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A Review of Bathyal Shell-bearing Gastropods in Sagami Bay

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Abstract. Shell-bearing gastropods occurring in Sagami Bay at bathyal depths from 400 to 1600 m were reviewed based on information in literature, voucher material of some previous studies, and newly acquired specimens. 110 species that have been recorded from this area in literature, excluding those exclusively associated with chemosynthesis-based communities, were reclassified into 97 species. 23 species were newly added to the fauna, resulting in 120 species in total recorded from this area. Among them, 88 species were identified as named species, two were only referrable to similar species, and 30 were not identifiable as any species previously known, at least in the northwestern Pacific. Among the 88 named species, six were recorded for the first time in this area, including one recorded for the first time in Japanese waters. Based on these results, the characteristics of the gastropod fauna in the Sagami Bay and adjacent areas is discussed from the bathymetrical and geographical points of view.
Key words: Gastropoda, Sagami, bathyal, fauna, biogeography.

Introduction

The Sagami-nada (the Japanese word "nada" means an open sea), or Sagami Sea, is a sea area in the central part of the Pacific coast of Honshū, Japan, that is bounded by the coastline of Sagami Bay to the north and by straight lines connecting the southernmost tips of the Izu Peninsula, Izu-ōshima Island and the Bōsō Peninsula to the south. Although Sagami Bay by original definition is restricted to the narrow area north of a straight line connecting the southernmost tips of the Manazuru and Miura Peninsula (almost equivalent to a tatitude of 35°8′N), it has sometimes been used as a snynonym of the Sagami-nada in a broad sense, especially in the context of deep-sea biogeography. This wording is also adopted in the present review in accordance with the previous study (e.g. Okutani, 1964, 1968b).

Extensive surveys on the marine fauna have been carried out in this area since the 19th century. The molluscan fauna of the intertidal zone and continental shelf of the bay has thus been well documented (see Hasegawa, 2006 for gastropods). Ikeda and Kuramochi (2010) recently summarized all the previous records, as well as unpublished data, and listed 2229 marine mollusks in total from Sagami Bay.

In regard to the deep-sea fauna, Sagami Bay has also attracted considerable attention in connection with the development of deep-sea fisheries since the middle of the 19th century, as represented by the discovery of *Perotrochus beyrichii* (Hilgendorf, 1877). In the first review of the Japanese marine mollusks, Lischke (1869–1874) described some shelf and upper bathyal species, such as *Buccinum leucostoma* Lischke, 1872 and *Ginebis argenteonitens* (Lischke, 1872), from "Bucht von Jedo und zwar von Jokohama bis hinaus zur Insel Eno-Sima" [Bay of Tokyo, and more precisely from Yokohama to Enoshima Island] (=Sagami Bay).

Data on bathyal mollusks have subsequently been gathered by research vessels, such as H.M.S.

Challenger and the steamer *Albatross* of the U.S. Fish Commission, and most significantly by a series of cruises of the R/V *Sōyō Maru* of the Imperial Fisheries Experimental Station (later the Tokai Regional Fisheries Research Laboratory), as described below in detail. The results (Okutani, 1964, 1966, 1968a) formed the basis of our current knowledge of the bathyal mollusks, not only of Sagami Bay but also throughout temperate Japanese waters.

Recent deep-sea research in Sagami Bay has focused on the chemosynthesis- based communities, mainly at the site located off Hatsushima Island that was found in 1984 by chance (Okutani & Egawa, 1985). No comprehensive review of the bathyal fauna of normal bottoms in Sagami Bay and the adjacent areas has been undertaken to date.

In the present paper, bathyal shell-bearing gastropods that inhabit a depth range of 400 to 1600 m in Sagami Bay are reviewed based on information in previous publications, some of the voucher material from those publications, and some newly acquired specimens.

Materials and Methods

Information from literature

Species identified from specimens recorded from Sagami Bay [= sea area Sagami-nada] (Fig. 1) at a depth of 400 m or deeper (down to ca. 1600 m) with precise position and depth data are included in the list (Table 1). Species that were recorded from this area but without precise data are not included. For example, *Ancillus apicalis* Ninomiya, 1988 is said to be distributed in "Sagami Bay to Kyushu. Mud bottom in 250–500 m deep." (Tsuchida in Okutani, 2000), but it was not included here because of the lack of specimens or information with precise data. Species recorded exclusively from chemosynthesis-based communities are not included either, but are listed separately in an appendix.

The identifications of species previously recorded in literature were reconsidered based on the description, figure(s), and available voucher material. Most of the vouchers from a series of Okutani's works are now preserved in the National Museum of Nature and Science (NSMT) and partly in the University Museum, University of Tokyo (UMUT; holotypes of new taxa described in Okutani, 1964). However, almost all voucher material of the family Turridae (*sensu lato*: including families Turridae, Drillidae and a part of Conidae), including types, was unfortunately not located. Accordingly, taxonomical problems surrounding some turrid taxa could not be solved.

Positive stations from previous publications are summarized in Tables 1–2, and plotted in Fig. 1.

Newly acquired materials

Additional material was obtained by research cruises of the R/V *Tansei Maru* of Japan Agency for Marine-Earth Science (JAMSTEC) (cruise numbers: KT-04-7, KT-04-10, KT-07-31), the T/S *Seiyō Maru* of the Tokyo University of Fisheries (now Tokyo University of Marine Science and Technology), and a commercial fishing boat, as summarized in Table 2. All the live-collected specimens were primarily fixed in neutralized 10% seawater formalin, and later preserved in 70% ethanol. They were examined only externally for identification, without destructive procedures including the extraction of radula. Empty shells are preserved as dry specimens. All the material examined is stored in the malacological collection of the NSMT, unless otherwise stated. Each specimen lot is to be registered separately and to be made available on the internet via the NSMT database [http://db.kahaku.go.jp/webmuseum/].

Results

Review of previous studies on bathyal gastropods in Sagami Bay

Specimens with precise position and depth data primarily stem from surveys by various research vessels. In Sagami Bay, several research vessels played especially important roles, and their results are here briefly reviewed.

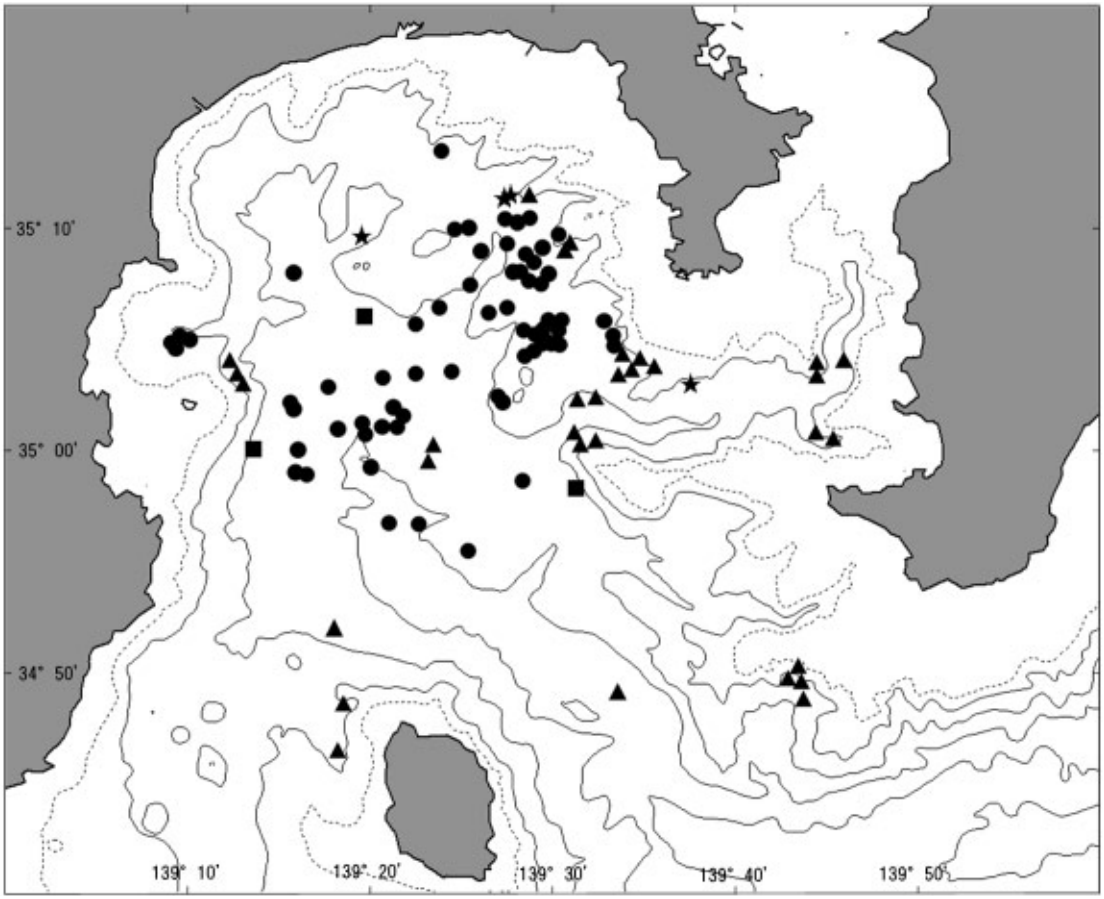


Fig. 1. A map showing positive stations in Sagami Bay [the sea area Sagami-nada]. Symbols: star, the *Challenger* and *Albatross* (Table 1); circle, the *Sōyō Maru* and *Rinkai Maru* (Table 1); triangle, the *Tansei Maru*, *Seiyō Maru* and *Ido-Inkyo Maru* (Table 2); square, Chemosynthetic sites (Appendix).

1) H.M.S. *Challenger*: *Challenger* visited Japan in 1875, and carried out dredging and trawling at several areas, such as in the Seto Inland Sea, offshore in the Enshū-nada, south off the Bōsō Peninsula, and in Sagami Bay. Two stations were located in Sagami Bay; st. 232, off Inosima [= Enoshima], 345 fathoms [627 m] and st. 236, near Okinoyama bank [1410 m] (see Table 1 and Fig. 1 for precise position). Two gastropod species *Bembix aeola* and *Pleurotoma* (*Genota*) *engonia* were described as new from st. 232, but no gastropods were recorded at st. 236.

2) The steamer *Albatross* of the U.S. Fish Commission (later Bureau of Fisheries): *Albatross* came to Japan three times, in 1890, 1896 and 1906. In Sagami Bay, she carried out 40 dredge or trawl runs in total, and nine of them exceeded 400 m in depth. Five new species were described based on specimens collected from three stations: st. 5087 (*Turricula hondoana* Dall, 1925), st. 5088 (*Turcicula japonica* Dall, 1925; *Suavodrillia sagamiana* Dall, 1925 [= *Bathytoma engonia*]; *Aforia japonica* Bartsch, 1945), and st. 5093 (*Turcicula japonica* Dall, 1925). Besides these, *Boreotrophon gorgon* Dall, 1913, which is also included in the present review, was described from st. 3698 at 153 fathoms [280 m].

3) The R/V *Sōyō Maru* of the Imperial Fisheries Experimental Station (later the Tokai Regional Fisheries Research Laboratory): The R/V *Sōyō*

Table 1. Station data from previous studies.

St.	Vessel	Original St.	Gear*	Date	Position	Depth (m)	Source of data**
C01	*Challenger*	232	1	17–19 May 1875	35°11′ N 139°28′ E	621	4
A01	*Albatross*	5087	1	23 October 1906	35°09.4′ N 139°19.05′ E	1105	5
A02	*Albatross*	5088	1	25 October 1906	35°11.25′ N 139°28.2′ E	664–729	5
A03	*Albatross*	5093	1	26 October 1906	35°03.15′ N 139°37.42′ E	544–544	5
S01	R/V *Sōyō Maru* II	2	2	12 November 1955	35°05.1′ N 139°33.3′ E	700–750	6
S02	R/V *Sōyō Maru* II	T28	2	3 October 1957	35°05′ N 139°22′ E	1320–1480	6
S03	R/V *Sōyō Maru* II	T24	2	4 October 1957	35°04.6′ N 139°07.4′ E	380–425	6
S04	R/V *Sōyō Maru* II	T29	2	8 April 1958	35°4.8′ N 139°30.2′ E	620–780	6
S05	R/V *Sōyō Maru* II	T29	2	15 November 1958	35°05′ N 139°29.3′ E	710–770	6
S06	R/V *Sōyō Maru* II	T28	2	16 November 1958	35°01′ N 139°19.6′ E	1360–1385	6
S07	R/V *Sōyō Maru* II	T28′	2	19 January 1959	35°03.5′ N 139°24.5′ E	1190–1220	6
S08	R/V *Sōyō Maru* II	T29′	2	17 March 1959	35°05.8′ N 139°32.4′ E	580–790	6
S09	R/V *Sōyō Maru* II	T29	2	12 August 1959	35°04.1′ N 139°28.4′ E	770–930	6
S10	R/V *Sōyō Maru* II	53	2	7 December 1959	35°06.3′ N 139°27.2′ E	740–1030	6
S11	R/V *Sōyō Maru* II	T29	2	9 July 1960	35°08.5′ N 139°28.9′ E	750	6
S12	R/V *Sōyō Maru* II	T28	2	10 July 1960	35°01.1′ N 139°21.3′ E	1400	6
S13	R/V *Sōyō Maru* II	59	2	27 November 1960	35°05.35′ N 139°18.7′ E	550	6
S14	R/V *Sōyō Maru* II	7	2	28 January 1962	35°05.8′ N 139°32.8′ E	750	6
S15	R/V *Sōyō Maru* II	118	2	10 March 1962	35°09.9′ N 139°30.4′ E	700	6
S16	R/V *Sōyō Maru* II	T28a	2	8 June 1962	35°07.5′ N 139°29.1′ E	710	6
S17	R/V *Sōyō Maru* II	T28d	2	8 June 1962	35°06.6′ N 139°23.9′ E	720	6
S18	R/V *Sōyō Maru* II	T28g	2	9 June 1962	35°08.4′ N 139°27.2′ E	1020	6
S19	R/V *Sōyō Maru* II	T29	2	13 June 1962	35°05.1′ N 139°30.3′ E	780–700	6
S20	R/V *Sōyō Maru* II	T23	2	11 December 1962	35°04.6′ N 139°29′ E	700	6
S21	R/V *Sōyō Maru* II	115	2	14 March 1963	35°08′ N 130°28.1′ E	735	6
S22	R/V *Sōyō Maru* II	169	2	30 May 1963	35°04.9′ N 139°33.2′ E	780	6
S23	R/V *Sōyō Maru* II	132	2	24 March 1964	35°07.8′ N 139°28.5′ E	650–680	6
S24	R/V *Sōyō Maru* II	T21(1)	2	20 July 1964	35°05′ N 139°30.1′ E	655–675	6
S25	R/V *Sōyō Maru* II	T22(1)	2	21 July 1964	34°58.8′ N 139°28.1′ E	1330–1340	6
S26	R/V *Sōyō Maru* II	T21(2)	2	15 December 1964	34°56.8′ N 139°21′ E	1470–1500	6
S27	R/V *Sōyō Maru* II	T22(2)	2	15 December 1964	35°02.5′ N 139°27′ E	1005–1020	6
S28	R/V *Sōyō Maru* II	174	2	9 March 1965	35°05.9′ N 139°29.8′ E	685	6
S29	R/V *Sōyō Maru* II	T7	2	1 October 1965	34°56.9′ N 139°22.7′ E	1510	6
S30	R/V *Sōyō Maru* II	T11	2	1 October 1965	35°50.5′ N 139°29′ E	690–780	6
S31	R/V *Sōyō Maru* II	T11	2	14 February 1966	35°06.5′ N 139°27.5′ E	855–865	6
S32	R/V *Sōyō Maru* II	T7	2	16 February 1966	34°54.1′ N 139°25.1′ E	1510–1530	6
S33	R/V *Sōyō Maru* II	T7	2	6 July 1966	35°13.5′ N 139°23.8′ E	565–590	6
S34	R/V *Sōyō Maru* II	T6	2	9 July 1966	35°01.6′ N 139°21.9′ E	1140	6
S35	R/V *Sōyō Maru* II	T7	2	13 November 1966	35°07′ N 139°27′ E	730–790	6
S36	R/V *Sōyō Maru* II	T7	2	30 June 1967	35°09.9′ N 139°24.5′ E	525–540	6
S37	R/V *Sōyō Maru* II	T6	2	1 July 1967	35°02′ N 139°17.8′ E	1395	6
S38	R/V *Sōyō Maru* II	T6	2	12 December 1967	35°00.8′ N 139°14.9′ E	1330	6
S39	R/V *Sōyō Maru* II	T7	2	12 December 1967	35°08.8′ N 139°28′ E	990–1000	6
S40	R/V *Sōyō Maru* II	T6	2	13 July 1968	35°02′ N 139°21.3′ E	1490	6
S41	R/V *Sōyō Maru* II	T6	2	11 December 1968	35°02.1′ N 139°15.7′ E	1340	6
S42	R/V *Sōyō Maru* II	T7	2	11 December 1968	35°08′ N 139°28.8′ E	890–930	6
S43	R/V *Sōyō Maru* II	T7	2	12 July 1969	35°09′ N 139°29.5′ E	730–765	6
S44	R/V *Sōyō Maru* II	T6	2	13 July 1969	34°59′ N 139°15.8′ E	1390	6
S45	R/V *Sōyō Maru* II	T6	2	4 October 1969	35°08′ N 139°15.7′ E	1380	6
S46	R/V *Sōyō Maru* II	T7	2	25 June 1970	35°10.1′ N 139°25.4′ E	700	8

Table 1. (continued).

St.	Vessel	Original St.	Gear*	Date	Position	Depth (m)	Source of data**
S47	R/V *Sōyō Maru* II	T6	2	26 June 1970	35°01.1′ N 139°20.6′ E	1200	8
S48	R/V *Sōyō Maru* III	T7	2	8 August 1971	35°10.3′ N 139°28.1′ E	750–850	8
S49	R/V *Sōyō Maru* III	T6	2	9 August 1971	34°59.9′ N 139°16′ E	1300	8
S50	R/V *Sōyō Maru* III	T6	2	20 November 1971	34°59.2′ N 139°19.9′ E	1560	8
S51	R/V *Sōyō Maru* III	T6	2	29 June 1972	35°20.3′ N 138°27.1′ E	1000–1190	8
S52	R/V *Sōyō Maru* III	T7	2	30 June 1972	35°07.7′ N 139°29.9′ E	450–700	7
S53	R/V *Sōyō Maru* III	T10	2	24 November 1972	35°04.7′ N 139°08.8′ E	450	8
S54	R/V *Sōyō Maru* III	T10	2	30 June 1973	35°05.9′ N 139°08.9′ E	400	8
S55	R/V *Sōyō Maru* III	T10	2	10 August 1976	35°05.2′ N 139°09.9′ E	520	8
S56	R/V *Sōyō Maru* III	T6	2	13 November 1976	35°01.1′ N 139°18.2′ E	1380	8
S57	R/V *Sōyō Maru* III	T10	2	17 November 1976	35°05.5′ N 139°08.4′ E	450	8
S58	R/V *Sōyō Maru* III	T7	2	23 November 1971	35°08.8′ N 139°26.1′ E	940	8
S59	R/V *Sōyō Maru* III	T7	2	26 November 1972	35°10.1′ N 139°29.9′ E	480	7
R01	R/V *Rinkai Maru*	RK01-01	3	20 February 2001	35°09.3′ N 139°31′ E	573–610	9
R02	R/V *Rinkai Maru*	RK01-04	3	21 February 2001	35°08.8′ N 139°30.9′ E	730–725	9
R03	R/V *Rinkai Maru*	RK01-10	3	16 March 2001	35°11.5′ N 139°28.7′ E	432–580	9
R04	R/V *Rinkai Maru*	RK02-08	3	27 February 2002	35°07.7′ N 139°33.1′ E	455–527	9

*Gear used. 1, dredge/trawl; 2, Nakai-type beam trawl; 3, biological dredge of 1 m span.
**Source of data. 4, Watson (1886); 5, National Museum of Natural History, web site, http://invertebrates.si.edu/albatross/albatross.cfm; 6, Okutani (1968b); 7, Okutani (1987); 8, unpublished data; 9, Hasegawa (2005).

Table 2. Station data for newly acquired materials.

St.	Vessel	Cruise #	Orginal St.	Gear*	Date	Position in	Position out	Depth (m)
I01	*Ido-Inkyo Maru*		01-TA2	1	22 February 2001	35°03.38′ N 139°46.02′ E		650
I02	*Ido-Inkyo Maru*		01-TA3	1	14 March 2001	35°03.56′ N 139°44.44′ E	35°03.821′ N 139°43.502′ E	500
I03	*Ido-Inkyo Maru*		02-TA3	1	8 March 2002	35°03.8′ N 139°43.69′ E		470
Y01	T/S *Seiyō Maru*		NB-2	2	21 April 1990	35°00.3′ N 139°45.38′ E		490
Y02	T/S *Seiyō Maru*		NB-3	2	21 April 1990	35°00.7′ N 139°44.17′ E		690
Y03	T/S *Seiyō Maru*		NB-5	2	22 April 1990	35°02.13′ N 139°31.37′ E		1190
T01	R/V *Tansei Maru*	KT-04-7	SB4-1	3	13 May 2004	35°00.46′ N 139°32.11′ E	35°00.26′ N 139°31.9′ E	613–541
T02	R/V *Tansei Maru*	KT-04-7	SB4-2	3	13 May 2004	35°00.27′ N 139°31.79′ E	35°00.15′ N 139°31.55′ E	87–481
T03	R/V *Tansei Maru*	KT-04-7	SB5-1	3	13 May 2004	35°00.64′ N 139°31.41′ E	35°00.48′ N 139°31.21′ E	848–718
T04	R/V *Tansei Maru*	KT-04-7	MR1-2	3	13 May 2004	34°49.93′ N 139°42.88′ E	34°50.1′ N 139°43.24′ E	646–517
T05	R/V *Tansei Maru*	KT-04-7	MR1-3	3	13 May 2004	34°49.78′ N 139°43.36′ E	34°49.64′ N 139°43.54′ E	600–573
T06	R/V *Tansei Maru*	KT-04-7	SA-1	4	13 May 2004	35°00.92′ N 139°23.29′ E	34°58.83′ N 139°23.33′ E	1393–1459
T07	R/V *Tansei Maru*	KT-04-10	B-1	3	5 June 2004	34°52′ N 139°18′ E		1087–1147
T08	R/V *Tansei Maru*	KT-04-10	B-5	3	6 June 2004	34°49′ N 139°33.5′ E		1415–1439
T09	R/V *Tansei Maru*	KT-07-31	L-1-800	4	23 November 2003	35°03.963′ N 139°12.437′ E	35°02.726′ N 139°13.733′ E	856–756.3
T10	R/V *Tansei Maru*	KT-07-31	L-1-700	4	23 November 2003	35°03.424′ N 139°12.421′ E	35°04.818′ N 139°12.593′ E	517–753.6
T11	R/V *Tansei Maru*	KT-07-31	L-1-500	5	24 November 2003	35°03.178′ N 139°12.461′ E	35°02.819′ N 139°12.006′ E	505–255.3
T12	R/V *Tansei Maru*	KT-07-31	L-2-500	5	24 November 2003	35°04.576′ N 139°33.974′ E	35°04.549′ N 139°34.792′ E	575–338
T13	R/V *Tansei Maru*	KT-07-31	L-2-800	4	24 November 2003	35°03.307′ N 139°33.789′ E	35°02.83′ N 139°31.975′ E	765–904.8
T14	R/V *Tansei Maru*	KT-07-31	L-2′-500	6	27 November 2003	35°03.773′ N 139°35.554′ E	35°03.982′ N 139°35.333′ E	498–437.7
T15	R/V *Tansei Maru*	KT-07-31	L-2′-600	6	27 November 2003	35°03.98′ N 139°34.745′ E	35°04.268′ N 139°34.957′ E	634–406.8
T16	R/V *Tansei Maru*	KT-07-31	L-2′-700	6	27 November 2003	35°03.745′ N 139°34.436′ E	35°04.087′ N 139°34.043′ E	723–728.1
T17	R/V *Tansei Maru*	KT-07-31	L-2′-1000	4	27 November 2003	35°02.223′ N 139°32.667′ E	35°03.038′ N 139°33.737′ E	1104–680.6

*Gear used. 1, comercial crab cage; 2, Sldge net; 3, ORE Beam trawl of 3m; 4, Sigsby-Agassiz Beam Trawl of 3m; 5, CB dredge; 6, ORI Biological dredge of 1m.

