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Taxonomy of Actiniidae (Anthozoa, Actiniaria, Thenaria, Endomyaria) from Korea

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ABSTRACT

Actinians were collected from 91 localities of Korea from 1962 to 2000. They are identified into 10 species within 6 genera, of which three species are newly recorded to Korean fauna: *Dofleinia armata* Wassilieff, 1908, *Urticina coriacea* (Cuvier, 1798) and *Urticina crassicornis* (Muller, 1776). They are redescribed in detail with figures, and the other species are examined.

Key words: Taxonomy, Actiniidae, Endomyaria, Korea

INTRODUCTION

The family Actiniidae contains the greatest number of genera (44) and species (about 225) in the order Actiniaria (Calrgren, 1949; Fautin, 1982) and belongs to the subtribe Endomyaria of tribe Thenaria. These actinians are characterized by an endodermal sphincter without acontia and the habitat living from the littoral zone to abyssal depth. Since taxonomic studies of Korean actinians have been performed from early 1980s (Song, 1984, 1992, 1998), seven species of actinians were known. The purpose of this study is to re-investigate the fauna of family Actiniidae in Korean waters.

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MATERIALS AND METHODS

For this systematic study of family Actiniidae, specimens stocked in the Department of Life

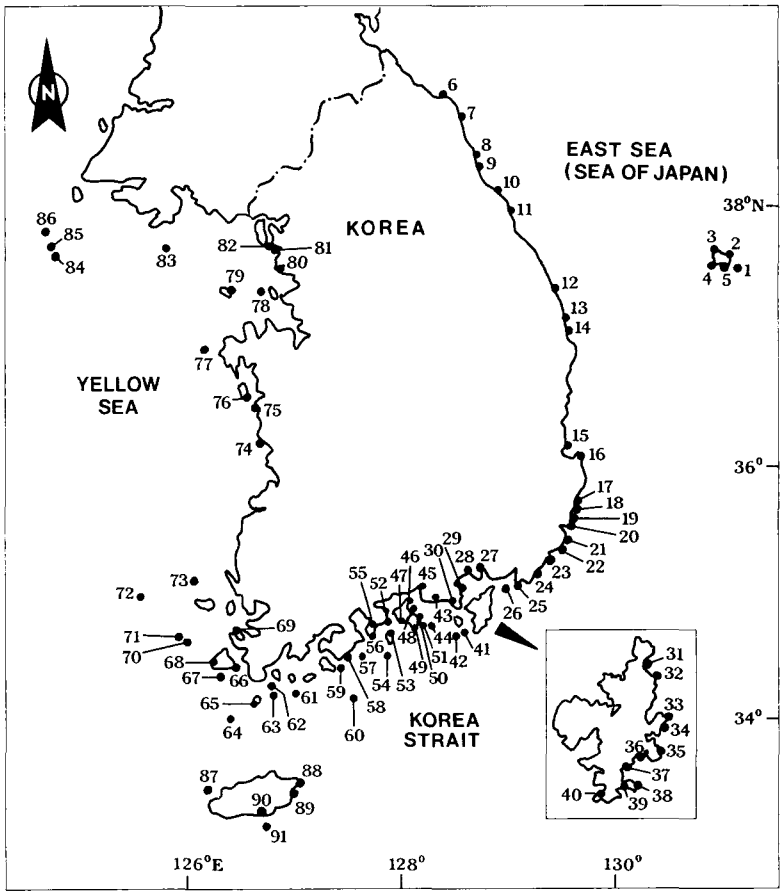

Fig. 1. A map showing the localities where the materials were collected from 1962 to 2000. 1, Dokdo; 2, Hyunpo; 3, Teaha; 4, Namyang; 5, Tonggumi; 6, Geojin; 7, Chuksan; 8, Namae; 9, Jukdo; 10, Jumunjin; 11, Samcheok; 12, Deoksan; 13, Kwangjin; 14, Gundeok; 15, Pohang; 16, Guryongpo; 17, Dangsa; 18, Ulgi; 19, Bangeojin; 20, Chundo; 21, Ijinri; 22, Jinha; 23, Ilgwang; 24, Mipo; 25, Dadaepo; 26, Gadeokdo; 27, Deokdong; 28, Gohyun; 29, Udupo; 30, Chungmu; 31, Jangmok; 32, Heungnam; 33, Jangseungpo; 34, Oklim; 35, Wahyeon; 36, Gujora; 37, Yanghwa; 38, Haegeumgang; 39, Hammok; 40, Gabaeri; 41, Yoenhwado; 42, Yokjido; 43, Goseong; 44, Seopdo; 45, Samcheonpo; 46, Changseon; 47, Seosang; 48, Nogdo; 49, Mijori; 50, Jodo; 51, Sinsudo; 52, Seosang; 53, Sorido; 54, Uhak; 55, Yeosu; 56, Dolsando; 57, Narodo; 58, Naebal; 59, Jijukdo; 60, Geomundo; 61, Chungsando; 62, Sohwado; 63, Dakseom; 64, Chujado; 65, Bogildo; 66, Hwadong; 67, Gilmado; 68, Gahak; 69, Hwawon; 70, Seosouido; 71, Uido; 72, Daedundo; 73, Jaewon; 74, Seocheon; 75, Boryeong; 76, Anmyundo; 77, Anheung; 78, Yeongheungdo; 79, Deokjeokdo; 80, Songdo; 81, Jakyakdo; 82, Yeongjongdo; 83, Yeonpyeongdo; 84, Socheongdo; 85, Daecheongdo; 86, Baekryungdo; 87, Biyangdo; 88, Seongsanpo; 89, Sinyang; 90, Seogwipo; 91, Munseom.

