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Upper Bathyal Gastropods of the Pacific Coast of Northern Honshu, Japan, Chiefly Collected by R/V *Wakataka-maru*

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Abstract: Gastropods collected chiefly by the R/V *Wakataka-maru* of the Fisheries Research Agency with an otter trawl off the Pacific coast of northern Honshu, Japan, at depths of 200–1500 m were examined taxonomically based solely on external morphology. About 2740 lots of gastropod specimens from 322 stations were classified into 177 species in 36 families. 103 were identified to species level, whereas 74 could not be identified as any taxa previously known in the northwestern Pacific. Eleven nominal taxa are shown here to be synonyms of others. From a biogeographical point of view, the deep-sea gastropod fauna in the survey area is a predominantly boreal fauna, although at least 18 species exhibit wide geographical distribution southwards along the Pacific coast of southern Japan. Even disregarding the un-named taxa, 40 species are shown to be endemic to the Pacific coast of northern Japan.

Key words: Gastropoda, deep-sea, bathyal, northern Honshu, Japan, taxonomy, distribution.

Introduction

The National Museum of Nature and Science has been carrying out a biological sampling program entitled “Study on Deep-Sea Fauna and Preservation of Deep-Sea Ecosystem” since 1993, to examine and describe the deep-sea fauna of Japan and its adjacent areas. For the fourth term in the program, an area off the Pacific coast of northern Honshu, from the Shimokita Peninsula in Aomori Prefecture to Joban in northern Ibaraki Prefecture, was chosen as the survey area, and intensive samplings were made mainly by the R/V *Wakataka-maru* of the Fisheries Research Agency (FRA) in cooperation with the Tohoku National Fisheries Research Institute, during the years 2005 to 2008. Considerable numbers of gastropods with detailed position and depth data were obtained at more than 300 stations at depths from 150 to 1500 m, corresponding to the upper bathyal zone. The present paper provides basic and preliminary information on the distribution and variation of all gastropods obtained during the present survey, with illustrations of representative specimens, and forms the basis for a comprehensive study of the gastropod fauna of this region. More detailed work on the taxonomy of problematic species and groups using anatomical characters will be the subject of future studies.

Brief review of taxonomical study of gastropods in northeastern Honshu

The taxonomical study of the deep-sea molluscan fauna off the Pacific coast of northern Honshu, including the area known in Japan as “the Sanriku Coast” (from Aomori Prefecture southwards to Miyagi Prefecture), started in the Meiji era (1868–1912) based on specimens collected by gill nets set for the Spiny Dogfish *Squalus acanthias*. By the end of the era, more than one thousand fishing boats were engaged in this shark fishery, and numerous gill nets were set at depths down to 300–400 fathoms (Toba, 1928 in 1928–1935). Shell-bearing molluscs, including gastropods, captured together with the sharks were gathered by local collectors, and part of this material was sent to American malacologists via Yoichiro Hirase in Kyoto for taxonomical studies. This resulted in the description of new species such as *Japelion hirasei* (Pilsbry, 1901), *Neptunea frater* (Pilsbry, 1901), *Clinopegma magna unicum* (Pilsbry, 1905) and *Beringius polynematicus* Pilsbry, 1907. The deep-sea molluscan fauna of this region was then briefly summarized by Genzo Toba (Toba, 1928–1935). Ranji Tiba subsequently continued Toba's activities in the Sanriku area, while studying northern Pacific mollusks more widely, and described many new species himself, including *Volutopsius pallidus* Tiba, 1973, *Colus kujianus* Tiba, 1973, *Plicifusus levis* Tiba, 1980 and *Mohnia iwateana* Tiba, 1981 [= *Mohnia bella* (Ozaki, 1958)]. These were collected from the Sanriku region at bathyal depths by commercial trawlers. Besides the activities of these local collectors, several scientific deep-sea surveys have also been carried out in this area. During the 1906 North Pacific Expedition, the Steamer *Albatross* of the U.S. Commission of Fish and Fisheries visited Japanese waters and trawled at many stations (Dunn, 1996), including two (stations 5050, 5051) off Kinkazan in Miyagi Prefecture, where several new species were discovered, such as *Solariella delicata* (Dall, 1919), *Paraspirotropis simplicissima* (Dall, 1907) and *Aforia sakhalinensis* Bartsch, 1945 [= *Aforia circinata* (Dall, 1873)]. This was followed by Japanese research vessels, such as the R/V *Soyo-maru I*, with discoveries of *Abyssotrophon delicatus* (Kuroda, 1953) from off Ishinomaki and *Parancistrolepis fujitai* (Kuroda, 1931) from off Kinkazan; the R.V. *Soyo-maru III*, with the discovery of *Neptunea nivea* Okutani, 1981 from off Kinkazan, and the Russian vessel R/V *Vitjaz*, with the discoveries of *Solariella tuberculata* Bagirov, 1995 [= *S. delicata* (Dall, 1919)], *Solariella fera* Bagirov, 1995 [= *Margarites margaritiferus* Okutani, 1964], *Abyssotrophon unicus* Egorov, 1993 and *A. convexus* Egorov, 1994 [both = *A. delicatus* (Kuroda, 1953)] off Iwate Prefecture. Although modern Japanese research vessels, such as the R/Vs *Tansei-maru* and *Hakuho-maru*, have carried out deep-sea research surveys repeatedly in this area in recent years, no significant results have been published yet based on the material they obtained, except for the works by Ishikawa (1970) who reported 13 species of gastropods off the Sanriku Coast at depths of 492–504 m and 1230–1250 m obtained by R/V *Tansei-maru*, and Okutani and Fujikura (2002) who reported molluscs associated with the chemosynthesis-based communities in Japan Trench at abyssal to hadal depths. Additional local faunal studies in this area include those by Ishiyama (1974), who recorded 12 gastropods from off Hachinohe in Aomori Prefecture at depths of 220 m and deeper, and Nemoto and Akimoto (1990), who listed ten gastropods from "bathyal depths" off Joban in Fukushima Prefecture. On the other hand, rather detailed taxonomical studies have been carried out in the sea area Kashima-nada, which abuts the southernmost part of the present survey area, based mainly on specimens gathered by local collectors from commercial bottom trawls. These studies include Shikama (1962), who described 12 new gastropod species and subspecies, and some other occasional papers including Habe and Ito (1965a). Okutani (1964) described six new gastropod species and subspecies from the Kashima-nada, based on material obtained by the R/V *Soyo-maru III*. Despite all this, however, there has been no comprehensive study to date of the bathyal gastropods of northeastern Japan, and there is thus a considerable degree of confusion in their taxonomy.

Materials and Methods

Most of the material examined in the present study was obtained during the research cruises of the FRA R/V *Wakataka-maru* off the Pacific coast of northern Honshu, in an area from 36.5°N to 41°N at depths of from 150 m to 1500 m by means of otter trawls. Survey stations were basically sited along 12 lines (lines "A" off Hachinohe in Aomori Prefecture though "H" off Hitachi in Ibaraki Prefecture: Fig. 1), at depths of 150, 210, 250, 280, 310, 350, 380, 410, 425, 450, 480, 510, 550, 650, 750 and 900 m, although some stations were omitted from several survey lines (e.g.

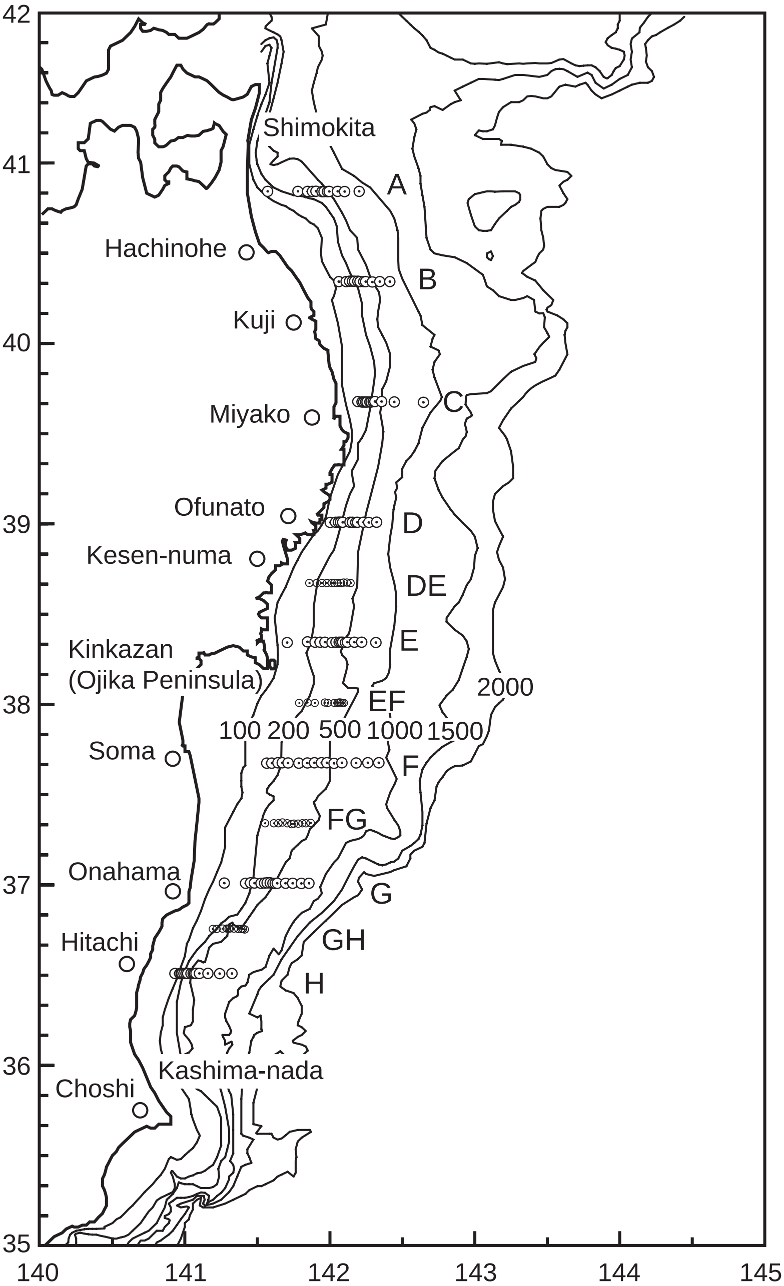


Fig. 1. A map showing the survey area and the sampling lines, with the major place names in northern Honshu that mentioned in the text.

150–210 m and 550–900 m from lines “DE”, “EF”, “FG” and “GH”). Deep-sea trawls beyond 900 m (at 1200 and 1500 m) were occasionally added on some lines, and dredge operations were also carried out at some stations (Fig. 2 for the years 2005–2007). Each station number is thus composed of the abbreviated name of vessel (e.g. WA: *Wakataka-maru*), followed by the year, survey line (A–H) and the depth. Where “D” is present at the end, this indicates dredge operation. Additional samples collected by earlier surveys of the R/V *Wakataka-maru* and also by Hyogo Prefecture’s T/S *Tanshu-maru*, which was chartered by the FRA for the same research program

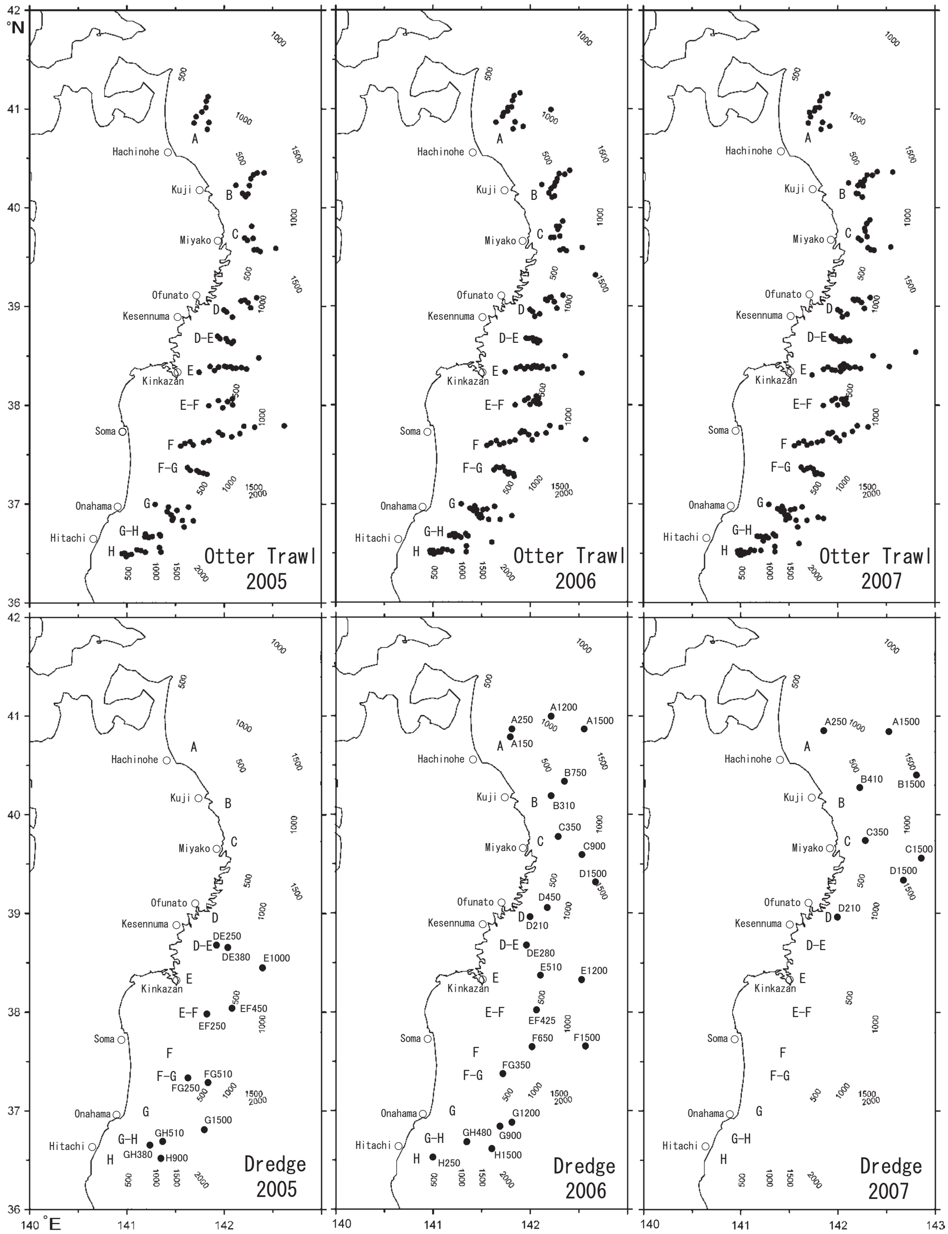


Fig. 2. A map showing the actual sampling sites by R/V *Wakataka-maru* during the years 2005–2007.

for bottom fish resources, were also examined. Detailed positional and bathymetrical data of these stations are summarized in Table 1. Finally, part of the material obtained by research cruises of the R/Vs *Tansei-maru* and *Hakuho-maru* of the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) from the same area at greater depths, down to the bottom of the Japan Trench, were examined for comparison, although this material is to be treated in detail in a separate paper.

Live-collected specimens were primarily fixed in a 10% seawater-formalin solution buffered by sodium tetraborate decahydrate for at least 48 hours, washed thoroughly in seawater or fresh water, and preserved in 75% ethanol. In order to save depository space, however, some of the larger specimens were preserved as dry shells by discarding the soft parts. All the specimens are

Table 1. Positive stations of R/V *Wakataka-maru* (WA) and T/S *Tanshu-maru* (TS) Cruises. B: beam trawl; D: dredge; O: otter trawl.

St. no.	Gear	Date	Position in	Position out	Depth (m)	Bottom Temp (˚C)
TS96-K2	O	20 April 1996	38˚02.6´N, 142˚40.9´E	38˚02.1´N, 142˚41.1´E	1455–1451	—
WA9101-3	B	20 October 1991	40˚45.3´N, 141˚57.5´E	40˚44.8´N, 141˚58.5´E	200–210	—
WA9101-4	B	20 October 1991	40˚42.0´N, 141˚55.3´E	40˚41.2´N, 141˚55.2´E	137–135	—
WA9201-2	B	13 February 1992	40˚43.7´N, 141˚44.4´E	40˚43.8´N, 141˚45.7´E	100–101	8.8
WA9201-4	B	12 February 1992	40˚50.9´N, 141˚42.6´E	40˚51.1´N, 141˚41.9´E	200–202	9.0
WA9201-6	B	12 February 1992	40˚54.1´N, 141˚44.6´E	40˚54.1´N, 141˚45.2´E	300–310	5.8
WA9203-B18	D	8 July 1992	40˚36.5´N, 142˚06.2´E	40˚36.8´N, 142˚06.0´E	451–455	2.8
WA9206-A41	D	5 November 1992	40˚40.2´N, 141˚37.6´E	40˚40.5´N, 141˚37.3´E	68–69	15.4
WA9206-A44	D	5 November 1992	40˚49.6´N, 141˚50.6´E	40˚49.7´N, 141˚50.2´E	205–200	8.4
WA9301-A64	D	20 February 1993	40˚50.5´N, 141˚43.5´E	40˚50.9´N, 141˚43.3´E	204–203	8.4
WA9303-K12	D	29 May 1993	40˚13.6´N, 142˚07.5´E	40˚13.3´N, 142˚07.6´E	155–156	9.1
WA9308-S12	D	7 August 1993	39˚16.1´N, 142˚07.7´E	39˚16.2´N, 142˚07.9´E	248–250	3.7
WA9308-S13	D	7 August 1993	39˚16.3´N, 142˚09.6´E	39˚16.0´N, 142˚09.5´E	307–307	2.1
WA9312-K35	D	3 October 1993	40˚15.0´N, 142˚10.8´E	40˚14.9´N, 142˚11.2´E	251–268	1.7
WA95-OT5	O	21 May 1995	37˚54.1´N, 142˚10.1´E	37˚57.8´N, 142˚09.9´E	706–706	2.6
WA95-B1000	O	6 November 1995	40˚19.3´N, 142˚28.4´E	40˚19.3´N, 142˚28.5´E	991–1000	2.6
WA95-C800	O	26 October 1995	40˚00.1´N, 142˚31.4´E	39˚55.5´N, 142˚36.2´E	806–822	—
WA95-E600	O	27 October 1995	39˚04.2´N, 142˚14.1´E	39˚03.4´N, 142˚14.2´E	612–616	3.5
WA05-DE250	O	19 November 2005	38˚42.1´N, 141˚56.0´E	38˚40.5´N, 141˚55.4´E	252–251	6.4
WA05-DE250D	D	19 November 2005	38˚40.6´N, 141˚55.3´E	38˚40.2´N, 141˚55.2´E	249–249	—
WA05-DE280	O	19 November 2005	38˚40.5´N, 141˚57.5´E	38˚42.1´N, 141˚58.0´E	281–282	5.4
WA05-DE310	O	19 November 2005	38˚40.2´N, 141˚58.9´E	38˚41.8´N, 141˚59.5´E	306–309	4.3
WA05-DE350	O	20 November 2005	38˚40.6´N, 142˚01.2´E	38˚38.9´N, 142˚00.9´E	347–345	3.1
WA05-DE380	O	19 November 2005	38˚38.9´N, 142˚02.3´E	38˚40.5´N, 142˚02.4´E	376–377	3.2
WA05-DE380D	D	19 November 2005	38˚39.1´N, 142˚02.2´E	38˚38.6´N, 142˚02.1´E	375–373	—
WA05-DE410	O	20 November 2005	38˚39.3´N, 142˚03.4´E	38˚40.9´N, 142˚03.5´E	407–404	3.3
WA05-DE425	O	20 November 2005	38˚39.7´N, 142˚03.9´E	38˚41.3´N, 142˚04.3´E	421–423	3.3
WA05-DE450	O	20 November 2005	38˚37.7´N, 142˚04.5´E	38˚39.3´N, 142˚04.8´E	451–447	3.3
WA05-DE480	O	21 November 2005	38˚39.0´N, 142˚05.8´E	38˚40.6´N, 142˚06.1´E	473–477	3.3
WA05-DE510	O	21 November 2005	38˚39.0´N, 142˚07.3´E	38˚37.9´N, 142˚07.2´E	511–511	3.4
WA05-E410	O	25 October 2005	38˚23.7´N, 142˚02.6´E	38˚22.1´N, 142˚03.3´E	407–409	3.3
WA05-E425	O	25 October 2005	38˚24.1´N, 142˚03.0´E	38˚00.2´N, 142˚02.6´E	424–425	3.9
WA05-E450	O	25 October 2005	38˚23.6´N, 142˚04.0´E	38˚25.2´N, 142˚03.7´E	448–452	3.9
WA05-E480	O	25 October 2005	38˚22.6´N, 142˚05.3´E	38˚20.9´N, 142˚06.0´E	482–483	3.9
WA05-E510	O	25 October 2005	38˚22.5´N, 142˚06.3´E	38˚23.6´N, 142˚05.8´E	514–505	3.8
WA05-E550	O	26 October 2005	38˚22.6´N, 142˚07.3´E	38˚23.6´N, 142˚07.5´E	545–561	3.9
WA05-E650	O	26 October 2005	38˚23.0´N, 142˚10.7´E	38˚21.8´N, 142˚10.6´E	658–657	3.6
WA05-E750	O	26 October 2005	38˚22.1´N, 142˚13.9´E	38˚23.1´N, 142˚14.5´E	753–758	3.4
WA05-E900	O	26 October 2005	38˚28.9´N, 142˚21.4´E	38˚29.7´N, 142˚21.6´E	900–904	3.1
WA05-E1000D	D	26 October 2005	38˚26.7´N, 142˚23.8´E	38˚26.4´N, 142˚23.7´E	1005–1004	—
WA05-EF250	O	17 November 2005	37˚59.8´N, 141˚50.5´E	38˚01.0´N, 141˚51.7´E	252–251	7.9
WA05-EF250D	D	17 November 2005	37˚58.7´N, 141˚49.3´E	37˚59.0´N, 141˚49.4´E	259–253	—
WA05-EF280	O	17 November 2005	38˚02.9´N, 141˚56.4´E	38˚04.4´N, 141˚56.0´E	285–278	4.4
WA05-EF310	O	17 November 2005	38˚02.5´N, 141˚59.4´E	38˚04.0´N, 141˚58.7´E	317–314	3.7
WA05-EF350	O	17 November 2005	37˚58.5´N, 141˚59.1´E	38˚00.1´N, 141˚59.8´E	358–359	3.7
WA05-EF380	O	17 November 2005	38˚02.3´N, 142˚02.1´E	38˚03.7´N, 142˚02.4´E	382–376	3.6
WA05-EF410	O	18 November 2005	37˚43.1´N, 141˚53.9´E	38˚05.0´N, 142˚03.7´E	412–411	3.7
WA05-EF425	O	18 November 2005	37˚44.3´N, 141˚54.8´E	38˚01.2´N, 142˚03.8´E	433–418	3.6
WA05-EF450	O	18 November 2005	38˚04.0´N, 142˚05.1´E	38˚02.2´N, 142˚04.9´E	454–454	3.7
WA05-EF450D	D	18 November 2005	38˚02.2´N, 142˚04.8´E	38˚02.6´N, 142˚04.9´E	452–454	—
WA05-EF480	O	16 November 2005	38˚00.4´N, 142˚05.2´E	37˚58.9´N, 142˚04.1´E	487–486	3.7
WA05-F350	O	4 November 2005	37˚37.5´N, 141˚47.3´E	37˚39.2´N, 141˚47.4´E	355–351	3.9
WA05-F380	O	4 November 2005	37˚38.6´N, 141˚50.6´E	37˚40.3´N, 141˚50.7´E	387–379	3.5
WA05-F410	O	4 November 2005	37˚43.1´N, 141˚53.9´E	37˚44.8´N, 141˚53.5´E	411–411	4.0
WA05-F425	O	27 October 2005	37˚44.3´N, 141˚54.8´E	37˚42.5´N, 141˚55.0´E	424–424	4.1
WA05-F450	O	27 October 2005	37˚43.6´N, 141˚56.6´E	37˚45.3´N, 141˚56.4´E	449–449	4.2
WA05-F480	O	27 October 2005	37˚41.9´N, 141˚59.0´E	37˚40.2´N, 141˚59.0´E	484–480	4.4
WA05-F510	O	27 October 2005	37˚39.4´N, 142˚01.2´E	37˚38.2´N, 142˚01.1´E	508–506	4.3

Table 1. (Continued)

St. no.	Gear	Date	Position in	Position out	Depth (m)	Bottom Temp (˚C)
WA05-F550	O	27 October 2005	37˚41.0´N, 142˚04.7´E	37˚42.0´N, 142˚04.0´E	551–546	4.2
WA05-F650	O	28 October 2005	37˚42.8´N, 142˚09.7´E	37˚43.9´N, 142˚09.2´E	652–649	3.8
WA05-F750	O	28 October 2005	37˚47.4´N, 142˚12.2´E	37˚48.4´N, 142˚11.8´E	749–744	3.5
WA05-F900	O	28 October 2005	37˚46.7´N, 142˚18.8´E	37˚45.7´N, 142˚19.1´E	900–904	3.3
WA05-F1200	O	28 October 2005	37˚47.6´N, 142˚37.1´E	37˚47.4´N, 142˚37.2´E	1196–1196	2.7
WA05-FG250	O	14 November 2005	37˚22.2´N, 141˚37.4´E	37˚20.4´N, 141˚37.6´E	251–254	8.7
WA05-FG250D	D	14 November 2005	37˚19.9´N, 141˚37.7´E	37˚20.0´N, 141˚37.4´E	255–253	—
WA05-FG280	O	15 November 2005	37˚20.5´N, 141˚39.2´E	37˚22.1´N, 141˚39.2´E	276–279	6.9
WA05-FG310	O	15 November 2005	37˚21.5´N, 141˚41.2´E	37˚19.7´N, 141˚41.2´E	311–312	5.8
WA05-FG350	O	14 November 2005	37˚20.3´N, 141˚43.2´E	37˚22.0´N, 141˚43.1´E	352–346	5.2
WA05-FG380	O	15 November 2005	37˚19.5´N, 141˚44.6´E	37˚21.1´N, 141˚44.8´E	383–383	4.3
WA05-FG410	O	14 November 2005	37˚18.9´N, 141˚45.8´E	37˚17.3´N, 141˚45.5´E	411–410	4.2
WA05-FG425	O	15 November 2005	37˚19.6´N, 141˚46.5´E	37˚17.9´N, 141˚46.2´E	426–426	4.0
WA05-FG450	O	14 November 2005	37˚18.8´N, 141˚47.2´E	37˚20.5´N, 141˚47.5´E	450–446	3.9
WA05-FG480	O	14 November 2005	37˚18.1´N, 141˚49.4´E	37˚16.5´N, 141˚48.9´E	480–480	3.8
WA05-FG510	O	15 November 2005	37˚17.7´N, 141˚50.3´E	37˚16.5´N, 141˚50.0´E	513–511	3.8
WA05-FG510D	D	15 November 2005	37˚16.9´N, 141˚50.0´E	37˚17.3´N, 141˚50.2´E	516–515	—
WA05-G150	O	29 October 2005	36˚59.8´N, 141˚17.4´E	37˚01.3´N, 141˚17.8´E	151–150	11.1
WA05-G210	O	29 October 2005	36˚58.3´N, 141˚25.6´E	36˚57.0´N, 141˚24.8´E	211–210	8.0
WA05-G280	O	29 October 2005	36˚55.4´N, 141˚24.9´E	36˚54.0´N, 141˚24.2´E	277–279	4.9
WA05-G350	O	3 November 2005	36˚56.3´N, 141˚30.9´E	36˚58.0´N, 141˚31.5´E	373–356	4.0
WA05-G380	O	3 November 2005	36˚53.4´N, 141˚27.4´E	36˚54.6´N, 141˚28.9´E	384–376	4.1
WA05-G425	O	9 November 2005	36˚53.2´N, 141˚29.2´E	36˚52.1´N, 141˚27.7´E	427–418	4.0
WA05-G450	O	9 November 2005	36˚51.6´N, 141˚28.7´E	36˚52.8´N, 141˚30.0´E	454–448	4.0
WA05-G510	O	9 November 2005	36˚51.6´N, 141˚30.3´E	36˚52.4´N, 141˚31.4´E	507–509	4.0
WA05-G550	O	3 November 2005	36˚58.2´N, 141˚37.9´E	36˚59.1´N, 141˚38.6´E	560–557	3.8
WA05-G650	O	9 November 2005	36˚50.2´N, 141˚34.2´E	36˚50.9´N, 141˚35.2´E	644–650	3.7
WA05-G750	O	10 November 2005	36˚46.2´N, 141˚35.4´E	36˚45.6´N, 141˚34.8´E	750–750	3.4
WA05-G900	O	10 November 2005	36˚49.9´N, 141˚41.0´E	36˚49.3´N, 141˚40.5´E	901–901	3.2
WA05-G1500D	D	10 November 2005	36˚48.4´N, 141˚47.7´E	36˚48.6´N, 141˚48.2´E	1498	2.4
WA05-GH250	O	11 November 2005	36˚41.9´N, 141˚11.4´E	36˚40.5´N, 141˚10.2´E	251–249	7.6
WA05-GH280	O	11 November 2005	36˚40.1´N, 141˚11.1´E	36˚41.5´N, 141˚12.3´E	278–278	8.0
WA05-GH310	O	11 November 2005	36˚40.3´N, 141˚12.4´E	36˚41.7´N, 141˚13.6´E	308–309	5.3
WA05-GH350	O	11 November 2005	36˚39.7´N, 141˚13.5´E	36˚41.0´N, 141˚15.0´E	344–351	4.3
WA05-GH380	O	12 November 2005	36˚40.4´N, 141˚15.6´E	36˚39.0´N, 141˚14.5´E	376–381	4.2
WA05-GH380D	D	12 November 2005	36˚39.0´N, 141˚14.3´E	36˚39.3´N, 141˚14.6´E	378–373	—
WA05-GH410	O	13 November 2005	36˚37.5´N, 141˚14.0´E	36˚38.3´N, 141˚15.7´E	417–413	4.1
WA05-GH425	O	13 November 2005	36˚39.5´N, 141˚17.3´E	36˚40.9´N, 141˚18.3´E	425–422	4.0
WA05-GH450	O	13 November 2005	36˚41.6´N, 141˚20.1´E	36˚40.2´N, 141˚19.0´E	454–452	4.1
WA05-GH480	O	13 November 2005	36˚40.8´N, 141˚20.8´E	36˚42.3´N, 141˚21.6´E	482–479	4.1
WA05-GH510	O	11 November 2005	36˚40.3´N, 141˚21.6´E	36˚41.3´N, 141˚22.2´E	509–511	4.1
WA05-GH510D	D	11 November 2005	36˚41.1´N, 141˚22.0´E	36˚40.9´N, 141˚21.9´E	512–508	—
WA05-H150	O	30 October 2005	36˚29.9´N, 140˚57.0´E	36˚31.3´N, 140˚58.1´E	154–156	10.9
WA05-H310	O	30 October 2005	36˚29.0´N, 140˚59.5´E	36˚30.5´N, 141˚00.4´E	311–306	4.5
WA05-H350	O	31 October 2005	36˚28.1´N, 140˚59.6´E	36˚29.2´N, 141˚00.3´E	352–352	4.5
WA05-H380	O	1 November 2005	36˚29.1´N, 141˚00.8´E	36˚30.0´N, 141˚01.7´E	380–384	4.0
WA05-H450	O	31 October 2005	36˚29.5´N, 141˚02.7´E	36˚30.3´N, 141˚03.6´E	450–457	4.1
WA05-H480	O	1 November 2005	36˚32.3´N, 141˚06.2´E	36˚33.1´N, 141˚07.3´E	481–476	4.1
WA05-H510	O	31 October 2005	36˚30.6´N, 141˚05.2´E	36˚31.4´N, 141˚06.1´E	507–510	4.1
WA05-H650	O	2 November 2005	36˚30.8´N, 141˚11.5´E	36˚31.6´N, 141˚12.6´E	661–647	3.7
WA05-H750	O	2 November 2005	36˚33.6´N, 141˚20.1´E	36˚34.1´N, 141˚21.2´E	748–758	3.5
WA05-H900	O	2 November 2005	36˚30.9´N, 141˚21.0´E	36˚30.4´N, 141˚20.3´E	900–899	3.2
WA05-H900D	D	2 November 2005	36˚30.9´N, 141˚21.0´E	36˚31.1´N, 141˚21.3´E	904–893	—
WA06-A150	O	9 October 2006	40˚47.6´N, 141˚49.4´E	40˚46.9´N, 141˚51.1´E	155–149	13.7
WA06-A150D	D	9 October 2006	40˚46.5´N, 141˚51.9´E	40˚46.5´N, 141˚52.2´E	146–147	—
WA06-A250D	D	10 October 2006	40˚51.4´N, 141˚50.9´E	40˚51.3´N, 141˚51.1´E	267–266	—
WA06-A310	O	6 October 2006	40˚49.0´N, 141˚55.5´E	40˚49.9´N, 141˚54.0´E	306–298	2.8
WA06-A350	O	11 October 2006	40˚55.3´N, 141˚42.9´E	40˚55.3´N, 141˚43.8´E	360–364	3.6

Table 1. (Continued)

St. no.	Gear	Date	Position in	Position out	Depth (m)	Bottom Temp (˚C)
WA06-A410	O	11 October 2006	40˚57.3´N, 141˚43.5´E	40˚57.8´N, 141˚43.0´E	409–421	2.7
WA06-A450	O	10 October 2006	40˚58.3´N, 141˚45.9´E	40˚58.9´N, 141˚45.4´E	466–474	2.9
WA06-A510	O	10 October 2006	41˚00.5´N, 141˚46.2´E	41˚00.0´N, 141˚46.9´E	511–510	3.0
WA06-A650	O	11 October 2006	41˚04.8´N, 141˚49.0´E	41˚04.6´N, 141˚49.2´E	663–662	3.3
WA06-A1200	O	12 October 2006	40˚56.0´N, 142˚15.7´E	40˚55.8´N, 142˚16.1´E	1182–1188	—
WA06-A1200D	D	12 October 2006	40˚59.3´N, 142˚12.7´E	40˚58.9´N, 142˚12.9´E	1202–1201	—
WA06-B150	O	14 October 2006	40˚13.6´N, 142˚07.1´E	40˚15.1´N, 142˚06.6´E	153–151	13.7
WA06-B310	O	14 October 2006	40˚11.3´N, 142˚12.8´E	40˚13.1´N, 142˚12.4´E	304–308	3.4
WA06-B310D	D	14 October 2006	40˚09.9´N, 142˚13.2´E	40˚10.0´N, 142˚13.2´E	305–305	—
WA06-B450	O	13 October 2006	40˚14.9´N, 142˚15.3´E	40˚13.3´N, 142˚16.1´E	461–475	2.8
WA06-B650	O	13 October 2006	40˚20.4´N, 142˚17.8´E	40˚19.4´N, 142˚18.4´E	644–654	3.3
WA06-C350	O	15 October 2006	39˚46.5´N, 142˚17.0´E	39˚48.1´N, 142˚17.0´E	362–355	2.7
WA06-C350D	D	15 October 2006	39˚48.9´N, 142˚17.1´E	39˚49.0´N, 142˚17.2´E	357–364	—
WA06-C450	O	16 October 2006	39˚42.3´N, 142˚18.2´E	39˚40.7´N, 142˚17.7´E	482–454	3.0
WA06-C550	O	5 October 2006	39˚33.8´N, 142˚18.5´E	39˚35.0´N, 142˚18.5´E	ND–558.0	3.5
WA06-C650	O	5 October 2006	39˚34.6´N, 142˚20.3´E	39˚35.6´N, 142˚20.4´E	663–649	3.5
WA06-C750	O	5 October 2006	39˚33.5´N, 142˚22.3´E	39˚34.2´N, 142˚22.5´E	750–749	3.3
WA06-D210D	D	19 October 2006	38˚56.4´N, 141˚59.3´E	38˚56.2´N, 141˚59.2´E	213–214	—
WA06-D450D	D	17 October 2006	39˚02.4´N, 142˚10.5´E	39˚02.7´N, 142˚10.6´E	460–460	—
WA06-D550	O	18 October 2006	39˚05.3´N, 142˚12.8´E	39˚04.1´N, 142˚12.7´E	548–551	3.2
WA06-D650	O	18 October 2006	39˚02.4´N, 142˚14.8´E	39˚03.6´N, 142˚14.9´E	646–663	3.2
WA06-D900	O	17 October 2006	39˚06.5´N, 142˚20.2´E	39˚05.8´N, 142˚20.2´E	909–ND	2.9
WA06-D1500	O	17 October 2006	39˚12.1´N, 142˚42.1´E	39˚11.9´N, 142˚42.2´E	1492–1509	—
WA06-DE280	O	23 November 2006	38˚40.5´N, 141˚57.4´E	38˚42.2´N, 141˚58.0´E	282–283	3.4
WA06-DE280D	D	23 November 2006	38˚42.9´N, 141˚58.3´E	38˚43.1´N, 141˚58.4´E	284–285	—
WA06-DE310	O	24 November 2006	38˚40.4´N, 141˚59.0´E	38˚41.7´N, 141˚59.8´E	306–315	3.4
WA06-DE350	O	23 November 2006	38˚40.7´N, 142˚01.3´E	38˚38.8´N, 142˚00.9´E	347–345	3.2
WA06-DE380	O	23 November 2006	38˚38.7´N, 142˚02.2´E	38˚40.4´N, 142˚02.4´E	376–378	3.2
WA06-DE410	O	24 November 2006	38˚39.3´N, 142˚03.4´E	38˚40.9´N, 142˚03.7´E	408–408	3.1
WA06-DE425	O	23 November 2006	38˚39.6´N, 142˚03.9´E	38˚40.9´N, 142˚04.3´E	421–424	3.2
WA06-DE450	O	24 November 2006	38˚37.7´N, 142˚04.5´E	38˚39.2´N, 142˚04.7´E	450–446	3.2
WA06-DE480	O	23 November 2006	38˚38.9´N, 142˚05.7´E	38˚39.8´N, 142˚05.9´E	476–476	3.4
WA06-E150	O	5 November 2006	38˚20.0´N, 141˚44.5´E	38˚18.2´N, 141˚44.1´E	154–151	13.0
WA06-E210	O	5 November 2006	38˚22.2´N, 141˚51.3´E	38˚24.0´N, 141˚51.6´E	209–212	9.1
WA06-E250	O	5 November 2006	38˚23.3´N, 141˚53.9´E	38˚21.6´N, 141˚54.1´E	242–244	—
WA06-E280	O	4 November 2006	38˚21.8´N, 141˚56.4´E	38˚23.6´N, 141˚56.6´E	275–275	4.2
WA06-E310	O	4 November 2006	38˚23.2´N, 141˚58.2´E	38˚21.5´N, 141˚58.4´E	305–309	3.6
WA06-E350	O	4 November 2006	38˚22.2´N, 142˚00.7´E	38˚24.0´N, 142˚00.3´E	349–350	3.5
WA06-E380	O	4 November 2006	38˚23.4´N, 142˚01.6´E	38˚21.9´N, 142˚02.3´E	377–382	3.3
WA06-E410	O	3 November 2006	38˚23.7´N, 142˚02.6´E	38˚22.1´N, 142˚03.3´E	406–409	3.3
WA06-E425	O	4 November 2006	38˚24.2´N, 142˚03.0´E	38˚24.9´N, 142˚02.7´E	423–423	3.4
WA06-E450	O	3 November 2006	38˚23.5´N, 142˚04.0´E	38˚25.2´N, 142˚03.6´E	448–451	3.6
WA06-E480	O	3 November 2006	38˚22.7´N, 142˚05.2´E	38˚21.2´N, 142˚05.9´E	480–484	3.4
WA06-E510	O	3 November 2006	38˚22.6´N, 142˚06.3´E	38˚23.9´N, 142˚05.7´E	514–506	3.4
WA06-E510D	D	3 November 2006	38˚23.8´N, 142˚05.6´E	38˚24.1´N, 142˚05.4´E	503–498	—
WA06-E550	O	3 November 2006	38˚23.4´N, 142˚07.3´E	38˚22.3´N, 142˚07.3´E	553–545	3.4
WA06-E650	O	2 November 2006	38˚21.7´N, 142˚10.6´E	38˚22.9´N, 142˚10.7´E	656–660	9.6
WA06-E750	O	2 November 2006	38˚23.1´N, 142˚14.5´E	38˚22.4´N, 142˚14.1´E	758–756	3.2
WA06-E900	O	2 November 2006	38˚29.8´N, 142˚21.6´E	38˚29.1´N, 142˚21.5´E	905–908	2.8
WA06-E1200	O	2 November 2006	38˚23.4´N, 142˚31.8´E	38˚23.8´N, 142˚31.9´E	1202–1206	—
WA06-E1200D	D	2 November 2006	38˚19.3´N, 142˚31.7´E	38˚19.4´N, 142˚31.7´E	1214–1213	—
WA06-EF250	O	21 November 2006	37˚59.9´N, 141˚50.3´E	38˚01.3´N, 141˚51.9´E	250–250	8.5
WA06-EF280	O	21 November 2006	38˚02.7´N, 141˚56.5´E	38˚04.5´N, 141˚56.0´E	283–277	9.6
WA06-EF310	O	21 November 2006	38˚04.0´N, 141˚58.7´E	38˚02.5´N, 141˚59.3´E	313–313	8.6
WA06-EF350	O	22 November 2006	38˚00.2´N, 141˚59.9´E	37˚58.7´N, 141˚59.3´E	356–357	8.1
WA06-EF380	O	22 November 2006	38˚02.3´N, 142˚02.1´E	38˚04.0´N, 142˚02.5´E	378–373	4.1
WA06-EF410	O	22 November 2006	38˚05.3´N, 142˚03.7´E	38˚03.6´N, 142˚03.7´E	410–409	3.9
WA06-EF425	O	21 November 2006	38˚00.9´N, 142˚03.8´E	38˚02.7´N, 142˚04.1´E	414–431	3.9

Table 1. (Continued)

St. no.	Gear	Date	Position in	Position out	Depth (m)	Bottom Temp (˚C)
WA06-EF425D	D	21 November 2006	38˚03.3´N, 142˚04.0´E	38˚03.1´N, 142˚04.1´E	420–424	—
WA06-EF450	O	22 November 2006	38˚04.0´N, 142˚05.1´E	38˚02.6´N, 142˚05.0´E	450–453	3.8
WA06-EF480	O	22 November 2006	38˚00.5´N, 142˚05.2´E	37˚59.2´N, 142˚04.3´E	486–482	3.9
WA06-EF510	O	22 November 2006	38˚00.7´N, 142˚05.8´E	38˚01.7´N, 142˚06.6´E	504–531	3.5
WA06-F150	O	29 October 2006	37˚35.3´N, 141˚33.2´E	37˚36.7´N, 141˚33.9´E	150–165	13.7
WA06-F210	O	29 October 2006	37˚36.9´N, 141˚35.9´E	37˚38.2´N, 141˚36.1´E	213–213	6.5
WA06-F250	O	29 October 2006	37˚38.1´N, 141˚39.1´E	37˚36.4´N, 141˚38.8´E	257–256	5.7
WA06-F280	O	29 October 2006	37˚35.7´N, 141˚41.0´E	37˚37.5´N, 141˚40.9´E	277–284	4.9
WA06-F310	O	29 October 2006	37˚36.8´N, 141˚43.7´E	37˚36.1´N, 141˚43.6´E	313–309	4.1
WA06-F350	O	30 October 2006	37˚37.6´N, 141˚47.3´E	37˚39.2´N, 141˚47.4´E	353–350	3.9
WA06-F380	O	30 October 2006	37˚38.5´N, 141˚50.5´E	37˚40.1´N, 141˚50.6´E	386–379	3.8
WA06-F410	O	30 October 2006	37˚43.0´N, 141˚53.9´E	37˚44.6´N, 141˚53.6´E	411–411	3.3
WA06-F425	O	30 October 2006	37˚44.0´N, 141˚54.8´E	37˚42.3´N, 141˚55.1´E	425–424	3.4
WA06-F450	O	30 October 2006	37˚43.6´N, 141˚56.6´E	37˚45.2´N, 141˚56.4´E	450–450	3.4
WA06-F480	O	31 October 2006	37˚41.7´N, 141˚59.0´E	37˚39.9´N, 141˚59.0´E	483–478	3.6
WA06-F510	O	31 October 2006	37˚38.6´N, 142˚01.1´E	37˚39.8´N, 142˚01.4´E	503–511	3.8
WA06-F550	O	31 October 2006	37˚42.1´N, 142˚04.1´E	37˚40.9´N, 142˚04.7´E	546–551	3.7
WA06-F650	O	31 October 2006	37˚42.9´N, 142˚09.7´E	37˚44.0´N, 142˚09.1´E	654–651	3.7
WA06-F650D	D	31 October 2006	37˚44.9´N, 142˚08.5´E	37˚45.2´N, 142˚08.4´E	647–641	—
WA06-F750	O	1 November 2006	37˚47.3´N, 142˚12.2´E	37˚48.1´N, 142˚12.0´E	749–747	3.4
WA06-F900	O	1 November 2006	37˚46.2´N, 142˚18.9´E	37˚45.7´N, 142˚19.1´E	904–909	3.0
WA06-F1500D-1	D	1 November 2006	37˚34.6´N, 142˚33.5´E	37˚35.0´N, 142˚33.5´E	1511–1508	—
WA06-F1500D-2	D	1 November 2006	37˚38.9´N, 142˚34.1´E	37˚39.4´N, 142˚34.3´E	1466–1471	—
WA06-FG250	O	19 November 2006	37˚20.4´N, 141˚37.6´E	37˚21.9´N, 141˚37.5´E	255–252	6.8
WA06-FG280	O	19 November 2006	37˚22.1´N, 141˚39.3´E	37˚20.4´N, 141˚39.1´E	278–277	5.6
WA06-FG310	O	19 November 2006	37˚21.6´N, 141˚41.2´E	37˚19.8´N, 141˚41.2´E	312–313	4.8
WA06-FG350	O	19 November 2006	37˚22.2´N, 141˚43.1´E	37˚20.4´N, 141˚43.1´E	346–351	5.0
WA06-FG350D	D	19 November 2006	37˚22.8´N, 141˚43.2´E	37˚23.2´N, 141˚43.2´E	346–346	—
WA06-FG380	O	19 November 2006	37˚19.5´N, 141˚44.6´E	37˚21.1´N, 141˚44.8´E	382–382	4.7
WA06-FG410	O	10 November 2006	37˚18.8´N, 141˚45.8´E	37˚17.1´N, 141˚45.5´E	410–410	4.2
WA06-FG425	O	10 November 2006	37˚17.8´N, 141˚46.2´E	37˚19.5´N, 141˚46.6´E	426–425	4.2
WA06-FG450	O	10 November 2006	37˚18.8´N, 141˚47.2´E	37˚20.5´N, 141˚47.5´E	449–444	4.0
WA06-FG480	O	10 November 2006	37˚18.2´N, 141˚49.5´E	37˚16.5´N, 141˚48.8´E	480–477	3.8
WA06-FG510	O	10 November 2006	37˚16.5´N, 141˚50.0´E	37˚17.6´N, 141˚50.2´E	511–512	3.8
WA06-G150	O	26 October 2006	36˚59.8´N, 141˚17.4´E	37˚01.4´N, 141˚17.9´E	151–150	12.3
WA06-G210	O	26 October 2006	36˚57.0´N, 141˚22.7´E	36˚58.4´N, 141˚23.8´E	210–208	8.9
WA06-G250	O	26 October 2006	36˚58.4´N, 141˚25.7´E	36˚57.0´N, 141˚24.8´E	251–252	6.9
WA06-G280	O	26 October 2006	36˚55.5´N, 141˚24.9´E	36˚54.0´N, 141˚24.2´E	276–279	5.3
WA06-G310	O	26 October 2006	36˚56.2´N, 141˚26.9´E	36˚54.8´N, 141˚26.5´E	301–315	4.8
WA06-G350	O	27 October 2006	36˚56.2´N, 141˚30.8´E	36˚57.9´N, 141˚31.5´E	373–355	5.0
WA06-G380	O	27 October 2006	36˚53.4´N, 141˚27.4´E	36˚54.5´N, 141˚28.9´E	384–377	4.7
WA06-G410	O	27 October 2006	36˚56.6´N, 141˚33.2´E	36˚58.1´N, 141˚34.4´E	414–411	4.7
WA06-G425	O	27 October 2006	36˚53.2´N, 141˚29.2´E	36˚52.1´N, 141˚27.6´E	428–420	5.0
WA06-G450	O	27 October 2006	36˚51.5´N, 141˚28.6´E	36˚52.7´N, 141˚30.0´E	454–454	4.6
WA06-G480	O	28 October 2006	36˚51.2´N, 141˚29.2´E	36˚50.0´N, 141˚27.7´E	481–483	4.5
WA06-G510	O	28 October 2006	36˚51.4´N, 141˚30.1´E	36˚52.1´N, 141˚31.2´E	508–508	4.4
WA06-G550	O	28 October 2006	36˚58.1´N, 141˚38.0´E	36˚59.2´N, 141˚38.8´E	558–554	4.2
WA06-G650	O	28 October 2006	36˚50.2´N, 141˚34.3´E	36˚50.9´N, 141˚35.2´E	648–648	3.8
WA06-G750	O	15 November 2006	36˚46.3´N, 141˚35.5´E	36˚46.4´N, 141˚35.7´E	753–754	3.6
WA06-G900	O	11 November 2006	36˚50.2´N, 141˚41.3´E	36˚49.4´N, 141˚40.7´E	907–910	3.2
WA06-G900D	D	11 November 2006	36˚47.5´N, 141˚39.4´E	36˚47.3´N, 141˚39.1´E	925–920	—
WA06-G1200	O	11 November 2006	36˚51.8´N, 141˚48.0´E	36˚51.3´N, 141˚47.6´E	1207–1200	—
WA06-G1200D	D	11 November 2006	36˚52.6´N, 141˚48.6´E	36˚52.3´N, 141˚48.2´E	1201–1182	—
WA06-GH250	O	17 November 2006	36˚40.5´N, 141˚10.2´E	36˚41.9´N, 141˚11.4´E	249–250	8.3
WA06-GH280	O	17 November 2006	36˚41.5´N, 141˚12.3´E	36˚40.0´N, 141˚11.0´E	278–278	6.9
WA06-GH310	O	16 November 2006	36˚41.6´N, 141˚13.5´E	36˚40.1´N, 141˚12.2´E	309–308	4.9
WA06-GH350	O	16 November 2006	36˚39.6´N, 141˚13.4´E	36˚40.8´N, 141˚14.8´E	345–352	4.6
WA06-GH380	O	16 November 2006	36˚40.4´N, 141˚15.6´E	36˚38.9´N, 141˚14.5´E	377–381	4.7

Table 1. (Continued)

St. no.	Gear	Date	Position in	Position out	Depth (m)	Bottom Temp (˚C)
WA06-GH410	O	17 November 2006	36˚37.6´N, 141˚13.8´E	—	410	4.5
WA06-GH425	O	18 November 2006	36˚39.4´N, 141˚17.3´E	36˚40.9´N, 141˚18.3´E	425–422	4.7
WA06-GH450	O	16 November 2006	36˚41.6´N, 141˚20.1´E	36˚40.3´N, 141˚19.0´E	453–450	4.5
WA06-GH480	O	18 November 2006	36˚40.7´N, 141˚20.8´E	36˚42.2´N, 141˚21.6´E	481–478	4.3
WA06-GH480D	D	18 November 2006	36˚40.0´N, 141˚20.3´E	36˚39.8´N, 141˚20.0´E	483–478	—
WA06-GH510	O	16 November 2006	36˚40.3´N, 141˚21.6´E	36˚41.2´N, 141˚22.2´E	509–510	4.3
WA06-H150	O	12 November 2006	36˚31.3´N, 140˚58.2´E	36˚29.9´N, 140˚57.1´E	157–154	12.8
WA06-H210	O	13 November 2006	36˚30.0´N, 140˚58.4´E	36˚31.4´N, 140˚59.0´E	213–193	11.8
WA06-H250	O	12 November 2006	36˚31.4´N, 140˚59.9´E	36˚29.8´N, 140˚58.8´E	243–246	8.5
WA06-H250D	D	12 November 2006	36˚30.9´N, 140˚59.6´E	36˚31.1´N, 140˚59.8´E	248–248	—
WA06-H280	O	13 November 2006	36˚30.8´N, 141˚00.2´E	36˚29.4´N, 140˚59.1´E	282–279	5.9
WA06-H310	O	12 November 2006	36˚30.6´N, 141˚00.6´E	36˚29.1´N, 140˚59.5´E	309–310	5.5
WA06-H350	O	12 November 2006	36˚29.3´N, 141˚00.4´E	36˚27.8´N, 140˚59.5´E	353–353	5.0
WA06-H380	O	12 November 2006	36˚30.1´N, 141˚01.8´E	36˚28.7´N, 141˚00.6´E	385–378	4.8
WA06-H410	O	13 November 2006	36˚30.9´N, 141˚03.1´E	36˚32.3´N, 141˚04.3´E	413–407	4.3
WA06-H425	O	13 November 2006	36˚30.6´N, 141˚03.0´E	36˚31.9´N, 141˚04.3´E	422–430	4.2
WA06-H450	O	13 November 2006	36˚30.4´N, 141˚03.6´E	36˚29.0´N, 141˚02.3´E	456–447	3.8
WA06-H480	O	13 November 2006	36˚32.1´N, 141˚06.0´E	36˚32.7´N, 141˚06.9´E	481–480	4.2
WA06-H510	O	14 November 2006	36˚30.3´N, 141˚04.9´E	36˚31.1´N, 141˚05.9´E	508–510	3.9
WA06-H550	O	14 November 2006	36˚31.8´N, 141˚08.7´E	36˚32.6´N, 141˚09.8´E	561–557	4.1
WA06-H650	O	14 November 2006	36˚31.0´N, 141˚11.7´E	36˚31.7´N, 141˚12.7´E	659–646	3.8
WA06-H750	O	14 November 2006	36˚34.1´N, 141˚20.5´E	36˚34.6´N, 141˚21.3´E	736–732	3.6
WA06-H900	O	14 November 2006	36˚30.6´N, 141˚20.5´E	36˚31.2´N, 141˚21.1´E	896–894	3.1
WA06-H1500	O	15 November 2006	36˚36.1´N, 141˚36.1´E	36˚35.9´N, 141˚36.1´E	1478–1475	—
WA06-H1500D	D	15 November 2006	36˚36.5´N, 141˚36.2´E	36˚36.7´N, 141˚36.1´E	1470–1450	—
WA07-A150	O	7 October 2007	40˚47.5´N, 141˚49.6´E	40˚46.8´N, 141˚51.3´E	154–146	15.2
WA07-A210	O	7 October 2007	40˚51.4´N, 141˚41.8´E	40˚51.7´N, 141˚39.8´E	207–215	7.2
WA07-A250	O	6 October 2007	40˚51.8´N, 141˚50.6´E	40˚50.5´N, 141˚51.9´E	273–258	5.4
WA07-A250D	D	6 October 2007	40˚51.0´N, 141˚51.2´E	40˚50.9´N, 141˚51.5´E	258–258	—
WA07-A310	O	6 October 2007	40˚49.4´N, 141˚55.0´E	40˚50.6´N, 141˚53.5´E	306–309	3.6
WA07-A350	O	7 October 2007	40˚55.3´N, 141˚43.2´E	40˚55.2´N, 141˚44.7´E	360–359	—
WA07-A410	O	9 October 2007	40˚57.9´N, 141˚42.5´E	40˚57.5´N, 141˚43.3´E	412–415	3.4
WA07-A450	O	9 October 2007	40˚58.7´N, 141˚45.6´E	40˚58.3´N, 141˚46.1´E	471–468	3.4
WA07-A510	O	9 October 2007	41˚00.6´N, 141˚46.1´E	41˚00.4´N, 141˚46.4´E	510–512	3.3
WA07-A550	O	9 October 2007	41˚00.9´N, 141˚48.7´E	41˚00.6´N, 141˚49.0´E	550–551	3.3
WA07-A650	O	10 October 2007	41˚04.9´N, 141˚48.9´E	41˚04.5´N, 141˚49.2´E	662–661	3.3
WA07-A750	O	10 October 2007	41˚07.6´N, 141˚50.0´E	41˚07.4´N, 141˚50.1´E	748–747	3.1
WA07-A900	O	10 October 2007	41˚09.3´N, 141˚53.8´E	41˚09.0´N, 141˚53.8´E	882–881	2.9
WA07-A1500D	D	11 October 2007	40˚50.5´N, 142˚31.5´E	40˚50.2´N, 142˚31.1´E	1402–1377	—
WA07-B150	O	14 October 2007	40˚15.0´N, 142˚06.6´E	40˚13.3´N, 142˚07.4´E	153–156	9.8
WA07-B210	O	13 October 2007	40˚08.6´N, 142˚11.4´E	40˚10.1´N, 142˚11.1´E	208–214	5.7
WA07-B250	O	13 October 2007	40˚08.5´N, 142˚12.4´E	40˚06.8´N, 142˚13.2´E	249–258	4.3
WA07-B310	O	13 October 2007	40˚13.4´N, 142˚12.4´E	40˚11.7´N, 142˚12.8´E	309–307	3.5
WA07-B350	O	13 October 2007	40˚06.4´N, 142˚15.1´E	40˚08.2´N, 142˚14.6´E	350–352	3.4
WA07-B410	O	13 October 2007	40˚15.4´N, 142˚14.1´E	40˚13.7´N, 142˚14.6´E	420–412	3.4
WA07-B410D	D	13 October 2007	40˚16.9´N, 142˚13.5´E	40˚17.1´N, 142˚13.5´E	416–416	—
WA07-B450	O	12 October 2007	40˚13.2´N, 142˚15.7´E	40˚14.7´N, 142˚15.4´E	454–459	3.5
WA07-B510	O	12 October 2007	40˚16.0´N, 142˚16.0´E	40˚17.3´N, 142˚15.6´E	510–509	3.4
WA07-B550	O	12 October 2007	40˚16.9´N, 142˚16.6´E	40˚18.0´N, 142˚16.5´E	544–555	3.4
WA07-B650	O	11 October 2007	40˚19.8´N, 142˚18.0´E	40˚20.6´N, 142˚17.7´E	644–640	3.3
WA07-B750	O	11 October 2007	40˚19.7´N, 142˚21.3´E	40˚20.1´N, 142˚20.9´E	759–749	3.3
WA07-B900	O	11 October 2007	40˚21.8´N, 142˚24.3´E	40˚21.5´N, 142˚24.4´E	898–900	3.1
WA07-B1200	O	12 October 2007	40˚21.6´N, 142˚33.9´E	40˚21.8´N, 142˚33.8´E	1208–1200	—
WA07-B1500D	D	12 October 2007	40˚23.9´N, 142˚48.5´E	40˚23.9´N, 142˚48.2´E	1511–1514	—
WA07-C210	O	15 October 2007	39˚41.3´N, 142˚12.6´E	39˚43.1´N, 142˚12.9´E	211–208	7.7
WA07-C250	O	15 October 2007	39˚40.0´N, 142˚14.3´E	39˚41.7´N, 142˚14.5´E	254–252	5.6
WA07-C310	O	14 October 2007	39˚47.3´N, 142˚16.4´E	39˚45.6´N, 142˚16.0´E	318–294	3.9
WA07-C350	O	15 October 2007	39˚45.7´N, 142˚16.9´E	39˚47.4´N, 142˚17.0´E	358–358	3.9

Table 1. (Continued)

St. no.	Gear	Date	Position in	Position out	Depth (m)	Bottom Temp (˚C)
WA07-C350D	D	15 October 2007	39˚44.2´N, 142˚16.9´E	39˚44.4´N, 142˚16.9´E	355–354	—
WA07-C410	O	14 October 2007	39˚50.3´N, 142˚17.9´E	39˚48.5´N, 142˚17.9´E	409–415	3.7
WA07-C450	O	17 October 2007	39˚42.3´N, 142˚18.0´E	39˚40.6´N, 142˚17.7´E	467–458	3.7
WA07-C510	O	14 October 2007	39˚52.5´N, 142˚19.8´E	39˚51.2´N, 142˚20.0´E	511–521	3.5
WA07-C550	O	16 October 2007	39˚35.5´N, 142˚18.6´E	39˚34.2´N, 142˚18.5´E	552–559	3.6
WA07-C650	O	16 October 2007	39˚34.3´N, 142˚20.3´E	39˚35.5´N, 142˚20.3´E	659–644	3.4
WA07-C750	O	16 October 2007	39˚34.1´N, 142˚22.5´E	39˚33.5´N, 142˚22.3´E	748–749	3.4
WA07-C900	O	16 October 2007	39˚36.1´N, 142˚32.7´E	39˚35.9´N, 142˚32.5´E	900–893	3.1
WA07-C1500D	D	16 October 2007	39˚33.4´N, 142˚51.3´E	39˚33.6´N, 142˚53.3´E	1499–1480	—
WA07-D210	O	18 October 2007	38˚57.8´N, 141˚59.9´E	38˚59.2´N, 142˚00.6´E	212–214	8.8
WA07-D210D	D	18 October 2007	38˚57.4´N, 141˚59.7´E	38˚57.7´N, 141˚59.9´E	213–213	—
WA07-D250	O	18 October 2007	38˚56.8´N, 142˚01.6´E	38˚55.1´N, 142˚01.0´E	253–254	6.7
WA07-D310	O	18 October 2007	38˚53.5´N, 142˚02.8´E	38˚55.0´N, 142˚03.3´E	303–307	4.6
WA07-D350	O	18 October 2007	38˚55.1´N, 142˚05.7´E	38˚53.5´N, 142˚05.2´E	354–351	5.0
WA07-D410	O	17 October 2007	39˚04.2´N, 142˚09.5´E	39˚06.0´N, 142˚09.8´E	406–406	4.1
WA07-D450	O	17 October 2007	39˚03.4´N, 142˚10.4´E	39˚01.5´N, 142˚10.5´E	448–463	3.7
WA07-D510	O	17 October 2007	39˚04.2´N, 142˚11.8´E	39˚05.3´N, 142˚12.0´E	505–513	3.6
WA07-D550	O	5 October 2007	39˚03.7´N, 142˚12.8´E	39˚04.9´N, 142˚12.7´E	556–545	3.6
WA07-D650	O	5 October 2007	39˚02.3´N, 142˚14.7´E	39˚03.3´N, 142˚14.9´E	640–661	3.6
WA07-D750	O	5 October 2007	38˚58.7´N, 142˚16.4´E	38˚59.5´N, 142˚16.6´E	754–751	3.4
WA07-D900	O	5 October 2007	39˚05.3´N, 142˚20.0´E	39˚06.0´N, 142˚20.1´E	898–905	3.2
WA07-D1500D	D	17 October 2007	39˚20.2´N, 142˚40.1´E	39˚20.5´N, 142˚40.3´E	1505–1489	—
WA08-A450	O	8 October 2008	40˚59.3´N, 141˚42.8´E	40˚59.2´N, 141˚43.0´E	460–460	—
WA08-B310	O	10 October 2008	40˚13.5´N, 142˚12.4´E	40˚11.9´N, 142˚12.8´E	311–314	—
WA08-D210	O	21 October 2008	38˚57.6´N, 141˚59.9´E	38˚59.0´N, 142˚0.6´E	215–215	—
WA08-E250	O	22 October 2008	38˚22.8´N, 141˚54.0´E	38˚21.2´N, 141˚54.2´E	243–246	—
WA08-E350	O	25 October 2008	38˚20.3´N, 142˚1.7´E	38˚21.65´N, 142˚1.1´E	355–356	—
WA08-E900	O	23 October 2008	38˚29.7´N, 142˚21.7´E	38˚29.2´N, 142˚21.3´E	908–891	—
WA08-E1200	O	23 October 2008	38˚23.8´N, 142˚31.7´E	38˚24.0´N, 142˚31.7´E	1199–1199	—
WA08-F900	O	31 October 2008	37˚46.7´N, 142˚18.8´E	37˚46.5´N, 142˚18.9´E	900–902	—
WA08-G350	O	29 October 2008	36˚56.3´N, 141˚30.9´E	36˚57.2´N, 141˚31.2´E	372–362	—
WA08-G410	O	29 October 2008	36˚57.2´N, 141˚33.8´E	36˚56.3´N, 141˚33.0´E	413–417	—
WA08-G510	O	28 October 2008	36˚51.7´N, 141˚30.7´E	36˚51.0´N, 141˚29.9´E	510–515	—
WA08-G650	O	27 October 2008	36˚50.1´N, 141˚34.2´E	36˚50.6´N, 141˚34.9´E	646–651	—
WA08-G1500	O	27 October 2008	36˚51.0´N, 141˚51.0´E	36˚51.1´N, 141˚51.3´E	1512–1512	—

deposited in the Department of Zoology, National Museum of Nature and Science, unless otherwise mentioned. They are being kept intact for future detailed studies, with no destructive treatments such as extraction of the radula.

In the present study, all the specimens were identified solely on the basis of conchological or external characters. However, a considerable range of variation was recognized in the shell characters in many cases, which made identification extremely difficult. The most important criterion used in distinguishing species is discontinuity in variable characters. If two similar forms occur sympatrically or at similar depths in the same area and they are discontinuous in certain character(s), they are regarded as distinct species. On the other hand, when a species shows a wide vertical distribution, it often exhibits considerable differences in shell characters between the populations at the extremes of its distribution. Accordingly, examination of specimens from intermediate depths is essential to define the species in such cases. If two similar forms were collected from different depths, but no intermediate forms were found due only to the scarcity of the species, they were provisionally regarded as intraspecific forms. This implies that some of the "species" groups treated under a single name in the present paper may comprise more than one species. In any case, all phenotypes of variable species are figured here.

Abbreviations used. BL — body length; d — dry live-collected shell(s) without soft-parts; e — dead-collected empty shell(s); NSM PM — paleontological molluscan collection of the Department of Geology and Paleontology, National Museum of Nature and Science, Tokyo; NSMT-Mo — Recent molluscan collection of the Department of Zoology, National Museum of Nature and Science, Tokyo; SL — shell length (Higo *et al*., 2001: figs. 2a–b); SW — shell width (Higo *et al*., 2001: fig. 2c); USBF — United States Bureau of Fisheries (cruises of U.S.S. *Albatross*). Measurement planes of shells for SL and SW follow Higo *et al*. (2001: 5).

Results

A total of ca. 2740 gastropod specimen lots were examined and classified into 187 species, excluding some imperfect or juvenile specimens. Among them, 177 species that occurred at depths of between 200 and 1500 m, corresponding to upper bathyal zone, are treated in detail in the following list. Ten species that occurred only at depths shallower than 200 m were not included in the list, and are separately summarized in an appendix. Among the 177 species, 103 are identified to the species level, 14 are only compared with similar species and 60 are not identified as any species previously recorded from the northwestern Pacific. All of these species are listed in systematic order following Okutani (2000), but the classification of the Buccinidae, Turridae and Conidae basically follows Kantor and Sysoev (2006).

In the list, each species is provided with synonymy, information on the type locality, geographical and vertical distributions and material examined, with station data and systematical and/or biogeographical remarks. The synonymy is not complete, but focuses on names that have appeared mainly in the Japanese literature and that were accompanied by identifiable figure(s), except in some cases where more detailed taxonomical discussion is necessary. Geographical and vertical distributions of each species are largely cited from Higo *et al*. (1999) and Kantor and Sysoev (2006), unless otherwise mentioned. Depth ranges in brackets only represent the present material from the survey area.