Maru I (1925–1955) engaged in a comprehensive benthic survey, entitled "Survey of the Continental Shelf Bordering Japan", during the years 1922–1930. Among the 658 stations sampled around the Japanese Archipelago, 26 were located in Sagami Bay (Horikoshi *et al*., 1982). However, most of the material acquired during the survey was scattered and lost before detailed taxonomic study could be undertaken.

The R/Vs *Sōyō Maru* II (1955–1970) and III (1970–1994) were equipped with more powerful winches that could operate trawls down to ca. 6000 m (in the case of R/V *Sōyō Maru* III). They carried out bottom trawling and dredging repeatedly in connection with a radioactivity survey during the years 1957–1976. More than 65 trawling operations were carried out in Sagami Bay within the depth range of 400–1600 m. Based on the material obtained during the survey, Okutani (1964, 1966, 1968a) recorded 94 species in total, including 20 new ones (77, including 16 new, in 1964; 14 additional species, including 4 new, in 1966; 3 additional species in 1968a). Seven further species, including two new ones, were subsequently added based on this material (Okutani, 1977, 1987).

4) Other research cruises: Deep-sea research activity in Japanese waters has increased rapidly in the last 50 years with the debuts of many powerful research vessels, represented by the R/Vs *Hakuho Maru* and *Tansei Maru*, both of the Ocean Research Institute, University of Tokyo (now transferred to JAMSTEC). However, no significant progress regarding the bathyal fauna in Sagami Bay has been made during this period. Although the *Hakuho Maru* and *Tansei Maru* carried out at least 629 trawl operations for benthic faunal surveys during the years 1967–1999, only two were in Sagami Bay (Tsuchida, 2000: fig. 1). This may be because bottom trawls, even for research purposes, have generally been prohibited by fisheries registrations in Sagami Bay. Furthermore, the focus of deep-sea faunal research was shifted to Suruga Bay, adjacent and to the west of Sagami Bay, during this period (Ohta, 1983). There had been no noticeable contributions on the bathyal gastropod fauna in this area, except for Hasegawa (2006) who recorded gastropods mainly dredged by R/V *Rinkai Maru* of the University of Tokyo from sublittoral to upper bathyal zones in Sagami Bay, although only five among 100 stations exceeded 400 m.

5) Chemosynthetic community: Since a chemosynthesis-based community was found off Hatsushima Island for the first time in the northwestern Pacific, extensive surveys and experiments have continuously been carried out at this site and at other sites subsequently found elsewhere in the bay (Fujikura *et al*., 2008). Gastropods exclusively associated with the communities have already been review in detail by Sasaki *et al*. (2005, 2007), and are only summarized in an appendix in this paper.

Results of taxonomical examination

110 shell-bearing gastropods have previously been recorded from normal bottoms in Sagami Bay at depths of 400–1600 m. Re-examination of these taxa, mainly based on figures and voucher material, resulted in the reduction of the number of species to 97. On the other hand, 23 species were added based on re-examination of voucher material and examination of newly acquired material. In total, 120 species were shown to occur in this area. Among them, 88 are named, two could only be referred to similar species, and 30 were not identifiable as any species previously known in the northwestern Pacific. Among the 88 named species, six were recorded for the first time in this area, including two recorded for the first time in Japanese waters. They are described below in systematic order.

Taxonomy

The following is a list of shell-bearing gastropod species that have been recorded, or are newly recorded herein, from Sagami Bay at bathyal depths from 400 to ca. 1600 m. Species recorded for the first time from this area are marked "*", and those here recorded for the first time in the Japanese waters "**". Species previously record-

ed in literature are provided with their synonymies. In the synonymies, specific taxa that were established based on a specimen collected from this area are denoted by "†". Individual records in literature are summarized under the "Records" heading, with abbreviated station data (Table 1), and the depth range of all stations is given in brackets. Specimens actually examined in the present study are listed separately under "Material examined"; voucher specimens of previous work and newly acquired specimens are separated by a semicolon. Each lot is denoted by the abbreviated station number (Tables 1–2), followed by the number of specimens in parentheses. Specimens are basically preserved in 70% ethanol unless otherwise noted, but dried live-collected specimens or dead-collected shells are denoted by attaching a character "d" or "e", respectively, to the number. Systematic order generally follows Bouchet and Rocroi (2005).

Class **Gastropoda**

Family **Lepetidae** Gray, 1850

Sagamilepeta sagamiensis (Kuroda and Habe in Kuroda, Habe and Oyama, 1971) [Japanese name (Jn.): Sagami-shiro-gasa]

†*Lepeta sagamiensis* Kuroda and Habe in Kuroda, Habe and Oyama, 1971: 30 [Japanese part], 21 [English part], pl. 8, figs. 5, 6 (type locality: "Sagami Bay" [depth unknown]).

Sagamilepeta sagamiensis (Kuroda & Habe in Kuroda, Habe & Oyama, 1971) – Okutani, 1987: 127–128, pl. 1, figs. 1–5.

Records. S52, S59 [450–480 m].

Materials examined. T09 (2), T10 (1), T12 (4), T13 (1) [338–905 m].

Remarks. *Lepeta sagamiensis* was originally described from "Sagami Bay" without precise locality data (Kuroda *et al*., 1971), but it has subsequently been recorded in a depth range of 180–480 m (Okutani, 1987; Ikeda, 1989; Hasegawa, 2006). The lower range was considerably extended to 800 m by the present newly acquired material. Specimens collected from deeper locations (around 400 m and beyond) tend to possess rougher sculpture than those from shallower waters, although the two forms intergrade. Okutani (1987) proposed the new monotypical genus *Sagamilepeta* based on the "deep-water form" of this species with rougher sculpture, due to peculiarities in radular morphology.

Family **Anatomidae** McLean, 1989

Thieleella sagamiana (Okutani, 1964) [Jn.: Sagami-kuchikire-ebisu] (Figs. 2–3)

Schizotrochus lamellatus (A. Adams, 1862) – Okutani, 1964: 376.

†*Scissurella sagamiana* Okutani, 1964: 377–8, pl. 5, fig. 2; Okutani, 1966: 14–15.

Schizotrochus exquisita (Schepman, 1908) – Okutani, 1964: 376, pl. 5, fig.1 [non *Scissurella exqisita* Schepman, 1908].

Schizotrochus sagamiana (Okutani, 1964) – Okutani, 1966: 14–15.

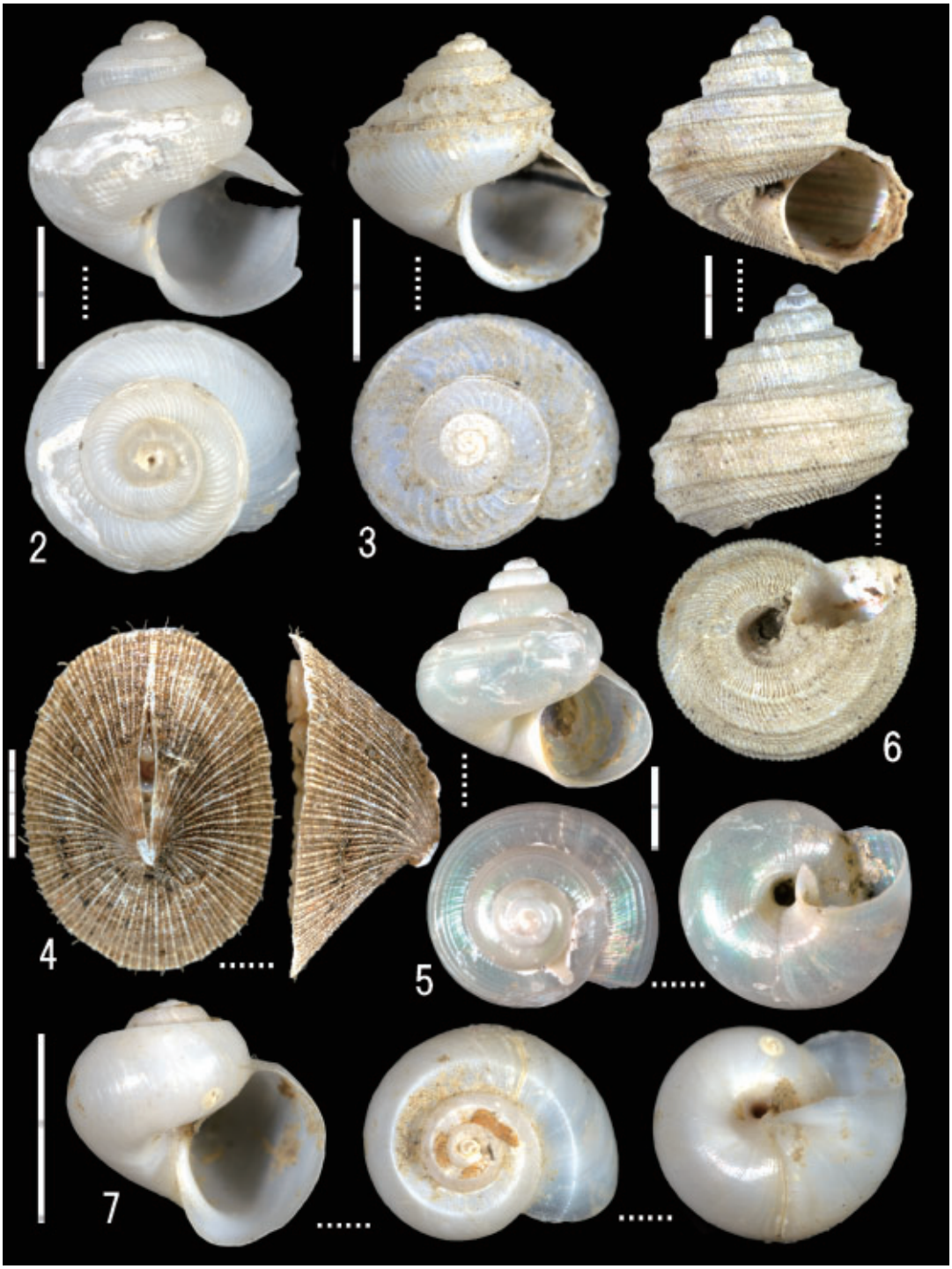
Anatoma sagamiana (Okutani, 1964) – Hasegawa, 2006: 231.

Records. S05 (type locality), S10 (as "*S. lamellatus*"), S13 (as "*S. exquisita*"), S15 (as "*S. lamellatus*"), S26, S27, R03 [432–1500 m].

Materials examined. S05 (holotype, UMUT RM8808; 1 paratype, NSMT-Mo 69582), S10 (1d), S15 (2e), S26 (2d+3e), R03 (2e); T17 (3), Y03 (1e) [723–1190 m].

Remarks. Sasaki and Geiger (2010) recently examined the type material and other specimens of "*Scissurella sagamiana*" in detail, and transferred this species to the genus *Thieleella* Bandel, 1998, on the basis of protoconch morphology.

Re-examination of the voucher material of Okutani (1964, 1966) in the present study revealed that all the anatomid specimens recorded from Sagami Bay under various names and listed in the above synonymy fall into the range of variation of a single species, viz. *Thieleella sagamiensis*. This species shows a wide range of variation in the number and strength of axial ribs, from the numerous fine ones seen in the holotype (Fig. 2) to widely spaced strong ones, seen in the specimens identified as "*Anatoma lamellatus*" (Fig. 3). However, they generally agree in other



Figs. 2–7. 2, *Anatoma sagamiana*, holotype, UMUT RM8808, S05 (710–770 m); 3, *Anatoma sagamiana*, S15 (700 m); 4, *Puncturella* sp., T14 (438–498 m); 5, *Solariella margaritiferus*, holotype, UMUT RM8810, S05 (710–770 m); 6, *Minolia* sp., S15 (700 m); 7, *Moelleriopsis nipponica*, holotype, UMUT RM8815, S06 (1360–1385 m); scale: 2 mm (2, 3, 5–7), 5 mm (4).

conchological characters, including the shape of the shell and morphology of the spiral cords. On the other hand, true "*A. lamellata*", which is distributed north to Suruga Bay, has a more globose shell with distinctly coarser spiral cords (see Okutani and Hasegawa in Okutani, 2000: pl. 18, fig. 1a–b, and Numanami and Okutani, 1990: fig. 7).

Although the specimens recorded under the name *Schizotrochus exquisita* (Schepman, 1908) from Sagami Bay by Okutani (1964: pl. 5, fig.1) are conspecific with *A. sagamiana*, the specimens recorded from off Miyakejima Island (R/V *Soyo-Maru* st. B2 (1967-XII-11), 1080–1205 m) comprise two species; one of the four specimens can indeed be identified as *Anatoma exquisita*, whereas the other three are *T. sagamiana.* The former specimen was incorrectly identified and illustrated by Okutani and Hasegawa in Okutani (2000: 37, pl. 18, figs. Scissurellidae-3a, b) as "*Anatoma maxima* [non Schepman, 1907]" using both light and scanning micrography. *Anatoma exquisita* is thus distributed in Japanese waters north to the Izu Islands, but not in Sagami Bay.

Family **Fissurellidae** Fleming, 1822

* ***Puncturella*** sp. (Fig. 4)

Material examined. T14 (1) [438–498 m].

Remarks. This species is represented by only one live-collected specimen. Two similar *Puncturella* species have been recorded from Sagami Bay and adjacent waters: *P. hirasei* Otsuka, 1935 [? = *P. kawamurai* Habe, 1961] and *P. regina* Shikama and Habe, 1961 (off Choshi; Shikama, 1962), but both significantly differ from the present species in outline, especially in lateral view, and sculpture. No other known species in the northwestern Pacific is comparable to the present one.

Family **Chilodontidae** Wenz, 1938

Bathybembix aeola (Watson, 1879) [Jn.: Kusairo-gin-ebisu (= Kogane-ebisu)]

†*Bembix aeola* Watson, 1879: 603; Watson, 1886: 95–96, pl. 7, fig. 13.

Bathybembix aeola (Watson, 1878) – Horikoshi, 1957: 60 (700–750 m); Okutani, 1964: 380–381, pl. 1, figs. 1–2; Okutani, 1966: 15, pl. 1, fig. 15; Okutani, 1968a: 26.

Records. C01 (type locality), S01, S04, S05, S11, S13, S16, S17, S15, S20, S18, S28, S35, S36 [550–1020 m].

Materials examined. S04 (2e), S05 (5d), S11 (2e), S13 (5e), S14 (2e), S28 (1e), S31 (1d), S35 (2d), S36 (2d); S54 (1d), T01 (2e), T02 (4), T03 (3e), T05 (1+4e), T09 (4+2e), T10 (7), T11 (2e), T13 (1+1e), T17 (1) [338–1104 m].

Remarks. This is one of the most dominant species in the bathyal zone of Sagami Bay.

Ginebis japonicus (Dall, 1925) [Jn.: Arare-gin-ebisu]

†*Turcicula japonica* Dall, 1925: 29, pl. 36, fig. 11.

Records. A02–03 (type localities) [544 –729 m].

Materials examined. T14 (2), T15 (3) [407–634 m].

Remarks. This species is more commonly found in shallower depths. Hasegawa (2006: 234) recorded it at a depth of 338–351 m in Sagami Bay.

Family **Trochidae** Rafinesque, 1815

Omphalomargarites sagamiensis Kuroda and Habe in Kuroda, Habe and Oyama, 1971 [Jn.: Sagami-habutae-shitadami]

†*Omphalomargarites sagamiensis* Kuroda and Habe in Kuroda, Habe and Oyama, 1971: 31–32 [Japanese part], 21–22 [English part], pl. 12, figs. 28, 29 (type locality: "Sagami Bay" [depth unknown]).

Material examined. T14 (1) [438–498 m].

Remarks. This species was originally described from Sagami Bay at an unknown depth. It had been known only from the type locality (Higo *et al*., 1999), until Hasegawa (2006: 234) re-recorded it from Sagami Bay at a depth of 338–351 m. The distribution of this species is so far restricted to an area near the mouth of Tokyo Bay at

300–500 m on muddy bottoms.

Hazuregyra watanabei Shikama, 1962 [Jn.: Hazure-shitadami]

Hazuregyra watanabei Shikama, 1962 – Okutani, 1966: 16.

Record. S26 [1470–1500 m].

Remarks. See Hasegawa (2009: 245) for the distribution and variability of this species.

Archiminolia iridescens (Habe, 1961) [Jn.: Suhada-shitadami]

Ethaliopsis iridescens Habe, 1961 – Okutani, 1964: 380, pl. 1, fig. 4.

Record. S19 [800 m].

Material examined. S19 (1d); T05 (3e) [573–610 m].

Remarks. *Ethaliopsis iridescens* Habe, 1961 was originally described from "off Ashizuri, Kochi Prefecture, Shikoku (about 200–300 m deep)" and is known to inhabit the continental shelf (e.g. 60–150 m: Sasaki in Okutani, 2000). Specimens examined in the present study generally agree with typical examples of this nominal taxon, but differ slightly by their smaller and more conical shell with a narrower umbilicus that is encircled by a sharper and granulate keel. Nevertheless these differences are not sufficient to separate them as distinct species, and the specimens examined in the present study are provisionally regarded as a phenotype of this species. Although the this species has been assigned to *Microgaza* Dall, 1881 by most previous authors, it is more appropriately placed in *Archiminolia* Iredale, 1929 as defined by Marshall (1999), due to its relatively high spire and narrowly open umbilicus (**new combination**).

Solariella delicata (Dall, 1919) [Jn.: Uba-shitadami]

Machaeroplax delicata (Dall, 1919) – Okutani, 1964: 381–2, pl. 1, fig. 8; Okutani, 1966: 15; Okutani, 1968a: 26–27.

Records. S04, S05, S11, S22, S27, S32 [620–1520 m].

Materials examined. S04 (11d), S05 (22d), S11 (10d), S22 (2d), S27 (6d), S32 (7d).

Remarks. See Hasegawa (2009: 247) for the distribution and variability of this species.

Solariella tenuicollaris Golikov and Sirenko, 1998 [Jn.: Toguro-shitadami]

Machaeroplax nyssonoides Kuroda, MS. – Okutani, 1964: 382, pl. 1, fig. 5 (nude name).

Machaeroplax sp. (*nyssonoides* Kuroda, MS) – Okutani, 1968a: 27 (nude name).

Records. S05, S32 [710–1520 m].

Materials examined. S05 (7d+2e), S32 (1e).

Remarks. This species had been cited in Japanese literature and in private collections as "*Machaeroplax nyssonoides*", a name that has not been validated to date. Okutani (1964) illustrated a specimen from Sagami Bay under this name, and Hasegawa (2009: 251) identified it as *S. tenuicollaris*, which was recently described from off Iturup Island, South Kurile Islands, at a depth of 1200 m. Re-examination of the voucher material confirmed this view. This species is characterized by the relatively small spire, the complete peristome that is slightly detached from the body whorl, and the sculpture with numerous dominant axial ribs.

Solariella margaritiferus (Okutani, 1964) [Jn.: Shinju-iro-shitadami] (Fig. 5)

†*Margarites margaritiferus* Okutani, 1964: 382, pl. 1, fig. 9, pl. 5, fig. 5; Okutani, 1966: 15.

Records. S04, S05 (type locality), S10, S27 [620–1030 m].

Materials examined. S04 (2d, NSMT-Mo 69581), S05 (holotype, UMUT RM8810), S10 (2d+1e), S27 (1d).

Remarks. This species can correctly be assigned to the genus *Solariella* S. Wood, 1842 because of the presence of weak but distinct spiral sculpture (**new combination**). Hasegawa (2009: 244) expanded the distribution of this species northwards to off Miyagi Prefecture.

Minolia sp. [Jn.: Tagakake-shitadami] (Fig. 6)

Minolia pseudobscura (Yokoyama, 1927) – Okutani, 1964: 379–80 [non *Solariella pseudob-*

scura Yokoyama, 1927].

Solariella sp. – Hasegawa, 2006: 235.

Records. S13, S15, R03 (as *Solariella* sp.) [432–700 m].

Materials examined. S13 (1e), S15 (1d), R03 (2e).

Remarks. The specimens recorded from Sagami Bay by Okutani (1964) as "*Minolia pseudobscura*" differ from holotype of *Solariella pseudobscura* Yokoyama, 1927 (UMUT CM24871: http://umdb2.um.u-tokyo.ac.jp/DKoseibu/specimens/en/24871_.html) in having a narrower umbilicus and more distinct axial sculpture, and are regarded as a undescribed species. Hasegawa (2006) also recorded this species as "*Solariella* sp." without illustration.

Family **Calliostomatidae** Thiele, 1924

* ***Otukaia kiheiziebisu*** (Otuka, 1939) [Jn.: Kiheiji-ebisu]

Material examined. T04 (1e) [517–528 m].

Remarks. Although this species is not rare off the northeastern coast of Honshu, ranging from the Kashima-nada north to Iwate Pretecture (Hasegawa, 2009: 245), and is also present in Tosa Bay (Okutani and Iwahori, 1992; Hasegawa, 2001), it has not been confirmed in Sagami Bay to date, except for a relatively ambiguous record by Ikebe (1942) as "off Misaki, Sagami Bay, 50–60 fathoms". Ikeda and Kuramochi (2010) suggested that the record in Sagami Bay could be based on a misidentification of *O ikukoae* Sakurai, 1994. However, although the specimen examined in the present study was an empty shell in rather poor condition, it can firmly be identified as *O. kiheiziebisu*. Furthermore, because specimens agreeing with the holotype of *O ikukoae* occur sympatrically with typical *O. kiheiziebisu* (Okutani and Iwahori, 1992) or even in the same haul (Hasegawa, 2001), and both differ only by the characters of the spiral cords (more numerous in number and granulate in *O. ikukoae*), they are regarded as phenotypes of a single species.

Family **Turbinidae** Rafinesque, 1815

Phanerolepida transenna (Watson, 1879) [Jn.: Kinuji-same-zanshō]

Phanelolepida transenna (Watson, 1879) – Okutani, 1964: 387–8, pl. 1, fig. 6; Okutani, 1966: 16; Okutani, 1968a: 28.

Records. S04, S11, S13, S15, S16, S19, S20, S27, S30, S31, S35 [550–1020 m].

Materials examined. S04 (2e), S13 (3e), S27 (2e), S31 (1e); T02 (1e) [481–565 m].

Remarks. This species is distributed along the Pacific coast from Sagami Bay to Tosa Bay. Several other species treated herein, including *Tachyrhynchus nomurai* (Ozaki, 1958), *Trochocerithium shikoensis* (Yokoyama, 1928) and *Buccinum leucostoma* (Lischke, 1874), show a similar distribution pattern, and they can be categorized as forming a temperate Japanese faunal element.

Moelleriopsis nipponica (Okutani, 1964) [New Jn.: Nejinuki-shitadami] (Fig. 7)

†*Choristes nipponica* Okutani, 1964: 388–389, pl. 6, fig. 2.

Records. S06 (type locality) [1360–1385 m].

Materials examined. S06 (holotype, UMUT RM8815); Y03 (2e) [1190 m].

Remarks. Although this species was originally assigned to the genus *Choristes* [= *Choristella*] in the family Choristellidae, McLean (1992) excluded it on the basis of conchological characters. It is rather tentatively assigned herein to the genus *Moelleriopsis* by the presence of angulations below the suture and around the umbilicus, although examination of the soft parts will be necessary to determine its precise systematic position (**new combination**).

Hasegawa (in Okutani, 2000: 87, pl. 43, fig. Skeneidae-18) mistakenly used the name "*nipponica* Okutani, 1964" to describe and illustrate *Choristes mollis* Okutani, 1964, which was described together in the same work. The present additional record is thus the second for this species besides the original description.

* ***Skenea*** sp. (Fig. 8)

Material examined. T17 (1) [681–1104 m].

Remarks. This probably undescribed species is provisionally assigned to the genus *Skenea* Fleming 1825 only because of its similarity in overall shell characters to the most of the species in the genus. Examination of soft parts is necessary for determination of its precise generic position.

* ***Cirsonella*** sp. (Fig. 9)

Material examined. Y03 (1e) [1190 m].

Remarks. The present material differs from the species recorded as "*Cirsonella* sp." by Hasegawa *et al*. (2001) and Hasegawa (2006) from off Shimoda, Izu Peninsula at depths of 93–109 m, and Sagami Bay at depths of 65–108 m, respectively, by the more conical shell and straighter columella.

