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Marine benthic community in Shirahama, southwestern Kii Peninsula, central Japan

MASANORI OKANISHI[a, *], ASUKA SENTOKU[b], SHINTA FUJIMOTO[c], NAOTO JIMI[d], RYO NAKAYAMA[e, f], YUSUKE YAMANA[g], HIROKI YAMAUCHI[f], HAYATE TANAKA[h, i], TETSUYA KATO[j], SHO KASHIO[k], DAISUKE UYENO[l], KOHKI YAMAMOTO[f], KATSUMI MIYAZAKI[m] AND AKIRA ASAKURA[f, j]

[*, a] College of Science, Ibaraki University, 2-1-1 Bunkyo, Mito, Ibaraki, 310-8512, Japan
[b] School of Earth Science, The University of Queensland, St. Lucia, QLD 4072, Australia
[c] Research Center for Marine Biology, Graduate School of Life Sciences, Tohoku University, 9 Sakamoto Asamushi, Aomori 039-3501, Japan
[d] Department of Natural History Sciences, Graduate School of Science, Hokkaido University, Kita 10 Nishi 8, Sapporo 060-0810, Japan
[e] Department of Zoology, Division of Biological Science, Graduate School of Science, Kyoto University, Kitashirakawa, Oiwake-cho, Sakyo-ku, Kyoto 606-8502, Japan
[f] Seto Marine Biological Laboratory, Field Science Education and Research Center, Kyoto University, 459 Shirahama, Nishimuro, Wakayama 649-2211, Japan
[g] Wakayama Prefectural Museum of Natural History, 370-1 Funao, Kainan, Wakayama 642-0001, Japan
[h] Department of Biological Sciences, Graduate School of Science, The University of Tokyo, 7-3-1, Hongo, Bunkyo-ku, Tokyo 113-0033, Japan
[i] National Museum of Nature and Science, 4-1-1 Amakubo, Tsukuba, Ibaraki 305-0005, Japan
[j] Shirahama Aquarium, Kyoto University, 459 Shirahama, Nishimuro, Wakayama 649-2211, Japan
[k] Natural History Museum, Kishiwada City, 6-5 Sakai-cho, Kishiwada, Osaka 596-0072, Japan
[l] Graduate School of Science and Engineering, Kagoshima University, 1-21-35 Korimoto, Kagoshima 890-0065, Japan
[m] Department of Environmental Science, Faculty of Science, Niigata University, 8050 Ikarashi 2-no-cho, Niigata 950-2181, Japan

[*]Corresponding author: mokanishi@teuru-mozuru.com

Abstract We herein present the results of a survey which assessed the benthic fauna from subtidal to continental shelf depth in the Shirahama area from 2012 to 2016. Our research resulted in the identification of 132 species from 75 families in seven phyla, Cnidaria, Annelida, Tardigrada, Arthropoda, Mollusca, Echinodermata and Chordata. This includes 24 newly recorded species to Shirahama. Two species were also new records for Japanese waters. Furthermore, six undescribed species and five potentially undescribed species were recorded. We provide a selection of relevant photos for future taxonomic studies and monitoring of environmental changes.

Keywords: Seto Marine Biological Laboratory, Kii Peninsula, Benthos, Marine biodiversity

Introduction

Japanese coastal area is a global biodiversity hot spot and high number of marine species are recorded (Fujikura et al., 2010). Numerous marine benthic surveys have been conducted along the Japanese coast. For example, from 1997 to 2014, National Science Museum, Tokyo (NSMT; currently referred as National Museum of Nature and Science) has carried out deep-sea taxonomic surveys in Suruga Bay, Tosa Bay, off Nansei Islands, off Tohoku District and in the Sea of Japan. The study area covered most of the Japanese coast except for Hokkaido. The NSMT has sampled depth as shallow as approximately 50 m but primary survey depth ranged from 100 m and deeper (NSMT, 1997; 2001; 2005; 2009; 2014). Water depth is an important environmental parameter, and comparative analysis between shallow and deep-water benthic communities is an active area of research (Sanders, 1968; Gray et al., 1997; Rex et al., 2000; Levin et al., 2001). But in many cases, the study areas have been limited to either the shallow (subtidal to littoral) or deep (more than 100 m) depths. 'Intermediate depths (approximately 40–100 m)' have been poorly studied in Japan. Recently, the JAMBIO (Japanese Association for Marine Biology) organized ten coastal marine taxonomic surveys, operated from the Shimoda Marine Research Center, University of Tsukuba and Misaki Marine Biological Station, The University of Tokyo, in order to study the marine benthic fauna of Sagami Bay (Namikawa, 2008; Nakano et al., 2015). Nakano et al. (2015) undertook surveys of this region, and although list of species and detailed locality information were not provided, at least 250 species including 50 likely undescribed species were collected from broad depth range (5–750 m).

In these studies, photographs of animals were provided for limited numbers of taxa. Photographs support identifications of the animals, and provide confirmation of the taxonomy. They are also useful for recognizing misidentifications, undescribed species and cryptic species for future studies. Because the color of living specimens is lost in dead and preserved specimens, high resolution photographs displaying the color of live specimens is essential to recognize the intraspecific variation, nuptial coloration and the discovery of new characters. Thus, ongoing and comprehensive assessments of marine benthic diversity should include more comprehensive sampling of intermediate, poorly sampled depths, more intensive color imagery, and well-maintained databases of sampled localities.

Shirahama is a temperate marine setting but is influenced by the Kuroshio Current, making its fauna more diverse than those of other adjacent areas on Kii Strait and Kumano Sea (Ohgaki, 2011) (Fig. 1A). It is an area which remains insufficiently understood in spite of prior research surveys. Seto Marine Biological Laboratory (SMBL) of Kyoto University is located in Shirahama, Wakayama Prefecture, southwestern Kii Peninsula where Kii Strait meets the Pacific Ocean. Many snorkeling and SCUBA diving surveys have revealed the rich marine fauna known from subtidal and littoral settings around Shirahama (e.g. Fauvel, 1936; Yamamoto, 1971; Habe, 1976; Yanagisawa, 1978; Fukano, 1980; Kuwamura, 1980; Irimura, 1981; Noda, 1987; Fujimoto et al., 2013; Yoshida et al., 2013; Zayasu et al., 2013). Most survey depths have been limited to depths shallower than 30 m. Deeper-water fauna present off Shirahama has been sampled based on fishing bycatch from sublittoral and continental shelf settings taken at Sakai Fishing Port in Minabe, northern part of Tanabe Bay (e.g. Utinomi, 1952; Irimura, 1981) (Fig. 1). Bieri and Tokioka (1968) used Dragonnet, a opening-closing quantitative trawl in southern Tanabe Bay and sampled species habitats from shallow-waters to 100 m (Bieri and Tokioka, 1968). However, the coordinates and depth of the sampling localities were not specified and the depths were mostly restricted to shallower than 100 m.

In this study, we conducted successive investigations in Shirahama using two SMBL research vessels, the '*Janthina*' and the '*Zoea*'. The purpose of the investigations was to obtain baseline benthic community information. To provide a 'detailed' inventory, the present survey sought to sample localities covered a broad depth gradient (4–295 m); using standardized protocols for dredges and bottom mud samplers. A part of the collected material was examined and the specimens were identified to species level whenever possible. Photographs of animals with value for recording were taken for future comparative research in this area (Fig. 1).

Materials and Methods

We conducted fourteen investigations with *Janthina* (Fig. 2A) and one investigation with *Zoea* (Fig. 2B) at 47 sampling sites, covering a broad sampling area and depth range in Shirahama (Table 1; Fig. 1B). Shirahama Marine Research (SMR) numbers were tentatively assigned to all the sampling sites for this paper. Animals and bottom sediments were collected by using three types of dredges and one bottom sampler: a 50 cm-front biological dredge (Fig. 2C), a Smith Mcintyre bottom grab sampler (Fig. 2D), a Kamiya-type dredge (Fig. 2E) and a dredge for meio-benthos (Fig. 2F). After picking up relatively large mega-benthos (more than several centimeter), the sediment samples were processed at SMBL with appropriate sieves. In some sampling sites, at least SMR15-03-1 and SMR15-04-1, collection of meiobenthos were carried out by the method of Akiyama et al. (2008).

Fixation and identification of samples were performed by the researchers participating in the survey or SMBL personnel. Samples were basically fixed with 70–99% ethanol. Holothuroidea (sea cucumber) specimens were fixed with 40–80% ethanol. All holothurian specimens were dissected, and the tentacles, anal appendages, Polian vesicles, stone canals, and calcareous rings were examined under a stereoscopic microscope (Nikon SMZ). To observe the morphology of the ossicles, small pieces of tissue were isolated from the body-wall integument, pedicels, tentacle and introvert. The tissue samples were dissolved in sodium hypochlorite solution (NaClO, 5%) under a compound microscope (Nikon Optiphot). The collected specimens and glass slides of their ossicles have been deposited in the Invertebrate Collection (INV) of the Wakayama Prefectural Museum of Natural History (WMNH), Kainan, Wakayama, Japan. Tardigrades were processed following methods outlined by Akiyama (2008). Filtered samples were directly fixed with 99% ethanol. To concentrate the sample, Ludox® HS-40 colloidal silica was used following Fujimoto (2015), a method modified from Burgess (2001). The specimens were sorted under a stereomicroscope and mounted in glycerol for phase-contrast microscopy (Olympus BX53). In Mollusca, living-specimens (represented as "A" in materials examined) were boiled to remove bodies and preserved in 99 % ethanol. Specimens of dead-shells (represented as "D" in materials examined) were preserved at dry condition.

A subset of sampled animals was photographed alive and later fixed, numbered and labelled. Most specimens were stored at SMBL but some of the collections were deposited in the authors' institutions, museums or personal collections. All individuals were counted, but solitary corals which were account to over 50 individuals were not concretely counted.

Taxonomic accounts

Phylum Cnidaria

General remarks

We collected eight species from eight genera, six families of azooxanthellate solitary corals. Concrete numbers of fresh specimens were not counted in this study.

Class Anthozoa Ehrenberg, 1834
Subclass Hexacorallia Haeckel, 1866
Order Scleractinia Bourne, 1900
Family Anthemiphylliidae Vaughan, 1907
Genus *Anthemiphyllia* Pourtalès, 1878

1. *Anthemiphyllia dentata* (Alcock, 1902) (Fig. 3A, B)
Material examined. SMR15-02-2 (50<), SMR15-03-1 (50<), SMR15-07-2 (50<*)

Family Caryophylliidae Dana, 1846
Genus *Premocyathus*Yabe and Eguchi, 1942

2. *Premocyathus dentiformis* (Alcock, 1902) (Fig. 3C, D)
Material examined. SMR15-03-1 (50<), SMR15-03-3 (50<), SMR15-07-2 (50<*)

Family Flabellidae Bourne, 1905
Genus *Truncatoflabellum* Cairns, 1989

3. *Truncatoflabellum phoenix* Cairns, 1995 (Fig. 3E, F)
Material examined. SMR15-02-2 (50<), SMR15-03-3 (50<), SMR15-04-1 (50<), SMR15-07-2 (50<*)

Family Micrabaciidae Vaughan, 1905
Genus *Letepsammia* Yabe and Eguchi, 1932

4. *Letepsammia formosissima* (Moseley, 1876) (Fig. 3G, H)
Material examined. SMR15-02-2 (50<), SMR15-03-1 (50<), SMR15-04-1 (50<), SMR15-07-2 (50<*)

Family Stenocyathidae Stolarski, 2000
Genus *Truncatoguynia* Cairns, 1989

5. *Truncatoguynia irregularis* Cairns, 1989 (Fig. 3I, J)
Material examined. SMR15-03-1 (50<), SMR15-07-2 (50<*)

Family Turbinoliidae Milne Edwards and Haime, 1848
Genus *Deltocyathoides* Yabe and Eguchi, 1932

6. *Deltocyathoides orientalis* (Duncan, 1876) (Fig. 3K, L)
Material examined. SMR15-03-1 (50<), SMR15-03-3 (50<), SMR15-04-1 (50<), SMR15-07-2 (50<*).

Genus *Idiotrochus* Wells, 1935

7. *Idiotrochus kikutii* (Yabe and Eguchi, 1941) (Fig. 3M, N)
Material examined. SMR15-02-2 (50<), SMR15-03-1 (50<), SMR15-04-1 (50<), SMR15-07-2 (50<*)

Genus *Peponocyathus* Gravier, 1915

8. *Peponocyathus folliculus* (Pourtalès, 1868) (Fig. 3O, P)
Material examined. SMR15-03-1 (50<), SMR15-04-1 (50<), SMR15-07-2 (50<*)

Phylum Mollusca

General remarks

We collected 25 species from nineteen genera, fourteen families including two undescribed species (*Cylindriscala* sp. (Epitoniidae) and *Gymnodoris* sp. (Gymnodorididae)). Systematics follows Bouchet and Rocroi (2005), Bouchet et al. (2010), Oskars et al. (2015), Gosliner et al. (2015) and WoRMS (World Register of Marine Species) (2016), and species identification follows Nakayama (2000; 2003), Okutani (2000), Tsuchida (2000). However, we here refrain from using order level classification because it is under discussion. Most Japanese names follow Okutani (2000). It cannot be determined whether specimens of dead shell are distributed on the sampling site or not. But records of dead shells have been traditionally considered by molluscan researchers as distribution ranges (e.g. Hasegawa, 2001; 2005). Therefore we here record them in this paper.

