius nigromaculatus Serène, 1962: 255, figs. 1A–H; 1984: 182 (key); Dai et al., 1986: 272, fig. 155A; Dai & Yang, 1991: 293, pl. 37(5), fig. 155A; Yeh et al., 2006: 70, figs. 1C, F, 2C–D.

Previous records of Korean fauna. Jejudo Is., Sacheon, Geoje, Haenam, Marado Is., Wando, Pusan (Kim, 1973; 전 등, 2000a; 이 등, 2000; Kim & Chang, 1985; 김 등, 1979a)

Fig. 114. *Leptodius affinis* (De Haan, 1835), male, 27 × 17.5 mm, dorsal view.

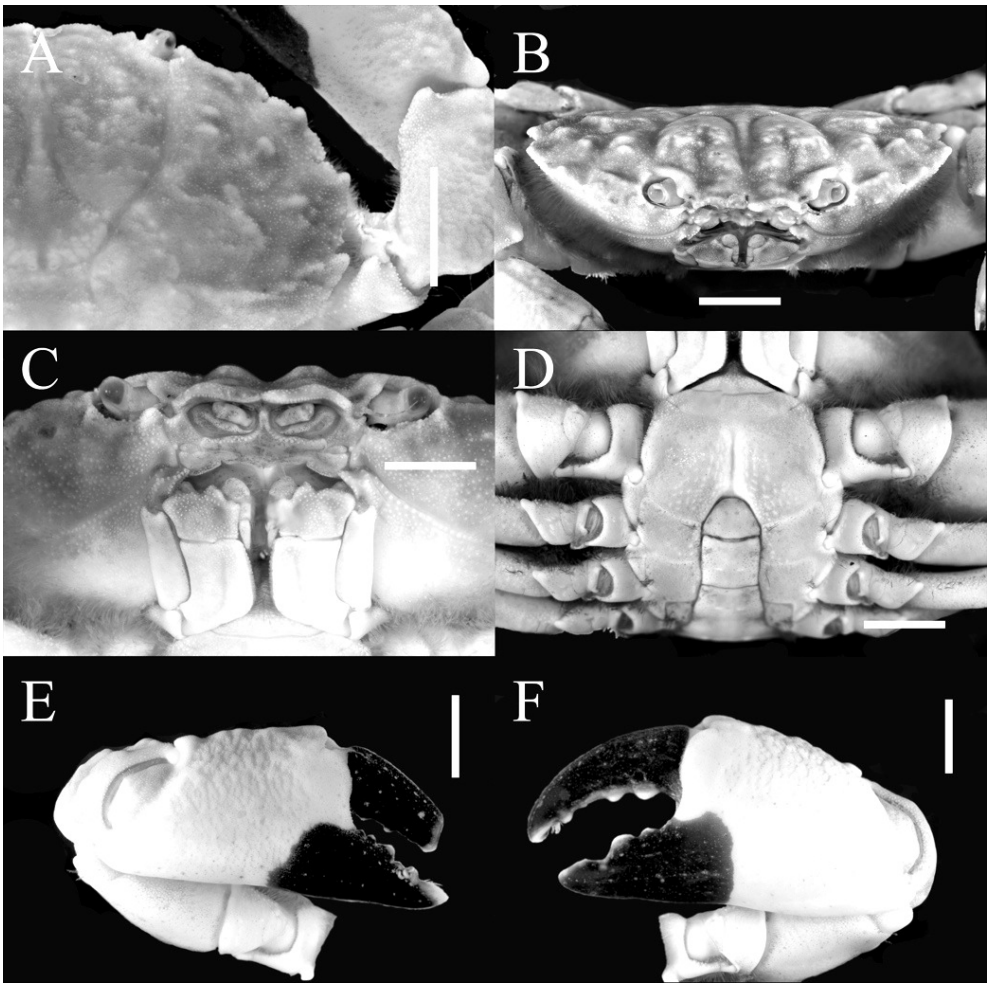

Fig. 115. *Leptodius affinis* (De Haan, 1835). A, Anterolateral margin, dorsal view; B, Front, anterior view; C, The third maxillipeds, ventral view; D, Thoracic sternum and male Abdomen, ventral view; E, Right cheliped, outer view; F, Left cheliped, outer view. Scale bars: A = 5 mm, B, C, D, E, F = 3 mm.

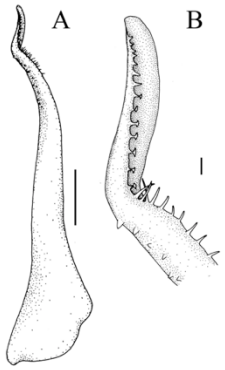

Fig. 116. Male first gonopod of *Leptodius affinis* (De Haan, 1835), external view. Scale bars: A = 10 mm, B = 0.1 mm.

Material examined. 2 inds. (MADBK 173012_011), Iho-ri, Jejudo, , 11 Aug. 1969, coll. H. S. Kim; 3 inds. (MADBK 173012_012), Sindo-ri, Jejudo, 25 Oct. 2005, coll. S. K. Lee; 1 ind. (MADBK 173012_013), Aewel-eup, Jejudo, 16 Oct. 2006, coll. S. K. Lee; 2 inds. (MADBK 173012_014), Jo-1ri, Udo Is., Jejudo, 14 Dec. 2006, coll. S. K. Lee; 10 inds., Seoguipo, Jejudo, 13 Oct. 1963; 3 inds., Sasudo Is., Jejudo, 8 Aug. 1969; 1 inds., Yeunhwado Is., Tongyoung, Gyeongsangnam-do, 19 Jul. 1978; 2 inds., small Daeando Is., Taean, Chungcheongnam-do, 28 Jun. 2000; 32 inds., Sindo-ri, Jejudo, 25 Oct. 2005; 82 inds., Udo Is., Jejudo, 31 May 2007; 6 inds., Udo Is., Jejudo, 14 Oct. 2006.

Diagnosis. Carapace (Fig. 114, 115A) transversely subovate, about 1.4–1.6 times as broad as long; dorsal surface depressed, finely granular, anterior, lateral regions varying from distinctly to faintly rugose; regions well defined, separated by narrow, shallow grooves; 2F separated by groove from 1M; 2M partly divided longitudinally, 1M fused to inner branch of 2M; 3M, 2L, 3L, 4L, 5L, 6L distinct, entire; 4M indistinct; 1L very small; 1R, 2R fused, separated from 3R by indistinct oblique groove; 1P, 2P indistinct. Front (Fig. 115B) about 0.3 times as broad as carapace breadth, not much protruded, cut into 2 lobes, each one slightly concave near outer side, separated from internal orbital tooth by notch. Orbit smaller, transverse oval; superior margin with 2 fissures; inferior margin bearing 2 blunt teeth on either side; exorbital angle separated from first anterolateral tooth by concavity. Anterolateral margin with 4 lobes behind exorbital angle: first small, almost indistinguishable, depressed; second broad, large; third similar, more prominent than second; last smallest but most produced; separation between teeth indicated by small sinus. Posterolateral margin somewhat concave, with pubescence. Posterior margin granular, central region straight. Pterygostomian region granular, setose.

Antennules (Fig. 115C) lying transversely, slightly obliquely. Basal article of antenna sub-romboidal, short, broad. Antennular flagellum occupied orbit hiatus. Epistome narrow; central region with median projection, separated from lateral regions by distinct notches. Third maxilliped completely filled buccal orifice; merus subquadrate, granular, anterolateral angle slightly produced, anterior margin with

wide V-shape notch medially; ischium subrectangular with submedian sulcus, smooth, punctuate; exopod stout, length about 4 times width.

Thoracic sternum (Fig. 115D) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture; sternites 3, 4 almost completely fused except for short notches laterally, sternite 3 distinguishable from sternite 4 by shallow groove; sternite 4 large, slightly convex; sternites 5–8 distinct, separate, within not visible externally. Median longitudinal line visible externally only on central portion of sternite 4, complete at level of sternites 6, 7, 8. Sternal press-button situated on sternite 5, equidistant from sutures 4/5, 5/6.

Chelipeds (Fig. 115E, 115F) asymmetrical, with a granular coating single ended, more or less curved and pointed. Merus with long setae on anterior and posterior borders, covered with fine corrugation on dorsal surface. Carpus covered with microscopic granules and fine corrugation on outer surface; inner-distal angle bluntly round. Fingers black coloured, with somewhat gaping between them closed, with distinctly toothed and contiguous within; Inner margins provided with obtuse teeth, tips spoon-shaped with bristles.

Ambulatory legs (Fig. 114) smooth; meri of first to third with setae on anterior and posterior margin; carpi, propodi subequal in length, sparsely setose; dactyli densely covered with short hairs, chitinous claw.

Male abdomen (Fig. 3B) narrow and long; somites 3–5 fused, sutures vaguely discernible; somite 6, median length about 1.6 times that of telson. Distal half slightly broader than proximal half, lateral margins slightly convave. Telson subtriangular, tip bradly rounded; tip not reaching level of sternal condyles of P1 coxae.

Male G1 (Fig. 116) slender, long, with 5 or 6 stout, curved subdistal spines; elongated apical lobe bordered on ventral margin by 5–6 mushroom-shaped outgrowths proximally and in distal half with 6–8 tongue-shaped outgrowths, simple, pointed, diminishing gradually near tip. Length of apical lobe measured from tip to subdistal region 0.11–0.14 times to total length.

Type locality. Japan (De Haan, 1835: 48).

Distribution. Andamans; Bay of Bengal; Gulf of Mannar; Laccadive Sea; Mergui Archipelago; Myanmar; Penang; Sri Lanka; Australia; China; Hong Kong; Indonesia; Japan; Korea; Micronesia; Philippines; Taiwan; Thailand; Vietnam; Marianas; Nauru, Marshall Is.; Pacific; Palau; Samoa, Fiji, Caroline Is.; Tuamotu Archipelago; French Polynesia; New Caledonia.

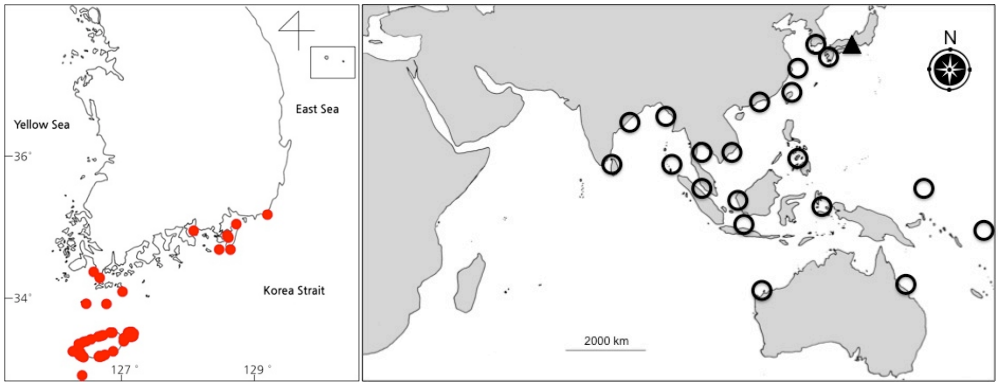

Fig. 117. Distribution of *Leptodius affinis* (De Haan, 1835). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. *Leptodius affinis* (De Haan, 1835) has been known as *Leptodius exaratus* (H. Milne-Edawards, 1834) since Miers (1879) reported in Korea. The author examined exhausted sample from Indo-west pacific. It was found that *Leptodius exaratus* from Eastern Indian Ocean and Western pacific are not *L. exaratus* sensu stricto. Eventally, *L. exaratus* in Korea, even from Eastern Indian Ocean and Western pacific, is synonymized as *L. affinis* (De Haan, 1835) herein. The author will be discussing in detail in the Chapter 3. of this dissertation.

37. *Macromedaeus distinguendus* (De Haan, 1835) 꽃부채게

Cancer (*Xantho*) *distinguendus* de Haan, 1833-1849 (1835): 48, pl. 13, fig. 7.

Chlorodius distinguendus: Stimpson, 1907: 56.

Xantho distinguendus: Alcock, 1898: 113(part); Sakai, 1939: 461, pl. 58, fig. 4, pl. 91, fig. 4; Forest & Guinot, 1961: 57, fig. 46.

Leptodius distinguendus: Rathbun, 1931: 100.

Macromedaeus distinguendus: Guinot, 1968: 708; Kim, 1970; Kim, 1973: 379, 630, fig. 143, pl. 27, fig. 108; Sakai, 1976: 419, fig. 221, pl. 153, fig. 2; Kim & Kim, 1982; Serène, 1984: 177(keys); Kim & Chang, 1985: 53; Dai & Yang, 1991: 286, fig. 151(1), pl. 36(5); 김, 1996: 430; Kim & Kim, 1998: 299; 이 등, 2000: 228; 안 등, 2000: 73; 전 등, 2001:250; Ng et al., 2008: 203.

Previous records of Korean fauna. Wonsan, Yeosu, Beaindo, Incheon, Deukjeok, Suundo, Guryeung-po, Ulreungdo Is., Bangjuk-po, Daecheon, Palmido Is., Sinan, Bryoung, Ganggwado Is., Mokdo Is., Neckseom Is., Myodo Is., Haenam, Jejudo Is., Odongdo Is., Youngjongdo Is., Geomundo Is., Upper Chujado Is., Suniudo Is., Jindo, Hongdo Is., Dokdo Is. (Kim, 1973; 전 등, 2001; 이 등, 2000; 안 등, 2000; Kim & Chang, 1985; Kim, 1970; Kim & Kim, 1982; 김 등, 1996, Kim & Kim, 1998).

Material examined. 1 ind. Daecheon, Chungcheongnam-do, 21 Aug. 1956; 3 ind., Namhaedo, Gyeongsangnam-do, 22 Jul. 1967; 3 inds., Jakiakdo Is., Incheon-si, 14 Apr. 1968; 2 ind., Dolsando, Gyeongsangnam-do, 14 Jun. 1969; 1 ind., Haeundae, Pusan-si, Gyeongsangnam-do, 9 Jul. 1970; 2 ind., Jakakdo Is., Incheon-si, 25 Apr. 1971; 1 ind., Biin-do Is., Sinan-gun, Jeollanam-do, 20 Jul. 1971; 5 inds., Gadukdo Is., Pusan, 22 May 1978; 2 inds., Geomundo Is., Jeollanam-do, 13 Jul. 1984; 1 ind., Munseom Is., Jejudo, 19 Sep. 1995; 22 inds., Port Daecheon, Chungcheongnam-do, 13 Jun. 1999; 4 inds., Sinjindo Is., Taean-gun, Chungcheongnam-do, 15 Jun. 1999; 9 inds., Ongdo Is., Taean-gun, Chungcheongnam-do, 15 Jun. 2000; 8 inds., Myodo Is., Taean-gun, Chungcheongnam-do, 1 Jul. 2000; 1 inds., Chagui-do., Jejudo, 8 Jun. 2001; 2 inds., Oriseom Is., Geomundo, Jeollanam-do, 20 Jun. 2002; 20 inds., Hweingkyongdo Is., Jeollabuk-do, 4 Aug. 2003; 2 inds., Hamo Beach, Daejung-eup, Jejudo, 30 May 2007; 2 inds., Palmido Is., Incheon-si, 19 Apr. 1969; 3 inds., Janggundo Is., Jeollanam-do, 24 Jul. 1967; 1 ind., Upper Baekdo Is., Geomundo, Jeollanam-do, 21 Jun. 2002; 7 inds., Yeonpyongdo Is., Incheon-si, 31 Mar. 2001; 2 inds., Jebudo Is., Gyeonggi-do, 28 Nov. 2008; 1 inds., Port Jukjin, Uljin-gun,

Fig. 118. *Macromedaeus distinguendus* (De Haan, 1835), male, 17.3 × 11.4 mm, dorsal view.

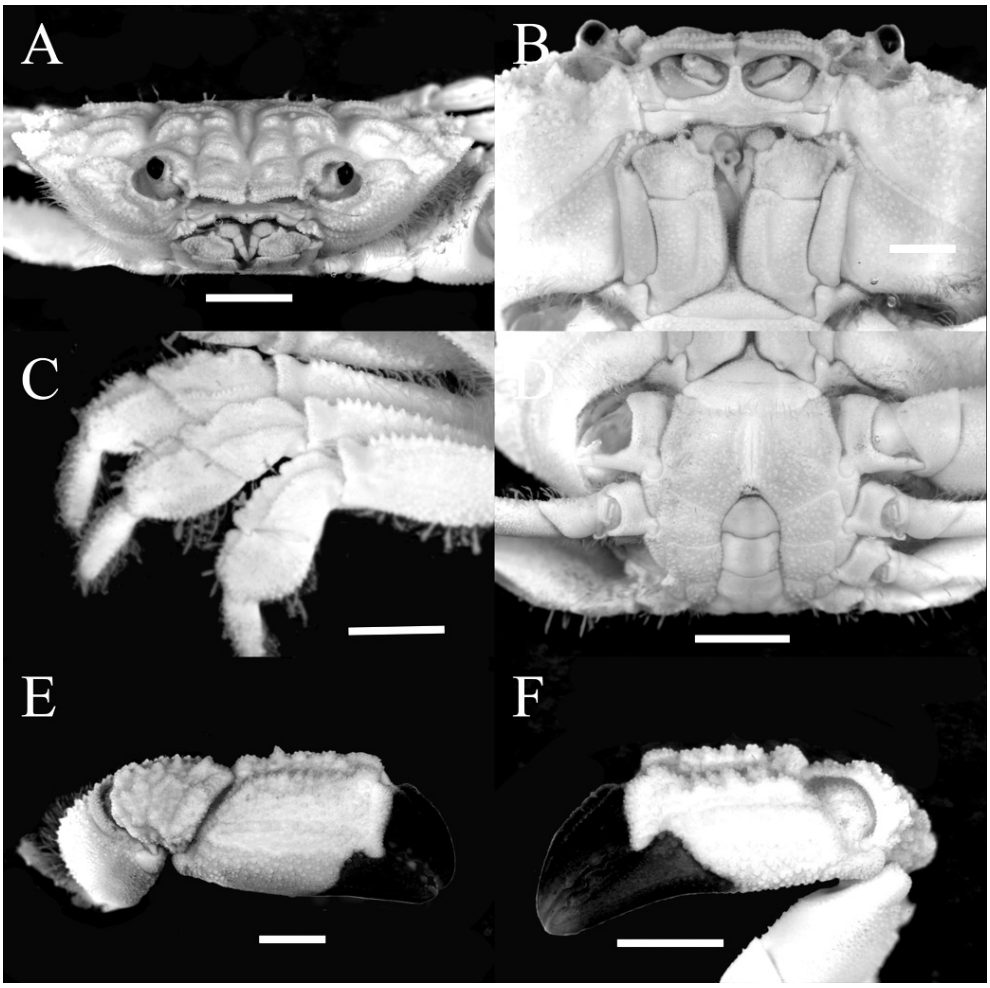

Fig. 119. *Macromedaeus distinguendus* (De Haan, 1835). A, Front, anterior view; B, The third maxillipeds, ventral view; C, Left second to fourth ambulatory leg, posterior view; D, Thoracic sternum and male abdomen, ventral view; E, Right cheliped, outer view; F, Left cheliped, outer view. Scale bars: A, D, E, F = 3 mm, B, C = 2 mm.

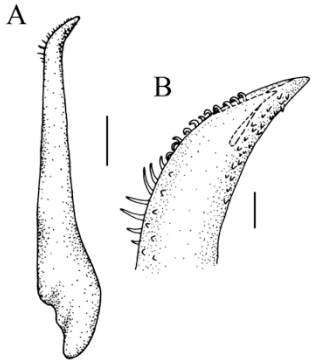

Fig. 120. Male first gonopod of *Macromedaeus distinguendus* (De Haan, 1835), external view. Scale bars: A = 0.5 mm B = 0.1 mm.

Gangwon-do, 30 Oct. 2009; 2 inds., Namhaedo Is., Gyeongsangnam-do, 3 Mar. 2006; 7 inds., Sinyang-eup, Tongyoung-si, Gyeongsangnam-do, 16 Oct. 2008; 1 ind., Happo, Masan-si, Gyeongsangnam-do, 29 Jun. 2006; 1 ind., Sunjaedo Is., Incheon-si, 2 Oct. 2008.

Diagnosis. Carapace (Fig. 118, 119A) transversely oval, surface convex, covered with small granules and corrugation in anterior two-third. Front about one-quarter as broad as breadth of carapace, divided into 2 lobes by shallow median notch, Separated from inner-orbital angle by right-angular

Chelipeds (Fig. 119E, 119F) asymmetrical. Marus with dorsal margin sharp, bearing granules and short hairs. Carpus with dorsal surface corrugated, inner-distal angle bearing small obtuse tooth, and its inner side with with short hair. Manus covered with granules and marked with 2 tubercular carinae. Fingers with obtuse teeth of various sized.

Ambulatory legs (Fig. 119C) short and depressed, granulated; dorsal margin of merus serrated and hairy; carpus with 2–3 angulate teeth and 1 granulated ridge on dorsal surface; dactylus densely covered with short hairs except cuticular tip.

Male abdomen (Fig. 119D) narrow and long, third to fifth segments fused; sixth segment squarish. Telson bluntly triangular. Female abdomen oval.

First pleopod of the male (Fig. 120) slender and elongate, distal portion curved laterally and armed with claw-shaped spines.

Habitat. Under stones or in crevices of rocks.

Distribution. China, Korea, Japan, Tahiti, India, Persian Gulf, Red Sea, and South Africa.

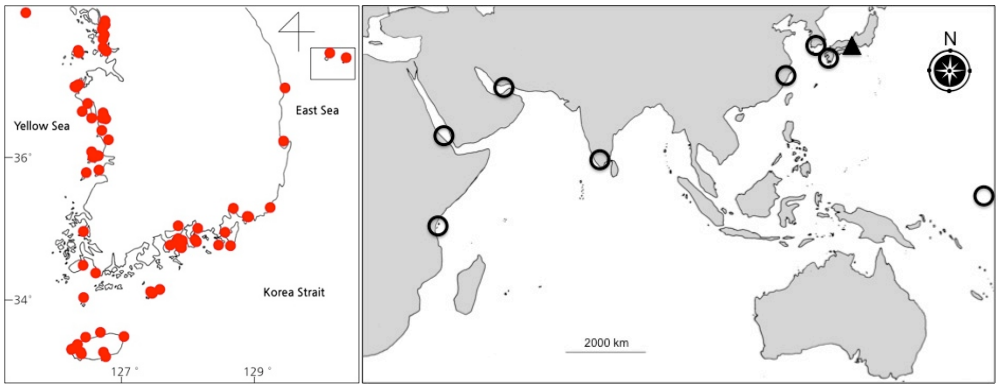

Fig. 121. Distribution of *Macromedaeus distinguendus* (De Haan, 1835). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. *Macromedaeus distinguendus* (De Haan, 1835) is quite common species in Korean fauna. This species inhabit under the rock or between debris on the mud flat in the intertidal zone. This species is similar to *Microcassiope orientalis* Takeda & Miyake, 1969. Differences between them are discussed under the Remarks of the latter species.

38. *Microcassiope orientalis* Takeda & Miyake, 1969 작은꽃부채게

Microcassiope orientalis Takeda & Miyake, 1969f: 201, figs 2-3. Ng et al.: 2008: 203.

Macromedaeus orientalis: Yamaguchi et al., 1976: 37, fig. 2 (3, 4 above); Takeda, 1977b: 84; Ko, 2002: 89; Lee & Ko, 2008: 18.

Previous records of Korean fauna. Udo Is., Port Mosulpo, Tongyoung (Ko, 2002; Lee & Ko, 2008)

Material examined. 1 ind., Oriukdo Is., Pusan-si, 13 Oct. 2009; 1 ind., Seongsanpo, Jejudo, 10 Jul. 1965; 3 inds., Port. Jingok, Uljin-gun, Gyeongsangbuk-do, 21 Oct. 2008; 4 inds., Seoguipo, Jejudo, 12 Mar. 2009; 1 ind., Dokdo Is., Gyeongsangbuk-do, 10 Oct. 2008; 1 ind., Ulreungdo Is., Gyeongsangbuk-do, 22 Jun. 2006; 2 inds., Chaguido Is., Jejudo, 16 Jun. 2008; 5 inds., Munseom Is., Jejudo, 11 Mar. 2009; 5 inds., Ulreungdo Is., Gyeongsangbuk-do, 22 Jun. 2006; 1 ind., in Port Jingok, Gyeongsangbuk-do, 29 Oct. 2009; 4 inds., Munseom Is., Jejudo, 19 Jan. 1997; 1 inds., Port Yulpo, Geojedo, Gyeongsangnam-do, 2 Mar. 2006; 2 inds., Rock Mulgae, Dokdo Is., Gyeongsangbuk-do, 4 Oct. 2008; 1 ind., Munseom Is., Jejudo, 11 Mar. 2009; 1 ind., Jukbyun, Uljin-gun, Gyeongsangbuk-do, 22 Oct. 2008; 2 inds., Jukdo Is., Ulreung Is., 21 Jun. 2006; 3 inds., Chujado Is., 2 Apr. 2009.

Diagnosis. Carapace (Figs. 122) transversely oval; dorsal surface well divided into areolae by wide smooth furrows; areolae provided with scattered brush-like hairs, covered with granules; Frontal region and areola 1M. Front (Fig. 123A) double-rimmed, bearing a median, large V-shaped sinus. Anterolateral border armed with four teeth excluding external orbital angle. Postero-lateral border is strongly convergent and near posterior. Epistome narrow; central region with median projection, separated from lateral regions by distinct notches. Third maxilliped (Fig. 123C) completely covering buccal orifice; merus subquadrate, granular; ischium subrectangular with submedian sulcus, smooth, punctate.

Fig. 122. *Microcassiope orientalis* Takeda & Miyake, 1969, male, 9.9 × 6.7 mm, dorsal view.

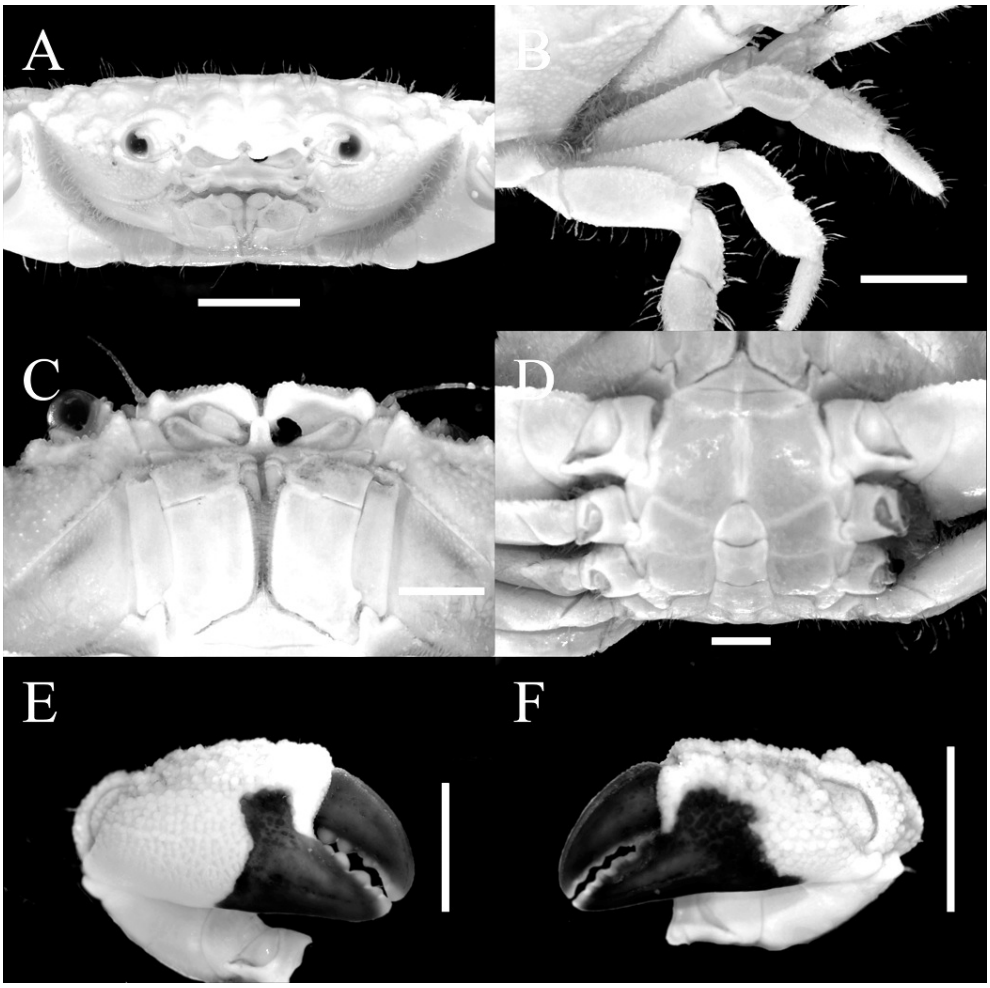

Fig. 123. *Microcassiope orientalis* Takeda & Miyake, 1969. A, Front, anterior view; B, Left Ambulatory legs, posterior view; C, The third maxillipeds, ventral view; D, Thoracic sternum and male abdomen, ventral view; E, Right cheliped, outer view; F, Left cheliped, outer view. Scale bars: A, B = 2 mm, C, D = 1 mm, E, F = 3 mm.

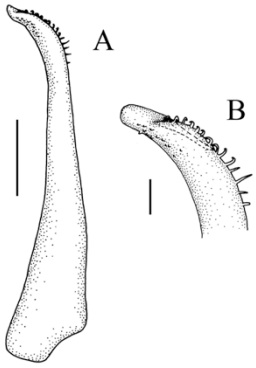

Fig. 124. Male first gonopod of *Microcassiope orientalis* Takeda & Miyake, 1969, external view. A, Whole; B, Distal view. Sclae bars: A = 0.5 mm, B = 0.1 mm.

Thoracic sternum (Fig. 123D) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture

Chelipeds (Fig. 123E, 123F) massive and slightly unequal but alike each other, left one being the larger. Merus short, as large as carpus; inner surface wholly excavated and concealed beneath the carapace. Outer surface of the carpus extremely roughened by conical thick granules, depressions and granulated prominences. Propodus also roughened by the granulated prominences somewhat like in the carpus, and provided with scattered brush-like hairs. Blackish brown colour of immovable finger fairly extended on to propodus towards the upper border and along the lower border. Cutting edge bears three or four rather blunt teeth of different size.

Ambulatory legs (Fig. 123B) hairy, armed with sharp granules. Merus bordered with row of sharp granules on upper border; subterminal depression of upper border fairly distinct. Carpus and propodus also granulated on and near upper borders. Upper border of the dactylus armed with small but spiniform granules; in each dactylus of last two ambulatory legs subterminal spine on lower border prominent.

Male abdomen (Fig. 123D) narrow; somites 3–5 fused, sutures vaguely discernible

Male first gonopod (Fig. 124) slender, narrow; apical lobe with subdistal lobe on subdistal portion.

Type locality. Munakata-Oshima Islet, Fukuoka Prefecture, Japan, 10 m.

Distribution. Japan, Korea.

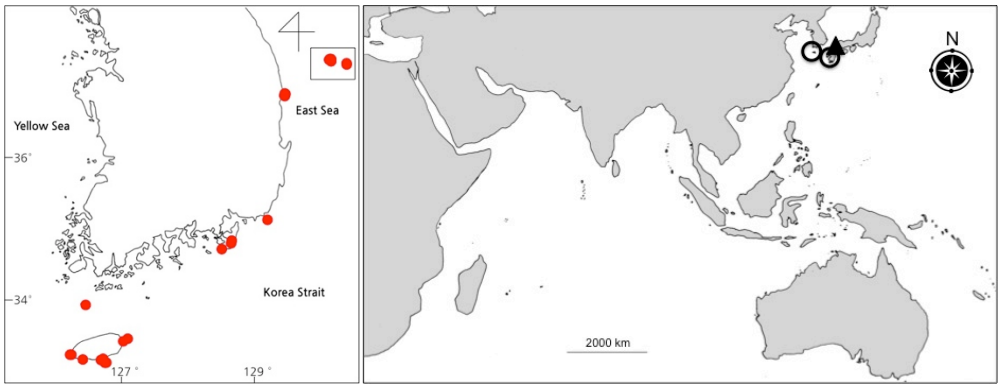

Fig. 125. Distribution of *Microcassiope orientalis* Takeda & Miyake, 1969. Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. *Microcassiope orientalis* Takeda & Miyake, 1969 were first reported as *Macromedaeus orientalis* by Lee & Ko, 2008. After the original description, Yamaguchi et al. (1976) suggested this species to be transferred to the genus *Macromedaeus* Ward, 1942 due to the close resemblance to M. distinguendus (De Haan, 1835). Takeda (1977) and many researchers followed this new combination. Ng et al. (2008), however, listed the original status of this species without any comments. The author examined this species with many specimens. And then, the author also followed the original status. The subdistal lobe of G1 of this spcies is on the apical lobe while those of members belonging to the genus *Macromedaeus* wrap the subdistal lobe. Other species of the genus *Microcassiope* are also similar to G1 descried in the literatures.

39. ***Nanocassiope granulipes*** **(Sakai, 1939) 꼬마부채게**

Heteropanope granulipes Sakai, 1939: 546, Fig. 59; Serène, 1964: 185, Pls. 6A.

Nanocassiope granulipes: Guinot, 1967: 355; 1971: 1075; Kim & Kim, 1982: 150; Kim & Chang, 1985: 54; Ko & Clark, 2002: 1463.

Previous records of Korean fauna. Seoguipo, Haeundae (Kim & Kim, 1982; Kim & Chang, 1985; Ko & Clark, 2002)

Material examined. 1 ind., Munseom Is., Jejudo, 6 Oct. 1995; 2 inds., Lower Baekdo Is., 21 Jun. 2002.

Distribution. Carapace (Fig. 126, 127A) transversely oval, slightly convex, glabrous. Front (Fig. 127B) relatively broad, divided into 2 straight lobes, each separated from supraorbital margin by small notch. Anterolateral margins cut into 4 teeth behind outerorbital angle: first small and rounded, second and third subequal and more salient, last very small but acuminate. Third maxilliped (Fig. 127C) completely covering buccal orifice; merus subquadrate, granular, anterolateral angle slightly produced, anterior margin with wide slightly concave medially; ischium subrectangular.

Thoracic sternum (Fig. 127D) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture; sternite 5 widest.

Chelipeds (Fig. 127E, 127F) slightly asymmetrical. Merus short, upper margin crestiform. Carpus thickly convered with granules and bearing ingerior half of outer surface smooth. Fingers about as long as manus, provided with acute teeth along cutting edges.

Ambulatory legs very slender, sparsely haire, anterior margin microscopically granulated; dactylus as long as or even long than propodus.

Male abdomen (Fig. 127D) narrow; somites 3–5 fused, sutures vaguely discernible; somite 6 long, distal half slightly broader than proximal half, lateral margins slightly concave; telson with distal margin semicircular.

First pleopod of male (Fig. 128) stout, distal portion armed with sinuous long hair.

Fig. 126. *Nanocassiope granulipes* (Sakai, 1939), male, 7.9 × 5.2 mm, dorsal view.

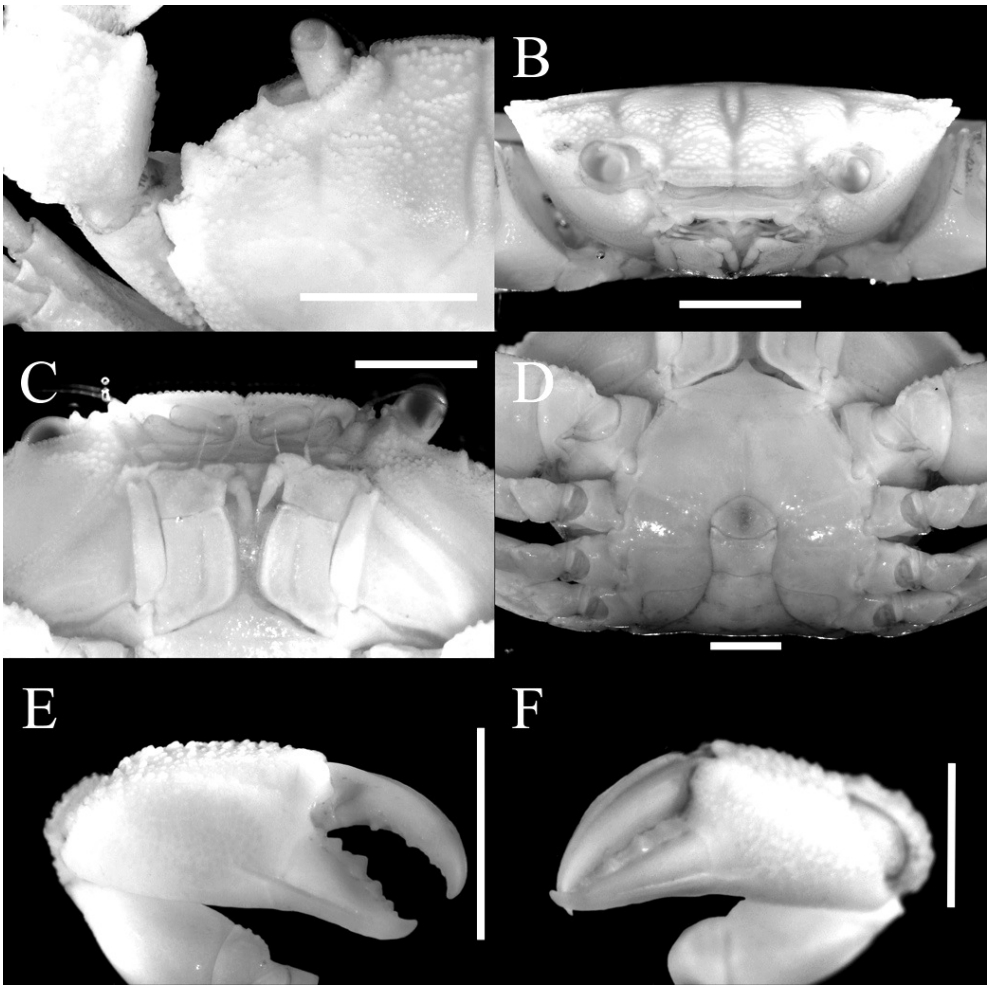

Fig. 127. *Nanocassiope granulipes* (Sakai, 1939). A, Anterolateral margin, dorsal view; B, Front, anterior view; C, The third maxillipeds, ventral view; D, Thoracic sternum and male Abdomen, ventral view; E, Right cheliped, outer view; F, Left cheliped, outer view. Scale bars: A, B, F = 2 mm, C, D = 1 mm, E = 3 mm.

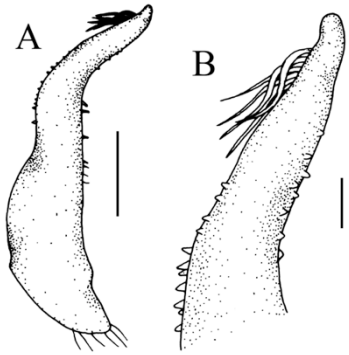

Fig. 128. Male first gonopod of *Nanocassiope granulipes* (Sakai, 1939), external view. Scale bar: A = 0.5 mm, B = 0.1 mm.

Habitat: muddy, shelly bottoms, 30– 120m deep.

Distribution: East China Sea; Japan, and South Coast of Africa.

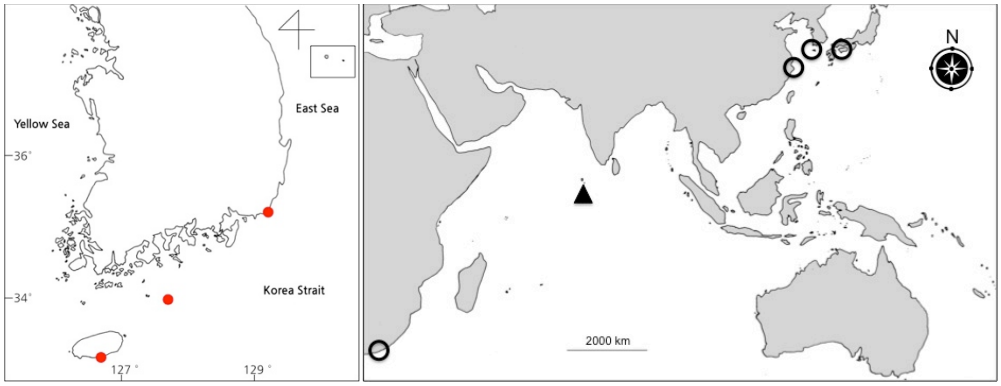

Fig. 129. Distribution of *Nanocassiope granulipes* (Sakai, 1939). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. Korea *Nanocassiope granulipes* (Sakai, 1939) looks like to juvenile of xanthoid crabs due to their size is less 10 mm. Their fingers are crossed when closed. The tubercles on dorsal surface are shown disctinct. *N. granulipes* is very similar *N. alcocki* Rathbun, 1902. G1 of the male of *N. granulipes* has smooth on subdistal portion while that of *N. alcocki* has a curved lobe on subdistal portion.

40. *Neoxanthops lineatus* (A. Milne Edwards, 1867) 줄무늬부채게

Cycloxanthus lineatus A. Milne Edwards, 1867: 269.

Neoxanthops lineatus: Guinot, 1968: 700, fig. 16; Sakai, 1976: 436, Pl. 157, fig. 1: 40; Serène, 1984: 211 (key), 212, Pl. 29C, fig. 127; Lee & Ko, 2011: 185.

Previous records of Korean fauna. Hyeongjeseom Is. (Lee & Ko, 2011)

Diagnosis. Carapace naked, about broader than long; regions ill defined; dorsal surface convex medially. Front produced, directed downward, divided into 2 lobes by longitudinal fissure. Anterolateral margins sharply crested, divided into 4 lobes by 3 narrow fissures. Posterolateral margins slightly concaved. Third

maxilliped; ischium subrectangular, bearing setae on inner margin; anteroexternal angle of merus produced.

Cheliped slightly asymmetirical, relatively long, robust. Carpus crenulated on anterior margin. Propodus long, slender, proximal; anterior margins crenulated. Fingers slender, curved, brown colored; cutting margin of immovable finger with 2 triangular teeth.

Ambulatory legs naked, generally short, stout, flattened; fourth ambulatory legs shorter than others; dactyli long, tips bluntly pointed, brown colored.

Female abdomen elongated, 6-segmented. Telson semicircular, broader than long.

Color of in life. Red diagonal lines distributed on lateral each half on carapace, fingers of chelipeds and proximal parts of propodi and dactyli of ambulatory legs are dark brown.

Habitat. Crevices of coral reef and under stones.

Distribution. Red Sea, Aden, Kenya, Zanzibar, Madagascar, Japan, Taiwan, Australia, New Caledonia (Sakai, 2004) and now to Korea.

Remarks. The author has not examined this species. The description of this species is cited from Lee & Ko (2011).

41. *Banareia subglobosa* (Stimpson, 1858) 반구부채게

Actaea subglobosa Stimpson, 1858: 33; 1907: 45, Pl. 5, Fig. 5; Odhner, 1925: 75, Pl. 4, Fig. 19; Kim, 1973: 386; Kim & Kim: 1982: 140.

Actaea (Banareia) *Subglobosa*: Sakai, 1939: 494, Pl. 61, Fig. 3; Pl. 94, Fig. 9; 1965: 147, Pl. 73, Fig. 2.

Banareia subglobosa: Balss, 1922: 123; Kim & Chang, 1985: 54. Ng et al., 2008: 205.

Fig. 130. *Banareia subglobosa* (Stimpson, 1858), male, 29.5 × 23.4 mm, dorsal view.

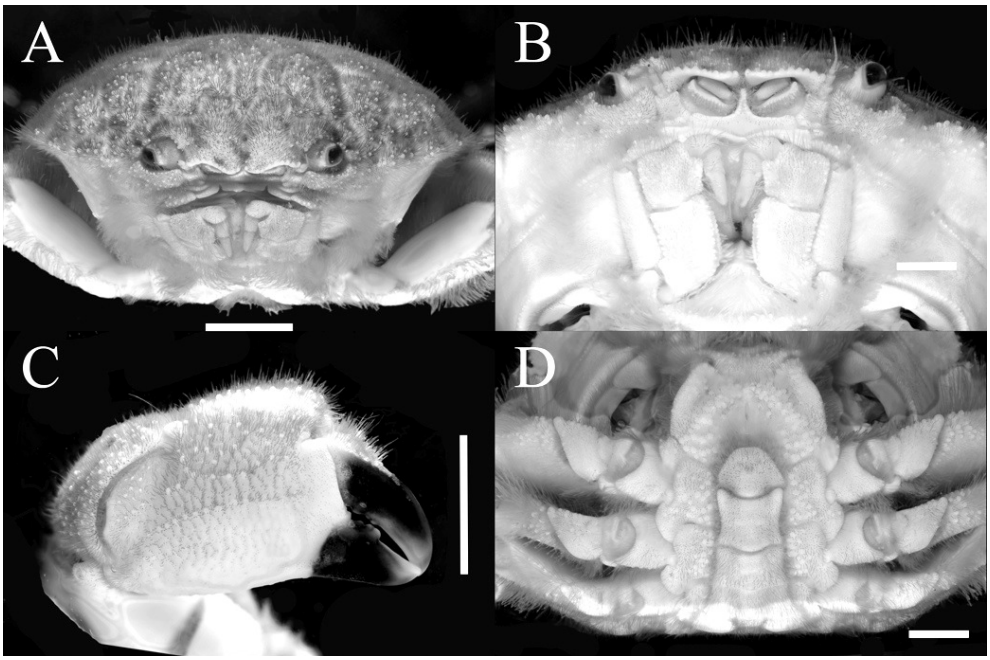

Fig. 131. *Banareia subglobosa* (Stimpson, 1858). A, Front, anterior view; B, The third maxillipeds, ventral view; C, Right cheliped, outer view; D, Thoracic sternum and male Abdomen, ventral view. Scale bars: A = 5 mm, B, C, D = 3 mm.

Previous records of Korean fauna. Seoguipo (Kim, 1973; Kim & Chang, 1985; Kim & Kim, 1982)

Material examined. 1 ind., Seoguipo, Jejudo, 17 Aug. 1969; 1 ind., Seoguipo, Jejudo, 3 Aug. 1970; 2 inds., Munseom Is., Jejudo, 19 Sep. 1995; 3 inds., Beomseom Is., Jejudo, 6 Jun. 2001; 1 inds, Seoguipo, Jejudo, 9 Mar. 2002; 1 ind., SSeggiseom Is., Jejudo, 19 Apr. 2002; 1 inds., Lower Baekdo Is., 21 Jun. 2002.

Diagnosis. Carapace (Fig. 130) slightly broader than long; dorsal surface convex, semiglobose, covered with pubescence; regions subdivided into areolae by fine grooves; each areola covered with scattered granules.

Frontal (Fig. 131A) margin cut into 2 lobes by V-shaped median notch, slightly more than one-quarter breadth of carapace; each lobe with its anterior margin concave. Orbit composed of 4 obtuse lobes besides outerorbital angle: first one low and flat, third broadest, second and fourth broad and subequal in breadth. Anterolateral margin with 4 lobes cut into narrow, low notch. Posterolateral margin

converging backwards and concave. Third maxilliped (Fig. 131B) completely covering buccal orifice; merus subquadrate, granular, anterolateral angle slightly produced; ischium subrectangular with submedian sulcus, smooth, punctate; exopod stout, length about 4 times width.

Thoracic sternum (Fig. 130D) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture

Chelipeds (Fig. 130C) stubby and symmetric. Merus with short hairs on dorsal margin, but inner and outer surface bald. Carpus and manus covered with pubescence on dorsal surface. Manus also covered with pubescence in upper half of outer surface, but smooth in lower half and on inner surface. Immovable finger armed with large tooth and small teeth at base of inner margin; movable finger armed with 2– 3 granular denticles.

Ambulatory legs short and small, thickly covered with pubescence; first to third pairs of ambulatory legs and merus smooth.

Male abdomen (Fig. 130D) narrow and elongated; third to fifth segments fused; sixth segment subrectangular; telson bluntly triangular, reaching level of coxo-sternal condyle of pereiopod 1.

Habitat. Usually found on soft coral, *Nephthya*, in depths of 10 to 35m.

