

FAUNA OF SHELL-BEARING MOLLUSKS IN MUTSU BAY
LAMELLIBRANCHIA (1)¹⁾

By

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(With 5 plates)

The fauna of Mollusca in Mutsu Bay have been investigated by three authorities in the series of the Biological Survey of Mutsu Bay conducted by the late Dr. Sanji Hôzawa since 1926. They are Takatsuki (1927), Baba (1935) and Is. Taki (1938) on shell-bearing mollusks, nudibranchs and chitons respectively. As to shell-bearing mollusks 74 species were listed up by Takatsuki: 36 species of lamellibranchs and 38 species of gastropods. Thereafter, Nomura and Hatai have published in Japanese a list of shell-bearing mollusks containing 85 species of lamellibranchs, 3 species of scaphopods and 65 species of gastropods collected in the bay (1932).

As the present writers have collected the shell-bearing mollusks with the helpful assistance of the members of the Marine Biological Station of Asamushi recently, species with high populations, and the distribution and habitats of the common species in the bay have been clarified. Therefore, the present reports were undertaken to throw further light on the fauna, distribution and habits of mollusks in the bay, and, in addition, on the specific characters of these shells with brief descriptions and illustrations, although it may not be expected that the number of species exceeds much that of Nomura and Hatai's collection. Especially, in this collection, a great care was taken to comprise all of the species having high population in the bay.

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Class LAMELLIBRANCHIA
Subclass PRIONODESMACEA
Order LIPODONTA (PALEOBRANCHIA, PALEOCONCHA)
Family SOLEMYIDAE

1. *Solemya (Acharax) japonica* Dunker (Pl. II, Figs. 1, 2)
Japanese name: Asahi-kinutare-gai

Solemya japonica Dunker 1882, p. 220, 261, Pl. 14, Fig. 3; Kira 1954, Pl. 41, Fig. 1.
Solemya yamakawai Yokoyama 1927, p. 435, Pl. 50, Figs. 10, 11.

This small solemyid species has a shell covered by a vernicose brownish periostracum on which many pale yellowish threads radiate. The ligament is external, at the short posterior dorsal margin. By this feature this species belongs to the subgenus *Acharax* and differs from the nearest ally *S. (Petrasma) pusilla* Gould (Pl. II, Figs. 3, 4), which has been reported from Hakodate, in the southernmost part of Hokkaido, and whose ligament sinks internally.

Locality: Off Ushirogata, Kobashi, Kugurizaka, Noheji, Ominato and St. 20.

Distribution: The Pacific coast of Honshu and Kyushu.

Habitat: This species is rather common in the shallow waters on the muddy bottom.

Order PROTOBRANCHIA
Family NUCULIDAE

2. *Acila (Truncacila) insignis* (Gould) (Pl. II, Fig. 6)
Japanese name: Kirara-gai

Nucula (Acila) insignis Gould 1861, p. 36; Nomura et Hatai 1932, p. 2.

This is characteristic in having a divaricate sculpture on the surface of shell, which is covered by a thick periostracum colored yellowish black. The interior of shell is pearly and at the dorsal margin expose many teeth and a oblique chondrophore beneath the umbo. This is included in the subgenus *Truncacila* in lacking the ear-like process at the posterior end of the dorsal margin.

Locality: Off Kanita, Ushirogata, Moura, Futago, Asadokoro, Noheji, Arito, Hamaokunai, Kawauchi, Shukunobe and St. 16.

Distribution: Northern Honshu and Hokkaido.

Habitat: This species has a wide vertical range from the lower tide mark to the deep sea of about 200 m on the fine sandy bottom.

Family NUCULANIDAE

3. *Nuculana (Thestyleda) yokoyamai* Kuroda (Pl. II, Fig. 8)
Japanese name: Arabori-robai

Leda ramsayi Yokoyama (non Smith) 1920, p. 176, Pl. 19, Fig. 3.
Nuculana (Thestyleda) yokoyamai Kuroda 1934, p. 204.

This small species is quite separable from other Japanese nuculanids in having a distinct undulation all over the shell surface, by which character this allocates in the subgenus *Thestyleda*. The shell narrows into a slightly recurved rostration posteriorly.

Locality: Off Moura and Sts. 7 and 22.

Distribution: Kyushu to Honshu.

Habitat: This is rather common species on the continental shelf around Japan.

4. *Cnesterium johanni* (Dall) (Pl. II, Fig. 5, Pl. IV, Fig. 1)
Japanese name: Ezo-sode-gai

Yoldia johanni Dall 1925, p. 32, Pl. 29, Fig. 7; Kira 1954, Pl. 41, Fig. 13.

This is characteristic in having, on the middle part of shell-surface which is covered by a vernicose yellowish black periostracum, oblique striae, which are not marked along the growth lines. The shell is thin and its interior is white, not pearly. The nearest ally *C. notabile* (Yokoyama) attains a larger size in the adult, exceeding 40 mm in length and its shell possesses the oblique striae all over the surface.

Locality: Off Moura and Sts. 21 and 22.

Distribution: Northern Honshu and Hokkaido.

Habitat: This is a mud dweller of shallow waters. Commonly found in this bay.

5. *Cnesterium notabile* (Yokoyama) (Pl. IV, Fig. 5)
Japanese name: Furisode-gai

Yoldia notabilis Yokoyama 1922, p. 196, Pl. 17, Fig. 10; Takatsuki 1927, p. 20, Kira 1954, Pl. 41, Fig. 12.

This species was reported by Takatsuki, but we have not yet obtained any specimen from this bay.

Locality: Off Yomogida.

Distribution: Northern Honshu and Hokkaido.

Order TAXODONTA (FILIBRANCHIA)
Family ARCIDAE

6. *Arca boucardi* Jousseaume (Pl. IV, Fig. 6)

Japanese name: Kobelt-fune-gai

Arca boucardi Jousseaume 1894, The Humming Bird, 4, Fig. 14; Takatsuki 1927, p. 20; Nomura et Hatai 1932, p. 2; Is. Taki 1951, Pl. 2, Fig. 1; Kira 1954, Pl. 42, Fig. 15.

Arca kobeltiana Pilsbry 1904, p. 559, Pl. 40, Figs. 16-19.

Arca rectangularis Tokunaga 1906, p. 61, Pl. 3, Figs. 23a-c.

This ark shell, having many ribs and covered by the hairy periostracum all over the surface, is purplish in color. On the wide and flat ligamental area between the umbones are prominent chevron-shaped ligamental grooves. The dorsal hinge line is straight and bears many small teeth. This species is easily distinguished from *Arca navicularis* which is very common in Southern Japan in having an oblique truncation posteriorly, not excavated in the middle. *Arca arabica* is an allied form, but the shell covered by yellowish hairs is smaller in the adult and shorter in length than this species.

Locality: Off Aburakawa, Nonai, Asamushi, Yunoshima, Tsuchiya, Moura, Mourashima, Futago-jima, Oshima, Asadokoro, Karibasawa, Noheji, Yokohama, Ominato, Kawauchi and Kozawa.

Distribution: Formosa to Hokkaido, especially common in Northern Japan.

Habitat: This species lives under rocks lower than the tide mark, and also on the fine sandy bottom, attaching by the byssus. This is sometimes collected by dredge for food by the inhabitants along the shore of this bay. The bivalve has showed a great fluctuation in its population in the bay.

7. *Arca arabica* Philippi (Pl. IV, Fig. 2)

Japanese name: Neji-asari

Arca arabica Philippi 1847, p. 28, Pl. 4, Fig. 2; Nomura et Hatai 1932, p. 3; Is. Taki 1951, Pl. 1, Fig. 9; Kira 1954, Pl. 42, Fig. 7.

This species has never been collected by the authors, while Nomura and Hatai reported this from this bay.

Locality: Yunoshima and Asamushi.

Distribution: Widely distributes in the southern seas, up to Honshu.

Habitat: This adheres to rock by the byssus.

8. *Arca miyatensis* Oyama (Pl. II, Figs. 17, 18)

Japanese name: Kitano-fune-gai

Arca kobeltiana Yokoyama (non Pilsbry) 1920, p. 163, Pl. 17, Fig. 4.

Arca miyatensis Oyama 1951, p. 155; Habe 1955, p. 3, Pl. 3, Figs. 1, 3.

This is smaller than *A. boucardi* in the adult despite of the close resemblance in shape, and the shell is colored blackish yellow and has bifurcate thick radial ribs on the postero-dorsal area. The ligamental area is restricted to the anterior half

of the rhomboidal area between the umbones.