Sciences during the period from 1962 to 1997 and new ones collected from 1998 to 2000 were examined. They were obtained at depths between intertidal and sublittoral zone of 91 localities of Korean waters by skin and SCUBA diving and fishing nets (Fig. 1). Samples were fixed in 5% neutral formalin after anesthetization by adding menthol or magnesium chloride ($MgCl_2$) and deposited in the Department of Life Sciences and the Natural History Museum, Ewha Womans University.

The identification was done on the base of morphological characters with microscope systems (Stemi SV VI and Zeiss Axioscop 2 microscope system, Zeiss Inc.). The observation of internal characters was facilitated by the microtome serial section using tissue processing systems (Reichert-Jung). To see the size and distribution of cnidae, they were examined and measured with an ocular micrometer at 1000 magnification of photo microscopes (Zeiss Axioscop 2 microscope system and Olympus BH2) by squashing a bit of tissue on a drop of phenol-glycerol solution. For the classification, we basically followed Carlgren's systematic scheme (1942, 1949).

RESULTS

Phylum Cnidaria Hatschek, 1888 자포동물문
Class Anthozoa Ehrenberg, 1834 산호충강
Subclass Zoantharia de Blainville, 1830 말미잘아강
Order Actiniaria R. Hertwig, 1882 해변말미잘목
Suborder Nynantheae Carlgren, 1899 니난트아목
Tribe Thenaria Carlgren, 1899 족반족
Subtribe Endomyaria Stephenson, 1921 내근아족
Family Actiniidae (Gosse, 1858) 해변말미잘과

Column smooth or sometimes provided with verrucae, marginal spherules or vesicle. Mesenteries never divided into macrocnemes and microcnemes. Sphincter absent or usually endodermal.

Key to the genera of Actiniidae

1. Marginal spherules present 2
   Marginal spherules absent 3
2. Column smooth, without vesicles or verrucae ..... *Actinia*
   Column without vesicle but with adhesive verrucae 4
3. Narrow pedal disc ..... *Paracondylactis*
   Broad pedal disc 5
4. Spincter more or less circumscribed ..... *Anthopleura*
   Spincter circumscribed usually strong ..... *Epiactis*
5. Tentacles short without papillae, pentamerously arranged ..... *Urticina*
   Tentacles very long with papillae, hexamerously arranged ..... *Dofleinia*

Genus *Actinia* Browne, 1756 해변말미잘속

Actiniidae with very wide pedal disc and smooth column. A ring of marginal spherules in the

deep fosse. Sphincter weak or strong, diffused. Perfect mesenteries numerous. All stronger mesenteries fertile.

1. *Actinia equina* Linne, 1767 해변말미잘

Previous records in Korea. Mipo, Seogwipo, Munseom, Taeha (Song, 1984, 1998).

Material examined. Seogwipo, 9 Dec. 1969, 4 inds. (BJ Rho); Dangsa, 4 Feb. 1996, many inds. (JI Song); Munseom, 22 May 1998, many inds. (JI Song), with young anemones; Dokdo, 4 May 1999, 5 inds. (YJ Lee); Sohwado, 26 Jun. 1999, 2 inds. (JH Won, YJ Lee); Seogwipo, 19 Jan. 2000, 3 inds. (BJ Rho, HR Cha), intertidal zone.

Distribution. Korea (Cheju Is. area, Korea Strait, East Sea), Japan, Atlantic, the Mediterranean, Black Sea.

Genus *Anthopleura* Duchassing & Michelotti, 1860 꽃해변말미잘속

Actiniidae with well developed pedal disc. Column with adhesive verrucae arranged in more or less distinct longitudinal rows, especially in its upper part. Marginal spherules present.