Distribution. Guangdong (China); Japan

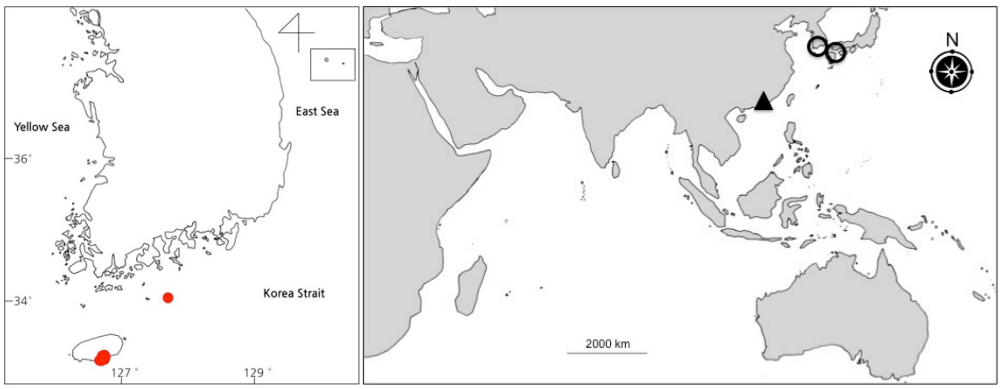

Fig. 132. Distribution *Banareia subglobosa* (Stimpson, 1858). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. The author has not examined G1 of *Banarieia subgrlobosa* (Stimpson, 1858) due to its loss in the bottle.

42. *Calvactaea tumida* Ward, 1993 산호숨이부채게

Calvactaea tumida Ward, 1933: 384, Pl. 23, Fig. 9; Sakai, 1976: 520, Pl. 187, Fig. 3, Text-fig. 279; Ko & Takeda, 2000: 33.

Atergatopsis globosa Balss, 1935: 137, Pl. 13, Fig. 4.

Previous records of Korean fauna. Moseulpo (Ko & Takeda, 2000)

Material examined. 1 ind., Munseom Is., Jejudo, 19 Sep. 1995; 5 inds., Beomseom Is., Jejudo, 6 Jun. 2001; 2 ind., Udo Is., Jejudo.

Diagnosis. Carapace (Fig. 133, 134A) quite convex, subglobose; surface marked with scattered fine granules, with shallow fine fissures; regions ill defined. Front produced, deflected; anterior margin divided into 2 lobes by fine hiatus; each lobe separated from innerorbital tooth by depression. Anterolateral margin arched, unarmed. Posterolateral margin shorter, concave.

Third maxillipeds (Fig. 134B) completely covering buccal orifice; merus subquadrate, granular, anterolateral agle slightly produced.

Thoracic steranum (Fig. 134C). Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture.

Chelipeds stubby, symmetrical. Merus short, triquetrous and furnished with short hairs along its margins. Outer and inner surface bald. Outer surface of carapace and dorsal surface of manus granulated. Movable finger with granules and short hairs; dactylus longer than or almost as long as carpus.

Ambulatory legs very slender and fringed with hairs

Male abdomen oblong, 7-segmented; each segment fringed with long hairs; telson subcircular.

Habitat. rocky beaches, commensally living with *Alcynarians*; shallow waters.

Fig. 133. *Calvactaea tumida* Ward, 1993, male, 18.4 × 14.3 mm, dorsal view.

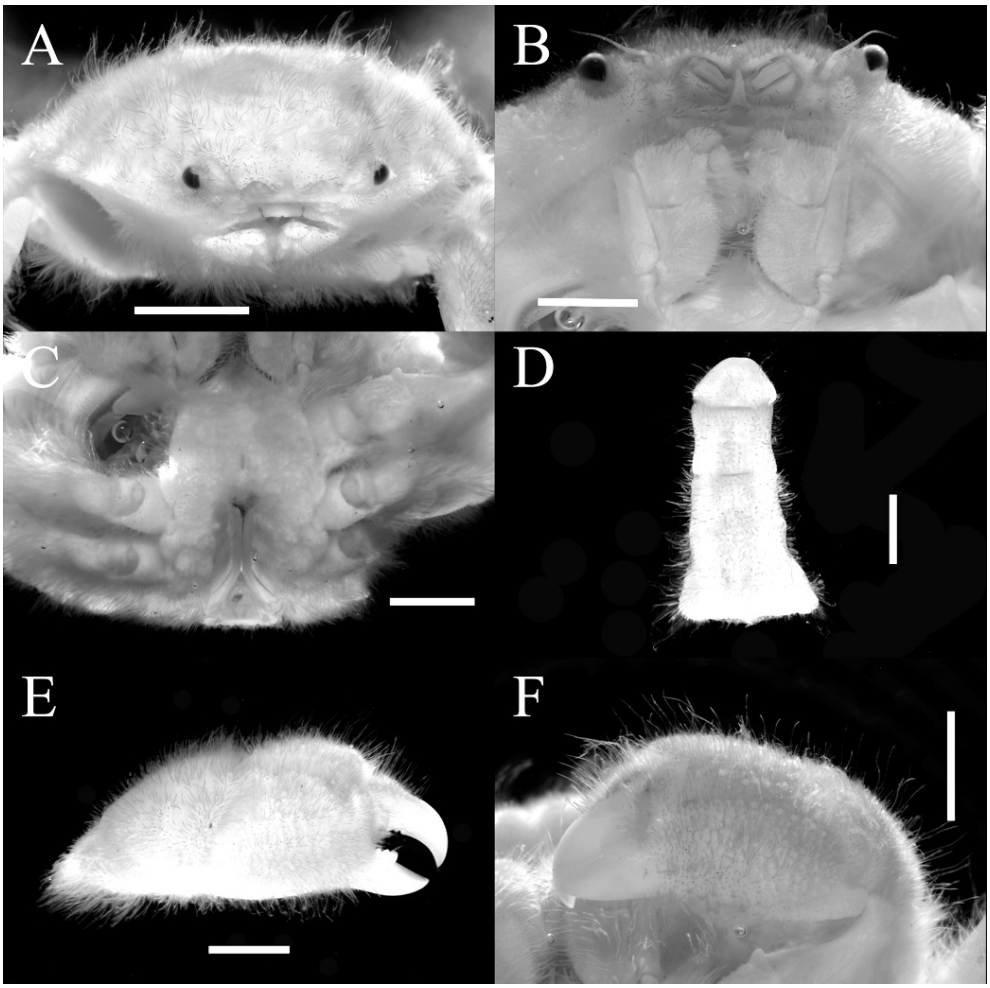

Fig. 134. *Calvactaea tumida* Ward, 1993. A, Front, anterior view; B, The third maxilliped, ventral view; C. Thoracic sternum and first gonopod, ventral view; D, Male abdomen, ventral view; E, Right cheliped, outer view; F, Left cheliped, outer view. Scale bars: A = 5 mm, B, C, E, F = 3 mm, D = 2 mm.

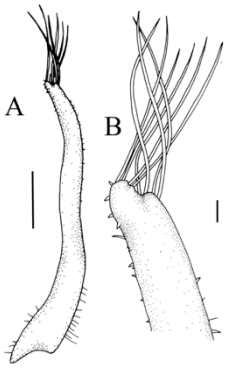

Fig. 135. Male first gonopod of *Calvactaea tumida* Ward, 1993, external view. Scale bars: A = 1 mm, B = 0.1 mm.

Distribution. China, Japan, and South Western Australia.

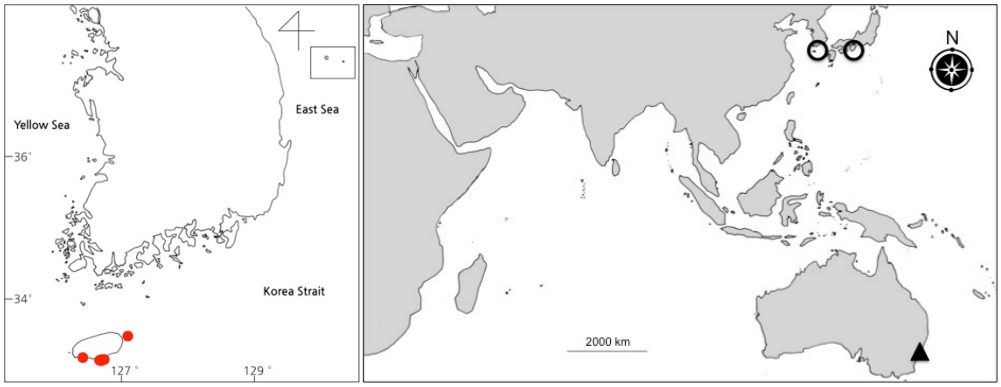

Fig. 136. Distribution of *Calvactaea tumida* Ward, 1993. Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. Korean *Calvactaea tumida* Wards, 1993 has been collected from Jejudo Island. In the life, they attached many organic material their setae on the dorsal surface of the carapace. The regions of the carapace can be shown distictly after removing them, and this speices has three notches of anterolateral border.

43. *Atergatis floridus* (Linnaeus, 1767) 매끈이송편게

Cancer floridus Linnaeus, 1767: 1041

Atergatis floridus: de Haan, 1835: 46; Kim & Rho, 1971: 20; Kim, 1973: 375; Sakai, 1976: 409, Pl. 148, Fig. 2; Kim & Chang, 1985: 53; Dai & Yang, 1991: 282.

Previous records of Korean fauna. Seoguipo (Kim & Rho, 1971; Kim, 1973; Kim & Chang, 1985)

Material examined. 1 ind., Munseom Is., Jejudo, 10 Jul. 2003; 1 ind., Seoguipo, Jejudo, 3 Aug. 1970; 1 ind., Seoguipo, Jejudo, 15 Aug. 1969; 1 ind., Chaguido Is., 17 Aug. 2001.

Diagnosis. Carapace (Fig. 137) borader than long, transversely oval; dorsal surface smooth, with yellow pattern on dark brown ground, microscopically punctated; regions well define. Front (Fig. 138A) about one-third as brad as carapace; slightly convex in the middle, divided into 2 broad lobes by shallow fissure.

Fig. 137. *Atergatis floridus* (Linnaeus, 1767), male, 57.6 × 39.8 mm, dorsal view.

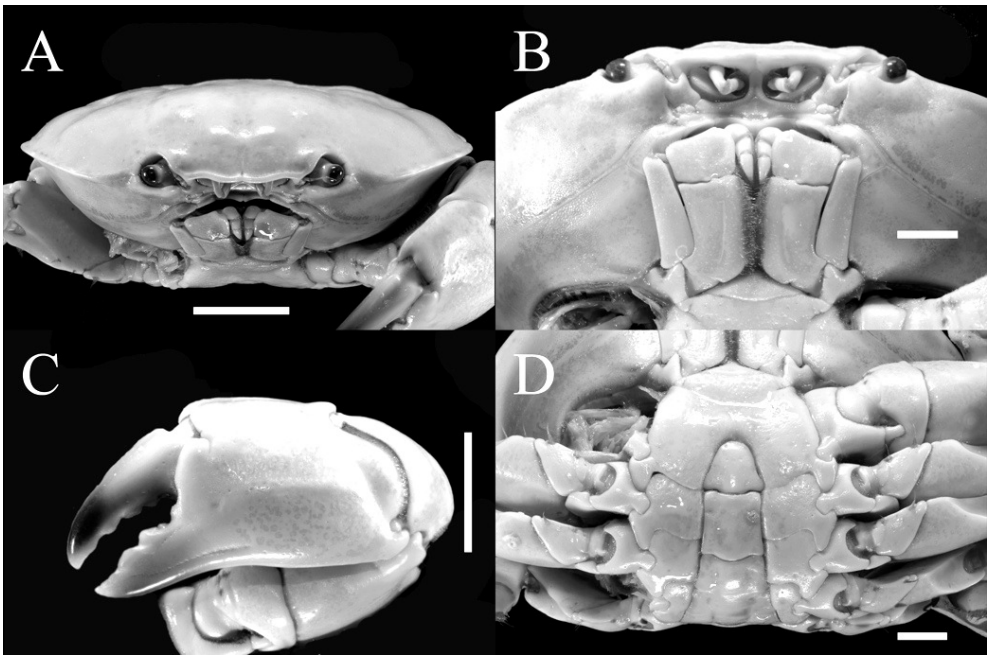

Fig. 138. *Atergatis floridus* (Linnaeus, 1767). A, Front, anterior view; B, The third maxillipeds, ventral view; C, Left cheliped, outer view; D, Thoracic sternum and male Abdomen, ventral view. Scale bars: A, C = 10 mm, B, D = 5 mm.

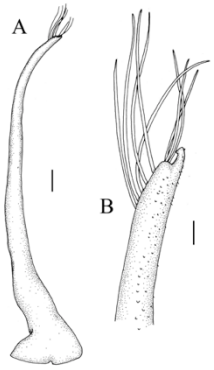

Fig. 139. Male first gonopod of *Atergatis floridus* (Linnaeus, 1767), external view. A, Whole; B, Distal portion. Scale bars: A = 1 mm, B = 0.2 mm.

Frontal and protogastric lobes distinct. Orbit small, orbital peduncle short and stout. Anterolateral margin elongated, crestiform, divided into 4 lobes by 3 shallow fissures, the last one angular. Posterolateral margin concave. Posterior border strgint, naked. Third maxilliped (Fig. 138B) completely covering buccal orifice; merus subquadrate, granular, anterolateral angle not produced, anterior margin with shallow notch medially; ischium subrectangular with submedian sulcus, smooth, punctate; exopod stout, length about 4 times width.

Thoracic sternum (Fig. 138D) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture.

Chelipeds (Fig. 183C) symmetrical. Merus short and triquetrous, with short hairs on anterior margin. Carpus with dorsal margin bluntly round, and inner-distal angle bearing 1 obtuse tooth. Manus relatively depressed, dorsal margin sharp and crestiform.

Ambulatory legs depressed, surface pited, margins of every joint sharp; propodus with short hair at distal end of the anterior margin and on posterior margin; dactylus densely covered with short and long hairs.

Male abdomen (Fig. 138D) elongated and narrow; third to fifth segments fused; sixth segment square; terminal segment bluntly triangular. Female abdomen oblong, fringed with short hairs.

First pleopod of male (Fig. 139) slender and elongated, slightly curved laterally; tip bluntly triangular, armed with long hairs.

Habitat. rocky shore near the low-tide mark or coral reefs in shallow waters.

Distribution. China, Japan, Hawaii, Tahiti Is., Tuamotu Arch., Society Island, Fuji, Marshall Is., Gilbert Is., Caroline Is., Australia, Malaysia, India, Sri Lanka, Red Sea, Mauritius, East and South Coast of Africa.

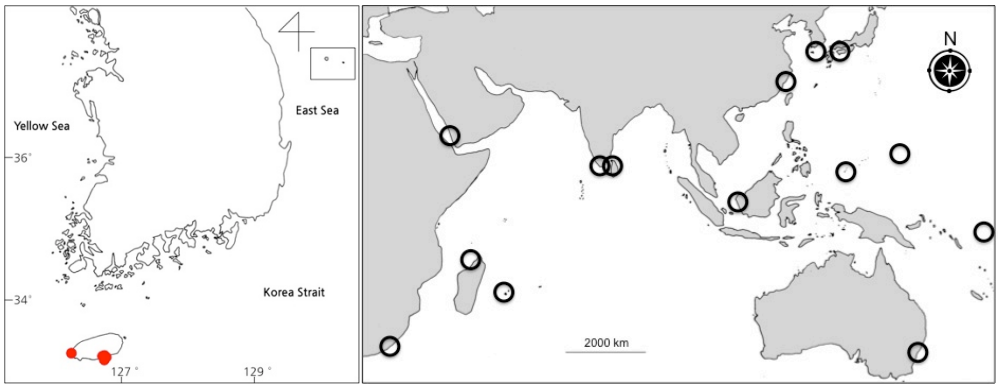

Fig. 140. Distribution of *Atergatis floridus* (Linnaeus, 1767). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. *Aterigatis floridus* (Linnaeus, 1767) in life shows dark brown coloured with irregular spots. In Korea, this species has been only collected from Jejudo Isaland. After fixation with etyl achole, they became the light ivory coloured without irregular spots.

44. *Atergatis reticulatus* (De Haan, 1835) 주름송편게

Cancer (*Atergatis*) *reticulatus* De Haan, 1835: 47, Pl. 3, Fig. 4.

Atergatis reticulatus: Kim 1973: 377; Sakai, 1976: 411, Pl. 147, Fig. 1; 김 과 최, 1981: 193; Kim & Chang, 1985: 53; Kim & Kim, 1986: 309; Dai & Yang, 1991: 283, fig. 150B(1), 전 등, 2000a, 144.

Previous records of Korean fauna. Jejudo Is., Guryeongpo, Haeundae, Gapado Is., Sacheon, Geojedo, Ulreundo Is., Geomundo, Upper Chujado Is. (Kim, 1973; 전 등, 2000; Kim & Chang, 1985; 김 과 최, 1981; Kim & Kim, 1986)

Material examined. 6 inds., Haeundae, Pusan, 10 Jul. 1969; 7 inds., Seoguipo, Jeju-do, 16 Aug. 1969; 1 ind., Gapado, Jeju-do, 12 Aug. 1970; 2 inds., Port Mipo, Pusan, Gyeongsangnam-do, 15 Jul. 1974; 2 inds., upper Chujado Is., Jeju-do, 18 Jul. 1985; 1 inds., Munseom Is., Jeju-do, 7 Nov. 2000; 1 ind., Beomseom Is., Jeju-do, 21

Feb. 2001; 1 ind., Chaguido Is., Jeju-do, 8 Jun. 2001; 1 ind., Geomundo Is., Jeollanam-do, 13 Jul. 1984.

Diagnosis. Carapace (Fig. 141) transversely oval; dorsal surface slightly convex, with coarse pits and corrugation; Regions well defined. Front (Fig. 142A) slightly produced, divided into 2 lobes by a median notch. Anterolateral margin sharp, cut into 4 shallow lobes. Posterolateral margin somewhat concave, posterior margin straight.

Third maxilliped (Fig. 142B). Anterolateral angle of merus sliglty produced.

Chelipeds (Fig. 142D) covered with coarse pits and corrugation. Dorsal surface of carpus and outer surface of merus with with coarse pits and corrugation. Carpus with sharp, prominent lobe. propodus with dorsal margin sharp, especially in the proximal half.

Ambulatory legs. Merus with anterior margin crestiform; posterior margin bearing 2 crests. Carpus and propodus crested on both anterior and posterior margin. Dactylus covered with dense pubescence, tipped with smooth claw.

Male abdomen (Fig. 142C) narrow and elongated, third to fifth segments fused, conjunctive hiatus recognizable. Somite 6 as squared segment, longer than broad; terminal one bluntly triangular.

Male first (Fig. 143) gonopod slender and long, with distal end hook-shaped.

Habitat. Crevices of rocks, from low-tide mark to a depth of 20 m.

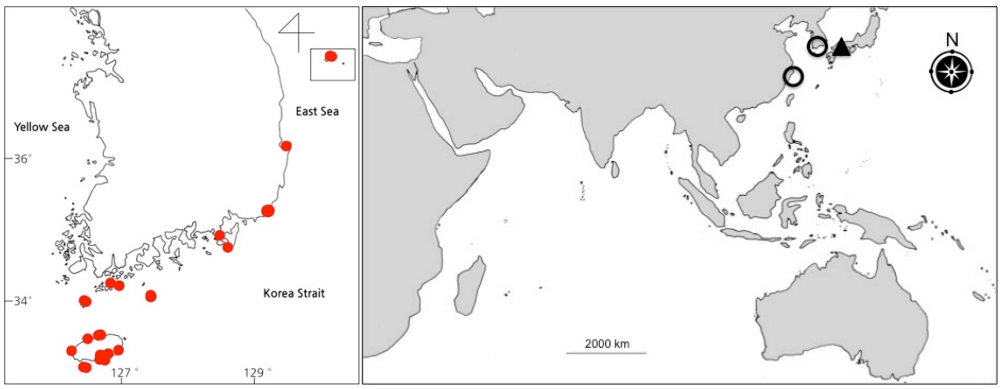

Fig. 141. Distribution of *Atergatis reticulatus* (De Haan, 1835). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Fig. 142. *Atergatis reticulatus* (De Haan, 1835), male, 37 × 23mm, dorsal view.

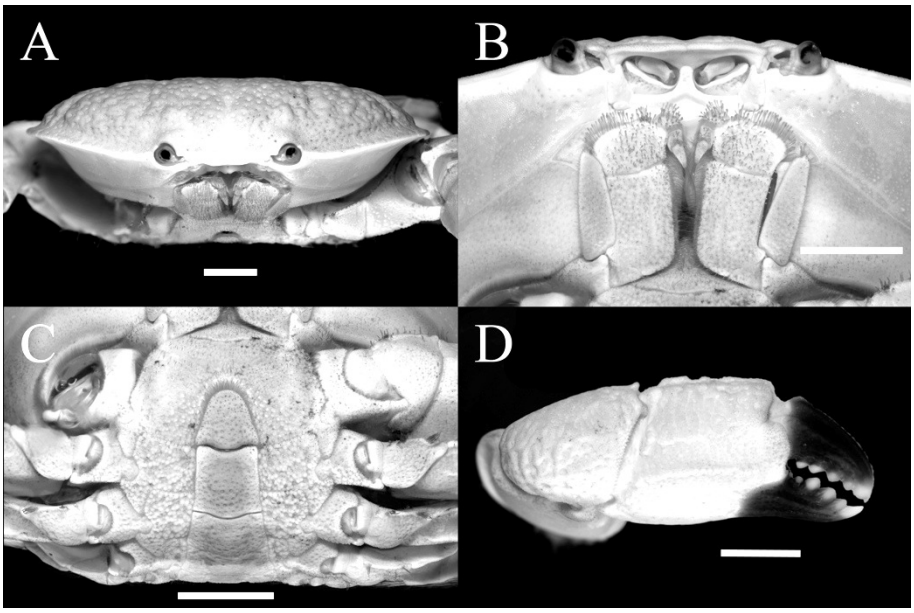

Fig. 143. *Atergatis reticulatus* (De Haan, 1835). A, Front, anterior view; B, The third maxillipeds, ventral view; C, Thoracic sternum and male abdomen, ventral view; D, Right cheliped, outer view. Scale bars: A, B, C, D = 5 mm.

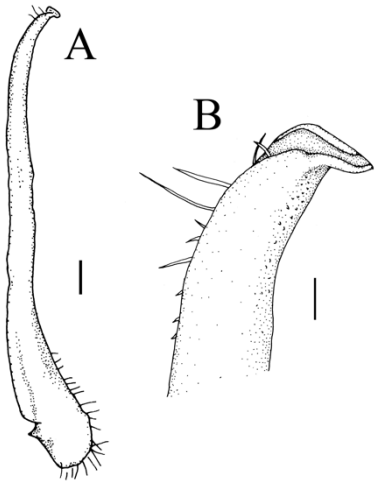

Fig. 144. Male first gonopod of *Atergatis reticulatus* (De Haan, 1835), external view. A, Whole; B, Distal portion. Scale bars: A = 1 mm, B = 0.1 mm.

Remarks. *Atergatis reticulatus* (De Hann, 1835) occurs in south-east part of the Korean peninsular. This speices in life have dark red-coulore, and some species has one white-spripe on the dactyli of ambulatory legs.

45. *Atergatopsis germaini* A. Milne-Edwards, 1865 고운반달게

Atergatopsis germaini A. Milne-Edwards, 1865, p. 257, pl.11, figs. 1a-b; Guinot, 1964, p. 16, figs. 3a-c; Sakai, 1976, p. 413, fig. 217; Serène, 1984, p. 141; Lee et al. 2008: 296.

Material examined. 1 ind., Hongdo Is., Gyeongsangnam-do, 20 May 1978, coll. H.S. Kim.

Diagnosis. Carapace (Figs. 145) naked, carmine coloured, covered with fine granular surfaces, convex in middle, and hemispherical in outline; each region obscurely defined and markedly convex in 2F; anterolateral margin conspicuously with three oblique teeth, lined with fine studded granules; anterolateral borders not crested; front (Fig. 146A) smooth, one third to carapace width, cutting into two lobes by longitudinal median trace. Third maxilliped (Fig. 146B) completely covering buccal orifice; merus subquadrate, granular, anterolateral angle slightly produced; ischium subrectangular with submedian sulcus, smooth, punctate; exopod stout, length about 4 times width.

Thoracic sternum (Fig. 146D) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture.

Chelipeds (Fig. 146E, 146F) with relatively long fingers; fingers blunt, black coloured at their apices with one row of four oblique teeth, hardly projecting; upper part of palm granular and lower part smooth.

Ambulatory legs (Fig. 146C) granular at surface, little depressed, and subcylindrical.

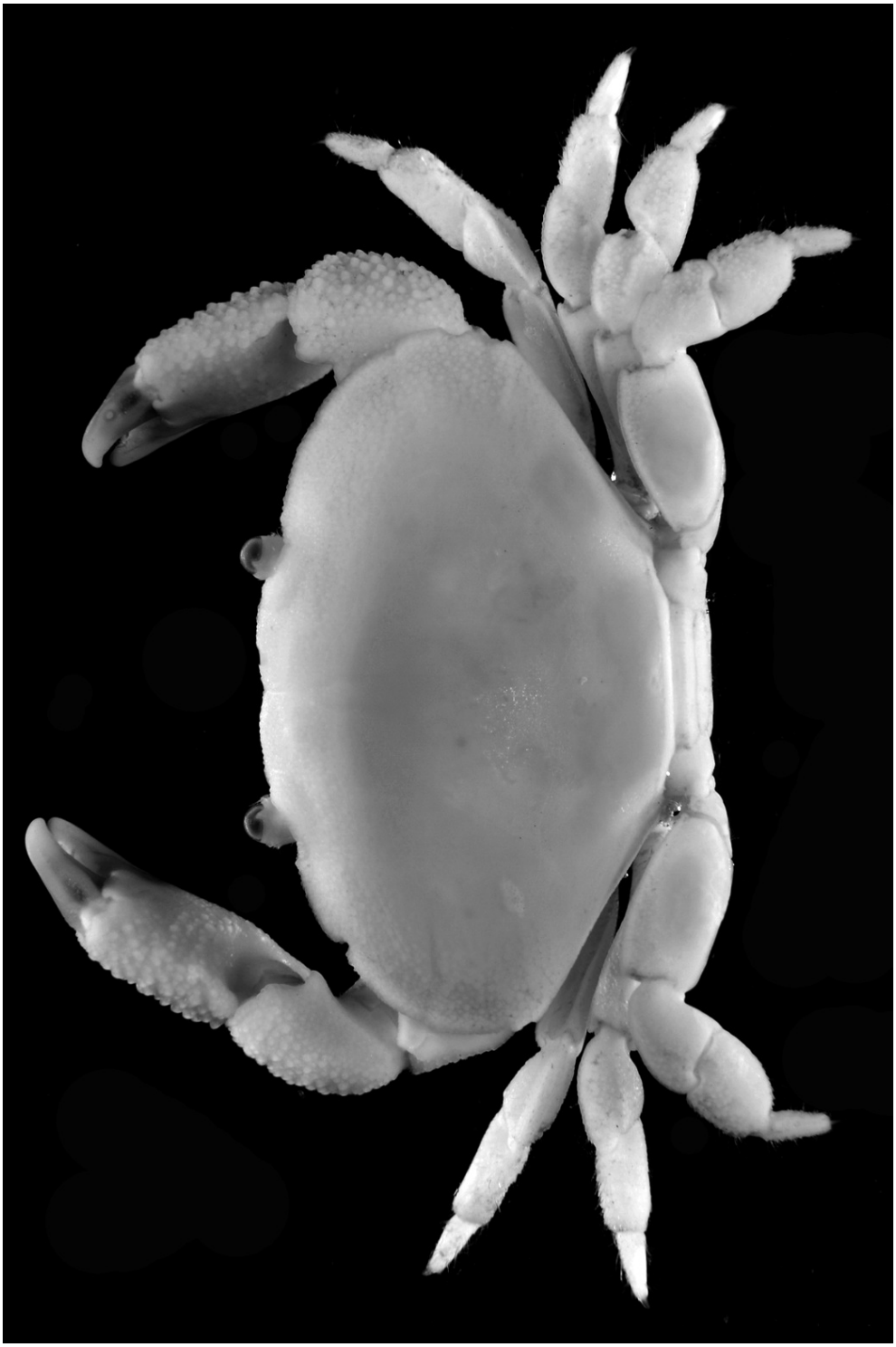

Fig. 145. *Atergatis germaini* A. Milne-Edwards, 1865, male, 15 × 8.8 mm, dorsal view.

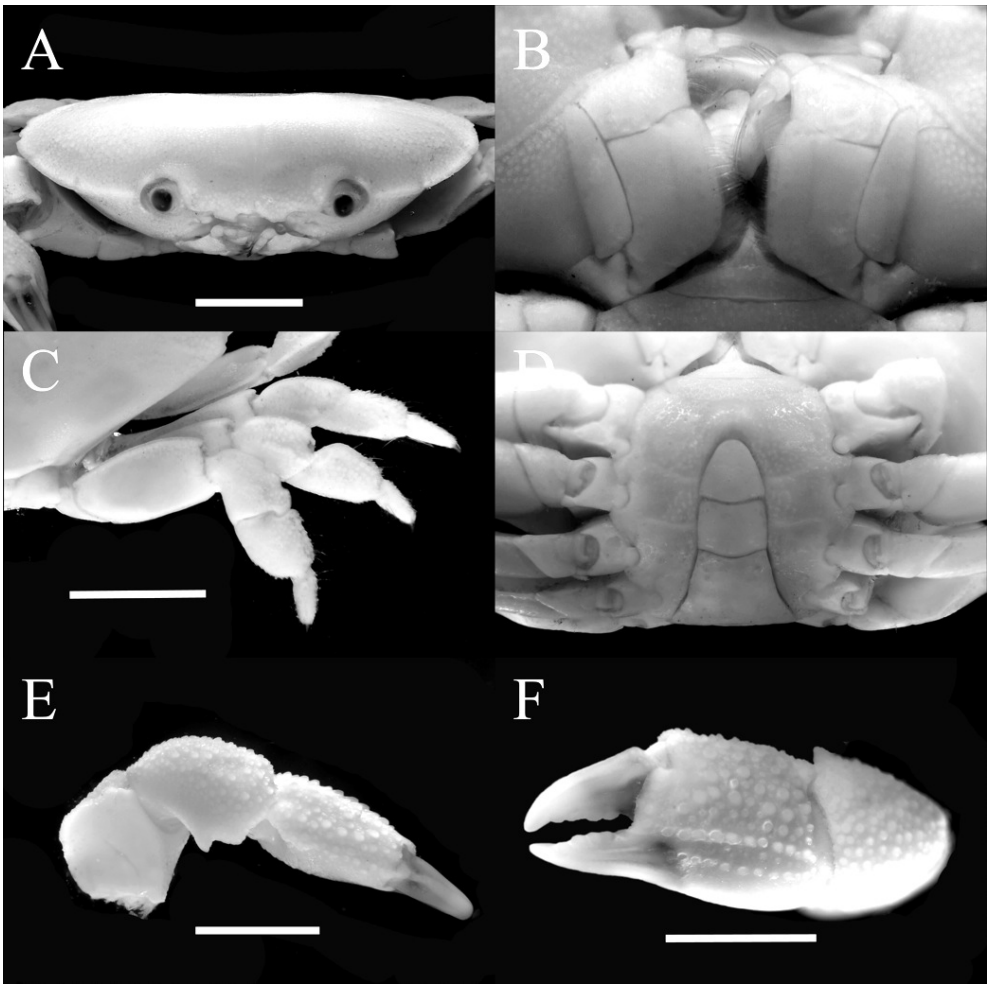

Fig. 146. *Atergatis germaini* A. Milne-Edwards, 1865. A, Front, anterior view; B, The third maxillipeds, ventral view; C, left second to fourth ambulatory legs, posterior view; D, Thoracic sternum and male abdomen, ventral view; E, Left cheliped, upper view; F, Left cheliped, outer view. Scale bars: A, C, E, F = 3 mm.

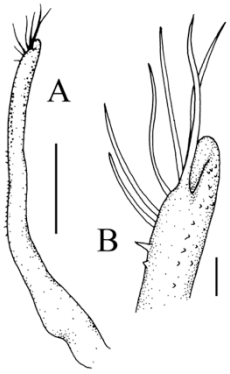

Fig. 147. Male first gonopod of *Atergatis germaini* A. Milne-Edwards, 1865, external view. A, Whole; B, Distal portion. Scale bars: A = 1 mm, B = 0.1 mm.

Male abdomen (Fig. 146D) narrow; somites 3–5 fused, sutures vaguely discernible

First gonopods (Fig. 147) very slender, inner curved, with four bristles on distal end.

Habitat. Coral reef, shallow waters.

Distribution. Japan, Taiwan, The Philippines, Vietnam, New Guinea, Korea.

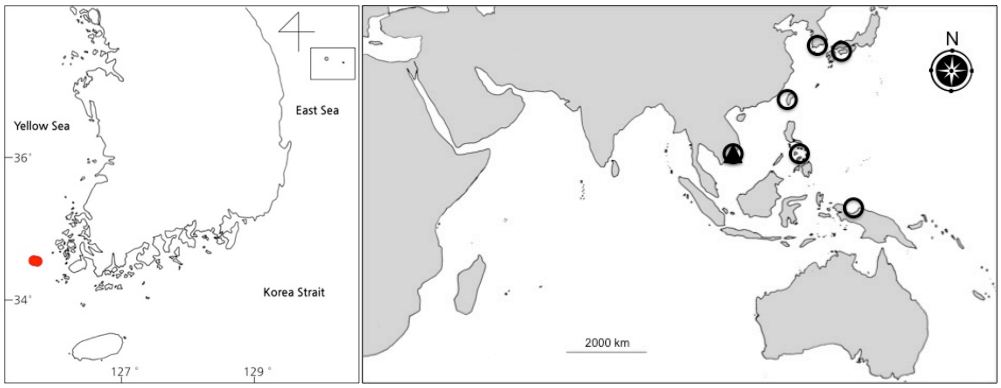

Fig. 148. Distribution of *Atergatis germaini* A. Milne-Edwards, 1865. Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. *Atergatopsis germaini* has three teeth on the inner immovable fingers (Sakai, 1976) but the present specimen has four teeth. The upper part of the movable fingers has two grooves due to longitudinal median crest, and the dorsal surface of the carapace has indistinct furrows.

46. *Platypodia tomentosa* (De Man, 1902) 납작발부채게

Lophactaea tomentosa De Man, 1902, p. 585.

Platypodia tomentosa: Buitendijk, 1941, p. 309, fig. 3C; Serène, 1984, p. 157; Lee et al., 2008: 296.

Material examined. 1 ind., Marado Is., Jeju-do, 4 Nov. 2000, coll. S.H. Kim.

Diagnosis. Carapace (Fig. 149) granular, covered with short brown tomentum and semicircular in outline; each hepatic region and protogastric region ornamented with bundles of long hair; each regions of carapace separated by feeble furrow; 1F and 2F conjugated, 1M convex, and 2M not divided into two pars longitudinally; front (Fig. 150A) cut into shallow notch; anterolateral borders well crested, and divided into four blunt lobes with indistinct notch between them. Third maxilliped (Fig. 150C) completely covering buccal orifice; merus subquadrate, granular, anterolateral angle slightly produced; ischium subrectangular with submedian sulcus, smooth, punctate; exopod stout, length about 4 times width.

Thoracic sternum (Fig. 150D) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture.

Chelipeds (Fig. 150E, 150F) well developed, black coloured at their apices; superior margin of palm with smooth crest along whole length; outer palm with small granules and few setae. Immovable fingers blade-like with strong trifid tooth proximally.

Ambulatory egs (Fig. 150B) very depressed, with few setae on upper and lower border; infra-border of merus with crest.

Fig. 149. *Platypodia tomentosa* (De Man, 1902), male, 7.4 × 5.1 mm, dorsal view.

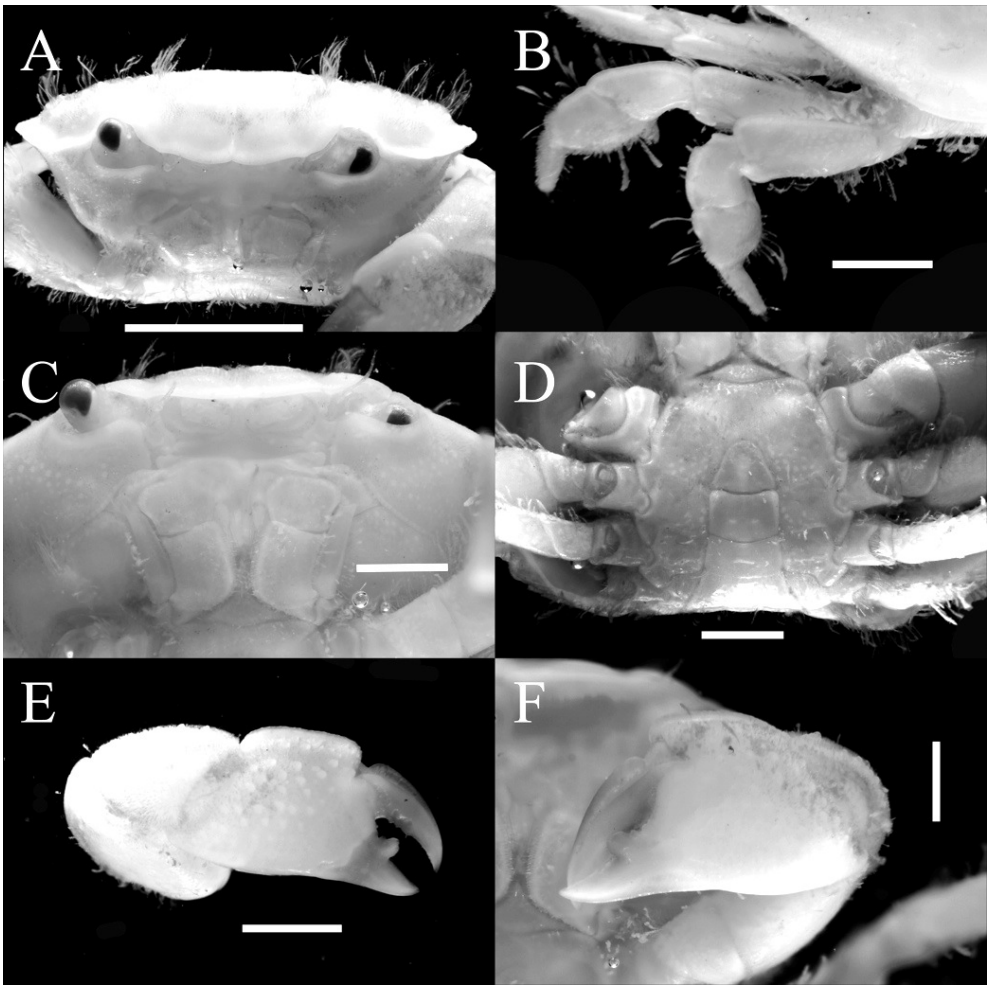

Fig. 150. *Platypodia tomentosa* (De Man, 1902). A, Front, anterior view; B, The two to third ambulatory leg, posterior view; C, The third maxillipeds, ventral view; D, Thoracic sternum and male abdomen, ventral view; E, Right cheliped, outer view; F, Left cheliped, outer view. Scale bars: A = 3 mm, B, C, D, E, F = 1 mm.

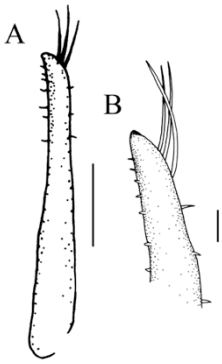

Fig. 151. Male first gonopod of *Platypodia tomentosa* (De Man, 1902), external view. A, Whole; B, Distal portion. Scale bars: A = 0.5 mm, B = 0.1 mm.

Male abdomen (Fig. 150D) narrow; somites 3–5 fused, sutures vaguely discernible

Male first gonopod (Fig. 151) short, straight, with 3 seta on subdistal portion.

Habitat. In the crevices and on the coral reef.

Distribution. Red sea, Madagascar, Japan, China, Taiwan, Australia, Hawaiian Islands, Korea.

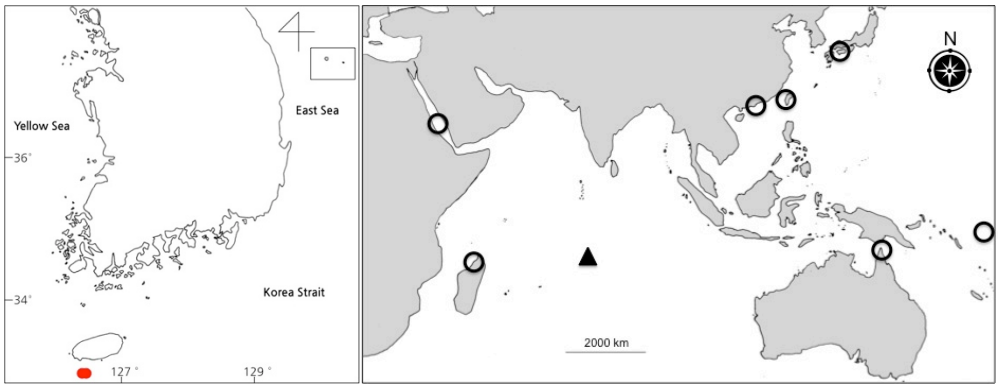

Fig. 152. Distribution of *Platypodia tomentosa* (De Man, 1902). Legend: black triangle= type locality; black oval= collected locality in Korea; blank oval= distribution in worldwide.

Remarks. In Korean specimen, the lobes of anterolateral margin are asymmetrical and the notches between lobes are irregular along outline of the carapace. This specimen has no bundle of long hair on the cardiac region, and 2M region is not divided by furrow longitudinally.

1-2. Molecular taxonomic study of Korean pilumnoids and xanthoids using DNA barcording.

INTRODUCTION

Pilumnoid and Xanthoid crabs are common and speciose in macrofaunal communities of reef habitats worldwide. The taxonomy and systematics of two superfamilies have changed substantially during the latter half of the last century. Several studies have attempted to intergrade groupings on the basis of the zoeal morphology and the setotaxy with traditional classifications of adult (Serène, 1984; Clark & Galil, 1988).

The members of two superfamilies, Pilumnoidea and Xanthoidea, show very similar appearances. The males of them can be identified with first pleopod that serves as important morphological key character on male but not on female and juvenile due to some species have a similar morphology between females. Furthermore, these crabs shown many varieties of colour patterns could be misidentified. The identification is of fundamental importance for subsequent studies, but species identification is problematic, especially for immature specimens, larvae, damaged specimens, and those with morphological differences between male and female (Pfenninger et al., 2007). In such cases, a molecular-based approach can be used for species identification (Tautz et al., 2002).

Hebert *et al*. (2003) introduced DNA barcoding as a molecular tool for species identification, and since then, the technique has been extensively used in molecular taxonomic studies (Hajibabaei *et al*, 2007; Ebihara *et al*. 2010). DNA barcoding is especially valuable for not only rapid and accurate species identification but also discrimination of cryptic species on animal species including some crustaceans (Radulovici et al., 2009). Thus molecular taxonomic study will have a potential to serve as a supplemental tool for the resolution of taxonomic problems and addition of valuable characters, when the reliable identification of species by morphology is challenging.

This study targeted the crabs belonging to Pilumnoidea and Xanthoidea from Korea to test the validity of DNA barcoding for these species identification. The mitochondrial cytochrome *c* oxidase subunit I (COI) gene was chosen as a genetic marker for DNA barcoding and analyzed on the basis of sequence divergence.

MATERIAL AND METHODS

Sample collection, DNA extraction, amplification, and sequencing

A total of 36 species representing 23 genera of superfamily Pilumnoidea and Xanthoidea, was sampled. They were primarily obtained from the Lab. of Systemtics and Molecular evolution, Seoul National University, Seoul, Korea. The rest of the specimens were collected from subtidal zones in the coastal regions of Korea. They were preserved directly in 95% ethyl alcohol after collection. Information on the detailed collecting locations is shown in Table 1. The materials for DNA extraction were excised from appendages or egg masses of alcohol-preserved specimens. Genomic DNA was extracted from samples using the DNeasy Tissue and blood kit (QIAGEN Inc., Valencia, CA) following the protocol of the manufacturer. Standard PCR amplification and DNA sequencing protocols were used to sequence a fragment of the COI. Primers used for PCR were LCO1490 (5′ -GGT CAA CAA ATC ATA AAG ATA TTG G-3′) and HCO2198 (5′ -TAA ACT TCA GGG TGA CCA AAA AAT CA-3′) (Folmer et al., 1994). The 5′ region of COI was amplified using the following thermal cycling program: 94°C for 5 min, 35 cycles at 94°C for 0.5 min, 45−50°C for 1 min, and 72°C for 1.5 min, followed by a final extension at 72°C for 10 min. The 25 μL PCR reaction mixture included 14.7 μL of ultrapure water, 5 μL of 5× PCR buffer, 1 μL of each primer (10 μM), 1 μL of dNTPs (10 mM), 0.3 μL of Taq polymerase (5 U), and 2 μL of the DNA template. PCR products were purified using QIAquick PCR Purification Kit (Qiagen). Sequencing reactions were resolved on an ABI 3730 automated DNA sequencer.

Sequence alignment

MAFFT (Katoh el al., 2002) was used to align sequences. The examined sequences were aligned using default parameters (FFT-NS-2), and then alignment was manually adjusted by Mesquite version 2.75 (Maddison & Maddison, 2011). Additional sequence data were downloaded from Genbank. For outgroup, *Dromia wilsoni* was chosen (Table 1).

DNA barcode analysis

The pair-wise nucleotide sequence divergences were obtained base on the Kimura 2 parameter (K2P) model of base substitution (Kimura, 1980). It is know that K2P model offers the best metric when genetic distances are low (Nei & Kumar, 2000).

Molecular taxonomic study based on COI sequences

Maximum likelihood (ML) and Bayesian inference (BI) were used to infer their taxonomical relationships. Likelihood tree searches were performed using Randomized Accelerated Maximum Likelihood (RAxML) version 7.2.6 (Stamatakis, 2006; Stamatakis et al., 2008) as implemented on the CIPRES portal (Http//www.phylo.org/sub_sections/portal, Miller et al., 2009) with the dataset. An estimate of the proportion of invariant sites is not implemented in RAxML, because it is sensitive to the number and divergences of the sequences included in the data. A rapid bootstrap (BS) analysis was performed with 1000 replication and used to search for the best ML tree with the GTRCAT model. After implementing the BS analysis, every fifth BS tree was used as a string point to search for the ML tree using a specified model of sequence evolution, saving 10 best-scoring ML tree (fast ML searches). Finally, RAxML calculated more accurate likelihood scores (slow ML searches) for those 10 trees and placed BS proportions on the best-scoring ML tree.

MrModeltest version 2.2 (Nylander, 2004) was used for identifying the best-fit model for individual loci partitions and the complete data set on the basis of the Akaike Information Criterion (AIC) for BI. The BI analysis was carried out by MrBayes version 3.1.2 (Huelsenbeck and Ronquist, 2003). Four Metropolis coupled

Monte Carlo Markov Chains were run for 10 milion generation with trees sampled every 1000 generation (10000 trees sampled). The first 250 generations (2500 trees) were discarded as "burn-in" and the posterior probabilities were estimated for the remaining sampled generations.

MrModeltest selected the models GTR+I+G (General Time Reversible plus Invariant sites plus Gamma distributed model) for the locus COI. Bayesian and likelihood analyses of the combined data produced similar, well-resolved, phylogenetic hypotheses (Fig. 155) with minor differences at nodes with low branch support (< 50%). Clades were mostly recovered at the genus level with high ML Bootstrap (BS) and BI posterior probability (PP) support. However, some clades did not corroborate the view of xanthoid classification as recognized by Serène (1984) or Ng et al. (2008).

RESULT

DNA barcoding of pilumnoids and xanthoids

The 5' end of the COI gene was sequenced partially in a total of 79 specimens (36 species, 23 genera, Table 1). The sequences were translated to detect nuclear mitochondrial pseudo-genes (NUMTs) that are common in eukaryotes, including indels, frame-shift mutations, and in-frame stop codons (Bensasson et al., 2001; Song et al., 2008). Amplified DNA from 79 specimens was 599 bp in length after manual checking of the alignment.

Of a total 599 characters, COI fragment represented 246 variable sites, 359 conservation sites, 19 singleton sites, and 227 parsimony-informative sites. A high level of maximum intraspecific K2P variation was observed in *Actaea polyacantha* (0.064), *Gaillardiellus orientalis* (0.069), and *Medaeops granulosus* (0.123), while a low level of minimum interspecific K2P variation was observed between *Leptodius affinis* and *Leptodius nigromaculatus* (0.020) and between *Gaillardiellus orientalis* and *Gaillardiellus rueppelli* (0.003). The average maximum intraspecific distances were calculated except for a single individual. The average minimum interspecific- and maximum intraspecific distances were 0.127 (n = 57) and 0.003 (n = 41),

respectively, for all species except problematic species, including *Actaea polyacantha*, *Gaillardiellus orientalis*, *G. rueppelli*, *Leptodius affinis*, *L. nigromaculatus*, and *Medaeops granulosus* (Table 2). The COI barcode sequences clearly discriminated each species group with significant interspecific K2P variations (0.070–0.189). Clear DNA barcode gaps were also displayed between minimum interspecific- and maximum intraspecific variation in the distributions of K2P genetic distance of COI (Hebert *et al.* 2003), indicating a high degree of species-level resolution (Figs. 153, 154).