Locality: St. 18.

Distribution: Northern Honshu and Hokkaido.

Habitat: This is found in the deeper bottom than *A. boucardi*.

9. *Pseudogrammatodon dalli* (Smith) (Pl. II, Fig. 24)

Japanese name: Shikoro-e-gai

Arca (Macrodon) dalli Smith 1885, p. 269, Pl. 17, Figs. 10, 10b.

Parallelodon obliquatus Yokoyama 1920, p. 170, Pl. 18, Figs. 9-11.

Cucullaria dalli obliquata Nomura et Hatai 1932, p. 3.

Pseudogrammatodon dalli Kira 1954, Pl. 42, Fig. 10.

This is similar to *Barbatia lima* (Reeve) of the south in the shell appearance. But the arrangement of teeth on the cardinal plate distinctly differs between them. In this species, the teeth arrange horizontally, not vertically as in that species. This feature is quite characteristic.

Locality: Asadokoro, Gomejima, Asamushi and St. 23.

Distribution: Kyushu to southern Hokkaido, and Korea.

Habitat: This lives on submarine rocks, attaching by the byssus.

11. *Anadara (Scapharca) broughtonii* (Schrenck) (Pl. V, Fig. 3)

Japanese name: Aka-gai

Arca inflata Reeve (non Schroeter) 1844, sp. 30; Takatsuki 1927, p. 20; Nomura et Hatai 1932, p. 3.

Arca broughtonii Schrenck 1867, p. 578, Pl. 24, Figs. 1-3; Is. Taki 1951, Pl. 3, Fig. 4; Kira 1954, Pl. 43, Fig. 14.

Arca tenuis Tokunaga 1907, p. 58, Pl. 4, Figs. 1a, b.

This is one of the important edible mussels in Japan. This species has radial ribs on the rather thin shell, the number of which is about 42. Therefore it is easily separable from the nearest ally *A. satowi* (Dunker) of about 37 ribs. The latter species moreover has a thicker shell on which the broader and higher radial ribs are present, resembling *A. subcrenata*.

Locality: Off Aburakawa, Aomori, Nonai, Kugurizaka, Asamushi, Yunoshima, Gomejima, Moura, Asadokoro, Ominato and St. 15.

Distribution: Kyushu to southern Hokkaido.

Habitat: This is a dweller of the muddy bottom in the deep of this bay. The fishing of the mussel is carried out at the center of the eastern part of the bay, especially near Sts. 9 and 23. The population fluctuates much periodically.

12. *Anadara (Scapharca) subcrenata* (Lischke) (Pl. IV, Fig. 4)

Japanese name: Sarubo or Mo-gai

Arca subcrenata Lischke 1869, p. 107.

Arca nodosocrenata Lischke 1869, Pl. 9.
Arca kagoshimensis Tokunaga 1906, p. 59, Pl. 3, Figs. 21a, b.

This is also an important edible mussel in Japan. The culture of this species is made in inland seas of Japan such as Nakanoumi, Kojima Bay and Tokyo Bay. The shell is thick and white on whose surface about 28 ribs are radiated and a brownish black-colored periostracum lies. In the left valve the ribs are granulated at the summit. *Anadara japonica* Reeve, that has a somewhat elongate shell ventrally, is perhaps a local form of this species.

Locality: Off Tsuchiya.

Distribution: Ryukyus to Honshu.

Habitat: In the young stage this species attaches to the leaves of eel-grass, so that it is called "mogai", meaning the mussel dwelling on sea grasses. But in the adult stage this lives on the muddy bottom in shallow waters of bays. This species is rather uncommon in this bay, but sometimes the young may be found.

13. *Anadara (Scapharca) troscheli* (Dunker) (Pl. IV, Fig. 3)

Japanese name: Hime-aka-gai

Scapharca troscheli Dunker 1882, p. 234, Pl. 14, Figs. 14, 15.
Arca troscheli Nomura et Hatai 1932, p. 3.
Anadara (Scapharca) troscheli Kira 1954, Pl. 43, Fig. 5.

This has a thick shell with about 24 radial ribs and a hairy periostracum. We have never seen this species in the bay, while Nomura and Hatai had reported it.

Locality: Kugurizaka.

Distribution: Kyushu to Honshu.

Habitat: The species lives in the eel grass field of the intertidal zone.

14. *Striarca (Galactella) symmetrica* (Reeve) (Pl. II, Figs. 19, 20)

Japanese name: Mimi-e-gai

Arca symmetrica Reeve 1844, p. 117; Nomura et Hatai 1932, p. 3.
Striarca symmetrica Is. Taki 1951, Pl. 2, Fig. 5.

This is a small ark shell with a diamond ligamental covering between umbones. The surface sculpture consists of many radial ribs crossed by weak growth lines.

Locality: Futagojima. Kanita and Yunoshima.

Distribution: Philippines to Japan, up to Mutsu Bay.

Habitat: This shell lives under stones along the coast between tide marks.

Family GLYCYMERIDAE

15. *Glycymeris yessoensis* (Sowerby) (Pl. II, Figs. 25, 26, Pl. IV, Fig. 8)

Japanese name: Yezo-tamaki-gai

Pectunculus yessoensis Sowerby 1888, p. 570.

Glycymeris yessoensis Takatsuki 1927, p. 20; Nomura et Hatai 1932, p. 2; Kira 1954, Pl. 44, Fig. 10.

The shell is thick and brownish outside and white inside, and its surface is sculptured with stripes and grooves alternately. The ventral margin is strongly crenulated. This approaches to the deep sea species *G. rotunda*, but the shell of this species is covered by a rough periostracum.

Locality: Off Kanita, Ushirogata, Aburakawa, Aomori, Kugurizaka, Asamushi, Yunoshima, Oshima, Higashitazawa, Asadokoro, Noheji, Yokohama, Ominato, Kawauchi, Wakinozawa and Sts. 5 and 17.

Distribution: Northern Honshu and Hokkaido.

Habitat: This is found on the fine sandy bottom in shallow waters.

16. *Limopsis tajimae* Sowerby (Pl. II, Figs. 22, 23)

Japanese name: O-shirasuna-gai

Limopsis tajimae Sowerby 1914, p. 445, Pl. 18, Fig. 3; Takatsuki 1927, p. 20; Is. Taki 1951, Pl. 1, Fig. 3; Kira 1954, Pl. 44, Fig. 2.

This species has been reported by Takatsuki from this bay, but the writers have collected no specimen until to-day. The shell has a smooth surface densely tufted with hairs. The genus *Limopsis* somewhat resembles the genus *Glycymeris* in the shell appearance, but the ligament of the former is small and central, and triangular in shape.

Locality: Off Okunai.

Distribution: Kyushu to Honshu.

Habitat: This is a deep sea shell dwelling on the muddy bottom.

Order DYSODONTA (ANISOMYARIA)

Family MYTILIDAE

17. *Modiolus difficilis* (Kuroda et Habe) (Pl. III, Figs. 1, 2)

Japanese name: Ezo-hibari-gai

Volzella difficilis Kuroda et Habe 1950, p. 30; Is. Taki 1951, Pl. 18, Fig. 9; Kira 1954, Pl. 45, Fig. 21.

Modiolus capax Takatsuki (non Conrad) 1927, p. 21; Nomura et Hatai 1932, p. 4

Modiolus modiolus Nomura et Hatai (non Linné) 1932, p. 4.

This species was formerly confused with the European *Modiolus modiolus* or with the American *M. capax* by its shell appearance so closely resembling. But, on the postero-dorsal area the shell has simple but long and strong bristles on the periostracum, that of the remaining area being smooth and vernicose. These features may distinguish this species from the two confused species. It exceeds 10 cm in length and loses the bristles on the surface in older specimens. Though *Volzella* Scopoli 1777 had generally been in use, the International Commission

of Zoological Nomenclature made a suspension of the rules and accepted *Modiolus* Lamarck 1801 as a *nomina conservanda* in Opinion 325 in 1955.

Locality: Off Aburakawa, Asamushi, Yunoshima, Gomejima, Moura, Oshima Asadokoro, Karibasawa, Noheji, Yokohama and Sts. 5, 6 and 18.

Distribution: Northern Honshu (down to Tokyo Bay), Hokkaido, Saghalien and Kuriles.

Habitat: This is the commonest horse mussel in this bay below the low water mark to the muddy bottom. Collected for food by dredging.