Key to the species of *Anthopleura*

1. Aggregation, irregularly arranegent of mesenteries ..... *Anthopleura pacifica*
   Solitary, hexamerously arrangement of mesenteries 2
2. Verrucae compound, column and tentacles without black granules 3
   Verrucae simple, column and tentacles with small black granules ..... *A. kurogane*
3. Column adhere to pebbles and dead shells ..... *A. midori*
   Column not or little adhere to pebbles and dead shells ..... *A. japonica*

2. *Anthopleura japonica* Verrill, 1889 갈색꽃해변말미잘

Previous records in Korea. Guryongpo, Hyunpo, Namyang, Teaha, Tongkumi, Jumunjin, Gundeok, Anmyundo, Anheung, Haegeumgang, Namae (Song, 1984, 1998).

Material examined. Daedundo, 22 Jul. 1982, 5 inds. (JH Park); Chundo, 3 Feb. 1996, many inds. (JI Song); Dangsa, 4 Feb. 1996, many inds. (JI Song); Gudo, 6 Feb. 1996, many inds. (JI Song); Isudo, 7 Feb. 1996, many inds. (JI Song); Oeipori, 7 July 1996, 3 inds. (JI Song); Chundo, 1 Feb. 1997, 3 inds. (JI Song); Dangsa, 2 Feb. 1997, 2 inds. (JI Song); Chundo, 30 Jun. 1997, many inds. (JI Song); Dangsa, 1 July 1997, many inds. (JI Song); Gujora, 4 July 1997, 8 inds. (JI Song); Seosouido, 13 Aug. 1998, 4 inds. (JI Song, YJ Lee); Seosouido, 17 Aug. 1998, many inds. (JI Song); Ijinri, 18 Dec. 1998, 6 ids. (YJ Lee, HR Cha); Gabaeri, 28 Jun. 1999, 2 inds. (JI Song, HR Cha, HS Lim); Gujora, 28 Jun. 1999, 3 inds. (JI Song, HR Cha, HS Lim); Boryeong, 17 Apr. 1999, 6 inds. (JI Song, HR Cha); Seosang, 28 Sep. 1999, 5 inds. (JI Song, HR Cha); Anheung, 18 Apr. 1999, 2 inds. (JI Song, HR Cha); Jangseungpo, 29 Sep. 1999, 4 inds. (JI Song, HR Cha); Changseondo, 24 Nov. 1999, 5 inds. (HR Cha, HS Lim); Dokdo, May 1999, 3 inds. (JI Song, YJ Lee); Gadeokdo, 22 Apr. 2000, 2 inds. (HR Cha, HS Lim); Jaewon, 4 Aug. 2000, 3 ind. (JI Song, HR Cha, HS Lim), intertidal zone.

Distribution. Korea (Yellow Sea, Korea Strait, East Sea), Japan (Honshu, Kyushu)

3. *Anthopleura kurogane* Uchida & Muramatsu, 1958 검정꽃해변말미잘

Previous records in Korea. Sangju, Bogildo, Wando, Chungsando, Narodo, Bijindo, Samchonpo, Sinsudo, Nukdo, Chujado, Geomundo, Yokjido, Yangpyung, Naebal, Pongnam, Chijuk (Song, 1992).

