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Author(s)	Kubota, Kiyoshi; Mawatari, Shunsuke F.
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A Systematic Study of Cheilostomatous Bryozoans from Oshoro Bay, Hokkaido

1. *Anasca*

Kiyoshi Kubota and Shunsuke F. Mawatari

Department of Systematic Zoology, Division of Environmental
Structure, Graduate School of Environmental Science,
Hokkaido University, Sapporo, 060, Japan

Abstract

Six anascan species, of which two are new to Hokkaido, are described as the first report of a serial study of marine bryozoans from Oshoro Bay, Hokkaido, northern Japan. Measurements and figures are given together with the full description of each species.

Key Words: Anascan Bryozoa, Systematic description, Northern Hokkaido.

1. Introduction

From Busk's Challenger Report (1884), in which three species were described, to a series of comprehensive systematic revision by Mawatari, S. and S. F. Mawatari (1973a, 1973b, 1974, 1979, 1980, 1981, 1984) many papers concerning taxonomic studies of Japanese bryozoans have been published. However, most of these works were made on the materials from southern Japan. On the coast of Hokkaido, northern Japan, only 17 species have so far been fully described and illustrated (Mawatari, S., 1956, 1957), though there are a preliminary list covering 60 species of *Anasca* and 70 species of *Ascophora* (Mawatari S. F. & S. Mawatari, 1981) and a list of 6 Cheilostomata (Motoda *et al.*, 1971).

In order to supplement such lack of information on the northern Japanese bryozoans, we made a faunal survey of cheilostomatous bryozoans in Oshoro Bay, on the coast of Hokkaido. As the first report from this survey, the present paper deals with six anascan species, of which two are new to Hokkaido. Particular efforts were paid to describe and illustrate the wanting characteristics in the previous lists. The photographs with a scanning electron microscope were taken for the

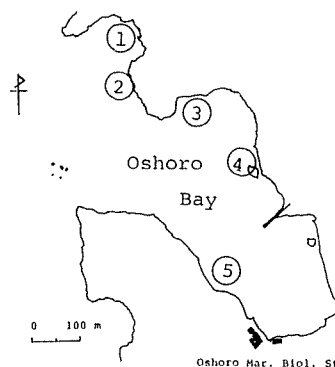


Figure 1. Location of Oshoro Bay (N 43°13', E 140°52'). Collecting sites are indicated by open circles: 1, Uchikabuto, 2, Hefuri-iwa, 3, Shamodomari, 4, Ebisu-Iwa, 5, Shirikoshi.

species with available specimens to get more adequate taxonomic characters.

2. Materials

Bryozoan surveys were made 28 times in total from April, 1982 to September, 1984 at Oshoro Bay (N 43°13', E 140°52'). The data of materials are basically given in the following order: 1) the appearance of colony; 2) the number of colonies examined and, when the species has oocidium, IM: Immatured form without oocidium, or MA: matured form with oocidium; 3) colonial size: short diameter × long diameter (incrusting form), or height × diameter (tuftic form); 4) collecting depth; 5) substratum; 6) collecting site (Figure 1); 7) collecting date; and 8) collector, KK: Kiyoshi Kubota, the first author, or SK: Dr. Shin Kubota (Hokkaido Univ).

3. Description

Order Cheilostomata Busk, 1852
Suborder Anasca Levinsen, 1902
Division Malacostega Levinsen, 1902
Family Membraniporidae Busk, 1854
Genus *Conopeum* Gray, 1848

Conopeum reticulum (Linne, 1767)
(Figure 2)

Millepora reticulum Linne, 1767, p. 1284.

Membranipora reticulum: Blainville, 1830, p. 447; Calvet, 1906, p. 387; Borg, 1931, p. 20, pl. 2, figs. 4, 5.

Conopeum reticulum: Gray, 1848, p. 108; Harmer, 1926, p. 221, pl. 13; Marcus, 1938, p. 13, pl. 2, fig. 5; 1939, p. 127, pl. 6, fig. 7; Osburn, 1950, p. 31, pl. 2, fig. 11; Silén, 1941, p. 18; Mawatari, 1952, p. 262; 1956, p. 115, fig. 1e; 1974, pp. 33-37, fig. 5; Kataoka, 1961, p. 224, pl. 26, fig. 9; Cook & Hayward, 1966, p. 441, fig. 3; Prenant & Bobin, 1966, p. 124, fig. 32; Ryland & Hayward, 1977, p. 60, fig. 20.

Membranipora lacroixii: Busk, 1854, p. 60, pl. 69, figs. 1-5 (nec. pl. 104, fig. 1); Hincks, 1880, p. 129, pl. 17, figs. 5-8; Waters, 1898, p. 656, pl. 48, figs. 14, 15; Robertson, 1908, p. 261, pl. 14, fig. 5; Canu, 1908, p. 251, pl. 1, figs. 8, 9; Canu, 1913, p. 125, pl. 1, figs. 5, 6; Osburn, 1912, p. 227, pl. 26, fig. 28; O'Donoghue & O'Donoghue, 1923, p. 167.

Conopeum lacroixii: Normann, 1903, p. 596; Canu & Bassler, 1920, p. 89, figs. 25, pl. 13, fig. 9; 1923, p. 26, pl. 1, fig. 6; Kirkpatrick & Metzelaar, 1923, p. 986, pl. 1, fig. 8, 10; Livingstone, 1929, p. 50, pl. 2, fig. 10.

Membranipora hippopus: Levinsen, 1909, pp. 144, 146; Annandale, 1915, p. 128.

Material: A circular incrusting colony, 0.4 × 0.4 cm; 2 m, on a stone, Ebisu-Iwa, 14-IV-1983, KK.

Colony prostrate, lace-like, unilaminar, calcified, grayish white in color.

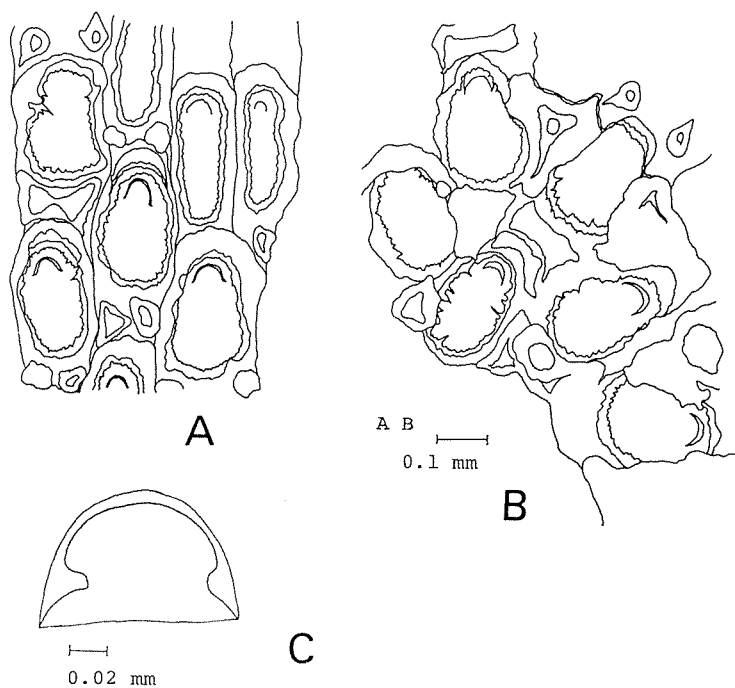


Figure 2. *Conopeum reticulum* (Linne). A, zooids arranged in regular rows; B, irregularly arranged older zooids; C, an operculum.

