Korean J. Syst. Zool. Vol. 24, No. 3: 251-263, November 2008

Taxonomy of Black Coral Family Myriopathidae (Anthozoa: Antipatharia) from Korea

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ABSTRACT

Eight species and four genera belonging to two families of antipatharians have been reported in Korea. In the present study, the major specimens were collected from the coastal areas of Jejudo Island from 2005 to 2006, and the other ones which have been deposited in the Natural History Museum and the Department of Life Science, Ewha Womans University during the period from 1965 to 2004 were reexamined. As a result of this work, four species, *Myriopathes bifaria*, *M. stechowi*, *M. ulex* and *Plumapathes pennacea* are new to Korean antipatharian fauna. In this study, total six species including previously recorded species of the family Myriopathidae were described. And the distribution range of *Myriopathes lata* was turned out to be expanded from southwestern sea to the eastern sea, up to Ulleungdo Is. of Korea. Especially, the sexuality and the gonadal stage of *M. lata* which are collected during their reproduction period were also determined by means of histological analysis.

Key words: taxonomy, Myriopathidae, Antipatharia, Anthozoa, Korea

INTRODUCTION

The classification of black corals has been complicated for many years by the description of numerous species from incomplete specimens and by the lack of a clearly defined taxonomic hierarchy of genus and family levels. The major taxonomic revision grouped all species into a single family Antipathidae (van Pesch, 1914). However, the revisionary works of Opresko (2001, 2002, 2003, 2004, 2005, 2006) offered the current classification including 235 species, 40 genera, seven subfamilies and seven families. The families are mainly separated on the basis of internal and external characteristics of the polyps and the shape, arrangement and development of the axial spines.

Even though many earlier studies dealt with the antipatharian fauna of the North Pacific (Brook, 1889; Silberfeld, 1909b; van Pesch, 1914; Pax, 1932), a surprisingly large number of undescribed forms have only recently been discovered. This has been mainly due to an increased interest in deep-water corals (Opresko, 2005).

On the Korean antipatharians, Kamita and Sato (1941) recorded only one species, *Antipathes japonica*, and Song (1987) added two species, *A. lata* and *Cirripathes anguina*. In addition, five species *Antipathes densa*, *A. grandiflora*, *A. dubia*, *Cirripathes spiralis* and *Stichopathes filiformis* were reported in earlier papers (Moon and Song, 2005, 2008).

In the present study, four species within the family Myriopathidae are turned out to be new to Korean fauna. They were described with figures including the colonial external features and microscopic skeletal features. Also, a key to the species of family Myriopathidae is presented.

MATERIALS AND METHODS

For the taxonomic study of antipatharians, specimens were collected from the rocky areas of Jejudo Island and Ulleungdo Island by SCUBA diving during the period from 2003 to 2006 (Fig. 1). They were first preserved in 4-5% seawater buffered formalin after anesthetization with menthol and then transferred to 70% ethanol, and deposited in the Natural History Museum and Department of Life Sciences, Ewha Womans University.

The specimens were identified on the basis of morphological characters under the light and stereo microscopes. Their examination was especially focused on the growth form and branching mode of corallums, the size and arrangement of polyps and spines on the axis. Especially, the distance between spines was measured between the centers of the bases of adjacent spines of the same longitudinal row, and also the height of a single spine was measured from the apex to the center of base.

To determine the sexuality and the gonadal stage of *Myriopathes lata*, the specimens were decalcified in the 10%

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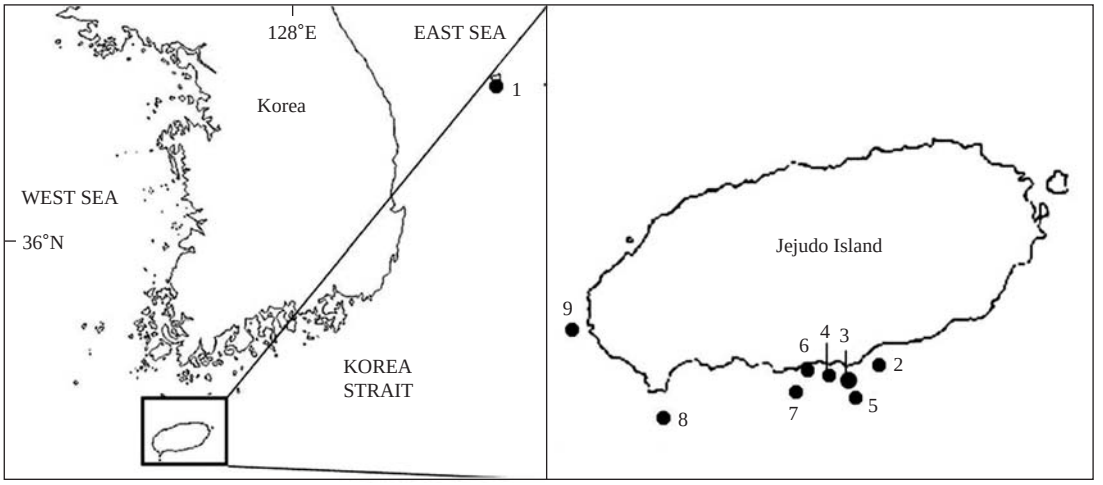

Fig. 1. The sampling sites of antipatharians. 1, Ulleungdo Is.; 2, Seopseom; 3, Breakwater of Seogwipo; 4, Saeseom; 5, Munseom; 6, Oedolgae; 7, Bumseom; 8, Gapado; 9, Chagwido.

