TAXONOMIC STUDIES ON RECENT MARINE PODOCOPID OSTRACODA FROM THE INLAND SEA OF SETO[1)2)]

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With Text-figures 1–23, and Tables 1–3

I INTRODUCTION

Marine Ostracoda occur abundantly in intertidal and subtidal zones along the shores of Japan and play some important roles as a member of benthoses. Only a few studies, however, have been made up to date, and until 1975 only about 200 recent species, including 150 marine podocopid species, have been reported from Japan and its adjacent seas. Besides, more than half of them have been described by paleontologists, who are interested in the valves alone, and who have not examined the soft parts. In order for a more exact identification and for a more natural systematization, attention should be paid to the soft parts as well as the calcareous parts. The deficiency of the systematic information also has much hindered the advance in the ecological and the biological researches on the ostracods.

Recently, the author has been collecting ostracods at a number of shores along the central area of the Inland Sea of Seto, and has discovered 66 podocopid species, including 34 new species, which are to be described here (52 species of them have already been published). The appendages of these species are described and figured in detail, as the soft parts of Japanese species are hardly clarified and as they are important to identify the species. In addition, the collecting data from about 30 stations may give some information on the zoogeography of the ostracods.

II ACKNOWLEDGEMENTS

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1) Recent Marine Ostracoda in the Inland Sea, Japan - 17.

2) Contribution from the Mukaishima Marine Biological Station, No. 179.

in collecting some species. The Scanning Electron Microscopic photographs were kindly taken by Mr. Yutaka Okada at the Palaeontological Laboratory, Geological Institute, Faculty of Science, University of Tokyo. The author is also indebted to Dr. I. G. Sohn of the U. S. National Museum, for his invaluable advice.

III HISTORICAL REVIEW

The only contribution to the systematical knowledge of podocopid Ostracoda in the Inland Sea of Seto was made by G. S. Brady (1880) in the "Report on the Ostracoda dredged by H.M.S. Challenger, during the years 1873–1876". When the "Challenger" came to Japan, Brady collected nine species from the Inland Sea (lat. 34°21'N, long. 133°35'E, 15 fathoms, Mud - St. 233B - the west area of the Bisan-Seto) on May 26, 1875. The species were as follows:

Cythere acupunctata n. sp.	(=*Cytheromorpha acupunctata*)
C. bicarinata n. sp.	(=*Nipponocythere bicarinata*)
C. cymba Brady, 1869	(=*Aurila subconvexa*)
C. quadriaculeata n. sp.	(=*Spinileberis quadriaculeata*)
C. hodgii Brady, 1866	(=*Bicornucythere bisanensis*)
C. darwini n. sp.	(=*Echinocythereis bradyi*)
C. scabrocuneata n. sp	(=*Trachyleberis scabrocuneata*)
Krithe hyalina n. sp.	
Loxoconcha sinensis Brady, 1869	

Since then, no Ostracoda have been taxonomically reported from the Inland Sea, except for *Cypridina hilgendorfi* Müller, a myodocopid ostracod, which is listed in the "Fauna and Flora of the Inland Sea of Seto" published in 1963 by the Mukaishima Marine Biological Station.

IV STATION DATA, MATERIAL AND METHODS

Specimens examined herein have been collected from about 30 shores of the middle east area of the Inland Sea of Seto, as shown in Table 1 and Figure 1.

Capitals in parentheses in Table 1 are symbols for Stations. HSB, SJI, IIO, F, MBS, HS, AI, SSI are in Hiroshima Prefecture, WI, NI, TI, SIG in Kagawa Prefecture, AK, AO in Hyogo Prefecture, and the others in Okayama Prefecture.

All the material examined were collected by the author mostly in the springs and summers of 1976 and '77. In the *Material* column of each species, [MO-provisional No., Sex, Left, Right valve (length-height in 0.01 mm), Symbol of Station] is to be written. The holotypes and allotypes will be deposited in the National Science Museum, Tokyo, and most of the paratypes in the Mukaishima Marine Biological Station, Hiroshima University.

Marine podocopid ostracods may be creeping about on or in any type of substrata, especially in thickets of algae, and even in mud or sand. In order to collect

ostracods on algae, some algae were picked up with a large pincette, put in a vessel filled with dilute formalin, and shaken in the vessel. Dead ostracods with detritus may sink on the bottom, or occasionally float on the surface of the water. Sediment with some sea water was transfused into a bottle. In order to collect ostracods in mud or sand, the matter near the sea-bed which was thought to contain ostracods was dredged and put in a bottle.

The sediment or the mud in the bottle was poured into Petri-dishes and observed under reflected light usually at 16 times magnification of a binocular microscope.

Table 1. Stations where ostracods were collected

ROCKY-SHORES—INTERTIDAL ZONE

2 (SJI) Shiju-shima Island (133° 9.9′E, 34°21.5′N), 18-VII-1977.
3 (IIO) In-no-shima Island (133°10.8′E, 34°21.0′N), 25-VII-1976.
5 (MBS) near the Mukaishima Marine Biological Station (133°13.2′ E, 34°21.7′N), on various days, date supplemented.
7 (AI) Ategi-shima Islet (133°15.6′E, 34°19.7′N), 6-VII-1975, 28-VII-1976.
8 (SSI) Sensui-to Island (133°24.0′E, 34°22.5′N), 10-VIII-1976, 3-VII-1977.
9 (KSI) Ko-no-shima Island (133°31.6′E, 34°26.8′N), 13-VI-1977.
10 (IK) Iwaya, Kurashiki (133°37.5′E, 34°29.4′N), 27-VII-1976, 31-V-1977.
11 (WI) Wasa-jima Island (133°48.5′E, 34°23.4′N), 23-VII-1976, 10-VII-1976.
12 (OH) Ohama (133°49.4′E, 34°25.6′N), 5-IX-1975, 2-VII-1977.
14 (OZI) Ozuchi-jima Islet (133°55.3′E, 34°25.0′N), 14-V-1976.
15 (UN) Uno (133°57.9′E, 34°29.8′N), 26-VI-1976.
16 (NI) Nao-shima Island (133°58.7′E, 34°26.9′N), 13-VII-1977.
17 (DW) Desaki-West coast (133°59.8′E, 34°30.9′N), 21-VI-1975, 28-V-1976, 3-V-1977.
18 (DE) Desaki-East coast (134°0.0′E, 34°31.3′N), 30-IX-1976, 12-IX-1977.
19 (MN) Muneage (134°1.5′E, 34°32.5′N), 23-VI-1975, 16-VI-1977.
20 (TI) Te-shima Island (134°3.3′E, 34°29.1′N), 29-VII-1977.
21 (KG) Kugui (134°4.3′E, 34°34.8′N), 18-VI-1978.
22 (INI) Inu-jima Island (134°6.4′E, 34°33.5′N), 18-VII-1978.
23 (HD) Hoden (134°6.7′E, 34°35.1′N), 27-VI-1976, 30-VI-1977.
24 (NW) Nishiwaki (134°8.4′E, 34°36.0′N), 6-IV-1977.
25 (MI) Mae-jima Island (134°10.5′E, 34°36.0′N), 28-V-1975, 7-VIII-1976, 16-V-1977, 21-VII-1978.
26 (SIG) Shodo-shima Island-Gamo (134°12.5′E, 34°28.4′N), 30-VII-1977.
27 (MS) Mushiage (134°13.6′E, 34°40.7′N), 6-IV-1977.
28 (KJI) Ko-jima Island (134°16.0′E, 34°41.6′N), 2 & 4-VIII-1976.
29 (OTI) Otabu-jima Island (134°18.0′E, 34°40.8′N), 7-IX-1976, 14-VII-1977.
30 (KI) Kakui-jima Island (134°18.6′E, 34°41.3′N), 23-II-1975.
31 (AK) Ako (134°24.8′E, 34°43.4′E), 12-VII-1975.
32 (AO) Aioi (134°28.4′E, 34°45.7′N), 26-VII-1976, 15-VII-1977.

SAND-MUD—INTERTIDAL ZONE

1 (HSB) Hoso-no-su Sand Bank (133°8.0′E, 34°21.9′N), 1-VI-1977, 17-VII-1977.
6 (HS) Hishio (133°13.2′E, 34°22.0′N), 11-VI-1976, 6-V-1977.
(DW), (MI), (SIG) & (KI).

MUD—SUBTIDAL ZONE (10–20 m deep)

4 (F) Fuka-ura (133°13.0′E, 34°21.5′N), 28-VII-1975.
13 (S) Shibukawa (133°54.2′E, 34°27.1′N), 28-V-1978.
(MBS).

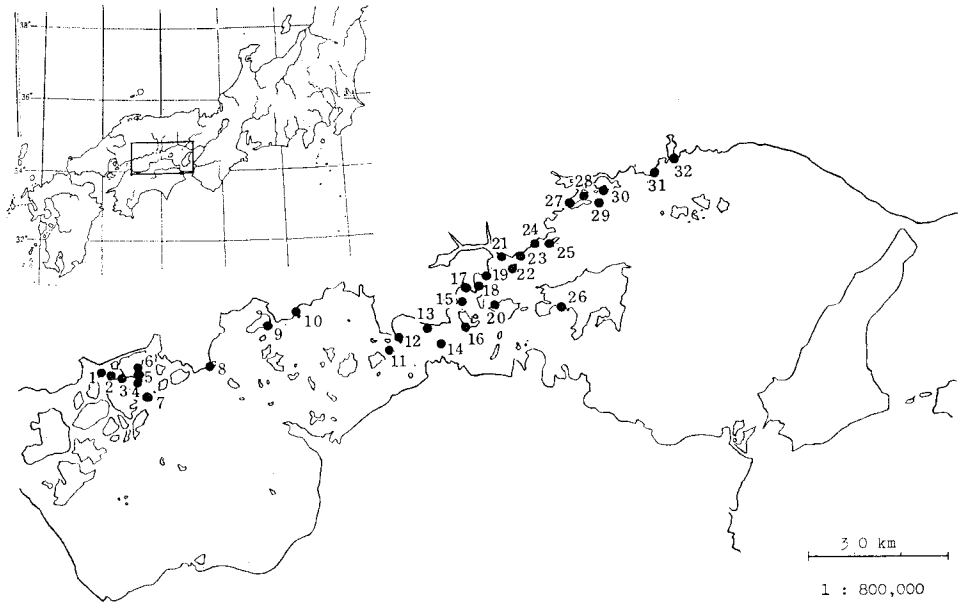

Fig. 1. Stations where ostracods were collected.

The ostracods found in it were picked up with a pipette and put into a vial containing 80 % alcohol. Some of them were preserved in it.

For the purpose of identification, a specimen, after washed in water, was placed in a drop of "Neo-Shigaral" on one side of a slide glass and dissected with a pair of fine needles through transmitted light under high magnifications, usually at 40 times, on a binocular microscope. The appendages were removed from the body and spread out in the drop, and then covered with a cover glass. Treatment of specimens with 5 % sodium hydroxide facilitated the dissection, though it dissolved the unchitinous parts of the body. The specimens mounted in glycerin were more easily observed, but hard to preserve.

The valves removed, first of all, were put in water as soon as possible, in order to wash out "Neo-Shigaral" that contains some acid. When valves were covered with mud or detritus, they were often cleaned with a sharpened toothpick, or in the case of hard valves with ultrasonic waves. The separate valves were preserved in the following two ways. One was to mount the valves in Canada balsam, after they were treated with absolute alcohol and xylene, being suitable for preserving thin valves of smooth surface and for observing the marginal areas of all the valves. The other was to glue the valves on a slide glass or a piece of black thick paper with a dilute solution of gum tragacanth in which a few drops of thymol or oil of cinnamon were added, being useful for examining the surface of valves with reflected light. The valves may be easily unglued from the glass or paper with a drop of water, when necessary.

Staining was not always necessary; in some specimens, methylene blue, mala-

chite green or rose bengal was used.

The length and height of valves were measured as in Figure 12.

V SYSTEMATIC DESCRIPTION

Order PODOCOPIDA Sars, 1866

Superfamily BAIRDIACEA Sars, 1888

Family BAIRDIIDAE Sars, 1888

Genus *Neonesidea* Maddocks, 1969

*1. *Neonesidea oligodentata* (Kajiyama, 1913)

Bairdia oligodentata Kajiyama, 1913, p. 3, Pl. 1, figs. 10–18; Hanai, 1959c, p. 424;—, in Ueno and Hanai, 1965, p. 454, figs. 419; Ishizaki, 1968, p. 16, Pl. 1, figs. 1,2, Pl. 3, figs. 1–3;—, 1975a, p. 54, fig. 1; Okubo, 1975b, p. 94, figs. 1a-k, 2.

Bairdia sp. Okubo, 1975b, p. 97, fig. 1–1.

Neonesidea oligodentata: Schornikov, 1975, p. 2; Hanai *et al.*, 1977, p. 18.

Superfamily CYPRIDACEA Baird, 1845

Family PONTOCYPRIDIDAE Müller, 1894

Genus *Propontocypris* Sylvester-Bradley, 1947

Subgenus *Propontocypris* Sylvester-Bradley, 1947

*2. *Propontocypris* (*Propontocypris*) *attenuata* (Brady, 1868)

Pontocypris attenuata: Ishizaki, 1968, p. 16, Pl. 3, fig. 6.

Propontocypris (*Propontocypris*) *attenuata*: Hanai *et al.*, 1977, p. 19; Okubo, 1979d, p. 31, fig. 1;—, 1980b, Pl. 1a, 1b.

Subgenus *Ekpontocypris* Maddocks, 1969

*3. *Propontocypris* (*Ekpontocypris*) *japonica* Okubo, 1979

Propontocypris (*Ekpontocypris*) *japonica* Okubo, 1979d, p. 34, figs. 2, 3 ; —1980b, Pl. 1c, d.

Family CANDONIDAE Kaufmann, 1900

Subfamily PARACYPRIDINAE Sars, 1923

Genus *Aglaiocypris* Sylvester-Bradley, 1947

*4. *Aglaiocypris nipponica* Okubo, 1980

Aglaiocypris nipponica Okubo, 1980b, p. 17, fig. 1, Pl. 1e, f.

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* Species asterisked have been reported by Okubo (1975–'80)

Subfamily THALASSOCYPRIDINAE Hartmann and Puri, 1974

Genus *Dolerocypria* Tressler, 1937

*5. *Dolerocypria mukaishimensis* Okubo, 1980

Dolerocypria mukaishimensis Okubo, 1980b, p. 20, fig. 2, Pl. 1g, h.

Genus *Thalassocypria* Hartmann, 1957

*6. *Thalassocypria inujimensis* Okubo, 1980

Thalassocypria inujimensis Okubo, 1980b, p. 22, fig. 3, Pl. 1i, j.

Superfamily CYTHERACEA Baird, 1850

Family CYTHERIDEIDAE Sars, 1925

Subfamily CYTHERIDEINAE Sars, 1925

Genus *Clithrocytheridea* Stephenson, 1936

*7. *Clithrocytheridea? japonica* (Ishizaki, 1968)

Clithrocytheridea sp. A Ishizaki, 1968, p. 18, Pl. 3, fig. 12.
Perissocytheridea japonica Ishizaki, 1968, p. 18, Pl. 1, fig. 4, Pl. 3, figs. 4, 5.
Clithrocytheridea? japonica (Ishizaki, 1968): Hanai *et al.*, 1977, p. 24; Okubo, 1979c, p. 143, fig. 1a-d.

Subfamily CUSHMANIDEINAE Puri, 1973

Genus *Pontocythere* Dubowsky, 1939

*8. *Pontocythere subjaponica* (Hanai, 1959)

Cushmanidea subjaponica Hanai, 1959a, p. 298, Pl. 16, figs. 4–6; Ishizaki, 1968, p. 19, Pl. 3, figs. 16, 17: —, 1969, p. 216, Pl. 26, fig. 17;—, 1971, p. 79, Pl. 2, fig. 18; Okubo, 1977c, p. 135, figs. 2, 3.
Pontocythere subjaponica: Hanai *et al.*, 1977, p. 25.

Subfamily KRITHINAE Mandelstam, 1958

Genus *Parakrithella* Hanai, 1961

*9. *Parakrithella pseudadonta* (Hanai, 1959)

Neocyprideis pseudadonta Hanai, 1959a, p. 300, Pl. 17, figs. 5–9, text-figs. 2a, b.
Parakrithella pseudadonta: Hanai, 1961a, p. 360, text-fig. 4A, figs, 2a, b; Ishizaki, 1968, p. 18, Pl. 3, figs. 13, 14; —, 1971, p. 78, Pl. 2, fig. 16; Okubo, 1976a, p. 99, figs. 1, 2; Hanai *et al.*, 1977, p. 27, Pl. 1, figs. 3–7, Pl. 2, figs. 1, 2.
Eukrithe zhirmunskyi Schornikov, 1975, p. 4, fig. 1.

Family LEPTOCYTHERIDAE Hanai, 1957

Genus *Callistocythere* Ruggieri, 1953

Callistocythere littoralis group

*10. *Callistocythere setouchiensis* Okubo, 1979

Callistocythere setouchiensis Okubo, 1979b, p. 15, fig. 1, Pl. 1a-d.

*11. *Callistocythere hosonosuensis* Okubo, 1979

Callistocythere hosonosuensis Okubo, 1979b, p. 17, fig. 2, Pl. 1e-h.

*12. *Callistocythere angulata* Okubo, 1979

Callistocythere angulata Okubo, 1979b, p. 18, fig. 3, Pl. 1i-1.

Callistocythere japonica group

*13. *Callistocythere japonica uranipponica* Hanai, 1957

Callistocythere japonica uranipponica Hanai, 1957a, p. 459, Pl. 9, fig. 3a-c; Hanai *et al.*, 1977, p. 33; Okubo, 1979b, p. 20, fig. 4, Pl. 2a-d.

*14. *Callistocythere pumila* Hanai, 1957

Callistocythere pumila Hanai, 1957a, p. 459, Pl. 10, figs. 2a-c; Okubo, 1975a, p. 24, fig. 1.

*15. *Callistocythere laevis* Okubo, 1979

Callistocythere laevis Okubo, 1979b, p. 23, fig. 5, Pl. 2e-h.

Family CYTHERIDAE Baird, 1850

Subfamily CYTHERINAE Baird, 1850

Genus *Cythere* O. F. Müller, 1785

*16. *Cythere nishinipponica* Okubo, 1976

Cythere nishinipponica Okubo, 1976c, p. 113, figs. 1–3.

Genus *Cytheromorpha* Hirschmann, 1909

*17. *Cytheromorpha acupunctata* (Brady, 1880)

Cythere acupunctata Brady, 1880, p. 68, Pl. 14, figs. 1a-h; Hanai, 1959c, p. 428.

Cytheromorpha acupunctata: Hanai, 1961a, p. 371, text-fig. 12, figs. 2a, b; Ishizaki, 1968, p. 35, Pl. 7, figs. 17, 18; —, 1969, p. 220, Pl. 26, figs. 5, 6; —, 1971, p. 90, Pl. 3, fig. 13; Hanai *et al.*, 1977, p. 64; Okubo, 1978b, p. 91, figs. 1a-f, 2, 4a-h.

Cytheromorpha japonica Ishizaki, 1968, p. 36, Pl. 9, figs. 11, 12; —, 1969, p. 221, Pl. 26, fig. 16.

Subfamily uncertain

Genus *Spinileberis* Hanai, 1961

*18. *Spinileberis quadriaculeata* (Brady, 1880)

Cythere quadriaculeata Brady, 1880, p. 86, Pl. 25, figs. 4a-d.
Cythereis quadriaculeata: Hanai, 1959c, p. 428.
Spinileberis quadriaculeata: Hanai, 1961b, p. 167, figs. 1–7; Ishizaki, 1968, p. 42, Pl. 7, figs. 15, 16; —, 1969, p. 222, Pl. 26, fig. 18; —, 1971, p. 95, Pl. 4, fig. 4; Hanai *et al.*, 1977, p. 40; Okubo, 1978b, p. 95, figs. 1g-j, 3, 4i-p.

Family HEMICYTHERIDAE Puri, 1953

Subfamily HEMICYTHERINAE Puri, 1953

Aurila Group

Genera *Aurila* Pokorný, 1955 & *Mutilus* Neviani, 1928

Description. Carapace of slight sexual dimorphism; female higher than male in general. Surface rather regularly pitted in *Aurila,* or coarsely, irregularly and strongly pitted in *Mutilus.*

Valves greatly asymmetrical; left valve higher than the right; almond-shaped (in most *Aurila*) to sub-quadrangular (in most *Mutilus*). Dorsal margin almost straight or somewhat convex (especially in left valve), descending backward, with prominent postero-dorsal angle. Anterior margin broadly and distortedly rounded, often with several tubercles. Posterior margin concave above, convex below, with several denticles. Ventral margin almost straight or slightly sinuated (especially in right valve).

Infold relatively wide. Inner margin smooth. Fused zone nearly as wide as infold. Vestibule very narrow anteriorly and postero-ventrally. Radial pore canals numerous. False radial pore canals present. Hingement amphidont.

