

Ostracode Fossils from the Late Pliocene to Early Pleistocene Omma Formation in the Hokuriku District, Central Japan

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OSTRACODE FOSSILS FROM THE LATE PLIOCENE TO EARLY PLEISTOCENE OMMMA FORMATION IN THE HOKURIKU DISTRICT, CENTRAL JAPAN

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Abstract: From the late Pliocene to early Pleistocene Omma Formation, 240 ostracode species belonging to 100 genera are recognized in 159 samples collected at five localities located at Kanazawa and Oyabe Cities in the Hokuriku district on the Japan Sea side of central Japan. The ostracode species from this strata generally consists of three different fossil groups. The first group was considered to be inhabiting in the inner bay environment, and the second contains species living in the open sea. The third group has both elements of the two groups.

Key words: Ostracoda, late Pliocene to early Pleistocene, Omma Formation

1. Introduction

The late Pliocene to early Pleistocene (about 2.1~0.8 Ma) Omma Formation is distributed in the basal area of the Noto Peninsula, the eastern part of Ishikawa Prefecture and western part of Toyama Prefecture on the Japan Sea coasts of central Japan. The Formation is a representative of the Plio-Pleistocene shallow marine strata widely distributed along the Japan Sea coasts from the southwestern Hokkaido to the Cheju Island at the Tsushima Strait. The Formation is well known for the abundant occurrence of shallow marine calcareous fossils, such as Mollusca, Foraminifera, Nannoplankton and Ostracoda (e. g. Yokoyama, 1927; Kaseno and Matsuura, 1965; Hasegawa, 1979; Matsuura, 1985; Cronin and Ikeya, 1987; Takayama *et al.*, 1988; Kitamura and Kondo, 1990; Ishizaki *et al.*, 1993). A couple of datum plains were well studied in the Omma Formation by the nanofossil analysis (e. g. Takayama *et al.*, 1988). In addition to the biostratigraphical correlation, the correlation of tuff layers between several localities provide other controlled time plains (Okubo, 1995 MS; Kitamura, 1996). As a result, these features make this stratum an excellent material for the detailed discussion on the shallow water environments and oceanography in the Japan Sea of this area during the late Pliocene and early Pleistocene. Ostracode fossil assemblages on five areas, which were correlated to the

lower and the base of the middle parts of Kitamura and Kondo (1990), were studied in this paper. The purpose of this study is to know the species occurrence in detail and give photographs of ostracode fossils, which will be fundamental and essential data for the future paleoenvironmental work in this area.

2. Outline of geology

Omma Formation which belongs to the Himi Group is widely distributed in the southern part of Kanazawa City in Ishikawa Prefecture and Oyabe City in Toyama Prefecture, on the Japan Sea side of central Japan (Fig. 1) (Motizuki, 1930; Hasegawa, 1979). This stratum mainly consists of blueish fine-grained sandstone and silty sandstone, and yields abundant molluscan fossils which are so called "Omma-Manganjian Molluscan Fauna" (Yokoyama, 1927; Kaseno and Matsuura, 1965; Ogasawara, 1977; Matsuura, 1985). The thickness of the Omma Formation attains about 210 m at the type locality in Kanazawa City and about 250 m in the southern part of Oyabe City (Hasegawa, 1979; Kitamura and Kondo, 1990), and has mainly NE-SW strike with 5~75° dip to the northwest.

The Formation covers unconformably the middle Miocene Saikawa Formation at the type locality (Okuwa area, Fig. 1, Loc. 1) (Motizuki, 1930; Ogasawara, 1977) and middle Miocene and early Pliocene Takakubo Formation (Ito, 1986) in the southern part of Kanazawa City (Sugimoto, 1994). The Omma Formation around Hakkouden area (Fig. 1, Loc. 4) covers the Takakubo Formation. The stratigraphic relationship

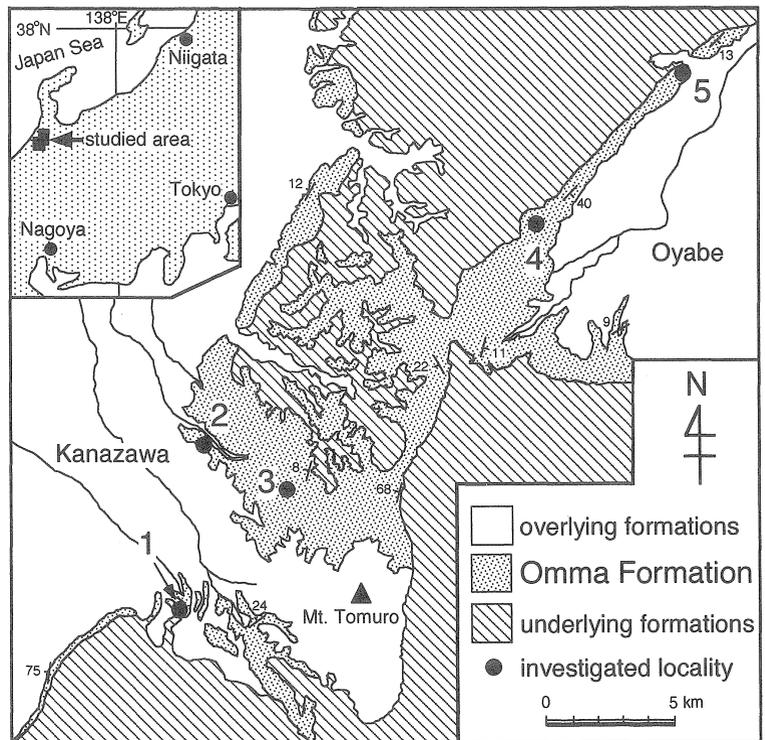


Fig. 1: Simplified geological map of the Omma Formation around Kanazawa and Oyabe Cities, central Japan, modified from Hasegawa (1979), with investigated localities in this study. Loc.1: Okuwa (type locality), Loc. 2: Yuhidera, Loc. 3: Kofutamata, Loc. 4: Hakkouden, and Loc. 5: Sakuramachi.

between the Omma and Takakubo Formations is still under debate. The Omma Formation around Sakuramachi area (Fig. 1, Loc. 5) is considered to be bounded by Yachi Formation (Pliocene?) in faults (Hasegawa, 1979; Takata, 1994 MS).

The middle Pleistocene Utatsuyama Formation overlies unconformably the Omma Formation around the type locality (Kitamura and Kondo, 1990). The middle Pleistocene Hanyu Formation covers the Omma Formation around Hakkouden area with unconformity (Hasegawa, 1979; Furuya, 1990 MS). At Sakuramachi area, the calcareous fine sandstone layers which have 0.3~2.2 m thickness are interleaved (Takata, 1994 MS). Sumi *et al.* (1989) described that this calcareous fine sandstone around Sakuramachi area was a distal part of the Zukawa Formation which was distributed in Takaoka City, 10 km NE of Sakuramachi.

The Omma Formation contains four white tuff layers that are named "O 1 to O 4 tuff layers" in upward sequence by Hasegawa (1979). The O 2 tuff layer is widely distributed in the southern part of Kanazawa and Oyabe Cities (Hasegawa, 1979; Okubo, 1995 MS; Ishikawa, 1995 MS). Okubo (1995 MS) reidentified the tuff layers and reported that the O 1 and O 2 tuff layers were found at Kofutamata area (Fig. 1, Loc. 3) and the O 2 tuff layer at Hakkouden area (Fig. 1, Loc. 4) in addition to the type locality (Fig. 1, Loc. 1).

The geological age of the Omma Formation was studied by several workers and plural biostratigraphic datum plains of calcareous nannofossils have been identified (Takayama *et al.*, 1988; Shida *et al.*, 1989; Takata, 1994 MS; Yamamoto and Ozawa, 1996). According to these studies, the Omma Formation of Sakuramachi area was deposited during about 2.1~1.3 Ma, and of Hakkouden area was deposited in about 1.7~1.3 Ma. The Omma Formation exposed at the type locality was deposited in about 1.4~0.8 Ma. The fission track age of the O 2 tuff layer was 1.4 ± 0.2 Ma (Ohmura *et al.*, 1989). Taking all data into consideration, the Omma Formation was concluded to deposit during the late Pliocene and early Pleistocene, but it began to deposit slightly earlier in the eastern area (Oyabe) than in the western area (Kanazawa) as Shida *et al.* (1989) indicated.

3. Material and method

Fossil Ostracoda from five localities were investigated in this study. They were the lower and partly the middle parts of Okuwa (Loc. 1 in Fig. 1; type locality of the Omma Formation), Yuhidera (Loc. 2), Kofutamata (Loc. 3), Hakkouden (Loc. 4) and Sakuramachi (Loc. 5). Field works were carried out for all areas in order to observe the lithology and molluscan fossils and collect samples except Sakuramachi area where the outcrops were lost at present.

A total of 52 sediment samples for the ostracode fossil analysis were collected from Kofutamata (Loc. 3) and Hakkouden (Loc. 4) areas by the author. Samples were collected carefully parallel to the bedding plane within a 15 cm in thickness to obtain contemporaneous sediments. Burrows filled with subsequent sediments were carefully excluded. After

being dried in an oven under 70°C, 320 g of consolidate samples and about 400 g of unconsolidate samples were washed through a 235 mesh (0.064 mm opening) sieve. The dried residues were divided by the quatering method into unit samples which contained about 200 ostracode individuals. The fractions between 0.25 mm and 1.0 mm of each sample were hand-picked for all ostracodes under the binocular microscope by using a fine brush and a grigged picking tray. The rest of the fraction is stored. Samples containig fewer than 200 specimens in total were picked entirely, and more samples were washed and hand-picked.

Ostracode fossils at Okuwa (Loc. 1) and Sakuramachi (Loc. 5) areas were already picked by Dresser (1992 MS), Ohi (1994 MS), and Matsuzaka (1995 MS) respectively. All the specimens were reidentified in this study, and additional samples were hand-picked when they were demanded.

After the identification of species, the individual number was determined by adding the total of single left and right valves one half complete, and was counted to the number of valves without regard to sex and instar stages. The ostracode species are listed in Tables 1~6 on each locality. All specimens and the rest of the fractions of samples are on deposited in the Department of Earth Sciences, Faculty of Science, Kanazawa University.

4. Descriptions of the sampling localities and ostracode fossils

After the identification of ostracode fossil specimens with a total of 25035 from 159 samples, 240 ostracode species belonging to 100 genera were recognized.

To describe the characters of the fossil assemblage, common species were used in the analysis. "Common species" are here termed as species that were contained more than 10% at least one sample in a locality. The ratio of "common species" is shown in Figs. 3~9, with five grades in accordance with percentages. Samples with more than 50 individuals were only taken into considerations in the analysis.

(1) Sakuramachi area (Loc. 5 in Fig. 2; this locality is equal to Route 3 of Takata (1994 MS). All lithological descriptions were summarized from Takata (1994 MS) because of the artificial covering of the outcrop.)

The Omma Formation in this area was divided into two parts, the "lower" and "upper" parts by Takata (1994 MS), based on the lithofacies. These two parts are bounded to an erosional bed with pebble. The "lower part" of this locality mainly consists of silty very fine sandstone and fine sandstone, and the whole thickness attains about 70 m. The "upper part" of this area contains five sedimentary cycles, and each cycle consists of three sedimentary facies; shell bed or pebble bed, calcareous fine sandstone, and silty very fine sandstone in upwards sequence. The whole thickness attains about 90 m.

Lower part (Fig. 3)

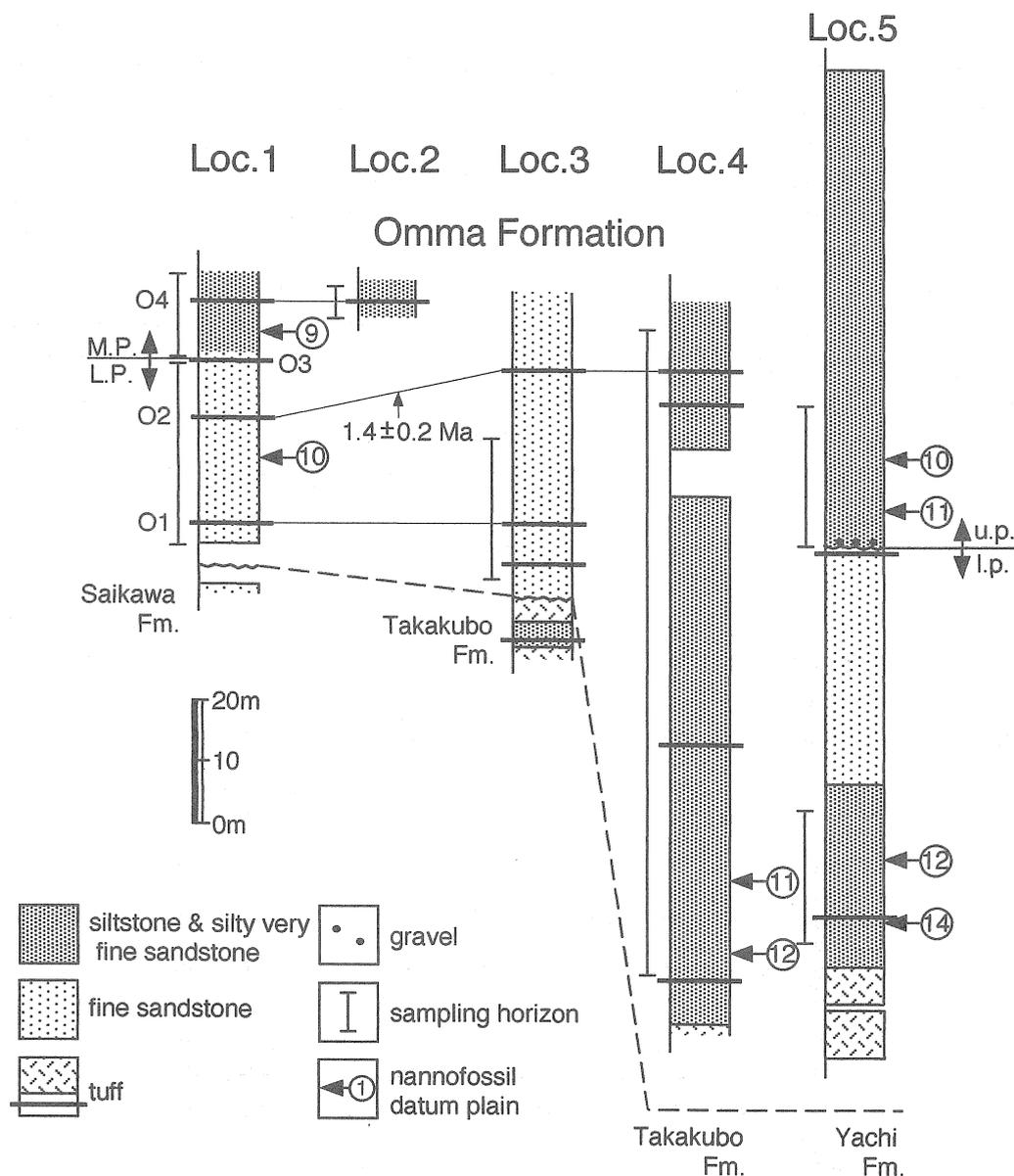


Fig. 2: Columnar sections and the correlation of studied localities. Correlation of tuff layers are cited from Okubo (1995MS) and Kitamura (1996). Nannofossil datum plains are referred to Takayama *et al.* (1988), Shida *et al.* (1989), and Takata (1994MS). Datum plain 14: OA *Gephyrocapsa* (2.13 Ma), plain 12: FAD *Gephyrocapsa caribbeanica* (1.66 Ma), plain 11: LAD *Calcidiscus macintyreii* and FAD *Gephyrocapsa oceanica* (1.57 Ma), plain 10: FAD Large *Gephyrocapsa* (1.36 Ma), plain 9: *Helicosphaera sellii* (1.19 Ma). The age of the O2 tuff layer is cited from Ohmura *et al.* (1989). The L.P. and M. P. of Loc. 1 indicate the lower and middle parts of Kitamura and Kondo (1990), and l.p. and u.p. of Loc. 5 show the lower and upper parts of Takata (1994MS). The dotted line represents the boundary between the Omma Formation and underlying strata. The columnar section of Loc. 5 is placed by adjusting to the datum plain 10.

Seventeen samples, numbered from Lo-1 to Lo-17, were obtained from the lower half (ca. 28 m thickness) of the "lower part" (see, Fig. 2, a vertical line beside the columnar section). The sediments were siltstone (lower 12 m) and silty very fine sandstone (upper 16 m) with molluscan fossils sporadically. All the samples yielded ostracode fossils with a total of 1244 specimens. A total of 55 species belonging to 36 genera were identified. Nine of 17 samples contained more than 50 individuals (Table 1). These samples abundantly included *Acanthocythereis dunelmensis* s.l., *Bicornucythere bisanensis*, *Cytheropteron* cf. *nodosolatum*, *Robertsonites tsugaruana* and *Yezocythere hayashii*, and these species occupy more than 20% in total in many horizons (Fig. 3). In addition to above species, *Paijenborchella tsurugasakensis* and *Robertsonites reticuliforma* are abundant in the lower half horizons, Lo-4 and 10, and these occupy about 30~35%. In the upper two horizons, Lo-16 and 17, *Cytheropteron* cf. *arcuatum* and *Loxococoncha optima* are common, and they form about 10~20%.