Family **Cocculinidae** Dall, 1882

Cocculina japonica Dall, 1907 [Jn.: Watazoko-shirogasa]

Cocculina subcompressa Schepman, 1908 – Okutani, 1964: 388, pl. 1, fig. 10 [non *Cocculina subcompressa* Schepman, 1908].

Records. S08, S09 [580–930 m].

Remarks. Although the voucher material of Okutani (1964) was not located, his illustrated specimen differs considerably from *C. subcompressa*, which was originally described from the Banda Sea at a much shallower depth (216 m), by its more elevated shell and more posteriorly situated apex. On the other hand, it generally agrees with *C. japonica*, which was originally described from off Sado Island in the Sea of Japan, and has been shown to be distributed along the northeastern coast of Honshu south to the Kashima-nada (Hasegawa, 2009: 237).

* ***Cocculina*** sp. cf. ***pacifica*** Kuroda and Habe, 1949 (Fig. 10)

Cocculina punctoradiata Kuroda and Habe, 1949 – Okutani, 1964: 388 [non *Cocculina punotoradiata* Kuroda and Habe, 1949].

Record. S22 [780 m].

Material examined. S22 (1d).

Remarks. The voucher specimen of Okutani (1964) closely resembles the specimen recorded from Suruga Bay as "*Coccopigya* sp. cf. *pacifica* Kuroda and Habe, 1949" by Hasegawa (1997), with its elongate and laterally compressed shape and distinct radial striae that are crossed by rather irregular growth lines. However, it differs from the true *C. pacifica*, which was originally described from off Tosa [Kōchi Prefecture], by the much more posteriorly situated apex, and may actually belong to a different species.

Family **Cerithiidae** Férussac, 1819

Bittium sp. (Fig. 11)

Bittium sp. – Hasegawa, 2006: 240.

Records. R01 [573–610 m].

Material examined. R01 (3d).

Remarks. Hasegawa (2006) previously recorded this species from Sagami Bay without illustration, and the voucher specimen is illustrated herein. All the specimens are dead-collected in poor condition. They closely resemble the original figure of *Bittium xanthum* Watson, 1886, which was described from the Torres Strait in northeastern Australia at 3–11 fathoms, but differ in having a more elongate and straight-sided shell with weaker and more numerous axial ribs.

Family **Turritellidae** Lovén, 1847

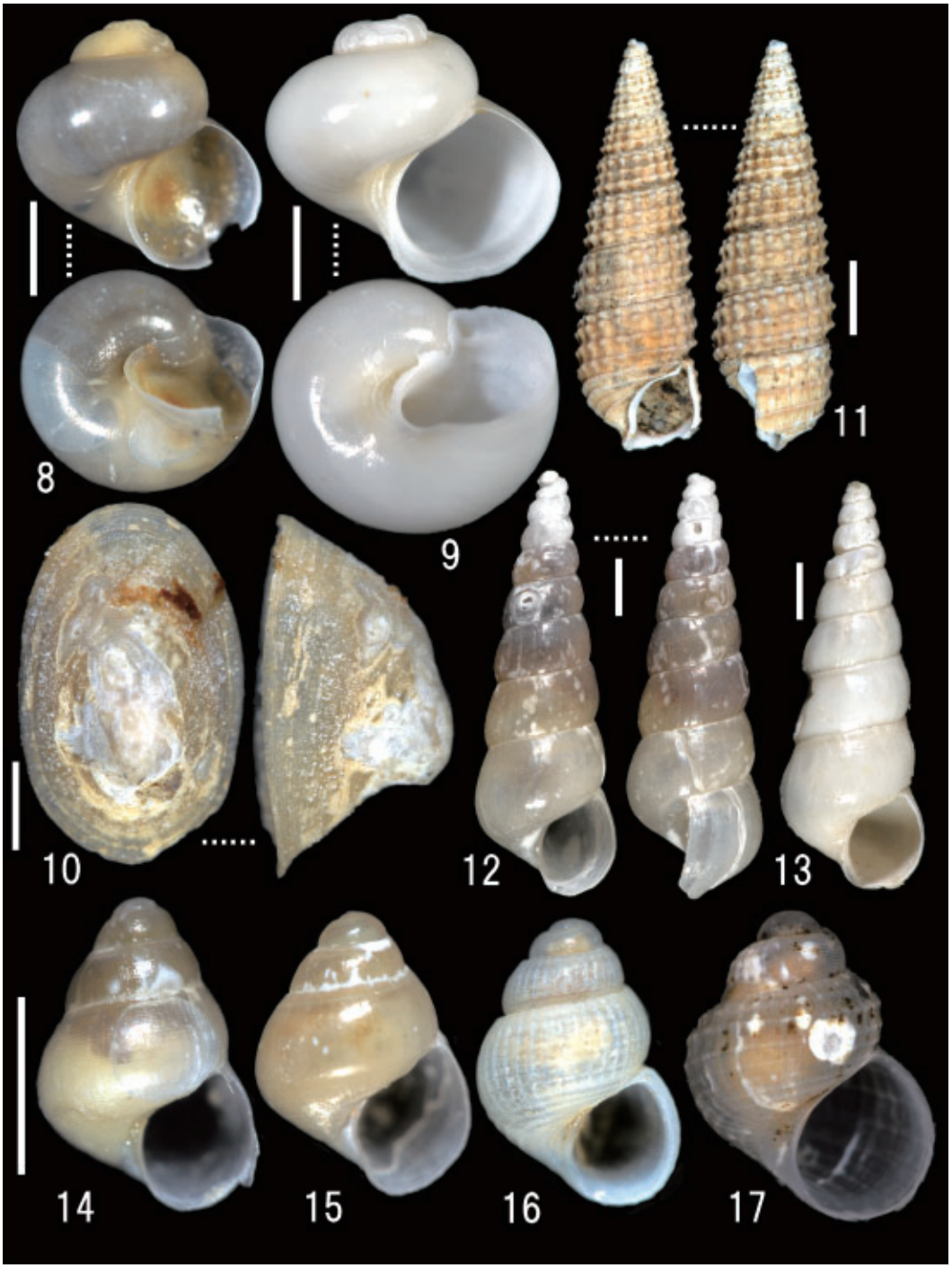
Tachyrhynchus nomurai (Ozaki, 1958) [New Japanese name: Nomura-hime-nina] (Figs. 12–13)

Eulimella sp. aff. *nomurai* Ozaki, 1958 – Okutani, 1964: 441; Okutani, 1968a: 43.

Records. S13, S35 [550–790 m].

Materials examined. S13 (ca. 170d), S35 (1e).

Remarks. This species has been recorded (as "*Abyssochrysos* ? sp.") from off the Bōsō Peninsula at 507–578 m (Tsuchida and Kurozumi, 1995) and from Tosa Bay at 742–1056 m (Hasegawa, 2001). However, because it possesses a round, multispiral operculum and a conventional



Figs. 8–17. 8, *Skenea* sp., T17 (681–1104 m); 9, *Cirsonella* sp., Y03 (1190 m); 10, *Cocculina* sp. cf. *pacifica*, S22 (780 m); 11, *Bittium* sp., R01 (573–610 m); 12, *Tachyrhynchus nomurai*, S13 (550 m); 13, *Tachyrhynchus nomurai*, holotype, NSM PM4477, Iioka Formation, Chiba Prefecture (Pliocene); 14, *Pseudosetia* sp. A, T17 (681–1104 m); 15, *Pseudosetia* sp. B, Y01 (490 m); 16, *Alvania* sp. A, Y02 (690 m); 17, *Alvania* sp. B, Y03 (1190 m); scale: 1 mm (14–17, at the same scale).

taenioglossate radula, and lacks a pallial tentacle [= pallial process (Houbrick, 1979)], it probably belongs to the genus *Tachyrhynchus* Morch, 1868 of the family Turritellidae (Hasegawa, personal observation). Direct comparison revealed no significant difference between the present material and Ozaki's (1958) holotype (National Museum of Nature and Science, Paleontological Collection, NSM PM44477: Fig. 13), which is a Pliocene fossil from the Iioka Formation in Chiba Prefecture (**new combination**).

Trochocerithium shikoensis (Yokoyama, 1928) [Jn.: Urauzu-kanimori]

Orectospira tectiformis (Watson, 1886) – Okutani, 1964: pl. 1, fig. 14; Okutani, 1968a: 29, pl. 3, fig. 6.

Trochocerithium shikoensis (Yokoyama, 1928) – Hasegawa, 2006: 241.

Records. S13, S15, S35, R01 [327–790 m].

Materials examined. S13 (2e), S35 (1d), R01 (2e); S52 (1d) [450–700 m].

Remarks. The specimens recorded by Kuroda *et al*. (1971) vaguely from "off Hayama (alive)" (NSMT-Mo R17810) were actually collected from "Amadai-ba Bank, ca. 400 m".

Family **Naticidae** Guilding, 1834

Euspira pallida (Broderip and Sowerby, 1829) [Jn.: Usuiro-tama-tsumeta]

Lunatia pallida Broderip & Sowerby, 1829 [sic; should be in parentheses] – Okutani, 1964: 393–4, pl. 1, fig. 19, pl. 5, fig. 8; Okutani, 1966: 16, pl. 2, fig. 6.

Eunatica pallida (Broderip & Sowerby, 1829) – Okutani, 1968a: 29.

Records. S04, S11, S16, S19, S23, S25, S26, S28, S33, S38, S39 [620–1500 m].

Materials examined. S11 (2d), S19 (1d), S23 (2e), S25 (1d+1e), S28 (1d+3e), S33 (1d+2e); S32 (1d), S38 (1d), S39 (1d); S32 (1d), S42 (1d), S46 (3e), S48 (1d+1e), S50 (1d), S51 (1e), S54 (3d), T02 (1e), T03 (1e), T05 (3e), T07 (1), T09 (2e), T10 (1e), T16 (1e) [481–1530 m].

Remarks. As discussed in detail by Hasegawa (2009: 262), this species shows remarkable variation in the shape, from globose to elongate, and in the size and width of the umbilicus. Future detailed study might reveal that it is a mixture of several cryptic species.

Euspira plicispira (Kuroda, 1961) [Jn.: Kizami-tama-tsumeta]

Lunatia plicispira Kuroda, 1961 – Okutani, 1964: 394, pl. 1, fig. 21.

Record. S03 [450 m].

Materials examined. S03 (2d).

Remarks. Kuroda *et al*. (1971) gave the vertical distribution of this species as 50–450 m, and it is more commonly found on the continental shelf. Hasegawa (2001) mentioned that specimens collected from bathyal depths in Tosa Bay (753–856 m) differ considerably from the typical form by having a more depressed shell with nearly completely closed umbilicus and indistinct plicate sculpture below the suture (Hasegawa, 2001: pl. 2, figs. J, K). On the other hand, neither the specimen illustrated by Kuroda *et al*. (1971: pl. 18, fig. 3; NSMT-Mo R18200), which was collected from "Amadai-ba Bank, ca. 400 m" in Sagami Bay according to the attached label, nor the present material from a depth of 450 m significantly differ from the typical form.

****Euspira nux*** (Okutani, 1964) [Jn.: Tane-tama-tsumeta]

Tectonatica clausa (Broderip & Sowerby, 1829) – Okutani, 1966: 17 (part) (non *Natica clausa* Broderip and Sowerby, 1829).

Lunatia sp. – Okutani, 1966: 17.

Records. S26 (as "*Lunatia* sp."), S32 (as "*Cryptonatica clausa*") [1470–1550 m].

Materials examined. S26 (1d), S32 (1d).

Remarks. This species can be distinguished from the closely similar *E. pallida* by possessing a thick periostracum, which becomes rugose around the umbilicus, and a very narrowly perforate umbilicus. It was originally described from the Kashima-nada, and subsequently recorded from Tosa Bay (Hasegawa, 2001: 135–6) and off the coast of northeastern Honshū (Hasegawa,

2009: 266), but the present material represents the first records of this species in Sagami Bay.

Euspira sp. [Jn.: Miyata-tama-tsumeta]

Lunatia miyatensis Oyama (MS) – Okutani, 1966: 17 (nude name).

Record. S26 [1470–1550 m].

Material examined. S26 (1d).

Remarks. The voucher material of Okutani (1966) is conspecific with the specimens identified by Hasegawa (2001: 136, pl. 2, fig. I) as "*Euspira* sp. 2" from Tosa Bay and by Hasegawa (2009: 267) as "*Euspira* sp." [Miyata-tama-tsumeta] from off northeastern Honshū. See Hasegawa (2009) for a discussion of the identification of this undescribed species.

Pseudopolinices sp. [Jn.: Shiro-obi-tama-tsumeta]

Lunatia nana Møll, 1878 – Okutani, 1964: 394, pl. 1, fig. 20, pl. 5, fig. 6; Okutani, 1966: 16–17, pl. 2, fig. 7 [non *Natica nana* Møller, 1842].

Eunatica nana (Moll, 1878) – Okutani, 1968a: 29–30, pl. 2, fig. 5 [non *Natica nana* Møller, 1842].

Records. S04, S05, S11, S12, S13, S25, S26, S27, S32, S33, S39 [480–1520 m].

Materials examined. S12 (1d), S27 (3d), S32 (1e), S33 (1d+1e); S22 (5d), S54 (1d) [480–780 m].

Remarks. See Hasegawa (2009: 268) for remarks on the identification of this species.

Cryptonatica affinis (Gmelin, 1791) [Jn.: Haiiro-tama-gai]

Tectonatica clausa (Broderip & Sowerby, 1829) – Okutani, 1964: 395–6, pl. 1, fig. 18, pl. 5, fig. 7; Okutani, 1966: 17, pl. 2, fig. 5, text-fig. 8; Okutani, 1968a: 30.

Records. S02, S05, S06, S11, S12, S22, S25 (part), S26, S27, S29, S32 (part), S37, S38, S39 [690–1520 m].

Materials examined. S12 (1d), S22 (3e), S25 (1d+2e), S26 (2d), S27 (1d), S32 (6e), S37 (4d), S38 (1d); S28 (2e), S33 (1d), S40 (2d), S41 (2d), S44 (5d+3e), S45 (2d), S46 (1d), S47 (1d), S49 (2d+3e), S50 (7d), S51 (1d), S54 (1d), T07 (1+1e), T08 (1e) [565–1560 m].

Remarks. The taxonomical relationship between the present species and the closely allied *C. aleutica* (Dall, 1919) is still unresolved (Hasegawa, 2009: 271), and more detailed examination would be necessary. Specimens identifiable as *C. aleutica* have not, however, been collected from Sagami Bay.

Family **Rissoidae** Gray, 1847

* ***Pseudosetia*** sp. A (Fig. 14)

Materials examined. T17 (2) [681–1104 m].

Remarks. This species resembles the specimen recorded from Sagami Bay at a depth of 93–108 m as "*Pseudosetia* sp." by Hasegawa (2006: fig. 4C), but differs in being much smaller in size (1.8 mm in shell length) and possessing fine spiral cords on the entire surface.

* ***Pseudosetia*** sp. B (Fig. 15)

Material examined. Y01 (1) [490 m].

Remarks. The present material comprises only one probably immature specimen. It closely resembles *Pseudosetia ficaratiensis* (Brugnone, 1876) distributed in the North Atlantic off Portugal and in the Strait of Gibraltar at 150–2000 m (Bouchet and Warén, 1993: 688, figs. 1595–6), but can be distinguished by possessing a distinct basal cord on the umbilical part.

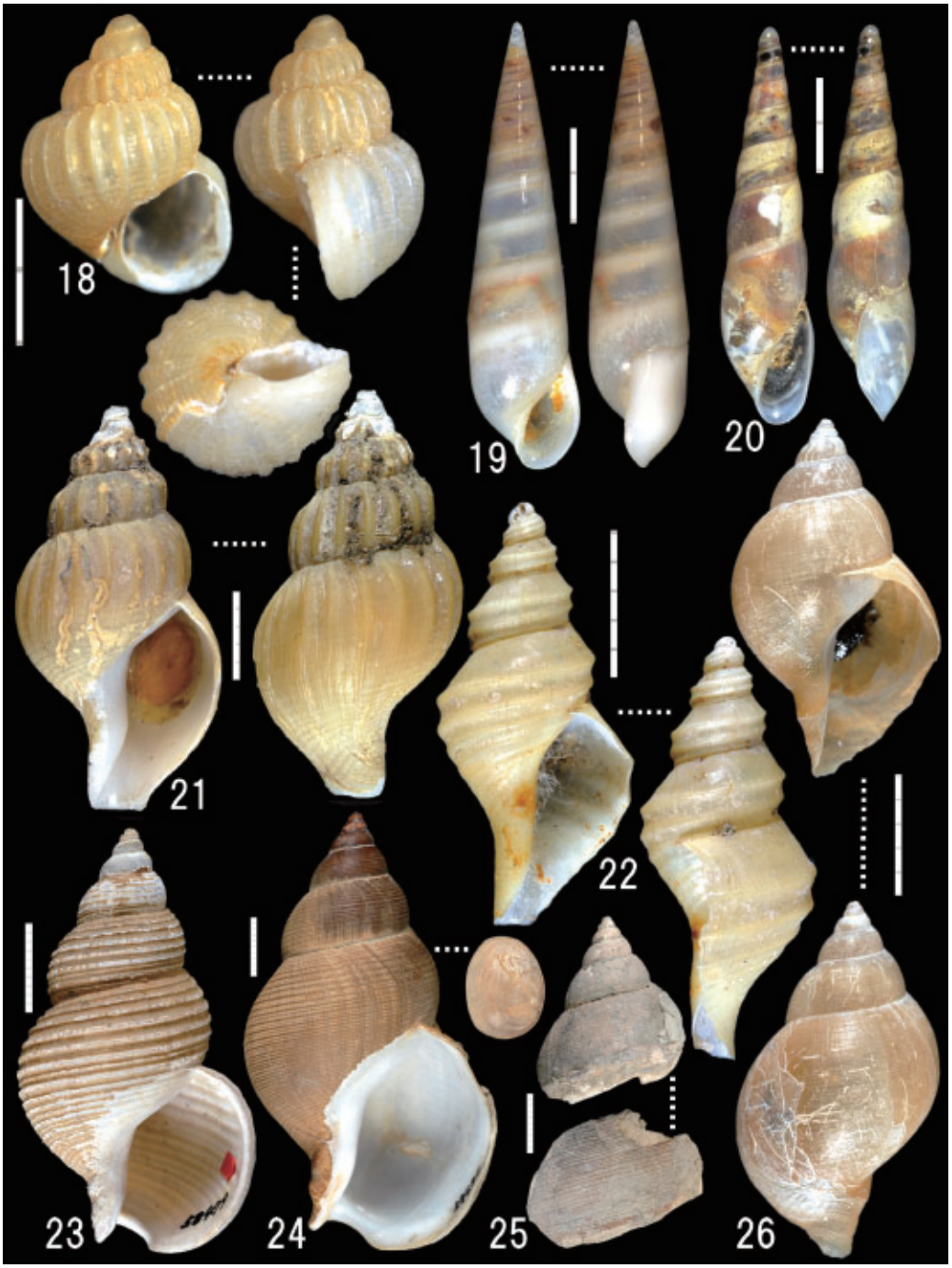
* ***Alvania*** sp. A (Fig. 16)

Material examined. Y03 (1e) [1190 m]

Remarks. The single available empty shell seems to fall into the range of variation of the North Atlantic *Alvania porcupinae* Gofas and Warén, 1982, as shown by Bouchet and Warén (1993: figs. 1424–1429). However, it is left undetermined because of the remarkable difference in geographical distribution and also the lack of enough material to assess intrapopulational variation.

* ***Alvania*** sp. B (Fig. 17)

Materials examined. Y02 (2) [690 m].



Figs. 18–26. 18, *Punctulum flava*, holotype, UMUT RM8817, S13 (550 m); 19, *Melanella* sp., S13 (550 m); 20, *Haliella* sp., S13 (550 m); 21, *Retifusus* sp., T08 (1415–1439 m); 22, *Pararetifusus tenuis*, holotype, NSMT-Mo 69570, S26 (1470–1500 m); 23, *Buccinum sagamianum*, holotype, NSMT-Mo 58479, S55 (400 m); 24, *Buccinum yoroianum*, holotype of *B. soyomaruae*, NSMT-Mo 58484, S57 (1380 m); 25, *Buccinum yoroianum*, holotype of *B. yoroianum*, NSM PM4483, Iioka Formation, Chiba Prefecture (Pliocene); 26, *Buccinum bombycinum*, T04 (517–528 m); scale: 2 mm (18–20), 5 mm (21, 22, 26), 10cmm (23–25).

Remarks. This species resembles *Punctulum flava* (Okutani, 1964) in possessing dense fine spiral sculpture on the protoconch, widely spaced thick axial ribs on the teleoconch whorls and a narrowly perforate umbilicus. However, it differs in having strong and widely spaced spiral cords and a larger aperture. No other comparable species is known.

Punctulum flava (Okutani, 1964) [Jn.: Watazoko-tsubo] (Fig. 18)

†*Microstelma flava* Okutani, 1964: 389–40, pl. 6, fig. 5.

Records. S13 (type locality) [550 m].

Materials examined. S13 (holotype, UMUT RM8817; 1 paratype, NSMT-Mo 69584).

Remarks. See Hasegawa (2009: 255) for details of the generic assignment and distribution of this species.

Frigidoalvania sp.

Frigidoalvania sp. – Hasegawa, 2006: 241–243, fig. 4A.

Records. R02 [725–730 m].

Materials examined. R02 (2e).

Remarks. Although the present species was discovered for the first time in Sagami Bay based on two old empty shells, it is more common off northeastern Honshū, at depths of 250–1500 m (Hasegawa, 2009: 256).

Family **Cassidae** Latreille, 1825

Semicassis inornata (Pilsbry, 1895) [Jn.: Hime-daiko]

Semicassis (Xenogalea) inornata (Pilsbry, 1895) – Hasegawa, 2006: 249.

Records. R04 [455–527 m].

Material examined. R04 (1e).

Remarks. Hasegawa (2006) recorded only one empty shell in poor condition. This species usually occurs in shallower water (its vertical range has been given as 50–200 m; Higo *et al.*, 1999, Okutani, 2000), and it has actually been recorded in Sagami Bay at a depth of 110–150 m (Kuroda *et al*., 1971). It is thus possible that the specimen had drifted from a shallower depth, although it slightly differs from ordinary examples of this species in being thinner and having a less developed apertural varix.

Family **Ranellidae** Gray, 1854

Fusitriton oregonensis (Redfield, 1846) [Jn.: Ayabora]

Fusitriton galea Kuroda & Habe – Okutani, 1977: 78.

Records: [S53, S54, S56 or S58 (Okutani, 1977)] [400–520 m].

Materials examined. I02 (1), I03 (2) [470–500 m]

Remarks. Hasegawa (2006) recorded this species at depths of 200–314 m in Sagami Bay. The taxonomical relationship between *F. oregonensis* and *F. galea* is a matter of argument, but they are regarded herein as phenotypes of single species (see Hasegawa, 2009: 271, for more discussion).

Family **Tonnidae** Suter, 1913

Oocorys schepmani Turner, 1948 [Jn.: Nagatamago-bora]

Oocorys elongata Schepman, 1909 – Okutani, 1966: 18, pl. 2, fig. 4.

Records. S26 [1470–1500 m].

Remarks. Although this species has been known as *Oocorys elongata* in most Japanese literature (e.g. Okutani, 2000), that name was originally preoccupied by *O. elongata* Locard, 1897, and a replacement name had been given.

Family **Epitoniidae** Berry, 1910

Cirsotrema* (*Elegantiscala*) *mituokai (Ozaki, 1958) [Jn.: Hokkai-itokake]

Cirsotrema kamiyanum Kuroda, MS — Okutani, 1964: 391, pl. 1, fig. 15; Okutani, 1968a: 42 (nude name).

Records. S11, S28 [750–685 m].

Material examined. S11 (1e).

Remarks. See Hasegawa (2009: 273) for de-

tails of the identification and synonymy of this species.

Epitonium* (*Mazescala*) *sawamurai (Azuma, 1960) [Jn.: Sawamura-itokake]

Spiniscala sawamurai (Azuma, 1960) – Okutani, 1964: 391; Okutani, 1966: 16.

Records. S15, S27 [700 m–1020 m].

Material examined. S15 (1e).

Remarks. Although the material examined was only a broken part of an empty shell, it can safely be identified as this species, because of the widely spaced and somewhat crenulate lamellae.

Family **Eulimidae** Philippi, 1853

Melanella sp. (Fig. 19)

Balcis sp. aff. *peronellicola* Kuroda et Habe, 1950 – Okutani, 1964: 393 (part).