Antennula: Of five podomeres. First podomere without seta. Second podomere with seta postero-distally. Third podomere with seta or claw antero-distally. Fourth podomere with one claw and two setae antero-medially, one claw, one short seta and two normal setae antero-distally. Fifth podomere with fine claw, two setae and sense club distally.

Antenna: Of four podomeres. First podomere without seta. Second podomere sub-square, with stout seta postero-distally. Third podomere elongate, with two setae antero-medially, two setae and sense club postero-medially, one seta at postero-distal corner; one postero-medial seta showing sexual dimorphism, various shapes in male, typical seta in female. Fourth podomere with three claws distally. Spinneret seta of great sexual dimorphism, three-segmented; slender and kneeling at distal joint in male, short and stout in female.

Mandible: Coxa relatively small; lower part rather wide, with seven rows of small teeth. Palp of four podomeres. First podomere with two (one normal, one

feather-like) setae; exopodite of thick plumose seta and short process. Second podomere with fine seta antero-distally, two long feather-like and two fine setae postero-distally. Third podomere with strong haired seta postero-medially and eight (five long normal, one medial striped, two fine) setae distally. Fourth podomere with four (one fine, one striped, two claw-like) setae distally.

Maxillula: Branchial plate with 15 feather-like setae, one of which is apart from the others. Palp of two podomeres; proximal podomere with one long and three short setae antero-distally, one stout seta postero-distally; distal podomere with three setae distally. Masticatory lobes with respective seven setae distally.

Walking legs: Of four podomeres. Setal formula of (antero-medial, antero-distal, posterior) areas of protopodites: (2,2,1),(1+1,1,1),(1,1,1). Second podomere with seta antero-distally, respectively; the seta of thoracopoda 1 generally slender in male. Claw rather strong.

Copulatory organ: Basal part semi-circular, with large, elongate process and long copulatory duct; processes asymmetric in general.

Remarks. The genus *Mutilus* differs from the genus *Aurila* only in having strong ornamentation on the surface. No difference in soft parts is found between both genera.

When the copulatory organ of the male is used as one of the important criteria to subdivide this group, *Aurila subconvexa* (=*A. miii* and=*A. cymba* from Japan) may be separated from the others.

19. *Aurila subconvexa* (Kajiyama, 1913)

(Figs. 2, 7 m,n, 9 a-d)

Cythere cymba: Brady, 1880, p. 80, Pl. 20, figs. 5a-f; Hanai, 1959c, p. 428.
Cythereis subconvexa Kajiyama, 1913, p. 14, Pl. 1, figs. 74, 75; Hanai, 1959c, p. 429.
Aurila miii Ishizaki, 1968, p. 22, Pl. 2, fig. 9, Pl. 4, figs. 1, 2; —, 1969, p. 217, Pl. 25, fig. 13; —, 1971, p. 81, Pl. 2, fig. 1.
Aurila cymba: Hanai *et al.*, 1977, p. 42.
Aurila subconvexa: Hanai *et al.*, 1977, p. 44.

Description. Surface ornamented with pits of nearly equal size. Anterior marginal ridge feeble, from mid-anterior margin through eye spot to postero-dorsal margin. Ventral marginal ridge distinct, broadly convex, from antero-ventral to just before posterior extremity, where it meets posterior radiate ridge. Radiate ridges very weak; three in number: two from antero-medial area toward above and below anterior extremity, one from postero-medial area to posterior extremity.

Sexual dimorphism slight; greatest height of left valve at the middle in female, at anterior two-fifths in male.

Valves asymmetrical. Left valve of almond shape. Dorsal margin evenly arched. Anterior margin broadly and obliquely rounded. Posterior margin concave above, convex below, with some small denticles. Ventral margin convex in general, somewhat concave anteriorly. Right valve sub-quadrangular; lower

than the left; somewhat angulated at highest point, postero-dorsal angle and posterior extremity.

Antennula: Distal four podomeres and terminal claw having length ratio 31:17:26:15:32. Antenna: Distal three podomeres and claw having length ratio 26:47+21:9:30; spinneret seta three-segmented at length ratio of 53:33:39.

Mandible and Maxillula: Of *Aurila-Mutilus* type.

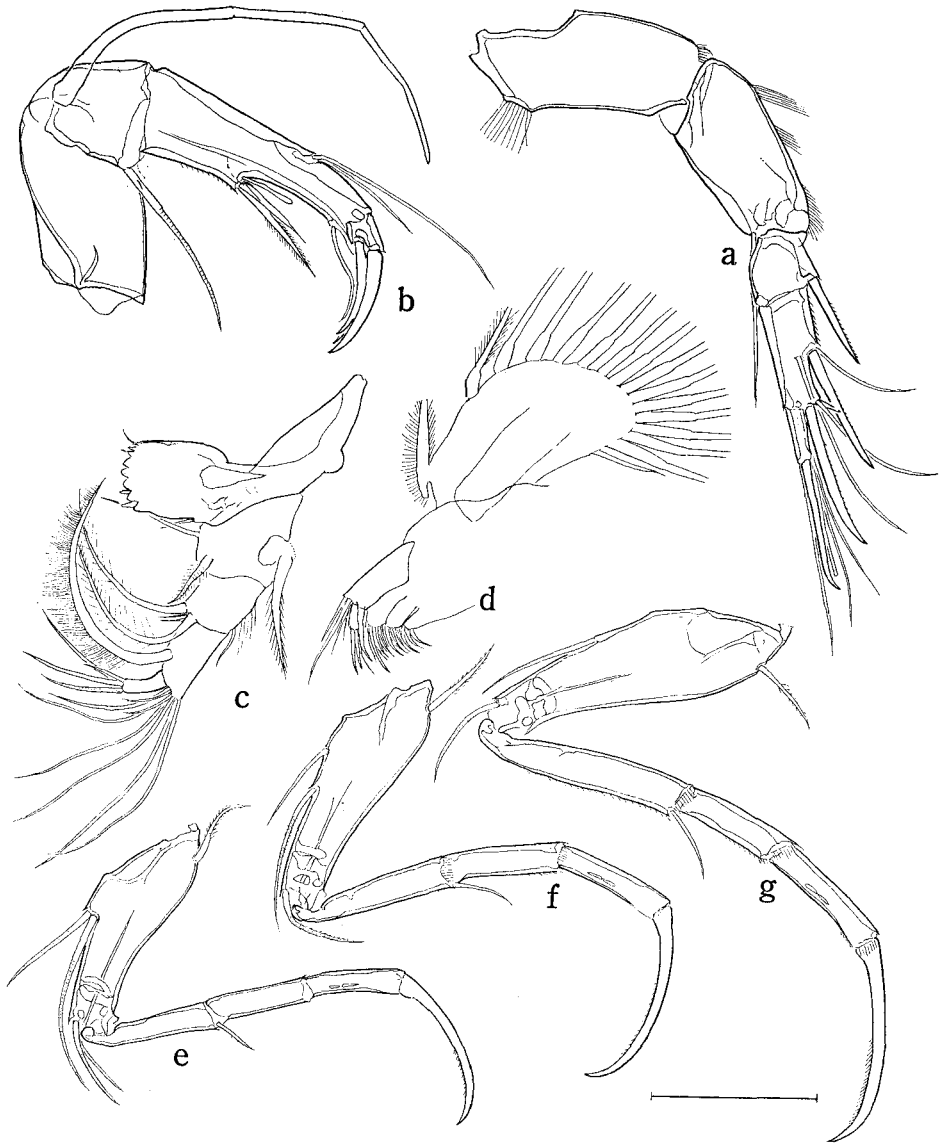


Fig. 2. *Aurila subconvexa*. MO-730, ♂.
a, antennula; b, antenna; c, mandible; d, maxillula; e, maxilla; f, thoracopoda 1; g, thoracopoda 2.
Scale given in 0.1 mm for all.

Walking legs: Second to fourth podomeres and claws having length ratio (33:27:25:46):(40:32:30:54):(56:30:32:59).

Copulatory organ: Basal part of *Aurila-Mutilus* type. Process very large, nearly twice that of other species; the tip tapered distally, bent like a beak slightly asymmetrically: left one bent at acute angle, right one at right angle.

(Other characters: Cf. generic description.)

Material. MO-713, ♂, LV (79–50), RV (81–47); MO-730, ♂, LV (74–45), RV (74–43); MO-731, ♀, LV (79–50), RV (77–47); HSB, 17-VII-1977.

Occurrence. Not common, rather abundant; in sandy shores as well as rocky shores in the Inland Sea.

Remarks. Hanai *et al.* (1977) have listed *Aurila miii* as a synonym of *A. cymba.* Specimens from the Inland Sea agree with *A. subconvexa* in the copulatory organ, and with *A. miii* in the carapace. Therefore, *A. cymba* of the Inland Sea, *A. subconvexa, A. miii* and the specimens are thought to be included within one and the same species. Although Brady (1880) thought the specimens from the Inland Sea of Seto were the same species as those from the Mediterranean, both specimens seem to be different from each other in all probability. Even Müller (1912) doubted the similarity between the Atlantic and the Indo-Pacific specimens. Here this species is named *A. subconvexa.*

20. *Aurila corniculata* sp. nov.

(Fig. 10 g-j)

Description. Male not discovered.

Surface rather regularly pitted, with small protuberance postero-dorsally. Ventral marginal ridge moderately developed, from near anterior terminal of ventral margin, parallel to ventral margin, reaching to posterior radiate ridge. Anterior marginal ridge from anterior radiate ridge, through eye spot, disappearing at anterior third of dorsal margin. Postero-dorsal marginal ridge from just below the end, parallel to dorsal margin, through postero-dorsal protuberance, down to posterior radiate ridge. Four radiate ridges prominent: anterior one nearly straight, horizontal; antero-ventral one slightly sinuate; both connecting near anterior margin, forming loop; posterior one slightly curved, reaching to posterior extremity; postero-dorsal one less noticeable, very short, ending in protuberance, not extending to valve margin.

Valves asymmetrical. Left valve almond-shaped; greatest height at the middle. Dorsal margin evenly arched. Anterior margin broadly rounded, dorso-anteriorly nearly straight. Posterior margin slightly concave above, round below, with several small denticles. Ventral margin convex. Right valve sub-trapezoidal; dorsal margin straight; ventral margin more sinuate.

Marginal zone and hingement of *Aurila-Mutilus* type.

Material. MO-1105, ♀ (holotype), LV (78–50), RV (76–47), HSB, 17-VII-

1977. MO-306, ♀ (paratype), LV (78–52), RV (77–48), MBS, 13-V-1976.

Occurrence. Not common, not abundant. In intertidal zones of sandy and rocky shores in the Inland Sea.

Remarks. The new species resembles *A. disparata* sp. nov. in the shape of valves, but differs from the latter in having the postero-dorsal protuberance.

21. *Aurila hataii* Ishizaki, 1968

(Figs. 3, 7 g-j, 8, 10 a-f)

Cythere villosa Baird, Imanishi, 1954, p. 90, fig. 2.
Aurila hataii Ishizaki, 1968, p. 20, Pl. 1, figs, 5, 6, Pl. 4, figs. 5, 6; Hanai *et al.*, 1977, p. 43.
Aurila cf. *hataii*: Ishizaki, 1971, p. 81, Pl. 2, figs. 2, 3.

Description. Surface ornamented with a number of pits, strong ridges, distinct eye spot, and postero-dorsal protuberance. Anterior marginal ridge from mid-anterior area to eye spot, making two loops with radiate ones; dorsal one from eye spot, parallel to dorsal margin, through postero-dorsal protuberance, to mid-posterior area; ventral one weak and short. Several radiate ridges prominent: antero-ventral one slightly sinuate, forming semi-loop with anterior one; antero-dorsal one to eye spot; postero-dorsal one prominent, from postero-medial area through postero-dorsal protuberance to the valve margin; posterior one sinuate, to posterior extremity.

Sexual dimorphism not remarkable. Valves distinctly asymmetrical. Left valve sub-quadrate; greatest height at anterior third. Dorsal margin slightly convex. Anterior margin broadly rounded. Posterior margin protruding at lower third, convex above, concave below. Ventral margin slightly sinuous or nearly straight. Right valve sub-trapezoidal; dorsal margin straight. Ventral margin distinctly sinuated.

Marginal zone and hingement of *Aurila-Mutilus* type.

Antennula: Distal four podomeres and terminal claw having length ratio 31:17:23:12:30. Antenna: Distal three podomeres and claw having length ratio 27:45+20:9:27; spinneret seta three-segmented at length ratio 52:32:35.

Mandible and Maxillula: Of *Aurila-Mutilus* type.

Walking legs: Second to fourth podomeres and claws of maxilla and thoracopoda 1 & 2 having length ratio (26:24:22:40):(33:29:27:47):(46:30:28:52).

Copulatory organ: Of *Aurila-Mutilus* type. Two types of processes existing: in one type, left process terminating in sharp end, right process in round end; in the other type, both processes in round ends. Copulatory ducts, however, of the same shape in the two types, curved and swollen at proximal third, narrowing and reflexed at distal third, extending beyond processes.

(Other characters: Cf. generic description.)

Material. MO-802, ♂, LV (72–43), RV (71–41), TI. MO-923, ♂, LV (72–43), RV (71–41); ♀, LV (73–46), RV (73–43); WI, 10-VII-1976. MO-941, ♂, LV (71–43), RV (71–42), OH, 2-VII-1977.

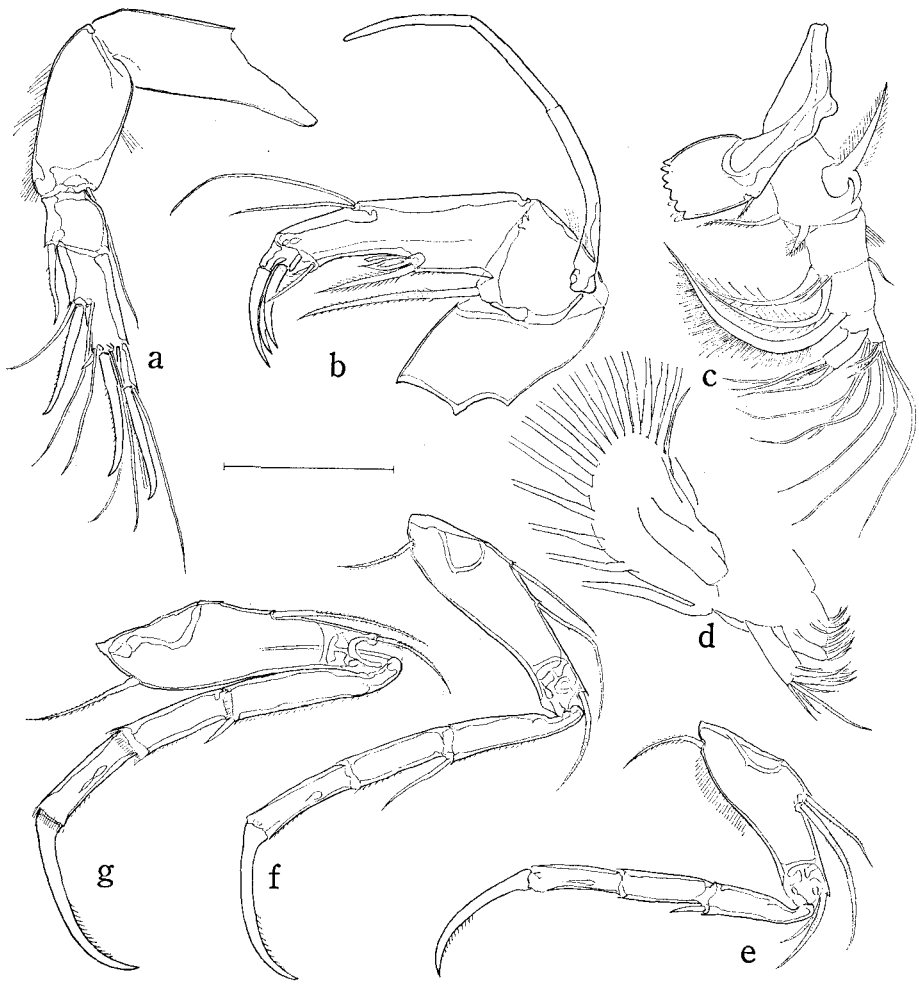


Fig. 3. *Aurila hataii*. MO-802, ♂.
a, antennula; b, antenna; c, mandible; d, maxillula; e, maxilla; f, thoracopoda 1; g, thoracopoda 2.
Scale given in 0.1 mm for all.

Occurrence. Not common, rather abundant; in intertidal zones of rocky shores.

Remarks. Specimens in the Inland Sea agree well with Ishizaki's (1968). The species is characterized by the sub-quadrangular left valve. Judging from the variety of copulatory organs, this species may be subdivided into a few subspecies or even a few species.

*22. *Aurila inabai* Okubo, 1976

(Figs. 7 k,l, 11 h-j)

Aurila inabai Okubo, 1976b, p. 34, fig. 1, Pl. 1.

23. *Aurila disparata* sp. nov.

(Figs. 4, 7 e,f, 9 e-j)

Description. Sexual dimorphism distinct; female higher than male; at a glance female and male looking separate species. Left and right valves asymmetrical.

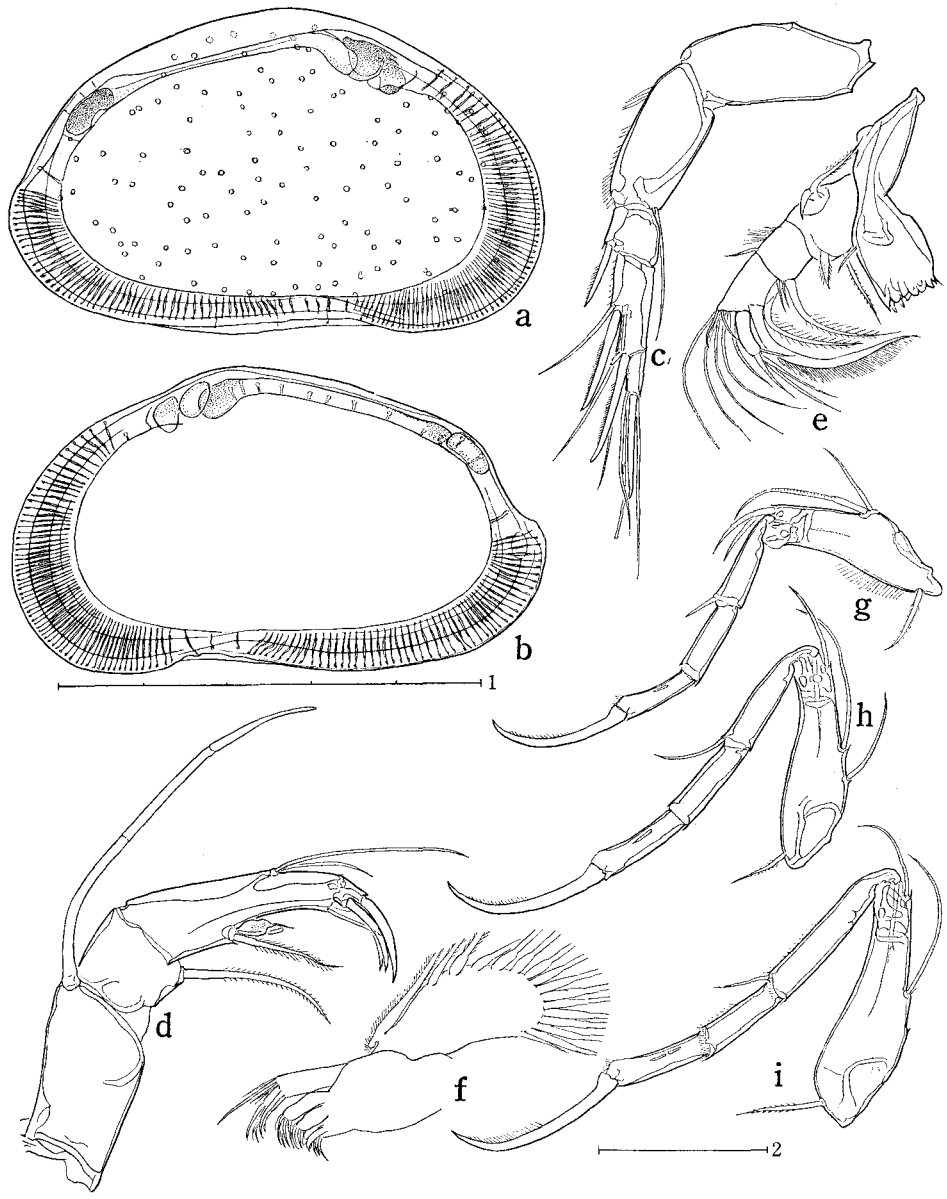


Fig. 4. *Aurila disparata.* MO-686, ♂.
a, left valve; b, right valve; c, antennula; d, antenna; f, mandible; g, maxillula; h, thoracopoda 1; i, thoracopoda 2.
Scale: 1 (=0.5 mm) for a, b; 2(=0.1 mm) for c-i.