Upper part (Fig. 4)

The lithology of this part represented five sedimentary cycles. Each cycle started with calcareous fine sandstone with the accumulated shell beds at the base, then changed to silty very fine sandstone. A total of 53 samples were collected from the lower half of the upper part (see, Fig. 2) which has about 22 m in thickness. These samples were numbered

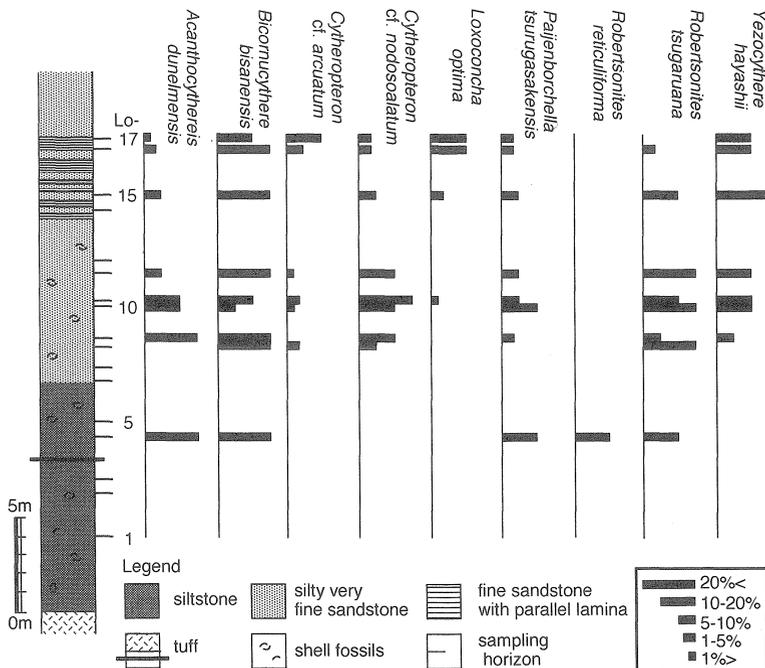


Fig. 3: Columnar section and the occurrence of common ostracode species in the lower part at Sakuramachi area (Loc. 5), simplified from Takata (1994MS).

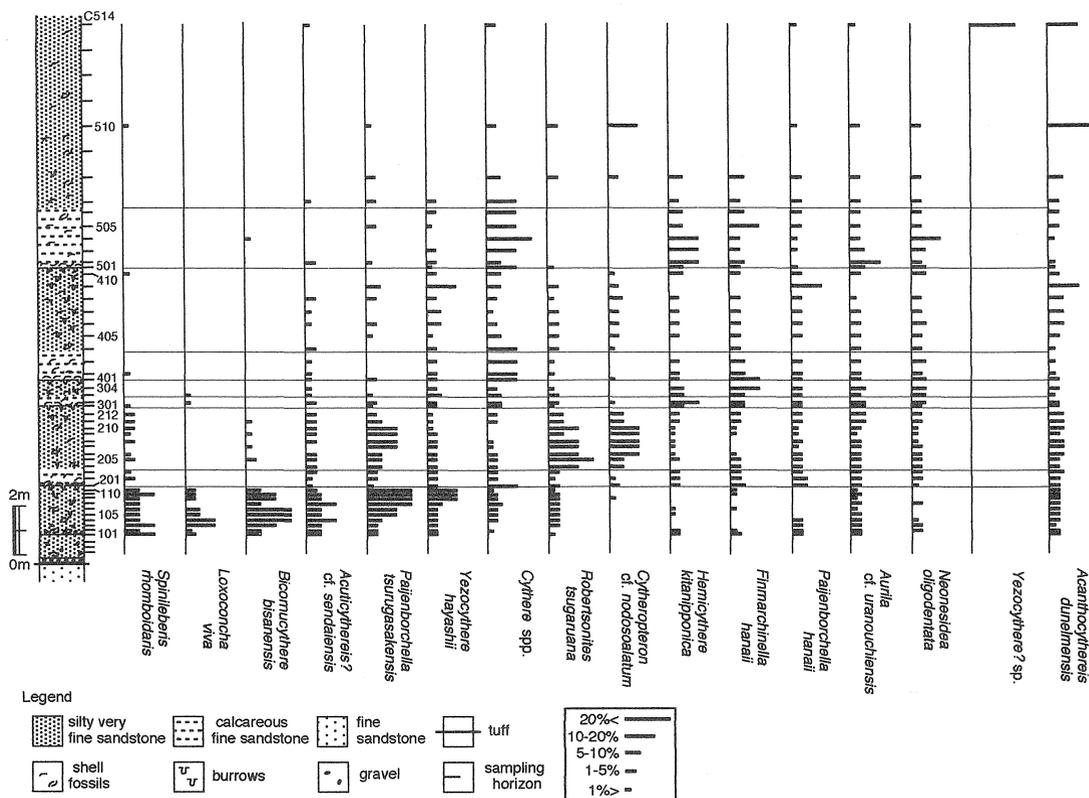


Fig. 4: Columnar section and the occurrence of common ostracode species in the upper part at Sakuramachi area (Loc. 5), simplified from Takata (1994MS).

as C 101 to C 110 in the first cycle, C 201 to C 212 in the 2 nd cycle, C 301 to C 304 in the 3 rd cycle, C 401 to C 410 in the 4 th cycle, and C 501 to C 514 in the 5 th cycle. Fifty samples yielded the ostracode fossils with a total of 9656 individuals, and only three samples from silty very fine sandstone contained no ostracode fossils. Forty six of 50 samples yielded more than 50 individuals. A total of 197 species belonging to 85 genera were recognized (Table 2).

Distribution of the common species divides the five cycles into three groups. The cycle 1 (1st cycle) is characterized by being rich in *Acuticythereis?* cf. *sendaiensis*, *Bicornucythere bisanensis*, *Loxoconcha viva*, *Paijenborchella tsurugasakensis*, *Spinileberis rhomboidaris* and *Yezocythere hayashii* from the silty very fine sandstone. *B. bisanensis* and *L. viva* increase in the middle horizon, and two species occupy about 30~35%. *P. tsurugasakensis* and *Y. hayashii* increase upwards, and reach about 45% in the uppermost horizon (C 110). In the cycle 2 (2nd cycle), these species become fewer than the cycle 1 with an exception of *P. tsurugasakensis*. In the lowest horizon (C 201) of the calcareous fine sandstone, *Cythere* spp. are abundant (about 10%), but decrease towards the upper horizons (silty very fine sandstone), and become about 1%. On the other hand, *Cytheropteron* cf. *nodosoalatum*, *P. tsurugasakensis*, and *Robertsonites tsugaruana* are common in the silty very fine sandstone. The three species occupy about 20~50% in the middle to upper horizons

(C 205~212). The cycles 3, 4 and 5 (3rd, 4th and 5th cycles) are characterized by the abundance of *Cythere* spp., *Finmarchinella hanaii* and *Hemicythere kitanipponica* from the calcareous fine sandstone, and *Acanthocythereis dunelmensis* s.l., *Paijenborchella hanaii*, *Yezocythere hayashii*, and *Yezocythere?* sp. in the silty very fine sandstone. The first three species occupy about 20~40% in the most samples (C 301, 302, 401~403 and 501~506) from the calcareous fine sandstone. These species are fewer in the silty very fine sandstone except in the cycle 3. The latter four

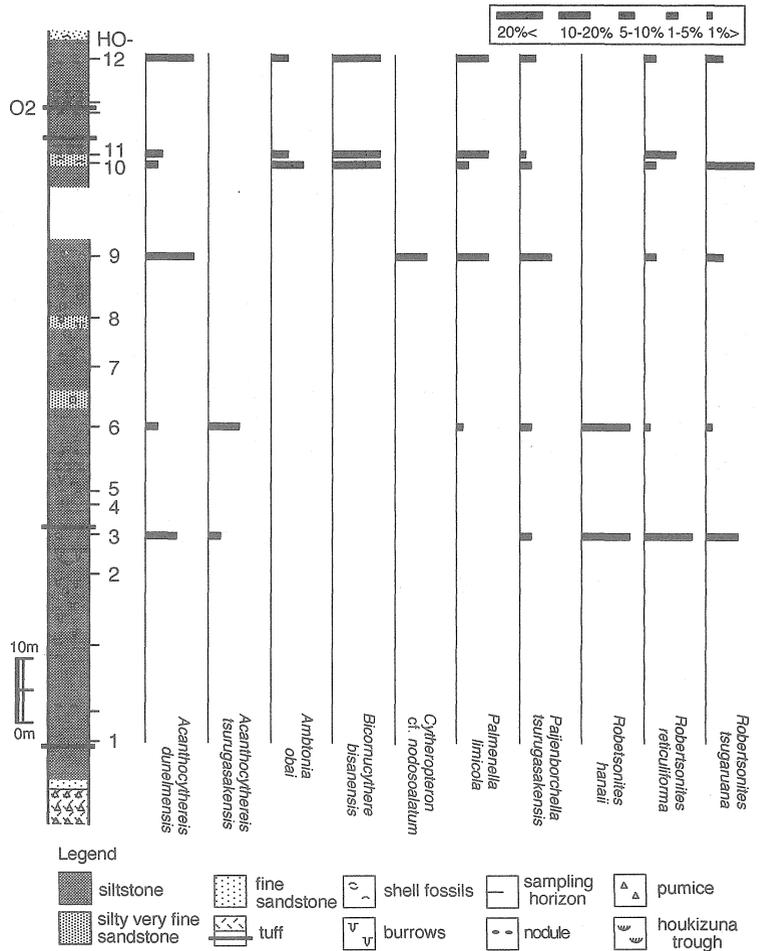


Fig. 5: Columnar section and the occurrence of common ostracode species at Hakkouden area (Loc. 4). The names of tuff layers are cited from Okubo (1995MS).

species usually occupy about 10~40% in the silty very fine sandstone. The uppermost horizon of the cycle 5 (C 514) abundantly contains *A. dunelmensis* s.l. and *Yezocythere?* sp. up to about 60%. But the silty very fine sandstone of the cycle 3 (C 303 and 304) occupies less than 10% of the species.

(2) Hakkouden area (Loc. 4 in Fig. 2, and Fig. 5; this area is equal to Hakkouden area of Shida *et al.*, 1989.)

Furuya (1992 MS) divided the Omma Formation in this area into five units. The present study covered unit II of Furuya (1992 MS), which has about 130 m thickness. The unit II consists of siltstone and silty very fine sandstone with four white tuff layers.

Sixteen samples were collected in this study from siltstone and silty very fine sand-

stone which had about 120 m thickness and contained molluscan fossils sporadically (Fig. 5). Twelve samples, which were numbered from HO-1 to HO-12, yielded ostracode fossils with a total of 800 individuals. Fourty one species belonging to 32 genera were identified. Six of 12 samples included more than 50 individuals (Table 3). These samples abundantly yielded *Acanthocythereis dunelmensis* s.l., *Paijenborchella tsurugasakensis*, *Palmenella limicola*, *Robertsonites reticuliforma* and *Robertsonites tsugaruana*, 30% or more in total (Fig. 5). On the lower two horizons (HO-3 and 6), *Acanthocythereis tsurugasakensis* and *Robertsonites hanaii* are common. Upper three samples (HO-10~12) contain many individuals of *Ambtonia obai* and particularly *Bicornucythere bisanensis* that is more than 20% in all three samples. *Cytheropteron* cf. *nodosoalatum* is common in one sample (HO-9) from a middle horizon, and occupies about 10%. *A. dunelmensis* s.l., *A. tsurugasakensis*, *C.* cf. *nodosoalatum*, *P. limicola* and *R.* spp. are common in the siltstone in this area. Two species, *A. obai* and *B. bisanensis*, are exclusively found in the silty very fine sandstone.

(3) Kofutamata area (Loc. 3 in Fig. 2, and Fig. 6; this area is equal to the outcrop at Kofutamata area of Yamamoto and Ozawa, 1996.)

The Omma Formation at this area consists of siltstone, silty very fine sandstone and fine sandstone with five white tuff layers, and the thickness attains about 50 m in all

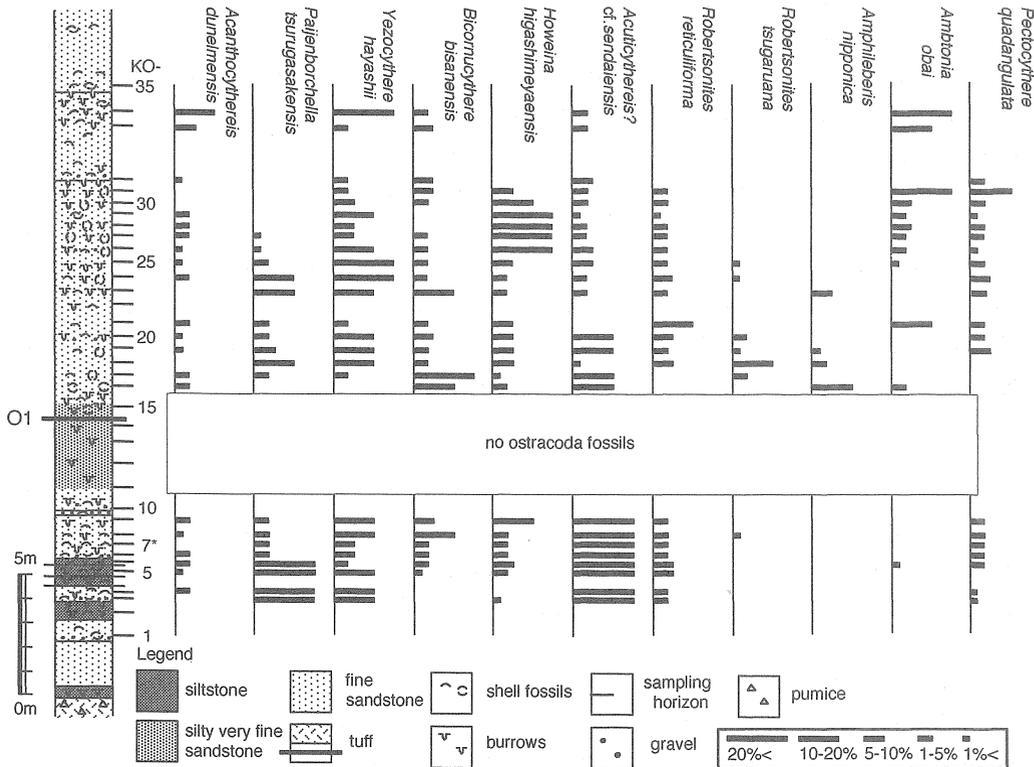


Fig. 6: Columnar section and the occurrence of common ostracode species at Kofutamata area (Loc. 3). The names of tuff layers are cited from Okubo (1995MS).

(Yamamoto and Ozawa, 1996).

A total of 36 samples were collected from the siltstone, silty very fine sandstone, and fine sandstone which were more than 37 m in thickness. The sediment had molluscan fossils sporadically except several horizons where the fossils were densely interbedded. The samples are numbered from KO-1 to KO-35, and 28 of 36 samples yielded the ostracode fossils with a total of 4930 specimens. The sum of 114 species belonging to 66 genera were identified (Table 4). Twenty six samples contained more than 50 individuals. This area is characterized by *Acanthocythereis dunelmensis* s.l., *Acuticythereis?* cf. *sendaiensis*, *Bicornucythere bisanensis*, *Howeina higashimeyaensis*, *Paijenborchella tsurugasakensis*, *Pectocythere quadangulata*, *Robertsonites reticuliforma* and *Yezocythere hayashii*. *A.?* cf. *sendaiensis* and *P. tsurugasakensis* are particularly abundant in the lower eight horizons (KO-3~9), and occupy about 40~70%. In the middle horizons, *H. higashimeyaensis* and *Y. hayashii* are abundant. The former species occupies about 10~30% in KO-26~30, and the latter about 10~30% in KO-23~26. *Amphileberis nipponica* (KO-16), *Ambtonia obai* (KO-21 and 32~34) and *Robertsonites tsugaruana* (KO-18) are common in some restricted horizons. The distribution of the common species does not seem to directly relate to the lithofacies.

(4) Okuwa area (Loc. 1 in Fig. 2; this area is the type locality of the Omma Formation.)

Kitamura and Kondo (1990) divided the Omma Formation at the type locality into three parts, that is the lower, middle and upper parts, on the basis of changes of lithofacies and molluscan fossil associations. The "lower part" which has about 30 m thickness consists of mainly monotonous fine sandstone, and contains three white tuff layers of O 1, O 2 and O 3. The 80 m thick "middle part" is characterized by ten sedimentary cycles, and O 4 tuff layer is interbedded (Kitamura, 1996). A typical sedimentary cycle consists of three lithologic units, that start from gravelly shell bed, then change to a well-sorted fine sandstone and finish with a muddy fine to very fine sandstone. The thickness of the "upper part" attains about 110 m, and are coarser than the lower and middle parts. The present study deals with ostracode fossils from the lower part and Cycles 1 and 2 of the middle part.