Some species with exceptional genetic divergence were discovered, and their morphological characters were rechecked (Fig. 154).

Table 1. List of the samples examined

Species	Accession number or catalogue number	Collection location
Actaea semblatae Guinot, 1976	101044_1	Geojedo, Korea
Actaea semblatae Guinot, 1976	101044_2	Munseom Is, Jeju-do, Korea
Actaea semblatae Guinot, 1976	3	Marado Is.,Jeju-do, Korea
Actaea semblatae Guinot, 1976	2	Gomundo Is, Jeollanam-do, Korea
Actaea polyacantha (Heller, 1861)	HM750946	Okinawa, Japan
Actaea polyacantha (Heller, 1861)	1	Munseom Is, Jeju-do, Korea
Actaea polyacantha (Heller, 1861)	2	Beomseom Is., Jeju-do, Korea
Atergatis reticulatus (De Haan, 1835)	3	Chaguido Is., Jeju-do, Korea
Atergatis obtusus A. Milne-Edwards, 1865	HM750951	Panglao, Philippines
Neoliomera insularis (Adams & White, 1849)	HM741036	Balicasag Is., Philippines
Neoliomera striata Buitendijk, 1941	HM741037	Balicasag Is., Philippines
Atergatopsis germaini A. Milne-Edwards, 1865	HM750952	Keelung, Taiwan
Atergatis floridus (Linnaeus, 1767)	101132_001_001	Munseom Is, Jeju-do, Korea
Atergatis floridus (Linnaeus, 1767)	HM750949	Pulau_seringat, Singapore
Nanocassiope alcocki (Rathbun, 1902)	WS750	Munseom Is, Jeju-do, Korea
Nanocassiope alcocki (Rathbun, 1902)	HM751033	Southwestern Luzon, Philippines
Nanocassiope alcocki (Rathbun, 1902)	HM751032	Southwestern Luzon, Philippines
Gaillardiellus orientalis (Odhner, 1925)	1	Ulreungdo Is., Korea
Gaillardiellus orientalis (Odhner, 1925)	2	Chujado Is., Korea
Gaillardiellus orientalis (Odhner, 1925)	WS464	Munseom Is, Jeju-do, Korea
Gaillardiellus orientalis (Odhner, 1925)	HM750987	Pulau_seringat, Singapore
Gaillardiellus rueppelli (Krauss, 1843)	HM750988	Bohol Is., Philippines
Leptodius nigromaculatus Serène, 1962	HM751003	Raffles Lighthouse, Singapore
Leptodius affinis (De Haan, 1835)		Shindo3-ri, Jeju-do, Korea
Leptodius affinis (De Haan, 1835)	2	Shindo3-ri, Jeju-do, Korea
Leptodius affinis (De Haan, 1835)	12	Udo Is., Jeju-do, Korea

Table 1. (Continued).

Leptodius affinis (De Haan, 1835)	13	Udo Is., Jeju-do, Korea
Leptodius affinis (De Haan, 1835)	16	Udo Is., Jeju-do, Korea
Leptodius affinis (De Haan, 1835)	19	Udo Is., Jeju-do, Korea
Microcassiope orientalis Takeda and Miyake, 1969	1	Ulreungdo Is., Korea
Microcassiope orientalis Takeda and Miyake, 1969	2	Chaguido Is., Jeju-do, Korea
Macromedaeus distinguendus (De Haan, 1835)	1	Nahaedo, Korea
Macromedaeus distinguendus (De Haan, 1835)	2	Nahaedo, Korea
Macromedaeus distinguendus (De Haan, 1835)	3	Sunjaedo Is., Korea
Macromedaeus distinguendus (De Haan, 1835)	HM180663	
Pilodius flavus	JF905673	
Pilodius flavus	JQ18238	
Pilodius nigrocrinitus Stimpson, 1858	1	Homo-ri, Jeju-do, Korea
Pilodius nigrocrinitus Stimpson, 1858	2	Homo-ri, Jeju-do, Korea
Pilodius nigrocrinitus Stimpson, 1858	3	Homo-ri, Jeju-do, Korea
Pilodius miersi (Ward, 1936)	1	Andeok-myoun, Korea
Pilodius miersi (Ward, 1936)	2	Hupo-ri, Korea
Pilodius miersi (Ward, 1936)	3	Hupo-ri, Korea
Cycloxanthops truncatus (De Haan, 1837)	2	Upper Baekdo Is., Korea
Cycloxanthops truncatus (De Haan, 1837)	101012_2	Port. Uljin, Korea
Cycloxanthops truncatus (De Haan, 1837)	WS742	Geomundo Is., Korea
Actaeodes hirsatissimus		
Actaeodes hirsatissimus	WS409	Beomseom Is., Jeju-do, Korea
Actaeodes hirsatissimus	WS412	Marado Is.,Jeju-do, Korea
Actaea bocki	1	Ulreungdo Is., Korea
Liomera bella (Dana, 1852)	HM751007	Okinawa, Japan
Liomera rugata	GQ260940	
Liomera edwarsi	HM751009	
Actiomera erythra (Lanchester, 1902)	WS415	
Liomera venosa (H. Milne Edwards, 1834)	HM751011	North coast of Pulau Bintan, Indonesia
Banareia subglobosa (Stimpson, 1858)	38_1	Beomseom Is., Jeju-do, Korea
Banareia nobilii (Odhner, 1925)	HM750954	Panglao, Philippines
Calvactaea tumida Ward, 1933	69	Udo Is., Jeju-do, Korea
Calvactaea tumida Ward, 1933	HM750956	Panglao, Philippines
Medaeops neglectus (Balss, 1922)	HM751020	Trois Freres Islet, Madagascar
Medaeops granulosus (Haswell, 1882)	HM751019	Pulau_seringat, Singapore
Medaeops granulosus (Haswell, 1882)	1	Port. Uljin, Korea
Medaeops granulosus (Haswell, 1882)	2	Port. Uljin, Korea
Medaeops granulosus (Haswell, 1882)	3	Port. Uljin, Korea
Medaeops granulosus (Haswell, 1882)	4	Port. Uljin, Korea
Medaeops granulosus (Haswell, 1882)	20	Port. Uljin, Korea
Medaeops granulosus (Haswell, 1882)	101111_1	Port. Uljin, Korea
Pilumnus longicornis Hilgendorf, 1878	11	Ulreungdo Is., Korea
Pilumnus longicornis Hilgendorf, 1878	12	Ulreungdo Is., Korea
Pilumnopeus granulatus Balss, 1933	1	Udo Is., Jeju-do, Korea
Pilumnopeus granulatus Balss, 1933	3	Udo Is., Jeju-do, Korea
Harrovia elegans de Man, 1887	WS769	Geojedo, Korea
Pilumnus minutus De Haan, 1835	22	Chujado Is., Korea
Pilumnus minutus De Haan, 1835	2	Chujado Is., Korea

Table 1. (Continued).

Pilumnus minutus De Haan, 1835	14	Chujado Is., Korea
Pilumnus minutus De Haan, 1835	15	Chujado Is., Korea
Pilumnus minutus De Haan, 1835	11	Chujado Is., Korea
Pilumnus minutus De Haan, 1835	12	Chujado Is., Korea
Dromia wilsoni	101029_1	Dokdo Is., Korea

Table 2. Summary of COI genetic divergence using the K2P distance model. Superscript a, b, c, d, and e alphabets are shown in Fig. 154

Species	Number of specimen	Minimum interspecific distance	Maximum intraspecific distance
[a]*Actaea polyacantha*	3	0.146	0.063
Actaea semblatae	5	0.125	0.008
Actaeodes hirsutissimus	2	0.136	0
Actiomera erythra	1	0.110	0
Atergatis floridus	2	0.109	0.005
Atergatis obtusus	1	0.070	0
Atergatis reticulatus	1	0.070	0
Atergatopsis germaini	1	0.109	0
Banareia nobili	1	0.097	0
Banareia subglobosa	1	0.097	0
Calvactaea tumida	2	0.126	0.001
Cycloxanthops truncatus	3	0.154	0.006
Dormia wilsoni	1	0.172	0
Actaea bocki	1	0.136	0
[b]*Gaillardiellus orientalis*	4	0.065	0.069
[c]*Gaillardiellus rueppelli*	1	0.003	0
Harrovia elegans	1	0.140	0
[d]*Leptodius affinis*	4	0.020	0
[d]*Leptodius nigromaculatus*	1	0.020	0
Liomera bella	1	0.114	0
Liomera edwarsi	1	0.128	0
Liomera rugata	1	0.138	0
Liomera venosa	1	0.110	0
Macromedaeus distinguendus	4	0.100	0.008
[e]*Medaeops granulosus*	7	0.125	0.122
Medaeops neglectus	1	0.125	0
Microcassiope orientalis	2	0.095	0
Nanocassiope alcocki	3	0.154	0.006
Neoliomera insularis	1	0.155	0
Neoliomera striata	1	0.144	0

Table 2. (Continued).

Pilodius flavus	2	0.124	0
Pilodius miersi	3	0.124	0
Pilodius nigrocrinitus	3	0.130	0
Pilumnopeus granulatus	2	0.161	0.005
Pilumnus longicornis	2	0.189	0.001
Pilumnus minutus	6	0.140	0

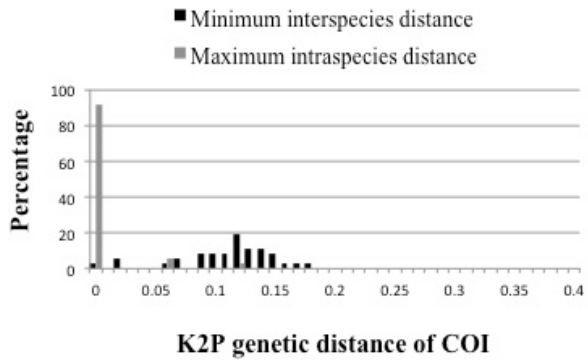

Fig. 153. Distribution of Kimura 2-parameter (K2P) genetic distance of mitochondrial cytochrome *c* oxidase I (COI) among 36 species of two superfamilies.

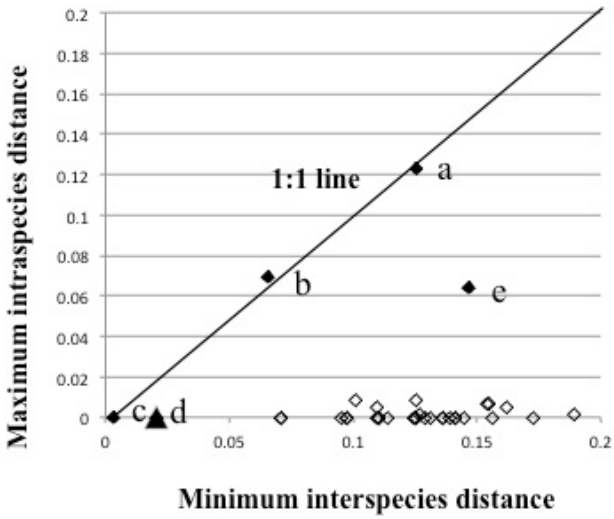

Fig. 154. Minimum interspecific- and maximum intraspecific distances for COI gene regions were calculated by the K2P genetic distance model. The bottom region of the 1:1 line represents the presence of a DNA barcode gap. Diamonds and a triangle (black) near the 1:1 line indicate controversial species (a: *Actaea polyacantha*; b: *Gaillardiellus orientalis*; c: *G. rueppelli*; d: *Leptodius affinis* and *L. nigromaculatus*; e: *Medaeops granulosus*).

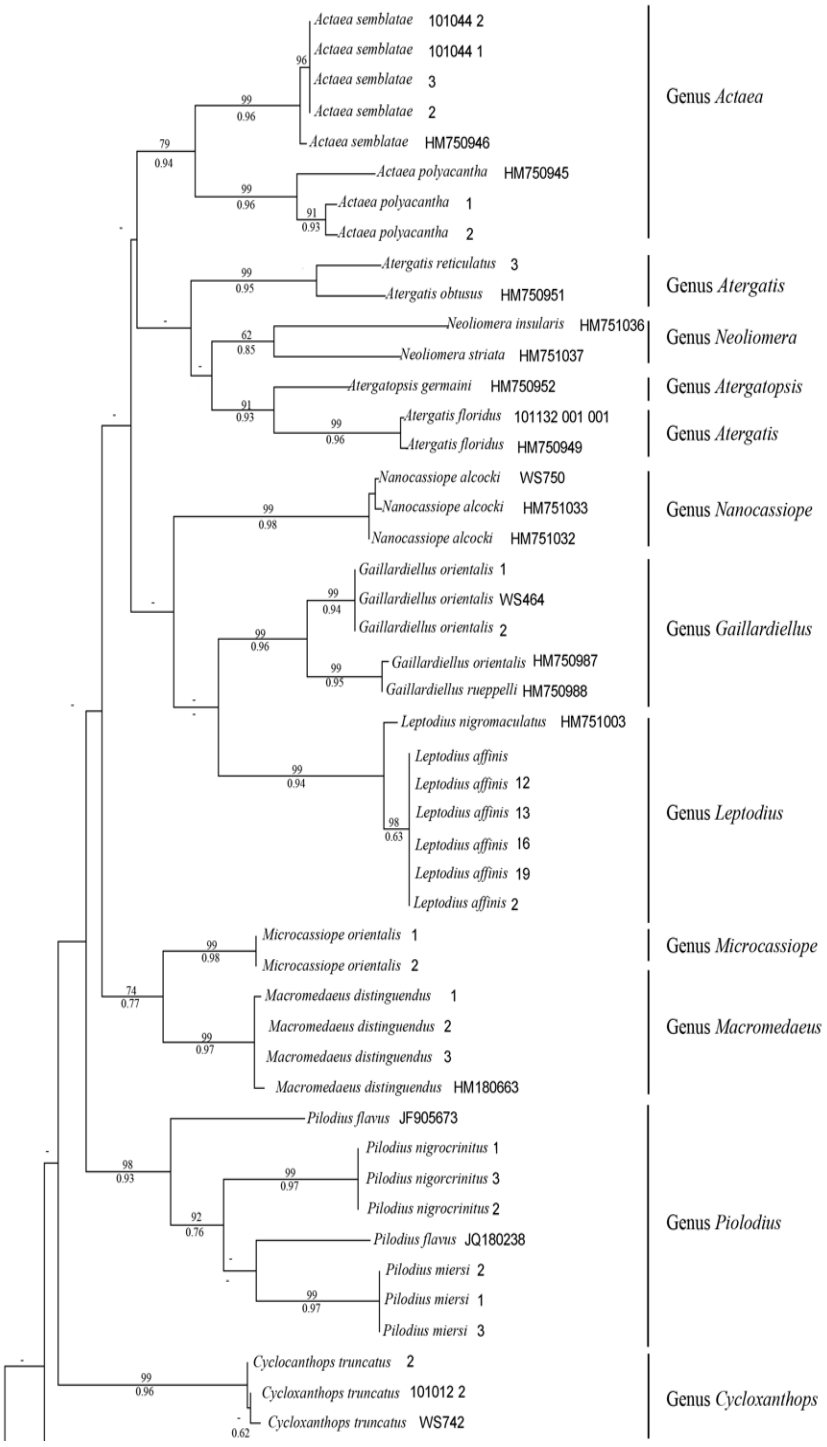

Fig. 155. Bayesian Inference (BI) tree was inferred from COI sequences. Numbers above and below branches BI posterior probability and Maximum Likelihood (ML) bootstrap support, respectively. "-" represents value below 0.5 or 50.

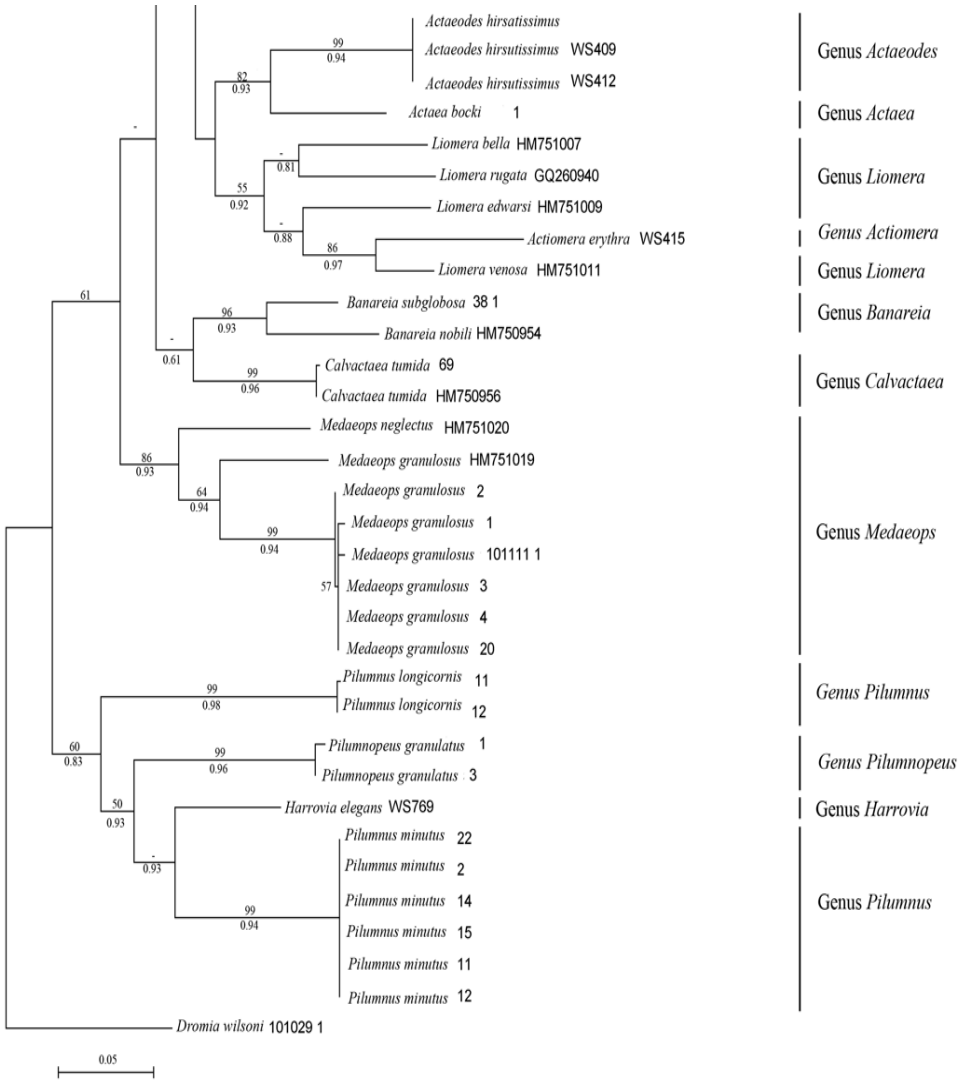

Fig. 155. (Continued).

Molecular taxonomic relationship

The each group of Korean two superfamilies formed one clade. All genera represented also one clade except the genus *Acatea* (Fig. 155). The each clade of genera *Atergatis*, *Atergatopsis*, and *Neoliomera* was displayed low value of BS and PP. Korean *Gaillardiellus orientalis* showed the different clade to *G. orientalis* and *G. rueppelli* from Genbank. Korean *Medaeops granulosus* was also formed a clade differed from *M. granulosus* from Genbank.

DISCUSSION

The 22 species out of the 46 crabs of Korean pilumnoids and xanthoids have been successfully sequenced, and the 20 species added sequences of some species from GenBank, was analyzed. As a result, most of the test specimens showed limited low intraspecific variation (0− 0.008), while *Actaea polyacatha, Gaillardiellus orientalis, G. rueppelli,* and *Medaeops granulosus* revealed high intraspecific COI sequence divergences (>6%). Although DNA barcoding is not completely error-free, it is very useful in discovering cryptic species or misidentification (Hebert *et al*. 2003; Hebert & Gregory 2005; Schindel & Miller 2005). The DNA barcoding rule or barcoding gap for delimiting species proposed by Hebert *et al*. (2003) worked well in this study.

In the BI tree, the genera *Atergatis*, *Neoliomera*, and *Atergatopsis* grouped one clade. The *Atergatis* and *Atergatopsis* are members of the subfamily Zosiminae Alcock, 1898, but the genus *Neoliomera* belongs to the subfamily Liomerinae Sakai, 1976. The members of the genus *Neoliomera* are as similar as the members of the subfamily Zosiminae such as width of their carapace and crest on anterior border of the ambulatory legs. In fact, *Neoliomera insularis* was originally reported as *Atergatis insularis* Adams & White, 1848 and then Odhner (1925) transferred to members of the genus *Neoliomera* when he established the genus *Neoliomera*. According to the molecular and morphological characteristics, *N. insularis* seems to be close to the subfamily Zosiminae. Therefore the author considered to need more examination between these genera.

Gaillardiellus orientalis formed two clades. *G. orientalis* and *G. rueppelli* are close species when their morphological characters are examined only. The xanthoids are generally distinguished by the first gonopod of male (Serène, 1984). The G1 of two species are very similar. The Korean specimens of *G. orientalis* formed one clade, the author reexamined specimens identified as *G. orientalis* with their morphological characters. As a result, the specimen of *G. orientalis* sequenced to the accession number HM7509687 seems to be misidentified or they would be same species.

According to the molecular analysis of *Leptodius nigromaculatus* and *L.*

affinis, these two species grouped one clade and they seem to be same species. This challenging problem will be more discussed in Chapter.3.

In the clade of *Actaeodes hirsutissimus* (Rüppell, 1830) and *Actaea bocki* (Odhner, 1925), they formed one group in the tree. The morphological identification in the Actaeinae is ambiguous because they superficially conform to a general explanation including an ovate carapace with a short front, distinct regions, many granules and /or spines arranged in complex ornamentations, short ambulatory legs and relatively short and stout chelipeds (Odhner, 1925; Guinot, 1976; Serène, 1984). As Lai et al. (2011) mentioned that the Actaeinae are polyphyletic, the present group was also divided by three clades representing the genera *Actaea*, *Actaeodes*, and *Gaillardiellus*. The subfamily Actaeinae seems to be a need revised by taxonomic studies afterward.

In the clade of genus *Medaeops,* Korean *Medaeops glanulosus* was separated from *M. glanulosus,* accession number HM751019 (BS: 64; PP: 0.94). The author reexamined many Korean *Medaeops glanulosus*, and noticed they are same morphology. The Korean *M. glanulosus* would be a cryptic species.

In the bottom-most clade, the genus *pilumnus longicornis* and *P. minitus* belonging to the superfamily Pilumnoidea were one clade in genera level. More data are needed for significant interpretation of their relationship.

DNA barcoding method was used to identify accurate species and discover cryptic species, and the author examined that molecular taxonomic study for their classification was additionally performed on the basis of the morphological and molecular characters, but it is still imperfect. Therefore, the author will perform an analysis with various molecular gene regions representing evolutionary relationship, such as 16S, 12S, and several regions of nuclear DNA.

Chapter 2. Taxonomic revision

2-1. Redescription of *Zehntneriana villosa* (Zehntner, 1894) (Crustacea: Decapoda: Pilumnidae), and new record of the rare rhizopine crab, *Zehntneriana* n. sp.

INTRODUCTION

Zehntneriana villosa (Zehnter, 1894) had been described as *Ceratoplax villosa* belonging to the family Goneplacidae, and this species was only recognized by the original description based on a small specimen from Amboina, Indonesia. The description was simple and inadequate, giving only general descriptive information.

There were no subsequent records of occurence, but the specimens at hand were in all probability referable to the rare speices. Later, Takeda (1972) considered systematic status of this species because of the following reasons: 1) the formation of the eyestalks shows the remarkable intergradation from the long or moderate eyestalks with the well-developed cornea to the short fixed ones with the obsolete cornea, 2) the genital openings are coxal or sternal, and if coxal, the membraneous or rather calcified prolongations of the *vasa deference* pass along the grooves protected by the penultimate sternal plate. Then he suggested that *Zehntneria villosa* was different from the species of the genus *Ceratoplax* Stimpson, 1858, the genus *Notonyx* A. Milne Edwards, 1873, and the genus *Ser* Rathbun, 1931. Eventually, he established the genus *Zehntneria* Takeda, 1972 with other three species: *Ceratoplax villosa* Zehntner, 1894, *Litocheira amakusae* Takeda & Miyake, 1969, and *Zehntneria miyakei* Takeda, 1972. *Z. novaeinsulicola,* the fourth species, was subsequently described by Takeda & Kurata (1977).

Ng (1987) mentioned the states of the genus *Zehntneria* by comparing the genus *Ceratoplax* and *Pseudolitochira* Ward, 1942 that is with some doubts. Ng & Takeda (2010) discussed the homonym between the genus *Zehntneria* Takeda, 1972 and *Zehntneria* Brunner Von Wattenwyl, 1907. They proposed a replacement name, *Zehntneriana,* for the brachyuran *Zehntneria* Takeda, 1972.

Zehntneriana villosa has been described only twice by Zehntner (1894) and Takeda (1972). In Zehntner (1894: 173, Pl. 8, Fig. 8a-c), the article was referred to

the simple description but the illustration of the original description did not have enough information: the dorsal whole animal abbreviated with seta, the right third maxiliped and the pteryogostomian region, and the left outer palm and finger. After the record of Zehnter (1894), Takeda (1972: 35, Fig. 1) reported this species with a detailed description and one figure (dorsal view of whole animal and outer view of chelipeds) from Ryukyu, Japan.

While the studying the identified *Zehntneriana villosa* collected from Okinawa in Japan, the author and Prof. Ng had a question regarding *Z. villosa* of Takeda (1972), because the crab of Takeda looked like *Heteropilumnus stomii* De Man, 1895 which is type species of the genus *Heteropilumnus* De Man, 1895. We examined the holotype of *Zehntneriana villosa* (Zehntner, 1894) and the specimens collected from Okinawa, and found out that the specimens differed from *Z. villosa* of Zehntner (1894). In the present paper, the author redescribes *Zehntneriana villosa* (Zehntner, 1894) with illustrations, and *Zehntneriana* n. sp. is also discussed.

SYSTEMATIC ACCOUNTS

Family Pilumnidae Samouelle, 1819
Subfamily Rhizopinae Stimpson, 1858
Genus *Zehntneriana* Ng & Takeda, 2010

***Zehntneriana villosa* (Zehntner, 1894)**
Ceratoplax villosa Zehntner, 1894:173, pl. 8, fig. 8.

Material. Holotype, 1 male, 3.25 × 2.75mm, from Amboina, Indonesia.

Description. Carapace (Figs. 156A, 158A, 158B) transversely oval, covered with adherent inorganic matter as fur; on removal of dorsal surface very smooth, ill-defined with weakly raised mesogastric and cardiac region. Anterolateral border (Fig. 158A) arched, more or less ridge-like with four indistinct spine, or tubercle, or granules being interrupted by three notches. Posterolateral border (Fig. 158A) rather

weakly concave. Front (Figs. 156B, 158B), with seta behind frontal boarder, rather half length of carapace width, bearing median notch; lateral angle of each lobe not produced but only roughened, being confluent with supraorbital border. Orbit (Figs. 156B, 158A, 158B) rather small; eyestalk with fur, stout and entirely fills, rather protruded forwards beyond general contour of carapace but movable; supraorbital border hardly raised along its inner part, and in dorsal view deeply concave at its inner part and then rather directed forwards towards blunt external orbital angle; inner angle not prominent, touched with very short ventral prolongation of front.

Antennal flagellum (Fig. 158A, 158B) sightly exceeds twice length of diameter of orbit. Epistome narrow; enter region without median projecting, separted from lateral regions by small, narrow, indistinct nothces. Third maxillipeds (Fig. 156C, 158C) rather sparsely covered with fur; merus quadrate with antero-external angle not angulated.

Thoracic sternum (Fig. 156C, 158D) covered with fur like carapace; Sternites 1, 2 completely fused, separated from sternite 3 by distinct sutrue; sternite 3, 4 almost completely fused excapt for short notches laterally, sternite 3 distingushable from sternite 4 by shllow groove; sternite 4 larger, inflated; sternites 5–8 distinct, separate.

Chelipeds (Fig. 157A, 157B) asymmetry. Merus and carpus being densely covered with fur like carapace. Whole surface of propodus of left cheliped bearing densely covered with fur and sparsely with longish hairs; on the remaval of them covered with sparse minute granules. Entired surface of propodus of right cheliped smooth and naked; left proximal half of movable finger and proximal end of lower border of immovable finger bearing coarsely granulated and hairy.

Ambulatory legs (Fig. 158E–H) slender and densely haired. Merus bearing densely haired on both border; anterior border not serrated; both surface covered with adherent inorganic matter. Dactyli with densely fringed with long hairs of various length, and subcylindrical; last pair weakly curved dorsally near terminal small claw.

Abdomen (Figs. 156C, 158I) narrow, rather broad subtriangular, consisting of 7 segments, bearing fur on ventral surface. Width of first segment sub equaled to third segment. Telson triangular.

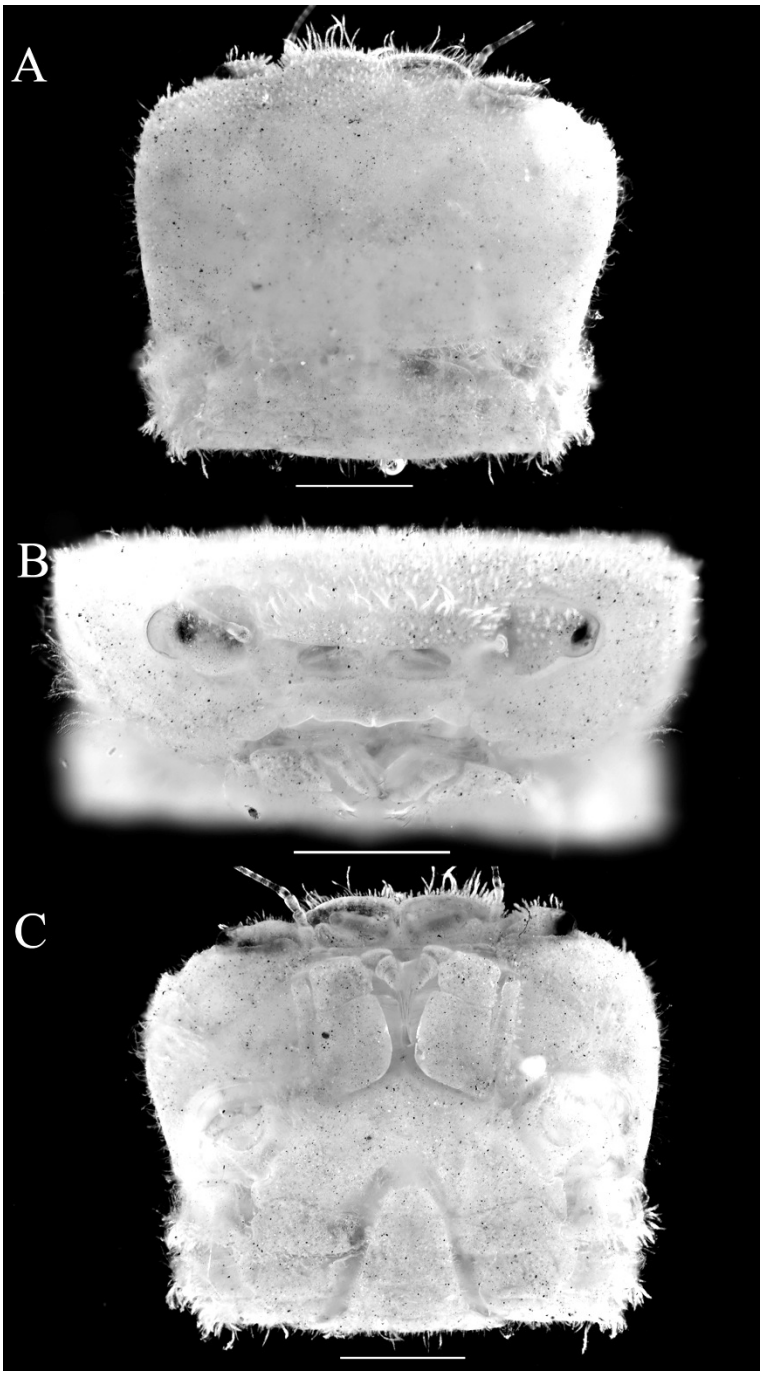

Fig. 156. *Zehntneriana villosa* (Zehntner, 1894), holotype, male, 3.25 × 2.75mm. A, Carapace, dorsal view; B, Front, anterior view; C, Third maxillipeds, thoracic sternum, and male abdomen. Scale bar: 1 mm.

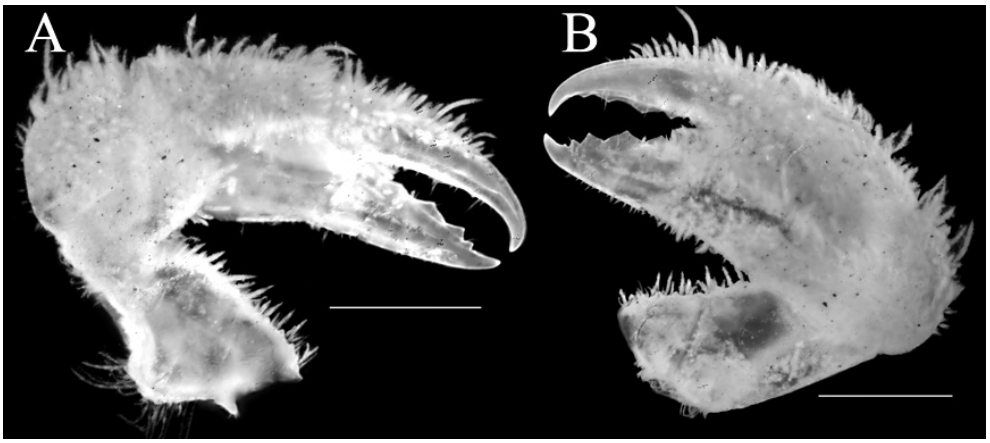

Fig. 157. Left cheliped of *Zehntneriana villosa* (Zehntner, 1894), holotype. A, dorsal view; B, outer view. Scale bar: 1 mm.

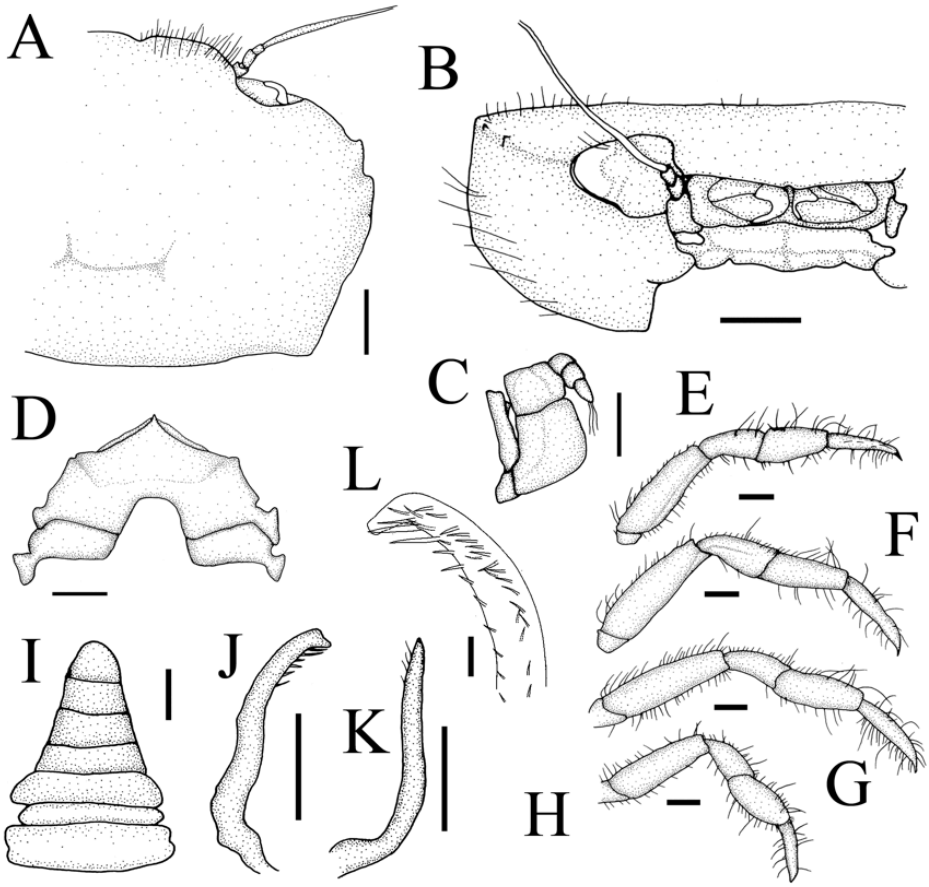

Fig. 158. *Zehntneriana villosa* (Zehntner, 1894), holotype. A, Right part of carapace, dorsal view; B, Front, anterior view; C, Right third maxilliped, ventral view; D, Sternites 1–5, ventral view; E–H, first to fourth of ambulatory legs, dorsal view; I, Male abdomen, ventral view; J, G1, external view; K, G1, lateral view; L, Distal portion of G1, internal view. Scale bars: A–K = 0.5mm, L= 0.1 mm.

Male first pleopod (Fig. 158J–L) generally curved with row of small and picky spine ornaments on distal region. Apical lobe bented 60º to rest of G1.

Gonopores coxal. Penis lying G1 exposed grooved formed by sternites 7 and 8.

Remarks. The holotype had been dried in the Geneva natural history museum. Recently, the specimen was hydrated, and then, preserved with Ethyle acohole. The entired body had been kept good condition without a male first gonopod. G1 had been transformed into a plate-like shape. The author used compound microscope to examine. Fig. 158J and 158K would be a bad illustration to show the characteristics due to the twisted or curved median portion of G1.

***Zehntneriana* n. sp.**

Zehntneriana villosa: Takeda, 1972: 35, Fig. 1.

Materials. 1 male 5.1 × 3.5 mm, 4 females, 3.6 × 2.6 – 5.2 × 3.6 mm (ZRC 2011.0673), Ohyama, Ginowan City, Okinawa, Japan, Coll. by T. Maenosono, 12 Mar 2008. 1 female, 7.6 × 5.8 mm (NSMT Cr 5781), Shiono-Misaki, Kii Peninsula, Japan, coll. M. Takeda, 20 July 1978; 1 male, 7.6 × 6.1 mm (NSMT Cr 5882), Shiono-Misaki, Kii Peninsula, Japan, coll. M. Takeda, 20 July 1978; 1 female, 8.0 × 5.8 mm (NSMT Cr 5809), Kushimoto, Kii Peninsula, Japan, coll. M. Takeda, 21 July 1978.

Comparative materials. ***Zehntneriana amakusae***: 1 male, 6.3 × 4.5 mm, Chuja Is., Jejudo province, Korea, Coll. by S. K. Lee, 31 Mar 2009; 1 male, 5.5 × 3.7 mm, Chagwido, Jeju Is., Coll. by S. H. Kim, 8 Jun 2001; 1 male, 8.5 × 6.0 mm (NSMT Cr 4133), Tsujishima, Amasuka, Japan, no other data; 1 male, 5.9 × 4.1 mm (NSMT), Doren, Kakeroma-Jima, Japan, station K5-26-2, 7m, coll. 4 March 2005. ***Zehntneria miyakei***: **Holotype,** 1 male, 4.8 × 3.5 mm (NSMT Cr 976), southwest Madlâi, Goréor Island, Palau, 7°20’30”N 134°28’28”E, coll. S. Murakami, 20 May 1938; **Paratype,** 1 male, 5.2 × 3.7 mm, **paratype,** 1 female, 5.7 × 3.9 mm (NSMT Cr 977-978), same data as holotype; 1 male, 5.4 × 3.9 mm (NSMT Cr 9747), west side of Nominoura, Oshima Passage, Japan, station 20, 45m, coll. M. Takeda, 6 August 1988; juvenile female, 3.9 × 2.7 mm (NSMT Cr 9746), near Tawara, Oshima

Passage, Japan, station 18, 30m, coll. M. Takeda, 6 August 1988. ***Zehntneria novaeinsulicola***: holotype male, 4.1 × 2.8 mm (NSMT Cr 5469), Nishino-shima-shinto, Japan, under coral block, coll. Y. Kurata, 25 July 1975. ***Heteropilumnus holthuisi***: 1 male, 9.1 × 6.5 mm, 3 female, 5.7 × 3.8 mm – 8.0 × 5.5 mm, Labrador, in rocks, Singapore, Coll. P. K. L. Ng, 12 April 1991 (ZRC 1992. 10565-10568). ***Ceratoplax ciliata***: 1 male, 9.5 × 4.9 mm, 2 females, 7.3 × 5.5 mm, 8.0 × 6.3 mm, Kallang Basin, Singapore, 5 Feb 1988 (ZRC 2008. 1148).

Description. Carapace (Fig. 159A, 160B) transversely oval, densely, uniformly covered with adherent inorganic matter as fur but without long hairs, being fairly convex fore and aft; on removal of dorsal surface very smooth, ill-defined with weakly raised mesogastric and cardiac region; anterolateral border arched, more or less ridge-like with indistinct granules, being interrupted by three notches; posterolateral border moderately or rather weakly convergent. Front (Fig. 159A, 160A, 160B) slightly less than half length of carapace, almost truncated bears median notch; lateral angle of each lobe not produced but only roughened, being confluent with supraorbital border. Orbit (Fig. 160A, 160B) rather small; major diameter equal in length to each frontal lobe; eyestalk with fur, stout and entirely fills, rather protruded forwards beyond general contour of carapace but movable; supraorbital border hardly raised along its inner part, and in dorsal view deeply concave at its inner part and then rather directed forwards towards blunt external orbital angle; inner angle not prominent, touched with very short ventral prolongation of front.

Antennal flagellum sightly exceeds twice length of major diameter of orbit. Epistome narrow; entire region with rather median projecting, separted from lateral regions by distinct nothces. Third maxillipeds (Fig. 160D) rather sparsely covered with fur; merus quadrate with antero-external angle rather angulated.

Thoracic sternum (Fig. 161A) covered with fur like carapace; Sternites 1, 2 completely fused, separated from sternite 3 by distinct sutrue; sternite 3, 4 almost completely fused excapt for short notches laterally, sternite 3 distingushable from sternite 4 by shllow groove; sternite 4 larger, inflated; sternites 5 – 8 distinct, separate.

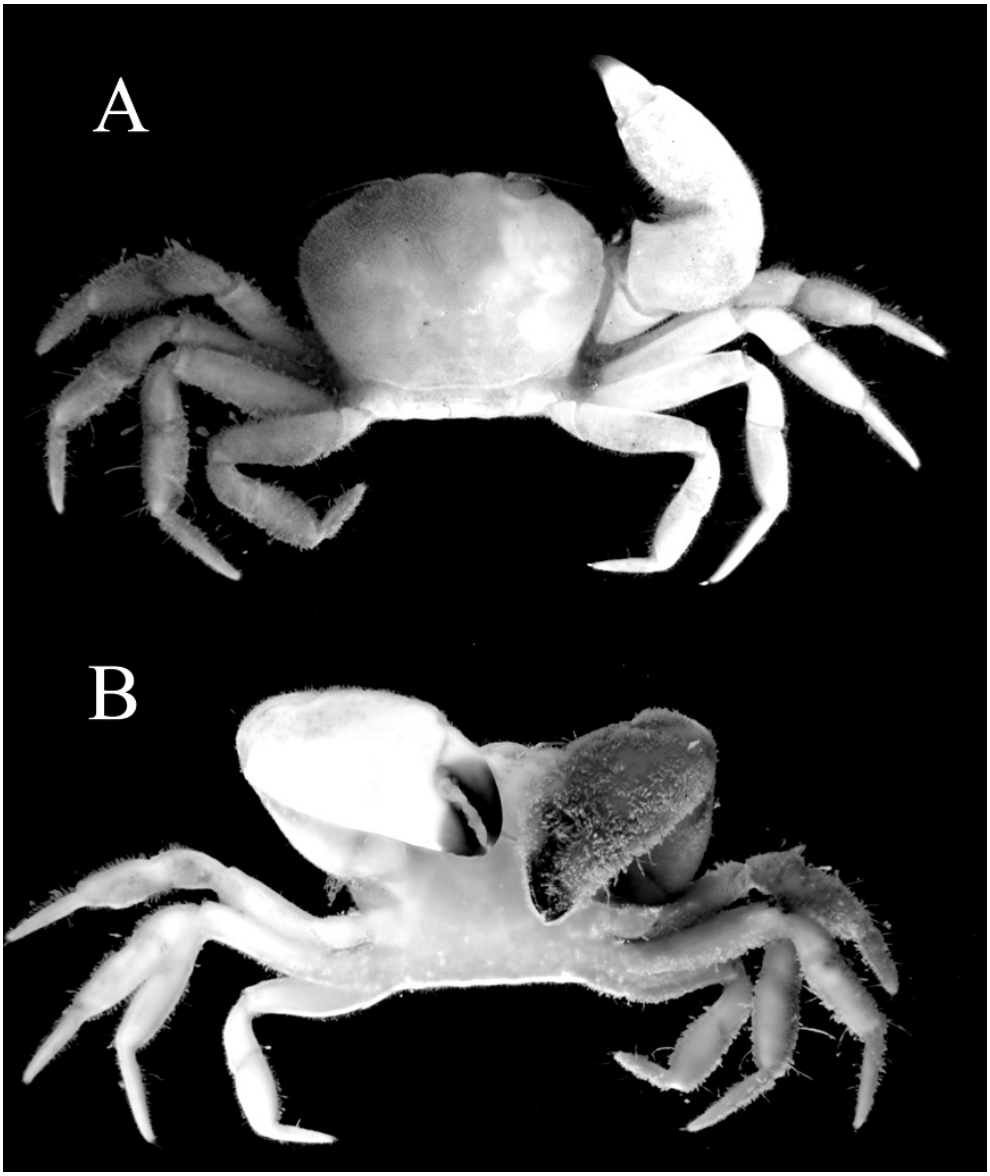

Fig. 159. *Zehntneriana* n. sp., holotype, 1 male, 5.1 × 3.5 mm (ZRC 2011.0673). A, Whole animal, dorsal view; B, Chelipeds, ventral view.

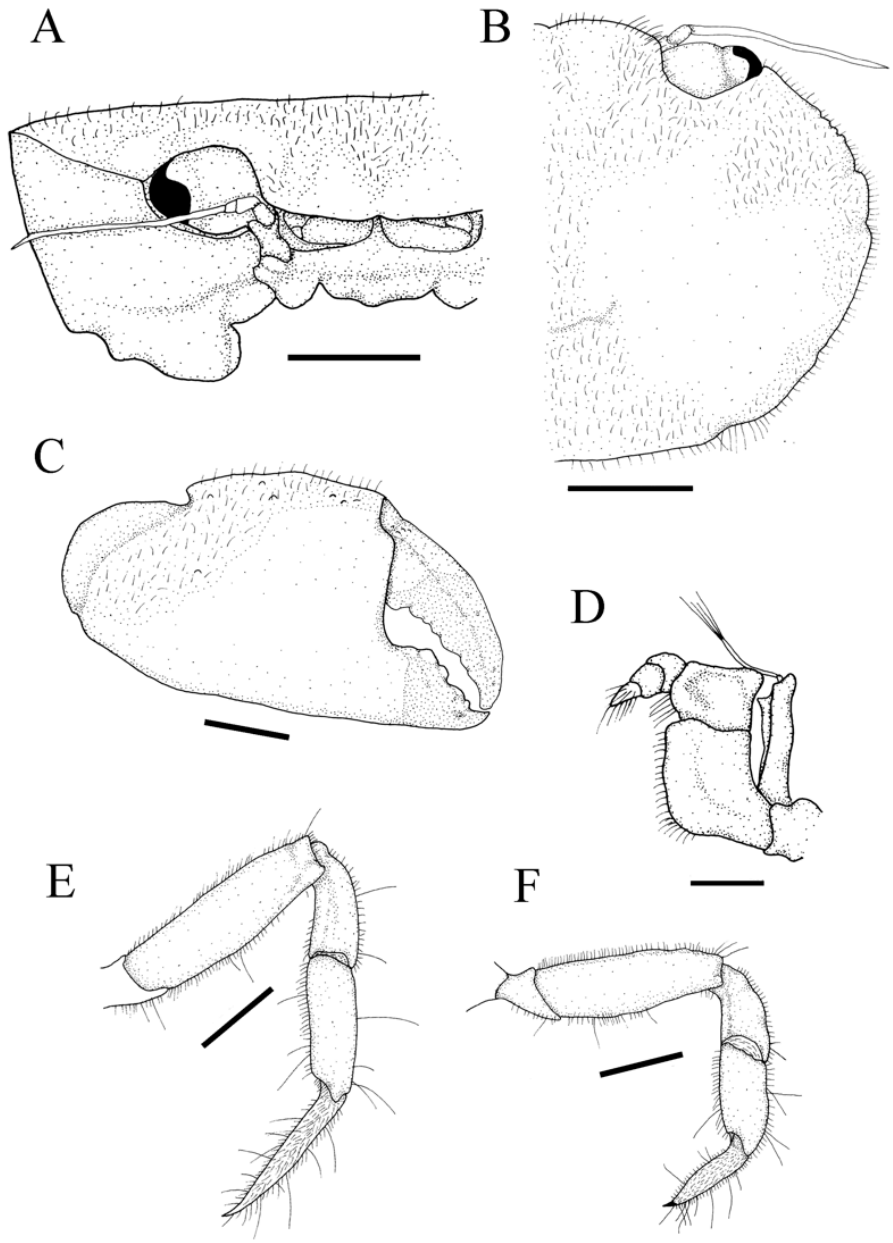

Fig. 160. *Zehntneriana* n. sp., holotype. A, Front, epistome, and pterygostome, anterior view; B, Right part of carapace, dorsal view; C, Right cheliped, outer view. D, Left third maxilliped, ventral view; E, Third ambulatory leg, dorsal view; F, Fourth ambulatory leg, dorsal view. Scale bars: A–C, E, F = 1mm, D = 0.5 mm.