18. *Modiolus nipponicus* (Oyama) (Pl. IV, Fig. 11)

Japanese name: Hibari-gai

VolSELLA nipponica Oyama 1950, p. 1; Is. Taki 1951, Pl. 18, Fig. 6; Kira 1954, Pl. 45, Fig. 16.

Modiolus barbatus Nomura et Hatai (non Linné) 1932, p. 4.

This is a species confused with the European *M. barbatus*, but the shell is rather thin and smaller, with about 4 cm in length in the full-grown specimen, and is marked with a reddish broad zone on the middle part, the dorsal and ventral parts being brownish and covered by the periostracum with serrated bristles except the rather narrow but vernicose antero-ventral area. This somewhat resembles *M. plumescens* Dunker from Southern Japan but the ventral margin of this species is not twisted but gaped.

Locality: Asamushi, Moura, Karibasawa, Noheji and St. 10.

Distribution: Formosa to Honshu and Korea.

Habitat: Uncommon in this bay. This species attaches to rocks under the low tide mark with its byssus.

19. *Modiolus* (*Modiolusia* n. subgen.) *elongatus* (Swainson)

(Pl. III, Fig. 22, Pl. IV, Fig. 20)

Japanese name: Tsuya-garasu

Modiola elongata Swainson 1821, Exot. Conch., 1, Pl. 8.

This is quite separable from the preceding two species in having vernicose periostracum all over the shell which gently increases in height posteriorly.

Lamy placed this species in the subgenus *Modiolatus* of this genus and Habe followed this view. But Soot-Ryen states this subgenus has *Mytilus plicatus* Chemnitz as its type under the original designation but it does not seem to be a Mytilid. Therefore for the group of *Modiolus elongatus* a new subgeneric name *Modiolusia* is introduced, the type of which being this species as follows:

Subgenus *Modiolusia* nov.

Type species: *Modiolus elongatus* (Swainson)

Shell rather large, thin, elongate, increasing in height posteriorly, inflated

ventrally, the posterior area being flattened; the anterior margin little produced before the umbo and the posterior sloping obliquely from the dorsal margin which is long and straight; the ventral is also nearly straight, but in some species a slight concavity in the middle; the surface smooth and shining, covered with a chestnut brown periostracum; an obtuse ridge runs from the umbo to the postero-ventral corner, becoming obsolete: the interior smooth and pearly; the hinge line very long, occupying four fifths of the dorsal margin no denticulation presents on the margins.

The species of this new subgenus live in mud or fine sand and spin nests of mud particles and fine byssal threads.

Modiolus hanleyi reported by Takatsuki and by Nomura and Hatai may be the misidentification of this species as they did not report this species which is rather common in this bay.

Locality: Sts. 8 and 9.

Distribution: Siam Bay to Japan (north to this bay).

Habitat: It lives in the muddy bottom forming a nest of gelatinous mass in shallow waters.

20. *Modiolus* (*Modiolusia*) *hanleyi* (Dunker)

Japanese name: Hanley-hibari-gai

Modiola hanleyi Dunker 1882, p. 223, Pl. 16, Figs. 3, 4.

Modiolus hanleyi Takatsuki 1927, p. 21; Nomura et Hatai 1932, p. 4.

This species from this bay as already stated above may be the preceding species.

Locality: Off Asamushi and Yunoshima.

Distribution: Kyushu to Honshu (up to Wakayama Prefecture).

21. *Musculus* (*Musculista* n. subgen.) *senhousia* (Benson) (Pl. II, Fig. 13)

Japanese name: ototogisu-gai

Modiola senhousia Benson 1842, p. 489.

Brachidontes senhousia Nomura et Hatai 1932, p. 4; Is. Taki 1951, Pl. 18, Fig. 1; Kira 1954, pl. 45, Fig. 1.

Modiola bellardiana Tapparone-Canefri 1874, p. 144 Pl. 4, Figs. 4, a, b.

This thin shell has narrow, reddish colored, radial bands on the postero-dorsal area and rather distinctly marked, radial cords on the antero-ventral area, the area between them being smooth and polished. This manner is more like the genus *Musculus* than the genus *Brachidontes* as Soot-Ryen said. Habe considered that this belongs to the *Arcuatula*, the type of which is *Modiolus arcuatula* by tautonymy as a subgenus of *Brachidontes*. But according to Soot-Ryen, the type species of this subgenus is not *Modiolus arcuatula* but *M. plicatula* which is the same as

M. demissa Dillwyn under the original designation. This type species is quite unlike "*Brachidontes*" *senhousia*. Therefore, for this species, a new subgeneric term *Musculista* is proposed, together with *M. perfragilis* and *M. japonica* both by Dunker, designating this species as the type, as follows:

Subgenus *Musculista* nov.

Type species: *Musculus senhousia* (Benson)

Shell medium sized, thin, ovate to elongate-ovate, rather inflated umbo from the anterior end to a little posterior and slightly elevated on the dorsal line the anterior margin rounded and the posterior sloping obliquely from the rather straight dorsal margin, the ventral margin nearly straight the surface marked only by lines of growth, but in the type specimen, several cords radiate from the umbo to the antero-ventral margin, causing the crenulations at their distal ends, and covered with a smooth and shinningly greenish periostracum, variegated with brown fulguration of all over and with brown radiating striae on the posterior dorsal portion the interior smooth and bluish white the ligament extends from the umbo posteriorly for a half of the dorsal margin, on the rest of which minute denticulations bear.

That this species is transferred from the *Brachidontes* to the *Musculus* is a more natural classification, because this secretes a nest of mud held together by the byssal threads.

Locality: Off Ushirogata, Asamushi, Kugurizaka and Ominato.

Distribution: China to Hokkaido; also Korea and Maritime Prov. of Siberia.

Habitat: This species lives on the muddy bottom in the tidal zone and under the lower tide mark in shallow waters and builds a nest made of mud and byssal threads. This is one of the indicator species of rather stagnant bottom waters.

22. *Musculus (Modiolarca) neglectus* Kuroda (Pl. II, Fig. 7)

Japanese name: Tama-e-gai

Musculus neglectus Kuroda 1941, p. 196; Is. Taki. 1951, Pl. 19, Fig. 7; Kira 1954, Pl. 45, Fig. 6.

Musculus cumingiana Takatsuki (non Reeve) 1927, p. 21.

This is characterized by an inflated shell with three distinct areas on the surface, the two being radially sculptured at the ends and with a median smooth area. Takatsuki reported this species from this bay, but no specimen is present in our collection.

Locality: Mourakojima.

Distribution: Southern Honshu (north to Sagami and Noto).

Habitat: This species is embedded in the test of ascidian species such as *Pyura vittata* (Stimpson) (*Cynthia karasboja* Oka) at the low tidal level.

23. *Lithophaga (Leiosolenus) curta* (Lischke) (Pl. II, Fig. 12, Pl. V, Fig. 6)

Japanese name: Ishi-mate or Ishi-wari

Lithophagus curtus Lischke 1874, p. 111, Pl. 9, Figs. 14-17.

Lithophaga curta Takatsuki 1927; Nomura et Hatai 1932, p. 4; Is. Taki. 1951, Pl. 19, Fig. 5; Kira 1954, Pl. 45, Fig. 11.

The surface of this cylindrical shell is smooth with a thin calcareous incrustation. No specimen was collected by us.

Locality: Tsuchiya, Futagojima and Aburamesaki.

Distribution: Ryukyus to Honshu (up to this bay).

Habitat: This species bores corals and other shells.

24. *Mytilus edulis* Linné (Pl. III, Figs. 7, 8)

Japanese name: Murasaki-igai

Mytilus edulis Linné 1758, p. 704; Is. Taki 1951, Pl. 17, Fig. 3; Kira 1954, Pl. 45, Fig. 19.

This is a thin and smooth shell colored purplish black, but sometimes brownish at the ventral area. This may be distinguished from the following two species in having two or three teeth just inside the umbo and no denticulation at the ventral margin.

Locality: Off Kanita, Ushirogata, Aomori, Nonai, Kugurizaka, Asamushi, Tsuchiya, Moura, Noheji, Yokohama, Ominato, Kawauchi, Wakinozawa and St. 6.

Distribution: The first record of collecting this introduced species in Japan has been made by Kanamaru at the Kobe harbor on 1934. Therefore, this species was not found in both Takatsuki's and Nomura and Hatai's papers.