Lower part (Fig. 7)

A total of 35 samples which are numbered from OL-1 to OL-35 yielded the ostracode fossils from the silty very fine sandstone and fine sandstone which have about 30 m thickness. Four samples (OL-1~4) of 35 were collected from silty very fine sandstone, and 31 samples (OL-5~35) were obtained from fine sandstone. One hundred and eighteen species belonging to 62 genera were identified from a total of 7011 specimens. Thirty two of 35 samples yielded more than 50 individuals (Table 5). This part is characterized by being rich in *Acuticythereis?* cf. *sendaiensis*, *Bicornucythere bisanensis* and *Howeina higashimeyaensis*. *B. bisanensis* occupies about 55% in OL-5. *Munseyella hokkaidoana*, *Paijenborchella tsurugasakensis* and *Johnnealella nopporensis* are common in the lower

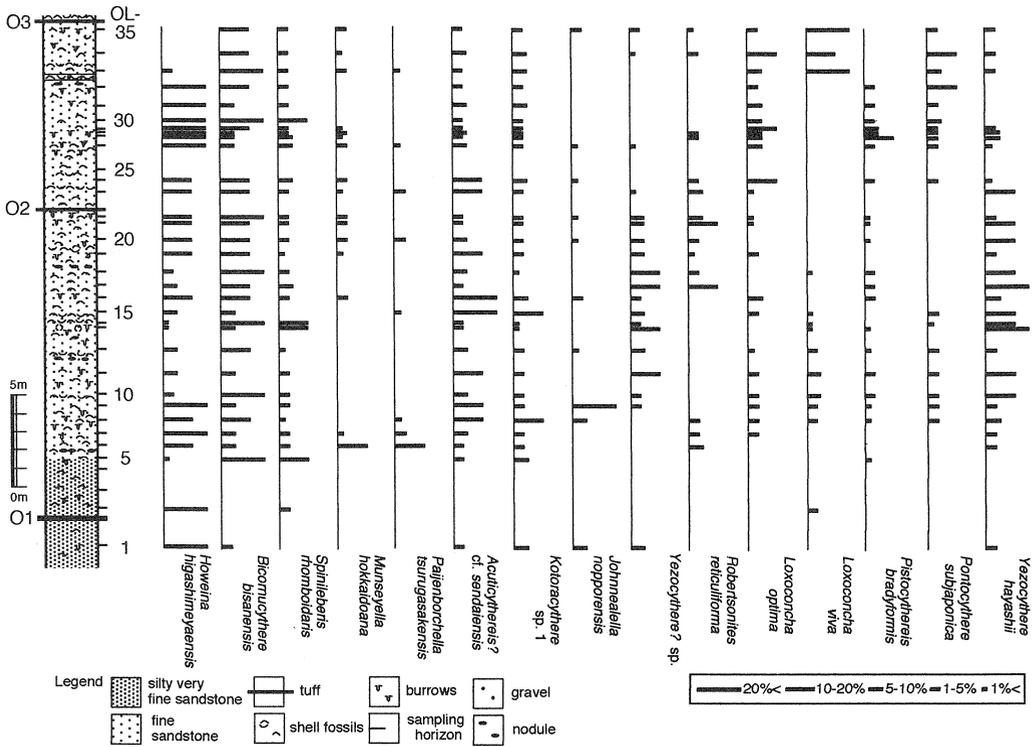


Fig. 7: Columnar section and the occurrence of common ostracode species in the lower part at Okuwa area (Loc. 1).

horizons, and the first two species are particularly common in OL-6 and the third species in OL-9. *Robertsonites reticuliforma* is common in the middle horizons (OL-17 and 21). *Loxoconcha optima*, *Loxoconcha viva*, *Pistocythereis bradyformis* and *Pontocythere subjaponica* are common in the upper horizons between O 2 and O 3 tuff layers, and *L. viva* is about 15~30% from OL-33 to 35. In this part, the silty very fine sandstone has a tendency to yield *H. higashimeyaensis* abundantly, but the occurrence of other common species does not correspond to the lithofacies.

Cycles 1 and 2 of middle part (Fig. 8)

Nine samples, which were named as C 1-1 to C 1-4 in the Cycle 1, C 2-1 to C 2-4 in the Cycle 2, and C 3-1 in the Cycle 3, yielded the ostracode fossils with a total of 820 specimens. Three samples (C 1-4, C 2-1 and C 3-1) were obtained from fine sandstone and other six samples (C 1-1 to C 1-3 and C 2-2 to C 2-4) from silty very fine sandstone. A total of 63 species belonging to 39 genera were recognized. Seven of nine samples included more than 50 individuals (Table 6). This part is characterized by being rich in *Acuticythereis?* cf. *sendaiensis* and *Bicornucythere bisanensis*. The latter occupies about 20~55% from C 1-1 to C 1-3. In the Cycle 1, in addition to the two species described above, *Ambtonia obai* and *Robertsonites reticuliforma* are common. In the Cycle 2, *Amphileberis nipponica*, *Bradleya*

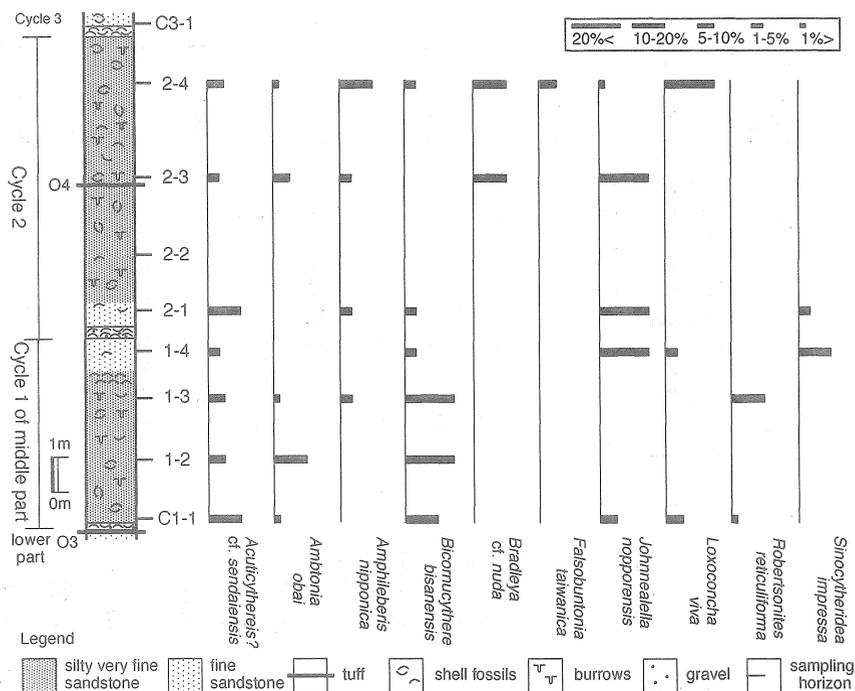


Fig. 8: Columnar section and the occurrence of common ostracode species in Cycles 1 and 2 in the middle part at Okuwa area (Loc. 1).

cf. nuda, *Falsobuntonia taiwanica* and *Loxoconcha viva* are abundant. *L. viva* is extremely rich and occupies about 40~75% in C 2-3 and C 2-4. *Johnnealella nopporensis* and *Sinocytheridea impressa* are common in the Cycle 1 (C 1-4) and Cycle 2 (C 2-1), and the former species occupies about 40~45% in C 1-4 and C 2-1. The silty very fine sandstone (C 1-1 to 1-3 and C 2-2 to 2-4) tends to yield *B. bisanensis* and *L. viva* abundantly, and the fine sandstone contains *J. nopporensis* and *Sinocytheridea impressa* dominantly.

(5) Yuhidera area (Loc. 2 in Fig. 2, and Fig. 9; this area is equal to Yuhidera area of Kitamura, 1996 and Kamiya *et al.*, 1996.)

Three sedimentary cycles are observed at this area, and each cycle consists of shell bed, fine sandstone, very fine sandstone, and siltstone with burrows (Kitamura, 1996). Kitamura showed that the Cycle 2 in Yuhidera area is correlated with the Cycle 2 in Okuwa area by O 4 tuff layer.

Nine samples were obtained from the siltstone, silty very fine sandstone, and fine sandstone of Cycle 2 of Kitamura (1996) (Fig. 9). Eight of nine samples were collected from silty very fine sandstone with molluscan fossils sporadically. One sample were obtained from siltstone with dense burrows. These samples were numbered from Y-1 to Y-9, and eight samples (Y-2~9) yielded the ostracode fossils (Kamiya *et al.*, 1996). A total of 52 species belonging to 34 genera were identified from a total of 580 specimens

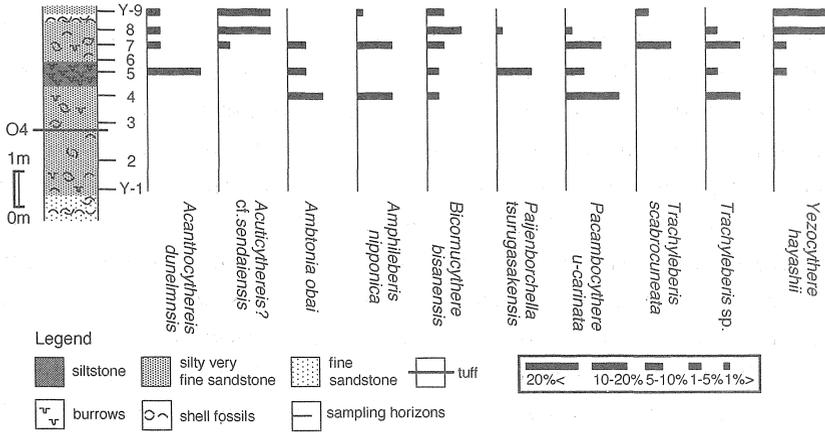


Fig. 9: Columnar section and the occurrence of common ostracode species in the Cycle 2 at Yuhidera area (Loc. 2).

(Table 6). Five of eight samples included more than 50 individuals. These samples abundantly yielded *Acanthocythereis dunelmensis* s.l., *Ambtonia obai*, *Amphileberis nipponica*, *Bicornucythere bisanensis*, *Pacambocythere u-carinata*, *Trachyleberis* sp. and *Yezocythere hayashii*. *A. dunelmensis* s.l. in Y-5 and *P. u-carinata* in Y-4 occupy about 40% in each sample, and *A. obai* occupies about 10~15% in Y-4 and Y-5. In the upper three horizons (Y-7~9), *Acuticythereis?* cf. *sendaiensis*, *Trachyleberis scabrocuneata* and *Y. hayashii* are common, and in particular *A.?* cf. *sendaiensis* occupies about 20~55% in Y-8 and Y-9. The siltstone with dense burrows (Y-5) yielded *A. dunelmensis* s.l. and *Paijenborchella tsurugasakensis* characteristically, and these two species make up about 55%. On the other hand, silty very fine sandstone (Y-4 and 6~9) contained mainly *A.?* cf. *sendaiensis*, *A. obai*, *A. nipponica*, *B. bisanensis*, *P. u-carinata*, *T. sp.* and *Y. hayashii*.

5. General account of the ostracode fossils from the Omma Formation

The ostracode species from the Omma Formation are generally characterized by three different fossil groups. The first group is mainly composed of species inhabiting in the recent inner bay around the Japanese Islands. *Bicornucythere bisanensis* is found dominantly in the first group with *Cytheromorpha acupunctata* and *Trachyleberis scabrocuneata*. This group is characterized by rare to common occurrences of *Acuticythereis?* cf. *sendaiensis*, *Finmarchinella uranipponica*, *Howeina higashimeyaensis*, *Kotoracythere* sp. 1, *Loxoconcha optima*, *Trachyleberis niitsumai*, *Spinileberis rhomboidaris*, *Yezocythere hayashii* and *Yezocythere?* sp. in addition to three species described above. These species are included mainly in the silty very fine sandstone and fine sandstone. This group is found mainly at the Locs. 1 and 3, and at the first cycle in the upper part of Loc. 5.

The second group dominantly contains species living in the open sea of the Japan Sea at present. The group is subdivided into two types, that are shallow and deep open sea

types. The shallow open sea type contains many individuals of *Cythere* spp., *Neonesidea oligodentata* and *Finmarchinella hanaii*. This type is characteristically found from the calcareous fine sandstone, and has very high-species diversity. These species are often associated with rare to common occurrences of *Aurila* cf. *cymba*, *A.* cf. *uranouchiensis*, *Hemicythere kitanipponica*, *Laperousecythere* sp. 1, *Laperousecythere?* sp., *Loxococoncha hattorii*, *Loxocorniculum mutsuense*, *Patagonacythere* sp. 1, *P.* sp. 2, *Schizocythere kishinouyei*, *S.* sp. 1, *Semicytherura subundata*, *S.* sp. 5 and *S.* sp. 6. This type occurs only at the upper part of Loc. 5. The deep open sea type includes *Acanthocythereis dunelmensis* s.l., *Palmenella limicola*, *Robertsonites hanaii*, *R. reticuliforma* and *R. tsugaruana*, and they occur in the siltstone and silty very fine sandstone dominantly. In addition, there are rare to common occurrences of *Cytheropteron* cf. *alatum*, *C.* cf. *arcuatum*, *C.* cf. *elaeni*, *C.* cf. *nodosoalatum* and *Elofsonella* cf. *concinna* in the assemblage. This type occurred in the second to fifth cycles of the upper part at Loc. 5, and lower half horizon of Loc. 4.

The third group is characterized by the mixture of the inner bay and deep open sea species, and it is found in the lower part of Loc. 5 dominantly. This group contains *Acanthocythereis dunelmensis* s.l., *Bicornucythere bisanensis*, *Robertsonites reticuliforma* and *R. tsugaruana*, and is characterized by the low species-diversity.

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Table 1: Individual number of the ostracode species from the lower part of Sakuramachi area (Loc. 5).

species name/ sample number	Lo1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1 Acanthocythereis dunelmensis (Norman) s.l.		5	4	27	4	11	2	10	16	27	10	9	3	5	4	7	2
2 A. mutsuensis Ishizaki				2				2	2	1	1	3	5	1	1		
3 Acuticythereis? cf. sendaiensis Ishizaki																1	8
4 Aurila cf. cymba (Brady)										1	1					1	
5 A. cf. tosaensis Ishizaki																1	2
6 A. sp. A																	2
7 Baffincythere ishizakii Irizuki																	1
8 Bicornucythere bisanensis (Okubo)		6	7	26		3		21	19	13	10	30	3	13	29	48	26
9 Callistocythere japonica Hanai											1						2
10 C. rugosa Hanai																	2
11 C. undulatifaciaris Hanai																	2
12 Cornucoquimba cf. saitoi (Ishizaki)																	1
13 C. tosaensis (Ishizaki)																1	2
14 C. sp. 1																	1
15 C. sp. 2		1															
16 Cythere spp.								1			1					10	10
17 Cytheromorpha acupunata (Brady)										1						4	10
18 Cytheropteon cf. arcuatum Brady and others								1		1	3	1				16	29
19 C. cf. elaei Cronin			1		1					5	1	2					
20 C. cf. nodosolatum Neale & Howe						1		3	10	20	19	16	3	1	5	8	4
21 C. sawanense Hanai						1				4			1				
22 Cytherura miii (Ishizaki)																	2
23 Falsobuntonia? sp.				1	1				4	3		1		5	2		
24 Finmarchinella uranipponica Ishizaki																3	5
25 Hemicythere kitanipponica (Tabuki)		1															
26 Hemicytherura kajiyamai Hanai																	1
27 Howeina higashimeyaensis Ishizaki																	8
28 Johnnealella nopporensis Hanai & Ikeya																1	
29 Leptocythere? sp.																	1
30 Loxoconcha cf. epeterseni Ishizaki																	1
31 L. optima Ishizaki										1					1	25	33
32 Loxocythere inflata Hanai										1						2	3
33 Munseyella hatatensis (Ishizaki)														1			2
34 M. hokkaidoana (Hanai)																	2
35 Neocytherideis sp.																	4
36 Neonesidea? sp.																	1
37 Paijenborchella hanai Tabuki							1										
38 P. tsurugasakensis Tabuki		3	2	13	5				1	24	6	6	1	1	4	4	7
39 Palmenella limicola (Norman)		1		2		2		3	3	8	1	1	3				
40 Pectocythere quadangulata Hanai	1		1				1		1	3		2	2	1			2
41 Pontocythere miurensis (Hanai)											1				1	1	3
42 P. subjaponica (Hanai)																1	3
43 Robertsonites reticuliforma (Ishizaki)		6	1	13	2	7	1										
44 R. tsugaruana Tabuki		9	3	15	2			14	5	42	9	29	7	7	8	2	
45 Robustaurila ishizakii (Okubo)																	1
46 Rotundacythere? sp.			1												1		1
47 Schizocythere kishinoueyi (Kajiyama)																	1
48 Semicytherura miurensis (Hanai)										1		1					
49 S. sp. 1																1	
50 S. sp. 2																	1
51 Spinileberis rhomboidaris Chen																17	1
52 Trachyleberis niitsumai (Ishizaki)																4	4
53 T. scabrocuneata (Brady)										1							
54 Xestoleberis spp.																1	1
55 Yezocythere hayashii Hanai & Ikeya		2			1				2	26	12	15	8	8	18	24	22
Miscellaneous															1		1
total number	1	34	20	99	16	25	5	55	63	183	76	116	36	44	74	183	214

Table 2: Individual number of the ostracode species from the upper part of Sakuramachi area (Loc. 5).