Records. S13 [550 m].

Material examined. S13 (1d).

Remarks. Re-examination of the voucher material of Okutani (1964), which comprises three dried live-collected specimens, revealed that it can be divided into two discrete species; one in the genus *Melanella* Bowdich, 1822 that superficially resembles "*Balcis pernellicola*", and the other in the genus *Haliella* Monterosato, 1878, as mentioned below. The former can be distinguished from *Hypermastus peronellicola* and its allies by the slightly opisthocline aperture that is not prosocyrt, and the remarkable difference in the habitat; species of *Hypermastus*, including *H. peronellicola*, are exclusively parasitic on irregular sea urchins in the intertidal to sublittoral zones (Matsuda *et al*., 2010).

* ***Haliella*** sp. (Fig. 20)

Balcis sp. aff. *peronellicola* Kuroda et Habe, 1950 – Okutani, 1964: 393 (part).

Records. S13 [550 m].

Materials examined. S13 (2d).

Remarks. This species can clearly be assigned to the genus *Haliella* Monterosato, 1878 by the tall, blunt cylindrical shell with a very tall aperture and a strongly twisted columella. It is possibly conspecific with the one recorded from Tosa Bay (781–810 m) by Hasegawa (2001: pl. 2, fig. L), but apparently different from the species recorded from off northeastern Honshū (350 m) by Hasegawa (2009: figs. 142–143) as "*Haliella* sp."

Family **Buccinidae** Rafinesque, 1815

* ***Retifusus*** sp. (Fig. 21)

Materials examined. T18 (1+2e), T10 (1e) [517–1639 m].

Remarks. The present material most closely resembles the species recorded from off northeastern Honshu by Hasegawa (2009: 307, fig. 231) as *R. virens* (Dall, 1877). However, it differs considerably in having a thinner shell with far weaker spiral sculpture and a less reflected siphonal canal. Although it also resembles *Mohnia bella* (Ozaki, 1958), which is common in bathyal depths in the Kashima-nada and off northeastern Honshū, it differs by its shorter shell with stronger axial ribs. The generic placement of this species here is based merely on the similarity to *R. virens*, and examination of radula will be necessary to confirm it.

Pararetifusus tenuis (Okutani, 1966) [Jn.: Kudamaki-tsumu-bai] (Fig. 22)

†*Phymorhynchus* ? *tenuis* Okutani, 1966: 26, pl. 2, fig. 21, text-fig. 13.

Records. S26 (type locality) [1470–1500 m].

Material examined. S26 (holotype, NSMT-Mo 69570; 6 paratypes, NSMT-Mo 69571).

Remarks. See Hasegawa (2009: 308) for details of the generic assignment and distribution of this species.

Aulacofusus hiranoi (Shikama, 1962) [Jn.: Hirano-itomaki-tsumu-bai]

Aulacofusus calmeus [sic; = *calamaeus*] *hiranoi* (Shikama, 1962) – Okutani, 1964: 408, pl. 3, fig. 4; Okutani, 1968a: 32.

Records. S04 [620–780 m].

Remarks. See Hasegawa (2009: 299) for details of the identification and ecology of this spe-

cies.

Parancistrolepis fujitai (Kuroda, 1931) [Jn.: Fujita-bai]

Ancistrolepis fujitai Kuroda, 1931 – Okutani, 1964: 409, pl. 2, fig. 6; Okutani, 1968a: 32.

?*Ancistrolepis kinoshitai* (Kuroda, 1931) – Okutani, 1964: 410, pl. 2, fig. 5.

Records. S09, S15, S36 [600–930 m].

Materials examined. S36 (2e); S52 (1e) [450–700 m].

Remarks. *Parancistrolepis fujitai* and *P. kinoshitai* (Kuroda, 1931) are closely allied on the basis of overall shell and operculum characters, and they are primarily distinguished by the thickness of the periostracum. In addition, *P. kinoshitai* tends to have a thicker and more solid shell with a taller spire. Specimens collected from Sagami Bay, however, show a rather intermediate state; they generally agree with typical *P. fujitai* in shape, but possess a thin periostracum. Although Okutani (1964) recorded both "species" at the same station (S15), they are all provisionally identified as *P. fujitai*, until the relationship between the two nominal taxa becomes clearer.

Bathyancistrolepis trochoideus (Dall, 1907) [Jn.: Chijiwa-bai]

Ancistrolepis trochoideus Dall, 1907 [sic; should be in parentheses] – Okutani, 1964: 410, pl. 2, figs. 9–10; Okutani, 1966: 19–20, text-figs. 9A–G; Okutani, 1968a: 32–33.

Records. S04, S10, S11, S12, S13, S16, S19, S22, S24–27, S28, S31, S34 [550–1500 m].

Materials examined. S04 (2d+3e), S10 (1e), S12 (1d), S25 (1d), S27 (1d+2e), S28 (5e), S34 (1e); T06 (2+5e), T07 (1), T08 (3+8e), T09 (4e), T10 (2e), T17 (2e) [517–1459 m].

Remarks. Two rather discontinuous forms have been recognized in this species, separated by depth. Off northeastern Honshū, specimens collected within a depth range of 450–2000 m are characterized by a tall conical shell, with strong spiral cords of similar strength [*B. trochoideus ovoideus* (Habe and Ito, 1965)], whereas those collected from 2500–3000 m have a more depressed shell with usually two strong spiral cords around the periphery and additional weaker interstitial cords [*B. trochoideus trochoideus* (Dall, 1907)] (Hasegawa, 2009: 283). The former variant shows a narrower geographical distribution from the southern Kuril Islands (Kantor and Sysoev, 2006) to Sagami Bay, whereas the latter has a wider distribution along the temperate Pacific coast of Japan southwards to the Okinawa Trough (Hasegawa, 2005: 159, fig. 8H) where it inhabits shallower depths (Fig. 56). Although most recent authors regard both forms as phenotypes of a single species, more detailed study will certainly be necessary to clarify the relationship between them (see Discussion for more detail).

Buccinum sagamianum Okutani, 1977 [Jn.: Sagami-bai] (Fig. 23)

Ancistrolepis n. sp. (juv.) – Okutani, 1964: 410–411, pl. 2, fig. 13.

Neptunea sp. *β* (juv.) – Okutani, 1964: 413.

†*Buccinum sagamianum* Okutani, 1977: 73–75, 79, text-figs. 1–3, 9.

Records. S13 (as "*Neptunea* sp. *β* (juv.)"), S15 (as "*Ancistrolepis* n. sp. (juv.)"), S53, S55 (type locality), S56, S58 [400–700 m].

Materials examined. S13 (4d), S15 (1e), S55 (holotype, NSMT-Mo 58479; 2 paratypes, NSMT-Mo 58482, 58483); T09 (1e), I01 (20) [600–856 m].

Remarks. Re-examination of the specimens recorded from Sagami Bay as "*Ancistrolepis* n. sp. (juv.)" and "*Ancistrolepis* n. sp. (juv.)" by Okutani (1964) revealed that they are actually immature examples of this species, which is endemic to Sagami Bay. Ikeda (1985) showed in detail its distribution within the bay.

Buccinum yoroianum Ozaki, 1958 [Jn.: Sōyō-bai] (Figs. 24–25)

†*Buccinum soyomaruae* Okutani, 1977: 75–77, text-figs. 5–8, 10. **New synonym**.

Records. S26, S57 (type locality of *B. soyomaruae*) [1380–1500 m].

Materials examined. S26 (2 paratypes of *B. soyomaruae*, NSMT-Mo 58485, 58486), S57 (ho-

lotype of *B. soyomaruae*, NSMT-Mo 58484).

Remarks. *Buccinum yoroianum* was described based on a Pliocene fossil from the Iioka Formation in Chōshi, Chiba Prefecture (Ozaki, 1958: 153, pl. 17, fig. 10, pl. 15, fig. 6). The holotype (NSM PM4483: Fig. 25) is a badly broken shell, but it can reasonably be regarded as conspecific with the holotype of *Buccinum soyomaruae* Okutani, 1977 (Fig. 24), on the basis of its characteristic spiral sculpture and the shape of the remaining apical whorls. On the other hand, the specimen recorded as "*B. yoroianum*" from Sagami Bay (Okutani, 1966: 20, pl. 1, figs. 1–2) belongs to a different and probably undescribed species, as discussed below in detail under "*Buccinum* sp.".

Buccinum leucostoma Lischke, 1872 [Jn.: Suruga-bai]

†*Buccinum leucostoma* Lischke, 1872: 101; Lischke, 1874 in 1869–1874: 23–24, pl. 1, figs. 2–4 (type locality: "Bucht von Jedo und zwar von Jokohama bis hinaus zur Insel Eno-Sima"[depth unknown]; holotype illustrated by Cosel, 1998: fig. 16).

Buccinum leucostomum Lischke – Okutani, 1977: 78.

Records. [S53, S54, S56 or S58 (Okutani, 1977)] [400–520 m].

Materials examined. I01 (4), I02 (2) [500–650 m].

Remarks. This species was originally described from Sagami Bay at unknown depth. It usually inhabits shallower waters, in a range given by Kuroda *et al*. (1971) as 50–200 m, and rarely occurs in bathyal depths.

****Buccinum bombycinum*** Dall, 1907 [Jn.: Donguri-bai] (Fig. 26)

Material examined. T04 (1) [517–528 m].

Remarks. Although *Buccinum bombycinum* was originally described from "[*Albatross*] Station 5067, in 29 fathoms, on the east coast of Sakhalin Island, Okhotsk Sea", the actual position of sta. 5067 is in Suruga Bay, at a depth of 293 fathoms [527 m], as has already been pointed out by Kuroda (1950: 387). The correctness of the type locality in Suruga Bay is proved by the fact that specimens identical to the type material are actually collected from this area (e.g. Okutani, 2000). On the other hand, the specimens identified as this nominal taxon from the southern Kuril Islands and southeastern Sakhalin at 50–920 m (Golikov, 1980; Kantor and Sysoev, 2006: pl. 74, figs. G–H, as *Bathybuccinum bombycinum*) do not agree with type or with specimens from Suruga Bay. Furthermore, this species was not obtained during the intensive deep-sea survey along the coast of northeastern Honshū (Hasegawa, 2009), suggesting a discrete distribution for both forms. One immature specimen examined in the present study generally agrees with the those from Suruga Bay, especially in possessing characteristic black soft parts with a small operculum, though it differs slightly from typical specimens by its narrow shell with more distinct spiral cords. This represents the first confirmed record of this species outside Suruga Bay.

Buccinum sp. [Jn: Yoroi-ezo-bai]

Buccinum yoroianum Ozaki, 1958 – Okutani, 1966: 20, pl. 1, figs. 1–2 [non *Buccinum yoroianum* Ozaki, 1958].

Records. S27 [1005–1020 m].

Remarks. Only one lot of immature specimens has been recorded from Sagami Bay. The figured specimens agree with the one illustrated by Okutani (2000: pl. 247, fig. 199) as *Buccinum yoroianum*, but clearly differ from the type material of *Buccinum yoroianum* Ozaki, 1958 by the rather irregularly spaced spiral cords. This species may be related to *B. niponense* Dall, 1907 and *B. sagamianum* Okutani, 1977 in some shell characters, such as the relatively thin and small shell with predominant narrow spiral ribs, but more detailed study will be necessary to clarify their taxonomical relationships.

Neptunea kuroshio Oyama in Kira, 1959 [Jn.: Hime-ezobora-modoki]

†*Chrysodomus intersculptus minor* Hirase, 1908: 397–398 [Japanese part], 72 [English part], pl.

42, fig. 263 (type locality: "Sagami Bay (?)"; depth unknown).

Neptunea minor Hirase, 1908 – Okutani, 1964: 411–2; Okutani, 1977: 78.

Records. S15, [S53, S54, S56 or S58 (Okutani, 1977)] [400–700 m].

Material examined. I01 (1), I02 (2) [470–650 m].

Remarks. Because *Neptunea minor* (Hirase, 1908) became a secondary homonym of *Neptunea minor* Link, 1807, the name was replaced by *Neptunea kuroshio* Oyama in Kira, 1959, which was proposed based on specimens collected from either off Kii (Wakayama Prefecture) or Tosa Bay (Takenouchi, 2001). Although Kuroda *et al*. (1971) gave its vertical distribution as 50–200 m, it inhabits a range of 316–750 m in Tosa Bay, based on specimens with precise locality data (Okutani and Iwahori, 1992; Hasegawa, 2001), and also around 400 m and deeper in Sagami Bay (based on specimens preserved in the NSMT). The voucher specimen of Kuroda *et al*. (1971) cited merely as from "Sagami Bay" (NSMT-MoR18622) was actually dredged from "Amadai-ba bank, ca. 400 m".

Family **Fasciolariidae** Gray, 1853

* ***Granulifusus*** sp. (Fig. 27)

Material examined. T14 (1) [407–634 m].

Remarks. This species can be assigned to the genus *Granulifusus* Kuroda and Habe, 1954 by its granulate surface sculpture and small round operculum that does not fill the aperture (Hadorn and Fraussen, 2005). It differs from all other known species in Japanese waters by its large mamillate paucispiral protoconch.

Family **Columbellidae** Swainson, 1840

Zemitrella siligo Okutani, 1964 (Fig. 28)

†*Zemitrella*? *siligo* Okutani, 1964: 405–6, pl. 6, fig. 9.

Record. S15 (type locality) [700 m].

Materials examined. S15 (holotype, UMUT RM8829; 1 paratype, NSMT-Mo 69589).

Remarks. The placement of this species in *Zemitrella* Finlay, 1927 is only provisional, and it must be confirmed based on examination of the radula.

Family **Nassariidae** Iredale, 1916

Profundinassa babylonica (Watson, 1882) [Jn.: Watazoko-mushiro]

Neadmete profundicola Okutani, 1964: 419–20 (part) [non *Neadmete profundicola* Okutani, 1964].

Records. S15 (as "*Neadmete profundicola*") [700 m].

Material examined. S15 (1e).

Remarks. Although this species was recorded from Sagami Bay by Kuroda *et al*. (1971) at an unknown depth, the voucher material (NSMT-Mo R18622) was dredged from "Amadai-ba Bank, ca. 400 m". One immature example of this species was also found in the voucher material identified as *Neadmete profundicola* from Sagami Bay.

Family **Muricidae** Rafinesque, 1815

Abyssotrophon delicatus (Kuroda, 1953) [Jn.: Hina-tsuno-oriire]

Trophonopsis delicatus Kuroda, 1953 – Okutani, 1964: 401, pl. 3, fig. 7.

Records. S13, S15 [550–700 m].

Materials examined. S13 (2d, 1e), S15 (1d, 1e); T11 (1e) [255–505 m].

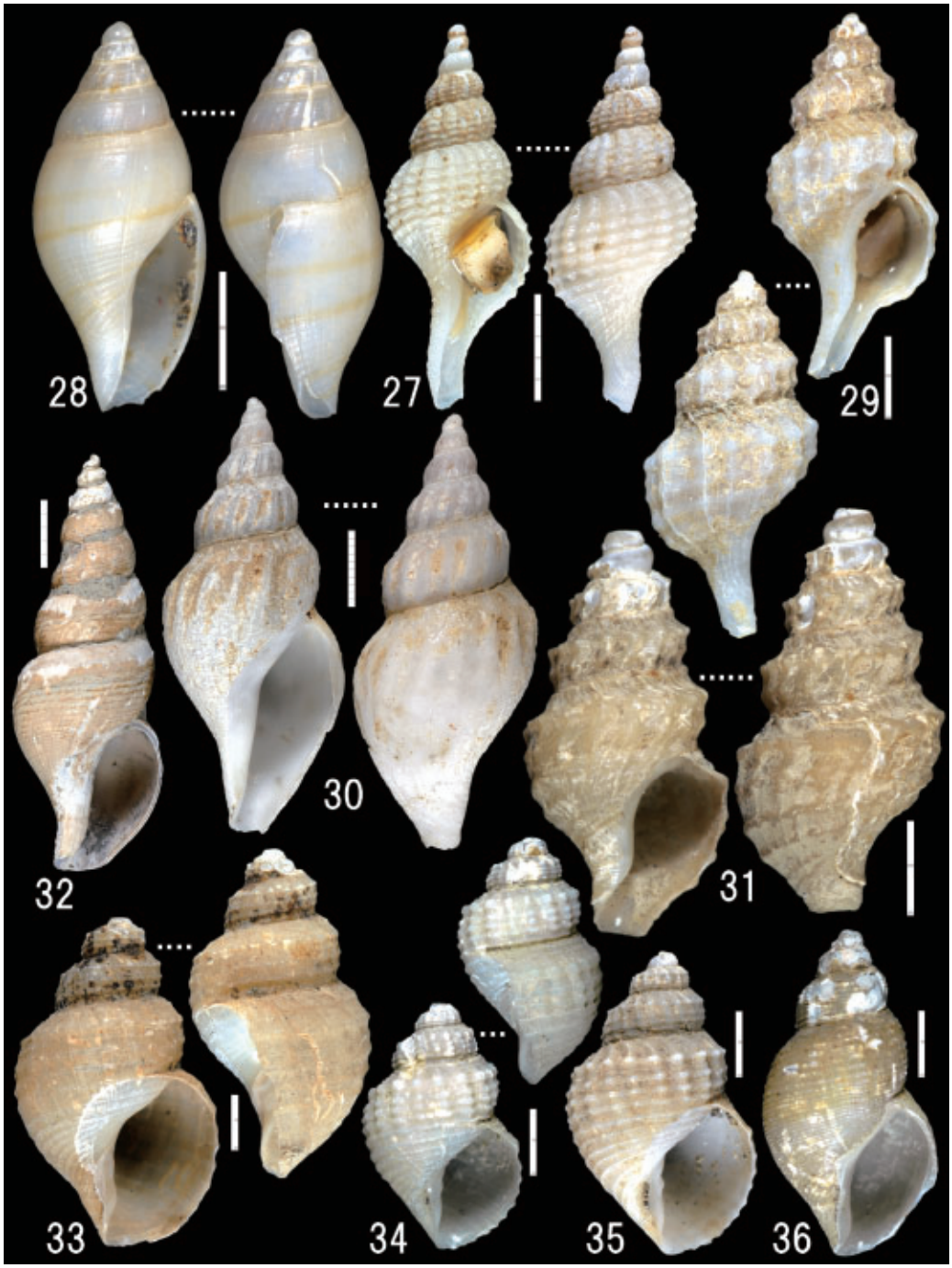
Remarks. See Hasegawa (2009: 276) for details of the identification of this variable species.

Boreotrophon gorgon Dall, 1913 [Jn.: Oni-tsuno-oriire]

†*Boreotrophon gorgon* Dall, 1913: 588 (type locality: USFC sta. 3698, of Hondo, Japan [off Manazuru-misaki, 153 fathoms]); Okutani, 1977: 78.

†*Boreotrophon echinus* Dall, 1918: 232 (type locality: Sagami Bay (Hirase Collection)); Okutani, 1964: 402–3, pl. 3, fig. 13. **New synonym**.

Records. S15, [S53, S54, S56 or S58 (Okuta-



Figs. 27–36. 27, *Granulifusus* sp., T14 (407–634 m); 28, *Zemitrella siligo*, holotype, UMUT RM8829, S15 (700 m); 29, *Trophonopsis kamchatkana*, T07 (1087–1147 m); 30, *Gymnobela sibogae*, T08 (1415–1439 m); 31, *Cryptogemma japonica*, Sagami Bay (700 m); 32, *Antiplanes isaotakii*, S50 (1560 m); 33, *Admete* sp. B, S26 (1470–1500 m); 34, *Neadmete profundicola*, holotype, UMUT RM8836, S13 (550 m); 35, *Neadmete profundicola*, S15 (700 m); 36, *Iphinopsis bathyalis*, holotype, UMUT RM8823, S13 (550 m); scale: 2 mm (28, 29, 31, 33–36), 5 mm (27, 32), 10 mm (30).

ni, 1977)] [400–700 m].

Materials examined. S52 (2e), T11 (1e) [450–700 m].

Remarks. *Boreotrophon gorgon* and *B. echinus* were both described by the same author from Sagami Bay (Dall, 1913, 1918). The primary types of both taxa have been illustrated by Kosuge (1972: pl. 7, figs. 2 and 1, respectively) and Higo *et al*. (2001: figs. G2250 and G2248, respectively). Although they were said to be distinguishable by the number of spiral ribs on the penultimate whorl (only one in *gorgon* and two in *echinus*) (Kuroda, 1964), both specimens actually possess only one spiral cords on the penultimate whorl, and there is no substantial difference between them. They are therefore regarded herein as synonyms. Identification of an other form with two spiral cords on the penultimate whorl (e.g. "*B. echinus*" fide Tsuchiya in Okutani, 2000: pl. 199, fig. 197) is the subject of further detailed study.

This species is represented in the present material by only empty shells, and it is more common in shallower depths (e.g. Okinoyama Reef, off the Bōsō Peninsula, 220 m; Okutani, 1985: 24, pl. 1, fig. 10, as "*Nipponotrophon echinus*").

Boreotrophon trophonis Egorov, 1993 [Jn.: Ikarigata-tsuno-oriire]

Boreotrophon xestra Dall, 1918 – Okutani, 1964: 403–4, pl. 3, fig. 10 [non *Boreotrophon xestra* Dall, 1918].

Record. S19 [800 m].

Remarks. Hasegawa (2009: 280) considered the specimen illustrated by Okutani (1964) as "*Boreotrophon xestra*" to be *B. trophonis* Egorov, 1993. Diagnostic characters of this species include the strongly angulate shoulder with a flat area just below the suture, although the species seems to show considerable variation in the number of axial plicae.

Boreotrophon alaskanus Dall, 1902 [Jn.: Arasuka-tsuno-oriire]

Boreotrophon xestra nipponicus (Yokoyama, 1920) — Okutani, 1964: 404, pl. 3, fig. 14.

Records. S13, S15 [550–700 m].

Remarks. Hasegawa (2009: 280, figs. 156–157) regarded the specimen illustrated in Okutani (1964: pl. 3, fig. 14) as an immature specimen of *B. alaskanus*, and illustrated similar examples from northeastern Honshū. *Trophon nipponicus* Yokoyama, 1920 was described based on a Pliocene (Pleistocene) fossil from the Koshiba Formation in Kanagawa Prefecture, and has been regarded by subsequent authors as a junior synonym (Hatai and Nisiyama, 1952) or subspecies (Taki and Oyama, 1954) of *Boreotrophon xestra* Dall, 1918. *B. xestra* was originally described from off Sado Island in the Sea of Japan. It is noteworthy that Dall (1918) mentioned "also at Sagami, Japan, Hirase collection." and "the Hirase specimens were immature", clearly indicating a similar specimen to those discussed herein. Examination of various Japanese material in related species has revealed that *B. xestra* seems to be endemic to the Sea of Japan (and possibly also the Okhotsk Sea), and smaller specimens that occur on the Pacific coast of Honshu can be regarded as the juvenile form of *B. alaskanus* Dall, 1902.

* ***Trophonopsis kamchatkana*** (Dall, 1902) [Jn.: Chigo-tsuno-oriire] (Fig. 29)

Materials examined. T07 (2) [1087–1147 m].

Remarks. The present material agrees with the holotype of this species (Kosuge, 1972: pl. 8, fig. 6), which was collected from southeast coast of Kamchatka (Dall, 1902), and also with the specimens illustrated by Kantor and Sysoev 2006: pl. 67, figs. H–I) from the Sea of Japan. Although this species is not rare in the Sea of Japan in the bathyal zone (from off Oki Island to northwestern Hokkaido, 210–710 m; Hasegawa, personal observation), it is apparently rare off the Pacific coast of northern Japan because it was not recorded during the extensive survey carried out there (Hasegawa, 2009). However, the specimens recorded from near Ōtsuchi, Iwate Prefecture, in the sublittoral zone (80–120 m) as "*Trophonopsis (Trophonopsis) delicatus*" (Tsuchida, 1991: 1–2, pl. 1, fig. 1; Tsuchida and Kurozumi, 1995: 178,

fig. 7-3) probably belong to this species.

Family **Volutidae** Rafinesque, 1815

Fulgoraria* (*Psephaea*) *prevostiana (Crosse, 1878) [Jn: Hon-hitachiobi]

Fulgoraria (*Psephaea*) *prevostiana* (Crosse, 1878) – Okutani, 1964: 417, pl. 3, fig. 18.

Fulgoraria prevostiana Crosse (*magna* Kuroda & Habe type) – Okutani, 1977: 78.