Family Acmaeidae Forbes, 1850

Pectinodonta rhyssa (Dall, 1925)
[Japanese name: Watazoko-shiro-amigasa]
(Fig. 3)

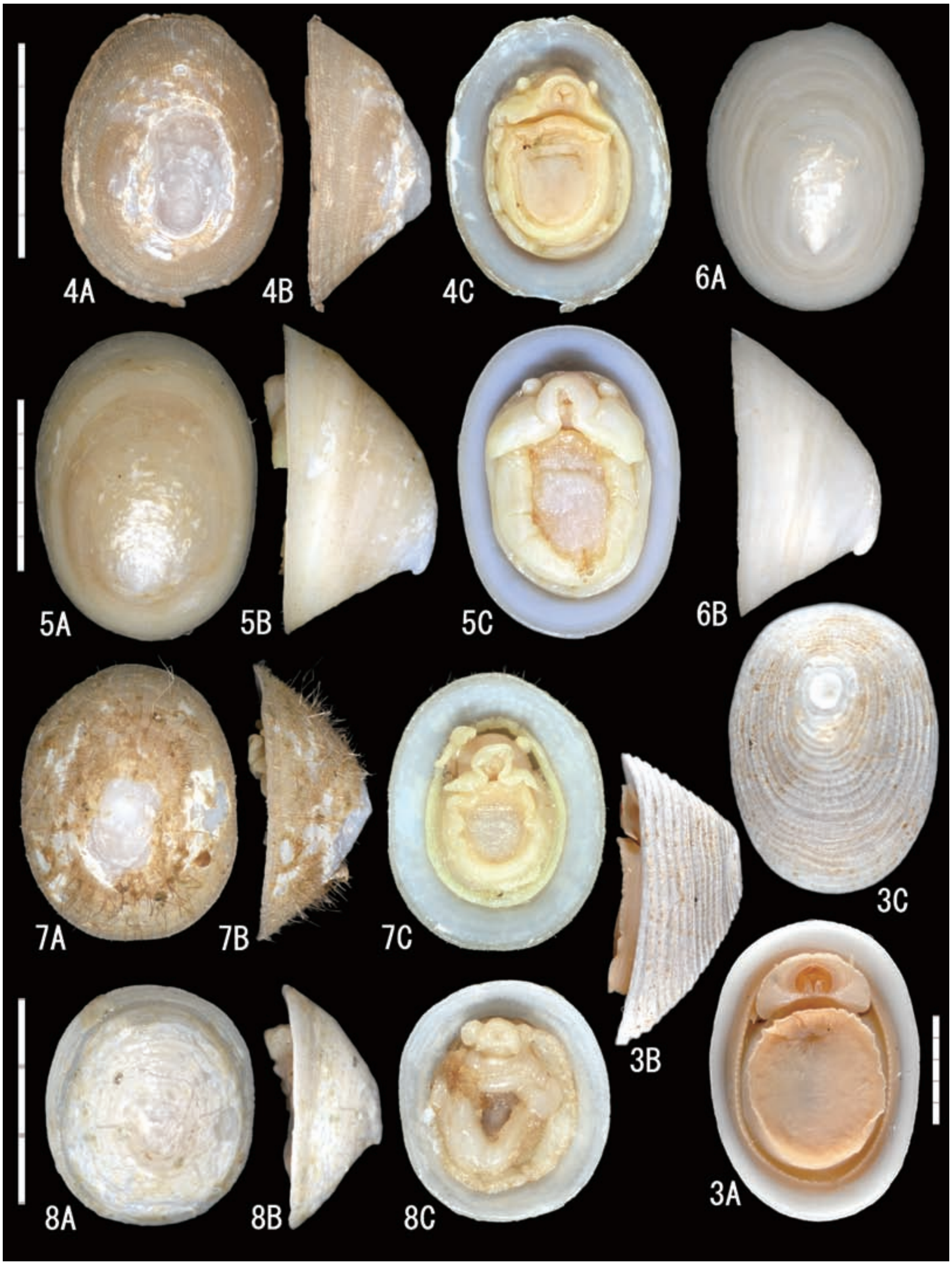
Cocculina rhyssa Dall, 1925: 11, pl. 32, figs. 3, 5.
Pectinodonta rhyssa — Habe, 1949: 67, text-fig. 1; Habe, 1955a: no page number, text-figs.; Habe, 1961a: 6, pl. 3, fig. 13; Okutani, 1964: 379, pl. 1, fig. 12; Tsuchida and Ishida, 1977: 148, fig. 1; Hasegawa, 1997: 63–64; Sasaki in Okutani, 2000: 27, pl. 13, fig. Acmaeidae-1.
Pectinodonta orientalis — Habe, 1964: 8, pl. 3. fig. 13; Habe and Okutani, 1975: 287, color fig. on page 41; Nakamura in Okutani, 1986: 37, with color fig. [non *Pectinodonta orientalis* Schepman, 1908].
[See Hasegawa (1997) for detailed synonymy.]

Type locality. “Dredged at [USBF] station 3721, in 250 fathoms, off Hondo, Japan”.

Distribution. Onahama in Fukushima Prefecture (present study) and southwards to Tosa Bay; 200–1640 m [380–510 m].

Material examined. WA05-GH380 (14: on sunken wood)； WA08-G510 (5: on sunken wood).

Remarks. This is one of the most dominant gastropods found on deep-water sunken wood in temperate Japanese waters (Hasegawa, 1997). The northern limit of its geographical distribution was previously thought to be off Choshi, in the sea area Kashima-nada, where the species was



Figs. 3–8. Acmaeidae, Cocculinidae and Pseudococculinidae. 3. *Pectinodonta rhyssa*, WA05-GH380. 4-6. *Cocculina japonica*, 4: WA05-F510; 5: WA05-EF280; 6: WA05-EF350 (empty shell). 7. *Coccopigya punctoradiata*, WA05-FG425. 8. *Copulabyssia similaris*, WA05-G280. Scales: 3 = 5 mm; 4 = 5 mm; 5–7 = 5 mm (at the same scale); 8 = 3 mm.

reported to be uncommon (Watanabe and Naruke, 1988). Only two lots were obtained during the present survey from the southern part of the survey area, in contrast to the dominant occurrence of *Cocculina japonica* on a relatively large number of sunken wood pieces recovered. The present records represent a northward range extension to Fukushima Prefecture, in northeastern Honshu.

Family Cocculinidae Dall, 1882
Cocculina japonica Dall, 1907
[Japanese name: Watazoko-shirogasa]
(Figs. 4–6)

Cocculina japonica Dall, 1907: 169; Dall, 1925: 11, pl. 26, figs. 3, 4; Tiba, 1941: 111; Kuroda and Habe, 1949: 58, 62; Habe, 1955c: no page number; Tsuchida and Ishida, 1977: 148, fig. 2 (shell and radula).

Type locality. [USBF] station 4813, off Sado Island, Sea of Japan [north point, Sado Id., S. 30˚W., 17 miles; 38˚35´N, 138˚43´E. 200 fathoms in depth].

Distribution. Off Choshi, in sea area Kashima-nada, and northwards to southern Hokkaido, and in Sea of Japan; 50–750 m [210–550 m].

Material examined. WA05-DE350 (14); WA05-DE410 (29); WA05-DE450 (1); WA05-DE510 (4); WA05-EF280 (16); WA05-EF350 (1+1e); WA05-EF380 (ca. 50); WA05-EF480 (18); WA05-F410 (3); WA05-F425 (8); WA05-F510 (5); WA05-FG310 (11); WA05-FG350 (1); WA05-FG380 (2); WA05-FG410 (8); WA05-FG425 (ca. 100); WA05-FG450 (3); WA05-FG480 (3); WA05-G425 (30); WA05-GH380 (32); WA05-GH410 (1); WA06-A350 (11); WA06-DE310 (1); WA06-DE380 (3); WA06-DE410 (20+1e); WA06-DE450 (22); WA06-DE480 (3); WA06-E380 (11); WA06-EF380 (1); WA06-EF410 (2); WA06-EF450 (13); WA06-EF480 (26); WA06-EF510 (1); WA06-F-410 (3); WA06-FG480 (1); WA06-G425 (7); WA06-GH380 (1); WA06-H480 (1e); WA07-A310 (7); WA07-A410 (ca. 30); WA07-A450 (4); WA07-B310 (ca. 50); WA07-B350 (20); WA07-B410 (ca. 100); WA07-B450 (ca. 25); WA07-B510 (12); WA07-B550 (2); WA07-C210 (3); WA07-C510 (ca. 50); WA07-D410 (ca. 40); WA08-A450 (8); WA05-B310 (20); WA08-E350 (13) [all associated with sunken wood pieces].

Remarks. This species was originally described from off Sado Island in the Sea of Japan, and subsequently recorded from off Cape Erimo on the Pacific coast of Hokkaido (Kuroda and Habe, 1949), and from off the Sanriku Coast in northern Honshu (Tiba, 1941; Tsuchida and Ishida, 1977). It was not recorded from Suruga Bay in the intensive survey of the sunken wood-associated gastropods there carried out by Hasegawa (1997), suggesting a boreal origin for the species.

Considerable intraspecific variation in conchological features was recognized among the specimens examined. Typical specimens are characterized by a rather solid, high conical shell with relatively weak radial ribs (Figs. 5, 6), but some specimens possess a more depressed shell with a thick, brownish periostracum and more distinct radial ribs ornamented with short hairy projections (Fig. 4). Nevertheless, examination of a large number of specimens revealed that these characters are continuous, and thus these forms can be regarded as phenotypes. Furthermore no significant differences were recognized in the external anatomy, including the penis among the specimens examined.

Coccopigya punctoradiata (Kuroda and Habe, 1949)
[Japanese name: Misono-watazoko-shirogasa]
(Fig. 7)

Cocculina punctoradiata Kuroda and Habe, 1949: 59–60, 64–65, pl. 3, figs. 7, 9; Kuroda *et al.*, 1971: 85 (Japanese part), 56 (English part), pl. 106, figs. 26–27.

Coccopigya punctoradiata — Hasegawa, 1997: 73–79, figs. 7A–G, 8A–D, 9A–G, 10A–H, 11A–C; Sasaki in Okutani, 2000: 25, pl. 17, fig. Cocculinidae-4 (reproduction of Hasegawa, 1997: fig. 9A–B).

Type locality. Off Tosa, Shikoku.

Distribution. Off Onahama in Fukushima Prefecture (present study) and southwards to Tosa Bay; 50–750 m [380–425 m].

Material examined. WA05-FG425 (9); WA05-G425 (7); WA05-GH380 (8); WA06-G425 (9) [all associated with sunken wood pieces].

Remarks. In contrast to the boreal origin of the preceding species, this species apparently belongs to the warm water fauna, and has hitherto been recorded from Sagami Bay and southwards to Tosa Bay. It was obtained in relatively small number from the southern part of the present survey area, and this represents a northward range extension to off Fukushima Prefecture, northeastern Honshu.

Hasegawa (1977) recognized three intraspecific forms on the basis of the shell and soft parts morphology among the specimens of this species collected from Suruga Bay. All the specimens examined in the present study belong to the form “1” that is characterized by the possession of a highly arched shell and a well-developed copulatory organ on the right cephalic tentacle (Fig. 7C).

Family Pseudococculinidae Hickman, 1983

Copulabyssia similaris Hasegawa, 1997

[Japanese name: Maru-chidori-watazoko-shirogasa]

(Fig. 8)

Copulabyssia similaris Hasegawa, 1997: 86–89, figs. 17A–J; Sasaki in Okutani, 2000: 33, pl. 17, fig. Pseudococculinidae-3 (reproduction of Hasegawa, 1997: fig. 17A–B).

Type locality. Off Toi, Suruga Bay, 34˚56.7´N, 138˚43.3´E, 430–710 m, commercial size bottom trawl (CT93-11).

Distribution. Off Onahama in Fukushima Prefecture (present study), Suruga and Tosa Bays (Hasegawa, personal observation); 180–740 m (Hasegawa, 1997) [280–425 m].

Material examined. WA05-G280 (1); WA05-G425 (1) [all associated with sunken wood pieces].

Remarks. Only two specimens of this minute species were collected, both from sunken wood at two separate stations. They generally agree with the type material of this species, which shows rather wide range of variation in shell profile, in general shell features, and in external anatomy, such as the morphology of the swollen right cephalic tentacle with a deep ciliated groove on its dorsal side, which possibly function as the copulatory organ. One of the present specimens, however, differs considerably in possessing a depressed shell, and further detailed study will be necessary for precise identification. The present records represent a northward range extension to Fukushima Prefecture, northeastern Honshu.

Family Fissurellidae Fleming, 1822

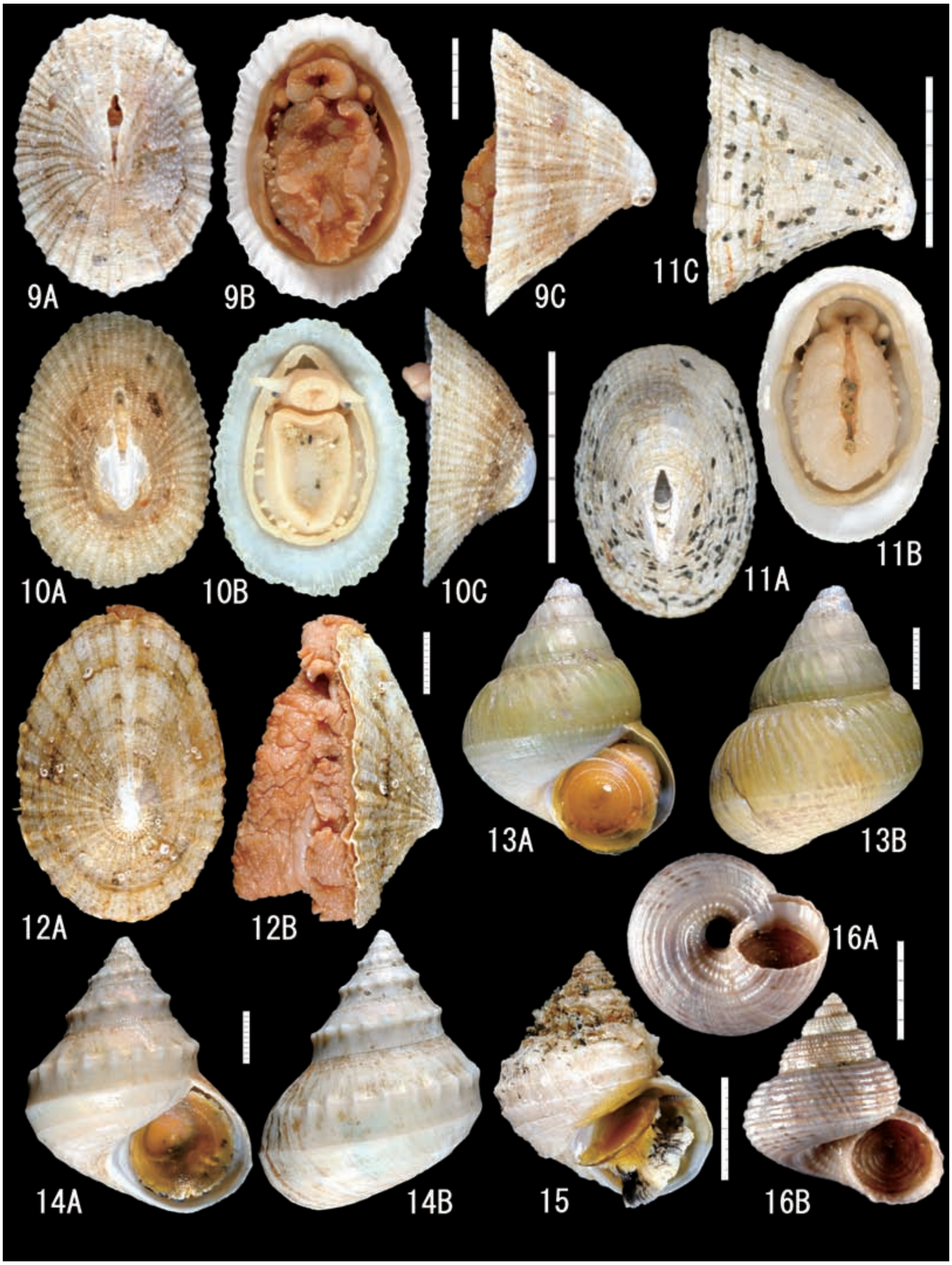
Puncturella sp. cf. ***nobilis*** A. Adams, 1860

(Fig. 9)

?*Cemoria nobilis* Adams, 1860: 422 (Okosiri [Okushiri, Japan Sea coast of Hokkaido], 35 fathoms).

Material examined. WA9206-A44 [200 m] (1).

*Remarks.*The only specimen available was provisionally identified as *P. nobilis*, based mainly



Figs. 9–16. Fissurellidae and Trochidae. 9. *Puncturella* sp. cf. *nobilis*, WA9206-A44 [200 m]. 10. *Puncturella* sp., WA05GH380. 11. *Puncturella fastigiata**, WA06-A150D. 12. *Tugalina* (*Scelidotoma*) *gigas**, WA9101-4 [135 m]. 13. *Bathybembix aeola*, WA06-GH425. 14. *Ginebis argenteonitens*, WA06-GH250. 15. *Ginebis cumingii**, WA07-B150. 16. *Minolia punctata**, WA06-A150D. Scales: 9–11, 16 = 5 mm; 12–14 = 10 mm (all at different magnifications). *: See Appendix.

on its high conical profile and coarse, irregular radial ribs. It differs from the typical specimens, which usually occur in shallower water, from the intertidal zone to depths of ca. 85 m (Higo *et al.*, 1999), in possessing considerably weaker radial ribs. However, the strength of the radial ribs is highly variable in this species, as seen in figures in literature, and some of them (e.g. Kira, 1959: pl. 4, fig. 8) seem to approach the present specimen. On the other hand, the present material also resembles *Puncturella kawamurai* Habe, 1961, described from off Choshi, in the sea area Kashima-nada, at a depth of ca. 200 m, and may interconnect both taxa, although examination of more material is necessary to confirm this.

Puncturella sp.
(Fig. 10)

Puncturella cucullata kawamurai — Golikov and Sirenko, 1998: 92, fig. 1A–B [non *Puncturella kawamurai* Habe, 1961].

Material examined. WA05-GH380 (1); WA06-G750 (1); WA08-G410 (2).

Remarks. This species differs from *P. kawamurai* in possessing a flatter shell with more regularly spaced primary radial ribs, with slightly weaker secondary ribs in the interspaces, and fine, thread-like but distinct concentric ribs that become granulate at the intersections with the radial ribs. In this sculpture it more closely resembles *P. granitesta* (Okutani, 1968) described from off Torishima Island in the Izu Islands at a depth of 2280 m, but it differs in its lower shell profile and significantly coarser axial ribs.

Family Trochidae Rafinesque, 1815
Bathybembix aeola (Watson, 1879)
[Japanese name: Kusairo-gin-ebisu (= Kogane-ebisu)]
(Fig. 13)

Bembix aeola Watson, 1879: 603; Watson, 1886: 95–96, pl. 7, fig. 13; Pilsbry, 1889: 162, pl. 40, figs. 10–11.
Bathybembix aeola — Crosse, 1892: 291; Schepman, 1905: 100, pl. 8, figs. 4–5; Kira, 1962: 9, pl. 7, fig. 4; Okutani, 1964: 380, pl. 1, figs. 1–2; Okutani, 1966: 15, pl. 1, fig. 15; Kuroda and Habe in Kuroda *et al.*, 1971: 44 (Japanese part), 30 (English part), pl. 9, fig. 3; Okutani, 1983: 5, pl. 6, fig. 10; Takenouchi in Okutani, 1986: 44, 45 with color fig.; Okutani *et al.*, 1988: 36, text-figs.; Hickman and McLean, 1990: fig. 44C; Matsukuma *et al.*, 1991: 162, pl. 18, fig. 9; Okutani and Iwahori, 1992: 237, figs. 2–6; Tsuchida, 1993: pl. 1, fig. 2; Tsuchida and Kurozumi, 1995: 174, figs. 6 (1–2); Sasaki in Okutani, 2000: 59, pl. 29, fig. Trochidae-26; Higo *et al.*, 2001: fig. G296 (holotype).
Turcicula aeola — Taki and Otuka, 1943: 98, pl. 1, figs. 1a–b.
Lischkeia aeola — Horikoshi, 1957: pl. 11, fig. 20.
Turcicula (*Bathybembix*) *aeola* — Kira, 1959: 12, pl. 6, fig. 4; Noda, 1975: 67–68, pl. 10, figs. 16–17.
Bathybembix (*Bathybembix*) *aeola* — Matsumoto, 1979: 6, pl. 1, fig. 7; Watanabe and Naruke, 1988: 31, pl. 4, fig. 10.

Type locality. H.M.S. *Challenger* station 232, “Mosima” [off Enoshima Island, Sagami Bay, central Honshu], 35˚11´N, 139˚28´W, 345 fathoms.

Distribution. Off Kinkazan in Miyagi Prefecture and southwards to off southern Kyushu, along Pacific coast, and East China Sea (Tsuchida, 1993); 507–1020 m [350–650 m].

Material examined. WA05-EF480 (1); WA05-FG450 (1d); WA05-FG-510 (2d); WA05-G425 (1); WA05-G450 (4); WA05-G510 (2); WA05-GH410 (2d) WA05-GH425 (2); WA05-GH510 (2); WA05-H380 (1); WA05-H480 (1); WA06-F550 (1); WA06-G350 (1); WA06-G425 (5); WA06-G450 (3); WA06-G550 (1); WA06-G650 (2); WA06-GH410-1 (1); WA06-GH425 (5); WA06-GH450 (2+1d); WA06-GH480 (1); WA06-GH510 (1d); WA06-H550 (1).

Remarks. There have been few records of this species from northeastern Honshu (Horikoshi *et al.*, 1979) except for Higo *et al*. (1999) who did not provide detailed locality or depth. It is rather commonly found in temperate areas, from Sagami Bay to Tosa Bay, at bathyal depths. The distribution of this species was limited in the southern part of the present survey area, and its northern limit was shown to be around Kinkazan in Miyagi Prefecture.

Ginebis argenteonitens (Lischke, 1872)
[Japanese name: Gin-ebisu (= Hirase-gin-ebisu)]
(Fig. 14)

Trochus argenteo-nitens Lischke, 1872: 104; Lischke, 1874: 66, pl. 4, fig. 1.
Calliostoma argenteonitens — Pilsbry, 1889: 346–347, pl. 63, fig. 32.
Bathybembix argenteo-nitens — Crosse, 1892: 291–292, pl. 4, figs. 4, 4a, 4b.
Bembix convexiusculum Yokoyama, 1920: 90, pl. 5, fig. 32 (type locality: Kamakura, Kanagawa Prefecture; Lower Musashino, Pleistocene).
Turcicula argenteonitens — Hirase, 1934: pl. 69, fig. 6; Taki and Otuka, 1943: 105–106, pl. 1, fig. 3.
Turcicula argenteonitens hirasei Kuroda MS. in Taki and Otuka, 1943: 106–7, pl. 1, fig. 4 (type locality: sea area Kashima-Nada and others).
Turcicula convexiuscula — Taki and Otuka, 1943: 107–108, pl. 1, fig. 5.
Lischkeia argenteonitens hirasei — Hirase and Taki, 1954: pl. 69, fig. 6; Horikoshi, 1957: pl. 11, fig. 19.
Lischkeia argenteonitens argenteonitens — Horikoshi, 1957: pl. 11, fig. 18.
Turcicula (*Ginebis*) *argenteonitens hirasei* — Kira, 1959: 12, pl. 6, fig. 5.
Turcicula (*Ginebis*) *argenteonitens* — Kira, 1959: 12, pl. 6, fig. 6; Kuroda and Habe in Okada *et al*. 1965: 27, text-fig.
Bathybembix (*Ginebis*) *argenteonitens* — Taki in Baba *et al*., 1960: 183, pl. 84, fig. 21; Kira, 1962: 9, pl. 7, fig. 6; Kuroda and Habe in Okada *et al*., 1965: 27, text-fig.
Lischkeia convexiuscula tosana Shikama, 1962: 40, pl. 1, figs. 12a–b, 13a–b (type locality: Tosa [Bay]).
Bathybembix (*Ginebis*) *argenteonitens hirasei* — Kira, 1962: 9, pl. 7, fig. 5.
Lischkeia (*Turcicula*) *argenteonitens argenteonitens* — Shikama and Horikoshi, 1963: 10, pl. 8, fig. 5.
Ginebis argenteonitens — Kuroda and Habe in Kuroda *et al*., 1971: 45 (Japanese part), 30 (English part), pl. 9, figs. 7–8; Takenouchi in Okutani, 1986: 44, 45 with 3 color figs.; Okutani *et al*., 1988: 34, text-figs.; Oshima, 1993: 99, pl. 4, fig. 16; Sasaki in Okutani, 2000: 59, pl. 29, fig. Trochidae-27; Higo *et al*., 2001: fig. G298 (holotype).
Turcicula (*Ginebis*) *argenteonitens argenteonitens* — Noda, 1975: 71–72, pl. 9, figs. 1–3, 11–12, 14, 18, pl. 10, fig. 4, pl. 11, figs. 2, 4, 6, pl. 12, fig. 6.
Turcicula (*Ginebis*) *argenteonitens hirasei* — Noda, 1975: 72–73, pl. 9, fig. 24, pl. 10, figs. 14, 24, pl. 11, figs. 3, 5, pl. 12, figs. 8, 13.
Turcicula (*Convexia*) *convexiuscula* — Noda, 1975: 76–77, pl. 9, figs. 4–5, pl. 10, fig. 18, pl. 11, fig. 1, pl. 12, fig. 9.
Ginebis nakamigawai Sakurai, 1983: 301–302, 303–304, figs. 1, 3 (type locality: off Kochi Prefecture); Hasegawa and Saito, 1995: 14, 31, pl. 1, fig. 8 (holotype).
Ginebis kirai Sakurai, 1983: 302–303, 304, figs. 2, 4 (type locality: off Kochi Prefecture); Matsukuma *et al*., 1991: 162, pl. 18, fig. 13 (paratype); Hasegawa and Saito, 1995: 13, 31, pl. 1, fig. 9 (holotype).
Ginebis argenteonitens kirai — Watanabe and Naruke, 1988: pl. 4, fig. 7.
Ginebis argenteonitens hirasei — Okutani *et al*., 1988: 35, text-figs.; Nemoto and Akimoto, 1990: pl. 2, fig. 7.
Bathybembix argenteonitens — Matsukuma *et al*., 1991: 162, pl. 18, fig. 12.
Ginebis argenteonitens form *hirasei* — Sasaki in Okutani, 2000: 59, pl. 29, fig. Trochidae-28.
Ginebis argenteonitens form *convexiuscula* — Sasaki in Okutani, 2000: 59, pl. 29, fig. Trochidae-29.

Type locality. “Bucht von Jedo und zwar von Jokohama bis hinaus zur Insel Eno-Sima” [Tokyo Bay, specifically from Yokohama to Enoshima].

Distribution. Off Kinkazan in Miyagi Prefecture and southwards to southern Kyushu and East China Sea; 50–400 m [150–350 m].

Material examined. WA05-EF250 (2d); WA05-G210 (1); WA05-G280 (1e); WA05-G350 (7+1e); WA05-GH250 (2); WA05-GH280 (3); WA05-H150 (1); WA06-E150 (2); WA06-E210 (1); WA06-EF250 (5d); WA06-EF280 (1e); WA06-F210 (3); WA06-F250 (3); WA06-F280 (2); WA06-F310 (1); WA06-G150 (3); WA06-G210 (2); WA06-G250 (2); WA06-G280 (2); WA06-GH250 (10+8d); WA06-GH280 (9d); WA06-GH310 (3d); WA06-H150 (1+1e); WA06-H210 (4d); WA06-H250 (15+5d); WA06-H280 (8+2d); WA06-H310 (3e).

Remarks. *Ginebis argenteonitens*, which is widely distributed along the Pacific coast of the

Japanese home islands, is usually classified in Japanese literature into two geographical forms. The one distributed in the sea area Kashima-nada and northwards (*G. argenteonitens hirasei*) is characterized by a row of conspicuous nodules at the periphery from the beginning of the teleoconch whorls, whereas the other, distributed around Sagami Bay and southwards (*G. argenteonitens argenteonitens*), lacks the nodules on the early teleoconch whorls. Furthermore, some specimens in the southern populations lack the nodules altogether, and are sometimes distinguished as *G. argenteonitens convexiuscula*. Noda (1975) proposed a new subgenus *Convexia* for this form. However, as Kira (1959: 12) and Takenouchi in Okutani (1986) have already suggested, intermediate forms exist in both northern and southern populations near the boundary, and all of them cannot be distinguished as distinct subspecies. Similarly, *G. nakamigawai* and *G. kirai*, which were described from Tosa Bay by Sakurai (1983), can be regarded as phenotypes of the present species as already noted by Hasegawa and Saito (1995).

Margarites sp. cf. ***rossicus*** Dall, 1919
[Japanese name: Sujimaki-ebisu (= Makisuji-ebisu)]
(Fig. 17–18)

?*Margarites* (*Pupullaria*) *rossica* Dall, 1919b: 365 (type locality: Aniwa Bay, Sakhalin Island); Dall, 1925: 24, pl. 25, fig. 1 (holotype); Kosuge, 1972, pl. 2, fig. 4 (holotype).

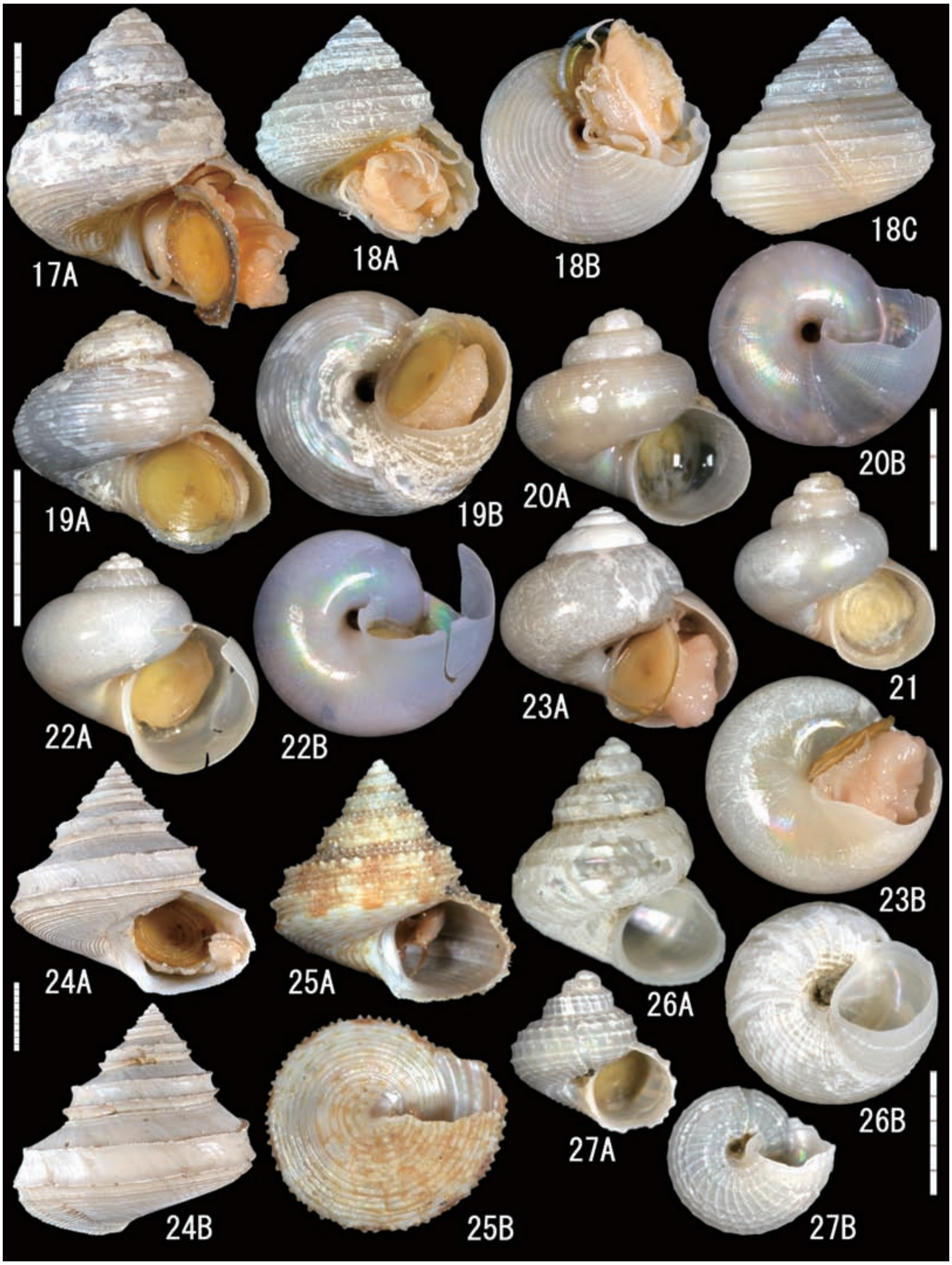
Material examined. WA05-DE410 (1); WA05-EF350 (1); WA05-EF380 (3); WA05-EF450 (1); WA05-FG350 (5+1e); WA05-FG410 (3); WA05-FG425 (2+1e); WA05-GH380 (1); WA05-GH380D (4e); WA05-H380 (1); WA06-D450D (1e); WA06-DE425 (1e); WA06-DE480 (1+1e); WA06-EF310 (2e); WA06-EF350 (1); WA06-EF380 (1e); WA06-EF425 (1); WA06-EF425D (1); WA06-F310 (1); WA06-F380 (1); WA06-FG310 (1e); WA06-FG350 (2); WA06-FG350D (3e); WA06-FG380 (2); WA06-FG410 (7+3e); WA06-FG425 (1); WA06-FG450 (1); WA06-GH380 (1); WA07-D350 (18+6e).

Remarks. Based on the brief description and the distribution it is probable that the present material corresponds to the species recorded from the same area by Toba (1930 in 1928–1935) as “*Margarites* (*Pupillaria*) *sordida* (Hancock)” with the new Japanese name “Sujimaki-ebisu”. It also somewhat resembles the specimen illustrated by Habe and Ito (1965a: pl. 6, fig. 14) as “*Pupillaria pupilla* (Gould, 1849)” with the Japanese name “Makisuji-ebisu”, but apparently differs in having a more rounded periphery and more deeply constricted suture. Among the northwestern Pacific species of the genus *Margarites*, the present material is most closely related in general shell features to *M. rossicus*, which was described from the southern Okhotsk Sea. However, the present material differs from the holotype of *M. rossicum* (Kosuge, 1972: pl. 2, fig. 4) in having a smaller shell with weaker and more crowded spiral cords. It is noteworthy that the present material was obtained only in the southern part of the survey area, from the northern part of Miyagi Prefecture south to Ibaraki Prefecture, but did not occur off Iwate Prefecture or northwards, suggesting possible isolation from the northern populations.

Margarites bisikovi Egorov, 2000
[New Japanese name: Hesoaki-makisuji-ebisu]
(Fig. 19)

Margarites bisikovi Egorov, 2000: 13, fig. 7A–B; Kantor and Sysoev, 2006: 32, pl. 13, fig. E.

Type locality. R/V *Odissey*, 34th cruise, station 29, Simushir Island, Dushnaya Bay, 150 m depth [southern Kurile Islands].



Figs. 17–27. Trochidae. 17–18. *Margarites* sp. cf. *rossicus*, 17: WA06-DE480; 18: WA05-FG350. 19. *Margarites bisikovi*, WA06-EF380. 20–21. *Marigarites margaritiferus*, 20: WA06-E1200D, 21: WA06-H1500. 22. *Margarites* sp. 1, WA05-F1200. 23. *Margarites* sp. 2, WA07-A410. 24. *Otukaia kiheiziebisu*, WA06-GH480. 25. *Calliostoma aculeatum**, WA9201-2 [100 m]. 26–27. *Solariella* sp. 1, 26: WA07-D210D (empty shell); 27: WA07-C350D. Scales: 17–18 = 5 mm (at the same scale); 19, 22, 25 = 5 mm (at the same scale); 20–21, 23 = 3 mm (at the same scale); 24 = 10 mm; 26–27 = 5 mm (at the same scale). *: See Appendix.

Distribution. Off Kinkazan in Miyagi Prefecture (present study) and northwards to southern Kurile Islands; 150 m [380 m].

Material examined. WA06-EF380 (1).

Remarks. Although this species is represented by only one specimen among the present material, it apparently differs from the preceding species by its smaller shell, with a widely perforated umbilicus, significantly finer spiral sculpture and a deeply canaliculated suture. It agrees well with the figures of the holotype of *M. biskikovi*. The present species has hitherto been known only from the type locality, and this is the first record of it in Japanese waters.

Margarites margaritiferus Okutani, 1964
[Japanese name: Shinjyu-iro-shitadami]
(Figs. 20–21)

Margarites margaritiferus Okutani, 1964: 382, pl. 1, fig. 9, pl. 5, fig. 5; Sasaki in Okutani, 2000: 61, pl. 30, fig. Trochidae-33 (holotype).

Solariella fera Bagirov, 1995: 5–6, fig. 1C (type locality: off northeastern Honshu, 41°20.0´N, 142°12.1´E, 1260 m). New synonym.

Type locality. R/V *Soyo-maru*, St. T29, 35°05.5´N, 139°29.3´E, Sagami Bay, 710–770 m.

Distribution. Sagami Bay and northwards to off Hachinohe in Miyagi Prefecture (present study); 620–1030 m [900–1500 m].

Material examined. WA95-B1000 (1+1e); WA06-E1200D (1); WA06-H1500 (1); WA07-D900 (3); TS96-K2 [1451–1455 m] (1e).

Remarks. *M. margaritiferus* has been known to be distributed in Sagami Bay and the sea area Kashima-nada (Sasaki in Okutani, 2000). Although it was also recorded from southwestern Kyushu in the East China Sea (Higo *et al.*, 1999), this cannot be confirmed without illustrations. On the other hand, *Solariella fera*, which was described from off Aomori Prefecture, at a depth of 1260 m (Bagirov, 1995), cannot be distinguished from conchological features, and is considered herein a junior synonym of this taxon. Regarding the generic position of the present species, although Bagirov (1995) assigned the species to *Solariella* Wood, 1842 (type species: *Solariella maculata* Wood, by monotypy), it is here rather tentatively retained in *Margarites* Gray, 1847 (type species: *Turbo helicinus* Phipps, 1774, by original designation) in view of the continued lack of anatomical information.

Margarites sp. 1
(Fig. 22)

Material examined. WA05-F1200 (1).

Remarks. In shell profile this species most closely resembles *Margarites giganteus* (Leche, 1878), which was originally described from the Kara Sea and subsequently recorded from the Japan and Okhotsk seas (Egorov, 2000). However, it differs in having a completely smooth shell with no trace of spiral sculpture.

Margarites sp. 2
(Fig. 23)

Material examined. WA07-A410 (1).

Remarks. This species is characterized by the small but solid shell with a very narrowly but distinctly perforate umbilicus, and can thereby be distinguished from all the known species in the genus in the northeastern Pacific.

Otukaia kiheiziebisu (Otuka, 1939)
[Japanese name: Kiheiji-ebisu]
(Fig. 24)

Calliostoma kiheiziebisu Otuka, 1939: 28–29, text-figs. a–b.
Calliostoma (*Otukaia*) *kiheiziebisu* — Ikebe, 1942: 277; Shikama and Horikoshi, 1963: 11, pl. 8, fig. 7.
Otukaia kiheiziebisu — Habe, 1961a: 10, pl. 5, fig. 12; Matsumoto, 1979: 6, pl. B, fig. 7; Okutani, 1983: 5, pl. 6, fig. 9; Watanabe and Naruke, 1988: 31, pl. 4, fig. 9; Matsukuma *et al*., 1991: 162, pl. 18, fig. 11; Okutani and Iwahori, 1992: 237–242, figs. 7–13; Sasaki in Okutani, 2000: 75, pl. 37, fig. Trochidae-108.
Otukaia ikukoae Sakurai, 1994: 292, 296, fig. 11 (type locality: off Kochi Prefecture); Hasegawa and Saito, 1995: 10, 30, pl. 1, fig. 7; Higo *et al.*, 2001: fig. G432 (holotype).

Type locality. Kashima-nada, 600 m.

Distribution. Off Ofunato in Iwate Prefecture (present study) and southwards to Tosa Bay; 50?–835 m [450–900 m].

Material examined. WA05-G650 (3); WA05-G750 (3); WA06-G900 (2); WA06-GH480 (3); WA06-GH510 (1); WA07-D450 (1).

Remarks. Although this species was originally described from the sea area Kashima-nada, off Ibaraki Prefecture, it is now known to be widely distributed along the Pacific coast of Honshu south to Tosa Bay, where it shows a considerable range of variation in the number of strong spiral cords (2 to 6 on the adapical part of the body whorl; Okutani and Iwahori, 1992). This species occurred only in the southern part of the present survey area (off Miyagi Prefecture and southwards), and all the specimens examined consistently possess three strong spiral cords on the body whorl.

Hazuregyra watanabei Shikama, 1962
[Japanese name: Hazure-shitadami]
(Figs. 28–37)

Hazuregyra watanabei Shikama, 1962: 41–42, text-figs, pl. 1, figs. 22a–d, 23a–b; Okutani, 1964: 383, pl. 5, fig. 11; Habe and Ito, 1965a: 16, pl. 6, fig. 3.

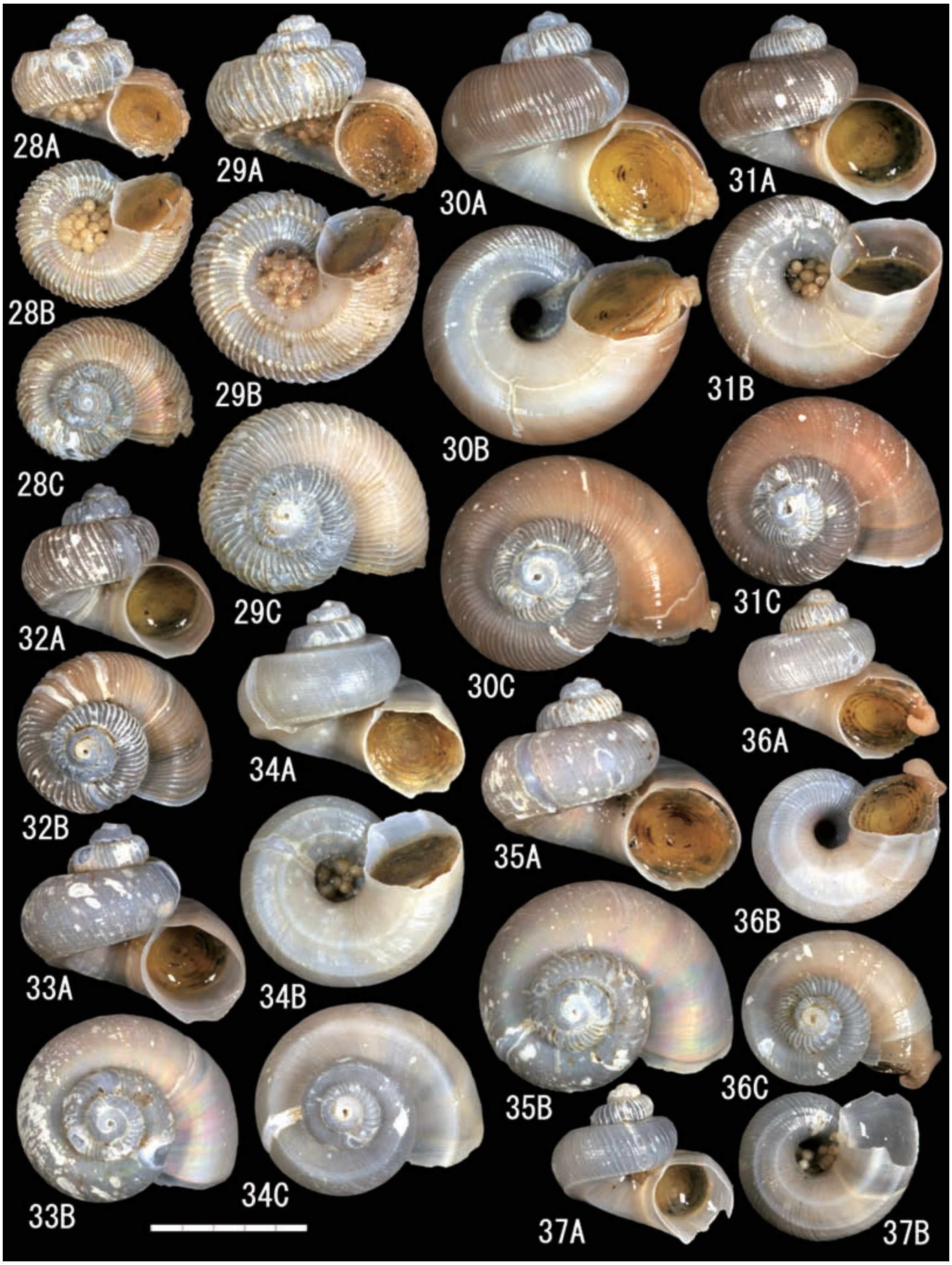
Type locality. [Off Choshi, sea area Kashima-nada] "Precisely unknown, 200–250 f; gained from stomach of *Lycodes caudimaculatus*".

Distribution. Off Hachinohe in Aomori Prefecture (present study) and southwards to sea area Kashima-nada; 300–870 m [210–900 m].

Material examined. WA9301-A64 [203–204 m] (1); WA05-DE380D (4+2e); WA05-EF250D (9+2e); WA05-EF425 (1e); WA05-EF450D (25+2e); WA05-FG250D (1); WA05-FG410 (1); WA05-FG450 (2e); WA05-FG510D (6); WA05-G280 (1+2e); WA05-GH380D (1); WA05-GH410 (1e); WA06-DE480 (1e); WA06-E510D (7); WA06-EF425D (11+5e); WA06-FG350D (2+1e); WA06-FG480 (1e); WA06-G900D (1); WA06-GH480D (1); WA06-H250D (2+5e); WA07-A250D (4+1e); WA07-D210D (9+4e).

Remarks. The specimens examined fall at a glance into several distinct forms, as shown in the figures, but detailed examination resulted in the recognition of only one extremely variable species. Important variable factors include 1) size, 2) coloration, 3) strength of the keel at the shoulder, and 4) strength of the axial sculpture. Various combinations of these factors make up very different phenotypic forms.

1) Size: The largest specimen (9.5 mm SW) is nearly twice as large as the smallest mature specimen (5.0 mm SW). Maturity can be confirmed by the presence of eggs brooded in the umbi-



Figs. 28–37. *Hazuregyra watanabei*, 28: WA05-EF250D; 29: WA05-FG410; 30: WA05-DE380DF; 31: WA06-EF425D; 32: WA06-FG350D; 33: WA05-EF450D; 34: WA06-E510D; 35: WA05-EF450D; 36: WA05-FG510D; 37: WA06-G900D. Scale: 5 mm (all at the same scale).

licus in females.

2) Coloration: Although most of the specimens are uniformly grayish white, some of them possess distinct brownish coloration on the adapical half of each whorl (Figs. 30–31). The basal

part is invariably white. Furthermore, the outer shell layer of some specimens transmits the iridescence of the internal nacre (Figs. 33, 35).

3) Keel at the shoulder: The specimens examined basically have three angulations on the body whorl; one at the shoulder and two at the base. Although the latter two angulations are of consistent strength in all the specimens, the one at the shoulder varies from very strong (Figs. 28, 29, 34) to nearly absent (Figs. 33, 35).

4) Axial sculpture: The strength of the axial sculpture is remarkably variable in this species. Axial ribs are very distinct in some specimens (Figs. 28, 29), in which the shell surface possesses a washboard-like appearance, but they are not very distinct in other specimens, and are sometimes completely absent on the body whorl (Figs. 34–35). However, it is noteworthy that strong axial ribs are consistently present in the early teleoconch whorls in all the specimens examined.

Although almost no significant vertical or geographical clines are seen to be reflected in any of these factors, specimens collected at around 500 m and deeper usually have a smaller shell with weaker axial sculpture (Figs. 36–37).

As mentioned above, mature female specimens were found to brood eggs in the umbilicus (Figs. 28, 31–34, 37). This kind of brooding has also been observed in *Margarites vorticiferus* Dall, 1873 (Lindberg and Dobberteen, 1981; Hasegawa, personal observation at Akkeshi, Hokkaido), which may suggest a systematic relationship between the genus *Hazuregyra*, which was proposed by Shikama (1962) to accommodate this particular species, and *Margarites*. On the other hand, although sexual dimorphism in the diameter of the umbilicus was observed in *M. vorticiferus*, no significant variation in the relative width of the umbilicus was recognized in the present species. Regarding the reproductive cycle, it was not possible to determine whether oviposition occurs in a limited season or throughout the year, because the present survey was carried out only between October and November of each year.

Solariella delicata (Dall, 1919)
[Japanese name: Uba-shitadami]
(Figs. 38–46)

Solariella delicata Dall, 1919b: 362; Kosuge, 1972: pl. 2, fig. 6 (holotype?).
Machaeroplax delicata — Habe, 1955b: no page number, text-fig (paratype); Okutani, 1964: 381–382, pl. 1, fig. 8.
Machaeroplax sp. cf. *M. nyssona* — Tsuchida, 1985: 96, pl. 1, fig. 1.
Machaeroplax delicatus — Takenouchi in Okutani, 1986: 48, with color fig.; Baba, 1990: 114, pl. 2, fig. 5; Sasaki in Okutani, 2000: 77, pl. 38, fig. Trochidae-111.
Machaerplax [sic; = *Machaeroplax*] sp. — Tsuchida and Kurozumi, 1995: 174–175, figs. 2, 6 (3–5).
Solariella tuberculata Bagirov, 1995: 2, figs. 1A, 2A–B, 4 (type locality: off northeastern Honshu, 39˚58.8´N, 142˚19.3´E, 425 m); Kantor and Sysoev, 2006: 37, pl. 16, fig. H. New synonym.
Solariella sp. — Hasegawa, 2001: 129, pl. 1, figs. I–J.
?*Solariella delicata* — Kantor and Sysoev, 2006: 37, pl. 16, fig. E.

Type locality. USBF station 5050, near Hakodate, Japan [off Kinkazan, Miyagi Prefecture], 38˚11.5´N, 142˚08´E, 266 fathoms.

Distribution. Off Hachinohe in Miyagi Prefecture (present study) and southwards to Tosa Bay (Hasegawa, 2001: as *Solariella* sp.); 620–1640 m [350–1500 m].

Material examined. WA9203-B18 [451–455 m] (1e); WA95-B1000 (21+9e); WA05-DE380D (2+3e); WA05-DE450 (1); WA05-DE480 (2+1e); WA05-DE510 (1); WA05-EF425 (1e); WA05-EF450D (13+2e); WA05-F410 (1e); WA05-FG350 (2); WA05-FG380 (2+1e); WA05-FG410 (9+3e); WA05-FG425 (6+5e); WA05-FG450 (9+4e); WA05-FG480 (1); WA05-FG510 (1); WA05-FG510D (2+8d); WA05-GH380 (2e); WA05-GH410 (1); WA05-GH425 (2); WA05-G450 (1); WA05-G1500D (1+1e); WA05-GH510D (1); WA06-DE380 (1e); WA06-DE425 (1e); WA06-

Figs. 38–46. *Solariella delicata,* 38: WA05-FG350; 39–42: WA06-H480; 43: WA06-F1500D-2; 44: WA06-F1500D-1; 45–46: WA95-B1000. Scale: 5 mm (all at the same scale).

DE450 (2e); WA06-DE480 (1); WA06-E510 (1); WA06-E510D (1+1e); WA06-EF350 (1); WA06-EF380 (1+1e); WA06-EF410 (2e); WA06-EF425D (18+14e); WA06-F380 (1); WA06-F650D (2e); WA06-F750 (1+1e); WA06-F1500D-1 (10+3e); WA06-F1500D-2 (5+4e); WA06-FG350D

(3+16e); WA06-FG380 (1); WA06-FG410 (6e); WA06-FG450 (5+13e); WA06-FG480 (1+3e); WA06-FG510 (1e); WA06-G410 (2); WA06-G900D (2+3e); WA06-GH410 (1); WA06-GH425 (1+4e); WA06-GH480 (1e); WA06-H480 (ca. 100+ca. 100e); WA06-H510 (5+1e); WA06-H750 (1); WA06-H1500D (2+1e); WA07-C1500D (1); WA07-D900 (15); WA08-F900 (8+4e); WA08-G1500 (1); TS96-K2 [1451–1455 m] (30+33e).

Remarks. This species also shows a considerable range of variation in shell morphology. The most variable character that affects the appearance is the strength and the number of spiral cords. The spiral sculpture is basically composed of 1) strong, widely spaced cords and/or 2) crowded finer cords. The number of strong spiral cords varies even in a single population (Figs. 39–42), ranging from 1–2 (Fig. 42) to 6 (Fig. 39) in number. Tsuchida and Kurozumi (1995: figs. 6 (3–5)) distinguished the specimens with a small number of strong spiral cords from *S. delicata* and cited them as *Machaeroplax* sp., but they are continuous to the typical form as shown here. Specimens with only finer axial ribs tend to occur both in shallower (Fig. 38: 350 m) and deeper (Fig. 45: 1000 m) habitats.

The general shape of the shell also varies among populations. The shell is typically conical with a weak angulation below the periphery (e.g. Fig. 39), but it is sometimes also angulate at the shoulder (Figs. 41–42, 45). Specimens collected from the deepest stations at around 1500 m (Figs. 43–44) possess a more depressed shell, with a rounded periphery and a wider umbilicus that is sculptured by many spiral cords. *S. tuberculata*, which was described from off northeastern Honshu (425 m at the type locality; paratypes were collected at depths of 366–2720 m), closely resembles this deep-water form, but displays a rather intermediate state of shell characters between the deep-water and typical forms, i.e. a depressed shell with many spiral cords and a few strong spiral cords on the umbilical wall. An important character that is consistently observed among the specimens examined is the weak, thread-like axial sculpture, and this is regarded here as a diagnostic character of the present species. Based on this criterion, *S. tuberculata*, the specimens recorded from off Kii Channel as "*Machaeroplax* sp. cf. *M. nyssona* (Dall, 1919)" by Tsuchida (1985), and those from Tosa Bay as "*Solariella* sp." by Hasegawa (2001) are identified as the present species.

Considering the high variability in the shell morphology of the present species, it is necessary to discuss its taxonomical relationship with the closely allied species *S. nyssonus* Dall, 1919, which was described by the same author in the same publication, from USBF station 3738, "off Hondo [Honshu], Japan". Specimens that agree well with the figures of the holotype of *S. nyssonus* (Kosuge, 1972; Higo *et al.*, 2001) were collected during our previous sampling programs from Sagami Bay (Hasegawa, 2006; 149–447 m) and Tosa Bay (Hasegawa, 2001; 239–302 m), and are illustrated herein (Figs. 47, 48; Sagami Bay and Tosa Bay, respectively). They are distinctly separable from the present material by having coarser axial sculpture, which becomes spiculate at its intersection with the strong spiral cords, especially at the shoulder. Furthermore, *S. delicata* inhabits significantly deeper waters than *S. nyssonus*, i.e. 620–1640 m in Sagami Bay (Okutani, 1964, 1966) and 975–1112 m in Tosa Bay (Hasegawa, 2001: as *Solariella* sp.), suggesting a difference in their vertical distributions. Regarding the geographical distribution, although *S. delicata* is restricted to an area along the Pacific coast of Honshu southwards to Tosa Bay, *S. nyssonus* is distributed in Sagami Bay and southwards to the East China Sea, and in the Sea of Japan. The specimen recorded by Ito (1990) from off the Noto Peninsula in the Sea of Japan as "*Machaeroplax delicatus* (Dall)" has coarser axial sculpture and can thus correctly be identified as *S. nyssonus*.

Figs. 47–55. Trochidae, Ataphridae and Turbinidae. 47–48. *Solariella nyssoides*, 47: RK01-3 (Sagami Bay, 149–180 m); 48: KM97-11-250 (Tosa Bay, 250–258 m). 49–50. *Solariella tenuicollaris*, 49: WA06-F1500D; 50: TS96-K2 [1451–1455 m]. 51. *Solariella* sp. 2, WA07-B210 (empty shell). 52. *Trochaclis* sp., WA05-F1200. 53–54. *Acremodonta* sp., 53: WA06-FG450; 54: WA06-EF425. 55. *Skenea* sp., WA07-D900. Scales: 47–50 = 5 mm (at the same scale); 51–55 = 3 mm (at the same scale).

Solariella tenuicollaris Golikov and Sirenko, 1998
[New Japanese name: Toguro-shitadami]
(Figs. 49–50)

Machaeroplax nyssonoides Kuroda MS — Okutani, 1964: 382, pl. 1, fig. 5 [nom. nud.].
Solariella tenuicollaris Golikov and Sirenko, 1998: 98, figs. 2C–D, 15A, H; Kantor and Sysoev, 2006: 37, pl. 16, fig. F.

Type locality. Off Iturup Island, South Kurile Islands, 44˚42.5´N, 149˚07´E, 1200 m.

Distribution. Sagami Bay (Okutani, 1964: as *Machaeroplax nyssonoides*) and northwards to the southern Kurile Islands; 700–1200 m [900–1500 m].

Material examined. WA05-F1200 (1); WA05-G1500D (1e); WA06-F1500D-1 (10); WA06-F1500D-2 (2+5e); WA06-G900D (1+1e); WA06-H1500D (2+2e); WA07-C1500D (1); WA07-D900 (32); TS96-K2 [1451–1455 m] (4+7e).

Remarks. This species is easily distinguishable from the preceding species by having a rather loosely coiled shell, with more rounded whorls that are detached from the body whorl near the aperture, and fine axial ribs that are usually more distinct than the spiral cords. This is the first record of this species in Japanese waters, and it represents a southward range extension to Ibaraki Prefecture.

Solariella sp. 1
(Figs. 26–27)

Material examined. WA07-C350D (1); WA07-D210D (2e).

Remarks. This species is represented by only two specimens; one live collected juvenile (Fig. 27) and one empty shell (Fig. 26). Both are characterized by a high conical shell, with lattice-like coarse axial and spiral cords, and are provisionally assigned to the genus *Solariella* Wood, 1842 (type species: *Solariella maculata* Wood, 1842, by monotypy) due to the similarity in the shell features.

Solariella sp. 2
(Figs. 51)

Material examined. WA07-B210 (2e).

Remarks. Only one empty shell is available, which shows some resemblance to the species of *Minolia* A. Adams, 1860. However, because of the absence of enough material in good condition, it is here treated as an unidentified species of *Solariella*, which is often regarded as a senior synonym of *Minolia* (Hickman and McLean, 1990).

Family Ataphridae Cossmann, 1915
[synonym: Trochaclididae Thiele, 1928]
Trochaclis sp.
(Fig. 52)

Material examined. WA05-F1200 (1).

Remarks. The single available specimen most closely resembles *Ganesa nitidiuscula* Jeffreys, 1883, the type species of the genus *Ganesa* Jeffreys, 1883 (Dr. A. Warén, personal communication). However, *G. nitiduscula* is known only from a partly broken syntype (Warén, 1992), and its systematic position is still uncertain. On the other hand, the present material also agrees well with the species of *Trochaclis* Thiele, 1912 (type species: *Trochaclis antarctica* Thiele, 1912, by monotypy) in the shell morphology (Marshall, 1995), although examination of the radula will be necessary to confirm its precise systematic position.

Acremodonta sp.
(Figs. 53–54)

Material examined. WA05-GH510 (1); WA06-EF425 (1); WA06-FG450 (1); WA06-FG480 (1: on sunken wood); WA06-GH480 (1).

Remarks. This species is provisionally assigned to the trochaclidid genus *Acremodonta* Marshall, 1983 (type species: *Conjectura carinata* Powell, 1940, by original designation), because of the similarity in the shell morphology to the type species and other species in the genus illustrated by Marshall (1995), especially its large size for the family, exceeding 5 mm SL, and presence of strong spiral cords. This is despite all the previously known species in the genus being distributed in the southern Pacific.

Family Turbinidae Rafinesque, 1815
[synonym: Skeneidae Clark, 1851]

Skenea sp.
(Figs. 55)

Material examined. WA07-D900 (1).

Remarks. One live-collected but poorly preserved specimen was tentatively assigned to *Skenea* Fleming, 1825 (type species: *Helix serpuloides* Montagu, 1808, subsequently designated by Gray, 1847) based only on the shell profile and operculum.

Family Turritellidae Lovén, 1847

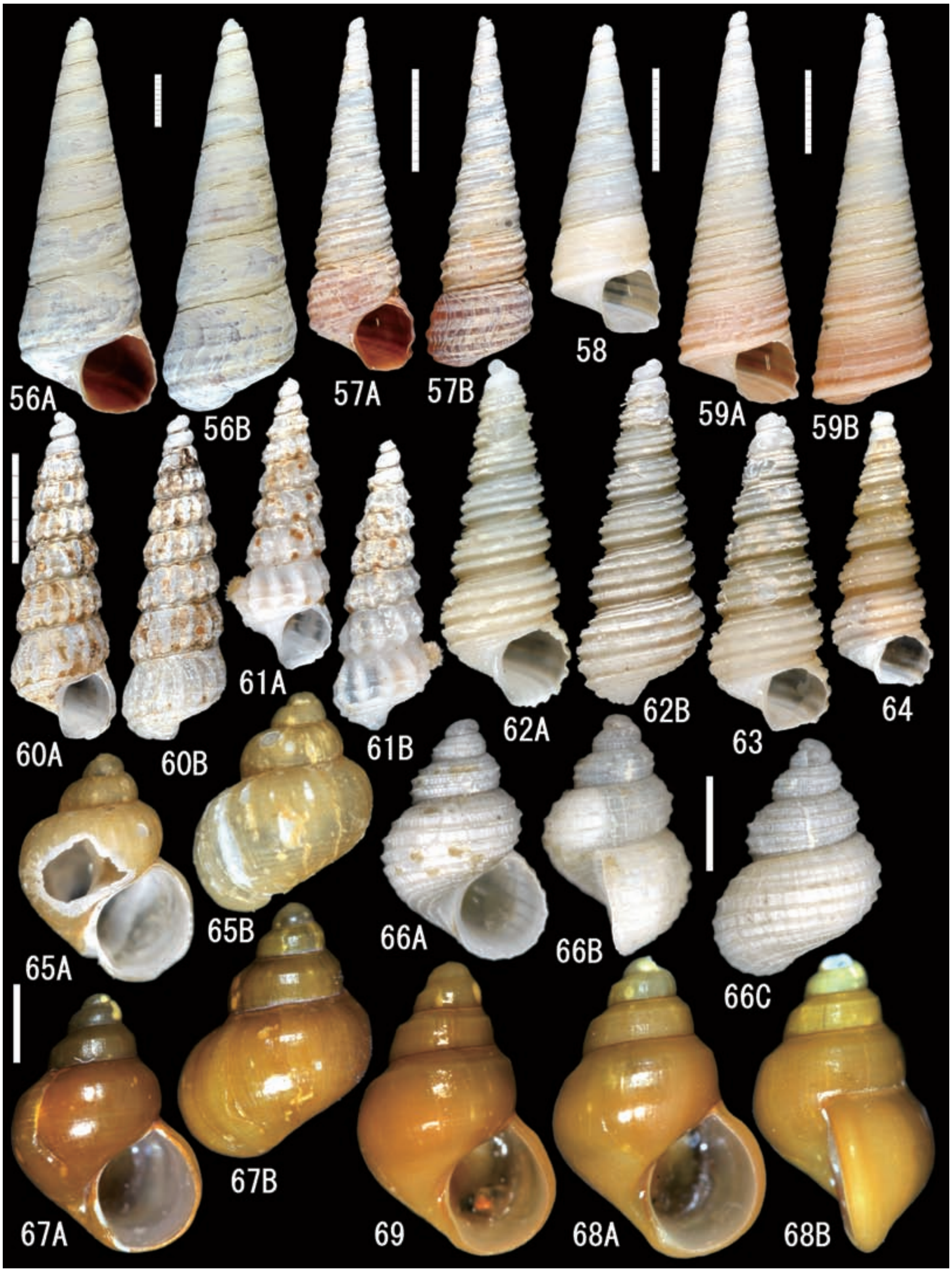
Neohaustator fortilirata (Sowerby, 1914)
[Japanese name: Ezo-kirigai-damashi]
(Figs. 56–57)

Turritella fortilirata Sowerby, 1914: 36, pl. 2, fig. 12; Kotaka, 1951: pl. 11, figs. 1–2; Galkin and Scarlato, 1955: 172, pl. 44, fig. 25.
Turritella (*Faustator* [sic; *Haustator*]) *fortilirata* — Kinoshita and Isahaya, 1934: 6, pl. 3, fig. 21.
Turritella (*Haustator*) *fortilirata* — Otuka, 1938: 39, fig. 29.
Turritella nipponica — Kotaka, 1951: 25, pl. 12, figs. 3–6 [non *Turritella nipponica* Yokoyama, 1920].
Turritella (*Neohaustator*) *fortilirata* — Kira, 1959: 26, pl. 12, fig. 2; Hasegawa in Okutani, 2000: 127, pl. 63, figs. Turritellidae-3a–c.
Neohaustator fortilirata — Habe and Ito, 1965a: 27, pl. 7, fig. 18; Okutani 1986: 76, 77 with color fig.; Higo *et al*., 2001: fig. G742 (holotype).
Haustator (*Neohaustator*) *fortilirata* — Kuroda and Habe in Okada *et al*. 1965: 56, text-fig.; Okutani *et al*., 1988: 42, text-fig.
Neohaustor [sic] *andenensis* — Watanabe and Naruke, 1988: pl. 5, fig. 5 [non *Turritella* (*Haustator*) *andenensis* Otuka, 1934].
Neohaustor [sic] *fortilirata* — Ito, 1989: 44, pl. 3, fig. 11.
[See Otuka (1938) for additional synonyms.]

Type locality. Nemuro, Yesso [Hokkaido].

Distribution. Off Choshi, in sea area Kashima-nada, and northwards to southern Kurile Islands and southern Okhotsk Sea; 30–300 m [210–1500 m].

Material examined. WA9308-S12 [250 m] (2e); WA06-D450D (1); WA06-DE380 (1e);



Figs. 56–69. Turritellidae and Rissoidae. 56–57. *Neohaustator fortilirata*, 56: WA07-B410; 57: WA07-A250D. 58–59. *Neohaustator* sp. cf. *andenensis*, 58: WA05-DE380D; 59: WA07-C350D. 60–61. *Tachyrhynchus yanamii*, 60: WA07-A250D; 61: WA05-EF250D. 62–64. *Tachyrhynchus* sp., 62: WA06-D450D; 63–64: WA07-D900. 65. *Punctulum flava*, WA06-H480 (empty shell). 66. *Alvania* sp., WA05-DE250D. 67–69. *Frigidoalvania* sp., 67: WA06-DE280D; 68–69: WA06-H1500D. Scale: 56–59 = 10 mm; 60–64 = 5 mm (at the same scale); 65, 67–69 = 1 mm (at the same scale); 66 = 1 mm.

WA06-DE410 (2e); WA06-E350 (1); WA07-A250D (13+14e); WA07-A410 (1e); WA07-A450 (1); WA07-A1500D (1e); WA07-B350 (3e); WA07-B410 (2); WA07-B410D (1e); WA07-C350D (4e); WA07-C510 (1e); WA07-D210D (3); WA07-D350 (3e); WA07-D450(1e).

Remarks. Japanese Cenozoic and Recent species of the genus *Turritella* (sensu lato) have extensively been studied by paleontological researchers (see Otuka, 1938, Kotaka, 1951). However, they are still difficult to identify because of the possible wide range of variation both in sculpture and the relative width to the height, in contrast to their rather simple shape. Besides *N.* sp. cf. *andenensis*, which is discussed below, two superficially different forms are recognized among the specimens examined; one is characterized by a larger (65–75 mm SL, excluding missing apical whorls) and stouter shell with a less distinct suture (Fig. 56), and the other by a smaller (less than 40 mm SL) and much more slender shell, with a deeply canaliculated suture (Fig. 57). The former occurred in deeper stations (350–450 m) and the latter in shallower stations (210–250 m). Some previous authors have distinguished the latter (smaller) form as "*Turritella nipponica*" but most recent authors regarded it as a phenotype or juvenile form of the former (e.g. Hasegawa in Okutani, 2000). Although no intermediate forms, either in size or locality depth, were obtained, they are provisionally considered to be conspecific based on the similarity of the spiral sculpture, which consists of four strong spiral cords and no secondary cords in the interspaces.

Neohaustator sp. cf. ***andenensis*** (Otuka, 1934)
(Figs. 58–59)

?*Turritella* (*Haustator*) *andenensis* Otuka, 1934: 622–623, pl. 51, figs. 100, 113 (type locality: Anden, Akita Prefecture; Shibikawa Formation, Pleiocene); Takayasu *et al*., 1986: pl. 68, figs. 11, 14a–b, pl. 71, fig. 31a–b (specimens from the type locality).

Material examined. WA05-DE380D (3); WA07-C350D (2).

Remarks. These specimens clearly differ from *N. fortilirata* by their significantly stouter shell, when compared at the same height, with an acutely angulate base and more complicated spiral sculpture. The sculpture consists of several strong spiral cords, which are strongest at the periphery and decline in strength adapically toward the suture, with finer secondary ribs in the interspaces. Based on these characters, this species resembles *Turritella andenensis*, which was described on the basis of a Pleistocene fossil and has subsequently been recorded from various parts of the Sea of Japan (Konishita and Isahaya, 1934 [as "*Turritella* sp. (cf. *perterebra* Yokoyama, var.)"]; Kotaka, 1951; Habe, 1961; Ito, 1967; Ito *et al*., 1986; Ito, 1990; Hasegawa in Okutani, 2000). *Turritella andenensis tsushimaensis* Kotaka, 1951 was described from the Tsushima Strait as a subspecies, but it has been regarded as a junior synonym of the nominate species. There is, however, a considerable difference in shell morphology among the illustrated specimens under these names, ranging from an extremely slender shell with fine spiral sculpture to a rather robust shell with strong spiral cords. Furthermore, the present material from the Pacific coast differs from all that in the Sea of Japan in possessing an acute angulation and stronger spiral cords at the periphery, and not a well-defined suture. It is here only provisionally regarded as a geographical form of *N. andenensis* in view of the known variability of that species and the existence of a possible intermediate form (Ito *et al*., 1986: pl. 5, fig. 2).

Tachyrhynchus yanamii (Yokoyama, 1926)
[Japanese name: Yuki-hime-nina]
(Figs. 60–61)

?*Turbonilla* (*Pyrgiscus*) *yanamii* Yokoyama, 1926: 280, pl. 35, fig. 4.

Tachyrhynchus reticulatum — Habe, 1961a: 24, pl. 11, fig. 2; Ito, 1967: 51: pl. 1, fig. 11; Ito, 1985: 27, pl. 2, fig. 3; Ito *et al*., 1986: 9, pl. 4, fig. 6; Ito, 1989: 45, pl. 3, fig. 13.
Tachyrhynchus cfr. reticulatus — Kotaka, 1962: 131–132, pl. 33, fig. 7.
Tachyrhynchus reticulatus — Habe and Ito, 1965a: 27, pl. 7, fig. 15 [non *Turritella retuculata* Mighels and C. B. Adams, 1842].
Tachyrhynchus yanamii — Hasegawa in Okutani, 2000: 127, 129, pl. 64, fig. Turritellidae-5.

Type locality. Sawane Formation, Sado Island, early Pleistocene

Distribution. From off Onahama in Fukushima Prefecture to southern Hokkaido, and Noto Peninsula and northwords in Sea of Japan; 50–1500 m [250–450 m].

Material examined. WA05-EF250D (4+1e); WA05-EF450D (5+2e); WA05-G280 (1e); WA07-A250D (8+9e).