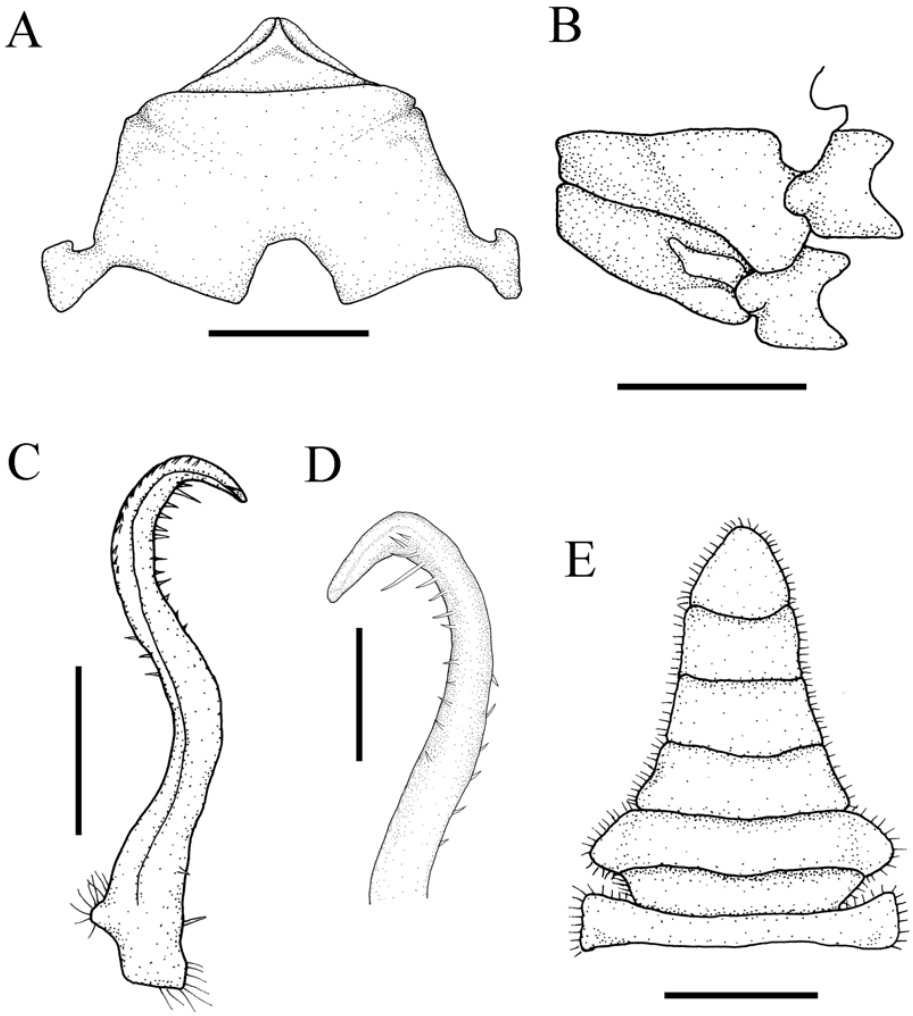

Fig. 161. *Zehntneriana* n. sp., holotype. A, Sternites 1–4, ventral view; B, Gonopore coxal, external view; C, Whole G1, external view; D, Distal portion of G1, internal view; E, Male abdomen, ventral view. Scale bars: A, B, E= 1 mm, C = 0.5 mm, D = 0.2 mm.

Chelipeds (Fig. 159A, 159B, 160C) asymmetry in both sexes. Merus and carpus being densely covered with fur like the carapace. Entire surface of the palm of both chelae of female and smaller chela of male being covered densely with fur and sparsely with longish hairs; on the remaval of them covered with sparse minute granules.

Ambulatory legs (Fig.159A, 159B, 160E, 160F) slender and densely haired as those of carapace. Merus bearing densely haired on both border; anterior border not serrated; both surface covered with adherent inorganic matter. Dactyli with densely fringed with long hairs of various length; in first three pairs 0.8 length of propodus, and subcylindrical; in last pair weakly curved dorsally near terminal small claw.

Abdomen (Fig. 161E) narrow and rather long subtriangular, consisting of 7 segments, bearing fur on ventral surface. Width of first segment sub equaled to third segment. Telson triangular.

Male first pleopod (Fig. 161C, 161D) generally curved with row of small and picky spine ornaments on distal region. Apical lobe bented 60º to rest of G1.

Gonopores coxal (Fig. 161B). Penis lying G1 exposed grooved formed by sternites 7 and 8.

Distribution. Ishigaki-jima, Okinawa-jima, Ryukyu, Japan.

Remarks. The author examined the specimens of *Zehntneriana villosa* identified by Prof. Takeda in NMST (National Museum of Nature & Science, Tokyo, Japan), and the specimens from Okinawa, Japan. These examined specimens agree well with the description of *Zehntneriana villosa* (*Zehntner*, 1894) by Takeda (1972). As a result of the examined holotype of *Ceratoplax villosa* Zehntner, 1894, the species of Takeda (1972) was found to be different characteristics from *Z. villosa* for the following reasons: 1) The species of Takeda (1972) has four small spines/ tubercles on anterolater margin while *Z. villosa* has indistinct four lobes by low notches 2) In regards to the front margin of the carapace, the species of Takeda (1972) does not have setae behind the front border while *Z. villosa* has a transverse row of seta behind the front border 3)The third maxilliped of the species of Takeda (1972) is rather angulated on antero-external angle of merus while *Z. villosa* has right angled on that 4) In epistomian region, The species of Takeda (1972) is narrow and its entire region is rather projecting at median, separated from lateral regions by distinct notch while *Z. villosa* is also narrow, but median region without projecting, separated from lateral regions by shallow notch. These reasons made the author consider that the species of Takeda (1972) would be a new species. This new species

will be discussed based on their systematic study and a comparision with other members of the genus *Zehntneriana* Takeda, 1972 will be followed in the discussion.

DISCUSSION

Some species can be easily found everywhere, while several species have no additional records after the first report. *Zehntneriana villosa* (Zehntner, 1894) is seemed to be one of those crabs that are rarely found. After the original description of Mr. Zehntner from Amboina, Indonesia, *Z. villosa* had not been known well. The information of given in the illustration of Zehntner (1894) would not be enough for the accurate identification of this species. The author could get a chance to examine the holotype from Geneva Museum and the specimens from Okinawa, Japan, and found that they were different species based on their morphologically.

The genus *Zehntneria,* established by Takeda (1972), was referred to *Ceretoplax villosa* Zehntner, 1894 as type species. In the results, the author considered that the species of Takeda (1972) would not be same as *Z. villosa*. The author also examined other members of the genus *Zehntneriana* Takeda, 1972, for this fact raised a question whether the genus *Zehntneriana* was valid or not: *Z. amakusae* Takeda and Miyake, 1969, *Z. miyakei* Takeda, 1972, and *Z. novaeinsulicola* Takeda & Kurata, 1977. In the Takeda (1972), the genus *Zehntneriana* has the following characteristics: the carapace is quadrated or rather ovate, and declivous anteriorly with the dorsal surface ill-defined. The carapace, chelipeds and ambulatory legs are thickly or partially covered with a tomentum, but without the fringes of long hairs. The front is cut into two weakly convex lobes by a median, small but distinct notch and bears no distinct lateral angles. The fronto-orbital breadth is twice of the frontal breadth and equal to or slightly less than the length of carapace. They eyestalk is tightly embedded in more or less transverse small orbit, but movable. The corenea is rather prominent and chiefly terminal and ventral, but rather deficient in pigments. The antennules are folded almost

transversely. The third maxillipeds are with subquadrate merus. The anterolateral border of the carapace is arched with four low teeth, and the posterolateral border is weakly convergent. The chelipeds are distinctly unequal in male and slightly in female. The fingers are not strongly curved downwards. The ambulatory legs are rather long without spines. The male abdomen is with several distinct segments and wide at first and third segments. The male first pleopod is somewhat *Pilumnus*-type, and male genital openings coxal. The other three species and the holotype of *Z. villosa* would be kept on including well with the original description of the genus *Zehntneriana* Takeda, 1972. Base on the result, the author concluded a result by examining, and decided the genus *Zehntneriana* is valid.

In regards to this new species from Japan, the new species was examined first with the other three species of the genus *Zehntneriana* to investigate its genus.

First, this new species was compared with the rest three species of *Zehntneriana*. The carapaces of these specimens were densely and uniformly covered with a fur without long hairs together and with adherent inorganic matter. The carapace of *Z. amakusae* and *Z. miyakei* were covered with a fur along the antero-lateral border. The carapace of *Z. novaeinsulicola* was glabrous and naked. The merus of the third maxillipeds of this new species were with antero-external angle ventrally curved and only slightly angulated. The merus of *Z. amakusae*, however, were subquadrated without angulated angle on antero-external. The cheliped of this new species was covered with a fur except for the fingers. The rest three species were without any fur on their surface. The ambulatory legs of this new species were slender, and with densely haired being sparsely fringed with long feathered and simple hairs on the antero border of the meurs. The first three pairs of ambulatory legs of the rest 3 species was thin and minutely serrated on the anterior borders of the meri, and the merus were sparsely provided with hairs. The male first pleopod of all *Zehntneriana* species had a strongly curved tip of distal region like those of the genus *Heteropilumnus*. In the abdomen, the telson of this new species was triangular but those of the rest three species of the genus *Zehntneriana* were broad and subtriangular. Based on the characteristics of the carapace, the ambulatory legs, the chelipeds, and the telson of this new species, this species would be differentiatied from the rest 3 species.

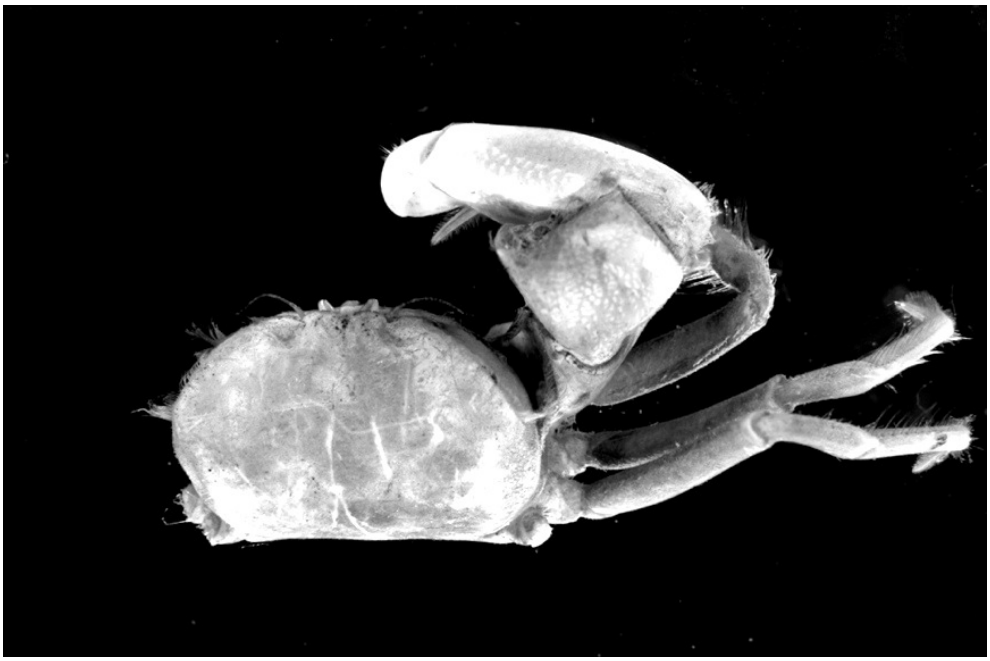

Fig. 162. *Ceratoplax ciliata* Stimpson, 1858, male, 9.5 × 4.9 mm, dorsal view.

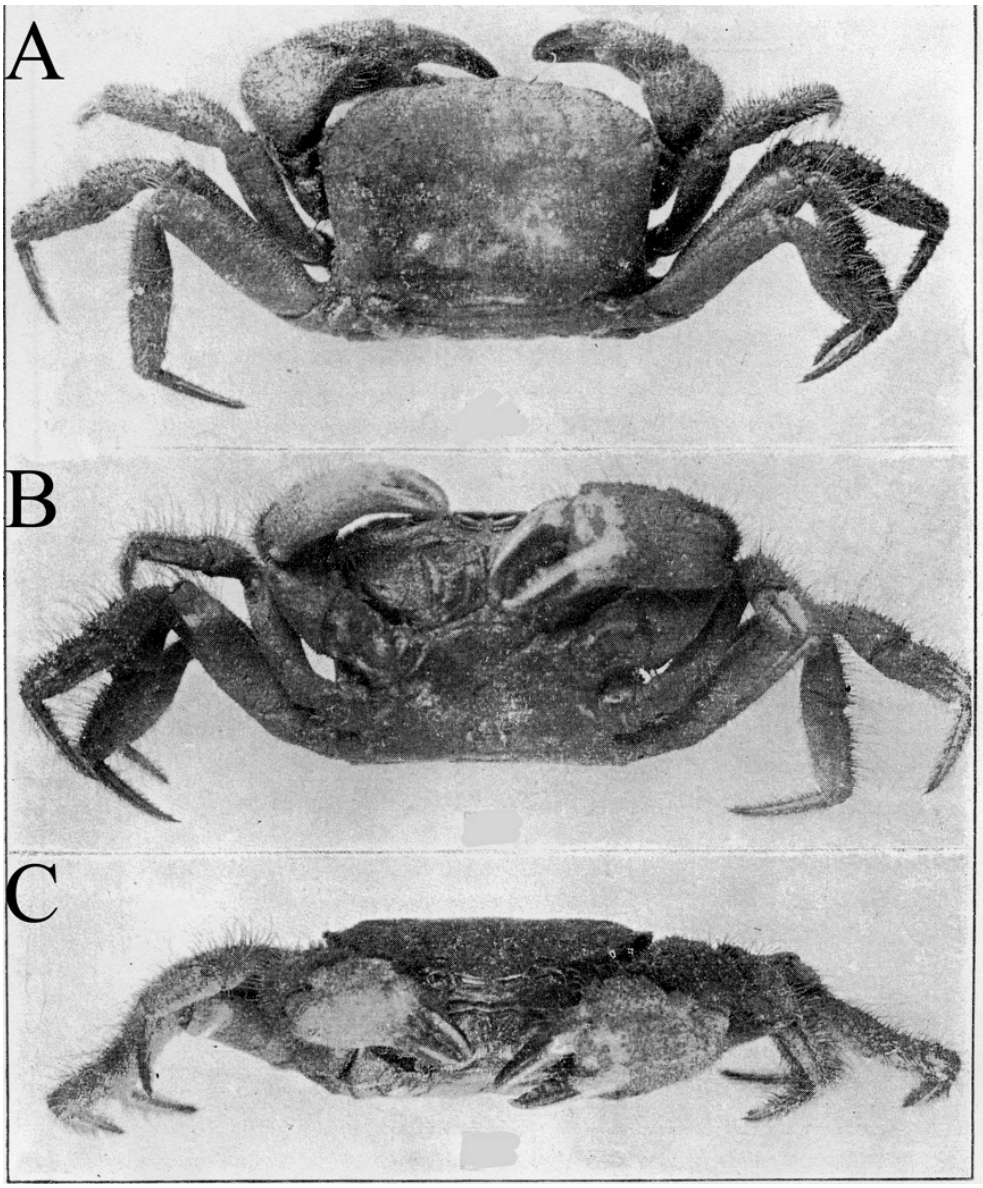

Fig. 163. *Ser fukiensis* Rathbun, 1931. A, Dosal view; B, Ventral view; C, Fontal view. (Cited from Rathbun (1931))

Second, this new species was studied with the species of the genus *Ceratoplax* Stimpson, 1858 and *Ser* Rathbun, 1931 that were mentioned to be close to this new species (Takeda, 1972). This new species was compared with the genus *Ceratoplax ciliate* Stimpson, 1858 (Fig. 162). The male genital opening of the genus *Ceratoplax* was rather calcified prolongation of the *vasa deference* pass along the grooves protected by the penultimate sternal plate, while the male genial opening of this new species is open with sternal groove between sternite 1 and 8. Comparing *Ser fukiensis* Rathbun, 1931, this new species did not have bias line on the sternites 3 and 4 of thoracic sternum, which is the characteristic of the genus *Ser* (Fig. 163). For such a reason, this new species would be concluded to be belonging to the genus *Zehntneriana* Takeda, 1972.

2-2. A revision of the genus *Leptodius* A. Milne-Edwards, 1863

INTRODUCTION

The genus *Leptodius* was established by Alphonse Milne-Edwards (1863). Later, he defined the group in the subdivision proposed by Dana (1852), as the genus *Chlorodius* H. Milne Edwards, 1834 (A. Milne-Edwards, 1873: 221). Three species with *L. exaratus* as the type species in the genus were described, but the diagnostic distinction of the species were not mentioned.

Ortmann (1893) mentioned the genus as follows: "…..Auch dei Gestalt des Cephalothorax ist für die Unterscheidung der Gattungen nicht zu verwenden: so hat z. B. *Xantho floridus* mit *Leptodius exaratus* in der äussern Form eine ganz auffallende aehnlichkeit, und der Typus der Gattung *Xanthodes* (X. larmarcki) zeigt in der äussern Körperform absolut keine auffälligen Unterschiede gegenüber echten Xanthen" The same publication established the genus *Leptodius* as a synonym of the genus *Xantho*. Alcock (1898) mentioned *Leptodius* as a subgenus of the genus *Xantho* without any comments.

Odhner (1925) synonymized the genus *Leptodius* as the genus *Xantho* (Leach, 1814) as follows: " … Ich stelle also ohne Bedenken die ganze Reihe der *Leptodius*-Arten, mit dem typischen *L. exaratus* (M. -Edw.) an der Spitze, zu *Xantho*…." Subsequently, many authors after Odhner (1925) used the genus *Leptodius* as a junior synonym of the genus *Xantho*. However, the revelation of the difference characters between *Leptodius* and *Xatho* genera, such as the fingertip of chelipeds, were considered appropriate to separate them.

Forest & Guinot (1961) reconsidered the relationship between the genus *Leptodius* and the genus *Xantho* in their publication as follows: "… la coupure *Xantho-Leptodius* est artificielle… le group qui résulte de la réunion des deux genres est hétérogène, à l'intérrieur devront être établies d'autres coupures génériques… l' examen des pléopodes males montre qu'il existe plusieurs types tout à fait differrents." In particular, they emphasized the male first gonopods of the genus *Leptodius* spp. and believed that the form of the male first gonopod was crucial for revision and reclassification.

Serène (1962) mentioned about three forms of the male first gonopod of the genus *Leptodius* spp.: " … Dans cette perspective, je distingue parmi les pléopodes males des: espèces du genre don't le dessin est publié à ce jour 3 formes différentes: …", and then, the genus *Leptodius* were described in " CRUSTACÉS DÉCAPODES BRACHYURES de l'Océan Indian Occidental et de la Mer Rouge" which was his great monograph (Seréne, 1984). After Serène's monograph, many researchers adopted the use of the genus *Leptodius*.

The genus *Leptodius* A. Milne-Edwards, 1863, contains 12 recognized species, which are all found in the Indo-West Pacific region, where they are often common and ubiquitous components of the intertidal and shallow subtidal fauna (Serène, 1968, 1984; Ng et al., 2008). The type species, *Chlorodius exaratus* H. Milne Edwards, 1834, was described from somewhere along the shore of the Indian subcontinent. This species has since been reported from many localities around the Indian Ocean and the western Pacific Ocean (e.g., Dana, 1852; A. Milne-Edwards, 1868, 1873; Kossmann, 1877; Haswell, 1882; Ortman, 1893; Nobili, 1906a, 1906b). Although not often discussed at length, the taxonomy of this species is actually quite complicated as a number of synonyms have never been recognized and/or treated (see Stimpson, 1907; Buitendijk, 1960; Forest & Guinot, 1961; Serène, 1984). There has also been some degree of variation. Stimpson (1907) discussed the taxonomy of *L. exaratus* (as *C. exaratus*) and recognized several varieties from the western Pacific (particularly southern Japan and China), although he observed some overlap in characters.

Recently, the author independently observed some differences between the populations of *L. exaratus* from the central and the western Indian Ocean, and from the western Pacific. Exhaustive examination of various material showed that *L. exaratus* should be restricted to the form found in the central and the western Indian Ocean, and that the "*L. exaratus*" widely reported from the western Pacific should instead be referred to as *Leptodius affinis* (De Haan, 1835). The main morphological characters that can be used to distinguish the species are the armament and relative lengths of the apical lobes of the G1. Furthermore, *L. affinis* has several synonyms in the literature, and the attending nomenclatural questions were resolved (Lee et al., in press).

Further more, Stimpson's varieties, several names, viz. *Chlorodius hombronii* Lucas, in Lucas & Jacquinot, 1853, *Leptodius davaoensis* Ward, 1941, *L. waialuanus* Rathbun, 1906 [the holotype of this species has been examined by two authors (JCEM, PKLN)], *L. planus* Ward, 1934, *L. australis* Ward, 1936, and the types thereof (if extant) need to be re-examined in greater detail.

SYSTEMATIC ACCOUNT

Superfamily Xanthoidea MacLeay, 1838

Family Xanthidae MacLeay, 1838

Genus *Leptodius* A. Milne-Edwards, 1863

Leptodius A. Milne-Edwards, 1863: 284; Miers, 1886: 136; Rathbun, 1930: 296; Forest & Guinot, 1961: 63; Guinot, 1968: 704; 1971: 1068; Serène, 1962: 255; Sakai, 1965: 140; 1976: 422; Takeda, 1976: 74.

Xantho (*Leptodius*): Alcock, 1898: 117; Sakai, 1939: 463.

Xantho: Ortmann, 1893: 443; Odhner, 1925: 79.

Diagnosis. Carapace broad, suboval, moderately conve anteriorly, flat in posterior half; regions generally well delimited and fairly well lobulated in anterior two-thirds, but not posteriorly. Antero-lateral borders arched, usually cut into four strong teeth; postero-lateral borders as long as chord of antero-lateral, moderately convergent, not concave. Fronto-orbital distance about half or more that half of extreme width of carapace. Front not produced, about a fourth the greatest width of carapace; notched in middle line, separated from supera-orbital margin by a notch or groove. Orbits suboval, margin with two suture lines above and one just below outer angle; usually a prominent tooth at inner angle of lower edge of orbit. Eyes on Short thick stalks. Basal antennal article short, meeting front at inner angle; flagellum lodged in orbital hiatus. Anterior edge of merus of external maxillipeds nearly transverse, with commonly a small tooth near antero-internal angle. Chelipeds unequal in both sexes. Legs thick, upper eges often sharp. Abdomen of male with third to fifth segements fused.

***Leptodius acutidens* (Stimpson, 1907)**

Chlorodius exaratus var. *acutidens* Stimpson, 1907: 55.
Chlorodius exaratus var. *cuplifer* Stimpson, 1907: 55.
Leptodius exaratus acutidens: Edmondson, 1923: 14.

Material examined. **Neotype**: 1 male (20.5 × 13.2 mm)(Ex ZRC 2009.0161), Okukubi river, Okinawa Is, Ryukyu, Japan, 21 Jun. 2000. *Others*: **Christmas island** — 1 male (19.6 × 12.5 mm), CI-17-2011, 23 Mar. 2011. **Fiji** — 1 male (17.2 × 11 mm), 1 female (11.6 × 7.7 mm), Vanese mudflat, Suva, Coll. C.E.M. 31. Jul. 2002. **Japan** — 7 males (14.3 × 9.1 mm – 18.7 × 12.3 mm), Ex ZRC 2009.0161, Okukubi river, Okinawa Is, Ryukyu, 21 Jun. 2000; 1 male (20.2 × 12.8 mm), RUMF ZC-352, Ryukyu; 2 males (15.2 × 9.8 mm, 15 × 9.7 mm), Ex. ZRC 2009.0110, coll. N. K. Ng et al., 16, Jun. 2000; 1 male (17.5 × 11.2 mm), Minatogawa, Urasoe, Okinawa Is., coll. T. Maenosono, 16 Sep. 2007; 1 male (17.5 × 11.2), Minatogawa, Urasoe, Okinawa Is., coll. T. maenosono, 16 Sept. 2007; 3 males (15.3 × 10.4 –18.5 × 12.1), 2 females (14.5 × 9.6– 14.8 × 9.6), Bise Village (Coral reef), Motobu-cho, Okinawa, Coll. P. K. L. Ng, Apl. 1992, ZRC 1993.641-645; 1 male (28.3× 18) Ogasawara Is., CBM ZC-10470; 1 male (28.3 × 18 mm) Ogasawara Is., CBM ZC-10470. **Philippines** — 1 male (15.4 × 10.3mm), Panglao2004, Stn. M25. 1 male (17.2 × 11.1 mm) Freshwater, rivermouth, a short distance, north of Siaton Beach, Southern negros, Coll. N. K. Ng, July. 2002.

Description. Carapace (Fig. 164A) transversely subovate, about 1.5–1.6 times as broad as long; dorsal surface slightly convex, finely granular, rugose particularly at anterior and lateral regions; regions well defined, separated by distinct grooves; 2F separated from 1M by shallow, transverse groove; 2M partly divided longitudinally, 1M fused to inner branch of 2M; 3M, 2L, 3L, 4L, 5L, 6L distinct, entire; 4M indistinct; 1L very small; 1R, 2R fused, separated from 3R by indistinct oblique groove; 1P, 2P indistinct. Front about 0.2–0.3 times as broad as carapace breadth, not much protruded; margin deeply, distinct sinuous medially, almost

quadridentate; separated from inner orbital tooth by notch. Orbit small, oval; superior margin with 2 fissures; inferior margin bearing 2 blunt teeth on either side; exorbital angle separated from first anterolateral tooth on anterolateral margin by shallow concavity. Anterolateral margin with 4 broad, triangular teeth having bump on the tip behind exorbital angle: first small; second distinct large; third similar to second, slightly more produced; last small. Posterolateral margin somewhat straight. Posterior margin granular, central region straight. Pterygostomian region granular, setose.

Antennules (Fig. 164B, Fig. 165A) folding transversely, slightly obliquely. Basal article of antenna sub-rhomboidal, short, broad; antennal flagellum entering orbital hiatus. Epistome narrow; central region with median projection, separated from lateral regions by distinct notches. Third maxilliped (Fig. 165A) completely covering buccal orifice; merus subquadrate, granular, anterolateral angle slightly produced, anterior margin with wide V-shaped notch medially; ischium subrectangular with submedian sulcus, smooth, punctate; exopod stout, length about 4 times width.

Thoracic sternum (Fig. 164C) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture; sternites 3, 4 almost completely fused except for short notches laterally, sternite 3 distinguishable from sternite 4 by shallow groove; sternite 4 largest, inflated; sternites 5–8 distinct, separate, sternite 8 not visible externally. Median longitudinal line visible externally only on central portion of sternite 4; within sternoabdominal cavity, visible only at posterior portion of sternite 4, complete at level of sternites 6, 7, 8. Sternal press-button situated on sternite 5, equidistant from sutures 4/5, 5/6.

Chelipeds (Fig. 164A, 165B) unequal, stout, rugulose. Merus with long setae on anterior and posterior borders. Carpus finely granular, rugose on external surface, with blunt tooth on inner angle. Palm inflated, rugose dorsally, smooth ventrally. Fingers stout, black, somewhat gaping, not strongly toothed within, forming large deep spoon-shaped cavieites or cups, hollowed out, with tufts of setae.

Ambulatory legs (Fig. 164A) short, stout; anterior margins finely granular; anterior and posterior margins of meri with long setae; carpi, propodi subequal in

length, sparsely setose; dactyli tomentose, spinose, ending distally in long, chitinous claw.

Male abdomen (Fig. 165C) narrow; somites 3 – 5 fused, sutures vaguely discernible; somite 6 long, median length about 1.6 times that of telson, distal half slightly broader than proximal half, lateral margins slightly concave. Telson subtriangular, tip broadly rounded; tip not reaching level of sternal condyles of P1 coxae.

G1 (Figs. 166A–D) long, slender, with 6–8 stout, subdistal spines; with elongate apical lobe set at strongly angle with rest of G1; distal region twisted shape.

Type locality. Ryukyu Is., Japan ('Loo Choo', see Stimpson, 1907)

Distribution. Ryukyu (Loo Choo); Ogasawara (Bonin Island) — Japan, Philippines, Fiji, Christmas Island.

Remarks. Stimpson (1907) discussed the taxonomy of *Chlorodius exaratus*, and recognized nine varieties from the western Pacific (particularly southern Japan and China), although he commented observing some overlap in characters. *C. exaratus* var. *acutidens* and var. *cuplifer* were mentioned first by Stimpson (1907). Subsequently, these two varieties were mentioned as *L. leptodon* Forest & Guinot, 1961 (Serène, 1962). Dr. Tomoyuki Komai examined specimens collected from Okinawa Island and Ogasawara Island to identify Stimpson's variety. He selected the typical specimens as G1 of *L. leptodon* and gave the author the specimens. Although *L. leptodon* from these two localities were very similar in their G1 slightly differences in shape were evident. Apical lobe was longer, slender, and narrower. Subdistal portion of their G1 was also shown to have one additional twist to those of *L. leptodon* (Fig. 2). The other characteristics of examined specimens agreed very well with the description of the two varieties by Stimpson (1907) with the carapace being less broad than in ordinary varieties, areolets of dorsal carapace being sharply prominent, antero-lateral teeth being strongly projecting and acuminate, and then chelipeds being stout and rugolose. The author considered these specimens would be the two varieties described by Stimpson (1907), given their similar collection

locations. Although *Chlorodius exaratus* var. *acutidens* and *C. e.* var. *cuplifer* could be used for these specimens' nomenclature, the author selected *C. exaratus* var. *acutidens, as* these specimens had having acuminated teeth on their anteiro-lateral boarder.

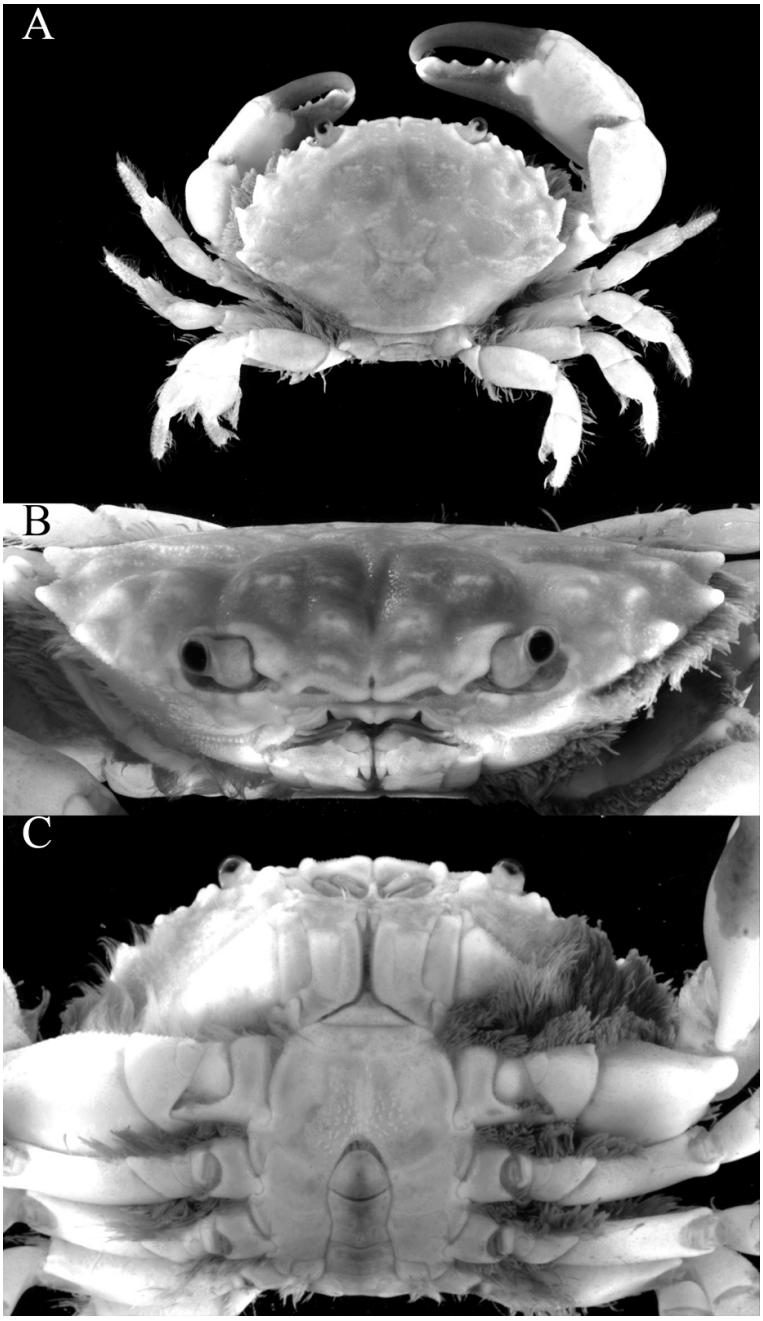

Fig. 164. *Leptodius acutidens* (Stimpson, 1907), male, (CW 20.5 × CL13.2 mm) (Ex ZRC 2009.0161). A, Dorsal view; B, Anterior view; C, Ventral view.

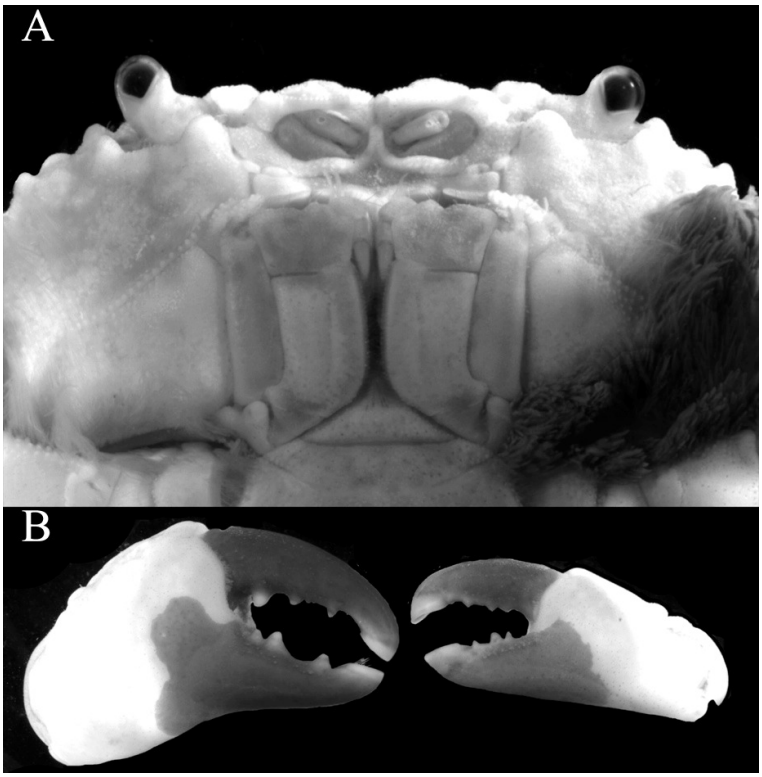

Fig. 165. *Leptodius acutidens* (Stimpson, 1907), male, (CW 20.5 × CL 13.2 mm) (Ex ZRC 2009.0161). A, Third maxilliped and pteryosotmian; B, Chelipeds, outer view.

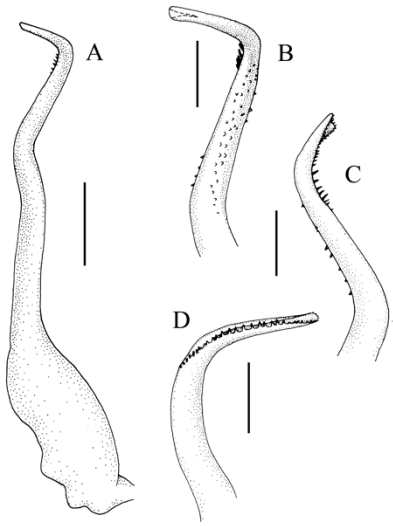

Fig. 166. *Leptodius acutidens* (Stimpson, 1907), first gonopod of male (CL 20.5 × CW13.2 mm) (Ex ZRC 2009.0161). A, ventral view; B –D, tip of G1: B, ventral view; C, lateral view; D, dorsal view. Scale bars: A= 1 mm, B, C, D= 0.5 mm.

Leptodius affinis (De Haan, 1835)

Cancer (*Xantho*) *affinis* De Haan, 1835: 48, pl. 13 fig. 8 [Japan]; Krauss, 1843: 30 [Japan].

Cancer (*Xantho*) *lividus* De Haan, 1835: 48, pl. 13 fig. 6 [Japan] [not *Cancer lividus* Latreille, in Milbert, 1812].

Chlorodius exaratus, Dana, 1852: 208 [Pacific] [not *Chlorodius exaratus* H. Milne Edwards, 1834].

Leptodius exaratus, A. Milne-Edwards, 1873: 222 [New Caledonia]; Miers, 1879: 31 [Korea and Japan]; Haswell, 1882: 60 [Australia]; De Man, 1887a: 33 [Mergui Archipelago]; 1887b: 285 [Nordwachter Island, Java Sea]; 1892: 278 [Sulawesi]; Alcock & Anderson, 1894: 200 [Bay of Bengal, Laccadive Sea]; Balss, 1922: 127 [Japan]; Shen, 1932: figs. 57, 58c, d; 1937: 307 (list) [northern China]; Yokoya, 1933: 189 [Japan]; Sakai, 1934: 309; 1936: 151, pl. 45, fig. 3; 1965: 140, pl. 70, fig. 6; 1976: 423, pl. 153, fig. 1 [Japan]; Chopra & Das, 1937: 398 (in part) [Bay of Bengal, Mergui Archipelago]; Sankarankutty, 1962: 129 [Andaman Is.]; 1966: 351 [Sri Lanka]; Kim, 1970: 14 [Korea]; 1973: 380, fig. 144, pl. 82, fig. 109 [Korea]; Takeda & Nunomura, 1976: 70 [New Caledonia]; Takeda, 1976: 74 [Palau]; 1978: 39 [Amakusa, Japan]; Takeda & Miyake, 1976: 109 [Ogasawara, Japan]; Yamaguchi et al., 1976: 37 [Amakusa, Japan]; Garth & Kim, 1983: 570 [Philippines]; Dai et al., 1986: 271, figs. 154(3), 155A(1), pl. 37(4), 37(5) [China]; Dai and Yang, 1991: 292, pl. 37(4), fig. 154(3) [China]; Yamaguchi & Baba, 1993: 446, figs. 164A, B [Japan]; Jones & Morgan, 1994: 166, 167, with figure [Australia]; Minemizu, 2000: 260, with figure [Japan]; Davie, 202: 550-551 [Australia]; Ng & Davie, 2002: 374 [Thailand]; Paulay et al., 2003: 504 [Marianas]; Poore, 2004: 472, fig. 150b [Australia]; Davie, 2011: 233, with figure [Australia][not *Chlorodius exaratus* H. Milne Edwards, 1834].

Xantho exaratus var. *typica* Ortmann, 1893: 445 (in part) [Samoa; Japan; Fiji; Caroline Is.; Australia] [not *Chlorodius exaratus* H. Milne Edwards, 1834].

Chlorodius exaratus var. *pictus* Stimpson, 1907: 54, fig. 6 [Simoda, Japan] [not *Chlorodius exaratus* H. Milne Edwards, 1834].

Chlorodius exaratus var. *typicus* Stimpson, 1907: 55 [China; Japan] [not *Chlorodius exaratus* H. Milne Edwards, 1834].

Xantho (*Leptodius*) *exaratus*, Alcock, 1898: 118 [353] (in part) [Mergui, Andamans, Sri Lanka, Burma, Malaysia]; Laurie, 1906: 402 [Sri Lanka]; Gravely, 1927: 146 [Gulf of Mannar]; Gordon, 1931:528, 543, fig. 22b; 1934: fig. 16b [China]; Boone, 1934: 110, pl. 58 [Australia, French Polynesia]; Balss, 1935: 133 [SW Australia]; 1938: 41 [Nauru, Marshall Is.]; Estampador, 1937: 525; 1959: 79 [Philippines]; Sakai, 1939: 464, pl. 58, fig. 3, pl. 91 [Japan]; Miyake, 1939: 209; 1940: 155 [Micronesia]; Chang, 1963: 99 [Taiwan]; McNeill, 1968: 58 [Australia] [not *Chlorodius exaratus* H. Milne Edwards, 1834].

Xantho exaratus, Holthuis, 1953: 27 [Gilbert Is.; Tuamotu Archipelago]; Buitendijk, 1960: 331, fig. 9 k-m (in part) [Indonesia; China; Fiji; Japan; Myanmar; Philippines; Samoa; Society Is.; Thailand] [not *Chlorodius exaratus* H. Milne Edwards, 1834].

Leptodius nigromaculatus Serène, 1962: 255, figs. 1A–H; 1984: 182 (key) [Vietnam]; Dai et al., 1986: 272, fig. 155A [China]; Dai & Yang, 1991: 293, pl. 37(5), fig. 155A [China]; Yeh et al., 2006: 70, figs. 1C, F, 2C–D [Taiwan].

Material examined. 1 male (25.9 × 16.6 mm) (NMST-Cr 6425), Shibasaki Hayama, Kanagawa, coll. M. Takeda, 25 Jul. 1980. *Others*: **Australia** — 2 males (21.1 × 13.8 mm) (ZRC 2012.0112), (23.4 × 15.1 mm) (ZRC 2012.0113), Ningaloo Reef, Western Australia, R. Lasley coll., 19 May 2010. **China** — 1 male (20 mm × 32.5 mm) (ZRC 2012.0114), 3 males (13.0 × 8.5 mm – 23.5 × 15.0 mm) (ZRC. 1998.542), Changpo, Hong Kong, coll. P. K. L. Ng & S. Y. Lee, 6 Jun. 1998; 2 males (30.2 × 18.6 mm, 30.7 × 19.0 mm) (ZRC. 1999.0625), 1 female (22.8 × 14.1 mm) (ZRC. 1999.0458), Nanao Is., Guangdong, coll. Y. Cai & N. K. Ng, 13 Nov. 1998; 2 males (15.4 × 10.0 mm, 19.6 × 13.1 mm), 1 female (14.2 ×9.3 mm) (ZRC 2012.0115), Hainan Is., coll. Y. Cai and N. K. Ng, 1 Dec. 1998; 2 males (17.0 × 11.6 mm, 13.2 × 8.1 mm), 2 females, (23.1 × 13.5 mm, 18.0 × 11.8 mm) (ZRC 2010.0352), Shi Jing Village, Xiamen County, Fujian Province, coll. Z. Jaafar & N.

K. Ng, 17 Nov. 2005. **Eastern India** — 1 male (23.9 × 15.4 mm) (ZRC 2012.0110), Tranquebar, Tamil Nadu, coll. N.K. Ng, B.Y. Lee & R.M. Lasley, Nov. 2011. **Indonesia** — 1 female (15.8 × 10.3 mm) (ZRC 1999.1203), Bintan Is., coll. Riau, J.B. Sigurdsson, 27 Mar. 1993; 1 female (13.9 × 9.5 mm) (ZRC. 2003.0548), Anambas Is., stn EA-2jc7, 15 Mar. 2002. **Japan —** 1 female (16.1 × 10. 6 mm) (NMST-Cr 6425), Shibasaki Hayama, Kanagawa, coll. M. Takeda, 25 Jul. 1980; 2 males (23.7 × 15.2 mm, 29.4 × 19.0 mm), 1 female (21.2 × 13.5 mm) (CBM-ZC 143), 2 males (12.9 × 8.6 mm, 35.0 × 21.7 mm), 1 female (20.3 × 13.3 mm) (CBM-ZC 559), Ogasawara Is.; 1 female (22.6 × 14.2 mm) (ZRC 2009.0145), Iriomote Is., Yaeyama Group, southern Ryukyu Islands, coll. N. K. Ng, 16 Jun. 2000; 2 males (14.6 × 9.2 mm, 23.3 × 15.0 mm) (ZRC 2011.0170), Amakusa, Kyushu, J.C.Y. Lai coll., 3 Apr. 2011. **Korea** — 2 males (32.0 × 20.3 mm, 36.8 × 23.2 mm) (MADBK 173012_011), Iho-ri, Jejudo Is., coll. H. S. Kim, 11 Aug. 1969; 3 male (19.7 × 12.7 mm – 30.6 × 19.3 mm) (MADBK 173012_012), Sindo-ri, Jejudo Is., S. K. Lee coll. 25 Oct. 2005; 1 male (15.7 × 10.4 mm) (MADBK 173012_013), Aewel-eup, Jejudo Is., coll. S. K. Lee, 16 Oct. 2006; 2 males (20.5 × 13.2 mm, 23.1 × 14.7 mm) (MADBK 173012_014), Jo-1ri, Udo Is., Jejudo, coll. S. K. Lee, 14 Dec. 2006. **Malaysia** — 1 male (19.4 × 12.6 mm) (ZRC. 1991.461), Pulau Tioman, coll. P. K. L. Ng, 30 Mar. 1982; 1 male, (26.4 × 16.0 mm), 3 females (13.6 × 8.9 mm – 16.8 × 11.3 mm) (ZRC. 1985.1722-1725), Tanjong Bidara, Malacca, coll. P. K. L. Ng, 16 Feb. 1985. **New Caledonia** — 2 males (15.8 × 10.5 mm, 17.0 × 11.4 mm), 2 females (18.3 × 12.8 mm, 17.4 × 11.4 mm) (MNHN-B8631), coll. Balansa, no date. **Philippines —** 2 males (23.5 × 15.6 mm, 27.7 × 18.0 mm), 1 female (21.8 × 14.1 mm) (ZRC 2012.0116), 8 males (13.6 × 9.0 mm – 29.5 × 19.3 mm), 2 females (12.6 × 8.4 mm, 23.8 × 15.5 mm) (with sacculinid) (ZRC 2012.0117), Punta Taytay, Bacolod, Negros Is., coll. J.C.E. Mendoza, 27-28 Dec. 2011. **Singapore** — 2 males (24.7 × 15.0 mm, 27.1 × 17.0 mm), 2 females (21.0 × 13.5 mm, 22.8 × 14.5 mm) (ZRC 1993.33-51), Labrador Beach, Jan. 1987; 3 males (19.0 × 12.1 mm – 22.7 × 14.0 mm) (ZRC 1995.339), Semakau, coll. P. K. L. Ng, 8 Feb. 1993; 3 males (23.6 × 15.0 mm – 29.0 × 18.3 mm) (ZRC 2000.1197), Pulau Seringat, C. M. Yang & S. L. Goh coll., 22 Jul. 1997. **Taiwan —** 1 male (29.3 × 18.5 mm) (ZRC. 1995.620), Shihmen, Taipei, C. H. Wang coll., 24 May 1987; 1 male (29.2 × 18.2 mm) (ZRC

1999.0590), 5 males (18.9 × 12.1 mm – 26.3 × 16.5 mm), 2 females (18.8 × 12.1 mm, 22.1 × 14.1 mm) (ZRC 1999.0591), Keelung, Magang, coll. H.H. Tan, 3 Aug. 1996; 2 males (29.0 × 18.5 mm, 23.0 × 15.1 mm) (ZRC 1999.0581), He Ping Tao, coll. Keelung, H.H. Tan, 4 Aug. 1996. **Thailand** — 9 males (14.8 × 9.7 mm – 24.5 × 15.5 mm), 4 females (13.0 × 8.4 mm – 16.7 × 11.2 mm) (ZRC. 2000.1034), Cape Panwa, Phuket, coll. H.H. Tan, 17 Jan. 2000; 1 male (19.3 × 12.5 mm) (ZRC. 2001.1076), Phuket, P. K. L. Ng coll., 17 Feb. 2001. **Vietnam** — 2 males (12.7 × 8.4 mm, 22.4 × 14.0 mm), 2 females (18.7 × 12.3 mm, 28.7 × 17.9 mm) (ZRC 2012.0118), Con Dau Is., coll. H.H. Tan *et al*., 12 Apr. 2010; 8 males (9.8 × 6.3 mm – 13.9 × 9.0 mm), 13 females (6.4 × 4.2 mm – 12.8 × 8.6 mm) (ZRC 2012.0119), Con Dau Is., 14 Apr. 2010.