Records. S03, [S53, S54, S56 or S58 (Okutani, 1977)] [400–520 m].

Remarks. Although several species of the genus *Fulgoraia* Schumacher, 1817 besides the two treated herein have been recorded from Sagami Bay and adjacent waters (e.g. off Chōshi), including *F. megaspira* Sowerby, 1844, *F. concinna rosea* Shikama, 1967, and *F. elongata* Shikama, 1962, their taxonomical relationships remain unsolved. Most species inhabit shallower depth ranges, given by Kuroda *et al*. (1971) for this species as 50–300 m, and only *F. smithi* is restricted to bathyal depths.

Fulgoraria* (*Kurodina*) *smithi (Sowerby, 1901) [Jn.: Usu-hitachiobi]

Fulgoraria (*Musashia*) *smithi* (Sowerby, 1901) – Okutani, 1964: 418; Okutani, 1968a: 36.

Records. S15, S30 [690–780 m].

Material examined. S15 (1e).

Remarks. This is the only species that can readily be distinguished from all the other taxa in the genus, by having a large and thin shell with a unique white columellar fold. It seems to show a very narrow geographical distribution, from the Kashima-nada (off Hitachi: Shikama, 1967) to Sagami Bay. Although most recent authors state its southern range limit as "the sea area Enshu-nada and off Kii Peninsula" (e.g. Higo *et al*., 1999; Bail & Chino, 2010), this remains to be confirmed based on specimens with accurate data.

Family **Volutomitridae** Gray, 1854

Volutomitra groenlandica alaskana Dall, 1902 [Jn.: Fude-hitachiobi]

Volutomitra alaskana Dall, 1902 – Okutani, 1964: 416, pl. 3, fig. 15; Okutani, 1966: 21.

Records. S13, S27 [550–1020 m].

Material examined. S27 (1e).

Family **Conidae** Fleming, 1822

Remarks. All the type material and most of the voucher material treated by Okutani (1964, 1966, 1968a) in the superfamily Conoidea (family Turridae *sensu lato*) from Sagami Bay has been lost. Re-examinations of taxa treated in those papers are thus primarily based on photographs or figures in previous works.

Bathytoma engonia (Watson, 1881) [Jn.: Yagen-kudamaki]

†*Pleurotoma* (*Genota*) *engonia* Watson, 1881: 405–407; Watson, 1886: 300–301, pl. 20, fig. 7.

†*Suavodrillia sagamiana* Dall, 1925: 27, pl. 21, fig. 2.

Riuguhdrillia engonia (Watson, 1881) – Okutani, 1964: 435–436, pl. 5, fig. 12; Okutani, 1966: 25, pl. 2, fig. 19; Okutani, 1968a: 38.

Records. C01 (type locality of *Pleurotoma engonia*), A02 (type locality of *Suavodrillia sagamiana*), S01, S04, S05, S11, S12, S13, S16, S19, S20, S21, S22, S23, S27, S34, S35, S36 [550–1400 m].

Materials examined. S04 (8d and 2e), S05 (3d), S12 (10e), S21 (1e), S22 (4d and 1e), S23 (1e), S27 (4e), S34 (1d), S35 (2e), S36 (3e); S26 (1d), S30 (1d), S31 (1d), S43 (2d+1e), S46 (1d), T06 (1e), T10 (2e), T09 (1e) [690–1500 m].

Remarks. Although Watson (1881) listed Challenger st. 232 (off Enoshima, 345 fathoms) and st. 169 (NE of New Zealand, 700 fathoms, though with query) as type localities, subsequent authors (e.g. Powell, 1942: 56) regarded the former as the correct type locality of this taxon.

Bathytoma virgo (Okutani, 1966) [New Jn.: Yase-yagen-kudamaki]

†"*Pleurotomella*" *virgo* Okutani, 1966: 25–26, pl. 2, fig. 18.

Spirotropis virgo (Okutani, 1966) – Okutani,

1968a: 38.

Records. S26 (type locality), S32 [1470–1520 m].

Remarks. Careful examination of the original figure of the holotype revealed it to represent the species recorded from off northeastern Honshū by Hasegawa (2009: 336, fig. 344) as "*Bathytoma* sp." It is apparently allied to the specimen recorded from the Okinawa Trough (1540–1557 m) by Hasegawa (2005: 167, fig. 10F) as "*Makiyamaia* sp.", although the latter differs slightly in having a thinner and more elongate shell with stronger axial sculpture on the apical whorls. Although this species has been variously placed in *Spirotropis* Sars, 1878 (Okutani, 1966) and *Gymnobela* Verrill, 1884 (Higo *et al*., 1999), it is most appropriately assigned to *Bathytoma* Harris and Burrows, 1891, because of its close resemblance to *B. engonia* (Watson, 1881), as clearly stated by Okutani (1964).

Ootomella admetoides Okutani, 1968

Ootomella admetoides Okutani, 1968a: 41–42.

Records. S37 [1395 m].

Remarks. The type locality of this species is off Miyakejima Island at 1080–1205 m, where the holotype and a paratype were obtained, but it was mentioned in the remarks that "an empty shell was also taken from st. T6 (1967-VII-1), Sagami Bay, 1395 m deep [st. S37]". However, because of the lack of voucher material, identification of the latter specimen could not be confirmed.

Curtitoma becklemishevi Bogdanov, 1989 [Jn.: Koshiboso-futa-manji]

Nematoma hokkaidoensis Bartsch, 1941 – Okutani, 1964: 431, pl. 7, fig. 9; Okutani, 1966: 24, pl. 2, figs. 8, 9 [non *Nematoma hokkaidoensis* Bartsch, 1941, fide Bogdanov and Ito (1992)].

Nodotoma hokkaidoensis Bartsch, 1941 [sic; should be in parentheses] – Okutani, 1968a: 40 [non *Nematoma hokkaidoensis* Bartsch, 1941, fide Bogdanov and Ito (1992)].

Records. S02, S06, S12, S25, S29, S37, S38 [1320–1510 m].

Remarks. Bogdanov and Ito (1992) identified the specimens recorded from Sagami Bay as *N. hokkaidoensis* by Okutani (1964, 1966) as the present taxon, and Hasegawa (2009: 339) followed this opinion in identifying specimens collected from off northeastern Honshū.

Curtitoma delicata (Okutani, 1964) [Jn.: Migaki-koshiboso-futa-manji]

†*Funitoma delicata* Okutani, 1964: 432–433, pl. 7, fig. 4; Okutani, 1966: 24; Okutani, 1968a: 40.

Records. S02 (type locality), S25, S26, S32 [1320–1520 m].

Remarks. See Hasegawa (2009: 340) for details of the identification and distribution of this species.

Oenopota candida (Yokoyama, 1926) [Jn.: Sado-futa-manji]

†*Nematoma microvoluta* Okutani, 1964: 431–432, pl. 6, fig. 10; Okutani, 1966: 24, pl. 2, figs. 10, 11.

Records. S04, S05 (type locality), S10, S11, S13, S22, S26 [550–1550 m].

Remarks. Hasegawa (2009: 345) regarded *Nematoma microvoluta* as a junior synonym of *Oenopota candida* (Yokoyama, 1926), which was described based on a Pliocene fossil from the Sawane Formation on Sado Island, in the Sea of Japan, following Bogdanov and Ito (1992).

Propebela subtrophonoidea (Okutani, 1964) [New Jn.: Kōshi-bori-manji]

Benthomangelia subtrophonoidea Okutani, 1964: 427–428, text-fig. 6; Okutani, 1968a: 38, pl. 3, fig. 12.

Records. S13 (type locality), S15, S29 [550–1510 m].

Remarks. Although the figure with the original description (Okutani, 1964: text-fig. 6) is not adequate for precise identification, a photograph of the specimen collected at st. S29 (Okutani, 1968a: pl. 3, fig. 12) agrees well with the species recorded from off northeastern Honshū as "*Propebela* sp. 2" by Hasegawa (2009: 350, figs.

400A–B, 401A–B). They are here considered to be conspecific, and the range of distribution is thus extended northwards to off Kesen-numa, Iwate Prefecture.

Propebela sp. cf. ***tersa*** (Bartsch, 1941)

Propebela (*Turritoma*) *yokoyamai* Taki & Oyama, 1954 – Okutani, 1964: 428–429, pl. 6, fig. 1; Okutani, 1966: 23–24, pl. 2, fig. 12 [?non *Propebela* (*Turritoma*) *yokoyamai* Taki and Oyama, 1954]

Funitoma (*Cestoma*) *eurybia* Bartsch, 1941 – Okutani, 1964: 432, pl. 7, fig. 3 [non *Funitoma* (*Cestoma*) *eurybia* Bartsch, 1941]

Propebela sp. aff. *yokoyamai* Taki & Oyama, 1954 – Okutani, 1968a: 39.

Records. S04 (as *Funitoma eurybia*), S06, S11 (as *Funitoma eurybia*), S25, S37 [620–1395 m].

Remarks. The specimens recorded from Sagami Bay as "*Propebela yokoyamai*" and "*Funitoma eurybia*" seem to fall within the range of variation of the species recorded from northeastern Honshū as "*Propebela* sp. cf. *tersa*" by Hasegawa (2009: 349) based on illustrations in previous works. It is known to be highly variable, and may comprise more than one cryptic species (Hasegawa, 2009). It somewhat resembles *Propebela* (*Turritoma*) *yokoyamai* Onoyama in Taki and Oyama, 1954, which was regarded by Bogdanov and Ito (1992) as a junior synonym of the Atlantic taxon *Propebela assimilis* (Sars, 1878), but differs in having a stouter shell with axial ribs that are rounder in section, besides its more bathyal habitat (vs. 200–300 m in Sea of Japan for *P. assimilis*; Bogdanov and Ito, 1992).

Nepotilla nezi (Okutani, 1964)

Taranis (*Nepotilla*) *nezi* Okutani, 1964 – Okutani, 1966: 24, pl. 2, fig. 17.

Records. S24 [655–675 m].

Remarks. This species was originally described from the Kashima-nada, 870m (Okutani, 1964: 434, text-fig. 7), and later recorded from Sagami Bay. Identification of the specimen from Sagami Bay could not be reconfirmed due to the lack of type and voucher material. It is here provisionally placed in the genus *Nepotilla* Hedley, 1918, following Higo *et al.* (1999), on the basis of general shell characters, including the presence of two distinct spiral cords on each whorl.

Pleurotomella granuliapicata Okutani, 1964

†*Pleurotomella granuliapicata* Okutani, 1964: 434–435, pl. 6, fig. 15.

Records. S05 (type locality) [710–770 m].

Remarks. Since its description from Sagami bay, this species has been recorded over an extremely wide vertical range from the Izu-Ogasawara (Bonin) Trench (3450–5160 m) and Shikoku Basin (3610 m) (both Okutani, 1974), and also from east off Bōsō Peninsula (507–578 m) (Tsuchida and Kurozumi, 1995: fig. 8-3). It cannot be ascertained whether the specimens from the abyssal zone belong to this species or not, due to the absence of the voucher material.

Mioawateria bigranulosa (Okutani, 1964) [Jn.: Daruma-shajiku]

"*Propebela*" *bigranosa* [sic; = *bigranulosa*] Okutani, 1964 – Okutani, 1966: 24.

Records. S26 [1470–1500 m].

Remarks. This species was originally described from "off Miyake Island, at a depth of 1230–1350 m", and subsequently recorded from Sagami Bay. Later Hasegawa (2005: 174, 176, fig. 12H) recorded it from the Okinawa Trough and suggested that it might be a junior synonym of *M. extensaeformis* (Schepman, 1913), although more detailed comparative study will be necessary to ascertain this.

Benthodaphne sp.

Benthodaphne species – Okutani, 1968a: 41.

Records. S35 [730–790 m].

Remarks. Identification of this species could not be reviewed due to the absence of voucher material.

****Gymnobela sibogae*** (Schepman, 1913) [New Jn.: Tsubu-magai-kudamaki] (Fig. 30)

Material examined. T08 (1) [1415–1439 m].

Remarks. This species had been known only from the holotype from off Maluku Island, Indonesia (560m). until Sysoev and Bouchet (2001: 306, figs. 125–128) recorded it from the tropical South Pacific. They showed a wide range of variation in the shell morophology of this species, and the present live-collected specimen falls well into the range of variation. *Pleurotomella ebor* Okuani, 1968, which was described from off Torishima Island at 2550 m and subsequently recorded near the type locality at a depth of 5160 m (Okutani, 1974), is apparently a closely allied species, and may prove to be a junior synonym of this nominal taxon.

Daphnella semivaricosa Habe and Masuda, 1990 [Jn.: Saki-yore-fude-shajiku]

Daphnella semivaricosa Kuroda (MS) – Okutani, 1966: 26 (nude name).

Records. S27 [1005–1020 m].

Remarks. Kuroda's manuscript name was later validated by Habe and Masuda (1990) based on material collected from the Enshū-nada, but the identification of the specimen from Sagami Bay could not be confirmed due to the lack of voucher material.

Spergo viridis (Okutani, 1966)

†*Speoides viridis* Okutani, 1966: 26–27, pl. 2, fig. 20; The Committee for Celebrating Dr Okutani's Retirement from Tokyo University of Fisheries, 1996: 80–81, pl. 4, fig. 12 (holotype).

Records. S26 (type locality) [1470–1500 m].

Remarks. This species is known only from the type material, which has been lost as mentioned above. *Speoides* Kuroda and Habe, 1961, to which this species was originally assigned, is regarded as a junior synonym of *Spergo* Dall, 1895 (see Powell, 1966: 137).

Family **Drillidae** Olsson, 1964

Splendrillia sp.

Imaclava hotei (Otuka, 1949) – Okutani, 1966: 22 [non *Cymatosyrinx hotei* Otuka, 1949].

Records. S26 [1470–1500 m].

Remarks. *Cymatosyrinx hotei* was originally described based on a recent specimen collected from the Sea of Japan at an unknown depth (Otuka, 1949: 305, pl. 13, fig. 6). It closely resembles and is probably related to *Splendrillia aomoriensis* (Nomura and Hatai, 1940). The specimen recorded from the Kashima-nada by Okutani (1964: pl. 7, fig. 7) differs from the holotype of *C. hotei* by possessing more convex whorls with a deeply constricted suture and narrower siphonal canal, but apparently belongs in the same genus, *Splendrillia* Hedley, 1922. The specimen recorded from Sagami Bay was not accompanied by an illustration or photograph, and its identification thus could not be confirmed.

Splendrillia hosoi (Okutani, 1964)

†*Imaclava hosoi* Okutani, 1964: 422, pl. 7, fig. 10; Okutani, 1966: 22.

Records. S13 (type locality), S27 [550–1020 m].

Remarks. Although the type and other voucher material was not available for the present study, this species can also be allocated to the genus *Splendrillia* due to its close similarity with the preceding species (**new combination**). The specimen recorded from Tosa Bay as "*Clinura hosoi* (Okutani, 1964)" by Hasegawa (2001: 148) differs from the present species in having a considerably longer siphonal canal and sharply angulate shoulder, and belongs to a different species. Hasegawa (2009: 232–3, figs. 328–30) also recorded a similar species from off northeastern Honshu as "*Crassispira* sp. cf. *hosoi*", but its identification could not be confirmed due to the poor condition of all the specimens examined. This species has hitherto been known only from Sagami Bay and adjacent waters (south off Izuōshima; Okutani, 1966).

Family **Turridae** H. Adams and A. Adams, 1853

Aforia circinata (Dall, 1873) [Jn.: Yagen-iguchi]

†*Turricula (Surcula) hondoana* Dall, 1925: 29, pl. 31, fig. 6.

†*Aforia japonica* Bartsch, 1945: 389, figs. 5, 6;

Okutani, 1966: 22.

Aforia hondoana Dall, 1925 [sic; should be in parentheses] – Okutani, 1964: 422, pl. 4, figs. 3, 4.

Aforia circinata (Dall, 1873) – Okutani, 1964: 422–3, pl. 4, figs. 2, 5.

Records. A01 (type locality of *Turricula hondoana*), A02 (type locality of *Aforia japonica*), S04, S15, S19, S20, S26, S27, S35 [620–1500 m].

Materials examined. S04 (1e), S19 (1e), S27 (4d), S35 (1e); S52 (6e), T08 (2e) [450–1439 m].

Remarks. See Hasegawa (2009: 325) for discussion of the taxonomical confusion surrounding this species.

****Aforia*** sp. [New Jn.: Warabe-iguchi]

Aforia japonica Bartsch, 1945 – Okutani, 1968a: 36–37 (part), text-fig. 5 [non *Aforia japonica* Bartsch, 1945].

Records. "S35 [730–760 m]" (possible voucher material, including the figured specimen, were collected from S32, and the latter may be the correct locality of this species).

Materials examined. S32 (2e) [1510–1530 m].

Remarks. Okutani (1968a) considered the present material to be a "juvenile specimen" of *Aforia japonica* [=*Aforia circinata* (Dall, 1873) herein]. However, specimens of similar shape and size have also been collected at bathyal depths at various localities from northeastern Honshū to Tosa Bay (14 specimens in 8 lots in total; Hasegawa, unpublished). They apparently differ from juvenile specimens of *Aforia circinata* of similar size by having a row of distinct spines but not a spiral keel along the periphery. It is therefore probable that they are mature examples of a different species.

Antiplanes sanctiioannis (E.A. Smith, 1875) [Jn.: Ezo-iguchi]

Antiplanes sanctaioannis [sic] (Smith, 1875) – Okutani, 1964: 423, pl. 4, fig. 8; Okutani, 1968a: 37.

Rectiplanes (*Rectisulcus*) *isaotakii* Habe, 1958 – Okutani, 1964: 424 [non *Rectiplanes* (*Rectisulcus*) *isaotakii* Habe, 1958].

Records. S04, S12 [620–1400 m].

Materials examined. S04 (1e) (2d; voucher of "*Rectiplanes* (*Rectisulcus*) *isaotakii*"); S32 (1e), S52 (3e) [450–1530 m].

Remarks. See remarks under *A. isaotakii* for identification of some of voucher material.

Antiplanes obesus Ozaki, 1958 [Jn.: Kawamura-ezo-iguchi]

Rectiplanes kawamurai Habe, 1958 – Okutani, 1964: 423, pl. 4, fig. 6; Okutani, 1966: 22; Okutani, 1968a: 37.

Records. S12, S26, S32 [1400–1520 m].

Materials examined. S26 (1e); T06 (1+2e), T08 (7) [1395–1459 m].

Remarks. See Hasegawa (2009: 328) for discussion of the change in the valid of name of this taxon.

Antiplanes motojimai (Habe, 1958) [Jn.: Motojima-ezo-iguchi]

Rectiplanes (*Rectisulcus*) *motojimai* Habe, 1958 – Okutani, 1964: 424, pl. 4, fig. 7; Okutani, 1966: 22–23.

Records. S13, S26 [550–1500 m].

Materials examined. S13 (1e), S26 (1d); S52 (1e), T06 (1+1e), T08 (5+1e) [450–1459 m].

Remarks. See Hasegawa (2009: 331) for discussion of the geographical distribution of this species.

****Antiplanes isaotakii*** (Habe, 1958) [Jn.: Taki-ezo-iguchi] (Fig. 32)

Not *Rectiplanes isaotakii* Habe, 1958 – Okutani, 1964: 424.

Material examined. S50 (1e) [1560 m].

Remarks. This species was originally described from the Kashima-nada off Chōshi, and recorded from Sagami Bay by Okutani (1964). Re-examination of the voucher specimen from Sagami Bay (collected at st. S04) revealed that it is actually an example of *A. sanctiioannis* with stronger spiral sculpture than normal. On the other hand, one empty shell collected by a subsequent cruise of the R/V *Sōyō Maru* could cor-

rected be identified as this species, representing the first correct record of this species in Sagami Bay.

Antiplanes yukiae (Shikama, 1962) [Jn.: Chichikake-iguchi]

Benthodaphne yukiae (Shikama, 1962) – Okutani, 1964: 424; Okutani, 1968a: 41, pl. 3, fig. 11.

Records. S10, S36 [600–1030 m].

Material examined. T03 (1e) [718–789 m].

Remarks. This species was originally assigned to the genus *Rectiplanes* Bartsch, 1944, which was regarded as a junior synonym of *Antiplanes* Dall, 1902 by Kantor and Sysoev (1991), and then variously assigned to *Benthodaphne* Oyama, 1962 (Okutani, 1964) or *Comitas* Finlay, 1926 (Higo *et al*., 1999). Although the precise generic position of this species still remains unresolved because of the lack of information concerning the soft parts and radula, it is provisionally kept in *Antiplanes* for its close resemblance to the other species in the genus.

Crassispira takeokensis (Otuka, 1949) [Jn.: Midori-momiji-bora]

Brachytoma takeokensis Otuka, 1949 – Okutani, 1964: 425–426, pl. 4, fig. 13.

Records. S10 [740–1030 m].

Material examined. T03 (1e), T13 (2e) [338–848 m].

Paradrillia sagamiana Okutani, 1964 [Jn.: Sagami-hime-shajiku]

†*Paradrilla* [sic; = *Paradrillia*] *sagamiana* Okutani, 1964: 426–427, pl. 7, fig. 2.

Records. S13 (?type locality), S15 (?type locality) [550–700 m].

Remarks. The type locality of this species was designated as "Sagami bay, 550 m [st. 59 (=S13)]" in the original description, but the locality of the illustrated holotype (pl. 7, fig. 2) was stated to be "35°05.35′N, 139°18.65′E, Sagami Bay, 700 m" in the figure legend, which corresponds to st. 118 (=S15). The specimens recorded as "*Cretaspira*? sp." from off northeastern Honshū at depths of 380–425 m (Hasegawa, 2009: 335, fig. 341) generally agree with the figure in the original description, although the identification could not be confirmed due to the unavailability of the type material.

Leptadrillia cinereopellis Kuroda and Oyama in Kuroda, Habe and Oyama, 1971 [Jn.: Haiginu-momiji-bora]

†*Leptadrillia cinereopellis* Kuroda & Oyama in Kuroda, Habe & Oyama, 1971: 323–324 [Japanese part], 210–211 [English part], pl. 56, fig. 3 (type locality: "Sagami Bay" [depth unknown]); Hasegawa, 2006: 263.

Records. R01 [573–610 m].

Material examined. R01 (1d).

Remarks. *Leptadrillia cinereopellis* was originally described from Sagami Bay at an unknown depth. There have been few records of this species with precise position and depth data, and Higo *et al.* (1999) gave the vertical range as "50–200 m". Hasegawa (2006) recently recorded empty shells from two stations at depths of 327–610 m in Sagami Bay.

Comitas kirai Powell, 1969 [Jn.: Akebono-iguchi]

Turricula lurida (Adams et Reeve, 1850) – Okutani, 1964: 420, pl. 4, fig. 10 [non *Pleurotoma lurida* Adams and Reeve, 1850].

Records. S15 [700 m].

Remarks. This species usually inhabits shallower waters (e.g. 50–400 m; Hasegawa *et al*. in Okutani, 2000), but live specimens that have been recorded from bathyal depth (Okutani, 1964: pl. 4, fig. 10) do not differ considerably from those collected from the subtidal zone (e.g. Kuroda *et al*., 1971: pl. 56, fig. 2).

Comitas subsuturalis (von Martens, 1902) [Jn.: Takumi-iguchi]

Turricula striatotuberculata (Yokoyama, 1928) – Okutani, 1964: 421, pl. 4, fig. 11 [non *Pleurotoma subdeclivis* var. *striatotuberculata* Yokoyama, 1926]

Records. S13 [550 m].

Remarks. See Hasegawa (2005: 169) for dis-

cussion of the identification of this species.

Makiyamaia coreanica (Adams and Reeve, 1850) [Jn.: Chōsen-iguchi]

Makiyamaia coreanica (Adams et Reeve, 1850) – Okutani, 1964: 421, pl. 4, fig. 14; Okutani, 1977: 78; Hasegawa, 2006: 264.

Records. S03, [S53, S54, S56 or S58 (Okutani, 1977)], R01, R04 [329 m (Hasegawa, 2006) –610 m].

Materials examined. R01 (1e), R04 (1e).

Remarks. This species is more commonly found on the continental shelf (160–450 m; Higo *et al*., 1999).

Cryptogemma corneus (Okutani, 1966) [Jn.: Chairo-kado-kudamaki]

†*Taranis corneus* Okutani, 1966: 25, pl. 2, fig. 16.

Records. S26 (type locality) [1470–1500 m].

Materials examined. T08 (2) [1415–1439 m].