EDTA solution for 5 days. The materials were dehydrated in a graded series of ethanol, cleared in ethanol-xylene mixtures and then embedded in paraffin. Serial histological sections (5 μm thick) were cut and stained with Harris hematoxylin and eosin Y (Hwang, 2005). Transverse and longitudinal sections were examined under a light microscope (Olympus BH2). Gonadal stages were recognized on the basis of the maturity stages of *Antipathes fiordensis* (Parker, 1997).

SYSTEMATIC ACCOUNTS

Phylum Cnidaria Hatschek, 1888
Class Anthozoa Ehrenberg, 1834
Order Antipatharia Milne Edwards and Haime, 1857
Family Myriopathidae Opresko, 2001

Diagnosis. Corallum monopodial or branched, branching irregular of pseudodichotomous. Stem and branches usually pinnulate to varying degrees of regularity. Primary pinnules simple or subpinnulate. Pinnular spines relatively large (maximum height of polypar spines at least two times width along base), acute, conical or slightly compressed and blade -like, smooth or papillose. Polypar spines generally larger than abpolypar spines. Spines increasing in density on larger branches and stem, becoming acicular and often forked or dendritic. Polyps 0.5-1.0 mm (usually 0.6-0.8 mm) in transverse diameter, with distinct interpolypar space 0.2-0.4 mm in width (in preserved material). Tentacles short with rounded apex.

Key to the genera of family Myriopathidae

1. Pinnules, branchlets simple and pinnules in two regular rows ····· *Plumapathes*
2. Pinnules subpinnulate, primary pinnules in two rows ····· *Myriopathes*

Genus *Myriopathes* Opresko, 2001

Diagnosis. Corallum flabellate or bushy. Stem and branches pinnulate to second order or more. Primary pinnules arranged bilaterally and alternately in two lateral or anterolateral rows. Secondary pinnules uniserially at base of primary pinnules, becoming biserial distally. Uniserial secondary pinnules usually projecting out of plane formed by biserial primary pinnules. When present, tertiary pinnules developing on secondary pinnules closet to base of primary pinnule.

Key to the species of genus *Myriopathes*

1. Colony flabellate ····· 2
   Colony bushy ····· 3
2. Branches and branchlets straight with slender pinnules (less than 0.10 mm) ····· *M. stechowi*
   Branches and branchlets inclined distally with thick pinnules as branchlet (more than 0.15 mm) ····· *M. ulex*
3. Stem branched in all directions with long branchlets (mostly 4.8-6.6 cm) ····· *M. bifaria*
   Stem branched in one plane with pinnulate branchlets ····· 4
4. Branchlets with interior angle of 160-180° ····· *M. japonica*
   Branchlets with narrow interior angle of 10-45° ····· *M. lata*

Fig. 2. *Myriopathes bifaria*. A, corallum; B, view of branchlets with pinnules; C, polyps on pinnules; D, spines on branches; E, spines on branchlets; F, spines on pinnules. Scale bars=5 cm (A), 5 mm (B), 0.1 mm (C-F).

[1]***Myriopathes bifaria* (Brook, 1889) (Fig. 2A-F)**

Antipathes bifaria Brook, 1889, p. 169, pl. 11, fig. 20; Silberfeld, 1909b, p. 22, pl. 2, fig. 1; Pax, 1932, p. 407; Opresko, 1974, p. 20; 1999, p. 146.

Antipathes lata Song, 1987, p. 68, pl. 3, figs. 1-6, text-fig. 2 (in part).

Myriopathes bifaria Opresko, 2001, p. 351, fig. 6.

Material examined. 1 ind. Seogwipo, 15 Dec. 1969 (B.J. Rho); 1 ind. Munseom, 22 May 1982 (J.I. Song); 1 ind. Munseom, 13 Jul. 1985 (J.I. Song), 20 m deep; 3 inds. Munseom, 6 Nov. 2005 (H.W. Moon), 17-21 m deep; 2 inds. Munseom, 18 Jan. 2006 (H.W. Moon), 22-27 m deep; 1 ind. Munseom, 2 Feb. 2006 (H.W. Moon), 14 m deep; 2 inds. Munseom, 4 Mar. 2006 (H.W. Moon), 8-10 m deep; 1 ind. Munseom, 12 Jun. 2006 (H.W. Moon), 16 m deep; 1 ind. Munseom, 25 Jul. 2006 (H.W. Moon), 9 m deep; 1 ind. Bumseom, 22 Aug. 2006 (H.W. Moon), 15 m deep.

Description. Largest colony about 143 cm high, 120 cm wide, densely and irregularly branched to 6th order or more, in thick plane. Stem thick and sinuous with strong branches. Branches irregularly curved or sinuous, spaced varied distance apart. Branchlets usually 4.8-6.6 cm in length, and inclined inside of branch because pinnules not occurred at distal part of branchlets. Pinnules about 0.6-1.7 cm in length, arranged uniserially to bilaterally on branches and branchlets, and spaced 2.0-2.5 mm apart in each lateral row. Pinnules directed distally, distal angle commonly about 25-48°, interior angle formed by two pinnulate rows 30-60°, increased in terms of increasing length and thickness of branchlets and tend to decreased in length at distal of branchlets. Subpinnules, 4-7 mm in length, one to two in number and restricted to middle of longest pinnules.

Spines acicular, slender with acute apex, arranged in 8-10 longitudinal rows. On branchlets 0.18-0.30 mm in diameter, unequal in size around circumference of axis. Polypar spines 0.10-0.15 (maximum about 0.20 mm) × 0.04-0.05 mm (as measured from middle of base to apex), acicular, acute, irregular in shape and abpolypar spines 0.10-0.11 × 0.05-0.08 mm, and their distal edge blunt, relatively uniform in size. On pinnules 0.13-0.16 mm in diameter, polypar spines 0.07-0.13 × 0.04-0.05 mm, and abpolypar spines 0.09-0.10 × 0.04-0.05 mm, sometimes bifurcated. On subpinnules 0.09-0.10 mm in diameter, spines 0.06-0.10 × 0.04-0.05 mm. Spines increased in size with increasing thickness of axis. Mutual distance between adjacent spines in one row, 0.10-0.15 mm (average about 0.14 mm), and angle of spines 40-70°.