Class Bivalvia Linnaeus, 1758
Superfamily Limopsoidea Dall, 1895
Family Limopsidae Dall, 1895
Genus *Nipponolimopsis* Habe, 1951

1. *Nipponolimopsis azumana* (Yokoyama, 1910) (Fig. 4A) [Jn: Maru-Shirasunagai]
Material examined. SMR15-02-2 (7*) (A), SMR15-04-1 (26) (A), SMR15-04-3 (6) (A)

2. *Nipponolimopsis decussata* (A. Adams, 1862) (Fig. 4B) [Jn: Mame-Shirasunagai]
Material examined. SMR15-05-2 (7*) (D)

Superfamily Tellinoidea Blainville, 1814
Family Tellinidae Blainville, 1814
Genus *Cadella* Dall, Bartsch and Rehder, 1938

3. *Cadella delta* (Yokoyama, 1922) (Fig. 4C) [Jn: Kusabi-Zara]
Material examined. SMR15-05-3 (12*) (D)

Genus *Nitidotellina* Scarlato, 1961

4. *Nitidotellina lischkei* Huber, Langleit and Kreipl, 2015 (Fig. 4D) [Jn : Uzu-Zakura]
Material examined. SMR15-04-3 (4) (A), SMR15-07-2 (7*) (A)

Family Veneridae Rafinesque, 1815
Genus *Timoclea* T. Brown, 1827

5. *Timoclea minuta* (Yokoyama, 1922) (Fig. 4E) [Jn: Adeyaka-Hime-Kanokoasari]
Material examined. SMR15-01-1 (5*) (A), SMR15-02-1 (5) (A), SMR15-07-2 (1) (A) SMR15-07-4 (12) (A)

Class Gastropoda Cuvier, 1795
Superfamily Buccinoidea Rafinesque, 1815
Family Fasciolariidae Gray, 1853
Genus *Granulifusus* Kuroda and Habe, 1954

6. *Granulifusus niponicus* (E. A. Smith, 1879) (Fig. 4F) [Jn: Arare-Naganishi]
Material examined. SMR15-04-1(5*) (D), SMR15-04-3 (5) (D), SMR15-07-1 (4) (D)

Superfamily Cerithioidea Fleming, 1822
Family Scaliolidae Jousseaume, 1912
Genus *Finella* A. Adams, 1860

7. *Finella purpureoapicata* Preston, 1905 (Fig. 4G) [Jn: Shima-Motsubo]
Material examined. SMR15-04-1 (6*) (D)

Superfamily Diaphanoidea Odhner, 1914 (1857)
Family Cylichnidae H. Adams and A. Adams, 1854
Genus *Decorifer* Iredale, 1937

8. *Decorifer insignis* (Pilsbry, 1904) (Fig. 4H) [Jn: Kometsubugai]
Material examined. SMR15-05-3 (6*) (D)

Superfamily Epitonioidea Berry, 1910 (1812)
Family Epitoniidae Berry, 1910 (1812)
Genus *Amaea* H. Adams and A. Adams, 1853

9. *Amaea dorysa* (Iredale, 1936) (Fig. 4I) [Jn: Dorisu-Arame-Itokake]
Material examined. SMR15-02-3 (1*) (A)

Genus *Cylindriscala* de Boury, 1909

10. *Cylindriscala* sp. (Fig. 4J)
Material examined. SMR15-04-1 (1*) (D)
Remarks. This undescribed species is also discovered by Hasegawa and Nakayama, and description is now under processing (Hasegawa and Nakayama, unpubl. data).

Genus *Epitonium* Röding, 1798

11. *Epitonium angustum* (Dunker, 1861) (Fig. 4K) [Jn: Toge-Hime-Nejigai]
Material examined. SMR15-05-2 (1) (A), SMR15-05-3 (2*) (D)

12. *Epitonium heloris* (Iredale, 1936) (Fig. 4L) [Jn: Hari-Daruma-Itokake]
Material examined. SMR15-07-1 (1*) (D)

13. *Epitonium liliputanum* (A. Adams, 1861) (Fig. 4M) [Jn: Kobito-Itokake]
Material examined. SMR15-04-1 (1*) (A), SMR15-07-1 (2) (D)

14. *Epitonium rimbogai* (Masahito and Habe, 1976) (Fig. 4N) [Jn: Rinbou-Itokake]
Material examined. SMR15-05-3 (1*) (D)

15. *Epitonium simplex* (Sowerby III, 1894) (Fig. 4O) [Jn: Maru-Hime-Nejigai]
Material examined. SMR15-05-3 (1*) (D)

16. *Epitonium pallasi* (Kiener, 1838) (Fig. 4P) [Jn: Kuwagata-Itokake]
Material examined. SMR15-02-2 (1*) (D)

Superfamily Muricoidea Rafinesque, 1815
Family Cystiscidae Stimpson, 1865
Genus *Gibberula* Swainson, 1840

17. *Gibberula novemprovincialis* (Yokoyama, 1928) (Fig. 4Q) [Jn: Ryugu-Kogomegai]
Material examined. SMR15-04-1 (6*) (D)

Superfamily Olivoidea Latreille, 1825
Family Olivellidae Troschel, 1869
Genus *Olivella* Swainson, 1831

18. *Olivella fulgurata* Adams and Reeve, 1850 (Fig. 4R) [Jn: Mushi-Botaru]
Material examined. SMR15-04-1 (8*) (D)

Superfamily Polyceroidea Alder and Hancock, 1845
Family Gymnodorididae Odhner, 1941
Genus *Gymnodoris* Stimpson, 1855

19. *Gymnodoris* sp. (Fig. 4S)
Material examined. SMR15-07-2 (1*) (A)
Remarks. This species is an undescribed species which is distinguished from the other congeners in having a crest-like protuberance on the posterior tail.

Superfamily Pyramidelloidea Gray, 1840
Family Pyramidellidae Gray, 1840
Genus *Ptycheulimella* Sacco, 1892

20. *Ptycheulimella misella* (Yokoyama, 1922) (Fig. 4T) [Jn: Mikazuki-Itokakegiri]
Material examined. SMR15-05-2 (9*) (D)

Genus *Odetta* de Folin, 1870

21. *Odetta lirata* (A. Adams, 1860) (Fig. 4U) [Jn: Itomaki-Kuchikire]
Material examined. SMR15-05-3 (19*) (A)

Superfamily Ringiculoidea Philippi, 1853
Family Ringiculidae Philippi, 1853
Genus *Ringicula* Deshayes, 1838

22. *Ringicula tosaensis* Habe, 1950 (Fig. 4V) [Jn: Tosa-Mame-Urashima]
Material examined. SMR15-04-1 (1*) (D), SMR15-04-4 (5) (D), SMR15-05-1 (1) (D)

Superfamily Trochoidea Rafinesque, 1815
Family Solariellidae Powell, 1951
Genus *Microgaza* Dall, 1881

23. *Microgaza fulgens* Dall, 1907 (Fig. 4W) [Jn: Hikari-Shitadami]
Material examined. SMR15-04-1 (1) (D), SMR15-04-2 (12*) (A), SMR15-04-3 (1) (D)

Genus *Minolia* A. Adams, 1860

24. *Minolia subangulata* Kuroda and Habe, 1952 (Fig. 4X) [Jn: Kado-Koshitaka-Shitadami]
Material examined. SMR15-04-1 (1) (D), SMR15-04-2 (17*) (A)
Remarks. This species has been recorded from Nansei Islands (Hasegawa, 2005), Bungo Channel (Hamada, 2010), Tosa Bay (Hasegawa, 2001), Mie Prefecture, (Ikebe, 2006), Rikucyu coast, (Habe, 1968). In faunistic surveys of molluscan shells in Wakayama Prefecture (Ikebe, 2006, 2008), this species was not recorded. Thus, this is the first record from off Shirahama.

Superfamily Vermetoidea Rafinesque, 1815
Family Vermetidae Rafinesque, 1815
Genus *Thylacodes* Guettard, 1770

25. *Thylacodes medusa* Pilsbry, 1891 (Fig. 4Y) [Jn: Hama-Kazura]
Material examined. SMR15-02-2 (1) (A), SMR15-04-1 (6*) (A), SMR15-04-2 (1) (A), SMR15-07-1 (1) (D)

Phylum Annelida

General remarks

We collected at least 41 species from 38 genera, 29 families, including two new records from Shirahama and three potentially undescribed species. Of these, it was impossible to identify 14 species and eleven genera to the species level due to their loss of taxonomic characters (e.g. prostomium and posterior segments) in process of sorting. Systematics follows Rouse and Pleijel (2001) and Japanese names follow Imajima (1996, 2001, 2007) and Uchida (1992). However, we here refrain from identifying order level classification because it is under discussion.

Family Phyllodocidae Örsted, 1843
Genus *Nereiphylla* Blainville, 1828

1. *Nereiphylla castanea* (Marenzeller, 1879) [Jn: Akeno-Sashiba]
Materials examined. SMR15-04-3 (1)

Family Syllidae Grube, 1850

2. Syllidae gen. sp.
Materials examined. SMR15-04-1 (6)

Family Hesionidae Grube, 1850
Genus *Leocratides* Ehlers, 1908

3. *Leocratides* sp.
Materials examined. SMR15-04-1 (3)

Family Nereididae Blainville, 1818

4. *Nereis* or *Neanthes* sp.
Materials examined. SMR15-04-1 (1).

5. *Tambalagamia fauveli* Pillai, 1961 (Fig. 5A) [Jn: Kani-Gokai]
Materials examined. SMR15-04-4 (4*)
Remarks. This species is known from Manazuru Bay and the Ariake Sea in Japan (Imajima, 1996). This is the first record from off Shirahama.

Family Glyceridae Grube, 1850
Genus *Glycera* Lamarck, 1818

6. *Glycera onomichiensis* Izuka, 1912 [Jn: Onomichi-chirori]
Materials examined. SMR15-04-1 (2)

Family Aphroditidae Malmgren, 1867
Genus *Laetmonice* Kinberg, 1856

7. *Laetmonice japonica* McIntosh, 1885 [Jn: Nihon-urokomushi]
Materials examined. SMR15-04-3 (1)

Family Polynoidae Kinberg, 1856
Genus *Lepidasthenia* Malmgren, 1867

8. *Lepidasthenia* sp.
Materials examined. SMR15-04-1 (1)

9. Polynoidae gen. sp.
Materials examined. SMR15-04-1 (10), SMR15-04-3 (1)

Family Pilargidae de Saint-Joseph, 1899
Genus *Sigambra* Müller, 1858

10. *Sigambra hanaokai* (Kitamori, 1960) [Jn: Hanaoka-kagigokai]
Materials examined. SMR15-04-4 (1)

Family Amphinomidae Lamarck, 1818
Genus *Chloeia* Lamarck, 1818

11. *Chloeia* sp.
Materials examined. SMR15-04-1 (4)

Family Euphrosinidae Williams, 1852

12. Euphrosinidae gen. sp.
Materials examined. SMR15-04-1 (1)

Family Eunicidae Berthold, 1827

13. Eunicidae gen. sp.
Materials examined. SMR15-04-1 (11)

Family Lumbrineridae Schmarda, 1861
Genus *Scoletoma* Blainville, 1828

14. *Scoletoma* sp.
Materials examined. SMR15-04-3 (1)

15. Lumbrineridae gen. sp.
Materials examined. SMR15-04-3 (6)

Family Onuphidae Kinberg, 1865
Genus *Hyalinoecia* Malmgren, 1867

16. *Hyalinoecia tubicola* (O.F. Müller, 1776) [Jn: Tuno-Isome]
Materials examined. SMR15-04-2 (1)

17. Onuphidae gen. sp.
Materials examined. SMR15-04-1 (10)

Family Chaetopteridae Audouin and Milne Edwards, 1833
Genus *Spiochaetopterus* M Sars, 1856

18. *Spiochaetopterus* sp.
Materials examined. SMR15-04-1 (16)

19. Chaetopteridae gen. spp.
Materials examined. SMR15-04-2 (3), SMR15-04-3 (10).

Family Magelonidae Cunningham and Ramage, 1888
Genus *Magelona* F. Müller, 1858

20. *Magelona japonica* Okuda, 1937 [Jn: Morote-Gokai]
Materials examined. SMR15-04-4 (1)

Family Poecilochaetidae Hannerz, 1956
Genus *Poecilochaetus* Claparède in Ehlers, 1875

21. *Poecilochaetus elongatus* Imajima, 1989 [Jn: Kazari-Tokkuri-Gokai]
Materials examined. SMR15-04-4 (2)

22. *Poecilochaetus* sp.
Materials examined. SMR15-04-4 (2)

Family Ampharetidae Malmgren, 1866
Genus *Samythella* Verrill, 1873

23. *Samythella* sp.
Materials examined. SMR15-04-1 (1)
Remarks. *Samythella bathycola* and *S. neglecta* have been recorded from Japan (Imajima, 2015). This species is distinguished from the two known species by tentacle shape and number of abdominal setiger and is potentially undescribed.

Family Terebellidae Johnston, 1846
Genus *Polycirrus* Grube, 1850

24. *Polycirrus* sp.
Materials examined. SMR15-05-2 (1)

25. Terebellidae gen. sp.
Materials examined. SMR15-04-1 (2), SMR15-04-4 (1).

Family Trichobranchidae Malmgren, 1866
Genus *Terebellides* Sars, 1835

26. *Terebellides kobei* Hessle, 1917 [Jn: Nise-Tamagushi-Fusa-Gokai]
Materials examined. SMR15-04-4 (13).

Family Pectinariidae Quatrefages, 1866
Genus *Lagis* Malmgren, 1866

27. *Lagis* sp.
Materials examined. SMR15-04-1 (1)

Family Cirratulidae Carus, 1863
Genus *Cirratulus* Lamarck, 1818

28. *Cirratulus* sp.
Materials examined. SMR15-04-2 (1)

Genus *Chaetozone* Malmgren, 1867

29. *Chaetozone* sp.
Materials examined. SMR15-05-2 (7)

Family Flabelligeridae de Saint-Joseph, 1894
Genus *Diplocirrus* Haase, 1915

30. *Diplocirrus nicolaji* (Buzhinskaja, 1994) (Fig. 5B) [Jn: Bouzu-Habouki]
Materials examined. SMR15-05-2 (2*)
Remarks. This species has been recorded from Oshoro, Tateyama, Misaki, Hiroshima (Jimi et al. 2016). This is the first record from off Shirahama and the southernmost record of the species.

Family Sternaspidae Carus, 1863
Genus *Sternaspis* Otto, 1821

31. *Sternaspis affinis* Stimpson, 1864
Materials examined. SMR15-04-4 (2)

Family Maldanidae Malmgren, 1867
Genus *Nicomache* Malmgren, 1865

32. *Nicomache* sp.
Materials examined. SMR15-04-1 (1)

Family Opheliidae Malmgren, 1867
Genus *Armandia* Filippi, 1861

33. *Armandia amakusaensis* Saito, Tamaki and Imajima, 2000 [Jn: Tutuo-Ophelia]
Materials examined. SMR15-05-2 (1)

Family Capitellidae Grube, 1862

34. Capitellidae gen. sp.
Materials examined. SMR15-05-2 (1)

Family Oweniidae Rioja, 1917
Genus *Owenia* Delle Chiaje, 1844

35. *Owenia* sp.
Materials examined. SMR15-04-1 (2), SMR15-04-2 (1).
Remarks. *Owenia gomsoni* and *O. fusiformis* have been recorded from Japan (Imajima 2001, Nishi et al., 2004). This species is distinguished from the two known species by prostomium color in life, and is potentially undescribed.