Description. Carapace (Fig. 167A) transversely subovate, about 1.4–1.6 times as broad as long; dorsal surface depressed, finely granular, anterior, lateral regions varying from distinctly to faintly rugose; regions well defined, separated by narrow, shallow grooves; 2F separated by groove from 1M; 2M partly divided longitudinally, 1M fused to inner branch of 2M; 3M, 2L, 3L, 4L, 5L, 6L distinct, entire; 4M indistinct; 1L very small; 1R, 2R fused, separated from 3R by indistinct oblique groove; 1P, 2P indistinct. Front about 0.3 times as broad as carapace breadth, not much protruded, cut into 2 lobes, each one slightly concave near outer side, separated from internal orbital tooth by notch. Orbit smaller, transverse oval; superior margin with 2 fissures; inferior margin bearing 2 blunt teeth on either side; exorbital angle separated from first anterolateral tooth by concavity. Anterolateral margin with 4 lobes behind exorbital angle: first small, almost indistinguishable, depressed; second broad, large; third similar, more prominent than second; last smallest but most produced; separation between teeth indicated by small sinus. Posterolateral margin somewhat concave, with pubescence. Posterior margin granular, central region straight. Pterygostomian region granular, setose.

Antennules (Fig. 167B) lying transversely, slightly obliquely. Basal article of antenna sub-rhomboidal, short, broad. Antennular flagellum occupied orbit hiatus. Epistome narrow; central region with median projection, separated from lateral regions by distinct notches. Third maxilliped completely filled buccal orifice; merus

subquadrate, granular, anterolateral angle slightly produced, anterior margin with wide V-shape notch medially; ischium subrectangular with submedian sulcus, smooth, punctuate; exopod stout, length about 4 times width.

Thoracic sternum (Fig. 167C) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture; sternites 3, 4 almost completely fused except for short notches laterally, sternite 3 distinguishable from sternite 4 by shallow groove; sternite 4 large, slightly convex; sternites 5–8 distinct, separate, within not visible externally. Median longitudinal line visible externally only on central portion of sternite 4, complete at level of sternites 6, 7, 8. Sternal press-button situated on sternite 5, equidistant from sutures 4/5, 5/6.

Chelipeds (Fig. 167A) asymmetrical, with a granular coating single ended, more or less curved and pointed. Merus with long setae on anterior and posterior borders, covered with fine corrugation on dorsal surface. Carpus covered with microscopic granules and fine corrugation on outer surface; inner-distal angle bluntly round. Fingers black coloured, with somewhat gaping between them closed, with distinctly toothed and contiguous within; inner margins provided with obtuse teeth, tips spoon-shaped with bristles.

Ambulatory legs (Fig. 167A) smooth; meri of first to third with setae on anterior and posterior margin; carpi, propodi subequal in length, sparsely setose; dactyli densely covered with short hairs, chitinous claw.

Male abdomen (Fig. 167C) narrow and long; somites 3–5 fused, sutures vaguely discernible; somite 6, median length about 1.6 times that of telson. Distal half slightly broader than proximal half, lateral margins slightly concave. Telson subtriangular, tip broadly rounded; tip not reaching level of sternal condyles of P1 coxae.

Male G1 (Figs. 168A–E) slender, long, with 5 or 6 stout, curved subdistal spines; elongated apical lobe bordered on ventral margin by 5–6 mushroom-shaped outgrowths proximally and in distal half with 6–8 tongue-shaped outgrowths, simple, pointed, diminishing gradually near tip. Length of apical lobe measured from tip to subdistal region 0.11–0.14 times to total length. Angle formed between apical lobe and rest of G1 more bent.

Type locality. Japan (De Haan, 1835: 48).

Distribution. — *Leptodius affinis* (De Haan, 1835) is found in the eastern Indian Ocean and in the western and central Pacific Ocean, ranging from the eastern coast of India all the way to the oceanic islands of French Polynesia; extending northward to central Japan and southward to southwestern and southeastern Australia. It has been recorded from the following localities: ***Eastern Indian Ocean***: Andamans (Alcock, 1898; Sankarankutty, 1962); Bay of Bengal (Alcock & Anderson, 1894; Chopra & Das, 1937); Gulf of Mannar (Gravely, 1927); Laccadive Sea (Alcock & Anderson, 1894); Mergui Archipelago (De Man, 1887a; Alcock, 1898; Chopra & Das, 1937); Myanmar (Alcock, 1898; Buitendijk, 1960); Penang (Alcock, 1898); Sri Lanka (Alcock, 1898; Laurie, 1906; Sankarankutty, 1966); western Thiland (Ng & Davie, 2002). ***Western Pacific*:** Australia (Haswell, 1882; Ortmann, 1893; Boone, 1934; Balss, 1935; McNeill, 1968; Jones & Morgan, 1994; Davie, 2002, 2011; Poore, 2004); China (Stimpson, 1907; Gordon, 1931; Shen, 1932, 1937; Dai et al., 1986; Dai and Yang, 1991); Gilbert Is. (Holthuis, 1953); Hong Kong (Stimpson, 1907); Indonesia (De Man, 1892; Buitendijk, 1960); Japan (De Haan, 1835; Krauss, 1843; Miers, 1879; Ortman, 1893; Stimpson, 1907; Balss, 1922; Yokoya, 1933; Sakai, 1934, 1936, 1939, 1965, 1976; Takeda & Miyake, 1976; Yamaguchi et al., 1976; Takeda, 1978; Yamaguchi & Baba, 1993; Minemizu, 2000); Korea (Miers, 1879; Kim, 1970, 1973); Micronesia (Miyake, 1939, 1940); Philippines (Estampador, 1937, 1959; Buitendijk, 1960; Garth & Kim, 1983); Taiwan (Chang, 1963; Yeh et al., 2006); Thailand (Buitendijk, 1960); Vietnam (Serène, 1962). ***Central Pacific***: Marianas (Paulay et al., 2003); Nauru, Marshall Is. (Balss, 1938); Pacific (Dana, 1852); Palau (Takeda, 1976); Samoa, Fiji, Caroline Is. (Ortmann, 1893, Buitendijk, 1960); Tuamotu Archipelago (Holthuis, 1953). ***South Pacific*:** French Polynesia (Boon, 1934); New Caledonia (A. Milne-Edwards, 1873; Takeda & Nunomura, 1976).

Remarks. De Haan (1835) described two species, *Cancer* (*Xantho*) *affinis* and *C.* (*X.*) *lividus*, from Japan. These two names were simultaneously synonymized under *Xantho exaratus* (H. Milne Edwards, 1834) var. *typica* by Ortmann (1893:

445) (see also Yamaguchi & Baba, 1993). The type material for these two names is still extant: the lectotype (RMNH D 44644) and paralectotypes (RMNH D 42334, RMNH D 42335, RMNH D 44646) of *Cancer* (*Xantho*) *affinis* De Haan, 1835, as well as the lectotype (RMNH D 42333) and paralectotype (RMNH D 42336) of *Cancer* (*Xantho*) *lividus* De Haan, 1835, are all deposited at the Nationaal Natuurhistorisch Museum at Leiden, The Netherlands, and have been well documented by Yamaguchi & Baba (1993: 446, Figs. 164A, B) and Fransen et al. (1997: 116). Stimpson (1907) noted the morphological variations among different populations of *L. exaratus* in the Pacific region, and established varieties within this species to distinguish these populations. Serène (1962) described another species, *Leptodius nigromaculatus*, from southern Vietnam, which he thought to be more closely allied to *L. gracilis* (Dana, 1852), perhaps due to the less rugose carapace and less projecting anterolateral teeth. The holotype of *L. nigromaculatus* could not be located; it has not been found in the MNHN, despite several attempts, and it may still be in Serène's former institution in Nhatrang, Vietnam. Several topotypic specimens from southern Vietnam were examined instead in order to confirm the synonymy. Besides these, the literature is rife with several records of "*Leptodius exaratus*", or variants thereof, from the western Pacific and eastern Indian Ocean. The colour of what has been called "*Leptodius exaratus*" in East Asia is extremely variable and is not a reliable distinguishing character (see Todd *et al*., 2009). The large series of specimens examined for this study demonstrates this (Fig.169).

Differences between *L. exaratus* s. str. and its close sibling *L. affinis* (De Haan, 1835) are discussed under the Remarks for *L. exaratus*.

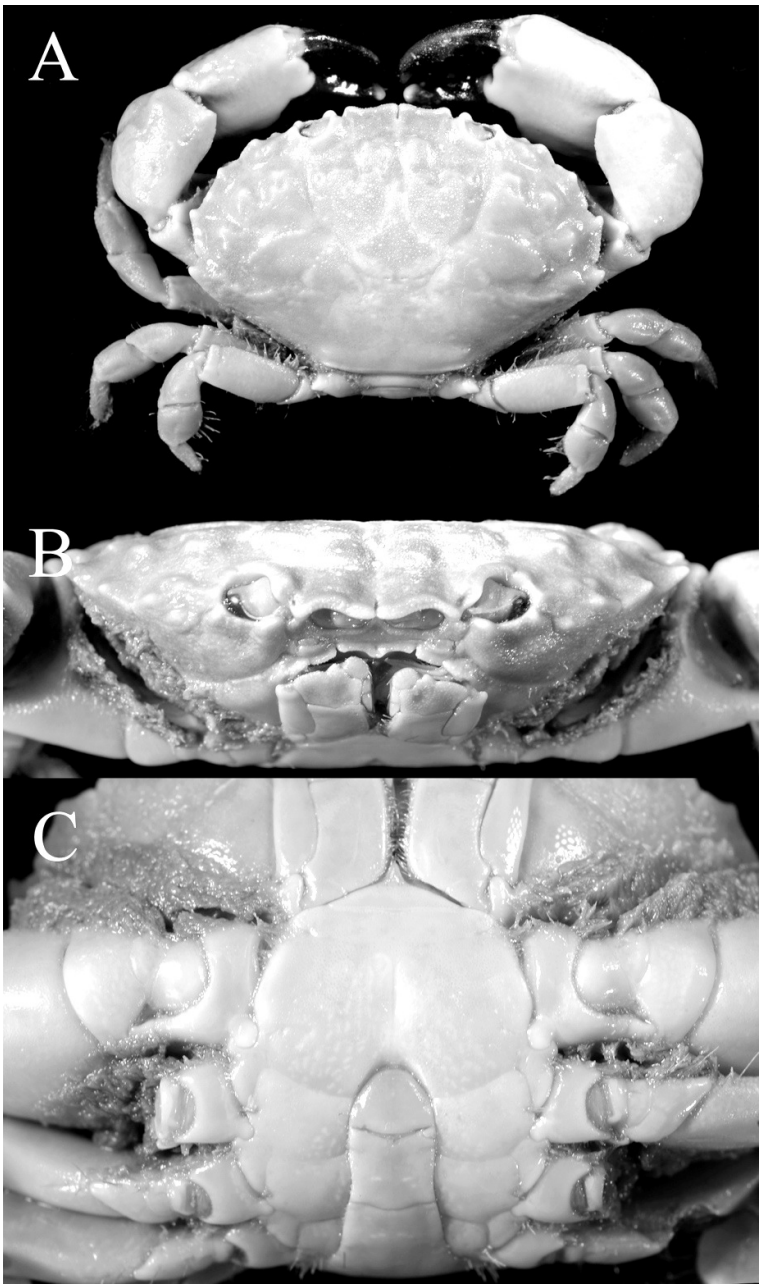

Fig. 167. *Leptodius affinis* (De Haan, 1835), male, 25.9 × 16.6 mm (NSMT-Cr6425), Shibasaki, Kanagawa, Japan. A, dorsal view; B, anterior view; C, ventral view.

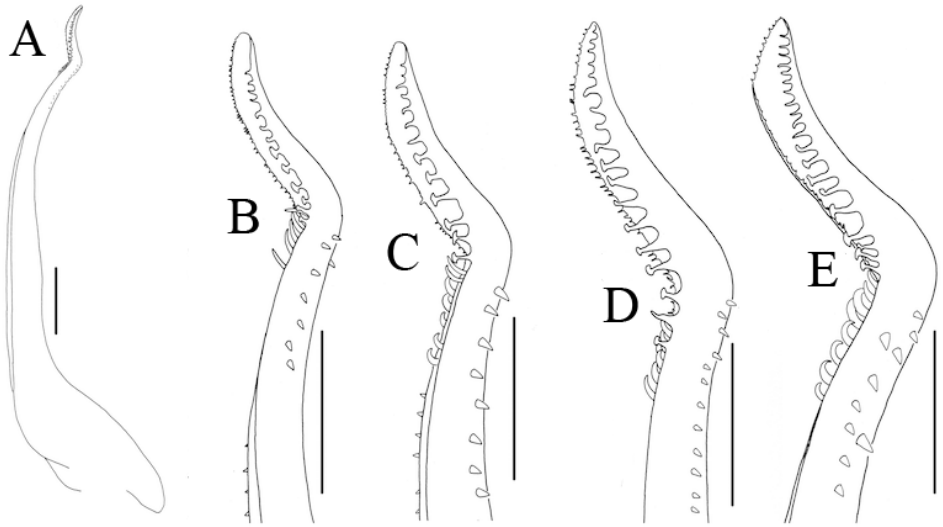

Fig. 168. Left G1. A-E, *Leptodius affinis* (De Haan, 1835): A, D, 25.9 mm × 16.6 mm, (NMST-Cr 6425), Shibasaki Hayama, Japan; B, 13.9 × 9.0 mm (ZRC 2012.0119), Con Dau, Vietnam; C, 23.9 × 15.4 mm (ZRC 2012.0110), Tranquebar, S.E. India; E, 29.5 × 19.3 mm, (ZRC 2012.0117), Negros, Philippines.

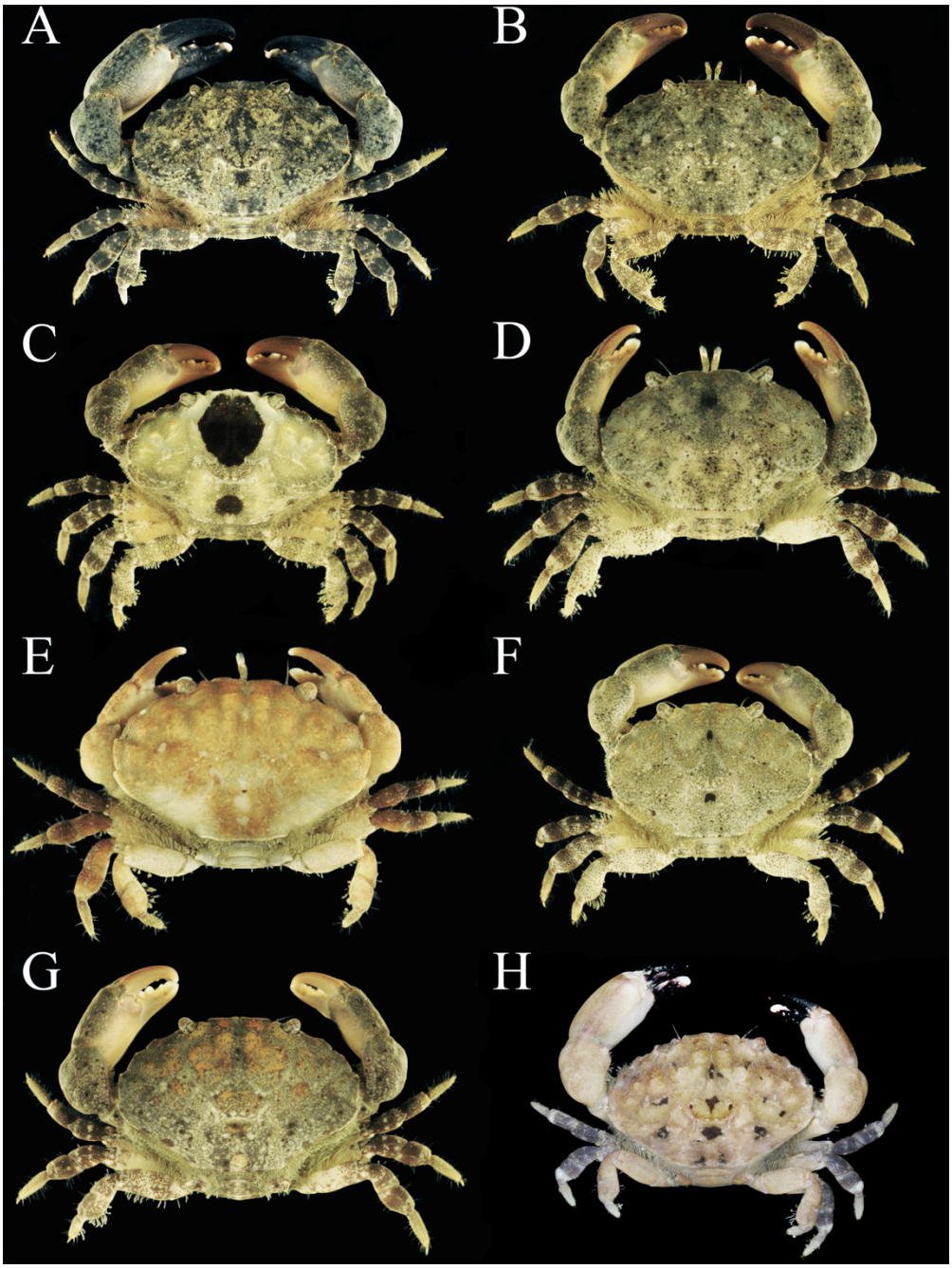

Fig. 169. Colour varieties in life of male *Leptodius affinis* (De Haan, 1835). A–G, collected from Changi beach park, Singapore, 04 May 2012: A, 31 mm × 20.2 mm; B, 26.8 mm × 16.9; C, 24 mm × 15.1 mm; D, 12.5 mm × 7.8 mm; E, 12 mm × 7.6 mm; F, 18.6 mm × 12.3 mm; G, 22 mm × 14.2 mm. H, collected from Espiritu Santo, Vanuatu, Oct. 2006.

Leptodius australis Ward, 1936

Leptodius australis Ward, 1936: 6.

Material examined. 1 males (17.1 × 11.0 mm)(ZRC ex. QM-W.12930), Dalrymple Point, Bowen, ME, Q, intertidal, under rocks, coll. P. Davie, J. Short, 22 March 1987. *Others*: **Australia** — 1 male (13.3 × 8.1 mm), 1 ovig. female (9.3 × 5.9 mm) (QM-W.12928), Home beach, Lindeman Is., ME, Q., east of jetty under rocks in intertidal zone, coll. P. Davie, J. Short, 23 March 1987; 3 males (15.2 × 10 mm – 19.8 × 12.1 mm), 1 female (12.1 × 7.8 mm), 3 ovig. females (13.1 × 8.3 mm – 17 × 10.9 mm) (QM-W.12930), 1 males (15.5 × 9.8 mm) (ZRC, ex. QM-W.12930), Dalrymple Point, Bowen, ME, Q, intertidal, under rocks, coll. P. Davie, J. Short, 22 March 1987. **Phillippines** — 1 male (11.3 × 7 mm) (ZRC PANGLAO), St. M 51, Panglao 2004, 30 Jun. 2004; 1 male (13.5 × 8.7 mm), Freshwater, rivermouth, a short distance, north of Siaton Beach, Southern negros, N. K. Ng, July. 2002.

Description. Carapace (Fig.170A) broader than long, transversely subovate, about 1.5 – 1.7 times as broad as long, very distinctly areolated; dorsal surface granulated anteriorly, flat posteriorly; regions defined, separated by distinct grooves; 2F separated from 1M by shallow, transverse groove; 2M partly divided longitudinally, 1M fused to inner branch of 2M; 3M, 2L, 3L, 4L, 5L, 6L distinct, entire; 4M indistinct; 1L very small; 1R, 2R fused, separated from 3R by indistinct oblique groove; 1P, 2P indistinct. Front about 0.2 – 0.3 times as broad as carapace breadth, protruded; margin deeply, distinct broad sinuous medially, almost quadridentate; separated from inner orbital tooth by notch. Orbit small, oval; superior margin with 2 fissures; inferior margin bearing 2 blunt teeth on either side; exorbital angle separated from first anterolateral tooth on anterolateral margin by shallow concavity. Anterolateral margin with 4 broad, triangular teeth having bump on the tip behind exorbital angle: first small; second distinct large; third similar to second, slightly more produced; last small. Posterolateral margin somewhat straight. Posterior margin granular, central region straight. Pterygostomian region granular, setose.

Antennules (Fig. 170B, 170C) folding transversely, slightly obliquely. Basal article of antenna sub-rhomboidal, short, broad; antennal flagellum entering orbital hiatus. Epistome narrow; central region with median projection, separated from lateral regions by distinct notches. Third maxilliped (Fig. 171C) completely covering buccal orifice; merus subquadrate, granular, anterolateral angle slightly produced, anterior margin with wide U-shaped notch medially; ischium subrectangular with submedian sulcus, smooth, punctate; exopod stout, length about 4 times width.

Thoracic sternum (Fig. 170C) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture; sternites 3, 4 almost completely fused except for short notches laterally, sternite 3 distinguishable from sternite 4 by shallow groove; sternite 4 largest, inflated; sternites 5–8 distinct, separate, sternite 8 not visible externally. Median longitudinal line visible externally only on central portion of sternite 4; within sternoabdominal cavity, visible only at posterior portion of sternite 4, complete at level of sternites 6, 7, 8. Sternal press-button situated on sternite 5, equidistant from sutures 4/5, 5/6.

Chelipeds (Fig. 171A, 171B) unequal, stout, rugulose. Merus projects beyond edge of carapace; carpus coarsely granulated with acuminate inner angle. Carpus finely granular, rugose on external surface, with blunt tooth on inner angle. Propodus coarsely granulated with acuminate inner angle. Dactylus stout, black, somewhat gaping, not strongly toothed within, forming large deep spoon-shaped cavieites or cups, hollowed out, with tufts of setae.

Ambulatory legs (Fig. 170A, 170C) short, stout; anterior margins finely granular; anterior and posterior margins of merus with long setae; carpus, propodus subequal in length, sparsely setose; dactylus tomentose, spinose, ending distally in long, chitinous claw.

Male abdomen (Fig. 170C) narrow; somites 3 – 5 fused, sutures vaguely discernible; somite 6 long, median length about 1.6 times that of telson, distal half slightly broader than proximal half, lateral margins slightly concave. Telson subtriangular, tip broadly rounded; tip not reaching level of sternal condyles of P1 coxae.

G1 (Figs. 172A–D) long, slender, with 8 stout, subdistal spines; with elongate apical lobe set at slightly angle with rest of G1; distal region twisted shape.

G2 (Fig. 172E) slender; distal sharp, curved.

Type locality. Lindeman Island, Whitsunday Passage, Queensland.

Distribution. Queens land — Australia, Philippines.

Remarks. The members belonging to the genus *Leptodius* were identified by G1 due to the overlapping variation of their carapace and chelipeds between species. However, *L. australis* was described without the illustration of G1 (Ward, 1936), and he mentioned that recognition of *L. sanguineus* (H. Milne Edwards, 1834), *L. exaratus* (H. Milne Edwards, 1834), *L. nudipes* (Dana, 1853), and *L. crassimanus* (A. Milne-Edward, 1867) have been recognized from the coast of Queensland. The author examined the topotypic specimens collected by Dr. Peter Davie. The examined specimens agreed with original description of *L. australis*; additionally, the G1 morphology did not agree those of *L. sanguineus, L. exaratus, L. nudipes*, and *L. crassimanus*. The first gonopod of *L. australis* is first described herein.

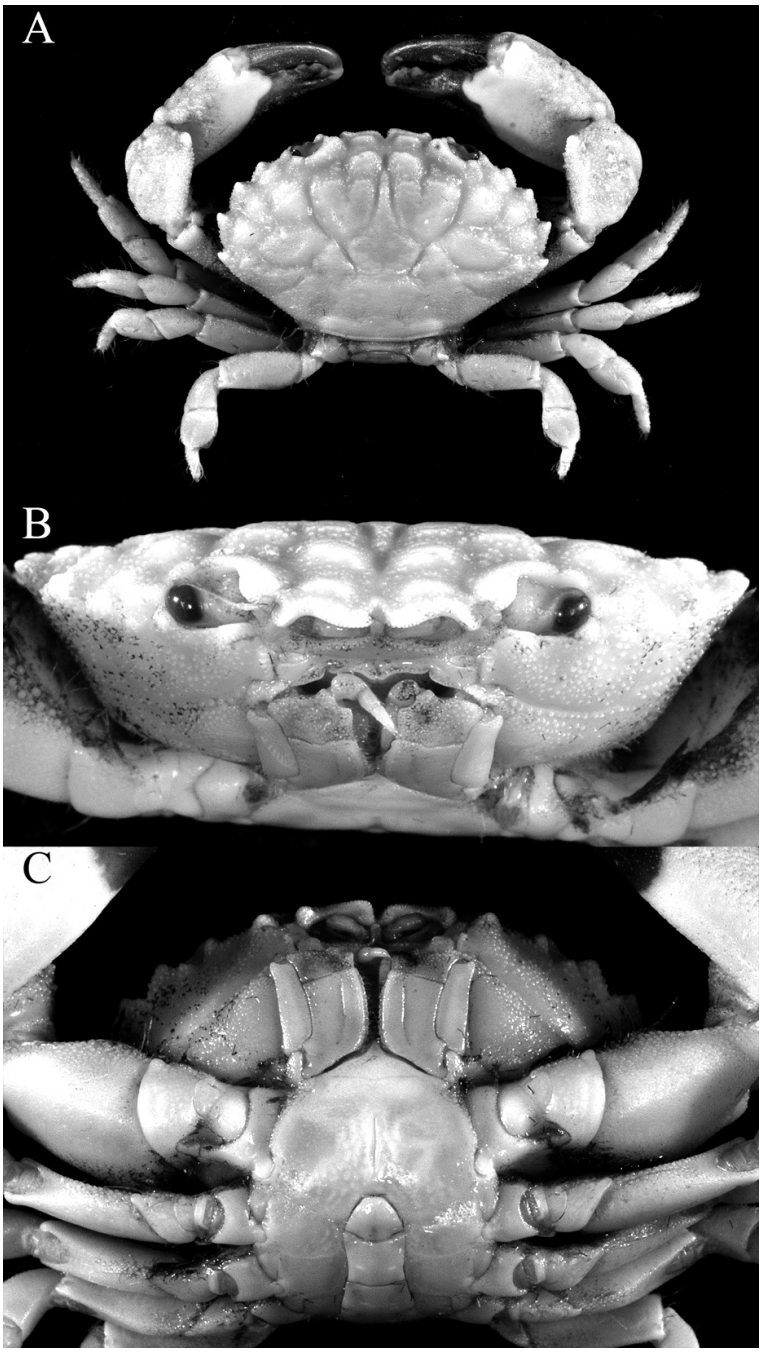

Fig. 170. *Leptodius australis* Ward, 1936, male, 17.1 × 11 mm (ZRC ex. QM-W12930). A, Dorsal view; B, Anterior view; C, Ventral view.

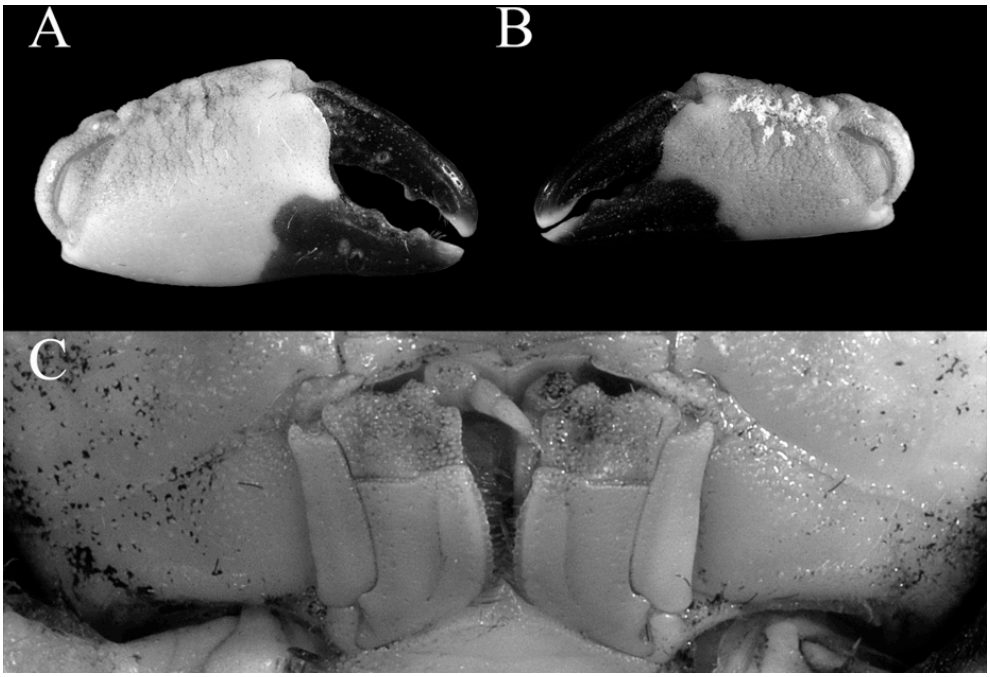

Fig. 171. *Leptodius australis* Ward, 1936, male, 17.1 × 11 mm (Ex ZRC 2009.0161). A, Right cheliped; B, Left cheliped; C, Third maxilliped and pteryosotmian.

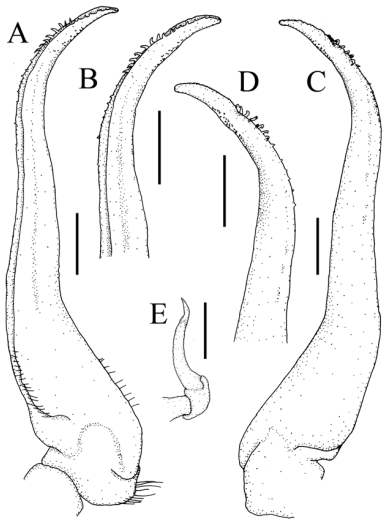

Fig. 172. *Leptodius australis* Ward, 1936, left first gonopod of male, 17.1 × CL 11 mm (ZRC ex. QM-W12930). A, External view; B, Distal portion, external view; C, Internal view; D, distal portion, internal view. Scale bars: A, B, C, D= 0.5 mm.

Leptodius davaoensis **Ward, 1941**

Leptodius davaoensis Ward, 1941: 10, figs; Takeda, 1980: 319.

Material examined. **Holotype**, 1 male (18 ×11 mm)(AMNH 8347), Padada beach, the gulf of Davao, Philippines, Coll. G. R. Oesch. *Others*: **Philippines** — 1 male (8.5 × 6 mm), 1 female (8.8 × 5.6 mm), (ZRC PANGLAO 2004), Stn M26. **Singapore** — 1 male (11.9 × 7.8 mm), Semakau, habitat: sandy, Coll. Yushang & Ruixiang, 28 Mar. 2010; 1 male (12.7 × 9 mm), Semakau, Coral rubble reef, Coll. Yabbie Rimp, 6 Nov. 2010; 2 males (6.5 × 4.6, 10.7 × 7mm), 2 females (7.2 × 4.7, 13.9 × 9.8) (ZRC 2002.0537), Paya Beach, Pulau Tioman, 7– 12 Sep. 2002; 8 males (12 × 7.8 – 20 × 12.6 mm), 6 females (10.8 × 7 –15 × 10.2 mm)(ZRC 2010.0327), East coast park, Coll. P. K. L. Ng, Oct. 2011; 7 males (12.5 × 8.5 – 19.8 × 12 mm), 3 females (13.3 × 8.5 – 15.8 × 10.3 mm)(ZRC 1993.33-51), Labrador Beach, Jan. 1987; 1 female (9.3 × 6.5 mm)(ZRC 1885.1327), Labrador, crevies honeycomb rock, Coll. D. S. Johnson, Jan. 1969; 20 males (10.6 × 7 – 20 × 13 mm), 10 females (9.5 × 6 – 14.4 × 9mm)(ZRC 1996.2060), Labrador Beach, Coll. P. K. L. Ng, 22 Jan. 1985; 1 male (20 × 12.6 mm)(Ex ZRC 2000.1151), Labrador Rocky Shore, Coll. Schubart, O.Chia, Yeah, Cilenner, 28 Sep. 1999; 1 male (16.3 × 10 mm)(Ex ZRC 1989.3442-3456), Sentosa reef, Coll. P. K. L. Ng, 1989; 1 male (14 × 9.1 mm), Semakau Phase 2 Lagoon, Coll. Lat, 4. Jan. 2011; 7 males (10.4 × 7.4 – 14 × 8.9 mm), 2 females (8.3 × 5.8 mm, 8.8 × 6.2 mm)(1965.11.9.135-143), Horseburgh Lighthouse, South China Sea. **Malaysia** — 11 males (12.1 7.5 – 16.3 10.2), 5 females (8.5 5.6 – 10.6 7.2)(ZRC 1965.11.9.153-162), Pulau Pisang, Malacca strait, Jan. 1934. **Indonesia** — 1 male (14.5 × 9.5 – 14.8 × 9.8 mm), 3 female (11 × 7 – 13.5 × 8.8 mm), Teluk Kudek, West Lombok Is., 30 Aug. 2005. **Micronesia** — 1 male (12.4 × 8.4 mm), Kosrae Island, Coll. S. K. Lee, 11 Jan. 2012.

Description. Carapace (Fig. 173A) transversely subovate, smooth, glossy, about 1.5–1.7 times as broad as long; regions ill defined, separated by narrow, shallow grooves; 2M partly divided longitudinally, 1M fused to inner branch of 2M; 3M, 4L, 5L, 6L distinct, entire; 4M indistinct; 1L, 2L, 3L indistinct; 1R, 2R fused, separated from 3R by indistinct oblique groove; 1P, 2P indistinct. Front about 0.25 –

0.3 times as broad as carapace width, slightly protruded, cut into 2 lobes, each one slightly concave near outer side, separated from internal orbital tooth by notch. Orbit smaller, transverse oval; superior margin with 2 fissures; inferior margin bearing 2 blunt teeth on either side; exorbital angle separated from first anterolateral tooth by concavity. Anterolateral margin with 4 lobes and bump behind exorbital angle: first small, almost indistinguishable, depressed; second broad, large; third similar, more prominent than second; fourth similar size of second; bump blunt, small. Posterolateral margin somewhat concave, with pubescence. Posterior margin granular; central region straight. Pterygostomian region granular, setose.

Antennules (Fig. 173B) transverse, slightly oblique. Basal article of antenna sub-rhomboidal, short, broad. Antennular flagellum occupied orbit hiatus. Epistome well developed, naked. Third maxilliped (Fig. 174B) completely filled buccal orifice; merus subquadrate, granular, anterolateral angle slightly produced, anterior margin with wide V-shape notch medially; ischium subrectangular with submedian sulcus, smooth, punctuate; exopod stout, length about 4 times width.

Thoracic sternum (Fig. 173C) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture; sternites 3, 4 almost completely fused except for short notches laterally, sternite 3 distinguishable from sternite 4 by shallow groove; sternite 4 large, slightly convex; sternites 5–8 distinct, separate, within not visible externally. Median longitudinal line visible externally only on central portion of sternite 4. Sternal press-button situated on sternite 5, equidistant from sutures 4/5, 5/6.

Chelipeds (Fig. 2A) asymmetrical. Merus with long setae on anterior and posterior borders, covered with fine corrugation on dorsal surface. Carpus covered with granules and fine corrugation on outer surface; inner-distal angle blunt spine. Fingers black coloured, slender, longer, with gaping between them closed; fixed finger with distinctly two teeth on inner margin; movable finger with three teeth on inner margins: one proximal region; one distal region; tips spoon-shaped with bristles.

Ambulatory legs (Fig. 174A) smooth; meri of first to third with setae on anterior and posterior margin; carpi, propodi subequal in length, sparsely setose; dactyli densely covered with short hairs, chitinous claw.

Male abdomen (Fig. 173C) narrow and long; somites 3–5 fused, sutures vaguely discernible; somite 6, median length about 1.6 times that of telson. Distal half slightly broader than proximal half, lateral margins slightly concave. Telson subtriangular, tip broadly rounded; tip not reaching level of sternal condyles of P1 coxae.

Male G1 (Figs. 175E–I) slender, long, with 6 stout, curved subdistal spines; apical lobe bordered on ventral margin by 10 – 12 tongue-shaped outgrowths proximally and in distal, simple, pointed, diminishing gradually near tip. Angle formed between apical lobe and rest of G1 more smooth curved.

Type locality. The gulf of Davao, Philippine.

Distribution. Philippines, Singapore, Indonesia, Malaysia, Kosrae Island — Micronesia.

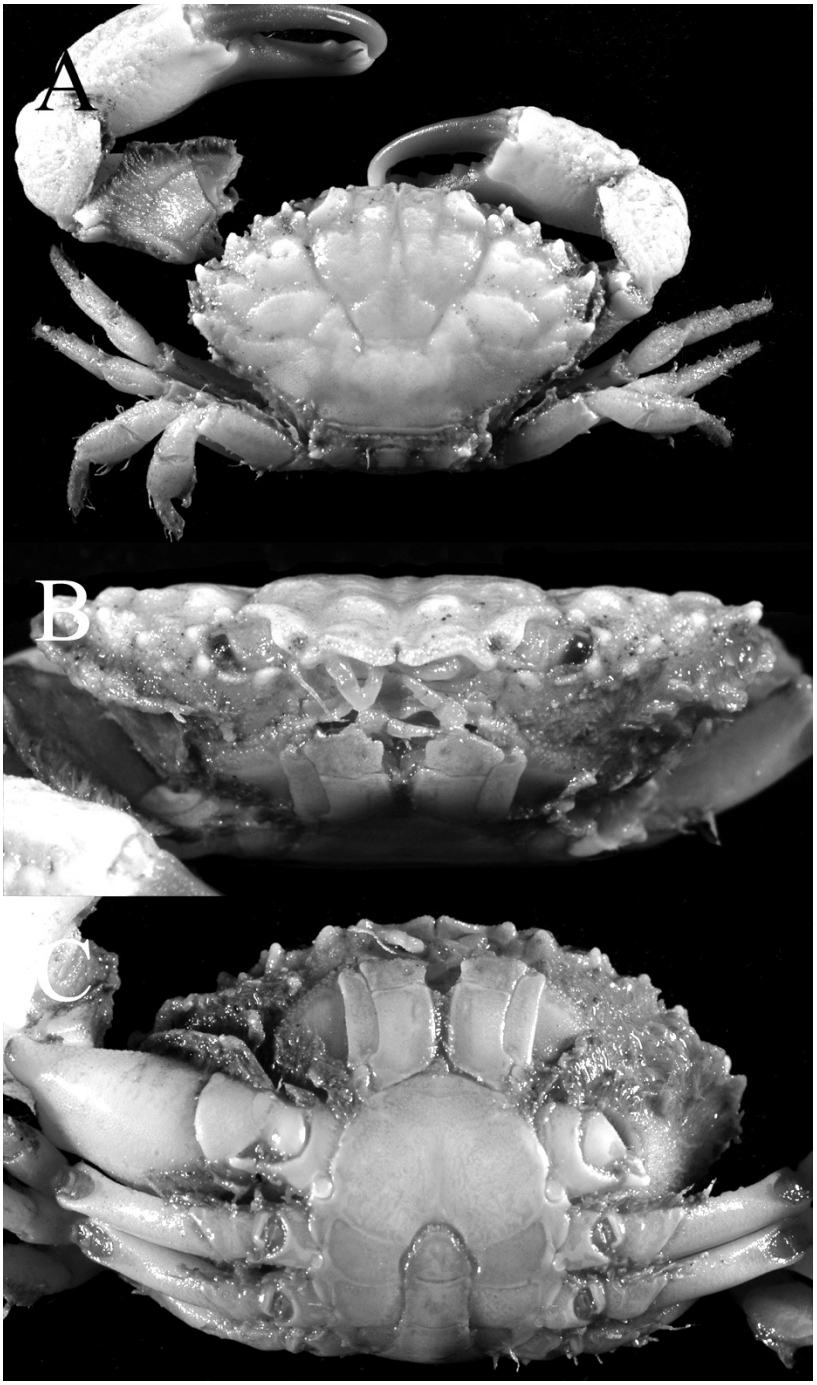

Fig. 173. *Leptodius davaoensis* Ward, 1941, male, (CW 18 × CL 10 mm)(AMNH8347). A, Dorsal view; B, Anterior view; C, Ventral view.

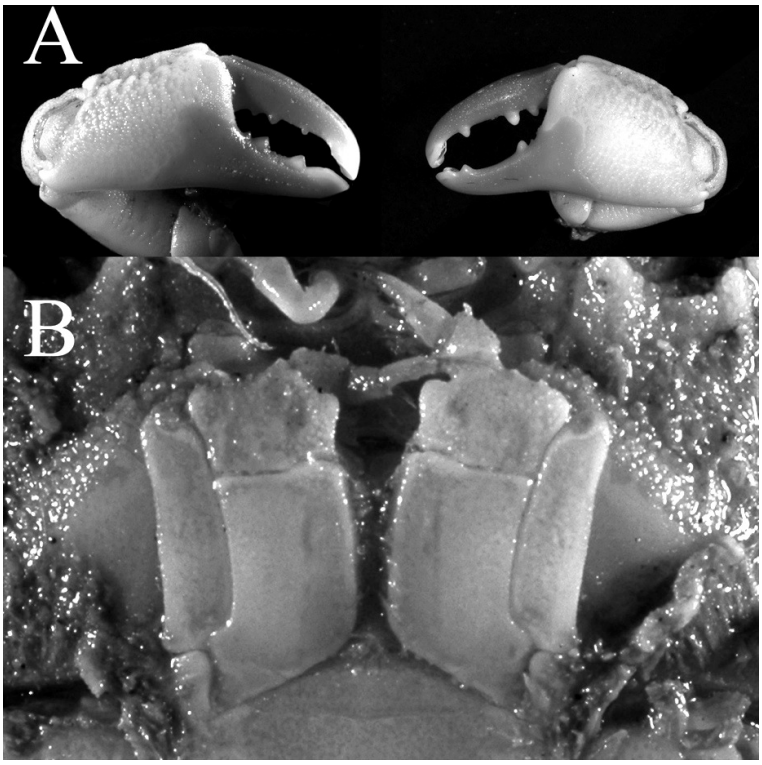

Fig. 174. *Leptodius davaoensis* Ward, 1941, male, (CW 18 × CL 10 mm)(AMNH8347). A, Cheliped, outer view; B, Third maxilliped and pteryosotmian.

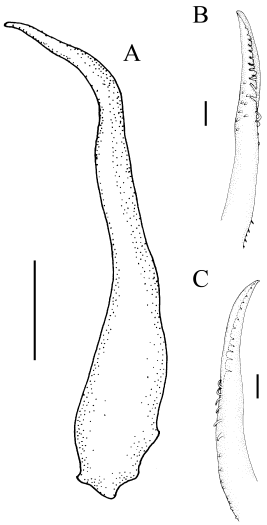

Fig. 175. *Leptodius davaoensis* Ward, 1941, left first gonopod of male, (CW 14.8 × CL 9.8 mm), Lombok Isl. A, External view; B, Distal portion, external view; C, Distal portion, internal view. Scale bars: A= 10mm, B, C= 0.5 mm.

Remarks. Takeda (1980) examined the type specimens deposited in AMNH and concluded that the type from Davao Gulf is conspecific with *L. leptodon* Forest & Guinot, 1961, and that some of the paratypic material are actually *L. nudipes* (Dana, 1852). Galil & Vanini (1990), also having examined the same material, and found "some of Ward's *L. davaoensis* identical with *L. gracilis* (Dana, 1852) and the rest, as Takeda identified, *L. nudipes*." Ng et al (2008) recognized the synonymy proposed by Takeda (1980) and listed *L. leptodon* Forest & Guinot, 1961, as a junior synonym of *L. davaoensis* Ward, 1941. However, examination of the holotype (AMNH 8347) by Dr. Mendoza revealed that the male G1 was not the same as that figured for *L. leptodon,* which has characteristically long apical lobe with a spinulos margin (cf. Forest & Guinot, 1961: fig. 59). Instead, it is nearly identical to the G1 of *L. gracilis*, which has a much shorter apical lobe (cf. Forest & Guinot, 1961: Fig. 58). However, the carapace morphology of *L. davaoensis* is distinct from either *L. gracilis* or *L. leptodon* in having more projecting and more acute anterolateral teeth (cf. Guinot & Forest, 1966: pl. 2, Figs. 2, 3; Serène, 1984: pl. 26, Fig. C). For now, *L. davaoensis* is considered as a distinct species from *L. leptodon.*

Leptodius davaoensis is related to *L. australis* but differs in having a flatter carapace, differently shaped frontal lobes, granulated chelipeds, fingers that are shorter and more robust, and a missing spinate process above the first antero-lateral tooth of *L. australis*.

***Leptodius exaratus* (H. Milne Edwards, 1834), sensu stricto**

Cancer inaequalis, Audouin, 1826: 86 [Egypt]; Savigny, 1809: pl. 5 fig. 7 [Egypt] [not *Cancer inaequalis* Olivier, 1791].

Chlorodius exaratus H. Milne Edwards, 1834: 402; 1849: pl. 11 fig. 3 [India].

Leptodius exaratus, A. Milne-Edwards, 1868: 71 [Madagascar]; Richters, 1880: 148 [Mauritius, Seychelles]; Nobili, 1906a: 121 [Persian Gulf]; 1906b: 240 [Red Sea]; Rathbun, 1911: 215 [Saya de Malha Bank, Madagascar]; Lenz, 1912: 3 [Africa]; Klunzinger, 1913: 209, pl. 3, fig. 6, pl.5, fig. 16 [Red Sea]; Bouvier, 1915: 284 [Mauritius]; Balss, 1924: 10 [Red Sea]; Pesta, 1928: 72 [Sudan]; Maccagno, 1936: 174 [Red Sea]; Ramadan, 1936: 32 [Red Sea]; Chopra & Das, 1937: 398 (in part) [Arabian Sea, Persian Gulf]; Forest & Guinot, 1961: 63, fig. 54 [Aldabra Is.]; Guinot, 1964: 11 [Aldabra Is., Madagascar]; 1967: 265 [Indian Ocean]; Serène, 1968: 75 (in part) [Indian Ocean]; Khan, 1977: 181, pl. 1D [Pakistan]; Kensley, 1981: 44 [South Africa]; Serène, 1984: 184, fig. 106, pl. 26 fig. A [Madagascar, Aldabra]; Tirmizi & Ghani, 1996: 48, fig. 18 [Pakistan]; Guinot & Cleva, 2009: 106, with figures [Egyptian Red Sea].

Actaeodes lividus Paul'son, 1875: 35, pl. 5 fig. 2 [Red Sea].

Chlorodius (*Leptodius*) *exaratus*, Kossmann, 1877: 32, pl. 2, fig. 1-6 [Red Sea].

Xantho exaratus var. *typica* Ortmann, 1893: 445 (in part) [Red Sea].

Xantho (*Leptodius*) *exaratus*, Alcock, 1898: 118 [353] (in part) [western India, Pakistan, Persian Gulf]; Stephensen, 1946: 149, fig. 37c [Persian Gulf]; Guinot, 1958: 92 [Mayotte Is.]; Michel, 1964: 32 [Mauritius].

Xantho hydrophilus, Laurie, 1915: 444, pl. 43, fig. 1 [Sudan] [not *Cancer hydrophilus* Herbst, 1790].

Xantho exaratus, Monod, 1938: 125, fig. 17B [Egyptian Red Sea]; Vatova, 1943: 19 [Somalia]; Buitendijk, 1960: 331 (in part) [South Africa].