Remarks. The present species was originally described from Sagami Bay, and it has been shown to be widely distributed along the Pacific coast of Japan, from the southern Kuril Islands southwards to the Nansei Islands, within a depth range of 350–1200 m (see Hasegawa, 2009: 333).

Cryptogemma japonica (Okutani, 1964) (Fig. 31)

†*Taranis japonicus* Okutani, 1964: 433–434, pl. 4, fig. 16, pl. 6, fig. 13.

Records. S13 (type locality) [550 m].

Remarks. Although the type material of this species could not be located, one specimen collected on an R/V *Soyo-Maru* cruise and labeled as "Sagami Bay 700 m" was available for examination (Fig. 32). It generally agrees with the figures of the holotype, and also with *C. corneus*, and *japonica* is probably a senior synonym of the latter nominal taxon. However, it is provisionally regarded as a separate species in the same genus because of some minor differences, such as the more elongate shell with more distinct axial sculpture and more lightly colored periostracum, and the absence of intermediate specimens (**new combination**). More detailed study is necessary to clarify the relationship between the two forms.

Taranis sp.

Taranis sp. 1 – Hasegawa, 2006: 266, fig. 6A.

Records. R03 [432–580 m].

Material examined. R03 (1e).

Remarks. Since one empty shell of this species was recoded and figured from Sagami Bay (Hasegawa, 2006), live specimens have been collected from off the Shimokita Peninsula in Aomori Prefecture, at a depth of 471–468 m (Hasegawa, 2009: 338, figs. 345–347). Re-examination of these specimens revealed that they are further conspecific with the specimen recorded from off the Noto Peninsula in the Sea of Japan at a depth of 250–305 m as "*Taranis* sp. (No. 1)" by Ito *et al*. (1986: 17, pl. 20, fig. 6). It thus became clear that this probably undescribed species is widely distributed along the Pacific coast of northeastern Japan and in the Sea of Japan, at bathyal depths.

Family **Cancellariidae** Forbes and Hanley, 1851

Admete viridula (Fabricius, 1780) [Jn.: Ezo-goromo]

Admete couthouyi (Jay, 1838) – Okutani, 1964: 419, pl. 3, fig. 16; Okutani, 1966: 21; Okutani, 1968a: 36, pl. 2, fig. 7 (same photograph as Okutani, 1964: 419, pl. 3, fig. 16).

Records. S02, S25, S37, S38 [1310–1480 m].

Material examined. S02 (2d), S25 (3d), S26 (2d), S37 (2d), S38 (1e); S44 (1d+1e), S45 (1d), S49 (1d), T08 (1e) [1415–1500 m].

Remarks. This species had been known in Japanese literature as "*Admete couthouyi*". See Hasegawa (2009: 318) for the synonymy of this taxon.

Admete sp. A [Jn.: Maru-ezo-goromo]

Admete globularia [sic] Smith, 1875 – Okutani, 1964: 419 [non *Admete globularis* E.A. Smith, 1875].

Admete watanabei Shikama, 1962 – Okutani, 1964: 419 [non *Admete watanabei* Shikama, 1962].

Neadmete profundicola Okutani, 1964: 419–20 (part) [non *Neadmete profundicola* Okutani, 1964].

Admete sp. juv. – Okutani, 1966: 21.

Records. S04 and S12 (as *Admete globularia*), S13 (as *Admete watanabei*), S15 (as *Neadmete profundicola*), S27 (as *Admete* sp. juv.) [620–1400 m].

Materials examined. S13 (2d), S15 (1e), S27 (4d); S22 (4d), T08 (2e) [780–1439 m].

Remarks. Re-examination of specimens that were recorded from Sagami Bay under various names as listed in the synonymy revealed that they could all be attributed to an undescribed species known in literature under the Japanese name "Maru-ezo-goromo" (see Hasegawa, 2009: 321, for discussion). This species is widely distributed at bathyal depths from Suruga Bay north to off Hokkaido in the Pacific (250–1500 m; Hasegawa, 2009: 321), and also in the Sea of Japan (180–1100 m; Hasegawa, personal observation).

* ***Admete*** sp. B (Fig. 33)

?*Neadmete profundicola* Okutani, 1964 – Okutani, 1966: 21, pl. 2, fig. 14.

Record. S26 [1470–1500 m].

Materials examined. S26 (2d).

Remarks. Two live-collected specimens from "T21 (15/12/1964) 1400–1500 m" [= S26 herein], which apparently correspond to the specimens recorded as *N. profundicola* by Okutani (1966), were available for examination. They differ from the illustrated specimen (Okutani, 1966: pl. 2, fig. 14), which can correctly be identified as *N. profundicola*, but belong to another possibly undescribed species of the genus *Admete* Kröyer in Möller, 1842. It can be distinguished from all the other known Japanese species in the genus by the relatively thin and elongate shell with a deeply constricted suture.

Neadmete profundicola Okutani, 1964 [Jn.: Watazoko-goromo] (Figs. 34–35)

†*Neadmete profundicola* Okutani, 1964: 419–20 (part), pl. 3, fig. 12, pl. 7, fig. 5; Okutani, 1966: 21, pl. 2, fig. 14.

Records. S13 (type locality), S15 (part), ?S26 [550–1500 m].

Materials examined. S13 (holotype, UMUT RM8836), S15 (1e); S50 (2d) [1560 m].

Remarks. Specimens recorded from st. S15 (Okutani, 1964) actually comprise 3 species, i.e. *N. profundicola*, *Admete* sp. A [Maru-ezo-goromo] and *Profundinassa babylonica* as already mentioned. Specimens from st. S50 differ from the holotype and other typical specimens by their larger size (exceeding 15 mm in shell length; 7.8 mm in the holotype) and broader shell with coarser axial ribs. However, they are provisionally identified as this species because of the general resemblance in shell morphology and especially the presence of a partly perforate umbilicus, which is a unique character among the genus.

Iphinopsis choshiensis (Habe, 1958) [Jn.: Koezo-nejinuki]

Iphinopsis choshiensis (Habe, 1958) – Okutani, 1964: 396, pl. 6, fig. 6; Okutani, 1966: 18; Okutani, 1968a: 30.

Records. S05, S06, S07, S11, S25, S27, S28, S35 [685–1385 m].

Materials examined. S07 (1d), S11 (1d), S25 (1d), S27 (1d), S35 (1e); S49 (1e) [1330 m].

Iphinopsis bathyalis (Okutani, 1964) [Jn.: Watazoko-neji-nuki] (Fig. 36)

†*Palaeadmete bathyalis* Okutani, 1964: 398, pl. 6, fig. 7.

Records. S13 (type locality) [550 m].

Material examined. S13 (holotype, UMUT RM8823).

Remarks. This species had been known only from the holotype until Hasegawa (2009: 324) recorded it from off the northeastern coast of Honshū. Although Hasegawa (in Okutani, 2000) relocated this species in the genus *Iphinopsis* Dall, 1924, more detailed study will be necessary to determine the precise generic position of this species.

Family **Acteonidae** d'Orbigny, 1843

* ***Acteon*** sp. (Fig. 37)

Hyporingicula japonica Habe, 1952 – Okutani, 1964: 438 (part).

Record. S22 (as "*Hyporingicula japonica*") [780 m]

Material examined. S22 (1e).

Remarks. One empty shell that can be assigned to the genus *Acteon* Montfort, 1810 [*sensu lato*] (see Valdés, 2008) was separated from voucher material previously recorded as "*Hyporingicula japonica*". This species can be distinguished from all the previously known species in Japanese waters and the tropical West Pacific by its almost smooth surface with extremely weak spiral sculpture and presence of wrinkle-like irregular axial ribs above the suture. The specimen recorded from east off the Bōsō Peninsula (507–578 m) by Tsuchida and Kurozumi (1995: 183, fig. 8-7) as "*Acteon*" *subincisus* is not that species but probably is conspecific with the present one, judging from the photographs. *Acteon subincisus* Okutani, 1968 was originally described from off Miyakejima Island (R/V *Sōyō Maru*, st. B2 (1965/10/11), 1270 m: holotype, NSMT-Mo 69568), and has regularly spaced distinct spiral grooves over its entire surface.

Crenilabium pacificus (Kuroda and Habe, 1961) [Jn.: Hachinoko-gai]

Lissacteon pacifica Kuroda & Habe, 1961 – Okutani, 1966: 27.

Records. S26 [1470–1500 m].

Remarks. *Crenilabium pacificus* was originally described from off Chōshi, in the Kashima-nada, and had been considered restricted to Japanese waters (Hori in Okutani, 2000). However, Valdés (2008) recently recorded it from the Philippines, New Caledonia, the Loyalty Ridge, Fiji and Tonga in 440–2050 m, showing it to be distributed widely in the West Pacific.

Family **Mathildidae** Dall, 1889

Turritellopsis subvenustellus (Okutani, 1964) [Jn.: Sagami-hime-nina] (Fig. 38)

†*Tachyrhynchus subvenustellus* Okutani, 1964: 390, pl. 5, fig. 13.

Turritellopsis subvenustellus (Okutani, 1964) – Hasegawa, 2006: 267.

Records. S15 (type locality), R03 [432–700 m].

Materials examined. S15 (holotype, UMUT RM8818), R03 (1e).

Remarks. This species is known only from two empty shells collected from Sagami Bay as listed in the synonymy (one each by Okutani, 1964, and Hasegawa, 2006, respectively). Systematic placement of this species in the family Mathildidae must be confirmed based on live-collected specimens (see Hasegawa, 2010, for more information).

Family **Pyramidellidae** Gray, 1840

Eulimella sp. (Fig. 39)

Eulimella sibogae Schepman, 1909 – Okutani, 1966: 28, text-fig. 14 [non *Eulimella sibogae* Schepman, 1909].

Records. S27 (as *E. sibogae*) [1005–1020 m].

Materials examined. T09 (3e) [756–859 m].

Remarks. Specimens examined in the present study agree well with the illustration provided by Okutani (1966: text-fig. 14), except for the size; the present specimens are nearly twice as large (16–20 mm in shell length vs. 9.0 mm). *E. sibogae* was originally described from Sulu Sea at a depth of 959 m (*Siboga* st. 52), and differs from the Japanese specimens by its more slender shell with distinct axial sculpture. These differences are sufficient to distinguish them as separate species.

Turbonilla corgani Okutani, 1968 [New Jn.: Watazoko-itokake-giri] (Fig. 40)

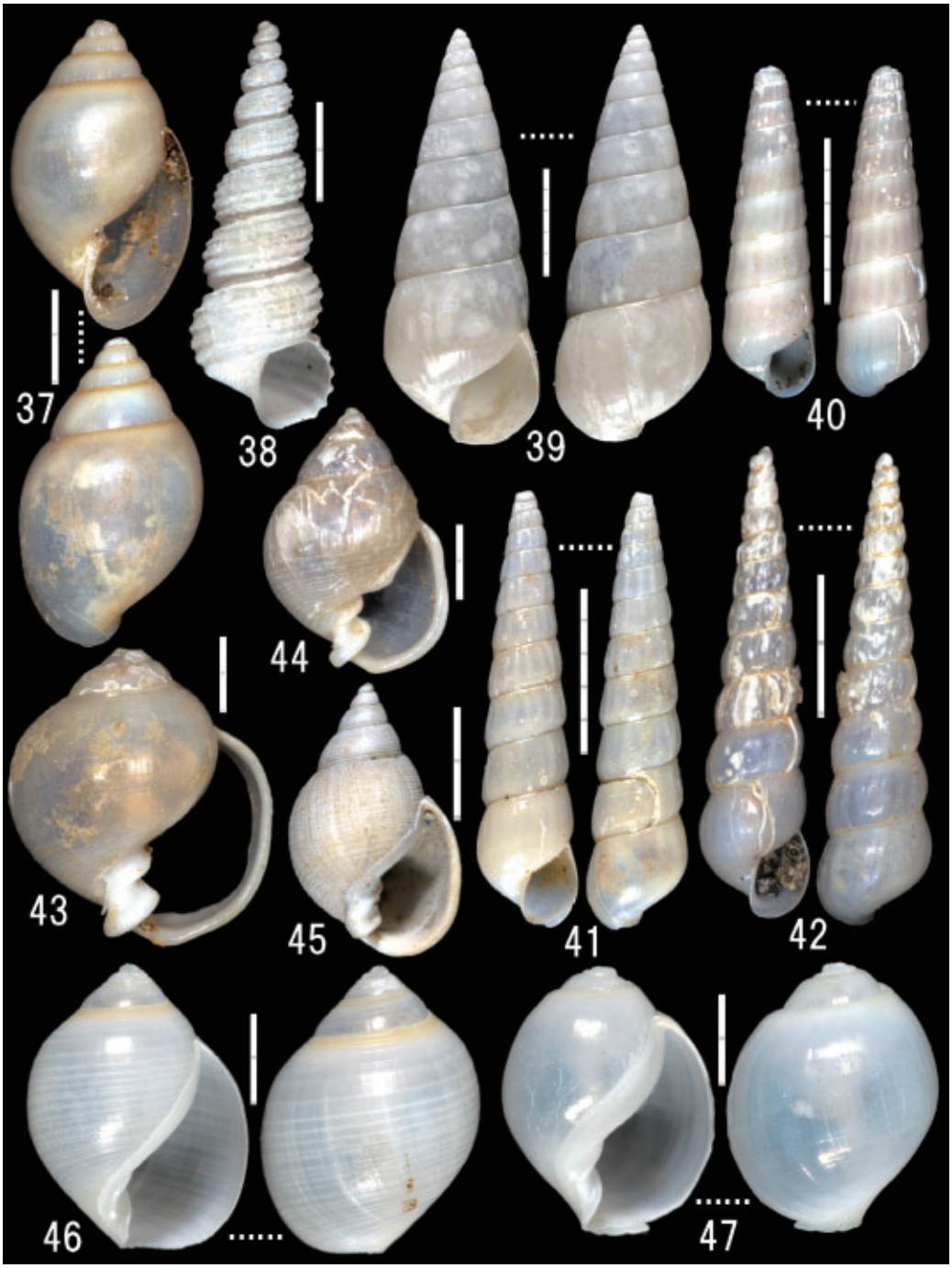
†"*Turbonilla*" *punicea* Okutani, 1964: 442, pl. 7, fig. 15 [preoccupied by Dall, 1884].

Turbonilla corgani Okutani, 1968a: [replacement name for "*Turbonilla*" *punicea* Okutani, 1964].

Records. S13 (type locality) [550 m].

Material examined. S13 (holotype, UMUT RM8850).

Remarks. Hasegawa (2001: 151) recorded the present species from Tosa Bay, and regarded *Turbonilla corgani* as a junior synonym of *T. subcylindrica* Schepman, 1909, which was described



Figs. 37–47. 37, *Acteon* sp., S22 (780 m); 38, *Turritellopsis subvenustellus*, holotype, UMUT RM8818, S15 (700 m); 39, *Eulimella* sp., T09 (756–859 m); 40, *Turbonilla corgani*, holotype [as *T. punicea*], UMUT RM8850, S13 (550 m); 41, *Turbonilla* sp. A, S31 (855–865 m); 42, *Turbonilla* sp. B, S15 (700 m); 43, *Ringicula* (*Ringiculina*) *pilula*, S27 (1005–1020 m); 44, *Ringicula* sp., S15 (700 m); 45, *Ringicula* (*Ringiculina*) *teramachii*, holotype, NSMT-Mo 39803, Tosa Bay; 46, *Microglyphis japonicus*, Y03 (1190 m); 47, *Microglyphis* sp., Y03 (1190 m); scale: 2 mm (37, 38, 42–47), 5 mm (39–41).

from the Sulu Sea at a depth of 535 m. Peñas and Rolán (2010: 254–5) subsequently mentioned that the figured specimens (Hasegawa, 2001: pl. 4, figs. M, N) do not correspond with Schepman's type material but are referable to their new species *T. terminuslevis* Peñas and Rolán, 2010. However, they did not compare their new species with the probably closely allied *T. corgani*. Future detailed study may reveal their conspecificity.

This species shows considerable intraspecific variation in the strength of the axial ribs as pointed out by Hasegawa (2001), and the specimen recorded from off the Bōsō Peninsula by Tsuchida and Kurozumi (1995: fig. 8-8) as "*Turbonilla* (*Ptycheulimella*) sp." falls within the range of variation of this species.

* ***Turbonilla*** sp. A (Fig. 41)

Material examined. S31 (1d) [855–865 m].

Remarks. Peñas and Rolán (2010) recently reviewed deep-water *Turbonilla* and related genera in tropical West Pacific, and described more than 200 new species. The present material most closely resembles *T. giribeti* Peñas and Rolán, 2010, among the known species, but it is distinguishable by its larger (exceeding 13.5 mm in length) and more slender shell with more deeply impressed suture. Similar but probably distinct species have been collected from the Enshu-nada (R/V *Sōyō Maru* st. 86A (14/5/61), 870 m), the Kumano-nada (R/V *Sōyō Maru* st. 18 (25/7/60), 360 m) and elsewhere, and a detailed review of the Japanese deep-water species of *Turbonilla*, based on Peñas and Rolán (2010), will be necessary.

Turbonilla sp. B (Fig. 42)

Eulimella sp. aff. *ventricosa* Forbes, 1846 – Okutani, 1964: 441.

Records. S15 [700 m].

Material examined. S15 (1d).

Remarks. The present species does not agree with any of those treated by Peñas and Rolán (2010), or others known in Japanese waters.

Family **Ringiculidae** Philippi, 1853

Ringicula* (*Ringiculina*) *pilula Habe, 1950 [Jn.: Shiratama-mame-urashima] (Fig. 43)

Ringicula (*Ringiculina*) *pilula* Habe, 1950 – Okutani, 1964: 437–438, pl. 4, fig. 18 (part); Okutani, 1966: 27.

Records. S05, S22, S27 [710–1020 m].

Materials examined. S22 (5e), S27 (4d).

***Ringicula* (*Ringiculina*)** sp. (Fig. 44)

Ringicula (*Ringiculina*) *pilula* Habe, 1950 – Okutani, 1964: 437–438 (part) [non *Ringicula pilula* Habe, 1950].

?*Ringicula (Ringiculina) teramachii* Habe, 1950, var – Okutani, 1968a: 44.

Records. S13 (1d) (as *R. pilula*), S15 (2e) (as *R. pilula*), S33 (as *R. teramachii* var.)[550–700 m].

Materials examined. S13 (1d), S15 (3e); T13 (1) [338–700 m].

Remarks. Specimens recorded from S13 and S15 (Fig. 45) as "*R. pilula*" differ from typical specimens of *R. pilula* (Fig. 43) in having a smaller and more elongate conical shell, and more closely resembling *R. teramachii* in proportion. A specimen recorded as "*R. teramachii* var." may also belong this form, although its voucher material was not located. However, these specimens also differ from the holotype of *R. teramachii* (Fig. 45) in having a larger shell, with weaker spiral ribs that attenuate towards the adapical suture, irregular wrinkle-like axial sculpture, and a well developed callus on the inner lip, and may belong to an undescribed species.

Ringiculopsis nipponica (Kuroda, 1961) [Jn.: Wadatsumi-mame-urashima]

Ringiculospongia nipponica Kuroda, 1961 – Okutani, 1964: 438, pl. 4, fig. 14.

Records. S03 [450 m].

Remarks. It is probable that *Ringiculopsis nipponica* is conspecific with, and thus becomes a junior synonym of, *R. faveolata* (Yokoyama, 1928), which was originally described from the Upper Byoritsu Beds in Takao (Kaohsiung) Prov-

ince, Taiwan (Pleistocene).

Microglyphis japonicus (Habe, 1952) [Jn.: Warabe-mame-urashima] (Fig. 46)

Hyporingicula japonica Habe, 1952 – Okutani, 1964: 438 (part).

Records. S07 [1190–1220 m].

Materials examined. S07 (1e); S59 (4e), Y03 (33+ca.100e) [940–1220 m].

Remarks. Another specimen recorded as this species from Sagami Bay at st. S22 (Okutani, 1964) was re-identified as *Acteon* sp., as mentioned above.

* ***Microglyphis*** sp. (Fig. 47)

Material examined. S48 (4e), Y03 (1+10e) [750–1190 m].

Remarks. This species occurs sympatrically in every station with *M. japonicus*, and can be distinguished from the latter by the more globose shell with an almost smooth surface lacking most of the spiral sculpture. The taxonomical relationship between the two forms remain unclear, but they are tentatively distinguished because of their discontinuity in shell morphology, until a more detailed study of the soft parts (especially the radula) becomes possible.

Family **Cylichnidae** H. Adams and A. Adams, 1854

Scaphander fragilis (Habe, 1952) [Jn.: Ō-suifu-gai]

Eoscaphander fragilis Habe, 1952 – Okutani, 1964: 439; Okutani, 1977: 78.

Eoscaphander teramachii Habe, 1954 – Hasegawa, 2006: 275 [non *Bucconia teramachii* Habe, 1954].

Records. S04, [S53, S54, S56 or S58 (Okutani, 1977)], R04 (as "*E. teramachii*") [240 m (Hasegawa, 2006) –780 m].

Materials examined. S52 (1e), S58 (4d) [450–700 m].

Remarks. This is the type species of *Eoscaphander* Habe, 1952, which was recently regarded as a junior synonym of *Scaphander* Montfort, 1810 by Valdés (2008: 668). Hasegawa (2006) erroneously recorded this species as "*E. teramachii*" from Sagami Bay.

Scaphander teramachii (Habe, 1954) [Jn.: Teramachi-suifu-gai] (Fig. 48)

Bucconia teramchii Habe, 1954 – Okutani, 1964: 439 (part).

Records. S05 [710–770 m].

Material examined. S05 (1d).

Remarks. Although this species has been recorded from Sagami Bay by Okutani (1964: two specimens from two stations) and Hasegawa (2006: one specimen), reexamination of voucher specimens revealed that most of them had been incorrectly identified: the one recorded by Hasegawa (2006: 275) was shown to be *Scaphander fragilis* as mentioned above, and the other from st. S22 was shown to be *Roxania smithae*. The rest from st. S05 (Fig. 48) agree well with the possible "type" of this taxon (NSMT-Mo 38721), although the two specimens in this "type" lot exceed 10 mm in shell length and are thus larger than the figured holotype (by monotypy), which was give as 9 mm SL.

* ***Scaphander*** sp. (Fig. 49)

Buccoina cumingii ventricosa Habe, 1954 – Okutani, 1964: 439.

Records. S12 [1400 m].

Material examined. S12 (1e).

Remarks. Re-examination of voucher material recorded as "*Buccoina cumingii ventricosa*" from Sagami Bay revealed that it differs from *B. cumingii ventricosa* in possessing a more strongly curved columella with a noticeably thickened margin. *Bucconia cumingii ventricosa* Habe, 1954 (Fig. 50) was recently transferred, together with its nominotypical subspecies *Scaphander cumingii* A. Adams, 1862, to the genus *Philine* Ascanius, 1772 by Valdés (2008: 717), but the present material more closely resembles *Scaphander teramachii*, and may belong to an undescribed species in the genus *Scaphander* as defined by Valdés (2008: 667).

Figs. 48–54. 48, *Scaphander teramchii*, S05 (710–770 m); 49, *Scaphander* sp., S12 (1400 m); 50, *Philine cumingii ventricosa*, possible holotype, NSMT-Mo 54566, Tosa Bay; 51, *Roxania smithae*, S05 (710–770 m); 52, *Roxania smithae*, S22 (780 m); 53, *Retusa sakuraii*, T10 (517–754 m); 54, *Retusa sakuraii*, T17 (681–104 m); scale: 1 mm (53, 54), 2 mm (48–52).

****Roxania smithae** Valdés, 2008 [New Japanese name: Hoso-kizami-kodama] (Figs. 51–52)

Abderospira punctulata (A. Adams, 1862) – Okutani, 1964: 440, pl. 7, fig. 12.

Eoscaphander teramchii Habe, 1954 – Okutani, 1964: 439 (part).

?"*Abderospira* ? sp." – Okutani, 1966: 28.

Records. S01, S04, S05 (as "*A. punctulata*");

S22 (as "*E. teramchii*"); ?S26 (as "*Abderospira* ? sp.") [620–1500 m].

Materials examined. S04 (1e), S05 (1d), S22 (1e); S32 (1e), T04 (1e), T09 (1e), T17 (1) [517–1520 m].