Zooids elongate oval or elliptical, arranged quincuncially, separated by distinct grooves or chitinous lines. Opesia elongate oval or elliptical, a little widened proximally; mural spines lacking. Operculum semicircular, wider than long, with a thickened margin. Mural rim rather thick and high. Distal mural wall often strongly thickened and raised. Inner margin of the rim roughly denticulated; some of these denticles developing inwards into pointed conical processes. Cryptocyst narrow, remarkably granulated, equally developed all around the opesium. Gymnocyst reduced proximally.

A pair of small triangular kenozooids with triangular or round opesia is usually situated at the distal corners of each ordinary zooid, but sometimes vestigial or wanting. The membranous opesium is sometimes wholly concealed under secondary calcification of the gymnocyst.

Avicularia and oecia wanting.

Polypide with 11 to 12 tentacles.

Rostte plate multiporous, occurring on distal half of each lateral wall.

Measurements :

		average	range	SD	n/N
Zooid	length	0.52 mm	(0.38-0.69)	0.061	50/1
	width	0.30 mm	(0.20-0.40)	0.050	50/1
Opesium	length	0.30 mm	(0.23-0.40)	0.039	50/1
	width	0.22 mm	(0.14-0.31)	0.036	50/1
Tentacles		12	(11-12)	0.408	25/1

Note: Secondary heavy calcification of mural wall results in such features as: 1) strongly serrated inner margin of the rim, 2) obscured boundary of zooids, 3) thickened distal wall raised in a low arch, 4) closed opesium of kenozooids.

Remarks: Many authors described and figured mural spines of *C. reticulum* (Hincks, 1880; Marcus, 1938, 1939; Prenant & Bobin, 1966; Ryland & Hayward, 1977). However, no spines were detected in our specimen as well as Japanese material reported by Mawatari (1974). Further, although Ryland & Hayward (1977) described a single communication pore in the distal septum, the present material lacked such a pore. Instead, our specimen has a pair of rosette plates on distal half of each lateral wall.

Distribution: Great Britain, Mediterranean, Malay Archipelago, Red Sea, Bengal Bay, New Britain Is., Australia, west coast of North America (Alaska to California), Japan.

Other records from Hokkaido: Muroran, Mori, Shirikishinai, Otaru.

Family Electridae Stach, 1937
Genus *Electra* Lamouroux, 1816

Electra tenella (Hincks, 1880)
(Figures 3 and 4)

Membranipora tenella: Hincks, 1880, p. 376, pl. 16, fig. 7.

Electra angulata: Levinsen, 1909, p. 149, pl. 22, fig. 4 a; Harmer, 1926, p. 207, pl. 13, fig. 11; Okada & Mawatari, 1938, p. 449; Sakakura, 1938, p. 717, figs. 1, 2; Mawatari, 1953, p. 5, fig. 1 A; Rao & Ganapati, 1974, p. 220, pls. 1-3.

Electra tenella: Marcus, 1937, P. 38, pl. 7, fig. 15; 1938, p. 67, pl. 15, fig. 37; Osburn, 1940, p. 356; 1947, p. 10; Silén, 1941, p. 18, fig. 14; Mawatari, 1952, p. 268, fig. 2; 1974, p. 42, fig. 7, pl. 3, figs. 3, 4; Soule, 1959, p. 10; Kubanin, 1975, p. 112, fig. 1 b.

Material: Some incrusting colonies, about 2 cm in diameter; 0-2 m, on stones, Ebisu-Iwa, 6-V-1983, KK.

Colony prostrate, filmy, delicate, unilaminar, thinly calcified, pale gray or white in color.

Zooids elongate oblong with angulate distal and a little attenuated proximal portions, arranged in regular quincuncial series, separated by distinct deep grooves. Opesia large, oval, with 6 to 8 pairs of slender mural spines; one or two distal pairs usually erect, the others obliquely overarching the opesia. Mural rim thinly calcified, rising obliquely inwards. Cryptocyst slight, granulated, situated on lateral and proximal inner margins of the mural rim. Gymnocyst developed proximally, occupying about one-quarter of the zooidal length, convex, bearing one or two conspicuous spinous processes directing upwards. Operculum semi-elliptical, wider than long, with thickened margin.

Avicularia and oecia wanting.

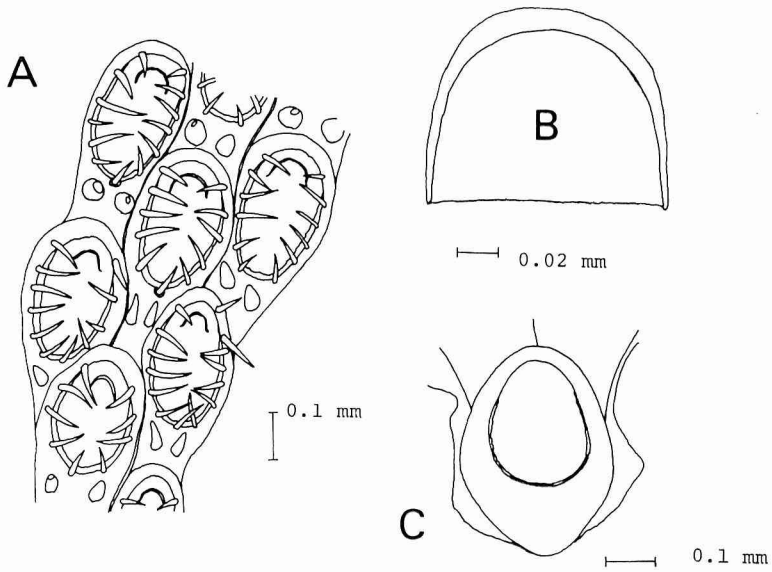


Figure 3. *Electra tenella* (Hincks). A, zooids with one or two spinous processes on their proximal gymnocysts; B, an operculum; C, an ancestrula.