Material examined. Guryongpo, 19 Jul. 1968, many inds. (BJ Rho); Hwadong (Jindo), 5 Aug. 1974, many inds. (BJ Rho); Gahakri (Jindo), 3 Aug. 1974, 5 inds. (BJ Rho); Jakyakdo, 17 Sep. 1974, many inds. (BJ Rho, JI Song); Daedundo, 22 Jul. 1982, 7 inds. (JH Park); Wado, 17 Jan. 1985, many inds. (JH Park); Chungmu, 18 Jan. 1986, many inds. (HS Choi); Biyangdo, 25 Feb. 1986, many inds. (S Shin, Lee, Seo); Jakyakdo, 11 Oct. 1986, many inds. (JI Song); Deoksan, 12 Aug. 1987, 8 inds. (BJ Rho, Lee); Jumunjin, 28 Jun. 1988, 8 inds. (JW Lee); Sinyang (Cheju Is.), 8 Apr. 1989, 5 inds. (JI Song); Jijukdo, 2 Jul. 1991, 12 inds. (Lee); Naebal, 30 Jul. 1991, many inds. (JI Song); Jakyakdo, 15 Jun. 1991, many inds. (JI Song, EK Kim, JH Won); Chundo, 3 Feb. 1996, many inds. (JI Song); Dangsa, 4 Feb. 1996, many inds. (JI Song); Gudo, 6 Feb. 1996, many inds. (JI Song); Isudo, 7 Feb, 1996, many inds. (JI Song); Deokdong, 6 July 1996, many inds. (JI Song); Oeipori, 7 July 1996, 3 inds. (JI Song); Heungnam, 3 Jan. 1997, many inds. (JI Song); Chundo, 1 Feb. 1997, many inds. (JI Song); Dangsa, 2 Feb. 1997, many inds. (JI Song); Chundo, 3 Jun. 1997, many inds. (JI Song); Deokdong, 1 July 1997, 15 inds. (JI Song); Heungnam, 3 July 1997, many inds. (JI Song); Gujora, 4 July 1997, many inds. (JI Song); Seosouido, 17 Aug. 1998, many inds. (JI Song); Deokdong, 12 Nov. 1998, many inds. (YJ Lee, HR Cha); Heungnam, 12 Nov. 1998, many inds. (YJ Lee, HR Cha, SJ Han); Dangsa, 18 Dec. 1998, many inds. (YJ Lee, HR Cha); Chundo, 18 Dec. 1998, 8 inds. (YJ Lee, HR Cha); Ijinri, 18 Dec. 1998, 8 inds. (YJ Lee, HR Cha); Jinha, 18 Dec. 1998, 8 inds. (YJ Lee, HR Cha); Ilgwang, 18 Dec. 1998, 8 inds. (YJ Lee, HR Cha); Gohyun, 18 Dec. 1998, 7 inds. (YJ Lee, HR Cha); Udupo, 18 Dec. 1998, many inds. (YJ Lee, HR Cha); Boryeong, 17 Apr. 1999, 5 inds. (JI Song, HR Cha); Anheung, 18 Apr. 1999, 4 inds. (JI Song, HR Cha, HS Lim); Gilmado, 26 Jun. 1999, 9 inds. (JH Won, SJ Lee); Gabaeri, 28 Jun. 1999, 8 inds. (HR Cha , HS Lim); Yanghwa, 4 Jul. 1999, 9 inds. (BSRI); Socheongdo, 30 Aug. 1999, 3 inds. (HR Cha, HS Lim); Daecheongdo, 31 Aug. 1999, 5 inds. (HR Cha, HS Lim); Seosang, 28 Sep. 1999, 5 inds. (JI Song, HR Cha); Gujora, 29 Sep. 1999, 4 inds. (HR Cha, HS Lim); Jangseungpo, 29 Sep. 1999, 5 inds. (JI Song, HR Cha); Changseondo, 24 Nov. 1999, 4 inds. (HR Cha, HS Lim); Oklim, 20 Dec. 1999, many inds. (JI Song); Yeosu, 13 Jan. 2000, 4 inds. (HS Lim); Dolsando, 4 Feb. 2000, 6 inds. (HS Lim); Gadeokdo, 22 Apr. 2000, 5 inds. (HR Cha); Dolsando, 12 Jul. 2000, 4 inds. (HS Lim): Jangmok, 27 Jul. 2000, 8 inds. (JW Lee); Hwawon, 4 Aug. 2000, 4 inds. (HR Cha, HS Lim); Jaewon, 4 Aug. 2000, 3 inds. (JI Song, HR Cha, HS Lim); Seogwipo, 19 Nov. 2000, 2 inds. (BJ Rho, HR Cha), intertidal zone.

Distribution. Korea (Yellow Sea, Korea Strait, East Sea, Cheju Is. area), Japan (Hokkaido, Northern parts of Honshu), Atlantic, Pacific Coasts of North America, Bering Sea.

4. *Anthopleura midori* Uchida & Muramatsu, 1958 풀색꽃해변말미잘

Previous records in Korea. Seopdo (Namhaedo), Cheongsan, Kwangjin, Yonhwado, Guryongpo, Daecheon, Jumunjin, Gundeok, Anmyundo, Seongsanpo, Anheung (Sinjindo), Wonsando, Maldo, Yeonpyeondo, Baekryeondo, Goseong, Jangseungpo, Namae (Song, 1984, 1998).

Material examined. Daksum, 27 Jul. 1974, 4 inds. (BJ Rho); Anheung , 27 Oct. 1984, 7 inds.