Surface regularly and uniformly pitted. Anterior marginal ridge from mid-anterior area, through eye spot, to anterior third of dorsal margin. Dorsal marginal ridge apart from, and along, dorsal margin. Ventral marginal ridge along ventral margin, from antero-ventral to posterior radiate ridge. Three radiate ridges prominent: anterior one nearly horizontal, almost straight; antero-ventral one nearly straight, toward antero-ventral area; posterior one slightly curved, reaching to posterior extremity. Postero-dorsal radiate ridge short, cut off by dorsal marginal ridge. No protuberance existing at postero-dorsal area.

Left valve triangularly almond-shaped; greatest height just in front of the middle. Dorsal margin greatly arched. Anterior margin broadly rounded. Posterior margin truncated above, rounded below, with several denticles. Ventral margin almost straight. Right valve sub-quadrangular, lower than the right.

Marginal area and hingement of *Aurila-Mutilus* type.

Antennula: Distal four podomeres and terminal claw having length ratio 26: 15:22:11:27. Antenna: Distal three podomeres and claw having length ratio 22:39+17:8:23; spinneret seta three segmented at length ratio 44:31:28.

Mandible and Maxillula: Of *Aurila-Mutilus* type.

Walking legs: Second to fourth podomeres and claws of maxilla and thoracopoda 1 & 2 having length ratio (25:22:20:38):(31:26:24:45):(43:24:24:47).

Copulatory organ: Both processes terminating in round ends. Copulatory duct slightly curved, with lamellar branch near end.

(Other characters: Cf. generic description.)

Material. MO-686, ♂, (holotype), LV (63–38), RV (62–36); MO-687, ♀ (allotype), LV (68–43), RV (67–41); OH, 2-VII-1977.

Occurrence. Not common. In sandy and rocky shores.

Remarks. This new species is discriminated from allied species by the copulatory organ with a lamellar branch. This species resembles in the shape of valves *A. corniculata* in this paper, but differs from the latter in having no postero-dorsal protuberance. This species also resembles *A. munechikai* Ishizaki, 1968, but differs from it in the outline of valves.

24. *Mutilus assimilis* (Kajiyama, 1913)

(Figs. 5, 7 a,b, 11 a-d)

Cythereis assimilis Kajiyama, 1913, p. 14, Pl. 1, fig. 76.
Mutilus aff. *assimilus* [*sic*]: Ishizaki, 1968, p. 24, Pl. 5, figs. 9, 10.

Description. Surface pitted coarsely and irregularly. The pits, except in the middle area, often disappearing. Anterior marginal ridge strong, parallel to anterior margin. Ventral marginal ridge greatly strong, from anterior terminal of ventral margin, along and sub-parallel to ventral margin, bent perpendicularly at postero-ventral margin, drawing arc behind it. Radiate ridges also strong; postero-dorsal and -ventral radiate ridges, ventral marginal ridge and posterior margin

building large hollow, in which a few small irregular pits are present; postero-dorsal radiate ridge of right valve projecting beyond dorsal margin, especially in female.

Sexual dimorphism slight, female somewhat larger than male. Valves asymmetrical. Left valve sub-quadrangular in lateral view; greatest height at anterior third. Dorsal margin slightly convex, descending backward, with distinct process postero-dorsally. Anterior margin broadly and distortedly rounded. Posterior

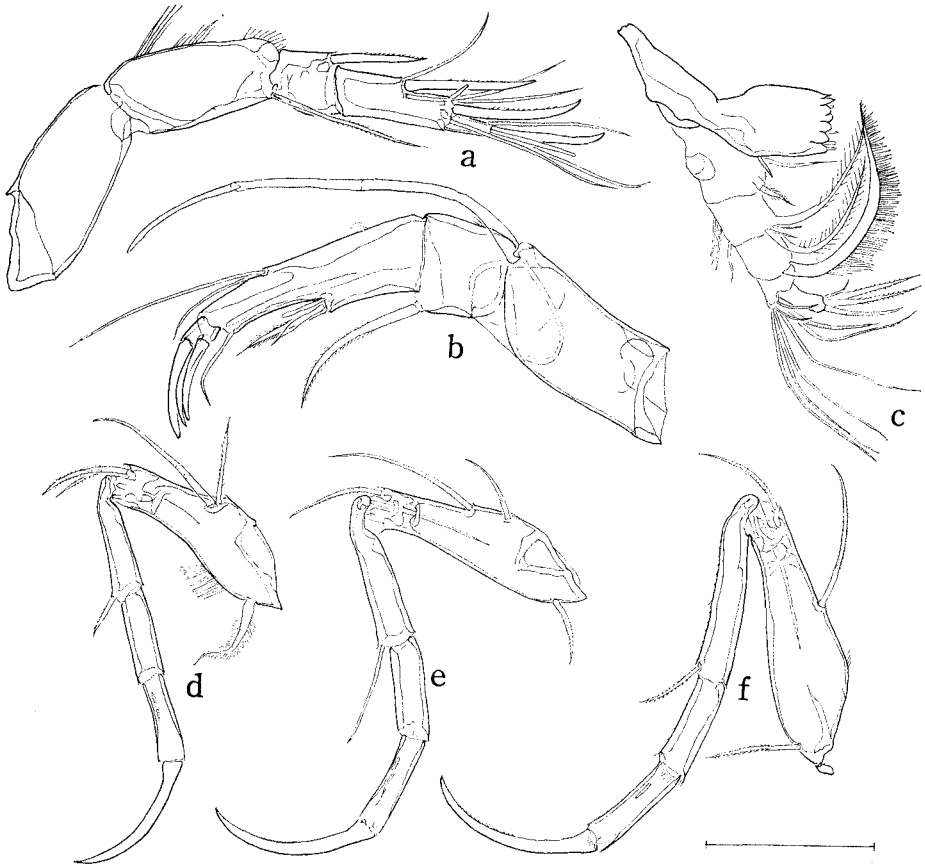


Fig. 5. *Mutilus assimilis*. MO-559, ♂.
a, antennula; b, antenna; c, mandible; d, maxilla; e, thoracopoda 1; f, thoracopoda 2.
Scale given in 0.1 mm.

margin concave above, convex below, with some denticles, the lowest one of which is most prominent. Ventral margin almost straight. Right valve lower than the left.

Marginal zone and hingement of *Aurila-Mutilus* type.

Antennula: Distal four podomeres and claw having length ratio 32:18:26:13:

29. Third podomere with claw. Antenna: Distal three podomeres and claw having length ratio 25:42+20:8:28. Spinneret seta three-segmented at length ratio 47:32:32.

Mandible and Maxillula: Of *Aurila-Mutilus* type.

Walking legs: Length ratio of second to fourth podomeres and claws of maxilla, thoracopoda 1 & 2 (29:25:22:41):(37:28:27:46):(49:28:28:49).

Copulatory organ: Left process with sharp end, the right with round end. Copulatory duct shorter than process, slightly swollen along the middle third, bent at distal third.

(Other characters: Cf. generic description.)

Material. MO-559, ♂, LV (74–46), RV (73–42), AK. MO-560, ♀, LV (74–46), RV (74–42), AK. MO-801, ♂, LV (70–44), RV (69–40), TI.

Occurrence. Common and abundant, in intertidal zones of rocky and sandy shores in the Inland Sea.

Remarks. Specimens from the Inland Sea agree with Kajiyama's (1913) and Ishizaki's (1968).

The specimen from Aomori Bay named *M. assimilus* [*sic*] (Ishizaki, 1971) does not belong to this species.

25. *Mutilus ishizakii* sp. nov.

(Figs. 6, 7 c,d, 11 e-g)

Mutilus assimilus [*sic*]: Ishizaki, 1971, p. 83, Pl. 3, fig. 14.

Description. Surface pitted somewhat coarsely, but not so coarse as in *M. assimilis.* Anterior marginal ridge weak, from mid-anterior to anterior third of dorsal margin. Ventral marginal ridge bent at an obtuse angle postero-ventrally. Radiate ridges somewhat strong: antero-ventral one most prominent, postero-dorsal one greatly sinuated, postero-ventral one not so noticeable.

Sexual dimorphism somewhat remarkable; female larger and higher than, but sub-equal in shape to, male. Valves asymmetric. Left valve sub-quadrangular, highest at anterior third. Dorsal margin slightly convex, descending backward, angled with posterior margin, without postero-dorsal process. Anterior margin broadly and distortedly rounded. Posterior margin concave above, truncate below, with several small projections. Ventral margin nearly straight. Right valve lower than the left; anterior margin looking to protrude toward antero-ventral area; therefore, forming concave antero-dorsally and -ventrally. Posterior margin somewhat projecting toward posterior end.

Marginal zones and hingement of typical *Aurila-Mutilus* type.

Antennula: Distal four podomeres and claw having length ratio 24:14:21:11:25. Antenna: Distal three podomeres and claw having length ratio 21:35+16:7:23; spinneret seta in male three-segmented at length ratio 39:26:28; kneeling at distal joint.

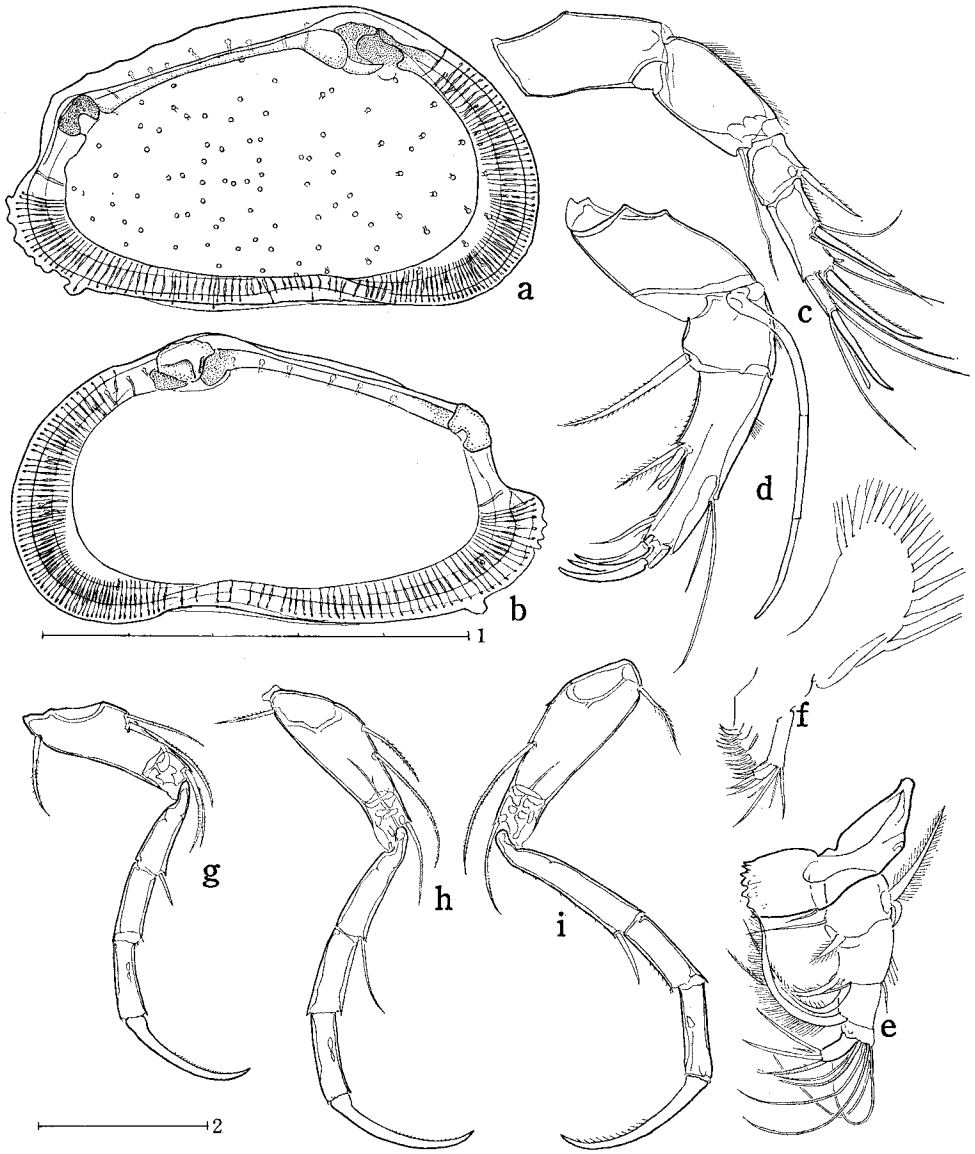


Fig. 6. *Mutilus ishizakii*. MO-818, ♂.
a, left valve; b, right valve; c, antennula; d, antenna; e, mandible; f, maxillula; g, maxilla; h, thoracopoda 1; i, thoracopoda 2.
Scale: 1 (=0.5 mm) for a, b; 2 (=0.1 mm) for c-i.

Fig. 7. *Aurila* & *Mutilus*. Copulatory organs of males.
a, b, *Mutilus assimilis*, MO-559. c, d, *M. ishizakii*, MO-818, e, f, *Aurila disparata*, MO-686, g-j, *A. hataii*; g, h, MO-802, i, j, MO-941. k, l, *A. inabai*, MO-327. m, n, *A. subconvexa*, MO-713.
a, c, e, g, k, m, left; b, d, f, h, l, n, right.
Scale given in 0.1 mm.

Mandible and Maxillula: Of *Aurila-Mutilus* type.

Walking legs: Distal three podomeres and claws having length ratio (24:21:20:36):(29:25:23:40):(42:23:23:43).

Copulatory organ: Left process terminating in sharp end, right process in dull end; copulatory duct symmetrical, almost straight, not reaching to tip of process.

(Other characters: Cf. generic description.)

Material. MO-818, ♂ (holotype), LV (63–36), RV (63–35); MO-819, ♀ (allotype), LV (72–44), RV (71–41); IK, 31-V-1977.

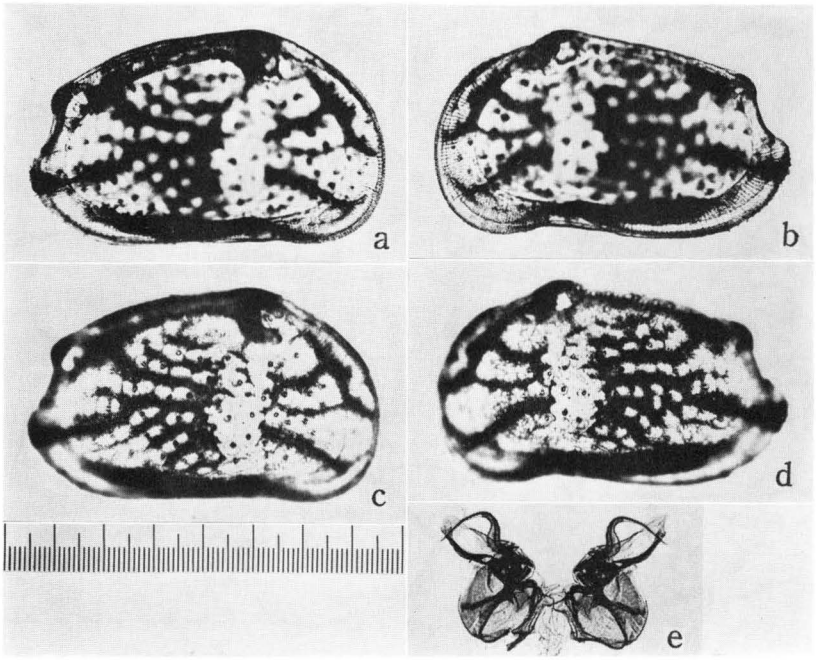


Fig. 8. *Aurila hataii.* MO-802, ♂.
a, c, left valve; b, d, right valve; e, copulatory organ. (a, b, focussed on margins; c, d, on lateral wall)
Scale given in 0.8 mm for all.

Occurrence. Only at Iwaya, Kurashiki-shi, where it is rather abundant. In intertidal zones of rocky shores.

Remarks. This new species is discriminated from *Mutilus assimilis* by the ornamentation of the surface. The former is adorned with definite pits and less prominent ridges.

A specimen from Aomori Bay named *M. assimilus* by Ishizaki (1971) resembles these specimens from the Inland Sea, but slightly differs from them in the shape of ventral ridges and postero-ventral denticles. Ishizaki's may enter within a geographical variation of this species.

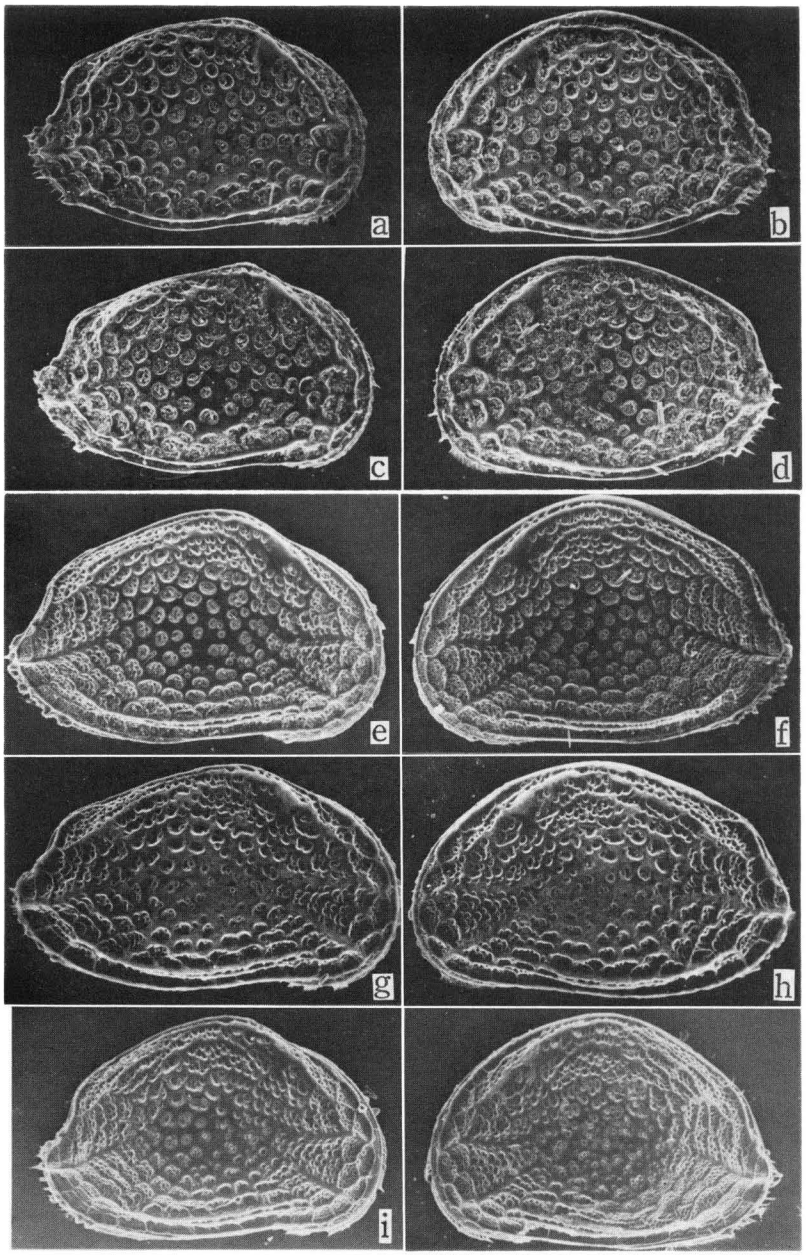


Fig. 9. *Aurila* spp. (SEM photo)
a-d, *A. subconvexa*; a, b, OM-1052, ♀; c, d, MO-1051, ♂. e-j, *A. disparata*; e, f, MO-1048, ♀; g, h, MO-1047, ♂. i, j, MO-1093, ♀. a-d larger than e-j.
a, c, e, g i, i, right valve; b, d, f, h, j, left valve. (mark j lost)

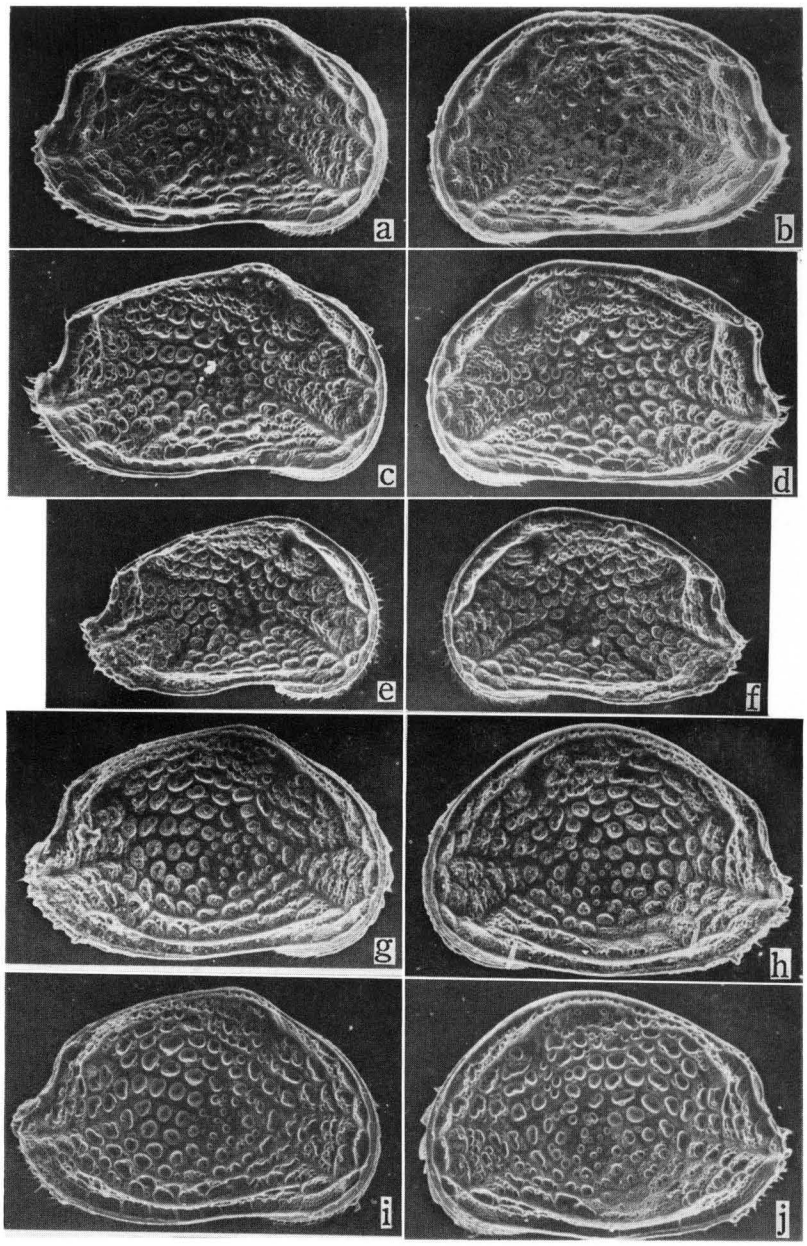


Fig. 10. *Aurila* spp. (SEM photo)
a-f, *A. hataii*; a, b, MO-1118, ♀; c, d, MO-938, ♂; e, f, MO-938b, A-1. g-j, *A. corniculata*; g, h, MO-1106, i, j, MO-1115; ♀.
a, c, e, g, i, right valve; b, d, f, h, j, left valve.