Habitat: This species is gregarious at the intertidal zone on rocks or pilings, associated with *M. crassitesta* under the strata of *Septifer virgatus*. Also dense populations are found on set nets recently. It seems that this mussel became to populate commonly the bay in about 1948.

25. *Mytilus crassitesta* Lischke (Pl. IV, Fig. 15)

Japanese name: Igai

Mytilus crassitesta Lischke 1868, p. 221; Nomura et Hatai 1932, p. 3; Is. Taki 1951, Pl. 17, Fig. 5; Kira 1954, Pl. 45, Fig. 20.

Mytilus dunkeri Lischke (non Reeve) 1869, p. 153, Pl. 10, Figs. 7, 8; Takatsuki 1927, p. 21.

This is a native mytilid, dwelling on rocks in the intertidal zone or under the low tide mark. At Asamushi, this species is associated with the preceding species, and they are very difficult to identify the two species in the young stage as they are too alike in shape and coloration. But this species has a thick shell even in the young stage, covered by the vernicose periostracum, black zones alternating

with brown ones along the growth lines. The about three hinge teeth are strong and several minute crenulations are present at the ventral margin near the apex.

Locality: Nonai, Asamushi, Kugurizaka and Futagojima.

Distribution: Kyushu to Southern Hokkaido and Korea.

Habitat: Cited in the preceding species. This species prefers rather off shore waters.

26. *Mytilus (Crenomytilus) grayanus* Dunker (Pl. IV, Figs. 14, 19)

Japanese name: Ezo-igai

Mytilus grayanus Dunker 1853, p. 84; Nomura et Hatai 1932, p. 3; Is. Taki 1951, Pl. 17, Fig. 4; Kira 1954, Pl. 45, Fig. 22.

Mytilus coruscus Gould 1861, p. 38.

This was frequently confused with the preceding species by Japanese authors but may be easily distinguished from the latter in having at the antero-ventral margin a longer series of minute crenulations as the endings of minute stripes on the surface which is covered by a olivaceous blackish periostracum.

The shell is thick, not elongate in shape as in *M. crassitesta* and the muscle scars impressed strongly are larger than those of the preceding two species.

On the basis of those features the genus *Crenomytilus* was created for this species by Soot-Ryen in 1955, but we use this term as the subgeneric rank of the genus *Mytilus*, because *M. crassitesta* shows a intergradation between *M. edulis* and *M. grayanus* in the crenulation at the margin.

Locality: Asamushi, Moura, Noheji, Yokohama and Sts. 4, 7, 8 and 19.

Distribution: Kuriles, Hokkaido and Northern Honshu.

Habitat: This dwells on rocks below the low tidal level attaching by byssus. This prefers rather more deeper waters than *M. crassitesta* does.

27. *Trichomya hirsuta* (Lamarck) (Pl. III, Figs. 5,6, Pl. IV, Fig. 17)

Japanese name: Kegai

Mytilus hirsutus Takatsuki 1927, p. 21.

Trichomya hirsuta Is. Taki 1951, Pl. 17, Fig. 6; Kira 1954, Pl. 45, Fig. 15.

This is characteristic in having long hirsutes on the surface, on which many ribs radiate from the terminal umbo all over. As a result of this feature, the margin is distinctly crenulated. We have no specimen from the bay.

Locality: Tsuchiya.

Distribution: Northern Australia to Japan. Probably this bay is the northern-most locality of this species.

Habitat: This attaches by a byssus in masses to rocks in the intertidal zone.

28. *Septifer (Mytilisepta) virgatus* (Wiegmann) (Pl. IV, Fig. 13)

Japanese name: Murasaki-inko

Trichogonia virgata Wiegmann 1837, p. 49.

Septifer crassus Nomura et Hatai 1932, p. 4.

Septifer virgatus Is. Taki 1951, Pl. 18, Fig. 4; Kira 1954, Pl. 45, Fig. 8.

Though the external form of this species is as variable as those of *M. edulis* and *M. crassitesta* which live together with, this surface of shell is sculptured with ribs which are divaricated and the periostracum is purplish in color. Moreover, the interior of shell has an anterior septum for the anterior muscle. By those features, it is easy to separate this species from the mytilid species. The interior is pearly and purplish, not white as in the species *M. keenae*. The crenulations at the margin are extremely variable in this species as well as in its allies so that the subgeneric term *Mytilisepta* was proposed against *Septifer sensu stricto* which has regular minute crenulations at the internal margin.

Locality: Asamushi, Gomejima, Mourajima, Futagojima, Asadokoro, Noheji, Ominato and St. 11.

Distribution: Australia to Japan (north to Yoichi, Hokkaido).

Habitat: This species builds a gregarious mass together with *M. edulis* and *M. crassitesta* at Asamushi on rocks at the intertidal zone.

29. *Septifer (Mytilisepta) keenae* Nomura (Pl. II, Figs. 9, 10, Pl. IV, Fig. 12)

Japanese name: Hime-igai

Septifer bifurcatus Nomura et Hatai (non Conrad) 1932, p. 3.

Septifer keeni (sic) Nomura 1936, p. 205, Textfigs. 1-5; Is. Taki 1951, Pl. 18, Fig. 5.

This species had been considered to be conspecific with *S. bifurcatus* of California, until Nomura pointed out the distinction of those two species as follows: The shell has sharper or more prominent umbonal ridges with slightly finer radiating ribbets and the interior coloration is pearly white or very slightly purplish. The periostracum is not purplish but brownish.

Locality: Asamushi, Tsuchiya, Gomejima, Futagojima, Noheji and Sts. 12 and 24.

Distribution: Kyushu to southern Hokkaido.

Habitat: This species attaches to rocks composing the association together with *Septifer virgatus*, *Mytilus edulis* and *M. crassitesta*, often among the rhizoids of *Sargassum*, thriving there.

Family PINNIDAE

30. *Atrina (Servatrina) pectinata* (Linné) (Pl. IV, Fig. 18)

Japanese name: Tairagi

Pinna pectinata Linné 1767, p. 1160.

Pinna japonica Reeve 1858, p. 47.

Pinna lischkeana Clessin 1891, p. 73, Pl. 28, Fig. 1.

Atrina japonica Is. Taki 1951, Pl. 4, Fig. 1 (with *A. j. lischkeana*, Pl. 4, Fig. 2).

Atrina (Servatrina) pectinata Kira 1954, Pl. 46, Fig. 10.

The shell attains a large size exceeding 20 cm in length and is trigonal in shape, broadly truncated at the posterior margin and tapered to the umbo. The surface is smooth in the typical form, but frequently serrated on the postero-dorsal area as the varietal form *lischkeana*. The intermediate between two forms is found even in the same locality.

Locality: Sts. 5 and 8.

Distribution: The Philippines to Japan. This bay is the northernmost locality.

Habitat: This stands by byssus on the muddy bottom in shallow waters in bays. This is rare in this bay.

Family PECTINIDAE

31. *Chlamys farreri nipponensis* Kuroda (Pl. IV, Figs. 9, 10)

Japanese name: Akazara or Azuma-nishiki

Pecten laetus Gould 1861 (non 1850), p. 91; Nomura et Hatai 1932, p. 3.

Pecten (Chlamys) farreri Jones et Preston 1904, p. 149.

Pecten laetus ruschenbergeri Takatsuki (non Tryon) 1927, p. 22.

Chlamys (farreri var.) nipponensis Kuroda 1932, app. p. 92.

Chlamys nipponensis akazara Kuroda 1932, app. p. 92, Textfig. 105.

Chlamys nipponensis Is. Taki 1951, Pl. 13, Fig. 4; Kira 1954, Pl. 49, Fig. 11.

This species is easily characterized by many serrated radial ribs on the shell, some of which are stronger than the rest. The coloration is usually purplish brown, but in some specimens it is freshly orange.

P. nipponensis akazara is only a northern form with numerous subequal radial ribs and colored freshly orange. There is no reason to distinguish this form from *Ch. nipponensis* with various kinds of the intermediate forms. Moreover, *Ch. farreri* of China Sea is also connected with this form by the presence of intergrade forms in shape and sculpture. Therefore the scientific name is *Chlamys farreri nipponensis* as a northern form of this species.

Locality: Off Aburakawa, Kugurizaka, Asamushi, Yunoshima, Gomejima, Futagojima, Oshima, Asadokoro, Karibasawa, Noheji, Yokohama and Ominato.

Distribution: China Sea to southern Hokkaido.