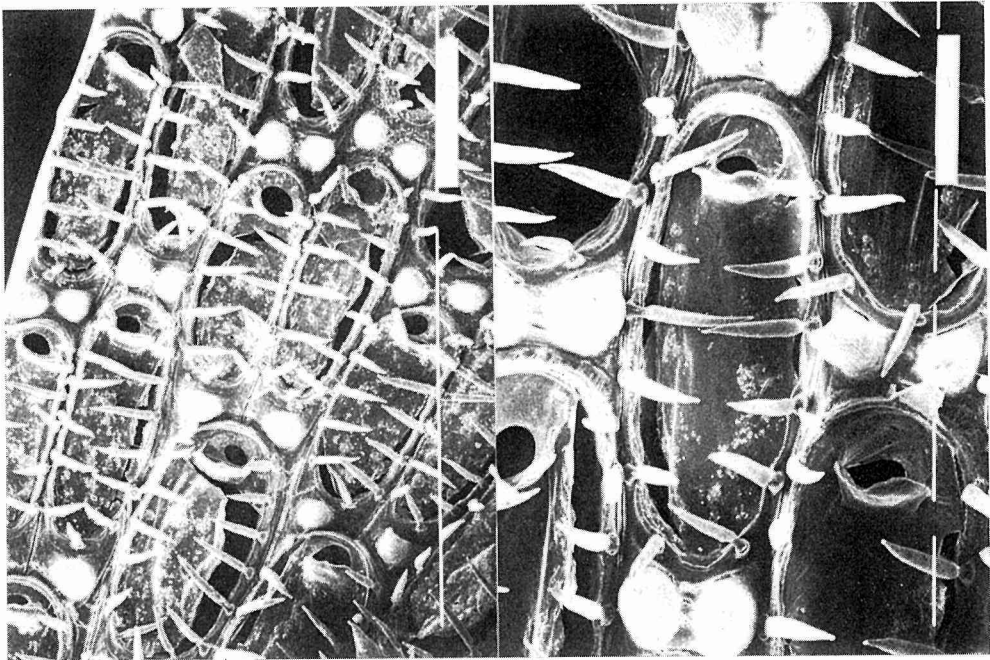


Figure 4. *Electra tenella* (Hincks). A, a portion of a colony showing bifurcation of zooecial row; B, enlarged view of a zooid. White-bars: 100 μ m.

Rosette plates multiporous; 2 along each lateral margin of the basal wall; 2 on distal septum.

Ancestrula rounded hexagonal, with vestigial cryptocyst, lacking spines. Only two primary zooids are budded from an ancestrula.

Measurements:

		average	range	SD	n/N
Zooid	length	0.79 mm	(0.69-0.89)	0.048	34/3
	width	0.27 mm	(0.23-0.36)	0.028	47/3
Opesium	length	0.57 mm	(0.48-0.66)	0.048	34/3
	width	0.21 mm	(0.16-0.28)	0.026	47/3
Operculum	length	0.08 mm	(0.06-0.13)	0.016	33/3
	width	0.12 mm	(0.09-0.16)	0.013	35/3
Spines		14	(12-16)	1.177	30/3
Tentacles		17	(16-18)	0.652	53/2

Remarks: This is the first record of the present species from Hokkaido. Mawatari (1952) reported Japanese forms having zooids with 4 to 5 or 9 to 12 pairs of mural spines, but such variation was not found in our survey. Three spinous processes on a proximal gymnocyst, occasionally recorded in Japanese specimens by Mawatari (1952), also could not be observed in our specimens.

Mawatari, S. F. & S. Mawatari (1981) recorded *E. crustulenta* (Pallas, 1766) and *E. arctica* (Borg, 1931) from Hokkaido. The present species is distinguishable from them in having mural spines and non-calcified operculum.

Distribution: Europe, west coast of North America, Brazil, East Indies, Japan.

Family Hincksinidae Canu & Bassler, 1927

Genus *Cauloramphus* Normann, 1903

Cauloramphus spiniferum (Johnston, 1832)

(Figure 5)

Flustra spinifera Johnston, 1832, p. 266, pl. 9, fig. 6.

Membranipora spinifera: Hincks, 1862, p. 29; 1880, p. 149, pl. 19, figs. 1 a-c; Waters, 1898, p. 659; 1900, p. 61; Robertson, 1900, p. 61; 1908, p. 265, pl. 15, fig. 15; O'Donoghue & O'Donoghue, 1923, p. 168; 1926, p. 39.

Membranipora (Cauloramphus) spinifera: Marcus, 1940, p. 130, fig. 69.

Cauloramphus spinifera: Normann, 1903, p. 588; O'Donoghue & O'Donoghue 1926, p. 85.

Cauloramphus spiniferum: Hastings, 1930, p. 713; Osburn, 1950, p. 55, pl. 5, fig. 9; Androsova, 1958, p. 106, fig. 15; 1971, p. 144; Soule, 1959, p. 13; Bobin & Prenant, 1961, p. 162, fig. 1; Kluge, 1962, p. 295, fig. 179; Prenant & Bobin, 1966, p. 219, fig. 70; Pinter, 1969, p. 205; Kubanin, 1975, p. 112; Hayami, 1975, p. 98, pl. 13, fig. 3; Ryland & Hayward, 1977, p. 98; Mawatari, S. & S. F. Mawatari, 1981, p. 43, fig. 10.

Material: Small incrusting colonies, 2, 0.4 × 0.4, 0.7 × 0.9 cm; 0-2 m, on stones, Shirikoshi, 28-VI-1983, KK.

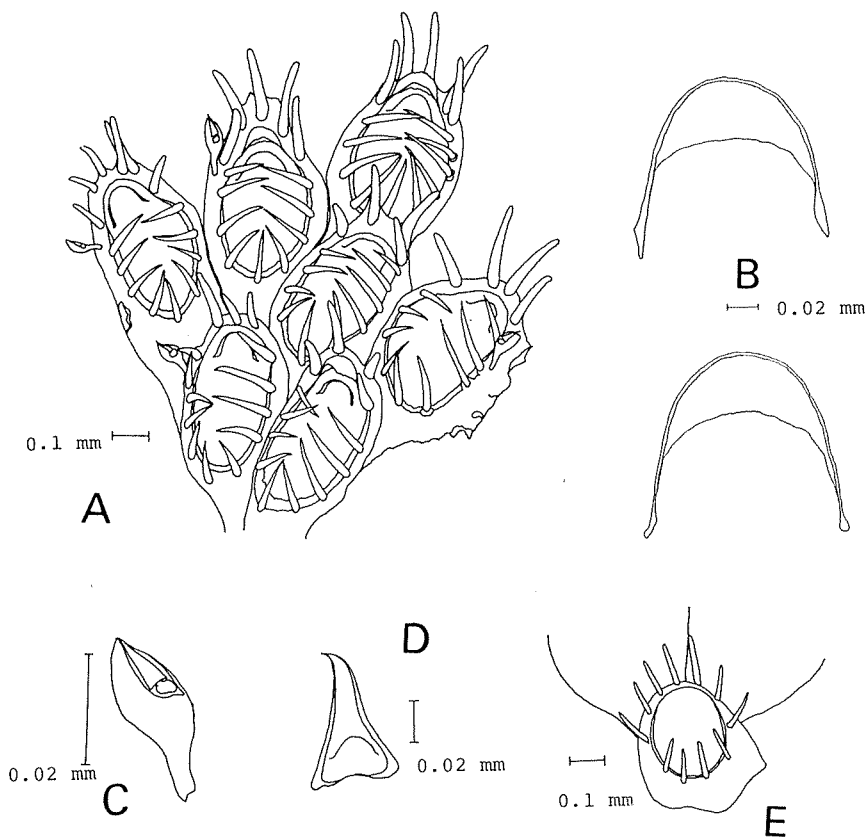


Figure 5. *Cautoramphus spiniferum* (Johnston). A, zooids with pedunculate marginal avicularia and capped oecia; B, two opercula; C, a pedunculate avicularium; D, a mandible with a hooked tip; E, an ancestrula with 11 marginal spines.

Colony prostrate, unilaminar, calcified, brownish white in color.