Remarks. This species has been rather consistently identified as "*Tachyrhynchus reticulata*" in the Japanese literature, as shown in the synonymy. *Turritella reticulata* Mighels and C. B. Adams, 1841 was originally described from Bay Chaleur, in the Gulf of St. Lawrence, in the northwestern Atlantic. Although the original illustration was too obscure and deformed for precise identification, one of the "paratypes" was subsequently illustrated by Clench and Turner (1950: pl. 40, fig. 14), and it resembles well the Japanese specimens. Nevertheless the latters, including the present material, can be distinguished from *T. reticulata* in always possessing a distinct basal cord. Accordingly Hasegawa (in Okutani, 2000) identified them as the Pliocene fossil species *Turbonilla* (*Pyrgiscus*) *yanamii* Yokoyama, 1926, with some hesitation. This identification was based on the strong basal cord, although *T. yanamii* still differs markedly from the Recent specimens by possessing significantly weaker axial and spiral sculpture (Hasegawa, 2009).

Tachyrhynchus sp.

(Figs. 62–64)

Material examined. WA95-B1000 (7+2e); WA06-D450D (1); WA06-GH480 (1e); WA07-D900 (ca. 100+ca. 40e).

Remarks. The material examined closely resembles the species known in Japanese literature as "*Turritellopsis acicula stimpsoni* Dall, 1919" [Japanese name: Yuki-no-kiri-nina], but differs in having a more slender shell with significantly finer spiral sculpture and a thinner periostracum. See Hasegawa (2009) for a discussion of the taxonomical confusion related to the latter species.

Family Rissoidae Gray, 1874

Punctulum flava (Okutani, 1964) new combination

[Japanese name: Watazoko-tsubo]

(Fig. 65)

Microstelma flava Okutani, 1964: 389–390, pl. 6, fig. 5; The Committee for Celebrating Dr Okutani's Retirement from Tokyo University of Fisheries, 1996: 73, pl. 2, fig. 12 (holotype).
Punctulum ochotense Golikov and Sirenko, 1998: 102, figs. 3E, 15D, K (type locality: off Paramushir Island, in Okhotsk Sea, 50˚32.2´N, 155˚37.4´E, 550 m); Kantor and Sysoev, 2006: 75, pl. 36, figs. F–G. New synonym.
Alvania (*Alvania*) *flava* — Hasegawa in Okutani, 2000: 149, pl. 74, fig. Rissoidae-6.

Type locality. R/V *Soyo-mru*, St. 59, 35˚05.35´N, 139˚18.65´E, Sagami Bay, 550 m.

Distribution. Southern Kurile Islands and southwards to Tosa Bay (Hasegawa, 2001); 500–776 m [480 m].

Material examined. WA06-H480 (1e).

Remarks. This species was represented in the present material by one dead-collected specimen. Although Hasegawa (in Okutani, 2000) transferred this species to the genus *Alvania* Risso, 1826, it is here relocated in the subgenus *Punctulum* Jeffreys, 1884, which has been regarded as a distinct genus by recent workers (e.g. Kantor and Sysoev, 2006), based on the combination of several distinct characters, such as the distinctly umbilicate shell with a thin outer lip, and a protoconch that is smooth except for fine spiral lines. *Punctulum ochotense* Golikov and Sirenko, 1998, described from the Okhotsk Sea at a depth of 500 m, cannot be distinguished from the present species, and is here regarded as a junior synonym.

Alvania sp.
(Fig. 66)

Material examined. WA05-DE250D (2).

Remarks. This species most closely resembles *Alvania maya* (Yokoyama, 1926) in general appearance, but differs by its small size (2.5 mm SL) and the possession of a smaller spire and finer, thread-like axial ribs. No comparable species can be found in Japanese or adjacent waters.

Frigidoalvania sp.
(Figs. 67–69)

Frigidoalvania sp. — Hasegawa, 2006: 241, 243, Fig. 4A.

Material examined. WA05-DE250D (2+1e); WA05-FG250D (14+13e); WA06-DE280D (5+4e); WA06-H480 (17+7e); WA06-H1500D (2+1e); WA07-D310 (1); TS96-K2 [1451–1455 m] (2).

Remarks. Hasegawa (2006) recorded poorly preserved specimens of this species from Sagami Bay, at a depth of 725–730 m. It most closely resembles *Mohrensternia derjugini* Golikov and Licharev in Golikov and Scarlato, 1985 (type locality: eastern coast of southern Sakhalin, 187 m), in having a smooth, solid shell covered by a thick brownish periostracum, but differs from the latter in having a strong carina at the shoulder and a larger sipre. The genus *Mohrensternia* Stoliczka, 1868 (type species: *Rissoa angulata* Eichiwald, 1830, subsequently designated by Nevill, 1885, Miocene in Europe) was deduced by Ponder (1985) to be a hydrobiid. The present species is here assigned to *Frigidoalvania* Warén, 1974 (type species: *Rissoa janmayeni* Friele, 1878, by original designation) for the overall shell characters and the distinctive thick periostracum.

Family Haloceratidae Warén and Bouchet, 1991

Haloceras japonica Okutani, 1964
(Fig. 73)

Haloceras japonicus Okutani, 1964: 397–398, pl. 6, fig. 8; The Committee for Celebrating Dr Okutani’s Retirement from Tokyo University of Fisheries, 1996: 74, pl. 2, fig. 4 (holotype).

Haloceras japonica — Warén and Bouchet, 1991: 140, figs. 34, 40, 62, 64–65; Hasegawa in Okutani, 2000: 205, pl. 102, fig. Haloceratidae-1 (holotype).

Type locality. R/V *Soyo-maru*, St. B2, 34˚10.0´N, 140˚05.5´E, 26 miles off Miyake Island [Izu Islands], 1230–1350 m.

Distribution. Off Izu Islands, off Iwate Prefecture (present study), and off Oregon in eastern Pacific (Warén and Bouchet, 1991); 1230–1580 m [1500 m].

Material examined. WA07-C1500D (1).

Remarks. The only available specimen bears a distinctive thick periostracum, which was not observed in the holotype or other examples of this species hitherto reported, but otherwise agrees

Figs. 70–79. Capulidae, Haloceratidae, Ranellidae and Velutinidae. 70. *Trichamathina nobilis**, WA07-B150. 71. *Neoiphinoe unicarinata**, WA06-A150D. 72. *Ciliatotropis ciliata**, WA07-B150. 73. *Haloceras japonica*, WA07-C1500D. 74–75. *Fusitriton oregonensis*, 74: WA05-EF450 (juvenile); 75: WA05-F450. 76. *Marsenina* sp. 1, WA05-GH425. 77. *Marsenina* sp. 2*, WA05-G150. 78–79. *Ciliatovelutina* sp., 78: WA07-D210; 79: WA9303-K12 [155–156 m]. Scales: 70 = 5 mm; 71–72 = 5 mm (at the same scale); 73, 74 = 3 mm; 75 = 20 mm; 76–79 = 5 mm (at the same scale). *: See Appendix.

with them in general shell characters. This is an apparently rare species, known until now only from three specimens (the holotype and a paratype from the type locality, and one other specimen from off Oregon at a depth of 1580 m; Warén and Bouchet, 1991). This is the fourth specimen identified, from the third locality.

Family Velutinidae Gray, 1840
Marsenina sp. 1
(Fig. 76)

Material examined. WA05-GH425 (1).

Remarks. This species was represented by only one live-collected example, in which the shell is completely covered by the mantle. Because the specimen was to be kept intact for future detailed study, precise identification was not possible.

Ciliatovelutina sp.
(Figs. 78–79)

Material examined. WA9303-K12 [155–156 m] (1); WA07-D210 (1).

Remarks. This species is characterized by the presence of distinct strong spiral cords ornamented by hairy tufts, and can thereby be assigned to the genus *Ciliatovelutina* Golikov and Gulbin, 1990 (type species: *Velutina lanigera* Møller, 1842, by original designation). It is distinguishable from all the known species in the genus by having a smaller shell with strong, widely spaced spiral cords. This is the first record of this genus in Japanese waters.

Limneria prolongata (Carpenter, 1864)
[Japanese name: Seitaka-hanazuto]
(Figs. 80–84)

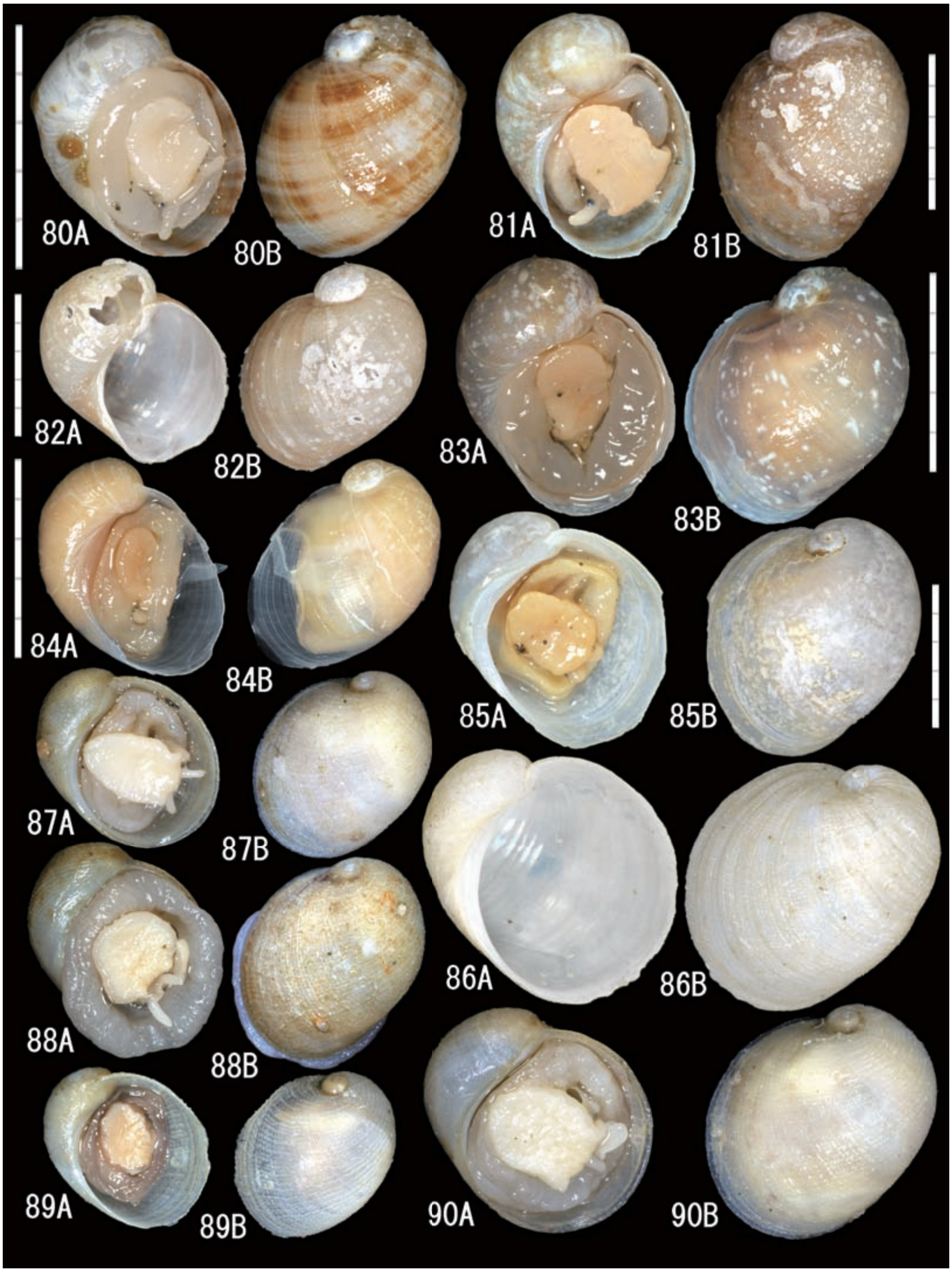
Velutina prolongata Carpenter, 1864: 628, 661; Palmer, 1958: 202, pl. 21, figs. 7–8 (syntype).
Velutina conica Dall, 1887: 305, pl. 3, fig. 10 (type locality: Unalashka, Kadiak [Alaska]); Kosuge, 1972: pl. 6, fig. 6 (holotype).
Velutina (*Limneria*) *conica* — Habe and Ito, 1965a: pl. 6, fig. 30 (paratype of *V. conica*).
Limneria prolongata — Kantor and Sysoev, 2006: 121–122, pl. 54, figs. F–F".
[See Palmer (1958) and Kantor and Sysoev (2006) for additional synonymy.]

Type locality. Neeah Bay [Washington, west coast of North America].

Distribution. Off Onahama in Fukushima Prefecture and northern part of Sea of Japan, both northwards to Alaska; 6–920 m [210–510 m].

Material examined. WA07-D210D (1+1e); WA05-DE380D (1e); WA05-EF250D (1); WA05-FG410 (1); WA05-GH350 (1e); WA05-GH510 (1).

Remarks. The specimen collected from WA07-D210D (Fig. 80) agrees perfectly with the one illustrated as *L. prolongata* (Carpenter, 1864) by Kantor and Sysoev (2006), who considered *Velutina conica* Dall, 1886 to be a junior synonym of this taxon. On the other hand, specimens illustrated in Japanese literature as "*Velutina* (*Limneria*) *conica*" (e.g. Okutani, 2000: pl. 124, Velutinoidae [sic]-11) apparently differs from the present material in possessing a larger shell (ca. 10 mm SL) with simpler spiral cords and uniformly brownish coloration. A syntype of *V. prolongata* illustrated by Palmer (1958), differs visually from the specimens treated here, partly due to deformation resulting from damage during its growth stage, and more detailed study will be necessary to clarify their taxonomical relationship.



Figs. 80–90. Velutinidae. 80–84. *Limneria prolongata*, 80: WA07-D210D; 81: WA05-EF250D; 82: WA05-DE380D (empty shell); 83: WA05-FG410; 84: WA05-GH510. 85–86. *Limneria undata ochotensis*, 85: WA05-DE380D; 86: WA05DE250D (empty shell). 87–90. *Limneria* sp., 87: WA07-D210D; 88: WA07-B210; 89: WA05-EF350; 90: WA07-B250. Scales: 5 mm (85–90 at the same scale).

Seven specimens obtained from six stations are identified as this species, although there is considerable range of variation. The shell from the shallowest station (WA07-D210D; Fig. 80) is small (5.0 mm SL), round conical in shape, and possesses fine, zigzag spiral cords and irregular brown spiral bands, whereas the one from the deepest station (WA05-GH510; Fig. 84) is slightly larger (7.7 mm SL), elongate conical in shape, thin and transparent, and possesses only very weak spiral cords. However, because the specimens collected in between these depths show intermediate characters (Figs. 81–83), they are all regarded here as intraspecific forms of single species.

Limneria undata ochotensis (Derjugin, 1950)
[New Japanese name: Hira-hanazuto]
(Figs. 85–86)

Velutina undata var. *ochotensis* Derjugin, 1950: 10, fig. 2, pl. 1, fig. 2, pl. 4, fig. 2.
Limneria undata ochotensis — Kantor and Sysoev, 2006: 122, pl. 55, fig. B (syntype).

Type locality. Okhotsk Sea.

Distribution. Off Kesen-numa in Iwate Prefecture (present study) and northwards, northern and middle Kurile Islands, Okhotsk Sea, Commander Islands and Pacific coast of Kamchatka; 24–218 m [250–380 m].

Material examined. WA05-DE250D (1+2e); WA05-DE380D (3); WA07-A250D (1e).

Remarks. Limneria undata ochotensis has been known from the middle Kurile Islands and northwards, and the present records from Japanese waters are distant from its known distribution. Nevertheless the specimens can be reasonably identified as this species based on the detailed color photograph of a syntype in Kantor and Sysoev (2006), although they are slightly smaller than type material (9.2 mm SL; a syntype was measured 14.0 mm SL). This species is characterized by a depressed white shell, with relatively thin periostracum and numerous weak spiral cords.

Limneria sp.
(Figs. 87–90)

Material examined. WA05-EF350 (1); WA07-A250 (1); WA07-B210 (2); WA07-B250 (1); WA07-D210D (4+2e).

Remarks. The specimens examined closely resemble the preceding species, but may be separated by their smaller shell (usually around 7 mm SL), with relatively strong spiral cords that are crossed by coarse growth lines, and thicker periostracum. More detailed study will be necessary, however, to clarify their taxonomical relationship.

Family Naticidae Guilding, 1834
Bulbus normalis (Middendorff, 1851)
[Japanese name: Usukawa-kuri-gai]
(Figs. 91–92)

Natica aperta forma *normalis* Middendorff, 1851: 206–208, pl. 11. figs. 1–2.
Bulbus tenuicula — Urita, 1929: 501, text-fig. 1 [non *Natica tenuicula* Sowerby, 1915].
Bulbus flavus elongatus Habe and Ito, 1965a: 31, pl. 8, fig. 8 ; Habe and Ito, 1965b: 17–18, 31, pl. 3, fig. 2 (type locality: Nemuro, Hokkaido); Higo *et al.*, 2001: fig. G1421 (holotype) [synonymy fide Kantor and Sysoev (2006)].
Bulbus tenuiculus — Ito, 1967: 53: pl. 2, fig. 7 [non *Natica tenuicula* Sowerby, 1915].
Bulbus smithi — Ito, 1967: 53: pl. 2, fig. 8 [non *Bulbus smithii* Brown in J. Smith, 1839].
Bulbus flavus — Ito, 1985: 27, pl. 3, fig. 3; Okutani *et al.*, 1988: 46, text-fig. [non *Natica* (*Acrybia*) *flava* Gould, 1839].
Bulbus flavus apertus — Watanabe and Naruke, 1988: 43, pl. 5, fig. 6 [*Natica aperta* sensu Middendorff, 1851, non Lovén,

Figs. 91–99. Naticidae. 91–92. *Bulbus normalis*, 91: WA07-C350D; 92: WA07-A310. 93–94. *Euspira nux*, 93: WA05-DE450; 94: WA07-D900. 95–97. *Euspira* sp. 1, 95: WA07-D900; 96: WA07-D750 (empty shell); 97: TS-96-K2 [1451–1455 m]. 98. *Euspira* sp. cf. *sagamiensis*, 98A: WA05-DE250D; 98B–C: WA07-A250D. 99. *Euspira yokoyamai*, RK-02-3 (Sagami Bay, 99–100 m). Scales: 91–92 = 10 mm (at the same scale); 93, 94 = 10 mm; 95–99 = 5 mm (at different magnifications).

1847; nov. nud.].
Bulbus normalis — Golikov and Sirenko, 1988a: 10, figs. 5 (“neotype” of *Natica aperta* forma *normalis* Middendorff, 1851; see remarks), 6, 25; Kantor and Sysoev, 2006: 63, pl. 30, fig. J.
Bulbus fragilis — Saito in Okutani, 2000: 251, pl. 125, fig. Naticidae-1 [non *Natica fragilis* Leach, 1819].

Type locality. Shantar Islands [northwestern Okhotsk Sea].

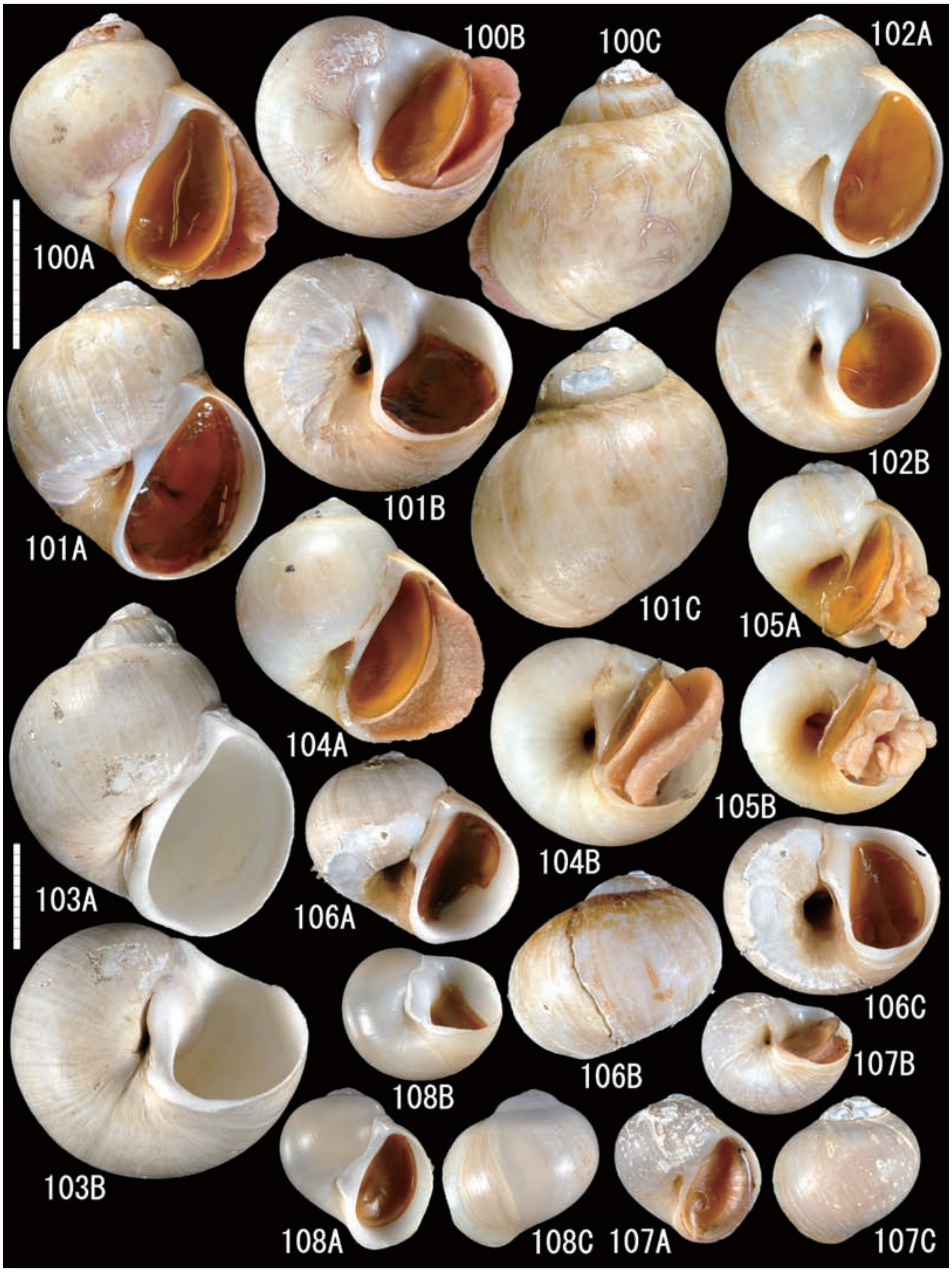
Distribution. Off Coshi, sea area Kashima-nada, and northwards; northern and western Sea of Japan, Okhotsk Sea, Kurile Islands; 40–150 m [150–410 m].

Material examined. WA9201-6 [300 m] (2); WA05-EF250D (1); WA05-G350 (1e); WA06-B310D (3); WA06-EF250 (1); WA06-EF280 (1); WA06-FG310 (1e); WA07-A310 (2+1e); WA07-A350 (1e); WA07-B150 (2e); WA07-B410D (1); WA07-C350 (1e); WA07-C350D (1); WA08-B310 (1e).

Remarks. The present material can reasonably be identified as the species previously known in Japanese literature as “Usukawa-kuri-gai” (e.g. Saito in Okutani, 2000: 251, pl. 125, fig. Naticidae-2), on the basis of its thin shell and completely closed umbilicus. However, there has been a remarkable confusion in the identification of this species. It has been variously identified as shown briefly in the synonymy, including “*B. fragilis* ‘*aperta* (Middendorff)’ (not *aperta* Lea, 1846)” (Kuroda and Kinoshita, 1951) and “*B. fragilis* (Leach, 1819)” (Saito in Okutani, 2000). The former name is unavailable, and the latter was proposed for an Atlantic species (type locality: Baffin Bay, western Greenland) that is not known in the Pacific. On the other hand, Golikov and Sirenko (1988a) illustrated a “neotype” (corrected to “lectotype” by Kantor and Sysoev, 2006: 63) of *Natica aperta* forma *normalis* Middendorff, 1851 that perfectly agrees with the present species. Furthermore, Golikov and Sirenko’s opinion that *B. flavus elongatus* Habe and Ito, 1965 is a synonym of *B. normalis* is here supported, because the only difference between them is the outline of the shell, and the present material contains intermediate forms. Accordingly, two species of the genus *Bulbus* are recognized in Japanese waters, i.e. *B. tenuiculus* (Sowerby, 1915), found in Hokkaido and northwards in shallow waters down to ca. 50 m, and *B. normalis*, found in the eastern Sea of Japan and on the Pacific coast of northern Japan and northwards in lower sublittoral to bathyal zones.

Euspira pallida (Broderip and Sowerby, 1829)
[Japanese name: Usuiro-tama-tsumeta]
(Figs. 100–108, 118–121)

Natica pallida Broderip and Sowerby, 1829: 372.
Polynices pallidus — Galkin and Scarlato, 1955: 174, pl. 45, fig. 6.
Lunatia pallida — Okutani, 1964: 393, pl. 1, fig. 19; Okutani, 1966: 16, pl. 2, fig. 6; Ishikawa, 1970: 133, pl. 9, fig. 1; Okutani *et al*., 1988: 47, text-fig.; Golikov and Sirenko, 1988a: 16, figs. 12–13, 30–33; Kantor and Sysoev, 2006: 66, pl. 32, fig. E.
Eunatica pallida — Habe and Ito, 1965a: 30, pl. 8, fig. 3; Ito, 1985: 27, pl. 3, fig. 1.
Lunatia choshiensis Kuroda (MS) — Ito, 1967: 53, pl. 2, fig. 6 [nom. nud.]; Higo *et al*., 2001: fig. G1426 (holotype of “*Lunatica*” *choshiensis* Tiba, 1985).
Lunatica [sic; = *Lunatia*] *choshiensis* Tiba, 1985: 19, pl. 9, figs. 1–4, 6, 8–10 [not figs. 5, 7; fig. 5 is *Euspira nux*, fig. 7 is probably *E*. sp. 1 in this study] (type locality: off Erimo, Hokkaido, 200–250 m).
Euspira sp. cf. *E. nana* — Tsuchida and Kurozumi, 1985: 96, pl. 1, fig. 6.
Euspira sp. cf. *E. pallida* — Tsuchida and Kurozumi, 1985: 96, pl. 1, fig. 7.
Eunatica miyatensis — Ito, 1985: 27, pl. 3, fig. 2 [nom. nud.].
Euspira pallida — Okutani, 1986: 97 with color fig.; Ito *et al*., 1986: 11, pl. 8, fig. 5; Baba, 1990: 146, pl. 7, fig. 8a–b; Tsuchida and Hayashi, 1994: 98, pl. 5, fig. 9; Tsuchida and Kurozumi, 1995: 177, fig. 6 (8); Uno and Masuda, 1997: 3, pl. 1, fig. 4; Saito in Okutani, 2000: 251, pl. 125, fig. Naticidae-5.
Euspira sp. A — Tsuchida and Hayashi, 1994: 98, pl. 5, fig. 7.
[Synonyms in the northern Atlantic are omitted; see Golikov and Sirenko (1988a) for more comprehensive synonymy.]



Figs. 100–108. *Euspira pallida*, 100: WA06-A510; 101: WA06-E650; 102: WA05-G450; 103: WA07-A650 (empty shell); 104: WA06-H510; 105: WA05-EF450; 106: WA07-D410; 107: WA07-D900; 108: WA06-G1200. Scales: 10 mm (all at the same scale, except for 103).

Type locality. Icy Cape [Arctic coast of Alaska, near Wainwright].

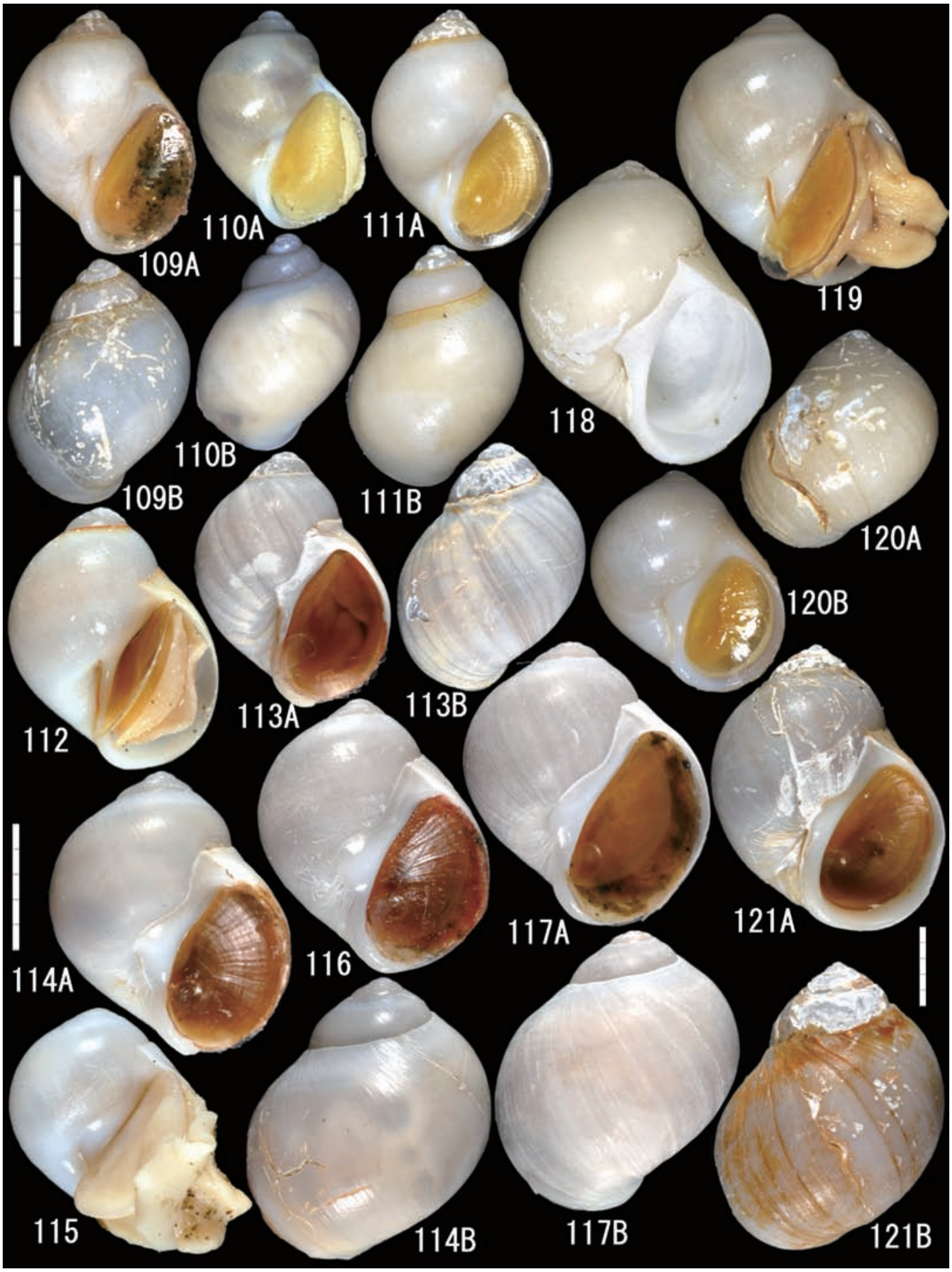
Distribution. Tosa Bay (Hasegawa, 2000), western part of Sea of Japan, and both northwards, circumpolar; 0–2430 m [250–1500 m].

Material examined. WA95-B1000 (6); WA05-DE250D (1); WA05-DE350 (4); WA05-DE380 (1); WA05-DE380D (35+3e*); WA05-DE425 (2); WA05-DE450 (1+1e); WA05-DE480 (4+1e); WA05-DE510 (2); WA05-E410 (1); WA05-E425 (1+1e); WA05-EF380 (1e); WA05-EF410 (1+1e); WA05-EF425 (1); WA05-EF450 (2); WA05-EF450D (8+1*+3e); WA05-F480 (1); WA05-F750 (1); WA05-F1200 (1e*); WA05-FG310 (2); WA05-FG425 (1); WA05-FG480 (1); WA05-G425 (1); WA05-G450 (3); WA05-G510 (1+2e); WA05-G650 (1); WA05-G750 (1); WA05-GH380 (3+1e); WA05-GH380D (3); WA05-GH410 (1); WA05-GH480 (1); WA05-GH510D (3); WA06-A510 (1); WA06-A650 (2); WA06-A1200 (1); WA06-A1200D (1); WA06-B310D (1); WA06-C350D (1); WA06-D450D (2); WA06-DE280D (4+4*+8e*); WA06-DE350 (8e*); WA06-DE380 (3+2e); WA06-DE410 (1+2e+2e*); WA06-DE425 (1+3e+2e*); WA06-DE450 (4+1*+2e*); WA06-DE480 (1); WA06-E350 (1); WA06-E380 (1); WA06-E410 (2); WA06-E450 (4); WA06-E480 (5); WA06-E510 (3); WA06-E510D (1+1e); WA06-E650 (1); WA06-E750 (1); WA06-EF250 (1); WA06-EF350 (1); WA06-EF380 (1+1e); WA06-EF410 (1); WA06-EF425 (3); WA06-EF425D (4+5e+1e*); WA06-EF450 (3); WA06-F425 (1); WA06-F550 (1); WA06-F650 (1); WA06-F650D (1e); WA06-F750 (4+2e); WA06-F1500D-1 (1); WA06-F1500D-2 (1); WA06-FG310 (1+3e); WA06-FG350D (1+4e); WA06-FG380 (1e+1e*); WA06-FG450 (1e); WA06-FG480 (1); WA06-G380 (1); WA06-G425 (1); WA06-F450 (1e); WA06-G750 (1); WA06-G900D (2e); WA06-G1200 (1*); WA06-GH350 (1); WA06-GH480 (1); WA06-GH480D (1+2e); WA06-H310 (1); WA06-H350 (1+1e); WA06-H380 (1+1e); WA06-H425 (1+1e); WA06-H480 (ca. 60+35e); WA06-H510 (6+1*); WA06-H550 (3); WA06-H900 (1e); WA06-H1500D (3+1e); WA07-A350 (1e); WA07-A450 (24+10e); WA07-A510 (1); WA07-A650 (9+3e); WA07-B350 (1+2e); WA07-B410D (9+14e); WA07-B650 (4e); WA07-C350D (4+12e+4e*); WA07-C510 (1e); WA07-C650 (1e); WA07-C1500D (1+1*+1e); WA07-D310 (2*+1**); WA07-D350 (2+2e+2e*); WA07-D410 (7+4e+2e*); WA07-D450 (1); WA07-D750 (1e); WA07-D900 (40+3e); WA08-F900 (2+6e+2e*); TS96-K2 [1451–1455 m] (1) [*: “miniature” form; **: “elongate” form].

Remarks. Because it was extremely difficult to understand the range of variations of this “species” on the basis of conchology alone, several rather distinct forms are here provisionally included under this name that nevertheless probably represents more than one species. However, the specimens shown in Figs. 100–107 seem to belong to a single species, in spite of the considerable variations in shell shape and the width of the umbilicus, because of the presence of intermediate forms. The species is typically characterized by the following features: the shell is thick and usually large for the genus, exceeding 30 mm SL, with relatively thick columellar and parietal calluses. The umbilicus is sometimes completely closed (Fig. 100), but usually narrowly perforate. It is widely perforate in some specimens (Fig. 106), and there seems to be a negative correlation between the width of the umbilicus and relative height of the shell to the width. *Lunatia choshiensis* Tiba, 1985 apparently falls within the range of this species, and is here regarded as a synonym.

On the other hand, some heterogeneous specimens are recognized within the material examined. The specimens shown in Figs. 118–120 [and marked with an asterisk in the “Material examined”] are characterized by a small, an elongate shell, always less than 10 mm SL, with a widely expanded parietal callus on the umbilicus. However, because there are some intermediate specimens (e.g. Fig. 108), they are still regarded as intraspecific forms of the present species. The specimen shown in Fig. 121 [marked with “**” in the “Material examined”] differs considerably from the other specimens by its markedly elongate profile, but Golikov and Sirenko (1998a: fig. 6A) identified a nearly identical specimen as this species. Further detailed study will apparently be necessary to clarify the taxonomical relationship between these forms.

There is an unresolved contradiction in opinions concerning the generic assignment of this and related species. These species had previously been assigned to *Lunatia* Gray, 1837 (type



Figs. 109–121. Naticidae. 109–113. *Euspira* sp. 2, 109: WA06-DE280D; 110: WA06-F1500D; 111: WA05-DE380D; 112: WA06-D450D; 113: WA07-D900. 114–117. *Pseudopolinices* sp., 114: WA06-H350; 115: WA06-FG350D; 116: WA06-H480; 117: TS96-K2 [1451–1455 m]. 118–121. *Euspira pallida*, 118: WA07-C350D (empty shell); 119–120: WA05-DE380D; 121: WA07-D310. Scales: 5 mm (109–111, 118–120 at the same scale; 112–117 at the same scale).

species: *Natica ampullaria* Lamarck, 1822, by original designation), but recent authors (including Majima, 1989 and Marincovich, 1977) preferred to use *Euspira* Agassiz, 1837 (see Bouchet and Warén, 1993, for discussion of the type species of this genus) for them, considering *Euspira* to be a senior synonym of *Lunatia*. Although Bouchet and Warén (1993) supported the latter view, Golikov and Sirenko (1988a) insisted on the validity of *Lunatia*. In the present paper, these species are assigned to *Euspira*, following most recent Japanese authors, in order to avoid confusion.

Euspira nux (Okutani, 1964)
[Japanese name: Tane-tama-tsumeta]
(Figs. 93–94)

Lunatia nux Okutani, 1964: 395, pl. 1, fig. 22; The Committee for Celebrating Dr Okutani's Retirement from Tokyo University of Fisheries, 1996: 75, pl. 2, fig. 7 (holotype).
Lunatia yokoyamai — Okutani and Iwahori, 1992: 244, 246, figs. 23–26; Izawa and Matsuoka, 2005: 10, pl. 6, fig. 4a–b [non *Polinices yokoyamai* Kuroda and Habe, 1952].
Euspira nux — Saito in Okutani, 2000: 251, pl. 125, fig. Naticidae-8.

Type locality. R/V *Soyo-maru*, St. 17, 36˚19.7´N, 141˚09.0´E, sea area Kashima-nada, 870 m.

Distribution. Off Shimokita Peninsula in Aomori Prefecture (present study) and southwards to Tosa Bay (Hasegawa, 2001); 700–1065 m (Hasegawa, 2001) [350–1000 m].

Material examined. WA95-B1000 (3); WA05-DE380D (4); WA05-DE410 (2); WA05-DE425 (1); WA05-DE450 (1); WA05-E650 (1); WA05-DE510 (1); WA05-G350 (1); WA05-GH380 (1e); WA06-B650 (1); WA06-C450 (2); WA06-C750 (1); WA06-DE380 (1+1e); WA06-DE450 (1e); WA06-E310 (1); WA06-E480 (2); WA06-F750 (4); WA06-F900 (2); WA06-FG350D (1); WA06-FG410 (1); WA06-G350 (1); WA06-G750 (1); WA06-G900D (1e); WA06-GH410 (-1) (1e); WA06-GH480D (2); WA06-H480 (37+16e); WA06-H900 (1); WA07-A450 (2+1e); WA07-A550 (1); WA07-A650 (5e); WA07-B350 (1e); WA07-B410 (2e); WA07-B450 (1e); WA07-C450 (3e); WA07-C550 (1); WA07-D350 (2); WA07-D510 (1e); WA07-D900 (ca. 50+33e); WA08-F900 (3+1e); WA08-G350 (1e).

Remarks. This had been an ambiguous species until Saito (in Okutani, 2000) illustrated a correctly identified specimen. Actually it is not rare, being found in various personal and public collections, but it is often erroneously identified as "*E. yokoyamai*". *Euspira nux* closely resembles *E. yokoyamai* (Fig. 99: Sagami Bay) in general shell features, but can be clearly distinguished by its significantly thinner shell with a thin inner lip and columellar callus, and the presence of a thick periostracum especially in the umbilicus. Regarding their vertical distribution, *E. yokoyamai* is found in the lower sublittoral and upper bathyal zones (95–340 m in Sagami Bay; Hasegawa, 2006), whereas *E. nux* is distributed in the deeper waters, i.e. 350–1000 m in the Sanriku region (present study) and 765–1056 m in Tosa Bay (Hasegawa, 2001). Unlike other deep-water *Euspira*, this species shows little intraspecific variation in shell shape or the width of the umbilicus.

Euspira sp. cf. ***sagamiensis*** Kuroda and Habe in Kuroda, Habe and Oyama, 1971
(Fig. 98)

?*Euspira sagamiensis* Kuroda and Habe in Kuroda *et al*., 1971: 186 (Japanese part), 122 (English part), pl. 109, fig. 5 (type locality: Sagami Bay, 85–87 m); Saito in Okutani, 2000: 251, pl. 125, fig. Naticidae-7.

Material examined. WA05-DE250D (1); WA07-A250D (1).

Remarks. The present material generally agrees with *E. sagamiensis*, which is distributed in temperate Japanese waters at lower littoral to upper bathyal depths, on the basis of its small shell for the genus, with a thickened inner lip, especially in the adapical part. However, it differs from that species in lacking a canaliculate suture, and additional material is necessary to confirm the identification.

Euspira sp. 1
[Japanese name: Miyata-tama-tsumeta]
(Figs. 95–97)

Lunatia miyatensis Oyama, MS — Okutani, 1964: 395 [name only; sea area Kashima-nada, 870 m]; Okutani, 1966: 17 [nom. nud.].
Uberella miyatensis Oyama — Matsumoto, 1979: 26, pl. 4, fig. 9 [nom. nud.].
Euspira sp. cf. *E. nux* — Tsuchida, 1985: 96, pl. 1, fig. 7.
Eunatica miyatensis Oyama (MS.) — Ito, 1989: 47, pl. 5, fig. 1 [nom. nud.].
Euspira sp. 2 — Hasegawa, 2001: 136, pl. 2, fig. I.
Not *Eunatica miyatensis* Oyama (MS.) — Ito, 1985: 27, pl. 3, fig. 2 [nom. nud.; is *Euspira pallida*].

Distribution. Off Ofunato in Miyagi Prefecture (present study) and southwards to Tosa Bay (Hasegawa, 2001), and in central part of Sea of Japan (Ito, 1989); [280–1455 m].

Material examined. WA05-GH380 (1e); WA05-H450 (1e); WA06-DE280D (1e); WA06-F1500D-1 (2); WA06-H480 (7e); WA07-D410 (1e); WA07-D450 (2e); WA07-D750 (1e); WA07-D900 (18+8e); TS96-K2 [1451–1455 m] (4+3e).

Remarks. This species so closely resembles the widely umbilicate form of *E. pallida* that it can hardly be distinguished from the latter in some cases. However, it is characterized by the presence of a thick periostracum and especially by the fine spiral sculpture around the umbilical area, which is never observed in *E. pallida*. The two can rather easily be distinguished when they occur sympatrically (e.g. WA07-D900). This species has often been identified as "*Lunatia miyatensis*" in some collections (e.g. the Kawamura and Sakurai collections in the NSMT), and in literature as shown in the synonymy, but the name has never been validated to date.

Euspira sp. 2
[Japanese name: Risu-tama-tsumeta]
(Figs. 109–113)

Lunatia mus Oyama (MS) — Ito, 1967: 53, pl. 2, fig. 4; Uno and Masuda, 1997: 4, pl. 1, fig. 10 [nom. nud.].
Uberella mus Oyama — Matsumoto, 1979: 26, pl. 5, fig. 6 [nom. nud.].
Euspira sp. B — Tsuchida and Hayashi, 1994: 98, pl. 5, fig. 8.
Euspira sp. — Hasegawa, 2006: 248 [Sagami Bay, 149–418 m].

Distribution. From off Shimokita Peninsula in Aomori Prefecture and southward to Kii Peninsula (Matsumoto, 1979), and in Sea of Japan (Ito, 1967); [210–900 m].

Material examined. WA05-DE250D (1e); WA05-DE380D (33+4e); WA05-FG250D (2); WA06-D450D (2); WA06-DE280D (2); WA06-DE350 (2e); WA06-DE380 (1+1e); WA06-E510D (1e); WA06-F1500D-1 (2); WA06-FG350D (2+6e); WA06-G900D (2e); WA06-GH480 (1); WA06-H250D (2+1e); WA06-H480 (2); WA06-H1500D (1e); WA07-A310 (1e); WA07-A450 (1); WA07-B410D (4+4e); WA07-C350D (2e); WA07-D210D (1+2e); WA07-D310 (1e); WA07-D450 (1); WA07-D900 (2); WA08-F900 (2).

Remarks. This species is also well known and has been illustrated as "*Lunatia* (or *Euspira*) *mus* Oyama" in Japanese literature, but the name has not been validated to date. Besides the localities mentioned above, Higo and Goto (1993) recorded this species in Tosa Bay without giving a source, but this was not confirmed by an intensive survey carried out in the area (Hasegawa, 2001). This species is characterized by the narrow, small shell (up to 10 mm SL) with an imperforated umbilicus covered by a narrow inner lip callus that never widens in the central part.

Pseudopolinices sp.
[Japanese name: Shiro-obi-tama-tsumeta (= Shiro-obi-tama-gai)]
(Figs. 114–117)

Lunatia nana — Okutani, 1964: 394–395, pl. 1, fig. 20, pl. 5, fig. 6; Okutani, 1966: 16–17, pl. 2, fig. 7 [non *Natica nana* Møller, 1842].
Eunatica nana — Okutani, 1968: 29–30, pl. 2, fig. 5 [non *Natica nana* Møller, 1842].
Euspira nana — Tsuchida, 1985: 96, pl. 1, fig. 5; Tsuchida and Kurozumi, 1985: 96, pl. 1, fig. 5; Tsuchida and Kurozumi, 1995: 117, fig. 6 (7); Saito in Okutani, 2000: 251, pl. 125, fig. Naticidae-10.
Euspira sp. 1 — Hasegawa, 2001: 136, pl. 2, fig. H [non *Natica nana* Møller, 1842].

Material examined. WA05-DE380 (1e); WA05-DE380D (2); WA05-EF250D (3); WA05-EF380 (1e); WA05-FG450 (1e); WA05-G280 (1e); WA05-G450 (1e); WA05-GH380 (1); WA05-GH380D (1e); WA05-GH510D (1e); WA06-H450 (1e); WA06-DE380 (1e); WA06-DE410 (1e); WA06-E550 (1); WA06-EF410 (2e); WA06-EF425D (4+1e); WA06-EF450 (2e); WA06-F480 (1); WA06-FG350D (2+3e); WA06-FG380 (1e); WA06-FG510 (1e); WA06-G350 (1); WA06-G900D (1e); WA06-GH380 (1); WA06-H350? (1); WA06-H480 (2+7e); WA07-B210 (1e); WA07-D210D (3+7e); WA07-D350 (2e); WA07-D410 (1); TS96-K2 [1451–1455 m] (1); WA08-F900 (1e).

Remarks. Although this species had consistently been identified as “*Lunatia* (or *Euspira*)” *nana* (Møller, 1842) by previous Japanese workers, as shown in the synonymy, Hasegawa (2001) distinguished it from the North Atlantic nominal taxon, based on the comparison of Japanese specimens with illustrated Atlantic specimens (e.g. Bouchet and Warén, 1993: fig. 1952). In the northern Pacific, specimens identifiable as *L. nana* have been recorded from “the southern part of the Bering Sea to Peter the Great Bay, and San Diego (California)” by Golikov and Sirenko (1988a: as *Pseudopolinices nana*). The specimens collected from Commander Island (Golikov and Sirenko, 1988a: fig. 48) and Bering Island (Kantor and Sysoev, 2006: pl. 32, fig. C) actually agree with the Atlantic form, but differ from the present material, in having a tumid parietal callus on the umbilicus, which is separated from the adjoining wall of the whorl by a distinct groove; this character was one of the diagnostic characters used to establish the new genus *Pseudopolinices* Golikov and Sirenko (1983). In the Japanese form, the parietal callus is relatively flat, with no surrounding groove. From the biogeographica point of view, Golikov and Sirenko (1998a) did not record *P. nana* from the waters around Kurile Islands, suggesting a possible discontinuity in distribution between the Japanese populations and the circumpolar populations. Accordingly it is reasonable to separate the Japanese form from *P. nanus* as either distinct species or at least geographical forms.

Cryptonatica hirasei (Pilsbry, 1905)
[Japanese name: Hirase-tama-gai]
(Figs. 122–123)

Natica (Haloconcha) hirasei Pilsbry, 1905: 105, pl. 2, figs. 5–6.
Natica ranzii Kuroda, 1961a: 129–130 (type locality: off Erimo-zaki, south of Hokkaido).
Tectonatica hirasei — Habe, 1961a: pl. 18, fig. 1; Habe and Ito, 1965a: 30, pl. 8, fig. 5.
Cryptonatica (Sulonatica) hirasei — Golikov and Kussakin, 1978: 156–157, fig. 112; Golikov and Sirenko, 1988a: 19–20, figs. 16, 38, 49.
Cryptonatica hirasei — Tsuchida and Kurozumi, 1995: 177, fig. 6 (9); Saito in Okutani, 2000: 266, pl. 132, fig. Naticidae-80; Higo *et al.*, 2001: fig. G1506 (syntype).
Cryptonatica ranzii — Higo *et al.*, 2001: fig. G1500 (holotype).

Figs. 122–133. Naticidae. 122–123. *Cryptonatica hirasei*, 122: WA07-C310; 123: WA07-D410. 124–127. *Cryptonatica aleutica*, 124: WA07-D350; 125–126: WA07-A450; 127: WA05-DE380D. 128–133. *Cryptonatica affinis*, 128: WA06-DE350; 129: WA06-A250D; 130: WA06-A410; 131: WA06-C450; 132: WA06-F1500D-2; 133: WA06-DE480. Scales: 122–123 = 10 mm (at the same scale); 124–126, 129, 131 = 10 mm (at differenct magnifications); 127–128, 132–133 = 5 mm (at the same scale).

Type locality. Akkeshi and Kushiro, Hokkaido.

Distribution. Off Ofunato in Iwate Prefecture and northward to southern Sakhalin, and northern part of the Sea of Japan (Golikov and Sirenko, 1988a); 0–300 m [150–410 m].

Material examined. WA07-B150 (1e); WA07-C310 (1); WA07-D410 (1).

Remarks. Although this species is common in the lower intertidal and upper sublittoral zones in northeastern Hokkaido (observed at Akkeshi; Hasegawa, personal observation), on the Pacific coast of northern Honshu it lives only at a considerable depth and downwards to the bathyal zone. Golikov and Sirenko (1988a) regarded *Cryptonatica ranzii* (Kuroda, 1961), which was described from southern Hokkaido, as an intraspecific form of this species, and that view is supported in the present study. *C. ranzii* is characterized by the presence of a small notch-like gap between the parietal callus and funiculum, but this character is variable among individual specimens, as shown in Figs. 122–123.

Cryptonatica aleutica (Dall, 1919)
[Japanese name: Koshidaka-tama-gai (= Kita-tama-gai)]
(Figs. 124–127)

Natica (*Cryptonatica*) *aleutica* Dall, 1919b: 352 [nom. nov. pro *Natica russa* Dall, 1874, non Gould, 1859].
Natica aleutica — Kosuge, 1972: pl. 6, fig. 7 (holotype).
Cryptonatica russa — Ito *et al*., 1986: 11, pl. 8, fig. 2; Okutani *et al*., 1988: 55, text-fig.
?*Cryptonatica clausa* — Okutani, 1986: 101, with color fig.
Tonea [sic; = *Tanea*] sp. — Ito, 1989: 47, pl. 5, fig. 13.
Cryptonatica sp. — Tsuchida and Kurozumi, 1995: 177, fig. 6 (10).
[See Marincovich (1977), Majima (1989) and Golikov and Sirenko (1988a) for more comprehensive synonymy.]

Type locality. Unalaska, Aleutians.

Distribution. Off Boso Peninsula (Tsuchida and Kurozumi, 1995), and off Noto Peninsula in Sea of Japan (Ito, 1989), both northwards to Aleutians; [210–480 m].

Material examined. WA9303-K12 [155–156 m] (1); WA05-DE250D (5+1e); WA05-DE380D (2); WA05-DE410 (1e); WA05-DE425 (2); WA05-E450 (1); WA05-EF250D (4); WA05-F380 (1); WA05-FG310 (1e); WA05-FG425 (1); WA05-G280 (1e); WA05-G350 (1); WA05-GH350 (1); WA05-GH380 (2e); WA05-GH380D (3+8e); WA05-H310 (1+1e); WA05-H380 (1e); WA06-DE280D (1); WA06-DE480 (1+1e); WA06-E350 (1); WA06-EF380 (1e); WA06-H250D (15+46e); WA06-H310 (1); WA06-H350 (1+2e); WA06-H380 (1); WA06-H425 (2e); WA06-H480 (1+7e); WA07-A250 (1); WA07-A250D (10+4e); WA07-A450 (13+3e); WA07-B250 (1e); WA07-C310 (1e); WA07-C350D (2e); WA07-C450 (1e); WA07-D210D (2+2e); WA07-D350 (1); WA07-D410 (1).

Remarks. Cryptonaticids with simple coloration and a completely closed umbilicus are classified into two forms. One (Figs. 124–127) is characterized by a relatively larger, thick shell that is slightly angulate at the shoulder, with light brownish coloration and white basal area, and numerous fine spiral cords that are rather regularly spaced. Smaller specimens of this form, corresponding to those illustrated by Ito (1989) and Tsuchida and Kurozumi (1995), bear brown, axial stripes and more distinct spiral cords. The other form (Figs. 128–133) is characterized by a smaller, relatively thin and uniformly yellowish white shell that shows no angulation at the shoulder, and it bears indistinct and irregularly spaced spiral cords on the surface. The former inhabits shallower depths (250–450 m), whereas the latter tends to inhabit deeper waters (350–1500 m). It is reasonable to consider them to belong to distinct species, at least based on the specimens examined, because of the absence of intermediate forms.

Regarding the identifications of these species, the former agree well with the original description and the photograph of the holotype illustrated by Kosuge (1972) of *C. aleutica*, especially in possessing an angulate shoulder and numerous fine spiral cords. The latter resembles *C. affinis* (as illustrated by Bouchet and Warén, 1993: figs. 1810–1812) in lacking the angulate shoulder. This opinion, however, contradicts that of Golikov and Sirenko (1988a), who seem to have identified their material the other way round. Furthermore *C. aleutica* has often been synonymized with *C. clausa* (Broderip and Sowerby, 1829) [= *C. affinis*] in recent major reviews (Marincovich, 1977; Majima, 1989), and more detailed study will apparently be necessary to stabilized the taxonomy of this species-complex.

Cryptonatica affinis (Gmelin, 1791)
[Japanese name: Haiiro-tama-gai]
(Figs. 128–133)

Nerita affinis Gmelin, 1791: 3675.
Natica clausa Broderip and Sowerby, 1829: 372 (type locality: unknown).
Tectonatica clausa — Kuroda and Habe in Okada *et al*. 1965: 88, text-fig.; Ito, 1985: 27, pl. 2, fig. 10.
Cryptonatica clausa — Ito *et al*., 1986: 11, pl. 8, fig. 1; Baba, 1990: 10, pl. 6, fig. 10; Tsuchida and Hayashi, 1994: 98, pl. 5, fig. 6; Uno and Masuda, 1997: 7, pl. 4, fig. 28; Saito in Okutani, 2000: 266, pl. 132, fig. Naticidae-81.
Cryptonatica russa — Baba, 1990: 143, pl. 6, fig. 11; Uno and Masuda, 1997: 6, pl. 4, fig. 24 [non *Natica russa* Gould, 1859].
[See Marincovich (1977), Majima (1989) and Golikov and Sirenko (1988a) for more detailed synonymy.]

Type locality. Iceland.

Distribution. Tosa Bay (Hasegawa, 2001), western part of Sea of Japan (Tsuchida and Hayashi, 1994), and both northwards, circumpolar; [350–1500 m]. For distribution in the northern Atlantic, see Bouchet and Warén (1993: 763).

Material examined. WA05-DE380D (3); WA05-DE480 (2+1d); WA05-DE410 (1); WA05-E1000D (1e); WA05-EF450D (4+1e); WA05-F1200 (1e); WA05-FG450 (1e); WA05-FG510D (1e); WA05-G450 (1e); WA05-G510 (1e); WA05-GH450 (1); WA05-E425 (1); WA05-EF450 (1); WA06-A250D (1); WA06-A410 (1); WA06-C450 (1); WA06-DE350 (1); WA06-DE380 (1); WA06-DE410 (1e); WA06-DE425 (1e); WA06-DE450 (1+1e); WA06-DE480 (2); WA06-E510D (1); WA06-E1200D (2); WA06-EF425D (3+2e); WA06-F650D (1); WA06-F750 (2); WA06-F1500D-1 (1); WA06-F1500D-2 (1); WA06-FG450 (1); WA06-FG480 (2e); WA06-G900D (1+2e); WA06-GH480D (2+5e); WA06-H425 (1e); WA06-H480 (16+3e); WA06-H510 (1); WA06-H550 (2); WA06-H900 (2); WA06-H1500 (1e); WA06-H1500D (2e); WA07-B1500D (1); WA07-D350 (2e); WA07-D410 (2+1e); WA07-D900 (22+6e); WA08-F900 (1); WA08-G650 (2); TS06-K2 [1451–1455 m] (2e).

Remarks. See remarks with the preceding species for the identification of this species. This species had been known as *C. clausa* (Broderip and Sowerby, 1829), until Bouchet and Warén (1993: 763) found the earlier available name. This is a typical circumpolar species; it inhabits shallow water, up to the intertidal zone, in the arctic regions, but deeper water in temperate regions both in the Atlantic and Pacific. In the western Pacific, it occurs at 350–1500 m on the Pacific coast of northern Honshu (present study), and at 823–1056 m in Tosa Bay (Hasegawa, 2001).

Family Ranellidae Gray, 1854
Fusitriton oregonensis (Redfield, 1846)
[Japanese name: Aya-bora]
(Figs. 74–75)

Triton oregonense Redfield, 1846: 165–166, pl. 11, fig. 2.

Triton (*Priene*) *cancellatus* — Hirase, 1907a: 242–244 [282–284], pl. 13, fig. 91.
Fusitriton oregonensis — Kira, 1959: 53, pl. 21, fig. 9; Taki in Baba *et al*., 1960: 196, pl. 89, fig. 7; Kuroda and Habe in Okada *et al*. 1965: 93, text-fig.; Kuroda and Habe in Kuroda *et al*., 1971: 189–190 (Japanese part), 124 (English part), pl. 28, fig. 4; Ito, 1985: 27, pl. 3, fig. 4 (1–2); Ito *et al*., 1986: 11–12, pl. 9, fig. 4; Okutani, 1986: 112, 113 with color fig.; Okutani *et al*., 1988: 58, text-fig.; Ito, 1989: 47, pl. 6, fig. 1; Nemoto and Akimoto, 1990: 8, pl. 3, fig. 12; Oshima, 1993: 108, pl. 6, fig. 9; Okutani, 2000: 285, fig. Ranellidae-1.
[See Smith (1970) for additional synonymy.]

Type locality. Straits of St Juan de Fuca, Oregon [west coast of North America].

Distribution. Off Choshi, in sea area Kashima-nada, and off Noto Peninsula in Sea of Japan, both northwards to Kamchatka; Pacific coast of North America; 0–420 m [150–750 m].

Material examined. WA9101-3 [200 m] (6); WA9201-6 [300 m] (12); WA9312-K35 [251–268 m] (1); WA05-DE250D (6+11e); WA05-DE280 (1d); WA05-DE310 (2d); WA05-DE380 (1d); WA05-DE410 (1+1d); WA05-DE425 (1d); WA05-DE450 (1d); WA05-DE480 (1d); WA05-DE510 (1d); WA05-EF250 (1d); WA05-EF280 (1d); WA05-EF350 (1d); WA05-EF380 (1d+1e); WA05-EF410 (1d+1e); WA05-EF425 (4+1d); WA05-EF450 (2); WA05-EF450D (1e); WA05-EF480 (2); WA05-F380 (1); WA05-F410 (1); WA05-F425 (5); WA05-F450 (3); WA05-F510 (3); WA05-F550 (1); WA05-FG250 (1d); WA05-FG250D (3e); WA05-FG280 (2); WA05-FG310 (1+1d); WA05-FG380 (1); WA05-FG410 (1+1d); WA05-FG425 (2d); WA05-FG450 (1d); WA05-FG480 (1+1d); WA05-FG510 (1d); WA05-G210 (1); WA05-G350 (2); WA05-G425 (2); WA05-G650 (1); WA05-GH250 (8); WA05-GH280 (4); WA05-GH310 (3); WA05-GH350 (6); WA05-GH380 (2+1e); WA05-GH425 (1); WA05-GH510 (1); WA05-H150 (1e); WA05-H380 (4+1e); WA06-A250D (2); WA06-A350 (1); WA06-A410 (1); WA06-B150 (1); WA06-B310D (1); WA06-B450 (1); WA06-C350 (2); WA06-C350D (2); WA06-C450 (1); WA06-DE280 (1+2d); WA06-DE280D (2+20e); WA06-DE310 (2+2d); WA06-DE350 (3+2d); WA06-DE380 (2d); WA06-DE410 (1+2d: on sunken wood); WA06-DE425 (2d); WA06-DE450 (6+2d); WA06-DE480 (1+2d); WA06-E150 (3); WA06-E210 (4); WA06-E250 (3); WA06-E280 (3); WA06-E310 (2); WA06-E350 (1); WA06-E380 (1); WA06-E410 (2); WA06-E425 (2); WA06-E450 (2); WA06-E480 (1); WA06-E550 (2); WA06-E650 (1); WA06-EF250 (2+1d); WA06-EF280 (2+2d); WA06-EF310 (1+1d+1e); WA06-EF350 (2+1d); WA06-EF380 (6+2d); WA06-EF410 (2+2d); WA06-EF425 (1+2d); WA06-EF425D (1e); WA06-EF450 (2+1d); WA06-EF480 (6); WA06-F150 (3); WA06-F210 (5); WA06-F250 (1); WA06-F280 (3); WA06-F310 (5); WA06-F350 (3); WA06-F380 (4); WA06-F410 (2) WA06-F425 (3); WA06-F450 (2); WA06-F480 (2); WA06-F510 (2); WA06-F550 (3); WA06-FG250 (2d); WA06-FG280 (3d); WA06-FG310 (2+1d+1e); WA06-FG350 (1); WA06-FG380 (3+2e); WA06-FG410 (3+4d); WA06-FG425 (2d); WA06-FG425 (4; in a conger trap); WA06-FG450 (6d); WA06-FG480 (8+5d+1e); WA06-FG480 (2: on sunken wood); WA06-FG510 (1d); WA06-G150 (1+1e); WA06-G210 (2); WA06-G250 (2); WA06-G280 (1); WA06-G350 (8); WA06-G380 (8); WA06-G425 (6); WA06-G450 (2); WA06-G510 (1); WA06-G750 (1); WA06-GH250 (5+2d); WA06-GH280 (6d); WA06-GH310 (2d); WA06-GH350 (11+2d); WA06-GH380 (10+3d); WA06-GH410 (-1) (1+1d+1e); WA06-GH425 (2+2d+2e); WA06-GH450 (6+3d); WA06-GH480 (2); WA06-GH480D (1e); WA06-GH510 (3d); WA06-H210 (1+3d); WA06-H250 (5d); WA06-H250D (1e); WA06-H280 (2d); WA06-H310 (5d+1e); WA06-H450 (1d); WA06-H480 (1); WA06-H550 (1); WA07-A210 (2); WA07-A250 (6); WA07-A250D (6+3e); WA07-A310 (7); WA07-A350 (3); WA07-A410 (15); WA07-A450 (7+5e); WA07-A510 (2); WA07-A550 (2); WA07-B210 (3); WA07-B310 (6+1e); WA07-B410 (2+3d+2e); WA07-B410D (3); WA07-B450 (3); WA07-B510 (1); WA07-B550 (3); WA07-C210 (1); WA07-C350D (2+7e); WA07-C550 (1); WA07-D210D (6+1e); WA07-D250 (1); WA07-D310 (3+1e); WA07-D350 (2+2e); WA07-D410 (ca. 30); WA06-D900 (1e); WA08-D210 (1); WA08-G410 (2: on sunken wood).

Remarks. Although this species is known to inhabit the intertidal zone in Hokkaido (e.g.

Yamazaki, 2007; Hasegawa, personal observation at Akkeshi, Hokkaido), it occurred in bathyal depths within the range of 210–750 m in the present survey area.

Most authors (e.g. Smith, 1970; Beu, 1999) distinguish the closely similar *Fusitriton galea* Kuroda and Habe in Habe, 1961, which is characterized by markedly coarser sculpture with nodules at the intersections, from *F. oregonensis* at species level. The boundary of both forms is known to be located at the southern tip of the Boso Peninsula, although *F. oregonensis* is reported to occur south to the Kii peninsula in deeper water (Tsuchida and Kurozumi, 1995). Because species of the family Ranellidae generally have a long planktonic larval stage (Scheltema, 1971), which is also suggested for the present species by the morphology of the protoconch (Fig. 74), and thus an extremely wide geographical distribution, it is unlikely that speciation could occur within such narrow range without any distinct geographical barriers, and the differences may thus be due to environmental factors.

Family Epitoniidae Berry, 1910
Cirsotrema* (*Elegantiscala*) *mituokai (Ozaki, 1958)
[Japanese name: Hokkai-itokake]
(Figs. 134–136)

Epitonium (*Boreoscala*) *mituokai* Ozaki, 1958: 142, pl. 15, fig. 24.
Cirsotrema kamiyanum Kuroda, MS — Okutani, 1964: 391, pl. 1, fig. 15 [nom. nud.].
Cirsotrema kagayai Habe and Ito, 1965a [June 1]: 29, pl. 7, fig. 25; Habe and Ito, 1965b [July 31]: 17, 30, pl. 2, fig. 9 [synonym and homonym of *C. kagayai* Habe and Ito, 1965a] (type locality: off Muroran, Hokkaido, 200–300 m); Higo *et al.*, 2001: fig. G1820 (holotype).
Cirsotrema (*Cirsotrema*) *kagayai* — Watanabe and Naruke, 1988: 61, pl. 11, fig. 1; Weil *et al.*, 1999: 116, fig. 369 (holotype).
Cirsotrema (*Erlegantiscala*) *mituokai* — Tsuchida in Okutani, 2000: 323, pl. 160, fig. Epitoniidae-23; Nakayama, 2003: 27, pl. 4, figs. 12–17.

Type locality. Cliff, 500 m south of Matugisi [= Matsugishi] railway station, Choshi City [Chiba Prefecture]; Iioka Formation [Pliocene, Inubo group].

Distribution. Sagami Bay (Okutani, 1964; based on fragmental specimen) and northwards to off Muroran in southern Hokkaido (Habe and Ito, 1965b); 200–300 m [250–900 m].

Material examined. WA9308-S13 [307 m] (2); WA05-DE380 (1); WA05-DE410 (1+1e); WA05-DE425 (2); WA05-DE450 (1); WA05-E480 (1); WA05-EF425 (1); WA05-EF450 (1); WA05-EF450D (2); WA05-F380 (1); WA05-F480 (1); WA05-F900 (1); WA05-FG380 (1); WA05-FG410 (2); WA05-G425 (1); WA05-G450 (3+1e); WA05-GH380 (1e); WA05-GH380D (1e); WA05-GH410 (7+1e); WA05-GH425 (3); WA05-GH480 (1); WA06-D450D (1); WA06-DE280 (1); WA06-DE380 (1); WA06-DE410 (4); WA06-DE425 (2+1e); WA06-DE450 (1); WA06-E350 (1); WA06-EF310 (1); WA06-EF350 (1e); WA06-EF410 (1); WA06-EF425 (2); WA06-EF480 (1); WA06-F750 (1); WA06-FG380 (1e); WA06-FG410 (3); WA06-FG425 (1e); WA06-FG425 (1e; in a conger trap); WA06-GH380 (1e); WA06-GH410 (-1) (1); WA06-GH425 (8+2e); WA06-GH450 (4); WA06-GH480 (2); WA07-A250D (1e); WA07-C350D (1e); WA07-D350 (3); WA07-D410 (3); WA07-D650 (1e).

Remarks. This species had been known as *Cirsotrema kagayai* in literature until Nakayama (2003) regarded that as a junior synonym of *C. mituokai*, which was described based on a Pliocene fossil from Choshi. Comparison of the holotypes of *Epitonium* (*Boreoscala*) *mituokai* Ozaki, 1958 (NSM PM4497; Fig. 134A) and *C. kagayai* Habe and Ito, 1965 (NSMT-Mo 49754; Fig. 134B–C) in the present study confirmed Nakayama’s view. Although this species has been considered to be rare, it is shown in the present study to be rather common especially in the southern part of the survey area.