Xantho (*Leptodius*) *hydrophilus*, Barnard, 1950: 223, fig. 41c, 42c-e [South Africa] [not *Cancer hydrophilus* Herbst, 1790].

Material examined. **Neotype**: male (23.7 × 16.1 mm) (NHM 1881.10), Karachi, Pakistan. *Others*: **Pakistan** — 1 ovig. female (29.4 × 19.1 mm) (NHM

1881.10), Karachi; 1 male (30.0 × 19.4 mm), 1 female (23.4 × 14.9 mm) (ZRC 2010.0073), Buleji, 24 Feb. 1982. **Western India** — 3 males (23.3 × 13.3 mm – 35.7 × 23.2 mm), 1 female (24.1 × 15.5 mm) (NHM 1889.6.17.112-115), Bombay (?), no further data. **Persian Gulf** — 1 female (26.6 × 17.3 mm) (NHM 1979.272), Fairlakka Is., Kuwait, coll. D.A. Clayton, 5 May 1979; 2 males (26.3 × 17.8 mm, 29.5 × 19.0 mm) (NHM 1985.55), Bandar-e-Abbas, Iran, coll. H. Fakow, 22 Feb. 1976; 2 males (20.6 × 13.9 mm, 25.8 × 17.1 mm (with sacculinid)), 1 female (20.3 ×13.7 mm) (NHM 2012.1027–1029), Ras Al Jlay'ah, Kuwait, coll. D. Clayton, 25 Oct. 1979; 2 males (25.4 × 16.7 mm (with sacculinid), 25.5 × 16.4 mm), 1 female (17.1 × 11.8 mm) (NHM 2012.1030–1032), Al-Wusail, Qatar, coll. 25 Mar. 1983, don. G. Bradley; 9 males (12.2 × 8.0 mm – 29.9 × 18.9 mm), 7 females (15.5 × 11.1 mm – 20.4 × 13.2 mm) (ZRC 2012.0111), Qushm Is., Iran, coll. M. Asgari, 19 Nov. 2008. **Madagascar** — 2 males (13.6 × 9.1 mm, 21.5 × 14.2 mm) (MNHN-B6640), Nosy Be, coll. P. Opic, 20 May 1923; 4 females (10.0 × 6.8 mm – 14.0 × 9.0 mm) (MNHN-B15992), Nosy Be, coll. A. Crosnier, Sept. 1958. **Seychelles** — 2 males (17.6 × 12.0 mm, 18.6 × 12.5 mm), 2 females (17.4 × 11.6 mm, 17.6 × 11.2 mm) (MNHN-B8623), Aldabra, coll. Calypso Expedition, May 1954.

Description. – Carapace (Fig. 176A) transversely subovate, about 1.5–1.6 times as broad as long; dorsal surface somewhat convex, finely granular, rugose particularly at anterior and lateral regions; regions well defined, separated by distinct grooves; 2F separated from 1M by shallow, transverse groove; 2M partly divided longitudinally, 1M fused to inner branch of 2M; 3M, 2L, 3L, 4L, 5L, 6L distinct, entire; 4M indistinct; 1L very small; 1R, 2R fused, separated from 3R by indistinct oblique groove; 1P, 2P indistinct. Front about 0.2–0.3 times as broad as carapace breadth, not much protruded; margin deeply sinuous medially, almost quadridentate; separated from inner orbital tooth by notch. Orbit small, oval; superior margin with 2 fissures; inferior margin bearing 2 blunt teeth on either side; exorbital angle separated from first anterolateral tooth on anterolateral margin by shallow concavity. Anterolateral margin with 4 broad, triangular teeth behind exorbital angle: first small, acute; second broad, large; third similar to second, slightly more produced;

last small, most acute. Posterolateral margin somewhat concave. Posterior margin granular, central region straight. Pterygostomian region granular, setose.

Antennules (Fig. 176B, 176C) folding transversely, slightly obliquely. Basal article of antenna sub-rhomboidal, short, broad; antennal flagellum entering orbital hiatus. Epistome narrow; central region with median projection, separated from lateral regions by distinct notches. Third maxilliped completely covering buccal orifice; merus subquadrate, granular, anterolateral angle slightly produced, anterior margin with wide V-shaped notch medially; ischium subrectangular with submedian sulcus, smooth, punctate; exopod stout, length about 4 times width.

Thoracic sternum (Fig. 176C) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture; sternites 3, 4 almost completely fused except for short notches laterally, sternite 3 distinguishable from sternite 4 by shallow groove; sternite 4 large, inflated; sternites 5–8 distinct, separate, sternite 8 not visible externally. Median longitudinal line visible externally only on central portion of sternite 4; within sternoabdominal cavity, visible only at posterior portion of sternite 4, complete at level of sternites 6, 7, 8. Sternal press-button situated on sternite 5, equidistant from sutures 4/5, 5/6.

Chelipeds (Fig. 176A) unequal. Merus with long setae on anterior and posterior borders. Carpus finely granular, rugose on external surface, with blunt tooth on inner angle. Palm inflated, rugose dorsally, smooth ventrally. Fingers stout, darkly pigmented throughout length, except at tips with white colour, pigment on fixed finger extending minimally into palm; gape moderately wide; cutting margins irregularly dentate; finger tips spoon-shaped, hollowed out, with tufts of setae.

Ambulatory legs (Fig. 176A) short, stout; anterior margins finely granular; anterior and posterior margins of meri with long setae; carpi, propodi subequal in length, sparsely setose; dactyli tomentose, spinose, ending distally in long, chitinous claw.

Male abdomen (Fig. 176C) narrow; somites 3–5 fused, sutures vaguely discernible; somite 6 long, median length about 1.6 times that of telson, distal half slightly broader than proximal half, lateral margins slightly concave. Telson subtriangular, tip broadly rounded; tip not reaching level of sternal condyles of P1 coxae.

G1 (Figs. 177A–D) long, slender, with 6–8 stout, curved subdistal spines; with elongate apical lobe set at slight angle with rest of G1, with 8-10 mushroom-shaped marginal outgrowths; apical lobe about 0.05–0.07 times total length. G2 about one-fourth length of G1.

Type locality. Coasts of India (H. Milne Edwards, 1834: 402).

Distribution. ***Western Indian Ocean***: Africa (Lenz, 1912); Madagascar (A. Milne-Edwards, 1868); Mauritius (Richters, 1880; Bouvier, 1915; Michel, 1964); Mayotte (Guinot, 1958); Pakistan (Alcock, 1898; Khan, 1977; Tirmizi & Ghani, 1996); Saya de Malha (Rathbun, 1911); Seychelles (Richters, 1880; Bouvier, 1915; Forest & Guinot, 1961; Guinot, 1964; Michel, 1964; Serène, 1984); Somalia (Vatova, 1943); South Africa (Barnard, 1950; Buitendijk, 1960; Kensley, 1981); Western India (H. Milne Edwards, 1834; Alcock, 1898). ***Persian Gulf***: Persian Gulf (Alcock, 1898; Nobili, 1906a; Chopra & Das, 1937; Stephensen, 1946). ***Red Sea*:** Egypt (Savigny, 1809; Audouin, 1826; Monod, 1938; Guinot & Cleva, 2009); Red Sea (Paul'son, 1875; Kossmann, 1877; Ortmann, 1893; Nobili, 1906b; Klunzinger, 1913; Balss, 1924; Maccagno, 1936; Ramadan, 1936); Sudan (Laurie, 1915; Pesta, 1928).

Remarks. — Henri Milne Edwards (1834: 402) described *Chlorodius exaratus* from an unspecified number of specimens collected from "les côtes de l'Inde". He later provided an illustration of this species (H. Milne Edwards, 1849: pl. 11 fig. 3), presumably of the type. The genus *Leptodius* was later established by A. Milne-Edwards (1863) for this species.

The present specimens agree with the description and illustrations of *Leptodius exaratus* (e.g., H. Milne Edwards, 1849: pl. 11 Fig. 3; Barnard, 1950: 223, Figs. 41c, 42c, e; Serène, 1984: 180, pl. 26 Fig. A), and particularly in the form of the G1 (e.g., Stephensen, 1946: Fig. 37C, Barnard, 1950: Fig. 42d; Forest & Guinot, 1961: Fig. 54; Serène, 1984: Fig. 106). The type, thus far, has not been found in the MNHN, where H. Milne Edwards' types are deposited, despite repeated attempts to locate it. It is reasonable to assume that the type is lost and, therefore, a neotype

must be selected to stabilize the complex taxonomy of this species. A topotypic specimen has been found (male, 23.7 × 16.1 mm; NHM 1881.10) from the western coast of the Indian subcontinent (Karachi, Pakistan), and is hereby selected as the neotype for *C. exaratus* H. Milne Edwards, 1834.

Based on differences in G1 morphology, however, it is clear that these records are not of *L. exaratus* s. str. Both *L. exaratus* s. str. and the similar *L. affinis* (De Haan, 1835) have a broad, transversely subovate carapace, which has four broadly triangular anterolateral teeth, a rugose dorsal surface and well-defined regions. There is much variability and overlap in the carapace morphology within each species. Features of the mouthparts, thoracic sternum, abdomen, and pereopods are also not useful, and morphometric analyses of the carapace and thoracic sternum (Figs. 178) reveal no significant difference between the two species.

The main difference between *L. exaratus* s. str. and *L. affinis* can be seen in the G1 morphology (Figs. 168, 177), where: 1) the apical lobe is proportionally shorter in *L. exaratus* than in *L. affinis*, 2) it is also more tightly curled, nearly a closed cylinder (vs. more open and expanded in *L. affinis*), 3) the angle formed between the apical lobe and the rest of the G1 is larger (vs. less in *L. affinis*, giving it a more bent appearance), and 4) the ventral lip of the apical lobe has fewer outgrowths in *L. exaratus* than in *L. affinis* (for *L. exaratus* see Forest & Guinot, 1961: 62, Fig. 54; Serène, 1984: 180, Fig. 106; for *L. affinis* see Serène, 1962: 258, Fig. 1; Yeh et al., 2006: 73, Fig. 2C–D).

Regarding the standard linear regression analysis between the morphological characteristics and species category, statistical significance was observed in all the selected characters: the ratio of sternite 4 width against combined the sternites 3 and 4 ($P = 0.001$), the ratio of frontal width against the carapace width ($P = 0.017$), and, especially so, the ratio of G1 apical lobe length against G1 total length ($P < 0.001$) (Fig. 178). The former two characters, however, showed considerable overlap between the two species and is not useful for discriminatory purposes. These characteristics would not be very practical key characters as the G1 despite their statistical significance.

The following discussion in this paper shows that these records refer to *L. affinis* (De Haan, 1835), and that at least some of the various synonyms in the

literature are justified. Concerning records of "*L. exaratus*" from the Hawaiian islands in the central Pacific (viz. Stimpson, 1858; Rathbun, 1906; Edmondson, 1925, 1946, 1962; Titgen, 1987; Castro, 2011), it is clear after examining the published figures and material collected from there that these are not *L. exaratus* or *L. affinis* as defined at present, and belong to other species. They will be treated and discussed elsewhere.

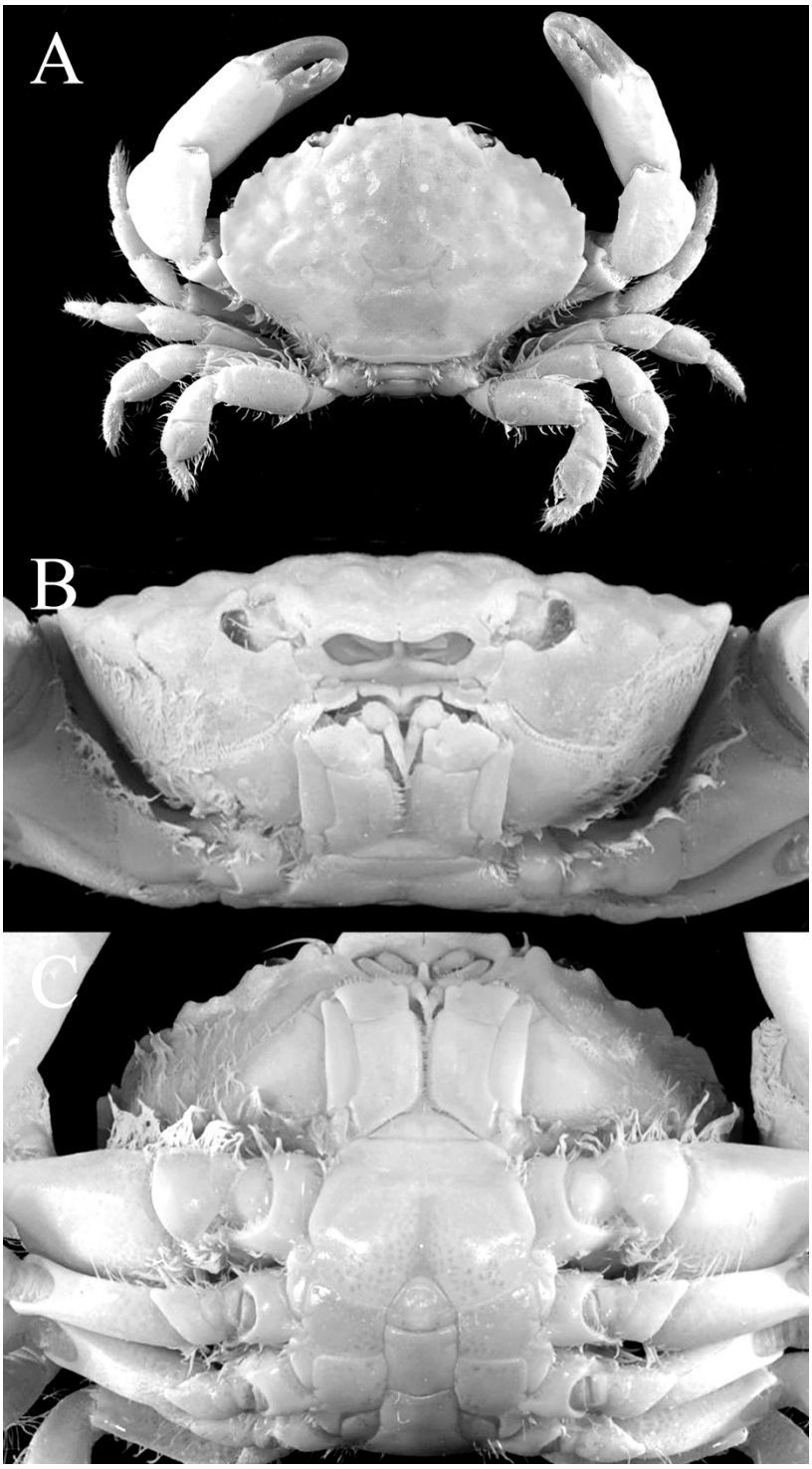

Fig. 176. *Leptodius exaratus* (H. Milne Edwards, 1834), neotype, male, 23.7 × 16.1 mm (NHM 1881.10), Karachi, Pakistan. A, dorsal view; B, ventral view; C, anterior view.

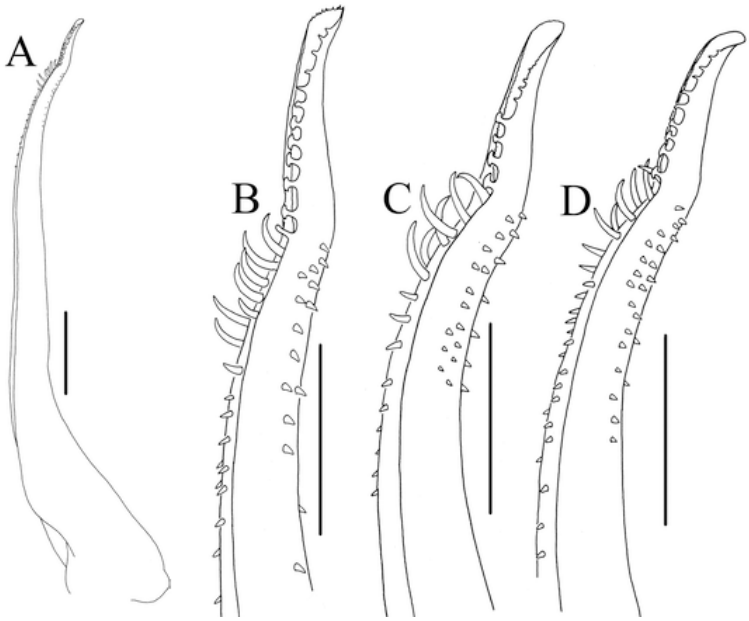

Fig. 177. *Leptodius exaratus* (H. Milne Edwards, 1834), male, left first gonopod. A, B, neotype, 23.7 × 16.1 mm (NHM 1881.10), Karachi, Pakistan; C, 23.6 × 15.5 mm (ZRC 2012.0111), Qushm, Persian Gulf; D, 21.5 × 14.2 mm (MNHN-B6640), Nosy Be, Madagascar.

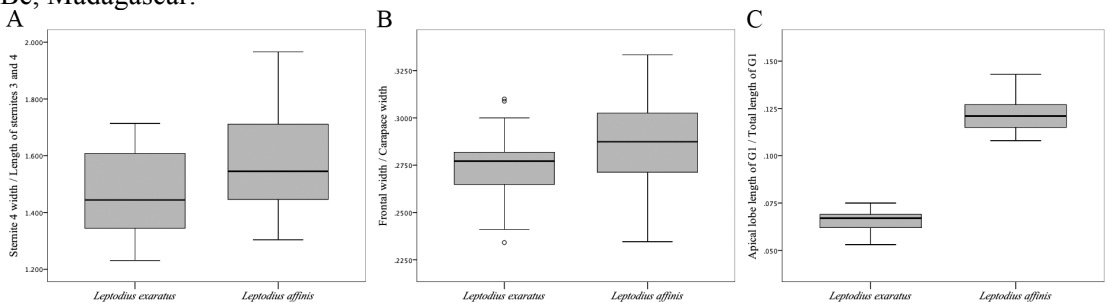

Fig. 178. Results of morphometric analyses between *Leptodius exaratus* (H. Milne Edwards, 1834) and *L. affinis* (De Haan, 1835), showing good separation between the two species when using G1 measurements. The linear regression was conducted for statistic test. A, Box plot depicting the difference using the ratio of the sternite 4 width and combined length of sternites 3 and 4 (n= 28 and 99 is L. exaratus and *L. exaratus*, respectively; P = 0. 001, R^2 = 0.085) against *Leptodius affinis* and *L. exaratus*; B, Box plot depicting the difference using the ratio of the frontal and carapace widths (n= 28 and 99 is *L. exaratus* and *L. affinis*, respectively; P = 0. 0017, R^2 = 0.044) against *Leptodius affinis* and *L. exaratus*; C, Box plot depicting the difference using the ratio of the G1 apical lobe length and total length (n= 14 and 64 is *L. exaratus* and *L. affinis*, respectively; P = 0, R^2 = 0.886) against *Leptodius affinis* and *L. exaratus*.

Leptodius gracilis (Dana, 1852)

Chlorodius gracilis Dana, 1852: 210; Dana, 1855: pl. 11, fig. 13a-e; Stimpson, 1907: 56.

Leptodius exaratus var. *gracilis*: Miers, 1884: 530; Ortmann, 1893: 447; Lenz, 1905: 353.

Leptodius gracilis: de Man, 1887: 287; de Man, 1888: pl. 11, fig. 2; de Man, 1890: 54; Rathbun, 1906: 848, pl. 9, fig. 2; Nobili, 1906b: 240; Rathbun, 1907: 39; Rathbun, 1911: 215; Klunzinger, 1913: 214; Bouvier, 1915: 283, fig. 32, pl. 6, fig. 7; Edmondson, 1923: 14; Balss, 1938: 42; Ward, 1939: 7; Edmondson, 1946: 289; Forest & Guinot, 1961: 64, figs 57-58, pl. 2, fig. 4; Guinot, 1962: 235; Edmondson, 1962: 237(key), 240, fig. 7a; Guinot, 1967: 265; Guinot, 1968: 704; Ooishi, 1970: 92, pl. 14, fig. 2; Guinot, 1971: 1068; Takeda & Hayashi, 1973: 71; Sakai, 1976: 424, fig. 223; Takeda, 1976: 75; Takeda & Miyake, 1976: 109; Takeda & Nunomura, 1976: 70; Takeda, 1978a: 39; Serène, 1984: 182(keys),184, fig. 107, pl. 26C; Dai & Yang, 1991: 293, fig. 155A(2), pl. 37(6); Wada, 1995: 398, pl. 109, fig. 3.

Leptodius exaratus gracilis: Lanchester, 1900: 738.

Xantho gracilis: Odhner, 1925: 80; Tweedie, 1950: 115; Holthuis, 1953: 27; Buitendijk, 1960: 335, 338(key).

Xantho (Leptodius) exaratus var. *gracilis*: Gordon, 1934: 29, fig. 16c.

Xantho (Leptodius) gracilis: Balss, 1938: 52; Miyake, 1939: 210; Sakai, 1939: 463(key), 465, pl. 91, fig. 2; Sakai, 1954: 74; Michel, 1964: 32.

Material examined. 1 male (19 × 12 mm)(ZRC 2000.0702), Mangroves, Apra Harbor, Inner Harbor, Coll. P. K. L. Ng, 19 Apr. 2000. *Others*: **Japan** — 4 males (13.4 × 9.1 mm – 19.5 × 12.5 mm)(Ex. ZRC 2009.0161), Okukubi river, Okinawa Is, Ryukyu, Coll. N. K. Ng and T. Naruse, 21 Jun. 2000; 1 male (18.9 × 12.2 mm)(RUMF ZC-329), Maira, Iriomote Island; 1 male (24 × 14.7 mm)(RUMF ZC-332), Awase, Nakagusuku bay, Okinawa Is. Ryu kyu Is, Coll. T. Naruse, 14 Jul. 2003; 2 males (15.5 × 10.1mm, 18 × 11.2 mm), 3 females (12 8.2 17.5 11.5) RUMF ZC-330, Mariana, Iriomote Island, Ryu kyu Island, Coll. T. Naruse, S. Kamimura&

M. I. Slim, 15 Mar. 2001; 2 males (5.5 × 3.7 mm, 10.4 × 6.9 mm), Kumejima 2009, Intertidal 7, Shirase River, 19 Nov. 2009; 4 males (12.2 × 8.3 mm – 14.3 × 9.6 mm), 5 females (9.8 × 6.3 – 19.2 × 16.5, Nagahama, Okinawa Is., Coll. N. K. Ng and T. Naruse, 21 Jun. 2000; 1 female (25.1 × 16.1 mm), Gushikami, Yaese, Okinawa Is., Col. T. Maenosono, 18 Aug. 2007. **New Caledonia** — 2 males (14 × 9.4 – 12.4 × 7.9mm), 13. rocky shore and Mangroves, cape Ndoura, (= Cape Boise), Southern Tip of island, South province, Coll. P. K. L. Ng & B. Richer de Forges, 8 Nov. 2006. **Micronesian** — 1 male (8.9 × 6.3 mm)(Kosrae330), Kosrae Island, Coll. S. K. Lee, 10 Jan. 2012. **Guam** — 3 female (14 × 9 mm – 15.6 × 10.5 mm)(ZRC 2000.0702), Mangroves, Apra Harbor, Inner Harbor, Coll. P. K. L. Ng, 19 Apr. 2000.

Description. Carapace (Fig. 179A) transversely subovate, about 1.4–1.5 times as broad as long; dorsal surface slightly convex, finely granular, not shining, anteriorly areolate; regions hardly projecting, ill distint. 2F separated by groove from 1M; 2M partly divided longitudinally, 1M fused to inner branch of 2M; 3M distinct, entire; 4M distinct; 1L, 2L, 3L fused; 4L, 5L, 6L indistinct by shallow grooves; 1R, 2R fused, separated from 3R by indistinct oblique groove; 1P, 2P indistinct. Front about 0.3 times as broad as carapace breadth, not much protruded, cut into 2 lobes, separated from internal orbital tooth by notch. Orbit smaller, transverse oval; superior margin with 2 fissures; inferior margin bearing 2 blunt teeth on either side; exorbital angle separated from first anterolateral tooth by concavity. Anterolateral margin with 4 lobes behind exorbital angle: first and fourth noticeably feeble. Posterolateral margin somewhat straight, with pubescence. Posterior margin granular, central region straight. Pterygostomian region granular, setose.

Antennules (Fig. 179B) lying transversely, slightly obliquely. Basal article of antenna sub-rhomboidal, short, broad. Antennular flagellum occupied orbit hiatus. Epistome narrow; central region with median projection, separated from lateral regions by distinct notches. Third maxilliped (Fig. 179C) completely filled buccal orifice; merus subquadrate, granular, anterolateral angle slightly produced, anterior margin with wide V-shape notch medially; ischium subrectangular with submedian sulcus, smooth, punctuate; exopod stout.

Thoracic sternum (Fig. 179C) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture; sternites 3, 4 almost completely fused except for short notches laterally, sternite 3 distinguishable from sternite 4 by shallow groove; sternite 4 large, slightly convex; sternites 5–8 distinct, separate, within not visible externally. Median longitudinal line visible externally only on central portion of sternite 4, complete at level of sternites 6, 7, 8. Sternal press-button situated on sternite 5, equidistant from sutures 4/5, 5/6.

Chelipeds (Fig. 179D) asymmetrical, with a granular coating single ended, more or less curved and pointed. Merus with long setae on anterior and posterior borders, covered with fine corrugation on dorsal surface. Carpus covered with microscopic granules and fine corrugation on outer surface; inner-distal angle bluntly round. Fingers black coloured, with gaping between them closed; fixed finger with two teeth on central region of inner margin; movable finger with two teeth on proximal region of inner margin.

Ambulatory legs (Fig. 179A) smooth; merus of first to third with setae on anterior and posterior margin; ratio merus length of fourth to merus width 2.5 times; carpus, propodus subequal in length, sparsely setose; dactylus densely covered with short hairs, chitinous claw.

Male abdomen (Fig. 179C) narrow and long; somites 3–5 fused, sutures vaguely discernible; somite 6, median length about 1.5 times that of telson. Distal half slightly broader than proximal half, lateral margins slightly concave. Telson subtriangular; tip not reaching level of sternal condyles of P1 coxae.

Male G1 (Figs. 180A – C) slender, long, with 5 or 6 stout, curved subdistal spines; elongated apical lobe bordered on ventral margin by 5 – 6 mushroom-shaped outgrowths.

Type locality. Wakes Island, Pacific Ocean (Dana, 1852: 210).

Distribution. Japan, New Caledonia, Kosrae Is. — Micronesia, Guam.

Remarks. *Leptodius gracilis* (Dana, 1852) has been described with an illustration of the whole animal by dorsal view and the third maxilliped. The same

study did not describe the male first gonopod and mentioned the differentiation from *L. sanguineus* in having five marginal teeth, and from *L. exaratus* in having the carpus and hand are not uneven in the dorsal surface and thin, even teeth.

Many *L. gracilis* collected from Pacific Ocean were examined by the author. *L. gracilis* complex collected from Okinawa Island was evident, based on the G1. *L. garcilis* including G1 and carapace morphology from Guam, New Caledonia, and Kosrae Island display the same characteristics as some of the specimens from Okinawa Island. The type locality of *L. garcilis* is Wakes Island, Pacific Ocean, so some of examined specimens would be expected to be *L. gracilis*. If that is the case, the author began to consider whether remaining specimens from Okinawa Island differed, and found *L. planus* Ward, 1941 displayed a similar morphology. Differences between *L. gracilis* and its close sibling *L. planus*, are discussed under the remarks for *L. planus*.

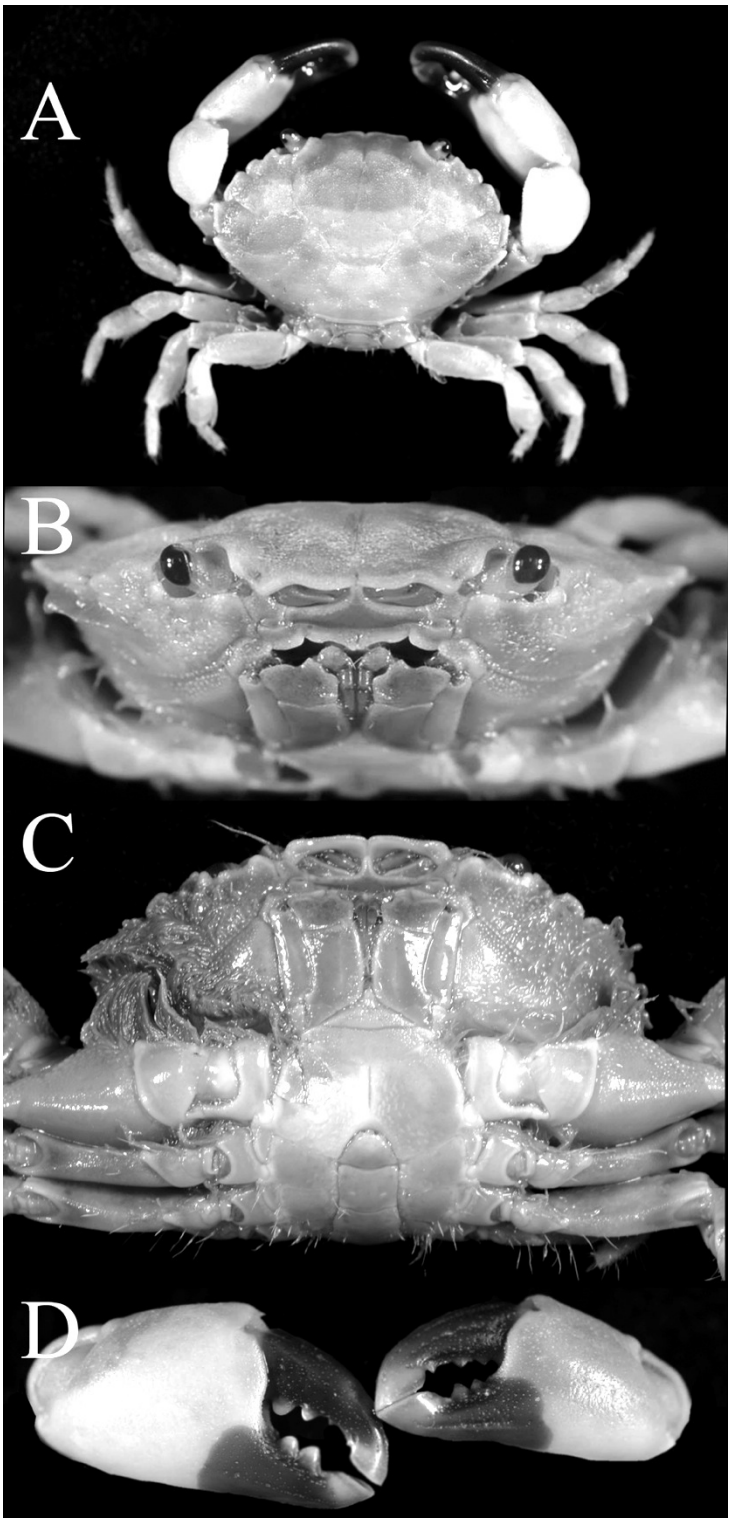

Fig. 179. *Leptodius gracilis* (Dana, 1852), male, 19 × 12 mm (ZRC 2000.0702). A, dorsal view; B, anterior view; C, ventral view; D, Cheliped.

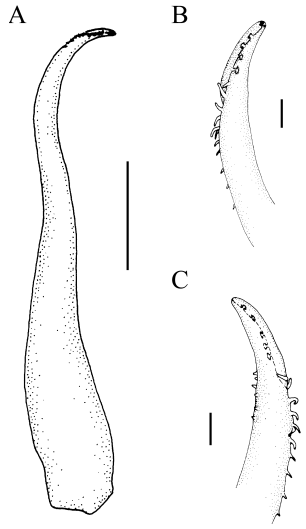

Fig. 180. *Leptodius gracilis* (Dana, 1852), first gonopod of male, 19 × 12 mm(ZRC 2000.0702). A, external view; B, Distal portion, external view; C, Distal portion, internal view. Scale bars: A= 10 mm, B, C= 0.1 mm.

Leptodius leptodon Forest & Guinot, 1961

Leptodius exaratus (not H. Milne Edwards, 1834) Nobili, 1907: 389.

Leptodius exaratus acutidens Edmondson, 1923: 14.

Leptodius davaoensis Ward, 1941: 10, figs; Takeda, 1980c: 319.

Leptodius leptodon Forest & Guinot, 1961: 65, figs 55, 56, 59, pl. 2, fig. 3; Miyake & Takeda, 1967: 294; Takeda & Hayashi, 1973: 71; Takeda, 1976a: 75; Takeda & Nunomura, 1976: 70; Serène, 1984: 182(key); Shokita et al., 1998: 66 (list).

Material examined. **Holotype**: 1 male (14 × 10 mm)(MNHM B.8634), Hikueru, Tuamotu. 1 male (17.8 × 11.7 mm)(Kosrae240-1), Kosrae Is., Coll. S. K. Lee, 11 Jan. 2012. *Others*: **Guam** — 1 male (8.5 × 5.5 mm)(ZRC 2000.0701) Pago bay, outside University of Guam, Marine Laboratory, Coll. P. K. L. Ng & C. H. wang, 15-18 APR 2000. **Kiribati** — 1 male(19.2×12 mm), While snokeling, Coll. R. England, 11 July 2001. **Micronesia** — 3 males (17 × 11)(Kosrae142), (15.9 × 10.2 mm)(Kosrae149-4), (13.2 × 9 mm) (Kosrae127), Wutue port, intertidal under Mangrove tree, Coll. S. K. Lee, 12 Jan. 2012; 1 male (14 × 10 mm)(Kosrae236), Intertidal, night, Coll. S. K. Lee, 11 Jan. 2012.

Description. Carapace (Fig. 181A) transversely subovate, about 1.5–1.6 times as broad as long; dorsal surface slightly convex, depressed near side edge; regions well marked by furrow; 2F not distinct; 2M partly divided longitudinally, 1M fused to inner branch of 2M; 3M distinct, entire; 4M distinct; 1L, 2L, 3L fused; 4L, 5L, 6L distinct by shallow grooves; 1R, 2R fused, separated from 3R by indistinct oblique groove; 1P, 2P indistinct. Front about 0.2 – 0.4 times as broad as carapace breadth, straight trensversely, not much protruded, cut into 2 lobes, bearing hole on median frontal margin. Orbit smaller, transverse oval; superior margin with 1 fissures; inferior margin bearing 2 blunt teeth on either side; exorbital tooth prominent, well separated form first anterolateral tooth by high triangular depression. Anterolateral margin with 4 lobes behind exorbital angle: first rounded; second largely truncated distal half of its posterior edge straight; third acute,

prominent; last shorter. Posterolateral margin somewhat straight, with pubescence. Posterior margin granular, central region straight. Pterygostomian region granular, setose.

Antennules (Fig. 181B) lying transversely, slightly obliquely. Basal article of antenna sub-rhomboidal, short, broad. Antennular flagellum occupied orbit hiatus. Epistome narrow; central region with median projection, separated from lateral regions by distinct notches. Third maxilliped (Fig. 181B) completely filled buccal orifice; merus subquadrate, granular, anterolateral angle slightly produced, anterior margin with wide V-shape notch medially; ischium subrectangular with submedian sulcus, smooth, punctuate; exopod stout.

Thoracic sternum (Fig. 181D) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture; sternites 3, 4 almost completely fused except for short notches laterally, sternite 3 distinguishable from sternite 4 by shallow groove; sternite 4 largest, slightly convex; sternites 5–8 distinct, separate, within not visible externally. Median longitudinal line visible externally only on central portion of sternite 4, complete at level of sternites 6, 7, 8. Sternal press-button situated on sternite 5, equidistant from sutures 4/5, 5/6.

Chelipeds (Fig. 181A, 181C) asymmetrical, with a granular coating single ended, more or less curved and pointed. Merus with long setae on anterior and posterior borders, covered with fine corrugation on dorsal surface. Carpus covered with microscopic granules on outer surface; inner-distal angle bluntly round. Fingers black coloured, with gaping between them closed; fixed finger with tooth on central region and obtuse teeth from side to side along inner margin; movable finger with tooth on central region of inner margin.

Ambulatory legs (Fig. 181A) smooth; merus of first to third with setae on anterior and posterior margin; carpus, propodus subequal in length, sparsely setose; dactylus densely covered with short hairs, chitinous claw.

Male abdomen (Fig. 181D) narrow and long; somites 3–5 fused, sutures vaguely discernible; median length of somite 6 about 1.3 times that of telson. Distal half slightly broader than proximal half, lateral margins slightly concave. Telson subtriangular; tip not reaching level of sternal condyles of P1 coxae.

Male G1 (Figs. 182A – D) slender, long, with 7 – 8 stout, curved subdistal spines; elongated apical lobe bordered on ventral margin by 14 tongue-shaped outgrowths; distal portion extremely curved to inside; tip straight, slender, long.

Type locality. Hikueru, Tuamotu. (Forest & Guinot, 1961).

Distribution. Kiribarti, Micronesia, Guam.

Remarks. Differentiation between *Leptodius leptodon* and *L. davaoensis* have already been discussed in the remark for *L. davaoensis*.

The first gonopod and the carapace morphology of *L. leptodon* were similar to *L. acutidens* and *L. gracilis*/ *L. planus,* respectively. However, *L. acutidens* had differenting features, which were acute teeth on anterolateral margin, a more elongated apical lobe, and an additional twist on subdistal propotion of the first gonopod. Even though the carapace morphology of *L. gracilis*/ *L. planus* is very closed to *L. leptodon,* the first gonopod of *L. gracilis*/ *L. planus* is quite different.

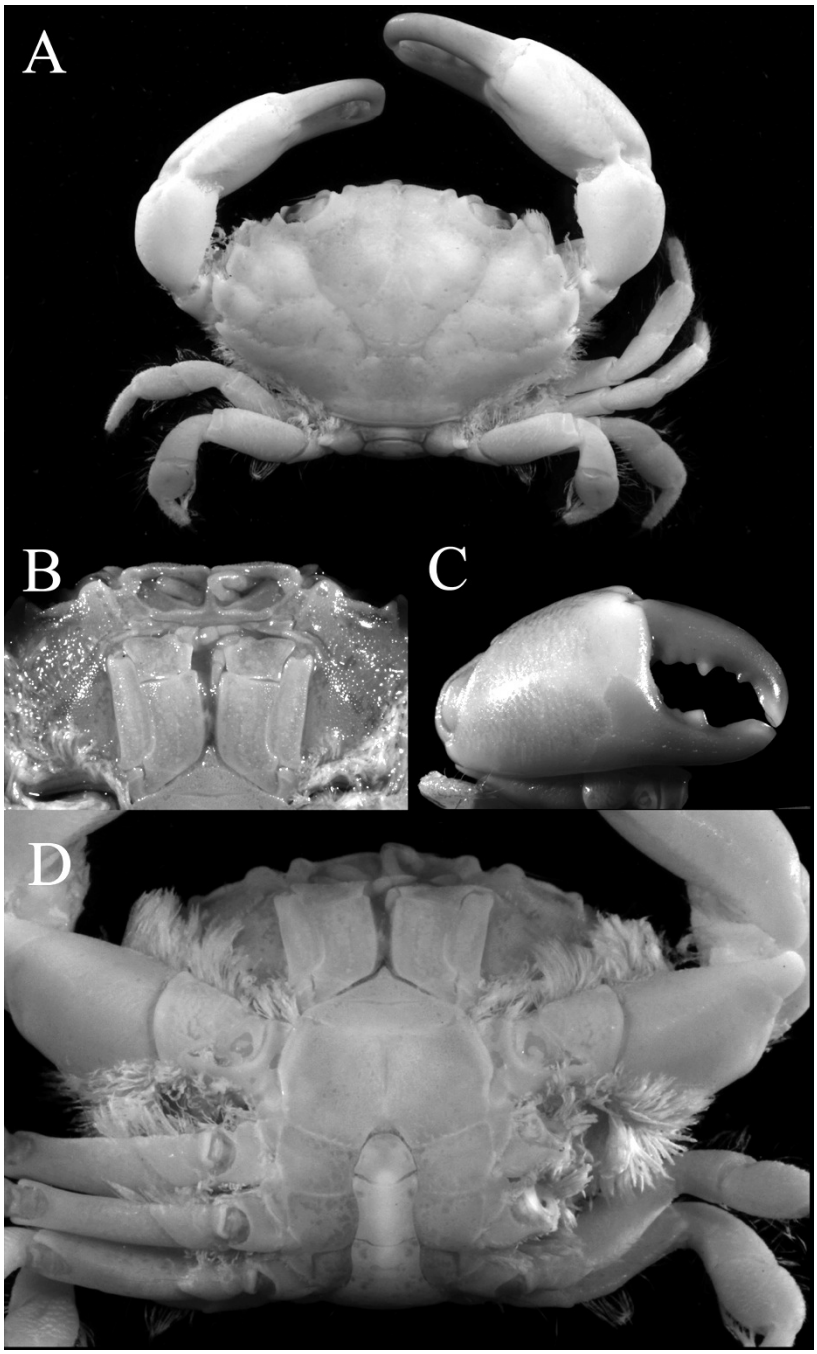

Fig. 181. *Leptodius leptodon* Forest & Guinot, 1961, male, holotype, 14 × 10 mm (MNHM B.8634). A, dorsal view; B, The third maxilipeds; C, Right cheliped, outer view; D, Thoracic sternum and abdomen, ventral view.

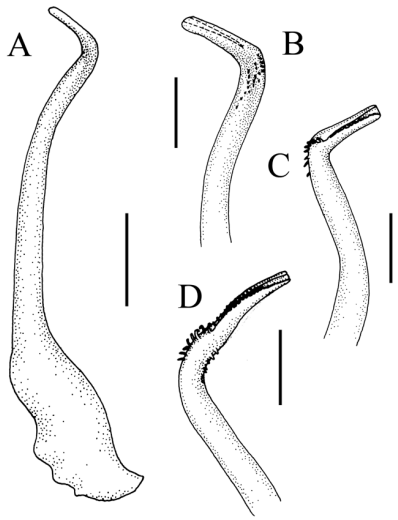

Fig. 182. *Leptodius leptodon* Forest & Guinot, 1961, first gonopod of male (17.8 × 11.7 mm)(Kosrae240-1). A, external view; B – D, Distal portion: B, external view; C, lateral view; D, internal view. Scale bars: A= 10 mm, B – D= 0.5 mm.

Leptodius nudipes (Dana, 1852)

Chlorodius nudipes Dana, 1852: 79; Dana, 1855: pl. 11, fig. 12a-c.

Leptodius nudipes: Milne Edwards A., 1873: 225; Miers, 1876: 17; de Man, 1887: 33; de Man, 1895: 523; Borradaile, 1902: 252; Rathbun, 1906: 848, pl. 9, fig. 3; Lenz, 1910: 548; Rathbun, 1911: 215; Bouvier, 1915: 282; Gravier, 1920: 466; Edmondson, 1923: 14; Sendler, 1923: 37; Chilton & Bennett, 1929: 747; Ward, 1933: 244; Ward, 1934: 14; Tweedie, 1947: 29; Forest & Guinot, 1961: 63, fig. 52; Guinot, 1962: 235; Sankarankutty, 1962: 128, figs 12-13; Sankarankutty, 1966: 50; Guinot, 1967: 265; Guinot, 1968: 704; Guinot, 1971: 1068; Takeda & Hayashi, 1973: 72; Takeda, 1976: 76, pl. 10, fig. A; Takeda & Nunomura, 1976: 71; Serène, 1984: 181(key), 182(key), 183, fig. 105, pl. 26F.

Xantho exaratus var. *nudipes* (not A. Milne Edwards, 1867): Ortmann, 1893: 447.

Xantho (*Leptodius*) *nudipes* (not A. Milne Edwards, 1867): Alcock, 1898: 118(key), 121; Miyake, 1939: 178, 209, pl. 14, fig. 4; Michel, 1964: 32.

Xantho danae Odhner, 1925: 80; Balss, 1935: 133; Balss, 1938: 41; Edmondson, 1946: 289; Buitendijk, 1960: 312, 338(key), fig. 9a; Edmondson, 1962: 236(key), 237, fig. 6b.

Xantho nudipes (not A. Milne Edwards, 1867): Chilton, 1911: 555; Tweedie, 1950: 117.

Xantho (*Leptodius*) *danae* McNeill, 1968: 58.

Leptodius danae Dai & Yang, 1991: 292, fig. 154 (2), pl. 37(3).

Material examined. 1 male (15.3 × 10 mm)(ZRC 2000.0703), Pago bay reef flat; night; on algae, Coll. G. Paulay, 28 Mar. 1998. *Others*: **Christmas Island** — 1 male (15.5 × 11.1 mm)(CI-09-2011), 21 Mar. 2011. **Guam** —1 male (16.5 × 10.4 mm), Amen'cun Nanal Bare, Er O-Ote Pon, Dadi Beach, Coll. P. K. L. Ng, 31 Jul. 2001. **Japan** — 1 male (9.6 × 6.1 mm)(CMB-ZC 5430), Ogasawara; 4 males (6.8 × 5.4 mm – 11.9 × 7.8 mm), 5 females (6.1 × 4.2 mm, 6.9 × 5.1 mm), Kumejima 2009, Intertidal 1, Ara Beach, 16-17 Nov. 2009; 3 males (7.5×5 mm – 13.1×8.8 mm), 1 female (9.6 × 6.9 mm), Kumejima 2009, Intertidal 8, Madomari, 19-20 Nov.

2009; 1 male (10.6 × 7.8 mm), Kumejima 2009, intertidal on reef flat, Coll. D. Rahaya, 14 Nov. 2009; 1 male (18.7 × 12.5 mm)(ZRC 1995.414), Laing Island, Coll. D. Vandenspiegel , 8 Mar. 1992; 1 female (13 × 8.4 mm), Yona, Kunigami, Okinawa Is., Coll. T. Maenosono, 22 Nov. 2007; 1 male (14.5 × 9.2 mm), Minatogawa, Urasoe, Okinawa Is., Coll. T. Maenosono, 12 Feb. 2010; 1 male (11.6 × 8.2 mm), Yona, Kunigami, Okinawa Is., Coll. T. Maenosono, 24 Nov. 2007. **Philippines** — 3 males (7.4 × 4.8 mm – 11.7 × 7.6 mm), stn. JCEM 07-004, NE Cagayan, Luzon, Coll. J. C. E. Mendoza & T. Naruse; 9 males (10.3 × 7.6 mm– 15.8 × 10.3 mm), 3 females (9.5 × 6.3 mm – 12 × 7.7 mm), Mindoro Is., Puerto Galera, La Laguna Beach, Coll. J. Williams, 19 Jul. 1997; 8 males (10.2 × 6.7 mm– 13.4 × 8.6 mm), 7 females (8.3 × 5.5 mm – 9.5 × 6.5 mm), Mindoro Is., Puerto Galera, La Laguna Beach, Coll. J. Williams, 18 Jul. 2000. **Indonesia** — 1 male (8 × 5.8 mm), Natuna, north-eastern coast of pulau panyang (cnorth-weast of Pulau Bunguran), Coll. EA. JL, 17 Mar. 2002. **Maldives** — 2 males (11.9 × 7.9 mm – 16.8 × 10.5 mm), 1 female (11.6 × 7.6 mm)(ZRC 2007.0742), Laamu Atoll, Coll. A. Anand Jeya Kumar, Nov. 2007. **Micronesia** — 11 males (10 × 6.7 mm – 18.6 × 12.1 mm), 3 females (8.5 × 5.4 mm – 11 × 7.1 mm)(Kosrae77), in front of Airport, intertidal, Coll. S. K. Lee and Y. Lou, 13 Jan. 2012; 1 male (13.7 × 9.2 mm)(Kosrae1), In font of Mr. Jung house, Coll. S. K. Lee, 11 Jan. 2012; 1 male (14 × 9.4 mm)(Kosrae32), 1 female (11.3 × 6.8 mm)(Kosrae36), 1 female (9.9 × 6.8 mm)(Kosrae48), 1 male (11 × 7.1 mm)(Kosrae4), 1 female (12.1 × 7.9)(Kosrae25), in front of Airport, intertidal, Coll. S. K. Lee and Y. Lou, 13 Jan. 2012.

Description. Carapace (Fig. 183A) transversely subovate, not shining, anteriorly neatly areolate, posteriorly nearly plan, about 1.5–1.6 times as broad as long; regions well defined, separated by narrow, shallow grooves; 2F separated by groove from 1M; 2M partly divided longitudinally; 1L, 2L, 3L, 4L, 5L, 6L distinct, entire; 4M indistinct; 1L very small; 1R, 2R fused, separated from 3R by indistinct oblique groove; 1P, 2P indistinct. Front about 0.3 times as broad as carapace breadth, protruded, cut into 2 lobes, each one concave near outer side, separated from internal orbital tooth by narrow notch. Orbit smaller, transverse oval; superior margin with 2 fissures; inferior margin bearing 2 blunt teeth on either side; exorbital

angle separated from first anterolateral tooth by concavity. Anterolateral margin with 10 – 11 teeth behind exorbital angle: last being position on S′. Posterolateral margin somewhat concave, with pubescence. Posterior margin granular, central region straight. Pterygostomian region granular, setose.