(JI Song); Jumunjin, 27 May 1985, 3 inds. (JI Song); Seongsanpo, 9 Jul. 1985, 7 inds. (JI Song); Seocheon, 27 Oct. 1985, 5 inds. (JI Song); Goseong, 26 Dec. 1986, 6 inds. (Song JI); Mijori, 27 Apr. 1990, 4 inds. (JI Song); Namae, 3 Jun. 1990, 3 inds. (JI Song); Naebal, 30 Jun. 1991. 2 inds. (JI Song); Chundo, 3 Feb. 1996, many inds. (JI Song); Dangsa, 4 Feb. 1996, many inds. (JI Song); Gudo, 6 Feb. 1996, many inds. (JI Song); Dangsa, 3 Jul. 1996, 4 inds. (JI Song); Isudo, 7 Feb. 1997, many inds. (JI Song); Chundo, 8 Feb. 1997, many inds. (JI Song); Heungnam, 3 Jul. 1997, 6 inds. (JI Song); Gujora, 4 Jul. 1997, many inds. (JI Song); Dangsa, 2 Feb. 1997, many inds. (JI Song); Chundo, 30 Jun. 1997, many inds. (JI Song); Dangsa, 1 Jul. 1997, 8 inds. (JI Song); Deokdong, 2 Jul. 1997, 1 ind. (JI Song); Jodo, Jul. 1998, 3 inds. (YJ Lee, HR Cha); Sangju, 30 Jun. 1998, 3 inds. (YJ Lee, HR Cha); Uido, 15 Aug. 1998, many inds. (JI Song); Dangsa, 18 Dec. 1998, 5 inds. (YJ Lee, HR Cha); Jinha, 18 Dec. 1998, 3 inds. (YJ Lee, HR Cha); Ilgwang, 18 Dec. 1998, 3 inds. (YJ Lee, HR Cha); Gohyeon, 18 Dec. 1998, 4 inds. (YJ Lee, HR Cha); Udupo, 19 Dec. 1998, 7 inds. (YJ Lee, HR Cha); Hammok, 20 Dec. 1998, 3 inds. (YJ Lee, HR Cha); Boryeong, 17 Apr. 1999, 3 inds. (JI Song, HR Cha); Daeguldo, 27 Jul. 1999, 4 inds. (JH Won, SJ Lee); Gabaeri, 28 Jul. 1999, 3 inds. (JI Song, HR Cha); Socheongdo, 30 Aug. 1999, 3 inds. (HR Cha, HS Lim); Daecheongdo, 31 Aug. 1999, 3 inds. (HR Cha, HS Lim); Seosang, 28 Sep. 1999, 3 inds. (JI Song, HR Cha); Jangseungpo, 29 Sep. 1999, 2 inds. (JI Song, HR Cha); Changseondo, 24 Nov. 1999, 4 inds. (HR Cha, HS Lim); Seogwipo, 19 Jan. 2000, 2 inds. (BJ Rho, HR Cha); Gadeokdo, 22 Apr. 2000, 3 inds. (HR Cha, HS Lim), intertidal zone.

Distribution. Korea (Korea Strait, Yellow Sea, East Sea, Cheju Is. area), Japan, Atlantic, Pacific Coast of America, Northern Europe.

5. *Anthopleura pacifica* Uchida, 1938 태평양꽃해변말미잘

Previous records in Korea. Guryongpo, Jumunjin, Gundeok, Yundoldo, Yangpyung (Song, 1984, 1998).

Material examined. Mijori, 21 Jun. 1967, 3 inds. (BJ Rho); Chundo, 3 Feb. 1996, many inds. (JI Song); Deokdong, 8 Feb. 1996, many inds. (JI Song); Deokdong, 6 Jul. 1996, many inds. (JI Song); Deokdong, 28 Jan. 1997, many inds. (JI Song); Chundo, 1 Feb. 1997, many inds. (JI Song); Dangsa, 2 Feb. 1997, many inds. (JI Song); Chundo, 30 Jun. 1997, many inds. (JI Song); Dangsa, 1 Jul. 1997, 3 inds. (JI Song); Deokdong, 2 Jul. 1997, many inds. (JI Song); Gujora, 4 Jul. 1997, many inds. (JI Song); Deokdong, 12 Jan. 1998, 6 inds. (YJ Lee, HR Cha, SJ Han); Jodo, 1 Jul. 1998, 4 inds. (YJ Lee , HR Cha); Uido, Aug. 1998, 4 inds. (JI Song, YJ Lee); Seosouido, Aug. 1998, 6 inds. (JI Song, YJ Lee); Jinha, 18 Dec. 1998, many inds. (HR Cha, SJ Han); Daecheongdo, 31 Aug. 1999, many inds. (HR Cha, HS Lim); Socheongdo, 31 Aug. 1999, 7 inds. (HR Cha, HS Lim); Dolsando, 4 Feb. 2000, 3 inds. (HS Lim), intertidal zone.

Distribution. Korea (Korea Strait, East Sea), Japan (Southern part of Hokkaido, Mutsu Bay, Sagami Bay).

Genus *Paracondylactis* Carlgren, 1934 측해변말미잘속

Actiniidae with very elongate body and narrow pedal disc. Column smooth. Sphincter diffuse. Tentacles hexamerously arranged, up to 96, rather weak. Mesenteries all or almost fertile.