Genus *Myriochele* Malmgren, 1867

36. *Myriochele heeri* Malmgren, 1867 [Jn: Bouzu-Chimakigokai]
Materials examined. SMR15-04-2 (2)

37. *Myriochele* sp. (Fig. 5C)
Materials examined. SMR15-04-3 (1)
Remarks. This species is distinguished from the related species of *Myriochele* by prostomium shape and color band pattern, and is potentially undescribed.

Genus *Galathowenia* Kirkegaard, 1959

38. *Galathowenia oculata* (Zachs, 1923) (Fig. 5D) [Jn: Manako-Chimakigokai]
Materials examined. SMR15-04-3 (1)

Family Sabellariidae Johnston, 1865
Genus *Lygdamis* Kinberg, 1867

39. *Lygdamis japonicus* Nishi and Kirtley, 1999 [Jn: Hana-Kanmurigokai]
Materials examined. SMR15-04-1 (1)

Family Sabellidae Latreille, 1825
Genus *Laonome* Malmgren, 1866

40. *Laonome* sp.
Materials examined. SMR15-04-1 (2)

41. Sabellidae gen. sp.
Materials examined. SMR15-05-2 (1)

Phylum Tardigrada

General remarks

We collected at least three species from three genera, one family of the order Arthrotardigrada (class Heterotardigrada) including an undescribed species and a potentially undescribed species. An expansion of habitat range is recorded for *Angursa clavifera*. The sorting and identification of specimens are still in progress.

Class Heterotardigrada Marcus, 1927
Order Arthrotardigrada Marcus, 1927
Family Halechiniscidae Thulin, 1928
Subfamily Styraconyxinae Kristensen and Renaud-Mornant, 1983
Genus *Angursa* Pollock, 1979

1. *Angursa clavifera* Noda, 1985 (Fig. 6A)
Material examined. SMR15-03-1 (1*)
Remarks. A four claw juvenile was collected. It is identified to this species based on the following combination of characters: club shaped primary clavae, presence of secondary and tertiary clavae (the exact outlines of these characters were not observable), leg IV sensory organs as enveloped, spherical papillae and short peduncles. However, the sensory organs of legs II and III were not recognized probably due to the leg orientation. This species has been only known from the beach environment (Noda 1985; 1994) and this is the first record of this species from the sublittoral zone.

Genus *Raiarctus* Renaud-Mornant, 1981

2. *Raiarctus* sp. (Fig. 6B)
Material examined. SMR15-03-1 (1), SMR15-04-1 (1*)
Remarks. An adult female and a four claw juvenile were collected. This species resembles *Raiarctus aureolatus* and *R. katrinae* by the alae-like structure surrounding the body with relatively long pillars. However, it differs from the two known species by the morphology of the cephalic cirri and the leg IV sensory organ. The description of this species is in process.

Family Tanarctinae Renaud-Mornant, 1980
Genus *Tanarctus* Renaud-Debyser, 1959

3. *Tanarctus* sp. (Fig. 6C)

Material examined. SMR15-04-1 (1*)

Remarks. A two claw juvenile was collected. This species is characterized by the presence of the club-shaped secondary clavae and the simple leg IV appendages. It differs from *T. diplocerus*, a species reported from a shallower site (water depth: 8.4 m) in the same region (Fujimoto et al. 2013), by the former character. For further identification, collection of four claw juveniles and adult specimens are necessary.

Phylum Arthropoda

Subphylum Crustacea Brünnich, 1772

Class Copepoda Milne-Edwards, 1840

Order Siphonostomatoida Thorell, 1859

Pennellidae Burmeister, 1835

Genus *Cardiodectes* Wilson C.B., 1917

1. *Cardiodectes* sp. (Fig. 6D–F)

Material examined. SMR 15-04-3 (3*2) (Fig. 6D), SMR 16-01-1 (2*) (Fig. 6E, F)

Remarks. All individuals were parasitic on eyes of *Pteropsaron evolans* (SMR 15-04-3) and *Osopsaron formosense* (SMR 16-01-1). The copepod is a member of *Cardiodectes* based on the key to genera of Pennellidae by Uyeno (2015). It is potentially undescribed because of combination of some morphological characters and its description is in process.

Phylum Echinodermata

Class Echinoidea Leske, 1778

General remarks

We collected five species from three genera, two families including a potentially undescribed species and a new record from off Shirahama. Systematics follows Kroh and Smith (2010) and Japanese names follow Shigei (1986).

Order Camarodonta, Jackson, 1912

Family Temnopleuridae A. Agassiz, 1872

Genus *Temnopleurus* L. Agassiz, 1841

1. *Temnopleurus apodus* (A. Agassiz and H. L. Clark, 1906) (Fig. 7A, B) [Jn: Shirotsubu-Sansyo-Uni]

Material examined. SMR15-04-2 (1*)

2. Temnopleuridae gen. sp. (Fig. 7C, D)

Material examined. SMR15-04-2 (2*)

Remarks. Two juveniles with undeveloped taxonomic characters were collected. This species is distinguished from *T. apodus* by having two buccal podia in each five pairs of buccal plates. Sampling of adults is necessary for further identification to the genus or species-level.

Order Clypeasteroida L.Agassiz, 1835

Infraorder Laganiformes Desor, 1847

Family Fibulariidae Gray, 1855

Genus *Echinocyamus* van Phelsum, 1774

3. *Echinocyamus provectus* de Meijere, 1903 (Fig. 7E, F)

Material examined. SMR15-04-2 (2*)

Remarks. The two collected specimens were dead denuded tests. Therefore, it cannot be decided whether *Echinocyamus provectus* lives on the sampling site or not (southwest off Shirahama, approximately 125 m depth).

4. *Echinocyamus subconicus* Mortensen, 1948 (Fig. 7G, H)

Material examined. SMR15-04-2 (6*)

Remarks. This species has been reported only once from southwest of Nagasaki, western Japan (Shigei, 1981). This is the first record from off Shirahama and the expansion of northernmost distribution record.

Genus *Fibularia* Lamarck, 1816

5. *Fibularia* sp. (Fig. 7I, J)

Material examined. SMR15-06-2 (1*)

Remarks. This species is distinguished from its congeners by flattened test and developed each petal. Description of this undescribed species is in process.

Class Holothuroidea de Blainville, 1834

General remarks

We collected thirteen species from ten or more genera, four or more families including one potentially undescribed species. Systematics follows Imaoka (1995), Rowe and Gates (1995), and Ohshima (1915-1918), and Japanese names follow Imaoka (1995) and Utinomi (1965).

Order Apodida Brandt, 1835
Family Synaptidae Burmeister, 1837
Genus *Labidoplax* Östergren, 1898

1. *Labidoplax variabilis* (Theel, 1886) (Fig. 8A)

Material examined. SMR 15-04-4 (3), SMR 15-05-3 (1), SMR 15-06-1 (1*)

Genus *Leptosynapta* Verril, 1867

2. *Leptosynapta* sp. (Fig. 8B)

Material examined. SMR 15-05-3 (2), SMR 15-06-2 (1*)

Remarks. This species has been known as *Leptosynapta inhaerens* (Müller, 1776) [Jn: Hoso-Ikari-Namako]. However, recent morphological studies (Massin et al., 2014) indicate that this species can be distinguished from *L. inhaerens* in lacking grain-ossicles of longitudinal muscles.

Order Dendrochirotida Grube, 1840
Family unknown

3. Unknown species 1 (Fig. 8C)

Material examined. SMR 15-04-1 (1*)

Remarks. This specimen has very unique unsymmetrical shaped ossicle in the body wall, well matured gonad, and has thick color. However, loss of tentacles and the calcareous ring prevent it from further identification.

4. Unknown species 2 (Fig. 8D)

Material examined. SMR 15-04-1 (1*)

Remarks. This specimen has gonad, however, loss of tentacles and the calcareous ring prevent it from further identification. The symmetrical shaped body wall ossicles and white or thin body color of this species is different from Unknown species 1.

Family Cucumariidae Ludwig, 1894

Genus *Amphicyclus* Bell, 1884

5. *Amphicyclus* sp.? (Fig. 8E)

Material examined. SMR 15-04-1 (1*)

Remarks. An incomplete calcareous ring infer its immature development, and it prevent the specimen from identification to species.

Genus *Neocucumis* Deichmann, 1944

6. *Neocucumis* sp.? 1 (Fig. 8F)

Material examined. SMR 15-04-1 (1*)

Remarks. This species is similar to *Neocucumis sagamiensis* (Ohshima, 1915), however, there are slight differences in the morphological layout and shape of pedicels. In this specimen, the pedicels are scattered on whole the body surface, while Ohshima (1915) reported that the pedicels were arranged in two rows along each ambulacrum in *N. sagamiensis*.

7. *Neocucumis* sp.? 2 (Fig. 8G)

Material examined. SMR 15-04-2 (1*)

Remarks. This specimen is distinguished from *Neocucumis* sp.? 1 in having the pedicels arranged in two rows along each ambulacrum. However, its incomplete calcareous ring, which may be a evidence of its immaturity, prevent it from identification to species.

Genus *Pentacta* Goldfuss, 1820

8. *Pentacta*? sp. (Fig. 8H)

Material examined. SMR 15-04-1 (1*)

Remarks. This specimen has characteristics of the genus *Pentacta* or *Plesiocolochirus*, however, taxonomic states of the two genera are presently uncertain.

Genus *Pseudocnus* Panning, 1949

9. *Pseudocnus* sp.? (Fig. 8I)

Material examined. SMR 13-04-2 (2), SMR 15-04-1 (3), SMR 15-04-2 (1*), SMR 15-07-1 (1)

Remarks. This species belongs to subfamily Cucumariinae. However, the taxonomic state of the subfamily is presently uncertain.

Family Phyllophoridae Östergren, 1907
Genus *Neothyonidium* Deichmann, 1938

10. *Neothyonidium* sp. (Fig. 8J)

Material examined. SMR 15-07-1 (1*)

Remarks. This specimen is in states of immature development, and it prevent the specimen from identification to species.

Genus *Pentamera* Ayres, 1852

11. *Pentamera* sp. (Fig. 8K)

Material examined. SMR 15-04-3 (3*)

Remarks. One of the specimens has a well matured gonad. In the body wall, all the specimens possess thick table ossicles with irregular shaped disc and with or without a short two pillared spire. No other congeners have those characters and this species is considered potentially undescribed species. It was also obtained in Misaki, Kanagawa, eastern Japan (unpubl. data).

Genus *Stolus* Selenka, 1867

12. *Stolus punctata* (Ohshima, 1915) (Fig. 8L)

Material examined. SMR 15-04-3 (1*)

Family Psolidae Burmeister, 1837
Genus *Psolus* Oken, 1815

13. *Psolus* sp. (Fig. 8M)

Material examined. SMR 15-04-1 (2*)

Remarks. Incomplete calcareous rings inferred its immature development and it prevent the two specimens from identification to species.

Class Ophiuroidea Gray, 1840

General remarks

We collected 27 species from 17 genera, eleven families, including one potentially undescribed species,16 new records from Shirahama and two new records from Japan. Two specimens of potentially undescribed species may be a juvenile and an adult. To clarify the species' taxonomic status, additional specimens covering other developmental stages and molecular information are required. Systematics follows Stöhr et al. (2012) and Japanese names follow Irimura (1995) and Fujita et al. (2015).

Order Euryalida Lamarck, 1816
Family Euryalidae Gray, 1840
Genus *Astroceras* Lyman, 1879

1. *Astroceras coniunctum* Murakami, 1944 [Jn: Oni-Tsuno-mozuru]

Material examined. SMR15-04- 1 (1)

Remarks. This species has been recorded from Ogasawara Islands (Murakami, 1944), Tosa Bay, Kumano Sea and Okinawa (Okanishi et al., 2014). This is the first record from off Shirahama.

Order Ophiurida Müller and Troschel, 1842
Family Amphiuridae Ljungman, 1867
Genus *Amphioplus* Verrill, 1899

2. *Amphioplus* (*Amphichilus*) *trichoides* Matsumoto, 1917 (Fig. 9A)
Material examined. SMR15-04-4 (3), SMR15-06-1 (1*)
Remarks. This species has been recorded from Sagami Sea (Matsumoto, 1917), off Ishikawa (Murakami, 1943), off Amakusa (Irimura, 1969), off Kumano (Saba et al., 1982) and south Korea (Ishida et al., 2001). This is the first record from off Shirahama.

3. *Amphioplus* (*Amphioplus*) *ancistrotus*? (Fig. 9B)
Material examined. SMR15-01-2 (2*)

Genus *Amphipholis* Ljungman, 1866

4. *Amphipholis squamata* (Delle Chiaje, 1828) (Fig. 9C) [Jn: Iso-Komochi-Kumohitode]
Material examined. SMR13-03-2 (1), SMR15-02-2 (2*), SMR15-04-1 (2)

Genus *Amphiura* Forbes, 1843

5. *Amphiura* (*Ophiopeltis*) *aestuarii* Matsumoto, 1915 (Fig. 9D) [Jn: Megane-Kumohitode]
Material examined. SMR13-03-3 (2), SMR13-03-4 (1), SMR15-05-4 (1*), SMR15-06-1 (1)
Remarks. This species has been recorded from Sagami Sea (Matsumoto, 1917), off Ishikawa (Murakami, 1943), off Amakusa (Irimura, 1969) and off Kumano (Saba et al., 1982). This is the first record from off Shirahama.

6. *Amphiura* (*Amphiura*) *koreae* Duncan, 1879 (Fig. 9E) [Jn: Cho-Sen-Kumohitode]
Material examined. SMR15-02-2 (1*)
Remarks. This species has been recorded from Sagami Sea, Kagoshima Gulf and Sea of Japan (Mataumoto, 1917), Suruga Bay (Matsumoto, 1917; Irimura, 1991; Fujita et al., 1997), off Sanriku (Irimura, 1991), Sendai Bay (Fujita, 1996) and off Noto (Fujita and Kohtsuka, 2003). This is the first record from off Shirahama.

7. *Amphiura* (*Amphiura*) *micraspis* (Fig. 9F) H.L.Clark, 1911
Material examined. SMR13-03-4 (1*), SMR13-04-2 (1).
Remarks. This species has been recorded from off Omai-Zaki (Matsumoto, 1917), off Amakusa (Irimura, 1969), Suruga Bay (Fujita et al., 1997), off Oki Island (Fujita et al., 2004). This is the first record from off Shirahama.