Habitat: This scallop is one of the commonest pectinid species in Mutsu Bay, found under the lower tide mark, attaching to the pebbles. This scallop populates the pebbly shore all over the bay and is collected for food instead of *Pecten yessoensis*.

32. *Chlamys (Swiftopecten) swifti* (Bernardi) (Pl. III, Fig. 4, Pl. V, Figs. 4, 7)

Japanese name: Ezo-ginchaku

Pecten swifti Bernardi 1858, p. 90, Pls. 1, 2, Fig. 1; Nomura et Hatai 1932, p. 3.

Chlamys swifti Is. Taki 1951, Pl. 12, Fig. 6. Kira 1954, Pl. 19, Fig. 14.

This species is at sight separable from all other Japanese *Chlamys*-species in having few, broad but low, radial ribs on the surface and the distinctly unequally sized ears, of which the anterior is larger than the posterior. Therefore, Hertlein proposed a section *Swiftopecten* for this species. The coloration is variable but generally white or purple.

Locality: Kanita, Asadokoro and Noheji.

Distribution: Northern Honshu to Alaska.

Habitat: Under the lower tide mark, this species attaches to rocks by the byssus.

33. *Pecten (Notovola) albicans* Schroeter (Pl. V, Figs. 1, 2)

Japanese name: Itaya-gai

Pecten albicans Schroeter 1802, p. 135.

Pecten laquetus Sowerby 1842, p. 46, Pl. 15, Fig. 101.

Pecten antonii Philippi 1844, p. 99, Pl. 1, Fig. 1.

Pecten albicans Is. Taki 1951, Pl. 14, Fig. 2; Kira 1954, Pl. 47, Fig. 2.

The right valve of this species is inflated to some extent, while the left is quite flat. There are strong but broad radial ribs on each valve. The ears on both sides of the umbo are almost equal in shape and size to each other. *Pecten sinensis* of Southern Japan has a more strongly inflated right valve and a distinctly excavated left valve.

Locality: Off Tsuchiya and Moura.

Distribution: Kyushu to southern Hokkaido.

Habitat: This species dwells on the fine sandy bottom in shallow waters. The spat is often found attaching to set nets or scallop collectors, but it is rather uncommon in the bay.

34. *Patinopecten yessoensis* (Jay) (Pl. V, Fig. 9)

Japanese name: Hotate-gai

Pecten yessoensis Jay 1856, p. 293, Pl. 3, Figs. 3, 4, Pl. 4, Figs. 1, 2; Is. Taki 1951, Pl. 14, Fig. 1.

Pecten brandtii Schrenck 1867, p. 411.

Patinopecten yessoensis Kira 1954, Pl. 49, Fig. 16.

This is one of the economically important mussels in Japan and the culture of this species is made in this bay and in Saromako, Hokkaido. This species grows very large in size exceeding 16 cm in length. The valves are more inflated in the

left than in the right, on which radiate about 25 ribs from the umbo. The ears are comparatively small in size and subequal in shape.

This is quite similar to *Patinopecten caurinus* ranging from Alaska to California, but may be distinguished from the latter at a glance in having small ears and a net-work sculpture covering the surface of the left valve and a smaller apical angle.

Locality: Off Kugurizaka, Asamushi, Moura, Futagojima, Oshima, Karibawasa, Noheji, Yokohama, Ominato, Kawauchi, Wakinozawa and Sts. 7, 9, 10, 16, 17 and 23.

Distribution: Northern Honshu to Kuriles.

Habitat: This species lives in the fourth area of this bay, which was named by Yamamoto (1950). This scallop forms a good bed off Kawauchi and Noheji. Its productions in the past fluctuated annually from about 160 to 30,000 tons.

Family SPONDYLIDAE

35. *Spondylus barbatus* Reeve (Pl. III, Figs. 10, 11)

Japanese name: Umi-giku

Spondylus barbatus Reeve 1856, p. 16; Is. Taki 1951, Pl. 15, Fig. 3; Kira 1954, Pl. 50, Fig. 6.

Spondylus sinensis Sowerby 1847 (non Schreibers), p. 427, Pl. 87, Figs. 32, 33.

Spondylus japonicus Kuroda 1932, app. p. 110.

This species attaches to rocks by the right valve which is deeply concaved. The left valve is rather flattish and arms itself with many spiny projections. The coloration of shell is usually reddish. *S. cruentus* which is the nearest ally, has small and sharply pointed spines on the shell surface.

Locality: Tairadate, Kanita and Kawauchi.

Habitat: Uncommon in the bay. This is found near the shore at the mouth of the bay.

36. *Acesta goliath* Sowerby (Pl. III, Figs. 13, 14, Pl. IV, Fig. 16)

Japanese name: O-hane-gai

Lima goliath Sowerby 1883, p. 30, Pl. 7, Fig. 3; Is. Taki 1951, Pl. 16, Fig. 4.

Acesta goliath Kira 1954, Pl. 52, Fig. 10.

This species attains about 15 cm in height in the fully grown specimen. The shell is white, and its outer surface shows very weak radial stripes which are stronger near the lunule and in the postero-dorsal area than the rest in the young specimen. But in the fully grown the central portion becomes almost smooth. *Acesta smithi* Sowerby is also distributed in Northern Japan, but it has distinct radial ribs all over the surface even in the adult specimen.

Locality: Off Kugurizaka, Asamushi and Noheji.

Distribution: Honshu (down to Sagami Bay) and southern Hokkaido.

Habitat: This is apparently a deep water species, and in fact is the bathymetric records of the collected shells, though not alive, ranging from 30 m to 1417 m.

37. *Promantellum basilanicum hakodatense* (Tokunaga) (Pl. IV, Fig. 7)

Japanese name: Fukure-yukimino

Lima basilanica A. Adams et Reeve 1850, p. 75, Pl. 21, Fig. 6.

Lima hakodatense Tokunaga 1907, p. 64, Pl. 3, Figs. 27a, b.

This white thin shell has numerous radials on its surface, which are somewhat serrated and weakened sideways. The northern form *hakodatense* is smaller than the southern *basilanicum* (Pl. II Figs. 14, 15) in size and has weaker surface radial ribs. But those two forms have no distinction showing the intergradation between them.

Locality: Off Asamushi and Noheji.

Distribution: The Philippines to southern Hokkaido.

Habitat: This lives under the pebbles in the lower tide mark and can swim freely by the action of valves.

Family ANOMIIDAE

38. *Anomia sinensis* Philippi (Pl. III, Figs. 11, 21)

Japanese name: Namima-gashiwa

Anomia sinensis Philippi 1849, p. 130.

Anomia cytaeum Gray 1850, p. 115; Takatsuki 1927, p. 21; Kira 1954, Pl. 46, Fig. 8.

Anomia lischkei Dautzenberg et Fischer 1907, p. 210 Pl. 5, Figs. 8-11; Nomura et Hatai 1932, p. 3; Is. Taki 1954, Pl. 17, Fig. 1.

This pearly saddle oyster is a sessile form adhering to the substrate by the calcareous byssus passing through a large perforation in the right valve. The holeless left valve has three scars inside at the center, while the species of the genus *Monia* (Pl. II Fig. 16) which are the nearest allies, have only two scars. The coloration is brown or white. There are no stripped bands as in that genus. The shape is quite variable owing to the sessile life, so that many names have been proposed for this species, besides those cited above.

Locality: Kanita, Ushirogata, Aomori, Kugurizaka, Asamushi, Gomejima, Moura, Mourajima, Futagojima, Oshima, Noheji, Yokohama, Ominato and Kawauchi.

Distribution: Indochina, China to Hokkaido.

Family OSTREIDAE

39. *Ostrea circumpicta* Pilsbry

Japanese name : Kokeyoromo

Ostrea circumpecta Pilsbry 1904, p. 559, Pl. 11, Figs. 11, 12.

This was confused with *O. nipponica* Seki by Hirase, but they are easily separable in having minute crenulations on both the anterior and posterior of the hinge in this species and in lacking this feature in that species. In the fully grown stage the right valve is generally somewhat orbicular and solid, covered by a brownish periostracum. It is larviparous as in *O. denselamellosa* and *O. edule*.

Locality : Asamushi, Futago and St. 3.

Distribution : Kyushu to Honshu (north to this bay) and Korea.

Habitat : This attaches to rocks by the left valve under the low tidal level.