6. *Paracondylactis hertwigi* (Wassilieff, 1908) 측해변말미잘

Previous records in Korea. Jakyakdo, Chokjeon (Incheon), Wonsando (Song, 1984).

Material examined. Deokjeokdo, 15 Jul. 1962, 6 inds. (BJ Rho); Jakyakdo, 8 Jun. 1963, many inds.; Jakyakdo, 14 Apr. 1968, many inds.; Jakyakdo, 25 Apr. 1971, many inds.; Jakyakdo, 7 Apr. 1974, many inds.; Jakyakdo, 17 Sep. 1977, many inds.; Jakyakdo, 29 Sep. 1984, many inds.; Jakyakdo, Oct. 1968, many inds.; Jakyakdo, 12 Nov. 1985, many inds. (JI Song); Jakyakdo, 3 Jun. 1985, many inds. (Seo, Choi); Songdo (Incheon), May 1986, 4 inds. (JI Song); Jakyakdo, Oct. 1986, many inds.; Yeongheungdo, 16 Jul. 1988, 4 inds. (Lee, Seo); Jakyakdo, 30 Sep. 1989, many inds.; Jakyakdo, 28 Sep. 1991, many inds.; Jakyakdo, 28 Sep. 1991, many inds.; Jakyakdo. 28 Apr. 1992, 8 inds. (S Shin, HK Kim); Heungnam, 30 Jan. 1997, 4 inds. (JI Song); Heungnam, 3 July 1997, many inds. (JI Song); Jakyakdo, 17 Oct. 1997, 10 inds. (JI Song), intertidal~subtidal zone (20m deep).

Distribution. Korea (Yellow Sea), Japan (Suru Bay, Envura Bay, Amakusa, Tomioka).

Genus *Dofleinia* Wassilieff, 1908 모래해변말미잘속 (신칭)

Actiniidae with broad base. Column smooth. Tentacles hexamerously arranged, not numerous, very large, inner ones at least twice as large as outer. Tentacles with papillae which represent strong batteries of very large basitrichs. Weaker papillae present also on the oral disc. Two broad siphonoglyphs. Mesenteries hexamerously arranged. Sphincter diffuse weak. Retractor diffuse.

***7. *Dofleinia armata* Wassilieff, 1908** 모래해변말미잘 (신칭)

(Figs. 2A-B, 3A-D, 6A-B. Table 1)

Dofleinia armata Wassilieff, 1908, p. 14, pl. I, figs. 7-8, pl. 5, figs. 49-51; Asano, 1911, p. 132; Stephenson, 1922, p. 277; Carlgren, 1945, p. 12; 1949, p. 57; Uchida and Soyama, 2001, p. 70.

Material examined. Geumodo, 6 Aug. 1983, 1 ind.; Uhak, 6 Aug. 1986, 1 ind. (JI Song); Heungnam (Geojedo), 13 Jan. 1998, 8 inds. (JI Song); Wahyeon (Geojedo), 4 Jul. 1999, 4 inds. (JI Song).

Description. Actiniidae with broad base. Column smooth, covered with sand by verrucae. In contracted specimens, column 29-48 mm long, 28-45 mm in average wide. In expanded specimens, column 32-52 mm long and oral disc 35-42 mm wide, largest one, column 65 mm long and oral disc 42 mm wide. Marginal papillae developed at margin of oral disc. Tentacles hexamerously arranged, up to 48, inner and outer cycles 24 for each. Tentacles very long, sharp tips and their longitudinal muscles ectodermal. Inner tentacles at least twice as long as outer ones, inner ones 118-126 mm long and outer ones 64-76 mm long. Two broad siphonoglyphs, aborally very prolonged. Mesenteries hexamerously arranged, up to 24 pairs. Sphincter diffuse weak. Retractor diffuse strong, with well-developed basilar muscle. No acontia.

Cnidae: Spirocyst, basitrichs, microbasic p-mastigophors.

Distribution and size (μm) of cnidae are as follows:

Tentacle	Spirocyst	19.0–41.0×2.5–4.0
	Basitrichs	37.0–70.0×3.2–5.0
Actinopharynx	Basitrichs	19.0–41.5×3.5–4.5,

		57.0–64.0×4.0–5.0
	Microbasic p-mastigophore (rare)	16.5–39.0×4.0–5.0
Column	Spirocyst	25.0–53.0×3.0–6.0
	Basitrichs	18.5–42.0×3.0–4.0
Mesenteric filament	Spirocyst	19.0–46.0×2.5–4.0
	Basitrichs	32.5–72.0×4.0–6.0
	Microbasic p-mastigophors (rare)	31.0–42.5×4.2–6.0

Coloration. In life, column and tentacles white and oral disc greyish white. Distal part of tentacles pale-brown. Column and tentacles ivory in formalin.