Zooids elongate oval, usually closely arranged in regular quincuncial series, separated by deep grooves. Opesium large, oval surrounded by 12 to 16 mural spines; 2 to 3 pairs of these spines occur distally, much elongated, stout, with blunt tip, directing distally upwards; other 4 to 5 pairs are situated latero-proximally to the opesium, slender, sharp-pointed, curving inwards to overarch the opesium. Mural rim high, thickened and often granulated. Cryptocyst vestigial or narrow around the opesium. Gymnocyst reduced, thinly calcified and narrow proximally.

Avicularia adventitious, pedunculate, much elongated and slender as long as the spine, carrying an inflated chamber terminally. The avicularia occur between distal and latero-proximal spines of each zooid, somewhat outer of the spines' row. Mandible triangular with a hooked tip, directing upwards.

Ooecium greatly reduced, immersed, obscure, forming only a shallow crescentic cap just distally to the zooid.

Polypide with 14 to 15 tentacles.

Three dietellae occur along each lateral side of the basal wall; other 2 on distal septum.

Ancestrula oval, about a half size of the ordinary zooid, with 12 spines around the opesium.

Remarks: Many authors (i. e. Kluge, 1962; Ryland & Hayward, 1977; Mawatari, S. & S. F. Mawatari, 1981) reported the pedunculate avicularia sometimes being paired, one on each side of the opesium, but such condition was not found in our specimens. Although a previously described Japanese specimen (Mawatari, S. & S. F. Mawatari, 1981, p. 44, figure. 10) has pedunculate avicularia standing in line with the row of mural spines, avicularia of the present specimen occur somewhat outer of the spines' row in the same way as the English material described by Ryland & Hayward (1977, p. 98, figure 41).

The present species is often confused with *C. cymbaeformis* (Hincks, 1877) and *C. disjunctus* (Canu and Bassler, 1929) both of which have been recorded from other regions of Hokkaido (Mawatari, S. & S. F. Mawatari, 1981, Mawatari, S. F. & S. Mawatari, 1981), but is easily distinguishable from them in the arrangement and number of mural spines and the shape of pedunculate avicularia.

Distribution: Cool temperate Atlantic and Pacific Oceans, Barents Sea, White Sea, Panama, Okhotsk Sea, Sea of Japan.

Other records from Hokkaido: Akkeshi, Kushiro, Muroran, Mori, Shirikishinai.

Division Cellularina Smitt, 1868

Family Bugulidae Gray, 1848

Genus *Bugula* Oken, 1815

Bugula neritina (Linne, 1758)

(Figure 6)

Sertularia neritina Linné 1758, p. 38.

Cellularia neritina: Pallas, 1766, p. 67.

Cellaria neritina: Ellis & Solander, 1786, p. 22.

Bugula neritina: Oken, 1815, p. 89; Busk, 1852, p. 44, pl. 43, figs. 1-6; 1884, p.42; Heller, 1867, p. 90; Waters, 1887, p. 91, pl. 4, figs. 3, 15; Carnus, 1889, p. 6; Ortmann 1890, p. 24, pl. 1, fig. 17; Calvet, 1900, p. 121; Robertson, 1905, p. 266, pl. 9, fig. 47, pl. 16, fig. 97; Thornely, 1907, p. 183; Osburn, 1914, p. 186; 1950, p. 154, pl. 23, fig. 3, pl. 24, fig. 3; Yanagi & Okada, 1918, p. 484; Harmer, 1926, pp. 432, 436; Hastings, 1927, p. 334; Okada, 1929, p. 13, pl. 1; Marcus, 1937, p. 67, pl. 13, fig. 34; Okada & Mawatari, 1937, p. 435; 1938, p. 451; Silén, 1941, p. 108; Mawatari, 1951 a, p. 47, text-figs. 1-8; 1952, p. 264; Soule, 1959, p. 39; Ryland, 1960, p. 74, figs. 1 c, 3 a, b, pl. 2 c; 1965, p. 45, text-figs. 23 a, b; Androsova, 1963, p. 42, pl. 2, fig. 8; 1971, p. 145; Prenant & Bobin, 1966, p. 492, figs. 158 (3), 159 (3), 161 (1), 162; Pinter, 1969, p. 206; Kubanin, 1975, p. 114; Ryland & Hayward, 1977, p. 162, fig. 78.

Material: An erect bushy colony 1 MA, 3.0 × 1.0 cm; 1-2 m, on a base rock with *Tricellaria occidentalis*, Hefuri-Owa, 15-V-1983, SK.

Colony weakly calcified, thickly chitinous, forming a bushy luxurious tuft; reddish brown- or purplish brown-colored in life but dark brown in spirits. Branching regular, dichotomous with bifurcation of type 4 or 5, showing a slight spiral growth; in each branch zooids biserial, alternate.

Zooids large, elongate quadrangular, truncate distally, narrow proximally. Each of the two distal corners of opesia wall produced into a short process. Opesium membranous, U-shaped, occupying more than three-fourths of the frontal. No spines present.

Avicularium wanting.

Ooecium conspicuous, globose, smooth, attached to the inner distal corner of the zooid by a short peduncle, and orientated obliquely to the axis of the branch.

Rootlets forming a tuft at the base of the colony.

Polypide with 23 to 24 tentacles.

Ancestrula short, club-shaped, without any process, attached by a widened pedestal-like base. Opesium U-shaped, occupying two-thirds of the frontal. Larva oval, greenish in color.

Remarks: A great number of species have been so far described world wide under the genus *Bugula*, of which the second author (unpublished) has detected up to 13 species from Japanese waters. Among them, the present species is unique in lacking any type of avicularium.

B. dentata (Lamouroux, 1816) and *B. californica* (Robertson, 1905) were recorded by Motoda *et al.* (1971) from Oshoro, though we could not collect them at all. The present species is similar to these two species in dichotomous colony and biserial zooids, but is distinguishable from them in wanting both spines and avicularium, and also in having ooecium attached by a short peduncle.

Distribution: Tropical and temperate waters of the world.

Other records from Hokkaido: Akkeshi, Shirikishinai, Muroran.

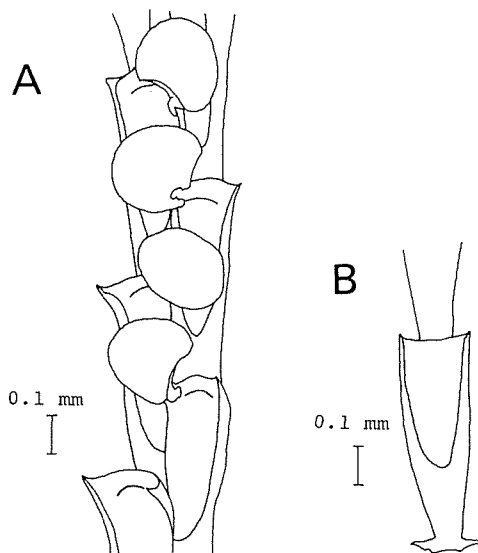


Figure 6. *Begula neritina* (Linne). A, frontal view of a part of an internode showing biserial zooids with pedunculate ooecia; B, an ancestrula.