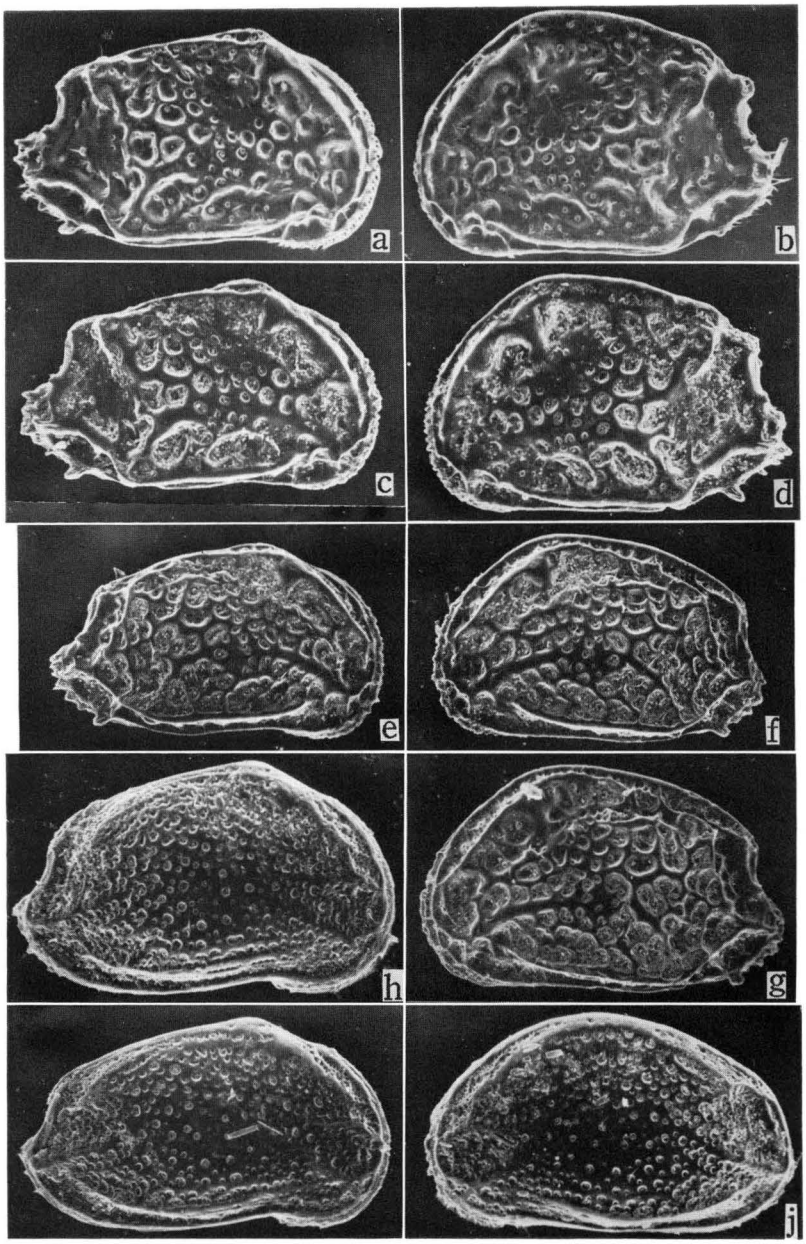


Fig. 11. *Aurila* & *Mutilus* spp. (SEM photo)
a-d, *Mutilus assimilis*; a, b, MO-1083, ♀; c, d, MO-1082, ♂. e-g, *Mutilus ishizakii*; e, f, MO-1035, ♂; g, MO-1036, ♀. h-j, *Aurila inabai*; h, ♀; i, j, ♂.
a, c, e, h, i, right valve; b, d, f, g, j, left valve. (mark i lost)

Subfamily COQUIMBINAE Ohmert, 1968

Genus *Cornucoquimba* Ohmert, 1968

*26. *Cornucoquimba tosaensis* (Ishizaki, 1968)

Hermanites tosaensis Ishizaki, 1968, p. 41, Pl. 2, fig. 4, Pl. 8, figs. 13, 14; —, 1969, p. 222, Pl. 26, fig. 19; —, 1971, p. 94, Pl. 4, fig. 3.
Cornucoquimba tosaensis: Hanai *et al.*, 1977, p. 48; Okubo, 1979c, p. 144, fig. 2g, h.

Subfamily UROCYTHEREIDINAE Hartmann and Puri, 1974

Genus *Ambostracon* Hazel, 1962

*27. *Ambostracon japonicus* (Ishizaki, 1971)

Caudites japonicus Ishizaki, 1971, p. 82, Pl. 1, fig. 4, Pl. 5, figs. 6, 8, Pl. 6, figs. 8, 9.
Hermanites? japonicus: Hanai *et al.*, 1977, p. 48.
Ambostracon japonicus: Okubo, 1979c, p. 146, figs. 2a-f, 3.

Family TRACHYLEBERIDIDAE Sylvester-Bradley, 1948

Subfamily TRACHYLEBERIDINAE Sylvester-Bradley, 1948

Trachyleberis group

Genus *Trachyleberis* Brady, 1898

*28. *Trachyleberis scabrocuneata* (Brady, 1880)

Cythere scabrocuneata Brady, 1880, p. 103, (part) Pl. 17, figs. 5e, f, (?) Pl. 17, fig. 5a-d, (not Pl. 23, figs. 2a-c).
Cythereis yamigera (Brady) [*sic*], Kajiyama, 1913, p. 12, Pl. 1, figs. 64–66; Hanai, 1959c, p. 428.
Trachyleberis scabrocuneata: Sylvester-Bradley, 1948, p. 794, Pl. 122, figs. 13–18; Hanai, 1959c, p. 435; —, 1961a, p. 373, text-fig. 14, fig. 2; —, in Ueno & Hanai, 1965, p. 455, fig. 423; Ishizaki, 1968, p. 38, Pl. 9, figs. 13, 14; —, 1969, p. 221, Pl. 26, fig. 8; —, 1971, p. 92, Pl. 4, fig. 16; Okubo, 1979c, p. 149, figs. 4, 7a-e.

Oertliella group

Genus *Cletocythereis* Swain, 1963

*29. *Cletocythereis bradyi* Holden, 1967

Cletocythereis bradyi: Ishizaki, 1968, p. 40, Pl. 8, fig. 9; Hanai *et al.*, 1977, p. 51; Okubo, 1979c, p. 152, fig. 1e-g.

Subfamily ECHINOCYTHEREIDINAE Hazel, 1967

Genus *Echinocythereis* Puri, 1954

*30. *Echinocythereis bradyi* Ishizaki, 1968

Cythere darwini Brady, Brady, 1880, p. 97, Pl. 25, figs. 2a-g.

Cythereis darwini Brady, Kajiyama, 1913, p. 12, Pl. 1, figs. 67–69.
Cythereis sp. Hanai, 1959c, p. 429.
Echinocythereis bradyformis Ishizaki, 1968, p. 40, Pl. 8, fig. 4; —, 1971, p. 94, Pl. 4, fig. 1.
Echinocythereis bradyi Ishizaki, 1968, p. 40, Pl. 9, fig. 17; —, 1969, p. 222, Pl. 25, fig. 14; —, 1971, p. 94, Pl. 4, fig. 2; Okubo, 1979c, p. 152, figs. 5, 6, 7f-h.
Echinocythereis? bradyformis: Hanai *et al.*, 1977, p. 51.
Echinocythereis? bradyi: Hanai *et al.*, 1977, p. 51.

Subfamily PTERYGOCYTHEREIDINAE Puri, 1957

Genus *Bicornucythere* Schornikov and Shaitarov, 1979

*31. *Bicornucythere bisanensis* (Okubo, 1975)

Cythere hodgii Brady, Brady, 1880, p. 94, Pl. 25, figs. 1a-d.
Cythereis hodgei [*sic*]: Kajiyama, 1913, p. 13, Pl. 1, figs. 70, 71; Hanai, 1959c, p. 428.
Leguminocythereis hodgii: Ishizaki, 1968, p. 25, Pl. 5, figs. 3, 4; —, 1969, p. 219, Pl. 25, fig. 15, Pl. 26, fig. 7; —, 1971, p. 84, Pl. 3, figs. 6, 7.
Leguminocythereis? hodgii: Ishizaki, 1975, p. 245, Pls. 1, 2, text-fig. 2.
Leguminocythereis bisanensis Okubo, 1975a, p. 26, figs. 2, 3.
Ruggieria (*Keijella*) *bisanensis*: Hanai *et al.*, 1977, p. 52.
Bicornucythere bisanensis: Schornikov and Shaitarov, 1979, p. 45, figs, 1, 2, Pl. 3.

Family CYTHERURIDAE Müller, 1894

Genus *Hemicytherura* Elofson, 1941

*32. *Hemicytherura cuneata* Hanai, 1957

Hemicytherura cuneata Hanai, 1957c, p. 24, Pl. 2, figs. 2a, b, text-figs. 1a, b;—, 1961a, p. 358, text-fig. 2, figs. la, b; Ishizaki, 1968, p. 20, Pl. 4, fig. 18; Hanai *et al.*, 1977, p. 55; Okubo, 1980a, p. 12, figs. 1a, b, 2a-d, 4.

*33. *Hemicytherura kajiyamai* Hanai, 1957

Cytheropteron videns Müller, Kajiyama, 1913, p. 4, Pl. 1, figs. 19–25.
Hemicytherura kajiyamai Hanai, 1957c, p. 24, Pl. 2, figs. 1a-d; —, 1959c, p. 430; Hanai *et al.*, 1977, p. 55; Okubo, 1980a, p. 14, figs. 1c, d, 2e-h, 5,

*34. *Hemicytherura tricarinata* Hanai, 1957

Hemicytherura tricarinata Hanai, 1957c, p. 25, Pl. 2, figs. 3a, b; Ishizaki, 1968, p. 20, Pl. 4, fig. 13; Hanai *et al.*, 1977, p. 55; Okubo, 1980a, p. 16, figs. 1e, f, 2i-l, 6.

Genus *Semicytherura* Wagner, 1957

(*Semicytherura henryhowei* group)

*35. *Semicytherura henryhowei* Hanai and Ikeya, 1977

Cytherura quadrata Hanai, 1957c, p. 20, Pl. 3, figs. 1a, b, text-figs. 2a, b.

Semicytherura quadrata: Hanai, 1961a, p. 358, text-fig. 2, fig. 2a, b; Ishizaki, 1968, p. 20, Pl. 4, figs. 11, 12;—, 1971, p. 81, Pl. 3, fig. 9.
Semicytherura henryhowei Hanai and Ikeya, 1977, p. 56; Okubo, 1980a, p. 19, figs. 1g, h, 3a-c, 7.

*36. *Semicytherura hiberna* Okubo, 1979

Semicytherura hiberna Okubo, 1980a, p. 22, figs. 3d-g, 8, 9.

(*Semicytherura miurensis* group)

*37. *Semicytherura mukaishimensis* Okubo, 1979

Semicytherura mukaishimensis Okubo, 1980a, p. 24, figs, 3h-k, 10.

Family LOXOCONCHIDAE Sars, 1925

Genus *Loxoconcha* Sars, 1866 &

Genus *Loxocorniculum* Benson and Coleman, 1963

Description. Carapace of distinct sexual dimorphism; male more elongate. Surface smooth, pitted or reticulated, often with a few ridges ventrally.

Left and right valves often showing asymmetry in shape; however, little different in sculpture. Valves moderate in length, sub-rhomboid. Dorsal margin almost straight; the outline occasionally convex or sinuated. Anterior and posterior margins rounded distortedly; anterior extremity at lower half, the posterior at upper half; posterior margin projecting toward dorso-posterior area, to be caudal process. Ventral margin nearly straight or slightly sinuated, merging into anterior and posterior margins.

Selvage moderately developed, very close to flange, often appearing to be coincident with it in lateral view in left valve; well-developed, prominently apart from flange along the whole margin in right valve. Flange peripheral, often ornamented with tubercles or striae, well-developed along anterior and posterior margins, especially at mid-posterior area where it is altered into posterior caudal process. List present along the middle of infold in both valves. Infold moderate in width. Inner margin smooth. Fused zone mostly as wide as infold. Line of concrescence rather smooth, slightly apart from inner margin along anterior and posterior margins, coincident with it along ventral margin. Radial pore canals small to moderate in number, unbranched. Normal pore canals sieve-type, scattered sparsely. Adductor muscle scars four in vertical row. Hinge gongylodont.

Antennula: Of five podomeres, slender, provided with relatively long setae and no claw. First podomere without seta. Second podomere with seta postero-distally. Third podomere with seta antero-distally. Fourth podomere long, showing signs of segmentation at the middle of both sides, provided with one respective seta there, and with one seta postero-distally, three setae antero-distally. Fifth podomere slender, with three long setae and sense club distally.

Antenna: Of four podomeres. Second podomere with seta postero-distally. Third podomere long, with two setae on anterior setiferous ledge, two setae and sense club on the posterior, and seta at postero-distal end. Fourth podomere very small, with two claws of sub-equal length. Spinneret seta two-segmented at ratio of roughly 3:1.

Mandible: Coxa rather stout, of normal shape. Palp four-segmented. First podomere with one or two setae distally; exopodite of four (one short, one very small, two long) setae. Second podomere with feather-like seta antero-distally, two long and two short setae postero-distally. Third podomere with five or six setae antero-distally, two setae of unequal length postero-distally, with stout seta between them. Fourth podomere distally with two claws and two setae.

Maxillula: Branchial plate rather small, with 16 setae in general; the most posterior seta whip-shaped, different clearly from the other feather-like setae in shape; its neighbour seta short, feather-like, situated somewhat closer to the whip-like seta than the others. Palp rather large, of two podomeres; proximal one with four setae antero-distally, one seta postero-distally; distal one with one strong claw and two stout setae. Three masticatory lobes distally with six stout setae, respectively; large plumose appendix seta existing near inner lobe.

Walking legs: Of four podomeres, comparatively slender, increasing in length backward; setal formula for (antero-medial, antero-distal, posterior) areas of maxilla and thoracopoda 1 & 2: (1+1,2,1),(1+1,1,1),(1+1,1,1); posterior setae feather-like. Second podomere with seta antero-distally, often possessing apodeme at proximal third. Claw slender.

Copulatory organ: Composed of large basal part surrounded with four chitin plates and two processes of various shapes.

(This generic description due to species from the Inland Sea in most respects.)

Remarks. No significant difference in the shape of appendages is found between *Loxoconcha* and *Loxocorniculum*.

The genus *Cytheromorpha* differs from the present genera in some characteristics of soft parts; therefore, the former is not thought to be included in the family Loxoconchidae.

Key to species in the Inland Sea.

A. Valves reticulated.
  B. Greatest height behind the middle. .....*Loxoconcha japonica.*
  B. Greatest height in front of the middle.
    C. Valve with wing-like ridge ventrally. .....*L. harimensis.*
    C. Valve without wing-like ridge.
      D. Valve rather regularly reticulated. .....*L. uranouchiensis.*
      D. Valve irregularly reticulated. .....*L. bizenensis.*
A. Valve pitted. .....*Loxocorniculum mutsuense.*

38. *Loxoconcha japonica* Ishizaki, 1968

(Figs. 12, 13, 18 a-d)

Loxoconcha impressa (Baird): Kajiyama, 1913, p. 9, Pl. 1, figs. 50, 51.
Loxoconcha rhomboidea (Fischer): Hanai, 1959c, p. 431.
Loxoconcha sp. Hanai, 1961a, p. 371, text-fig. 12, figs. 4a, b.
Loxoconcha japonica Ishizaki, 1968, p. 28, Pl. 2, fig. 1, Pl. 6, figs. 10–12; —, 1971, p. 86, Pl. 3, fig. 21; Schornikov, 1975, p. 5; Hanai *et al.*, 1977, p. 61.
Loxoconcha sp. A. Ishizaki, 1968, p. 34, Pl. 7, figs. 4, 5; —, 1971, p. 88, Pl. 3, fig. 16; Schornikov, 1975, p. 5.

Description. Carapace of distinct sexual dimorphism; both valves nearly symmetric. (Female) Left valve ovate; greatest height just behind the middle. Dorsal margin slightly arched, rather short; anterior and posterior cardinal angles prominent. Anterior margin warpedly rounded; the extremity at lower third. Posterior margin broadly rounded; the extremity at upper third; slightly projecting toward postero-dorsal area to become caudal process; concave above, broadly rounded below. Ventral margin nearly straight. Right valve similar in shape to the left. (Male) Valves larger and more elongate than female. Dorsal margin conspicuously ascending backward; greatest height at posterior fourth; posterior extremity at upper

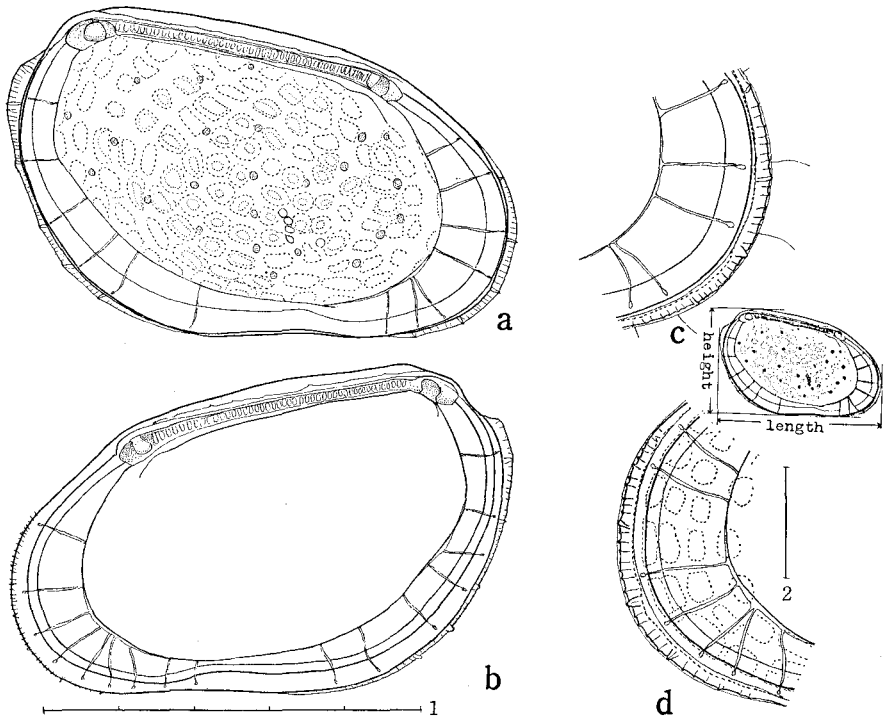


Fig. 12. *Loxoconcha japonica*. MO-891, ♂.
a, left valve; b, right valve; c, d, anterior margin of left, right valve.
Scale: 1 (=0.5 mm) for a, b; 2 (=0.1 mm) for c, d.