Remarks. This species usually burrow into sandy substratum. In spite of all specimens are damaged their pedal disc when they were collected, other characters are same with references of

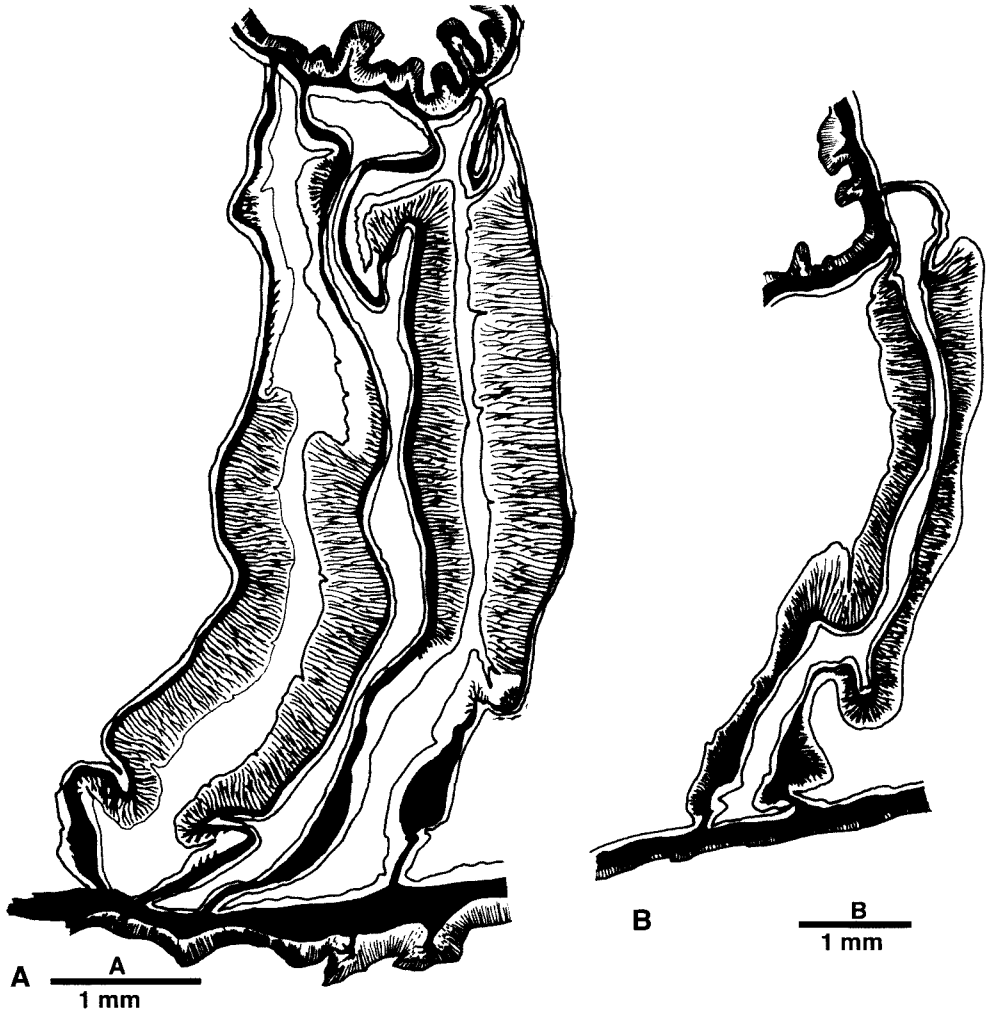

Fig. 2. Mesenteries of *Dofleinia armata*. A, directives; B, complete mesenteries.