Polyps arranged in single row on one side of branches, usually with 10-11/cm. polyps 0.7-1.0 mm in transverse diameter and interpolypar space 0.1-1.0 mm. On largest branches, polyps less crowded, and arranged less uniformly than those on branchlets. Most of polyps arranged in regular size but small polyps sometimes occurring between larger ones. Tentacles in preserved state, 0.30 mm in length, sagittal tentacles lower than laterals and more slender at distal apex. Oral cone 0.45-0.50 mm in diameter, prominent and slightly elongated along sagittal axis.

Color. Axis black, base dark brown and polyps vivid yellow.

Habitat. Several colonies less than 0.5 m in height inhabited on a vertical wall of rock within 10 m in depth. Larger colonies over than 1 m in height also occurred on relatively flat area of vertical wall of rock at 20 m deep. This species were distributed more shallow water 10-24 m than other most Korean antipatharians living at 15-30 m deep. Most of them associated with ectosymbionts, and copepods.

Remarks. This species inhabits at shallow water around the submarine service area. So, the turbid water conditions in this location also result in decreased light penetration and this, in turn, allows for the settlement of the antipatharian planulae in shallower water than normal (Opresko and Sănchez, 1997).

Among the specimens which were identified as *Antipathes lata* Silberfeld, 1909 recorded by Song (1987), some were re-identified as a new to Korean fauna, *Myriopathes bifaria* (Brook, 1889) (Table 1).

Distribution. Korea (Jejudo Is.), Japan (Sagami Bay), China, Taiwan.

***Myriopathes lata* (Silberfeld, 1909)**

Antipathes lata Silberfeld, 1909a, p. 761; 1909b, p. 22, pl. 2, fig. 2; van Pesch, 1914, p. 7; Pax, 1932, p. 407; Opresko, 1974, p. 24; 1999, p. 146; Song, 1987, p. 68, pl. 3, figs. 1-6; 1992, p. 270; 2000, p. 318; Song and Lee, 1998, p. 239.

Myriopathes lata Opresko, 2001, p. 349.

Previous record. Jejudo Is. (Munseom, Seogwipo, Seopseom, Moseulpo, Gapado), Geomundo Is., Hongdo Is. (Song, 1987).

Material examined. 1 ind. Seogwipo, 11 Jul. 1965 (B.J. Rho); 1 ind. Munseom, 3 Dec. 1978 (J.I. Song), 30 m deep; 1 ind. Gapado, 6 Jun. 1985 (B.J. Rho); 1 ind. Munseom, 13 Jul. 1985 (J.I. Song), 20 m deep; 1 ind. Munseom, 21 May 1987 (J.I. Song); 1 ind. Munseom, 22 Jan. 1998, 20 m deep; 1 ind. Munseom, 11 Jun. 2001 (J.I. Song); 4 inds. Munseom, 19 May 2005 (H.W. Moon), 15-20 m deep; 1 ind.

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Table 1. Comparison of characteristics on the synonymous species of *Myriopathes bifaria*

Characteristics / Species	*Myriopathes bifaria* (in present study)	*Antipathes bifaria* (see Brook, 1889)	*Antipathes bifaria* (see Silberfeld, 1909)	*Antipathes lata* (in part, Song, 1987)
Size of colony (cm) (high × wide)	143 × 120	90	–	–
Growth form	irregularly, densely branched	irregularly, bushy	irregularly, bushy	irregularly, bushy
Arrangement of branches/ pinnules	pinnulate, uniserially to bilaterally	pinnulate, uniserially to bilaterally	pinnulate, uniserially to bilaterally	pinnulate, uniserially to bilaterally
Length of branches/ pinnules (cm)	4.8-6.6/0.6-1.7	/0.5-2.5	–	/0.6-2.5
Distal angle of branches/ pinnules	25-48° (interior angle: 30-60°)	≤45°	acute angle	30-45° (interior angle: 30-40°)
Distance of branches/ pinnules (mm)	2.0-2.5	–	–	3.0-4.0
Diameter of branches/ pinnules (mm)	0.60/0.18-0.25, 0.09-0.15	–	0.14	0.60/0.15-0.20, 0.10-0.14
Number of subpinnules	1-2	2-6	–	1-2
Shape of spines	slender, acute	–	–	slender, acute
Arrangement of spines	8-10	–	10	8
Size of spines (mm) (length × width)	0.06-0.15 × 0.04-0.05	–	0.09	0.07-0.20 × 0.03-0.07
Mutual distance of spines (mm)	0.10-0.15	–	–	0.10-0.17
Arrangement of polyps	single row	–	–	single row
Size of polys (mm)	0.7-1.0	1.0	1.0	0.8-1.0
Interpolypar distance (mm)	0.1-1.0	–	–	0.1-0.2
Number of polyps/cm	10-11	10	10	10-11
Length of tentacles (mm)	0.20-0.60	–	–	0.30-0.25
High of oral cone (mm)	0.45-0.50	–	–	0.20-0.30
Color of polyps	vivid yellow	–	–	dull yellow (in alcohol)
Distribution	Jejudo Is. (Munseom), 10-24 m	Japan	Japan	Jejudo Is. (Munseom), 20 m