40. *Crassostrea gigas* (Thunberg) (Pl. III, Fig. 3, Pl. V, Figs. 5, 8, 10, 11)

Japanese name : Magaki

Ostrea gigas Thunberg 1793, p. 140; Takatsuki 1927, p. 22; Nomura et Hatai 1932, p. 3; Is. Taki 1951, Pl. 8, Fig. 5; Kira 1954, Pl. 51, Fig. 3.

Ostrea lapervousi Schrenck 1861, p. 411.

Ostrea tailenwhanensis Crosse 1862, p. 149, Pl. 6, Fig. 6.

This is the most important culture oyster of Japan, the seeds of which are exported to U. S. A. This species is characteristic in having the purplish brown radial zones on the rough surface of the right valve. No crenulation on any of the anterior and posterior sides of the hinge, and the muscle scar is generally tinted deep purple on the chalky white interior. The shape of shell is as variable as that of other oysters.

Locality : Kanita, Okunai, Aomori, Kugurizaka, Asamushi, Gomejima, Moura, Futagojima, Oshima, Noheji, Ominato, Kawauchi and St. 2.

Distribution : China, Japan, Korea and Maritime Prov. of Siberia.

Habitat : This lives in the area of low salinity in bays, attaching to rocks by the left valve in the intertidal zone. The large and solid specimens collected on submarine rocks at Asamushi and other places may be the huge form of this species.

EXPLANATION OF PLATE I

Sketch map of Mutsu Bay with stations where collections were carried out. In addition, collecting the material was made about all along the coast of the bay.

EXPLANATION OF PLATE II

- Figs. 1, 2. *Solemya (Acharax) japonica* Dunker ×2
 Figs. 3, 4. *Solemya (Petrasma) pusilla* Gould ×2
 Fig. 5. *Cnesterium johanni* (Dall) ×0.5
 Fig. 6. *Acila (Truncacila) insignis* (Gould) ×2
 Fig. 7. *Musculus (Modiolarca) neglectus* Kuroda ×1
 Fig. 8. *Nuculana (Thestyleda) yokoyamai* Kuroda ×3
 Figs. 9, 10. *Septifer (Mytilisepta) keenae* Nomura ×1.2
 Figs. 11, 21. *Anomia sinensis* Philippi Fig. 11, ×0.7; Fig. 21, ×1.2
 Fig. 12. *Lithophaga (Leiosolemus) curta* (Lischke) ×1.2
 Fig. 13. *Musculus (Musculista) senhousia* (Benson) ×1.3
 Figs. 14, 15. *Promantellum basilanicum* (A. Adams et Reeve) ×0.6
 Fig. 16. *Monia umbonata* (Gould) ×0.5
 Figs. 17, 18. *Arca miyatensis* Oyama ×1
 Figs. 19, 20. *Striarca (Galactella) symmetrica* (Reeve) ×3
 Figs. 22, 23. *Limopsis tajimae* Sowerby ×1.5
 Fig. 24. *Pseudogrammatodon dalli* (Smith) ×1.5
 Figs. 25, 26. *Glycymeris yessoensis* (Sowerby) ×1.2

EXPLANATION OF PLATE III

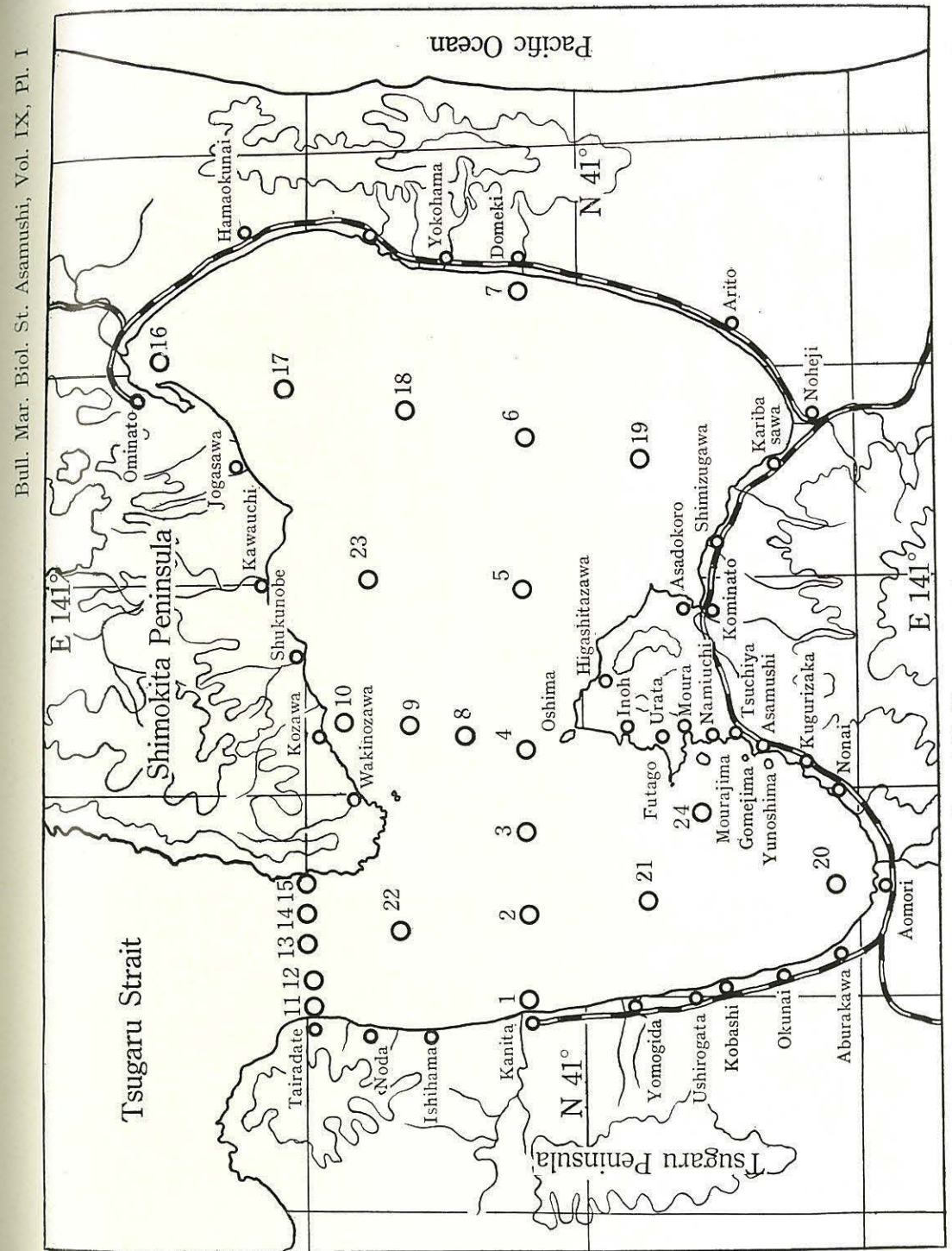
- Figs. 1, 2. *Modiolus difficilis* (Kuroda et Habe) ×0.7
 Fig. 3. *Crassostrea gigas* (Thunberg) ×0.5
 Fig. 4. *Chlamys (Swiftopecten) swifti* (Bernardi) ×0.7
 Figs. 5, 6. *Trichomya hirsula* (Lamarck)
 Figs. 7, 8. *Mytilus edulis* Linné ×0.7
 Fig. 9. *Monia umbonata* (Gould) ×0.8
 Figs. 10, 11. *Spondylus barbatus* Reeve ×1
 Fig. 12. *Modiolus (Modiolusia) elongatus* (Swainson) ×0.5
 Figs. 13, 14. *Acesta goliath* (Sowerby) (young specimen) ×1