Remarks. The specimens recorded by Okutani (1964) as "*Abderospira punctulata*" can correctly be identified as *Roxania smithae* Valdés, 2008, which was recently described from Tonga and adjacent waters, by the absence of a perforate umbilicus and the presence of clearly punctuate spiral grooves in the central region of the shell. It has also been recorded under various names from Sagami Bay, as shown in the synonymy. The specimens recorded as "*Sabatia ovata* Habe, 1952" by Hasegawa (2001: pl. 4, fig. R) from Tosa Bay also belong to this species.

Cylichna alba (Brown, 1827) [Jn.: Itoko-kaikogai-damashi]

Cylichna consobrina Gould, 1859 – Okutani, 1964: 440.

Adamnestia toyamaensis (Habe, 1955) – Hasegawa, 2006: 276.

Records. S05, S08, S13, R01 [240 m (Hasegawa, 2006) –790 m].

Materials examined. S05 (6e), S08 (1d), R01 (1e).

Remarks. This species is widely distributed in circumpolar seas in the Northern Hemisphere, both in the Atlantic and the Pacific (Hasegawa, 2009: 355), and it shows considerable geographical variation in Japanese waters. Specimens collected in the Sea of Japan and the Pacific coast of northeastern Honshū (Kashima-nada and northwards) possess a straight-sided shell with a truncate posterior end (e.g. Hasegawa, 2009: figs. 417–8). Those in the temperate Pacific waters, from Sagami Bay to the Ryūkyū Islands, possess a slightly rounded shell with a gradually narrowing posterior end (e.g. Hori in Okutani, 2000: pl. 370, fig. Cylichnidae–25). The latter form was identified by Hasegawa (2001: pl. 4, figs. P–Q; 2005: fig. 15K) as "*A. toyamaensis*", which may be regarded as a junior synonym of *C. alba* (Hasegawa, unpublished observation). Accordingly, it becomes clear that this species is more widely distributed in the Japanese waters, southwards to off the Ryūkyū Islands, than previously been known (Izu-ōshima Island and northwards: Hori in Okutani, 2000).

Family **Retusidae** Thiele, 1925

****Retusa sakuraii*** (Habe, 1958) [Jn.: Sakurai-kometsubu] (Figs. 53–54)

Materials examined. T10 (1), T13 (1e), T17 (1) [517–1104 m].

Remarks. This species has been known only from the type material, which was collected from "off Chōshi, Chiba Pref., Japan, by trawl fishing in deep sea". The present material represents the second record, and the first from Sagami Bay, of this species.

Discussion

Okutani (1967, 1968b, 1969, 1972) discussed in detail the characteristics of deep-sea mollusks in Sagami Bay and adjacent waters along the Pacific coast of Honshū from the viewpoints of water system, bathymetry and geography. Species inhabiting bathyal to abyssal depths were classified into three groups: 1) species of northern origin in subarctic water mainly at bathyal depths, 2) species of southern origin in western Pacific bottom water mainly at abyssal depths, and 3) endemic species in intermediate water, which are thought to be derived from the boreal species by geographical separation. More specifically, in Sagami Bay the bathyal molluscan assemblage was shown to be composed of three elements: a) species that had invaded from the lower sublittoral or continental slope, b) species of boreal origin, and c) endemic species.

The bathyal gastropod faunas along the Pacific coast of the Japanese archipelago have gradually been clarified since then. For instance, the National Museum of Nature and Science has been carrying out a research program entitled "Study on Deep-sea Fauna and Preservation of Deep-sea Ecosystem" since 1993, and gastropods collected

during the survey have been preliminarily listed by Hasegawa (2001, 2005, 2009) for Tosa Bay, off the Nansei Islands (the Ryukyus), and off northeastern Honshū (Sanriku), respectively. The gastropod fauna in Russian Pacific waters was recently reviewed by Kantor and Sysoev (2006) in detail, with color photographs of all the species treated, and this was of considerable help in understanding the identity of hitherto ambiguous species of boreal origin. Furthermore, revisionary studies on several groups in the tropical Pacific have been published, mainly based on the results of the systematic deep-sea exploration by the Muséum National d'Histoire Naturelle and Institute of Research for Development, France (IRD). These have included many Japanese species (e.g. Valdés, 2008; Peñas and Rolán, 2010, as mentioned in the Taxonomy part). As a result, the identifications of some of the species cited in previous studies were reconsidered, and their vertical and geographical distributions have been revised. Based on this revised information, characteristics of the bathyal gastropod assemblage in Sagami Bay and its adjacent waters [the Sagami-nada] were reevaluated as follows.

Bathymetrical implications

Regarding the vertical distribution of the species examined in the present study, 15 of 120 species (12.5%) have also been recorded from depths shallower than 400 m in this area, and they are considered to belong to the "lower shelf fauna" as classified by Okutani (1967, 1968b). It is noticeable that this element does not occupy a large portion of the total fauna, and nearly 90% of total species are regarded as true bathyal elements.

In order to summarize the vertical distribution of all species, the number possibly occuring within every 100 m increment from 400 to 1500 m are calculated and shown in Fig. 55. In calculating the number of species, each is considered to occur throughout its depth range (between the shallowest record and the deepest record). For instance, although *Volutomitra alaskana* was recorded from only two stations, S13 [550 m] and S27 [1005–1020 m], this species is considered to occur throughout the range 550–1020 m. Profiles of vertical distribution were then compared be-

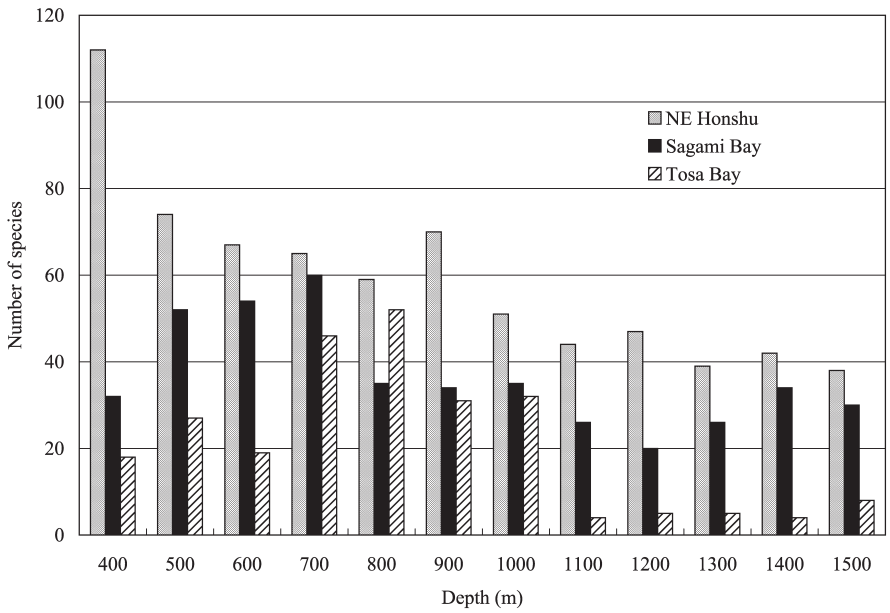


Fig. 55. Comparison of the number of species possibly occurring within every 100 m from 400 to 1500 m in northeastern Honshū, Sagami Bay and Tosa Bay. See text for the method used to calculate the number of species. Data for NE Honshū and Tosa Bay after Hasegawa (2009, 2001).

tween Sagami Bay (filled columns), off northeastern Honshū (shaded columns: based on the results of Hasegawa, 2009) and Tosa Bay (striped columns: based on the results of Hasegawa, 2001). In Sagami Bay, the number of species gradually increases with depth, and reaches a peak at about 700 m. The number then decreases with depth, but there is another small peak at about 1400 m. A similar profile is observed in Tosa Bay, although it is not as clear, possibly because of the insufficiency of material. On the other hand, in the waters off northeastern Honshū, the number of species is by far the largest in the shallowest water, and gradually decreases with depth. This is apparently correlated with the fact that 76 (54%) of the 140 species recorded from the bathyal depths also occur at depths shallower than 400 m, showing a stronger association of the upper bathyal fauna with the lower shelf fauna in this area. The difference in the vertical distributions in northern and temperate areas may be related to the degree of difference between surface and bottom temperatures, reflecting the presence of the Kuroshio Current in temperate areas (Fig. 56).

Considering the vertical distribution of each species, some were found to occur over an extremely wide range. These usually show a considerable range of variation in shell morphology depending on depth, as exemplified by *Propebela* sp. cf. *tersa* (see Hasegawa, 2009: 349). The accumulation of information from various areas may provide a new insight into the taxonomical status of such ambiguous species (or "complexes"). A good example is the case of *Bathyancistrolepis trochoideus*. This species was originally described from off the Kii Peninsula at 440 and 600 fathoms [804–1097 m] (Dall, 1907). A similar form was subsequently described from off Chōshi at "ca. 200 m" by Habe and Ito (1965a, b) as the subspecies *B. trochoideus ovoideus*, which was distinguished from the nominotypical subspecies by its larger and higher conical shell with regularly spaced thicker spiral cords. The latter was regarded as a junior synonym of the nominotypical subspecies by most subsequent authors (e.g. Okutani, 1966), and this view is provisionally adopted in the present review. However, this "species" shows a remarkably wide vertical distribution with "*ovoideus*" occurring in the shallower zone and "*trochoideus*" in the deeper zone. In northeastern Honshu, for instance, "*ovoideus*" occurs between 450 and 2000 m, whereas "*trochoideus*" is in 2700–3000 m, a rather discontinuous pair of distributions (Hasegawa, 2009; personal observation). In Sagami Bay, only "*ovoideus*" occurs in 517–1459 m, and "*trochoid-*

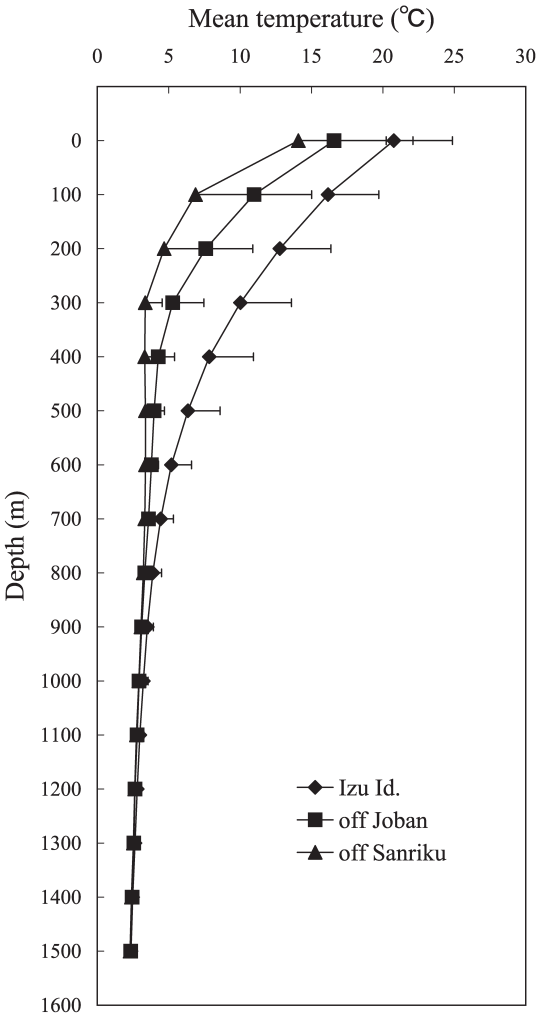


Fig. 56. Comparison of the vertical profile of water temperature in northeastern Honshū and Izu Island near Sagami Bay. Data were cited from Japan Oceanographic Data Center at http://jdoss1.jodc.go.jp/cgi-bin/1997/bts.jp.

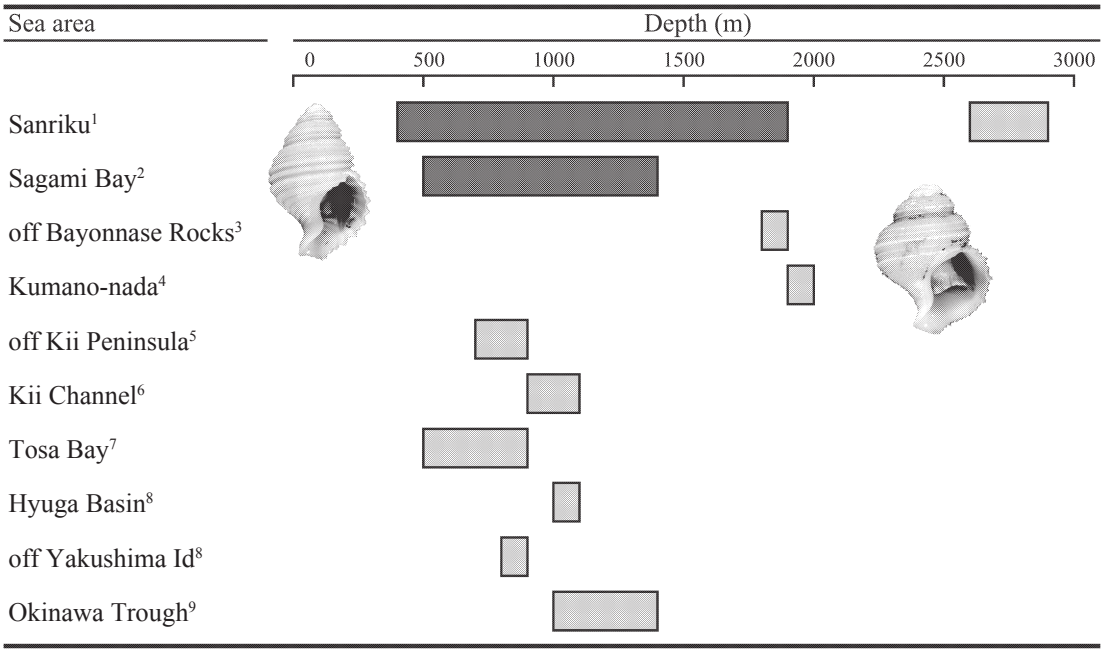


Fig. 57. Comparison of the vertical distribution of *Bathyancistrolepis trochoideus* in various sea areas. Shaded bar for "*trochoideus*" form, solid bar for "*ovoideus*" form. Source of information: 1: Hasegawa (2009; personal observation); 2: present study; 3: Okutani (1966); 4: Okutani (1964); 5: Dall (1907); 6: Tsuchida (1985); 7: Okutani and Iwahori (1992) and Hasegawa (2001); 8: Tsuchida (1993); 9: Hasegawa (2005).

eus" was recorded in adjacent areas, such as off Bayonnaise Rocks in the Izu Islands, and in the Kumano-nada, at depths of 1940–2050 m (Okutani, 1964, 1966). In the temperate area from off the Kii Peninsula to Tosa Bay, only the "*trochoideus*" form has been recorded within a range of 654–1141 m, which corresponds to the vertical range of "*ovoideus*" in northern areas (Fig. 57). This distribution pattern may suggest that the two forms represent different species that adapted in separate niches in northern waters, and that only the deeper form then expanded its geographical distribution to temperate areas and shifted its vertical distribution to shallower depths. Because of the parapatry of both forms, however, further detailed taxonomical study, including molecular analysis, will certainly be necessary to confirm this possibility.

Geographical implications

The species recorded in the present revision from Sagami Bay were classified into four categories from the viewpoint of geographical distribution: 1) species also recorded from northeastern Honshū (Hasegawa, 2009); 2) species also recorded from Tosa Bay or off the Nansei Islands (Hasegawa, 2001, 2005); 3) species also recorded from both areas; 4) species endemic to this area. The result is summarized in Fig. 58. Fifty species in total (41.7%) are considered to be of boreal origin, and a part of them (17 species) extends its distribution south to Tosa Bay. 21 (17.5%) are considered to be temperate or subtropical species, mostly endemic to the Pacific coast of the Japanese archipelago from Sagami Bay to Tosa Bay. The remaining 47 species (39.2%) are so far recorded only from Sagami Bay and adjacent waters, although some of them are known only from one or a few specimens and their precise distributions are still unclear.

The dominance of subarctic elements in the bathyal fauna in Sagami Bay has already been pointed out by Okutani (1972). The present result generally supports this view. However, 92 of the

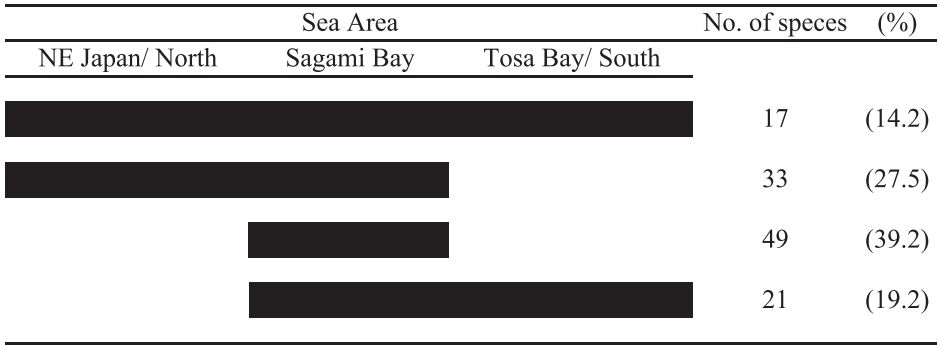


Fig. 58. Geographical distribution of the bathyal gastropods recorded in Sagami Bay.

140 species (66%) recorded from off northeastern Honshū (Hasegawa, 2009) were not recorded from Sagami Bay. Because there are no significant gaps in the extensive area from southern Hokkaido to the Kashima-nada (Hasegawa, 2009), except for a rather gradual decrease in the number of temperate species moving northward, the difference in the gastropod faunas between the Kashima-nada and Sagami Bay is noticeable. On the other hand, it is also noteworthy that a large part of the boreal species inhabiting Sagami Bay do not invade Suruga Bay, which is located across the nearby Izu Peninsula, and many temperate species in Suruga Bay similarly do not occur in Sagami Bay. Sagami Bay may thus be a partial barrier to both northern and southern elements.

Based on the protoconch morphology, most bathyal gastropods are supposed to undergo direct development without free-swimming larva, and their distribution can thus be strongly influenced by the topography of the sea bottom. Gaps in the distributions of bathyal gastropods around Sagami Bay may thus be related to the complexity of the topography of this area, as shown in Fig. 59, where bathyal ranges from 400 to 1000 m and 1000 to 1500 m are shaded in light and dark gray respectively. Although Sagami Bay is bounded by mainland Honshū, the Izu and Bōsō Peninsulas, and Izu-ōshima Island, the Sagami Trough, which diverges from a range of the Japan and Izu-Ogasawara (Bonin) Trenches, enters Sagami Bay from the area between the Bōsō peninsula and Izu-ōshima Island. Accordingly a bathyal zone extending down to a depth of more than 1500 m is well developed in this embayed area. This topographical feature makes the dominance of boreal elements in this area logical. However, it is noticeable in Fig. 58 that the slope of the Sagami Trough is extremely steep around the southern tip of the Bōsō Peninsula, with a very narrow bathyal zone. In addition, several deep canyons, such as the Kamogawa, Bōsō and Katagai Canyons, are present along the southeastern coast of Bōsō Peninsula. This bottom structure may explain the difference in gastropod faunas between the sea areas Kashima-nada and Sagami Bay.

On the other hand, there is the Izu Ridge, a range of islands and shallow banks, on the western part of Sagami Bay, extending from the Izu Peninsula to Miyake and Mikura Islands. The deepest part of the ridge, between Izu-ōshima Island and the Izu Peninsula, is about 500 m in depth, and may function effectively as a barrier to dispersal of lower bathyal benthic organisms, including gastropods. In order to go beyond this area, it would be necessary to go around the ridge far to the south of Miyake Island, making it difficult especially for boreal species to disperse westwards.

Looking at the topography within Sagami Bay, its largest part consists of the bathyal zone with a relatively slight slope, which is complicated by the presence of many small canyons, especially on the eastern slope. These geographical features may have contributed to the speciation of many

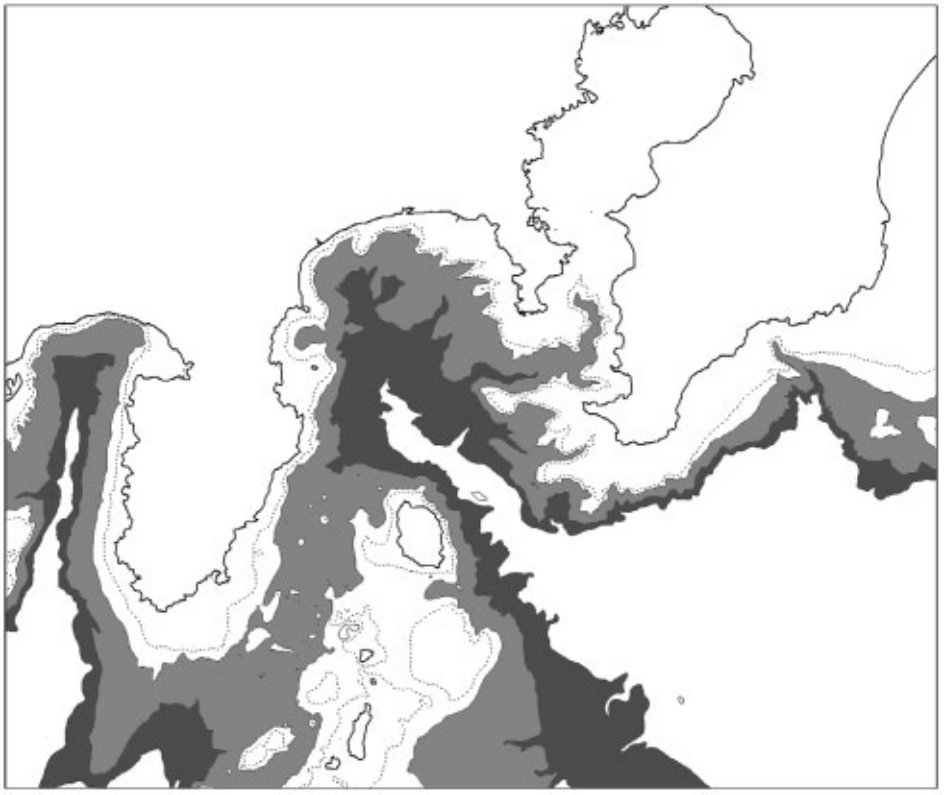


Fig. 59. Topography of Sagami Bay and adjacent waters. Depth range from 400 to 1000 m is shaded light gray, and range from 1000 to 1500 m in dark gray, respectively. A broken line represents a 200 m contour.

endemic species inhabiting this restricted area.

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References

Bail, P. and M. Chino, 2010. The Family Volutidae. The Endemic Far East Asian Subfamily Fulgorariinae Pilsbry & Olsson, 1854. A Review of the Recent Species. A Conchological Iconography. 74 pp., 64 pls., ConchBooks, Hackenheim.

Bartsch, P., 1945. The West Pacific species of the molluscan genus *Aforia*. *Journal of the Washington Academy of Sciences*, 35: 388–393.

Bogdanov, I.P. and K. Ito, 1992. The Oenopotinae (Gastropoda: Turridae) mollusks from the southeastern part of the Japan Sea. *Venus, Japanese Journal of Malacology,* 51: 11–41.

Bouchet, P. and J.-P. Rocroi, 2005. Classification and nomenclator of gastropod families. *Malacologia*, 47: 1–397.

Bouchet, P. and A. Warén, 1993. Revision of the Northeast Atlantic bathyal and abyssal Mesogastropoda. *Bollettino Malacologico*, supplemento, (3): 580–840.

The Committee for Celebrating Dr Okutani's Retirement from Tokyo University of Fisheries, 1996. Bibliography on the Malacological Works of Dr Takashi Okutani 1955–1994. 101 pp., 9 pls., Published by the Committee, Tokyo.

Cosel, R. von, 1998. Mayor Lischke and the Japanese marine shells. A bio-bibliography of Carl Emil Lischke and a brief history of marine malacology in Japan with bibliography. *The Yuriyagai, Journal of Malacozoological Association of Yamaguchi*, 6: 7–50.

Dall, W.H., 1902. Illustrations and descriptions of new, unfigured or imperfectly known shells, chiefly American, in the U.S. National Museum. *Proceedings of the United States National Museum*, 24 (1264): 499–566, pls. 27–40.

Dall, W.H., 1907. Descriptions of new species of shells, chiefly Buccinidae, from dredgings of the U.S.S. "Albatross" during 1906, in the northwestern Pacific, Bering, Okhotsk, and Japanese seas. *Smithsonian Miscellaneous Collections*, 50: 139–173.

Dall, W.H., 1913. New species of the genus *Mohnia* from the North Pacific. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 65: 501–504.