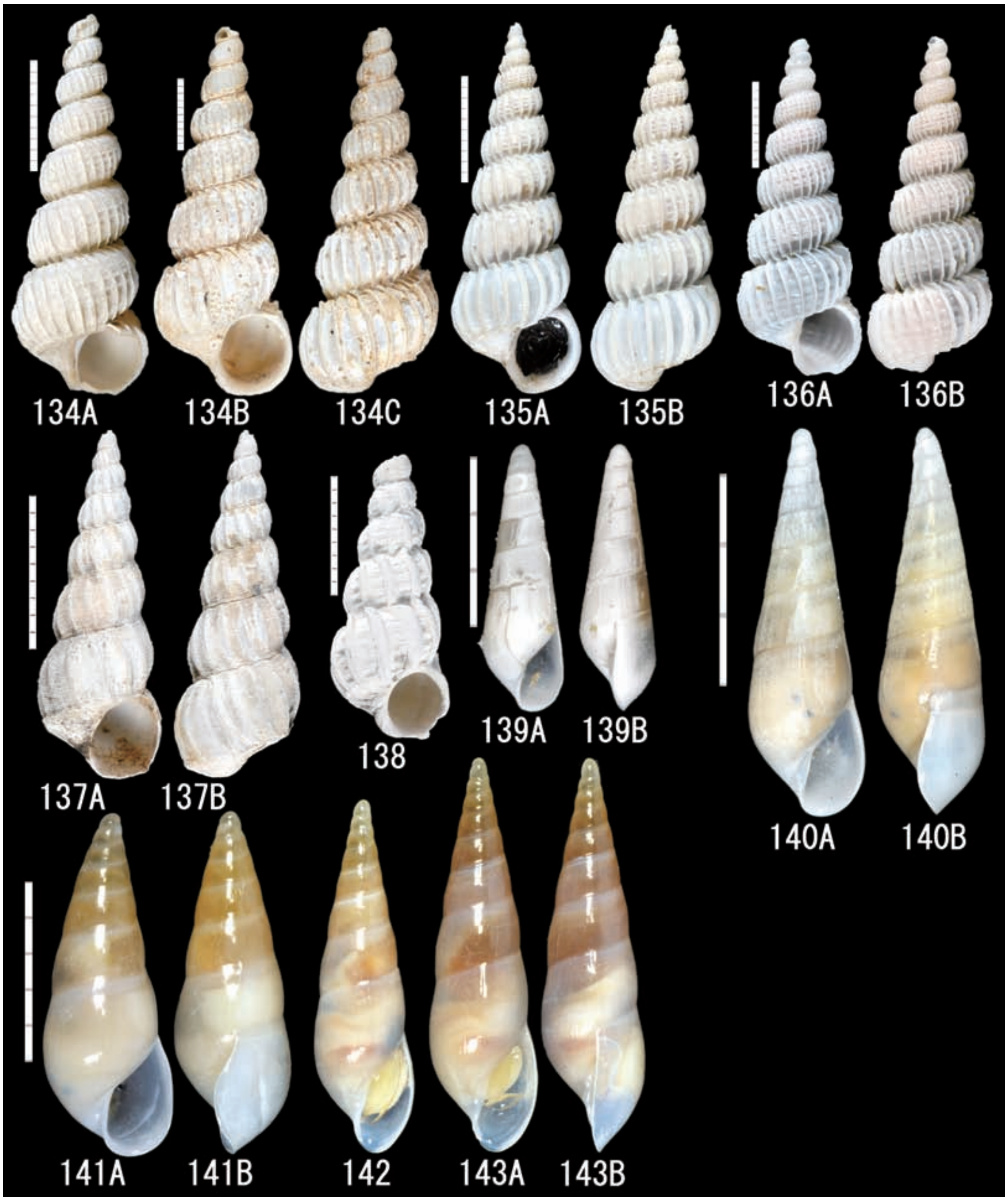


Fig. 134–143. Epitoniidae and Eulimidae. 134–136. *Cirsotrema* (*Elegantiscala*) *mituokai*, 134A: holotype of *Epitonium* (*Boreoscala*) *mituokai* Ozaki, 1958, NSM PM4497; 134B–C: holotype of *Cirsotrema kagayai* Habe and Ito, 1965, NSMT-Mo 49754; 135: WA06-EF310; 136: WA06-F750. 137. *Opaliopsis hiranoi*, WA07-A250D (empty shell). 138. *Boreoscala greenlandica*, WA05-EF250D (empty shell). 139–140. *Melanella* sp. 1, 139: WA06-H1500D; 140: WA05-FG250D. 141. *Melanella* sp. 2, WA07-C350D. 142–143. *Haliella* sp., WA07-C350D. Scale: 134–138 = 10 mm; 139–140 = 3 mm; 141–143 = 5 mm (at the same scale).

Opaliopsis hiranoi (Shikama, 1962)
[Japanese name: Hirano-itokake]
(Fig. 137)

Nystiella hiranoi Shikama, 1962: 43, pl. 1, figs. 21a–b, 22a–b; Watanabe and Naruke, 1988: 62, pl. 11, fig. 7.
Opaliopsis hiranoi — Weil *et al.*, 1999: 124, fig. 393; Tsuchida in Okutani, 2000: 321, pl. 159, fig. Epitoniidae-11; Nakayama, 2003: 85, pl. 1, figs. 35–37.

Type locality. East of Choshi [sea area Kashima-nada], 250–260 fathoms.
Distribution. Off Miyagi Prefecture and southwards to off Choshi, in sea area Kashima-nada; 250–500 m [250 m].
Material examined. WA07-A250D (2e).
Remarks. Only two empty shells were obtained during the present survey, which agree well with the figure and description by Shikama (1962) and represent the first record of this species outside the type locality. Habe and Ito (1965a: 29) suggested synonymy of *A. hiranoi* with *Acirsa ochotensis* (Middendorff, 1849), but the specimens collected from northeastern Honshu, including the present material, are significantly smaller than the latter species, and have coarser and stronger axial ribs. Additional material will thus be necessary to clarify their taxonomical relationship.

Boreoscala greenlandica (Perry, 1811)
[Japanese name: Ezo-itokake (= Chibi-ezo-itokake)]
(Fig. 138)

Scalaria greenlandica Perry, 1811: pl. 28, fig. 8.
Epitonium (*Boreoscala*) *greenlandicum japonicum* Shikama, 1962: 42, pl. 1, fig. 17a–c (type locality: off Choshi [sea area Kashima-nada]).
[See Nakayama (2003) for additional synonymy.]

Type locality. Greenland (restricted by Clench and Turner, 1952: 320).
Distribution. Off Choshi, in sea area Kashima-nada, and northwards to Arctic; 0–650 m [250 m].
Material examined. WA05-EF250D (1e).
Remarks. Only one poorly preserved dead-collected specimen was recovered in this study. *Epitonium* (*Boreoscala*) *greenlandicum japonicum* Shikama, 1962, described from off Choshi, was regarded by Nakayama (2003) as a junior synonym of this species.

Family Eulimidae Philippi, 1853
Melanella sp. 1
(Figs. 139–140)

Material examined. WA05-FG250D (1); WA06-H1500D (1).
Remarks. Two specimens from different depths are provisionally considered to be conspecific, because of the similarity in overall shell morphology. The taxonomical study of deep-water Eulimidae has been nearly left untouched, and this and next species are provisionally assigned to *Melanella* Bowdich, 1822 sensu lato, on the basis of the simple and slender shell.

Melanella sp. 2
(Fig. 141)

Material examined. WA07-C350D (2).

Haliella sp.
(Figs. 142–143)

Material examined. WA07-C350D (5+6e).

Remarks. This species can be assigned to the genus *Haliella* Monterosato, 1878 (type species: *Eulima stenostoma* Jeffreys, 1858, by monotypy) based on the apertural characters. Species of the genus *Haliella* probably parasitize irregular sea urchins (Dr. A. Warén, personal communication), and a number of such sea urchins (not identified) were collected in the same haul, together with numerous ophiuroids. Hasegawa (2001: pl. 2, fig. L) and Hasegawa (2005: fig. H) recorded the species of *Haliella* at bathyal depths from Tosa Bay and the Nansei (Ryukyu) Islands respectively, but the present species differs markedly from those by the more acutely tapering apex.

Family Muricidae Rafinesque, 1815

Abyssotrophon delicatus (Kuroda, 1953)
[Japanese name: Hina-tsuno-oriire]
(Figs. 144–148)

Trophonopsis delicatus Kuroda, 1953: 186–187, 199–200, text-fig. 2; Okutani, 1964: 401, pl. 3, fig. 7; Baba, 1990: 155, pl. 9, fig. 12a–b.

Trophonopsis soyoae minimus — Ishikawa, 1970: 133, pl. 9, fig. 2 [non *Trophonopsis osyoae minimus* Okutani, 1964].

Abyssotrophon unicus Egorov, 1993: 30–31, figs. 26, 37G–H (type locality: Kurile-Kamchatka Trench, 40°12.0´N, 143°35.8´E, 2500 m). New synonym.

Abyssotrophon convexus Egorov, 1994: 98, figs. 1A–B (type locality: [off Iwate Prefecture], 39°58.8´N, 142°19.7´E, 425 m). New synonym.

Abyssotrophon sp. — Tsuchida and Kurozumi, 1995: 178, fig. 7 (2).

Abyssotrophon soyoae minimus — Tsuchiya in Okutani, 2000: 403, pl. 200, fig. Muricidae-203 [non *Trophonopsis soyoae minimus* Okutani, 1964].

Abyssotrophon crystallinus — Tsuchiya in Okutani, 2000: 403, pl. 200, fig. Muricidae-204 [non *Trophonopsis crystallinus* Kuroda, 1953].

Not *Trophonopsis (Trophonopsis) delicatus* — Tsuchida, 1991: 1–2, pl. 1, fig. 1; Tsuchida and Kurozumi, 1995: 178, fig. 7 (3) [is *Trophonopsis* sp.].

Type locality. R/V *Soyo-maru*, Station 126, SE of Ishino-maki, east coast of Honshu, depth 146 m.

Distribution. Off Ofunato in Iwate Prefecture and southwards to Sagami Bay (Okutani, 1964); 550–700 m [250–1500 m].

Material examined. WA06-DE280D (1e); WA05-DE380D (5+3e); WA05-EF250D (8); WA05-EF450D (4); WA05-FG410 (1); WA05-FG425 (2); WA05-FG450 (1); WA05-FG510D (1); WA05-G280 (2); WA05-G510 (1); WA05-GH380D (2+2e); WA05-GH410 (2); WA06-DE350 (2); WA06-EF410 (1); WA06-EF425D (3e); WA06-F1500D-1 (9); WA06-F1500D-2 (1e); WA06-FG350D (3e); WA06-FG450 (1e); WA06-FG480 (1); WA06-G900D (4e); WA06-GH350 (1+1e); WA06-GH380 (2+1e); WA06-GH410 (-1) (1); WA06-GH425 (2e); WA06-GH480 (1); WA06-GH480D (4e); WA06-H1500D (1); WA07-D410 (1); WA07-D900 (ca. 35+5e); TS96-K2 [1451–1455 m] (11+15e).

Remarks. The specimens examined show a considerably wide range of variation in shell morphology, especially in sculpture. The number of spiral cords on the penultimate whorl varies from two to five, and the density of the axial ribs also varies, even within populations. Furthermore, some specimens possess scale-like projections at the intersection of the spiral cords and the axial ribs (Fig. 146). Most specimens possess a white shell with a very thin periostracum. Although some of them seem to be covered by a relatively thick yellowish brown periostracum, this may be caused by the attachment of hydroids. Because of the presence of intermediate forms, all of them

Figs. 144–155. Muricidae. 144–148. *Abyssotrophon delicatus*, 144: WA05-EF250D; 145: WA05-DE380D; 146: WA05-EF450D; 147: WA06-H1500D; 148: WA06-F1500D-1. 149. *Abyssotrophon minimus*, WA07-A650. 150–151. *Abyssotrophon crystallinus*, 150: WA07-C450; 151: holotype of *Suavodrillia bicarinata* Ozaki, 1958, NSM PM4501. 152. *Scabrotrophon* sp., WA07-A450. 153. *Boreotrophon trophonis*, WA05-H900. 154–155. *Pagodula* sp., 154: WA05-F1200; 155: WA06-F750. Scales: 144–149 = 5 mm (at the same scale); 150, 152–153 = 10 mm (at the same scale); 151 = 5 mm; 154–155 = 10 mm (at the same scale).

are considered here as intraspecific forms.

Regarding the identification of this species, it agrees well with the figure of a specimen recorded from Sagami Bay (550–700 m) and identified as *Trophonopsis delicatus* by Okutani (1964). *Trophonopsis delicatus* was originally described from the present survey area on the continental slope, and is an obscure species that has seldom been found in literature. Kuroda's (1953: text-fig. 2) original figure of the holotype is very small and taken from a slightly tilted angle, and the specimen itself is not present in Kuroda's collection at the Nishinomiya Shell Museum (Ms. Y. Otani, personal communication). Although the holotype (7.5 mm SL) is considerably smaller than the present specimens, which usually reach 10 mm and can be up to 12 mm SL, it reasonably agrees with them not only in general shape but also in the sculpture of thick spiral cords and fine, thread-like axial ribs. *Abyssotrophon unicus* Egorov, 1993, described from off northeastern Honshu in the Japan Trench at a depth of 2500 m, and *A. convexus* Egorov, 1994, described from off Iwate Prefecture at a depth of 425 m, correspond to the two phenotypes (Figs. 147–148 and 145, respectively) of the present taxon, and are regarded here as junior synonyms. On the other hand, the specimens recorded under this name from near Otsuchi in Iwate Prefecture, in the sublittoral zone (Tsuchida, 1991; Tsuchida and Kurozumi, 1995) possess significantly coarser and thicker axial sculpture and apparently belong to a different species.

Abyssotrophon minimus (Okutani, 1964)
[Japanese name: Mame-tsuno-oriire]
(Fig. 149)

Trophonopsis soyoae minimus Okutani, 1964: 402, pl. 5, fig. 9; The Committee for Celebrating Dr Okutani's Retirement from Tokyo University of Fisheries, 1996: 75, pl. 2, fig. 11 (holotype).
Not *Abyssotrophon soyoae minimus* — Tsuchiya in Okutani, 2000: 403, pl. 200, fig. Muricidae-203 [is *Abyssotrophon delicatus* (Kuroda, 1953) in the present study].

Type locality. R/V *Soyo-maru*, St. 17, 36˚19.7´N, 141˚09.0´E, the sea area Kashima-nada, 870 m.

Distribution. Off Choshi, in sea area Kashima-nada, and northwards to off Shimokita Peninsula in Aomori Prefecture (present study); 870 m [650 m].

Material examined. WA07-A650 (2+1e).

Remarks. The specimens agree well with the original description and figure in Okutani (1964). The shell is small for the genus and closely resembles that of the preceding species, with which the present material was collected sympatrically, but can be distinguished by the thicker and more indistinct spiral cords, and the widely spaced and somewhat plate-like axial ribs. It has seldom been reported with correctly identified figures in literature since the original description, and most of the previous records (e.g. Higo *et al.*, 1999 from Hokkaido) can be considered doubtful. Therefore the present material represents the first definitive record of this species outside the type locality. It was originally described as a subspecies of *A. soyoae* (Okutani, 1959), but there seems to be no close relationship with the latter species, at least on the basis of conchology, and *A. minimus* is regarded here as distinct species. Although it was represented by only a few specimens from a single station in the present material, it occurred more frequently among the material obtained by the R/V *Tansei-maru* in the lower bathyal depths (2000–3000 m).

Abyssotrophon crystallinus (Kuroda, 1953)
[Japanese name: Chijiwa-tsuno-oriire]
(Figs. 150–151)

Trophonopsis crystallinus Kuroda, 1953: 188–189, text-figs. 3–4; Hanshin shell Club, 1986: 39, pl. 8, figs. 5, 6 (holotype: the locality was erroneously mentioned as "Okinawa Miyako-jima"); Baba, 1990: 155, pl. 9, fig. 13a–b; Habe and Inaba (eds.), 1996: 21–22, pl. 9, fig. 59a–b (holotype); Higo *et al.*, 1999: 202.

Suavodrillia bicarinata Ozaki, 1958: 161, pl. 16, figs. 10, 11 (type locality: Choshi, Chiba Prefecture; Iioka Formation, Pliocene).

Neptunea bicarinata — Masuda and Noda, 1976: 261–262 (name only).

Abyssotrophon soyoae soyoae — Egorov, 1993: 29, fig. 38E, F; Kantor and Sysoev, 2006: 141, pl. 62, fig. G [non *Trophonopsis soyoae minimus* Okutani, 1959].

Trophonopsis crystalline — Higo *et al.*, 2001: fig. G2222 (holotype).

Abyssotrophon crystallinus — Kantor andand Sysoev, 2006: 140, pl. 62, fig. F (holotype); Higuchi, 2006: pl. 19, two figures at upper right.

Not *Abyssotrophon crystallinus* — Tsuchiya in Okutani, 2000: 403, pl. 200, fig. Muricidae 204 [is *Abyssotrophon delicatus* (Kuroda, 1953)].

Type locality. R/V *Soyo-maru*, St. 58, depth 177 m, off Miyako [Iwate Prefecture], east coast of Honshu.

Distribution. Known only from Pacific coast of northern Honshu, from off Hachinohe in Aomori Prefecture (present study) to off Kinkazan in Miyagi Prefecture (Higuchi, 2006); 177–530 m [450–1445 m].

Material examined. WA07-A450 (1+3e); WA07-C450 (1); TS96-K2 [1451–1455 m] (1e).

Remarks. Despite its large and distinctive shell, this species had long been known in the Recent fauna only from the holotype, until Higuchi recently (2006) illustrated a specimen collected from off Kinkazan in Miyagi Prefecture at a depth of 530 m. The specimen illustrated under this name by Tsuchiya (in Okutani, 2000) is not this species, but probably *A. delicatus*. All the other figures of this species ever published were based on the holotype. Specimens identified as *Abyssotrophon soyoae* (Okutani, 1959) in Russian literature (e.g. Egorov, 1993) resemble the present species, and are possibly more closely related to it, but they possess significantly finer axial sculpture.

In contrast to its rareness in the Recent fauna, this species was much commoner in this area in the Pliocene epoch. It was described as *Suavodrillia bicarinata* Ozaki, 1958 (Fig. 151: holotype, NSM PM4501), which is regarded as a junior synonym of the present taxon, from the Iioka Formation in Choshi, Chiba Prefecture, and Baba (1990) mentioned that it was not uncommon in the Kazusa Group.

Scabrotrophon sp.
(Fig. 152)

?*Trophonopsis tenuiscculptus* [sic] — Higuchi, 2006: pl. 15 [non *Trophon tenuisculptus* Carpenter, 1864].

Material examined. WA07-A450 (1); WA06-E1200D (1e); WA07-C410 (1e).

Remarks. The specimens examined resemble *S. scitulus* (Dall, 1891) in general morphology, but differ significantly in possessing finer and more numerous spiral cords that lack spines at their intersections with the axial sculpture. Furthermore, the shell is more elongate in shape, with a long, gradually tapering siphonal canal. They also resemble in sculpture the specimens illustrated by Higuchi (2006) as "*Trophonopsis tenuisculptus* Carpenter, 1866 [sic]", which is a Pleistocene fossil species described from Santa Barbara, California, but differ in being smaller and more slender with a longer siphonal canal.

Pagodula sp.
(Figs. 154–155)

Material examined. WA05-F1200 (1); WA06-F750 (2); WA07-D900 (ca. 100+ca. 70e).

Remarks. This species is readily distinguished from all the known species in the subfamily Trophoninae with the exception of *Boreotrophon golikovi* Egorov, 1992, described from the Bering Sea at a depth of 3100 m, by the presence of distinct flat projections situated perpendicular to the shell axis at the shoulder. Although *B. golikovi* possesses similar projections at the shoulder, the shell of the latter species is more depressed with a significantly longer siphonal canal and irregular axial sculpture. Generic assignment of the present species is not certain because of the unique conchological features, but it probably belongs in *Pagodula* Monterosato, 1884 (type species: *Murex vaginatus* Cristofori and Jan, 1832, Pleistocene, Mediterranean, subsequently designated by Radwin and D'Attilio, 1976), based on its similarity to the type species.

Boreotrophon trophonis Egorov, 1993
[New Japanese name: Ikarigata-tsuno-oriire]
(Fig. 153)

?*Boreotrophon xestra* — Okutani, 1964: 403, pl. 3, fig. 10 [non *Boreotrophon xestra* Dall, 1918].

Boreotrophon trophonis Egorov, 1993: 17–18, figs. 11, 33E–F (Bering Sea, 54°11.8´N, 168°36.5´E, 508 m); Kantor and Sysoev, 2006: 144, pl. 65, fig. C.

Type locality. R/V *Akademik Oparin*, 54°11.8´N, 168°36.5´E, depth 508 m, Bering Sea.

Distribution. Off Hitachi in Ibaraki Prefecture and northwards to off Ofunato in Iwate Prefecture, and Bering Sea; 508 m [900–1500 m].

Material examined. WA05-H900 (1); WA06-F1500D-2 (1); WA07-D900 (1).

Remarks. Although this species has hitherto been known only from the type locality in the Bering Sea, the present material agrees well with the illustrated holotype, which is characterized by the distinctly angulate shoulder and thin, closely set plate-like axial projections that reach the base of the narrow siphonal canal. Accordingly the present record represents a wide southward range extension of this species to northeastern Honshu.

Boreotrophon alaskanus Dall, 1902
[Japanese name: Arasuka-tuno-oriire (= Shiro-hashi-tsuno-oriire)]
(Figs. 156–160)

Boreotrophon alaskanus Dall, 1902b: 545–546; Dall, 1925: 22, pl. 22, fig. 3; Kosuge, 1972: pl. 7, fig. 8 (holotype); Tiba and Kosuge, 1985 in 1979–1992: 15 (7–9), figs. 1 (holotype), 2–4 on page 7 (15); Fujioka in Okutani, 1986: 127, with color fig.; Tsuchiya in Okutani, 2000: 403, pl. 200, fig. Muricidae-212; Higo *et al.*, 2001: fig. G2243 (holotype).

Boreotrophon alborostratus Taki, 1938: 402, text-figs. 2–3, 5–8 (type locality: sea area Kashima-Nada, 600 m); Watanabe and Naruke, 1988: pl. 6, fig. 1.

Boreotrophon xestra nipponicus — Okutani, 1964: 404, pl. 3, fig. 14 [non *Trophon nipponicus* Yokoyama, 1920].

Boreotrophon alaskanus alaskanus — Egorov, 1993: 15, fig. 32A–B.

Boreotrophon ithitoma — Egorov, 1993: 16–17, figs. 32E–H [non *Neptunea ithitoma* Dall, 1919].

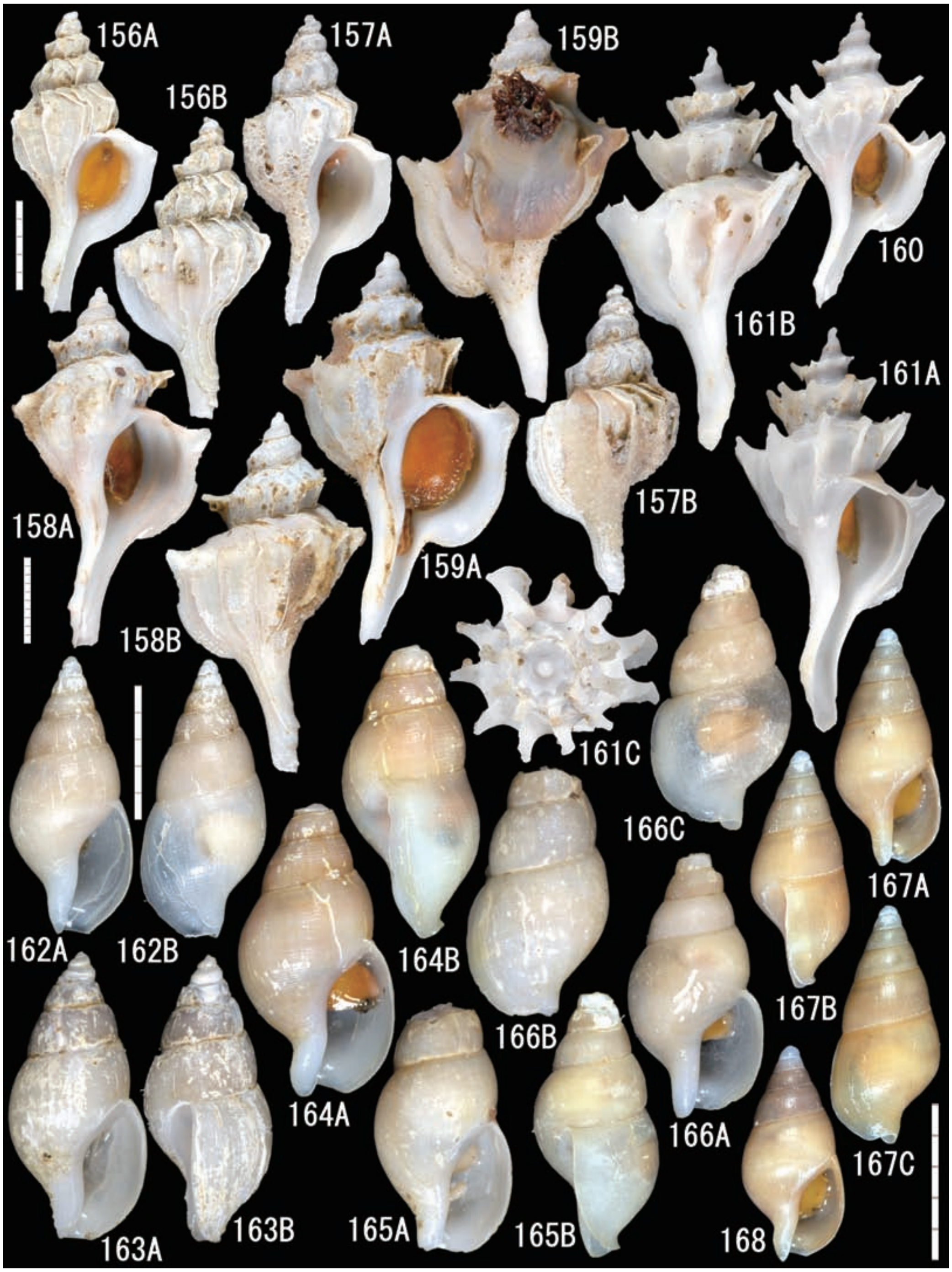
Boreotrophon beringi — Tsuchiya in Okutani, 2000: 403 (in part), pl. 200, fig. Muricidae-206, the specimen on the right [non *Boreotrophon beringi* Dall, 1902].

Boreotrophon xestra xestra — Tsuchiya in Okutani, 2000: 403, pl. 200, fig. Muricidae-208 [non *Boreotrophon xestra* Dall, 1918].

[See Tiba and Kosuge (1983 in 1979–1992) for additional synonymy.]

Type locality. USBF station 3227, in Bering Sea, north of Unalaska.

Distribution. Sagami Bay (Okutani, 1964 as *B. xestra nipponicus*) and northwards to Bering



Figs. 156–168. Muricidae and Columbellidae. 156–160. *Boreotrophon alaskanus*, 156: WA06-GH280; 157: WA05-GH510; 158: WA06-A410; 159: WA06-DE450; 160: WA06-FG480. 161. *Boreotrophon flos*, WA06-H750. 162–166. *Mitrella* sp. 1, 162: WA07-D250; 163: WA07-D350; 164: WA07-A410; 165: WA07-C510; 166: WA06-H1500. 167–168. *Mitrella* sp. 2, WA07-D210D. Scales: 156–157 = 5 mm (at the same scale); 158–161 = 10 mm (at the same scale); 162–166 = 5 mm (at the same scale); 167–168 = 5 mm (at the same scale).

Sea; 54–800 m [250–900 m].

Material examined. WA9312-K35 [251–268 m] (1e); WA05-DE250D (2); WA05-E750 (2); WA05-EF250D (2); WA05-EF350 (1); WA05-F425 (1); WA05-FG380 (1); WA05-FG410 (1); WA05-FG425 (2); WA05-FG510 (1); WA05-GH310 (1); WA05-GH350 (1); WA05-GH510 (3); WA05-H380 (1); WA06-A410 (1); WA06-DE450 (1); WA06-DE480 (2); WA06-E425 (1); WA06-EF250 (1); WA06-F650 (3); WA06-FG380 (2); WA06-FG425 (1); WA06-FG480 (1); WA06-GH280 (1); WA06-GH350 (2); WA06-GH380 (1+1e); WA07-A250D (5e); WA07-A450 (1); WA07-D750 (1); WA07-D900 (1).

Remarks. This species is easily distinguished from others in the genus by its relatively large shell with an inflated base and widely spaced axial plates that bear acutely triangular projection of varying strength. However, the smaller specimens mainly collected from shallower depths are somewhat confusing (Figs. 156–157). They were at first separated as distinct species in the present study, but later regarded as the young stage of this species, based on comparison with the morphology of the upper whorls in larger specimens, although these are usually heavily eroded and difficult to observe in most of the specimens. Smaller examples of this species may have been confused in literature with different species, especially *B. xestra* Dall, 1918, as shown in part in the synonymy.

Boreotrophon flos Okutani, 1964
[Japanese name: Yaguruma-tsuno-oriire]
(Fig. 161)

Boreotrophon flos Okutani, 1964: 403, pl. 3, fig. 1; Tiba and Kosuge, 1985 in 1979–1992: 15 (19–20), figs. 1 (holotype), 2–4 on page 15 (15); Tsuchiya in Okutani, 2000: 403, pl. 200, fig. Muricidae-211.
Boreotrophon ithitoma — Kantor and Sysoev, 2006: pl. 64, fig. G [non *Neptunea ithitoma* Dall, 1919].

Type locality. R/V *Soyo-maru*, St. 17, 36°19.7´N, 141°09.0´E, the sea area Kashima-nada, 870 m.

Distribution. Sea area Kashima-nada and northwards to Sanriku coast (Tiba and Kosuge, 1985 in 1979–1992); 600–1000 m [650–750 m].

Material examined. WA06-G650 (1); WA06-H750 (1).

Remarks. Two specimens collected during the present survey differ somewhat from the holotype in having a more slender shell with shorter spatulate projections at the shoulder, but agree reasonably in the other diagnostic characters of this species, such as the triangular axial plates with backwardly curved projections (Fig. 161C), relatively thin columellar callus covering the inner lip, and the long siphonal canal. The specimen identified by Kantor and Sysoev (2006) as *B. ithitoma* also resembles the present species in general shell features, and is probably conspecific with it, although the holotype of *B. ithitoma* (Kosuge, 1972: pl. 7, fig. 5) is considerably different from them.

Family Columbellidae Swainson, 1840

Mitrella sp. 1
(Figs. 162–166)

Material examined. WA05-DE250D (2*); WA05-G1500D (1e); WA06-DE410 (1: on sunken wood); WA06-DE450 (1); WA06-F650 (1); WA06-F1500D-1 (2); WA06-H1500D (2); WA07-A410 (1); WA07-B410 (1); WA07-C510 (2); WA07-D250 (2*); WA07-D350 (1*); WA07-D410 (1); WA07-D650 (1); WA07-D900 (2); TS96-K2 [1451–1455 m] (3) [*: “slender form”].

Remarks. This species is characterized by a small, simple white shell with rather distinct spiral grooves over the entire surface. In general shell features and in the presence of weak spiral grooves on the entire surface it most closely resembles *Astyris costata* Gulbin, 1983, described from off Medny Island, Commander Islands, at a depth of 150–200 m, but differs in totally lacking axial sculpture. It also resembles the species known in the Japanese literature as “*Mitrella saitoi* Kuroda (MS)” nom. nud. [Japanese name: Saito-mugigai], as illustrated by Ito *et al*. (1986: pl. 12, fig. 3), but differs in having more inflated whorls and also in total of a color pattern. The specimens treated here are rather heterogeneous, and they may be classified into two forms; those collected at 350 m and shallower (Figs. 162; “slender form”) possess a slender shell with an indistinct suture and a straight siphonal canal, whereas those collected at 410 m and deeper (Figs. 164–166) have a slightly larger shell with a more deeply constricted suture and a reflected siphonal canal, as well as more distinct spiral sculpture. However, the specimen shown in Figure 163 shows a somewhat intermediate condition in those characters, and these two forms also occur allopatrically in terms of vertical distribution. They are thus here regarded as intraspecific variations of single species.

Mitrella sp. 2
(Figs. 167–168)

?“*Astyris*” *kobai* — Tsuchiya in Okutani, 2000: 429, pl. 213, fig. Columbellidae-22 [non *Pyrene kobai* Golikov and Kussakin, 1962].

Material examined. WA05-EF250D (4); WA05-EF280 (1: on sunken wood); WA05-FG310 (1: on sunken wood); WA05-GH280 (1); WA06-D210D (1); WA06-EF250 (1); WA06-H250D (2+1e); WA07-C210 (2); WA07-D210 (1); WA07-D210D (32+15e).

Remarks. This species can be distinguished from the preceding one by its significantly smaller (up to 7.7 mm SL), smooth and yellowish brown shell, with a more angulate base and a shorter siphonal canal. The specimen illustrated as “*Astyris*” *kobai* by Tsuchiya (in Okutani, 2000) may be the present species, although *A. kobai* actually possesses a more inflated shell (holotype illustrated by Kantor and Sysoev, 2006: pl. 106, fig. G), and is apparently different from the one illustrated by Tsuchiya (in Okutani, 2000), or from the present species.

Family Buccinidae Rafinesque, 1815
Subfamily Ancistrolepidinae Habe and Sato, 1973
Bathyancistrolepis trochoideus (Dall, 1907)
[Japanese name: Chijiwa-bai (= Watazoko-chijiwa-bai)]
(Figs. 170–171)

Chrysodomus trochoideus Dall, 1907: 156; Kosuge, 1972: pl. 15, fig. 7.

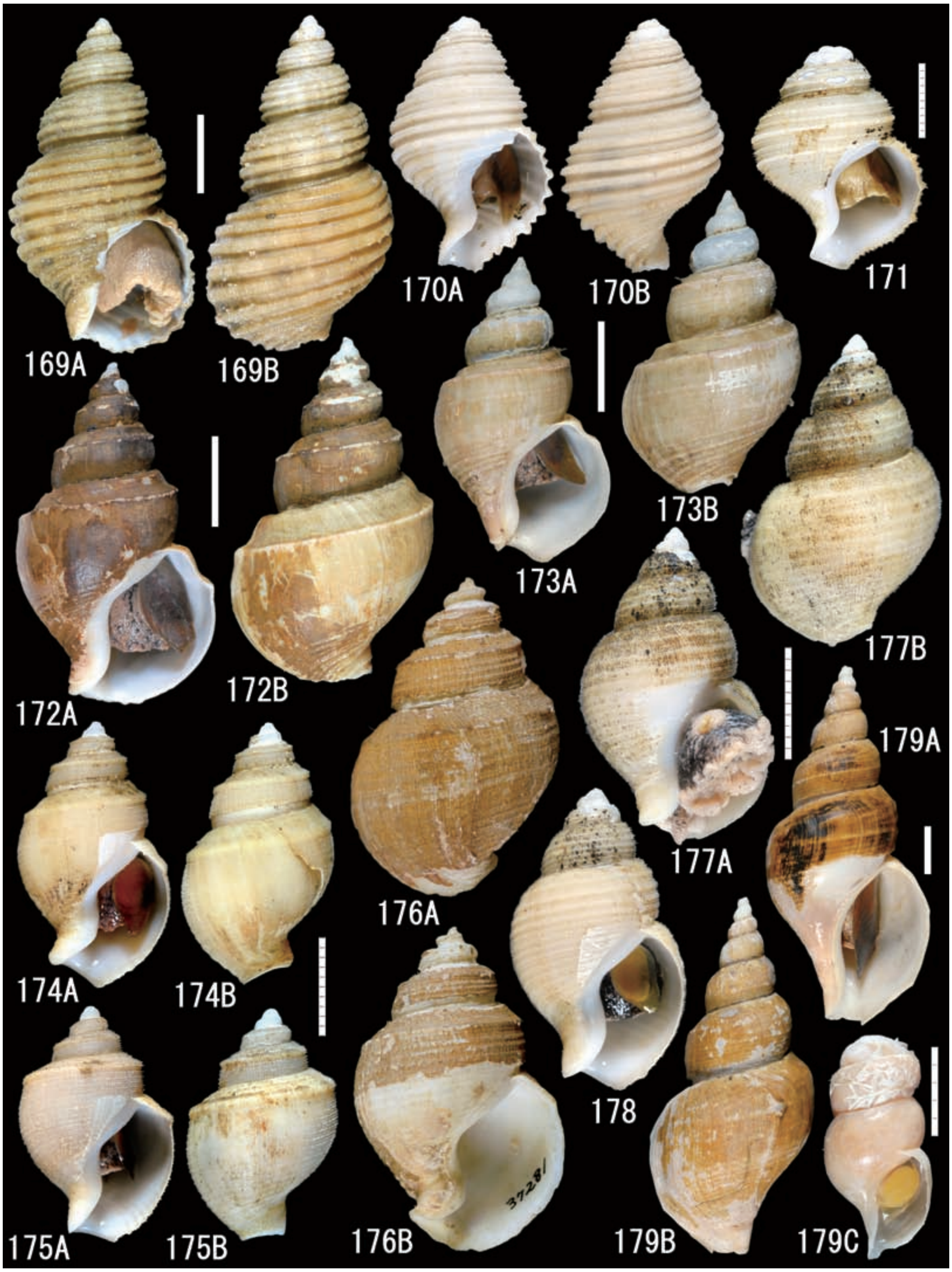
Ancistrolepis trochoideus — Dall, 1921: pl. 9, fig. 5; Kuroda, 1931: fig. 5 (reproduction of Dall’s (1921) figure); Suzuki, 1935: 187–194, figs. 1–9 (Middle Pliocene, Chiba Prefecture); Ozaki, 1958: 149–150, pl. 15, figs. 14–15 (Middle Pliocene, Choshi, Chiba Prefecture); Okutani, 1964: 410, pl. 2, figs. 9–10; Habe and Ito, 1965a: 46, pl. 13, fig. 17 (paratype); Okutani, 1966: 19–20, text-figs. 9A–G; Baba, 1990: 162, pl. 10, fig. 13.

Ancistrolepis trochoideus tokoyodaensis Ozaki, 1958: 150, pl. 15, figs. 16–17 (type locality: Tokoyoda, Chiba Prefecture; Iioka Formation, Pliocene) [fide Okutani (1966); Noda and Kikuchi (2001)].

Ancistrolepis trochoideus ovoideus Habe and Ito, 1965a: 46, pl. 13, fig. 17; Habe and Ito, 1965b: 20, 33–34, pl. 2, fig. 13 (type locality: off Choshi, Chiba Prefecture, at ca. 200 m).

Bathyancistrolepis trochoideus — Habe and Ito, 1968: 7 (proposal of the genus *Bathyancistrolepis* with this species as the type species); Bouchet and Warén, 1986: 460, figs. 7 (radula), 34–35; Okutani *et al*., 1988: 110, text-fig.; Watanabe and Naruke, 1988: 49, pl. 7, fig. 5; Tsuchida, 1993: pl. 1, fig. 9; Higo *et al.*, 2001: fig. G2550 (holotype); Noda and Kikuchi, 2001: 103–111, figs. 2–7.

Ancistrolepis (Bathyancistrolepis) trochoideus — Tiba and Kosuge, 1981 in 1979–1992: 11 (11–13), figs. 1–9 on page 11 (11); Hasegawa, 2005: 159, fig. 8H.



Figs. 169–179. Buccinidae. 169. *Parancistrolepis fujitai*, WA06-FG380. 170–171. *Bathyancistrolepis trochoideus*, 170: WA07-D900; 171: KT-08-27, St. S-4 (off Shimokita Peninsula, 2900 m). 172–173. *Clinopegma magna unicum*, 172: WA06-H450; 173: WA06-F380. 174–176. *Ancistrolepis sasakii*, 174: WA05-DE250D; 175: WA06-H350; 176: holotype, NSMT-Mo 37281. 177–178. *Pseudoliomesus canaliculatus*, 177: WA06-DE280D; 178: WA05-DE380D. 179. *Beringius polynematicus*, 179A–B: WA06-F350; 179C: WA06-EF425. Scales: 169, 172, 173, 179A–B = 20 mm; 170–171 = 10 mm (at the same scale); 174–176 = 10 mm (at the same scale); 177–178 = 10 mm (at the same scale); 179C = 5 mm.

Bathyancistrolepis trochoideus ovoideus — Okutani, 1986: 149 with color fig.; Okutani, 2000: 463, pl. 230, Buccinidae-44.
Bathyancistrolepis trochoideus trochoideus — Okutani, 2000: 463, pl. 230, Buccinidae-43.

Type locality. USBF station 4972, in 440 fathoms, and 4973, in 600 fathoms, “off Yokohama, Japan” [actually off Shiono-misaki, Wakayama Prefecture, 33˚25´45"N, 135˚33´E].

Distribution. Southern Kurile Islands (Kantor and Sysoev, 2006) and southwards, to East China Sea (Tsuchida, 1993), along Pacific coast, and Okinawa Trough (Hasegawa, 2005); 550–2050 m [450–1500 m].

Material examined. WA05-G900 (1e); WA06-A1200 (1); WA06-E1200D (1e); WA06-F1500D-1 (1e); WA06-F1500D-2 (1e); WA06-G900D (3e); WA06-G1200 (1e); WA06-H450 (1e); WA06-H480 (7e); WA06-H510 (2e); WA06-H1500D (4+2e); WA07-D900 (10+2e); WA08-G1500 (2); TS96-K2 [1451–1455 m] (2e).

Remarks. Although Habe and Ito (1965a) distinguished the form of this species inhabiting shallower waters off Choshi and northwards as *Ancistroleps trochoideus ovoideus*, most subsequent authors (e.g. Okutani, 1966; Tiba and Kosuge, 1981 in 1979–1992; Okutani and Iwahori, 1992; Noda and Kikuchi, 2001) regarded it as merely an intraspecific form of the nominotypical taxon, on the basis of the known variability in shell morphology. This species certainly has the widest geographical distribution in Japanese waters of all in this study, from the southern Kurile Islands to the Okinawa Trough, and exhibits a considerable range of geographical and vertical variation. As Habe and Ito (1965a) mentioned, specimens obtained from the present survey area in the relatively shallower portion of its vertical distribution (450 to 1500 m) are rather uniformly characterized by a relatively thick, large tall-conical shell with strong spiral cords in larger numbers and similar strengths (Fig. 170). However, the shell morphology becomes more variable in deeper waters; the shell becomes smaller and thinner, and the spiral cords tend to become fewer in number with many weaker secondary ribs (holotype of *A. trochoideus*; Okutani and Iwahori, 1992: fig. 30; Okutani, 2000: pl. 230, Buccinidae-43; Fig. 171). Specimens from the Okinawa Trough, at the southern most margin of the distribution of this species, bear only two strong acute spiral cords on the periphery (Hasegawa, 2001: fig. 8H). Nevertheless these forms are continuous, and cannot be divided into multiple distinct taxa.

Ancistrolepis sasakii (Habe and Ito, 1970)
[Japanese name: Sasaki-moroha-bai]
(Figs. 174–176)

Ancistrolepis magnus — Kinoshita, 1937: 12, pl. 3, fig. 18 [non *Chrysodomus (Ancistrolepis) magnus* Dall, 1895].
Ancistrolepis (Clinopegma) magnus — Kotaka, 1962: 141, pl. 33, fig. 37 [non *Chrysodomus (Ancistrolepis) magnus* Dall, 1895].
Clinopegma magnum — Habe and Ito, 1965a: 49, pl. 13, fig. 19; Tiba, 1968: pl. 2, fig. 3 [non *Chrysodomus (Ancistrolepis) magnus* Dall, 1895].
Clinopegma sasakii Habe and Ito, 1970: 107–109, text-fig. 1; Tiba and Kosuge, 1982 in 1979–1992: 12 (37–38), figs. 1–11 on page 12 (37); Okutani, 2000: 461, pl. 229, fig. Buccinidae-38; Higo *et al.*, 2001: fig. G2545 (holotype).
Pseudolimesus nassula — Golikov and Sirenko, 1998a: 110, fig. 6H [non *Liomesus nassula* Dall, 1901].
Not *Clinopegma sasakii* — Okutani *et al.*, 1988: 116, text-fig. [is *Clinopegma* sp.].
?Not *Ancistrolepis sasakii* — Kantor and Sysoev, 2006: 154, pl. 70, fig. E [is *Ancistrolepis* sp.].

Type locality. Off Iwami Town, on the Japan Sea coast of Hokkaido.

Distribution. Hitachi in Ibaraki Prefecture and southwards to southern Hokkaido on Pacific coast, and off southwestern Hokkaido in Sea of Japan; 200–300 m [250–410 m].

Material examined. WA05-DE250D (14+2e); WA06-DE280D (6e); WA06-H350 (1); WA07-B410D (1+1e); WA07-C350D (2); WA07-D410 (1e).

Remarks. As noted by Tiba and Kosuge (1982 in 1979–1992), this species had previously been regarded as a dwarf form of *Clinopegma magna* (Dall, 1895) due to a superficial similarity in outline to the latter species. However, *A. sasakii* differs from *C. magna* not only in size but also in its significantly coarser axial and spiral sculptures and thicker periostracum. Specimens from the Pacific coast of northern Honshu (Figs. 174–175; Tiba, 1968: pl. 2, fig. 3) differ slightly from those from the Sea of Japan (Fig. 176: holotype, NSMT-Mo 37281; Okutani, 2000: pl. 229, Buccinidae-38), in possessing distinctly weaker sculpture, but otherwise agree well in overall shell characters. Kantor and Sysoev (2006) transferred this species to the genus *Ancistrolepis* Dall, 1895 (type species: *Chrysodomus eucosmius* Dall, 1891, by original designation), based on the radula characters (Dr. Yu. Kantor, personal communication), although the specimen illustrated by them under this name seems to differ from the present species.

Clinopegma magna unicum (Pilsbry, 1905)
[Japanese name: Moroha-bai (= Yagen-bai; Himokake-yagen-bai; Hitoha-bai)]
(Figs. 172–173)

Buccinum unicum Pilsbry, 1905: 102; Pilsbry, 1907: 244–245, pl. 20, fig. 7; Hirase, 1908a: 71, pl. 26, fig. 38.
Chrysodomus (*Ancistrolepis*) *damon* Dall, 1907: 157 (type locality: S coast of Yesso [Hokkaido]); Dall, 1925: 3, pl. 34, fig. 5; Kosuge, 1972: pl. 17, fig. 1.
Ancistrolepis damon var. *polygramma* Dall, 1918: 230 (type locality: Nemuro, Yesso [Hokkaido]).
Ancistrolepis damon — Dall, 1925: 3, ol. 34, fig. 5.
Ancistrolepis magnus — Urita, 1929: 504, text-fig. 4.
Ancistrolepis magnus uritai Kuroda, 1931: 225, 230–231, figs. 9, 9a (type locality: Aniwa Bay, Karafto).
Ancistrolepis unicus — Kuroda, 1931: 231, figs. 11, 11a.
Ancistrolepis damon — Kuroda, 1931: 231, fig. 7.
Ancistrolepis damon polygramma — Kuroda, 1931: 231–232, fig. 10
Ancistrilepis (*Clinopegma*) *unicum* — Kira, 1959: 69, pl. 26, fig. 5.
Clinopegma unicum unicum — Habe and Ito, 1965a: 55, pl. 16, fig. 2; Okutani, 1986: 150, 151 with color fig.; Okutani, 2000: 459, pl. 228, figs. Buccinidae-32a–b; Higo *et al.*, 2001: fig. G2535 (holotype).
Clinopegma unicum polygramma — Habe and Ito, 1965a: 55, pl. 16, fig. 3.
Clinopegma unicum — Kuroda and Habe in Okada *et al.*, 1965: 118, text-fig.; Tiba, 1968: pl. 2, fig. 4; Tiba and Kosuge, 1982 in 1979–1992: 12 (41–43), text-fig. on page 12 (1) (holotype), figs. 1–10 on page 12 (41); Okutani *et al.*, 1988: 112, text-fig.; Baba, 1990: 163, pl. 10, fig. 15a–b.
Clinopegma damon polygramma — Tiba, 1968: pl. 2, fig. 5.
Clinopegma aequepaceum Tiba, 1981b: 107–108, pl. 35, figs. 1–7 (type locality: off Cape Erimo, Hokkaido, ca. 250 m) [synonymy fide Kantor and Sysoev (2006)].
Clinopegma unicum damon — Tiba and Kosuge, 1982 in 1979–1992: 12 (45–48), figs. 1–13on page 12–45; Okutani, 1986: 150, 151 with color fig.; Okutani, 2000: 459, pl. 228, fig. Buccinidae-33; Higo *et al.*, 2001: fig. G2536 (holotype).
Clinopegma uritai — Tiba and Kosuge, 1982 in 1979–1992: 12 (49–50), fig. on page 12 (1).
Ancistrolepis (*Clinopegma*) *damon* — Kantor, 1988: 1127–1129, figs. 1A–B, Ж, 5H.
Clinopegma magnum uritai — Okutani, 2000: 461, pl. 229, fig. Buccinidae-35.
Clinopegma magna unicum — Kantor and Sysoev, 2006: 156, pl. 71, figs. A–B.

Type locality. “Kisennuma, Rikuzen” [Kesen-numa, Iwate Prefecture].

Distribution. Off Ibaraki Prefecture and northwards to southwestern and northern Okhotsk Sea (Kantor and Sysoev, 2006); 23–457 m [250–550 m].

Material examined. WA05-DE380 (1d); WA05-DE380D (1e); WA05-DE425 (2); WA05-DE480 (1e); WA05-E410 (3); WA05-EF450 (1d); WA05-EF450D (7); WA05-F425 (1); WA05-F450 (2); WA05-F480 (2); WA05-F510 (1); WA05-FG250D (1e); WA05-FG410 (1d); WA05-FG425 (2d); WA05-FG480 (2d); WA05-G450 (1); WA05-G510 (3); WA05-GH410 (1d); WA05-GH425 (1); WA05-GH450 (1d); WA05-GH480 (1+3d); WA05-GH510 (2); WA06-D450D (1); WA06-DE280 (1e); WA06-DE280D (1); WA06-DE350 (1+3e); WA06-DE380 (5e); WA06-DE410 (1d); WA06-DE425 (2e); WA06-DE450 (4e); WA06-DE480 (1); WA06-E350 (1); WA06-E380 (1); WA06-E550 (1); WA06-EF350 (3e); WA06-EF380 (2e); WA06-EF410 (4e); WA06-

EF425 (1e); WA06-EF425D (3); WA06-F350 (2); WA06-F380 (2); WA06-F410 (2); WA06-F450 (1); WA06-F480 (2); WA06-F550 (2); WA06-FG350 (1e); WA06-FG350D (1); WA06-FG380 (1); WA06-FG410 (1e); WA06-FG425 (1+1e); WA06-FG450 (1d+2e); WA06-FG480 (3d); WA06-FG510 (1d); WA06-G450 (1); WA06-G510 (1); WA06-GH425 (3e); WA06-GH450 (1d+2e); WA06-GH480 (1+1e); WA06-GH510 (1e); WA06-H280 (1d); WA06-H350 (4d); WA06-H380 (2d+3e); WA06-H410 (2d); WA06-H425 (3d); WA06-H450 (4); WA06-H480 (18d+1e); WA06-H510 (1e); WA06-H550 (1e); WA07-A350 (1); WA07-A410 (1e); WA07-A450 (16); WA07-A550 (1e); WA07-B350 (1e); WA07-B410 (1+2e); WA07-B410D (3); WA07-B450 (1); WA07-B510 (1+1e); WA07-B650 (1e); WA07-C450 (1e); WA07-D310 (3); WA07-D350 (1+1e); WA07-D410 (4e); WA07-D450 (1e).

Remarks. This is a considerably variable taxon, and a number of the nominal taxa listed above have been regarded as junior synonyms of *C. unicum*. *Clinopegma unicum* was itself further regarded as a geographical subspecies of *C. magna* (Dall, 1895), which is distributed in the western Bering and Chukchi Seas, by Kantor and Sysoev (2006).

Pseudoliomesus canaliculatus (Dall, 1874)
[Japanese name: Iwade-itomaki-bai]
(Figs. 177–178)

Buccinopsis canaliculata Dall, 1874: 252; Kosuge, 1972: pl. 24, fig. 7.
Liomesus canaliculatus — Dall, 1902b: 531, pl. 38, fig. 2; Toba, 1930: 224; Higuchi, 2006: pl. 50, no figure numbers (3 specimens).
Liomesus ooides — Habe and Ito, 1965a: 50 (in part), pl. 14, fig. 11 [non *Tritonia* (*Buccinum*) *ooides* Middendorff, 1848].
Clinopegma okhotense — Ito, 1985: 28, pl. 5, fig. 6; Ito, 1989: 49, pl. 8, fig. 5 [non *Ancistrolepis okhotense* Dall, 1925].
Pseudoliomesus canaliculatus — Kantor and Sysoev, 2006: 156, pl. 72, fig. A.

Type locality. Cape Espenberg [Alaska].

Distribution. Off Kesen-numa in Iwate Prefecture and northwards to northern Bering Sea and Alaska; 16–246 m [280–380 m].

Material examined. WA9308-S13 [307 m] (1); WA05-DE380D (1); WA06-C350D? (2); WA06-DE280D (1); WA06-DE380 (1e); WA07-B310 (1e); WA07-B350 (1e); WA07-C350 (1e); WA07-C350D (4); WA07-D350 (1e); WA07-[data missing] (1e).

Remarks. The present material is probably conspecific with the one recorded by Toba (1930 in 1928–1935) from "deep-sea" in the present survey area as "*Liomesus canaliculatus*" with a brief description of the shell. Although it somewhat differs from the holotype of *Buccinopsis canaliculatus* Dall, 1874 (Kosuge, 1972: pl. 24, fig. 7), it reasonably agrees with the specimen identified by Kantor and Sysoev (2006) as *P. canaliculatus*, and is identified as that taxon. The present material can be distinguished from *P. ooides* (Middendorff, 1848), which is known to be distributed in northeastern Japanese waters, in having a more elongate shell, with more distinct spiral cords and less thickened outer lip, and a relatively thin and yellowish white operculum.

Subfamily Parancistrolepidinae Habe, 1973
Parancistrolepis fujitai (Kuroda, 1931)
[Japanese name: Fujita-bai]
(Fig. 169)

Ancistrolepis fujitai Kuroda, 1931: 223, 225, fig. 8; Kira, 1959: 70, pl. 27, fig. 7; Okutani, 1964: 409, pl. 2, fig. 6; Okutani, 1968: 32; Watanabe and Naruke, 1988: 49, pl. 7, fig. 1; Okutani, 2000: 459, pl. 228, Buccinidae-28.
Ancistrolepis hiranoi Shikama, 1962: 44–45, pl. 2, Fig. 1a–b (type locality: east off Choshi, 200–250 fathoms).
Parancistrolepis fujitai — Habe and Ito, 1965a: 56, pl. 16, figs. 5, 6; Kuroda and Habe in Okada *et al*. 1965: 118, text-fig.;

Habe, 1972: 51–52, figs. 1–2; Okutani, 1986: 149 with color fig.; Okutani *et al*., 1988: 108, text-figs.

Type locality. Off Kinkazan [Miyagi Prefecture, northeastern Honshu], dredged by the R/V *Soyo-maru*.

Distribution. Off Shimokita Peninsula in Aomori Prefecture and southwards to Sagami Bay, ?and sea area Enshu-nada, off central Honshu (Okutani, 1964); 300–930 m [280–1200 m].

Material examined. WA05-DE480 (2d); WA05-EF410 (1d); WA05-EF450D (1); WA05-F480 (1e); WA05-F510 (1); WA05-FG410 (1d); WA05-FG425 (1d); WA05-FG510 (1d); WA05-G280 (3e); WA05-G350 (2); WA05-G425 (1e); WA05-G510 (1e); WA05-G650 (1); WA05-GH310 (3e); WA05-GH350 (5+8e); WA05-GH450 (2d); WA06-A1200 (1); WA06-DE480 (1e); WA06-E480 (1); WA06-EF350 (1d); WA06-EF380 (2d); WA06-EF410 (1); WA06-EF425 (2d); WA06-F280 (1); WA06-F510 (2); WA06-FG350 (1e); WA06-FG350D (1); WA06-FG380 (3); WA06-FG410 (1e); WA06-FG425 (1d+4e); WA06-FG450 (1e); WA06-FG480 (1d+1e); WA06-FG510 (3e); WA06-G310 (1); WA06-G380 (1); WA06-G900D (1); WA06-GH350 (2d+1e); WA06-GH380 (4d); WA06-GH410-1 (1); WA06-GH425 (2e); WA06-GH450 (1e); WA06-GH480 (2e); WA06-H480 (1e); WA06-H510 (1); WA07-A550 (1); WA07-B1200 (2); WA07-C450 (1); WA07-D450 (1).

Remarks. Azuma (1965) established the new genus *Parancistrolepis* for *Japelion* (?) *kinoshitai* Kuroda, 1931 based on the distinct radular features. Habe (1972) subsequently transferred *A. fujitai* to this genus after examining its radula, and proposed the subfamily Parancistrolepisinae [sic; = Parancistrolepidinae]. However, the genus and the subfamily have often been ignored in recent Japanese literature.

Subfamily Beringiinae Golikov and Starobogatov, 1975
Beringius polynematicus Pilsbry, 1907
[Japanese name: Naga-bai]
(Fig. 179)

Beringius polynematicus Pilsbry, 1907: 243, pl. 19, fig. 1; Hirase, 1908c: 399, pl. 43, fig. 266; Tiba and Kosuge, 1981 in 1979–1992: 10 (23–25): figs. 1 (holotype), 2–11 on page 10 (23); Kantor and Sysoev, 2006: 158, pl. 73, figs. I (holotype), J.
Beringius frielei polynematicus — Kuroda, 1936: 177; Habe, 1964: 94, pl. 30, fig. 11.
Beringion marshalli — Habe, 1964: 60, pl. 30, fig. 11; Habe and Ito, 1965a: 58, pl. 17, fig. 4; Kuroda and Habe in Okada *et al*., 1965: 119, text-fig.; Okutani, 1986: 148, 149 with color fig.; Watanabe and Naruke, 1988: 48, pl. 6, fig. 5 [non *Beringius marshalli* Dall, 1919].
Beringius (*Beringion*) *marshalli* — Habe and Sato, 1973: 4 [non *Beringius marshalli* Dall, 1919].
Beringion polynematicus — Okutani *et al*., 1988: 86, text-fig.; Higo *et al*., 2001: fig. G2497 (holotype).
Beringius (*Beringion*) *polynematicus* — Okutani, 2000: 453, pl. 225, fig. Buccinidae-2.

Type locality. “Kisennuma, Rikuzen” [Kesen-numa in Iwate Prefecture, northeastern Honshu].

Distribution. Off Choshi, in sea area Kashima-nada, and northwards to southern Kurile Islands, and Okhotsk Sea; 300–400 m [250–425 m].

Material examined. WA05-DE350 (1d); WA05-EF310 (1d); WA05-EF350 (1d); WA05-FG280 (1); WA05-FG310 (2d); WA05-FG350 (1); WA05-FG410 (1d); WA05-GH310 (1e); WA05-GH410 (1d); WA05-GH425 (1d); WA05-H380 (1); WA06-DE280 (1d); WA06-DE350 (1e); WA06-DE410 (2d); WA06-E250 (2); WA06-E280 (3); WA06-EF250 (1d); WA06-EF280 (1); WA06-EF425 (8); WA06-F310 (1); WA06-F350 (2); WA06-F380 (2); WA06-FG250 (1); WA06-FG280 (1e); WA06-FG310 (2d); WA06-FG350 (1); WA06-FG380 (2d); WA06-FG410 (3d); WA06-FG425 (1d); WA06-GH310 (1d); WA06-GH380 (1+1e); WA06-H350 (1d); WA07-A350 (1+1e); WA07-B350 (1e).

Remarks. Although Habe and Ito (1965a) proposed the new genus *Beringion* for this species, based solely on the difference in density of the spiral sculpture, sculpture cannot be used as a distinguishing character for higher classification in this highly variable group. The taxonomical relationship between this and possibly related species, such as *B. marshalli* Dall, 1919, will be the subject of future study.

Subfamily Buccininae Rafinesque, 1815
Bathybuccinum bicordatum Golikov and Sirenko, 1988
[Japanese name: Fukami-ezo-bai]
(Figs. 180–181)

Bathybuccinum (Bathybuccinum) bicordatum Golikov and Sirenko, 1988b: 87–88, figs. 2–5.
Bathybuccinum bicordatum — Golikov and Sirenko, 1998: 124, fig. 12D; Kantor and Sysoev, 2006: 159–160, pl. 74, figs. A–B; Fraussen and Chino, 2009: 146, figs. 5, 13.

Type locality. Southern Kurile Islands, Etorofu (Iturup) Island, 44°58´N, 149°19´E, 605–620 m.

Distribution. Off Soma in Fukushima Prefecture (Fraussen and Chino, 2008) and northwards to southern Kurile Islands; 285–920 m [380–450 m].

Material examined. WA06-DE380 (1); WA06-DE450 (1)； WA06-EF425 (1e).

Remarks. Fraussen and Chino (2009) recently recorded an immature specimen of this species from the present survey area (off Soma in Fukushima Prefecture), together with the new species listed below.

Bathybuccinum higuchii Fraussen and Chino, 2009
[Japanese name: Mutsu-fukami-ezo-bai]
(Fig. 182)

Bathybuccinum higuchii Fraussen and Chino, 2009: 148–149, figs. 1–2, 16.

Type locality. Off Soma in Fukushima Prefecture Northeast Honshu, Tohoku, Japan, 300 m deep.

Distribution. Known only from off Fukushima Prefecture, Pacific coast of northern Honshu, at 300 m [450 m].

Material examined. WA06-GH450 (1).

Remarks. This species was recently described from the present survey area. It closely resembles the preceding one, but can be distinguished by the presence of one additional thick spiral rib on the base, in addition to the two on the periphery, and a thicker periostracum. They are otherwise very similar both in overall shell features and external anatomy, and more detailed study may be necessary to clarify the taxonomical relationship between these two nominal taxa.

Ovulatibuccinum perlatum Fraussen and Chino, 2009
[Japanese name: Shiratama-marumi-ezo-bai]
(Fig. 183)

Buccinum sp. B. — Tsuchida and Kurozumi, 1995: 179–180, fig. 7 (9).
Bathybuccinum perlatum Fraussen and Chino, 2009: 152, 154, figs. 7–8, 17–18.

Type locality. Off Iwate Prefecture, northeastern Honshu, Japan, 900–1000 m deep, on the slope of Japan Trench.

Figs. 180–192. Buccinidae and Conidae. 180–181. *Bathybuccinum bicordatum*, 180: WA06-DE450; 181: WA06-EF425 (empty shell). 182. *Bathybuccinum higuchii*, WA06-GH450 (paratype). 183. *Ovulatibuccinum perlatum*, WA05-DE450 (paratype). 184–185. *Ovulatibuccinum* sp. 1, 184: WA06-F650; 185: WA06-F750. 186. *Ovulatibuccinum* sp. 2, TS96-K2 [1451–1455 m]. 187. *Propebela*? sp. 8 (Conidae), WA06-F1500D. 188–189. *Buccinum isaotakii*, 188: WA06-DE280 (immature specimen); 189: WA06-F250. 190–191. *Buccinum niponense*, 190: WA05-FG350; 191: WA06-FG480. 192. *Buccinum kushiroensis*, WA07-A550. Scales: 180–187 = 5 mm; 188, 190–191 = 10 mm; 189, 192 = 20 mm (all at different magnifications).

Distribution. Off Iwate Prefecture and south to off Boso Peninsula, Chiba Prefecture (Tsuchida and Kurozumi, 1995, as *Buccinum* sp. B); 300–2700 m (Fraussen and Chino, 2009) [350–480 m].

Material examined. WA05-DE410 (1); WA05-DE450 (1); WA05-EF450 (1); WA05-EF450D (1); WA05-FG380 (6); WA05-FG410 (10+2e); WA05-FG425 (6+2e); WA05-FG450 (1); WA06-DE425 (1e); WA06-DE450 (1); WA06-DE480 (1e); WA06-E480 (1); WA06-E510D (1); WA06-EF425 (1+1e); WA06-EF425D(1e); WA06-EF450 (1e); WA06-FG350D (1+2e); WA06-FG380 (1e); WA06-FG410 (1+1e); WA06-FG425 (1+1e); WA06-FG480 (2).

Remarks. This species was also recently described from off northeastern Japan at upper bathyal to abyssal depths by Fraussen and Chino (2009). *Ovulatibuccinum* was originally proposed as a subgenus of *Bathybuccinum* by Golikov and Sirenko (1988b) (type species: *Buccinum ovulum* Dall, 1895, by original designation), but was elevated to generic level by Fraussen and Chino (2009) on the basis of differences in the characters of shell, periostracum and operculum.

Ovulatibuccinum sp. 1
(Figs. 184–185)

Material examined. WA05-F650 (1); WA06-F650 (1); WA06-F750 (1); WA06-G900D (1+1e).

Remarks. This species most closely resembles *Buccinum bulimuloideum* Dall, 1907 (Kosuge, 1972: pl. 20, fig. 6, holotype; Kantor and Sysoev, 2006: pl. 75, fig. E; Okutani, 2000: pl. 247, fig. Buccinidae-204, as “*B. rondinum* Dall, 1919”), but differs in its smaller size, and in having a smaller spire and very fine but distinct spiral sculpture on the entire surface. Furthermore, it possesses a remarkably small operculum relative to the size of the aperture, with a terminal nucleus, suggesting allocation to the genus *Ovulatibuccinum* Golikov and Sirenko, 1988. This species also resembles the specimen illustrated by Fraussen and Chino (2009: fig. 9) as *O. fimbriatum* Golikov and Sirenko, 1988, but differs in its larger size and strong spiral sculpture.

Ovulatibuccinum sp. 2
(Fig. 186)

Material examined. TS96-K2 [1451–1455 m] (1).

Remarks. This species closely resembles the preceding one in general shell and operculum features, but differs markedly in possessing a more solid shell and acute angulation at the shoulder, which warrant specific distinction.

Buccinum isaotakii Kira, 1959
[Japanese name: Shira-itomaki-bai]
(Figs. 188–189)

Buccinum leucostoma — Hirase, 1908a: 73, pl. 26, fig. 39; Kinoshita and Isahaya, 1934: 10, pl. 7, fig. 51; Kuroda, 1947: 1112, fig. 3156; Hirase and Taki, 1954: pl. 104, fig. 1; Golikov, 1980: 178–181 (in part), pl. 1, fig. 2a [non *Buccinum leucostoma* Lischke, 1872].

Buccinum isao-takii Oyama, MS. Kira, 1959: 70, pl. 27, fig. 8.

Buccinum isaotakii — Oyama, 1959: 250; Taki in Baba *et al*., 1960: 144, pl. 69, fig. 1; Oyama, 1962: 55, pl. 2, figs. 1–4, pl. 3, figs. 5–7; Habe and Ito, 1965a: 74, pl. 27, fig. 7; Kuroda and Habe in Okada *et al*., 1965: 116, text-fig.; Habe and Sato, 1973: 1, pl. 2, fig. 23; Okutani, 1986: 155 with color fig.; Okutani *et al*., 1988: 139, text-fig.; Watanabe and Naruke, 1988: 50, pl. 7, fig. 6; Nemoto and Akimoto, 1990: pl. 7, fig. 7; Okutani, 2000: 489, pl. 243, fig. Buccinidae-163.

Buccinum (*Buccinum*) *isaotakii* — Shikama and Horikoshi, 1963: 85, pl. 66, fig. 2.

Type locality. Not mentioned; figured syntype was collected from "Rikuzen-Otomo" [= Otomo, Rikuzen-Takada, Iwate Prefecture] (Takenouchi, 2001).

Distribution. Sea area Kashima-nada and northwards to Pacific coast off southern Hokkaido; 300–600 m [150–425 m].

Material examined. WA9308-S12 [250 m] (3); WA9308-S13 [307 m] (1); WA05-DE250 (2d); WA05-DE250D (1d); WA05-DE280 (1+1d+1e); WA05-DE310 (3d); WA05-DE350 (1d); WA05-EF250 (2d); WA05-EF250D (3+1e); WA05-EF280 (1d); WA05-FG250 (2d); WA05-FG250D (1e); WA05-FG280 (2); WA05-FG310 (2); WA05-G350 (13); WA05-G425 (1); WA05-GH250 (1); WA05-GH280 (3); WA05-GH310 (1); WA05-GH350 (3); WA05-GH380 (4); WA05-GH380D (1e); WA05-H150 (1+2e); WA05-H350 (4); WA05-H380 (1e); WA06-A350 (1); WA06-A410 (1); WA06-D210D (1); WA06-DE280 (5+1d+1e); WA06-DE280D (4+1e); WA06-DE310 (2+2e); WA06-DE350 (6e); WA06-E210 (2); WA06-E250 (3); WA06-E280 (5); WA06-E310 (3); WA06-EF250 (2d); WA06-EF280 (1+5e); WA06-EF310 (19+4e); WA06-EF350 (1+2e); WA06-EF425 (1); WA06-F210 (2); WA06-F250 (2); WA06-F280 (3); WA06-F310 (5); WA06-FG250 (1d); WA06-FG280 (4d); WA06-FG310 (9+5d+2e); WA06-G250 (2); WA06-G280 (1); WA06-G310 (2); WA06-G380 (5); WA06-GH250 (3d); WA06-GH280 (7d); WA06-GH310 (3d); WA06-GH350 (1+4d); WA06-GH380 (4d+2e); WA06-GH425 (1e); WA06-H150 (1+1d+2e); WA06-H210 (1d); WA06-H250 (4d+2e); WA06-H250D (3+1e); WA06-H280 (10d); WA06-H310 (20d); WA06-H350 (10+11d); WA06-H380 (5+9d); WA06-H410 (2+4d); WA06-H425 (3d); WA06-H450 (2+4d); WA06-H480 (5d+1e); WA07-A150 (1e); WA07-A250D (1); WA07-A310 (2+1e); WA07-A350 (16+18d); WA07-A410 (4+19d+1e); WA07-B150 (2e); WA07-B250 (1e); WA07-B410 (1d); WA07-B410D (1); WA07-C310 (1); WA07-C350D (1); WA07-D210D (10+5e); WA07-D350 (1e).