8. *Amphiura* (*Fellaria*) *vadicola* (Fig. 9G) Matsumoto, 1915
Materials examined. SMR13-03-5 (4*)

Genus *Ophiophragmus* Lyman, 1865

9. *Ophiophragmus japonicas* Matsumoto, 1915
Materials examined. SMR13-02-3 (1), SMR15-04-3 (1)
Remarks. This species ha been recorded from Kagoshima Bay, Suruga Bay and Rikuzen (Matsumoto, 1917). This is the first record from off Shirahama.

Family Ophiacanthidae Ljungman, 1867
Genus *Ophiomitrella* Verrill, 1899

10. *Ophiomitrella stellifera* Matsumoto, 1917 (Fig. 9H)
Material examined. SMR15-02-2 (1*)
Remarks. This species has been recorded from off Izu (Matsumoto, 1917) and Sagami Sea (Irimura, 1982; Fujita et al., 2006). This is the first record from off Shirahama.

Genus *Ophiomyces* Lyman, 1869

11. *Ophiomyces papillospinus* Litvinova, 2001 [New Jn: Toge-Kanmuri-Kumohitode]
Material examined. SMR13-02-1 (2*), SMR15-01-1 (1), SMR15-04-3 (4)
Remarks. Ophiomyces papillospinus is known from 510 m of south off New Caledonia so far (Litvinova, 2001) and this is the first record of this species from Japanese water, with the shallowest record at 75 m. New Japanese name "Toge-Kanmuri-Kumohitode" is proposed for this species.

Family Ophiactidae Matsumoto, 1915
Genus *Ophiactis* Lütken, 1856

12. *Ophiactis dyscrita* H.L. Clark, 1911 (Fig. 9I) [New Jn: Noumen-Kumohitode]
Material examined. SMR15-04-1 (1*), SMR15-04-2 (1)
Remarks. This species has been recorded from Sagami Sea (Matsumoto, 1917), off Amakusa (Irimura, 1969), South Korea (Ishida et al., 2001) and off Ogasawara Islands (Irimura and Tachikawa, 2003). This is the first record from off Shirahama. New Japanese name "Noumen-Kumohitode" is proposed for this species.

13. *Ophiactis macrolepidota* Marktanner-Turneretscher, 1887 (Fig. 9J) [Jn: Dairin-Chibi-Kumohitode]
Material examined. SMR13-01-1 (4*), SMR15-04-2 (1)

14. *Ophiactis profundi* Lütken and Mortensen, 1899 (Fig. 9K) [Jn: Ara-Uroko-Kumohitode]
Material examined. SMR15-02-2 (2*)

Family Ophiodermatidae Ljungman, 1867
Genus *Ophiopsammus* Lütken, 1869

15. *Ophiopsammus anchista* (H.L.Clark, 1911) (Fig. 9L) [Jn: Menashi-Kumohitode]
Material examined. SMR13-01-2 (1*)
Remarks. The examined individual show striking orange color bands on arms and concentric patterns on their aboral body on white back ground color. This probably is the first recorded color pattern for this species.

Genus *Ophiurochaeta* Matsumoto, 1915

16. *Ophiurochaeta mixta* (Lyman, 1878) (Fig. 9M)
Material examined. SMR14-03-4 (2*)
Remarks. This is the first record of this genus from Japanese waters.

Family Ophiolepididae Ljungman, 1867
Genus *Ophiomusium* Lyman, 1869

17. *Ophiomusium lymani* Wyville-Thomson, 1873 [Jn: Lyman-Kumohitode]
Material examined. SMR15-02-2 (5*), SMR15-04-1 (2), SMR15-04-2 (1)
Remarks. This species has been recorded from off Omai-Zaki and Sea of Japan (Matsumoro, 1917) and Tosa Bay (Irimura, 1991). This is the first record from off Shirahama.

18. *Ophiomusium scalare* Lyman, 1878 [Jn: Taira-Ishigaki-Kumohitode]
Material examined. SMR13-01-2 (4*)

Family Ophioleucidae Matsumoto, 1915
Genus *Ophioleuce* Koehler, 1904

19. *Ophioleuce seminudum* Koehler, 1904 (Fig. 9N) [Jn: Goyou-Kumohitode]
Material examined. SMR15-07-1 (2*)
Remarks. This species has been recorded from Sagami Sea (Matsumoro, 1917, Irimura, 1982), Suruga Bay (Fujita et al., 1997) off Shimoda (Irimura et al., 2001), East China Sea (Fujita and Irimura, 2005) and Sea of Japan (Matsumoto, 1917; Fujita et al., 2014). This is the first record from off Shirahama.

Family Ophiomyxidae Ljungman, 1867

20. *Ophiodera*? sp. (Fig. 9O, P)
Material examined. SMR13-01-2 (1*)
Remarks. This species may belong to Ophiomyxidae in the features of having skin covering disc and lacks of dorsal arm plates. The most striking feature of this species is their fan-shaped upper-most arm spines and they have never seen in other *Ophiodera* species. Description of this undescribed species is in process.

Genus *Ophiologimus* H.L. Clark, 1911

21. *Ophiologimus hexactis* H.L.Clark, 1911 (Fig. 9Q) [Jn: Mutsuude-Kawa-Kumohitode]
Material examined. SMR13-01-2 (7*), SMR15-02-2 (2), SMR15-04-1 (1)
Remarks. This species has been recorded from Sagami Sea (Matsumoto, 1917; Fujita et al., 2006) and Suruga Bay (Fujita et al., 1997). This is the first record from off Shirahama.

Family Ophionereididae Ljungman, 1867
Genus *Ophiocrasis* H.L. Clark, 1911

22. *Ophiocrasis dictydisca* H.L. Clark, 1911 (Fig. 9R)
Material examined. SMR14-01-1 (3*)
Remarks. This species has been recorded from Sagami Bay (Matsumoto, 1917). This is the first record from off Shirahama.

Family Ophiotrichidae Ljungman, 1867
Genus *Ophiothrix* Müller and Troschel, 1842

23. *Ophiothrix koreana* Duncan, 1879 (Fig. 9S)
Material examined. SMR15-02-2 (2*), SMR15-04-1 (5)

24. *Ophiothrix panchyendyta* H.L. Clark, 1911 (Fig. 9T) [Jn: Toge-Kumohtiode]
Mateirial examined. SMR13-01-1 (1*)
Remarks. This species has been recorded from Korea Strait (Matsumoto, 1917), Sagami Sea (Irimura, 1982), off Tsushima (Irimura, 1990), Sendai Bay (Fujita, 1996), Suruga Bay (Fujita et al., 1997) and East China Sea (Irimura and Kubodera, 1998; Fujita and Irimura, 2005). It is surprisingly that this common species has never been recorded from off Shirahama.

Family Ophiuridae Lyman, 1865
Genus *Ophiura* Lamarck, 1801

25. *Ophiura kinbergi* Ljungman, 1866 (Fig. 9U) [Jn: Kushinoha-Kumohitode]
Material examined. SMR13-01-1 (24*), SMR13-03-1 (1), SMR15-01-2 (2), SMR15-03-2 (1), SMR15-04-2 (3), SMR15-04-3 (6), SMR15-07-2 (316), SMR15-07-4 (96)

26. *Ophiura ooplax* (H.L. Clark, 1911) (Fig. 9V) [Jn: Hana-Kushinoha-Kumohitode]
Material examined. SMR15-04-2 (1*)
Remarks. This species has been recorded from Sagami Sea and Sea of Japan (Matsumoto, 1917), off Kumano (Saba et al., 1982) Suruga Bay (Fujita et al., 1997). This is the first record from off Shirahama.

27. *Stegophiura vivipara* [Jn: Komochi-Kumohitode] (Fig. 9W)
Material examined. SMR13-01-1 (5*), SMR13-02-2 (11), SMR15-01-2 (2), SMR15-04-1 (7)
Remarks. This species has been recorded from Sagami Sea (Matsumoto, 1917; Irimura, 1982), Suruga Bay (Fujita et al., 1997) off Shimoda (Irimura et al., 2001), off Ogasawara Islands (Irimura and Tachikawa, 2003), off Oki Island (Fujita et al., 2004) and East China Sea (Fujita and Irimura, 2005). This is the first record from off Shirahama.

Phylum Chordata

General remarks

We collected ten species from ten genera, eight families, including two new records from off Shirahama. Systematics follow Nakabo and Nakayama (2013).

Class Osteichthyes
Order Gadiformes
Family Bregmacerotidae Gill, 1872
Genus *Bregmaceros* Thompson, 1840

1. *Bregmaceros nectabanus* Whitley, 1941 (Fig. 10A) [Jn: Toyama-Sai-Uo]
Material examined. SMR15-04-4 (1*)
Remarks. *Bregmaceros nectabanus* is commonly known from Japanese waters (Nakabo and Kai, 2013), but this is the first record of off Shirahama.

Order Perciformes
Family Callionymidae Bonaparte, 1831
Genus *Repomucenus* Whitley, 1931

2. *Repomucenus virgis* (Jordan and Fowler, 1903) (Fig. 10B) [Jn: Horo-Numeri]
Material examined. SMR13-01-1 (1), SMR15-07-2 (1*)

Family Champsodontidae Jordan and Snyder, 1902
Genus *Champsodon* Günther, 1867

3. *Champsodon snyderi* Franz, 1910 (Fig. 10C) [Jn: Wani-Gisu]
Material examined. SMR15-07-2 (1*)

Family Gobidae Cuvier, 1816
Genus *Paratrypauchen* Murdy, 2008

4. *Paratrypauchen microcephalus* (Bleeker, 1860) (Fig. 10D) [Jn: Akauo]
Material examined. SMR15-04-4 (1*)

Family Percophidae Swainson, 1839
Genus *Pteropsaron* Jordan and Snyder, 1902

5. *Pteropsaron evolans* Jordan and Snyder, 1902 [Jn: Hokake-Tora-Gisu]
Material examined. SMR15-04-3 (1)

Family Pinguipedidae Günther, 1860
Genus *Parapercis* Bleeker, 1863

6. *Parapercis* sp. Bleeker, 1863 (Fig. 10E)
Material examined. SMR15-07-1 (1*)
Remarks. The present specimen cannot be identified because of lacking a body part.

Family Serranidae Swainson, 1839
Genus *Plectranthias* Bleeker, 1873

7. *Plectranthias kelloggi azumanus* (Jordan and Richardson, 1910) (Fig. 8F) [Jn: Azuma-Hana-Dai]
Material examined. SMR15-04-1 (1*)

Order Pleuronectiformes
Family Cynoglossidae Jordan, 1888
Genus *Symphurus* Rafinesque, 1810

8. *Symphurus orientalis* (Bleeker, 1879) (Fig. 10G) [Jn: Azuma-Garei]
Material examined. SMR15-04-2 (1*)
Remarks. *Symphurus orientalis* is known from Heda, Owase, Tosa Bay, Shibushi Bay and East China Sea (Yamada and Yagishita, 2013). This is the first record from off Shirahama.

Family Paralichthyidae Regan, 1910
Genus *Pseudorhombus* Bleeker, 1862

9. *Pseudorhombus pentophthalmus* Günther, 1862 (Fig. 10H) [Jn: Tama-Ganzo-Birame]
Material examined. SMR15-07-2 (1*), SMR15-07-4 (1)

Genus *Tarphops* Jordan and Thompson, 1914

10. *Tarphops elegans* Amaoka, 1969 (Figure 10(I)) [Jn: Yume-Arame-Garei]
Material examined. SMR15-04-3 (1*)

Discussion

Although animals examined in this study were only a small fraction of SMR samples, we obtained 132 species from seven phyla in total with six undescribed species and five potentially undescribed species, 22 new record species from off Shirahama and two new records from Japan (Table 2). A summary of remarkable discoveries are as follows.

Six undescribed species were found in four invertebrate phyla (Mollusca: *Cylindriscala* sp. and *Gymnodoris* sp., Tardigrada: *Raiarctus* sp., Arthropoda: *Cardiodectes* sp., and Echinodermata: *Fibularia* sp. and *Ophiodera*? sp.), and five potentially undescribed species were found in three phyla (Annelida: *Samythella* sp. *Owenia* sp. *Myriochele* sp., Tardigrada: *Tanarcus* sp., and Echinodermata: *Pentamera* sp.) (Table. 2). These species are in process of description or further identification under each expert. For tardigrades, the three species found in this study are the deepest records from Japanese waters. We collected one new record of a fish species (*Symphurus pentophthalmus*) from Shirahama. This finding is a surprise because the fish fauna in Japan is relatively well studied (e.g. Nakabo, 2013). We refrain from comparing benthos communities with respect to each depth zone (shallower, intermediate and deeper) because all samples were not identified in this study. But it is noteworthy that the 'intermediate depth zone (approximately 40–100 m)', included an undescribed species, *Cardiodectes* sp. (Arthropoda, Crustacea, Copepoda) and two potentially undescribed species, *Myriochele* sp.(Annelida, Oweniidae) and *Pentamera* sp.(Holothroidea, Dendrochirotida), and 6 newly recorded species in Ophiuroidea. Annelida and Holothuroidea have also been well studied in Shirahama (e.g. Fauvel, 1936; Imaoka, 1995; Imajima, 1996, 2001, 2007, 2015) and it shows that the 'intermediate depth zone' is an overlooked and unexplored environment in ocean.

According to the strict definition, the parasitic copepod (*Cardiodectes* sp.) is not a benthos. Accomplishment of this unexpected finding by the present sampling method should be noted here. Moreover, a living specimen of undescribed species of sand-burrowing echinoids (*Fibularia* sp.) was found in shallow waters near Hatakejima Island (5 m) (Table 2). In this Kyoto University possessed island, at intertidal zone, successive inventory researches of marine biodiversity have been conducted for more than 50 years. Finding of this small irregular echinoid species implicates that sand-borrowers may remain undiscovered even in littoral zone of one of the most intensively studied marine areas in the world (Table 2). Surveys focused on those 'overlooked' depth and environment would be desired for future marine biodiversity surveys around Shirahama.

Sponges, decapods, bryozoans and kinorhynchs and other benthic invertebrates were collected during the SMR but are not reported herein. Further examinations for the remaining samples would provide more taxonomic findings.

Images of living specimens provided several significant insights. For example, the ophiurid *Ophiopsammus anchista* showed beautiful vivid orange stripes on its body, a color pattern which has not been

previously reported (Fig. 7L). In total, photographs of 88 out of 132 species were provided in this study. Combination of these photographs, accurate sampling locality information and species list provide a graphic record of the biodiversity of the fauna from this region for future records.