Dall, W.H., 1918. Notes on *Chrysodomus* and other mollusks from the North Pacific Ocean. *Proceedings of the United States National Museum*, 54 (2234): 207–234.

Dall, W.H., 1925. Illustrations of unfigured types of shells in the collection of the United States National Museum. *Proceedings of the United States National Museum*, 66 (2554): 1–41, pls. 1–36.

Fujikura, K., J. Hashimoto and T. Okutani, 2002. Estimated population densities of megafauna in two chemosynthesis-based communities: a cold seep in Sagami Bay and a hydrothermal vent in the Okinawa Tragh. *Benthos Research*, 57: 21–30.

Fujikura, K., T. Okutani and T. Maruyama (eds.), 2008. Deep-sea Life – Biological Observation using Research Submersibles. xxii + 487 pp., Tokai University Press, Hadano. (In Japanese.)

Golikov, A.N., 1980. Molluscs Buccininae of the World Oceans. *Fauna of USSR*, *Mollusks. Leningrad*, *Nauka*, 5 (2): 1–466. (In Russian.)

Habe, T. and K. Ito, 1965a. Shells of the World in Colour. Vol. I. vii+176 pp., 56 pls., Hoikusha, Osaka. (In Japanese.)

Habe, T. and K. Ito, 1965b. New genera and species of shells chiefly collected from the North Pacific. *Venus* (*Japanese Journal of Malacology*), 24: 16–45, pls. 2–4.

Habe, T. and O. Masuda, 1990. Catalogue of the molluscan shells donated by Mr. Hiroshi Noguchi to the Natural History Museum, Tokai University. *Science Reports of the Natural History Museum, Tokai University*, (4): 1–152, pls. 1–4.

Hadorn, R. and K. Fraussen, 2005. Revision of the genus *Granulifusus* Kuroda & Habe, 1954, with description of some new species. *Archiv für Molluskenkunde*, 134: 129–171.

Hasegawa, K., 1997. Sunken wood-associated gastropods collected from Suruga Bay, Pacific side of the central Honshu, Japan, with descriptions of 12 new species. *National Science Museum Monographs*, (12): 59–123.

Hasegawa, K., 2001. Deep-sea gastropods of Tosa Bay, Japan, collected by the R/Vs *Kotaka-Maru* and *Tansei-Maru* during the Years 1997–2000. *In*: Fujita, T., H. Saito and M. Takeda (eds.), *Deep-sea Fauna and Pollutants in Tosa Bay*. *National Science Museum Monographs*, (20): 121–165.

Hasegawa, K., 2005. A preliminary list of deep-sea gastropods collected from the Nansei Islands, southwestern Japan. *In*: Hasegawa, K., G. Shinohara and M. Takeda (eds.), *Deep-sea Fauna and Pollutants in Nansei Islands*. *National Science Museum Monographs*, (29): 137–190.

Hasegawa, K., 2006. Sublittoral and bathyal shell-bearing gastropods chiefly collected by the T/V *Rinkai-Maru* of the University of Tokyo around the Miura Peninsula, Sagami Bay, 2001–2004. *Memoirs of the National Science Museum*, (40): 225–281.

Hasegawa, K., 2009. Upper bathyal gastropods of the Pacific coast of northern Honshu, Japan, chiefly collected by R/V *Wakataka-maru*. *National Museum of Nature and Science Monographs*, (39): 225–383.

Hasegawa, K., 2010. A taxonomical note on the species previously recorded as "*Turritellopsis acicula stimpsoni* Dall" in the northwestern Pacific. *Chiribotan*, 40: 69–78. (In Japanese with English abstract.)

Hasegawa, K., S. Hori and R. Ueshima, 2001. A preliminary list of sublittoral shell-bearing gastropods in the vicinity of Shimoda, Izu Peninsula, central Honshu, Japan. *Memoirs of the National Science Museum*, (37): 203–228.

Hatai, K. and S. Nisiyama, 1952. Check list of Japanese Tertiary marine Mollusca. The Science *Reports of the Tohoku University, Sendai, Japan*. Second Series (Geology). Special volume, (3): 1–464.

Higo, S., P. Callomon and Y. Goto, 1999. Catalogue and Bibliography of the Marine Shell-bearing Mollusca of Japan. 749 pp., Elle Scientific Publications, Yao, Osaka.

Higo, S., P. Callomon and Y. Goto, 2001. Catalogue and Bibliography of the Marine Shell-bearing Mollusca of Japan. Type Figures. 208 pp., Elle Scientific Publications, Yao, Osaka.

Hirase, Y., 1908. Appendix – on Japanese marine Mollusca (II), with the descriptions of new species of Muricidae and Buccinidae. *The Conchological Magazine*, 2 (12): 387–403, 69–74, pls. 41–43.

Horikoshi, M., 1957. Note on the molluscan fauna of Sagami Bay and its adjacent waters. *Science Reports of the Yokohama National University, Sec. II*, (6): 37–64, pl. 11, charts I–II.

Horikoshi, M., T. Fujita, M. Takeda, M. Okiyama, S. Ohta, E. Tsuchida and M. Yamamoto, 1982. Preliminary compilation of the results obtained by the "Survey

of Continental Shelf Bordering Japan" carried out on board the S/S *Sōyō Maru* during 1923-1930. *In*: Horikosi, M. (ed.), Report for a part of the result of Grant-in-Aid for Cooperative Research (A), Ministry of Education, Science and Culture: "Studies on Off-shore and Deep-sea Faunas in the West Pacific and Indian Oceans" (Project no. 00534033). 252 pp., Ocean Research Institute, University of Tokyo.

Houbrick, R.S., 1979. Classification and systematic relationships of the Abyssochrysidae, a relict family of bathyal snails (Prosobranchia: Gastropoda). *Smithsonian Contributions to Zoology*, (290): 1–21.

Ikebe, N., 1942. Trochid Mollusca *Calliostoma* of Japan, fossil and Recent. *Japanese Journal of Geology and Geography*, 18: 249–282, pls. 16–18.

Ikeda, H., 1985. "Distribution of *Buccinum sagamianum* Okutani [*trans*. *auct*.]". *Mitamaki*, *Sagami Shell Club*, (18): 2–4. (In Japanese.)

Ikeda, H., 1989. "*Sagamiletepa sagamiensis* from Sagami Bay [*trans*. *auct*.]". *Mitamaki, Sagami Shell Club*, (23): 3. (In Japanese.)

Ikeda, H. and T. Kuramochi, 2010. A Catalogue of Mollusks of Sagami Bay. 100 pp., Hayama Shiosai Museum, Hayama. (In Japanese.)

Ito, K., Y. Matano, Y. Yamada and S. Igarashi, 1986. Shell species caught [sic] S/S Rokko-Maru off the coast Ishikawa Prefecture. *Bulletin of Ishikawa Prefectural Fisheries Experimental Station*, (4): 1–179. (In Japanese with English abstract.)

Kantor, Yu. I. and A.V. Sysoev, 1991. Mollusks of the genus *Antiplanes* (Gastropoda: Turridae) of the northwestern Pacific Ocean. *The Nautilus*, 105: 119–146.

Kantor, Yu. I. and A.V. Sysoev, 2006. Marine and Brackish Water Gastropoda of Russia and adjacent Countries: an Illustrated Catalogue. 371 pp., 140 pls., KMK Scientific Press Ltd., Moscow.

Kosuge, S., 1972. Illustrations of Type Specimens of Molluscs described by William Healey Dall (North Western Pacific Gastropods). 3 pp., 29 pls., Published by the author, Tokyo.

Kuroda, T., 1950. "Localities of shells during the 1906 research cruise of Albatross" [*tans*. *auct*.]. *Yumehamaguri*, (48): 386–388. (In Japanese.)

Kuroda, T., 1964. "Letters from Hyakumanben, Kyoto [*trans*. *auct*.]". *Chiribotan*, 3: 62-64. (In Japanese.)

Kuroda, T., T. Habe and K. Oyama, 1971. The Sea Shells of Sagami Bay. Collected by His Majesty the Emperor of Japan. xix + 741 pp. [Japanese part] + 121 pls. + 489 pp. [English part] + 51 pp. [index], Maruzen Co. Ltd., Tokyo.

Lischke, C.E., 1869–1874. Japanische Meeres-Conchylien. Ein Beitrag zur Kenntnis der Mollusken Japans mit besonderer Rücksicht auf die geographische Verbreitung derselben. Vol. 1: 192 pp., 14 pls., 1869; Vol. 2: 184 pp., 14 pls., 1871; Vol. 3: 123 pp., 9 pls., 1874. T. Fischer, Kassel.

Lischke, C.E., 1872. Diagnosen neuer Meeres-Conchylien von Japan. *Malakozoologischen Blätter*, 19: 100–109.

Marshall, B.A., 1999. A revision of the Recent Solariellinae (Gastropoda: Trochoidea) of the New Zealand region. *The Nautilus*, 113: 4–42.

Matsuda, H., Y. Hamano, S. Hori and K. Nagasawa, 2010. Redescription and attachment modes of *Hypermastus peronellicola* and *H. tokunagai* (Prosobranchia: Eulimidae), ectoparasites on sand dollars (Echinodermata: Clypeasteroida) in Japanese waters. *Venus*, 69: 25–39.

McLean, J.H., 1992. Systematic review of the family Choristellidae (Archaeogastropoda: Lepetellacea) with description of new species. *The Veliger*, 35: 273–294.

Numanami, H. and T. Okutani, 1990. A new and two known species of the genus *Anatoma* collected by the Icebeaker *Shirase* from Brid Bay and Günnerus Bank, Antactica (Gastropoda: Schissurelidae). *Venus, Japanese Journal of Malacology,* 49: 93–106.

Ohta, S., 1983. Photographic census of large-sized benthic organisms in the bathyal zone of Suruga Bay, central Japan. *Bulletin of the Ocean Research Institute, University of Tokyo*, (15): 1–244.

Okutani, T., 1964. Report on the archibenthal and abyssal gastropod Mollusca mainly collected from Sagami Bay and adjacent waters by the R.V. *Soyo-Maru* during the years 1955–1963. *Journal of the Faculty of Science*, *University of Tokyo*, Section II, 15 (3): 371–447, pls. 1–7.

Okutani, T., 1966. Archibenthal and abyssal Mollusca collected by the R.V. *Soyo-Maru* from Japanese waters during 1964. *Bulletin of the Tokai Regional Fisheries Research Laboratory*, (46): 1–32, 2 pls.

Okutani, T., 1967. Characteristics and origin of archibenthal molluscan fauna on the Pacific coast of Honshu, Japan. *Venus, Japanese Journal of Malacology*, 25: 136–146.

Okutani, T., 1968a. Bathyal and abyssal Mollusca trawled from Sagami Bay and the south off Boso Peninsula by the R/V *Soyo-Maru*, 1965–1967. *Bulletin of the Tokai Regional Fisheries Research Laboratory*, (56): 7–55.

Okutani, T., 1968b. Systematics, ecological distribution and palaeoecological implication of archibenthal and abyssal Mollusca from Sagami Bay and adjacent area. *Journal of the Faculty of Science, University of Tokyo*, Sec. II, 17(1): 1–98, pl. 1.

Okutani, T., 1969. Synopsis of bathyal and abyssal megalo-invertebrates from Sagami Bay and the south off Boso Peninsula trawled by the R/V *Soyo-Maru*. *Bulletin of the Tokai Regional Fisheries Research Laboratory*, (57): 1–62.

Okutani, T., 1972. The probable subarctic elements found in the bathyal megalobenthos in Sagami Bay. *Journal*

of the Oceanographical Society of Japan, 28(3): 95–102.

Okutani, T., 1974. Review and new records of abyssal and hadal molluscan fauna in Japanese and adjacent waters. *Venus, Japanese Journal of Malacology,* 33: 23–39.

Okutani, T., 1977. Two new species of the genus *Buccinum* from bathyal zone in Sagami Bay, Japan (Gastropoda: Buccinidae). *Venus, Japanese Journal of Malacology,* 36: 73–80.

Okutani, T., 1985. A note on molluscan fauna of Okinoyama Reef, off Boso Peninsula, Japan. *Special Publication of the Mukaishima Marine Biological Station* 1985: 23–31.

Okutani, T., 1987. *Sagamilepeta*, a new genus for "*Lepeta*" *sagamiensis* Kuroda & Habe, 1971 (Gastropoda: Lepetidae). *Venus, Japanese Journal of Malacology,* 46: 127–130.

Okutani, T. (ed.), 2000. Marine Mollusks in Japan. xlviii+1173 pp., Tokai University Press, Tokyo.

Okutani, T. and K. Egawa, 1985. The first underwater observation on living habit and thanatocenoses of *Calyptogena soyoae* in bathyal depth of Sagami Bay. *Venus, Japanese Journal of Malacology*, 44: 285–289.

Okutani, T. and K. Fujikura, 1992. A new turrid gastropod associated with metachromatic seabed near the *Calyptogena*-community in Sagami Bay. *Venus, Japanese Journal of Malacology,* 51: 1–7.

Okutani, T. and A. Iwahori, 1992. Noteworthy gastropods collected from bathyal zone in Tosa Bay by the R/V *Kotaka-Maru* in 1987 and 1988. *Venus, Japanese Journal of Malacology,* 51: 235–268.

Okutani T., E. Tsuchida and K. Fujikura, 1992. Five bathyal gastropods living within or near the Calyptogena-community of the Hatsushima Islet, Sagami Bay. *Venus, Japanese Journal of Malacology*, 51: 137–148.

Okutani, T., K. Fujikura and T. Sasaki, 1993. New taxa and new distribution records of deepsea gastropods collected from or near the chemosynthetic communities in the Japanese waters. *Bulletin of the National Science Museum*, Series A, 19: 123–143.

Otuka, Y. 1949. Fossil Mollusca and rocks of the Kiyosumi Group exposed at Minato-machi, Chiba Prefecture, and its environs (1st paper). *Japanese Journal of Geology and Geography*, 21: 296–309, pl. 13.

Ozaki, H., 1958. Stratigraphical and paleontological studies on the Neogene and Pleistocene Formations of the Tyôsi [= Choshi] District. *Bulletin of the National Science Museum*, 4: 1–182, pl. 1–24.

Powell, A.W.B., 1942. The New Zealand Recent and fossil Mollsuca of the family Turridae, with general notes on turrid nomenclature and systematics. *Bulletin of the Auckland Institute and Museum*, (2): 1–188, pls. 1–14.

Powell, A.W.B., 1966. The molluscan families Speightiidae and Turridae. An evaluation of the valid taxa, both Recent and fossil, with lists of characteristic species. *Bulletin of the Auckland Institute and Museum*, (5): 1–184, pls. 1–22.

Peñas, A. and E. Rolán, 2010. Deep water Pyramidelloidea of the tropical South Pacific: *Turbonilla* and related genera. *In*: Gofas, S. (ed.), Tropical Deep-Sea Benthos 26. *Mémoires du Muséum national d'Histoire naturelle*, 200: 1–436.

Sasaki, T., T. Okutani and K. Fujikura, 2005. Molluscs from hydrothermal vents and cold seeps in Japan: a review of taxa recorded in twenty recent years (1984–2004). *Venus*, 64: 87–33.

Sasaki, T., K. Fujikura and T. Okutani, 2007. Molluscs collected in the cruise NT06-04 of R/V *Natsushima* from methane-seeps off Hatsushima Island, Sagami Bay. *Chiribotan*, 37: 197–207. (In Japanese.)

Sasaki, T. and D.L. Geiger, 2010. A new species of *Anatoma* (Vetigastropoda: Anatomidae) from a hydrothermal vent field in Myojin Knoll Caldera, Izu-Ogasawara Arc, Japan. *The Veliger*, 51: 63–75.

Shikama, T., 1962. On some noteworthy shells from off Choshi, Chiba Prefecture. *Science Reports of the Yokohama National University*, Section II, Biological and Geological Sciences, (8): 29–56, pls. 1–3.

Shikama, T., 1967. System [sic] and evolution of Japanese fulgorarid Gastropoda. *Science Reports of the Yokohama National University*, Section II, Biological and Geological Sciences, (13): 23–132, pls. 1–17.

Sysoev, A. and P. Bouchet, 2001. New and uncommon turriform gastropods (Gastropoda: Conidae) from the South-West Pacific. *In*: Bouchet, P. and B.A. Marshall (eds.), Tropical Deep-sea Benthos, volume22. *Mémoires du Muséum National d'Histoire Naturelle*, 185: 271–320.

Takenouchi, K., 2001. Shells from Japan and its adjacent waters collected by Tetsuaki Kira: Gastropoda. *Special Publications from Osaka Museum of Natural History*, (33): 1–110. (In Japanese.)

Taki, I. and K. Oyama, 1954. Matajiro Yokoyama's the Pliocene and later faunas from the Kwanto Region in Japan. *Palaeontological Society of Japan*, *Special Papers*, (2): 1–68, 1–49 pls.

Tsuchida, E., 1985. Archibenthal Mollsuca collected by the R.V. *Tansei-Maru* from off Kii Channel. *Nankiseibutsu*, *the Nanki Biological Society*, 27: 95–104. (In Japanese.)

Tsuchida, E., 1991. Fauna of marine mollusks of the sea around Otsuchi Bay, Iwate Prefecture. (2) Neogastropoda. *Otsuchi Marine Research Center Report*, (17): 1–27. (In Japanese with English abstract.)

Tsuchida, E., 1993. A review and preliminary notes on the deep sea molluscs in the Kyushu coast and adjacent areas. *Kyushu-no-kai* [Shells of Kyushu], (40·41): 41–50. (In Japanese.)

Tsuchida, E., 2000. “The present status of the research on deep-sea mollusks in Japan [*trans*. *auct*.].” *Kaiyo Monthly*, 25–39. (In Japanese.)

Tsuchida, E. and T. Kurozumi, 1995. Preliminary report of bathyal Mollusca collected off the Boso Peninsula by R.V. Tansei-Maru. *Journal of the Natural History Museum and Institute*, *Chiba*, 3: 173–189. (In Japanese with English abstract.)

Valdés, A., 2008. Deep-sea “cephalaspidean” heterobranchs (Gastropoda) from the tropical southwest Pacific. *In*: Héros, V., R.H. Cowie and P. Bouchet (eds.), “*Tropical Deep-sea Benthos 25*”. *Mémoires du Muséum national d’Histoire naturelle*, 196: 587–792.

Watson, R.B., 1879. Mollusca of H.M.S. Challenger Expedition, III. Trochidae, viz. the genera *Sequenzia*, *Basilissa*, Gaza and *Bembix*. *Journal of the Linnean Society of London*, *Zoology*, 14: 586–605.

Watson, R.B., 1881. Mollusca of H.M.S. Challenger Expedition. Parts VIII–X. *Journal of the Linnean Society*, London, 15: 388–475.

Watson, R.B., 1886. Report on the Scaphopoda and Gasteropoda collected by H.M.S. Challenger during the years 1873–1876. *Report on the Scientific Results of the Voyage of H.M.S. Challenger during the Years 1873–76*. Zoology, 15: v + 756 pp., 50 pls.

相模灘漸深海帯の有殻腹足類相

長谷川和範・奥谷喬司

相模灘の漸深海帯性有殻腹足類相について，過去の文献情報，その証拠標本の一部，及び新規採集標本に基づいて再検討を行った．対象水深は陸棚下の水深 400m から相模灘最深部の 1600m 付近までで，情報は確実な地点と水深のデータが伴うものに限った．過去の文献の再検討では，これまで相模湾の対象水深から記録されていた 110 種（化学合成群集に固有の種類を除く）は，97 種に整理された．一方，証拠標本と新規標本の検討で新たに 23 種が加わり，この海域から確実に記録された種類は合計 120 種となった．これらのうち，88 種は種まで同定されたが，2 種は近似種を示唆するにとどまり，残りの 30 種は従来少なくとも北西太平洋から知られているどの種類にも同定することができなかった．種まで同定された 88 種のうち，6 種は相模湾から新記録となり，そのうち 2 種は日本新記録となる．これらの結果と，近隣海域での最近の研究成果に基づき，相模灘の有殻腹足類相の成り立ちについて考察した．

Appendix: Gastropods recorded from the chemosynthetic community in Sagami Bay.

Location of chemosynthetic communities in Sagami Bay: CC01, of Hatsushima Island, 35°00′N, 139°14′E, 800–1300 m; CC02, Sagami Knoll, 35°06′N, 139°20′E, 1400–1500 m; CC03, Okinoyama Bank, 34°59′N, 139°31′E, 750–1300 m (after Fujikura *et al*., 2008).

Family **Acmaeidae** Forbes, 1850

Serradonta vestimentifericola Okutani, Tsuchida and Fujikura, 1992 [Jn.: Watazoko-yadori-gasa-gai]

Serradonta vestimentifericola Okutani *et al*., 1992: 139–140, figs. 2–6; Sasaki *et al*., 2005: 109, fig. 12B–C; Sasaki *et al*., 2007: 197–198, fig. 1.

Recorded sites. CC01 (type locality) [1100–1200 m].

Bathyacmaea nipponica Okutani, Tsuchida and Fujikura, 1992 [Jn.: Watazoko-shiro-amigasagai-modoki]

Bathyacmaea nipponica Okutani *et al*., 1992: 140–141, figs. 7–11; Sasaki *et al*., 2005: 109; Sasaki *et al*., 2007: 197–199.

Recorded sites. CC01 (type locality) [1100–1200 m].

Family **Pyropeltidae** McLean and Haszprunar, 1987

Pyropelta sp.

Pyropelta sp. – Sasaki *et al*., 2007: 199.

Recorded sites. CC01 [1100–1200 m].

Family **Trochidae** Rafinesque, 1815

Margarites shinkai Okutani, Tsuchida and Fujikura, 1992 [Jn.: Shinkai-shitadami]

Margarites shinkai Okutani *et al*., 1992: 142–143, figs. 12–16; Sasaki *et al*., 2005: 115, fig. 15B; Sasaki *et al*., 2007: 199, fig. 2.

Recorded sites. CC01 (type locality) [1100–1200 m].

Family **Provannidae** Warén and Ponder, 1991

Provanna glabra Okutani, Tsuchida and Fujikura, 1992 [Jn.: Sagami-haikaburi-nina]

Provanna glabra Okutani *et al*., 1992: 143–145, figs. 17–21; Sasaki *et al*., 2005: 118; Sasaki *et al*., 2007: 200, fig. 2.

Recorded sites. CC01 (type locality) [1100–1200 m].

Family Buccinidae Rafinesque, 1815

Buccinum yoroianum Ozaki, 1958 [Jn.: Soyo-bai] (Figs. 24–25)

Buccinum soyomaruae Okutani, 1977 – Okutani *et al.,* 1992: 145–146, figs. 22–23; Sasaki *et al*., 2005: 119; ?Sasaki *et al*., 2007: 200 [with question mark].

Recorded sites. CC01 [1173 m].

Neptunea acutispiralis Okutani, 1968 [Jn.: Oshi-roi-ezo-bora]

Neptunea acutispiralis Okutani, 1968 – Okutani *et al*., 1993: 137, figs. 51–54; Fujikura *et al*., 2002: 24; Sasaki *et al*., 2005: 119.

Recorded sites. CC01, CC02, CC03 [830–1230 m].

Remarks. This species was originally described from off Miyake Island, Izu Islands, at a depth of 1280–1380 m. It was subsequently found to associate with chemosynthetic communities on Okinoyama Bank (1110 m; Okutani *et al*., 1993), and off Hatsushima (830–1230 m; Fujikura *et al*., 2002) in Sagami Bay, although it is regarded to invade chemosynthetic communities from normal bottom.

Oenopota sagamiana Okutani and Fujikura, 1992 [Jn.: Sagami-manji-gai]

Oenopota sagamiana Okutani & Fujikura, 1992: 2–4, text-figs. 2–3, pl. 1, figs. 1–4; Sasaki *et al.,* 2005: 121, fig. 17D; Sasaki *et al*., 2007: 200, fig. 3.

Recorded sites. CC01 (type locality) [1100–1200 m].

Family **Conidae** Fleming, 1822

Oenopota sp.

Oenopota sp. – Sasaki *et al*., 2007: 200.

Recorded sites. CC01 [1100–1200 m].

Phymorhynchus buccinoides Okutani, Fujikura and Sasaki, 1993 [Jn.: Tsubunari-shajiku]

Phymorhynchus buccinoides Okutani *et al*., 1993: 140, figs. 44–46; Sasaki *et al*., 2005: 123, fig. 17E; Sasaki *et al*., 2007: 200–201, fig. 4.

Recorded sites. CC01 (type locality) [1100–1200 m].