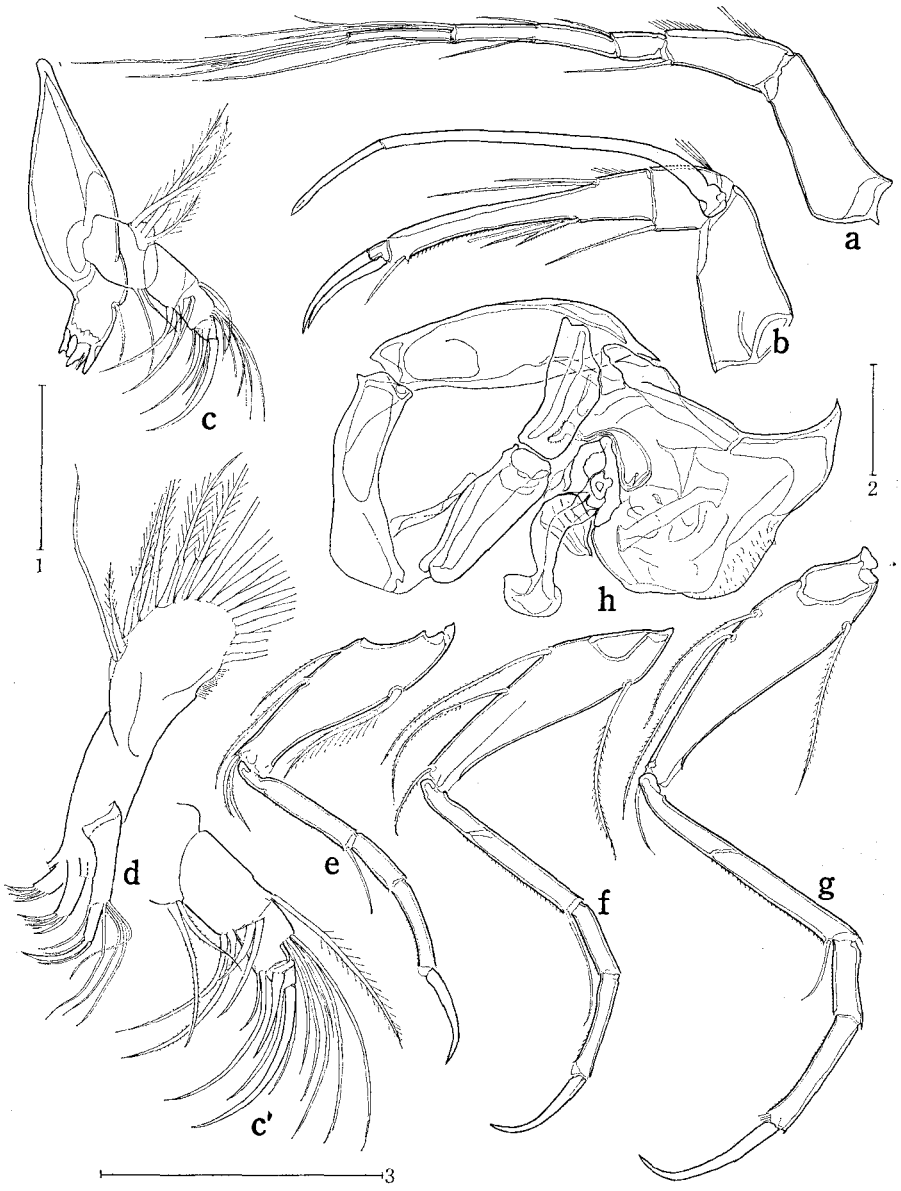


Fig. 13. *Loxoconcha japonica*. MO-891, ♂.
a, antennula; b, antenna; c, c′, mandible; d, maxillula; e, maxilla; f, thoracopoda 1; g, thoracopoda 2; h, copulatory organ.
Scales given in 0.1 mm: 1 for a-g; 2 for h; 3 for c′.

fourth. Surface reticulate regularly. Marginal area and hingement of *Loxoconcha* type.

Antennula: Distal four podomeres having length ratio 18:7:10+10:13, along posterior chitinous margins. Antenna: Distal three podomeres and claw having length ratio 10:7+29:3:14, along anterior margins; third podomere serrated along distal half of posterior margin; spinneret seta two-segmented at ratio of 3:1; anterior claw shorter than the posterior.

Mandible: Of loxoconche type; first podomere of palp with two postero-distal setae; third podomere with six setae and short outgrowth antero-distally. Maxillula: Of loxoconche type.

Walking legs: Distal three podomeres and claws of maxilla, thoracopoda 1 & 2 having length ratio (37:17:24:27):(52:22:28:31):(72:24:34:41), along posterior margins. Thoracopoda 1: seta of second podomere slender.

Copulatory organ: Basal part sub-triangular. Anterior process of large lamella with curved, pointed end; posterior process mushroom-shaped.

(Other characters: Cf. generic description.)

Material. MO-891, ♂, LV (68–45), RV (67–44), MBS, 11-VIII-1976. MO-509, ♀, LV (61–42), RV (60–42), MBS, 27-X-1976.

Occurrence. Only near the Mukaishima Marine Biological Station, where it is not abundant.

Remarks. Specimens from the Inland Sea agree well with Ishizaki's (1968, '71). His elongate forms (1968, Pl. 6, figs. 11, 12; 1971, Pl. 3, fig. 21) are the male of this species, and his reduced form (1968, Pl. 6, fig. 10) the female.

39. *Loxoconcha bizenensis* sp. nov.

(Figs. 14, 18 e-j)

Description. Valves showing prominent sexual dimorphism; both valves noticeably asymmetrical. (Female) Left valve of warped oblong; greatest height in front of the middle. Dorsal margin short, nearly straight; however, the outline remarkably concave at posterior third, owing to posterior cardinal process and mid-dorsal hump. Anterior margin rounded broadly; the extremity at lower third; forming slight obtuse anterior cardinal angle with dorsal margin, merging into ventral margin. Posterior margin distortedly rounded, projecting to become caudal process; the extremity at two-thirds of height; upper half short and truncate, making distinct cardinal angle with dorsal margin; lower half broadly rounded, merging into the ventral. Ventral margin slightly sinuated in front of the middle; the outline remarkably convex. Right valve slightly different in shape from the left; posterior cardinal angle less prominent; hump of dorsal margin less noticeable; ventral margin less convex; anterior cardinal angle more remarkable. (Male) Valves more elongate.

Surface irregularly reticulated, possessing postero-medially a pattern of polygon, which is characteristically reinforced with radiate ridges; the pattern is observed

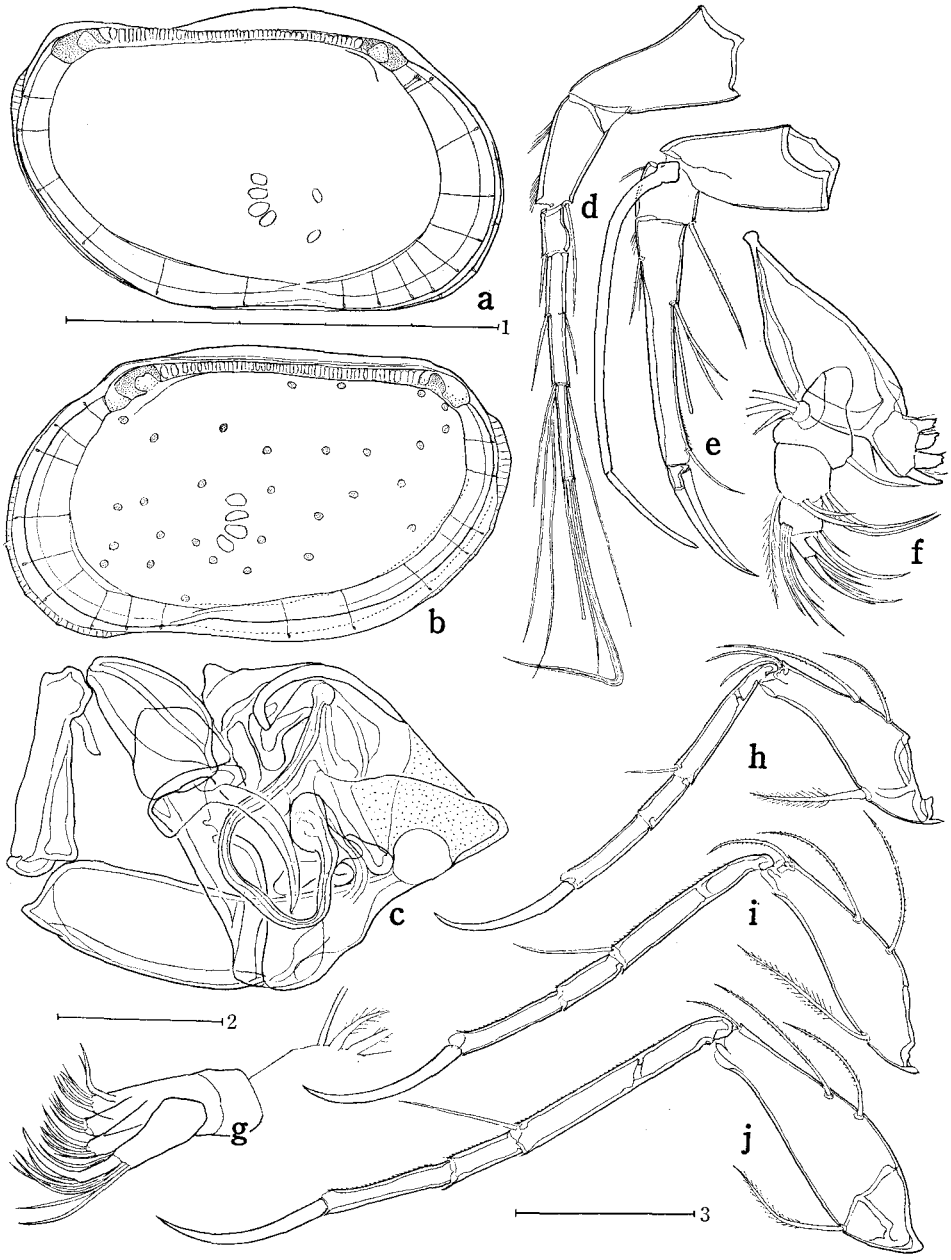


Fig. 14. *Loxoconcha bizenesis*. MO-912, ♂.
a, left valve; b, right valve; c, copulatory organ; d, antennula; e, antenna; f, mandible; g, maxillula; h, maxilla; i, thoracopoda 1; j, thoracopoda 2.
Scale: 1 (=0.5 mm) for a, b; 2(=0.1 mm) for c; 3 (=0.1 mm) for d-j.

through transmitted light, not reflexed light. Three ventral ridges present; the lowest from antero-ventral to mid-ventral area; the middle from antero-ventral to postero-ventral area, strongest, more convex than ventral outline; the upper from antero-ventral to postero-ventral.

Marginal zone and hingement of *Loxoconcha* type.

Antennula: Distal four podomeres having length ratio 31:10:15+17:24. Antenna: Distal three podomeres and claw having length ratio 14:10+53:7:33. Third podomere serrated along distal fifth of posterior margin. Both claws sub-equal in length. Spinneret seta two-segmented at length ratio of 3:1.

Mandible: First podomere of palp with one seta postero-distally. Third podomere with five setae antero-distally. Maxillula: Branchial plate with one long whip seta anteriorly.

Walking legs: Distal three podomeres and claws of maxilla and thoracopoda 1 & 2 having length ratio of (38:16:24:36):(48:19:28:46):(63:20:34:47). Anterior margins of second to fourth podomeres all serrated.

Copulatory organ: Basal part triangular; two processes large, roughly triangular.

(Other characters: Cf. generic description.)

Material. MO-912, ♂ (holotype), LV (58–36), RV (58–35), MN, 16-VI-1977. MO-608, ♀ (allotype), LV (53–37), RV (52–35), DW, 3-V-1977. MO-908, ♂ (paratype), LV (59–36), RV (60–35), MS. MO-613, ♀ (paratype), LV (54–37), RV (55–35), DW, 3-V-1977.

Occurrence. Rather common, not abundant. In intertidal zones of rocky shores in the Inland Sea.

Remarks. At first, judging from the outline of valves, the author regarded the female of this species as *Loxoconcha kattoi* Ishizaki and the male as *L. viva* Ishizaki; both were found from the Uranouchi Bay. This view, however, was negated by Dr. Ishizaki, who has told this is an unknown species in Japan. The female of this species is also similar in the shape of valves to *L. hattorii* that was discovered from Aomori Bay by Ishizaki (1971).

40. *Loxoconcha uranouchiensis* Ishizaki, 1968

(Figs. 15, 19 a-f)

Loxoconcha uranouchiensis Ishizaki, 1968, p. 32, Pl. 7, figs. 2, 3; —, 1969, p. 220, Pl. 26, fig. 15; —, 1971, p. 87, Pl. 3, fig. 17; Hanai *et al.*, 1977, p. 63.

Description. Carapace of sexual dimorphism, male more elongate than female. Both valves similar to each other. Left valve oblong, slightly tapering backward; greatest height at anterior third. Dorsal margin straight, the outline slightly convex. Anterior margin broadly rounded, forming faint anterior cardinal angle with dorsal margin, merging into ventral margin. Posterior margin somewhat narrowly rounded, the extremity at two-thirds height, with slight caudal process;

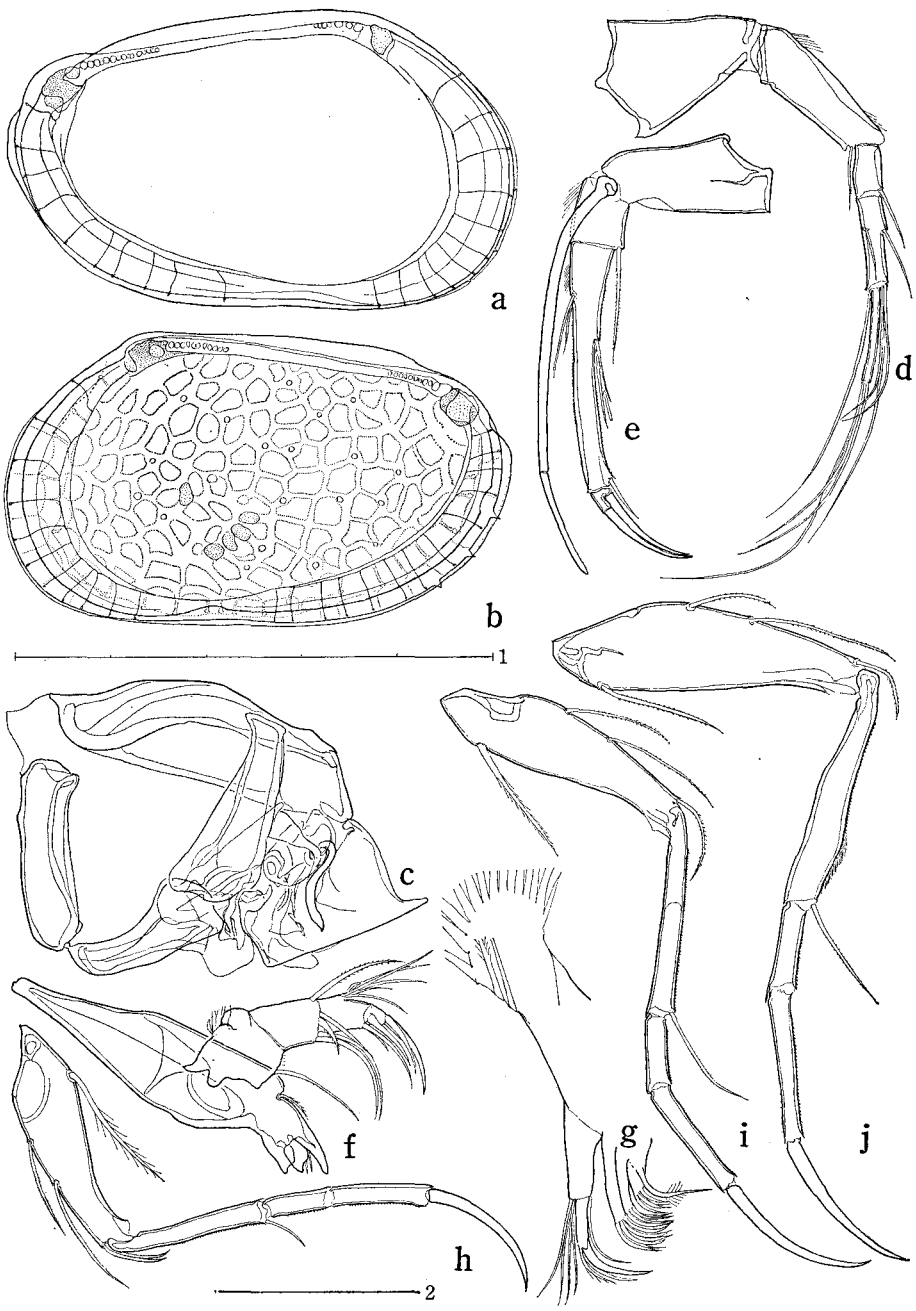


Fig. 15. *Loxoconcha uranouchiensis.* a, b, MO-838, ♀; c-j, MO-836, ♂. a, left valve; b, right valve; c, copulatory organ; d, antennula; e, antenna; f, mandible; g, maxillula; h, maxilla; i, thoracopoda 1; j, thoracopoda 2.
Scale: 1 (=0.5 mm) for a, b; 2 (=0.1 mm) for c-j.

making posterior cardinal angle with dorsal margin, merging into the ventral. Ventral margin almost straight.

Surface reticulated rather regularly. Two low ridges extending along ventral margin: lower one smooth, continuous; upper one irregular, distinctly concave near posterior end. Inside of carapace covered with purplish pigment.

Marginal zone and hingement of loxoconche type.

Antennula: Distal four podomeres having length ratio 21:6:4+7:13. Antenna: Distal three podomeres and claw having length ratio 9:7+25:3:13. Third podomere serrated along mid-anterior and posterior margins. Anterior claw shorter than the posterior. Spinneret seta two-segmented at length ratio of roughly 3:1.

Mandible: Of loxoconche type. First podomere with one postero-ventral seta. Third podomere with six anterior setae. Maxillula: Of loxoconche type.

Walking legs: Distal three podomeres and claws having length ratio (14:6:9:13):(18:7:11:15):(21:8:14:15). Second podomere with obscure chitin bridge. Second to fourth podomeres all serrated along anterior margins. Claws slender. Thoracopoda 2: Second podomere of slight sexual dimorphism: in male, anterior margin ornamented with dense hair along distal fourth; in female, no hair as in other walking legs.

Copulatory organ: Basal part relatively large, triangular; anterior process sub-quadrangular, with small process at anterior end; posterior one small.

(Other characters: Cf. generic description.)

Material. MO-720, ♂, LV (57–31), RV (57–31); MO-836, ♂, LV (56–30), RV (56–30); MO-733, ♀, LV (50–30), RV (51–30); MO-838, ♀, LV (53–32), RV (52–31); HSB.

Occurrence. Not abundant. Only on the sand bank where eel grass grew thick; the other loxoconche species in the Inland Sea all collected from rocky shores.

Remarks. Specimens from the Inland Sea agree well with those from Uranouchi Bay. The holotype of Ishizaki's (1968, Pl. 7, fig. 3) is thought to be a male, the paratype (Pl. 7, fig. 2) a female.

41. *Loxoconcha harimensis* sp. nov.

(Figs. 16, 19 g-l)

Description. Carapace of slight sexual dimorphism; female larger and higher than males. Valves somewhat asymmetric. (Female) Left valve sub-triangular, remarkably tapering backward; greatest height at anterior third. Dorsal margin almost straight, the outline sinuated posteriorly owing to prominent cardinal process. Anterior margin rounded broadly and warpedly. Posterior margin projecting toward postero-dorsal area, rounded narrowly; upper half nearly truncate, lower half merging into the ventral. Ventral margin somewhat convex. Right valve narrower, and less prominently winged, than the left.

Surface ornamented with reticulation, with wing-like ridge along ventral margin; the wing ridge making the carapace rhomboidal in dorsal view.