Remarks. Classification of the northwestern Pacific species of the genus *Buccinum* is still in a state of confusion, and a modern method using molecular analysis will be necessary to clarify it. The present taxon is apparently related to parapatrically distributed strongly ribbed taxa such as *B. leucostoma* Lischke, 1872, which is distributed from Sagami Bay to Tosa Bay along the Pacific coast of Honshu, *B. zelotes* Dall, 1907, found in the northeastern part of the Sea of Japan, and *B. morchianum* (Dunker, 1858) [including *B. inclytum* Pilsbry, 1904 as a junior synonym] and *B. verkruzeni* Kobelt, 1882 in the northern Pacific and Okhotsk Sea. Golikov (1980) regarded *B. leucostoma*, which is the oldest available name for this "species group", and *B. zelotes* as synonyms of this taxon, together with *B. niponense* Dall, 1907. Among these taxa, *B. isaotakii* is most closely related to *B. leucostoma* in shell morphology. However, shell characters are rather consistent and stable among each taxon, in spite of their rather wide geographical distributions, and distributions of both taxa are rather clearly separated at the tip of the Boso Peninsula, central Honshu. Accordingly *B. isaotakii* is here provisionally regarded as a valid taxon following most previous Japanese authors, pending more detailed study.

Buccinum niponense Dall, 1907

[Japanese name: Hime-shira-itomaki]

(Figs. 190–191)

Buccinum niponense Dall, 1907: 142–3; Dall, 1925: 7, pl. 35, fig. 9; Kosuge, 1972: pl. 21, fig. 3 (holotype); Okutani *et al.*, 1988: 141, figures on same page.

Buccinum nipponense [sic] — Kira, 1959: 68, pl. 26, fig. 22; Kanagawa Prefectural Museum (ed.), 1972: pl. 3, fig. 10; Habe and Ito, 1965a: 72, pl. 26, fig. 6; Golikov, 1980: 178–179 (in part); Matsukuma *et al.*, 1991: 173, pl. 73, fig. 3; Tsuchida and Kurozumi, 1995: 179, fig. 7 (8); Okutani, 2000: 489, pl. 243, fig. Buccinidae-164; Higo *et al.*, 2001: fig. G2741 (holotype).

Type locality. USBF station 5038, “on the south coast of Nippon, in 175 fathoms” [off southern Hokkaido, 42˚02´40"N, 142˚36´E], also at station 5049, in 182 fathoms.

Distribution. Sea area Kashima-nada and northwards to off Hidaka in southern Hokkaido (Okutani *et al.*, 1988); 100–300 m [250–510 m].

Material examined. WA05-DE250D (1); WA05-DE350 (3d); WA05-DE380 (6); WA05-DE380D (3+1e); WA05-DE410 (1+2e); WA05-DE425 (4); WA05-DE450 (2+1e); WA05-DE480 (1d); WA05-EF350 (3); WA05-EF380 (3+1d+1e); WA05-EF410 (2d); WA05-EF450 (1+1d); WA05-F425 (1); WA05-F450 (1); WA05-FG310 (2e); WA05-FG250 (1e); WA05-FG350 (6+1e); WA05-FG425 (1); WA05-FG480 (1); WA05-FG510 (1); WA05-G350 (1); WA05-G425 (2+2e); WA05-G450 (2); WA05-G510 (2e); WA05-GH380 (3); WA05-GH380D (1e); WA05-GH425 (1); WA05-GH450 (1); WA05-GH480 (1); WA05-GH510 (1); WA05-H380 (2); WA06-DE310 (1+1e); WA06-DE350 (2+1e); WA06-DE380 (4+4e); WA06-DE410 (3+6e); WA06-DE425 (12+3e); WA06-DE450 (2e); WA06-E450 (1); WA06-E480 (1); WA06-E510 (1); WA06-E510D (1); WA06-EF280 (5e); WA06-EF310 (4e); WA06-EF350 (9+4e); WA06-EF380 (ca. 35+33e); WA06-EF410 (1+6e); WA06-EF425 (4+6e); WA06-EF425D (1); WA06-F310 (1); WA06-F350 (3); WA06-F380 (3); WA06-F410 (3); WA06-F425 (4); WA06-F450 (1); WA06-FG310 (4+7e); WA06-FG350 (1); WA06-FG380 (5+4e); WA06-FG410 (1e); WA06-FG425 (9+1e); WA06-FG425 (3e; in a conger trap); WA06-FG450 (1); WA06-FG480 (6); WA06-FG480 (2ee; in a conger trap); WA06-G350 (11); WA06-G380 (8); WA06-G425 (4+1e); WA06-G450 (1); WA06-GH350 (2e); WA06-GH380 (4+6e); WA06-GH410 (-1) (1+1e); WA06-GH425 (1+2e); WA06-GH450 (1+1e); WA06-GH480 (1); WA06-GH480D (1e); WA06-GH510 (1e); WA06-H350 (1); WA06-H480 (1+1d); WA07-C450 (1); WA07-D310 (1e); WA07-D350 (8+7e); WA07-D410 (1+2e) WA08-G350 (7).

Remarks. Although Golikov (1980) regarded this taxon and *B. isaotakii* Kira, 1959 as junior synonyms of *B. leucostoma* Lischke, 1872, *B. niponense* differs significantly and discontinuously from both in overall shell morphology. The shell is always smaller and stouter in shape than the latter species, with a shorter siphonal canal. In addition, the size of the operculum relative to the aperture is always smaller. In the present survey area the vertical distributions of *B. niponense* (310–510 m) and *B. isaotakii* (150–480 m) overlap at depths of 310–480 m, confirming their specific separation (Fig. 452).

The geographical distribution of this species is relatively narrow in comparison with most of other species in the genus. Although some previous authors (e.g. Habe and Ito, 1965a) cited it from the Sea of Japan, this may have resulted from the confusion with other small spirally-ribbed buccinid species, such as *B. habui* Tiba, 1984. However, the taxonomical relationships among the small spirally-ribbed buccinid species distributed around the Japanese archipelago, including *B. habui* and *B. kawamurai* Habe and Ito, 1965 in the Sea of Japan, *B. sagamianum* Okutani, 1977 in Sagami Bay, and *B. koshikinum* Okutani in Okutani, Tagawa and Horikawa, 1988 in Tosa Bay and East China Sea, await further detailed study.

Buccinum kushiroensis Habe and Ito, 1976
[Japanese name: Kushiro-ezo-bai]
(Fig. 192)

Buccinum kushiroensis Habe and Ito, 1976: 85, pl. 1, fig. 3; Golikov, 1980: 266–267, pl. 21, fig. 5; Okutani *et al.*, 1988: 158, text-fig.; Okutani, 2000: 497, pl. 247, fig. Buccinidae-205; Higo *et al.*, 2001: fig. G2810 (holotype).

Type locality. Off Kushiro, Hokkaido, at about 300 m deep.

Distribution. Off Kushiro in northeastern Hokkaido and southwards to off Shimokita Peninsula in Aomori Prefecture; 300–550 m [450–550 m].

Material examined. WA05-DE510 (1); WA07-A450 (14+3e); WA07-A510 (4); WA07-A550 (3+1e); WA07-B510 (2e).

Remarks. The present species is characterized by a small and globose shell for the genus, with a narrow flat shelf below the suture and hairy periostracum, and is apparently related to, or probably conspecific with, *B. tsubai* Kuroda and Kikuchi, 1933, which was in turn regarded as a junior synonym of *B. rossicum* Dall, 1907 by Golikov (1980). The genetic population structure of *B. tsubai* and related forms in the Sea of Japan has been reported by Iguchi *et al.* (2004, 2005), although populations in the Pacific were not treated in the studies.

Buccinum kashimanum Okutani, 1964
[Japanese name: Kashima-nada-bai (= Kashima-bai)]
(Figs. 193–199)

Buccinum kashimanum Okutani, 1964: 413–414, pl. 2, fig. 1, text-fig. 4; Habe and Ito, 1965a: 49, pl. 14, fig. 3; Lus, 1976: 80–83, figs. 1 (3–4), 3 (8, 11), 4; Golikov, 1980: 249–250, text-figs. 67, 166, pl. 18, fig. 2; Okutani, 1983: 9, pl. 28, fig. 2; Okutani, 1986: 156, 157 with color fig.; Okutani *et al.*, 1988: 148, text-fig.; Matsukuma *et al.*, 1991: 173, pl. 73, fig. 8; The Committee for Celebrating Dr Okutani's Retirement from Tokyo University of Fisheries, 1996: 76, pl. 3, fig. 6 (holotype); Okutani, 2000: 499, pl. 248, fig. Buccinidae-208; Higuchi, 2006: pl. 103, 3 figs. in bottom row, pl. 110, 5 figs. in middle and bottom rows.

Buccinum n. sp. α — Okutani, 1964: 414–415, pl. 2, fig. 11.

Buccinum n. sp. β — Okutani, 1964: 415, pl. 2, fig. 8.

Buccinum concinnum Tiba, 1980b: 79, pl. 26, figs. 1–5 (type locality: east coast of the tip of Kamchatka Peninsula, ca. 300–400 m); Tiba and Kosuge, 1984 in 1979–1992: 14 (21–23), figs. 1–7 on page 14 (21) [preoccupied by *B. concinnum* Dillwyn, 1817, and C. B. Adams, 1848].

Buccinum boucheti Tiba, 1984: 2 [nom. nov. pro *B. concinnum* Tiba, 1980, non *B. concinnum* Dillwyn, 1817, and *B. concinnum* C. B. Adams, 1848]; Higo *et al.*, 2001: fig. G2812 (holotype).

Buccinum lamelliferum — Higuchi, 2006: pl. 107, fig. on the lower right, pl. 108, all figures [non *Buccinum lamelliferum* Lus, 1976].

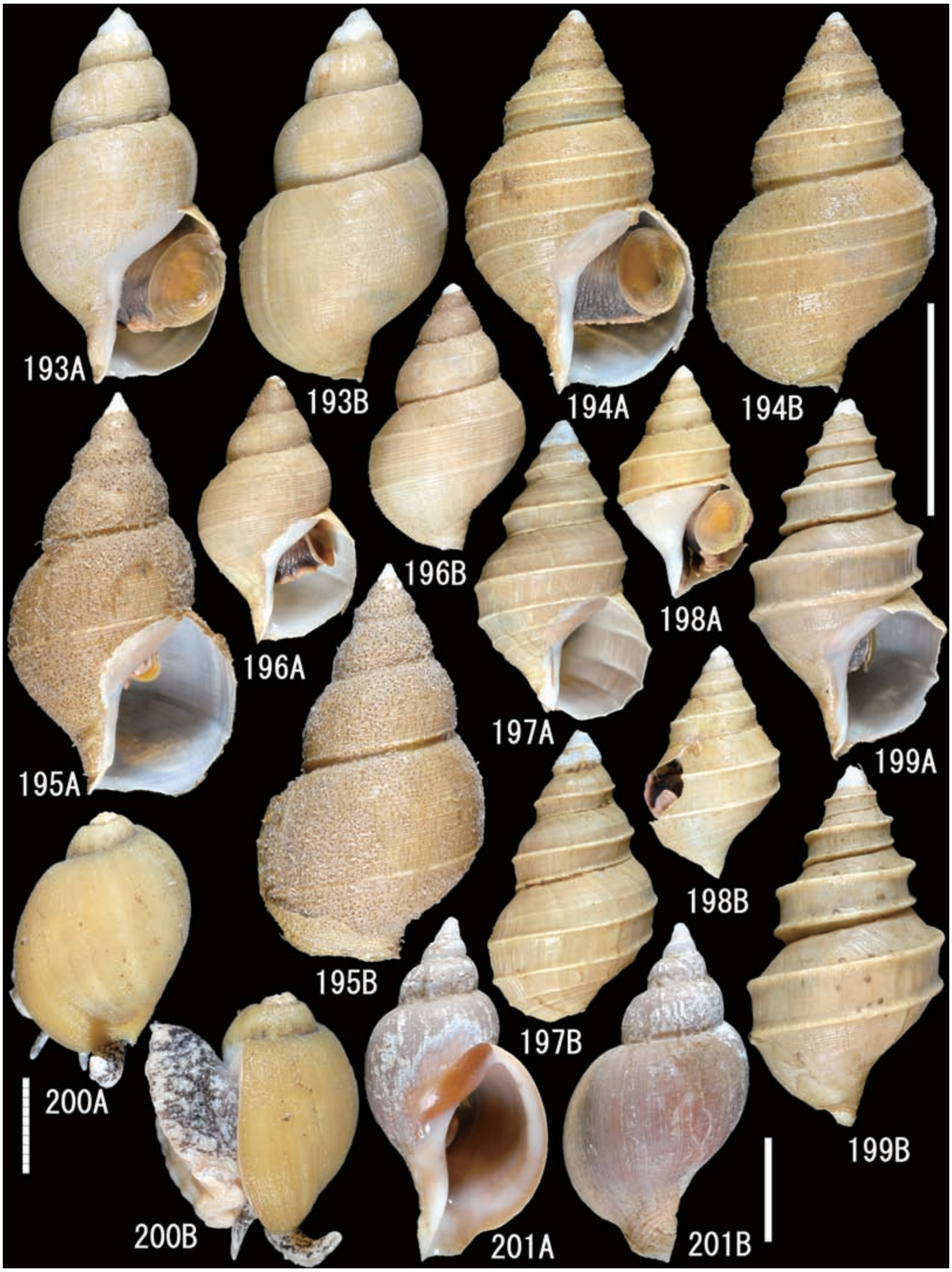
Buccinum pemphigus — Higuchi, 2006: pl. 87, all figs. except the one on the top, pl. 110, 5 figs. in top and middle rows [non *Buccinum pemphigus* Dall, 1927].

Type locality. R/V *Soyo-maru*, St. 17, 36°19.7´N, 141°09.0´E, the sea of Kashima-nada, 870 m.

Distribution. Sea area Kashima-nada and northwards to east of Kamchatka Peninsula (Tiba, 1980b; as *B. concinnum*); 300–1941 m (Lus, 1976) [410–1500 m].

Material examined. WA05-E650 (9+3e); WA05-G900 (7); WA05-G750 (1+1d); WA05-H750 (1); WA06-A650 (1); WA06-E550 (1); WA06-E650 (1); WA06-E750 (6); WA06-F550 (1); WA06-F650 (4); WA06-F750 (2); WA06-G750 (1); WA06-G900 (1+1e); WA06-H750 (7); WA07-A410 (1e); WA07-A550 (1e); WA07-A650 (ca. 25); WA07-A750 (1e); WA07-A900 (1); WA07-B510 (1e); WA07-B650 (10); WA07-B750 (7+7e); WA07-B900 (1e); WA07-C650 (2); WA07-C750 (12*); WA07-C900 (1*+1e*); WA07-D650 (8); WA07-D750 (6+1e); WA07-D900 (1); WA08-G1500 (1*) [*: "carinate form"].

Remarks. This is a highly variable species, even within a single population. The shell is generally thin for the genus, well inflated and usually sculptured with numerous fine spiral grooves over the entire surface. The number and strength of the spiral cords, however, varies from 0 to 5 among specimens, excluding the obscure ribs around the siphonal canal (e.g. Figs. 193 and 194; both obtained from the same station). Specimens possessing a slightly elongate shell with two strong spiral cords (Figs. 197–198) agree with holotype of *B. kashimanum*, and specimens possessing a conical shell with a strong spiral rib around the periphery agree with the holotype of *B. concinnum* Tiba, 1980. On the other hand, specimens with two strong keels (Fig. 199: "carinate form"), which occasionally occur at depths of 750–1500 m, differ rather abruptly from the other forms.



Figs. 193–201. Buccinidae. 193–199. *Buccinum kashimanum*, 193–194: WA06-F650; 195: WA07-D750; 196: WA07-A900; 197: WA07-C750; 198: WA05-G900; 199: WA07-C900. 200. *Volutharpa ampullacea*, WA07-C310. 201. *Habevolutopsius hirasei*, WA05-DE450. Scales: 193–199 = 50 mm (at the same scale); 200 = 10 mm; 201 = 20 mm.

Higuchi (2006) thus identified that form as *B. lamelliferum* Lus, 1976, but *B. lamelliferum* is actually an apparently different species, characterized by a significantly smaller (54 mm SL in holotype) and elongate shell with distinct axial lamellae. The "carinate form" is thus here regarded as a deep-water phenotype of *B. kashimanum*, until more detailed study distinguishes them. Lus (1976: fig. 1 (3)) identified a similar specimen, which was obtained from the Kurile Trench at a depth of 1941 m, as *B. kashimanum*.

Several North Pacific buccinid taxa that possess similarly thin shells and bathyal distributions are apparently related to the present species. These include *B. pemphigus* Dall, 1927 in the Okhotsk and Bering Seas, and *B. rausicum* Shikama, 1952 in the southern part of Okhotsk Sea, but both may be distinguished from the present species by their significantly stouter shells and different expressions of sculpture (more irregular in *B. pemphigus* and more crowded in *B. rausicum*).

Volutharpa ampullacea (Middendorff, 1848)
[Japanese name: Hime-mosuso-gai]
(Fig. 200)

Bullia ampullacea Middendorff, 1848: 245.

Volutharpa ampullacea — Tryon, 1881: 200, pl. 77, figs. 359, 360, pl. 79, fig. 390; Hirase, 1908a: 77, pl. 28, fig. 52; Galkin and Scarlato, 1955: 179, pl. 47, fig. 7; Habe and Ito, 1965a: 51, pl. 14, fig. 16; Golikov, 1980: 413–417, pl. 40, fig. 1; Okutani, 2000: 499, pl. 248, fig. Buccinidae-214; Kantor and Sysoev, 2006: 177–178, pl. 86, fig. G (syntype).

[Names for *V. ampullacea perryi* (Jay, 1855) are not included. See Golikov (1980) for more detailed synonymy.]

Type locality. Shantar islands, western Okhotsk Sea.

Distribution [of *V. amullacea* sensu stricto]. Sea area Kashima-nada (Hasegawa, personal observation) and northwards to Kamchatka Peninsula, Bering Sea, and west coast of North America (Golikov, 1980); [310–450 m].

Material examined. WA07-C310 (3+2e); WA07-C410 (1e); WA07-C450 (1e).

Remarks. One lot of live collected specimens and several additional fragmental shells obtained during the present survey can be assigned to the taxon known as *V. ampullacea* “Hime-mosuso-gai” in Japanese literature, which is usually distinguished from the common shallow water form *V. ampullacea perryi* (Jay, 1855) or “Mosuso-gai” at subspecies level, by the relatively small and less inflated shell. However, Golikov (1980) regarded the latter, as well as all the other nominal taxa of the genus recognized in the northwestern Pacific, including *V. ainos* Kuroda and Kinoshita, 1956, as junior synonyms of *V. ampullacea*. Because there is a significant difference in the vertical distributions of *V. ampullacea* [sensu Japanese authors] and *V. ampullacea perryi*, the latter inhabiting the intertidal to sublittoral zones down to about 10 m, more detailed study will be necessary to clarify their taxonomical relationship.

Subfamily Colinae Gray, 1857

Japelion* (*Japelion*) *hirasei (Pilsbry, 1901)
[Japanese name: Nejinuki-bai]
(Figs. 206–207)

Buccinum hirasei Pilsbry, 1901: 391, pl. 20, fig. 22; Hirase, 1908a: 72, pl. 26, fig. 39.

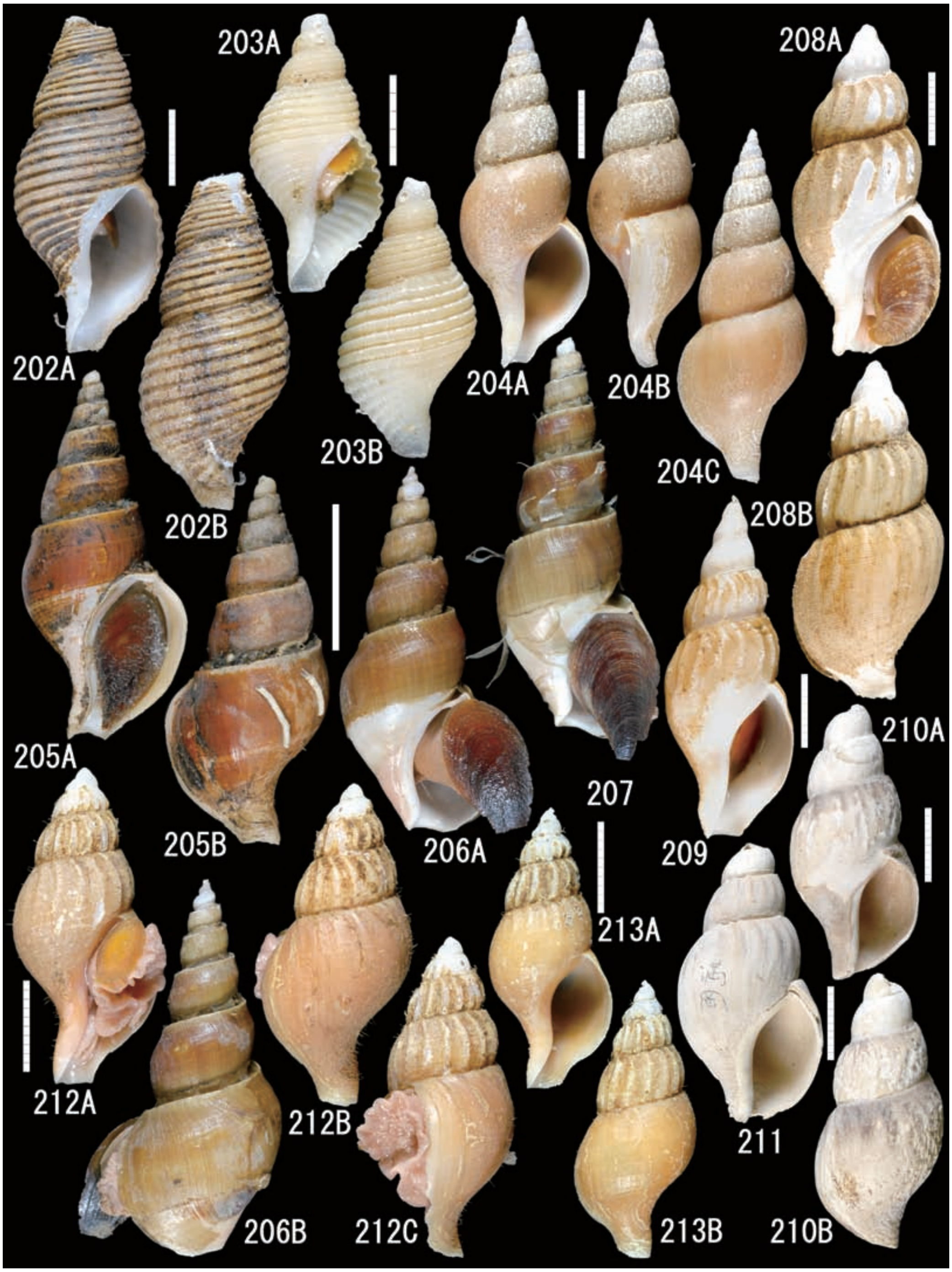
Chrysodomus (*Ancistrolepis*) *hirasei* — Dall, 1907: 157.

Ancistrolepis (*Japelion*) *hirasei* — Dall, 1916: 8; Shikama and Horikoshi, 1963: 80, pl. 64, fig. 1.

Japelion hirasei — Kuroda, 1931: 232, figs. 14, 14a; Hirase and Taki, 1954: pl. 102, fig. 7; Taki in Baba *et al*., 1960: 144, pl. 69, fig. 4; Habe and Ito, 1965a: 57, pl. 17, fig. 1; Ishikawa, 1970: 133, pl. 9, fig. 4; Tiba and Kosuge, 1980 in 1979–1992: 6 (3–5), text-figs. 1–7; Okutani, 1986: 148, 149 with color fig.; Okutani *et al*., 1988: 89, text-figs.; Egorov and Barsukov, 1994: 21–22, figs. 4B, 5N, 29A–D; Okutani, 2000: 453, pl. 225, fig. Buccinidae-7; Higo *et al*., 2001: fig. G2504 (holotype); Kantor and Sysoev, 2006: 185, pl. 93, fig. A.

Beringius (*Japelion*) *hirasei* — Kira, 1959: 70, pl. 27, fig. 11.

Japelion pericochlion — Matsukuma *et al*., 1991: 174, pl. 78, fig. 5 [non *Tritonium* (*Buccinum*) *pericochlion* Schrenck, 1862].



Figs. 202–213. Buccinidae. 202–203. *Aulacofusus hiranoi*, 202: WA05-F750; 203: WA06-FG480. 204. *Colus kujianus*, WA06-DE310. 205. *Japelion* (*Metajapelion*) *pericochlion*, WA06-G150. 206–207. *Japelion* (*Japelion*) *hirasei*, 206: WA06-F550; 207: WA07-B650. 208–211. *Plicifusus rhyssoides*, 208: WA07-A450; 209: WA06-H480; 210–211: holotype (210) and paratype (211) of *Plicifusus sugiyamai* Ozaki, 1958, NSM PM4462. 212–213. *Plicifusus levis*, 212: WA07-A450; 213: WA05-DE425. Scales: 202, 204, 208–213 = 10 mm; 203 = 5 mm; 205–207 = 50 mm (at the same scale).

Type locality. Off Kesen-numa, Rikuzen [Miyagi Prefecture, northeastern Honshu].

Distribution. Off Choshi, in sea area Kashima-nada, and northwards to southern Kurile Islands (Egorov and Barsukov, 1994); 250–2000 m [250–750 m].

Material examined. WA95-E600 (1d+1e); WA05-DE380 (3d); WA05-DE410 (1d); WA05-DE425 (3d); WA05-DE450 (4d); WA05-DE480 (2d); WA05-DE510 (1d); WA05-EF425 (1d); WA05-F425 (1); WA05-F450 (1); WA05-F480 (1); WA05-F510 (2); WA05-FG250D (1); WA05-FG480 (1d); WA05-G425 (1); WA05-G650 (2); WA05-GH250 (1e); WA05-GH350 (1+1e); WA05-GH410 (1d); WA05-GH450 (1d); WA05-GH480 (4d); WA05-GH510 (4); WA06-A350 (1); WA06-B650 (1); WA06-DE380 (5d); WA06-DE410 (3d); WA06-DE425 (4d); WA06-DE450 (1d); WA06-DE480 (4d); WA06-E450 (2); WA06-E480 (1); WA06-E510 (1); WA06-E550 (1); WA06-E750 (1); WA06-EF380 (1d); WA06-EF480 (2); WA06-EF510 (3d); WA06-F380 (1); WA06-F425 (1); WA06-F450 (1); WA06-F480 (3); WA06-F510 (2); WA06-F550 (2); WA06-F650 (2); WA06-FG410 (1d); WA06-FG450 (1d); WA06-FG480 (1d); WA06-G350 (1); WA06-G425 (2); WA06-GH280 (1e); WA06-GH310 (3d); WA06-GH350 (1); WA06-H310 (2e); WA06-H350 (2d); WA06-H380 (2d); WA06-H410 (2e); WA06-H425 (1d); WA06-H450 (1); WA06-H480 (2d+5e); WA06-H550 (1e); WA06-H750 (1); WA07-A310 (2e); WA07-A410 (1e); WA07-A550 (1); WA07-B350 (1); WA07-B510 (4+5d); WA07-B550 (1e); WA07-B650 (6); WA07-C350D (2e); WA07-C450 (1); WA07-C510 (1e): WA07-C550 (2d); WA07-C650 (1); WA07-D450 (2); WA07-D550 (4); WA07-D650 (4); WA07-D750 (3).

Remarks. The present species closely resembles *J.* (*M.*) *pericochlion* in general shell features, and is sometimes confused with it, but the resemblance may be due to homoplasy. Tiba and Kosuge (1980 in 1979–1992) examined the radula of *J. hirasei*, which is the type species of the genus *Japelion* Dall, 1916 by original designation, and suggested a possible relation to the Ancistrolepidinae Habe and Sato, 1973. However, their figure is too obscure to be used for precise higher classification. It nevertheless apparently differs from the radulae of *J. adelphicus* (Dall, 1907) and *J. pericochlion*, which were illustrated by Kuroda and Habe (1954) and Habe and Sato (1973), respectively, in lacking cusps on the central tooth. Based on this significant difference, Tiba and Kosuge (1980 in 1979–1992) proposed the new subgenus *Metajapelion* to accommodate the latter two species. Such differences in radula characters can warrant at least generic distinction, although additional study will be necessary to confirm this.

Japelion hirasei exhibits a relatively wide vertical distribution. Examples from the deeper stations (550 m and deeper) differ somewhat from the typical specimens (Fig. 206) by their relatively larger size (up to ca. 15 cm SL; usually up to 10 cm SL in shallower stations), and more elongate shell with a highly turreted spire (Fig. 207).

Japelion* (*Metajapelion*) *pericochlion (Schrenck, 1863)
[Japanese name: Neji-bora]
(Fig. 205)

Tritonium (Buccinum) pericochlion Schrenck, 1863 in 1861–1863: 513; Schrenck, 1867: 433–434, pl. 17, figs. 11, 12.
Neptunea (*Volutopsis* [*sic*; = *Volutopsius*]) *pericochlion* — Tryon, 1881: 121, pl. 49, fig. 284.
Chrysodomus pericochlion — Pilsbry, 1901: 391, pl. 20, fig. 23.
Volutopsis [*sic*] *pericochlion* — Hirase, 1907b: 361 [401], pl. 20, fig. 132.
Chrysodomus (*pericochlion* Schrenck, var?) *parallelus* Dall, 1907: 154 (type locality: E coast of Nippon).
Japelion pericochlion — Kuroda, 1931: 233, figs. 15, 15a, 16; Habe and Ito, 1965a: 57, pl. 17, fig. 2; Kuroda and Habe in Okada *et al*., 1965: 119, text-fig.; Okutani, 1986: 148, 149 with color fig.; Okutani *et al*., 1988: 90, text-figs.; Nemoto and Akimoto, 1990: pl. 6, fig. 1; Egorov and Barsukov, 1994: 23, figs. 4E, 5M, 30A–B; Okutani, 2000: 453, pl. 225, fig. Buccinidae-8.
Japelion pericochlion parallelus — Kuroda, 1931: 233, fig. 13; Kinoshita and Isahaya, 1934: 10, pl. 7, fig. 49; Hirase and Taki, 1954: pl. 102, fig. 4; Taki in Baba *et al*., 1960: 144, pl. 69, fig. 3.

Beringius (*Japelion*) *pericochlion* — Kira, 1959: 70, pl. 27, fig. 10.
Japelion (*Metajapelion*) *pericochlion* — Tiba and Kosuge, 1980 in 1979–1992: 6 (11–14), text-figs. 1–21.

Type locality. Hakodate [southern Hokkaido].

Distribution. Off Choshi, in sea area Kashima-nada, and northwards to southern Hokkaido; 100–400 m [150–310 m].

Material examined. WA05-FG250 (1e); WA06-F210 (1); WA06-F280 (1e); WA06-FG250 (1+2e); WA06-FG280 (1e); WA06-G150 (1); WA06-H210 (1e); WA06-H310 (5e).

Remarks. As mentioned above, Tiba and Kosuge (1980 in 1979–1992) proposed the new subgenus *Metajapelion* for *J. pericochlion* and related species in the genus *Japelion*, based on the radular features, but it has been ignored by most subsequent authors. This species is replaced by a possible sister species, *J.* (*M.*) *adelphicus* (Dall, 1907) in Sagami Bay and southwards to Tosa Bay and the East China Sea.

Aulacofusus hiranoi (Shikama, 1962)

[Japanese name: Hirano-itomaki-tsumu-bai (= Midori-itomaki-tsumu-bai)]

(Figs. 202–203)

Colus calameus [sic; = *calamaeus*] *hiranoi* Shikama, 1962: 43–44, pl. 2, fig. 4a–b;
Colus (Aulacofusus) calameus [sic] *hiranoi* — Shikama and Horikoshi, 1963: 80, pl. 63, fig. 4.
Colus calaneus [sic] — Habe and Ito, 1965a: 51, pl. 14, fig. 15 [non *Tritonofusus calamaeus* Dall, 1907].
Aulacofusu acosmius — Habe and Ito, 1965a: 53, refer to the fig. 15 in pl. 14; Higuchi, 2006: Gastropoda-18, pl. pl. 36, fig. in upper row [non *Chrysodomus (Sipho) acosmius* Dall, 1891].
Colus hiranoi — Tiba and Kosuge, 1981 in 1979–1992: 8 (13–14), text-figs. 1–4; Higo *et al.*, 2001: fig. G2584 (holotype).
Aulacofusus calamaeus — Okutani, 1983: 9, pl. 28, fig. 5 [non *Tritonofusus calamaeus* Dall, 1907].
Aulacofusus calamaeus hiranoi — Watanabe and Naruke, 1988: 48, pl. 6, fig. 9.
Colus (Aulacofusus) hiranoi — Okutani, 2000: 465, pl. 231, fig. Buccinidae-58.

Type locality. Off Choshi, Chiba Prefecture.

Distribution. Off Choshi, in sea area Kashima-nada, and northwards to eastern Hokkaido; 200–1300 [425–900] m.

Material examined. WA05-E480 (1); WA05-F750 (1); WA05-G425 (2); WA05-G650 (2); WA05-H450 (4); WA05-H510 (1); WA05-H900 (1); WA06-C650 (1); WA06-D550 (4); WA06-E550 (1); WA06-FG480; (4); WA06-FG480 (12: on sunken wood); WA06-GH480 (1); WA06-H480 (2+1e); WA06-H510 (4); WA06-H550 (2); WA06-H750 (1); WA07-B510 (1e); WA07-B650 (1); WA07-D410 (3); WA07-D900 (5); WA08-G410 (21: on sunken wood); WA08-G510 (5); WA08-G650 (1).

Remarks. This taxon was originally proposed as a subspecies of *Colus calamaeus* (Dall, 1907), which was described from off Avacha Bay, Kamchatka (locality corrected by Kantor and Sysoev, 2006). The similarity, however, lies only in the configuration of the strong spiral sculpture, and the two taxa are not actually closely related each other when judged by overall shell morphology, including the shape of the siphonal canal and aperture, as suggested by Tiba and Kosuge (1981 in 1979–1992). It is noteworthy that juvenile specimens smaller than ca 1.5 cm SL (Fig. 203) were found attached to pieces of sunken-wood, and a similar ecology has been observed in *A. coerulescens* (Kuroda and Habe in Habe, 1961), which is distributed along the temperate Pacific coast of central to western Honshu, from the sea area Enshu-nada to Tosa Bay (Hasegawa, personal observation).

Colus kujianus Tiba, 1973
[Japanese name: Tsumu-bai]
(Fig. 204)

Colus (*Aulacofusus*) *esychus* — Kira, 1959: 66, pl. 26, fig. 7 [non *Tritonofusus esychus* Dall, 1907].
Helicofusus minor — Habe and Ito, 1965a: 53, pl. 15, fig. 7 [non *Volutopsius minor* Dall, 1925].
Colus kujiana [sic; = *kujianus*] Tiba, 1973b: 65–67, pl. 6, figs. 6–8; Tiba and Kosuge, 1981 in 1979–1992: 8 (17–18), text figs. 1–10.
Tritonofusus esychus — Okutani, 1986: 148, 149 with color fig. [non *Tritonofusus esychus* Dall, 1907].
Colus esychus kujiana [sic; = *kujianus*] — Okutani *et al.*, 1988: 101, text-figs.
Colus (*Colus*) *kujianus* — Golikov and Sirenko, 1998: 114 (in part), fig. 8.
Colus esychus — Okutani, 2000: 463, pl. 230, fig. Buccinidae-53 [non *Tritonofusus esychus* Dall, 1907].
Colus esychus kujianus — Higo *et al.*, 2001: fig. G2575 (holotype).
Colus kujianus — Kantor and Sysoev, 2006: 183, pl. 91, fig. D.

Type locality. Off Kuji, Iwate Prefecture, 400 m deep.

Distribution. Off Soma in Fukushima Prefecture (present study) and northwards to southern Kurile Islands; northern Sea of Japan and Okhotsk Sea (Kantor and Sysoev, 2006); 222–2000 m [280–425 m].

Material examined. WA05-DE410 (1); WA06-B310D (3); WA06-DE310 (1); WA06-DE350 (2); WA06-DE380 (1); WA06-DE410 (1); WA06-EF280 (1); WA06-EF310 (2); WA06-EF425 (1); WA06-FG350D (1+1e); WA06-FG425 (1; in a conger trap); WA07-A410 (1); WA07-B350 (1); WA07-C350D (1).

Remarks. There had been confusion concerning the name of this species, until Tiba (1973b) established a new name for it. Although Ito (1967) recorded it as *Helicofusus minor* (Dall) from off Tajima, Hyogo Prefecture in the southern part of the Sea of Japan, at approximately 200 m depths, this cannot be confirmed due to the absence of figures.

Plicifusus rhyssoides Dall, 1918
[Japanese name: Rikuzen-shiwa-bai]
(Figs. 208–211)

Plicifusus (*Aulacofusus*) *rhyssoides* Dall, 1918: 227; Kosuge, 1972: pl. 14, fig. 7.
Plicifusus (Latifusus) wakasanus — Kinoshita and Isahaya, 1934: 9, pl. 6, fig. 47 [non *Plicifusus* (*Latifusus*) *wakasanus* Dall, 1918].
Plicifusus sugiyamai Ozaki, 1958: 149, pl. 15, figs. 13, 20–21 (type locality: Choshi, Chiba Prefecture; Iioka Formation, Pliocene). New synonym.
Plicifusus rhyssoides — Tiba and Kosuge, 1980 in 1979–1992: 7 (19–20); Higo *et al.*, 2001: fig. G2607 (syntype); Kantor and Sysoev, 2006: 198, pl. 101, figs. I, J (syntype).
Plicifusus rhyssus — Okutani *et al*., 1988: 102, text-fig. [non *Tritonofusus (Plicifusus) rhyssus* Dall, 1907].
Helicofusus rhyssus — Watanabe and Naruke, 1988: 48, pl. 6, fig. 6 [non *Tritonofusus (Plicifusus) rhyssus* Dall, 1907].
Mohnia sugiyamai — Baba, 1990: 161, pl. 10, fig. 11a–b.
Plicifusus (Retifusus) rhyssoides — Higuchi, 2006: pl. 40, figs. in upper and middle rows.
Not *Plicifusus (Retifusus) rhyssoides* — Okutani, 2000: 467, pl. 232, fig. Buccinidae-66 [is *Colus kujianus* Tiba, 1973].

Type locality. Rikuzen [Iwate Prefecture, northeastern Honshu].

Distribution. Off Choshi, in sea area Kashima-nada, and northwards to western Bering Sea (Golikov *et al.*, 2001); 90–1530 m [410–510 m].

Material examined. WA05-F480 (1); WA05-FG410 (1); WA06-F450 (1); WA06-FG425 (1+2e; in a conger trap); WA06-H410 (1); WA06-H450 (1e); WA06-H480 (1+2e); WA06-H510 (1e); WA07-A450 (1).

Remarks. Although this is not a rare species and is found in various collections, it has seldom been illustrated in popular identification guides with the correct name. Habe and Ito (1965a) seemed to regard *P. rhyssoides* as a junior synonym of *Helicofusus rhyssus* (Dall, 1907), which was originally described from Aniwa Bay, Sakhalin Island and is distributed in the Okhotsk and western Being Seas (Golikov *et al.*, 2001), because they illustrated *H. rhyssus* with the same Japanese name "Rikuzen-shiwa-bai". However, *H. rhyssus* can be distinguished from the present species by having a stouter shell with a more strongly recurved siphonal canal. The present species may be most closely related to *Plicifusus aurantius* (Dall, 1907), a possible counterpart in the Japan and Okhotsk Seas. Local specimens of *P. aurantius* in northern Hokkaido and the Okhotsk Sea, that were previously been identified as "*Plicifusus elaeodes*" [non *P. elaeodes* Dall, 1907] by Habe and Ito (1965a: pl. 13, fig. 24, and pl. 15, fig. 4) or *Fusivolutopsius verkruzeni* [non *Neptunea (Sipho) verkruzeni* Kobelt, 1876] by Tiba and Kosuge (1981 in 1979–1992: text-figs. 2–7) with the Japanese name "Midori-tsumu-bai", agree well with the present species in general shell shape and configuration of the fine spiral sculpture, and are distinguished only by the strength of the axial ribs (finer in *P. aurantius*). More detailed study will be necessary to clarify the relationship between these two nominal taxa. On the other hand, *Plicifusus sugiyamai* Ozaki, 1958 (Figs. 210–211: holotype and paratype, NSM PM4462), which was established based on specimens from the Iioka Formation (Pliocene), is indistinguishable from the present species, and is here regarded as a junior synonym.

Plicifusus levis Tiba, 1980
[Japanese name: Usude-shiwa-bai]
(Figs. 212–213)

Plicifusus levis Tiba, 1980a: 47, pl. 11, figs. 1–8; Tiba and Kosuge, 1980 in 1979–1992: 7 (13–14), figs. 1–9 on page 7 (13); Higuchi, 2006: pl. 39, figs. in upper row.
Mohnia (Retimohnia) robusta — Okutani, 2000: 463, pl. 230, fig. Buccinidae-49 [non *Mohnia robusta* Dall, 1913].

Type locality. Off the coast of Rikuzen, Iwate Prefecture, Japan (at about 250–300 m deep).

Distribution. Off Hitachi in Ibaraki Prefecture (present study) and northwards to off Kushiro, eastern Hokkaido (Higuchi, 2006); 250–450 m [250–450 m].

Material examined. WA05-DE425 (1); WA05-EF250D (1); WA05-FG380 (2); WA05-FG450 (1); WA06-DE450 (1); WA06-EF425D (1); WA06-FG310 (1); WA06-FG380 (2); WA06-FG410 (1); WA06-H350 (1); WA07-A450 (2); WA07-B450 (1); WA08-F900 (4).

Remarks. This is another little-known species in the genus *Plicifusus* Dall, 1902. The holotype is now deposited in the Sea and Shell Museum, Rikuzen-Takada City, Iwate Prefecture (UKM-MO-33228, R-13258), and a color photograph of it is available at the web site: *http://www.city.rikuzentakata.iwate.jp/kakuka/umikai/mosiki.file/13.usudesiwa/13.usudesiwa*. *Plicifusus parvus* Tiba, 1980, described from off Dal'Negorsk in the Maritime Province of Russia (Primorskiye Krai), is closely similar to the present species, and can only be distinguished by the presence of distinct spiral sculpture.

Mohnia bella (Ozaki, 1958)
[Japanese name: Shiwa-midori-hoso-bai (= Iwate-hoso-bai)]
(Figs. 214–225)

?*Mohnia hondoensis* Dall, 1913: 504 (type locality: off Hondo, Japan); Dall, 1925: 21, pl. 32, fig. 4; Kosuge, 1972: pl. 27, fig. 5 (holotype); Kantor and Sysoev, 2006: pl. 102, fig. G (holotype).
Opisthodermella bella Ozaki, 1958: 162, pl. 16, fig. 4.
Mohnia frielei — Okutani, 1964: 407, pl. 3, fig. 3 [non *Mohnia frielei* Dall, 1891].
Mohnia multicostata Habe and Ito, 1965a: 45, pl. 13, fig. 12; Habe and Ito, 1965b: 23, pl. 2, fig. 2 (type locality: off Choshi, Chiba Prefecture, at a depth of ca. 200 m); Ito, 1967: 55, pl. 3, fig. 4; Watanabe and Naruke, 1988: 48, pl. 6, fig. 7; Tiba

Figs. 214–224. *Mohnia bella*, 214: WA06-H380; 215: WA05-FG410; 216: WA05-EF480; 217: WA05-G425; 218: WA06-E550; 219: WA05-DE410; 220: WA06-EF410; 221: WA05-G750; 222: WA95-B1000; 223: holotype of *Mohnia multicostata* Habe and Ito, 1965, NSMT-Mo 53551; 224: off Choshi, Chiba Prefecture, ex. Kawamura collection. Scale: 10 mm (all at the same scale).

and Kosuge, 1992 in 1979–1992: 18 (13–14), text-figs. 1–3 on page 18 (13); Higo *et al.*, 2001: fig. G2556 (figured syntype); Kantor and Sysoev, 2006: 187, pl. 93, fig. E (noted as “holotype”, but is a reproduction of Tiba and Kosuge, 1992 in 1979–1992: text-fig. 1 on page 18 (13), not type material). New synonym.

Mohnia iwateana Tiba, 1981a: 85, pl. 30, figs. 1–3 (type locality: off Kuji in Iwate Prefecture Pacific coast of Northern Honshu, Japan 299–250 m deep); Tiba and Kosuge, 1992 in 1979–1992: 18 (9–10), text-figs. 1–7; Higo *et al.*, 2001: fig. G2557 (holotype). New synonym.

Plicifusus bella — Baba, 1990: 161–162, pl. 10, fig. 12.

Mohnia hondoensis — Tiba and Kosuge, 1992 in 1979–1992: 18 (7–8), text-fig. 2; Okutani, 2000: 463, pl. 230, fig. Buccinidae-47.

Plicifusus rhyssoides — Okutani, 2000: 467, pl. 232, fig. Buccinidae-66 [non *Plicifusus* (*Aulacofusus*) *rhyssoides* Dall, 1919].

Not *Mohnia multicostata* — Ito, 1985: pl. 5, fig. 3; Ito *et al.*, 1986: pl. 12, fig. 5; Ito, 1989: pl. 7, fig. 4 [is *Plicifusus* sp. cf. *parvus* Tiba, 1980].

Type locality. Road-side cutting 500 m southwest of Tokoyoda-machi, Choshi City, Iioka Formation [Pleiocene].

Distribution. Off Choshi, in sea area Kashima-nada, and northwards to off southern Hokkaido (Tiba and Kosuge, 1992 in 1979–1992), and in Sea of Japan (Ito, 1967); 299–1398 m [380–750 m].

Material examined. WA95-B1000 (4**); WA05-DE380D (1*+1e); WA05-DE410 (2*); WA05-EF480 (1); WA05-FG410 (1); WA05-G425 (1+1e); WA05-G510 (1e); WA05-G750 (1**); WA05-GH380D (1e); WA05-H380 (1e); WA06-E480 (1*); WA06-E550 (1*); WA06-EF410 (1); WA06-FG410 (1e); WA06-FG425 (1+2e; in a conger trap); WA06-FG450 (1e); WA06-FG480 (1); WA06-FG510 (2e); WA06-G380 (1); WA06-G425 (1); WA06-GH425 (1e); WA06-GH450 (1); WA06-GH480 (1); WA06-GH480D (1+4e); WA06-H380 (2); WA08-F900 (2e); TS96-K2 [1451–1455 m] (1**) [*: “slender form”; **: “deep-water form”].

Remarks. The specimens examined may be classified into several rather distinct forms. 1) The typical form (Figs. 214–217) is characterized by a fusiform shell with regularly spaced strong axial ribs and indistinct spiral cords. Fine spiral cords are usually present on the base, but are indistinct in some specimens. Several widely spaced indistinct spiral cords may appear around the periphery, with the most prominent one at the shoulder (e.g. Fig. 217). 2) The “Slender form” is characterized by a more elongate shell with less inflated whorls and a narrower siphonal canal (Figs. 218–219). Fine spiral grooves are usually apparent over the entire surface, but are indistinct in some specimens. It is noteworthy that live specimens of this form are often covered by a colony of a hydrozoan. 3) The “Deep-water form” may be distinguished from the others by its thinner shell, with a more deeply constricted suture (Figs. 221–222). Fine spiral sculpture is usually present over the entire surface. Despite these distinctions, it was difficult to clearly delineate these forms because of the presence of rather intermediate or obscure examples, and they are here regarded as phenotypes of a single species.

The typical form agrees perfectly with the holotype of *Mohnia iwateana* Tiba, 1981, described from off Kuji in Iwate Prefecture, which is within the present survey area. On the other hand, the holotype of *Mohnia multicostata* (Fig. 223; NSMT-Mo 53551), which was originally described from off Choshi, in the neighboring area, differs slightly from the present material in possessing stronger axial ribs that usually persist to the outer lip, indistinct spiral cords even on the base, and thicker brown periostracum. However, an examination of additional specimens from the type locality (Figs. 224–225) revealed a wide range of variation in shell characters in *M. multicostata*, and some specimens approach the present material. Furthermore, *Opisthodermella bella* Ozaki, 1958 (Fig. 225: holotype, NSM PM4473), described from the Middle Pliocene of Choshi in Chiba Prefecture, also closely resembles the present material except for its more slender shape and longer siphonal canal. However, the shape of the siphonal canal may have been altered by the destruction of the outer lip, and a specimen recorded from the same locality (Baba, 1990) has a similar shell profile to that of the present material. Accordingly *O. bella* is here regarded as the oldest available name for the present taxon. *Mohnia hondoensis* Dall, 1913, described from "off Hondo [Honshu], Japan", is another similar taxon. The holotype has been illustrated by Kosuge (1972: pl. 27, fig. 5), Tiba and Kosuge (1992 in 1979–1992: text-fig. 1 on page 18 (7)), and Kantor and Sysoev (2006: pl. 102, fig. G), and it differs considerably both from the present material and any other specimen from Japanese or adjacent waters so far examined, by its stouter shell with more widely spaced thick axial ribs.

Mohnia similis Golikov and Gulbin, 1977
[New Japanese name: Niyori-hoso-bai]
(Figs. 226–230)

Mohnia similis Golikov and Gulbin, 1977: 179–180, fig. 2; Golikov and Sirenko, 1998: 112–113, fig. 7H; Kantor and Sysoev, 2006: 187, pl. 93, Fig. B.

Type locality. Paramushir Island, Kurile Islands, 300 m.

Distribution. Off Soma in Fukushima Prefecture and northwards to northern Kurile Islands; 50–300 m [410–900 m].

Material examined. WA06-DE410 (1); WA06-E900 (1); WA06-F750 (1); WA07-D900 (ca. 40).

Remarks. This is the first record of this species in Japanese waters. It can be distinguished from *M. bella* (Ozaki, 1958) by its smaller shell with more inflated whorls and a narrower siphonal canal, and the more distinct axial and spiral sculpture, which does not diminish even on the body whorl. The color of the shell is usually white with a thin yellowish periostracum, but occasional reddish brown examples occur together with ordinary specimens in the same population (Fig. 228).

Mohnia robusta Dall, 1913
[Japanese name: Kesen-hoso-bai]
(Figs. 232–234)

Mohnia robusta Dall, 1913: 5011; Dall, 1921: 915, pl. 10, fig. 12; Oldroyd, 1927: 199–200, pl. 17, fig. 3; Kosuge, 1972: pl. 13, fig. 6; Tiba and Kosuge, 1992 in 1979–1992: 18 (17–19), figs. 1–6 on page 18 (17); Higo *et al.*, 2001: fig. G2569 (holotype).

Helicofusus robusta — Habe and Ito, 1965a: 47, pl. 13, fig. 21 (paratype).

Type locality. Off Pribiloff Islands, Bering Sea (988 fathoms).

Distribution. Off Onahama in Fukushima Prefecture and northwards, and eastern Bering Sea; 1000–3000 m [450–1000 m].

Material examined. WA05-E1000D (1e); WA06-A510 (1); WA06-G900D (2e); WA07-A450 (1); WA08-F900 (1e); TS96-K2 [1451–1455 m] (1e).

Remarks. The present material agrees with the specimens identified by Tiba and Kosuge (1992 in 1979–1992) as *M. robusta*, as well as the figures of its holotype (Kosuge, 1972; Tiba and Kosuge, 1992 in 1979–1992) and a paratype (Habe and Ito, 1965a). However, because *M. robusta* has not been recorded in Russian waters (Golikov and Sirenko, 1998; Kantor and Sysoev, 2006), it is probable that the Japanese populations are genetically isolated from those in the eastern Bering Sea, and further detailed study will be necessary for their precise identification.

Figs. 225–237. Buccinidae. 225. *Mohnia bella*, holotype of *Opisthodermella bella* Ozaki, 1958, NSM PM4473. 226–230. *Mohnia similis*, 226: WA06-E900; 227: WA06-F750; 228–229: WA07-D900; 230: WA06-DE410. 231. *Retifusus virens*, WA9312-K35 [251–268 m]. 232–234. *Mohnia robusta*, 232: WA06-G900D (empty shells); 233: WA06-A510; 234: WA07-A450. 235–236. *Mohnia* sp. cf. *japonica*, WA07-D900. 237. *Hindsia* (*Microfusus*) *acutispirata**, WA9206-A41 [68–69 m]. Scales: 10 mm (at the same scale, except for 225, 230, 233 and 237). *: See Appendix.

Figs. 238–250. Buccinidae. 238–246. *Mohnia daphnelloides*, 238: WA05-FG350; 239: WA05-EF450; 240: WA05-GH410; 241: WA06-E480; 242: WA05-DE510; 243: WA06-H750; 244: WA06-F750; 245: WA07-A900; 246: WA05-FG410. 247–250. *Pararetifusus tenuis*, 247: WA06-F1500D; 248: WA06-EF410; 249: WA06-EF350; 250: WA06-GH350. Scale: 10 mm (all at the same scale).

Mohnia daphnelloides Okutani, 1964
[Japanese name: Shajiku-hoso-bai]
(Figs. 238–246)

Mohnia daphnelloides Okutani, 1964: 407, pl. 3, fig. 9; The Committee for Celebrating Dr Okutani's Retirement from Tokyo University of Fisheries, 1996: 75–76, pl. 3, fig. 4 (holotype); Okutani, 2000: 463, pl. 230, fig. 51 (reproduction of Okutani, 1964: pl. 3, fig. 9).

Type locality. R/V *Soyo-maru*, St. 17, 36°19.7´N, 141°09.0´E, sea area Kashima-nada, 870 m.

Distribution. Off Hachinohe in Aomori Prefecture (present study), and southwards to off Choshi, in sea area Kashima-nada; 870 m [350–900 m].

Material examined. WA05-DE510 (1); WA05-EF410 (1); WA05-EF425 (1); WA05-EF450 (1); WA05-EF450D (1); WA05-F450 (1e); WA05-FG350 (1); WA05-FG410 (2+1e); WA05-FG425 (1+1e); WA05-FG450 (1); WA05-GH410 (1); WA05-GH425 (1); WA05-H480 (1e); WA06-DE480 (1); WA06-E480 (1); WA06-E510 (1); WA06-E510D (1+1e); WA06-EF450 (1); WA06-F750 (1); WA06-FG410 (2e); WA06-FG450 (1); WA06-FG480 (1); WA06-GH450 (2); WA06-GH480 (1e); WA06-GH480D (1); WA06-H380 (1); WA06-H480 (2+1e); WA06-H750 (1); WA07-A450 (2+1e); WA07-A900 (1).

Remarks. This species has been known only from the type material in literature, although it has occasionally been collected off Choshi and can be found in several collections (e.g. Kawamura and Sakurai collections in NSMT). It is characterized by a relatively small shell, which does not exceed 20 mm SL among the specimens examined, with well-inflated whorls, fine closely set spiral grooves and regularly spaced thick axial ribs. The axial ribs tend to disappear on the body whorl in specimens collected from deeper stations (Figs. 243–245). The specimen illustrated in Fig. 246 differs from others in possessing relatively thick and indistinct spiral cords, in stead of fine spiral grooves, and is only provisionally included in this species, because of the over all similarity in other shell features.

Retifusus semiplicatus Golikov in Golikov and Scarlato, 1985, described from southeastern Sakhalin in shallow waters (78 m), closely resembles the present species, both in shell shape and sculpture, but differs by its markedly large size (the holotype of *R. semiplicatus* is 32.3 mm SL).

Retifusus virens (Dall, 1877)
[New Japanese name: Arabori-shiwa-bai]
(Figs. 231)

Chrysodomus virens Dall, 1877: 1–2; Kosuge, 1972: pl. 14, fig. 2 (holotype).
Tritonofusus (*Plicifusus*) *virens* — Dall, 1902b: 525, pl. 36, fig. 8 (holotype).
Plicifusus virens — Oldroyd, 1927: 209, pl. 4, fig. 8 (holotype); Higo *et al*., 2001: fig. G2605 (holotype).
Mohnia virens — Tiba and Kosuge, 1992 in 1979–1992: 18 (25–26) [in part], fig. 1 on page 18 (25) (holotype); Golikov and Sirenko, 1998: 112, fig. 7F.
Retifusus virens — Kantor and Sysoev, 2006: 200, pl. 102, figs. E (holotype), F.
Not *Mohnia virens* — Habe and Ito, 1965a: 46, pl. 13, fig. 15 [is *Mohnia okhotskana* Tiba, 1981; with the new Japanese name: Futo-shiwa-bai]; Tiba and Kosuge, 1992 in 1979–1992: 18 (25–26) [in part], fig. 2 on page 18 (25) [is *Propebela* sp. (Conidae)].

Type locality. Kyska Harbor, Alaska, 10 fathoms.

Distribution. Off Kuji in Iwate Prefecture (present study) and northwards to southern Sakhalin, Bering Sea, and Alaska; 18–430 m [250 m].

Material examined. WA9312-K35 [251–268 m] (3).

Remarks. The present material agrees well with the specimen identified by Kantor and

Sysoev (2006: pl. 102, fig. F) as *R. virens*, which was originally described based on an immature specimen, by its small but solid shell for the genus, with distinct axial ribs as well as broad spiral cords that become more obvious on the base. All the previous records of this taxon in Japanese waters were, however, based on incorrectly identified specimens as shown in the synonymy, and this represents the first record of this species from Japan. On the other hand, the present material also resembles *Mohnia okhotskana* Tiba, 1981, which is known only from the northwestern part of the Okhotsk Sea, as well as *Mohnia toyamana* Tiba, 1981, known only from Toyama Bay in the Sea of Japan, and *Plicifusus saginatus* Tiba, 1980, known only from off Sakhalin in the Okhotsk Sea, and more comprehensive study will be necessary to clarify their taxonomical relationships.

Mohnia sp. cf. ***japonica*** Dall, 1913
(Figs. 235–236)

?*Mohnia japonica* Dall, 1913: 503 (type locality: off Sado Island, Japan Sea, 225 fathoms); Dall, 1925: 21, pl. 32, fig. 6; Kosuge, 1972: pl. 13, fig. 8.

Material examined. WA05-H900D (1e); WA06-G900D (2e); WA07-D900 (ca. 80+7e).

Remarks. The present material generally agrees with *M. japonica* Dall, 1913, which was described in the Sea of Japan, in possessing a smooth shell that is covered by a thick, dark brownish periostracum and lacks any distinct spiral sculpture. However it differs from *M. japonica* in being more slender in shape with a longer siphonal canal, and also lacking thick but indistinct axial ribs that are apparent on the upper whorls and distinct spiral ribs on the base of the latter species. The present material also resembles *Retimohnia clarki* (Dall, 1907) in general shell appearance, but significantly differs in lacking distinct axial ribs on the upper whorls.

Pararetifusus tenuis (Okutani, 1966)
[Japanese name: Kudamaki-tsumu-bai]
(Figs. 247–250)

Phymorhynchus? *tenuis* Okutani, 1966: 26, pl. 2, fig. 21, text-fig. 13; The Committee for Celebrating Dr Okutani's Retirement from Tokyo University of Fisheries, 1996: 80, pl. 4, fig. 8 (holotype).
Retifusus (*Pararetifusus*) *tenuis* — Kosuge, 1967: 59–62, pls. 3–4.
Pararetifusus tenuis — Bouchet and Warén, 1986: 483, figs. 4, 26, 106–107; Hasegawa, 2001: 141; Fraussen and Hadorn, 2001: fig. 10 (reproduction of the original figure of holotype); Higo *et al.*, 2001: fig. G2611 (holotype); Kosyan, 2006: 5–6, figs. 1F, 2, 3A.
Mohnia tenuis — Golikov and Sirenko, 1998: 112, fig. 7G.
Retifusus tenuis — Kantor and Sysoev, 2006: 200, pl. 102, fig. C.

Type locality. R/V *Soyo-maru*, St. T21(2), 34°56.8´N, 139°21.0´E, Sagami Bay, 1470–1500 m.

Distribution. Off Iturup Island (Kosyan, 2006) and southwards to Sagami Bay, and Tosa Bay (Hasegawa, 2001); 765–1500 m [350–1500 m].

Material examined. WA05-DE480 (1e); WA05-FG410 (1); WA05-FG510 (1); WA05-GH380D (1); WA05-H380 (2); WA06-DE425 (1); WA06-EF350 (2); WA06-EF410 (1); WA06-EF425 (1); WA06-F900 (1); WA06-F1500D-1 (2); WA06-F1500D-2 (1e); WA06-FG410 (2); WA06-FG425 (2); WA06-FG450 (1); WA06-FG480 (1e); WA06-FG510 (2); WA06-G750 (1); WA06-G900D (2+1e); WA06-GH350 (1); WA06-GH425 (1); WA06-GH450 (1); WA06-H450 (1); WA06-H480 (3e); WA07-A450 (1e); WA07-D900 (12+2e); TS96-K2 [1451–1455 m] (3e).

Remarks. This species was originally assigned to the turrid genus *Phymorhynchus* Dall, 1908 with a question mark, but subsequently transferred by Kosuge (1967) to the buccinid genus

Retifusus Dall, 1916 on the basis of anatomical characters. Because of the complete lack of axial sculpture on the shell, Kosuge (1967) also established the new subgenus *Pararetifusus* to accommodate it, which was elevated by Bouchet and Warén (1986) to generic status. More recently, Kosyan (2006) included two additional new species from the Bering Sea in this genus and excluded *Pararetifusus* sp. sensu Bouchet and Warén (1986: figs. 3, 108) from Indonesia, and *P. dedeoderi* Fraussen and Hadorn, 2001, described from the Philippines.

There is a considerable variation in the strength of spiral sculpture among the specimens examined. Moreover, the present material differs slightly from the specimens from Tosa Bay in being stouter with a shorter siphonal canal, suggesting a wide geographical variation.

Neptunea intersculpta (Sowerby, 1899)
[Japanese name: Chijimi-ezobora (= Ezobora-modoki)]
(Figs. 251–253, 263)

Chrysodomus intersculptus Sowerby, 1899: 371–372, fig. 2.

Chrysodomus insularis Dall, var. *constrictus* Dall, 1907: 153–154 (type locality: USBF station 4863, off Korea and others); Kosuge, 1972: pl. 27, fig. 2 (holotype).

Chrysodomus hypolispus Dall, 1919: 324 (type locality: USBF station 4991, Japan Sea) [non Dall, 1891]; Habe, 1961b: 148–149, text-fig. 1 (paratype).

Neptunea intersculpta — Hirase, 1907b: 360–361 [400–401]; Taki in Baba *et al*., 1960: 144, pl. 69, fig. 6; Oyama and Takemura, 1961: *Neptunea* (2), figs. 4–5; Kuroda and Habe in Okada *et al*., 1965: 117, text-fig.; Okutani, 1986: 150, 151 with color fig.; Okutani, 2000: 467, pl. 232, fig. Buccinidae-73; Higo *et al*., 2001: fig. G2617 (holotype).

Neptunea antiqua subsp. *japonica* Dautzenberg and Fischer, 1912: 77–78, pl. 2, fig. 2 (type locality: off Kumihama, Tango [Sea of Japan]); Fraussen and Terryn, 2007: text-fig. 57a–b (holotype).

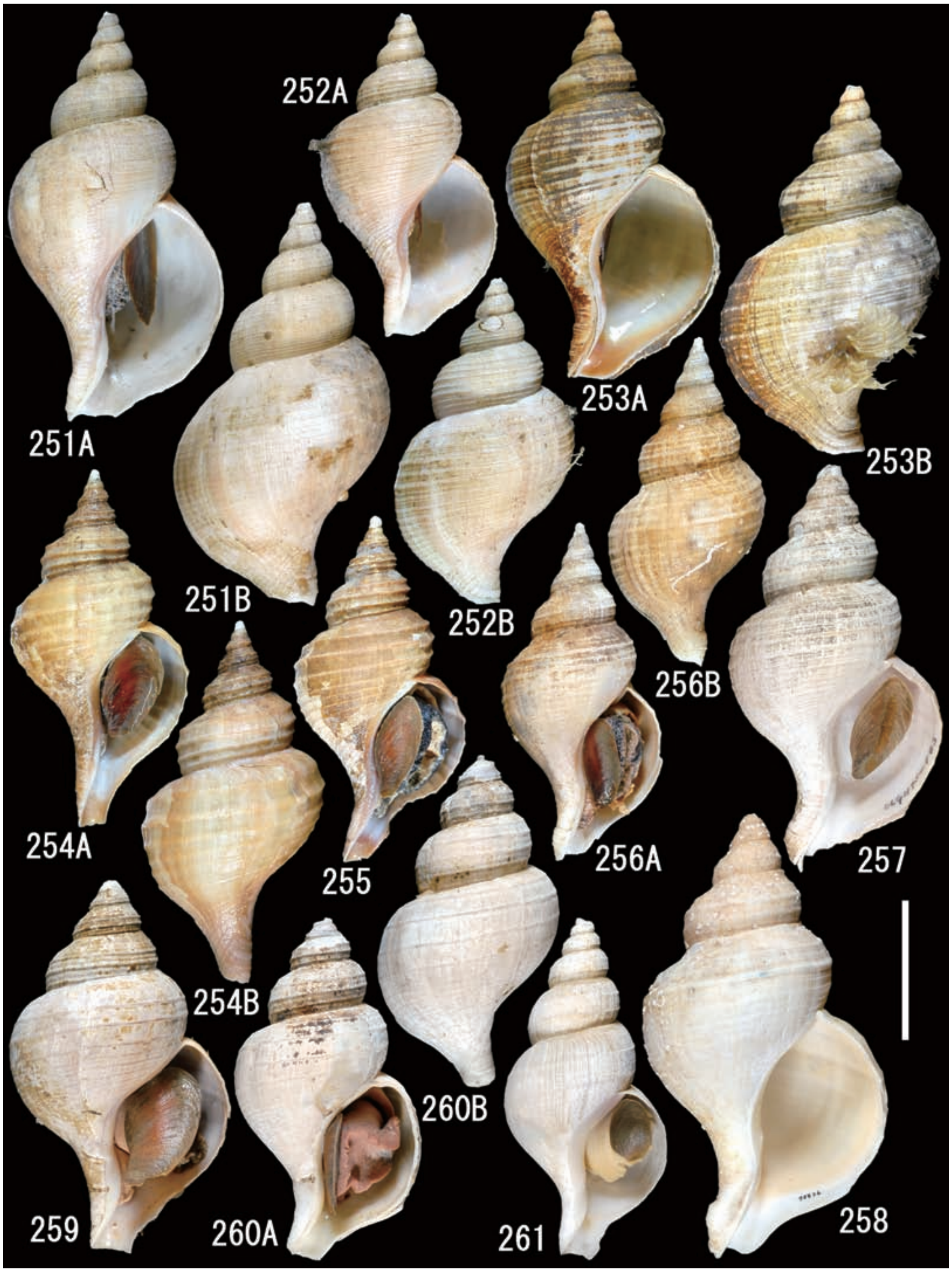
Neptunea constricta — Oyama and Takemura, 1961: *Neptunea* (2), fig. 3; Okutani, 1986: 150, 151 with color fig.; Okutani *et al*., 1988: 122, text-figs.; Nemoto and Akimoto, 1990: 10, pl. 5, fig. 8; Okutani, 2000: 469, pl. 233, fig. Buccinidae-33.

[See Golikov (1963) and Tiba and Kosuge (1988 in 1979–1992) for more detailed synonymy under the names, *N. intersculpta* and *N. constricta*.]

Type locality. Tango, Japan [Sea of Japan coast of Kyoto, central Honshu, Japan].

Distribution. Off Choshi, in sea area Kashima-nada, and northwards to eastern Hokkaido on Pacific coast, and in Sea of Japan; 50–1200 m [250–650 m].

Material examined. WA05-DE310 (1d); WA05-DE380 (1d); WA05-DE410 (2d); WA05-DE425 (3d); WA05-DE450 (2d); WA05-DE480 (2d); WA05-EF250 (1d); WA05-EF280 (1d); WA05-EF310 (1d); WA05-EF350 (2d); WA05-EF410 (1d); WA05-EF450 (2+1d); WA05-F425 (1); WA05-F450 (2); WA05-F480 (1); WA05-F510 (1); WA05-FG280 (3); WA05-FG310 (1); WA05-FG350 (1+1d); WA05-FG380 (2+2d); WA05-FG410 (2d); WA05-FG425 (1d); WA05-FG450 (1d); WA05-FG480 (2d); WA05-FG510 (1d); WA05-G425 (1); WA05-G510 (1e); WA05-GH310 (1); WA05-GH350 (5+3d+1e); WA05-GH380 (2d); WA05-GH410 (2d); WA05-GH425 (1d); WA05-GH450 (2+1d); WA05-GH480 (5d); WA05-GH510 (1); WA05-H310 (1); WA05-H350 (5); WA05-H380 (1); WA06-DE280 (1d); WA06-DE280D (1); WA06-DE310 (1d); WA06-DE350 (4d); WA06-DE380 (5d); WA06-DE410 (5d); WA06-DE425 (3d); WA06-DE450 (2d); WA06-DE480 (4d); WA06-E280 (2); WA06-E310 (3); WA06-E450 (2); WA06-E480 (1); WA06-E510 (1); WA06-EF250 (1d); WA06-EF280 (1d); WA06-EF310 (1d); WA06-EF350 (2d); WA06-EF380 (1+3d); WA06-EF410 (2d); WA06-EF425 (2d); WA06-EF450 (1d); WA06-EF510 (1d); WA06-F280 (2); WA06-F310 (3); WA06-F350 (1); WA06-F380 (2); WA06-F410 (2); WA06-F425 (2); WA06-F450 (1); WA06-F480 (2); WA06-F510 (2); WA06-F550 (1); WA06-F650 (1e); WA06-FG310 (2d); WA06-FG350 (1); WA06-FG350D (2); WA06-FG380 (1d+1e); WA06-FG410 (3d+1e); WA06-FG425 (1d); WA06-FG425 (1+1e; in a conger trap); WA06-FG450 (3d); WA06-FG480 (5d); WA06-FG510 (1d); WA06-G310 (1); WA06-G350 (2); WA06-G425 (4); WA06-G450



Figs. 251–261. *Neptunea* spp. 251–253. *Neptunea intersculpta*, 251–252: WA06-F425; 253: WA07-A550. 254–255. *Neptunea frater*, 254: WA05-GH250; 255: WA06G250. 256–258. *Neptunea hiberna*, 256: WA06-G350; 257: WA06-GH450; 258: holotype, NSMT-Mo 73836. 259–260. *Neptunea* sp. cf. *convexa*, 259: WA06-F900; 260: WA05-G900. 261. *Neptunea nivea*, KT08-27, St. K-4 (off Kinkazan, 3055–3169 m). Scale: 5 cm (all at the same scale).