Family Beaniidae Canu & Bassler, 1927

Genus *Beania* Silén, 1941

Beania vegae Silén, 1941

(Figure 7)

Beania vegae Silén, 1941, p. 97, figs. 125-128.

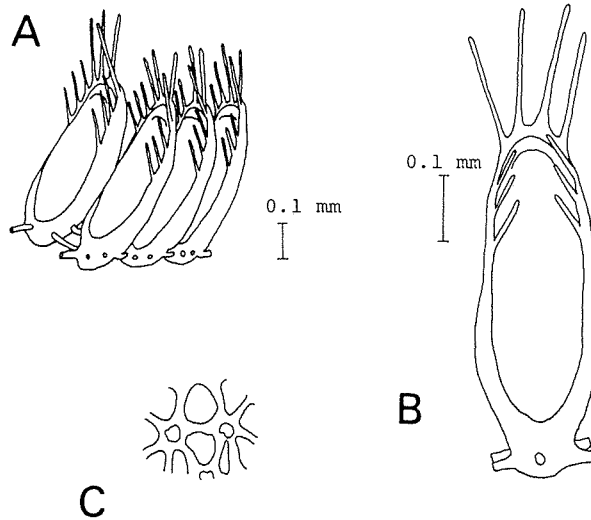


Figure 7. *Beania vegae* Silén. A, erect zooids connected each other with six proximal tubes; B, a zooid in frontal view; C, proximal view of connecting tubes.

Material: A mat-like circular colony, 1.0×1.2 cm; 2 m, on a stone, Ebisu-Iwa, 6-V-1983, KK.

Colony incrusting, unilaminar, forming a mat-like tuft, lightly calcified but thickly chitinous, dark or dull yellow in color. Zooids erect, prolonged oval, attached to the substratum with rounded proximal end, not fused but united with each other by the connecting tubes, arranged densely in quincuncial series. Six short tubes emanate from periphery of the proximal end of a zooid, connecting itself with six neighbouring zooids. A rather long rootlet with a base is often protruded from the proximo-central end of the zooid, also fixing the zooid on the substratum. Dorsal wall strongly convex; frontal side flat, entirely occupied by a membranous opesium. Two to four long, slender, erect spines are protruded from distal end of the zooid. Three pairs of spines, a little shorter and slenderer than the distal spines, surrounding the disto-lateral portion of the opesium, directing obliquely inwards.

Avicularium and oecium wanting.

Polypide bright yellow in color, with 23 to 24 tentacles.

Remarks: This is the first record of the present species from Hokkaido. Silén (1941) originally described the present species with 5 to 8 distal spines, but 2 to 4 in our specimen. He also described lateral spines being curved inwards, but these spines are rather straight in our material.

B. hexaceras (Ortmann, 1890), which has mat-like colonies and zooids with 6 connecting tubes, was reported from Japan. The present species is distinguishable from it by lacking both avicularium and oecium.

Distribution: Japan.

Family Scrupocellaridae Levinsen, 1909

Genus *Tricellaria* Fleming, 1828***Tricellaria occidentalis*** (Trask, 1857)

(Figure 8 and 9)

Menipea occidentalis Trask, 1857, p. 113, pl. 4; Robertson, 1905, p. 254, pl. 6, figs. 22-25; Yanagi & Okada, 1918, p. 409; O'Donoghue & O'Donoghue, 1923, p. 17; Okada & Mawatari, 1936, p. 59; 1937, p. 437.

Menipea compacta: Hincks, 1882, p. 461; Ortmann, 1890, p. 21.

Menipea compacta var. *dilatata*: Ortmann, 1890, p. 21, pl. 1, fig. 2.

Menipea occidentalis catalinensis: Robertson, 1905, p. 255, pl. 6, figs. 26, 27; Yanagi & Okada, 1918, p. 409; Okada, 1929, p. 15, pl. 1, fig. 3; Okada & Mawatari, 1937, p. 437.

Tricellaria occidentalis: Harmer, 1923, p. 353; Silén, 1941, p. 79; Osburn, 1950, p. 122, pl. 13, figs. 6, 7; Mawatari, 1951 b, pp. 9-11, figs. 1, 2; Androsova, 1959, p. 60, pl. 1, fig. 6; Kubanin, 1975, p. 117, fig. 2 d.

Tricellaria occidentalis Var. *dilatata*: Harmer, 1923, p. 352.

Tricellaria occidentalis catalinensis: Osburn, 1950, p. 122, pl. 13, figs. 8, 9.

Material: Compact bushy colonies, 1 MA, 3.0 × 3.5 cm; 1-2 m, on rope of buoys, Shamodomari, 22-IV-1982, KK.—1 MA, 0.8 × 1.3 cm; 0-2 m, on *Sargassum confusum*, Uchikabuto, 7-IV-1983, KK.—2 MA, 2.0 × 3.5, 3.0 × 4.0 cm; 1-2 m, on ropes of buoys, Ebisu-Iwa, 29-V-1983, KK.—1 MA, 1.0 × 1.5 cm; 1-2 m, on a shell of *Mytilus corusius*, Uchikabuto, 22-VII-1983, KK.

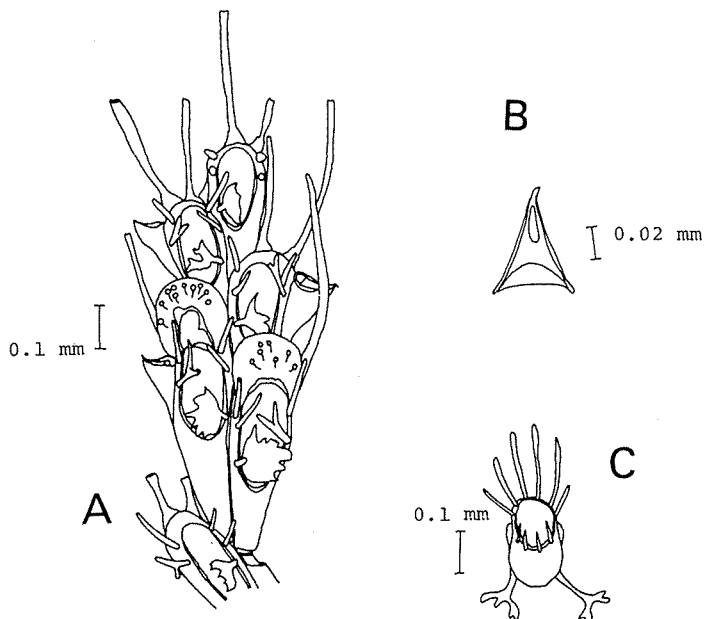


Figure 8. *Tricellaria occidentalis* (Trask). A, zooids in frontal view; B, a mondible; C, an ancestrula supported by two rhizoids.