On the other hand, we could not reconcile species which had only once originally described from the present study area. For example, *Ophiolepis utinomii* and *Ophiocentrus tokiokai* (Ophiuroidea) was originally described from subtidal zone of Hatakejima Island (Irimura, 1981) but not discovered during this study. The successive investigations must be important to encourage further monitoring of biotic transition, which should directly connect to environmental changes and we should be able to discuss the extinction of these species by those investigations.

We here conclude that our successive and detailed surveys covering wide range of depth and taxa accompanied with accurate locality data, and species-level identifications, provide important and fundamental information for future marine biodiversity research.

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Table 1. Sampling sites of Shirahama Marine Research. Asterisks indicate that the data is not recorded. Circles in "Animal" column indicatestations where listed animals were collected. Abbreviations: DMB, Dredge for meio-benthos; J, *Janthina*; KD, Kamiya-type dredge; SMBS, Smith McIntyre bottom grab sampler; Z, *Zoea*; 50BD, 50 cm-front biological dredge.

Station	Date	Gear	Position in	Position out	Depth (m)	Animal	Vehicle
SMR12-01-1	13 November 2012	DMB	33°36.2119'N 135°16.8795'E	*	433	-	J
SMR12-01-2	13 November 2012	DMB	33°36.5307'N 135°16.3168'E	*	308	-	J
SMR13-01-1	17 June 2013	KD	33° 37.6120'N 135° 37.6120'E	33° 37.7880'N 135° 37.7580'E	93-93	○	J
SMR13-01-2	17 June 2013	KD	33° 36.6470'N 135° 36.4690'E	33° 37.0540'N 135° 37.1680'E	193-210	○	J
SMR13-02-1	6 August 2013	KD	33° 36.4166'N 135° 17.6333'E	*	229	○	J
SMR13-02-2	6 August 2013	KD	33° 38.6918'N 135° 18.6252'E	*	81	○	J
SMR13-02-3	6 August 2013	KD	33° 39.9071'N 135° 19.0499'E	*	57	○	J
SMR13-03-1	17 September 2013	KD	33° 40.3175'N 135° 18.7006'E	33° 40.7639'N 135° 18.6803'E	50.5-45.6	○	J
SMR13-03-2	17 September 2013	KD	33° 40.9550'N 135° 18.6452'E	33° 41.0281'N 135° 18.6412'E	44.1-43.2	○	J
SMR13-03-3	17 September 2013	KD	33° 42.1314'N 135° 19.0022'E	33° 42.1950'N 135° 18.9689'E	42.3-42.2	○	J
SMR13-03-4	17 September 2013	KD	33° 43.5214'N 135° 19.0838'E	33° 43.5665'N 135° 19.1056'E	31.1-30.4	○	J
SMR13-03-5	17 September 2013	KD	33° 43.5631'N 135° 19.0788'E	33° 43.5752'N 135° 19.1454'E	30.6-30	○	J
SMR13-04-1	18 September 2013	KD	33° 37.3342'N 135° 16.5923'E	33° 37.6309'N 135° 16.4962'E	175-137	○	J
SMR13-04-2	18 September 2013	KD	33° 37.5253'N 135° 16.4122'E	33° 37.7639'N 135° 16.1896'E	146-139	○	J
SMR14-01-1	7 May 2014	DMB	33° 36.7552'N 135° 16.4591'E	33° 36.8406'N 135° 16.6968'E	184-167	○	J
SMR14-01-2	7 May 2014	KD	33° 36.6761'N 135° 18.8216'E	33° 36.8519'N 135° 18.1623'E	194-173	-	J
SMR14-01-3	7 May 2014	DMB	33° 39.7600'N 135° 16.5928'E	33° 39.8859'N 135° 16.5602'E	68.3-67.5	-	J
SMR14-02-1	8 May 2014	DMB	33° 43.8640'N 135° 19.8363'E	33° 43.8880'N 135° 19.7870'E	22.7-22.6	-	J
SMR14-02-2	8 May 2014	DMB	33° 43.5374'N 135° 20.3986'E	33° 43.6092'N 135° 20.3589'E	21.7-21.3	-	J
SMR14-03-1	21 October 2014	KD	33° 35.5408'N 135° 17.0150'E	33° 36.8196'N 135° 16.9003'E	286 -169	-	J
SMR14-03-2	21 October 2014	KD	33° 38.1577'N 135° 17.4542'E	33° 38.3688'N 135° 17.3500'E	104 -104	-	J
SMR14-03-3	21 October 2014	KD	33° 38.1651'N 135° 17.4272'E	33° 38.3150'N 135° 17.3583'E	104 -104	-	J
SMR14-03-4	21 October 2014	KD	33° 40.8917'N 135° 17.2333'E	33° 41.0833'N 135° 17.0722'E	74 -74	○	J
SMR15-01-1	14 April 2015	KD	33° 39.4563'N 135° 18.3679'E	33° 39.9469'N 135° 17.9586'E	76.1-75.8	○	J
SMR15-01-2	14 April 2015	KD	33° 40.3133'N 135° 18.2067'E	33° 40.6207'N 135° 17.9691'E	66.7 -65.6	○	J
SMR15-02-1	27 April 2015	KD	33° 36.5297'N 135° 15.9027'E	33° 37.0301'N 135° 15.2931'E	295-217	○	J
SMR15-02-2	27 April 2015	KD	33° 37.2618'N 135° 15.1607'E	33° 37.6507'N 135° 14.7445'E	180-173	○	J
SMR15-02-3	27 April 2015	KD	33° 37.7698'N 135° 14.6279'E	33° 37.9290'N 135° 14.5255'E	188-247	○	J
SMR15-03-1	22 May 2015	50BD	33° 37.2991'N 135° 15.1098'E	33° 37.4010'N 135° 14.9560'E	177-175	○	J
SMR15-03-2	22 May 2015	50BD	33° 38.7078'N 135° 15.5414'E	33° 38.8776'N 135° 15.5309'E	128-124	○	J
SMR15-03-3	22 May 2015	50BD	33° 39.5157'N 135° 18.3230'E	33° 39.7289'N 135° 18.2344'E	75-73.4	○	J
SMR15-04-1	27 May 2015	50BD	33° 37.5484'N 135° 14.8603'E	33° 37.5755'N 135° 14.9760'E	169-164	○	J
SMR15-04-2	27 May 2015	50BD	33° 38.8328'N 135° 15.4698'E	33° 38.8929'N 135° 15.4997'E	126-124	○	J
SMR15-04-3	27 May 2015	50BD	33° 39.7547'N 135° 18.1521'E	33° 40.1084'N 135° 18.0326'E	75-72	○	J
SMR15-04-4	27 May 2015	50BD	33° 42.2404'N 135° 20.5134'E	33° 42.6522'N 135° 20.6508'E	31-30	○	J
SMR15-05-1	28 May 2015	SMBS	33° 42.4482'N 135° 22.8197'E	*	13.2	○	J
SMR15-05-2	28 May 2015	SMBS	33° 41.6617'N 135° 21.7451'E	*	3.7	○	J
SMR15-05-3	28 May 2015	DMB	33° 41.6386'N 135° 21.7664'E	*	7.7	○	J
SMR15-06-1	12 June 2015	SMBS	33° 42.20'N 135° 20.13'E	33° 42.20'N 135° 20.13'E	34-34	○	Z
SMR15-06-2	12 June 2015	SMBS	33° 41.52'N 135° 21.32'E	33° 41.52'N 135° 21.32'E	5-5	○	Z
SMR15-06-3	12 June 2015	SMBS	33° 41.41'N 135° 21.44'E	33° 41.41'N 135° 21.44'E	4-4	-	Z
SMR15-06-4	12 June 2015	SMBS	33° 41.47'N 135° 21.53'E	33° 41.47'N 135° 21.53'E	4-4	-	Z
SMR15-07-1	29 June 2015	50BD	33° 37.2768'N 135° 15.2148'E	33° 37.1925'N 135° 15.3868'E	175-175	○	J
SMR15-07-2	29 June 2015	50BD	33° 39.6232'N 135° 18.2800'E	33° 39.4974'N 135° 18.4200'E	74-73.5	○	J
SMR15-07-3	29 June 2015	SMBS	33° 39.5284'N 135° 18.5384'E	33° 39.4536'N 135° 18.6925'E	72.1-71.4	-	J
SMR15-07-4	29 June 2015	50BD	33° 40.4003'N 135° 18.0122'E	33° 40.3763'N 135° 19.1354'E	48.2-46.2	○	J
SMR16-01-1	27 June 2016	50BD	33° 40.6848'N 135° 18.0105'E	33° 40.7101'N 135° 18.0539'E	63-61.5	○	J

Table 2. Species list with sampling localities and numbers of collected specimens at each site. The sites are ordered in depth (m). Depth indicates the shallowest one if there is depth range. Total number indicates total of numbers of all animals except for Cnidaria in each site. Abbreviations: +, numerous (>50); *, new record to Shirahama; **, new record to Japan; ***, potentially undescribed species; ****, undescribed species. Characters in brackets after each species name corresponds to those in figures.

	SMR15-05-2	SMR15-06-2	SMR15-05-3	SMR15-05-1	SMR13-03-5	SMR15-04-4	SMR13-03-4	SMR15-06-1	SMR13-03-3	SMR13-03-2	SMR15-07-4	SMR13-03-1	SMR13-02-3	SMR15-01-2	SMR14-03-4	SMR15-07-2	SMR15-03-3	SMR15-04-3	SMR15-01-1	SMR13-02-2	SMR13-01-1	SMR15-04-2	SMR15-03-2	SMR13-04-2	SMR15-04-1	SMR13-04-1	SMR15-07-1	SMR15-03-1	SMR15-02-2	SMR14-01-1	SMR15-02-3	SMR13-01-2	SMR13-02-1	SMR15-02-1
Depth (m)	3.7	5	7.7	13	31	31	31	34	42	44	48	51	57	67	74	74	75	75	76	81	93	126	128	146	169	175	175	177	180	184	188	193	229	295
Cnidaria																																		
Hexacorallia																																		
Scleratinia																																		
Anthemiphylliidae																																		
Anthemiphyllia dentata (3A-B)																+												+	+					
Caryophylliidae																																		
Premocyathus dentiformis (3C-D)																+	+											+						
Flabellidae																																		
Truncatoflabellum phoenix (3E-F)																+	+							+					+					
Micrabaciidae																																		
Letepsammia formosissima (3G-H)																+	+							+					+					
Stenocyathidae																																		
Truncatoguynia irregularis (3I-J)																+	+																	
Turbinoliidae																																		
Deltocyathoides orientalis (3K-L)																+	+							+				+						
Idiotrochus kikutii (3M-N)																+								+				+	+					
Peponocyathus folliculus (3O-P)																+								+				+						
Mollusca																																		
Bivalvia																																		
Limopsidae																																		
Nipponolimopsis azumana (4A)																		26							!				7					
Nipponolimopsis decussata (4B)	7																																	
Tellinidae																																		
Cadella delta (4C)			12																															
Nitidotellina lischkei (4D)																7		4																	

Table 2 (Continue).

	15-05-2	15-06-2	15-05-3	15-05-1	13-03-5	15-04-4	13-03-4	15-06-1	13-03-3	13-03-2	15-07-4	13-03-1	13-02-3	15-01-2	14-03-4	15-07-2	15-03-3	15-04-3	15-01-1	13-02-2	13-01-1	15-04-2	15-03-2	13-04-2	15-04-1	13-04-1	15-07-1	15-03-1	15-02-2	14-01-1	15-02-3	13-01-2	13-02-1	15-02-1
Veneridae																																	
Timoclea minuta (4E)											12					1			5														5
Gastropoda																																	
Fasciolariidae																																	
Granulifusus niponicus (4F)																		5						5		4							
Scaliolidae																																	
Finella purpureoapicata (4G)																																	
Cylichnidae																																	
Decorifer insignis (4H)			6																														
Epitoniidae																																	
Amaea dorysa (4I)																														1			
Cylindriscala sp. **** (4J)																								1									
Epitonium angustum (4K)	1		2																														
Epitonium heloris (4L)																										1							
Epitonium liliputanum (4M)																								1		2							
Epitonium rimbogai (4N)			1																														
Epitonium simplex (4O)			1																														
Epitonium pallasi (4P)																												1					
Cystiscidae																																	
Gibberula novemprovincialis (4Q)																								6									
Olivellidae																																	
Olivella fulgurata (4R)																								8									
Gymnodorididae																																	
Gymnodoris sp. **** (4S)																1																	
Pyramidellidae																																	
Ptycheulimella misella (4T)	9																																
Odetta lirata (4U)			19																														
Ringiculidae																																	
Ringicula tosaensis (4V)				1		5																		1									
Microgaza fulgens (4W)																		1				12		1									
Minolia subangulata * (4X)																						17		1									

Table 2 (Continue).

	15-05-2	15-06-2	15-05-3	15-05-1	13-03-5	15-04-4	13-03-4	15-06-1	13-03-3	13-03-2	15-07-4	13-03-1	13-02-3	15-01-2	14-03-4	15-07-2	15-03-3	15-04-3	15-01-1	13-02-2	13-01-1	15-04-2	15-03-2	13-04-2	15-04-1	13-04-1	15-07-1	15-03-1	15-02-2	14-01-1	15-02-3	13-01-2	13-02-1	15-02-1
Vermetidae																																		
Thylacodes medusa (4Y)																						1			6		1		1					
Annelida																																		
Phyllodocidae																																		
Nereiphylla castanea																		1																
Syllidae																																		
Syllidae gen. sp.																									6									
Hesionidae																																		
Leocratides sp.																									3									
Nereididae																																		
Nereis or *Neanthes* sp.																									1									
*Tambalagamia fauveli** (5A)						4																												
Glyceridae																																		
Glycera onomichiensis																									2									
Aphroditidae																																		
Laetmonice japonica																		1																
Polynoidae																																		
Lepidasthenia sp.																									1									
Polynoidae sp.																		1							10									
Pilargidae																																		
Sigambra hanaokai						1																												
Amphinomidae																																		
Chloeia sp.																									4									
Euphrosinidae																																		
Euphrosinidae gen. sp.																									1									
Eunicidae																																		
Eunicidae gen. sp.																									11									
Lumbrineridae																																		
Scoletoma sp.																		1																
Lumbrineridae gen. sp.																		6																

Table 2 (Continue).