Seogwipo, 6 Jun. 2005 (S.H. Kim), 25 m deep; 4 inds. Munseom, 25 Jun. 2005 (H.W. Moon), 20 m deep; 3 inds. Munseom, 2 Aug, 2005 (H.W. Moon), 15-33 m deep; 2 inds. Munseom, 6 Nov. 2005 (H.W. Moon), 20 m deep; 7 inds. Munseom, 18 Jan. 2006 (H.W. Moon), 20 m deep; 1 ind. Munseom, 1 Feb. 2006 (H.W. Moon); 2 inds. Munseom, 21 Apr. 2006 (H.W. Moon); 6 inds. Munseom, 12 Jun. 2006 (H.W. Moon), 16-38 m deep; 4 inds. Munseom, 25 Jul. 2006 (H.W. Moon), 16-33 m deep; 1 ind. Ulleungdo, 23 Aug. 2006 (H.W. Moon), 7.9 m deep; 4 inds. Munseom, 7 Sep. 2006 (S.J. Hwang), 16-33 m deep.

Remarks. This species with various size and color habitats on rocky substrates of the subtidal zone, 10-45 m and is the most common species in Jejudo Is.. Only one colony has been found where there is very little light, on the surface of a gorge between large rocks in Ulleungdo Is. 7.9 m deep. So, the distribution range of *M. lata* was turned out to be expanded from southwestern sea to the eastern sea, up to Ulleungdo Is.

Colonies from Jejudo Is. usually reached sexual maturity more than 100 cm high as a gonochoric, but colonies of Ulleungdo Is. about 50 cm high, contained gonads in their body. Gonads were found in samples taken at Jejudo Is. on 2 Aug. 2005. Colony about 123 cm high was determined as a female of mature stage through the analysis of the histological sections (Fig. 3).

(Mature stage-Large number of oocytes packed closely together with uniform appearance, oocytes are about 300 μm in size (Parker et al., 1997)).

Distribution. Korea (Jejudo Is., Ulleungdo Is.), Japan (Misaki).

***Myriopathes japonica* (Brook, 1889)**

Antipathes japonica Brook, 1889, p. 169, pl. 11, fig. 25; Silberfeld, 1909b, p. 26, pl. 2, fig. 3; Pax, 1932, p. 407 Utinomi, 1958, p. 181, text-fig. 8; 1965, p. 300, text-fig. 466; Opresko, 1974, p. 20; 1976, p. 239; Grigg and Opresko, 1977, p. 255; Zhou and Zou, 1984, p. 57; Zou and

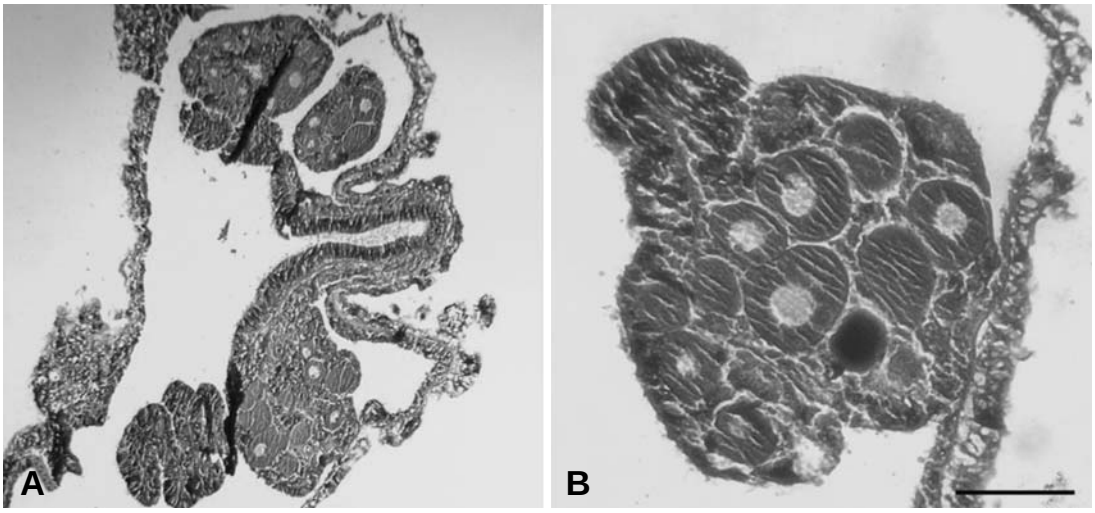

Fig. 3. Gonads of *Myriopathes lata*. A, longitudinal section of polyps; B, oocytes of mature stage (Scale bar=0.3 mm).

Zhou, 1984, p. 101; Song, 1987, p. 66, pl. 2, figs. 1-6; 1992, p. 270; 2000, p. 351; Uchida and Soyama, 2001, p. 132.

Antipathes (*Euantipathes*) *japonica* van Pesch, 1914, p. 50, text-figs. 25-28.

(*Antipathes*) *bifaria* Brook, 1889, p. 170, pl. 11, fig. 20; Opresko, 1974, p. 20.

Antipathella japonica Zou and Zhou, 1984, p. 101.

Myriopathes japonica Opresko, 2001, p. 143, fig. 6.

Previous record. Jejudo Is. (Bumseom, Seogwipo, Munseom, Gapado, Moseulpo) (Song, 1987).

Material examined. 1 ind. Munseom, 3 Dec. 1978 (J.I. Song); 1 ind. Moseulpo, 17 Jan. 1985 (J.H. Park); 30 m deep; 1 ind. Munseom, 11 Jun. 2001 (J.I. Song); 1 ind. Chagwido, 17 Aug. 2001 (J.I. Song); 1 ind. Seogwipo, 6 Jun. 2005 (S.H. Kim), 25 m deep.