Antennules (Fig. 183B) located transversely, slightly oblique. Basal article of antenna sub-rhomboidal, short, broad. Antennular flagellum occupied orbit hiatus. Epistome narrow; central region with median projection, separated from lateral regions by distinct notches. Third maxilliped (Fig. 183B) completely filled buccal orifice; merus subquadrate, granular, anterolateral angle slightly produced; ischium subrectangular with submedian sulcus, smooth, punctuate; exopod stout, length about 4 times width.

Thoracic sternum (Fig. 183C) glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture; sternites 3, 4 almost completely fused except for short notches laterally, sternite 3 distinguishable from sternite 4 by shallow groove; sternite 4 large, somewhat convex; sternites 5–8 distinct, separate, within not visible externally. Median longitudinal line visible externally only on central portion of sternite 4, complete at level of sternites 6, 7, 8. Sternal press-button situated on sternite 5, equidistant from sutures 4/5, 5/6.

Chelipeds (Fig. 183A, 183D) asymmetrical, with a granular coating single ended, more or less curved and pointed. Merus with long setae on anterior and posterior borders, covered with fine corrugation on dorsal surface. Carpus covered with microscopic granules and fine corrugation on outer surface; inner-distal angle bluntly round. Fingers black coloured, with gaping between them closed, with distinctly toothed and contiguous within; tips spoon-shaped with bristles.

Ambulatory legs (Fig. 183A) smooth; merus with setae on anterior and posterior margin; carpus, propodus subequal in length, sparsely setose; dactylus densely covered with short hairs, chitinous claw.

Male abdomen (Fig. 183C) narrow and long; somites 3–5 fused, sutures vaguely discernible. Distal half slightly broader than proximal half, lateral margins slightly concave. Telson triangular; tip rounded, not reaching level of sternal condyles of P1 coxae.

Male G1 (Figs. 184A–C) with distal end shaped like a thin rod, directed inner-laterlly and armed with 7 mushroom-shaped outgrowth. Angle formed between apical lobe and rest of G1 more bent.

Type locality. Mangsi Island (Dana, 1852: 209).

Distribution. Christmas Island, Guam, Maldives, Philippines, Kosrae — Micronesia, Japan, Indonesia.

Remarks. *Leptodius nudipes* (Dana, 1852) shows a unique shape of carapace and the apical lobe of the first gonopod that is characteristic of the genus *Leptodius* (Figs. 184). There were no variations in the examined specimen, but the teeth on anterolateral in Dana (1852: pl. 11, Fig. 12a) appeared slightly different to the examined specimens in having more acute tubercles on that (Fig. 185).

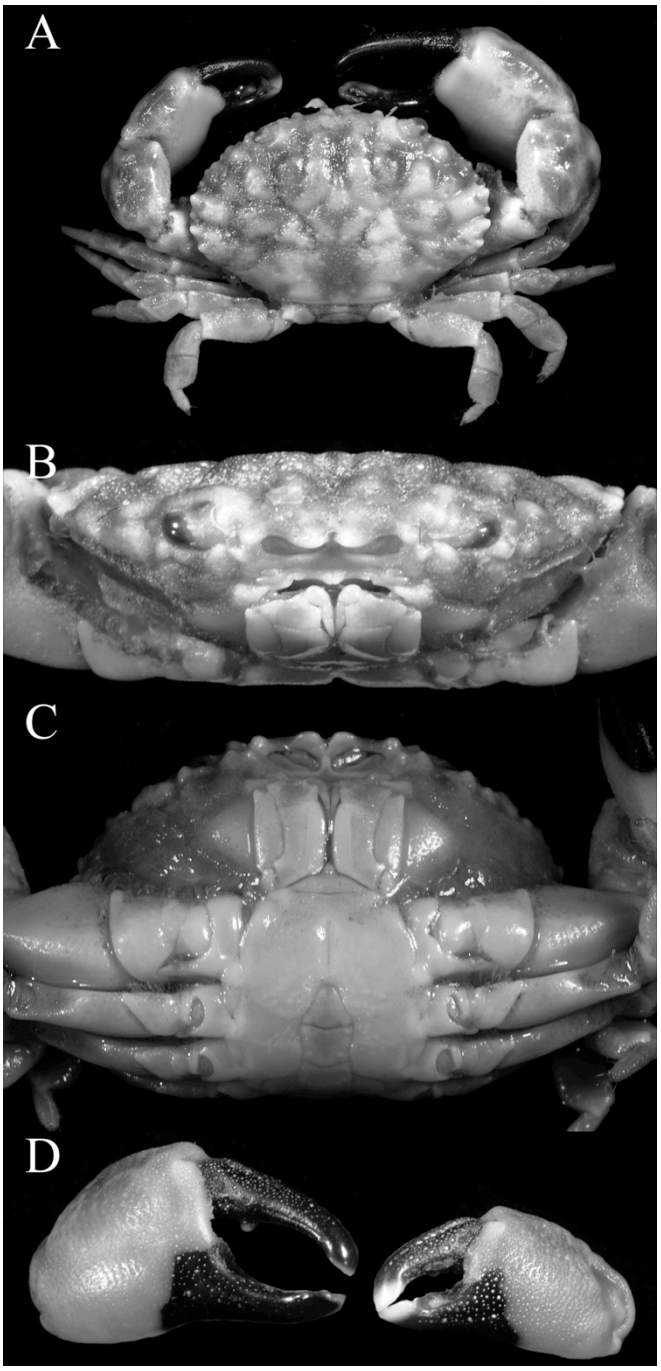

Fig. 183. *Leptodius nudipes* (Dana, 1852), male, 15.3 × 10 mm (ZRC 2000.0703). A, Dorsal view; B, anterior view; C, ventral view; D, Cheliped, outer view.

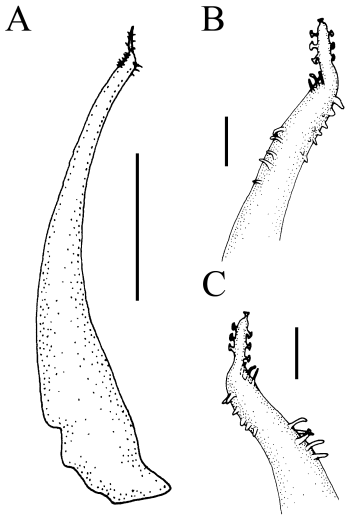

Fig. 184. *Leptodius nudipes* (Dana, 1853), left male first gonopod. 15.3 × 10 mm (ZRC 2000.0703). A, external view; B, Distal portion, external view; C, Distal portion, internal view. Scale bars: A= 1 mm; B, C = 0.1mm.

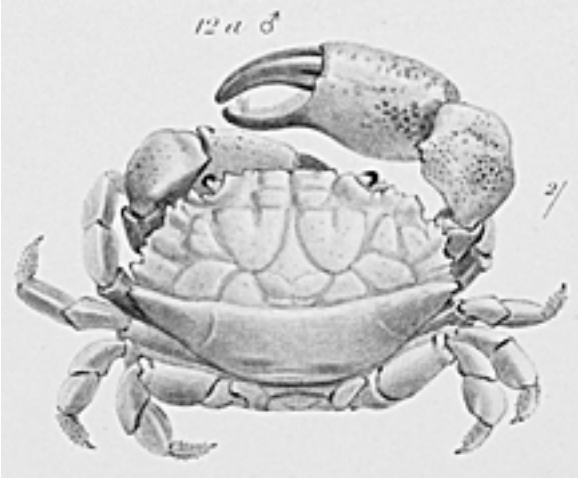

Fig. 185. The illustration of *Leptodius nudipes* in Dana (1852: pl. 11, fig. 12a).

Leptodius planus Ward, 1934

Leptodius planus Ward, 1934: 14, pl. 3, fig. 6.
Leptodius gracilis: Balss, 1938: 52.

Material examined. **Paratype**: 1 males (18.5 × 11.5 mm)(NMS. 1975.7.1.11-13), Christmas Island, Coll. C. A. Gibson-Hill, 8 Sep. 1932. *Others*: **Christmas Island** — Paratype, 2 males (7.5 × 5.4 mm, 18.5 × 11.5 mm), 1 female (14.3 × 9.4 mm)(NMS. 1975.7.1.11-13), Coll. C. A. Gibson-Hill, 8 Sep. 1932; 4 males (8.6 × 5.9 mm – 18.5 × 11.3 mm), 1 female (9.9 × 6.8 mm)(CI-09), 23 Jan. 2010. **Japan** — 1 male (20.2 × 12.4 mm)(CMB-ZC 6020), 2 males (13.3 × 8.7 mm, 14.9 × 9.5mm), 1 female (11.1 × 7.7 mm)(CMB-ZC 7066), Ogasawara; 1 male (17.4 × 11.5 mm), Minatogawa, Urasoe, Okinawa Is., Coll. T. Maenosono, 9 Sep. 2010; 1 male (14.9 × 9.5 mm), Kitanashiro, Itoman, Okinawa Is. Coll. T. Maenosono, 27 Sep. 2010; 1 male (16 × 10 mm), Gushikami, Yaese, Okinawa Is., Coll. T. Maenosono, 18 Aug. 2007; 1male (12.5 × 8.3 mm), Yamada, Onna, Okinawa Is., Coll. T. Maenosono, 31 Sep. 2007; 1 male (14.3 × 9 mm), 2 female (7.8 × 5.2 mm – 8.5 × 6.2 mm), Okinawa Is., Makiminato, Coll. P. K. L. Ng, T. Naruse & Osawa. 30 Oct. 2008; 7 males (11.3 × 7.5 mm – 17.5 × 11 mm) Minatogawa, Urasoe, Okinawa Is., Coll. T. Maenosono, 16 Oct. 2010; 1 male (17.3 × 10.6 mm)(Kumejima2009), Kumejima, Intertidal 8, Coll. Madomari, 19-20 Nov. 2009. **Maldives —** 2 males (10.6 × 7 mm – 12.1 × 8.1 mm)(8.7 × 5.9 mm – 12.8 × 8.7 mm)(ZRC 2007.0743), Laamu Atoll, Coll. A. Anand Jeya Kumar, Nov. 2007.

Description. Carapace (Fig. 186A) wider than long, transversely subovate, convex anteriorly; dorsal surface granules becoming more pronounced on anterolateral margins, with scattered coarse puncture; regions defined by shallow grooves which become faint on the central portions; 2F separated by groove from 1M; 2M partly divided longitudinally, 1M fused to inner branch of 2M; 3M, 2L, 3L, 4L distinct, entire; 4M indistinct; 1L very small, closed to first tooth on anterolateral margin; 5L, 6L fused; 1R, 2R fused, separated from 3R by indistinct oblique groove; 1P, 2P indistinct. Front about 0.3 times as broad as carapace width, produced

sufficiently to form, with anterolateral margins, graceful curve; median notch shallow; lateral angles produced into rounded teeth. Anterolateral margin with 4 lobes behind exorbital angle: first and fourth noticeably feeble. Posterolateral margin somewhat straight, with pubescence. Posterior margin granular, central region straight. Pterygostomian region granular, setose.

Antennules (Fig. 186B, 186C) lying transversely, slightly oblique. Basal article of antenna rhomboidal, short, broad. Antennular flagellum occupied orbit hiatus. Epistome narrow; central region with short median projection, separated from lateral regions by distinct notches. Third maxilliped completely filled buccal orifice; merus subquadrate, granular, anterolateral angle produced, anterior margin with slightly concave medially; ischium subrectangular with submedian sulcus, smooth, punctuate; exopod stout, length about 4 times width.

Thoracic sternum (Fig. 186C) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture; sternites 3, 4 almost completely fused except for short notches laterally, sternite 3 distinguishable from sternite 4 by shallow groove; sternite 4 large, slightly convex; sternites 5–8 distinct, separate, within not visible externally. Median longitudinal line visible externally only on central portion of sternite 4, complete at level of sternites 6, 7, 8. Sternal press-button situated on sternite 5, equidistant from sutures 4/5, 5/6.

Cheliped (Fig. 186A, 186D) asymmetrical, with a granular coating single ended, more or less curved and pointed. Merus with long setae on anterior and posterior borders, covered with fine corrugation on dorsal surface. Carpus covered with microscopic granules and fine corrugation on outer surface; inner-distal angle bluntly round. Fingers black coloured, with gaping between them closed, with distinctly toothed and contiguous within; fixed of major with tooth on proximal portion of inner margins; movable of major with three teeth: two proximal, one distal; fixed of minor with two teeth on proximal portion of innermargin; movable of minor with blunt tooth on proximal portion of innermargin; tips spoon-shaped with bristles.

Ambulatory legs (Fig. 186A) smooth; meri of first to third with setae on anterior and posterior margin; ratio merus length of fourth to merus width 2.5 times;

carpi, propodi subequal in length, sparsely setose; dactyli densely covered with short hairs, chitinous claw.

Male abdomen (Fig. 186C) narrow and long; somites 3–5 fused, sutures vaguely discernible; median length of somite 6 about 1.6 times that of telson. Distal half slightly broader than proximal half, lateral margins slightly concave. Telson subtriangular, tip broadly rounded; tip not reaching level of sternal condyles of P1 coxae.

Male G1 (Figs. 187A–C) slender, long, with 7 or 10 stout, curved subdistal spines; apical lobe bordered on ventral margin by 4–5 mushroom-shaped, diminishing gradually near tip. Angle formed between apical lobe and rest of G1 bent inward.

Type locality. Christmas Island (Ward, 1934: 14).

Distribution. Christmas Island, Ogasawara, Okinawa, Kumejima— Japan, Maldives

Remarks. *Leptodius planus*, described by Ward (1934), was published with the illustrations of the whole animal and the third maxilipeds. Mr. Tweedie, once the curator of Raffles Museum in Singapore, sent Dr. Balss some specimens collected from Christmas Island for identification. Balss (1938b: 52) commented as follows: "Fundangabe: paratypen von ward's art, die zeigen, dass es sich um diese altbekannte, allerdings seltenere art des indopacific handelt." He examined Ward's illustration and the specimens collected from Christmas Island, and he synonymized *L. planus* as *L. gracilis*. Tweedie (1947) listed *L. planus* as *L. gracilis* based on the Dr. Balss's opinion. However, Ng et al. (2008) considered *L. planus* as a valid species.

The author examined the paratype of *L. planus* (NMS. 1975.7.1.11-13) deposited in Raffles Museum in Singapore, and found that the first gonopod of *L. planus* differed from those of *L. gracilis* even if their carapaces were very similar. The apical lobe of L. planus is bent for the remainder of G1, but those of *L. gracilis* are curved inwards. Moreover, *L. planus* differs in having one bump on the

posterolateral margin and a number of teeth on finger of the cheliped. Also, while the ratio of the merus width and merus length of the fourth ambulatory leg of *L. planus* is about 2 times, that of *L. gracilis* is about 2.5 times.

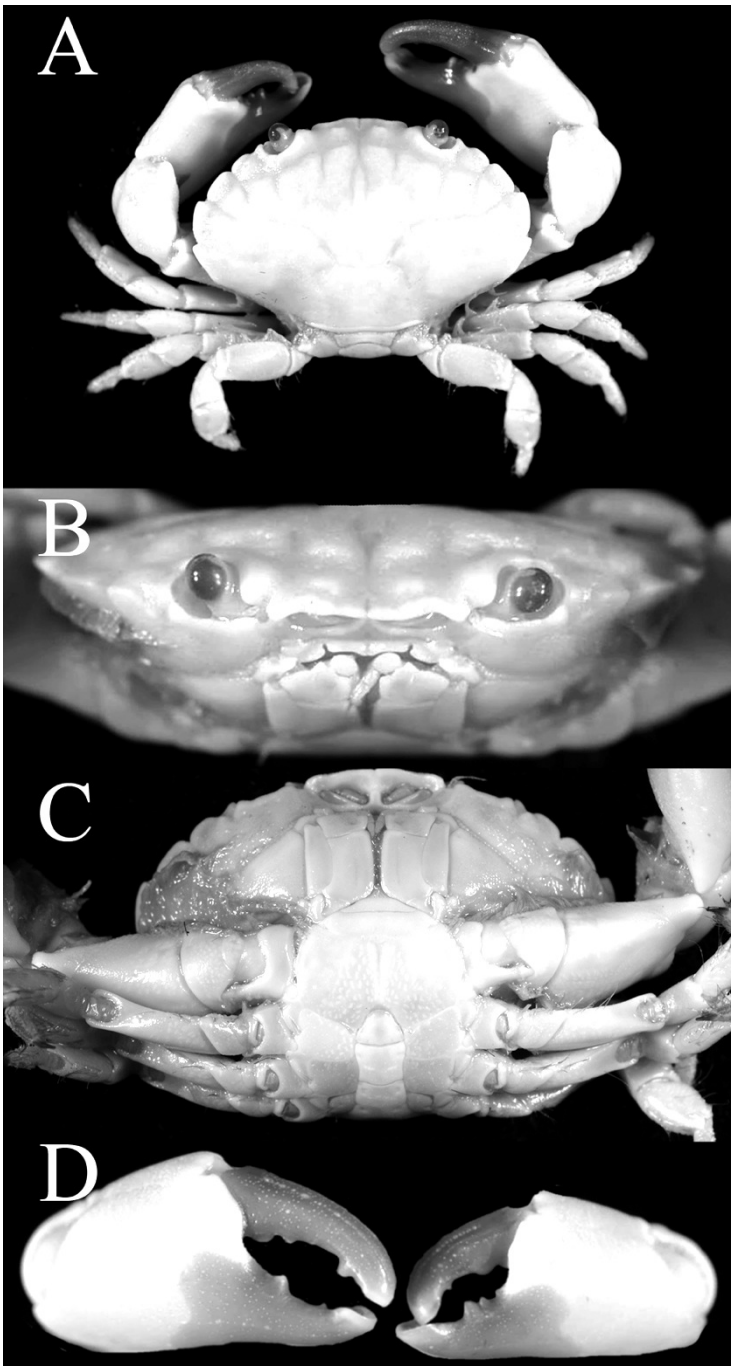

Fig. 186. *Leptodius planus* (De Haan, 1835), paratype, male, 18.5 × 11.5 mm (NSM.1975.7.11–13). A, whole animal, dorsal view; B, front and face region, anterior view; C, Thoraic sternum, ventral view; D, Chelipeds, outer view.

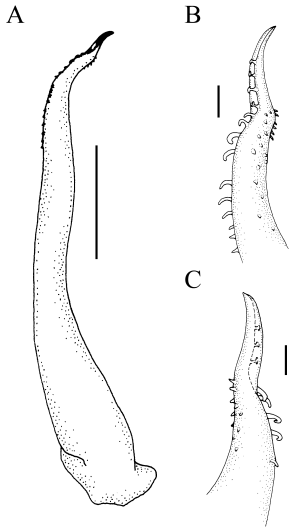

Fig. 187. *Leptodius planus* Ward, 1934, left male first gonopod, (18.5 × 11.5 mm)(NMS,1975.7.11–13). A, whole, external view; B, Distal portion, external view; C, Distal portion, internal view. Scale bars= A= 1mm, B, C= 0.1 mm.

***Leptodius sanguineus* (H. Milne Edwards, 1834)**

Chlorodius sanguineus Milne Edwards H., 1834: 402; Dana, 1855: pl. 11, fig. 11a-d.

Lagostoma nodosa Randall, 1840: 111.

Chlorodius nodosus: Dana, 1852: 210; Dana, 1855: pl. 11, fig. 14a-g.

Chlorodius edwardsi Heller, 1861: 336.

Leptodius sanguineus: Milne Edwards A., 1873: 224; Richters, 1880: 147; Haswell, 1882: 60; Alcock & Anderson, 1894: 200; de Man, 1895: 521; Whitelegge, 1897: 137; de Man, 1902: 602; Borradaile, 1902: 252; Lenz, 1905: 352; Grant & McCulloch, 1906: 10; Nobili, 1906b: 240; Rathbun, 1906: 847; Rathbun, 1907: 39; Nobili, 1907: 389; Calman, 1909b: 704; Rathbun, 1910a: 548; 1910b: 350; 1911: 215; Klunzinger, 1913: 213; Bouvier, 1915: 284; Parisi, 1916: 181; Gravier, 1920: 466; Balss, 1922: 127; Edmondson, 1923: 14; Sendler, 1923: 37; Edmondson, 1925: 51; McNeill, 1926: 313; Ward, 1933: 244; Boone, 1934: 116, pls 60-61; Ward, 1934: 14; Sakai, 1934: 309; Miyake, 1936: 508; Balss, 1938: 42; Ward, 1942: 89; Edmondson, 1946: 288, fig. 177a; Forest & Guinot, 1961: 63, fig. 50; Sankarankutty, 1961: 129; Sankarankutty, 1962: 128, figs 10-11; Edmondson, 1962: 237(key), 240, fig. 6e; Guinot, 1962: 235; Sakai, 1965: 141, pl. 70, fig. 4; Guinot, 1967: 265; Ooishi, 1970: 92, pl. 13, fig. 12; Takeda & Hayashi, 1973: 72; Sakai, 1976: 422, fig. 222; Takeda, 1976: 77; Takeda & Miyake, 1976: 109; Takeda & Nunomura, 1976: 71; Chen & Lan, 1978: 263, pl. 4, fig. 13;

Miyake, 1983: 108, pl. 37, fig. 1; Serène, 1984: 182(key), 183(key), 185, fig. 108, pl. 26B; Suzuki H., 1985; Dai et al., 1986; Dai & Yang, 1991: 291, fig. 154(1), pl. 37(2); Chang & Chen, 1992; Yamaguchi & Baba, 1993: 448, fig. 165; Wada, 1995: 398, pl. 109, fig. 2; Wang & Liu, 1996a; Yu et al., 1996; Ho & Hung, 1997; Jeng et al., 1997; Jeng, 1998; Wang & Liu, 1998; Muraoka, 1998: 40.

Leptodius exaratus var. *sanguineus*: Miers, 1886: 138; Ortmann, 1893: 447; Doflein, 1904: 101; Stimpson, 1907: 53.

Xantho (Leptodius) sanguineus: de Man, 1895: 525, Alcock, 1898: 118(key), 119; Pesta, 1911: 43; Urita, 1926: 10; Miyake, 1939b: 180, 210, fig. 7, pl. 14, fig. 5; Sakai, 1939: 463(key), 464, pl. 90, fig. 3; Lin, 1949: 21; Sakai, 1954: 74; Chang, 1963: 98; Michel, 1964: 32.

Leptodius edwardsii: Lenz, 1905: 352.

Xantho sanguineus: Odhner, 1925: 80; Tweedie, 1950: 117; Holthuis, 1953: 27; Buitendijk, 1960: 323, 338(key).

Xantho (= *Leptodius*) *sanguineus*: Stephensen, 1945: 150.

Leptodius sanguineus philippinensis Ward, 1941: 10; Ng et al., 2008: 203 (list).

Chlorodius hombronii Lucas, in Jacquinot & Lecas, 1853: 24; Ne et al., 2008: 203 (list).

Material examined. 1 male (16 × 10 mm)(MNHN B.8656), 263, Coll. P. Carié, 1910. 1 males (33.4 × 20.3mm)(CI-17-2011), Christmas Island, 23 Feb. 2011. *Others*: **China—** 1 male (31 × 19.4 mm), Seashore along road from Changpo to Huiwen, Haina Is., Coll. Y. Cai & N. K. Ng, 1 Dec. 1998. **Christmas Island—** 5 males (8.9 × 5.7 mm – 32 × 20 mm), 5 females (17 × 11mm – 29 × 19 mm)(CI-09-2011), 21 Mar. 2011; 5 males (19.5 × 12.2 mm – 33.4 × 20.3mm), 10 females (15 × 10 mm – 26 × 17.4 mm)(CI-17-2011), 23 Feb. 2011; 1 male (37 × 23.4 mm)(CI-13 (27)), 25 Jan. 2010; 2 males (16 × 10.2 – 23.4 × 14 mm), 1 female (11.8 × 9 mm)(CI-03), 22 Jan. 2010; 3 males (19.5 × 12.5 mm – 28.5 × 17.4 mm), 1 female (24.2 × 14.9 mm)(CI-31), 2 Feb. 2010; 1 male (22 × 14 mm), 1 female (19.6 × 12.3 mm)(CI-09), 23 Jan. 2010; 1 female (13.1 × 8.9 mm)(CI-13), 25 Jan. 2010; 4 males (11.5 × 8 mm – 34.3 × 21.8 mm), 6 females (14.4 × 9.5 mm – 31 × 20 mm)(ZRC 1965.11.9.118-127), Coll. C. A. G.-H. Aug.–Sep. 1932. **Cocos Keeling—** 4 males (25.8 × 16.4 mm – 34.4 × 20.9)(CK2-21); 4 males (20.6 × 12.9 mm – 42.9 × 25.9 mm), 6 females (10 × 6.8 mm – 33.5 × 20.5 mm) (ZRC 1965.11.10.3-12), Cocos Keeling Islands, Coll. C. A. G.-H., 1941; 3 males (26.4 × 16.5 – 34.5 × 21.2mm), 8 females (12.6 × 8.3mm – 26 × 16.5 mm)(ZRC 1965.11.10.3-12), CocosKeeling Islands, Coll. C. A. G.-H., 1941. **Fiji—** 1 male (15.9 × 10.5 mm), Cod coast, nr. Suva, 30 Jul. 2002. **Guam—** 12 males (12.6 × 9mm – 24.8 × 15.9 mm), 5 females (11.5 × 7.5 mm – 27.6 × 17.3)(ZRC 2000.0704), Pago Bay, Out side university of

Guam Marine Laboratory, Coll. P. K. L. Ng & C. H. wang, 15–18 Apr. 2000; 1 male (22.8 × 15mm)(ZRC 2001.0745), Hapato Beach, Coll. P. K. L. Ng, 3 Aug. 2001. **Hawaii—**1 male (11.9 × 7.3 mm)(ZRC 2000.0476), 1 foot water in coral rubble Is., 1st & 2ND bridge, Coll. D. Takaoka, 2 Aug. 1997; 1 male (21.8 × 13.5 mm), Kaneohe Bay #23, Rubble Is.; 5 males (10.8 × 7.2 mm – 25.2 × 15.8 mm) 8 females (11.4 × 7.9 mm – 18.5 × 11.7), Kaneohe Bay, Oahu, Coll. R. De Felice & S. Coles, 26 Jan. 2000; 6 males (11.8 × 8.2 mm – 24.6 × 15.7 mm), 2 females (12.2 × 7.7 mm, 20 × 13 mm), Intertidal area, Maipalaoa Beach, near Maili Point, Maili, Waianae coast, Leeward side of Oahu, Coll. P. K. L. Ng & SH Tan, 22 Jan. 2000; 1 male (21.5 × 13.8 mm)(ZRC 2011.0667), Mavi, Ahini – Kinav Natural Area Reserve, Coll. P. K. L. Ng & M. Ramsey, 10 Jun. 2011; 3 females (21.8 × 13.9 – 36.8 × 22.5), Oahu, Kahala, Coll. D. Takaoka, Jan. 2000; 1 male (22.5 × 14.2 mm), Kewalo, on sea wall. Surf zone, Ala moana area, Waikiki, Oahu; 2 males (15.5 × 10 mm – 17.1 × 11.2 mm), 4 females (20 × 12.4 mm – 39 × 24.8 mm), Oahu, Sandy Beach, in 6 inches of water, In tide pool, Coll. D. Takaoka, 27 Jan. 2000; 1 female (18.6 × 11.8 mm), Kaneohe Bay #23, Rubble Is.**;** 1 male (26.6 × 16.8 mm)(ZRC 2000.0475), Kai, Oahu, Near 2nd bridge, 2 feet water, Coll. D. Takara, 27 May. 1999. **Indonesia—**2 males (21 × 13.9 mm, 30 × 19.2 mm), 1 female (14 × 9.1 mm)(ZRC 2008.0590), Pantai Cerecok, Painan, W. Sumatura, Coll. J. Lai & N. K. Ng, 6 Jul. 2003. **Japan—**1 male (17.6 × 11.6 mm), 2 females (12.3 × 8.1, 19 × 12.5 mm)(RUMF ZC-353), Ryukyu; 1 male (21.8 × 14.1 mm)(CMB-ZC 720), Ogasawara Is.; 1 male (27.6 × 17.8 mm)(CBM ZC-10471), Ogasawara Is.; 5 males (16.4 × 11.5 mm – 24.1 × 15.6 mm), 2 females (11.1 × 7.5 mm, 15.6 × 10.5)(ZRC 2009.0127), Nagahama River, Okinawa Is., Coll. N. K. Ng & T. naruse, 21 Jun. 2000; 2 males (12.8 × 8.9mm – 18.4 × 11.9), 6 females (8.4 × 5.6 – 25.5 × 16.1 mm)(ZRC 2009.0117), Fukido River Mouth, Ishigaki, Coll. N. K. Ng et al., 13 Jun. 2000**;** 2 males (7.3 × 5.1, 13.6 × 9 mm), 1 female (15.2 × 10.5 mm)(ZRC 2009.0135), Haenrido Beach, Iriomete Island, Okinawa, Coll. N. K. Ng et al. 14 Jun. 2000; 5 males (10 × 6.5mm – 14.5 × 9.5 mm), 4 females (9.2 × 6.2 mm – 10.4 × 7mm)(ZRC 2009.0127), Nagahama River, Okinawa Is., Coll. N. K. Ng & T. naruse, 21 Jun. 2000; 7 males (14.2 × 9.7 mm – 21.4 × 14 mm), 4 females (15 × 10mm – 18 × 11.8 mm)(ZRC 2009.0171), Fukido River, Ishigaki Island, Okinawa, Coll. N. K.

Ng et al., 13 Jun. 2000; 1 male (18 × 11.5 mm), Ryukyu Is., Okinawa, Mikiminato, Coll. P. K. L. Ng, T. Naruse & Osawa, 30 Oct. 2008; 1 female (16.2 × 11mm)(ZRC 1993.640), Bisevillage (Coral reef), Motobu-cho, Okinawa, Coll. P. K. L. Ng. Apr 1992; 1 male (32.8 × 21.1mm), Benoki, Kunigami, Okinawa Is., Coll. T. Maenosono, 16 Apr. 2010; 1 male (21 × 13.8mm), Awase, Okinawa, Okinawa Is., Coll. T. Maenosono, 12 Feb. 2010; 1 male (35 × 21.5mm), Sashiki, Nanjo, Okinawa Is., Coll. T. Maenosono, 8 Mar. 2010; 1 male (25.4 × 16mm), Awase, Okinawa, Okinawa Is., Coll. T. Maenosono, 19 Aug. 2007; 3 males (16.5 × 10.6 – 25 × 16.3mm), Minatogawa, Urasoe, Okinawa Is., Coll. T. Maenosono, 16 Oct. 2010; 2 males (14 × 9mm, 18.2 × 12mm), 1 female (15.5 × 10mm)(ZRC 2009.0110), Omija River, Ryukyu, Coll. N. K. Ng et al., 16 Jun. 2000. **Micronesia—**2 males (12 × 8 mm, 22.7 × 14.5 mm), 5 females (10.8 × 7.5 mm – 17.7 × 11.5 mm)(Kosrae314), In front of Mr. Jung's house, Coll. S. K. Lee, 9 Jan. 2012; 2 males (19.5 × 12.8 mm, 33 × 20.1 mm), 2 female (19.5 × 12.8 mm, 21.5 × 13.8 mm)(Kosrae78), 1 female (18.7 × 12.6mm)(Kosrae12), 1 female (20.4 × 13.4mm)(Kosrae96), 1 male (14.6 × 9.9 mm)(Kosrae92), in front of Airport, intertidal, Coll. S. K. Lee and Y. Lou, 13 Jan. 2012; 1 male (14.6 × 9.8 mm)(Kosrae130), 1 male (19.7 × 12.7 mm)(Kosrae150), 1 female (23.2 × 14.8 mm)(Kosrae122), 1 female (19.3 × 12.8 mm)(Kosrae137), Wutue port, intertidal under Mangrove tree, Coll. S. K. Lee, 12 Jan. 2012; 1 male (13.8 × 10 mm)(Kosrae94), infront of Airport, intertidal, Coll. S. K. Lee and Y. Lou, 13 Jan. 2012; 1 male (16.8 × 11 mm), Intertidal, night, Coll. S. K. Lee, 12 Jan. 2012; 1 male (17 × 12 mm)(Kosrae243 – 3), Intertidal, night, Coll. S. K. Lee, 11 Jan. 2012. **Loyalty Island—**1 male (23.3 × 15.3mm), Loyalty Islands (Original label lost), Coll. B. Richer de Forges, 2008. **Maurice**—1 femle(16.5 × 10.6 mm)(MNHN B.8670), Smr. Port Louis, Coll. P. Carié, 1913; 2 females (9.5 × 6.5 – 14 × 9.5 mm)(MNHN B.8656), 263, Coll. P. Carié, 1910; 1 female (11.5 × 7.8 mm)(MNHN B.8660), 263, Coll. P. Carié, 1910. **New Caledonia—**5 males (18.1 × 12 mm – 28.7 × 18.4 mm), 5 female (11.5 × 7.9 mm – 20.2 × 13 mm), 13. rocky shore and Mangroves, cape Ndoura, (=Cape Boise), Southern Tip of island, South province, Coll. P. K. L. Ng & B. Richer de Forges, 8 Nov. 2006. **Philippines—**2 males (30 × 19 mm – 32 × 20 mm), 2 females (21 × 14 mm – 23.9 × 15.5 mm), Panglao Is.,

Alona beach at low tide, Coll. J. C. Mendoza, 12 Sep. 2011; 1 male (19.3 × 12.2 mm), 1 female (16.4 × 11 mm), Sapao Beach, E. Samar, Coll. Ng & Jafar et al., 2 Jul. 2010; 1 male (23.5 × 15 mm), 4 female (14 × 9.3 mm – 22.5 × 14 mm)(PANGLAO 2004), Panglao island, Stn M1, Coll. Bet. May to Jul. 2004; 3 males (18.5 × 12 mm – 31.5 × 19.6 mm), 2 females (15.8 × 10.3 mm, 16.3 × 10.6 mm)(Stn. JCEM 07-007), NE Cagayan, Luzon, Coll. J. C. E. Mendoza & T. Naruse; 1 male (38.5 × 24.3 mm)(PANGLAO 2004), Stn R42, Panglao Island, 3 Jun. 2004; 2 males (10.4 × 6.5mm, 25.5 × 16 mm), 2 females (13.2 × 8.6mm – 22.5 × 14.8), stn. JCEM 07-001, NE cagayan, Luzon, Coll. J. C. E. Mendoza & T. Naruse; 2 males (12 × 8.2mm, 15.8 × 10.2mm), Cebu Is., Matutinao River, Coll. H. C. Lin et al., 3 Dec. 2001. **Taiwan—**1 male (35 × 21.5 mm), 1 female (28.6 × 18.5 mm)(ZRC 1995.629), Kaoshiung, Coll. C. H. Wang, 16 OCT. 1987; 1 male (32.3 × 19.9 mm)(ZRC 1999.0596), Ma-Gang. ~45km east of keelung, flat rocks before crashing waves, Coll. H. H. Tan, 3 Aug. 1996; 1 male (18 × 12 mm)(ZRC 1999.0532), Chuan Fan Shr, Coll. P. K. L. Ng et al., 31 May 1997. **Vanuatu—**1 male (26.2 × 16.5 mm)(SANTO 2006), Santo island. 11 Oct. 2006.

Description. — Carapace (Fig. 188A) transversely subovate, about 1.6 times as broad as long; dorsal surface depressed, finely granular, anterior, lateral regions varying from distinctly to faintly rugose; regions well defined in anterior two-thirds of surface, every region separated into elevated subregions; posterior one-third of surface depressed and smooth; 2F separated by groove from 1M; 2M partly divided longitudinally, 1M fused to inner branch of 2M; 3M, 4M hard distinguished; 1L, 2L, 3L, 4L, 5L, 6L distinct, entire; 1R, 2R fused, separated from 3R by indistinct oblique groove; 1P, 2P indistinct. Front about 0.25 times as broad as carapace breadth, slightly produced, cut into 2 lobes, each one slightly concave near outer side, separated from internal orbital tooth by notch. Orbit smaller, transverse oval; superior margin with 2 fissures; inferior margin bearing a blunt round dentiform process; exorbital angle separated from first anterolateral tooth by concavity. Anterolateral margin with 5 lobes behind exorbital angle: first one with accessory tooth, fourth more acuminate, last smallest. Posterolateral margin slightly shorter

than anterolateral margin, and somewhat concave. Posterior margin granular, central region straight. Pterygostomian region granular, setose.

Antennules (Fig. 188B) lying transversely, slightly obliquely. Basal article of antenna sub-rhomboidal, short, broad. Antennular flagellum occupying orbit hiatus. Epistome narrow; central region with median projection, separated from lateral regions by distinct, narrow, deep notches. Third maxilliped completely filled buccal orifice; merus subquadrate, granular, anterolateral angle slightly produced, anterior margin with broad U-shape notch medially; ischium subrectangular with submedian sulcus, smooth, punctuate; exopod stout, length about 4 times width.

Thoracic sternum (Fig. 188C) finely granular, glabrous. Sternites 1, 2 completely fused, separated from sternite 3 by distinct suture; sternites 3, 4 almost completely fused except for short notches laterally, sternite 3 distinguishable from sternite 4 by shallow groove; sternite 4 large, slightly convex; sternites 5–8 distinct, separate, within not visible externally. Median longitudinal line visible externally only on central portion of sternite 4, complete at level of sternites 6, 7, 8. Sternal press-button situated on sternite 5, equidistant from sutures 4/5, 5/6.

Cheliped (Fig. 188A, 188D) asymmetrical, with a granular coating single ended, more or less curved and pointed. Merus with long pubescence on dorsal and ventral margins. Carpus covered with fine corrugation on outer surface; inner-distal angle bluntly round. Fingers black coloured, with somewhat gaping between them closed, with 3 obtuse teeth of various sizes on either inner margin; tip spoon-shaped with bristles.

Ambulatory leg (Fig. 188A) smooth; merus with setae on anterior and posterior margin; carpus, propodus subequal in length, sparsely setose; dactylus densely covered with short hairs, chitinous claw.

Male abdomen (Fig. 188C) narrow and long; somites 3–5 fused, sutures vaguely discernible; somite 6, median length about 1.3 times that of telson. Distal half slightly broader than proximal half, lateral margins slightly concave. Telson bluntly triangular; tip not reaching level of sternal condyles of P1 coxae.

Male G1 (Figs. 189A– E) slender, long, with 3–4 feeble, straight, subdistal spines; short apical lobe bordered on 5–6 mushroom-shaped tubercles followed

distally by 1–2 curved spines; apical lobe twisted on subdistal portion. Angle formed between apical lobe and rest of G1 more bent.

Type locality. Mauritius (H. Milne Edwards, 1834)

Distribution. China, Christmas Island, Cocos Keeling, Fiji, Guam, Hawaii, Indonesia, Japan, Micronesia, Loyalty Island, Maurice, New Caledonia, Philippines, Taiwan, Vanuatu.

Remarks. *Leptodius sanguineus* is very common species in the Indo-West Pacific. Henry Milne Edwards described this species from Mauritius in the Indian Ocean in 1834. The characteristic of this species is the small *S′* tooth behind the S tooth (fourth tooth on anterolateral margin). The *S′* tooth is characterized as a small, acute, and dissimilar bump. Some specimens of *L. davaoensis* possess a slightly bigger bump as *S′* tooth of *L. sanguineus*. The apical lobe of *L. sanguinus* is bent on the subdistal portion, while those of *L. davaoensis*'s male G1 are smoothly curved along the subdistal portion. The ventral margin of the G1 apical lobe of *L. sanguineus*, moreover, has 5–6 mushroom shaped outgrowths, while those of *L. davaoensis* has 10–12 tongue shaped outgrowths.

The author examined the holotype of *L. sanguineus philippinensis* Ward, 1941 (AMNH8520) (Fig. 190). This species has a small *S′* tooth behind the S tooth (the fourth tooth on the anterolateral margin) and the same G1 morphology as *L. sanguineus*. The author could not find any differences between these species. Eventually, *L. s. philippinensis* will be synonymized as *L. sanguineus*.

Chlorodius hombronii Lucas, in Jacquinot & Lucas, 1853 was described with an illustration of the whole animal. Type locality was not mentioned. Following this report, no others have been forthcoming for this species. Ng et al. (2008) recently listed this species as belonging to the genus *Leptodius*. *C. hombronii* was collected during the voyage of a ship called La Zelee in the Central Pacific and Antarctic oceans. *C. hombronii* was collected during the Central Pacific Ocean portion of the expedition. The author examined specimens collected from Hawaii and Fiji, and found out only *L. sanguineus* possessed the *S′* tooth and tubercles on

upper surface of the cheliepds such as a specimen from Okinawa specimen displayed in Fig. 191. As a result, *C. hombronii* would be considered to be *L. sanguineus.*

Leptodius exaratus var. *rugosus* Stimpdon, 1907 was described from Bonin Island, Japan (the present name: Ogasawara Island). Only *L. sanguineus* was associated with possession of a *S′* tooth, and the description of *L. e*. var. *rugosus* are agreed well with that of *L. sanguineus*. The author designed the **neotype** of *L. exaratus* var. *rugosus* Stimpson, 1907, and this species can be considered to be *L. sanguineus*.

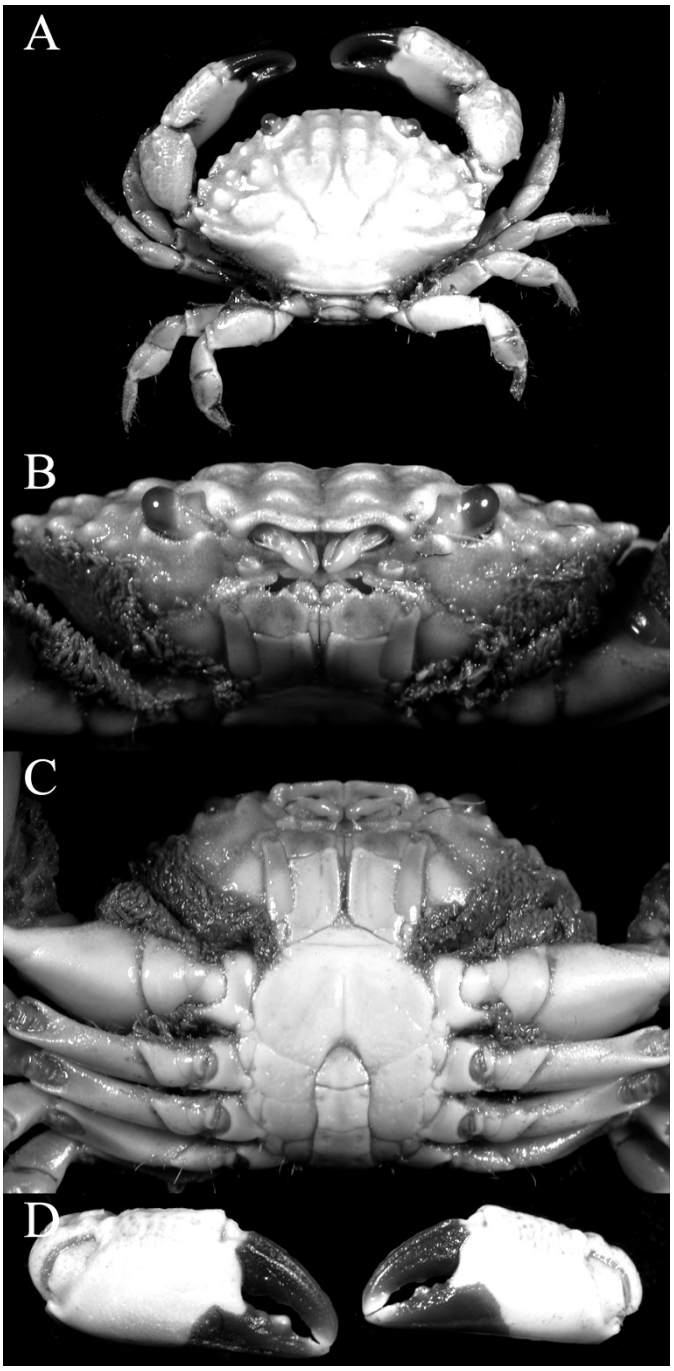

Fig. 188. *Leptodius sanguineus* (H. Milne Edwards, 1834), Male, Topotypic specimen, 16 × 10 mm (MNHN B.8656). A, Whole, dorsal view; B, Front, anterior view; C, Thoraic sternum, ventral view; D, Chelipeds, outer view.

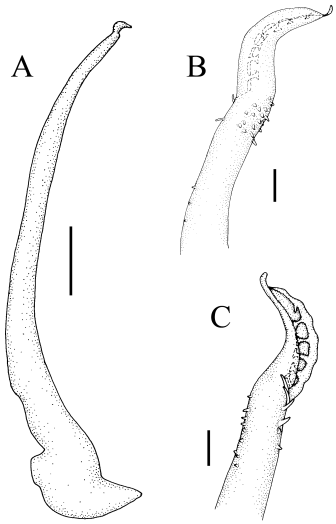

Fig. 189. *Leptodius sanguineus* (H. Milne Edwards, 1834), left first gonopod, 33.4 × 20.3 mm (CI-17-2011). A, whole, external view; B, Distal portion, external view; C, Distal portion, internal view. Scale bars: A= 1mm, B, C= 0.1 mm.

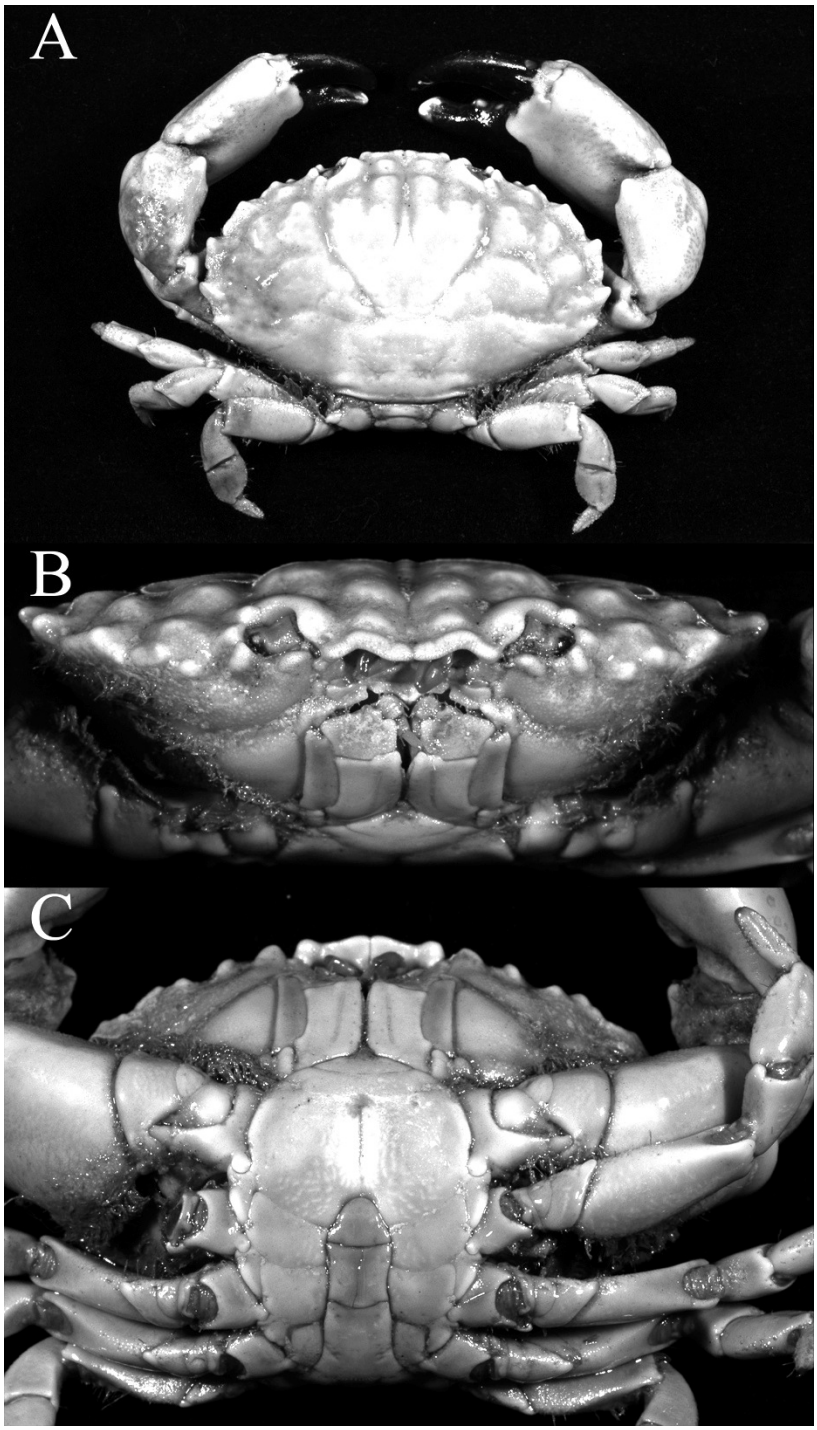

Fig. 190. *Leptodius sanguineus philippinensis* Ward, 1941, male, Holotype, 37.5 × 23.5 mm (AMNH8520). A, whole animal, distal view; B, Front and third maxilliped, anterior view; C, thoracic sternum, ventral view.