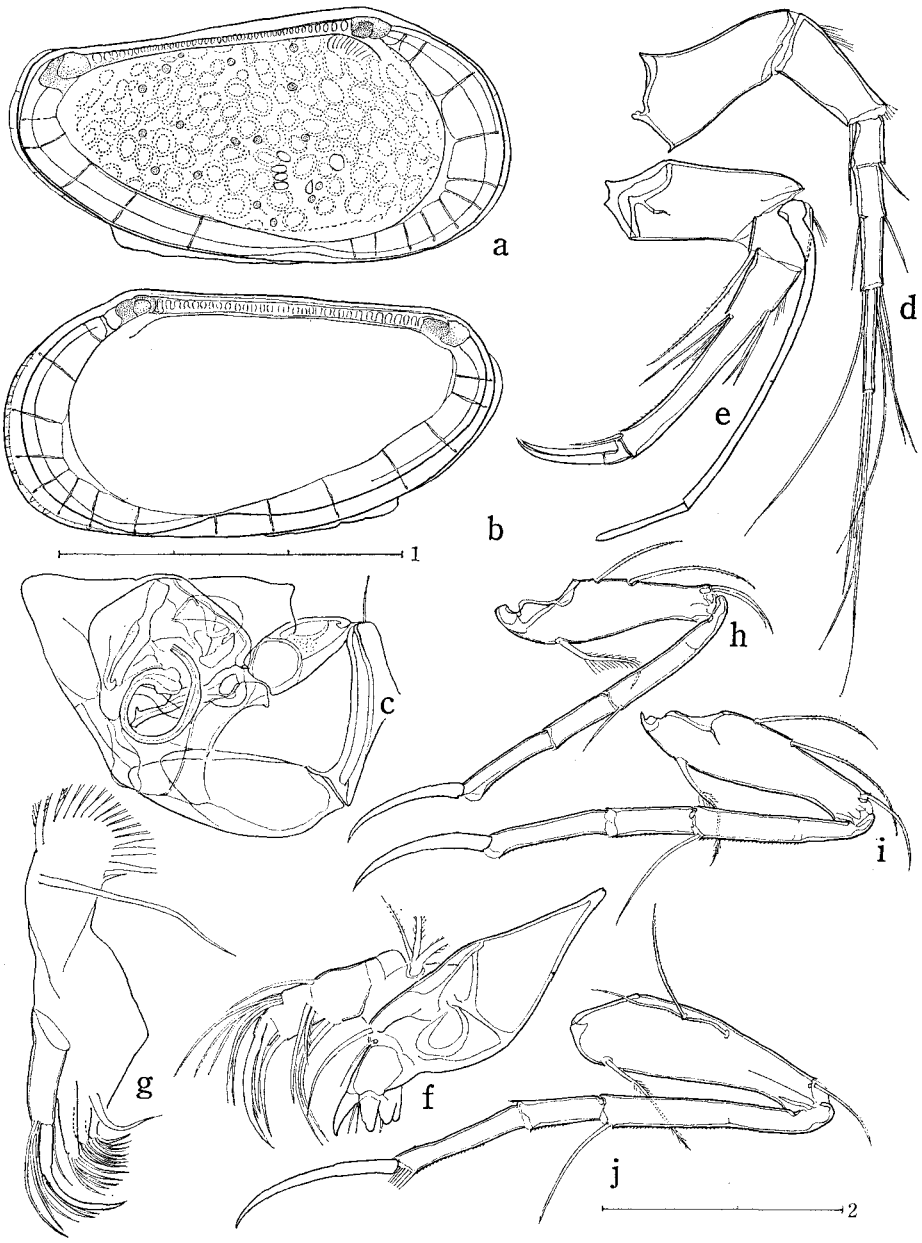


Fig. 16. *Loxoconcha harimensis*. a, b, MO-590, ♂; c-j, MO-856, ♂. a, left valve; b, right valve; c, copulatory organ; d, antennula; e, antenna; f, mandible; g, maxillula; h, thoracopoda 1; i, thoracopoda 2.
Scale: 1 (=0.3 mm) for a, b; 2 (=0.1 mm) for c-j.

Marginal zone and hingement of loxoconche type.

Antennula: Distal four podomeres having length ratio 16:6:7+8:14. Antenna: Distal three podomeres and claw having length ratio 16:13+54:8:23. Third podomere slender, serrated along one third of posterior margin. Anterior claw shorter than the posterior. Spinneret seta two-segmented at length ratio 7:2; proximal segment with signs of segmentation at the middle.

Mandible and Maxillula: Of loxoconche type.

Walking legs: Distal three podomeres and claws having length ratio (20: 10:13:18):(24:11:15:20):(30:11:17:24). Second podomeres with signs of chitin bridges at proximal third. Anterior margins of second to fourth podomeres all serrated.

Copulatory organ: Basal part triangular. Anterior process trapezoid; posterior process oblong.

(Other characters: Cf. generic description.)

Material. MO-856, ♂ (holotype), LV (44–24), RV (45–23). MO-856b, ♀ (paratype), 1-w (49–31). MO-857, ♀ (allotype), LV (51–29), RV (52–27). MO-590, ♂ (paratype), LV (43–23), RV (44–22). MO-814, ♀ (paratype), LV (49–28), RV (48–27). All AO.

Occurrence. Only at Aioi, where this species was collected in two successive summers. Not abundant.

Remarks. This species is discriminated from the congeners by its winged carapace.

42. *Loxocorniculum mutsuense* Ishizaki, 1971

(Figs. 17, 20)

Loxocorniculum mutsuensis [*sic*] Ishizaki, 1971, p. 89, Pl. 5, fig. 11, Pl. 6, figs. 3, 6, 7, Pl. 7, fig. 5.
Loxocorniculum mutsuense: Hanai *et al.*, 1977, p. 65.

Description. Carapace of distinct sexual dimorphism; male much more elongate. Both valves similar to each other. Valve trapezoid in lateral outline; greatest height at anterior third. Dorsal margin straight. Anterior margin broadly and obliquely rounded, forming cardinal angle with the dorsal, merging into the ventral. Posterior margin narrowly rounded, slightly projecting toward postero-dorsal area; the extremity at upper third; the lower half nearly straight. Ventral margin slightly sinuated, nearly parallel to the dorsal.

Surface pitted, except on radial ridges, and also ornamented with numerous very small hairs of chitin on the whole surface. Five radiate ridges prominent: two anterior and three posterior; postero-dorsal one terminating in horn-like protuberance. Colour purplish, when alive.

Marginal zone of loxoconche type. Adductor muscle scars four in vertical row; most upper one inversely T-shaped, the second one longest; crescent frontal scar present.

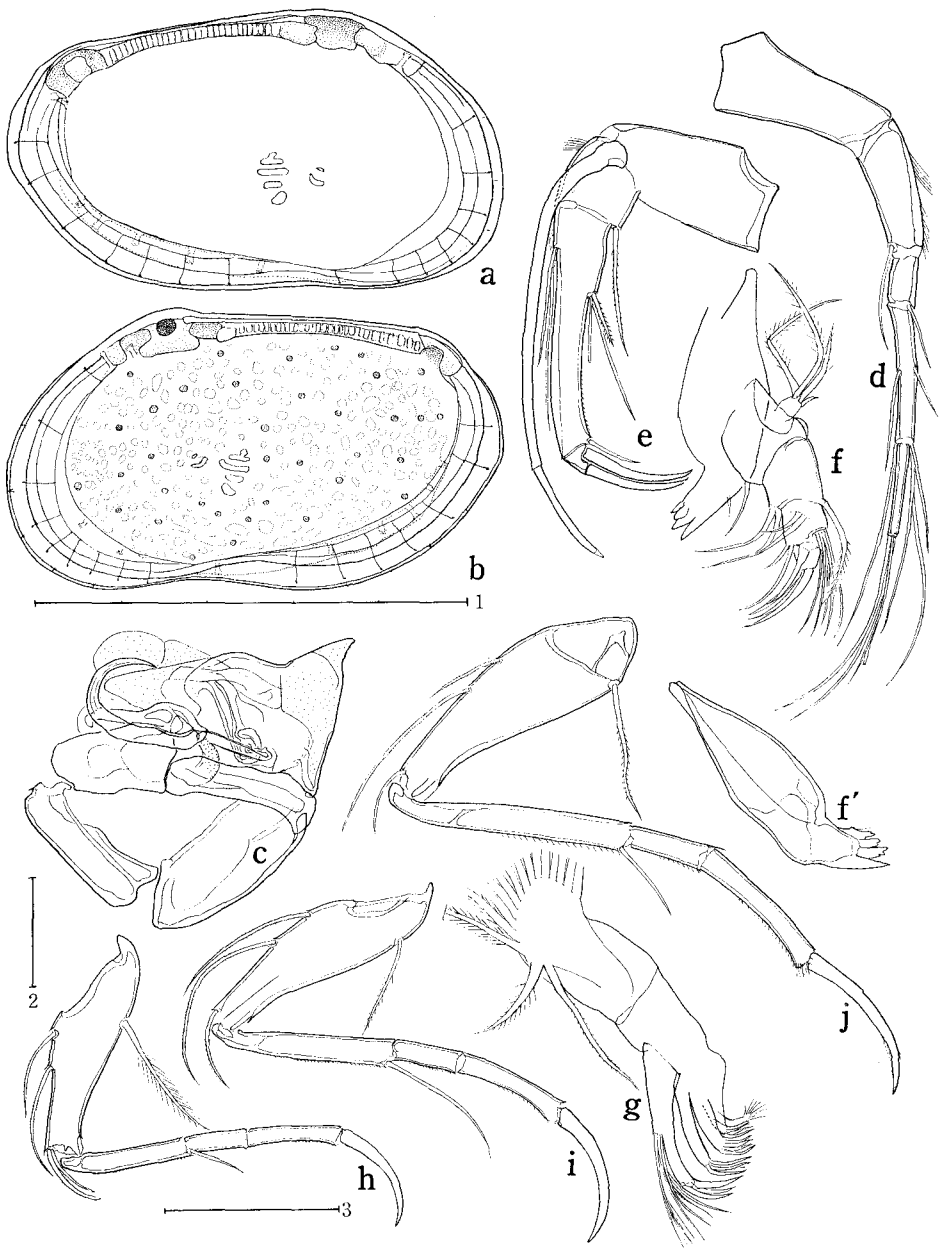


Fig. 17. *Loxocorniculum mutsuense.* a, b, MO-839, ♀; c-j, f′, MO-703, ♂. a, left valve; b, right valve; c, copulatory organ; d, antennula; e, antenna; f, f′, mandible; g, maxillula; h, maxilla; i, thoracopoda 1; j, thoracopoda 2.
Scale: 1 (=0.5 mm) for a,b; 2 (=0.1 mm) for c; 3 (=0.1 mm) for d-j, f′.

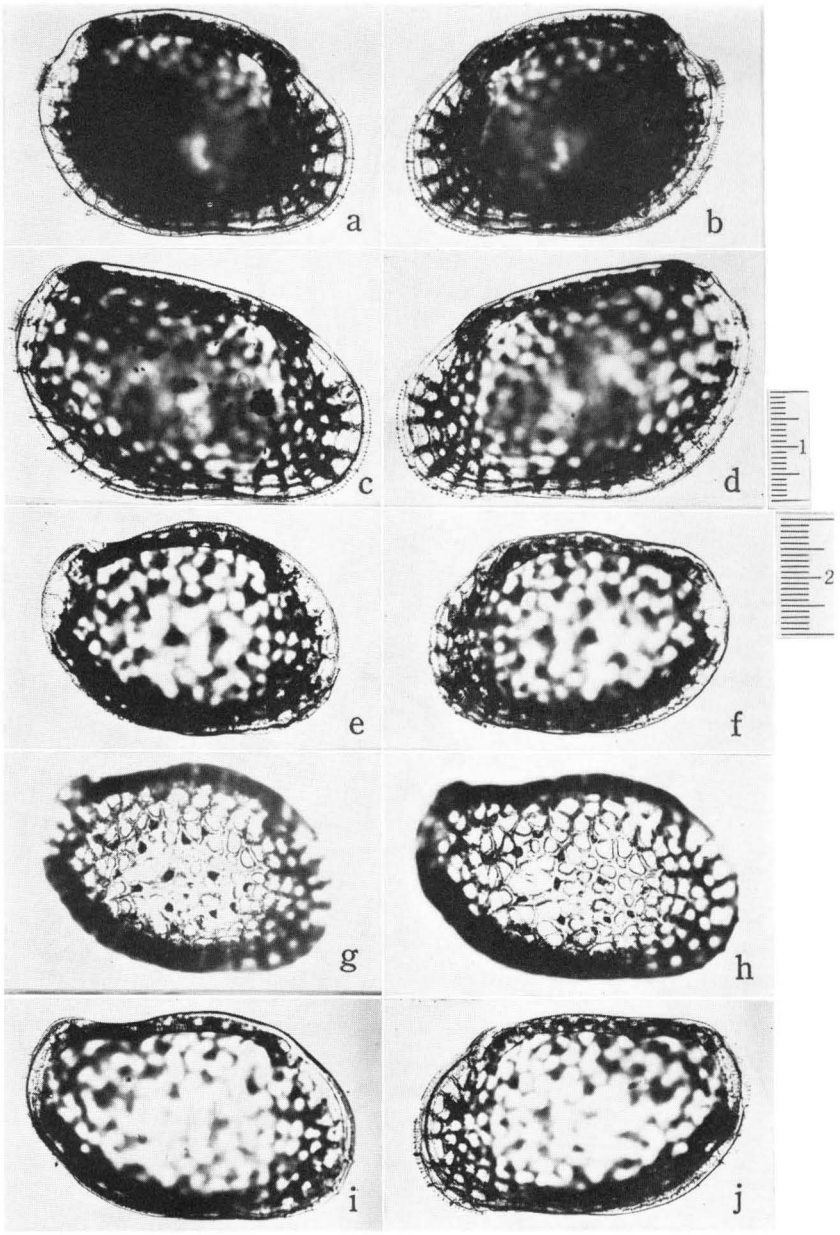


Fig. 18. *Loxoconcha* spp.
a-d, *L. japonica;* a, b, MO-509, ♀; c, d, MO-891, ♂. e-j, *L. bizenensis*; e-g, MO-608, ♀; h-j, MO-912, ♂.
a, c, e, g, h, i, left valve; b, d, f, j, right valve.
(g, h, focussed on lateral wall; the others on margins).
Scale (=0.2 mm): 1 for a-d; 2 for e-j.

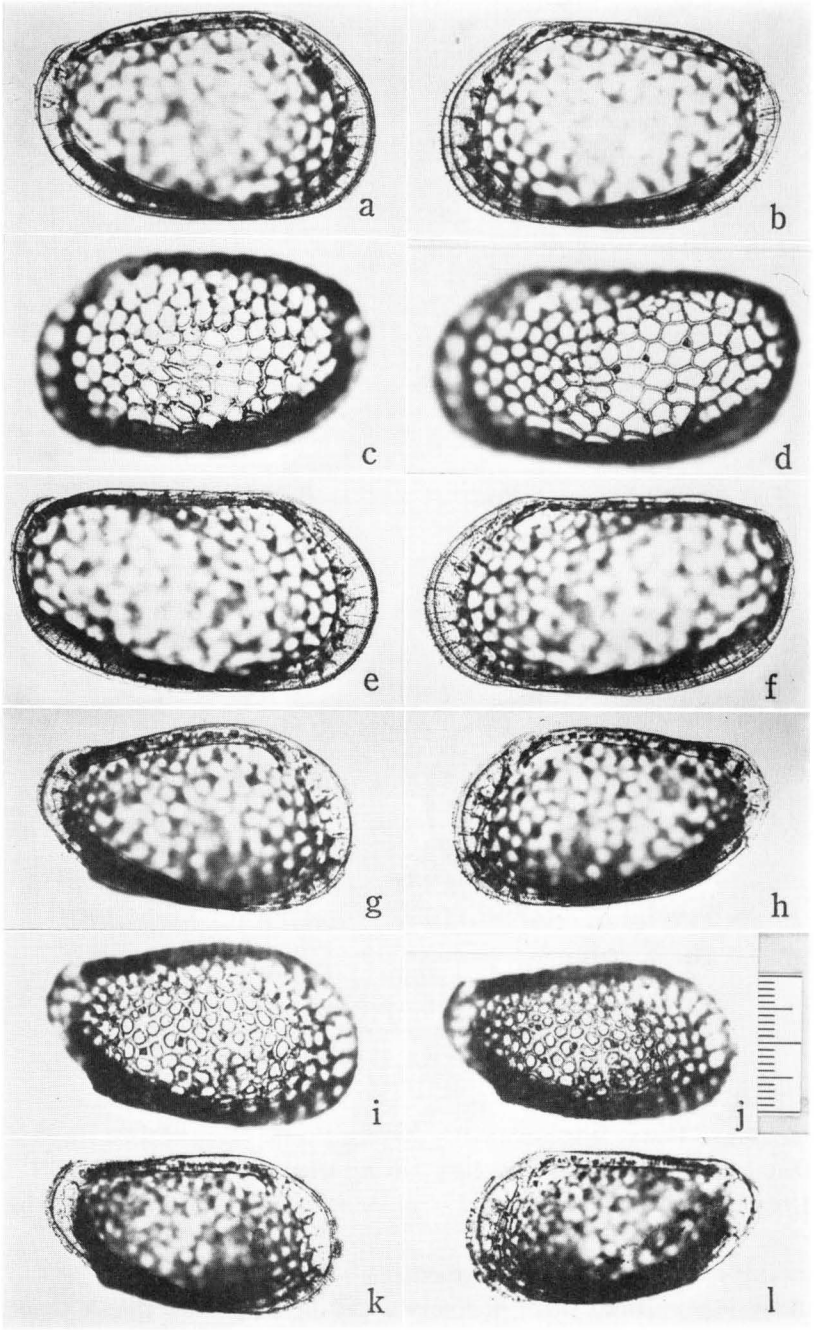


Fig. 19. *Loxoconcha* spp.
a-f, *L. uranouchiensis*; a-c, MO-838, ♀; d-f, MO-836, ♂. g-l, *L. harimensis*; g-i, MO-591, ♀; j-l, MO-856, ♂.
a, e, g, i, j, k, left valve; b, c, d, f, h, l, right valve. (c, d, i, j, focussed on lateral wall; the others on margins).
Scale given 0.2 mm for all.

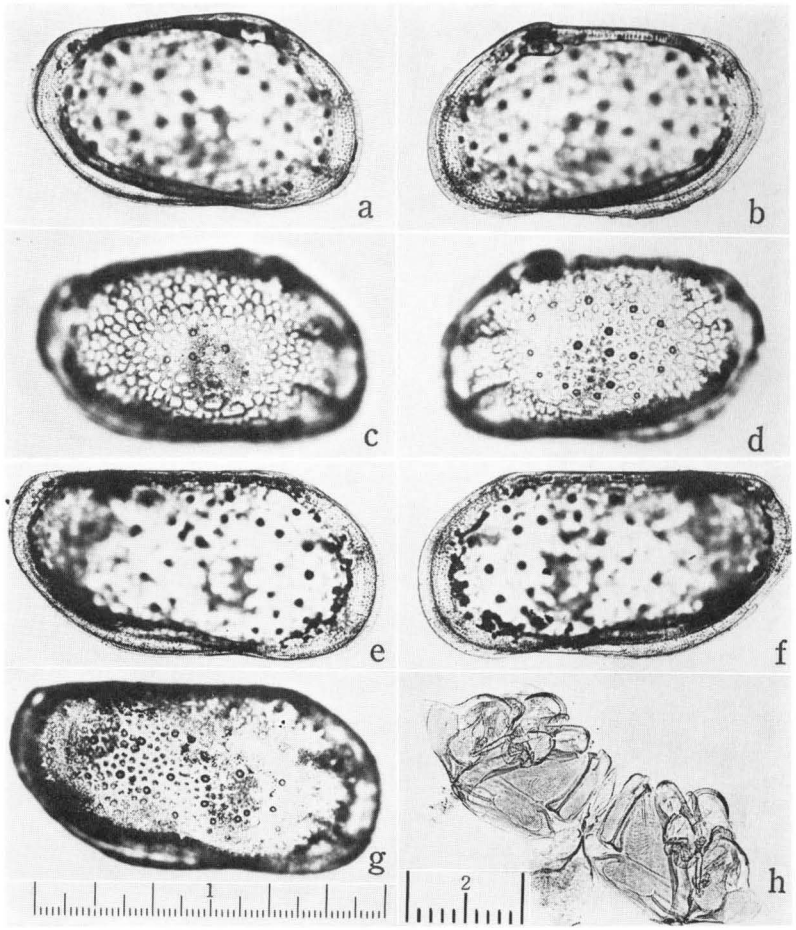


Fig. 20. *Loxocorniculum mutsuense.*
a-d, MO-889, ♀; e-g, MO-702, ♂; MO-703, ♂.
a, c, e, g, left valve; b, d, f, right valve; h, copulatory organ.
(a, b, e, f, focussed on margins; c, d, g, on lateral wall).
Scale: 1 (=0.6 mm) for a-g; 2 (=0.2 mm) for h.

Antennula: Distal four podomeres having length ratio 34:14:16+18:23. Antenna: Distal three podomeres and claw having length ratio 20:4+53:7:27; anterior claw not reaching tip of the posterior. Spinneret seta two-segmented at length ratio of 3:1.

Mandible and Maxillula: Of loxoconche type.

Walking legs: Distal three podomeres and claws having length ratio (32:15:24:29):(44:19:29:35):(57:22:36:40).

Copulatory organ: Basal part sub-triangular; anterior process narrowly triangular.

(Other characters: Cf. generic description.)