Remarks. The species of genus *Myriopathes* were divided into two subgroups by Opresko (2001). In one group containing *M. ulex*, *M. panamensis* and *M. stechowi*, the corallums are generally flabellate. In another group containing *M. bifaria*, *M. lata* and *M. japonica*, they are bushier (Opresko, 2001). However, *M. japonica* shows an intermediate form between those two groups in respect that all main branches lie in a one plane but the entire colony is bushy, and branching pattern is regular at all part of the corallum.

Distribution. Korea (Jejudo Is.), Japan (Sagami Bay, Enoshima), Formosa, Indonesia.

[1]**Myriopathes stechowi* (Pax, 1932) (Fig. 4A-F)

Aphanipathes stechowi Pax, 1932, p. 436, fig. 16; Utinomi, 1965, p. 300, text-fig. 468; Opresko, 1974, p. 27.

Myriopathes stechowi Opresko, 2001, p. 349.

Material examined. 1 ind. Munseom, 27 Nov. 2005 (H.W. Moon), 25 m deep.

Description. Colony small, flabellate, about 20 cm high, 22 cm wide, branched to 5th order and almost entirely in one plane. Stem directed upward from basal plate and axis diameter gradually tapering. Branches and branchlets arranged irregularly alternate at varying intervals on lateral sides of branches with regular distal angle (about 45˚) at all parts. Length of branchlets varies (about 0.6-4.2 cm long), arranged bilaterally with distal angle about 45-60˚ (internal angle 160-180˚), and spaced 2-5 mm apart in each lateral row. Pinnules straight, about 2-12 mm in length, spaced 2-4 mm apart, and placed in two anterolateral rows, arranged bilaterally with interior angle formed by two pinnules 60-80˚. Pinnules with one to two subpinnules (mostly 2-5 mm in length), arranged uniserially on upper side of pinnule with distal angle about 20-45˚.

Spines variable in size and shape according to diameter of branches and pinnules, generally compressed laterally and arranged in 8 longitudinal rows. On branchlets 0.10-0.30 mm in diameter, spines 0.12-0.16 × 0.05-0.08 mm, become narrower and sinuous at their base. On pinnules 0.07-0.20 mm in diameter, spines 0.10-0.15 (average: 0.12 mm) × 0.03-0.06 mm, usually smooth with acute apex and occasionally occur smaller ones in size. On subpinnules 0.06-0.08 mm in diameter, spines 0.07-0.10 × 0.03 mm, directed more horizontally than branchlets. Mutual distance between adjacent spines in one row about 0.10-0.18 mm (average: 0.13 mm),

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Fig. 4. *Myriopathes stechowi*. A, corallum; B, view of branchlets with pinnules; C, polyps on branches; D, spines on branches; E, spines on branchlets; F, spines on pinnules. Scale bars=5 cm (A), 5 mm (B), 0.1 mm (C-F).