species name/ sample number	C101	102	103	104	105	106	107	108	109	110	201	202	203	204	205	206	207	208	209	210	211	212	301	302	303	304	401	402	403	404	405	406	407	408	409	410		
1 <i>Acanthocythereis dunelmensis</i> (Norman) s.l.	2	6	2	9	4	4	7	3	7	9	3	4	10	5	7	17	12	16	11	18	16	16	2	5	2	4	3	1	1	1	5	20	15	18	13	10		
2 <i>A. mutsuensis</i> Ishizaki	2	1		1		3				2		1		1	2	2																						
3 <i>A. sp. 1</i>				1			2	1	1						2			2																				
4 <i>A. sp. 2</i>				2						1								2																				
5 <i>Acuticythereis? cf. sendaiensis</i> Ishizaki	12	12	18	24	13	19	22	14	11	7	1	1	6	5	3	6		5	4	3	3	3		2	1	1	2	2	2	2								
6 <i>Ambocythere japonica</i> Ishizaki	1				1									2			1							2	1		1	1										
7 <i>Ambostracon? sp.</i>																																						
8 <i>Ambtonia obai</i> (Ishizaki)								1														1																
9 <i>A.? sp.</i>				2																																		
10 <i>Amphileberis nipponica</i> (Yajima)	1	2	1			2								1	2		2	1																				
11 <i>Aurila cf. cymba</i> (Brady)	1		8	5	3			2	1	1	8	1	1	5		1	2		1				3	4	8	6	7	13	11	2	1	1			1	1		
12 <i>A. cf. tosaensis</i> Ishizaki															1							1				4		1										
13 <i>A. cf. uranouchiensis</i> Ishizaki	6	9	6	2	6	1	3	1	2	1	7	6	9	7	5	8	9	6	2	6	11	16	9	13	12	9	9	9	5	6	4	8	7	2		5	2	
14 <i>A. sp. A</i>																2																						
15 <i>Balfinicythere ishizakii</i> Irizuki			1								2	1																	1							1	2	
16 <i>B. reticulata</i> Irizuki											1																											
17 <i>B. robusticostata</i> Irizuki	6	10	3	1	2	1			1			6	7	2	2	2	2	5	1	4	6	6	4	2	4	4	4	2	1			5	3	5	3	1	5	
18 <i>Bicornucythere bisanensis</i> (Okubo)	10	12	36	45	48	43	17	20	25	21	7				1																							
19 <i>Bradleya cf. japonica</i> Benson																																						
20 <i>B. cf. nuda</i> Benson																																						
21 <i>Bythoceratina hanaii</i> Ishizaki						1																	2	1	1		3	5	4		3	4					2	
22 <i>B. cf. orientaris</i> (Brady)																																						
23 <i>B. sp. 1</i>																											1											
24 <i>Bythocythere cf. maisakensis</i> Ikeya & Hanai																												1										
25 <i>Callistocythere alata</i> Hanai				1	2	4	4	1												1								1		1								
26 <i>C. ishizakii</i> Ikeya & Zhou												1																										
27 <i>C. japonica</i> Hanai																										1												
28 <i>C. cf. nipponica</i> Hanai		1																																				
29 <i>C. reticulata</i> Hanai						1				1																												
30 <i>C. setanensis</i> Hanai													1	1	1		1																		2		1	
31 <i>C. cf. setanensis</i> Hanai																																						
32 <i>C. undata</i> Hanai																													2									
33 <i>C. undulatifacialis</i> Hanai		1									1	2	3	5	1	2				2	2	3	2	1		5	2	4	7	5	1	2	4	4			4	
34 <i>C. sp. 1</i>																																						
35 <i>Caudites japonicus</i> Ishizaki																																						
36 <i>Cletocythereis rastromarginata</i> (Brady)																																						
37 <i>Cluthia japonica</i> Tabuki																																						
38 <i>C.? sp. 1</i>						1																																
39 <i>Coquimba ishizakii</i> Yajima																									1													
40 <i>C. cf. ishizakii</i> Yajima													1																									
41 <i>Cornucoquimba alata</i> (Tabuki)						1					1	1									1	1	1				2			1					1	1	3	
42 <i>C. cf. alata</i> (Tabuki)																																						
43 <i>C. cf. moniwiensis</i> (Ishizaki)		2		1		2	1		1						1																							8
44 <i>C. cf. saitoi</i> (Ishizaki)																																						
45 <i>C. tosaensis</i> (Ishizaki)	6	2	2	2		1			1	2	3		1		5	4		3																				
46 <i>C. cf. tosaensis</i> (Ishizaki)											3	3	1	1									3	1	1		3	1	1									
47 <i>C. sp. 1</i>				1																																		
48 <i>C. sp. 2</i>																																						
49 <i>C. sp. 3</i>																																						
50 <i>C. sp. 4</i>																																						

species name/ sample number	C101	102	103	104	105	106	107	108	109	110	201	202	203	204	205	206	207	208	209	210	211	212	301	302	303	304	401	402	403	404	405	406	407	408	409	410		
51 Cornucoquima sp. 5	1		1								2	1			1	3	3				1	1	5	2	2	5	2	4	5	2	4	2	2	1	9			
52 C. sp. 6																					1																	
53 C. sp. 7	5	2			1	1				1		5	6	3		2	3	2	1	3	4	3	4	4	12	6	5	5	7	4	9	4	3	7	1	4		
54 Cythere spp.		1			3	8	9	3	4	2	21	5	5	8		5	2	2			3	3	13	15	21	5	26	39	40	32	24	4	1	9	5	13		
55 Cytherois asamushiensis Ishizaki		2	2	1						1			1		1																							
56 C. sp.																																						
57 Cytheroma? hanaii Yajima												1		3	4	14	17	14	22	19	3	5	2															
58 Cytheromorpha acupunctata (Brady)			1	1		1								1																								
59 C.? sp.																																						
60 Cytheropteron cf. alatum Sars												1		2	4	7	2	4	10	2		3																
61 C. cf. arcuatum Brady and others	1		3	7	4	4	4	2	1	1		1	2	4	11	12	8	11	23	12	2	4			2					4	2	4	10	4	1			
62 C. cf. elaeini Cronin																																						
63 C. miurense Hanai	5	1							2	1	2	1	1			1					4		1	1	4	3	5	1	5		6	3	1	8		1		
64 C. cf. miurense Hanai											2	1				2			1		1				1	1	2	2			3	3	1					
65 C. cf. nodosoalatum Neale & Howe								1			5	1		10	14	50	47	48	38	34	17	13		1						1	4	8	5	23	3	1		
66 C. sawanense Hanai	4	7	2	3	3			1		2	3	9	3	5	1	3	2	2	7	2	2	6	2	6	6	1	7	11	13	6	21	1	3	9	1	5		
67 C. cf. sawanense Hanai																																						
68 C. subuchioi Zhao	2	2																																				
69 C. yajimai Tabuki													2													4	1	2			1	1						
70 C. sp. 1												1			2	1		1								1	1			1	1	2		2		1		
71 C. sp. 2																																						
72 C. sp. 3																																						
73 Cytherura cf. daishakaensis Tabuki							1	1				1												1				1										
74 C. miii (Ishizaki)																																						
75 C. sp.																																						
76 Daishakacythere abei (Tabuki)											2																											
77 D.? sp.																				1																		
78 Eucythere sp.																																						
79 Falsobuntonia taiwanica Malz			2						1	1	1		2	2				3	1	1										1							1	
80 F.? spp.													1								2	2																
81 Finmarchinella hanaii Okada	4	1			1			1	2	13	8	8	3	1	1	3		5	1	1	2	5	14	12	25	20	29	23	24	2	3	3	8	4		6		
82 F. japonica (Ishizaki)	1	2	1		1		2				8	3	1	1	4	4	5				1	3															1	
83 F. cf. japonica (Ishizaki)																																						
84 F. nealei Okada																								1		3												
85 F. cf. rectangulata Tabuki	1																																					
86 F. uranipponica Ishizaki					4	3	7	5	5	3	4						1					1			1		1	3	1	3	1	1					1	
87 F. cf. uranipponica Ishizaki					1																																	
88 F. sp. 1															1																							
89 F. sp. 2																																						
90 F. sp. 3																																						2
91 F.? sp. 1																																						
92 F.? sp. 2																																						
93 F.? sp. 3														1		2	1				1	3	1															
94 F.? sp. 4																																						
95 F.? sp. 5											1				2		1	1																				
96 Hanaiborchella miurense (Hanai)																1																						1
97 H. triangularis (Hanai)																1	1		1																			
98 Hemicythere emarginata (Sars)																																						3
99 H. gorokuensis Ishizaki														1	1			1																				
100 H. kitanipponica (Tabuki)	2	2			1	1					7	4	5		2	3	1	1	1	1	1	3	3	11	24	26	8	12	10	10		6	5	4	1		16	

species name/ sample number	C101	102	103	104	105	106	107	108	109	110	201	202	203	204	205	206	207	208	209	210	211	212	301	302	303	304	401	402	403	404	405	406	407	408	409	410	
101 Hemicythere cf. orientaris Schornikov											1										1	1															
102 H. cf. posterovestigulata Schornikov		1										1		1																							
103 H. sp. 1		1									2		1											2	1	1		1	2	4	6	5	5	5	1		2
104 H.? sp. 1																					1				1												
105 H.? sp. 3																								1													
106 Hemicytherura cuneata Hanai				1		1							1			1									1							1	1				
107 H. kajiyamai Hanai															1											1			1						2		
108 H. sp.																										1											
109 Hirsutocythere? hanaii Ishizaki		2																						1	7	9	4	1	2	4	4	9	3	3	2	2	5
110 Howaina higashimeyaensis Ishizaki	16	16	6	1	4	2	2	1	2	5		1		2	1	1							1	7	9	4	1	2	4	4	9	3	3	2	2	6	
111 H. sp. 1																							1														
112 H. sp. 2																																					
113 Johnnealella nopporensis Hanai & Ikeya		2		1	1	4	1		2		3	2	2																					1	2	1	
114 J. sp.		4	4																																	4	3
115 J.? sp.																																				2	
116 Kotorocythere sp. 1	1		1	1		1	1		2							2		1																			
117 K. sp. 2																								1	1												2
118 Krithe spp.		1																						1	1												2
119 Laperousecythere cf. ishizakii Irizuki & Matsubara						1																	1				1	1	1								2
120 L. sp. 1						1																						4	2	2							3
121 L. sp. 2		2	1									1		3		2	1	3		1		1	1		1	4	1	1	1	2	2	7	9	2	1	2	
122 L.? sp.											5	3	4	3		3								4	7	5	8	3	4							5	
123 Loxoconcha cf. epeterseni Ishizaki																																					
124 L. harimensis Okubo											2	2	1												2	2	1					2	2	2			
125 L. hattorii Ishizaki	1			1		1				4	2	1	3				1							2	3	2	4	3	3	3	1					3	
126 L. japonica Ishizaki																																					
127 L. cf. kattoi Ishizaki		2																						1													
128 L. cf. kitanipponica Ishizaki												2			1	2				2	1	3						2	1				1		1		
129 L. optima Ishizaki	6	3	3	1	5	3	3	2		1	4	8	4					2		1	1			2	1	1										1	
130 L. ozawai Tabuki		1	1			3	1		1	1	4	8	4					3	1	1	1				2	1	1		2	6	3	3	2	1	2	1	4
131 L. subkotoriforma Ishizaki		1	1				1									2							1									1	4	3		2	1
132 L. viva Ishizaki	12	6	26	28	16	12	4	4	4	10		1											1	1			1	7	12	7	4	2	2	3		1	
133 L. sp. 1						1					5	1	6	1	1	1	2						1	2	7	4	1										
134 L. sp. 2																																					
135 L. sp. 3																							3														
136 L. sp. 4																																					
137 L.? sp.																																					
138 Loxocorniculum mitsuense Ishizaki	1	1									5	1	2	2									3	3	3		2	3	7	2	2	1	5	4		2	
139 Loxocythere inflata Hanai	2	3		1	2	1			1	3	4	4	2	1		3												2	1	1	1	2	3	6	3	1	1
140 Mackencythere? sp.																								2													
141 Metacytheropteron sp.		1	1																																		
142 Miia? sp.																																					
143 Munseyella hatatatisensis (Ishizaki)		1	1	2	1	1	6	2	5	1		5	1	2	1	3	2		2	1	2		1	3	8	1	2	1	4			1	1	4			
144 M. hokkaidoana (Hanai)		1	1	1	4	4	3			4		3	3					1		2	1	2		1	4		1									1	
145 M. sp. 1												2	1	4		1	1						1		1	1		1									1
146 M.? sp.																	4																				
147 Neocytherideis sp.								1				1																									
148 Neonesidea oligodentata (Kajiyama)		8	3	1			2				1	6	3	5	5	6	4	1	1	1	4	7	6	9	18	8	13	10	20	5	7	13	4	3	16		
149 Pacambocythere u-carinata (Ishizaki)																										1											
150 Pajienborchella hanaii Tabuki	6	3	1	2							11	9	7	3	6	4	2	6	2	1	4	2	3	4	8	5	7	5	3							4	

species name/ sample number	C10	102	103	104	105	106	107	108	109	110	201	202	203	204	205	206	207	208	209	210	211	212	301	302	303	304	401	402	403	404	405	406	407	408	409	410	
151 Paijenborchella tsurugasakensis Tabuki	6	5	7	16	21	27	37	45	41	54	1	2	5	17	15	28	27	35	27	31	13	8	1	2	2		4				2	5		3	6		
152 P.? sp. 1															1																						
153 P.? sp. 2					1																																
154 Palmenella limicola (Norman)	1	2	4	3	1	6	2	2	1		1	5	2	14	8	12	8	13	19	10	8	9		2	2	1			5	3	4		4	2	3		
155 P.? sp.											1														1		1										
156 Paracytheridea neolongicaudata Ishizaki	1	2	1	1					1			2					1								2	1	2										
157 Paradoxostoma spp.																																					
158 Patagonacythere sp. 1		3		1		1		1			13	3	7	3	1	1	1	2	1	2	3	1	2	5	3	3	2		1	2	1		1	3			
159 P. sp. 2											5	1	2		1								3	2	7	1	3	1		2	1	2		3	2	1	
160 Pectocythere quadangulata Hanai											1	1	1	1			1					1		1									4	4	1		
161 Pistocythereis bradyformis (Ishizaki)	1	2	5	3	1	2		1																													
162 Pontocythere miurensis (Hanai)					1	1	1					2					1		1	1														1			
163 P. subjaponica (Hanai)	1		3		2	1		1	2	3	2				1			1	1																		
164 Propontocypris spp.		2		1		1							2											1										1			
165 Robertsonites hanaii Tabuki											1	1														1								3	3	3	
166 R. reticuliforma (Ishizaki)	2	2	1	2	2	3	3	15	6	17																1	1			2			1		1		
167 R. tsugaruana Tabuki	1		1	4	6	4	4	5	5	2	2	1	5	22	38	56	41	45	19	24	16	16	1	3	3	1	1		6	14	6	3	2	3			
168 Robustaurilla ishizakii (Okubo)		1				1										1									1												
169 R. cf. salebrosa (Brady)							1				1					1	1																			1	
170 Roundacythere? sp.																																					
171 Schizocythere kishinouyei (Kajiyama)	4	5				2					3	1	6	5	3	3	1	5	1	1	6	4	9	7	6	9	5	4	8		2	1	1				
172 S. okhotskensis Hanai											9	3	5		3	3		1	1	1	3		4	2	2	9	9	4	3		2			1	2		
173 S. sp. 1	1	4			2																																
174 S. sp. 2																							1	1	1												
175 Sclerochilus sp.			1						1																											1	
176 Semiccytherura henryhowei Hanai & Ikeya											1	3		2	2	2	1		3				1	1	2		1	1	3	7	6	7	2	4		1	
177 S. miurensis (Hanai)		1									4	4	2	3	1				2	1	1		2	6	2	7	8	8	14	4	5	2	1	2			
178 S. subundata Hanai											1																1	1	1	1	1						
179 S. cf. undata (Sars)											1						1										1	1	1	1	1					1	
180 S. sp. 3																																					
181 S. sp. 4		1												1		2		1	1					1	6	2		3	1	3							
182 S. sp. 5		1	1		1		1				1		1		1	1		1	1		2	2	4		5	4	7	8	12	5	2	1	1	3			
183 S. sp. 6											2	3		1	1						1			4	7	1	3	1	1	1	3						
184 S. sp. 7																																					
185 S.? sp. 1			1										1	2			1	1	3	1			1				1	1	1	2	2				1		
186 Sinocytheridea sp.					1			2	3																												
187 Spinileberis rhomboidaris Chen	20	15	30	14	13	16	14	15	21	13		2	1		2	3		3	2	4	4	3	1												2		
188 Trachyleberis niitsumai (Ishizaki)	3	3	2	1	3		1				1			1													1										
189 T. scabroconeata (Brady)				1										1																							
190 T. sp.															1																						
191 T.? sp.											1	1																									
192 Typhlocythere? sp.												1	1																							1	
193 Urocythereis? gorokuensis Ishizaki																																					
194 Xestoleberis hanaii Ishizaki			1		1																																
195 X. sp.		1	5										2	2	1																						
196 Yezocythere hayashii Hanai & Ikeya	5	12	6	9	9	5	16	25	24	37	8	3	7	8	3	4	4	9	9	2	1	1	6	9	16	3	5	5	6	3	1	15	16	4	8	5	
197 Y.? sp.																																					
Miscellaneous	1				1	2						1	1			3							1		1							1	1	1	1		
total nuber	167	196	212	204	197	210	181	180	183	211	196	173	178	198	183	322	239	266	247	212	182	201	147	195	313	157	258	254	299	207	285	240	172	236	75	210	