	15-05-2	15-06-2	15-05-3	15-05-1	13-03-5	15-04-4	13-03-4	15-06-1	13-03-3	13-03-2	15-07-4	13-03-1	13-02-3	15-01-2	14-03-4	15-07-2	15-03-3	15-04-3	15-01-1	13-02-2	13-01-1	15-04-2	15-03-2	13-04-2	15-04-1	13-04-1	15-07-1	15-03-1	15-02-2	14-01-1	15-02-3	13-01-2	13-02-1	15-02-1
Onuphidae																																	
Hyalinoecia tubicola																						1											
Onuphidae gen. sp.																								10									
Chaetopteridae																																	
Spiochaetopterus sp.																								16									
Chaetopteridae spp.																		10				3											
Magelonidae																																	
Magelona japonica						1																											
Poecilochaetidae																																	
Poecilochaetus elongatus						2																											
Poecilochaetus sp.						2																											
Ampharetidae																																	
Samythella sp. ***																								1									
Terebellidae																																	
Polycirrus sp.	1																																
Terebellidae gen. sp.						1																		2									
Trichobranchidae																																	
Terebellides kobei						13																											
Pectinariidae																																	
Lagis sp.																								1									
Cirratulidae																																	
Cirratulus sp.																						1											
Chaetozone sp.	7																																
Flabelligeridae																																	
Diplocirrus nicolaji * (5B)	2																																
Sternaspidae																																	
Sternaspis affinis						2																											
Maldanidae																																	
Nicomache sp.																								1									
Opheliidae																																	
Armandia amakusaensis	1																																

Table 2 (Continue).

	15-05-2	15-06-2	15-05-3	15-05-1	13-03-5	15-04-4	13-03-4	15-06-1	13-03-3	13-03-2	15-07-4	13-03-1	13-02-3	15-01-2	14-03-4	15-07-2	15-03-3	15-04-3	15-01-1	13-02-2	13-01-1	15-04-2	15-03-2	13-04-2	15-04-1	13-04-1	15-07-1	15-03-1	15-02-2	14-01-1	15-02-3	13-01-2	13-02-1	15-02-1
Capitellidae																																	
Capitellidae gen. sp.	1																																
Oweniidae																																	
Owenia sp. ***																					1			2									
Myriochele heeri																					1												
Myriochele sp. *** (5C)																		1															
Galathowenia oculata (5D)																		1															
Sabellariidae																																	
Lygdamis japonicus																								1									
Sabellidae																																	
Laonome sp.																								2									
Sabellidae gen. sp.	1																																
Tardigrada																																	
Heterotardigrada																																	
Arthrotardigrada																																	
Halechiniscidae																																	
Angursa clavifera (6A)																											1						
Raiarctus sp.**** (6B)																								1			1						
Tanarctus sp. *** (6C)																								1									
Arthropoda																																	
Copepoda																																	
Siphonostomatoida																																	
Pennellidae																																	
Cardiodectes sp. **** (6D-F)																		3															
Echinodermata																																	
Echinoidea																																	
Camarodonta																																	
Temnopleuridae																																	
Temnopleurus apodus (7A-B)																					1												
Temnopleuridae gen. sp. (7C-D)																					2												

Table 2 (Continue).

	15-05-2	15-06-2	15-05-3	15-05-1	13-03-5	15-04-4	13-03-4	15-06-1	13-03-3	13-03-2	15-07-4	13-03-1	13-02-3	15-01-2	14-03-4	15-07-2	15-03-3	15-04-3	15-01-1	13-02-2	13-01-1	15-04-2	15-03-2	13-04-2	15-04-1	13-04-1	15-07-1	15-03-1	15-02-2	14-01-1	15-02-3	13-01-2	13-02-1	15-02-1
Clypeasteroida																																	
Fibulariidae																																	
Echinocyamus provectus (7E-F)																						2											
*Echinocyamus subconicus** (7G-H)																						6											
Fibularia sp.**** (7I-J)		1																															
Holothuroidea																																	
Apodida																																	
Synaptidae																																	
Labidoplax variabilis (8A)			1			3		1																									
Leptosynapta sp. (8B)		1	2																														
Dendrochirotida																																	
Fam. Undetermined																																	
Unknown species 1 (8C)																								1									
Unknown species 2 (8D)																								1									
Cucumariidae																																	
Amphicyclus sp.? (8E)																								1									
Neocucumis sp.? 1 (8F)																								1									
Neocucumis sp.? 2 (8G)																						1											
Pentacta? sp. (8H)																								1									
Pseudocnus sp.? (8I)																						1		2	3		1						
Phyllophoridae																																	
Neothyonidium sp. (8J)																										1							
Pentamera sp. *** (8K)																		3															
Stolus punctata (8L)																		1															
Psolidae																																	
Psolus sp. (8M)																								2									
Ophiuroidea																																	
Euryalida																																	
Euryalidae																																	
Astroceras coniunctum *																								1									

Table 2 (Continue).

	15-05-2	15-06-2	15-05-3	15-05-1	13-03-5	15-04-4	13-03-4	15-06-1	13-03-3	13-03-2	15-07-4	13-03-1	13-02-3	15-01-2	14-03-4	15-07-2	15-03-3	15-04-3	15-01-1	13-02-2	13-01-1	15-04-2	15-03-2	13-04-2	15-04-1	13-04-1	15-07-1	15-03-1	15-02-2	14-01-1	15-02-3	13-01-2	13-02-1	15-02-1
Ophiurida																																	
Amphiuridae																																	
Amphioplus (*Amphichilus*) *trichoides* * (9A)						3		1																									
Amphioplus (*Amphioplus*) *ancistrotus*? (9B)														2																			
Amphipholis squamata (9C)										1														2				2					
Amphiura (*Ophiopeltis*) *aestuarii* * (9D)							1	1	2																								
Amphiura (*Amphiura*) *koreae* * (9E)																												1					
Amphiura (*Amphiura*) *micraspis* * (9F)							1																1										
Amphiura (*Fellaria*) *vadicola* (9G)					3																												
Ophiacanthidae																																	
Ophiophragmus japonicas *													1					1															
Ophiomitrella stellifera * (9H)																												1					
Ophiomyces papillospinus **																		4	1													2	
Ophiactidae																																	
Ophiactis dyscrita * (9I)																						1			1								
Ophiactis macrolepidota (9J)																					4	1											
Ophiactis profundi (9K)																												2					
Ophiodermatidae																																	
Ophiopsammus anchista * (9L)																															1		
Ophiurochaeta mixta ** (9M)															2																		
Ophiolepididae																																	
Ophiomusium lymani *																						1		2				5					
Ophiomusium scalare																															4		
Ophioleucidae																																	
Ophioleuce seminudum * (9N)																										2							
Ophiomyxidae																																	
Ophiodera? sp. **** (9O-P)																															1		
Ophiologimus hexactis * (9Q)																								1				2			7		
Ophionereididae																																	
Ophiocrasis dictydisca * (9R)																													3				

Table 2 (Continue).

	15-05-2	15-06-2	15-05-3	15-05-1	13-03-5	15-04-4	13-03-4	15-06-1	13-03-3	13-03-2	15-07-4	13-03-1	13-02-3	15-01-2	14-03-4	15-07-2	15-03-3	15-04-3	15-01-1	13-02-2	13-01-1	15-04-2	15-03-2	13-04-2	15-04-1	13-04-1	15-07-1	15-03-1	15-02-2	14-01-1	15-02-3	13-01-2	13-02-1	15-02-1
Ophiotrichidae																																	
Ophiothrix koreana (9S)																								5				2					
Ophiothrix panchyendyta * (9T)																					1												
Ophiuridae																																	
Ophiura kinbergi (9U)											96	1		2		316		6			24	3	1										
Ophiura ooplax * (9V)																						1											
Stegophiura vivipara * (9W)														2						11	5			7									
Chordata																																	
Osteichthyes																																	
Gadiformes																																	
Bregmacerotidae																																	
Bregmaceros nectabanus * (10A)						1																											
Callionymidae																																	
Repomucenus virgis (10B)																1					1												
Champsodontidae																																	
Champsodon snyderi (10C)																1																	
Gobidae																																	
Paratrypauchen microcephalus (10D)						1																											
Percophidae																																	
Pteropsaron evolans																		1															
Pinguipedidae																																	
Parapercis sp. (10E)																										1							
Serranidae																																	
Plectranthias kelloggi azumanus (10F)																								1									
Cynoglossidae																																	
Symphurus orientalis * (10G)																						1											
Paralichthyidae																																	
Pseudorhombus pentophthalmus (10H)											1					1																	
Tarphops elegans (10I)																		1															
Total numbers	30	2	44	1	3	39	2	3	2	1	109	1	1	6	2	328	0	78	6	11	35	58	1	3	162	1	13	2	24	3	1	13	2	5

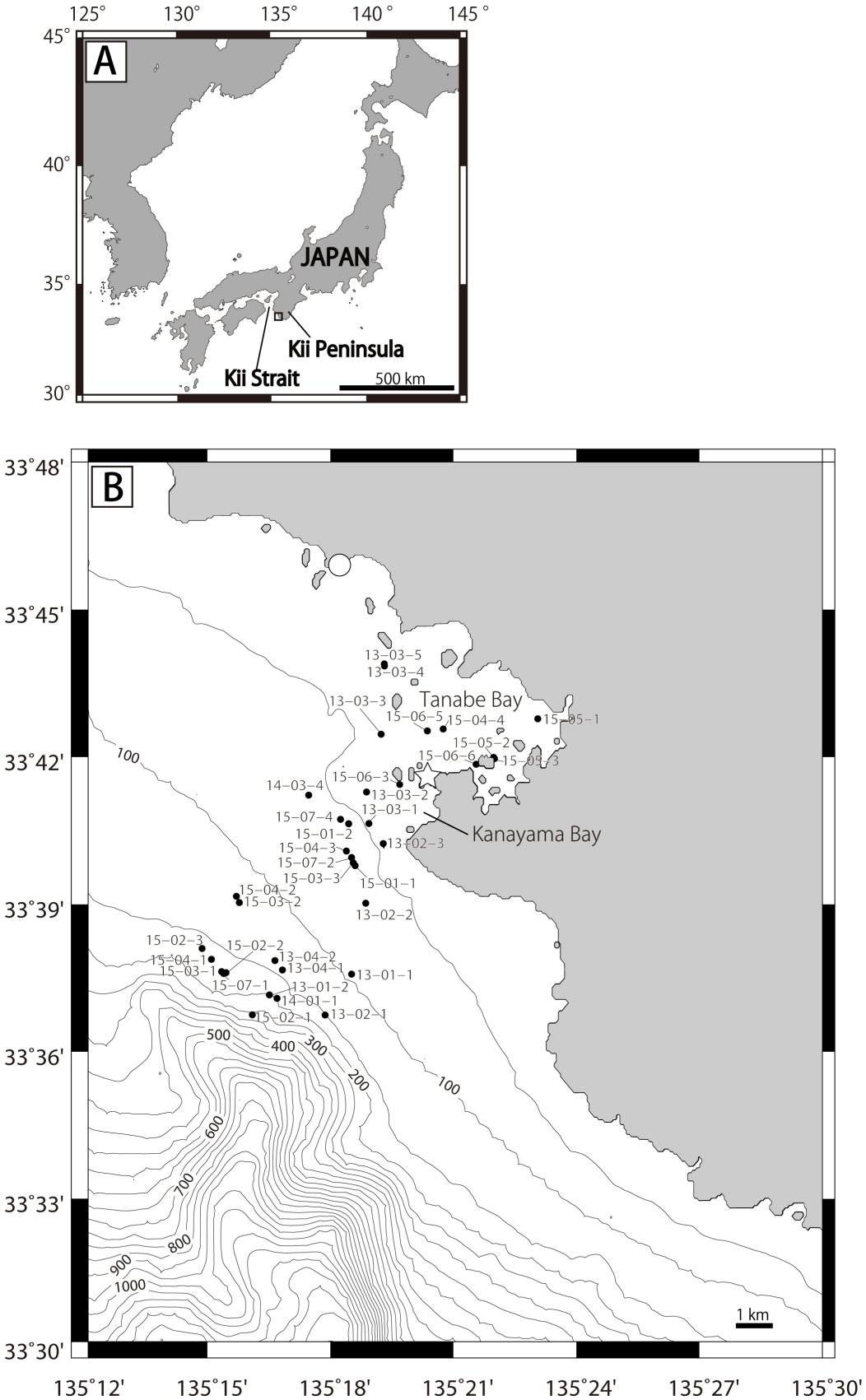

Figure 1. Survey area of the present study. A, a map of Japan. Shirahama Area is indicated by a square. B, SMR sampling sites (black dots). A star indicates Seto Marine Biological Laboratory and a circle indicates Sakai fishery port. Fig. B generated using GMT5 (Wessel et al., 2013) and ETOPO1 (Amante and Eakins, 2009).