(1); WA06-G480 (1); WA06-G550 (2); WA06-GH310 (2d); WA06-GH350 (3d+1e); WA06-GH380 (2+2d+1e); WA06-GH410 (-1) (1d); WA06-GH425 (1d); WA06-GH450 (6d); WA06-GH480 (4d); WA06-GH510 (2d); WA06-H310 (11d); WA06-H350 (14d); WA06-H380 (3d+1e); WA06-H410 (4d); WA06-H425 (3d); WA06-H450 (2+1d); WA06-H480 (10d); WA07-A310 (1); WA07-A350 (3); WA07-A410 (7); WA07-A450 (6); WA07-A510 (7d); WA07-A550 (9); WA07-A650 (1); WA07-B410 (3d); WA07-B510 (4+5d); WA07-B550 (3); WA07-B650 (4d); WA07-D410 (2).

Remarks. Recent progress in molecular analysis has revealed that two well-known deep-water taxa of the genus *Neptunea* Röding, 1798 in the Sea of Japan, the spirally sculptured *N. intersculpta* (Sowerby, 1899) and relatively smooth *N. constricta* (Dall, 1907), are merely phenotypes of a single species (Iguchi *et al.*, 2007), and the earlier *N. intersculpta* has priority over *N. constricta*. Actually it was rather hard to distinguish the two on the basis of morphological features, and they have often been treated as the same, especially in fisheries studies (e.g. Kato, 1979). Both forms of the present species are widely distributed in the Sea of Japan, Okhotsk Sea, as well as in the Pacific coast of northern Japan (Tiba and Kosuge, 1988 in 1979–1992; Figs. 251–253). On the other hand, there are some closely similar species inhabiting bathyal depths on the Pacific coast of northern Japan, such as *N. frater*, *N. hiberna* and *N.* sp. cf. *convexa*. It is sometimes hard to distinguish them on the basis of shell characters alone, but they represent distinct species, as discussed in the remarks for each here (also see Fig. 262). It is noteworthy that the vertical distribution of *N. intersculpta* on the Pacific coast of northern Honshu (250–650 m, present study) is significantly narrower than that in the Sea of Japan (250–1248 m, Kato, 1979). This may be related to competition with other species; see Discussion below.

Neptunea frater (Pilsbry, 1901)
[Japanese name: Ko-ezobora-modoki]
(Figs. 254–255)

Chrysodomus intersculptus var *frater* Pilsbry, 1901: 197, 391, pl. 20, fig. 21.
Neptunea intersculptus var. *frater* — Hirase, 1907b: 361 [401], pl. 19, fig. 130.
Neptunea frater — Oyama and Takemura, 1961: *Neptunea* (2), figs. 1–2; Tiba and Kosuge, 1988 in 1979–1992: 17 (33–34), text-figs. 1–8 on page 17 (33); Okutani, 2000: 469, pl. 232, fig. Buccinidae-74; Higo *et al.*, 2001: fig. G2618 (syntype); Fraussen and Terryn, 2007: 116–117, pls. 93–94.
Neptunea intersculpta form *frater* — Abbott and Dance, 1982: 165, text-fig.
Neptunea intersculpta — Okutani *et al.*, 1988: 119, text-figs.; Nemoto and Akimoto, 1990: 10, pl. 6, fig. 7 [non *Chrysodomus intersculptus* Sowerby, 1899].
Neptunea kurosio [sic] — Oshima, 1993: 112, pl. 9, fig. 40 [non *Neptunea kuroshio* Kira, 1959].

Type locality. Kizennuma, Prov. Rikuzen [Kesen-numa, Miyagi Prefecture, northeastern Honshu].

Distribution. Sea area Kashima-nada and northwards to off southern Hokkaido; 210–450 m.

Material examined. WA9101-4 [135 m] (1); WA9201-4 [200 m] (1); WA05-FG250 (1d); WA05-GH250 (3); WA06-E210 (1); WA06-EF250 (2d); WA06-F210 (1); WA06-FG280 (1d); WA06-G210 (3); WA06-G250 (1); WA06-G280 (2); WA06-GH250 (4d); WA06-GH280 (4d); WA06-GH310 (2d); WA06-GH450 (1e); WA06-H210 (1); WA06-H250D (1); WA06-H310 (2d).

Remarks. Although many previous authors have regarded *N. frater* as a geographical form or merely a synonym of *N. intersculpta* (Sowerby, 1899) (e.g. Habe and Ito, 1965a; Okutani *et al.*, 1988; Kantor and Sysoev, 2006), it can be clearly distinguished from the latter in possessing a significantly longer and narrower siphonal canal (Fig. 262B) and different sculpture. The spiral sculpture of the present species consists of strong primary cords and minute regularly spaced secondary cords in the slightly concave interspaces. The protoconch of the present species seems to be smaller than that of *N. intersculpta* (ca. 3 mm in *N. frater* and 3.9–4.1 mm in *N. intersculpta*),

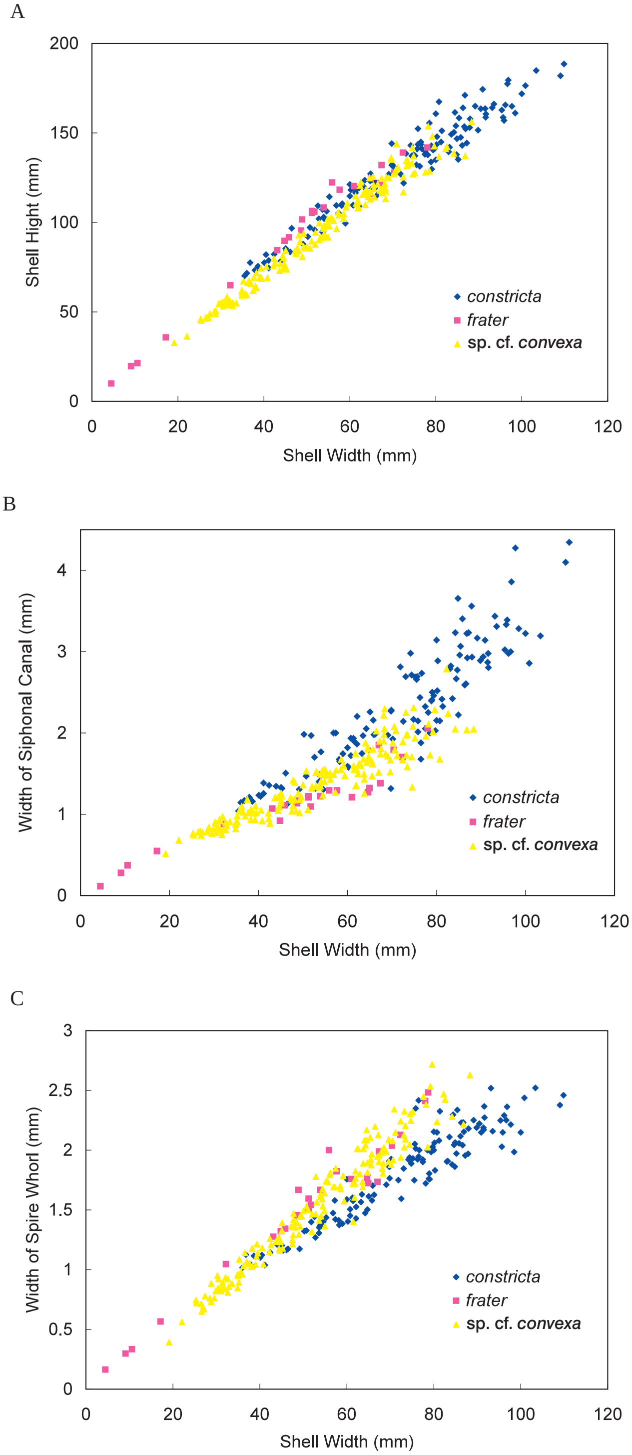


Fig. 262. Comparison of several shell parameters of three species of the genus *Neptunea*. A. Relative height to the width of the shell. B. Relative width of the siphonal canal to the shell width. Width of the siphonal canal was measured at 1/8 of the body whorl from the siphonal tip. **C**. Relative width of the spire to the shell width. Width of the spire is represented by the width of the whorl above the penultimate whorl. N=133 (*N. intersculpta*), 28 (*N. frater*) and 191 (*N.* sp. cf. *convexa*).

although in most of the specimens examined the apical part of the shell is eroded. It can also be distinguished from *N. intersculpta* by the color of the head-foot; this is almost black in *N. frater*, but grayish white with scattered black spots in *N. intersculpta*. The vertical distributions of both species also differ (210–310 m in *N. frater* and 250–650 m in *N. intersculpta*; Fig. 453), but they co-occur at several stations, where they are clearly distinguished from each other by the characters mentioned above. In contrast to the wide geographical distribution of *N. intersculpta*, that of the present species is narrow and restricted to the Pacific coast of northeastern Japan.

Neptunea hiberna Fraussen and Terryn, 2007
[New Japanese name: Yukidoke-ezobora]
(Figs. 256–258)

Neptunea hiberna Fraussen and Terryn, 2007: 124–125, pls. 105–106.

Type locality. Japan, Hokkaido, off Shiretoko Misaki (Cape Shiretoko), 100 m.

Distribution. Off Onahama in Fukushima Prefecture and northwards to eastern and northern Hokkaido in Okhotsk Sea; 100–200 m [250–450 m].

Material examined. WA05-DE250 (1d); WA05-EF380 (1d); WA06-G350 (1); WA06-GH450 (2d); WA07-B350 (1e); WA07-C350D (1e).

Remarks. The holotype of *N. hiberna* (Fig. 258; NSMT-Mo 73836) is a dead-collected, somewhat worn specimen, and looks slightly different from the four illustrated paratypes that are all live-collected and in good condition. The present material agrees well with the illustrated paratypes (Fraussen and Terryn, 2007: pls. 105–106) in both shell shape and sculpture. It superficially resembles *N. intersculpta*, with which it occurs sympatrically, but differs by possessing a narrower and longer siphonal canal, and different sculpture. The spiral sculpture consists of numerous strong, closely set primary cords, with secondary cords of variable strength in the interspaces. Although the present species is apparently very rare in the Pacific coast of northern Honshu, represented in the present material only by five live-collected specimens and two empty shells, it is rather common on the southern coasts of Hokkaido and northwards, where it is a fisheries resource (Hasegawa, personal observation).

Of the northwestern Pacific species in this genus, *N. hiberna* may be most closely related to *N. elegantula* Ito and Habe, 1965, described from off Kasumi, Hyogo Prefecture, in the western part of the Sea of Japan, judging by resemblances both in outline and in the sculpture, but the latter generally has more elongate shell with more prominent spiral cords. On the other hand, an unidentified species of *Neptunea* recorded from the southern East China Sea (Hasegawa, 2005: fig. 8F) is practically indistinguishable from the present species in overall shell characters, despite its greatly disjunct geographical distribution. Detailed comparative study of these forms will be the subject of future study.

Neptunea sp. cf. ***convexa*** Goryachev, 1978
(Figs. 259–260, 264)

Neptunea intersculpta — Ishikawa, 1970: 133–134 (in part), pl. 9, fig. 5a [non *Chrysodomus intersculptus* Sowerby, 1899].

?*Neptunea convexa* Goryachev, 1978: 26 (type locality: W of Paramushir, Okhotsk Sea, 50°30′2″N, 155°38′8″E, 640 m) [nom. nov. pro *Neptunea insularis* var. *convexa* Golikov, 1963, nom. nud.]; Kantor, 2002: fig. 1E–F (lectotype).

Neptunea nivea — Higuchi, 2006, pl. 76, fig. on left in lower row [non *Neptunea* (*Tacita*?) *nivea* Okutani, 1981].

Material examined. WA95-C800 (1); WA05-DE480 (1d); WA05-DE510 (1d); WA05-E900 (2); WA05-F900 (2); WA05-G900 (3); WA05-H900 (1); WA06-B650 (2); WA06-C550 (1); WA06-E510

(1); WA06-E550 (2); WA06-E650 (1); WA06-E900 (2); WA06-E1200 (1); WA06-F650 (1); WA06-F900 (3); WA06-G900 (4+1e); WA06-G1200 (4); WA06-H750 (1); WA06-H900 (1); WA06-H1500 (1e); WA07-A510 (4d); WA07-A550 (2+1e); WA07-A650 (1+1e); WA07-A750 (1); WA07-A900 (1+1e); WA07-B550 (3); WA07-B650 (2+9d); WA07-B900 (1); WA07-B1200 (1); WA07-C510 (1); WA07-C550 (3d); WA07-C650 (5); WA07-C750 (2); WA07-C900 (1+1e); WA07-C1500D (1e); WA07-D550 (1d); WA07-D650 (ca. 13+1e); WA07-D750 (ca. 35); WA07-D900 (ca. 40); WA08-G1500 (1).

Remarks. This is one of the most dominant species at depths around 1000 m in the survey area. It is characterized by a lightly built shell with well-inflated whorls and a deeply constricted suture. The sculpture consists of narrow spiral cords that are clearly visible on the spire whorls but decline in strength towards the body whorl, with very fine indistinct spiral threads in their interspaces. In these conchological characters the present form closely resembles *Neptunea nivea* Okutani, 2000, which is distributed in the present survey area at greater depths of ca. 2000–3000 m (Fig. 261), but differs from it in having a stouter shell and a significantly larger operculum relative to the size of the aperture. Examination of the detailed morphology of the penis revealed that this form might be related to the N. *insularis* – *N. convexa* species complex, as it has a narrow slit-like opening with the circular central part fringed with granules (see Golikov, 1963: fig. 48). Although the present form somewhat resembles *N. convexa* in having a stout shell with well inflated whorls, it differs considerably from the latter in having a shorter slit-like opening of the penis and a more elongate shell with a deeply constricted suture. Accordingly it is here only provisionally identified as *N. convexa*.

The present form is rather easily separable from examples of another dominant species in the same genus, *N. intersculpta*, from shallower depths (Fig. 453), but the two tend to be convergent in shell morphology at the margins of their distributions, where they co-occur. The present form can generally be distinguished from *N. intersculpta* by having a larger spire relative to the size of the body whorl and a narrower siphonal canal (Fig. 262B–C), smaller first teleoconch whorl (Fig. 264; compare with *N. intersculpta* in Fig. 263), and in the soft parts by the complete absence of black pigment on the head-foot, and different morphology of the penis (see Golikov, 1963: fig. 39, for *N. intersculpta*).

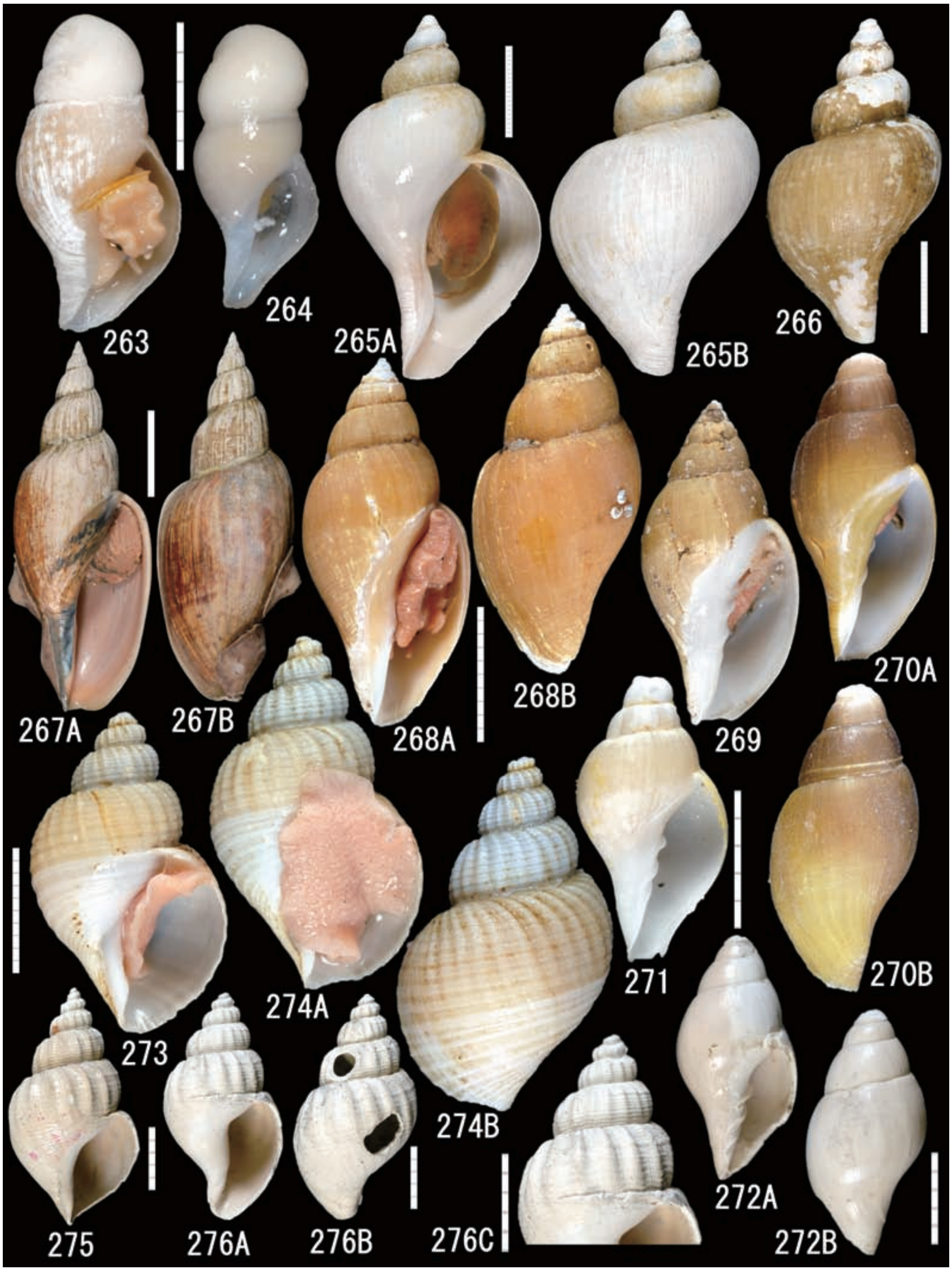
Neptunea sp. cf. ***gulbini*** Goryachev and Kantor, 1983
(Figs. 265–266)

Neptunea intersculpta — Ishikawa, 1970: 133–134 (in part), pl. 9, fig. 5c [non *Chrysodomus intersculptus* Sowerby, 1899].

?*Neptunea gulbini* Goryachev and Kantor, 1983: 1768–1770, figs. 2–3.
Neptunea nivea — Higuchi, 2006, pl. 76, figs. in upper row [non *Neptunea* (*Tacita*?) *nivea* Okutani, 1981].

Material examined. WA05-E900 (2); WA06-D1500 (2); WA06-E1200 (1); WA06-H1500D (1e); WA07-B1200 (2); WA07-D900 (8).

Remarks. The present material can easily be distinguished from the other congeners in the survey area by the complete absence of spiral sculpture, the deeply constricted sutures and the presence of a thick brown periostracum. Although it superficially resembles a smooth phenotype of *N. convexa* that occurs off northeastern Hokkaido, it differs significantly from the latter in the morophology of the penis, the opening of which is narrowly protruding and lacks a slit-like structure. In this character, it resembles *N. gulbini*, which is known to be distributed off the Middle and North Kurile Islands at 300–1680 m depths, and is here provisionally identified as that species. However, *N. gulbini* slightly differs in shell morphology in possessing a shallower suture and weak but distinct spiral cords.



Figs. 263–276. Buccinidae, Volutidae, Volutomitridae and Cancellariidae. 263. *Neptunea intersculpta*, WA05-EF450. 264. *Neptunea* sp. cf. *convexa*, WA05-H900. 265–266. *Neptunea* sp. cf. *gulbini*, 265: WA05-E900; 266: WA07-D900. 267. *Fulgoraria* (*Nipponomelon*) *magna*, WA06-G310. 268–272. *Volutomitra groenlandica alaskana*, 268: WA05-FG425; 269: WA06-E310; 270: WA07-D900; 271: TS96-K2 [1451–1455 m]; 272: holotype of *Mitra takii* Ozaki, 1958, NSM PM4471. 273–276. *Admete viridula*, 273–274: WA07-A450; 275–276: holotype (276) and paratype (275) of *Nematoma tomiyaensis iiokaensis* Ozaki, 1958, NSM PM4450. Scales: 263–264 = 5 mm (at the same sclale); 265–266 = 20 mm; 267 = 50 mm; 268–270 = 10 mm (at the same scale); 271–272, 275–276 = 5 mm; 273–274 = 10 mm (at the same scale).

Subfamily Volutopsinae Habe and Sato, 1973
Habevolutopsius hirasei (Pilsbry, 1907)
[Japanese name: Rikuzen-bora]
(Fig. 201)

Volutopsius hirasei Pilsbry, 1907: 243, pl. 19, fig. 2; Hirase, 1908c: 398, pl. 43, figs. 264–265; Habe and Ito, 1965a: 67, pl. 23, fig. 13; Tiba and Kosuge, 1979 in 1979–1992: 9–11, figs. 2–17 on page 9 (in part); Baba, 1990: 160, pl. 10, fig. 9a–b.
Volutopsius diminutus Dall, 1919b: 311 (type locality: USBF station 4844, Japan Sea); Habe, 1961b: 147–148, text-fig. 2 (paratype); Habe and Ito, 1965a: 52–53, pl. 15, fig. 5; Kosuge, 1972: pl. 26, fig. 7.
Volutopsius middendorffi hirasei — Taki in Baba *et al*., 1960: 141, pl. 68, fig. 30.
Volutopsius (*Volutopsius*) *middendorfi* [sic] *diminutus* — Shikama and Horikoshi, 1963: pl. 63, fig. 3.
Fusivolutopsius hirasei — Habe and Okutani, 1975: 284, fig. on p. 120; Tiba and Kosuge, 1981 in 1979–1992: 9 (1–2), text-figs.
Habevolutopsius hirasei — Kantor, 1983: 340–343, figs. 1A, 2 (1–10); Okutani *et al*., 1988: 97, text-fig.; Kantor, 1990: 142–146, figs. 40, 98–99; Golikov and Sirenko, 1998: 112, fig. 7A; Higo *et al*., 2001: fig. G2520 (holotype); Kantor and Sysoev, 2006: 203, pl. 103, fig. I.
Bobetopsius [sic; = *Volutopsius*] *diminutus* — Okutani, 1986: 148, 149 with color fig.
Volutopsius (*Habevolutopsius*) *hirasei* — Okutani, 2000: 457, pl. 227, fig. Buccinidae-19.
Volutopsius (*Habevolutopsius*) *limatus* — Okutani, 2000: 457, pl. 227, fig. Buccinidae-20 [non *Volutopsius limatus* Dall, 1907].

Type locality. Kisennuma [Kesen-numa, Miyagi Prefecture, northeastern Honshu].

Distribution. Sea area Kashima-nada and northwards to southern Kurile Islands, and also in northern Bering and Chukchi Seas around Bering Strait (Kantor, 1983); 55–300 m [280–510 m].

Material examined. WA05-DE450 (3); WA05-EF425 (1e); WA05-GH310 (1); WA06-B310D (2); WA06-DE280 (1d); WA06-DE280D (2); WA06-DE380 (1+1d); WA06-DE410 (1e); WA06-DE450 (1e); WA06-EF380 (2); WA06-GH350 (1); WA06-GH480 (2); WA06-H425 (1e); WA06-H480 (2e); WA07-A310 (1e); WA07-B350 (2e); WA07-B410 (1); WA07-B510 (1); WA07-C350D (1).

Remarks. Habe and Sato (1973) proposed the new genus *Fusivolutopsius* for *Volutopsius hirasei* based on the radular features only, without giving a figure or description of the shell. Kantor (1983) subsequently showed that the radula of *V. hirasei* differs markedly from the one drawn by Habe and Sato, and regarded *Fusivolutopsius* as nomen dubium, with an unknown type species. The new genus *Habevolutopsius* was thus established by him for *V. hirasei*, although *Fusivolutopsius* has still erroneously been used in recent Japanese literature.

Although several additional volutopsine whelks have been recorded from off northern Honshu, such as *Volutopsius middendorffi* (Dall, 1891), *V. pallidus* Tiba, 1973, and *V. simplex* Dall, 1907 [= *V. castaneus* (Mörch, 1857)], none were obtained during the present comprehensive survey. *Volutopsius middendorffi* was shown by Kantor (1990) to be distributed only in the Bering Sea, and records from further south, including those from Japanese waters, were proved to be based on misidentifications. Tiba and Kosuge (1979 in 1979–1992) recorded *V. simplex* from "off Kuji, Iwate", but Kantor (1990) regarded it as a junior synonym of *V. castanea*, and gave its distribution as the southern Kurile Islands and northwards. Furthermore, although *V. pallidus* was originally described from "off Kuji, Iwate Pref., 400 m deep" based on the specimens obtained by a commercial trawler operating out of Hirota Fishing Port in Iwate Prefecture (Tiba, 1973a), all records apart from the type are restricted to the northern part of the Okhotsk Sea. Accordingly, it is necessary to confirm the distribution of these species in Japanese waters based on specimens with precise location data.

Family Volutidae Rafinesque, 1815
Fulgoraria* (*Nipponomelon*) *magna Kuroda and Habe, 1950
[Japanese name: O-hitachi-obi]
(Fig. 267)

Voluta megaspira prevostiana — Hirase, 1908b: 216, pl. 31, figs. 125 [non *Voluta prevostiana* Crosse, 1878].

Fulgoraria (*Psephaea*) *prevostiana* — Kinoshita and Isahaya, 1934: 11, pl. 8, fig. 58 125 [non *Voluta prevostiana* Crosse, 1878].

Fulgoraria prevostiana magna Kuroda and Habe, 1950: 34, 38, pl. 6, figs. 3–4; Kira, 1959: 84, pl. 32, fig. 12; Baba, 1990: 183–184, pl. 14, fig. 4a–b.

Fulgoraria (*Psephaea*) *prevostiana magna* — Taki in Baba *et al*., 1960: 134, pl. 66, fig. 1.

Fulgoraria magna — Habe and Ito, 1965a: 78, pl. 29, fig. 6; Higo *et al*., 2001: fig. G3077 (figured syntype).

Musashia (*Nipponomelon*) *prevostiana magna* — Shikama, 1967: 68–70, pl. 4, figs. 3–8, pl. 9, fig. 11.

Musashia (*Nipponomelon*) *prevostiana salebrosa* Shikama, 1967: 70–71, pl. 4, figs. 9–11, pl. 5, figs. 1–2 (type locality: Urakawa, Hidaka region, southeastern Hokkaido).

Nipponomelon magna — Okutani, 1986: 174, 175 with color fig.; Okutani *et al*., 1988: 175, text-fig.

Musashia prevostiana magna — Ito, 1989: 49, pl. 9, fig. 3.

Fulgoraria (*Nipponomelon*) *magna* — Okutani, 2000: 521, pl. 259, fig. Volutidae-13.

Type locality. Hitachi [Ibaraki Prefecture], Honshu.

Distribution. Sagami Bay and northwards to off southern Hokkaido; 50–600 m [150–380 m].

Material examined. WA9201-2 [100 m] (1); WA05-EF250 (1d); WA05-FG280 (1); WA05-FG310 (3d); WA05-G350 (1); WA05-GH280 (2); WA05-GH350 (1e); WA05-GH350 (2); WA06-A150D (2); WA06-D210D (1); WA06-E150 (2); WA06-F210 (2); WA06-F250 (1); WA06-F280 (2); WA06-F310 (2); WA06-FG250 (1e); WA06-FG280 (1d); WA06-G210 (2); WA06-G250 (1); WA06-G280 (2); WA06-G310 (1); WA06-GH280 (1d+1e); WA06-GH310 (1d); WA06-GH380 (1e); WA06-H150 (1e); WA06-H250 (2e); WA06-H280 (2d); WA06-H310 (1d); WA06-H350 (3d); WA06-H380 (1d); WA07-A150 (1e); WA07-A250 (2e); WA07-B150 (1+1e); WA08-E250 (1).

Remarks. Classification of the species of the genus *Fulgoraria* Schumacher, 1817 sensu lato (type species: *Fulgoraria chinensis* Schumacher, 1817 [= *Voluta rupestris* Gmelin, 1791], by original designation) is in a state of great confusion, and clarifying the taxonomical relationship of this species to other possible relatives, especially *F. prevostiana* (Crosse, 1878), is beyond the scope of this study. However, *Musashia* (*Nipponomelon*) *prevostiana salebrosa* Shikama, 1967, described from southeastern Hokkaido, is indistinguishable from the present species in shell morphology, and is regarded as a junior synonym.

Family Volutomitridae Gray, 1854
Volutomitra groenlandica alaskana Dall, 1902
[Japanese name: Fude-hitachi-obi]
(Figs. 268–272)

Volutomitra alaskana Dall, 1902a: 103; Dall, 1921: 87, pl. 11, fig. 3; Smith, 1942: 69, pl. 26, fig. 180; Kuroda and Habe, 1950: 38, pl. 5, figs. 6, 8; Okutani, 1964: 416, pl. 3, fig. 15; Cernohorsky, 1970: 98–100, pl. 13, figs. 2–5; Kosuge, 1972: pl. 29, fig. 1; Abbott, 1974: 240, fig. 2640; Tiba and Kosuge, 1980 in 1979–1992: 3 (3–5), text-figs. 1–5 on page 3 (3); Higo *et al*., 2001: fig. G3291 (holotype).

Mitra takii Ozaki, 1958: 154, pl. 15, figs. 9–10 (type locality: Choshi, Chiba Prefecture; Iioka Formation, Pliocene).

Volutomitra groenlandica alaskana — Habe, 1961a: 71, pl. 35, fig. 9; Habe and Ito, 1965a: 80, pl. 30, fig. 5; Kuroda and Habe in Okada *et al*., 1965: 137, text-fig.; Golikov and Sirenko, 1998: 128, fig. 13H; Kantor and Sysoev, 2006: 152, pl. 69, fig. E.

Volutomitra groenlandica Møller, 1842 — Kotaka, 1962: 142, pl. 33, fig. 32.

Volutomitra greenlandia [sic] *alaskana* — Habe and Ito, 1965a: 80, pl. 30, fig. 5.

Voltomitra [sic] *grrenlandia* [sic] *alaskana* — Ito, 1985: 29, pl. 6, fig. 4; Ito, 1989: 49, pl. 9, fig. 4.

Type locality. Unimak Island, eastern Bering Sea, 156 m, mud.

Distribution. Sagami Bay on Pacific coast of Honshu, off Sado Island in Sea of Japan, and both northwards. Okhotsk Sea and Bering Sea; 50–920 m [310–1200 m].

Material examined. WA05-DE380 (1e); WA05-DE380D (1); WA05-DE410 (1); WA05-EF410 (2); WA05-FG410 (2+1e); WA05-FG425 (2); WA05-FG480 (1); WA05-G450 (1); WA05-GH410 (1); WA05-GH425 (1); WA05-GH450 (1); WA06-DE350 (1); WA06-DE450 (1e); WA06-E310 (1): WA06-EF350 (2+1e); WA06-F750 (1); WA06-FG410 (2+1e); WA06-FG425 (1); WA06-FG450 (1e); WA06-FG480 (2); WA06-G900D (1e); WA06-G1200D (1e); WA06-GH380 (1e); WA06-GH410 (-1) (1); WA06-GH425 (1e); WA06-H480 (2e); WA07-A410 (1); WA07-A450 (1+3e); WA07-C350D (1+3e); WA07-D550 (1e); WA07-D900 (1+2e); TS96-K2 [1451–1455 m] (2+1e).

Remarks. This is the only representative of the genus *Volutomitra* H. and A. Adams, 1854 (type species: *Mitra groenlandica* Beck in Møller, 1842, subsequently designated by Fischer, 1884), in the North Pacific, except for "*Volutomitra*" *tenella* Golikov and Sirenko, 1998 that was only provisionally assigned to this genus. This taxon is regarded by recent authors as a subspecies of *V. groenlandica* (Beck in Møller, 1842), which is distributed from the northern Atlantic eastwards to the Barents Sea. It exhibits a relatively wide vertical distribution, and the variation in shell morphology reflects this; specimens collected from deeper stations (Fig. 271) are smaller and more slender than those from shallower stations, with a darker periostracum (Figs. 268–269). *Mitra takii* Ozaki, 1958, described from from the Iioka Formation in Choshi (upper Pliocene) (Fig. 272: holotype, NSM PM4471), is regarded as a synonym as previously pointed out by Baba (1990).

Family Cancellariidae Forbes and Hanley, 1851

Admete viridula (Fabricius, 1780)

[Japanese name: Ezo-goromo]

(Figs. 273–278)

Tritonium viridulum Fabricius, 1780: 402.

Cancellaria couthouyi Jay, 1839: 77 (type locality: Massachusetts Bay).

Admete viridula — Galkin and Scarlato, 1955: 180, pl. 47, fig. 12; Golikov and Gulbin, 1977: 232–233; Bouchet and Warén, 1985: 258, figs. 683–689; Golikov and Sirenko, 1998: 131 (in part), fig. 13J; Hasegawa in Okutani, 2000: 583, pl. 290, fig. Cancellariidae-21; Kantor and Sysoev, 2006: 212, pl. 108, fig. G (neotype, reproduction of Bouchet and Warén, 1985: fig. 683).

*Nematoma tomiyaensis iiokaensis*Ozaki, 1958: 163, pl. 15, fig. 5 (type locality: Choshi, Chiba Prefecture; Iioka Formation, Pliocene). New synonym.

Admete couthonyi [sic] — Habe, 1961a: 72, pl. 35, fig. 16; Habe, 1961c: 436, pl. 24, fig. 18.

Admete couthouyi — Oyama and Takemura, 1963: *Neadmete・Admete*, fig. 5; Okutani, 1964: 419, pl. 3, fig. 16; Habe and Ito, 1965a: 79, pl. 30, fig. 4; Okutani, 1968: 36, pl. 2, fig. 7; Okutani, 1986: 177 with color fig.; Ito *et al*., 1986: 15, pl. 18, fig. 1; Ito, 1989: 50, pl. 9, fig. 7; Baba, 1990: 190, pl. 16, fig. 1.

[See Bouchet and Warén (1985) for the synonymy in the Atlantic with discussion, and Hemmen (2007) for more detailed synonymy.]

Type locality. Groenl. [W. Greenland].

Distribution. Sagami Bay and northwards, circumpolar (Bouchet and Warén, 1985); 0–1100 m (including Arctic seas) [450–1500 m].

Material examined. WA06-H1500D (1); WA07-A450 (ca. 30+ca. 40e).

Remarks. Examples of this species from the northwestern Pacific have generally been identified by Japanese authors as *A. couthouyi* (Jay, 1839), which was originally described from Massachusetts Bay, east coast of North America, but by some Russian authors as *A. viridula*. Bouchet and Warén (1985) settled the taxonomical confusion about *A. viridula*, by selecting a neotype, and

Figs. 277–288. Cancellariidae. 277–278. *Admete viridula*, 277: WA07-A450; 278: WA06-H1500D. 279. *Admete choshiensis*, WA06-EF410. 280–281. *Admete watanabei*, 280: WA05-DE250D; 281: WA07-D210D. 282–288. *Admete* sp. 1, 282: WA05-DE380D; 283: WA07-A450D; 284: WA06-H1500D; 285–286: WA95-B1000; 287: WA06-F750; 288: WA07-A450. Scales: 277–278, 282–287 = 5 mm (at the same scale); 279 = 10 mm; 280–281 = 5 mm (at the same scale); 288 = 5 mm.

synonymised *A. couthouyi* and many other Atlantic nominal taxa with that taxon. Harasewych and Petit (1986) described the anatomy and shell morphology in some detail based on West Atlantic material. Northwestern Pacific specimens are slightly different from those in the Atlantic, being larger size, reaching 40 mm SL, and having flatter spiral cords with narrow grooves in between. *Nematoma tomiyaensis iiokaensis* Ozaki, 1958 (Figs. 275, 276: paratype and holotype, respectively, NSM PM4450), described from the Middle Pliocene of Choshi, Chiba Prefecture, possesses much finer spiral cords and coarser axial ribs, but it is much closer to the present material than the Atlantic specimens and is here regarded as a junior synonym. Immature specimens of this species (Figs. 277–278) closely resembles some other smaller species in the same genus, but they can be distinguished from the latters in having more distinct axial ribs that do not attenuate on the body whorl and fine but distinct spiral cords.

The specimen recorded from off Noto Peninsula in the Sea of Japan by Ito *et al.* (1986: pl. 14, fig. 6) as "*Buccinum tenue* Gray" also resembles the present species, but it can be identified as *A. solida* (Aurivillius, 1885) by its stout shell with numerous fine spiral threads and widely spaced thick axial ribs. The holotypes of *A. solida* and its synonym *A. regina* Dall, 1911 were illustrated by Kantor and Sysoev (2006: pl. 108, figs. A–B).

Admete choshiensis Shikama, 1962
[Japanese name: Choshi-goromo]
(Fig. 279)

Admete (?) *choshiensis* Shikama (MS) — Habe, 1961c: 436, pl. 24, figs. 17, 18 [nom. nud.].
Admete choshiensis Shikama, 1962: 47–48, pl. 2, figs. 13a–b (holotype), 14a–b; Oyama and Takemura, 1963: *Neadmete*・*Admete*, fig. 6; Watanabe and Naruke, 1988: 54, pl. 9, fig. 3; Matsukuma *et al.*, 1991: 179, pl. 111, fig. 7; Hasegawa in Okutani, 2000: 583, pl. 291, fig. Cancellariidae-23; Hemmen, 2007: 83, text-fig. (reproduction of Hasegawa in Okutani, 2000).
Turritropis cancellata — Okutani, 2000: 199, pl. 99, fig. Capulidae-18 [non *Trichotropis cancellata* Hinds, 1843].

Type locality. Southeast of Choshi [Chiba Prefecture, Honshu], 250–260 fathoms.

Distribution. Off Choshi, in sea area Kashima-nada, and northwards to off Hachinohe in Aomori Prefecture (present study); 450 m [380–450 m].

Material examined. WA06-EF410 (1); WA06-H380 (1); WA07-A450 (1).

Remarks. This species has been known only from the type locality, off Choshi, in the sea area Kashima-nada, until the present study. It is easily distinguished from all the other species in the genus, by its strong spiral cords with wide interspaces, and the thick periostracum.

Admete watanabei Shikama, 1962
[Japanese name: Hime-usukawa-goromo]
(Figs. 280–281)

Admete watanabei Shikama, 1962: 47, pl. 2, figs. 12a–b; Oyama and Takemura, 1963: *Neadmete*・*Admete*, fig. 8; Okutani, 1964: 419, pl. 3, fig. 11; Watanabe and Naruke, 1988: 54, pl. 9, fig. 2; Hasegawa in Okutani, 2000: 583, pl. 291, fig. Cancellariidae-22; Higo *et al.*, 2001: fig. G3426 (holotype); Hemmen, 2007: 347, text-fig. (reproduction of Hasegawa in Okutani, 2000).

Type locality. Precisely unknown, probably east off Choshi, [Chiba Prefecture, Honshu] above 100 fathoms.

Distribution. Sagami Bay and northwards to off Ofunato in Iwate Prefecture (present study); 210–800 m [210–350 m].

Material examined. WA05-DE250D (2); WA05-G510 (1e); WA05-GH280 (1); WA06-H250D (2); WA06-H350 (1); WA07-D210D (1).

Remarks. This species is characterized by an elongate and relatively solid shell for its size, sculptured with indistinct spiral grooves and growth lines. It can be distinguished from its possibly most closely related ally, *Admete* sp. 1 in the present study [= *Admete globularia* auct. non E. A. Smith, 1875], by the relatively large and thick shell that lacks the distinct axial ribs on the upper spire whorls that are always present in the latter. *A. watanabei* also has a shallower and narrower distribution than the latter species (210–350 m in *A. watanabei* and 210–1500 m in *A.* sp.).

Admete sp. 1
[Japanese name: Maru-ezo-goromo (= Usukawa-goromo)]
(Figs. 282–288)

Admete globularia [sic] — Habe, 1961c: 436, pl. 24, fig. 21; Oyama and Takemura, 1963: *Neadmete*・*Admete*, fig. 7; Okutani, 1964: 419; Habe and Ito, 1965a: 79, pl. 30, fig. 3; Ishikawa, 1970: 134, pl. 9, fig. 6 [non *Admete globularis* E. A. Smith, 1875].
Admete ovata — Ito, 1967: 57, pl. 4, fig. 13 [non *Admete ovata* E. A. Smith, 1875].
Admete watanabei — Baba, 1990: 190, pl. 16, figs. 2–3 [non *Admete watanabei* Shikama, 1962].

Material examined. WA95-B1000 (8); WA05-DE380D (2); WA05-DE480 (1); WA05-EF450D (3); WA05-FG250D (2+1e); WA05-G510 (1); WA05-GH380D (1e); WA06-DE350 (1e); WA06-DE480 (2e); WA06-E510D (1+1e); WA06-EF350 (1e); WA06-EF410 (1e); WA06-EF425D (3e); WA06-F650D (1e); WA06-F750 (1); WA06-F1500D-1 (1); WA06-FG350D (1e); WA06-FG410 (1e); WA06-GH480D (1e); WA06-H250D (5e); WA06-H480 (ca. 50+ca. 60e); WA06-H1500D (1+2e); WA07-A450 (ca. 50+ca. 52e); WA07-A650 (1e); WA07-B410D (1); WA07-D210D (1); WA07-D900 (12+3e); WA08-F900 (3); WA08-G650 (1); TS96-K2 [1451–1455 m] (4+8e).

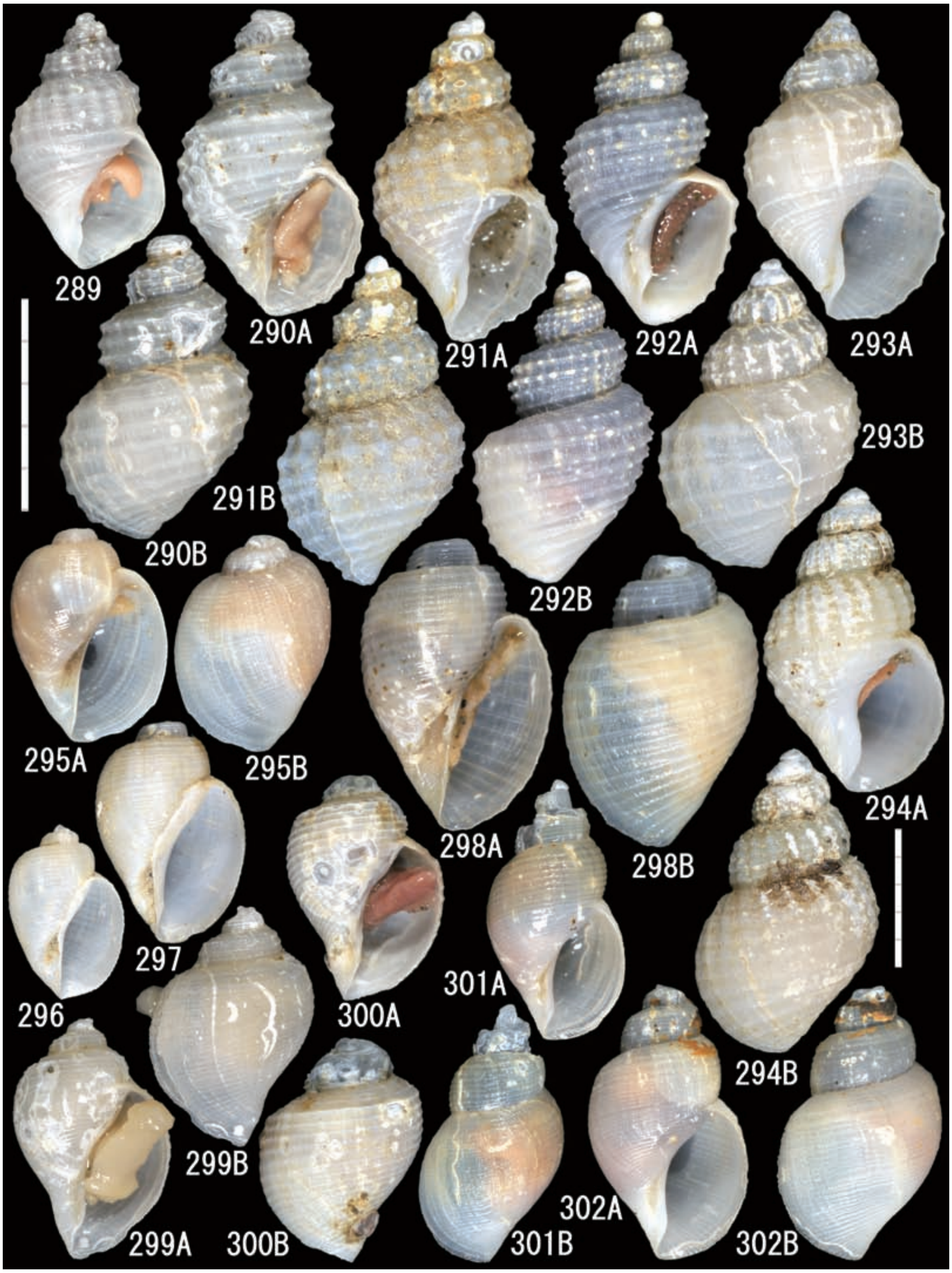
Remarks. Although this species had been identified by Japanese authors as “*Admete globularia*”, Petit (1974) demonstrated that *A. globularis* E. A. Smith, 1875 was not a cancellarid but a species of the genus *Microglyphis* (Ringiculidae) by examining syntypes preserved in the Natural History Museum, London. No other available names have been proposed for this rather common cancellariid.

Admete sp. 2
(Figs. 289–292)

Admete viridula — Golikov and Sirenko, 1998: 131 (in part), fig. 13I [non *Tritonium viridulum* Fabricius, 1780].
Neadmete yokoyamai — Baba, 1990: 189, pl. 15, fig. 16 [non *Admete yokoyamai* Oyama in Taki and Oyama, 1954 [nom. nov. pro *Admete viridula* Yokoyama, 1920, non Fabricius, 1780].

Material examined. WA95-B1000 (1); WA05-DE380D (2); WA05-EF450D (1); WA06-H480 (1+2e); WA07-D210D (3+1e); WA07-D900 (14).

Remarks. This undescribed species shows remarkable intraspecific variations both in the shell shape and especially in the sculpture. Some specimens (Fig. 290) bear sharp spiral cords without distinct axial ribs, whereas others (Fig. 291) also have thick axial ribs that cross the spirals to form nodules. The specimens illustrated by Golikov and Sirenko (1998) as *A. viridula* and by Baba (1990) as *Neadmete yokoyamai* apparently belong the former form. Specimens collected at depths of 900 m and deeper are slender in shape with a more deeply constricted suture, and possess finer sculpture that gives a granulate appearance (Fig. 292). They are here considered phenotypes of a single species, however, on the basis of overall similarity in other shell characters.



Figs. 289–302. Cancellariidae. 289–292. *Admete* sp. 2, 289: WA07-D210D; 290: WA05-DE380D; 291: WA06-H480; 292: WA07-D900. 293. *Admete* sp. 3, WA07-A250D. 294. *Neadmete* sp. cf. *okutanii*, WA05-DE250D. 295–297. *Iphinopsis choshiensis*, 295: WA95-B1000; 296: WA05-EF450D (empty shell); 297: possible paratype of *Iphinoella choshiensis* Habe, 1958, NSMT-Mo 70297. 298. *Iphinopsis* sp. 1, WA06-F1500D-2. 299–300. *Iphinopsis* sp. 2, 299: WA05-DE380D; 300: WA07-D900. 301–302. *Iphinopsis bathyalis*, WA06-H480. Scales: 5 mm (all at the same scale, except 294).

Admete sp. 3
(Fig. 293)

Neadmete nakayamai — Ito, 1967: 57, pl. 4, fig. 15 [non *Neadmete nakayamai* Habe, 1961].
Neadmete okutanii — Baba, 1990: 189–190, pl. 15, fig. 17a–b [non *Neadmete okutanii* Petit, 1974].

Material examined. WA07-A250D (1).

Remarks. The present material, which consists of only one live-collected specimen, superficially resembles *Neadmete nakayamai* Habe, 1961 in general shell morphology, but differs in the broader and thinner shell with more inflated whorls, and weaker axial sculpture. On the other hand, the specimens recorded as *N. nakayamai* from the western part of the Sea of Japan by Ito (1967), and as *N. okutanii* from Pliocene Iwasaka Formation, Chiba Prefecture, by Baba (1990) agree well with the present material, and are certainly conspecific.

Neadmete sp. cf. *okutanii* Petit, 1974
(Fig. 294)

?*Neadmete okutanii* Petit, 1974: 110–11, text-fig. 2 [nom. nov. pro *Neadmete japonica* (Smith) sensu Habe, 1961, non *Cancellaria japonica* E. A. Smith, 1879]; Hasegawa in Okutani, 2000: 585, pl. 291, fig. Cancellariidae-28 (holotype).

Material examined. WA05-DE250D (1); WA07-A250D (1e).

Remarks. The present material most resembles *N. okutanii* in size and general shape, but differs by possessing thick, more narrowly spaced spiral cords and more distinct axial ribs. There is not enough material to hand to assess the range of variation, however, and it is thus only provisionally identified as *N. okutanii*.

Iphinopsis choshiensis (Habe, 1958)
[Japanese name: Ko-ezo-nejinuki]
(Figs. 295–297)

Iphinoella choshiensis Habe, 1958a: 34, 40–41, text-fig. 7.
Iphinopsis choshiensis — Habe, 1962: 73, pl. 7, figs. 3–4; Okutani, 1964: 396, pl. 6, fig. 6; Hasegawa and Saito, 1995: 20, 34–35, pl. 3, fig. 4 (holotype); Hasegawa in Okutani, 2000: 585, pl. 291, fig. Cancellariidae-30 (holotype); Higo *et al.*, 2001: fig. G1135s (holotype).
?*Iphinopsis* aff. *choshiensis* — Golikov and Sirenko, 1998: 131, fig. 3I; Kantor and Sysoev, 2006: 213, pl. 108, fig. J.

Type locality. Off Choshi, Chiba Prefecture, Honshu.

Distribution. Sagami Bay and northwards to off Kuji in Iwate Prefecture; 450–1400 m [450–1000 m].

Material examined. WA95-B1000 (1); WA05-EF450D (1e); WA06-H480 (2e); WA07-D900 (4+2e).

Remarks. Habe (1958a) proposed the new genus *Iphinoella* in the family Trichotropidae Gray, 1850 to accommodate this species, but subsequently (1962) treated it as a junior synonym of *Iphinopsis* Dall, 1924 (type species: *Iphinoe kelseyi* Dall, 1908, by original designation). The genus was then transferred to the Cancellariidae by Bouchet and Warén (1985: 261) on the basis of conchological and anatomical features. Although the specimens from shallower stations (Fig. 296) agree reasonably well with the holotype (Hasegawa and Saito, 1995: pl. 3, fig. 5) and a possible paratype (Fig. 297; NSMT-Mo 70297) of this species, those from deeper stations (Fig. 295) differ slightly in possessing a thinner shell with finer spiral cords. However, examination of specimens obtained from the type locality (Kawamura and Sakurai Collections) revealed a wide range of variation both in shell texture and sculpture even within a single lot, and the latter form is thus here regarded as a phenotype of the same species. On the other hand, the specimen illustrated by Golikov and Sirenko (1998) and Kantor and Sysoev (2006) as "*Iphinopsis* aff. *choshiensis*" considerably differs from the present species even in the broad sense, in having a significantly stouter shell that is widest at the shoulder. It may thus belong to a different species.

Iphinopsis bathyalis (Okutani, 1964)

[Japanese name: Watazoko-neji-nuki]

(Figs. 301–302)

?*Admete ovata* Smith, 1875: 426 (type locality: 42°52´N, 144°40´E, 48 fathoms [off northeastern Hokkaido]); Higo *et al*., 2001: fig. G3427 (syntype).

Palaeadmete [sic; = *Paladmete*] *bathyalis* Okutani, 1964: 398, pl. 6, fig. 7; The Committee for Celebrating Dr Okutani's Retirement from Tokyo University of Fisheries, 1996: 74, pl. 3, fig. 3 (holotype).

?*Admete regina* — Golikov and Scarlato, 1985: 427 [non *Admete regina* Dall, 1921 (see Kantor and Sysoev, 2006: pl. 108, figure legend)].

Iphinopsis bathyalis — Hasegawa in Okutani, 2000: 585, pl. 291, fig. Cancellariidae-31 (holotype).

?*Admete* sp. — Kantor and Sysoev, 2006: 212, pl. 108, fig. C (a specimen reported by Golikov and Scarlato, 1985 as *Admete regina*).

Type locality. R/V *Soyo-maru*, St. 59, 35°05.3´N, 139°18.65´E, Sagami Bay, 550 m.

Distribution. Sagami Bay and northwards to off Ofunato in Iwate Prefecture, and ?Aniwa Bay, Sakhalin; 550 m [480–1500 m].

Material examined. WA06-F1500D-2 (1e); WA06-H480 (6+1e); WA07-D900 (7+1e).

Remarks. The specimens examined generally agree with the holotype of *Paladmete bathyalis*, except for the weakly angulate shoulder, which is not clearly observed in the holotype, and their finer spiral sculpture that is crossed by indistinct axial sculpture. Considering the variability in most species of the family, however, they can reasonably be identified as this species. On the other hand, they also resembles the syntype of *Admete ovata* Smith, 1875 illustrated by Higo *et al*. (2001), in possessing numerous fine spiral cords and indistinct axial sculpture, but the present specimens differ considerably from the latter in its much more elongate shape. A specimen recorded from Aniwa Bay, 95 m, by Golikov and Scarlato (1985) as *A. regina* and subsequently illustrated by Kantor and Sysoev (2006) as *Admete* sp., is also apparently related to these species, and further study based on additional material will be necessary to clarify the taxonomical relationship between them.

Although it differs from other species in the genus by the absence of a perforated umbilicus and the elongate shell shape, Hasegawa (in Okutani, 2000) transferred *P. bathyalis* to the genus *Iphinopsis* based on conchological features such as the thin, small shell with predominantly spiral sculpture. Determination of the precise generic positions of the present and other species in this and related genera also requires further detailed study based on the anatomy.

Iphinopsis sp. 1

(Fig. 298)

Material examined. WA06-F1500D-2 (2); TS96-K2 [1451–1455 m] (1+1e).

Remarks. The present species closely resembles *Iphinopsis choshiensis*, but differs by its larger size, significantly stronger spiral cords and thread-like growth lines in the interspaces.

Iphinopsis sp. 2
(Figs. 299–300)

?*Iphinopsis* sp. — Hasegawa, 2001: 147, pl. 3, fig. M.

Material examined. WA05-DE380D (1); WA07-D900 (5+1e).

Remarks. Although the present species bears a resemblance to the two species above in general shell shape, it differs significantly from them by completely lacking a perforate umbilicus and having an angulate shoulder. It is possibly more closely related to the genus *Admete*. There is considerable variation in the strength of the spiral cords (Figs. 299–300) among the specimens examined, and those recorded from Tosa Bay by Hasegawa (2001) as *Admete* sp. may also fall within the range of variation.

Family Turridae H. Adams and A. Adams, 1853
Aforia circinata (Dall, 1873)
[Japanese name: Yagen-iguchi (= Hime-yagen-iguchi)]
(Figs. 303–310)

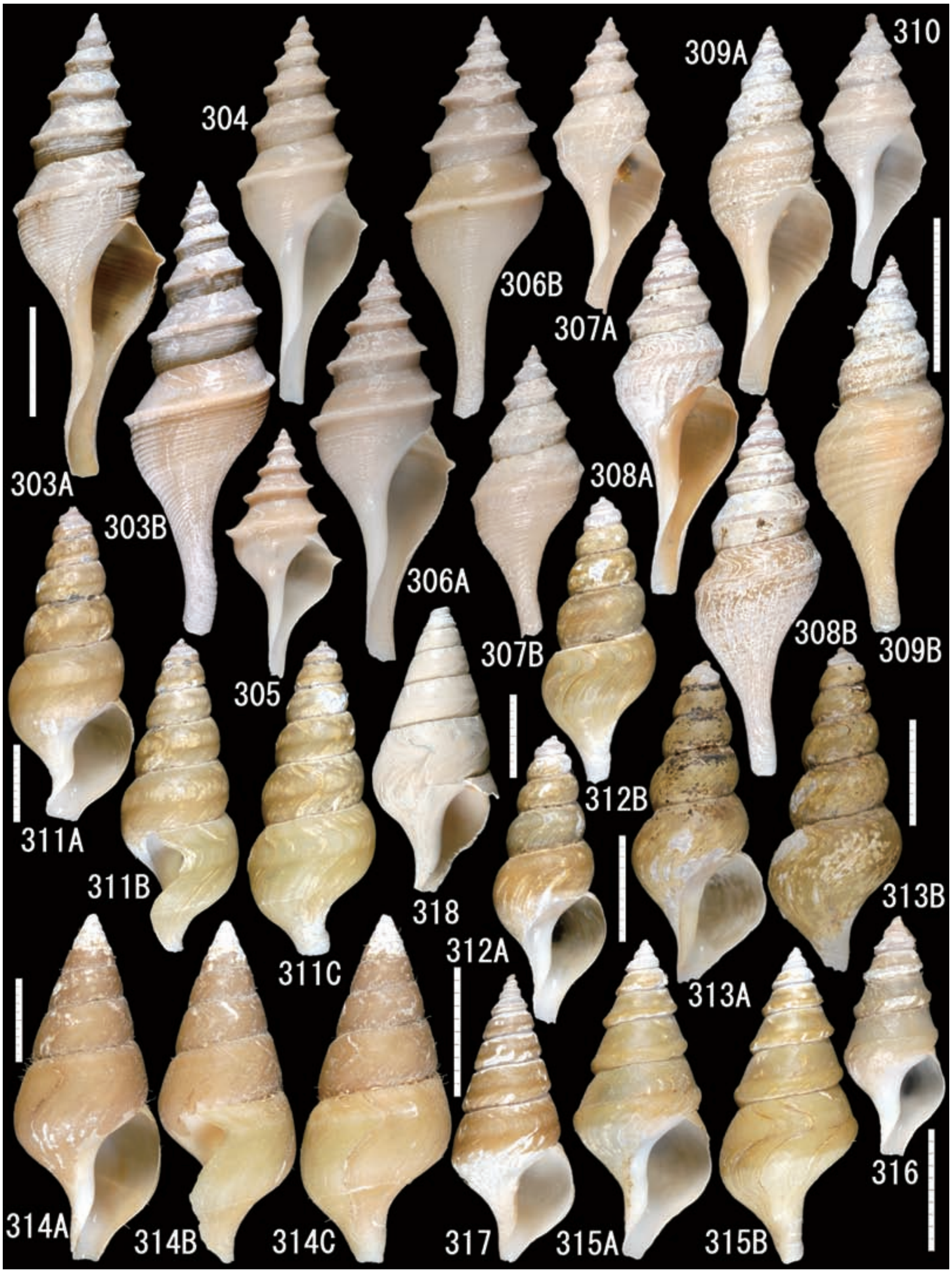
Pleurotoma circinata Dall, 1873: 61, pl. 2, fig. 5.
Turricula (*Surcula*) *hondoana* Dall, 1925: 29–30, pl. 31, fig. 6 (type locality: USBF station 5087, in Sagami Bay off Hondo, Japan in 614 fathoms).
Leucosyrinx circinata — Oshima, 1938: 102–109, pl. 2, figs. 1–12; Galkin and Scarlato, 1955: 180, pl. 47, fig. 13.
Aforia japonica (Dall, 1925) Bartsch, 1945 [non *Turcicula japonica* Dall, 1925]: 388–389, figs. 5–6 (type locality: USBF station 5088, off Joka [Joga] Shima Light in Sagami Bay, Honshu, Japan in 369 fathoms); Higo *et al.*, 2001: fig. G3549 (holotype).
Aforia diomedea Bartsch, 1945: 389, figs. 11, 12 (type locality: USBF station 5044, off Yerimo [Erimo] Zaki, southeast Hokkaido, in 309 fathoms); Oyama, 1958: 115; Kuroda *et al.*, 1971: 341 (Japanese part), 220 (English part), pl. 55, fig. 14; Okutani *et al.*, 1988: 191, text-fig; Watanabe and Naruke, 1988: 56, pl. 9, fig. 4; Higo *et al.*, 2001: fig. G3548s (holotype).
Aforia hondoana — Bartsch, 1945: 389–391, figs. 7–8; Oyama, 1958: 117; Hasegawa *et al.* in Okutani, 2000: 637, pl. 317, fig. Turridae-87; Higo *et al.*, 2001: fig. G3550 (holotype).
Aforia sakhalinensis Bartsch, 1945: 392, figs. 3, 4 (type locality: USBF station 5051, off Kinka San Light east of Sakhalin Island [Kinkazan, northeastern Honshu] in 399 fathoms).
Aforia circinata diomedea — Kira, 1959: 91–92, pl. 35, fig. 14.
Leucoryrinx [sic; = *Leucosyrinx*] (*Aforia*) *diomedea* — Shikama and Horikoshi, 1963: pl. 100, fig. 11.
Aforia circinata — Habe and Ito, 1965a: 83, pl. 30, fig. 25; Kuroda and Habe in Okada *et al.*, 1965: 147, text-fig.; Ishikawa, 1970: 134, pl. 9, fig. 9; Okutani, 1983: 11, pl. 41, fig. 1.
Aforia japonica diomedea — Kuroda, 1971: 87, text-fig. 3.
Aforia hondoensis — Watanabe and Naruke, 1988: 54, pl. 9, fig. 5.

Note. In the above synonymy only names that have been recorded from the Pacific coast of northern Japan are listed. They are provisionally regarded as synonyms of *Aforia circinata*, which is widely distributed in the North Pacific and known to show a wide range of variation in shell morphology (Sysoev and Kantor, 1987). This is because the material examined could not be classified into more than one distinct species on one hand, and could not be distinguished from North Pacific specimens, on the other hand.

Type locality. Natekeen Bay, Captain’s Bay, Unalaska.

Distribution. Sagami Bay, and western part of Sea of Japan, both northwards to Okhotsk Sea, and Bering Sea; [350–1500 m].

Material examined. WA95-C800 (2); WA05-DE380D (1+1*); WA05-DE410 (2e+2*); WA05-DE425 (1e+1*); WA05-DE450 (1+1e); WA05-DE480 (2*); WA05-DE510 (2); WA05-E750 (1e); WA05-EF410 (1*); WA05-EF450D (1*); WA05-F380 (1); WA05-F750 (3); WA05-FG480 (1*); WA05-G550 (1); WA05-G900 (1); WA05-H480 (1); WA05-H900D (1e); WA06-D650



Figs. 303–318. Turridae. 303–310. *Aforia circinata*, 303: WA05-F750; 304: WA05-G900; 305: WA06-F350; 306: WA06-DE380; 307: WA06-F510; 308: WA06-GH450; 309: WA05-DE380D; 310: WA05-FG480. 311. *Antiplanes dendritoplicata*, WA05-G900. 312–313. *Antiplanes obliquiplicata*, 312: WA06-F1500D; 313: WA06-G1200. 314–318. *Antiplanes obesus*, 314: WA06-DE410; 315: WA05-F900; 316: WA07-D900; 317: holotype of *Rectiplanes kawamurai* Habe, 1958, NSMT-Mo 38598; 318: figured syntype of *Antiplanes obesus* Ozaki, 1958, NSM PM4454. Scales: 303–310 = 20 mm (304–310: at the same scale); 311–318 = 10 mm (315–316: at the same scale).

(2); WA06-DE310 (1*); WA06-DE350 (1); WA06-DE380 (1); WA06-DE410 (1+1e); WA06-DE425 (1e+1*+1e*); WA06-DE450 (2); WA06-DE480 (1e); WA06-E650 (2); WA06-E750 (3); WA06-EF350 (1+1e); WA06-EF380 (1); WA06-EF425D (1e); WA06-EF450 (1e); WA06-EF480 (1e); WA06-EF510 (1e); WA06-F350 (1); WA06-F750 (2); WA06-F1500D-1 (1); WA06-F380 (1*); WA06-F510 (2*); WA06-FG410 (1+1e+1*); WA06-FG450 (1e); WA06-FG480 (1*); WA06-FG510 (1); WA06-GH380 (2); WA06-GH425 (1e); WA06-GH450 (2*); WA06-GH480D (1e*); WA06-H480 (1e); WA07-A650 (1); WA07-B510 (1); WA07-C650 (6); WA07-C900 (1e); WA07-D650 (3+1*); WA07-D750 (1); WA07-D900 (3+6e); WA08-F900 (3) [*: "*hondoana*" form].

Remarks. The specimens listed above may superficially be classified into several morphotypes. Relatively large specimens with distinct spiral sculpture (Fig. 303) may be identified as *A. diomedea*; relatively small specimens with feeble sculpture (Fig. 304) as *A. japonica*; and smaller specimens with coarser spiral sculpture and an indistinct spiral carina at the periphery (Fig. 309) as *A. hondoana*. The last form seems to be quite different from the others, and tentatively distinguishable from the other form(s) in the above list. However, because even this form shows considerable variation in the strength of the spiral keel and the thickness of spiral cords, and some specimens cannot clearly be classified into either group (e.g. Figs. 307–308), it is appropriate not to separate it as a distinct species. Furthermore, there is no clear correlation between trends in variation and geographical factors, such as depth and latitude, and various phenotypes often occur sympatrically within the same population. Considering such variability, Japanese populations of this species are not distinguished herein from *A. circinata*, which is known to be widely distributed in the North Pacific, as noted above. It should be mentioned, however, that sexual dimorphism in the shell morphology, i.e. the possession of a canal-like notch on the outer lip in mature females, which was described in *A. circinata* (Shimek, 1984), has not been observed among the Japanese specimens (Oshima, 1938). It is not clear at present whether this difference warrants specific distinction or not.

Antiplanes dendritoplicata Kantor and Sysoev, 1991
[New Japanese name: Kubire-ezo-iguchi]
(Fig. 311)

Antiplanes dendritoplicata Kantor and Sysoev, 1991: 127–128, figs. 2, 21, 36–44, 45; Kantor and Sysoev, 2006: 214, pl. 110, Fig. A.

Type locality. R/V *Vityaz*, 39th cruise, Sta. 5603, south-east of Simushir, Kurile Islands, 46°22´N, 153°03´E, depth 3175–3250 m.

Distribution. Off Onahama in Fukushima Prefecture and northwards to Okhotsk Sea; 103–1845 m [900–1200 m].

Material examined. WA05-G900 (1); WA05-E1000D (3e); WA06-A1200 (2); WA06-E900 (1); WA06-F900 (1); WA08-E900 (1).

Remarks. The present material was identified as *A. dendritoplicata* based mainly on the sculpture; the shell surface is generally smooth except for the dendritic ribs around the periphery and rather distinct spiral cords on the siphonal canal. However, it resembles *A. obliquiplicata* in general shape, and more detailed comparative study may be necessary to confirm the identification.

Antiplanes obliquiplicata Kantor and Sysoev, 1991
[New Japanese name: Watazoko-ezo-iguchi]
(Figs. 312–313)

Antiplanes obliquiplicata Kantor and Sysoev, 1991: 128, 130, figs. 3, 20, 45, 47–52; Kantor and Sysoev, 2006: 215, pl. 110,

Fig. J.

Type locality. R/V *Vityaz*, 24th cruise, Sta. 3577, E. of Honshu, 386˚40.1´N, 142˚29.3´E, depth 3042 m.

Distribution. Off Hitachi in Ibaraki Prefecture and northwards to eastern and southern Kamchatka; 3360–3875 m [1200–1500 m].

Material examined. WA06-F1500D-1 (4); WA06-G1200 (1); WA06-H1500D (1).

Remarks. *Antiplanes obliquiplicata* most closely resembles *A. dendritoplicata*, but can be distinguished by the invariable absence of spiral cords on the siphonal canal (Kantor and Sysoev, 2006). Accordingly specimens with this character are here identified as *A. obliquiplicata*.

Antiplanes obesus Ozaki, 1958
[Japanese name: Kawamura-iguchi (Kawamura-ezo-iguchi)]
(Figs. 314–318)

Antiplanes obesus Ozaki, 1958 [March]: 158, pl. 16, fig. 17.

Rectiplanes kawamurai Habe, 1958b [October]: 181–189, 183–184, text-fig. 1 (type locality: off Choshi, Chiba Prefecture, Honshu, 100-150 fathoms in depth); Shikama, 1962: 50–51, pl. 3, figs. 1a–b, 2a–b; Habe and Ito, 1965a: 83, pl. 30, fig. 27; Ishikawa, 1970: 134, pl. 9, fig. 15.

Antiplanes (*Rectiplanes*) *kawamurai* — Shikama and Horikoshi, 1963: pl. 100, fig. 9.

Rectiplanes (*Rectiplanes*) *kawamurai* — Watanabe and Naruke, 1988: 56, pl. 9, fig. 6; Hasegawa *et al.* in Okutani, 2000: 637, pl. 317, fig. Turridae-90.