species name/ sample number	C501	502	503	504	505	506	507	508	509	510	511	512	513	514
1 Acanthocythereis dunelmensis s.l.	1	1		1	6	8	4	13	2	62		1	1	46
2 A. mutsuensis								1		2				
3 A. sp. 1														
4 A. sp. 2														
5 Acuticythereis? cf. sendaiensis		2					2							1
6 Ambocythere japonica	1		2			1								
7 Ambostracon? sp.	3									14		1	1	3
8 Ambtonia obai										2				
9 A.? sp.														
10 Amphileberis nipponica														
11 Aurila cf. cymba	4	8	10	16	4	9	8	2						
12 A. cf. tosaensis														
13 A. cf. uranouchiensis	7	14	14	12	9	5	9	5		8				1
14 A. sp. A	4													
15 Baffinicythere ishizakii	2							1						11
16 B. reticulata													1	
17 B. robusticostata	5	7	4	4	5	2	5	2						
18 Bicormucythere bisanensis				1										
19 Bradleya cf. japonica														
20 B. cf. nuda														
21 Bythoceratina hanaii	1			3	2	5	2							
22 B. cf. orientaris														
23 B. sp. 1				1			1							
24 Bythocythere cf. maisakensis														
25 Callistocythere alata				1	1									
26 C. ishizakii														
27 C. japonica														
28 C. cf. nipponica														
29 C. reticulata														
30 C. setanensis				1	2									
31 C. cf. setanensis														
32 C. undata				1										
33 C. undulatifacialis	4		1	2		2	1							
34 C. sp. 1														
35 Caudites japonicus				3	1	2								
36 Cleocythereis rastromarginata														
37 Cluthia japonica														
38 C.? sp. 1														
39 Coquimba ishizakii														
40 C. cf. ishizakii														
41 Cornucoquimba alata	3		2	3			1							
42 C. cf. alata														
43 C. cf. moniwensis		1	2	1	1	3	2	4						
44 C. cf. saitoi														
45 C. tosaensis		1						1						
46 C. cf. tosaensis	1		2	2	5	2	4	1						
47 C. sp. 1	4	1	2	2		1	2	1		1				1
48 C. sp. 2	1	1	2	2	3	2								
49 C. sp. 3														
50 C. sp. 4														

species name/ sample number	C501	502	503	504	505	506	507	508	509	510	511	512	513	514
51 Cornucoquima sp. 5	4	1	2	3	1	2	3	7						
52 C. sp. 6	2	1												
53 C. sp. 7	2		1		1	4	1					1		
54 Cythere spp.	14	11	23	58	39	35	26	15		10		1	2	12
55 Cythereis asamushiensis														
56 C. sp.														
57 Cytheroma? hanaii														
58 Cytheromorpha acupunctata														
59 C.? sp.														
60 Cytheropteron cf. alatum														
61 C. cf. arcuatum	1					1						7		
62 C. cf. elaei								2	2			20		
63 C. miurense	1								1			1		
64 C. cf. miurense						1						5		
65 C. cf. nodosoalatum												32		
66 C. sawanense	3	3	6	7	16	8	18	7	1	5				
67 C. cf. sawanense														
68 C. subuchioi														
69 C. yajimai														
70 C. sp. 1				1										1
71 C. sp. 2														
72 C. sp. 3														
73 Cytherura cf. daishakaensis														
74 C. miii														
75 C. sp.														1
76 Daishakacythere abei				4										
77 D.? sp.														
78 Eucythere sp.							1							
79 Falsobuntonia taiwanica									1	3	3		1	
80 F.? spp.													2	1
81 Finmarchinella hanaii	5	7	5	11	22	20	10	12						
82 F. japonica	1				2	1	1							4
83 F. cf. japonica						1		1						
84 F. nealei						1		1		1				
85 F. cf. rectangulata														
86 F. uranipponica			1	1										
87 F. cf. uranipponica														
88 F. sp. 1														
89 F. sp. 2														
90 F. sp. 3	2	3	2			1	3	2	1					6
91 F.? sp. 1														
92 F.? sp. 2														
93 F.? sp. 3														
94 F.? sp. 4														
95 F.? sp. 5														
96 Hanaiborchella miurense	1			1	1									
97 H. triangularis				1				1						
98 Hemicythere emarginata	1												3	1
99 H. gorokuensis							2	1					1	
100 H. kitanipponica	11	22	21	38	19	16	8	10	1			5	1	4

species name/ sample number	C50	502	503	504	505	506	507	508	509	510	511	512	513	514
101 Hemicythere cf. orientaris									1					4
102 H. cf. posterovestibulata														
103 H. sp. 1	2	1		1	1	1	4	4		3				
104 H.? sp. 1														
105 H.? sp. 3						1								
106 Hemicytherura cuneata														
107 H. kajiyamai			1											
108 H. sp.														
109 Hirsutocythere? hanaii	3			1										
110 Howeina higashimeyaensis			7	8	2	2	1		5			1		9
111 H. sp. 1														
112 H. sp. 2														
113 Johnnealella nopporensis						2		1		1				
114 J. sp.														
115 J.? sp.		1	2	2	1	2	1	1		1				
116 Kotoracythere sp. 1						1								
117 K. sp. 2	1	3												
118 Kriihe spp.														
119 Laperousecythere cf. ishizakii	3	3	5	1	2	3	1							
120 L. sp. 1	6	4	3	3	2	5	2	1						
121 L. sp. 2	2	2	1	2	1	2	4	4						
122 L.? sp.	2	2	3	2	4	2	2	5						6
123 Loxoconcha cf. epeterseni						1		1						
124 L. harimensis														
125 L. hattorii	2	1		3	1	8	3							
126 L. japonica							1							
127 L. cf. kattoi										2				1
128 L. cf. kitanipponica														
129 L. optima		1		1		1								1
130 L. ozawai			1		1	1	1			1				2
131 L. subkotoriforma										1				
132 L. viva														
133 L. sp. 1	3	3	2	1	1	4	6	1						4
134 L. sp. 2														
135 L. sp. 3														
136 L. sp. 4														
137 L.? sp.														
138 Loxocorniculum mutsuense		2	1	4	7	4	4	3		2				
139 Loxocythere inflata	1		3		3	3	2			2				15
140 Mackencythere? sp.														
141 Metacytheropteron sp.														
142 Milia? sp.														
143 Munseyella hatatensis			2		1		2			1				
144 M. hokkaidoana					2	1		1						
145 M. sp. 1														
146 M.? sp.					1	2	3			3				
147 Neocytherideis sp.														
148 Neonesidea oligodentata	9	4	11	27	9	14	15	5						
149 Pacambocythere u-carinata														
150 Paijenborchella hanaii	1		1	2	6	4	7	5		1				

species name/ sample number	C50	502	503	504	505	506	507	508	509	510	511	512	513	514
151 Paijenborchella tsurugasakensis		1						6	5		1			
152 P.? sp. 1														
153 P.? sp. 2														
154 Palmenella liimicola	1				1	1	2	6	1	18	7	2	1	
155 P.? sp.														
156 Paracytheridea neolongicaudata	1			1			1							2
157 Paradoxostma spp.														
158 Patagonacythere sp. 1	2						2	4	1					
159 P. sp. 2				1			2		2					
160 Pectocythere quadangulata								2						
161 Pistocythereis bradyformis								1						1
162 Pontocythere miurensis														
163 P. subjaponica			1			2	1	1						
164 Propontocypris spp.														1
165 Robertsonites hanaii								1	12		11		4	
166 R. reticuliforma								1	15	1	1		3	1
167 R. tsugaruana	1								7		3			
168 Robustaurila ishizakii							1							
169 R. cf. salebrosa	2	1	3	2		2	2							
170 Rotundacythere? sp.														
171 Schizocythere kishinouyei	2	1	3	3	2	7	4	7						
172 S. okhotskensis			2					1						
173 S. sp. 1		3		7	6	4	1	4						
174 S. sp. 2							1	1						
175 Sclerochilus sp.								1						
176 Semiccytherura henryhowei														
177 S. miurensis				1	1			1			2			1
178 S. subundata										5	5			
179 S. cf. undata						2		1	3	1				
180 S. sp. 3														
181 S. sp. 4							2							
182 S. sp. 5		1	1	1		2	3	3						
183 S. sp. 6			1			2		3	2					
184 S. sp. 7														
185 S.? sp. 1							2							
186 Sinocytheridea sp.														
187 Spinileberis rhomboidaris											1			
188 Trachyleberis niitsumai														
189 T. scabrocuneata														
190 T. sp.	1		1											
191 T.? sp.														
192 Typhlocythere? sp.														
193 Urocythereis? gorokuensis	2	2		2	1									
194 Xestoleberis hanaii														
195 X. spp.								1						6
196 Yezocythere hayashii	1	2	3		1	3	4							
197 Y.? sp.														
Miscellaneous							1	1	1					4
total nuber	137	123	156	256	217	227	213	195	16	239	7	14	15	245

Table 3: Individual number of the ostracode species from Hakkouden area (Loc. 4).

species name/ sample number	HO-1	2	3	4	5	6	7	8	9	10	11	12
1 <i>Acanthocythereis dunelmensis</i> (Norman) s.l.			9	1	2	6			78	2	9	19
2 <i>A. mutsuensis</i> Ishizaki										3	4	2
3 <i>A. tsurugasakensis</i> Tabuki	1	9	4			31						
4 <i>Acuticythereis?</i> cf. <i>sendaiensis</i> Ishizaki											3	
5 <i>Ambtonia obai</i> Ishizaki				7	1		1			13	10	4
6 <i>Amphileberis nipponica</i> (Yajima)				2	1							5
7 <i>Aurila</i> sp. A											1	
8 <i>Bicornucythere bisanensis</i> (Okubo)										26	40	21
9 <i>Cornucoquimba tosaensis</i> (Ishizaki)											2	
10 <i>Cythere</i> spp.											2	1
11 <i>Cytheroma?</i> <i>hanaii</i> Yajima									2		1	
12 <i>Cytheromorpha acupunctata</i> (Brady)											3	1
13 <i>Cytheropteron</i> cf. <i>elaeni</i> Cronin									3			
14 <i>C. miurense</i> Hanai											3	3
15 <i>C. cf. nodosolatum</i> Neale & Howe									21			
16 <i>C. sawanense</i> Hanai											1	
17 <i>Elofsonella</i> cf. <i>concinna</i> (Jones)			1			13						
18 <i>Falsobuntonia?</i> sp.			2						1			
19 <i>Hanaiborchella miurenensis</i> (Hanai)											1	
20 <i>Howeina higashimeyaensis</i> Ishizaki									1			
21 <i>Kotoracythere</i> sp. 1											4	3
22 <i>Krithe</i> spp.									1	1		
23 <i>Metacytheropteron</i> sp.										1		
24 <i>Munseyella hatatensis</i> (Ishizaki)											5	2
25 <i>M. hokkaidoana</i> (Hanai)												1
26 <i>M.?</i> sp.											4	
27 <i>Neocytherideis</i> sp.											1	
28 <i>Paijenborchella hanaii</i> Tabuki					2							
29 <i>P. tsurugasakensis</i> Tabuki			2	1	4	9	1		34	1	1	4
30 <i>Palmenella limicola</i> (Norman)						3	1		2	2	18	10
31 <i>Pectocythere quadangulata</i> Hanai			2			5			14		1	
32 <i>Pistocythereis bradyformis</i> (Ishizaki)											1	
33 <i>Pontocythere subjaponica</i> (Hanai)								1			2	1
34 <i>Robertsonites hanaii</i> Tabuki		1	15			140						
35 <i>R. reticuliforma</i> (Ishizaki)		1	11			2	2		2	1	19	1
36 <i>R. tsugaruana</i> Tabuki		1	8	3	7	2	1		17	32		1
37 <i>Rotundacythere?</i> sp.											1	
38 <i>Schizocythere kishinouyei</i> (Kajiyama)												2
39 <i>Semicytherura henryhowei</i> Hanai & Ikeya												
40 <i>Spinileberis rhomboidaris</i> Chen												1
41 <i>Xestoleberis</i> spp.												1
Miscellaneous								1			4	
total number	1	12	54	14	17	211	6	2	176	82	146	78

Table 4: Individual number of the ostracode species from Kofutamata area (Loc. 3).

species name/ sample number	KO3	4	5	6	7	7*	8	9	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
1 Acanthocythereis dunelmensis (Norman) s.l.		5	1	3	2		1	4	2	5	1	1	1	6	3		3	1	1	3	6	5			1	11	20	2
2 A. mutsuensis Ishizaki		3	4	8				1			1	1	1				5									4		
3 A. sp. 1	1		1	1						1	1	1	1							1				1				
4 A. sp. 2																						1						
5 A. sp. 3																							1					
6 A. sp. 4																												
7 Acuticythereis? cf. sendaiensis Ishizaki	60	79	83	74	133	139	95	77	8	22	2	30	27			2	10	15	19	7	5	1	8	6	18	3	7	11
8 Ambtonia obai (Ishizaki)				1					3					35				1	5	7	11	4	15	31	1	32	36	
9 Amphileberis nipponica (Yajima)									8			2				4						1						
10 Aurila cf. cymba (Brady)									4			1				1		2		3	1				3			
11 A. cf. tosaensis Ishizaki												1		1							1		2					
12 A. cf. uranouchiensis Ishizaki											1	3	2					1					1					
13 A. sp. A													3					2			2			2	2			
14 Australimoosella tomokoe (Ishizaki)																												
15 Bicornucythere bisanensis (Okubo)			1	6	4	3	21	11	8	57	4	9	10	8	8	9	9	10	6	5			5	7	21	14	4	
16 Callistocythere alata Hanai									1				1				3	2	8	1		1	1	2	2			
17 C. japonica Hanai																	1											
18 C. reticulata Hanai																					2				1	1		
19 C. rugosa Hanai											1										1							
20 C. setanensis Hanai																							1					
21 C. undulatifacialis Hanai												1	1			1		2		1	1			1	2			
22 C. sp. 1	1				1	3																						
23 C. sp. 2																												
24 Cluthia japonica Tabuki												1																
25 C.? sp. 2														1														
26 Coquimba cf. ishizakii Yajima																		1										
27 Cornucoquimba cf. moniwnensis (Ishizaki)											1	1	2	1	2		1				1			1	4	1	1	
28 C. cf. saitoi (Ishizaki)							1					1													8	1	3	
29 C. tosaensis (Ishizaki)									2	6	1	4	1	1	1	2	4	6	4	5	2	2	6		8	1		
30 Cythere spp.	1									1	1	4	1	1	1	2	4	6	4	6	4	1	1		9	1		
31 Cythereis asamushiensis Ishizaki									1	3	1	1	3	3	3	1	1	1	3	3		2			3			
32 C. spp.												2																
33 Cytheromorpha acupunctata (Brady)												2	3	2		2	2	2	1	2	2			3	4		1	
34 Cytheropteron arcuatum Brady and others	1	2		2	1						1	1	4	1		2	5	3	1					2				
35 C. cf. elaei Cronin	1													1	1													
36 C. higashikawai Ishizaki											1	1	3	1					2	2	2	2	4	1	1	6	2	3
37 C. miurense Hanai											4		1				1											
38 C. sawanense Hanai													1															
39 C. subuchioi Zhao																					4							
40 C. sp. 1													1															
41 C. sp. 3													1	3	1												1	
42 C.? sp.																												
43 Cytherura? sp.																	1											
44 Eucythere sp.							1													3		1	1					
45 Falsobuntonia taiwanica Malz					1								1	5	1		1		1			1	4		3			
46 F.? sp.																	1											
47 Finmarchinella hanaii Okada												1	1			1							1	1	2		1	
48 F. japonica (Ishizaki)										2		1	1				1			1							1	
49 F. cf. nealei Okada												1																
50 F. uranipponica Ishizaki									1		1	2	2	2	2	2	4	2	3	2	2	1	2	3	12		2	
51 Hanaiborchella miurense (Hanai)					1					2		1				1		1	1				3	2	2			
52 H. triangularis (Hanai)														1									2	2	5			
53 Hemicythere gorokuensis Ishizaki																					1	1						
54 H.? sp. 2																					1							
55 Hemicytherura kajiyamai Hanai																												
56 Hirsutocythere? hanaii Ishizaki									5	1							1											
57 Howaina higashimeyaensis Ishizaki	1		2	16	7	9	4	28	2	1	19	22	18	18		1	3	23	56	89	63	40	27	8	12			
58 Johnnealella nopporensis Hanai & Ikeya						1						1	1			1	1	3	20	6	4	1	1	1	2			
59 Kotoracythere sp. 1	2		4		12	8	4	18	1	18	4	8	11		1	4	5	6	14	6	7	4	5	1	6	3	11	2
60 Krithe spp.																												