Material. MO-702, ♂, LV (66–33), RV (66–33), HD, 30-VI-1977. MO-600,

♂, LV (67–34), RV (67–34), NW. MO-897, ♀, LV (64–37), RV (63–37), WI, 10-VII-1976. MO-895, ♀, LV (57–34), RV (57–34), MBS, 11-VIII-1976.

Occurrence. Common, not abundant. In rocky shores.

Remarks. Specimens from the Inland Sea agree with Ishizaki's (1971) specimens.

The postero-dorsal protuberance is not prominent in some specimens, though the genus *Loxocorniculum* is thought to be discriminated from the genus *Loxoconcha* by its pitted surface and postero-dorsal protuberances.

Family XESTOLEBERIDIDAE Sars, 1928

Genus *Xestoleberis* Sars, 1928

*43. *Xestoleberis dentata* Schornikov, 1975

Xestoleberis dentata Schornikov, 1975, p. 7, fig. 3; Hanai *et al.*, 1977, p. 65; Okubo, 1979a, p. 9, fig. 1a-c.

*44. *Xestoleberis hanaii* Ishizaki, 1968

Xestoleberis sp. Hanai, 1961a, p. 364, text-fig. 7, figs. 2a, b, c.

Xestoleberis hanaii Ishizaki, 1968, p. 41, Pl. 9, figs. 1, 2; —, 1971, p. 95, Pl. 4, fig. 14; Schornikov, 1974, p. 184, fig. 26; Hanai *et al.*, 1977, p. 66; Okubo, 1979a, P. 9, fig. 1d-g.

*45. *Xestoleberis setouchiensis* Okubo, 1979

Xestoleberis setouchiensis Okubo, 1979a, p. 10, figs. 2, 3, Pl. 1.

Family PARADOXOSTOMATIDAE Brady and Norman, 1889

Genus *Paradoxostoma* Fischer, 1855

*46. *Paradoxostoma pedale* Hiruta, 1975

Paradoxostoma pedale Hiruta, 1975, p. 118, figs. 1–3, Pl. 4–1; Hanai *et al.*, 1977, p. 72; Okubo, 1977b, p. 108, figs. 1a, b, i, 4i, j, 7.

*47. *Paradoxostoma coniforme* Kajiyama, 1913

Paradoxostoma coniforme Kajiyama, 1913, p. 5, Pl. 1, figs. 30–33; Hanai, 1959c, p. 434; Ishizaki, 1971, p. 92, Pl. 4, fig. 24; Hanai *et al.*, 1977, p. 69; Okubo, 1977b, p. 108, figs. 1c, d, j, 4a, 5a, 8.

*48. *Paradoxostoma bingoense* Okubo, 1977

Paradoxostoma bingoense Okubo, 1977b, p. 110, figs. 1e, f, k, 5b, 9.

*49. *Paradoxostoma yatsui* Kajiyama, 1913

Paradoxostoma Yatsui Kajiyama, 1913, p. 7, Pl. 1, figs. 43–49.

Paradoxostoma yatsui: Hanai, 1959c, p. 435; —, 1961a, p. 359, text-fig. 3, figs. 1a, b; —, in Ueno and Hanai, 1965, p. 456, fig. 424; Hanai *et al.*, 1977, p. 73; Okubo, 1977b, p. 112, figs. 1g, h, l, 5c, 10.
? *Paradoxostoma yatsui*: Ishizaki, 1968, p. 36, Pl. 9, figs. 5, 6.

*50. *Paradoxostoma flaccidum* Schornikov, 1975

Paradoxostoma faccidum [*sic*] Schornikov, 1975, (Jul.), p. 25, fig. 13; Hanai *et al.*, 1977, p. 70.
Paradoxostoma ezoense Hiruta, 1975 (Oct.), p. 133, figs. 9–12, Pl. 4–4.
Paradoxostoma flaccidum: Okubo, 1977b, p. 114, fig. 2a, b, k.

*51. *Paradoxostoma setoense* Schornikov, 1975

Paradoxostoma setoensis [*sic*] Schornikov, 1975, p. 27, fig. 14.
Paradoxostoma setoense: Hanai *et al.*, 1977, p. 72; Okubo, 1977b, p. 114, figs. 2c, d, l, 11.

*52. *Paradoxostoma inabai* nom. nov.

Paradoxostoma convexum Okubo, 1977b, p. 115, figs. 2e, f, m, o, 4c-e, 6a, 12.
(*non P. convexum* Schornikov, 1965.)

*53. *Paradoxostoma hartmanni* nom. nov.

Paradoxostoma affine Okubo, 1977b, p. 117, figs. 2g, h, p, 6b, 13.
(*non P. affine* Scott, 1890, p. 325, Pl. 12, figs. 8, 9.)

*54. *Paradoxostoma depressum* Okubo, 1977

Paradoxostoma depressum Okubo, 1977b, p. 119, figs. 2i, j, n, 4b, 14.

*55. *Paradoxostoma assimile* Okubo, 1978

Paradoxostoma assimile Okubo, 1978a, p. 12, fig. 2, Pl. 1c, d, l.

*56. *Paradoxostoma fragile* Okubo, 1977

Paradoxostoma fragile Okubo, 1977b, p. 120, figs. 3a-c, 6d, 15.

*57. *Paradoxostoma lunatum* Okubo, 1977

Paradoxostoma lunatum Okubo, 1977b, p. 122, figs. 3d-h, 6e, 16.

*58. *Paradoxostoma denticulatum* Okubo, 1977

Paradoxostoma denticulatum Okubo, 1977b, p. 124, figs. 3i-k, 5d, 17.

*59. *Paradoxostoma rhomboideum* Okubo, 1977

Paradoxostoma rhomboideum Okubo, 1977b, p. 125, figs. 3i-k, 5e, 18.

*60. *Paradoxostoma sohni* nom. nov.

Paradoxostoma elongatum Okubo, 1978a, p. 14, fig. 3, Pl. 1e, f.
(*non P. elongata* [*sic*] Puri, 1954, p. 288, Pl. 15, fig. 2.)

*61. *Paradoxostoma vandenboldi* nom. nov.

Paradoxostoma caudatum Okubo, 1978a, p. 15, fig. 4, Pl. 1g-j, m.
(*non P. caudatum* Hartmann, 1974, p. 342, Pl. 123, figs. 860–869.)

*62. *Paradoxostoma brunneum* Schornikov, 1974

Paradoxostoma brunneum Schornikov, 1974, p. 207, fig. 41; Hanai, *et al.*, 1977, p. 69; Okubo, 1978a, p. 10, fig. 1, Pl. 1a, b, k.

*63. *Paradoxostoma setosum* Okubo, 1977

Paradoxostoma setosum Okubo, 1977b, p. 127, figs. 4f-h, 19.

Genus *Sclerochilus* Sars, 1866

*64. *Sclerochilus mukaishimensis* Okubo, 1977

Sclerochilus mukaishimensis Okubo, 1977a, p. 59, figs. 1, 2, Pl. 6.

Genus *Cytherois* Müller, 1894

65. *Cytherois bingoensis* sp. nov.

(Figs. 21, 23 a, b)

Description. Carapace small, compressed, spindle-shaped in dorsal view. Colour dirty drab, upper half darker than the lower.

Left valve bow-shaped in lateral outline; greatest height behind the middle. Dorsal margin arched rather evenly. Anterior margin narrowly and distortedly rounded. Posterior margin warpedly and broadly rounded. Ventral margin almost straight, somewhat sinuated just in front of the middle. Right valve slightly higher than the left.

Selvage existing along all the free margins in left valve; selvage and probably flange in right valve. Infold rather wide; mid-ventrally inner margin coincident with line of concrescence. Fused zone moderate in width; line of concrescence obvious along anterior and posterior margins, obscure along the ventral. Radial pore canals a few in number, clearly observable anteriorly and posteriorly, but hardly observed ventrally.

Adductor muscle scars composed of four vertical scars, with two anterior scars; upper one tumid, lower one slender. Normal pore canals only a few in number.

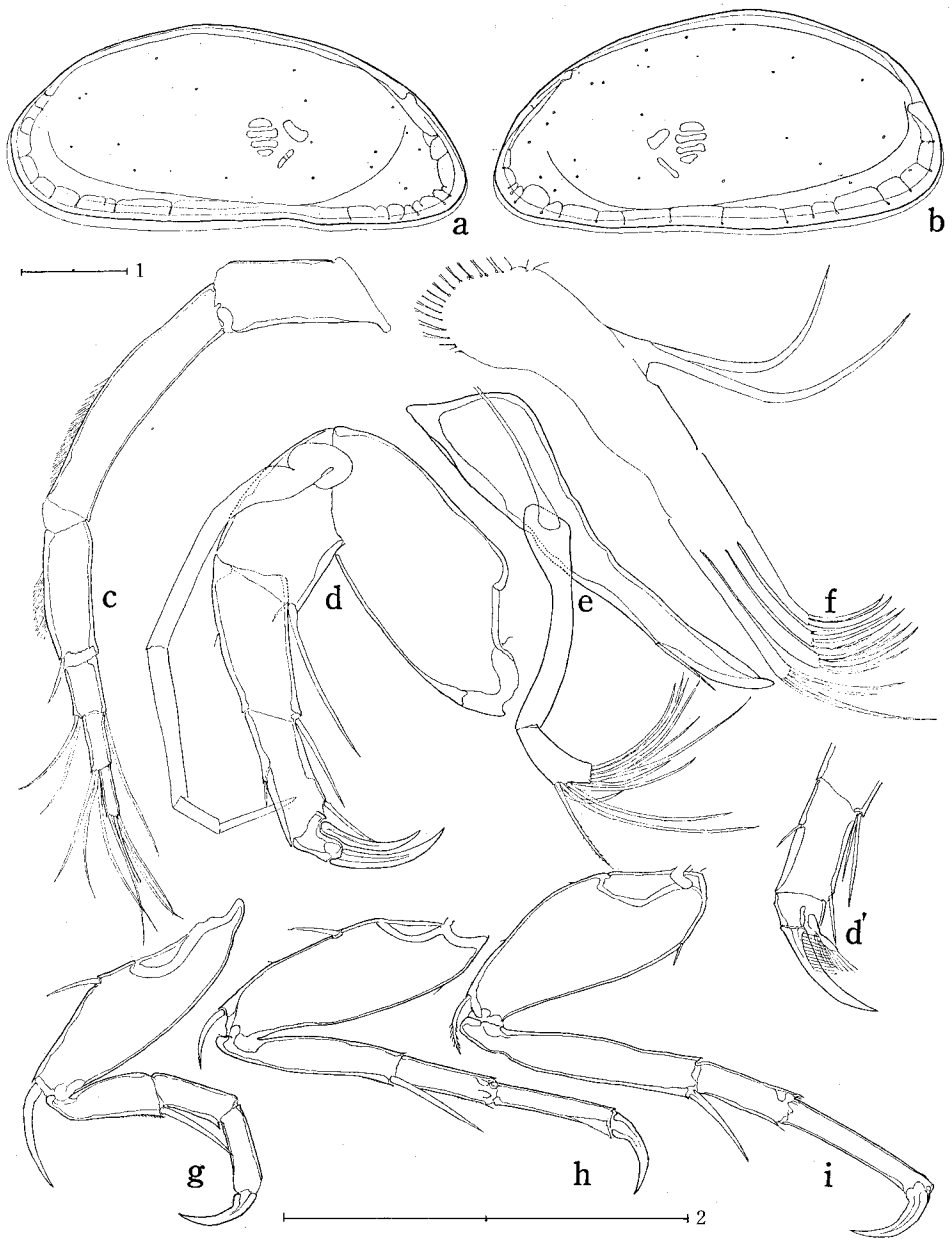


Fig. 21. *Cytherois bingoensis.*
a, left valve; b, right valve; c, antennula; d, d′, antenna (♀,♂); e, mandible; f, maxillula; g, maxilla; h, thoracopoda 1; i, thoracopoda 2.
Scales given in 0.1 mm.

Antennula: Of six podomeres. Second podomere elongate, about twice length of third podomere. Distal four podomeres having length ratio of roughly 2:1:1:1. Third podomere with short seta antero-distally. Fourth podomere with two setae antero-distally, seta postero-distally. Fifth podomere with three setae antero-distally. Sixth podomere with three setae and sense club distally.

Antenna: Of five podomeres. Second podomere with long, proximally swollen seta and fine seta postero-distally. Third podomere with seta postero-distally and fine seta antero-medially. Fourth podomere with one seta in female and with two setae in male postero-distally, with seta antero-medially. Fifth podomere with two claws in females, with one claw haired proximally and one stout haired seta in male. Spinneret seta reaching tips of terminal claws, four-segmented, the length ratio roughly 11:6:2:3; fourth, third segment narrower than the preceding.

Mandible: Coxa sub-styliform; lower end finely splitting in two; upper half tapering toward middle part. Palp of two podomeres. First podomere with one long seta or exopodite. Second podomere one-third the length of first podomere, with five setae near end, seven setae at distal end.

Maxillula: Palp and masticatory lobes well-developed, slender. Respiratory plate with two long setae.

Walking legs: Of four podomeres, increasing backward in length. Setal formula of protopodites (1,1,0),(1,1,0),(0,1,1). In addition, hair or vestigial seta existent at posterior margin of thoracopoda 1, and at antero-proximal and -medial margins of thoracopoda 2. Each second podomere with seta. Third, fourth podomere without seta. Terminal claw rather stout, curved strongly.

Copulatory organ: Asymmetrical. Basal parts similar to each other, subsquare in shape. Right process of sub-rectangular lamella, left process leaf-like lamella with long whip.

Material. MO-494, ♀ (holotype), LV (44–19), RV (43–21), MBS, 16-IV-1976. MO-489, ♀ (paratype), LV (43–19), RV (43–20), MBS, 11-VI-1976. MO-393, ♂ (allotype), LV (40–17), RV (40–18), KJI. MO-488, ♂ (paratype), LV (42–?), RV (42–?), MBS, 11-VI-1976.

Occurrence. In intertidal zones of several coasts of the Inland Sea of Seto. Rather rare.

Remarks. The new species is characterized by the shape of the antenna. Namely, the antenna of the female is provided with two distal claws; that of the male with one claw and one haired seta. Most congeneric species have a claw and a fine seta on the distal end of the antenna.

This species also differs from three Japanese species (Ishizaki, 1968, '69, '71) in the outline of valves.

66. *Cytherois decorata* sp. nov.

(Figs. 22, 23 c-f)

Description. Small. Both valves nearly symmetrical. Left valve triangular in

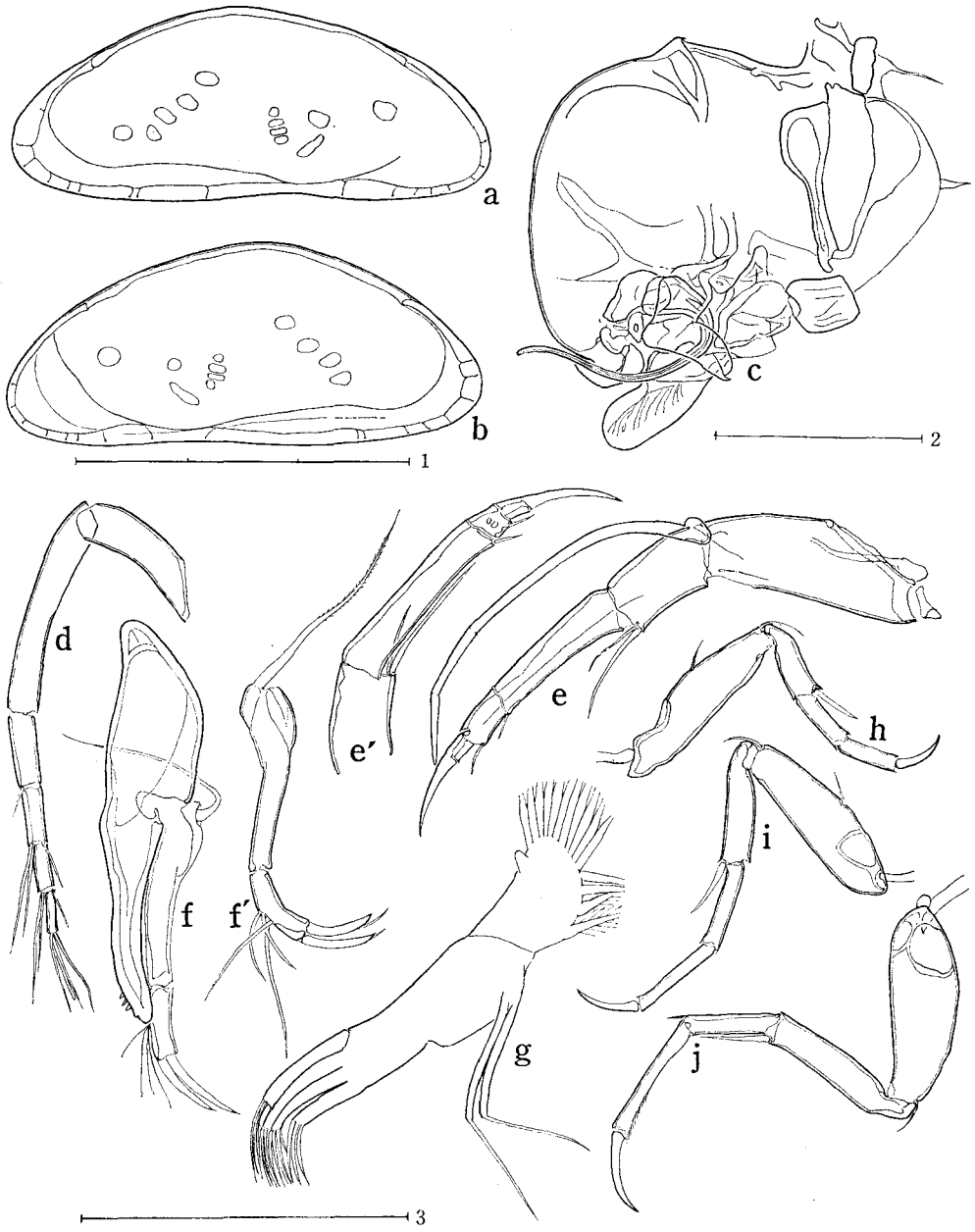


Fig. 22. *Cytherois decorata*. a-j, f′, MO-716, ♂; e′, MO-771, ♀. a, left valve; b, right valve; c, copulatory organ; d, antennula; e, e′, antenna; f, f′, mandible; g, maxillula; h, maxilla; i, thoracopoda 1; j, thoracopoda 2.
Scale: 1 (=0.3 mm) for a,b; 2 (=0.1 mm) for c; 3 (=0.1 mm) for d-j, e′, f′.

lateral outline; greatest height just behind the middle. Dorsal margin arched, both halves roughly symmetrical. Anterior and posterior margins rounded narrowly and distortedly. Ventral margin almost straight, faintly sinuated at the middle.

Selvage moderately developed along ventral margin. List existing anteriorly and posteriorly. Infold wide anteriorly, narrow antero-ventrally, moderate mid-ventrally to posteriorly. Inner margin somewhat irregular. Fused zone narrow, even in greatest width. Radial pore canals moderate in number, unbranched.

Surface finely pittsd throughout. Adductor muscle scars small, four in vertical row, just in front of the middle. Two large anterior scars present. In addition, one to several large scars existent at anterior fourth and at posterior half, which are characteristic of this species.

Antennula: Of six podomeres; length ratio of distal five podomeres: 28:9:7:6:6 in a female, 29:9:8:6:6 in a male, along anterior chitinous margins; second podomere conspicuously elongate. First, second podomere without setae. Third podomere with fine seta antero-distally. Fourth, fifth podomere with seta antero-distally, two setae postero-distally, respectively. Sixth podomere with three setae and sense club distally.

Antenna: Of five podomeres; length ratio of distal four podomeres and claw: 27:40:13:8:23 in a female, 22:30:7:6:27 in a male. First podomere large, without seta. Second podomere with two setae postero-distally. Third podomere elongate, with fine seta postero-distally. Fourth podomere, relatively small in male, with

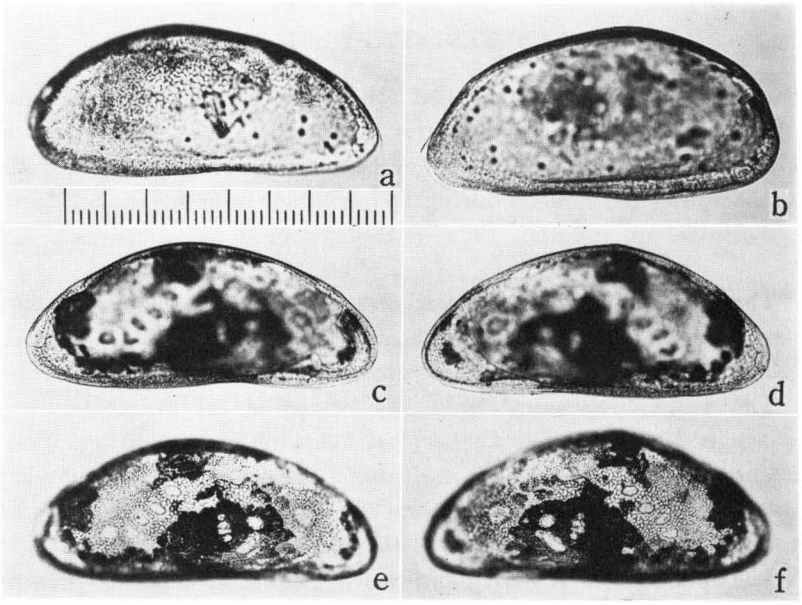


Fig. 23. *Cytherois* spp.
a-d, *C. bingoensis*. c-f, *C. decorata*.
a, c, e, left valve; b, d, f, right valve.
(a–d, focussed on margins; e, f, on lateral wall).
Scale given in 0.4 mm.

seta postero-distally. Fifth podomere small, fused with claw in part. Claw slightly longer in male than in female. Spinneret seta three-segmented at length ratio 7:2:2.