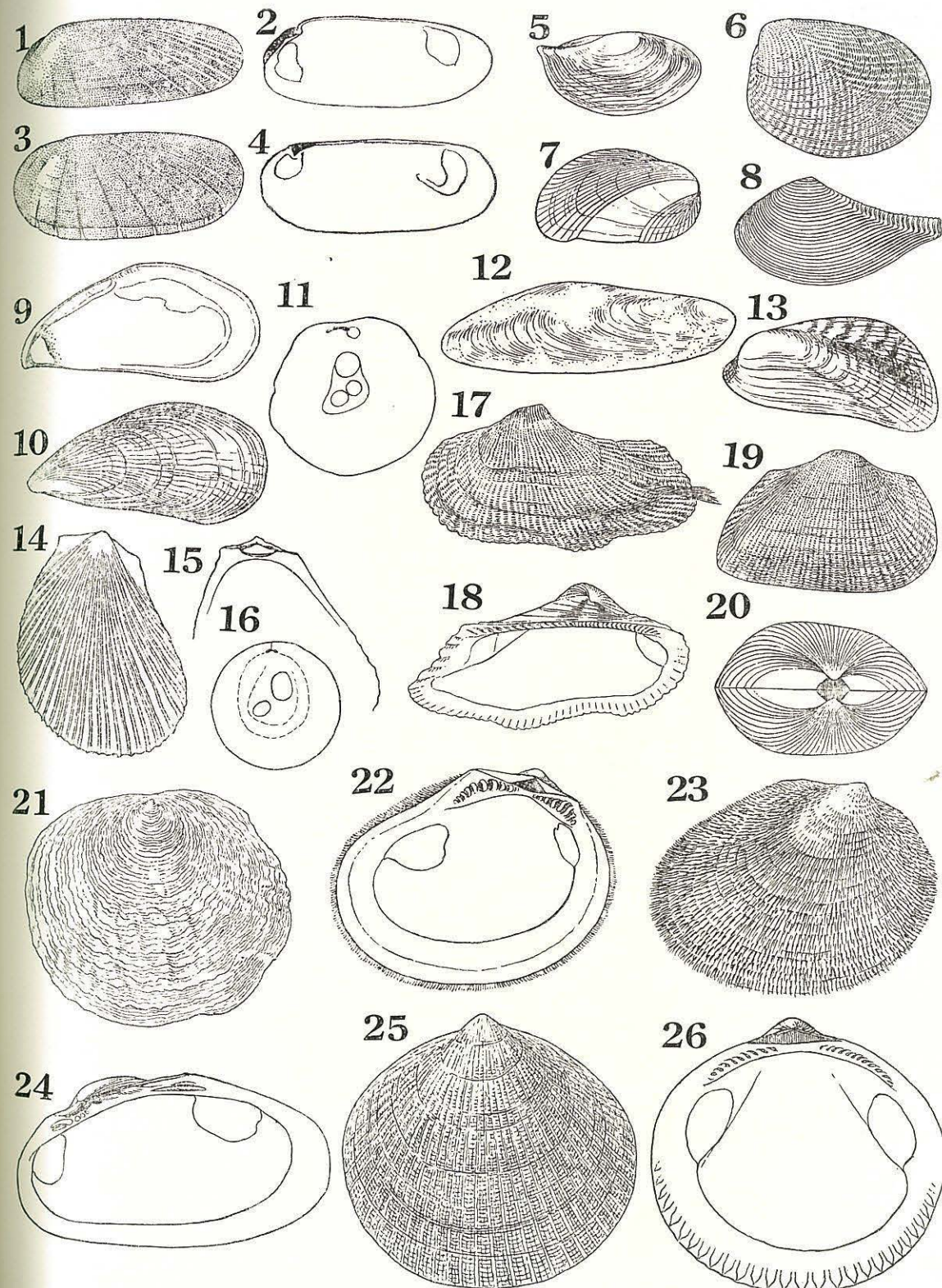
EXPLANATION OF PLATE IV

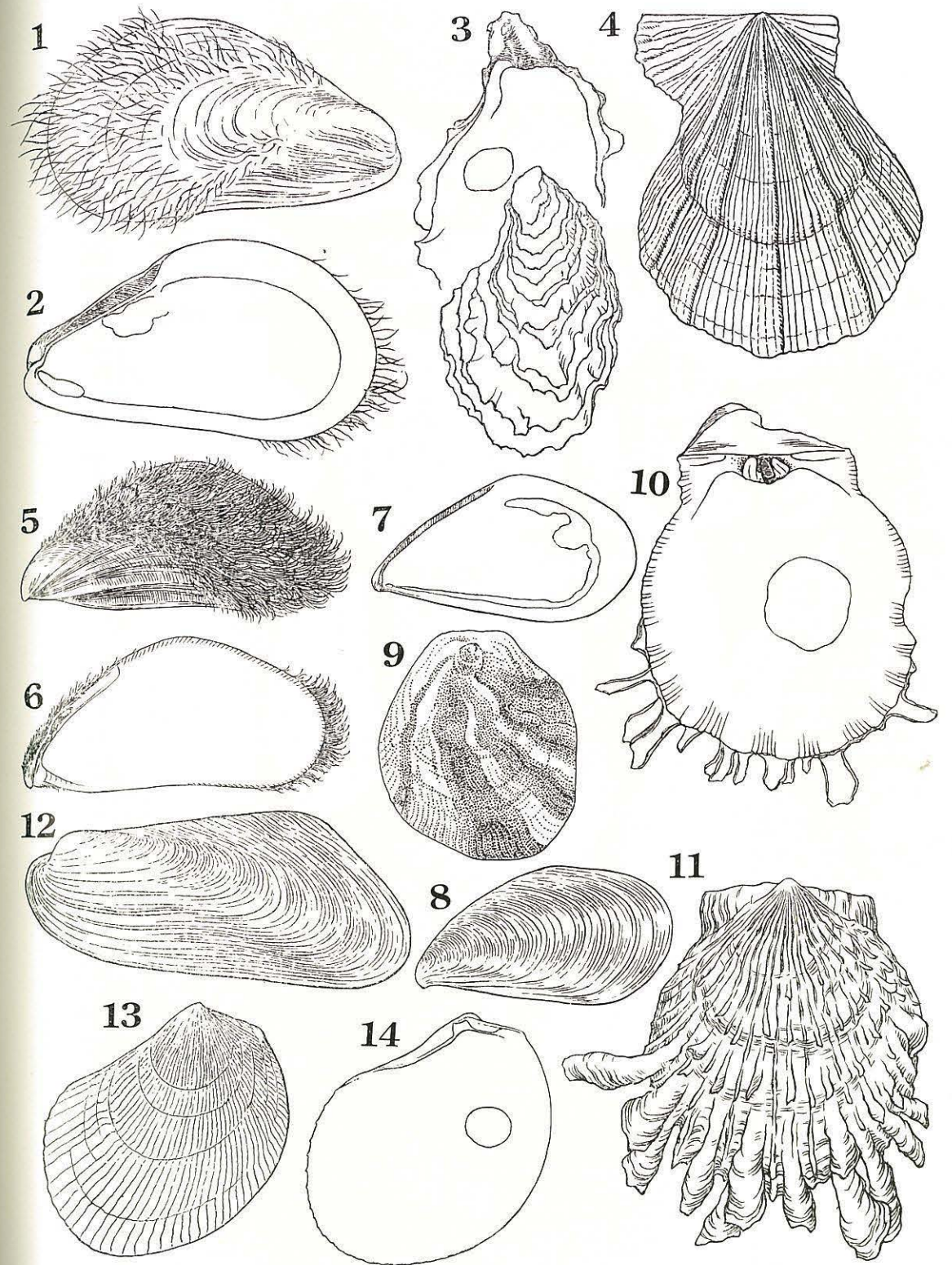
- Fig. 1. *Cnesterium johanni* (Dall) $\times 0.6$
 Fig. 2. *Arca arabica* Philippi $\times 1.3$
 Fig. 3. *Anadara (Scapharca) troscheli* (Dunker) $\times 0.8$
 Fig. 4. *Anadara (Scapharca) subscrenata* (Lischke) $\times 0.6$
 Fig. 5. *Cnesterium notabile* (Yokoyama) $\times 0.8$
 Fig. 6. *Arca boucardi* Jousseau $\times 0.6$
 Fig. 7. *Promantellum basilanicum hakodatense* (Tokunaga) $\times 0.6$
 Fig. 8. *Glycymeris yessoensis* (Sowerby) $\times 0.8$
 Figs. 9, 10. *Chlamys farreri nipponensis* Kuroda $\times 0.5$
 Fig. 11. *Modiolus nipponicus* (Oyama) $\times 0.8$
 Fig. 12. *Septifer (Mytilisepta) keenae* Nomura $\times 1$
 Fig. 13. *Septifer (Mytilisepta) virgatus* (Wiegmann) $\times 0.7$
 Fig. 14. *Mytilus (Crenomytilus) grayanus* Dunker $\times 0.5$
 Fig. 15. *Mytilus crassilesta* Lischke $\times 0.7$
 Fig. 16. *Acesta goliath* (Sowerby) $\times 0.7$
 Fig. 17. *Trichomya hirsuta* (Lamarck) $\times 1$
 Fig. 18. *Atrina (Servatrina) pectinata* (Linné) $\times 0.3$
 Fig. 19. *Mytilus (Crenomytilus) grayanus* Dunker $\times 0.8$
 Fig. 20. *Modiolus (Modiolus) elongatus* (Swainson) $\times 0.4$