species name/ sample number	KO3	4	5	6	7	7*	8	9	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
61 Laperousecythere sp. 2																			1	1					1			
62 Leptocythere? sp.												1					1				1					1		
63 Loxoconcha cf. epeterseni Ishizaki												1														2	3	
64 L. harimensis Okubo												1									1					3		1
65 L. optima Ishizaki								1						1	2				3	3	3				2			
66 L. ozawai Tabuki	1			1					1		1	1	1				1					1	1		2	3		
67 L. subkotoriforma Ishizaki													1			3					1		3	1	2	1		
68 L. viva Ishizaki											1									3	2	1	1		3	2	1	
69 L. sp. 5																									1	1		
70 Loxocorniculum mutsuense Ishizaki																									1			
71 Meiacyclotherion sp.												1														2	1	
72 Munseyella hatatensis (Ishizaki)	3	1	2	3			2	2	5		6	11	12	9	12		1	10	14		9	7	8	7	8	7	17	
73 M. hokkaidoana (Hanai)	3	3		8	1		1	2		1	7	20	7	5	8	1	1	6	9		1			2	1	12	13	
74 M. cf. japonica (Hanai)											4															4		
75 M. sp. 1													1													2		
76 Neocythereideis spp.													1	1						1								
77 N. ? sp.									1																			
78 Neonesidea oligodentata (Kajiyama)													1		1	1											1	
79 Nipponocythere? spp.														1										1				
80 Normanicythere? sp.																								1	1	2		
81 Pacambocythere u-carinata (Ishizaki)												2	3												1	14	12	
82 Pajienborchella hanai Tabuki	3	1	2	2				1	2		3	1					3	2					1	1		1	1	
83 P. tsurugasakensis Tabuki	44	67	52	50	7		3	2	2		5	40	14	4	9		4	9										
84 Palmenella limicola (Norman)	7	20	10	12	4		6	5	5		5	4	3	6	8		1	6			1		1		1		1	
85 Paracytheridea neolongicaudata Ishizaki													1															
86 P. sp.																												
87 Paradoxostma sp.																												
88 Patagonocythere sp. 1												7		4	1				1	3							1	
89 Pectocythere quadangulata Hanai	1	2		6	5		6	3	4				12	8	9		3	17	7	2	5	8	1	10	13	15		
90 Pistocythereis bradyformis (Ishizaki)										1																1	1	
91 Pontocythere miurensis (Hanai)														4	1	1		1	2	1	1	1	1	5	3	6	2	
92 P. subjaponica (Hanai)																2		2	13	1		1	1	6		6		
93 Propontocypris sp.												3									1							
94 Pseudosammocythere sp.													18	21	15	29	1	1	12	11	6	7	5	1	2	6		
95 Robertsonites reticuliforma (Ishizaki)	3	5	12	13	3		4	5	2																			
96 R. tsugaruana Tabuki								1			4	28	1	3		2		2	1									
97 Robustaurilla ishizakii (Okubo)																					1							
98 Rotundocythere? sp.														3												5	1	
99 Schizocythere kishinouyei (Kajiyama)															3					2	3						1	
100 Sclerochilus sp.																										1	1	
101 Semicytherura henryhowei Hanai & Ikeya																							1					
102 S. miurensis (Hanai)																						1						
103 S. sp. 1																												
104 S. sp. 8																												
105 S. ? sp. 2																												
106 Sinocythereidea? sp.																												
107 Spinileberis rhomboidaris Chen	1	3	3		2	3				1	13	1	1	1	4	1	1	3	2	10	9	7	4	13	3	6	12	
108 Trachyleberis nitsumai (Ishizaki)										1	2		2	1			2	1	2			3	1	3			3	
109 T. scabroconata (Brady)										1	1			1	1	1					2	3	1					
110 T. sp.										3	5			2	1													
111 Xestoleberis hanai Ishizaki									1																			
112 X. sp.																												
113 Yezocythere hayashii Hanai & Ikeya	17	27	26	10	19	16	21	28		7	28	42	22	6		8	65	59	39	11	16	17	14	5	5	90		
114 Y. ? sp.					1	1	9	4				1	1	5							2	4	8	4	3	17	2	
Miscellaneous	1		1		1						2		1		2						1					2	1	
total number	152	220	205	216	207	206	185	201	54	195	211	228	189	194	33	66	223	237	254	205	186	122	165	128	244	212	174	20

species name/ sample number	OL1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35			
61 Laperousecythere sp. 2										1		2		1				2	1				1												1			
62 Leptocythere? sp.												1	1											1				1	2			1				3		
63 Loxoconcha cf. epeterseni Ishizaki																						1		1														
64 L. harimensis Okubo																							1															
65 L. hattorii Ishizaki																																						
66 L. cf. kattoi Ishizaki							1																															
67 L. cf. kitanipponica Ishizaki								4	8	8	8	7	1			2	7	1			5		2	3	1	26	10	10	16	15	28	12	13	7	15	29	10	
68 L. optima Ishizaki														1						1	1														1			
69 L. ozawai Tabuki																	1																					
70 L. subkotoraraforma Ishizaki																			3																	1		
71 L. viva Ishizaki		2	1	2				3	3	13	10	11	2	2	1				4																	52	46	41
72 L. sp. 1																																				1		
73 Loxocorniculum mutsuense Ishizaki																																				1		
74 Loxocythere inflata Hanai					1		1																															
75 Metacytheropteron sp.																						3																
76 Munseyella hataaensis (Ishizaki)				1	16	5	9	5		4	1	2	16	9	1	3	2	21	4	8	18	16	4	1	1	5	1	1	1	1	2			8	3	10	6	
77 M. hokkaidoana (Hanai)					23	1										5			1	6	7	9	1	2			3	2	3	1				2	1	4		
78 M. cf. japonica (Hanai)																					3																	
79 Neonesidea oligodentata (Kajiyama)							1											4	4	1	2	4							1									
80 Normanicythere? sp.									3	4	1																											
81 Pacambocythere u-carinata (Ishizaki)							13	1						21	20	1					1	16	22		1													
82 Pajienborchella hanaii Tabuki		1	1		1	1																1																
83 P. tsurugasakensis Tabuki					29		2	1													6				3											1		
84 Palmenella limicola (Norman)			1		5	10						2	2	1	1	1			1		1	1	1				1							1	1		1	
85 Paradoxostoma spp.																			4																			
86 Parakriethella pseudadonta (Hanai)																																						
87 Patagonocythere sp. 1							2						1								3																	
88 Pectocythere quadangulata Hanai									1	2		3						4		4		5	5	1	2	1	2	5	6	2					1			
89 Pistocythereis bradyiformis (Ishizaki)					1			1	1	5	6	2	1			1	3	5			1	2	3					8	25	23	10	5	5	5				
90 P. bradyi (Ishizaki)																													2									
91 Pontocythere miurensis (Hanai)											1												1	2														
92 P. subjaponica (Hanai)							3	3	8	3	3		1	2														3	8	5	2	9	21	23	17	36	8	
93 P. sp.											1																											
94 Propontocypris spp.																																						
95 Pseudoaurilla japonica (Ishizaki)							1												1																			
96 Robertsonites reticuliforma (Ishizaki)						13	3	3										18	11	1	3	53	30	14	2	3										3	1	
97 R. tsugaruana Tabuki					6																	1						1										
98 Robustaurilla assimilis (Kajiyama)													1									1																
99 R. ishizakii (Okubo)							2	1		1	1		2						1		1		2	2	2		2	1					2	4	2		1	1
100 Schizocythere kishinoueyi (Kajiyama)						2	3	2		5	4	1					1	4	3			1	2	4									1	2	4	6		1
101 S. sp. 2																																						
102 Semicytherura miurensis (Hanai)																																						
103 S. sp. 1																																						
104 S. sp. 8																																						
105 S. sp. 9											1																											
106 S. sp. 10																																						
107 Sinocytheridea? sp.												1																										
108 Sinoleberis tosaensis (Ishizaki)											1		1	1																								
109 Spinileberis rhomboidaris Chen		2	1	1	36	4	4	1	2	3	8	1	50	43			3	12	14	1	5	14	6	4	14	3	12	12	10	9	32	8	6	7	6	7		
110 Trachyleberis nitsumai Ishizaki			1			1	4	5	4	4	2	9	3	3			1	2	22	3	4	11	11	1	2													
111 T. scabroconata (Brady)			2		5		3	2		5	1	10	1	1					12	1		2	3	3													4	
112 T. sp.		2			6	1	2				1							1																				4
113 T.? sp.																																						
114 Xestoleberis hanaii Ishizaki			1																																			1
115 X. spp.																																						2
116 X?. sp.																																						
117 Yezocythere hayashii Hanai & ikeya		1		1			8	3	9	7	24	28	53	112	32	13	9	45	80	6	40	47	13	29	1	3	1	12	14	2				3	9	5		
118 Y.? sp.		1		1						4	9	23	18	39	8	15	4	31	48	19	21	42	26	1													2	4
Miscellaneous																																						
total number	51	58	49	15	313	187	200	167	181	201	185	223	348	219	120	105	165	453	193	224	446	430	174	196	47	172	216	232	197	192	217	190	187	289	171			

species name/ sample number	C11	C12	C13	C14	C21	C22	C23	C24	C31	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
41 Laperousecythere sp. 2		2															2
42 Loxoconcha cf. epeterseni Ishizaki															1		
43 L. hattorii Ishizaki	1																
44 L. ikeyai Zhou				1													
45 L. optima Ishizaki	10		1	3	5												1
46 L. ozawai Tabuki								1	1	1							1
47 L. subkotoriforma Ishizaki																	3
48 L. viva Ishizaki	9			1			85	46	1			3	4	2	5	2	
49 L. sp. 6								2		2							
50 Metacytheropteron sp.																	2
51 Munseyella hatatensis (Ishizaki)	2	1															1
52 M. hokkaidoana (Hanai)																	8
53 Neocytherideis sp.					1												
54 Neonesidea oligodentata (Kajiyama)		1						1									
55 Pacambocythere u-carinata (Ishizaki)												26	5	2	13	1	
56 Paijenborchella hanaii Tabuki								1					2	3			
57 P. incosa Kingma								1								1	
58 P. tsurugasakensis Tabuki												16	4			2	
59 Palmenella limicola (Norman)		1	2					1					2		2	5	
60 Patagonacythere sp.				1									2				
61 Pectocythere cf. daishakaensis Tabuki			1														
62 Pistocythereis bradyformis (Ishizaki)		3	5		2												1
63 Pontocythere miurensis (Hanai)				1	2												1
64 P. subjaponica (Hanai)	3			2	2												
65 Robertsonites reticuliforma (Ishizaki)	1		17			2							2	2	1	16	2
66 R. tsugaruana Tabuki													9	5			2
67 Schizocythere kishinoueyi (Kajiyama)										2							1
68 Sinocytheridea impressa (Brady)				12	1												
69 Spinileberis rhomboidaris Chen	3				1	2							2				6
70 Trachyleberis niitsumai (Ishizaki)	2		1	1				3					1		3		
71 T. scabrocuneata (Brady)		7													1	9	1
72 T. sp.			3		1		1					9	1		11	3	
73 Xestoleberis spp.	1							2		1			2		1		
74 Yezocythere hayashii Hanai & Ikeya	8	1	8	2				1	1				2		2	45	8
75 Y.? sp.	3	2		2				1									7
Miscellaneous	1							1		1							
total number	124	110	140	77	93	10	113	126	27	19	2	69	100	36	90	213	51

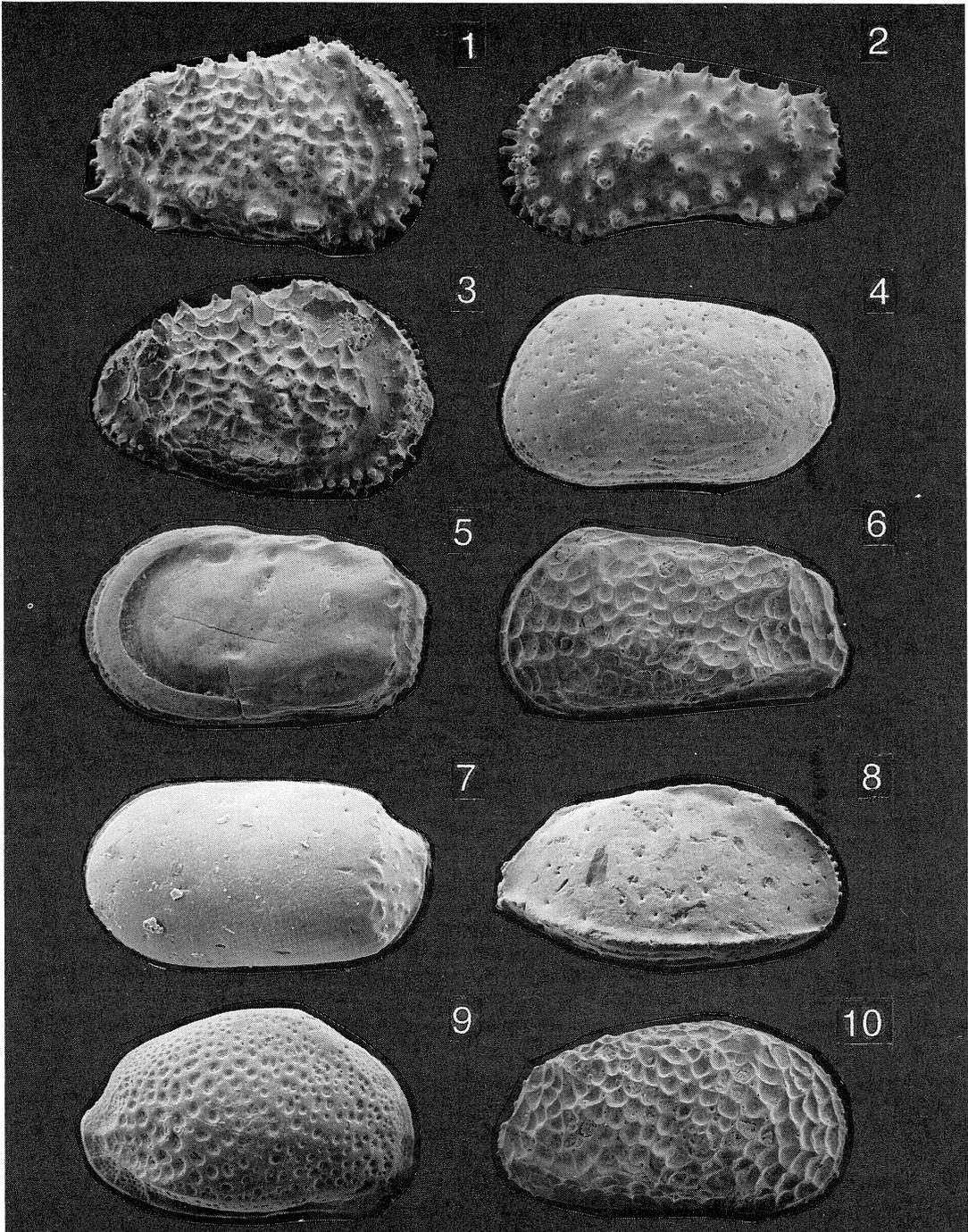


Plate 1: 1. *Acanthocythereis dunelmensis* (Norman), RV, Lo-30, x 41; 2. *Acanthocythereis mutsuensis* Ishizaki, LV, Lo-40, x 47; 3. *Acanthocythereis tsurugasakensis* Tabuki, RV, Ho-6, x 55; 4. *Acuticythereis?* cf. *sendaiensis* Ishizaki, LV, Y-9, x 49; 5. *Ambocythere japonica* Ishizaki, LV, C503, x 88; 6. *Ambostracon?* sp., LV (juvenile), C405, x 59; 7. *Ambtonia obai* (Ishizaki) : LV, Ho-11, x 83; 8. *Amphileberis nipponica* (Yajima), RV, Ho-11, x 65; 9. *Aurila* cf. *uranouchiensis* Ishizaki, RV, C401, x 53; 10. *Baffinicythere ishizakii* Irizuki, RV, C410, x 45.