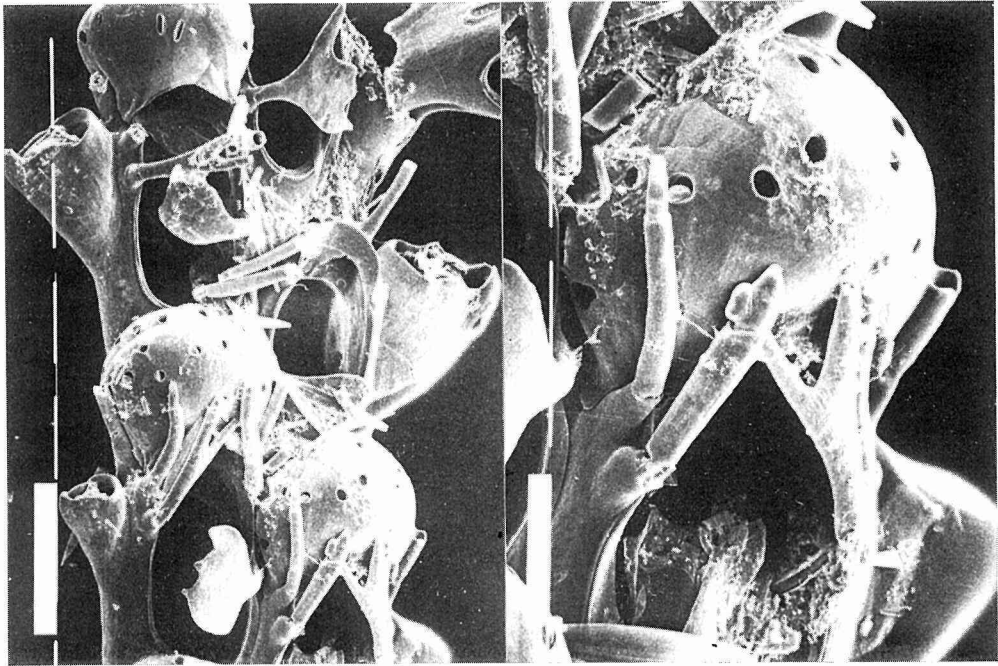


Figure 9. *Tricellaria occidentalis* (Trask). A, a portion of an internode showing a broad flabellate scutum with three tips; B, enlarged view of a mature zooid. White-bars: 100 μ m.

Colony weakly calcified, chitinous, forming a compact bushy tuft, attached by a large number of rootlets; bright brown or grayish white in color. Branching regular, dichotomous; each internode slightly curved and rolled inwards, consisting of three or five biserially arranged zooids. Internodes of the upper part of a colony usually bear larger number of zooids than those of the lower part. Joints chitinous, strong, yellow or brown in color, developing from definite chamber on each side of the most distal zooid within an internode.

Zooids elongate, narrow proximally. Opesia elongate oval or elliptical, occupying about a half or less of the frontal with a narrow cryptocyst. Marginal jointed spines usually 6, rarely 5 or 7; two longer pairs are situated on distal margin of the opesium, directing distally; one shorter pair on the upper half of the opesial margin, extending obliquely over the opesium, often bifurcated. Scutum is arised from the inner lateral gymnocyst, variable in shape all the way from a simple folk to a broad flabellate process with three, four, or more points, often wide enough to cover the lower half of the opesium.

Lateral avicularium large, prominent, sessile, triangular, situated on all the zooids except those at the bifurcation of branches, projecting disto-laterally from the lateral gymnocyst. Mandible triangular with a hooked tip, facing distally. Frontal avicularium wanting.

Ooecium large, hyperstomial, prominent, globose, perforated by a number of small pores.

A number of rootlets occurs on the lower part of a colony; each rootlet emanates from lower half of the root chamber at proximal end of the outer zooids, extending downwards and attaches to a substratum.

Polypide with average of 13 (12-14) tentacles.

Two dietellae along the inner disto-lateral wall of biserial zooids.

Ancestrula elliptical with 9 to 11 marginal spines, of which distal 6 are comparatively longer than the others. Opesium oval, with a narrow cryptocyst, occupies almost whole of the frontal. Two rhizoids arise from the mid-lateral part of the dorsal wall, extending along the dorsal wall downwards and attached to a substratum to support the ancestrula.

Larva oval or pyriform, reddish orange-colored, with a pair of red pigments.

Remarks: Robertson (1905), Yanagi & Okada (1918), Okada (1929), and Mawatari (1951 a) described and illustrated spinous and non-divided feature of the scuta, but such variation was not observed in the present specimens.

The present species is easily distinguishable from the other species of *Tricellaria* (e. g. *T. gracilis* (Busk, 1881) and *T. longispinosa* (Yanagi & Okada, 1918) well-known as closely related to the present species) in wanting frontal avicularium.

Distribution: West coast in North America (British Columbia to southern California), China (Taiwan, Shanton Peninsula), Sakhalin, Japan.

Other records from Hokkaido: Akkeshi, Muroran, Mori, Rishiri, Shirikishinai.

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References

- Androsova, E. I. (1958): Bryozoa of the Order Cheilostomata from the northern part of the Sea of Japan. *Issled. Dal'nevost. Mor. SSSR*, 5: 90-204.
- Androsova, E. I. (1959): Nekotorie dannie po fauna Mschanok (Bryozoa) Shel'togo Morya. *Trud. sovmest. Kitaisk. Sovyet. mor. biolog. Eksped.*, 3: 41-70.
- Androsova, E. I. (1963): Bryozoa from South China Sea. *Studia Marina Sinica*, 4: 21-47.
- Androsova, E. I. (1971): Bryozoa of the Possjet Bay of the Sea of Japan. *Issled. Fauna Mor. SSSR*, 8(16): 144-150.
- Annandale, N. (1915): Fauna of Chilka Lake. The Polyzoa of the lake and of brackish water in the Gangetic delta. *Mem. Ind. Mus.*, 5: 127-132.
- Blainville, H. M. de (1930): Zoophytes. *Dictionnaire Sci. Nat.*, 60: 1-631.
- Bobin, G. & M. Prenant (1961): Remerques sur certaines "Hincksinidae", Alderinidae et Flustridae (Bryozoaaires, Cheilostomes). *Cah. Biol. Mar.*, 2: 161-175.