Rectiplanes obesus — Baba, 1990: 197, pl. 17, fig. 9.

Antiplanes kawamurai — Kantor and Sysoev, 1991: 130, figs. 53–58; Higo *et al*., 2001: fig. G3557 (holotype); Kantor and Sysoev, 2006: 215, pl. 110, figs. C–D.

Type locality. Road-side cutting at Tokoyoda-machi, Choshi City; Iioka Formation [Upper Pliocene, Inubo Group].

Distribution. Sagami Bay and northwards to Shikotan Island, southern Kurile Islands; 183–1520 m [410–1500 m].

Material examined. WA05-E1000D (1e); WA05-F900 (2); WA05-H900D (1e); WA06-A1200 (1); WA06-DE410 (1+1e); WA06-E510D (1e); WA06-E900 (1); WA06-F750 (3); WA07-A1500D (1e); WA07-C900 (1e); WA07-D750 (1e); WA07-D900 (ca. 50+17e); WA08-E1200 (1); WA08-F900 (15+4e).

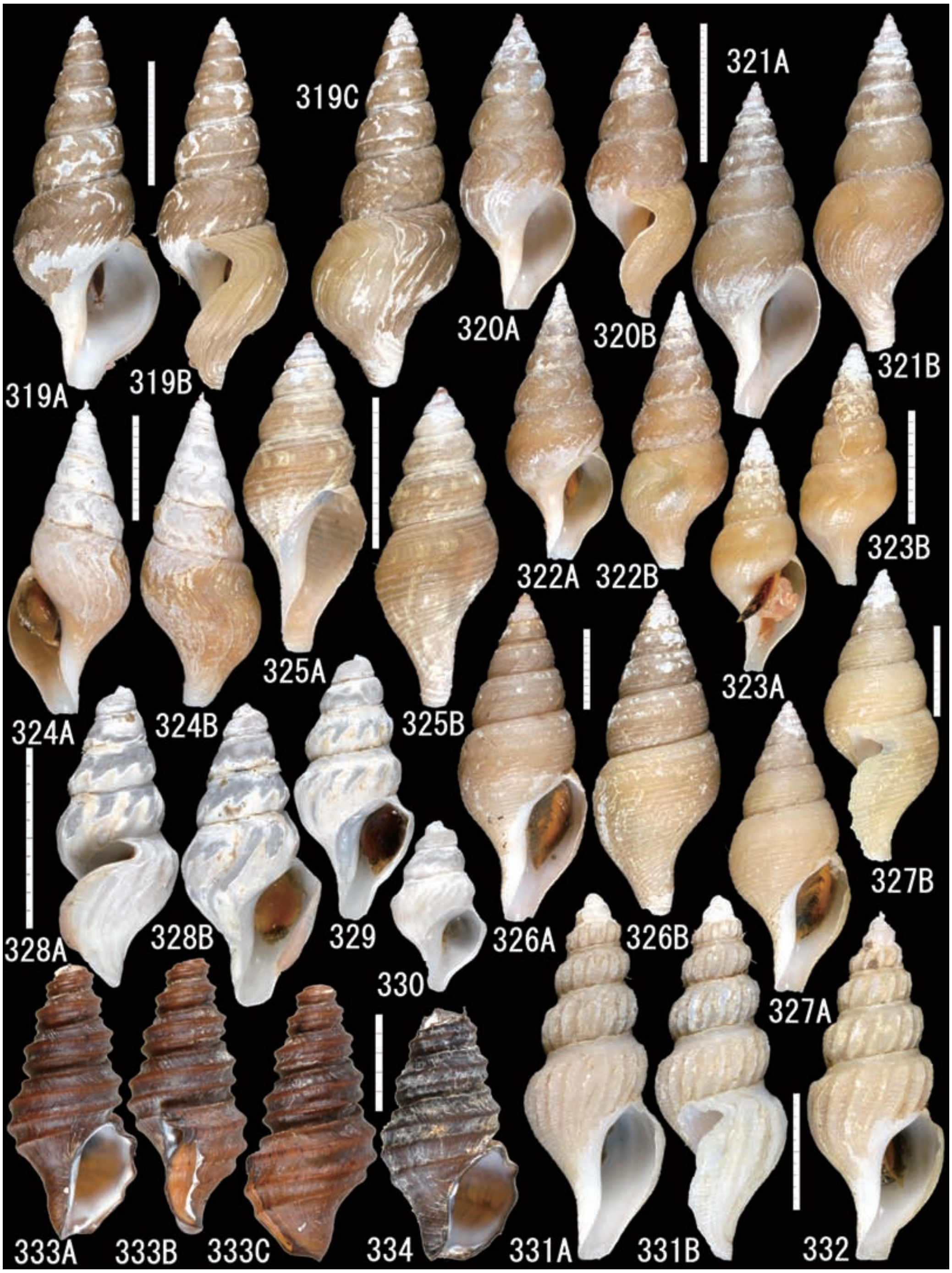
Remarks. This species had been well known as *A. kawamurai* in literature, but that taxon was recently shown to be a junior synonym of *A. obesus* by Baba (1990). This is confirmed here by the examination of the type material of *A. obesus* (Fig. 314; syntype, NSM PM4454) and direct comparison with the holotype of *A. kawamurai* (Fig. 317; NSMT-Mo 70297). It is clearly distinguishable from all other species in the genus, including *A. sanctiioannis*, by its broad shell with strongly angulate whorls. Specimens from the deeper stations (at depths of 900–1500 m; Figs. 315–316) look different from the typical form in possessing a strong spiral keel on the periphery and a deeply constricted suture, and sometimes being smaller and more elongate in shape (Fig. 316), but otherwise agree in general features.

Antiplanes sanctiioannis (E. A. Smith, 1875)
[Japanese name: Ezo-iguchi]
(Figs. 319–323)

Pleurotoma (?) *Sancti-Ioannis* Smith, 1875: 416–417.

Antiplanes yessoensis Dall, 1925: 4, pl. 21, fig. 3 (type locality: USBF 5036, off S coast of Yesso, Hokkaido).

Rectiplanes sanctioannis [sic] — Habe, 1961a: 80, pl. 39, fig. 29; Habe and Ito, 1965a: 83, pl. 30, fig. 28; Okutani, 1986: 180,



Figs. 319–334. Turridae. 319–323. *Antiplanes sanctiioannis*, 319: WA06-G650; 320: WA06-DE425; 321: WA07-A450; 322: WA07-D350; 323: WA05-EF250D. 324. *Antiplanes vinosa*, WA05-GH380D. 325. *Antiplanes* sp., WA06-G900D. 326–327. *Antiplanes motojimai*, 326: WA06-H480; 327: WA06-GH450. 328–330. *Crassispira* sp. cf. *hosoi*, 328: WA06-DE480; 329: WA07-D900; 330: WA06-F1500D. 331–332. *Crassispira takeokensis*, 331: WA07-D900; 332: WA06-FG450. 333–334. *Decollidrillia nigra*, 333: WA07-D900; 334: WA07-B410D. Scale: 319–322 = 20 mm (320–322 at the same scale); 323–332 = 10 mm (328–330 at the same scale; 331–332 at the same scale); 333–334 = 5 mm (at the same scale).

181 with color fig.; Hasegawa *et al.* in Okutani, 2000: 637, pl. 317, fig. Turridae-89.
Antiplanes sanctaioannis [sic] — Okutani, 1964: 423, pl. 4, fig. 8.
Rectiplanes sanctaioannis [sic] — Ishikawa, 1970: 134, pl. 9, fig. 10; Ito, 1985: 29, pl. 6, fig. 10.
Rectiplanes motojimai — Ito, 1985: 29, pl. 7, fig. 1 [non *Rectiplanes* (*Rectisulcus*) *motojimai* Habe, 1958].
Mohnia vernalis — Ito *et al*., 1986: 13, pl. 12, fig. 6 [non *Mohnia vernalis* Dall, 1913].
Rectiplanes (*Rectiplanes*) *sanctaioannis* [sic] — Ito *et al*., 1986: 19: pl. 25, fig. 3.
Rectiplanes (*Rectiplanes*) *motojimai* — Ito *et al*., 1986: 19, pl. 25, fig. 4 [non *Rectiplanes* (*Rectisulcus*) *motojimai* Habe, 1958].
Rectiplanes sanctiioannis — Baba, 1990: 196, pl. 17, fig. 8a–b.
Antiplanes sanctiioannis — Kantor and Sysoev, 1991: 130, 134–136, figs. 1, 11–17, 25–28, 59–88, 100–103; Higo *et al.*, 2001: fig. G3556 (lectotype); Kantor and Sysoev, 2006: 215, pl. 110, fig. I.
Antiplanes yessoensis — Higo *et al.*, 2001: fig. G3556s (holotype) [as a junior synonym of *Antiplanes sanctiioannis*].
[See Kantor and Sysoev (1991) for additional synonymy.]

Type locality. "about 100 miles south-eastward of Yesso [Hokkaido, Japan]".

Distribution. Sagami Bay, and northern part of Sea of Japan, both northwards to Okhotsk Seas; widespread in boreal region north to Gulf of Anadyr in northwestern Bering Sea; 50–1530 m [350–1200 m].

Material examined. WA9312-K35 [251–268 m] (1e); WA05-DE380 (2); WA05-DE380D (2+4e); WA05-DE425 (2); WA05-DE450 (1); WA05-DE480 (1e); WA05-E550 (1); WA05-EF250D (6+2e); WA05-EF410 (1); WA05-EF425 (1e); WA05-EF450D (4); WA05-F425 (1); WA05-F450 (3); WA05-FG380 (3); WA05-FG410 (4); WA05-FG425 (4); WA05-FG450 (5+3e); WA05-G510 (1e); WA05-GH350 (1); WA05-GH380D (2+2e) WA05-GH450 (1e); WA05-G510D (1e); WA05-H480 (1); WA06-DE350 (1); WA06-DE380 (1+1e); WA06-DE410 (2); WA06-DE425 (3+2e); WA06-DE450 (1); WA06-DE480 (3); WA06-E450 (1); WA06-E480 (1); WA06-E1200D (1+1e); WA06-EF350 (1e); WA06-EF425 (1e); WA06-EF425D (1); WA06-EF450 (1e); WA06-F425 (1); WA06-F750 (1); WA06-FG350D (4e); WA06-FG410 (5+1e); WA06-FG425 (1); WA06-FG425 (2e; in a conger trap); WA06-FG450 (1+1e); WA06-FG480 (1); WA06-FG510 (2); WA06-G480 (1); WA06-G650 (1); WA06-G900D (2+4e); WA06-GH380 (1); WA06-GH425 (1+1e); WA06-GH480 (1e); WA06-GH480D (1e); WA06-GH510 (1e); WA06-H250D (1+10e); WA06-H280 (1); WA06-H350 (1); WA06-H380 (1); WA06-H450 (1+1e); WA06-H480 (3+11e); WA06-H550 (1e); WA07-C350 (1e); WA07-C350D (3e); WA07-D210D (1e); WA07-D310 (1); WA07-D350 (2+1e); WA07-D410 (1); WA07-D900 (1+2e); TS96-K2 [1451–1455 m] (2).

Remarks. This is commonest and most widely distributed species in the genus, and it exhibits a wide range of variation in shell morphology. The species is most typically characterized by the possession of distinct fine spiral sculpture below the anal fasciole of the spire whorls (Kantor and Sysoev, 1991), and the present material was identified based on this character, regardless of the shape of the shell. Although this and other related dextral species have usually been assigned to *Rectiplanes* Bartsch, 1944 (type species: *Pleurotoma* (*Antiplanes*) *santarosana* Dall, 1902, by original designation) by most previous Japanese authors, *Rectiplanes* differs from *Antiplanes* Dall, 1902 (type species: *Pleurotoma* (*Surcula*) *perversa* Gabb, 1865, by original designation) only in the direction of shell coiling, and is regarded as a synonym of the latter (Kantor and Sysoev, 1991).

Antiplanes vinosa (Dall, 1874)
[Japanese name: Hidarimaki-iguchi (= Hoso-hidarimaki-iguchi)]
(Fig. 324)

Pleurotoma vinosa Dall, 1874: 253.
Pleurotoma (*Antiplanes*) *vinosa* — Dall, 1902b: 514, pl. 34, fig. 4.
Antiplanes kamchatica Dall, 1919a: 33–34, pl. 10, fig. 1 (type locality: W Bering Sea and SE coast of Kamchatka).

?*Pleurotoma contraria* Yokoyama, 1926: 383, pl. 44, figs. 2a–b (type locality: Manganji, Akita Prefecture; Wakimoto Formation, Pleistocene).

Antiplanes contraria — Kira, 1959: 90, pl. 35, fig. 2; Taki in Baba *et al*., 1960: 198, pl. 88, fig. 5; Habe and Ito, 1965a: 83, pl. 30, fig. 26; Kuroda and Habe in Okada *et al*., 1965: 147, text-fig.; Ito, 1985: 29, pl. 6, figs. 8 (1–2); Okutani, 1986: 180, 181 with color fig.; Ito *et al*., 1986: 19, pl. 25, fig. 2; Baba, 1990: 196, pl. 17, fig. 7; Hasegawa *et al.* in Okutani, 2000: 637, pl. 317, fig. Turridae-88 [?non *Pleurotoma contraria* Yokoyama, 1926].

Antiplanes vinosa — Kotaka, 1962: 142–143, pl. 33, fig. 33; Kantor and Sysoev, 1991: 137–140, figs. 9–10, 24, 29, 105–120; Higo *et al*., 2001: fig. G3558 (holotype).

Antiplanes (*Antiplanes*) *contraria* — Shikama and Horikoshi, 1963: pl. 100, fig. 7.

Type locality. Kyska Harbour, Great Kyska Island, Aleutian Islands, 10 fathoms.

Distribution. Sea area Kashima-nada, and off Noto Peninsula in Sea of Japan, both northward to northern Okhotsk and Bering Seas; 100–300 m [350–410 m].

Material examined. WA05-DE380 D (1e); WA05-GH380D (1+1e); WA05-GH410 (1+1e); WA07-C350D (1e).

Remarks. It is not clear whether the Recent Japanese specimens are conspecific with *A. contraria*, which was described based on Pleistocene fossils from Manganji, because of the incompleteness of the types. Nevertheless, Kantor and Sysoev (1991) recognized only one sinistral species in the genus in the northwestern Pacific, and identified it as *A. vinosa*, which is older than Yokoyama's name.

Antiplanes motojimai (Habe, 1958)

[Japanese name: Motojima-iguchi]

(Figs. 326–327)

Rectiplanes (*Rectisulucus*) *motojimai* Habe, 1958b: 182–183, 184–185, text-fig. 3; Habe, 1961a: 80, pl. 39, fig. 28; Okutani, 1964: 424, pl. 4, fig. 7; Habe and Ito, 1965a: 82, pl. 30, fig. 18; Okutani, 1986: 180, 181 with color fig.; Watanabe and Naruke, 1988: 56, pl. 9, fig. 8; Hasegawa *et al.*, in Okutani, 2000: 637, pl. 317, fig. Turridae-91.

Rectiplanes motojimai — Ito, 1985: 29, pl. 7, fig. 1.

Antiplanes motojimai motojimai — Kantor and Sysoev, 1991: 140, figs. 122, 137; Higo *et al*., 2001: fig. G3560 (possible holotype); Kantor and Sysoev, 2006: 215, pl. 110, fig. G.

Type locality. Off Choshi, Chiba Prefecture, Honshu.

Distribution. Sagami Bay and northwards to off Kesen-numa in Iwate Prefecture (present study); 225–870 m [350–900 m].

Material examined. WA06-EF410 (1e); WA06-FG380 (1e); WA05-FG410 (2); WA05-FG425 (2); WA05-FG450 (1); WA05-FG480 (1+1e); WA05-FG510D (1); WA05-GH480 (1); WA05-H510 (1); WA06-F510 (1); WA06-G480 (1); WA06-G900D (1); WA06-GH410 (-1) (1); WA06-GH450 (1); WA06-H350 (2); WA06-H380 (1+1e); WA06-H410 (1+1e); WA06-H450 (1); WA06-H480 (1+2e); WA07-D550 (1e); WA07-D900 (2e).

Remarks. Records of this species in the Sea of Japan (Higo *et al.*, 1999) were based on erroneously identified specimens (see synonymy of *A. sanctiioannis*). Thus it had been recorded only from the Pacific coast of northern Honshu, until Kantor and Sysoev (1991) described a new subspecies *A. motojimai aquilonalis* from the eastern Bering Sea and northern Okhotsk Sea. Although Habe (1958b) proposed the new subgenus *Rectisulcus* in the genus *Rectiplanes* for this species (designating it as the type species) and *R. isaotakii* Habe, 1958 based on the difference in the strength of sculpture, it was regarded as junior synonym of *Antiplanes* by Kantor and Sysoev (1991).

Antiplanes sp.
(Fig. 325)

Material examined. WA05-G280 (1e); WA06-G900D (1); WA06-H250D (4e).

Remarks. This species most closely resembles *Antiplanes isaotakii*, which was described from the sea area Kashima-nada off Choshi, in its slender shell shape and smaller number of spiral cords, but differs in having a significantly longer siphonal canal and a shorter spire. Because all the specimens examined were apparently immature, additional material will be necessary to confirm identification.

Crassispira takeokensis (Otuka, 1949)
[Japanese name: Midori-momiji-bora]
(Figs. 331–332)

Brachytoma takeokensis Otuka, 1949: 307, pl. 13, fig. 18; Okutani, 1964: 425–426, pl. 4, fig. 13.
Clavus (*Brachytoma*) *takeokensis* — Ozaki, 1958: 155–156, pl. 16, fig. 20.
Clathrodrillia takeokensis — Habe and Ito, 1965a: 82, pl. 30, fig. 20; Okutani, 1986: 182, 183 with color fig.; Higo and Goto, 1993: 280; Watanabe and Naruke, 1988: 57, pl. 6, fig. 8; Hasegawa *et al.* in Okutani, 2000: 619, pl. 308, fig. Turridae-2.
Inquisitor? *takeokaensis* [sic] — Kanagawa Prefectural Museum, 1972: 94.
Pseudoinquisitor takeokensis — Higo, 1973: 185.
Crassispira takeokensis — Okutani and Iwahori, 1992: 260, 262, figs. 62–64; Tsuchida and Kurozumi, 1995: 181, fig. 8 (1); Hasegawa, 2001: 147–148; Takenouchi, 2001: 67.
Inquisitor takeokaensis [sic] — Higo *et al.*, 1999: 308.
[Detailed synonymy, including citations without illustrations, is shown here to indicate the confusion in the generic allocation of this species.]

Type locality. Tomiya, Minato-machi, Japan. Tomiya tuffaceous sandstone, Pliocene.

Distribution. Off southwestern Hokkaido and southwards to Tosa Bay; 100–1350 m [350–900 m].

Material examined. WA05-DE380D (5); WA05-DE410 (1); WA05-DE425 (1); WA05-DE480 (1); WA05-E480 (1); WA05-EF350 (1); WA05-EF450D (1e); WA05-EF480 (1e); WA05-F425 (1); WA05-F480 (2); WA05-FG410 (2); WA05-FG425 (1); WA05-FG450 (1+1e); WA05-FG510D (1e); WA05-G510 (2e); WA05-G750 (1); WA05-G1500D (1e); WA05-GH480 (2); WA05-H650 (1e); WA05-H900D (2e); WA06-C750 (1); WA06-DE380 (3); WA06-DE410 (1+1e); WA06-DE425 (2); WA06-DE450 (1); WA06-DE480 (1); WA06-E480 (1); WA06-E510 (1e); WA06-E550 (1); WA06-E750 (1); WA06-EF410 (2); WA06-EF425 (1e); WA06-EF425D (2e); WA06-F750 (3); WA06-FG450 (1); WA06-FG480 (1e); WA06-G900D (4e); WA06-GH450 (1); WA06-GH480 (2); WA06-GH480D (6e); WA06-H480 (4+6e); WA06-H750 (1); WA07-C750 (1); WA07-D350 (2); WA07-D410 (2+2e); WA07-D900 (17); WA08-F900 (1+2e).

Remarks. As shown in synonymy, there is considerable confusion regarding the generic allocation of this species. Okutani and Iwahori (1992) examined the radula of specimens collected from Tosa Bay, and allocated this species to the genus *Crassispira* (type species: *Pleurotoma bottae* Kiener, 1840, subsequently designated by Herrmannsen, 1847), based on simiralities there. This opinion is provisionally adopted in this paper, although most of the known species in the latter genus are shallow water dwellers in tropical to temperate waters.

Crassispira sp. cf. ***hosoi*** (Okutani, 1964)
(Figs. 328–330)

?*Imaclava hosoi* Okutani, 1964: 422, pl. 7, fig. 10 (type locality: Sagami Bay, 35˚05.35´N, 139˚18.65´E, 550 m).

Material examined. WA05-E550 (1); WA05-EF350 (1); WA05-FG425 (1); WA05-GH480 (1); WA06-DE480 (1); WA06-EF425 (1e); WA06-F750 (1); WA06-F1500D-1 (2); WA06-F1500D-2 (1); WA06-FG350D (1e); WA06-FG410 (1); WA07-D900 (ca. 30+2e); TS96-K2 [1451–1455 m] (1+1e).

Remarks. All the specimens examined are so heavily eroded that they cannot be positively identified to species level. This most closely resembles *Imaclava hosoi* in general appearance, but differs in being at least 1.5 times larger, and possessing a less excavated subsutural slope and shallower anal sinus. It is assigned to *Crassispira* only provisionally due to its similarity to the preceding species.

Decollidrillia nigra Habe and Ito, 1965
[Japanese name: Kubikire-shajiku]
(Figs. 333–334)

Decollidrillia nigra Habe and Ito, 1965a [June 1]: 80, pl. 30, fig. 6; Habe and Ito, 1965b [July 31]: 27, 43, pl. 4, fig. 6; Golikov and Sirenko, 1998: 131, fig. 14B; Higo *et al.*, 2001: fig. G3490 (holotype); Medinskaya, 2003a: 125, fig. 4F (anatomy); Medinskaya, 2003b: 135, figs. 2I, 4A–B (anatomy); Kantor and Sysoev, 2006: 218, pl. 111, fig. G.

Type locality. Off Iwate Prefecture, Honshu, ca. 200 m (see remarks).

Distribution. Off Hitachi in Ibaraki Prefecture and northwards to southern Kurile Islands, and in Sea of Japan; 200–920 m [310–900 m].

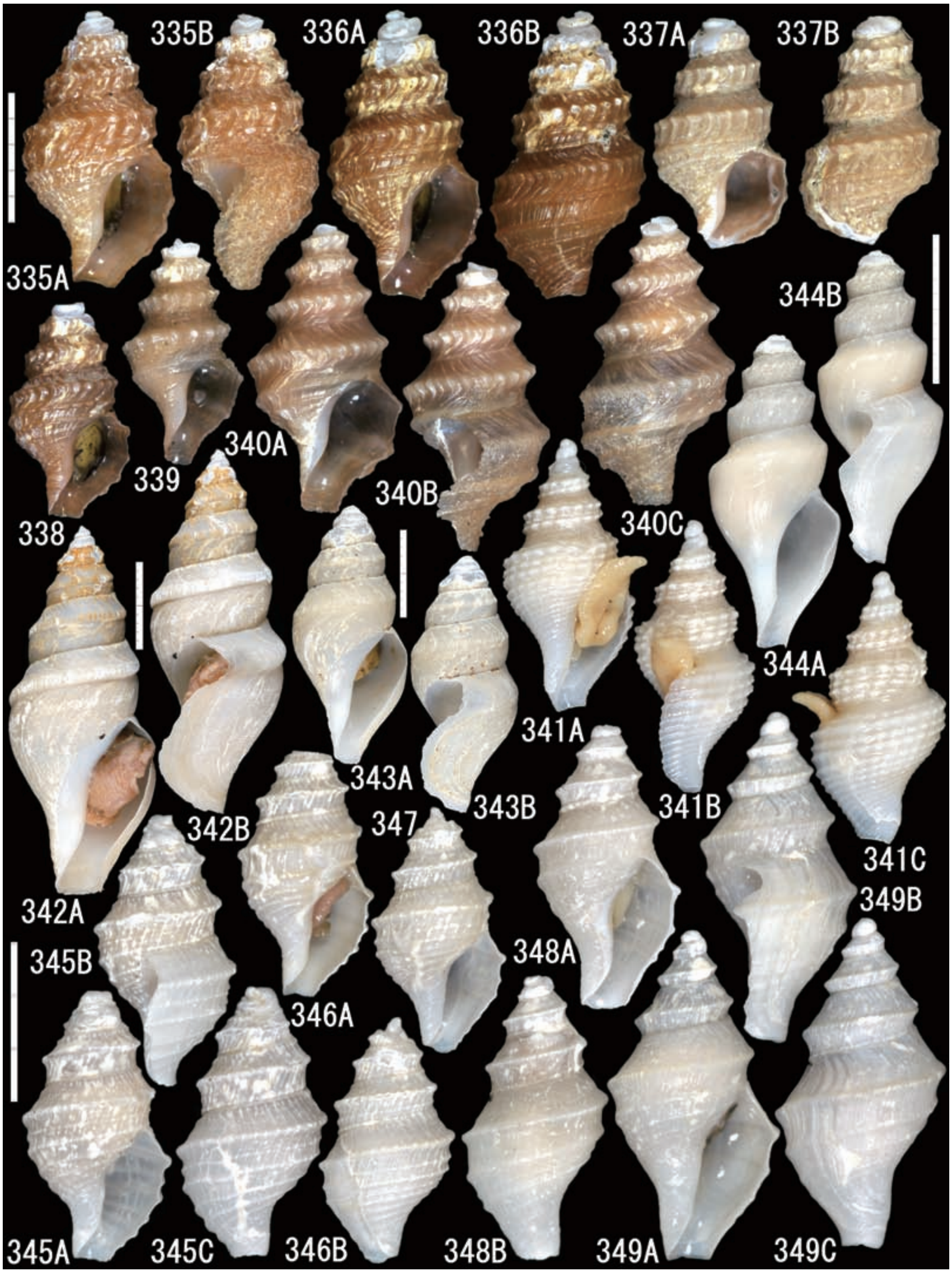
Material examined. WA9308-S13 [307 m] (2); WA05-DE380D (2); WA05-EF450D (12); WA05-H900D (5e); WA06-DE310 (1e); WA06-DE350 (1e); WA06-EF425D (2+1e); WA06-FG350D (1e); WA06-FG480 (1+1e); WA06-FG510 (1); WA06-G900D (5+10e); WA06-GH480D (3e); WA07-B410D (6+5e); WA07-D410 (3+2e); WA07-D450 (1e); WA07-D900 (1); WA08-F900 (2).

Remarks. There is a nomenclatural problem concerning the molluscan taxa, including the present one, proposed by Habe and Ito (1965a, b). Although Habe and Ito (1965b) formally described thirty new taxa that were treated in a popular book written by the same authors (Habe and Ito, 1965a), the latter was actually published two months earlier than the former, and all the taxa described in detail in the former paper became synonyms (and homonyms) of the same taxa treated in the latter publication. However, all the specimens selected as holotypes by Habe and Ito (1965b) are the same as those illustrated by Habe and Ito (1965a), and they can be regarded as figured syntypes or holotypes (when a taxon is represented by only one specimen). In the case of the present species, the type locality was given by Habe and Ito (1965b) as “off Iwate Prefecture, Honshu, ca. 200 m” in the Japanese description and “at a depth of about 200 m, south of Erimomisaki, Hokkaido” in English. The correct locality of the illustrated specimen (NSMT-Mo 49880) was “off Iwate Prefecture (ca. 200 m), collected by R. Tiba”, and this is here formally restricted as the type locality of this species.

Cryptogemma corneus (Okutani, 1966)
[Japanese name: Chairo-kado-kudamaki]
(Figs. 335–338)

Taranis corneus Okutani, 1966: 25, pl. 2, fig. 16; Ishikawa, 1970: 134, pl. 9, fig. 8; Tsuchida, 1985: 97, pl. 12, fig. 12; The Committee for Celebrating Dr Okutani’s Retirement from Tokyo University of Fisheries, 1996: 79, pl. 4, fig. 5 (holotype); Baba, 1990: 200, pl. 18, fig. 6a–b; Hasegawa, 2001: 149.

Cryptogemma corneus — Sysoev and Kantor, 1986: 1457, pl. 1, fig. 1, pl. 2, fig. 1, pl. 3, figs. 1–2; Golikov and Sirenko, 1998: 132, fig. 14C; Medinskaya, 2003a: 125, fig. 3A (anatomy); Medinskaya, 2003b: 135, figs. 2H, 3A–B (anatomy).



Figs. 335–349. Turridae and Conidae. 335–338. *Cryptogemma corneus*, 335: WA05-DE380D; 336: WA06-DE350; 337: WA06-G1200D (empty shell); 338: WA06-G900D. 339–340. *Cryptogemma* sp., 339: WA06-G900D; 340: WA95-B1000. 341. *Cretaspira*? sp., WA05-DE380D. 342–343. *Bathytoma engonia*, 342: WA06-H480; 343: WA06-F1500D. 344. *Bathytoma* sp., WA06-F1500D. 345–347. *Taranis* sp. 2, WA07-A450. 348–349. *Taranis* sp. 1, 348: WA07-A510; 349: WA07-A450. Scale: 335–341 = 5 mm (at the same scale); 342–344 = 10 mm; 345–349 = 3 mm (at the same scale).

Type locality. R/V *Soyo-maru*, St. T21(2), 34°56.8´N, 139°21.0´E, Sagami Bay, 1470–1500 m.

Distribution. Southern Kurile Islands and southwards to Tosa Bay (Hasegawa, 2001); 823–2940 m [350–1200 m].

Material examined. WA05-DE380D (4); WA05-DE480 (1); WA05-EF450 (1e); WA05-EF450D (15+5e); WA05-G450 (1); WA06-DE350 (1+1e); WA06-DE425 (3); WA06-E510D (1e); WA06-EF410 (1+1e); WA06-EF425D (3+7e); WA06-G900D (1+3e); WA06-G1200D (1e); WA06-GH480D (3e); WA06-H480 (2e); WA07-B410D (1+4e); WA07-D410 (3); WA08-F900 (2); TS96-K2 [1451–1455 m] (3e).

Remarks. This species was recently transferred to the genus *Cryptogemma* Dall, 1918 (type species: *Gemmula benthina* Dall, 1908, by monotypy) by Sysoev and Kantor (1986) on the basis of shell and radula morphology. It was originally described from Sagami Bay, but is now known to be distributed widely in the temperate and subarctic regions at bathyal depths.

Cryptogemma sp.
(Figs. 339–340)

Material examined. WA95-B1000 (5); WA06-F1500D-1 (1e); WA06-G900D (2+4e); WA06-H1500D (2); WA07-C1500D (1e); WA07-D900 (ca. 100+ca. 38e); TS96-K2 [1451–1455 m] (10).

Remarks. The specimens listed above closely resemble *C. corneus* in overall conchological features, but differ in their more slender shape, more distinctly constricted suture, weaker axial ribs that are present only on the spiral cord at the shoulder, and by lacking a spiral cord on the periphery between the two major spiral cords at the shoulder and the base. These specimens are here separated from *C. corneus* at species level because no intermediate forms could be found, even at the station (WA06-G900D) where the two occur sympatrically.

Cretaspira? sp.
(Fig. 341)

Material examined. WA05-DE380D (1); WA06-EF425D (1e).

Remarks. This probably undescribed turrid is only provisionally allocated to the genus *Cretaspira* Kuroda and Oyama in Kuroda, Habe and Oyama, 1971 (type species: *Cretaspira cretacea* Kuroda and Oyama in Kuroda, Habe and Oyama, 1971, by original designation), based on the superficial similarity in the shell features, but it likely belongs in a different, possibly new, genus.

Family Conidae Fleming, 1822
Bathytoma engonia (Watson, 1881)
[Japanese name: Yagen-kuda-maki]
(Figs. 342–343)

Pleurotoma (*Genota*) *engonia* Watson, 1881: 405–407; Watson, 1886: 300–301, pl. 20, figs. 7a–c.
Bathytoma engonia — Suter, 1915: 492, pl. 21, fig. 17; Golikov and Sirenko, 1998: 132, fig. 14E [*Bathytoma* (*Riuguhdrillia*) *engonia* in figure legend]; Higo *et al.*, 2001: fig. G3605; Kantor and Sysoev, 2006: 218, pl. 111, fig. L.
Suavodrillia sagamiana Dall, 1925: 27, pl. 21, fig. 2 (type locality: USBF 5088, off Hondo, Sagami Bay).
Riuguhdrillia engonia — Oyama, 1953: 153–154; Kira, 1959, 91, pl. 35, fig. 8; Okutani, 1964: 127, pl. 5, fig. 12; Shikama, 1964: 127, pl. 69, fig. 7; Okutani, 1966: 25, pl. 2, fig. 19; Ishikawa, 1970; 134, pl. 9, fig. 7; Okutani, 1986: 181 with color fig.; Watanabe and Naruke, 1988: 57, pl. 9, fig. 9; Hasegawa *et al.* in Okutani, 2000: 641, pl. 319, fig. Turridae-104.
Suavodrillia engonia — Ozaki, 1958: 161, pl. 16, fig. 7.

Bathytoma (*Riuguhdrillia*) *engonia* — Powell, 1966: pl. 9, fig. 17; Shuto, 1975: 163, pl. 6, figs. 6–7.
Bathytoma sagamiana — Higo *et al.*, 2001: fig. G3605s (holotype; as a synonym of *B. engonia*).
[See Tucker (2004) for additional classical synonymy.]

Type locality. Off Inosima [Enoshima, Sagami Bay], Japan, 35˚11´N, 139˚28´E, 345 fathoms (H.M.S. *Challenger* station 232); NE from New Zealand?, 37˚34´S, 179˚22´E, 700 fathoms (H.M.S. *Challenger* station 169).

Distribution. Sagami Bay and northwards to southern Kurile Islands; 200–1530 m [480–1500 m].

Material examined. WA05-G750 (1e); WA05-G1500D (1); WA05-GH480 (1); WA06-E650 (1); WA06-E750 (1); WA06-E1200D (1); WA06-F750 (5); WA06-F1500D-2 (3); WA06-G900D (1e); WA06-G1200D (1e); WA06-H480 (2+2e); WA06-H550 (1e); WA07-D900 (ca 60+11e); WA08-F900 (6+2e); WA08-G1500 (1).

Remarks. Although Oyama (1951) proposed the new genus *Riuguhdrillia* for the present species (as monotypy), it was regarded by subsequent authors as a subgenus or a junior synonym of *Bathytoma* Harris and Burrows, 1891 (nom. nov. pro *Dolichotoma* Bellardi, 1875 non Hope, 1839; type species: *Murex cataphractus* Brocchi, 1814, by monotypy). The latter opinion is adopted herein.

Bathytoma sp.
(Fig. 344)

?*Makiyamaia* sp. — Hasegawa, 2005: 167, fig. 10F.

Material examined. WA06-F1500D-2 (1).

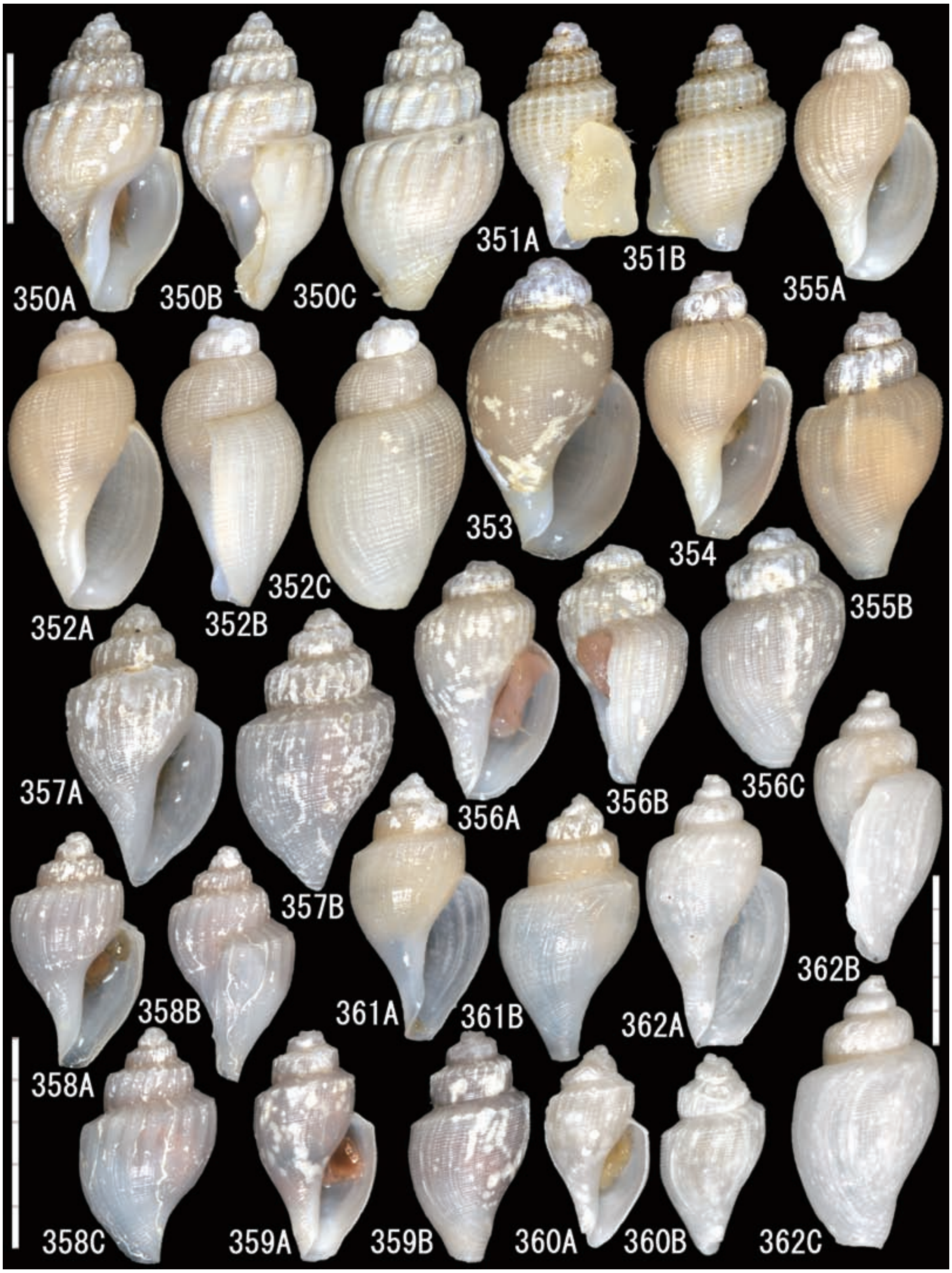
Remarks. In its simple and slender shell, this species superficially resembles *Paraspirotropis simplicissima* (Dall, 1907), which was described from “northeast of Yesso [Hokkaido], Okhotsk Sea, in 1800 fathoms” [USBF station 5050 is actually located off Kinkazan, northeastern Honshu]. However, it differs significantly in having inclined axial ribs that become granulate at the peripheral keel on the spire whorls. In this and other general characters, it approaches a phenotype of *Bathytoma engonia* (Fig. 343), and it is thus provisionally assigned to the same genus. Although this species was represented only by one specimen in the present material, it occurred more frequently among the material obtained by R/Vs *Tansei-maru* and *Hakuho-maru* in the lower bathyal depths (2000–3000 m). The specimen recorded from north off Okinawa Islands (1540–1557 m) as *Makiyamaia* sp. (Hasegawa, 2005) is apparently related to the present one, but has a taller spire and a more narrowly constricted siphonal canal.

Taranis sp. 1
(Figs. 348–349)

Taranis sp. — Ito, 1985: 29, pl. 7, fig. 3; Ito *et al*., 1986: 17, pl. 20, fig. 7.

Material examined. WA07-A450 (9); WA07-A510 (1).

Remarks. This species is assigned to *Taranis* Jeffreys, 1870 (type species: *Trophon mörchi* Malm, 1863, by monotypy) due to the general agreement in conchological characters. It also resembles *Nepotilla bathentoma* (Verco, 1909), the type species of *Nepotilla* Hedley, 1918 (by original designation), based on the illustration of Powell (1966: pl. 20, fig. 10), and more detailed study will be necessary to determine its precise generic position. This species has also been recorded in the Sea of Japan by Ito (1985) and Ito *et al.* (1986) as *Taranis* sp.



Figs. 350–362. Conidae. 350. *Curtitoma incisula*, WA07-A450. 351. *Propebela* sp. 1, WA06-GH480D. 352–356. *Curtitoma bartschi*, 352: TS96-K2 [1451–1455 m]; 353–354: WA06-F1500D; 355: TS96-K2; 356: WA07-A450. 357–358. *Curtitoma becklemishevi*, WA06-H480. 359–360. *Curtitoma hinae*, 359: WA07-D900; 360: TS96-K2. 361. *Curtitoma delicata*, WA06-DE480. 362. *Curtitoma* sp., TS96-K2. Scales: 5 mm (350–355 at the same scale; 356–361 at the same scale).

Taranis sp. 2
(Figs. 345–347)

Taranis sp. — Ito *et al*., 1986: 17, pl. 20, fig. 6.

Material examined. WA07-A450 (6).

Remarks. These specimens were collected together with *Taranis* sp. 1 at the same station, and generally agree with it in overall shell characters. However, they can be distinguished by a shorter shell with more distinct axial ribs and more numerous spiral cords. Because of the absence of intermediate forms, they are regarded as separate species. Ito *et al*. (1986) also recorded this species and distinguished it from the preceding one in the Sea of Japan.

Curtitoma incisula (Verrill, 1882)
[New Japanese name: Maki-mizo-futa-manji]
(Fig. 350)

Bela incisula Verrill, 1882: 461–463, pl. 43, fig. 12, pl. 57, fig. 14.
Lora incisula — Oldroyd, 1927: 108–109.
Curtitoma hecuba Bartsch, 1941: 10, pl. 1, fig. 3 (type locality: Japan Sea).
Nodotoma hecuba — Powell, 1966: pl. 19, fig. 8.
Curtitoma incisula — Bogdanov, 1990: 84, figs. 63–65, 386B–E, 407 (21–23), 408 (1–6), 439; Kantor and Sysoev, 2006: 223, pl. 113, figs. D–E.
[See Bogdanov (1990) and Tucker (2004) for additional synonymy in the North Atlantic.]

Type locality. Off New England coast, 10–500 fathoms [Northwestern Atlantic].

Distribution. Off Shimokita Peninsula in Aomori Prefecture and northwards to Chukchi Sea, norterh part of Sea of Japan, and boreal Atlantic seas; 15–494 m [450 m].

Material examined. WA07-A450 (1).

Remarks. The single available specimen perfectly agrees with those illustrated by Bogdanov (1990) under this name. *Curtitoma incisula* was regarded by Bogdanov (1990) as a senior synonym of *C. hecuba*, which was originally described from the Sea of Japan and designated as the type species of the genus *Curtitoma* Bartsch, 1941. Researchers differ in their recognition of oenopotine genera mostly proposed by Bartsch (1941). Bouchet and Warén (1980) did not accept any genera proposed by Bartsch (1941), and regarded them as junior synonyms of *Oenopota* Mörch, 1852 (type species: *Fusus pleurotomarius* Couthouy, 1838, subsequent designation Dall, 1918), in view of the remarkable variability of arctic species of *Oenopota*, whereas Bogdanov (1990) recognized not only *Curtitoma* but also *Granotoma* Bartsch, 1941 (type species: *Bela krausei* Dall, 1886, by original designation) and *Obesotoma* Bartsch, 1941 (type species: *Obesotoma japonica* Bartsch, 1941, by original designation), as well as *Propebela* Iredale, 1918 (type species: *Murex turricula* Montague, 1803, by original designation), all based on the shell and radula characters. In the present study, Bogdanov's opinion is provisionally adopted, although some species show rather intermediate characters, and cannot be confidently assigned to any genus, without examination of the radula.

Curtitoma bartschi (Bogdanov, 1985)
[New Japanese name: Baachi-futa-manji]
(Fig. 352–356)

Oenopota bartschi Bogdanov, 1985: 452, fig. 1 (c–y).
Curtitoma bartschi — Bogdanov, 1990: 131–132, figs. 113–115, 409, 16–17; Kantor and Sysoev, 2006: 221.

Type locality. Off Urup Island near Kitovyi Cape, 150 m [Middle Kurile Islands].

Distribution. Off Soma in Fukushima Prefecture and northwards to northern and western Okhotsk Sea; 150–345 m [1350–1500 m].

Material examined. WA06-F1500D-1 (5+1e); WA07-A450 (1); TS96-K2 [1451–1455 m] (16+17e).

Remarks. There is a considerable variation in the shell morphology among the specimens examined. Some specimens have a relatively slender shell with fine sculpture (Fig. 353), whereas others have a shorter shell with angulate shoulder and coarser axial sculpture (Fig. 356). However, all agree reasonably well with the type specimens illustrated by Bogdanov (1985), although the figures are not very clear for precise identification. Furthermore, the vertical distribution of the present specimens is significantly deeper than that of the type material. Kantor and Sysoev (2006) mentioned that no material of this taxon, including types, was found in Zoological Institute of the Russian Academy of Science. The present material also somewhat resembles *Oenopota pygmaea* (Verrill, 1882) as figured by Bogdanov (1990), however, and examination of the radula will be necessary for precise identification.

Curtitoma becklemishevi Bogdanov, 1989
[Japanese name: Koshiboso-futa-manji]
(Figs. 357–358)

Nematoma hokkaidoensis — Okutani, 1964: 431, pl. 7, fig. 9; Okutani, 1966: 24, pl. 2, figs. 8, 9; Ito, 1985: 29–30, pl. 7, fig. 5; Ito, 1989: 52, pl. 12, fig. 1 [non *Nematoma hokkaidoensis* Bartsch, 1941, fide Bogdanov and Ito (1992)].
Propebela sp. No. 3 — Ito *et al*., 1986: 18, pl. 23, fig. 1 [fide Bogdanov and Ito (1992)].
Curtitoma becklemishevi Bogdanov, 1989a: 134, fig. 1 (1–2), 2a–б; Bogdanov, 1990: 132, figs. 60–62, 390Д–Е, 407 (14–20); Bogdanov and Ito, 1992: 13, figs. 3a–g, 23; Hasegawa *et al.* in Okutani, 2000: 653, pl. 325, fig. Turridae-169.
Propebele [sic; = *Propebela*] sp. — Tsuchida and Kurozumi, 1995: 181–182, fig. 8 (4).

Type locality. Okhotsk Sea, 51˚10´N, 154˚17´E, 583 m.

Distribution. Off Hitachi in Ibaraki Prefecture on Pacific coast, and off Sado Island in Sea of Japan, both northwards to eastern Okhotsk Sea; 418–538 m [480 m].

Material examined. WA06-H480 (7+10e).

Remarks. The present material differs from the holotype and other specimens from the Okhotsk Sea (e.g. Kantor and Sysoev, 2006: pl. 112, fig. G), as well as those from the Sea of Japan (Bogdanov and Ito, 1992: figs. 3a–g; Hasegawa *et al.* in Okutani, 2000: pl. 325, fig. Turridae-169), in having much finer spiral sculpture, but otherwise agrees in overall shell characters, such as the triangular-shaped body whorl with a tapering siphonal canal, and distinct sculpture consisting of thick axial ribs and fine but distinct spiral cords of regular thickness. However, it also resembles several other possibly related taxa, including *C. hinae* (Okutani, 1966) and *C. delicata* (Okutani, 1964) as mentioned below, and more detailed comparison will be necessary to clarify their taxonomical relationships.

Curtitoma hinae (Okutani, 1968) new combination
[New Japanese name: Hina-futa-manji]
(Figs. 359–360)

Propebela hinae Okutani, 1968: 39–40, text-fig. 6.

Type locality. R/V *Soyo-maru*, St. B2, 34˚22.2´N, 139˚1.9´E, off Miyake Island, 1080–1205 m.

Distribution. Off Ofunato in Iwate Prefecture and southwards to off Soma in Fukushima

Prefecture; off Miyake Islands; 1080–1205 m [450–1455 m].

Material examined. WA06-DE450 (1e); WA07-D900 (14+7e); WA08-F900 (1e); TS96-K2 [1451–1455 m] (2).

Remarks. Propebela hinae has been known only from the type material, which consists of eight specimens including the holotype and four measured paratypes, all from the type locality. Although the holotype of this taxon has never been illustrated, the present material agrees well with its description as well as a line drawing of a paratype (Okutani, 1968: text-fig. 6) in its small size (up to 4 mm in shell height), strongly carinate shoulder, rosy coloration and delicate sculpture that gives a decussate appearance. Reganding the generic position, it is here assigned to *Curtitoma* based on the close similanity to the preceding species.

Curtitoma delicata (Okutani, 1964) new combination
[New Japanese name: Migaki-koshiboso-futa-manji]
(Figs. 361)

Funitoma delicata Okutani, 1964: 432–3, pl. 7, fig. 4; Okutani, 1966: 24.
Oenopota (*Funitoma*) *delicata* — Okutani, 1968: 40.
Not *Propebela delicata* — Kantor and Sysoev, 2006: 233, pl. 118, fig. H [is *Propebela* sp.].

Type locality. R/V *Soyo-maru*, St. T28, 35°03.6´N, 139°22.4´E, Sagami Bay, 1320–1400 m.

Distribution. Sagami Bay and northwards to off Kesen-numa in Iwate Prefecture (present study); 1320–1520 m [480 m].

Material examined. WA06-DE480 (1).

Remarks. This taxon had been known only from Sagami Bay, and was considered to be endemic to that area (Okutani, 1968), until Kantor and Sysoev (2006) recorded it from off Iturup in the Kurile Islands. However, their specimen differs considerably from the figure of the holotype in being stouter in shape with more distinct axial ribs that are apparently opisthocline. On the other hand, the present material agrees well with the holotype in having an elongate shell with a narrow siphonal canal and indistinct axial sculpture, although more material may be necessary to confirm the identification.

Curtitoma lawrenciana (Dall, 1919)
[New Japanese name: Fukure-futa-manji]
(Figs. 363–365)

Bela tenuilirata — Krause, 1885: 274, pl. 18, fig. 8 [non *Bela tenuilirata* Dall, 1871, fide Bogdanov (1990)].
Lora lawrenciana Dall, 1919a: 43, pl. 15, fig. 6 [nom. nov. pro *Bela tenuilirata* sensu Krause, 1885, non Dall, 1871].
Lora nazanensis Dall, 1919a: 45, pl. 15, fig. 8 (type locality: Nazan Bay, Atka Island, Aleutian Islands) [fide Bogdanov (1990)].
Curtitoma lawrenciana — Bogdanov, 1990: 128–130, figs. 109–111, 411 (9–13), 445; Kantor and Sysoev, 2006: 223, pl. 113, fig. L.
[See Bogdanov (1990) for additional synonymy.]

Type locality. Plover Bay.

Distribution. Off Kesen-numa in Iwate Prefecture, and northern part of Sea of Japan, both northwards to southern Kurile Islands; eastern and southern Kamchatka, and Bering and Chukchi Seas; 4–380 m [410–450 m].

Material examined. WA05-DE450 (1); WA07-B410D (2).

Remarks. The material examined agrees reasonably well with the specimens identified by Bogdanov (1990) and Kantor and Sysoev (2006) as *C. lawrenciana* in having a rather globose shell

Figs. 363–374. Conidae. 363–365. *Curtitoma lawrenciana*, 363–364: WA07-B410D; 365: WA05-DE450. 366–368. *Granotoma krausei*, 366: WA05-DE480; 367: WA05-FG425; 368: WA07-A450. 369–372. *Granotoma albrechti*, 369–370: WA05-DE380D; 371: WA06-DE425; 372: WA07-A450. 373–374. *Granotoma* sp., 373: TS96-K2 [1451–1455 m]; 374: WA07-D900. Scales: 5 mm (363–365 at the same scale; 366–374 at the same scale).

with recurved strong axial and fine but distinct spiral cords. There seems to be a considerable variation in adult size within this species; one illustrated by Kantor and Sysoev (2006: pl. 113, fig. L) measures 15.3 mm SL, whereas the smallest specimen examined was of 8.0 mm SL (Fig. 365). This is the first record of this species in Japanese waters.

Curtitoma violacea (Mighels and C. B. Adams, 1842)
[Japanese name: Nunome-futa-manji]
(Figs. 375–379)

Pleurotoma violacea Mighels and Adams, 1842: 50.
Nematoma sp. — Ito, 1985: 29, pl. 7, fig. 4.
Propebela sp. No. 9 — Ito, 1985: 30, pl. 8, fig. 3.
Nematoma sp. No. 3 — Ito *et al*., 1986: 17, pl. 21, fig. 4.
Benthomangelia? sp. — Ito, 1989: 52, pl. 12, fig. 7.
Curtitoma violacea — Bogdanov, 1990: 123–125, figs. 83–96, 387B–E, 388A–E, 408 (7–29), 409 (20–22), 441–442; Bogdanov and Ito, 1992: 12–13, figs. 1a–e, 22; Hasegawa *et al.* in Okutani, 2000: pl. 325, fig. Turridae-168; Kantor and Sysoev, 2006: 225, pl. 113, fig. C.
[See Bogdanov (1990) for additional synonymy.]

Type locality. Casco Bay, Maine [Massachusetts, east coast of North America].

Distribution. Off Kinkazan in Miyagi Prefecture on Pacific coast, Noto Peninsula in Sea of Japan, both northwards to Bering and Chukchi Seas, circumpolar; 0–869 m [250–425 m].

Material examined. WA05-DE250D (1e); WA06-DE280D (16+5e); WA06-DE350 (3+1e); WA06-DE410 (1e); WA06-EF425D (1+1e); WA06-FG350D (1e); WA07-C350D (6+14e); WA07-D310 (3).

Remarks. Curtitoma violacea was originally described from the northwestern Atlantic, and has been shown to be widely distributed in the boreal-arctic northern hemisphere (Bogdanov, 1990). In Japanese waters, it has been recorded from off Nemuro in northeastern Hokkaido (Bogdanov, 1990) and from the Noto Peninsula to Sado Island in the Sea of Japan (Bogdanov and Ito, 1992). Bogdanov (1990) showed a remarkably wide range of intraspecific variation in shell shape and sculpture in this species, and the specimens examined here fall within that range. They represent a range extension for this species southwards to the Pacific coast of northern Japan.

Curtitoma sp.
(Fig. 362)

Material examined. TS96-K2 [1451–1455 m] (3).

Remarks. This species resembles *C. becklemishevi*, but differs in having a thinner and much more inflated shell with a more constricted suture. It also closely resembles the specimen illustrated as *Oenopota kurilensis* Bogdanov, 1989 by Kantor and Sysoev (2006: pl. pl. 117, fig. I), but it does not agree with the type material (Bogdanov, 1989b: figs. 1 (3–4)) or other specimens illustrated by Bogdanov (1990: figs. 179–183).

Granotoma albrechti (Krause, 1885)
[Japanese name: Kubire-futa-manji]
(Figs. 369–372)

Bela albrechti Krause, 1885: 276, pl. 18, figs. 3, 11.
Lora albrechti — Oldroyd, 1927: 106, pl. 11, fig. 5.
Oenopota (Funitoma) albrechti — Powell, 1966: 16, fig. F153.
Oenopota albrechti — Sysoev, 1983: 1626, figs. 1м, 3 ж (radula only); Bogdanov, 1986: 38, fig. 5 (4) (protoconch).

Nematoma dissoluta — Ito, 1985: 30, pl. 7, fig. 6 [non *Bela dissoluta* Yokoyama, 1926].
Nematoma sp. No. 2 — Ito *et al.*, 1986: 17, pl. 21, fig. 3.
Granotoma albrechti — Bogdanov, 1990: 135–137, figs. 39, 122–127, 391А–Е, 392Д–Е, 393А–Б, 412 (1–22), 446 (1); Bogdanov and Ito, 1992: 15, figs. 6a–d, 24a–b; Hasegawa *et al.* in Okutani, 2000: 653, pl. 325, fig. Turridae-172.
[See Bogdanov (1990) and Tucker (2004) for detailed synonymy.]

Type locality. Plover Bay [Bering Sea].

Distribution. Off Soma Fukushima Prefecture (present study), off Noto Peninsula in Sea of Japan, and both northwards to Chukchi Sea; 3–900 m [425–480 m].

Material examined. WA9203-B18 [451–455 m] (1e); WA05-DE380D (4+1e); WA06-DE425 (1); WA07-A450 (ca. 50+10e); WA07-B410D (1); WA07-D350 (1).

Remarks. The present records represent a range extension for this species southwards to northern Honshu in the Pacific. Although this species is known to be variable in sculpture (Bogdanov, 1990), specimens examined in the present study were rather uniform in conchological characters.

Granotoma krausei (Dall, 1887)
[New Japanese name: Kurausu-futa-manji]
(Figs. 366–368)

Bela krausei Dall, 1887: 301, pl. 4, fig. 4; Dall, 1919a: 46, pl. 15 fig. 3.
Lora krausei — Oldroyd, 1927: 107, pl. 7, fig. 7.
Granotoma krausei — Bartsch, 1941: 5, pl. 1, fig. 9; Bogdanov, 1990: 134–135, figs. 128–135, 393В–Е, 413 (1–16), 446 (2).
Oenopota (Fusitoma) krausei — Powell, 1966: 121, pl. 19, fig. 11.
[See Bogdanov (1990) and Tucker (2004) for detailed synonymy.]

Type locality. Port Etches, Alaska.

Distribution. Off Kesen-numa in Iwate Prefecture (present study), and northern Sea of Japan, both northwards to southern Okhotsk Sea and eastern Kamchatka; 115–925 m [350–450 m].

Material examined. WA05-DE480 (1); WA05-FG425 (1); WA06-DE425 (2e); WA07-A450 (14+3e).

Remarks. The specimens listed above generally resemble *G. albrechti*, but differs significantly in possessing flattened axial ribs of sigmoid shape separated by narrow spiral grooves, in contrast to narrow axial ribs of triangular cross-section in *G. albrechti*. They agree well with a specimen illustrated by Bogdanov (1990: fig. 135) and also Kantor and Sysoev (2006: pl. 114, fig. C) as *G. krausei*. The present records represent a range extension of this species southwards to northeastern Honshu, and are the first from Japanese waters.

Granotoma sp.
(Figs. 373–374)

Material examined. WA07-D900 (6); TS96-K2 [1451–1455 m] (2+1e).

Remarks. This species most closely resembles *G. albrechti* in general shell characters, but differs significantly in possessing an angulate shoulder and more sigmoid axial sculpture.

Oenopota sp. cf. ***pygmaea*** (Verrill, 1882)
(Fig. 380)

?*Bela pygmaea* Verrill, 1882: 460, pl. 57, fig. 8 (type locality: off Martha’s Vineyard, 312–487 fathoms).
Oenopota pygmaea — Kantor and Sysoev, 2006: pl. 118, fig. E [?non *Bela pygmaea* Verrill, 1882].

Material examined. WA05-DE380D (2e); WA07-A1500D (1); WA07-C350D (1); WA07-

Figs. 375–388. Conidae. 375–379. *Curtitoma violacea*, 375: WA06-EF425D; 376: WA06-DE280D; 377: WA07-D310; 378–379: WA06-DE350. 380. *Oenopota* sp. cf. *pygmaea*, WA07-C350D. 381–385. *Oenopota candida*, 381–383: WA07-D900; 384: WA05-DE380; 385: WA06-G900D. 386–388. *Obesotoma oyashio*, 386: WA07-D350; 387–388: WA06-EF425D. Scales: 375–380 = 5 mm (at the same scale); 381–385, 388 = 5 mm (at the same scale); 386–387 = 10 mm (at the same scale).

D210D (1).

Remarks. The present material agrees reasonably well with the specimen illustrated as *O. pygmaea* by Kantor and Sysoev (2006), which is the voucher material for the records of Golikov *et al.* (2001) in the northwestern Pacific. However, specimens from the northeastern Pacific differ considerably from the figure of Verrill's type (reproduced by Abbott, 1974: text-fig. 3321), in their rather ovate shell shape, an indistinct suture and significantly finer spiral and axial sculpture. Fruthermore, *Bela pygmaea* has been regarded as a junior synonym of *Pleurotoma ovalis* Friele, 1877 by European authors (e.g. Bouchet and Warén, 1980: 68).

Oenopota candida (Yokoyama, 1926)
(Figs. 381–385)

Bela candida Yokoyama, 1926: 261, pl. 34, fig. 1.
Propebela (*Turritoma*) *candida* — Makiyama, 1958: pl. 46, fig. 1–2 (part).
Nematoma microvoluta Okutani, 1964: 431–432, pl. 6, fig. 10 (type locality: Sagami Bay, 35˚05. 5´N, 139˚29.3´E, 710–770 m); Okutani, 1966: 24, pl. 2, fig. 10–11; Baba, 1990: 201, pl. 18, fig. 11a–b. New synonym.
Obesotoma sp. — Ito, 1967: 57, pl. 5, fig. 6.
Turritoma candida — Ito, 1985: 30, pl. 8, fig. 6.
Propebela sp. No. 1 — Ito, 1989: 51, pl. 11, fig. 8.
Oenopota candida — Bogdanov and Ito, 1992: 17, figs. 9a–d; Hasegawa *et al.* in Okutani, 2000: 655, pl. 326, fig. Turridae-173.
Not *Turritoma candida* — Habe and Ito, 1965a: 80, pl. 30, fig. 8 [is *Turritoma exquisita* Bartsch, 1941].
[See Tucker (2004) for additional synonymy especially in paleontological papers.]

Type Locality. Sawane Formation [Sado Island, Niigata Prefecture; Pliocene].

Distribution. Sagami Bay and northwards to off Kuji in Iwate Prefecture, on Pacific coast (present study); Hyogo Prefecture and northwards to Sado Island in Sea of Japan; [350–1000 m].

Material examined. WA95-B1000 (1+1e); WA05-EF450D (1e); WA05-FG425 (1); WA05-DE380D (1); WA06-DE425 (1e); WA06-DE480 (1e); WA06-E510D (1e); WA06-EF425D (1e); WA06-FG350D (1e); WA06-FG425 (1e); WA06-G900D (1+1e); WA07- D900D (24+1e).

Remarks. The specimens examined show a wide range of variation, in shape, angulation at the shoulder and sculpture, as illustrated in the figures. However, they intergrade and can reasonably be assigned to a single species. Specimens with an angulate shoulder (Figs. 384–385) agree well with those recorded by some previous authors (see synonymy) from the Sea of Japan as *O. candida*, in general shell shape and in their sculpture, which consists of obliquely sigmoid axial ribs and minute, crowded spiral cords. *Bela candida* Yokoyama, 1926 was originally described from the Pliocene Sawane Formation, and has subsequently been recorded in the Recent fauna, but there is a discrepancy in its identification. Habe and Ito (1965a: 80, pl. 30, fig. 8) identified a specimen with a strongly angulate shoulder and thick axial ribs as "*Turritoma candida*", and regarded *Turritoma exquisita* Bartsch, 1941 as a junior synonym. However, Bogdanov and Ito (1992) identified a different species with well-inflated whorls and weaker axial ribs as this taxon. The discrepancy originates in the fact that Yokoyama (1926: pl. 34, figs. 1–2) illustrated two different-looking specimens under this name. Habe and Ito (1965a) apparently identified their material as the specimen illustrated in figure 2, although Yokoyama actually proposed with some hesitation a name "var. *angulata*" to that specimen, which is thus excluded from the type series according to ICZN Art. 72.4.1. The specimen illustrated in figure 1 of Yokoyama's paper, which can be regarded as the holotype of *Bela candida* by monotypy, generally agrees with those illustrated by Bogdanov and Ito (1992) as well as those examined in the present study (Fig. 385).

On the other hand, specimens with a sloping shoulder (Figs. 381–383) agree well both in shape and sculpture with the figure of the holotype of *Nematoma microvoluta* Okutani, 1964, which was originally described from Sagami Bay, and the taxon is regarded here as a junior synonym of *O. candida*. *Oenopota kurilensis* Bogdanov, 1989, which was described from Okhotsk Sea at a depth of 11 m, also resembles the present species, but seems to differ in having a shorter siphonal canal and more distinct spiral cords. However, more detailed study is necessary to clarify the relationship.

Obesotoma oyashio Shikama, 1962
[Japanese name: Usubeni-futa-manji (= Usubeni-harabuto-kudamaki)]
(Figs. 386–388)

Obesotoma oyashio Shikama, 1962: 51, pl. 2, figs. 15a–b; Shikama, 1964: 126, pl. 69, fig. 2; Baba, 1990: 202, pl. 18, fig. 12a–b; Hasegawa *et al*. in Okutani, 2000: 655, pl. 326, fig. Turridae-177; Higo *et al*., 2001: fig. G3656 (holotype).
Obestoma [sic] *oyashio* — Watanabe and Naruke, 1988: 57, pl. 9, fig. 10.

Type locality. East of Choshi, [Chiba Prefecture, Honshu], 200–350 fathoms.

Distribution. Off Choshi, in sea area Kashima-nada, and northwards to off Miyako in Iwate Prefecture (present study); 400–700 m [350–1500 m].

Material examined. WA05-DE380D (1); WA05-EF425 (1); WA05-FG425 (1); WA06-C350D (1); WA06-EF425D (3+2e); WA06-FG350D (1); WA07-C1500D (1); WA07-D350 (2).

Remarks. The present material is rather provisionally identified as *O. oyashio*, from the general similarity in shell characters, but differs slightly in having more inclined axial ribs. Classification of the Japanese species of the genus *Obesotoma* Bartsch, 1941 is in a state of confusion, and a comprehensive review is necessary.

Propebela exquisita Bartsch, 1941
[Japanese name: Koshi-futa-manji]
(Figs. 389–390)

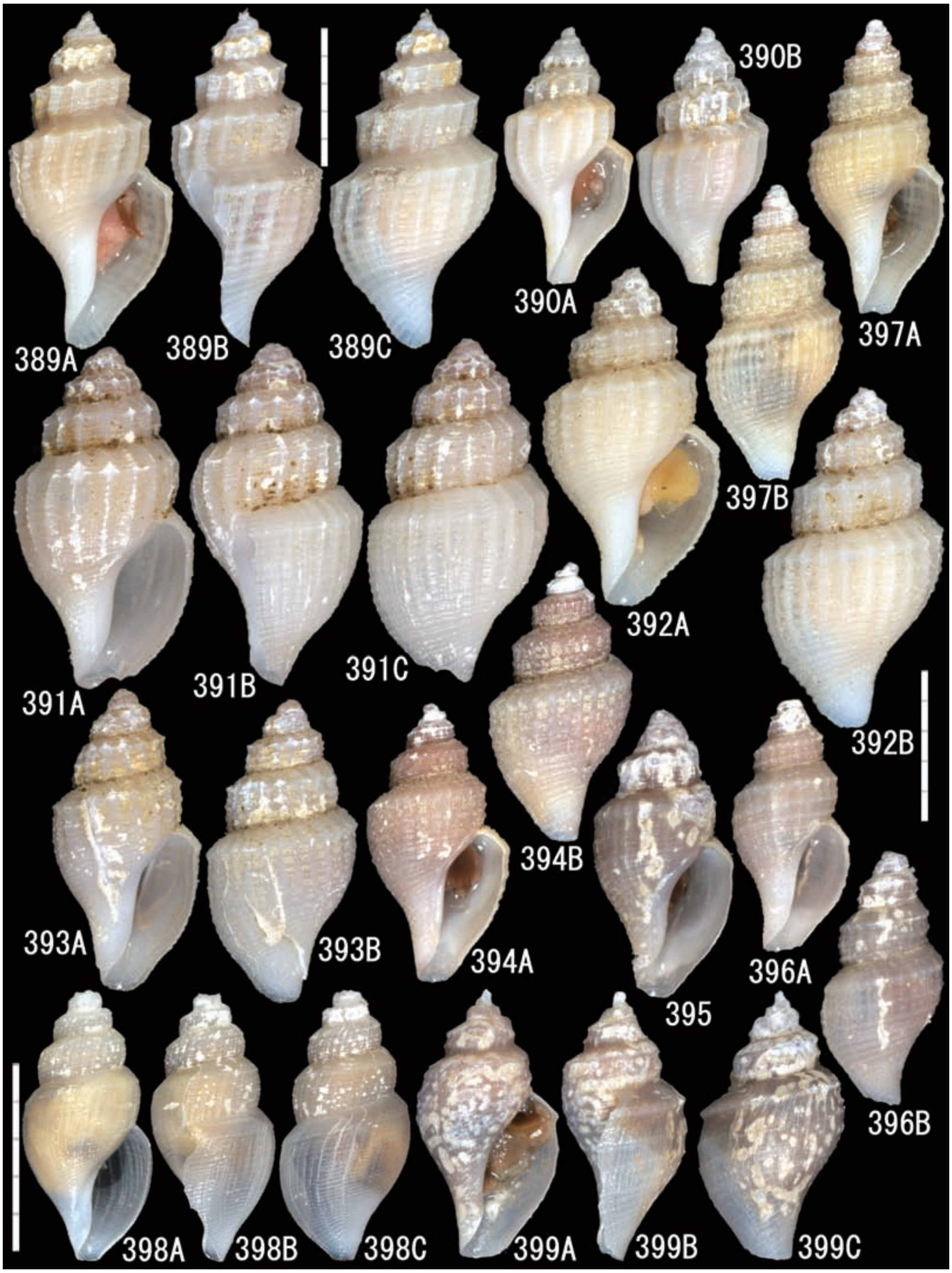
Propebela (*Turritoma*) *exquisita* Bartsch, 1941: 12, pl. 1, fig. 4.
Propebela (*Turritoma*) *venusta* Okutani, 1964: 429, pl. 7, fig. 8 (type locality: sea area Enshu-Nada, 34˚25.7´N, 137˚58.5´E, 620 m). New synonym.
Turritoma candida — Habe and Ito, 1965a: 80, pl. 30, fig. 8; Ito *et al*., 1986: 18, pl. 21, figs. 5 (1–2). [non *Bela candida* Yokoyama, 1926].
Propebela exquisita — Powell, 1966: pl. 19, fig. 2 (holotype).
?*Propebela* (*Propebela*) *exquisita* — Bogdanov and Ito, 1992: 22, fig. 18.
Oenopota exquisita — Higo *et al*., 2001: fig. G3667s (holotype).
Not *Propebela* (*Propebela*) *exquisita* — Hasegawa *et al*. in Okutani, 2000: 657, pl. 327, fig. Buccinidae-185 [is *Propebela* sp.].