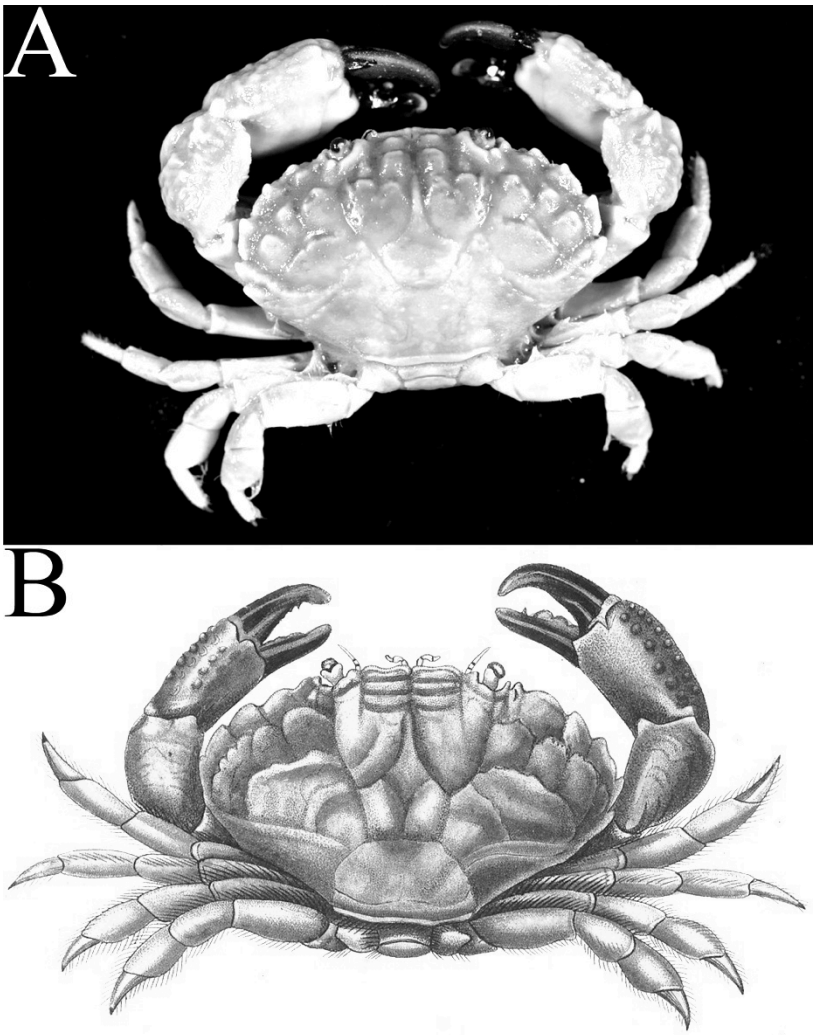

Fig. 191. Whole animal, dorsal view. A, *Leptodius Sanguineus* collected from Okinawa Is., Japan; B, *Leptodius hombronii* Lucas, in Jacquinot & Lucas, 1853, original illustration.

Incertae sedis

?*Cancer eudora* Herbst, 1801

Lagostoma nodosa Randall, 1840

Chlorodius edwardsii Heller, 1861

DISCUSSION

Relationship of *Leptodius exaratus* and *L. affinis*

The taxonomy of one of the most common intertidal Indo-West Pacific xanthid crab species, *Leptodius exaratus* (H. Milne Edwards, 1834) has generally been regarded as stable, and most recent syntheses have not questioned its identity (e.g., Serène, 1984). Following the general consensus, Ng et al. (2008: 203) listed just four junior synonyms under *L. exaratus*: *Cancer inaequalis* Olivier, 1791, *Cancer inaequalis* Audouin, 1826, *Leptodius lividus* Paul'son, 1875, and *Xantho exaratus* var. *typica* Ortmann, 1893. *Cancer inaequalis* Olivier, 1791, is now regarded as belonging to American genus *Xanthodius* Stimpson, 1859. This confusion probably arose from material identified as *Cancer inaequalis* from the Red Sea by Audouin (1826), which is now believed to be *L. exaratus* (see Guinot & Cleva, 2009).

However, the problems associated with *L. exaratus* and allied taxa have been understated. Stimpson (1907) discussed the taxonomy of *Leptodius exaratus* (as *Chlorodius exaratus*) and commented that while he chose to recognise a number of varieties, they also appeared to intergrade. He commented: "… one would scarcely be prepared to find so much variety in the character of the surface, the number and shape of the lateral teeth, and the sculpture of the feet, as we see in the present instance, these characters being in other genera and species of the highest specific importance. The varieties described below, however, are found to run into each other in all the characters which at first sight strike the examiner as specific, and several of them are often found living together under circumstances which do not fail to impress the collector with the idea that they are one and the same species." (Stimpson, 1907: 52). He noted that *Chlorodius sanguineus* H. Milne Edwards, 1834, was probably not a good species and chose to only recognize it as a variety of *L. exaratus*. In addition, he recognized eight other varieties (here listed in the order Stimpson named them) — *rugosus* (Bonin Islands), *pictus* (Simoda, Japan), *latifrons* (Loo Choo), *typicus* (Japan and China), *acutidens* (Loo Choo), *cupulifer* (Bonin Islands), *latus* (Hong Kong), and *granulosus* (Hong Kong). All these names are available nomenclatures, as they were all named before 1960 (ICZN, 1999) and were accompanied by descriptions, figures and /or comparisons.

The Bonin Islands are today known as the Ogasawara Islands, while Loo Choo is the old name for the Ryukyu Islands (in particular, Okinawa).

With regard to "*Chlorodius exaratus* var. *typicus*", Castro et al. (2004: 39) discussed the use of the epithet "*typica*" for various species of Trapeziidae, either used as a form or variety. It was a common practice in the late 19th and early 20th centuries for taxonomists to name the typical or nominate form or variety (nomenclaturally equivalent to the modern subspecies) as "forma *typica*". However, the Code (1999) allows for all forms and varieties to be recognized as available names equivalent to species if they were described before 1960. The use of "var. *typicus*" for one of Stimpson's forms therefore makes this an available name. Ortmann (1893) first used the name *Xantho exaratus* var. *typica*, so this name has priority over *Chlorodius exaratus* var. *typicus* Stimpson, 1907. Ortmann's (1893) "var. *typica*" was based on material he had from the West Pacific region, with only one male specimen from the Red Sea; and he also listed De Haan's (1835) two taxa under his synonymy for the form. Ortmann's (1893) var. *typica* can therefore be referred to either *L. exaratus* s. str. or *L. affinis*, depending on which specimen is selected. This point is discussed in more detail below.

Stimpson (1907) compared his varieties to three other species described by De Haan (1835) from Japan — *Cancer* (*Xantho*) *affinis* (cf. De Haan, 1835: 48, pl. 13 Fig. 6), *Cancer* (*Xantho*) *distinguendus* (cf. De Haan, 1835: 48, pl. 13 Fig. 7), and *Cancer* (*Xantho*) *lividus* (cf. De Haan, 1835: 48, pl. 13 Fig. 8). *Cancer distinguendus* is now in the genus *Macromedaeus* Ward, 1942. *Cancer* (*Xantho*) *lividus* De Haan, 1835, however, is a junior homonym of *Cancer lividus* Latreille, in Milbert, 1812 (presently in the genus *Juxtaxanthias* Ward, 1942), although both species are clearly different taxa. The name *Cancer* (*Xantho*) *affinis* De Haan, 1835, on the other hand, seems to have been largely forgotten. Stimpson (1907), however, did not make any firm decisions on the validity of *Cancer affinis* and of *Cancer lividus*. Ortmann (1893) considered both *Cancer* (*Xantho*) *affinis* De Haan, 1835, and *Cancer* (*Xantho*) *lividus* De Haan, 1835, as junior subjective synonyms of *Xantho exaratus* var. *typica*. This has been followed by other authors including Buitendijk (1960), as *Xantho exaratus*, and Barnard (1950), as *Xantho* (*Leptodius*) *hydrophilus*. Likewise, Yamaguchi & Baba (1993: 446, 447, Figs. 164A, 164B)

examined De Haan's material in Leiden and figured the types regarding both names as junior subjective synonyms of *Leptodius exaratus*, but without comment. Interestingly, both of De Haan's names have generally been missed in most treatments of Japanese and East Asian taxa (e.g., Sakai, 1965, 1976; Dai et al., 1986; Dai & Yang, 1991; Ng et al. 2001, 2008).

Serène (1962) added to the confusion when he described a new species from Vietnam, *L. nigromaculatus*. He noted that the new species was different from typical *L. exaratus* from the Indian Ocean, but that it was very close to the variety "*pictus*" of Stimpson (1907) (Serène, 1962: 259). In fact, he commented: "Stimpson (1907) définit 9 variétés d'*exaratus,* réduisant *sanguineus* au rang de variété d'*exaratus*; s'il laisse *gracilis* comme espèce distincte, il écrit « qu'elle n'est peut-être qu'une variété lisse de *exaratus* ». Il pense toutefois que de futures observations permettront sans doute « la reconnaissance de caractères constants définissant des espèces vraies dans ce qu'il ne considère encore que comme des variétés » Il est possible que *waialuanus* Rathbun, 1906 soit la var. *latus* Stimpson; *australis* Ward, 1939, la var. *rugosus* Stimpson; *leptodon* Forest et Guinot, 1961*,* la var. *acutidens* ou la var. *cupulifer* Stimpson, *nigromaculatus* nov. sp., la var. *pictus* Stimpson." (Serène, 1962: 260). However, from his discussion, it is clear that he believed that none of the new names proposed by Stimpson could be used. He also did not discuss the validity of De Haan's two names noted above. He probably took the advice of Barnard (1950: 225) who commented that "Stimpson (1907, Smiths. Misc. Coll., xlix, pp. 52 *sqq.*, pl. 6, Figs. 3, 4, 6–9) discusses this species and several varieties, some of which have a "supplementary tooth" on the antero-lateral margin, making 5 in all (as in *quinquedentatus*). At that time the importance of male 1st gonopod as a specific character was not realized, so that it is not only impossible to recognize any of his varieties from the descriptions, but it is also quite probable that several distinct species are confused." While this is true and Barnard's observations are valid, the fact remains that all of the new names proposed by Stimpson (1907) are actually nomenclaturally available. Moreover, because of their date, some may be senior synonyms of *Leptodius* species names established since 1907, including *L. nigromaculatus* Serène, 1962. The problem is compounded by the fact that none of Stimpson's specimens are extant (see Evans, 1967; Deiss & Manning, 1981;

Manning, 1993; Manning & Reed, 2006). The only solution is to examine a good series of specimens in the area where Stimpson (1907) obtained his specimens (East Asia), find topotypes when possible, match them against his descriptions and figures, and designate the appropriate neotypes to fix the identity of these names.

The author has gathered a large collection of "*Leptodius exaratus*" from China, Japan, Korea, Taiwan, the Philippines, Singapore and adjacent areas, and believe that all of Stimpson's nominal varieties can be identified from this collection. The "supplementary" anterolateral tooth mentioned by Stimpson (1907) is in fact a reliable character and not as variable as has been indicated. Two varieties belong to this group - var. *rugosus* and var. *latus* - both of which are allied to, or synonymous with, what is currently known as *L. sanguineus* (H. Milne Edwards, 1834) and/or *L. philippinensis* Ward, 1941. Six varieties have four anterolateral teeth: var. *pictus*, var. *latifrons*, var. *typicus*, var. *acutidens*, var. *cupulifer,* and var. *granulosus*. On the basis of Stimpson's (1907) description and figure, var. *granulosus*, is likely to be synonymous or very close to *Macromedaeus distinguendus*. Two taxa, var. *acutidens* and var. *cupulifer* may be synonymous, and because both have a strongly projecting front with acuminate anterolateral teeth, they are unlikely to be *L. exaratus* or *L. affinis* as presently defined. From Stimpson's description and figures, these two taxa are closely allied or synonymous with *L. davaoensis* Ward, 1941, and/or *L. leptodon* Forest & Guinot, 1961 (see Takeda, 1976). The two latter species were regarded as synonymous by Takeda (1980), but comparisons done by Mendoza (2010) suggest they may be separate taxa. A third Stimpson variety, *latifrons*, is probably also synonymous with var. *acutidens* and var. *cupulifer*. According to his description (no figure was provided), Stimpson's (1907) var. *latifrons* differs from var. *typicus* and var. *pictus* only in its slightly wider front and angular carapace anterolateral teeth and little else. His description and comments, however, are far too brief to ascertain much. We are of the opinion that var. *latifrons* is unlikely to be var. *typicus* or var. *pictus* because the most common form present in Okinawa (on the basis of the extensive material collected and examined) is actually not *L. affinis* which has yet to be collected from the island. In terms of the carapace and G1 morphology, these Okinawan specimens are much closer to his var. *acutidens*, var. *cupulifer* as well as *L. davaoensis*/*L. leptodon*. All the other specimens examined

share the same carapace features as well as the same G1 structure. We believe they are synonymous.

The remaining two varieties, var. *pictus* and var. *typicus* cannot be effectively separated. Stimpson (1907) (as well as Ortmann, 1893) recognized a typical common form in the Chinese and Japanese seas and other parts of the Pacific Ocean, and this variety agrees very well with what is recognized here as *Leptodius affinis*. As discussed above, Serène (1962) had already commented that his species, *L. nigromaculatus*, is very close to var. *pictus*, sharing a smooth posterior carapace region, broad and non-projecting triangular anterolateral teeth and the yellowish colour of the carapace. As such, the oldest names available for this entire group should be *Cancer* (*Xantho*) *affinis* De Haan, 1835, and *Cancer* (*Xantho*) *lividus* De Haan, 1835. Both these names are regarded by the current Code as simultaneously published as they appeared in the same publication, and seniority must be chosen by First Reviser action. We hereby select *Cancer* (*Xantho*) *affinis* De Haan, 1835, as having priority over *Cancer* (*Xantho*) *lividus* De Haan, 1835, whenever the two names are regarded as subjective synonyms. This is mainly because *Cancer* (*Xantho*) *lividus* De Haan, 1835, may be confused with the unrelated *Cancer lividus* Latreille, in Milbert, 1812, which is now in the genus *Juxtaxanthias*.

Four names - *Xantho exaratus* var. *typica* Ortmann, 1893, *Chlorodius exaratus* var. *typicus* Stimpson, 1907, *Chlorodius exaratus* var. *pictus* Stimpson, 1907, and *Leptodius nigromaculatus* Serène, 1962 - now become junior subjective synonyms of *Cancer* (*Xantho*) *affinis* De Haan, 1835. To stabilize the taxonomy of this species, we are of the opinion that it is necessary to select a lectotype and neotypes for Ortmann's (1893) and Stimpson's (1907) varieties, respectively. We hereby select the lectotype of *Cancer* (*Xantho*) *affinis* (female, RMNH) as also the simultaneous lectotype of *Xantho exaratus* var. *typica* Ortmann, 1893, by reason of this De Haan name being included in the synonymy of Ortmann's "var. *typica*", and in accordance with Article 72.4 of the Code (1999) concerning type series. Both names now become objective synonyms. Ortmann (1893), in listing down various names in his synonymy for *Xantho exaratus* var. *typica* (e.g., *Chlorodius exaratus* H. Milne Edwards, *Cancer* (*Xantho*) *affinis* De Haan, *Cancer* (*Xantho*) *lividus* De Haan, etc.), effectively used the type material for these species as syntypes of his

"var. *typica*" by indication, therefore making them available for selection as lectotypes by subsequent workers. The specimens examined by Ortmann from East Asia and Red Sea (Ortmann, 1893: 446) are now paralectotypes. The lectotype of *C.* (*X.*) *affinis* is also selected as the simultaneous neotype of *Chlorodius exaratus* var. *typicus* Stimpson, 1907, and *Chlorodius exaratus* var. *pictus* Stimpson, 1907, in accordance with the Code (1999). While Stimpson (1907) recognized several varieties, we find that these two varieties, at least, are conspecific due to the lack of differences in the morphology (especially that of the G1) of topotypic specimens examined in this study. Since the type localities of *Cancer* (*Xantho*) *affinis* De Haan, *Chlorodius exaratus* var. *typicus* Stimpson, and *Chlorodius exaratus* var. *pictus* can be considered to be generally the same (all within the vicinity of mainland Japan), we do not expect that they would be different species. Hence, one name-bearing type is sufficient for the three names. We do not believe that selecting separate neotypes for Stimpson's varieties serves the cause of nomenclatural stability for this species, especially since the taxonomy has been rather confused. While we cannot discount the existence of cryptic species within this group in the future, the best available evidence does not suggest this. As discussed, since Stimpson's taxa are almost impossible to ascertain with confidence, it is better to objectively fix their identities through designation of appropriate neotypes and move on with their taxonomy. As for Stimpson's (1907) remaining varieties, we have matched each of those with available topotypic material with the help of his descriptions and illustrations.

New combination of *Leptodius efferens* Rathbun, 1907 and *Leptodius waialuanus* Rathbun, 1906

The genus *Leptodius* recorded of 12 species so far (Ng et al., 2008). The 10 species are already discussed in the dissertation.

Leptodius efferens Rathbun, 1907 was described by collected specimen from **Pohnpei** (formerly known as **Ponape**) belonging to Pohnpei State, one of the four states in the Federated States of Micronesia. The author with help of Mr. Lasley examined holotype (USNM32847) (Fig. 192, 193). The carapace of the holotype (Fig. 192A) looked as those of *L. gracilis* and/or *L. planus*. Not only the fingertips of the chelipeds of this crab are acuted, but also outer surface of the palm of the

chelipeds displays with much small tubercles (Fig. 193A). Sharp-shaped fingertip to pinch is not characteristic of the genus Leptodius spp. Moreover, the first pleopod morphology of the holotype is very close to that of the members of the genus *Liocarpilodes* Klunzinger, 1913 belonging to the subfamily Chlorodiellinae (Figs. 193B, 193C). In the result, *Leptodius efferens* would be synonymized as *Liocarpilodes efferens* (Rathbun, 1907).

Leptodius waialuanus Rathbun, 1906 was described from one collected 1 female from Waialua, Oahu (USNM29506). She mentioned the characteristics as followed: "Also of the *exaratus* group, but approaching nearer *L. sanguineus*. Supplementary tooth wanting, although there is a short granulated ridge, leading out to the point where the supplementary tooth exists in *L. sanguineus*. … Antero-lateral teeth angular, hooked forward, not much projecting, fifth retreating. Front advanced, median emargination minute, lobes slightly concave, but not subdivided…" (Rathbun, 1906: 848). The author examined holotype (Fig. 194, 195). The carapace and cheliped morphology would be similar as those of the *Leptodius* spp. she described with female so it is different to classify. The orbital hiatus and dactylus of *L. waialuanus*, however, are totally different of those of the *Leptodius* spp. In case of *L. waialuanus*, the antennal flagellum does not insert to the orbital hiatus, and the dactyllus have many distinct tubercles. These characteristics of *L. waialuanus* are close to the genus Etisus H. Milne Edwards, 1834 rather than to the genus *Leptodius*. *L. waialuanus* would be synonymized as *Etisus waialuanus* (Rathbun, 1906).

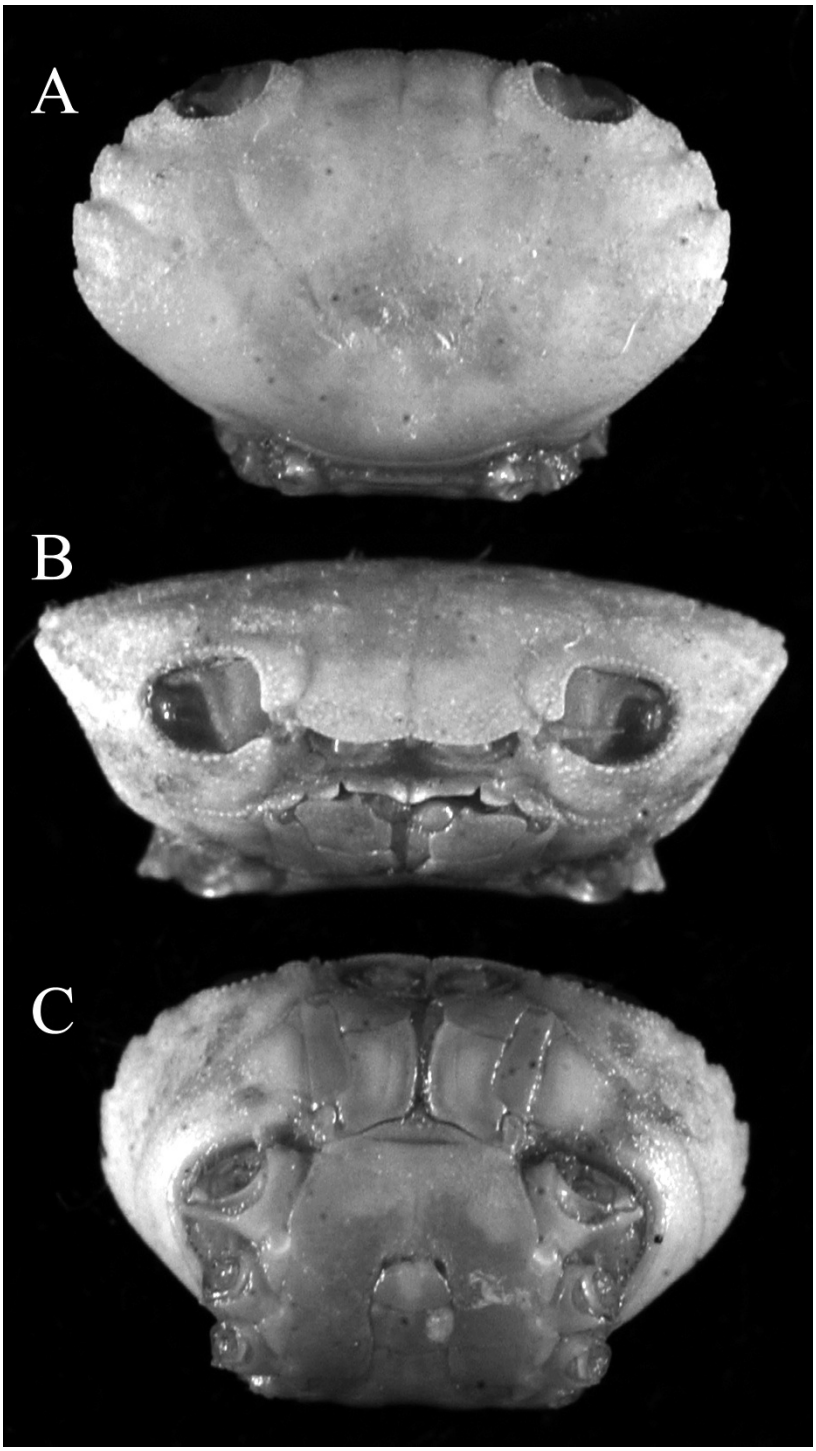

Fig. 192. *Liocarpiloses efferens* Rathbun, 1907, holotype (USNM 32847). A, dorsal view; B, Frontal view; C, ventral view.

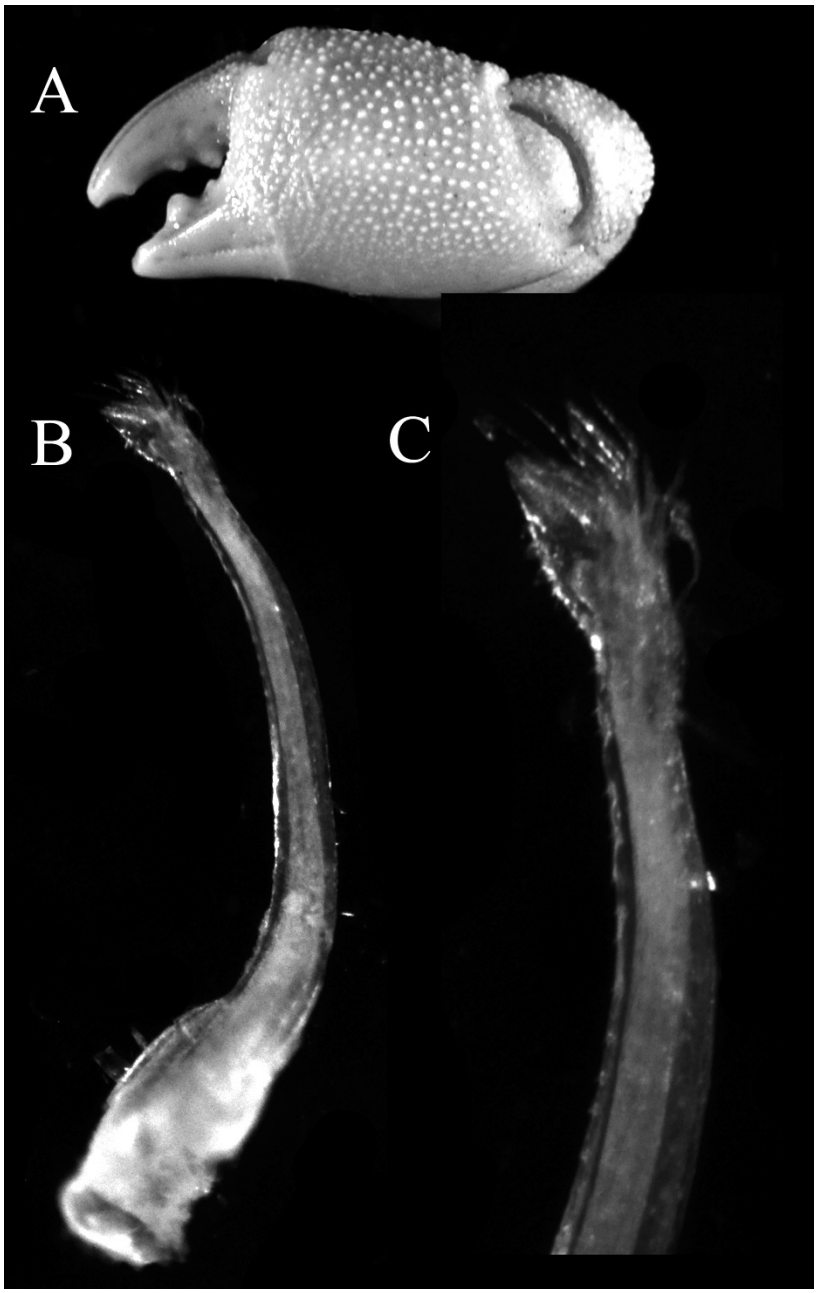

Fig. 193. *Liocarpilodes efferens* Rathbun, 1907, holotype (USNM 32847). A, left cheliped, outer view; B, left G1, external view; C, distal portion of left G1, external view.

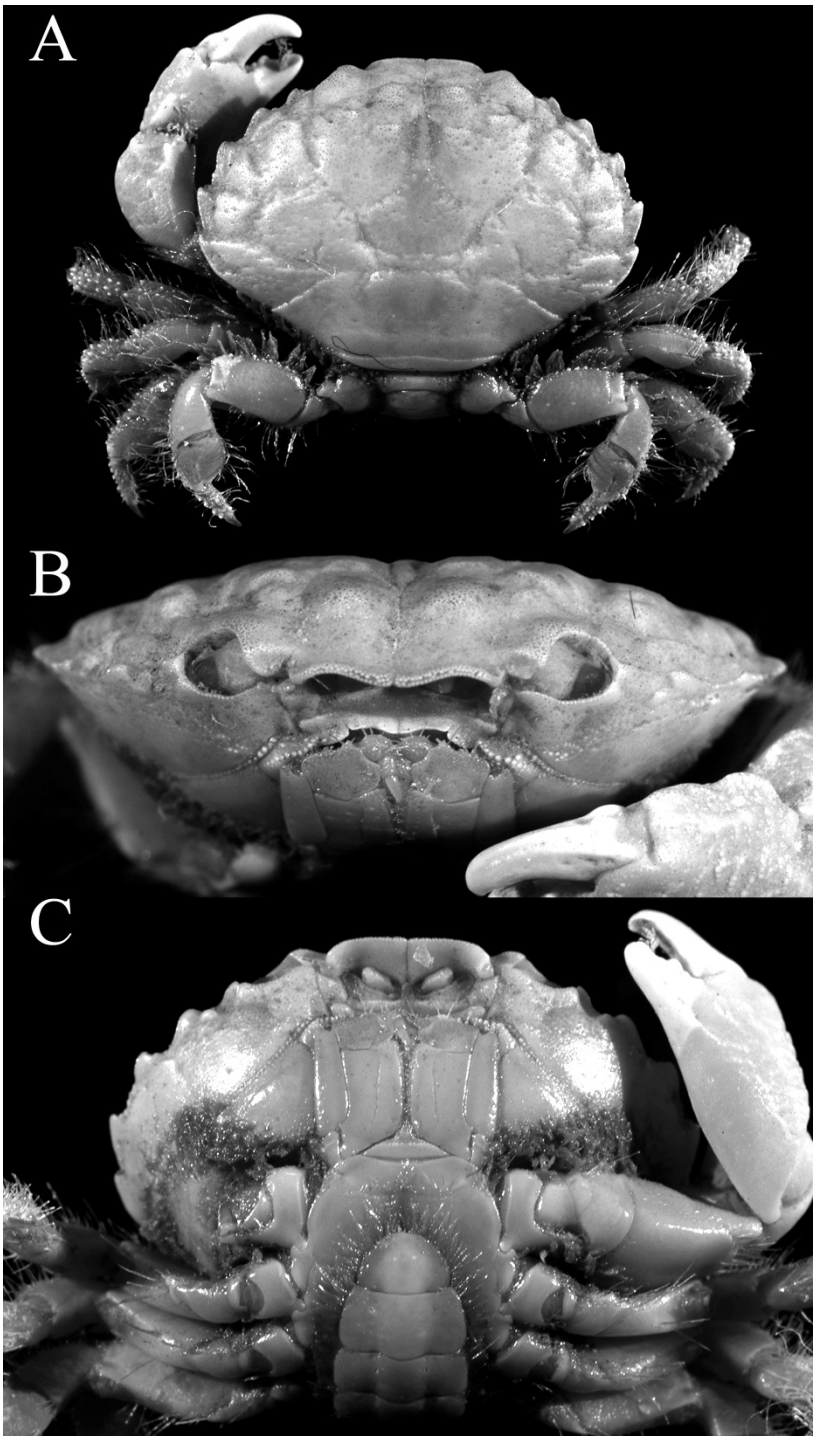

Fig. 194. *Etisus waialuanus* Rathbun, 1906, holotype (USNM29506). A, Whole animal, dorsal view; B, Front, anterior view; C, Third maxilliped, ventral view.

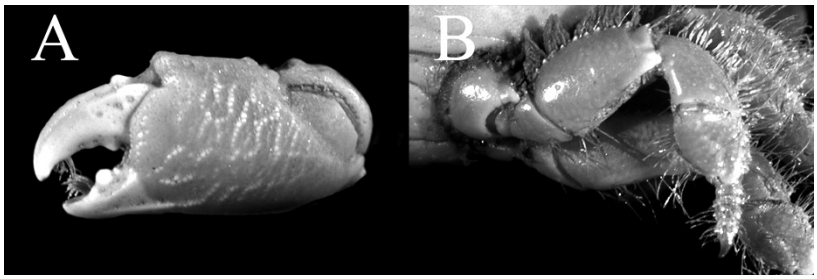

Fig. 195. *Etisus waialuanus* Rathbun, 1906, holotype (USNM29506). A, Left cheliped, outer view; B, Fourth ambulatory leg, posterior view.

CONCLUSION

To imagine crustaceans is to imagine crabs, as the crabs are considered to be the best-known group. Most crabs are cryptic under stones or other shelters. 6,793 species and subspecies, 1,271 genera and subgenera, 93 families, and 38 superfamilies were recognized. Of these, 404 species of 68 genera belonging to 3 families of the superfamily **Pilumnoidea** Samouelle, 1819, and 737 species of 154 genera belonging to 3 families of the superfamily **Xanthoidea** McLeay, 1838 were listed (Ng et al., 2008). The numbers of crabs, however, are still counting. Mr. E. J. Mier first introduced the Korean crabs in 1879. In 1956, Mr. Jung providing "Check list of Crab from Gyeonggi-do" by recording 51 species of 32 genera belonging to 12 families and giving naming Korean name to each crab. His article was the starting point of researching fauna study of the Korean crabs. Sequentially, the monograph, entitled " Illustrated encyclopedia of fauna & flora of Korea. Vol, 14" was published in 1973 by Dr. H. S. Kim. The monograph included the illustrations, Korean description, their distribution, and charateristics key of 168 species of 18 families. Of these, 7 pilumnoids and 9 xanthoids had been recorded. Until now, the Korean Brachyura consist of 223 species of 41 families belonging to 23 superfamilies. Of these, 18 pilumnoids and 28 xanthoids have been reported in the Korea fauna, but no revised study of these two families has been conducted.

In Chapter 1 of this dissertation, the author provide an updated and revised checklist of the pilumnoid and xanthoid crabs found within the Korean Peninsular, and with the support of the molecular data based on the Korean pilumnoids and xanthoids. The author studied that the 18 pilumnoids and 28 xanthoids reported in the Korean fauna. While studying these two superfamiles, the author discovered and reported the one unrecorded one Pilumnoid and 7 xanthoids in Korea, and they have been published.

Their distribution in Korea and their habitat, moreover, was studied (Table 3). Most Korean pilumnoids and xanthoids are distributed southern part of the Korean peninsular. As the pilumnoid and the xanthoid crabs are mainly distributed in the tropical region, the Korean pilumnoids and xanthoids would prefer to inhabit

warm region. The some species are investigated to associate with symbiosis of marine animals. *Echinoecus pentagonus* (A. Milne-Edwards, 1879) and *E. nipponicus* Miyake, 1939) are associated with Sea urchins, and *Harrovia elegans* De Man, 1887 and *H. japonica* Balss, 1921 are with feather star. *Banareia subglobosa* (Stimpson, 1858) and *Calvactaea tumida* Ward, 1933 are associated with soft coral. Almost species of Korean pilumnoid and xanthoids are investigated to inhabit in the crevices of rocks or under the stones.

Table 3. The list of the distribution and the habitat of the Korean pilumnoids and xanthoids

Species	Yellow sea	Korean Strait	East Sea	Habitat
Halimede fragifer (De Haan, 1835)	+	+		Muddy or Sandy-muddy bottom
Parapanope eugora De Man, 1895	+	+		Shallow waters on coral reef
Echinoecus pentagonus (A. Milne-Edwards, 1879)		+		Surfaces of sea urchins
Echinoecus nipponicus Miyake, 1939		+		Surfaces of sea urchins
Harrovia elegans De Man, 1887		+		Symbiosis of feather star
Harrovia japonica Balss, 1921				Symbiosis of feather star
Actumnus elegans De Man, 1888		+	+	Crevices on rocks or coral reefs
Actumnus marissinicus Takeda and Kim, 1977		+		-
Benthopanope indica (De Man, 1887)	+	+	+	Coral reef or shallow waters

Table 3. (Continued).

Heteropilumnus ciliatus (Stimpson, 1858)	+	+	+	Muddy or Sandy-muddy bottom
Neoactumnus convexus Sakai, 1965		+		On rocks or sand and sea anemone
Pilumnopeus granulatus Balss, 1933		+		Crevices on rocks
Pilumnopeus makianus (Rathbun, 1929)	+	+	+	Under stones, weedy bottoms, muddy bottoms
Pilumnus longicornis Hilgendorf, 1878		+	+	Sandy bottoms, in sponges
Pilumnus minutus De Haan, 1833	+	+	+	Crevices of rocks, Sandy bottoms, in sponges
Pilumnus trispinosus (Sakai, 1965)		+		Crevices of rocks, Sandy bottoms, in sponges
Typhlocarcinops canaliculatus Rathbun, 1909	+			Muddy or Sandy-muddy bottom
Zehntneriana amakusae (Takeda & Miyake, 1969)		+		Sandy bottoms, in sponges
Actaea semblatae Guinot, 1976		+	+	Crevices of rocks, under stones
Actaea polyacantha (Heller, 1861)		+		Crevices of rocks
Actaeodes hirsutissimus (Rüppell, 1830)		+		On coral reef
Forestia depressa (White, 1847)				Under stones

Table 3. (Continued).

Gaillardiellus orientalis (Odhner, 1925)	+	+	+	Sanddy and rocky bottom
Gaillardiellus rueppelli (Krauss, 1843)	+	+	+	Sanddy and rocky bottom
Novactaea pulchella (A. Milne-Edwards, 1865)		+		Crevices of rocks
Pilodius nigrocrinitus Stimpson, 1858		+		Coral reef
Pilodius miersi (Ward, 1936)		+	+	Coral reef
Danielea noelensis (Ward, 1934)		+		Crevices of rocks
Medaeops granulosus (Haswell, 1882)	+	+	+	Crevices of rocks
Etisus anaglyptus H. Milne Edwards, 1834			+	Under stones
Palapedia integra (De Haan, 1835)		+	+	Sand or under stones
Liomera magaritata Serène, 1984				Crevices of coral reef or under stones
Neoliomera insularis (Adams & White, 1849)		+	+	Crevices of coral reef or under stones
Lybia caestifera (Alcock, 1898)		+		Coral reef
Cycloxanthops truncatus (De Haan, 1837)		+	+	Sand or under stones
Leptodius affinis (De Haan, 1835)		+		Sand or under stones
Macromedaeus distinguendus (De Haan, 1835)	+	+	+	Crevices of rocks, under stones
Microcassiope orientalis Takeda & Miyake, 1969		+	+	Crevices of rocks, under stones

Table 3. (Continued).

Nanocassiope granulipes Sakai, 1939		+	Muddy, shelly bottoms
Neoxanthops lineatus (A. Milne-Edwards, 1867)		+	Crevices of coral reef, under stones
Banareia subglobosa (Stimpson, 1858)		+	On soft coral
Calvactaea tumida Ward, 1933		+	Symbiosys of Alcyonaian coral
Atergatis floridus (Linnaeus, 1767)		+	Crevices of rocks, under stones
Atergatis reticulatus De Haan, 1833		+	+ Crevices of rocks, under stones
Atergatopsis germaini A. Milne-Edwards, 1865	+		Coral reef
Platypodia tomentosa (De Man, 1902)		+	Crevices and on coral reef

After studying their morphology of Korean specimens, the author attempted the molecular taxonomic study using DNA barcording. The 26 species out of the 46 crabs of Korean pilumnoids and xanthoids have been successfully sequenced, and the 36 species, added sequences of some species from GenBank, was analyzed. As a result, most of the test specimens showed limited low intraspecific variation (0−0.008), while *Actaea polyacatha, Gaillardiellus orientalis, G. rueppelli,* and *Medaeops granulosus* revealed high intraspecific COI sequence divergences (>6%). The author found some suspected cryptic species or misidentified specimens using the DNA barcoding method. Most of the examined specimens showed very limited intraspecific variation while *Actaea polyacatha, Gaillardiellus orientalis, G. rueppelli, Leptodius affinis, L. nigromaculatus,* and *Medaeops granulosus* revealed intraspecific COI sequence divergences that exceeded 5%. These specimens were reexamined based on their morphology, and then their taxonomic relationship was inferred with Maximum likelihood and Baysian inference base on the sequences data

of COI. According to BI tree, a significant taxonomic relationship was found as follows: 1) *Neoliomera insularis* would be questioned their taxonomic status, 2) Based on the relationship between *Leptodius nigromaculatus* and *L. affinis*, the two species are the same species based on COI sequences. In fact, morphological characteristicts are also supported to this result. The article of the author, examined by morphological character, will be published, 3) *Actaea bocki* (Odhner, 1925) would be considered to examined their taxonomic status, 4) Korean *Medaeops granulosus* would be not real *M. granulosus* or a cryptic species. The author used DNA barcoding methods for finding cryptic species or misidentified specimens, and the problematic species were conducted to examine with the morphological characters, but feels lacked data for more studies. Therefore, the author will be conducting further study with more specimens and sequences of other region such as 16S, 12S, or any region of nuclear DNA.

In Chapter 2 of this dissertation, the taxonomical study of the crabs was studied. During to the study of *Zehntneriana amakusae* Takeda & Miyake, 1969, the issue as to the identification of *Z. villosa* (Zehntner, 1894), which is the type species of the genus *Zehntneriana* Ng & Takeda, 2010, was found. The other three species belonging to the genus *Zehntneriana* and the holotype of *Z. villosa* agrees well with the original description of the genus *Zehntneriana* Takeda, 1972. Based on the result of examination, the author concluded that the genus *Zehntneriana* is valid. In regards to this new species from Japan, the new species were examined along with the other 3 species of the genus *Zehntneriana* to determine its genus. This new species was compared with the genus *Ceratoplax ciliate* Stimpson, 1858. The male genital opening of members of the genus *Ceratoplax* was rather calcified prolongation of the vasa deference pass along the grooves protected by the penultimate sternal plate, while the male genital opening of the new species is opened as a groove between sternite 7 and 8. When compared to *Ser fukiensis* Rathbun, 1931, this new species did not have a bias line on the sternites 3 and 4 of thoracic sternum, which is the characteristic of the genus *Ser*. For such a reason, this new species would be concluded be belonging to the genus *Zehntneriana* Takeda, 1972.

In Chapter 3 of this dissertation, a revision of the genus *Leptodius* A. Milne-Edward, 1863, was conductd. While studying *Leptodius exaratus* A. Milne-Edwards, 1834 collected from Korea, the author found some confusing characteristics with *L. nigromaculatus* Serène, 1962. Furthermore, various confusion presented in the genus were found. The author examined a large number of specimens collected from the Indo-West Pacific, and the result obtained were as follows:

1) In regards to *L. acutidens*, *C. exaratus* var. *acutidens* and var. *cuplifer* were mentioned first by Stimpson (1907). Subsequently, these two varieties were mentioned with *L. leptodon* Forest & Guinot, 1961 (Serène, 1962). The author considered that these specimens would be the two varieties described by Stimpson (1907), given their similar collection locations. Although *C. exaratus* var. *acutidens* and *C. e.* var. *cuplifer* could be used for these specimens nomenclature, the author selected *C. exaratus* var. *acutidens*, as these specimens had the acuminated teeth on their anteiro-lateral boarder.

2) In *L. affinis*, *Leptodius affinis* (De Haan, 1835) were synonymized as *L. exaratus* (A. Milne-Edwards, 1834) by Ortmann (1893: 445). The author revealed a result that *L. affinis* is not *L. exaratus* based on their G1 morphology and distribution. Moreover, *L. nigromaculatus* and 3 varieties of Stimpson (1907) were synonymized as *L. affinis*.

3) *L. australis* was described with the illustration of G1 (Ward, 1936) and compared to the members of the genus *Leptodius*.

4) Takeda (1980) examined the type specimens deposited in the AMNH and concluded that the type from Davao Gulf is conspecific with *L. leptodon* Forest & Guinot, 1961. The author discussed the differences between *L. davaoensis* and *L. leptodon*, and concluded that they are not conspecific.

5) *L. gracilis* would not be conspecific with *L. planus*.

6) *L. sanguineus* is the very common species in the Indo-West Pacific. Henry Milne Edwards described this species from Mauritius in the Indian Ocean in 1834. The author examined the holotype of *L. sanguineus philippinensis* Ward, 1941. *L. s. philippinensis* would be synonymized as *L. sanguineus*. *C. hombronii* would also be considered to be *L. sanguineus.* The author designed the neotype of *L. exaratus var. rugosus* Stimpson, 1907, and this species can be considered to be *L. sanguineus*.

7) The morphology of male first pleopod of the holotype is very close to that of the members of the genus *Liocarpilodes* Klunzinger, 1913 belonging to the subfamily Chlorodiellinae. *L. efferens* would be synonymized as *Liocarpilodes efferens* (Rathbun, 1907).

8) The orbital hiatus and dactyls of *L. waialuanus* are totally different from those of the *Leptodius* spp. In *L. waialuanus*, the antennal flagellum is not inserted to the orbital hiatus and the dactyllus have many distinct tubercles. These characteristics of *L. waialuanus* are close to the genus *Etisus* (Milne Edwards, 1834), rather than to those of the genus *Leptodius*. *L. waialuanus* would thus be synonymized as *Etisus waialuanus* (Rathbun, 1906).

On the basis of Chapter 1, the author could understand the systematic accounts of the Korean pilumnoid and xanthoid crabs and their distribution based on the collected sites and literatures. Moreover, the Cytochrome Oxydase subunit I (COI) sequences were obtained from these crabs based on the present study of Chapter 1-1. The author found the suspected cryptic species and taxonomic relationship of members of two superfamilies based on their COI sequences. On the way to studying Chapter 1, the author was extended the study to *Zehntneriana* n. sp. and the genus *Leptodius*. However, more sequences of other mitochondrial or nuclear region from many individuals would be needed in order to define the molecular taxonomic relationship more accurately.

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요 약

한국에 서식하는 애기털보부채게류와 부채게류에 대해 계통분류학적 연구를 수행하였다. 서울대학교 계통분류 및 분자진화학실험실에 1950 년 이후로 채집되어진 표본들을 사용하였다. 대부분의 표본들은 한국 연안에 조간대에서 채집되었다. 애기털보부채게상과 12 속 28 종과 부채게류 24 속 28 종에 대한 연구를 진행하여 총 48 종에 대한 종목록, 분류검색표, 기재, 사진 및 삽화 등을 작성하였다. 추가적으로 각 종마다 한국내 문헌상 채집와 실험된 표본들의 채집지를 조사하여 한반도 지도에 표시하였고, 종의 모식산지와 전세계 분포를 조사하여 지도에 표기하였다. 연구를 수행하는 기간동안 애기털보부채게상과 1 종(민이마부채게)과 부채게상과 8 종(넓은가시옴부채게, 다모그물등부채게, 잔물결부채게, 돋음부채게, 짧은털부채게, 가는손부채게, 고운반달게, 납작발부채게)의 한국내 미기록종을 기재하였다. 한국에 서식하는 두개상과 26 종의 mtCOI 의 염기서열을 획득하여 DNA barcoding 을 사용하여 실험하여 오동정된 표본들이나 은둔종으로 의심되는 개체들을 발견하고 그들간에 분자계통학적 관계를 알아보기 위해 Baysian inference 와 Maximum likelihood analysis 를 사용하여 다음과 같은 결과를 얻었다: 1) 꼬마매끈이송편게의 분류학적 위치에 대한 의문, 2) *Leptodius nigromaculatus*(Serène, 1962)와 *Leptodius affinis* (De Haan, 1835)와 같은 종이라는것, 3) *Actaea bocki* (Odhner, 1925)의 분류학적 위치에 대한 의문, 4) 한국에 서식하는 두드러기부채게에 대한 의문. Zehntneriana villosa (Zehntner, 1984)의 기재와 삽화등을 재기재하였으며, 일본에서 Zehntneriana villosa 로 Takeda 가 명명하였던 개체는 신종으로써 기재하였다. Leptodius 속에 관한 제고로써 총 10 종이 이속을 구성한다: *L. acutidens* (Stimpson, 1907), *L. affinis*, *L. australis* Ward, 1936, *L. davaoensis* Ward, 1941, *L. exaratus* A. Milne-Edwards, 1834, *L. gracilis* Dana, 1852, *L. planus* Ward, 1834, *L. sanguineus* A. Milne-Edwards, 1834, *L. nudipes* (Dana, 1853). 그리고 *Leptodius nigromaculatus* 는 *L. affinis* 로, *L. philippinensis* Ward, 1941 와 *L. hombronii* (Lucas, in Jacquinot & Lucas, 1853)는 *L. sanguineus* 로 동종이명처리하였다. 또한 *Leptodius efference* Rathbun, 1907 은 *Liocarpilodes* Klunzinger, 1913 속으로, *L. waialuanus* Rathbun, 1906 는 *Etisus* H. Milne Edwards, 1834 속으로 변경한다.

주요어 : 애기털보부채게, 부채게, 부채게속, 긴발둥글게속, 계통분류학.
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