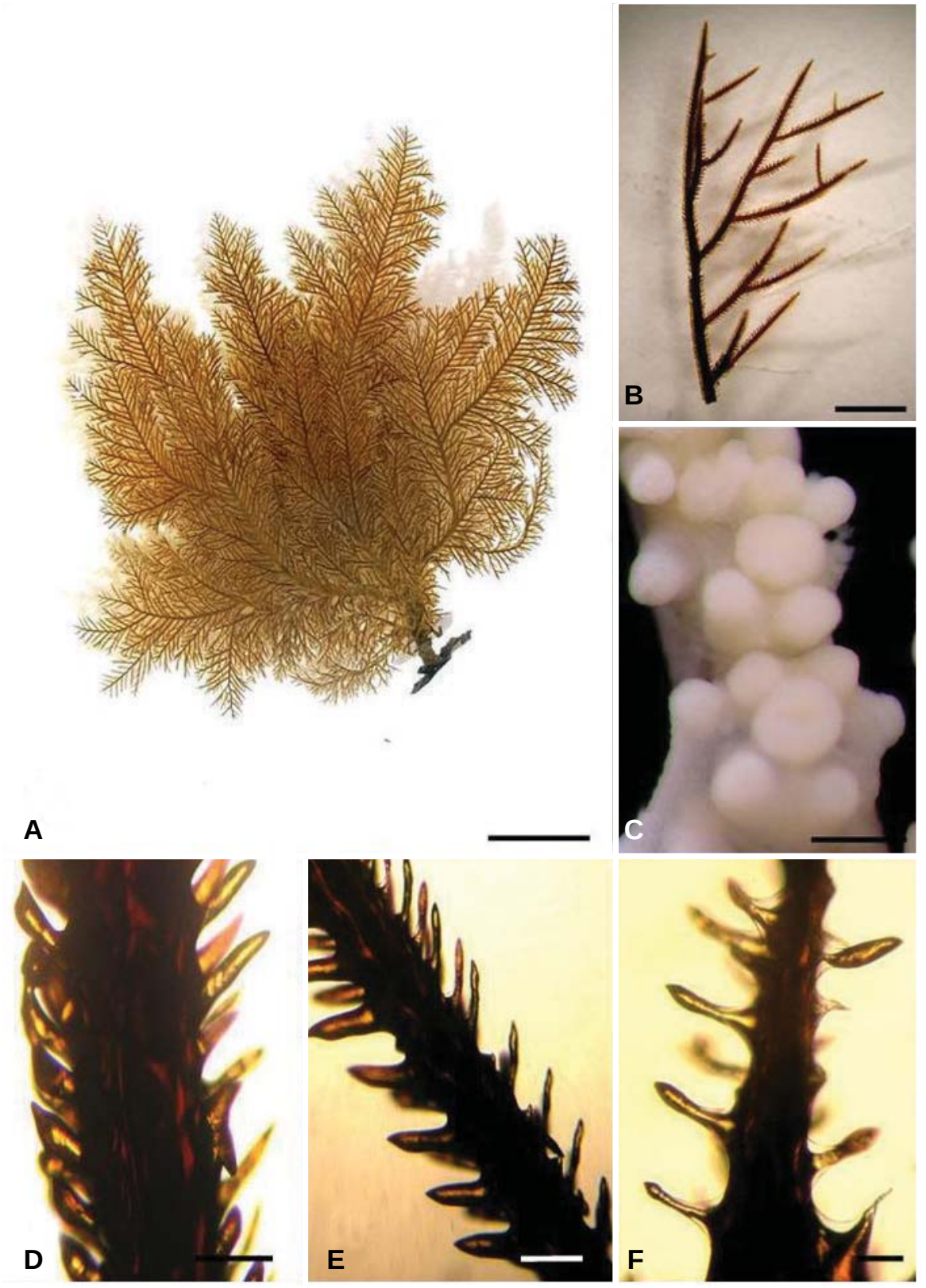

Fig. 5. *Myriopathes ulex*. A, corallum; B, view of branchlets with pinnules; C, polyps on pinnules; D, spines on branches; E, spines on branchlets; F, spines on pinnules. Scale bars=5 cm (A), 5 mm (B), 0.1 mm (C-F).

Table 2. Comparison of characteristics in relation to species within genus *Myriopathes*

Characteristics \ Species	*M. bifaria*	*M. lata*	*M. japonica*	*M. stechowi*	*M. ulex*
Size of colony (cm) (high × wide)	143 × 120	45 × 26	37 × 25	20 × 22	22 × 25
Growth form	irregulary, densely branched	straight, densely branched	regulary branched in a one plane	branched entirely in a one plane	branched in a one plane
Arrangement of branches/ pinnules	pinnulate, uniserially to bilaterally	pinnulate, alternately, inclined distally	pinnulate, tapering, inclined distally	straight with regular distal angle, tapeing	irregulary alternate, inclined distally
Length of branches/ pinnules (cm)	4.8-6.6/0.6-1.7	1.0-4.0/0.3-1.1	0.4-3.5/0.3-1.6	0.6-4.2/0.2-1.2	1.5-3.5/0.3-0.8
Distal angle of branches/ pinnules	25-48° (interior angle: 30-60°)	30-45° (interior angle: 10-45°)	36-50° (interior angle: 160-180°)	45-60° (interior angle: 160-180°)	45-60° (interior angle: 120°)
Distance of branches/ pinnules (mm)	2.0-2.5	1.0-3.0	1.0-3.0	2.0-5.0	2.0-3.0
Diameter of branches/ pinnules (mm)	0.60/0.18-0.25, 0.09-0.15	0.50/0.18-0.25, 0.08-0.10	0.40/0.15-0.25, 0.10-0.15	0.30/0.07-0.22, 0.06-0.08	0.35-0.40/ 0.15-0.20, 0.15
Number of subpinnules	1-2	1-5	1-2	1-2	1-3
Shape of spines	slender, acute	blunt, compressed	simple, conical with acute apex	simple, smooth with acute apex	conical to subcylindrical or blunt
Arrangement of spines	8-10	8	8-10	8	8
Size of spines (mm) (length × width)	0.06-0.15 × 0.04-0.05	0.10-0.25 × 0.05-0.10	0.08-0.15 × 0.03-0.06	0.07-0.16 × 0.03-0.08	0.15-0.20 × 0.05-0.10
Mutual distance of spines (mm)	0.10-0.15	0.10-0.15	0.10-0.15	0.09-0.18	0.13-0.30
Arrangement of polyps	single row	single row, sometimes back side	single row	single row and twist	single row on upper side
Size of polys (mm)	0.7-1.0	0.8-1.0	0.8-1.0	0.2-0.5	0.8-1.0
Interpolypar distance (mm)	0.1-1.0	0.1	1.0	1.0	0.1-0.5
Number of polyps/cm	10-11	10-11	11-12	11-14	8-9
Length of tentacles (mm)	0.20-0.60	0.60	0.04-0.05	0.20-0.45	0.25-0.30
High of oral cone (mm)	0.45-0.50	0.35	0.25	0.20	0.35
Color of polyps	vivid yellow	white to reddish brown	light brown	light brown	brown
Distribution	Jejudo Is., 10-24 m	Jejudo Is., 10-45 m, Ullengdo Is., 7.9 m	Jejudo Is., 20-25 m	Jejudo Is., 24 m	Jejudo Is., 25 m

and slightly reduced at tips of branchlets and pinnules.

Polyps small, arranged in a single row and twist on upper side of pinnules and elongated transversely with 11-14/cm along axis. Polyps 0.2-0.5 mm in transverse diameter with interpolypar space 1.0 mm, and irregular in size and shape depending on part. Tentacles in preserved specimens, 0.30-0.45 mm in length with rounded apex, and sagittal tentacles and lateral ones equal in size. Oral cone 0.30 mm in diameter, raised about 0.20 mm.

Color. Axis dark brown, base black and polyps soft yellow brown.

Habitat. The colony with small size attached aslant on the side of a rock, at 25 m deep.

Remarks. The branching mode of this species is similar to a young colony of *Myriopathes japonica*. While branching angle is regular (about 45°) at all parts except for the subpinnules, and branches are straighter.

Distribution. Korea (Jejudo Is.), Japan (Sagami Bay).

[1]**Myriopathes ulex* (Ellis & Solander, 1786) (Fig. 5A-F)

Antipathes ulex Ellis & Solander, 1786, p. 100; Brook, 1889, p. 167, pl. 11, fig. 5; Opresko, 1974, p. 49; 1976, p.