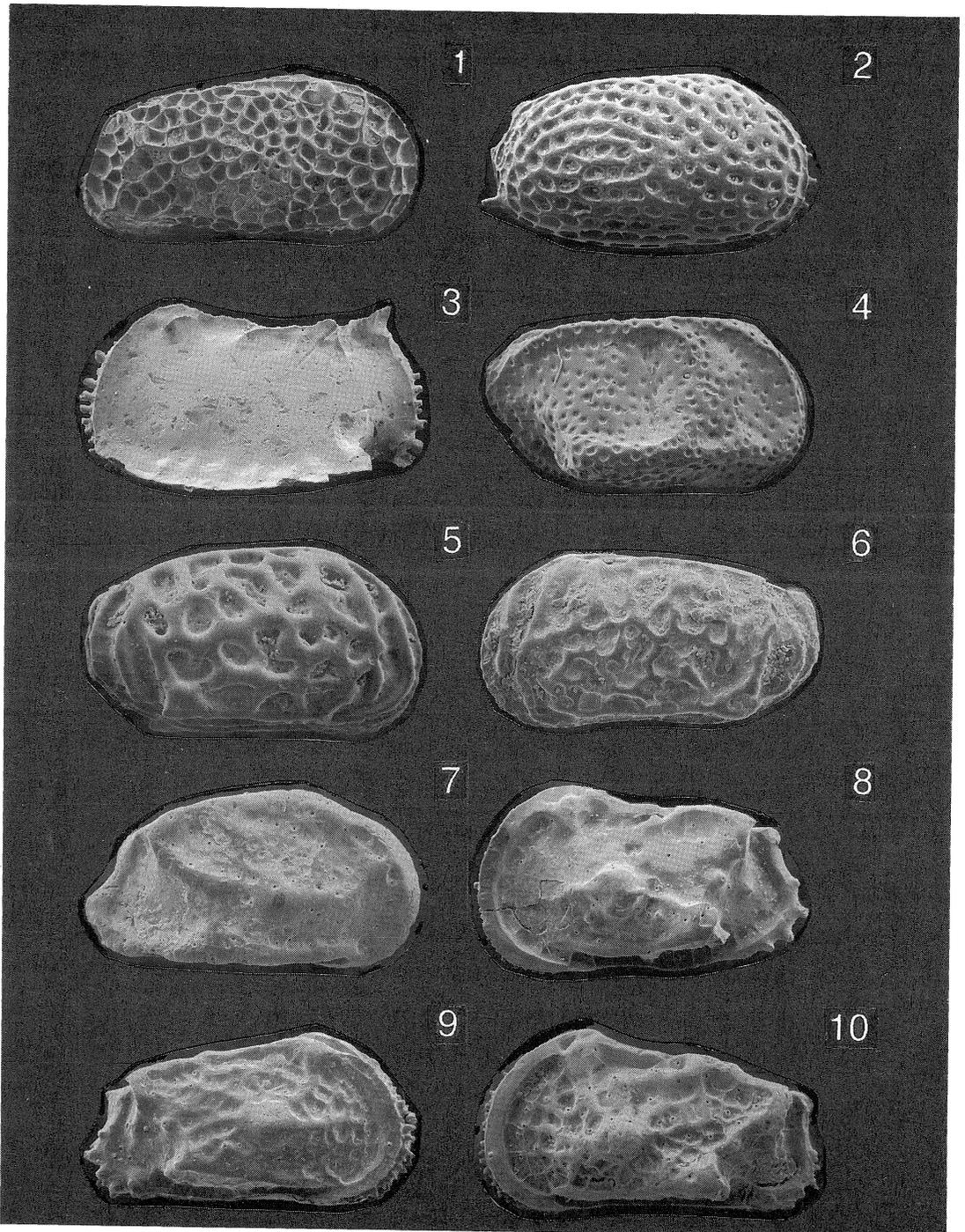


Plate 2: 1. *Baffinicythere robusticostata* Irizuki, RV, C501, x 41; 2. *Bicornucythere bisanensis* (Okubo), RV, Lo-30, x 58; 3. *Bradleya* cf. *nuda* Benson, LV (juvenile), Y-7, x 51; 4. *Bythoceratina hanaii* Ishizaki RV, C506, x 62; 5. *Callistocythere alata* Hanai, RV, OL-10, x 87; 6. *Callistocythere* sp. 1, LV, OL-35, x 83; 7. *Caudites japonicus* Ishizaki, RV, C506, x 65; 8. *Cornucoquimba* cf. *moniwenensis* (Ishizaki), LV, C410, x 58; 9. *Cornucoquimba* cf. *saitoi* (Ishizaki), RV, C212, x 75; 10. *Cornucoquimba tosaensis* (Ishizaki), LV, C102, x 62.

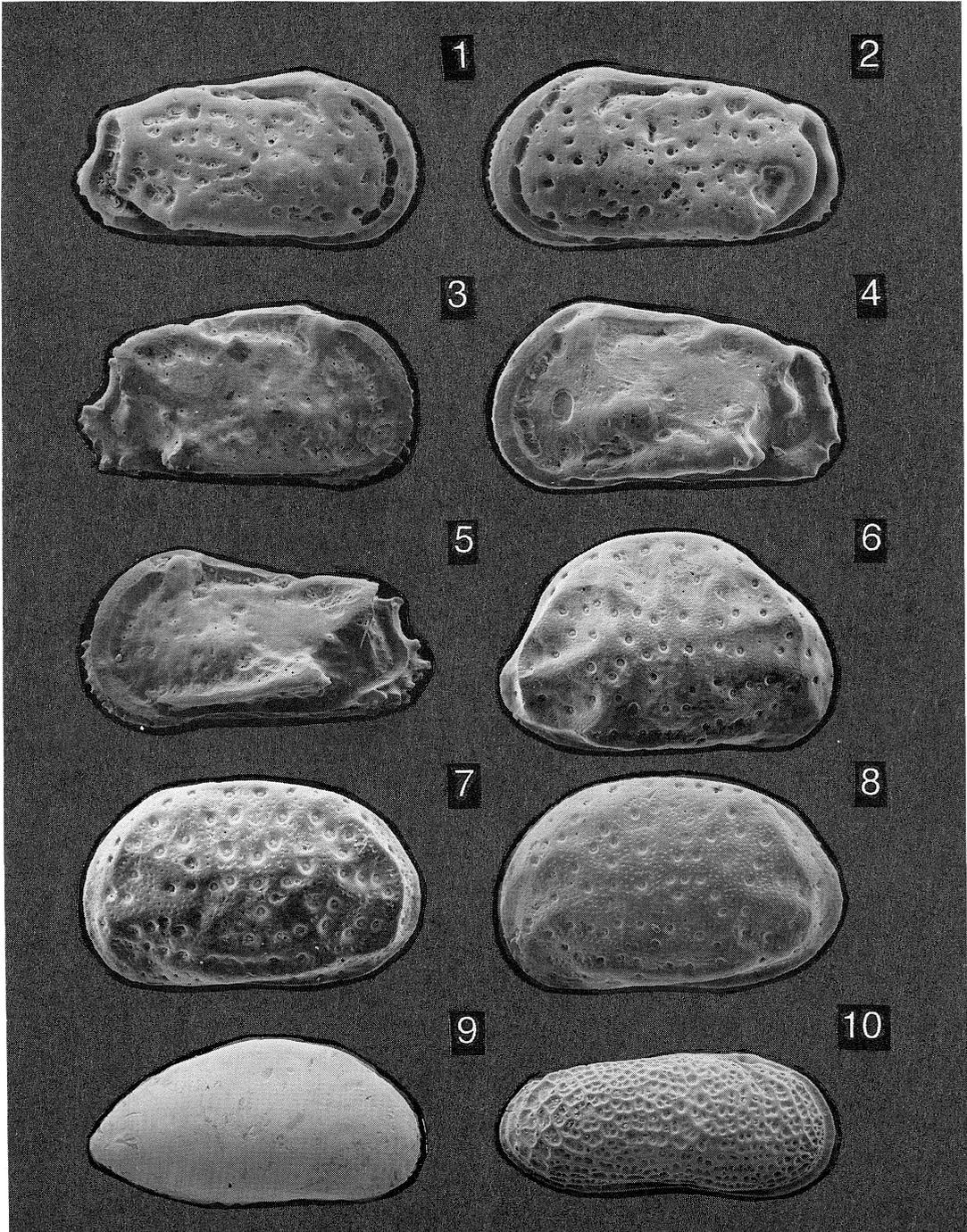


Plate 3: 1. *Cornucoquimba* sp. 1, RV, C501, x 68; 2. *Cornucoquimba* sp. 2, LV, C504, x 68; 3. *Cornucoquimba* sp. 5, RV, C410, x 68; 4. *Cornucoquimba* sp. 6, LV, C403, x 62; 5. *Cornucoquimba* sp. 7, LV, C410, x 68; 6. *Cythere hanaii* Tsukagoshi & Ikeya, RV, C410, x 68; 7. *Cythere nishinipponica* Okubo, LV, C403, x 71; 8. *Cythere uranipponica* Hanai, LV, C404, x 75; 9. *Cytheroma?* *hanaii* Yajima, RV, C206, x 65; 10. *Cytheromorpha acupunctata* (Brady), RV, OL-31, x 91

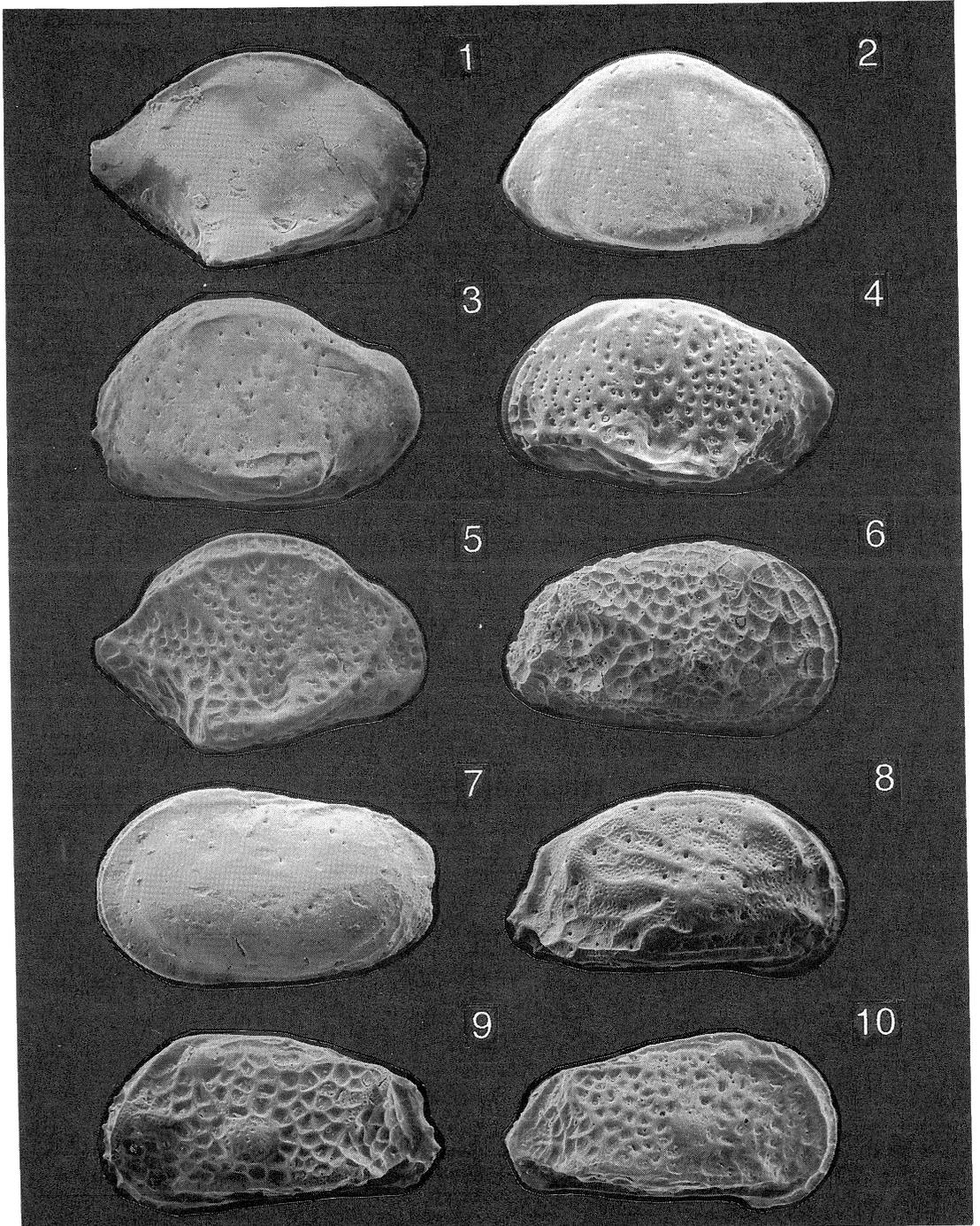


Plate 4: 1. *Cytheropteron* cf. *alatum* Sars, RV, C206, x 75; 2. *Cytheropteron* cf. *arcuatum* Brady and others, LV, C408, x 75; 3. *Cytheropteron* cf. *elaeni* Cronin, LV, C405, x 92; 4. *Cytheropteron* cf. *nodosoalatum* Neal & Howe, RV, C210, x 83; 5. *Cytheropteron* *sawanense* Hanai, RV, C402, x 83; 6. *Elofsonella* cf. *concinna* (Jones), RV, Ho-6, x 50; 7. *Falsobuntonia taiwanica* Malz, LV, C203, x 83; 8. *Finmarchinella hanaii* Okada, RV, C401, x 71; 9. *Finmarchinella japonica* (Ishizaki), LV, C303, x 78; 10. *Finmarchinella nealei* Okada, RV, C303, x 68.

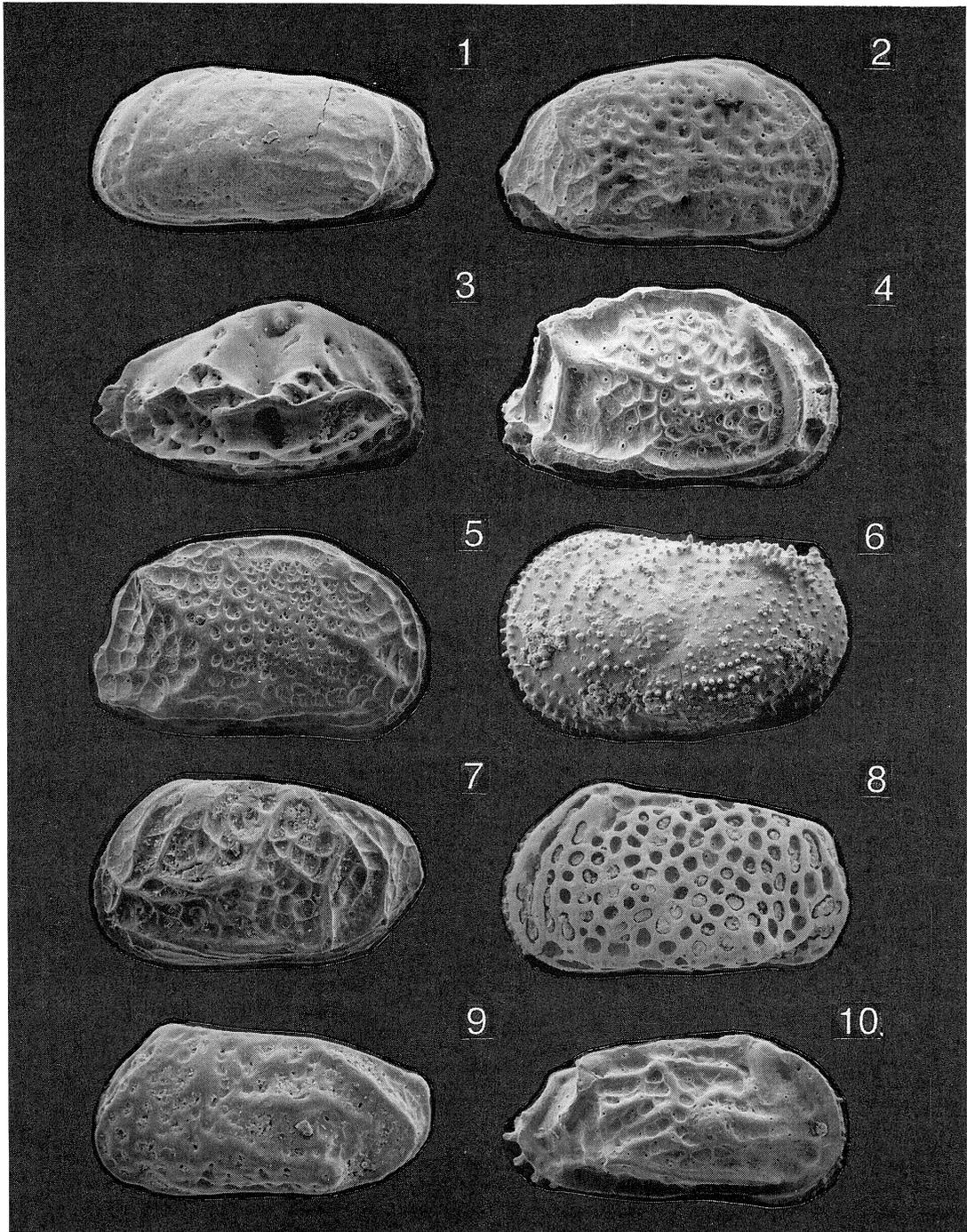


Plate 5: 1. *Finmarchinella* sp. 2, LV, OL-35, x 75; 2. *Finmarchinella* sp. 3, RV, C410, x 62; 3. *Hanaiborchella triangularis* (Hanai), RV, OL-26, x 95; 4. *Hemicythere kitanipponica* (Tabuki), RV, C401, x 59; 5. *Hemicythere* sp. 1, RV, C508, x 55; 6. *Hirsutocythere? hanaii* Ishizaki, LV (juvenile), Y-7, x 59; 7. *Howeina higashimeyaensis* Ishizaki, LV, OL-28, x 97; 8. *Johnnealella?* sp., LV, C401, x 45; 9. *Kotoracythere* sp. 1, LV, OL-31, x 83; 10. *Laperousecythere* cf. *ishizakii* Irizuki & Matsubara, RV, C410, x 40.