Mandible: Coxa somewhat strong, distally with a few small teeth. Palp of two podomeres: First podomere with exopodite of one large plumose seta. Second podomere with four setae antero-medially, two claws and two setae distally.

Maxillula: Branchial plate with 15 feather-like setae. Vibratory setae two in number, juxtaposed. Palp and masticatory lobes rather elongate.

Walking legs: Of four podomeres; setal formula for (antero-medial, antero-distal, posterior) areas of protopodites (1,1,0),(1,1,0),(0,1,0); length ratio of distal three podomeres and claws (10:8:8:8):(16:12:12:9):(21:13:17:12) along posterior margins in a female. Second podomere with each seta antero-distally. Thoracopoda 2: Fourth podomere with hairs along distal half of anterior margin.

Copulatory organ: Relatively large. Basal part ovate, with tongue-like process and rather strong copulatory tube.

Material. MO-771, ♀ (holotype), LV (43–18), RV (43–19); MO-770, ♂ (paratype), LV (48–19), RV (49–?); DW, 28-VII-1977. MO-716, ♂ (allotype), LV (48–19), RV (-), HSB, 17-VII-1977.

Occurrence. Very rare. In intertidal zones of muddy sand.

Remarks. This species is distinguished from the congeners by the pitted valves with several large decorative scars.

VI SYSTEMATIC REMARKS

Hanai *et al.* (1977) have published the "Checklist of Ostracoda from Japan and Its Adjacent Seas" and listed all the Japanese ostracod species reported until 1975. The publication has much contributed to this work. Some different aspects that the author has noticed during this work are to be mentioned here.

(1) *Neonesidea* sp. (Okubo, 1975) is thought to be *N. oligodentata* (Kajiyama, 1913).

(2) The Japanese specimen named *Propontocypris* (*Propontocypirs*) *attenuata* may be different from the European species found by Brady (1868).

(3) The subfamilies Paracyprinae and Thalassocyprinae are new to Japan.

(4) The genus *Cytheromorpha* does not belong to the family Loxoconchidae. Here it is assigned to the family Cytheridae, following Hartmann and Puri (1974).

It has been indicated by Hanai *et al.* that *C. acupunctata* and *C. japonica* are one and the same species. It is appended here that the elongate form is the male and the stout form is the female, regardless of the coarseness of the surface.

(5) The specimen from the Inland Sea of Seto named *Aurila cymba* by Brady (1880) is thought to be unequal to the Mediterranean species. Here it is allotted to *A. subconvexa* Kajiyama, 1913.

(*A. miii* is also equal to *A. subconvexa.*)

(6) The specimen from Aomori Bay named *Mutilus assimilus* by Ishizaki

(1971) is thought to be equal to *M. ishizakii* in this paper.

(7) It is clarified that *Echinocythereis bradyi* and *E. bradyformis* belong to one and the same species; the former is the male and the latter is the female. *E. bradyi* remains as the specific name.

(8) The species of the genus *Semicytherura* are better subdivided into two groups: "*henryhowei*-group" and "*miurensis*-group".

(9) The elongate and reduced forms within *Loxoconcha japonica* are the male and female of this species.

(10) *Paradoxostoma* sp. Ishizaki, 1968, is thought to belong to the genus *Sclerochilus*.

VII MORPHOLOGICAL COMMENTS

Some paleontologists, *viz.*, Moore (1961), Van Morkhoven (1962, '63) and Pokorny (1965) have described the main characters of valves in most genera of Ostracoda. Recently, Hartmann and Puri (1974) have summarized the diagnoses of the families of Recent Ostracoda. Here the author also shows the main structural features of appendages in 20 genera of the superfamily Cytheracea found in the Inland Sea of Seto in Table 2.

As regards appendages, most cytherid ostracods have the following features. (1) The antennula consists of five or six podomeres. (2) The antenna is composed of four or five podomeres and has two or three terminal claws. (3) The mandible owns a broad coxa with several teeth distally (normal cytherid type). (4) The maxillula is provided without or with one or two vibratory setae. (5) The walking legs are formed of four podomeres; the maxilla is the smallest and the thoracopoda 2 the largest.

Some genera, however, are furnished with unusual characters, as shown below.

(1) *Pontocythere* (Male): The thoracopoda 1 is larger than the maxilla and the thoracopoda 2.

(2) *Parakrithella*: The maxilla and the thoracopoda 1 are composed of three podomeres.

(3) *Cytheromorpha*: The antennula, composed of six podomeres, differs from other genera of the family Cytheridae. The number, however, may be rather variable, as shown in *Loxoconcha*.

(4) *Aurila, Mutilus* and *Ambostracon* (Family Hemicytheridae): The walking legs bear complicated apodemes near the knees in the protopodites.

(*Loxoconcha*: Some species have chitinous bridges in the second podomeres of walking legs.)

(5) Families Cytheruridae, Loxoconchidae, Xestoleberididae and Paradoxostomatidae: The antennula is provided with no claw. The maxillula has one (?) or two vibratory setae.

(6) Family Paradoxostomatidae: The mandible is more or less styliform: normal-styliform or more elongate-styliform in *Paradoxostoma,* and somewhat broad

Table 2. Main structural features of appendages in 20 genera of the superfamily Cytheracea

Genera	Podomeres A_1	A_2	L_1	L_2	L_3	Claws A_1	A_2	Spinneret seta	Md	Mx	Setal formula L_1	L_2	L_3	Sexual dimorphism
Pontocythere	5	4	4	4*	4	3	2+1	3	C-1	0	0 2 1,	1 1 1,	1 1 1	L_2, L_3
Parakrithella	5	4	3	3	4	5	3+0	3	C-3	0	0 3 1,	1 1 1,	1 1 1	L_2
Callistocythere	5	4	4	4	4	3 or 4	2+0	2 or 3	C-1.5	0	2′ 2 1,	2′ 1 1,	2′ 1 1	
Cythere	5	4	4	4	4	3	2+0	3	C-3	0	2′ 2 1,	2′ 1 1,	2′ 1 1	L_2
Cytheromorpha	6	4	4	4	4	4	2+0	3	C-3	0	2′ 2 1,	2′ 1 1,	2′ 1 1	
Spinileberis	5	4	4	4	4	3	3+0	3	C-3	0	2 2 1,	1 1 1,	1 1 1	A_2
Aurila / *Mutilus*	5	4	4a	4a	4a	3 or 4	3+0	3	C-1.5	0	2 2 1,	2′ 1 1,	1 1 1	A_2
Ambostracon	5	4	4a	4a	4a	4	3♂ / 2♀	3	C-2.5	0	2′ 2 1,	2′ 1 1,	2′ 1 1	A_2, L_2
Trachyleberis	6	4	4	4	4	3	3+1	3	C-5	0	2′ 2 1,	2′ 1 1,	2′ 1 1	A_2
Echinocythereis	6	4	4	4	4	3	3+1	3	C-5	0	2′ 2 1,	2′ 1 1,	1 1 1	A_2
Bicornucythere	6	4	4	4	4	3	3+0	3	C-5	0	2′ 2 1,	2′ 1 1,	1 1 1	A_2, L_2, L_3
Hemicytherura	6	5	4	4	4	0	2+0	3	C-1	2	1 2 2,	2′ 1 2,	0 1 0	
Semicytherura (h)	6	5	4	4	4	0	2+0	3	C-1	1.5	1 2 2,	2′ 1 1,	0 1 0	
Semicytherura (m)								4			1 2 1,	2′ 1 0,	0 1 0	
Loxoconcha / *Loxocorniculum*	5 or (6)	4	4	4	4	0	2+0	2	C-3.5	1	2′ 2 1,	2′ 1 1,	2′ 1 1	
Xestoleberis	5 or 6	4	4	4	4	0	2+0 or 1	2	C-3	1	2? 2 1,	2′ 1 1,	2′ 1 1	A_2
Paradoxostoma	6	5	4	4	4	0	2 or 1 +0	3 or 4	S-0 or 1	2	1 1 0,	1 1 0,	0 1 0	
Cytherois (b)	6	5	4	4	4	0	2♀ / 1♂ +0	4	S′-1	2	1 1 0,	1 1 0,	0 1 1	A_2
Cytherois (d)							1	3			1 1 0,	1 1 0,	0 1 0	
Sclerochilus	7	5	4	4	4	0	3	2	S′-3	?	3′ 2 3,	2′ 1 1,	2′ 1 1	A_2

EXPLANATORY NOTES

A_1: antennula; A_2: antenna; Md: mandible; Mx: Maxillula; L_1: maxilla; L_2: thoracopoda 1; L_3: thoracopoda 2.
(Podomeres): number of podomeres; *: largest unusually in male; a: with apodeme.
(Claws-A_1): total number of claws in A_1. (Claws-A_2): number of claws of distal podomere+of other podomeres in A_2.
(Spinneret seta): number of segments.
(Md): shape of coxa-number of setae in exopodite; C: cytherid type, S: styliform, S′: sub-styliform; 0.5: very small process.
(Mx): number of vibratory setae; 1.5: long and short setae. (Setal formula): 2′=1+1.

stilyform in *Cytherois* and *Sclerochilus*.

(7) *Paradoxostoma*: The antenna has two terminal claws (*P. pedale* and allied species) or one claw and one seta (*P. flaccidum* and allied species).

(8) *Sclerochilus*: The antennula consists of seven podomeres.

The arrangement of the families within the superfamily Cytheracea is thought to be based on the characters of valves. In general, the characters of appendages also support the order. The family Loxoconchidae (and Xestoleberididae), however, are thought to be better placed between the families Trachyleberididae and Cytheruridae, judging from the data obtained from the species of the Inland Sea.

VIII ZOOGEOGRAPHICAL SUMMARY

The relation between the sixty-six species and 32 stations where they were found are shown in Table 3. This may give some zoogeographical summary on the species of the Inland Sea of Seto.

(1) Sixty-six species in 29 genera of the order Podocopida have been discovered in the middle area of the Inland Sea. Among them, 34 species are described as new to science, and 26 species as new to the Inland Sea of Seto. By the way, Recent marine podocopid ostracods in Japan have about 180 species, inclusive of the new species described here. When the species from the Kurile Islands are counted, the total comes to 210.

(2) The most predominant genus in the Inland Sea of Seto was *Paradoxostoma,* in which 18 species were discovered. The diversity in this genus, which has characteristically the fragile carapace and the sucking mouth, may be related to the physico-chemical conditions of this sea, where the waves are relatively calm, the tidal currents are somewhat rapid, and the salinity is comparatively low.

(3) The next largest genera were *Callistocythere, Aurila,* and *Loxoconcha,* which were also predominant at various shores of Japan.

(4) The following 10 species were found at more than half of the stations, and therefore are thought to be the common species in the Inland Sea of Seto: *Xestoleberis hanaii, Paradoxostoma flaccidum, Parakrithella pseudadonta, Paradoxostoma setoense, Xestoleberis setouchiensis, Cythere nishinipponica, Paradoxostoma pedale, P. inabai, Mutilus assimilis* and *Sclerochilus mukaishimensis.*

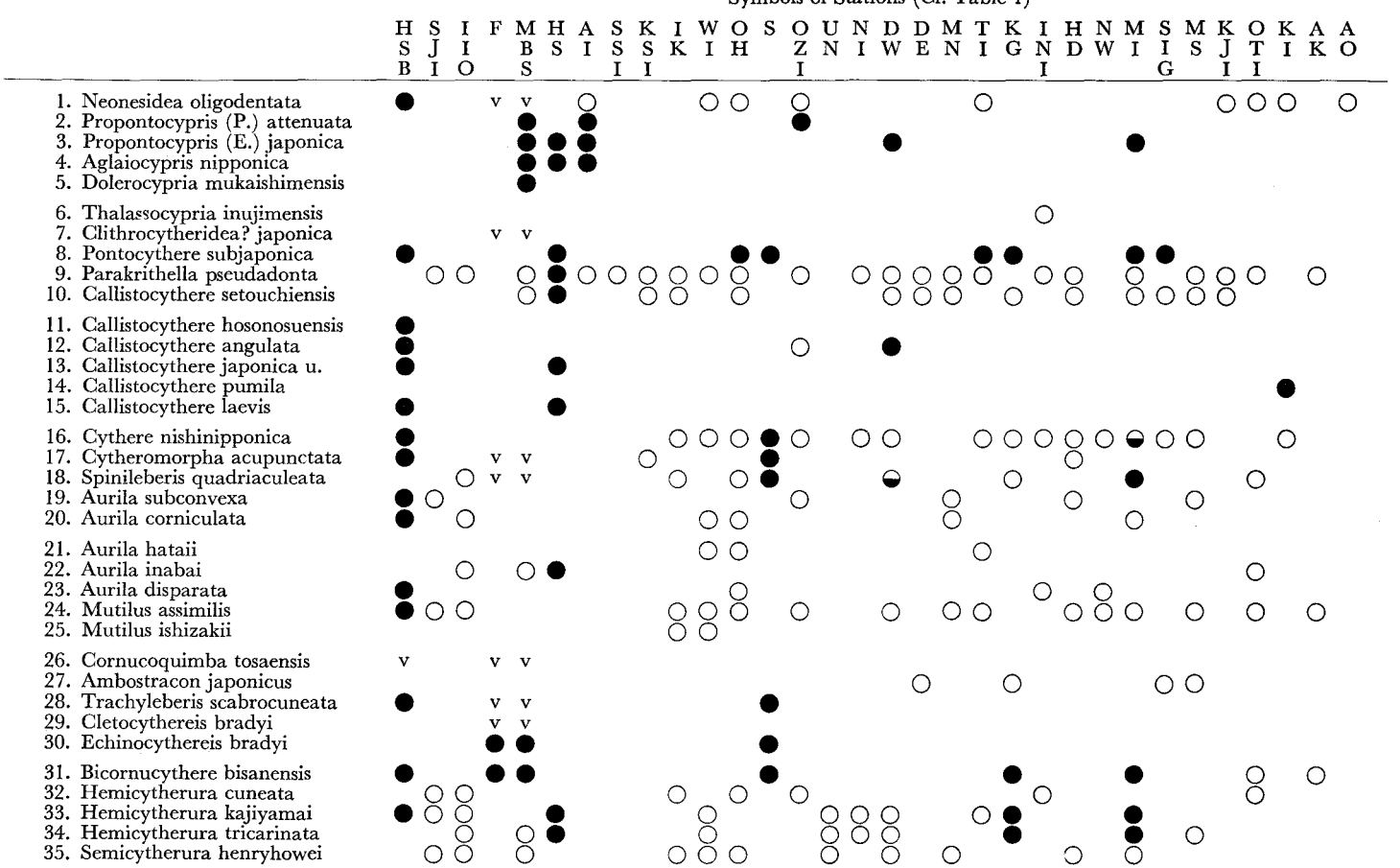
(5) The species collected exclusively from subtidal zones were *Trachyleberis scabrocuneata* and *Echinocythereis bradyi.*

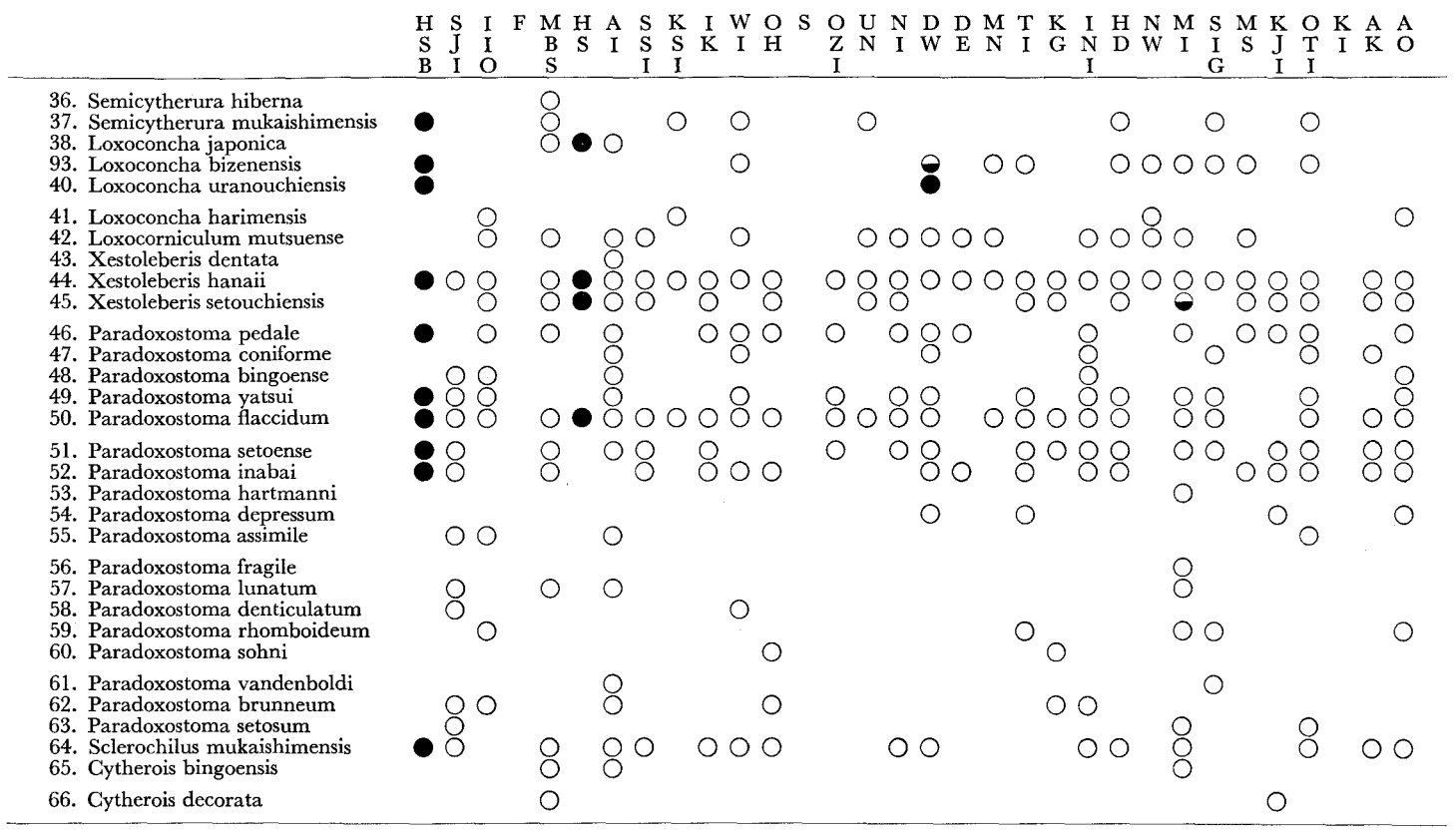
The following three species, whose valves alone were found at a depth of about 10 m, probably may inhabit subtidal zones: *Clithrocytheridea? japonica, Cornucoquimba tosaensis* and *Cletocythereis bradyi.*

The next three species were mostly collected from subtidal zones: *Cytheromorpha acupunctata, Spinileberis quadriaculeata* and *Bicornucythere bisanensis.*

(6) Most ostracods are thought to have a specific habitat. Some were discovered on clusters of algae in rocky shores, and others on or in mud or sand where eel grass grew on occasion. The species inhabiting the latter environment were

Table 3. Occurrence of each species





v : valves alone
○: on algae
●: in or on sand or mud

the following species: two species of *Propontocypris, Aglaiocypris nipponica, Dolerocypria mukaishimensis, Pontocythere subjaponica,* five species of *Callistocythere, Trachyleberis scabrocuneata, Echinocythereis bradyi, Bicornucythere bisanensis* and *Loxoconcha uranouchiensis.*

Ostracods collected from both rocky and muddy (or sandy) shores were shown below: *Cytheromorpha acupunctata, Spinileberis quadriaculeata, Aurila subconvexa, A. disparata, Mutilus assimilis, Hemicytherura kajiyamai, H. tricarinata* and *Semicytherura mukaishimensis.*

(7) Almost all the ostracods of the Inland Sea of Seto occur in summer, except only one species, *Semicytherura hiberna,* collected in winter.

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