- Borg, L. A. G. (1931): On some species of *Membranipora*. *Ark Zool.*, **22A**(4): 1-35.
- Busk, G. (1852): *Catalogue of marine Polyzoa in the collection of the British Museum*, Part 1. 1-54. London.
- Busk, G. (1854): *Ditto*. Part 2. 55-120. London.
- Busk, G. (1884): Report on the Polyzoa collected by H. M. S. Challenger during the years 1873-1876. Part 1. *Rep. Voy. Challenger, Zool.* **10**(30): 1-216.
- Calvet, L. (1900): Contribution a l'Historie Naturelle des Bryozoaires Ectopoctes marins. *Trans. Inst. Zool. Univ. Montpellier, N.S.*, **8**: 1-488.
- Calvet, L. (1906): Note preliminaire sur les Bryozoaires recoltés par les expeditions du Travailleur et du Talisman. *Bull. Mus. Hist. Nat.*, **3**: 355-495.
- Canu, F. (1908): Iconographie des Bryozoaires foosiles des l'Argentine. *Ann. Mus. Nac. Buenos Aires*, **17**(10): 245-341.
- Canu, F. (1913): Contribution a l'etude des Bryozoaires fossiles. *Bull. Soc. Geol. France*, **4**(13): 124-131.
- Canu, F. & R. S. Bassler (1920): North American early tertiary and quaternary Bryozoa. *Bull. U. S. Nat. Mus.*, **106**: 1-879.
- Canu, F. & R. S. Bassler (1923): North American later tertiary and quaternary Bryozoa. *Ibid.*, **125**: 1-302.
- Canu, F. & R. S. Bassler (1927): Classification of the Cheilostomatous Bryozoa. *Proc. U. S. Nat. Mus.*, **69**(14): 1-42.
- Canu, F. & R. S. Bassler (1929): Bryozoa of the Philippine region. *U. S. Nat. Mus. Bull.*, **100**(9): 1-568.
- Carnus, J. F. (1889): Brachiostomata (Molluscoidea). Bryozoa (Polyzoa). *Prodr. Faunae Mediterraneae*, **2**(1): 1-54.
- Cook, P. L. & P. J. Hayward (1966): The development of *Conopeum seurati* (Canu) and some other species of membraniporine Polyzoa. *Cah. Biol. Mar.*, **7**: 437-443.
- Ellis, J. & D. Solander (1786): *The natural history of Zoophytes*. 1-208. London.
- Fleming, J. (1828): *A history of British animals*. 1-256. Edinburgh.
- Gray, J. E. (1848): *List of the specimens of British animals in the collection of the British Museum. 1. Centroniae or Radiated Animals*. 1-173. London.
- Harmer, S. F. (1923): On Cellarina and other Polyzoa. *J. Linn. Soc. Zool.*, **35**: 293-361.
- Harmer, S. F. (1926): The Polyzoa of the Siboga Expedition, Part 2. Cheilostomata, Anasca. *Siboga Exped.*, **28b**: 181-501.
- Hastings, A. B. (1927): Report on the Polyzoa. *Trans. Zool. Soc. London*, **22**: 331-353.
- Hastings, A. B. (1930): Cheilostomatous Polyzoa from the vicinity of the Panama Canal collected by Dr. C. Crossland on the cruise of the S. Y. St. George. *Proc. Zool. Soc., London*, **47**(4): 697-740.
- Hayami, T. (1975): Neogene Bryozoa from Northern Japan. *Sci. Rep. Tohoku Univ. ser. 2, Geol.*, **45**(2): 83-126.
- Heller, C. (1867): Bryozoen des Adriatischen Meers. *Verhandl. Zool. Bot. Ges. Wien*, **17**: 77-136.
- Hincks, T. (1862): A catalogue of the Zoophytes of South Devon and south Cornwall. *Ann. Mag. Nat. Hist., Ser. 3*, **9**: 22-30, 200-207, 303-310 and 467-475.
- Hincks, T. (1877): On British Polyzoa. *Ann. Mag. Nat. Hist., ser. 4*, **20**: 212-218 and 520-532.
- Hincks, T. (1880): *A History of the British Marine Polyzoa*. vol. **1** & **2**, 1-601. London.
- Hincks, T. (1882): Report on the Polyzoa of the Queen Charlotte Islands. 1. *Ann. Mag. Nat. Hist. ser. 5*, **10**. 248-256 and 459-471.
- Johnston, G. (1832): A descriptive catalogue of the recent zoophytes found on the coast of north Durhan. *Trans. Nat. Hist. Soc. Newcastle*, **2**: 239-272.
- Kataoka, J. (1961): Bryozoan fauna from the "Ryukyu Limestone" of Kikai-jima, Kagoshima

- Prefecture, Japan. *Sci. Rep. Tohoku Univ. Geol.*, **32**(2): 213-272.
- Kirkpatrick, R. & J. Metzelaar (1923): On an instance of commensalism between a hermit crab and a Polyzoan. *Proc. Zool. Soc. London*, **1922**: 983-990.
- Kluge, G. A. (1962): Bryozoa of the northern seas of the U. S. S. R.. *Opred Faune SSSR*, **76**: 1-584.
- Kubanin, A. A. (1975): Cheilostomata (Bryozoa) from the Peter the Great Bay. *Sbornik Rab. Inst. Biol. Morya*, **3**: 108-136.
- Lamouroux, J. V. (1816): *Histoire des Polypiers Coralligenes flexibles, vulgairement nommes Zoophytes*. 1-556. Caen.
- Levinsen, G. M. R. (1909): *Morphological and systematic studies on cheilostomatous Bryozoa*. 1-431. Copenhagen.
- Linne, C. (1758): *Systema Naturae*, Vol. 1. Holmiae, Zoophyta. Ed, 10, 799-821.
- Linne, C. (1767): Ditto. Ed. 12. 1278-1327.
- Livingstone, A. A. (1927): Studies on Australian Bryozoa. *Rec. Austr. Mus. Sydney*, **16**(1): 50-69.
- Livingstone, A. A. (1929): Bryozoa Cheilostomata from New Zealand. Papers from Dr. Mortensen's Pacific Expedition, 1914-1916. *Vidensk. Medd. fra Dansk. naturh. Foren.*, **87**: 45-104.
- Marcus, E. (1937): Bryozoarios marinhos Brasileiros I. *Biol. Fac. Philos. Sci. Univ. S. Paulo Zool.*, **1**: 3-224.
- Marcus, E. (1938): Ditto. II. *Ibid.*, **2**: 1-196.
- Marcus, E. (1939): Ditto. III. *Ibid.*, **3**: 111-353.
- Marcus, E. (1940): Mosdyr (Bryozoa eller Polyzoa.) *Danmarks Fauna, Kjbenhavn*, **46**: 1-401.
- Mawatari, S. (1951 a): The natural history of a common fouling bryozoan, *Bugula neritina* (Linnaeus). *Misc. Rep. Res. Inst. Natur. Resources*, **19-21**: 47-54.
- Mawatari, S. (1951 b): On *Tricellaria occidentalis* (Trask), one of the fouling Bryozoans in Japan. *Ibid.*, **22**: 9-16.
- Mawatari, S. (1952): Bryozoa of Kii Peninsula. *Publ. Seto Mar. Biol. Lab.*, **2**(2): 261-288.
- Mawatari, S. (1953): On *Electra angulata* Levinsen, one of the fouling Bryozoans in Japan. *Misc. Rep. Res. Inst. Natur. Resources.*, **32**: 5-11.
- Mawatari, S. (1956): Cheilostomatous Bryozoa from the Kurile Islands and the neighbouring districts. *Pacif. Sci.*, **10**: 113-135.
- Mawatari, S. (1957): On two bryozoans from Hokkaido. *Jour. Fac. Sci. Hokkaido Univ. Ser. IV, Zool.*, **13**: 78-84.
- Mawatari, S. (1973 a): Studies on Japanese Anascan Bryozoa. 1. Inovicellata. *Bull. Nation. Sci. Mus.*, **16**(3): 409-428.
- Mawatari, S. (1973 b): Ditto. 2. Division Scrupariina *Ibid.*, **16**(4): 605-624.
- Mawatari, S. (1974): Ditto. 3. Division Malacostega (1). *Ibid.*, **17**(1): 17-52.
- Mawatari, S. & S. F. Mawatari(1979): Ditto. 4. Division Malacostega (2). *Bull. Lib. Arts & Sci. Course, Sch. Med. Nihon Univ.*, **7**: 11-53.
- Mawatari, S. & S. F. Mawatari (1980): Ditto. 5. Division Malacostega (3). *Ibid.*, **8**: 21-114.
- Mawatari, S. & S. F. Mawatari (1981): Ditto. 6. Division Malacostega (4). *Ibid.*, **9**: 23-61.
- Mawatari, S. F. & S. Mawatari (1981): A preliminary list of cheilostomatous bryozoans collected along the coast of Hokkaido. *Proc. Jap. Soc. Syst. Zool.*, **21**: 41-58.
- Mawatari, S. F. & S. Mawatari (1984): Studies on Japanese anascan Bryozoa. 7. Division Malacostega (5). *Environ. Sci. Hokkaido*, **7**(1): 109-120.
- Motoda, I. et al. (1971): Oshoro Marine Biological Station. *Bull. Plankton Soc. Japan*, **18**(1): 32-94.
- Norman, A. M. (1903): Notes on the natural history of East Finmark. *Tromso Mus. Aarsh.*, ser. **7**, **11**: 567-598.