[1]*관목해송(신칭)

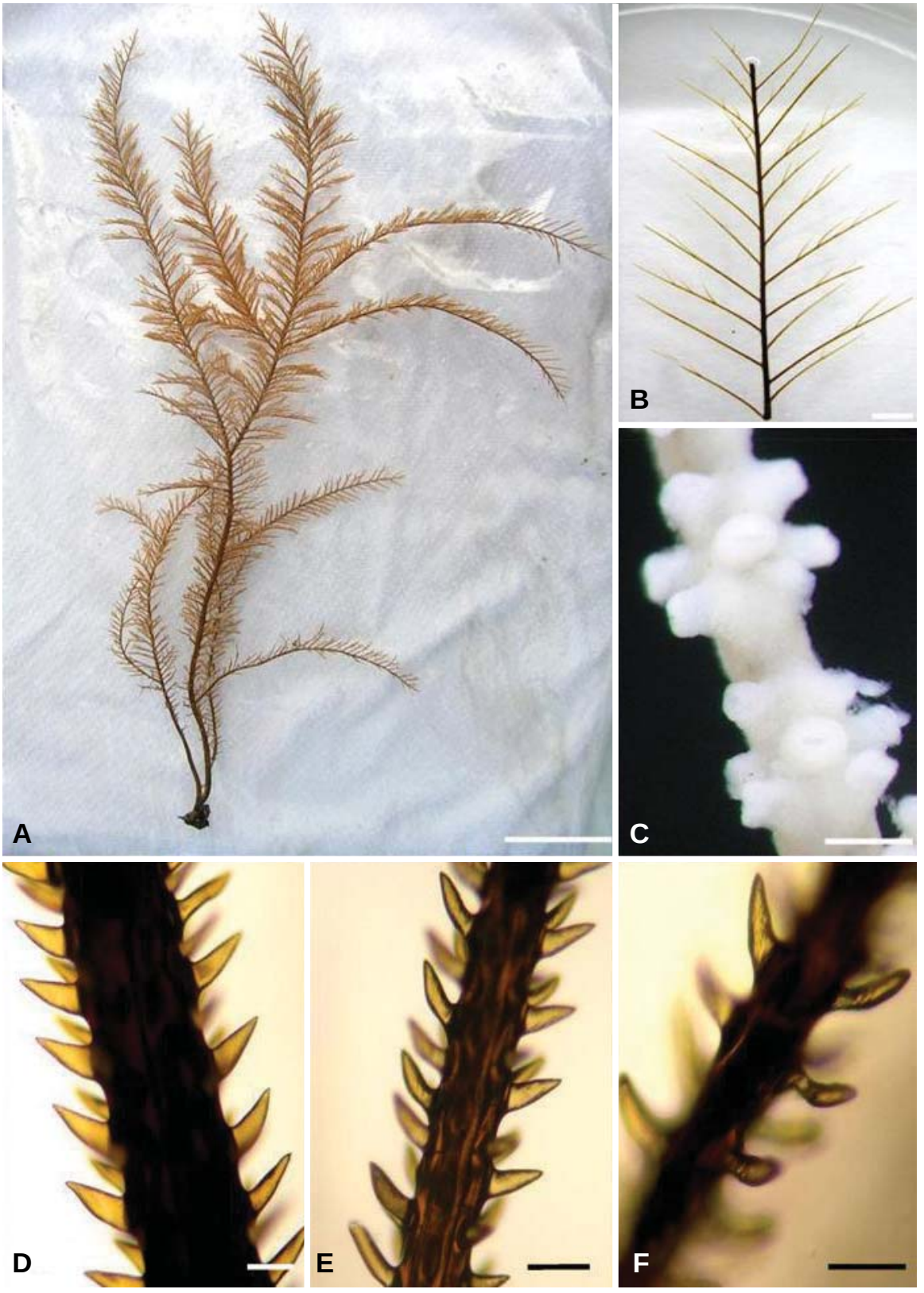

Fig. 6. *Plumapathes pennacea*. A, corallum; B, view of branchlets with pinnules; C, polyps on branchlets; D, spines on branches; E, spines on branchlets; F, spines on pinnules. Scale bars=5 cm (A), 5 mm (B), 0.1 mm (C-F).

239; Grigg and Opresko, 1977, p. 255, fig. 15; Montgomery, 2002, p. 159.

Antipathes (*Euantipathes*) *ulex* van Pesch, 1914, p. 79, fig. 62.

Myriopathes ulex Opresko, 2001, p. 349.

Material examined. 1 ind. Seogwipo, 6 Jun. 2005 (S.H. Kim), 25 m deep.

Description. Colony flabellate, about 22 cm high, 25 cm wide, and 3.4 cm in diameter at basal part of stem, branched to 6th order in one plane. Stem about 0.7 cm long and 0.6 cm in diameter, curved in lateral side with a number of branches in two rows. Branches and branchlets arranged irregularly alternate on lateral side of axis, and gradually tapering in diameter. Branchlets usually 1.5-3.5 cm in length, spaced 2-3 mm apart in same row, and distal angle about 45-60˚, no fusion in any part of colony with interior angle 120˚. Pinnules about 3-8 mm in length, strong, occasionally forked and thick as branchlet, spaced 2 mm apart, and arising from antero-lateral side with interior angle formed by two pinnules about 90˚. Most pinnules with subpinnules (up to 5 mm long), arranged on lower part of pinnules with distal angle about 45˚. Single tertiary pinnules occur on mid point of subpinnules with distal angle about 90˚.

Spines large, conical to subcylindrical with acute apex, arranged in 8 longitudinal rows. On branchlets 0.15-0.40 mm in diameter, spines 0.15-0.18 (max.: 0.20 mm) × 0.08-0.10 mm, difference between polypar and abpolypar spines obvious in shape (acute and sinuous at polypar vs. blunt at abpolypar).