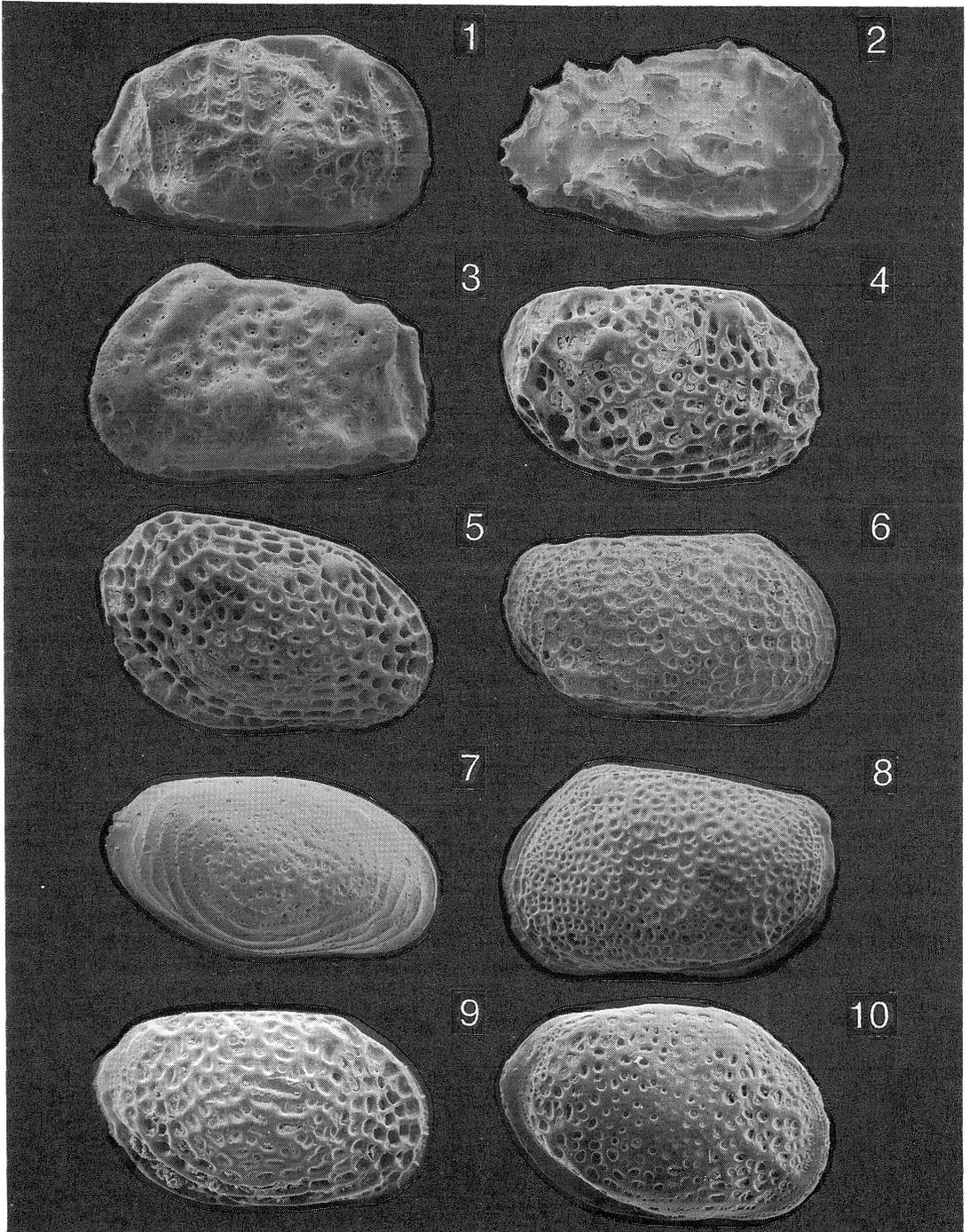


Plate 6: 1. *Laperousecythere* sp. 1, RV, C401, x 58; 2. *Laperousecythere* sp. 2, RV (juvenile), C407, x 50; 3. *Laperousecythere?* sp, LV, C410, x 65; 4. *Loxoconcha hattorii* Ishizaki, RV, C506, x 85; 5. *Loxoconcha japonica* Ishizaki, RV, C402, x 78; 6. *Loxoconcha* cf. *kitanipponica* Ishizaki, RV, C206, x 83; 7. *Loxoconcha optima* Ishizaki, RV, OL-28, x 59; 8. *Loxoconcha ozawai* Tabuki, LV, C302, x 78; 9. *Loxoconcha viva* Ishizaki, RV, C402, x 78; 10. *Loxoconcha* sp. 1, RV, C507, x 78.

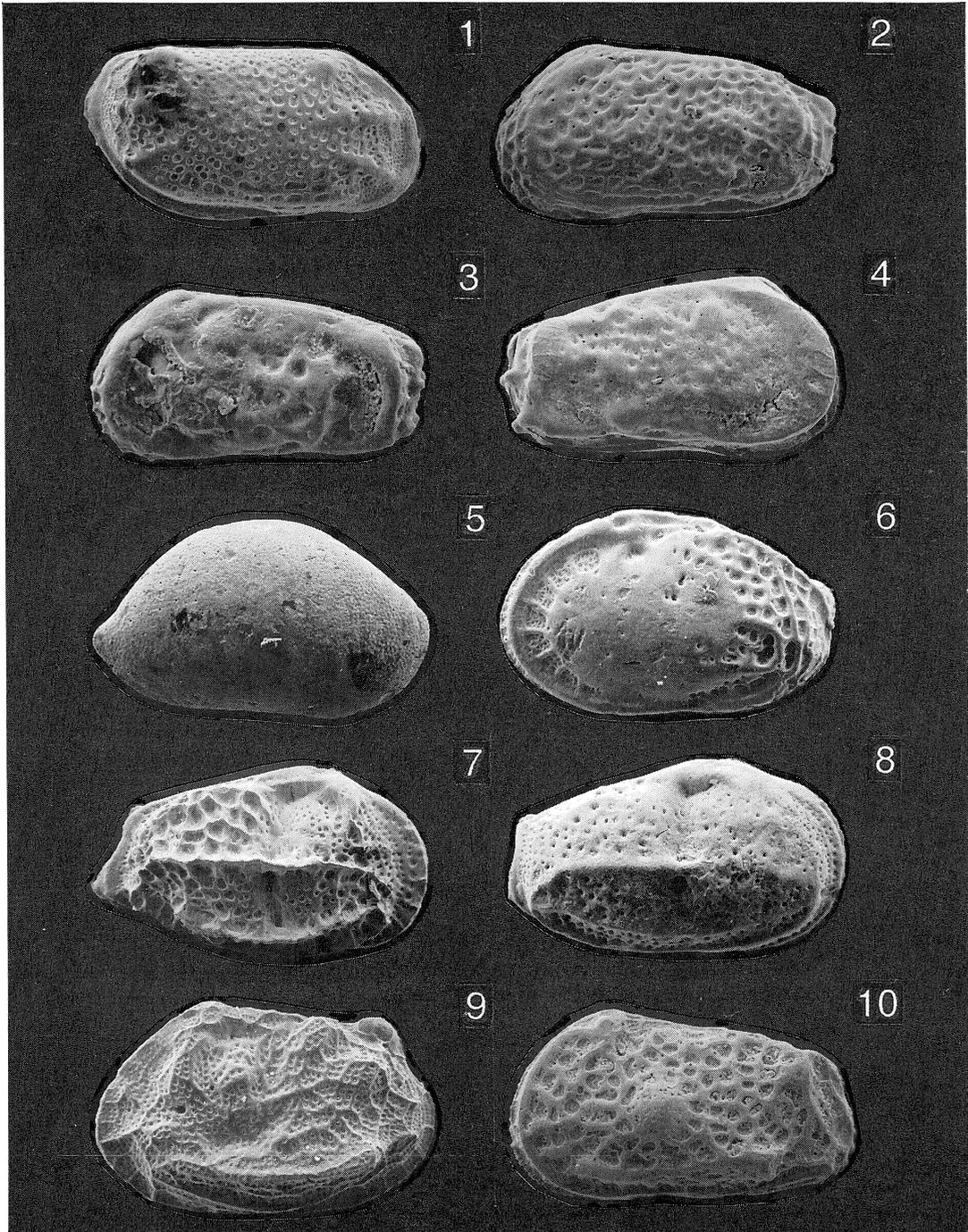


Plate 7: 1. *Loxocorniculum mutsuense* Ishizaki, RV, C302, x 65; 2. *Munseyella hatatatensis* (Ishizaki), LV, OL-7, x 92; 3. *Munseyella* cf. *japonica* (Hanai), LV, OL-21, x 110; 4. *Munseyella* sp. 1, RV, C303, x 100; 5. *Neonesidea oligodentata* (Kajiyama), RV, C303, x 36; 6. *Pacambocythere u-carinata* (Ishizaki), LV, Y-7, x 83; 7. *Paijenborchella hanaii* Tabuki, RV, C401, x 62; 8. *Paijenborchella tsurugasakensis* Tabuki, RV, Y-8, x 89; 9. *Palmenella limicola* (Norman), LV, Lo-30, x 87; 10. *Patagonacythere* sp. 1, LV, C211, x 53.

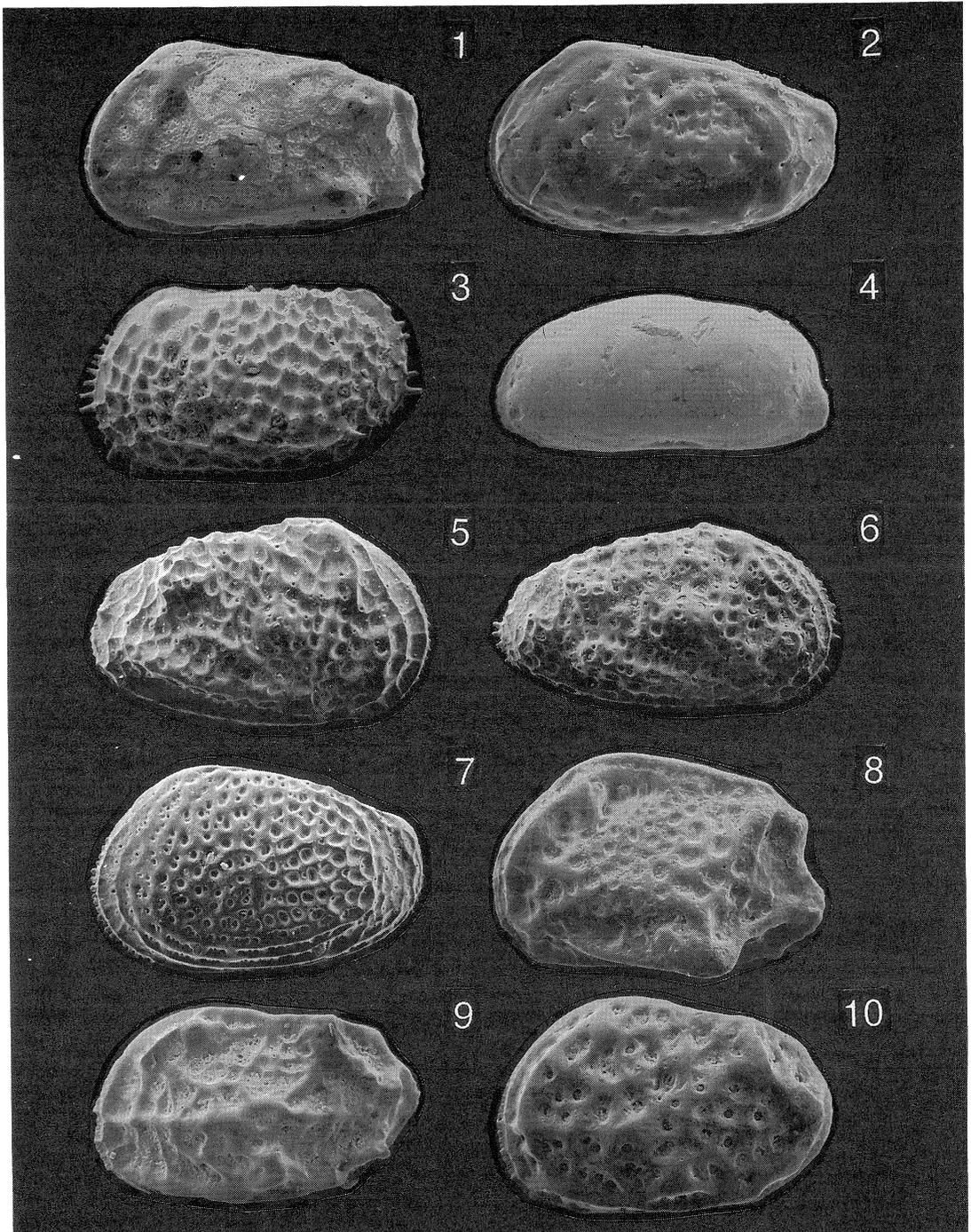


Plate 8: 1. *Patagonacythere* sp. 2, LV, C506, x 55; 2. *Pectocythere quadangulata* Hanai, LV, C408, x 90; 3. *Pistocythereis bradyformis* (Ishizaki), LV, OL-27, x 55; 4. *Pontocythere subjaponica* (Hanai), LV, OL-32, x 78; 5. *Robertsonites hanaii* Tabuki, RV, C409, x 59; 6. *Robertsonites reticuliforma* (Ishizaki), RV, Y-8, x 55; 7. *Robertsonites tsugaruana* Tabuki, LV, C409, x 58; 8. *Robustaurila* cf. *salebrosa* (Brady), LV, C503, x 65; 9. *Schizocythere kishinouyei* (Kajiyama), LV, C301, x 75; 10. *Schizocythere* sp. 1, LV, C401, x 65.

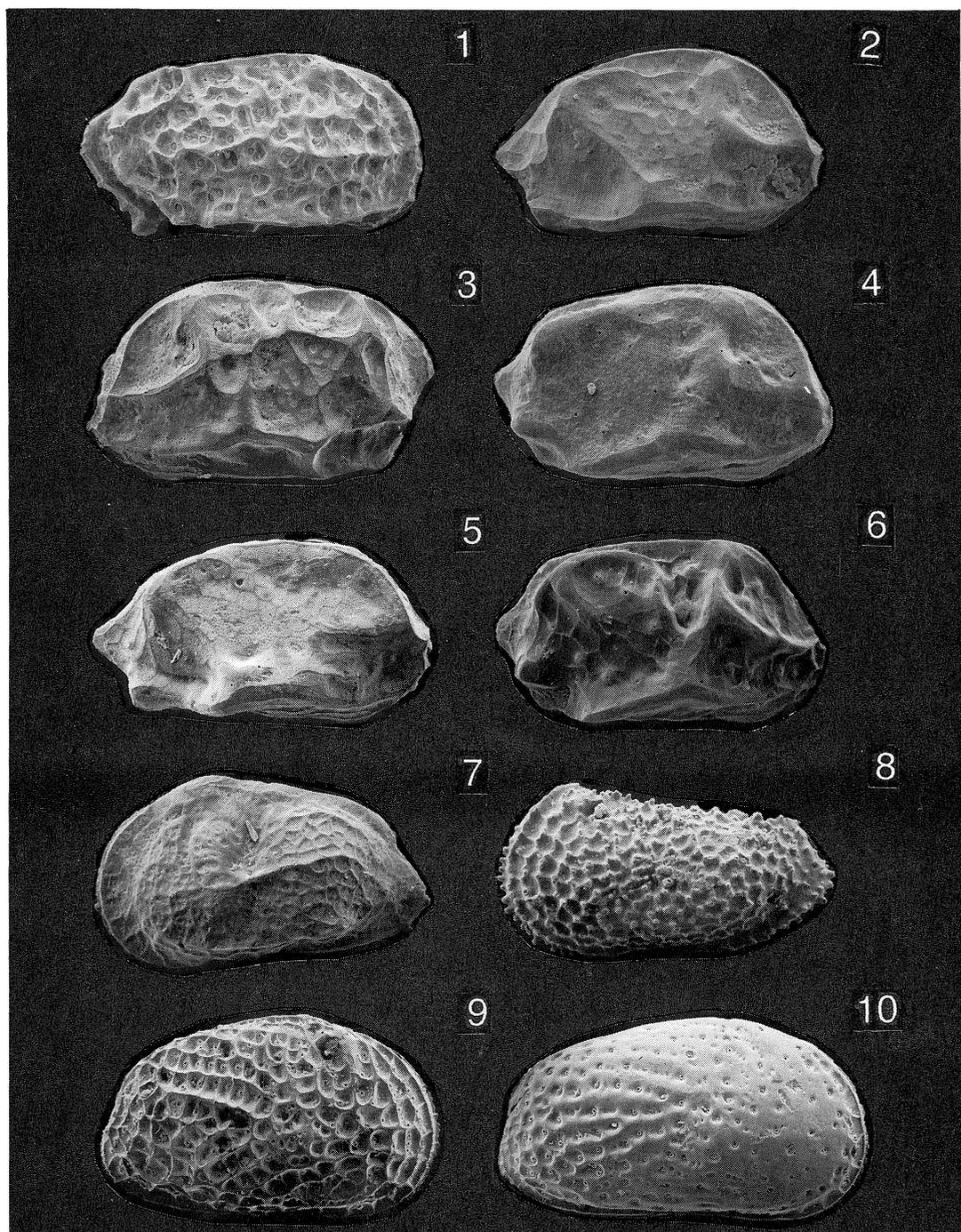


Plate 9: 1. *Schizocythere* sp. 2, RV, C507, x 75; 2. *Semicytherura subundata* Hanai, RV, C403, x 75; 3. *Semicytherura* cf. *undata* (Sars), LV, C507, x 88; 4. *Semicytherura* sp. 4, RV, C303, x 115; 5. *Semicytherura* sp. 5, RV, C503, x 90; 6. *Semicytherura* sp. 6, RV, C401, x 88; 7. *Spinileberis rhomboidaris* Chen, LV, Lo-51, x 62; 8. *Trachyleberis* sp., LV (juvenile), Y-7, x 53; 9. *Yezocythere hayashii* Hanai & Ikeya, RV, OL-13, x 53; 10. *Yezocythere*? sp., RV, OL-11, x 68.