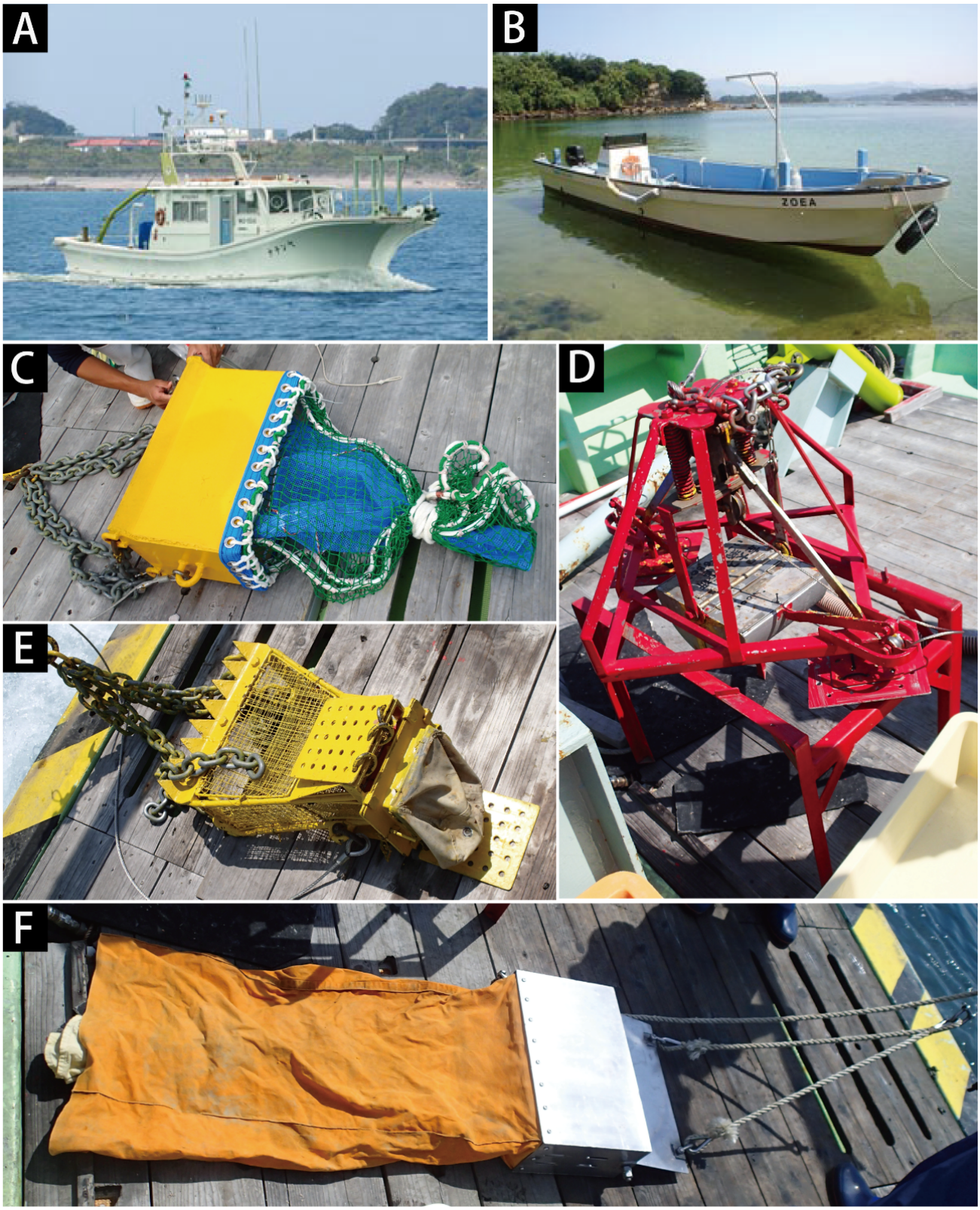

Figure 2. Vessels and sampling gears used in SMR. A, B: Research vessels of SMBL, *Janthina* (A) and *Zoea* (B). C-F: Sampling gears, 50 cm-front biological dredge (C), Smith-Mcintyr bottom grab sampler, (D), Kamiya-type dredge (E), Dredge for meio-benthos (F).

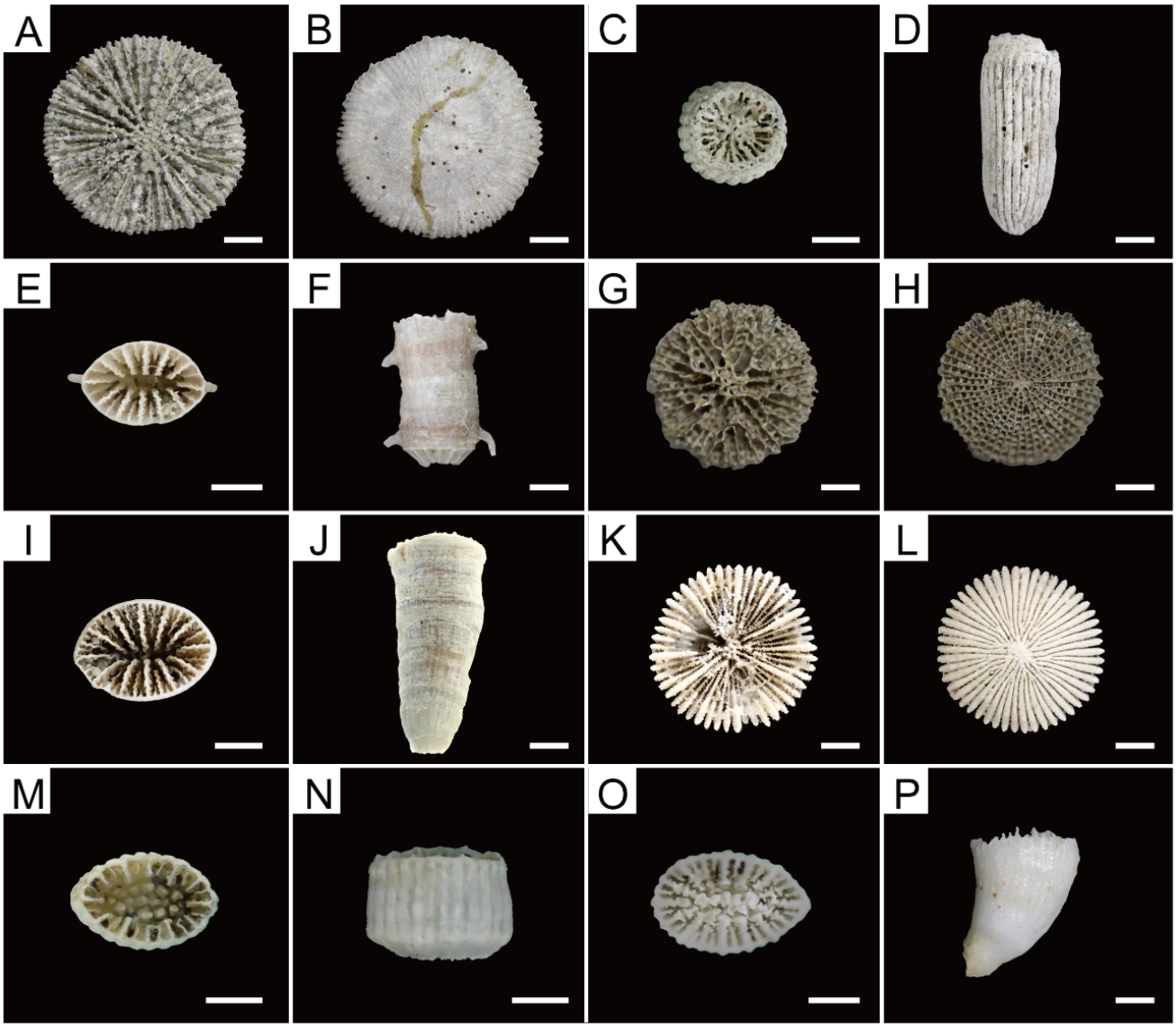

Figure 3. Cnidaria, Hexacolrallia. A–B. *Anthemiphyllia dentate.* C–D. *Premocyathus dentiformis.* E–F. *Truncatoflabellum phoenix.* G–H. *Letepsammia formosissima.* I–J. *Truncatoguynia irregularis.* K–L. *Deltocyathoides orientalis.* M–N. *Idiotrochus kikutii.* O–P. *Peponocyathus folliculus.* Scale bars = 2 mm.

Figure 4. Mollusca, Bivalvia (A–E) and Gastropoda (F–Y). A. *Nipponolimopsis azumana.* B. *Nipponolimopsis decussata.* C. *Cadella delta.* D. *Nitidotellina lischkei.* E. *Timoclea minuta.* F. *Granulifusus niponicus.* G. *Finella purpureoapicata.* H. *Decorifer insignis*. I. *Amaea dorysa.* J. *Cylindriscala* sp. K. *Epitonium angustum*. L. *Epitonium heloris.* M. *Epitonium liliputanum*. N. *Epitonium rimbogai*. O. *Epitonium simplex.* P. *Epitonium pallasi.* Q. *Gibberula novemprovincialis.* R. *Olivella fulgurata.* S. *Gymnodoris* sp. T. *Ptycheulimella misella.* U. *Odetta lirata.* V. *Ringicula tosaensis.* W. *Microgaza fulgens*. X. *Minolia subangulata.* Y. *Thylacodes medusa.* Scale bars = 2 mm.

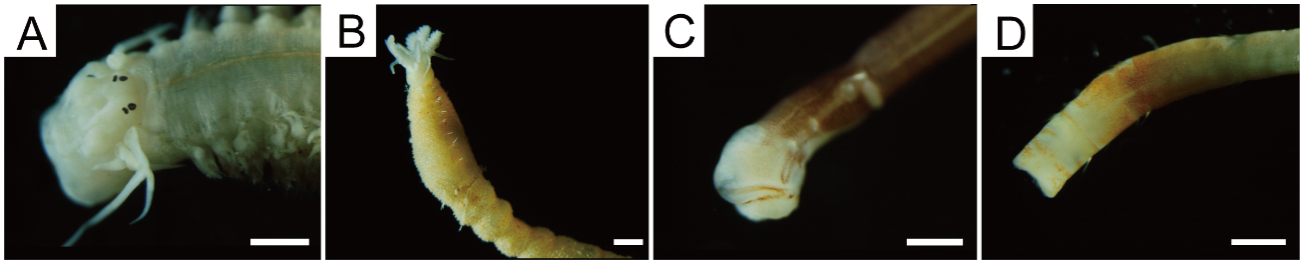

Figure 5. Annelida, polychaetes, anterior end. A. *Tambalagamia fauveli.* B. *Diplocirrus nicolaji.* C. *Myriochele* sp. D. *Galathowenia oculata.* Scale bars = 0.5 mm.

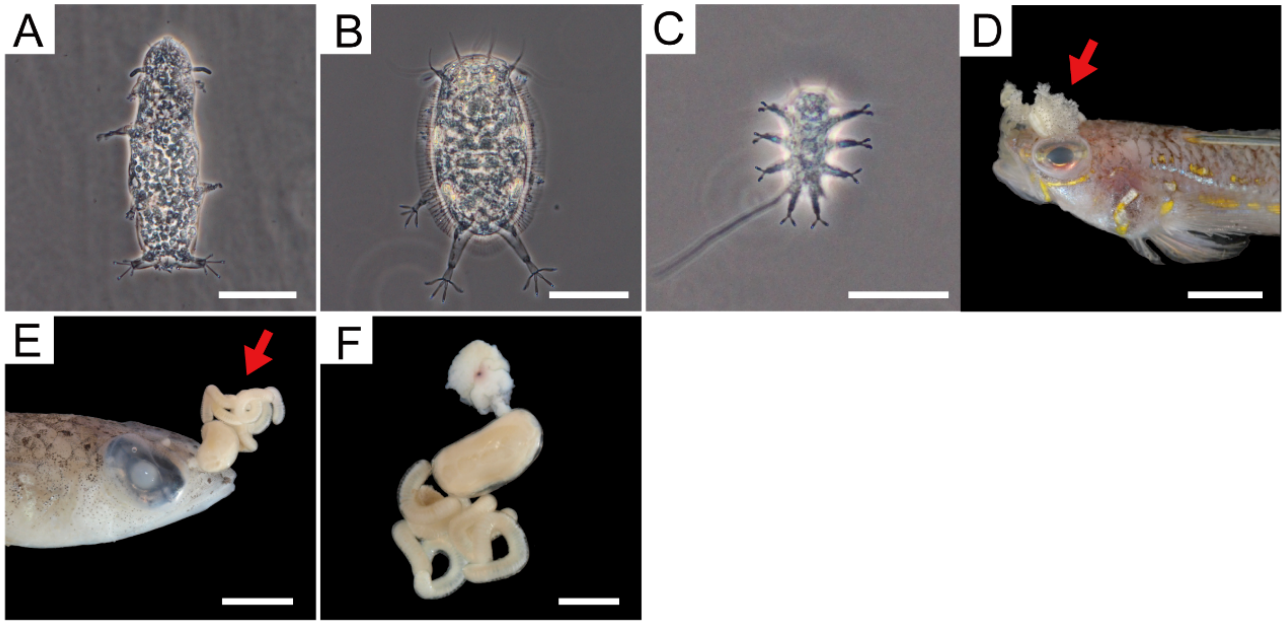

Figure 6. Tardigrada, Heterotardigrada (A–C) and Arthropoda, Copepoda (D–F). A. *Angursa clavifera.* B. *Raiarctus* sp. C. *Tanarctus* sp. D–F. *Cardiodectes* sp., parasitic on an eye of *Pteropsaron evolans*, indicated by an arrow, collected in SMR 15-04-3 (D), on an eye of *Osopsaron formosense*, indicated by an arrow (E), and a separated individual, dorsal view (F), collected in SMR 16-01-1. Scale bars = 50 μm (A–C), 5 mm (D), 2 mm (E), 1 mm (F).

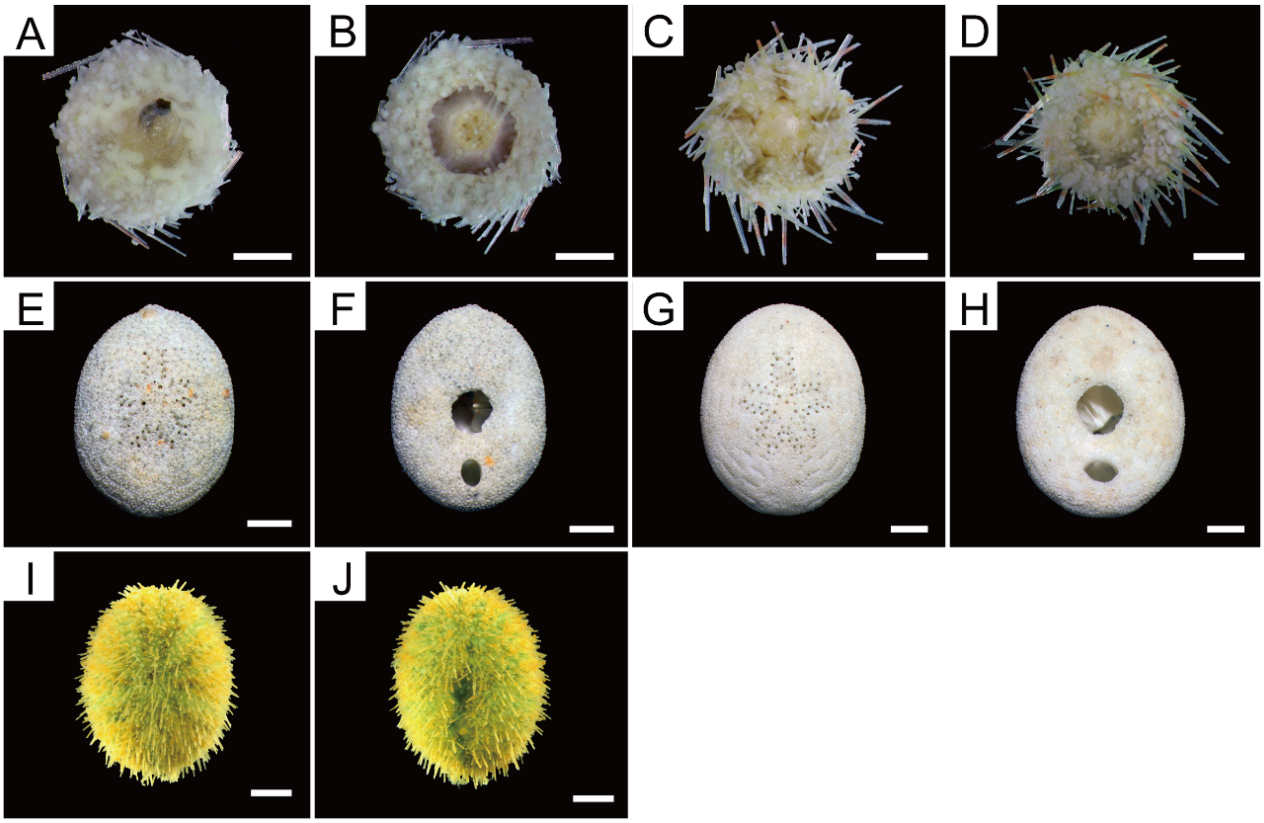

Figure 7. Echinodermata, Echinoidea. A-B. aboral and oral side views of *Temnopleurus apodus*. C–D. aboral and oral side views of Temnopleuroidae sp. gen. E–F. aboral and oral side views of *Echinocyamus provectus*. G–H. aboral and oral side views of *Echinocyamus subconicus*. I–J. aboral and oral side views of *Fibularia* sp. Scale bars = 1 mm.