Type locality. USBF station 3738, off Yokohama, Japan, 167 fathoms, on mud bottom.

Distribution. Sagami Bay and northwards to off Shimokita Peninsula in Aomori Prefecture, and possibly in northern Sea of Japan; 300 m [410–650 m].

Material examined. WA06-H480 (1); WA07-A650 (2+1e); WA07-B410D (1); WA07-D350 (1e).

Remarks. The specimens listed above agree perfectly not only with the holotype of *P. exquisita* but also with the figured paratype of *P. venusta*, which was originally described from the sea area Enshu-nada off central Honshu, at a depth of 620 m. The latter is thus here regarded as a junior synonym of the present taxon. Although *P. exquisita* was erroneously regarded as a junior synonym of “*Turritoma candida* (Yokoyama, 1926)” by Habe and Ito (1965a) and subsequent authors (e.g. Higo *et al*., 1999), it is apparently a distinct taxon as discussed in the remarks under *Oenopota candida* here. On the other hand, *P. exquisita* may fall into a range of the highly variable



Figs. 389–399. Conidae. 389–390. *Propebela exquisita*, 389: WA07-A650; 390: WA07-B410D. 391–397. *Propebela* sp. cf. *tersa*, 391: WA06-GH380; 392: WA05-DE380D; 393: WA06-H480; 394–396: WA07-D900; 397: WA06-F1500D. 398. *Propebela*? sp. 6, WA06-G900. 399. *Propebela*? sp. 7, WA95-B1000. Scales: 5 mm (390–397 at the same scale; 398–399 at the same scale).

Figs. 400–412. Conidae. 400–401. *Propebela* sp. 2, 400: WA05-DE250D; 401: WA05-EF450D. 402–403. *Propebela* sp. cf. *terpeniensis*, 402: WA07-A250D; 403: WA05-GH425. 404–405. *Propebela* sp. 3, 404: WA05-DE380; 405: WA06-DE380. 406–409. *Propebela* sp. 4, 406: WA07-C900; 407–409: WA07-D900. 410–412. *Propebela* sp. 5, WA07-D900. Scales: 5 mm (400–405 at the same scale; 406–412 at the same scale).

species *P. nobilis* (Møller, 1842), which is known to be distributed widely in boreal-arctic seas, including the Japanese coast of the Sea of Japan (Bogdanov and Ito, 1992). A comprehensive review will be necessary to clarify the taxonomy of this complex species-group.

Propebela sp. cf. ***tersa*** (Bartsch, 1941)
(Figs. 391–397)

?*Canetoma tersa* Bartsch, 1941: 11–12, pl. 1, fig. 6 (type locality: Japan Sea).
Propebela tersa — Kantor and Sysoev, 2006: 236, pl. 117, fig. F.

Material examined. WA95-B1000 (2+1e); WA05-DE380D (1); WA05-EF450D (4+4e); WA05-FG410 (1e); WA05-FG425 (1e); WA05-FG510D (2e); WA05-GH380 (1e); WA05-GH380D (2e); WA05-H900 (1e); WA06-DE280D (1e); WA06-DE310 (1e); WA06-EF425D (1e); WA06-F650D (1e); WA06-F1500D-1 (1); WA06-F1500D-2 (1); WA06-FG350D (4e); WA06-FG480 (1e); WA06-G900D (1); WA06-GH380 (1); WA06-GH425 (1e); WA06-GH480 (1); WA06-GH480D (1e); WA06-H480 (8+1e); WA06-H550 (1); WA07-A450 (1+1e); WA07-C350D (2); WA07-D900 (ca. 100+23e); TS96-K2 [1451–1455 m] (3e).

Remarks. Several rather heterogeneous forms are here provisionally regarded as phenotypes of a single species, because of the occurrence of possible intermediate specimens, but further detailed study may reveal the presence of more than one species within the "species" treated here. The shell may be stout or slender in shape, yellowish white to pale reddish brown in color, with fine to relatively thick spiral sculpture as shown in Figs. 391–397. There is a tendency for relative width of the shell to the height to decrease, and for the strength and thickness of the spiral cords to increase with depth. Although axial ribs are usually stronger than spiral cords in specimens from shallower stations (380–480 m), both spirals and axials are nearly equal in strength at around 900 m, and axials are apparently weaker than spirals, which become rather irregular, at depths around 1500 m. This "species" most closely resembles the specimen illustrated as *P. tersa* by Kantor and Sysoev (2006), to which it is provisionally assigned.

Propebela sp. cf. ***terpeniensis*** Bogdanov, 1989
(Figs. 402–403)

?*Propebela terpeniensis* Bogdanov, 1989b: 151–152, figs. 1 (10), 2 (х–щ) (type locality: Topina Cape, South Sakhalin, 46°47′N, 143°52′E, 187 m).

Material examined. WA05-GH380 (1e); WA05-GH380D (1e); WA05-GH425 (2); WA07-A250D (1).

Remarks. This species most closely resembles *P. terpeniensis* in possessing an elongate shell bearing irregular thick axial ribs and spiral cords, with fine secondary spiral cords.

Propebela sp. 1
(Fig. 351)

Material examined. WA06-GH480D (2).

Remarks. These specimens closely resembles *P.* sp. cf. *tersa*, but are distinguished by the smaller shell with significantly finer axial ribs. They also resemble *Curtitoma novajasemljensis* (Leche, 1878), which is distributed in the Arctic Ocean (Bogdanov, 1990), in general shell shape and size, but differ in having significantly stronger axial and spiral sculpture, and a strong carina at the shoulder.

Propebela sp. 2
(Figs. 400–401)

Material examined. WA05-DE250D (1); WA05-DE480 (1e); WA05-EF450D (3); WA06-EF350 (1e); WA06-EF380 (2e).

Remarks. The material examined most closely resembles *Propebela golikovi* Bogdanov, 1985 in general shell characters, such as the spindle-shaped shell and characteristic strong lattice-like sculpture with fine secondary spiral cords in the interspaces, but differs considerably in being much more slender in shape and by having stronger spiral cords especially on the spire whorls. Furthermore *P. golikovi* is known to be distributed in the northern Sea of Japan in shallow water (15–46 m; Bogdanov, 1990), in contrast to the bathyal habitat of the present form.

Propebela sp. 3
(Figs. 404–405)

Material examined. WA05-DE380D (1); WA05- GH380D (3e); WA06-DE380 (1); WA06-EF425 (1e).

Remarks. The material examined most closely resembles the holotype of *Oenopota uschakovi* Bogdanov, 1985 in overall shell characters, but significantly differs in having thick but indistinct spiral cords.

Propebela sp. 4
(Figs. 406–409)

Material examined. WA07-C900 (1); WA07-D900 (7+6e).

Remarks. The present material is probably conspecific with the specimen illustrated as "*Propebela delicata* (Okutani, 1964)" by Kantor and Sysoev (2006), although the latter differs significantly from Okutani's (1964) original figure as discussed in the remarks under *Curtitoma delicata* here. No other comparable taxon was found.

Propebela sp. 5
(Figs. 410–412)

Material examined. WA95-B1000 (2); WA06-H480 (1e); WA07-D900 (11+3e); TS96-K2 [1451–1455 m] (1e).

Remarks. This closely resembles the preceding species in general shell features, but can be consistently separated by the presence of distinct axial ribs and spine-like projection from the axial ribs at the shoulder. Specific distinction is also supported by the co-occurrence of both forms at the same station (WA07-D900), where no intermediate forms were found.

Propebela? sp. 6
(Fig. 398)

Material examined. WA06-G900D (1).

Remarks. This and the following species are represented only by single or a few imperfect specimens, and cannot be assigned to appropriate genera. They are only provisionally assigned to *Propebela*.

Figs. 413–426. Pyramidellidae and Cephalaspidea. 413. *Liostomia* sp. cf. *eburnea*, WA07-D1500D. 414. *Derjuginella rufofasciata*, WA07-D200D. 415. *Odostomia* sp. 1, WA06-GH480. 416. *Odostomia* sp. 2, WA95-07-5. 417–418. *Cylichna alba*, 417: WA05-DE380D; 418: WA06-F1500D. 419. *Microglyphis japonica*, WA06-H1500. 420–421. *Diaphana tibai*, 420: WA07-C350D; 421: WA07-D310. 422. *Rhizorus* sp., WA07-A450. 423–426. *Eoscaphander fragilis*, 423: WA06-H510; 424: WA06-E750; 425: WA06-DE350; 426: WA06-FG480 (empty shell). Scales: 413 = 2 mm; 414 = 5 mm; 415–416, 422 = 1 mm; 419–421 = 5 mm; 417–418 = 5 mm; 423–425 = 10 mm; 426 = 10 mm (at the same scale, respectively).

Propebela? sp. 7
(Fig. 399)

Material examined. WA95-B1000 (1).

Propebela? sp. 8
(Fig. 187)

Material examined. WA06-F1500D-1 (1+1e); WA06-F1500D-2 (1e).

Family Pyramidellidae Gray, 1840
Derjuginella rufofasciata (E. A. Smith, 1875)
[Japanese name: Kinsuji-kuchi-kire]
(Fig. 414)

Stylopsis rufo-fasciatus Smith, 1875: 103.
Turbonilla (Pyrgolampros) vladivostokensis Bartsch, 1929: 135, pl. 4, fig. 2 (type locality: Vladivostok).
Turbonilla (Pyrogolampros) petri Bartsch, 1929: 135–136, pl. 4, fig. 3 (type locality: Vladivostok).
Turbonilla (Pyrogolampros) acosta Bartsch, 1929: 136, pl. 4, fig. 5 (type locality: Vladivostok).
Syrnola (Syrnola) hanagaiensis Nomura, 1938: 21, pl. 4, fig. 36a–b (type locality: Hanagai, Iwate Prefecture).
Derjuginella rufofasciata — Habe, 1958c: 34–35, pl. 1, fig. 19; Habe, 1961a: 85, pl. 41, fig. 32; Habe and Ito, 1965a: 86, pl. 31, fig. 12; Tsuchida, 1998: 87, pl. 3, figs. 6, 7; Hori in Okutani, 2000: 709, pl. 353, fig. Pyramidellidae-44.
Derjujinella [sic] *hanagaiana* [sic] — Ito, 1985: 31, pl. 9, fig. 7; Ito *et al*., 1986: 21, pl. 28, fig. 7.
Turbonilla (*Derjuginella*) *rufofasciata* — Tsuchida and Hori, 1992: 8, pl. 1, fig. 5, pl. 3, fig. 4.
Pyrgolampros rufofasciata — Kantor and Sysoev, 2006: 245, pl. 122, fig. M.

Type locality. East of Yesso [Hokkaido], 42˚52´N, 144˚40´E, 48 fathoms.

Distribution. Off Kesen-numa in Iwate Prefecture on Pacific coast, Wakasa Bay in Sea of Japan, both northwards to southern Kurile Islands and southern Sakhalin; 40–205 m [200 m].

Material examined. WA07-D210D (2).

Remarks. This is a shallow water species, found from the sublittoral zone to the upper part of the continental shelf. It is highly variable in shape and sculpture, and many synonyms have been proposed. Specimens collected from the continental shelf are generally smaller in size and have weaker axial sculpture, as represented by the present material.

Liostomia sp. cf. **eburnea** (Stimpson, 1851)
(Fig. 413)

?*Rissoa eburnea* Stimpson, 1851: 14 (type locality: off Cape Ann, Massachusettes Bay, 54 m).
?*Liostomia eburnea* — Warén, 1991: 108–110, fig. 27B–C (neotype).

Material examined. WA07-D1500D (1).

Remarks. Although the present material was indistinguishable from the neotype and another specimen of *L. eburnea* illustrated by Warén (1991) in the profile of the shell, its identification cannot be confirmed because the outer surface of the shell was heavily eroded. This taxon was originally described from northwestern Atlantic, but it has subsequently been recorded from Arctic seas, from the Barents to Chukchi Seas, and the northern Bering Sea.

Odostomia sp. 1
(Fig. 415)

Material examined. WA06-GH480 (1d).

Remarks. This and the next species can be assigned to the genus *Odostomia* Fleming, 1817 (type species: *Turbo plicata* Montagu, 1803, subsequently designated by Gray, 1847) by their completely smooth shell and the absence of palatal ridges on the inner side of the outer lip, but cannot be identified as any known species.

Odostomia sp. 2
(Fig. 416)

Material examined. WA95-OT5 [706 m] (1: from the gut of the flatfish *Clidoderma asperrimum*); WA07-D900 (1).

Family Ringiculidae Philippi, 1853
Microglyphis japonica (Habe, 1952)
[Japanese name: Warabe-mame-urashima]
(Fig. 419)

Hyporingicula japonica Habe, 1952: 73, 76, fig. 5; Habe, 1953: 214, pl. 30, fig. 7; Okutani, 1964: 438; Okutani, 1968: 44.
Microglyphis noguchii Kuroda, 1961b: 139–140, fig. 1 (type locality: [sea area of] Enshu-nada); Higo *et al*., 2001: fig. G4754s (holotype) [as a junior synonym of *Microglyphis japonicus*].
Microglyphis japonicus — Kuroda, 1961b: 140, figs. 3, 4; Kuroda and Habe in Kuroda *et al*., 1971: 459–460 (Japanese part), 287 (English part), pl. 114, fig. 21; Hori in Okutani, 2000: 739, pl. 368, fig. Ringiculidae-11; Kantor and Sysoev, 2006: 249, pl. 124, fig. C.
Not *Hyporingicula japonica* — Ito, 1985: 31, pl. 10, fig. 3 [is an immature specimen of *Ringiculina* sp.]

Type locality. Tosa Bay, Shikoku.

Distribution. Off southwestern Kyushu and northwards to northern Kurile Islands, Tatar Strait and western coast of Sakhalin; and in Sea of Japan; 100–1220 m [450–1500 m].

Material examined. WA05-EF450D (1e); WA05-FG510D (1e); WA06-H480 (1e); WA06-H1500 (1); WA07-A450 (1e); WA07-A650 (1e); WA07-D900 (2+3e).

Remarks. The shell shape of this species varies from narrowly ovate (holotype) to relatively globose (Fig. 419), but the species can clearly be characterized by its indistinct suture. Kuroda *et al*. (1971) and subsequent authors (e.g. Kantor and Sysoev, 2006) regarded *M. noguchii* as a junior synonym of *M. japonicus*, and this point of view is here supported. On the other hand, *M. furukawai* Kuroda, 1961 (type locality: "Hokkaido", from a fish stomach) can clearly be distinguished from the present species by having a significantly more globose shell with a deeply canaliculate suture. Petit (1974) demonstrated by examining its syntypes that *Admete globularis* E. A. Smith, 1875, which was originally described from off northeastern Hokkaido at a depth of 48 fathoms, is a species of the genus *Microglyphis*, and identified it as *M. furukawai*. However, no further specimens identifiable as *M. globularis* (= *M. furukawai*) have been recovered from this area.

Habe (1952) proposed the monotypic genus *Hyporingicula* to accommodate the present species, but Kuroda (1961b) and most subsequent authors treated it as a junior synonym of *Microglyphis* Dall, 1902 (type species: *Actaeon curtulus* Dall, 1889, by original designation).

Family Diaphanidae Odhner, 1914

Diaphana tibai Habe, 1976

[Japanese name: Migaki-awatsubu-gai]

(Figs. 420–421)

Diaphana tibai Habe, 1976: 152, pl. 1, fig. 11; Hori in Okutani, 2000: 741, pl. 368, fig. Diaphanidae-1 (holotype); Higo *et al*., 2001: fig. G4892 (holotype).

Type locality. Off Kuji, Iwate Prefecture, Honshu, at about 200 m deep.

Distribution. Known only from off Iwate Prefecture, northeastern Honshu; 200 m [310–350 m].

Material examined. WA07-C350D (3+2e); WA07-D310 (1e).

Remarks. This species exhibits very narrow geographical distribution, being known only from off Iwate Prefecture, and it is possibly endemic to the Pacific coast of northern Honshu. On the other hand, it closely resembles *Diaphana glacialis* Odhner, 1907, which is distributed in Arctic seas and also in the northern Kurile Islands and Peter the Great Bay in the northern Sea of Japan (Chaban, 1996), and the relationship between these two taxa will be the subject of a future study.

Family Cylichnidae H. Adams and A. Adams, 1854

Eoscaphander fragilis Habe, 1952

[Japanese name: O-suifu-gai]

(Figs. 423–426)

Eoscaphander fragilis Habe, 1952: 75–77, text-figs. 7–8; Habe, 1954: 307, pl. 38, fig. 28; Habe, 1961a: 91, pl. 43, fig. 21; Okutani, 1964: 439; Habe and Ito, 1965a: 85, pl. 31, fig. 7; Okutani, 1966: 27; Hori in Okutani, 2000: 741, pl. 369, fig. Cylichnidae-1; Hasegawa, 2001: 153; Higo *et al*., 2001: fig. G4839 (possible type material); Chaban and Martynov in Kantor and Sysoev, 2006: 254–255, pl. 126, fig. J.

Type locality. R/V*Soyo-maru*, St. 15, Kashima-nada, Ibaraki Prefecture, 216 m [35˚59´00˝N, 140˚59´25˝E].

Distribution. Off southern Kurile Islands and southwards to Tosa Bay; 216–1056 m [210–750 m].

Material examined. WA05-DE280 (1); WA05-DE350 (2+1e); WA05-DE380 (1); WA05-DE425 (1); WA05-DE450 (4); WA05-DE480 (3); WA05-DE510 (2); WA05-E650 (1); WA05-E750 (1); WA05-F350 (1); WA05-F480 (1); WA05-F750 (3); WA05-FG310 (1); WA05-FG380 (1); WA05-FG425 (1); WA05-FG450 (3); WA05-FG480 (3); WA05-G350 (1); WA05-G425 (3); WA05-G510 (2); WA05-G650 (1e); WA05-GH380 (1); WA05-GH410 (1); WA05-GH480 (1); WA05-G510D (1); WA05-H310 (1); WA05-H380 (2); WA05-H650 (5); WA06-A410 (1); WA06-C350D (1); WA06-C450 (1); WA06-C550 (1); WA06-D210D (1); WA06-D550 (6); WA06-DE280D (1); WA06-DE280 (2); WA06-DE350 (8); WA06-DE380 (2); WA06-DE480 (1); WA06-E310 (2); WA06-E350 (2); WA06-E380 (2); WA06-E650 (3); WA06-E750 (9); WA06-EF310 (1); WA06-F280 (4); WA06-F310 (5); WA06-F480 (1); WA06-F510 (2); WA06-F550 (1); WA06-F750 (5); WA06-FG310 (1); WA06-FG350 (1); WA06-FG350D (1e); WA06-FG410 (1); WA06-FG480 (2+3e); WA06-G380 (2); WA06-G425 (1); WA06-G450 (1); WA06-G480 (2); WA06-G650 (1); WA06-H310 (1); WA06-H350 (1); WA06-H480 (1); WA06-H510 (2); WA06-H550 (2+1d+1e); WA06-H650 (3); WA07-A310 (20); WA07-A350 (4); WA07-A410 (3); WA07-A450 (2e); WA07-B310 (4); WA07-B410 (15); WA07-C250 (2); WA07-C350 (1); WA07-C350D (1e); WA07－C410 (1); WA07-C450 (2); WA07-C510 (1); WA07-C550 (2); WA07-C750 (1); WA07-D210D (1+5e); WA07-D250 (ca. 30); WA07-D310 (1); WA07-D350 (1); WA07-D410 (3); WA07-D450 (1); WA07-D650 (1); WA07-D750 (3).

Remarks. Although the recorded distribution of this species had been restricted to the Pacific coast of central to northern Honshu, from off southern Hokkaido southwards to Suruga Bay (e.g. Hori in Okutani, 2000), it was recently extended northwards to the southern Kurile Islands by Chaban (2000) and southwards to Tosa Bay off Kochi Prefecture by Hasegawa (2001), revealing a rather wide geographical distribution. This is the type species of the monotypic genus *Eoscaphander* Habe, 1952, which was proposed based on the difference in radular characters from the northern Atlantic "*Tricla* Oken, 1815 [non Retzius, 1788]".

Cylichna alba (Brown, 1827)
[Japanese name: Itoko-kaikogai-damashi]
(Figs. 417–418)

Volvaria alba Brown, 1827: 3, pl. 19, figs. 43, 44.
Cylichna alba corticata Beck in Møller, 1842: 79 (type locality: [West] Greenland).
Cylichna consobrina Gould, 1859: 141 (type locality: west coast of Jesso [Hokkaido]); Habe, 1954: 311, pl. 38, fig. 29; Okutani, 1964: 440; Habe and Ito, 1965a: 84–85, pl. 31, fig. 3; Ito *et al*., 1986: 24, pl. 31, fig. 6; Ito, 1989: 55, pl. 16, fig. 7; Tsuchida and Hayashi, 1994: 100, pl. 5, fig. 10; Hori in Okutani, 2000: 745, pl. 370, fig. Cylichnidae-25;
Haminoea grisea Smith, 1875: 114 (type locality: [off northeastern Hokkaido], 42˚52´N, 144˚40´E, in 48 fathoms).
Cylichna alba — Kotaka, 1962: 143–144, pl. 34, figs. 1–3.
Cylichna grisea — Higo *et al*., 2001: fig. G4852 (syntype).
Cylichna alba — Chaban and Martynov in Kantor and Sysoev, 2006: 253–254, pl. 126, figs. B–E.
[See Lemche (1948) for additional synonymy in the northern Atlantic and Atlantic seas.]

Type locality. Greenock, Scotland.

Distribution. Sagami Bay on Pacific coast, off Hino-Misaki in Shimane Prefecture in Sea of Japan (Tsuchida and Hayashi, 1994), both northwards, circumpolar; 0–2222 m (Chaban and Martynov in Kantor and Sysoev, 2006) [150–1500 m].

Material examined. WA95-B1000 (1e); WA05-DE380D (5+4e); WA05-EF450D (2); WA05-G900 (1); WA06-B310D (1); WA06-C350D (2); WA06-DE280D (3+2e); WA06-DE310 (1e) WA06-DE350 (1e); WA06-DE450 (1); WA06-E1200D (1); WA06-EF425D (1e); WA06-F1500D-1 (9+1e); WA06-F1500D-2 (2+5e); WA06-FG350D (1e); WA06-G900D (1e); WA06-GH480 (1); WA06-GH480D (1+2e); WA06-H480 (1); WA07-A250D (4+3e); WA07-A450 (5e); WA07-B150 (1); WA07-B410D (5e); WA07-C350D (1+8e); WA07-D210D (12+4e); WA07-D310 (1e); WA07-D350 (1e); WA07-D410 (1e); WA07-D650 (1e); WA07-D900 (ca. 50+25e); TS96-K2 [1451–1455 m] (1+27e).

Remarks. Although the species name *Cylichna consobrina* Gould, 1859 has consistently been used in Japanese literature for the present species, it has been regarded as a junior synonym of *Volvaria alba* Brown, 1827 by recent Russian authors (e.g. Chaban and Martynov in Kantor and Sysoev, 2006). The illustrated specimens from the Atlantic and Arctic seas are indeed indistinguishable from those from the northwestern Pacific in general shell features, and they are also considered here to be conspecific.

Habe (1954) regarded *Cylichna nipponensis* Nomura and Hatai, 1940, which was described from the Sea of Japan off Kyuroku-jima Island in Aomori Prefecture, as a junior synonym of *C. consobrina*, but examination of the holotype of *C. nipponensis* revealed that it is a different species.

Family Retusidae Thiele, 1925

Rhizorus **sp.**

(Fig. 422)

?*Retusa* cf. *toyamaensis* — Kantor and Sysoev, 2006: 260, pl. 129, fig. B [non *Pyrunculus toyamaensis* Habe, 1955].

Material examined. WA07-A450 (10e).

Remarks. The present material is apparently conspecific with the specimen provisionally identified as "*Retusa toyamaensis*" by Chaban and Martynov (in Kantor and Sysoev, 2006). It differs, however, from *Adamnestia toyamaensis* (Habe, 1955) in its shell being oval, not cylindrical, with a pointed apex. It more closely resembles *Rhizorus kinokunianus* Habe, 1946 in shell shape, but differs in being 1.5 times smaller in size, and having a more inflated base.

Family Gastropteridae Swainson, 1840

Gastropteron **sp.**

(Fig. 438)

Gastropteron? sp. — Tsuchida *et al*., 2000: 12–13, pl. 4, fig. 7.

Material examined. WA06-EF250 (1); WA06-H210 (1); WA06-H250 (2); WA07-D210D (3).

Remarks. Tsuchida *et al*. (2000) recorded a gastropterid from Otsuchi Bay in Iwate Prefecture, northeastern Honshu, at depths of 50–120m, that was characterized by a pair of large parapodia decorated with numerous reddish brown specks. Although the coloration of live specimens has not been recorded, the present species closely resembles the specimens illustrated by Tsuchida *et al*. in the morphology of the head and parapodia. Hasegawa (2001) also recorded similar gastropterid species from the continental slope of Tosa Bay, but its conspecificity with the present species could not be confirmed by the preliminary rough examination of the specimens. The present species most probably belongs in *Gastropteron* Meckel in Kosse, 1813 (type species: *Sarcopterus rubrum* Rafinesque, 1814, subsequently designated by Pilsbry, 1895), due to the lack of 1) a prominent medial siphonal crest and 2) a pair of stalked spheres on the posterior end of the parapodia (see Gosliner, 1989 for diagnoses of genera in the family).

Family Philinidae Gray, 1850

Philine **sp. 1**

(Figs. 427–429)

Material examined. WA05-E550 (2); WA05-E650 (2); WA05-E750 (5); WA05-EF480 (2); WA05-F550 (4); WA05-F650 (10); WA05-F750 (11); WA05-F900 (11); WA05-F1200 (16); WA05-FG480 (4); WA05-FG510 (8); WA05-G425 (1); WA05-G450 (2); WA05-G510 (36); WA05-G550 (5); WA05-G650 (25); WA05-G750 (14); WA05-G900 (11); WA05-GH510 (3); WA05-H380 (3); WA05-H450 (2); WA05-H510 (7); WA05-H650 (9); WA05-H750 (2); WA06-C750 (1); WA06-D650 (15); WA06-E550 (1); WA06-E900 (3); WA06-E1200 (2); WA06-EF510 (1); WA06-F1500D-1 (2); WA06-F1500D-2 (1); WA06-FG480 (2); WA06-FG510 (2); WA06-G480 (1); WA06-G550 (2); WA06-G750 (1); WA06-G1200 (ca. 30); WA06-H480 (ca. 30); WA06-H510 (4); WA06-H550 (ca. 35); WA06-H650 (13); WA06-H750 (6); WA06-H1500 (2); WA07-B900 (6); WA07-C750 (3); WA07-D650 (ca. 30); WA07-D750 (2); WA08-F900 (1).

Remarks. Philinid specimens obtained during the present survey were provisionally classified into four "species" on the basis of the rough external morphology of the soft parts. It is probable that some of the "species" are mixtures of several distinct species. The present "species" is

Figs. 427–437. Cephalaspidea. 427–429. *Philine* sp. 1, 427: WA06-H1500; 428: WA07-B900; 429: WA05-G510. 430–431. *Philine* sp. 2, 430: WA07-D210D; 431: WA07-A210. 432–434. *Philine* sp. 3, 432: WA05-FG510; 433: WA05-FG480; 434: WA06-H750. 435. *Philine* sp. 4, WA07-A450. 436. *Philinorbis teramachii*, WA9206-A44 [200 m]. 437. *Philinopsis* sp., WA05-EF350. Scales: 427–429 = 5 mm; 430–431 = 5 mm; 432–434 = 5 mm (at the same scale, respectively); 435 = 2 mm; 436 = 10 mm; 437 = 5 mm.

characterized by a broad, triangular foot, relatively small cephalic shield, which is usually less than 1/2 of the visceral hump in length in fixed specimens, and a thick mantle that completely covers the shell. The fragile shell was broken during the fixation process in most examples of this and other "species", and precise identification based on the shell morphology was thus not possible.

Philine sp. 2
(Figs. 430–431)

Material examined. WA95-B1000 (1); WA05-DE480 (1); WA05-DE510 (3); WA05-E480 (3); WA05-EF250D (4); WA05-EF350 (2); WA05-FG450 (4); WA05-FG480 (5); WA05-FG510 (2); WA05-G280 (1); WA05-G425 (1); WA05-G450 (2); WA05-G510 (6); WA05-G550 (1); WA05-G750 (2); WA05-G900 (1); WA05-GH280 (2); WA05-H310 (2); WA05-H350 (1); WA05-H380 (5); WA05-H450 (5); WA05-H510 (1); WA06-E510D (1); WA06-E550 (2); WA06-EF250 (6); WA06-EF425 (1); WA06-F425 (1); WA06-FG480 (2); WA06-FG510 (1); WA06-G900D (2); WA06-H310 (1); WA06-H350 (24); WA06-H380 (17); WA06-H450 (1); WA06-H480 (ca. 80); WA06-H750 (1); WA07-A510 (2); WA07-A550 (20); WA07-B410 (1); WA07-C350D (8); WA07-D310 (1); WA07-D350 (2); WA07-D410 (1); WA07-D550 (1); WA07-D650 (11).

Remarks. This "species" is similar to the preceding one, but differs in having a larger cephalic shield that is only slightly smaller than the visceral hump, a longer foot, and a distinct crest-like posterior pallial lobe on the posterior part of the visceral hump. The body is generally larger than that of the preceding "species".

Philine sp. 3
(Figs. 432–434)

Material examined. WA9201-4 [200 m] (1); WA9206-A44 [200 m] (1); WA05-G150 (7); WA05-G210 (5); WA05-H150 (1); WA06-E210 (2); WA06-FG250 (4); WA06-FG410 (1); WA06-GH410 (-1) (1); WA06-H150 (2); WA06-H250 (7); WA06-H250D (11); WA07-A210 (3); WA07-A250D (5); WA07-D210D (3).

Remarks. This "species" is easily distinguished from the others in the genus in having a significantly thinner mantle, through which the shell can easily be observed, and small, round head-foot parts with small parapodia. It occurs only in relatively shallower waters down to 410 m, in contrast to preceding two "species".

Philine sp. 4
(Fig. 435)

Material examined. WA07-A450 (7).

Remarks. The shell of this species is not covered by the mantle, and is entirely exposed in the fixed specimens. The generic assignment of this species is based on shell morphology, and is only provisional.

Philinorbis teramachii Habe, 1950
(Fig. 436)

Philinorbis teramachii Habe, 1950: 52, pl. 9, figs. 3–5; Habe, 1955d: 78 (name only); Watanabe and Naruke, 1988: 69; Hori in Okutani, 2000: 753, 754, pl. 374, fig. Aglajidae-11.

Type locality. Tosa Bay, Shikoku.

Distribution. Off Hachinohe in Aomori Prefecture (present study), and southwards to off Taiwan (Lan, 2000) along Pacific coast; 80–120 m [150–205 m].

Material examined. WA9206-A44 [200 m] (1); WA06-H150 (2).

Remarks. The shell of this species, which can be observed through the thin mantle, is flattish and round in shape, sculptured with distinct spiral grooves, and agrees well with the holotype of *P. teramachii*. Habe (1950) proposed the monotypic genus *Philinorbis* to accommodate this species and assigned it to the family Aglajidae, but subsequently transferred it to the Philinidae (Habe, 1955d) without explanation. The external morphology of the soft parts generally agrees with other species in the Philinidae, but the animal differs in being flattish, and in having very large, broad foot and cephalic shield. Since its description from Tosa Bay, this species has been recorded only from off Choshi, Chiba Prefecture (Habe, 1955d; Watanabe and Naruke, 1988), the Shima Peninsula in Mie Prefecture (Higo *et al*., 1999) and off Taiwan (Lan, 2000). The present record represents a range extension of this species northwards to Aomori Prefecture.

Family Aglajidae Pilsbry, 1895

Philinopsis sp.

(Fig. 437)

Material examined. WA05-EF350 (1).

Remarks. This species can be assigned to the genus *Philinopsis* Pease, 1860 (type species: *Philinopsis speciosa* Pease, 1860, subsequently designated by Rudman, 1974), in having a relatively short cylindrical body and two bifurcated lobes at the posterior end of the visceral hump, but cannot be identified to species level because of the lack of the coloration and other information in live specimens.

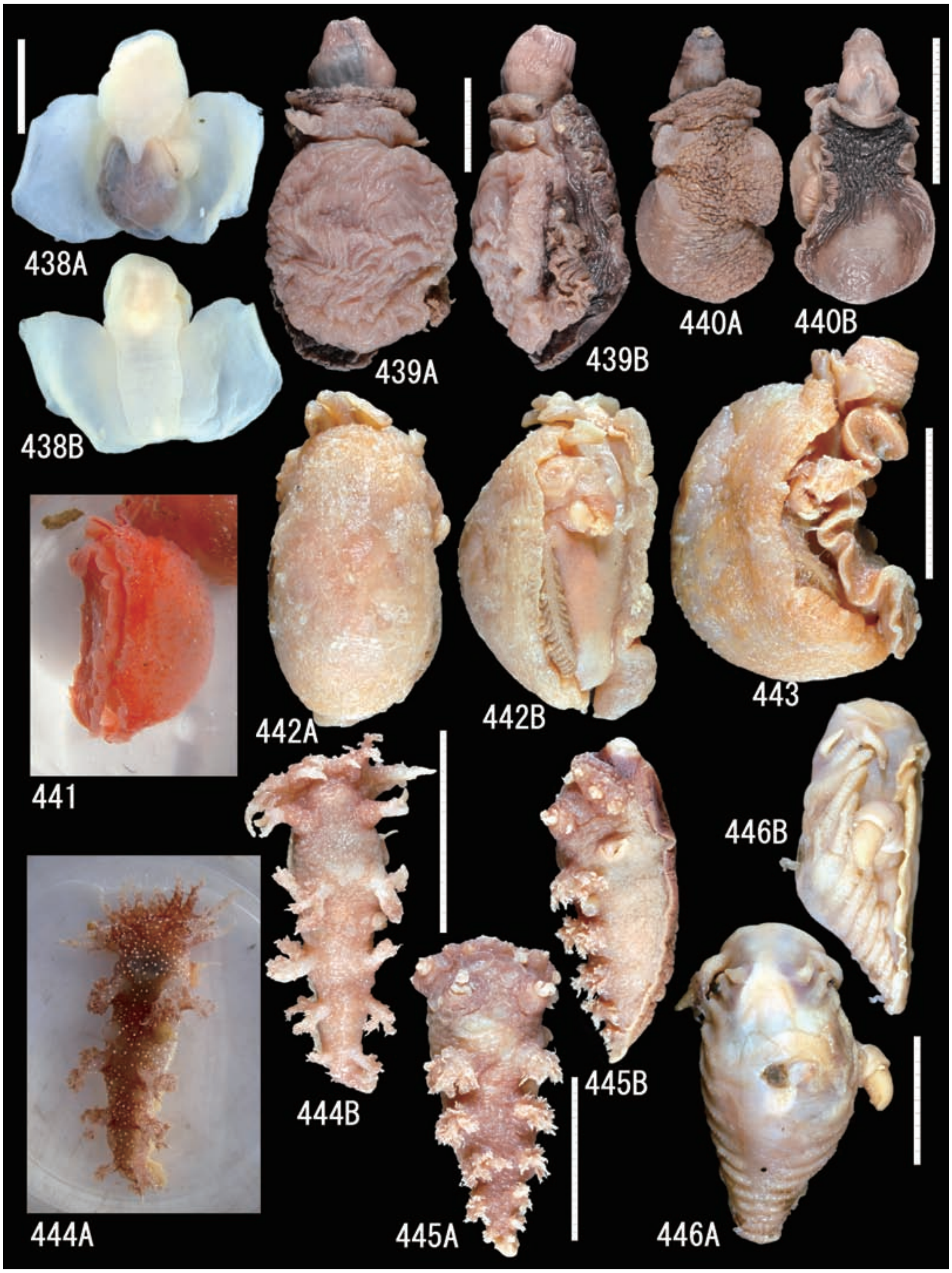
Family Pleurobranchidae Gray, 1827

Berthellina sp.

(Figs. 441–443)

Material examined. WA05-DE380 (3); WA05-DE380D (3); WA05-DE410 (1); WA05-DE425 (1); WA05-DE510 (1); WA05-EF425 (3); WA05-EF450 (2); WA05-F350 (1); WA05-F380 (2); WA05-F410 (4); WA05-F425 (8); WA05-F450 (2); WA05-F480 (4); WA05-F510 (3); WA05-F900 (1); WA05- FG310 (1); WA05-FG350 (4); WA05-FG380 (2); WA05-FG425 (1); WA05-FG450 (2); WA05-FG480 (4); WA05-FG510 (1); WA05-G350 (4); WA05-G450 (4); WA05-G510 (1); WA05-G550 (2); WA05-G650 (1); WA05-G750 (1); WA05-G900 (7); WA05-GH350 (3); WA05-GH410 (2); WA05-GH425 (4); WA05-GH450 (2); WA05-GH480 (3); WA05-GH510 (1); WA05-GH510D (1); WA05-H380 (5); WA05-H900 (1); WA06-C350 (2); WA06-DE410 (1); WA06-DE425 (6); WA06-DE480 (2); WA06-EF410 (4); WA06-EF425 (1); WA06-EF450 (4); WA06-EF480 (1); WA06-EF510 (2); WA06-F310 (2); WA06-F350 (2); WA06-F380 (1); WA06-F410 (2); WA06-F425 (1); WA06-F450 (1); WA06-F510 (1); WA06-FG350 (4); WA06-FG380 (5); WA06-FG410 (18); WA06-FG425 (12); WA06-FG450 (11); WA06-FG480 (26); WA06-FG510 (14); WA06-G380 (1); WA06-G450 (2); WA06-G480 (1); WA06-G550 (1); WA06-G900 (1); WA06-G900D (1); WA06-GH250 (1); WA06-GH350 (1); WA06-GH380 (5); WA06-GH410-1 (4); WA06-GH425 (5); WA06-GH450 (35); WA06-H480 (2); WA07-A310 (1); WA07-C250 (1); WA07-C350 (1); WA07-C350D (1).

Remarks. Although this conspicuous pleurobranchid species is rather commonly found in the upper bathyal zone of the Pacific coast of northern Honshu, from the Shimokita Peninsula south to



Figs. 438–446. Opisthobranchia. 438. *Gastropteron* sp., WA07-D210D. 439–440. *Pleurobranchaea japonica*, 439: WA06-GH480; 440: WA07-A150. 441–443. *Berthellina* sp., 441: WA06-FG425; 442–443: WA06-FG350. 444–445. *Dendronotus robustus*, 444: WA07-D310; 445: WA05-DE250D. 446. *Aeolidia* sp. cf. *herculea*, WA05-G750. Scales: 438 = 2 mm; 439–445 = 20 mm; 446 = 10 mm (live photos not to scale).

off Ibaraki Prefecture in the sea area Kashima-nada, and especially in its southern part, no available names could be found for it. It bears a pair of rhinophores that are fused at the base and situated on the top of the head under the mantle edge, and has a smooth dorsal surface without polygonal speckles. It thus probably belongs to the genus *Berthellina* Gardiner, 1936 (type species: *Berthellina engeli* Gardiner, 1936, nom. nov. pro *Berthella plumula* (Montagu, 1801) sensu Vayssiére, 1898, non *Bulla plumula* Mongagu, 1801).

Family Pleurobranchaeidae Pilsbry, 1896
Pleurobranchaea japonica Thiele, 1925
[Japanese name: Umi-fukuro]
(Figs. 439–440)

Pleurobranchaea japonica Thiele, 1925: 283–284, pl. 45, fig. 8.
Pleurobranchaea novaezelandiae — Baba, 1937: 229–231, fig. 12 [non *Pleurobranchaea novaezalandiae* Cheeseman, 1878].
[See Tsubokawa *et al*. (1992) for detailed synonymy.]

Type locality. Kobe (Japan).

Distribution. Northernmost extreme of Honshu to west coast of Kyushu on both Pacific and Japan Sea coasts, and Yellow Sea (Tsubokawa *et al*., 1992); 0–400 m [150–480 m].

Material examined. WA05-G150 (4); WA05-GH510 (1); WA05-H150 (1); WA06-A150 (5); WA06-A150D (3); WA06-E150 (2); WA06-E210 (2); WA06-F150 (1); WA06-F210 (2); WA06-G150 (3); WA06-G210 (2); WA06-H150 (1); WA06-H210 (9); WA06-GH480 (3); WA07-A150 (4); WA07-B150 (2); WA07-D210D (1).

Remarks. This species shows a wide vertical distribution, ranging from the intertidal zone down to more than 400 m. Based on the specimens collected from Tosa Bay, Hasegawa (2001) noted some differences between the specimens collected from sublittoral to bathyal depths and those in the intertidal zone, such as that the former bear peculiar dark purplish brown coloration on the sole. The present material supported this view.

Family Dorididae Rafinesque, 1815
Archidoris sp. cf. ***odhneri*** (MacFarland, 1966)
(Fig. 449)

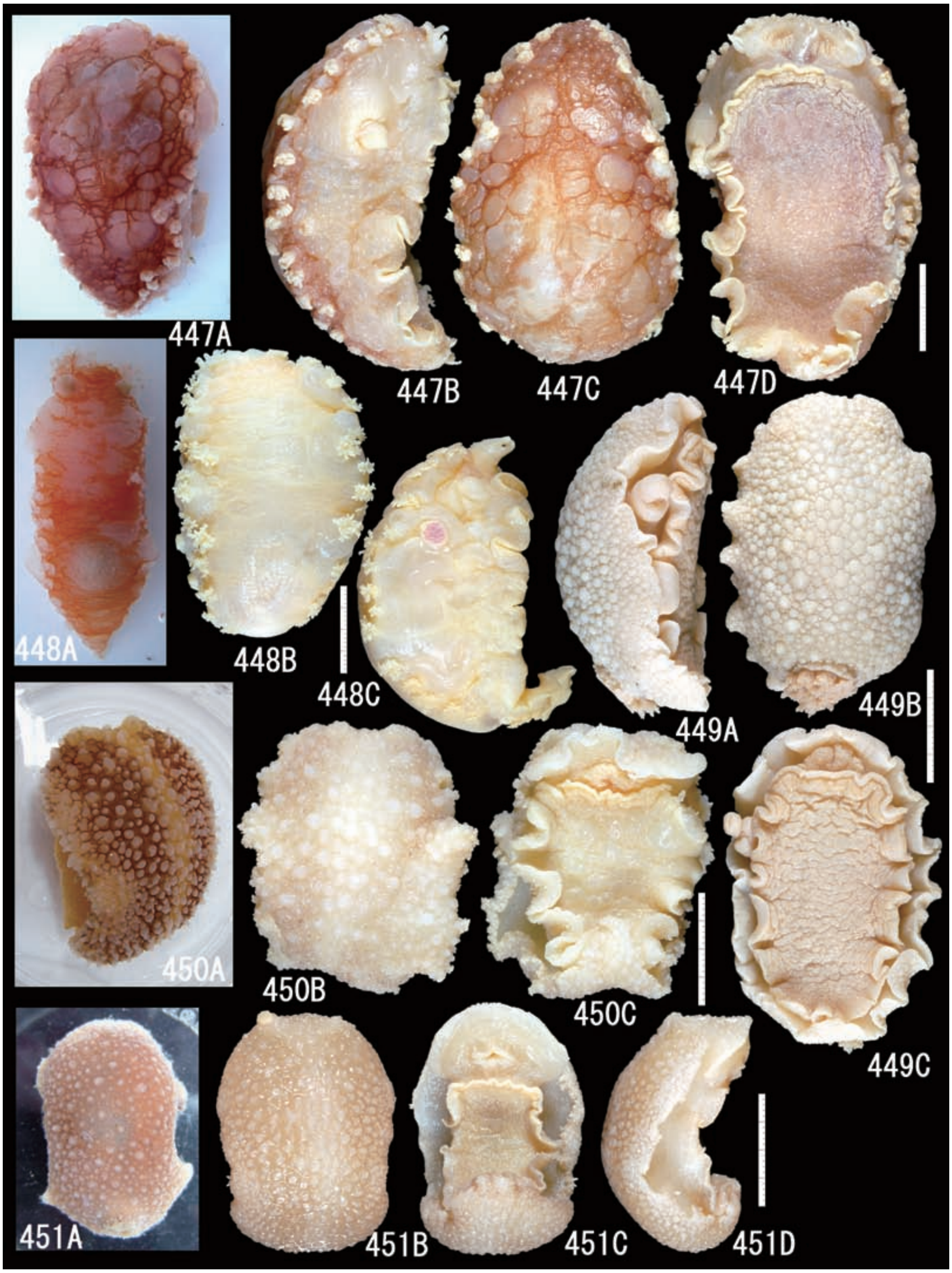
?*Austrodoris odhneri* MacFarland, 1966: 173–179, pl. 26, fig. 1, pl. 29, fig. 14, pl. 36, figs. 1–19 (type locality: Cypress Point, California).

Material examined. WA05-EF280 (1); WA05-GH250 (2); WA05-G350 (1); WA06-GH250 (2); WA07-A250 (1).

Remarks. The present material was provisionally identified as *A. odhneri* on the basis of its entirely white coloration, mammillate mantle tubercles of irregular size, and well developed bushy gills. *Archidoris odhneri* has recently been recorded from Iwate Prefecture in shallow water (Hagiwara and Tanaka, 2005).

Dorididae gen. et sp.
(Figs. 450–451)

Material examined. WA06-A310 (1); WA07-A150 (1); WA07-C210 (1).



Figs. 447–451. Opisthobranchia. 447. *Tritonia* sp., WA07-C210. 448. *Tritonia tetraquetra*, WA07-B310. 449. *Archidoris* sp. cf. *odhneri*, WA05-EF280. 450–451. Dorididae gen. et sp., 450: WA07-A150; 451: WA07C-210. Scales: 20 mm (live photos not to scale).

Family Tritoniidae Lamarck, 1809

Tritonia tetraquetra (Pallas, 1788)

[Japanese name: Hokuyo-umiushi]

(Fig. 448)

Limax tetraquetra Pallas, 1788: 237–239, pl. 5, fig. 22.

Tritonia diomedea Bergh, 1894: 146–150, pl. 2, figs. 10–11, pl. 3, figs. 6–10, pl. 4, figs. 1–5 (type locality: Shumagin Bay, Aleutian Islands, Alaska); Volodchenko, 1955: 182, pl. 48, fig. 3.

Duvaucelia (*Duvaucelia*) *septemtrionalis* Baba, 1937: 391–392, text-fig. 1 (type locality: Sea of Okhotsk, 59˚45´N, 155˚22´E).

[See Martynov (in Kantor and Sysoev, 2006: 280) for additional synonymy and nomenclatural discussion.]

Type locality. “urilis Insulis”[North Kurile Islands, according to Martynov (in Kantor and Sysoev, 2006)].

Distribution. Off Hitachi in Ibaraki Prefecture (present study), and off Sado Island in Sea of Japan, both northwards to Bering Sea; west coast of North America; 2–640 m [150–450 m].

Material examined. WA05-H150 (1); WA05-F410 (1); WA06-A310 (1); WA06-A450 (1); WA06-B310 (2); WA06-C350 (1); WA07-A250 (1); WA07-A310 (5); WA07-B310 (2); WA07-B350 (1); WA07-B410 (4); WA07-C210 (2); WA07-C310 (3); WA07-C350 (2); WA07-X410 (5).

Remarks. Although this species had been well known as *Tritonia diomedea* Bergh, 1894 in literature, it was recently synonymized by Martynov (in Kantor and Sysoev, 2006) with *T. tetraquetra*, which had erroneously been applied to a different species *Tochuina gigantea* (Bergh, 1904).

Tritonia sp.

(Fig. 447)

Material examined. WA07-C210 (3).

Remarks. This species closely resembles the preceding species, but differs in its broader body with purplish brown coloration. It occurred sympatrically with the preceding species at WA07-C210, but they can be clearly separated.

Family Dendronotidae Allman, 1845

Dendronotus robustus (Verrill, 1870)

(Figs. 444–445)

Dendronotus robustus Verrill, 1870: 405–406, fig. 1; Bergh, 1894: 141–144, pl. 2, figs. 6–9, pl. 3, fig. 1; Robilliard, 1970: 450–451; Robilliard, 1972: 430–432, fig. 7 (reproductive system); Martynov in Kantor and Sysoev, 2006: 281, pl. 135, fig. C.

Dendronotus veliger Sars, 1878: 238–239, pl. 28, fig. 2; Debelius and Kuiter, 2007: 287, figs. (type locality: Vadsö, Norway).

Type locality. Whale Cove, Grand Manan, Canada.

Distribution. Kinkazan in Miyagi Prefecture and northwards, circumpolar; 10–300 m [210–510 m].

Material examined. WA05-DE250D (2); WA05-DE280 (1); WA05-DE310 (1); WA05-EF380 (1); WA06-A510 (3); WA06-C350 (1); WA06-E310 (1); WA07-A250 (1); WA07-C210 (1); WA07-D310 (1).

Remarks. The present material agrees well with the figures of *D. robustus* previously published. This is the first record of this species in Japanese waters, and represents range extension southwards to Miyagi Prefecture on the Pacific coast of Honshu.

Family Aeolidiidae Gray, 1827
Aeolidia sp. cf. ***herculea*** Bergh, 1894
(Fig. 446)

?*Aeolidia herculea* Bergh, 1894: 128–129, pl. 1, figs. 8–12; Martynov in Kantor and Sysoev, 2006: 294, pl. 138, fig. F (type locality: St. Barbara, California).

Material examined. WA05-G210 (1); WA05-G750 (1); WA05-G900 (1).

Remarks. The branchial papillae of all the specimens examined were lost during the trawl operations, making precise identification difficult. However, in their morphology and bathyal habitat the specimens examined agree well with the syntype of *Aeolis grandis* Volodchenko, 1941 illustrated by Martynov (in Kantor and Sysoev, 2006: pl. 138, fig. F). *Aeolis grandis* is usually considered to be a junior synonym of *A. herculea*.

Discussion

The deep-sea molluscs of the northeastern Pacific, including the waters off northeastern Japan, have been relatively well studied since the 19th century by American, Russian and Japanese researchers, resulting in the proposal of many nominal taxa and the publication of monographs of certain groups from the area. However, molluscs inhabiting northern waters are known in general to be highly variable in shell features, especially those that undergo direct development in the growth stage, such as most species of the Buccinidae, and they may have been unnecessarily split into too many nominal taxa, reflecting the geographical complexity of this area. As described in detail in the introduction, knowledge of the taxonomy of the deep-water gastropods of northeastern Japanese waters has been accumulated based mostly on specimens collected by commercial trawls that lack detailed position and depth data, with only a small number of specimens collected by research vessels. Data have thus been too fragmentary to clarify the relationships among confusing taxa.

The significance of the present study thus mostly stems from the large number of specimens collected according to a carefully prepared scheme (Fig. 1). A total of ca. 2740 gastropod specimen lots from more than 322 stations can now form the basis of a comprehensive faunal study of this area and also of detailed taxonomical studies in the future. Already, as a result of the present preliminary study, 11 nominal taxa are here regarded as synonyms, and further synonyms proposed in previous studies have been confirmed. On the other hand, several nominal taxa that have often been regarded by previous authors as synonyms of allied species are shown here to be distinct. These include *Cryptonatica aleutica* (from *C. affinis*) and *Neptunea frater* (from *N. intersculpta*). Furthermore, this rich material with precise data provides information on the spatial utilization of the seabed by several allied species in a limited area, which is important for determining species. Figures 452–453 show the vertical and geographical distributions in the survey area of dominant species of the genera *Neptunea* and *Buccinum* respectively. In both cases, several species occurred in different depth ranges, with some overlaps at their margins, and this makes it possible for these species to inhabit in the same geographical area without competition. It is noteworthy that *Neptunea constricta* (including the phenotype *N. intersculpta*), which is known to be the only dominant species of the genus in the bathyal zone of the Sea of Japan (Iguchi *et al*., 2007), exhibits a significantly wider vertical distribution there (250–1248 m; Kato, 1979).

From a biogeographical point of view, the species composition shown in the present study reveals a strongly boreal fauna. Table 2 summarizes the distributions of all the taxa that have been identified to species level, based on the present results as well as published data (mostly from Higo

A. *Buccinum isaotakii*

Survey Line	Depth (m) 150	210	250	280	310	350	380	410	425	450	480	510	550	650	750	900	1200–
A	0	0	1		2	35		24		0		0	0	0	0	0	0
B	0	0	0		0	0		2		0		0	0	0	0	0	0
C		0	0		1	1		0		0		0	0	0	0	0	0
D		11	0		0	0		0		0		0	0	0	0	0	0
DE			4	12	5	1	0	0	0	0	0	0					
E		2	3	5	3					0	0	0	0	0	0	0	0
EF			7	2	19	1	0	0	2	0	0	0					
F	0	2	2	3	5	0	0	0	0	0	0	0	0	0	0	0	0
FG			3	6	16	0	0	0	0	0	0	0					
G	0	2	4	7	5	18	9	0	1	0	0	0	0	0	0	0	0
GH			1	3	1	3	4	0	0	0	0	0					
H	3	1	7	10	20	25	14	6	3	6	5	0	0	0	0	0	0

B. *Buccinum niponense*

Survey Line	Depth (m) 150	210	250	280	310	350	380	410	425	450	480	510	550	650	750	900	1200–
A	0	0	0		0	0		0		0		0	0	0	0	0	0
B	0	0	0		0	0		0		0		0	0	0	0	0	0
C		0	0		0	0		0		1		0	0	0	0	0	0
D		0	0		0	8		1		0		0	0	0	0	0	0
DE			1	0	1	5	10	4	16	2	1	0					
E	0	0	0	0	0					1	0	1	2	0	0	0	0
EF			0	0	0	12	39	3	5	2	0	0					
F	0	0	0	0	1	3	3	3	5	2	0	0	0	0	0	0	0
FG			0	0	4	7	5	0	13	1	7	1					
G	0	0	0	0	0	19	8	0	6	3	0	0	0	0	0	0	0
GH			0	0	0	0	8	1	2	2	1	1	1				
H	0	0	0	0	0	1	2	0	0	0	1	0	0	0	0	0	0

C. *Buccinum kashimanum*

Survey Line	Depth (m) 150	210	250	280	310	350	380	410	425	450	480	510	550	650	750	900	1200–
A	0	0	0		0	0		0		0		0	0	25	0	1	0
B	0	0	0		0	0		0		0		0	0	10	7	0	0
C		0	0		0	0		0		0		0	0	2	12	1	0
D		0	0		0	0		0		0		0	0	8	6	1	0
DE			0	0	0	0	0	0	0	0	0	0					
E	0	0	0	0	0					0	0	0	1	10	6	0	0
EF			0	0	0	0	0	0	0	0	0	0					
F	0	0	0	0	0	0	0	0	0	0	0	0	1	4	2	0	0
FG			0	0	0	0	0	0	0	0	0	0					
G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	8	1
GH			0	0	0	0	0	0	0	0	0	0					
H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0

Fig. 452. Vertical and geographical distribution of dominant species of the genus *Buccinum* collected from north-eastern Honshu. A. *B. isaotakii*. B. *B. niponense*. C. *B. kashimanum*.

A. *Neptunea frater*

Survey Line	Depth (m) 150	210	250	280	310	350	380	410	425	450	480	510	550	650	750	900	1200–
A	0	0	0		0	0		0		0		0	0	0	0	0	0
B	0	0	0		0	0		0		0		0	0	0	0	0	0
C		0	0		0	0		0		0		0	0	0	0	0	
D		0	0		0	0		0		0		0	0	0	0	0	0
DE			0	0	0	0	0	0	0	0	0	0					
E	0	1	0	0	0					0	0	0	0	0	0	0	0
EF			2	0	0	0	0	0	0	0	0	0					
F	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FG			0	1	0	0	0	0	0	0	0	0					
G	0	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
GH			7	4	2	0	0	0	0	0	0	0					
H	0	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0

B. *Neptunea intersculpta*

Survey Line	Depth (m) 150	210	250	280	310	350	380	410	425	450	480	510	550	650	750	900	1200–
A	0	0	0		1	3		7		6		7	9	1	0	0	0
B	0	0	0		0	0		3		0		9	3	4	0	0	0
C		0	0		0	0		0		0		0	0	0	0	0	
D		0	0		0	0		2		0		0	0	0	0	0	0
DE			0	2	2	4	6	7	6	4	6	0					
E	0	0	0	2	3					2	1	1	0	0	0	0	0
EF			2	2	2	4	4	3	2	3	0	1					
F	0	0	0	2	3	1	2	2	3	3	3	3	1	0	0	0	0
FG			0	3	3	5	5	5	3	4	7	2					
G	0	0	0	0	1	2	0	0	5	1	1	2	0	0	0	0	0
GH			0	0	3	11	6	3	2	9	9	3					
H	0	0	0	0	12	19	4	4	3	3	10	0	0	0	0	0	0

C. *Neptunea* sp. cf. *convexa*

Survey Line	Depth (m) 150	210	250	280	310	350	380	410	425	450	480	510	550	650	750	900	1200–
A	0	0	0		0	0		0		0		4	2	1	1	1	0
B	0	0	0		0	0		0		0		0	3	13	0	1	1
C		0	0		0	0		0		0		1	4	5	2	1	0
D		0	0		0	0		0		0		0	1	13	35	40	0
DE			0	0	0	0	0	0	0	0	1	1					
E	0	0	0	0	0					0	0	0	2	1	0	4	1
EF			0	0	0	0	0	0	0	0	0	0					
F	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4	0
FG			0	0	0	0	0	0	0	0	0	0					
G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	5
GH			0	0	0	0	0	0	0	0	0	0					
H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0

Fig. 453. Vertical and geographical distribution of dominant species of the genus *Neptunea* collected from north-eastern Honshu. A. *N. frater*. B. *N. intersculpta*. C. *N.* sp. cf. *convexa*.

Table 2. Geographical distribution of gastropods collected from northeastern Honshu, and identified to the species level.

Species	Arctic	Beling	Kurile	Hok-kaido	Northeastern Honshu (present study): A	B	C	D+DE	E+EF	F+FG	G+GH	H	Choshi	Sagami Bay	Suruga Bay	Kii Pen.	Tosa Bay
Pectinodonta rhyssa											+		+	+	+	+	+
Cocculina japonica				+	+	+	+	+	+	+	+	+	+				
Coccopigya punctoradiata										+	+		+	+	+	+	+
Copulabyssia similaris											+				+		+
Bathybembix aeola									+	+	+	+	+	+	+	+	+
Ginebis argenteonitens									+	+	+	+	+	+	+	+	+
Margarites bisikovi			+						+								
Margarites margaritiferus						+		+	+			+		+			
Otukaia kiheiziebisu								+			+		+	+		+	+
Hazuregyra watanabei					+			+	+	+	+		+				
Solariella delicata						+	+	+	+	+	+	+	+	+		+	+
Solariella tenuicollaris			+				+	+		+	+	+	+	+			
Neohaustator fortilirata			+		+	+		+	+				+				
Punctulum flava			+									+		+	+		+
Haloceras japonica							+										
Limneria prolongata		+	+					+	+	+	+						
Limneria undata ochotensis		+	+					+									
Bulbus normalis			+		+	+	+		+	+	+						
Euspira pallida	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Euspira nux					+	+	+	+	+	+	+	+	+	+	+	+	+
Cryptonatica hirasei			+	+		+	+	+									
Cryptonatica aleutica		+	+	+	+	+	+	+	+	+	+	+	+	+			
Cryptonatica affinis	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Fusitriton oregonensis		+	+	+	+	+	+	+	+	+	+	+	+	+			
Cirsotrema (*Elegantiscala*) *mituokai*				+	+		+	+	+	+	+		+	+			
Opaliopsis hiranoi					+								+				
Boreoscala greenlandica	+	+							+				+				
Abyssotrophon delicatus								+	+	+	+	+	+	+			
Abyssotrophon minimus					+								+				
Abyssotrophon crystallinus					+		+										

Table 2. (Continued)

Species	Arctic	Beling	Kurile	Hok-kaido	Northeastern Honshu (present study)								Choshi	Sagami Bay	Suruga Bay	Kii Pen.	Tosa Bay
					A	B	C	D+DE	E+EF	F+FG	G+GH	H					
Boreotrophon trophonis		+						+		+		+					
Boreotrophon alaskanus		+	+	+	+			+	+	+	+	+	+	+			
Boreotrophon flos											+	+	+				
Parancistrolepis fujitai					+	+	+	+	+	+	+	+	+	+			
Bathyancistrolepis trochoideus			+	+	+			+	+	+	+	+	+	+	+	+	+
Clinopegma magna unicum			+	+	+	+	+	+	+	+	+	+	+				
Clinopegma sasakii				+		+	+	+				+					
Pseudoliomesus nassula		+	+	+		+	+	+									
Beringius polynematicus			+	+	+	+		+	+	+	+	+	+				
Bathybuccinum bicordatum			+					+	+								
Bathybuccinum higuchii											+						
Ovulatibuccinum perlatum								+	+	+							
Buccinum isaotakii				+	+	+	+	+	+	+	+	+	+				
Buccinum niponense				+			+	+	+	+	+	+	+				
Buccinum kushiroensis				+	+	+		+									
Buccinum kashimanum				+	+	+	+	+	+	+	+	+	+				
Volutharpa ampullacea		+	+	+	+	+	+	+	+	+	+	+	+				
Japelion (*Japelion*) *hirasei*			+	+	+	+	+	+	+	+	+	+	+				
Japelion (*Metajaperion*) *pericochlion*				+						+	+	+	+				
Aulacofusus hiranoi				+		+	+	+	+	+	+	+	+				
Colus kujianus			+	+	+	+	+	+	+	+							
Plicifusus rhyssoides			+		+					+		+					
Plicifusus levis				+	+	+		+	+	+		+					
Mohnia bella								+	+	+	+	+	+				
Mohnia similis			+					+	+	+							
Mohnia robusta		+	+		+				+	+	+						
Mohnia daphnelloides					+			+	+	+	+	+	+				
Retifusus virens		+	+			+											
Pararetifusus tenuis			+		+			+	+	+	+	+	+	+			+
Neptunea intersculpta				+	+	+	+	+	+	+	+	+	+				

Table 2. (Continued)

Species	Arctic	Beling	Kurile	Hok-kaido	Northeastern Honshu (present study)								Choshi	Sagami Bay	Suruga Bay	Kii Pen.	Tosa Bay
					A	B	C	D+DE	E+EF	F+FG	G+GH	H					
Neptunea frater									+	+	+	+	+				
Neptunea hiberna				+		+	+	+	+		+						
Neptunea nivea				+	+	+	+	+	+	+	+	+					
Habevolutopsius hirasei			+	+	+	+	+	+	+		+	+	+				
Fulgoraria (*Nipponomelon*) *magna*				+	+	+		+	+	+	+	+	+				
Volutomitra groenlandica alaskana		+	+	+	+		+	+	+	+	+	+	+	+			
Admete viridula	+	+	+	+	+							+	+	+			
Admete choshiensis					+				+			+	+				
Admete watanabei								+			+	+	+	+			
Iphinopsis choshiensis						+		+	+			+	+	+			
Iphinopsis bathyalis			+					+		+		+		+			
Aforia circinata		+	+	+	+	+	+	+	+	+	+	+	+	+			
Antiplanes dendritoplicata			+		+				+	+	+						
Antiplanes obliquiplicata		+								+	+	+					
Antiplanes obesus			+	+	+		+	+	+	+		+	+	+			
Antiplanes sanctiioannis		+	+	+	+	+	+	+	+	+	+	+	+	+			
Antiplanes vinosa		+	+	+			+	+			+						
Antiplanes motojimai								+	+	+	+	+	+	+			
Crassispira takeokensis							+	+	+	+	+	+	+	+	+	+	+
Decollidrillia nigra			+	+		+		+	+	+	+	+					
Cryptogemma corneus			+	+		+		+	+		+	+	+	+		+	+
Bathytoma engonia			+	+				+	+	+	+	+	+	+			
Curtitoma incisula	+	+	+		+												
Curtitoma bartschi			+							+							
Curtitoma becklemishevi			+	+								+					
Curtitoma delicata								+					+	+			
Curtitoma hinae					+			+		+							
Curtitoma lawrenciana		+	+			+		+									
Curtitoma violacea	+	+	+	+			+	+	+	+							
Granotoma albrechti	+	+	+	+	+			+		+							

Table 2. (Continued)

Species	Arctic	Beling	Kurile	Hok-kaido	Northeastern Honshu (present study) A	B	C	D+DE	E+EF	F+FG	G+GH	H	Choshi	Sagami Bay	Suruga Bay	Kii Pen.	Tosa Bay
Granotoma krausei		+	+		+	+		+									
Oenopota candida						+		+	+	+	+						
Obesotoma oyashio							+	+	+	+			+				
Propebela exquisita					+	+								+			
Derjuginella rufofasciata			+	+				+									
Microglyphis japonica			+	+	+	+			+	+		+	+	+	+	+	+
Diaphana tibia							+	+									
Eoscaphander fragilis			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Cylichna alba	+	+	+	+	+	+	+	+	+	+	+	+	+	+			
Philinorbis teramachii					+							+	+				+
Pleurobranchaea japonica					+	+			+	+	+	+	+	+	+	+	+
Tritonia tetraquetra		+	+	+	+	+	+			+		+					
Dendronotus robustus	+	+	+		+		+	+	+								

et al., 1999 and Kantor and Sysoev, 2006), supplemented by material obtained during the series of surveys in this project. Among the total of 103 species, 53 (51%) are known to occur in the waters off the Kurile Islands and northwards. To the south, the number of shared species gradually decreases to 67 (65%) in the sea area Kashima-nada (off Choshi), with which the present survey area is contiguous, and then sharply decreases to 38 (37%) in Sagami Bay. This can be related to the topographical features of this area; although Sagami Bay is linked as a continuous deep-sea system to the Japan Trench by the Sagami Trough, the continental slope is strongly disturbed by the presence of some steep canyons around the Boso Peninsula. The most significant barrier in terms of the biogeographical distribution is the saddle between the Izu Peninsula and the northern Izu Islands, and only 19 among the 103 species (18%) are known from westwards of this point, mostly to Tosa Bay. It is noteworthy that only one species of the Buccinidae, which is one of the most dominant groups in northern waters, is included among these 18 species, probably related to its development mode (direct or planktonic). On the other hand, about 40 species (ca. 40%), not counting a large number of unidentified ones, are shown to be endemic to the Pacific coast of northern Japan, although some of them have counterparts in boreal waters, and more detailed study will be necessary to confirm or refute their endemism.

As mentioned above, the present survey represents the fourth term of a series of sampling programs, and the accumulation of material from various Japanese waters is contributing to more precise knowledge of the biogeography and taxonomy of deep-sea gastropods. For instances, the specimens reported by Hasegawa (2001) from Tosa Bay as "*Solariella* sp." were demonstrated in the present study to be a phenotype of *Solariella delicata*, based on the comparison of both sets of material. *Punctulum flava*, which had long been known only from the type material from Sagami Bay, has been shown to be distributed from the southern Kurile Islands to Tosa Bay. Additional material gathered by various research cruises are also being deposited in our collection, and more detailed examination of this integrated material will greatly contribute to the understanding of the Japanese deep-water gastropod fauna and its classification.

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Appendix. Species occurring only at depths shallower than 200 m.

Family Fissurellidae Fleming, 1822
Puncturella fastigiata A. Adams 1853
[Japanese name: Ensui-sukashi]
(Fig. 11)

Material examined. WA06-A150D (1); WA9201-2 [100 m] (5).

Tugalina* (*Scelidotoma*) *gigas (v. Martens, 1881)
[Japanese name: Saru-awabi]
(Fig. 12)

Material examined. WA9101-4 [135 m] (1).

Family Trochidae Rafinesque, 1815
Ginebis cumingii (Pilsbry, 1893)
[Japanese name: Iga-ginebisu]
(Fig. 15)

Material examined. WA06-A150D (1e); WA07-B150 (1+2e).

Calliostoma aculeatum Sowerby Ⅲ, 1912
[Japanese name: Toge-ebisu]
(Fig. 25)

Material examined. WA9201-2 [100 m] (1).

Minolia punctata A. Adams, 1860
[Japanese name: Koshitada-shitadami]
(Fig. 16)

Material examined. WA06-A150D (8).

Family Capulidae Fleming, 1822
Neoiphinoe unicarinata (Broderip and Sowerby, 1829)
[Japanese name: Neji-nuki-gai]
(Fig. 71)

Material examined. WA06-A150D (1).

Ciliatotropis ciliata (Golikov and Gulbin, 1978) new to Japan
(Fig. 72)

Material examined. WA07-B150 (1).

Trichamathina nobilis (A. Adams, 1867)
[Japanese name: Ezo-iso-chidori]
(Fig. 70)

Material examined. WA07-B150 (3).

Family Velutinidae Gray, 1840
Marsenina sp. 2 (Fig. 77)

Material examined. WA05-G150 (1).

Family Buccinidae Rafinesque, 1815
Hindsia* (*Microfusus*) *acutispirata (Sowerby, 1913)
[Japanese name: Hime-nishi]
(Fig. 237)

Material examined. WA9206-A41 [68–69 m] (1).