EXPLANATION OF PLATE V

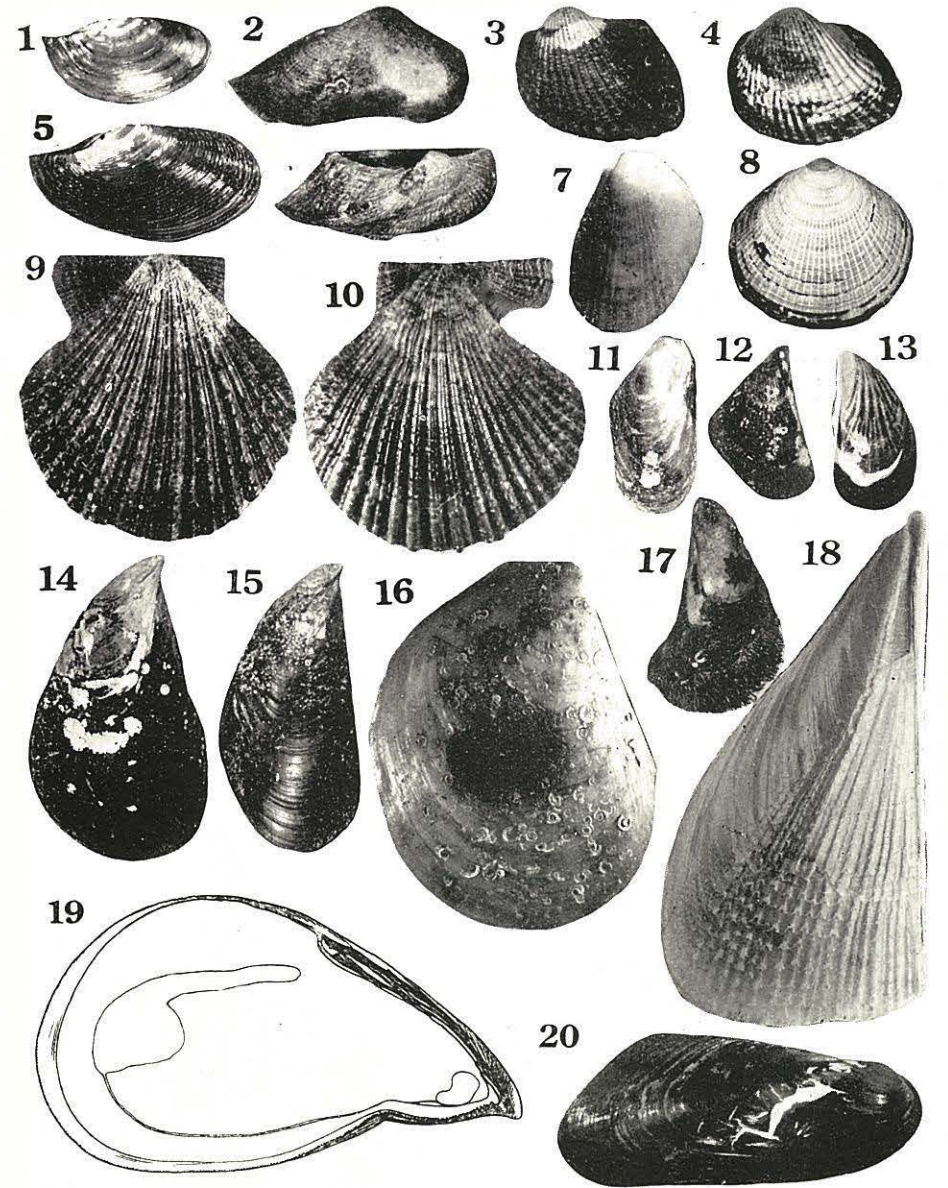
- Figs. 1, 2. *Pecten (Notovola) albicans* (Schroeter) $\times 0.7$
 Fig. 3. *Anadara (Scapharca) broughtonii* (Schrenck) $\times 0.3$
 Figs. 4, 7. *Chlamys (Swiftopecten) swifti* (Bernardi) $\times 0.5$
 Figs. 5, 8. *Crassostrea gigas* (Thunberg) $\times 0.5$
 Fig. 6. *Lithophaga (Leiosolenus) curia* (Lischke) $\times 1.2$
 Fig. 9. *Patinopecten yessoensis* (Jay) $\times 0.5$
 Figs. 10, 11. *Crassostrea gigas* (Thunberg) $\times 0.5$



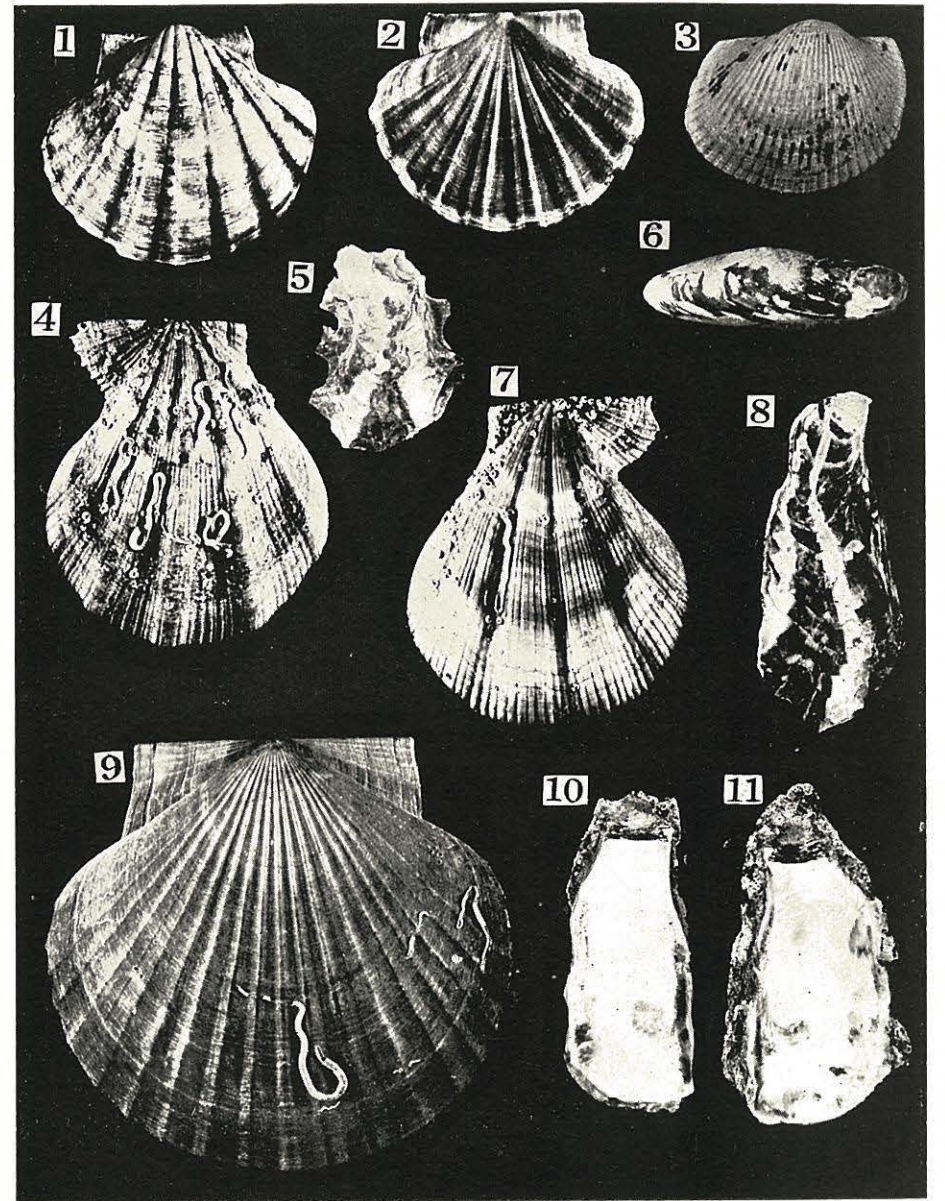




YAMAMOTO, G. and T. HABE: Molluscan Fauna in Mutsu Bay



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