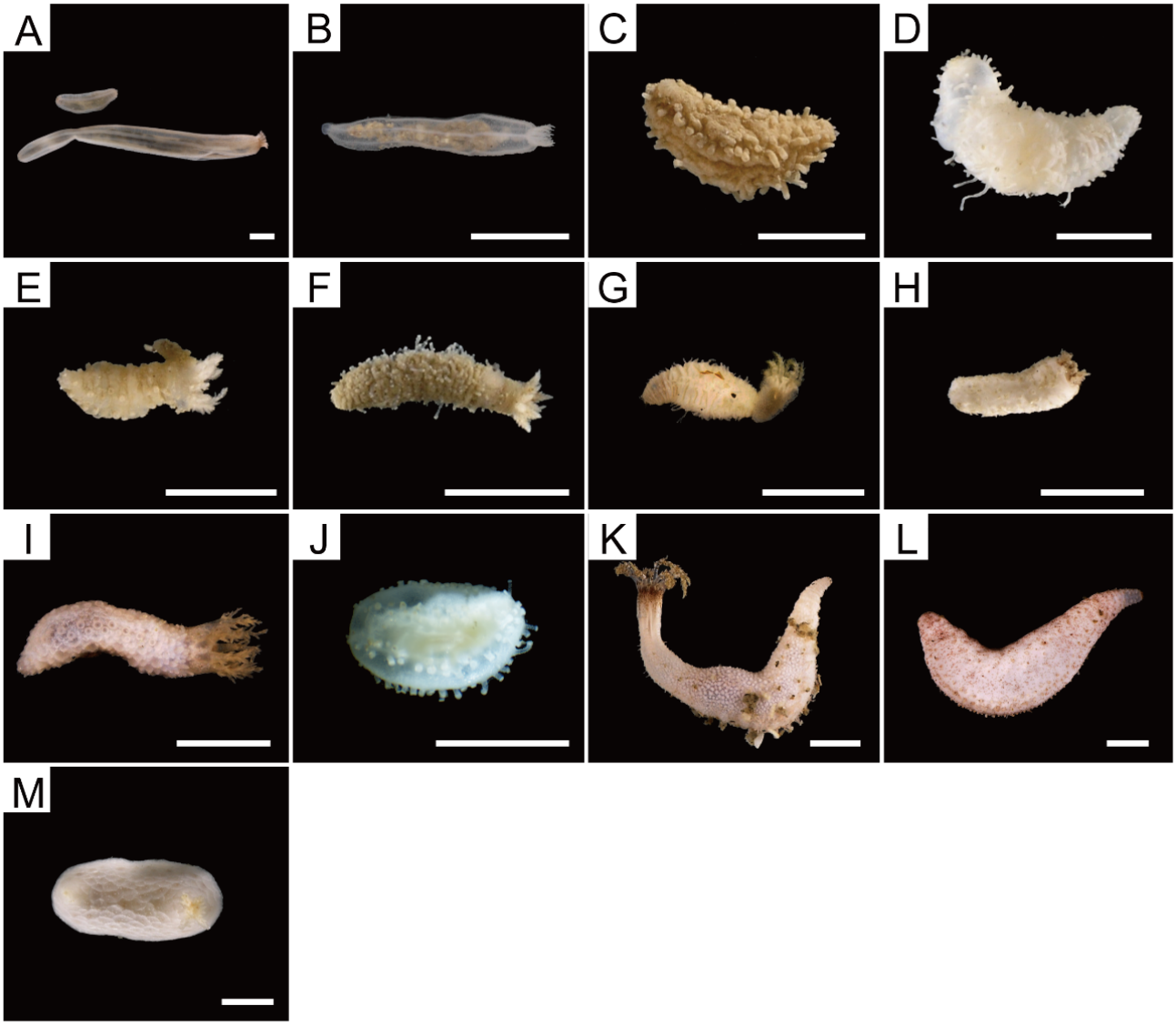

Figure 8. Echinodermata, Holothuroidea. A. lateral view of *Labidoplax variabilis*. B. lateral view of *Leptosynapta* sp. C. lateral view of unknown species 1. D. lateral view of unknown species 2. E. lateral view of *Amphicyclus* sp.? F. lateral view of *Neocucumis* sp.? 1. G. lateral view of *Neocucumis* sp.? 2. H. dorsal view of *Pentacta*? sp. I. lateral view of *Pseudocnus* sp.? J. lateral view of *Neothyonidium* sp. K. lateral view of *Pentamera* sp. L. lateral view of *Stolus punctata*. M. dorsal view of *Psolus* sp. Scale bars = 5 mm.

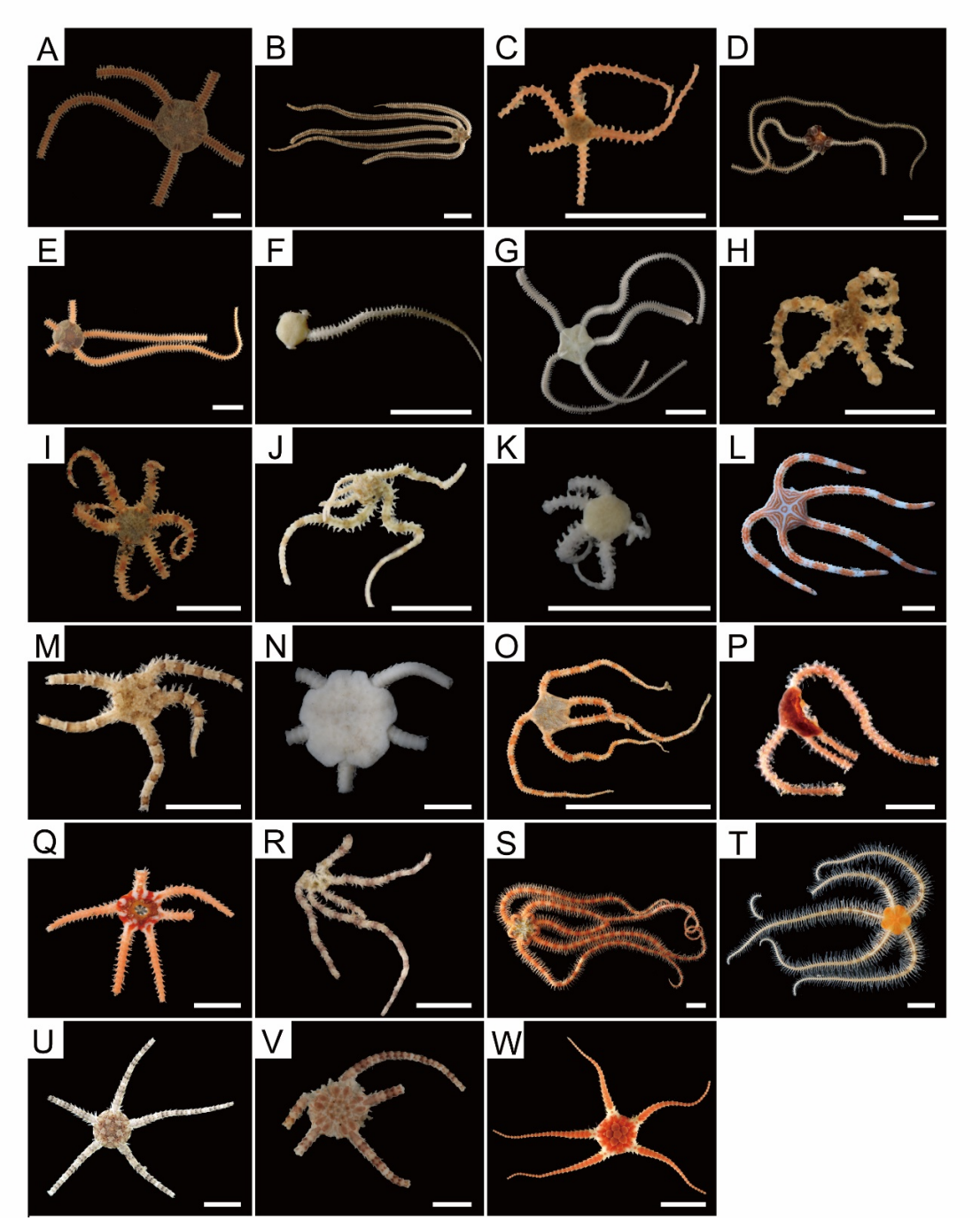

Figure 9. Echinodermata, Ophiuroidea, aboral views. A. *Amphioplus* (*Amphichilus*) *trichoides.* B. *Amphioplus* (*Amphioplus*) *ancistrotus*?. C. *Amphipholis squamata.* D. *Amphiura* (*Ophiopeltis*) *aestuarii.* E. *Amphiura* (*Ophiopeltis*) *koreae.* F. *Amphiura* (*Amphiura*) *micraspis.* G. *Amphiura* (*Fellaria*)*vadicola*.. H. *Ophiomitrella stellifera.* I. *Ophiactis dyscrita.* J. *Ophiactis macrolepidota.* K. *Ophiactis profundi.* L. *Ophiopsammus anchista.* M. *Ophiurochaeta mixta.* N. *Ophioleuce seminudum.* O, P. *Ophiodera*? sp. Adult (O) and juvenile (P). Q, *Ophiologimus hexactis.* R. *Ophiocrasis dictydisca.* S. *Ophiothrix koreana.* T. *Ophiothrix panchyendyta.* U. *Ophiura kinbergi.* V. *Ophiura ooplax.* W. *Stegophiura vivipara.* Scale bars = 5 mm.

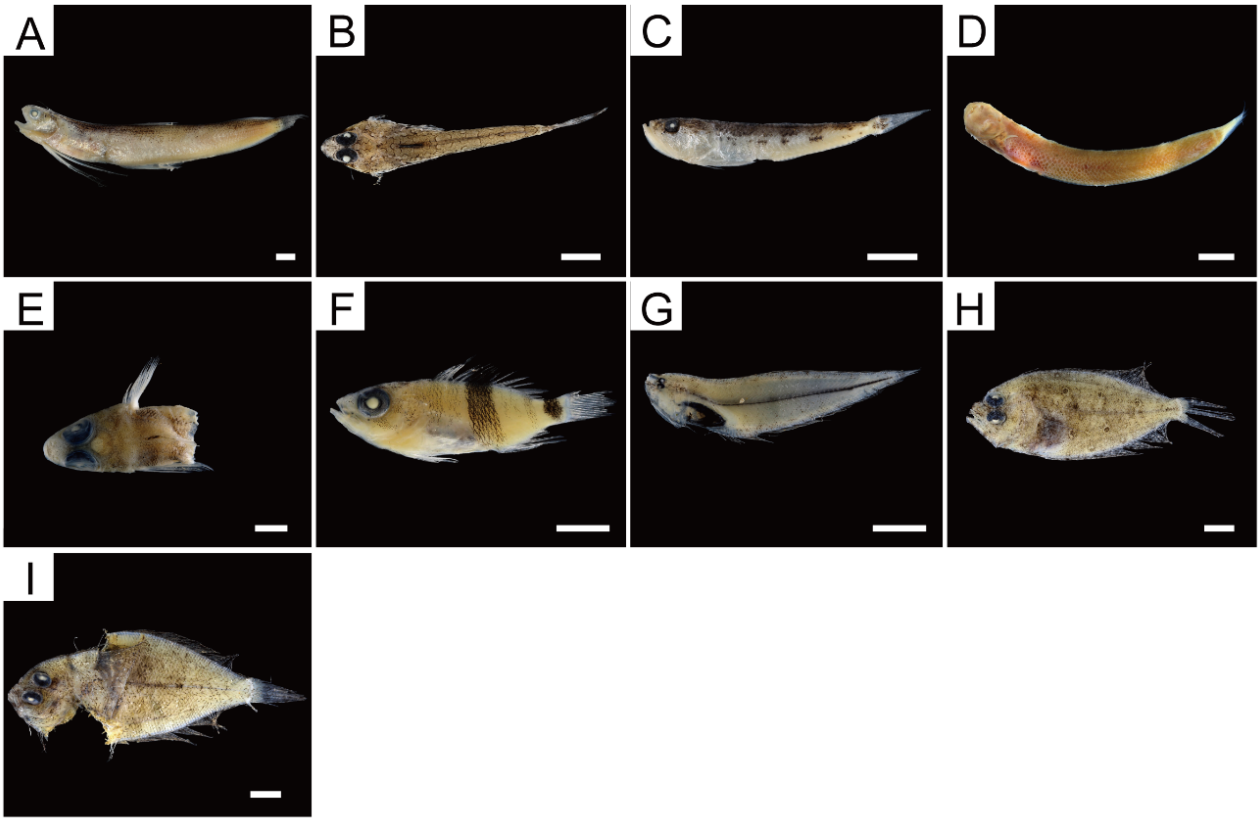

Figure 10. Chordata, Osteichthyes. A. lateral view of *Bregmaceros nectabanus*. B. dorsal view of *Repomucenus virgis*. C. lateral view of *Champsodon snyderi*. D. lateral view of *Paratrypauchen microcephalus*. E. dorsal view of *Parapercis* sp. F. lateral view of *Plectranthias kelloggi azumanus*. G. lateral view of *Symphurus orientalis*. H. lateral view of *Pseudorhombus pentophthalmus*. I. lateral view of *Tarphops elegans*. Scale bars = 5 mm.