On pinnules and subpinnules 0.15-0.20 mm in diameter, spines 0.15-0.20 × 0.05-0.10 mm, usually not hooked upward at their apex and arranged spirally. Mutual distance between adjacent spines in one row variable, about 0.12-0.30 mm.

Polyps arranged in a single row on upper side of pinnules with 8-9 cm along axis, therefore, corallum distinct polypar and abpolypar side. Polyps usually 0.8-1.0 mm in transverse diameter (some as small as 0.6 mm) and interpolypar space 0.1-0.5 mm. Tentacles in preserved specimens, 0.25-0.30 mm in length, very short and thick. Oral cone 0.45 mm in diameter, raised about 0.35 mm.

Color. Axis dark brown, base black and polyps soft pink.

Habitat. The colony with short branches inhabits at rocky substrate of subtidal zone in Jejudo Is., 25 m deep.

Remarks. In comparison with description of van Pesch, 1914, our specimen is similar in most of features except for the average mutual distance of spines.

Distribution. Korea (Jejudo Is.), Indian Ocean (East India, Madagascar), Pacific Ocean (Hawaii, Oahu, Philippines, Indonesia, Mexico, United States), Atlantic Ocean (Lucon Is., Mermaid Channel).

Genus [1]**Plumapathes* Opresko, 2001

Diagnosis. Corallum sparsely to densely branched and tending to be planar. Stem and branches pinnulate. Primary pinnules simple, relatively uniform in size, and not subpinnulate, arranged in two, very regular bilateral rows, pinnules in each row alternating with those in opposite row.

[2]***Plumapathes pennacea* (Pallas, 1766) (Fig. 6A-F)**

Antipathes pennacea Pallas, 1766, p. 209; Opresko, 1972, p. 974; 1974, p. 82, figs. 7-9; Oakley, 1988, p. 77; Opresko and Sănchez, 1997, p. 80.

Aphanipathes? pennacea Brook, 1889, p. 129, pl. 11, fig. 23.

Aphanipathes pennacea Silberfeld, 1909b, p. 9; van Pesch, 1914, p. 92, figs. 83-88; Bayer, 1959, p. 234.

Plumapathes pennacea Opresko, 2001, p. 361, figs. 13-14; Boland and Sammarco, 2005, p. 127, figs. 2-3.

Material examined. 1 ind. Seopseom, 14 Jun. 2006 (H.W. Moon), 25 m deep; 2 inds. Seopseom, 15 Jun. 2006 (H.W. Moon), 20-25 m deep; 1 ind. Seogwipo (Oedolgae), 8 Sep. 2006 (S.J. Hwang), 24 m deep.

Description. Largest colonies about 100 cm high or more, small colony about 38 cm high, 24 cm wide and 1.8 × 1.0 cm in diameter at basal part of stem. Stem about 0.5 cm long and 0.3 cm in diameter. Corallum sparsely and irregularly branched to 5th order in one plane. Main branches straight, reached to top of corallum. Branches up to 20 cm long and inclined distally (distal angle about 45˚) with simple filiform pinnules. Pinnules alternately arranged in two anterolateral rows, usually 1.5-2.5 cm in length, spaced 2-4 mm apart and distal angle about 35-55˚ with interior angle 120-160˚. Most pinnules have a series of 1-5 subpinnules, mostly 3-4 mm long and 0.10 mm in diameter, and spaced 1.7-2.0 mm part. subpinnules arranged uniserially on upper part of pinnules with distal angle about 20-30˚.

Spines variable in size and shape, conical to subcylindrical with acute apex and arranged in 8 longitudinal rows. On branchlets 0.30-0.60 mm in diameter, spines 0.15-0.18 × 0.05-0.06 mm, mostly sinuous and sometimes bifurcated. On pinnules 0.10-0.18 mm in diameter, spines 0.09-0.12 × 0.04-0.06 mm, usually simple. On subpinnules 0.10 mm in diameter, spines 0.05-0.07 × 0.01-0.03, irregular in shape and near tips inclined distally. Mutual distance between adjacent spines in one row about 0.09-0.20 mm and enlarged

[1]*깃해송속(신칭), [2]*깃해송(신칭)

with increasing thickness of axis.

Polyps blunt, arranged in a single row on upper side of pinnules with 8-9/cm along axis. Polyps regular in size about 0.8 mm in transverse diameter and interpolypar space 0.2-0.3 mm. Tentacles in preserved specimens, 0.25-0.38 mm in length, sagittal tentacles slightly longer than lateral ones. Oral cone 0.40 mm in diameter, raised about 0.30 mm and elongated along sagittal axis.

Color. Axis brown, base black and polyps soft pink.

Habitat. The colonies are living at vertical wall of rock, 20-25 m deep, and associated with polychaetes.

Remarks. This species with various sizes can be recognized easily by its simple filiform pinnules. However, there is intraspecific variability from colony to colony (Opresko, 1974). In comparison between specimens, the branching mode is variable according to the size of colonies or environmental conditions.

Distribution. Korea (Jejudo Is.), Atlantic Ocean (Bahamas, Barbados, Brazil, Dominica, Guadeloupe, Honduras, Jamaica, Martinique, Puerto Rico, Saint Helena, Trinidad and Tobago), Pacific Ocean (Columbia, Indonesia, Mexico, Panama, Philippines, United States), Indian Ocean (Madagascar).

ACKNOWLEDGEMENTS

This work was supported by the Korea Research Foundation Grant (KRF-2005-070-C00124).

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Received October 14, 2008
Accepted November 5, 2008