- O'Donoghue, C. H. & E. O'Donoghue (1923): A preliminary list of Bryozoa (Polyzoa) from the Vancouver Island Region. *Contr. Canad. Biol. Fish. N. S.*, **1**(10): 143-201.
- O'Donoghue, C. H. & E. O'Donoghue (1926): A second list of the Bryozoa (polyzoa) from the Vancouver Island Region. *Contr. Canad. Biol. Tronto, N. S.*, **3**(3): 49-131.
- Okada, Y. (1929): Report of the biological survey of Mutsu Bay. 12. Cheilostomatous Bryozoa of Mutsu Bay. *Sci. Rep. Tohoku Univ. Biol.*, **4**(1): 11-35.
- Okada, Y. & S. Mawatari (1937): On the collection of Bryozoa along the coast of Onagawa Bay and its vicinity, northern part of Honshu, Japan. *Sci. Rep. Tohoku Imp. Univ.*, **4**(11): 433-445.
- Okada, Y. & S. Mawatari (1938): On the collection of Bryozoa along the coast of Wakayama-ken, the middle part of the Honshu, Japan. *Annot. Zool. Japon.* **17**(3, 4): 445-462.
- Oken, L. (1815): *Lehrbuch der Naturgeschichte, 3. Teil, Zoologie, 1 Abth., Fleischlose Tiere.* 1-842. Leipzig.
- Ortmann, A. (1890): Die Japanische Bryozoen Fauna. *Arch. Naturg.*, **66**(1): 1-74.
- Osburn, R. C. (1912): The Bryozoa of the Woods Hole Region. *Bull. Bur. Fish.*, **30**(760): 203-266.
- Osburn, R. C. (1914): The Bryozoa of the Tortugas Islands, Florida. *Publ. Carneg. Inst. Wash.*, **182**: 181-122.
- Osburn, R. C. (1940): Bryozoa of Porto Rico with a Resume of the West Indian Bryozoan Fauna. *Sci. Surv. Porto Rico and Virgin Is.*, **16**(3): 321-486.
- Osburn, R. C. (1947): Bryozoa of the Allan Hancock Atlantic Expedition 1939. *Rep. Allan Hancock Atlantic Exped.*, **5**: 1-65.
- Osburn, R. C. (1950): Bryozoa of the Pacific Coast of America. Part 1. Cheilostomata Anasca. *Allan Hancock Pacific Exp.*, **14**(1): 1-269.
- Pallas, P. S. (1966): *Elenchus Zoophytorum sistens generum Adumbrationes generaliores et specierum cognitarum succinctas descriptions cum selectis auctorum synonymis.* 1-451.
- Pinter, P. (1969): Bryozoan-algal associations in Southern California Waters. *Bull. S. Calif. Acad. Sci.*, **68**(4): 199-218.
- Prenant, M. & G. Bobin (1966): Bryozoaires, cheilostomes Anasca. *Faune de France*, **68**: 1-647.
- Rao, K. S. & P. N. Ganapati (1974): On the common anascan genus *Electra* from Visakhapatnam and its vicinity. *Proc. Indian natn. Sci. Acad. ser. B*, **38**(3, 4): 220-223.
- Robertson, A. (1900): The Bryozoa. Papers from the Harriman Alska Exped. *Proc. Wash. Acad. Sci.*, **2**: 315-340.
- Robertson, A. (1905): Non-incrusting cheilostomatous Bryozoa of the west coast of North America. *Univ. Calif. Publ. Zool.*, **2**(5): 235-322.
- Robertson, A. (1908): The incrusting cheilostomatous Bryozoa of the west coast of North America. *Ibid.*, **4**(5): 253-344.
- Ryland, J. S. (1960): British species of *Bugula* (Polyzoa). *Proc. zool. Soc. Lond.*, **134**(1): 65-105.
- Ryland, J. S. (1965): Polyzoa. *Catalogue of main marine fouling organisms.* **2**: 1-82. O. E. C. D., Paris.
- Ryland, J. S. & P. J. Hayward (1977): British anascan bryozoans. *Synopses of the British Fauna n. s.*, **10**: 1-188.
- Sakakura, K. (1938): Bryozoaires pleistocene aux environs de Takomati, Prefecture de Tiba. *Trans. Pal. Soc. Japan in J. Geol. Soc. Japan*, **45**(540): 717-722.
- Silén, L. (1941): Cheilostomata Anasca, collected by Prof. Dr. Sixteen Bock's Expedition to Japan and the Bonin Islands, 1914. *Ark. Zool.*, **34**(12): 1-130.
- Smitt, F. A. (1868): Kritisk forteching ofver Skandinaviens Hafs-Bryozoer, III. *Ofvers Kgl. Vetensk. Akad. Forh.*, **24**: 279-429.
- Soule, J. D. (1959): Results of the Purit-American Museum of Natural History Expedition to Western Mexico. 6. Anascan Cheilostoma (Bryozoa) of the Gulf of California. *Amer. Mus.*

- Novit.*, 1969: 1-54.
- Stach, L. W. (1937): The application of the Bryozoa in Cainozoic stratigraphy. *Rep. Austr. New Zealand Assoc. Adv. Sci.*, 23: 80-83.
- Thornely, L. R. (1907): Report on the Marine Polyzoa in the collection of the Indian Museum. *Rec. Ind. Mus. Calcutta*, 1: 179-196.
- Trask, J. B. (1857): On some new microscopic Organisms. *Proc. Calif. Acad. Sci.*, 1-2: 99-102.
- Waters, A. W. (1887): Bryozoa from New South Wales, North Australia, etc. Pt. 2. *Ann. Mag. Nat. Hist.*, 5(20): 181-203.
- Waters, A. W. (1898): Observation on Membraniporidae. *J. Linn. Soc. Zool. London*, 26: 654-693.
- Waters, A. W. (1900): Bryozoa from Franz Josef Land, collected by the Jakson-Harmsworth Expedition, 1896-1897: Part I. Cheilostomata. *Ibid.*, 28: 43-105.
- Yanagi, N. & Y. Okada (1918): On a collection of Japanese cheilostomatous Bryozoa. I. *Annot. Zool. Japon.*, 9(2): 409-429.

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