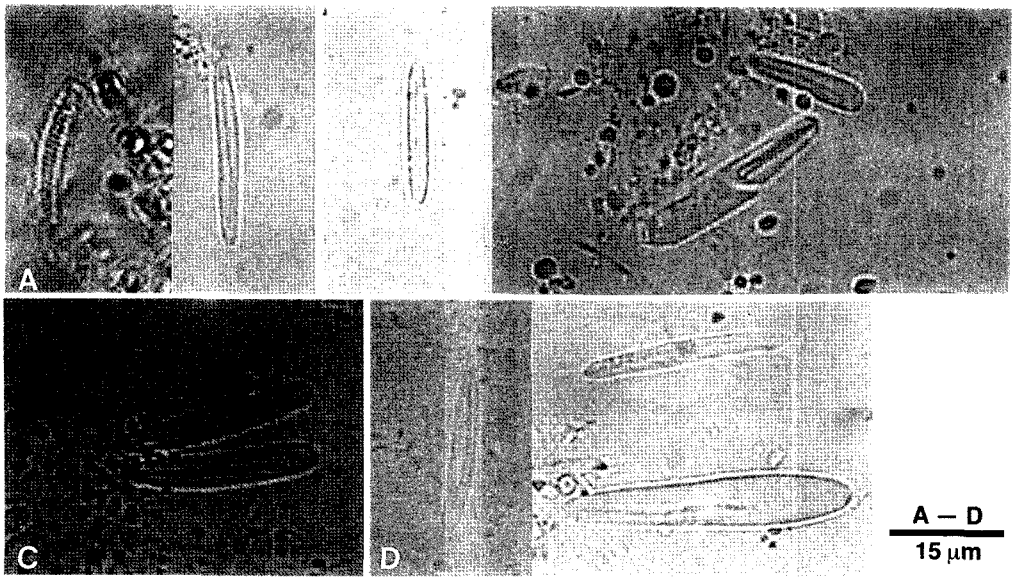

Fig. 3. Cnidae of *Dofleinia armata*. A, tentacle; B, actinopharynx; C, column; D, mesenteric filament.

Table 1. Comparison of size (mm) in relation to state of specimens

Parts \ State		Expanded		Contracted	
		length	width	length	width
Column		32-52	32-40	29-48	28-45
Scapus		55			
Scapulus		10	42		
Tentacle	inner	118-126	5-7		
	outer	64-76			
Oral disc		35-42			

Wassilieff (1908) and Carlgren (1945).

Distribution. Korea (Korea Strait), Japan (Honshu, Sagami Bay 20 m deep).

Genus *Epiactis* Verrill, 1869 방사해변말미잘속

Actiniidae with well developed base and smooth column. Margin and fosse distinct. Sphincter usually circumscribed, often strong. Tentacles simple and short. Mesenteries arranged hexamerously. Retractors diffuse to restricted.

8. *Epiactis japonica* (Verrill, 1869) 방사해변말미잘

Previous records in Korea. Jukdo, Kwangjin, Guryongpo, Jumunjin, Samcheok, Pohang, Mipo, Anmyundo, Hyunpo (Ulleungdo), Ulgi (Song, 1984, 1998).

Material examined. Guryongpo, 20 Jul. 1968, many inds. (BJ Rho); Bangeojin, 2 Aug. 1972, 4 inds. (BJ Rho); Namae, 30 Jun. 1990, many inds. (JI Song); Jumunjin, Aug. 1999, 5 inds. (SJ Kim); Dokdo, May 1999, 3 inds. (YJ Lee).

Distribution. Korea (East Sea, Northern part of Korea Strait), Japan (Kurile Is., Hokkaido-Middle parts of Honshu).

Genus *Urticina* Ehrenberg, 1834 (=*Tealia* Gosse, 1858) 가죽해변말미잘속 (신칭)

Actiniidae with well developed pedal disc. Column with adhesive verrucae. Fosse well developed. Tentacles short, cylindrical, their muscles ectodermal to more or less mesogloeal. Radial muscles of oral disc ectodermal to meso-ectodermal. Numerous perfect mesenteries as a rule decamerously arranged. Basitrichs of actinopharynx much larger than those of tentacles. Sphincter strong, circumscribed.

Key to the species of *Urticina*

1. Verrucae present, well developed, adhesive or not. Nematocysts of actinopharynx both basitrichs (up to 79 μm long) and microbasic-p-mastigophores (rare) ..... *U. coriacea*
   No verrucae; or verrucae few, and weak. Nematocysts of actinopharynx basitrichs only (up to 98 μm long) ..... *U. crassicornis*

***9. *Urticina coriacea* (Cuvier, 1798) 가죽해변말미잘 (신칭) (Figs. 4A-E, 6C, Table 2)**

Urticina felina coriacea: Carlgren, 1921, p. 161, text-figs. 171-174, pl. 4, figs. 1-4.

Tealia coriacea: Stephenson, 1922, p. 272; Hand, 1955, p. 72, text-figs. 18-19; 1975, p. 90; Chia, 1976, p. 265; Sebens and Laakso, 1978, p. 166; Morris *et al.*, 1980, p. 60, pl. 22, fig. 3.34.

Tealia felina var. *coriacea*: Stephenson, 1935, p. 139, text-fig. 67, pl. 8, figs. 1, 3, p. 9, fig. 5, pl. 12, fig. 2, pl. 13, fig.1, pl. 29, fig. 1; Pax, 1936, p. 270; Uchida, 1940, p. 270, text-figs. 3-4; 1941, p. 386, text-fig. 3; Carlgren, 1949, p. 63, pl. 3, fig. 1.

Urticina felina: Manuel, 1988, p. 106; Cairns *et al.*, 1991, p. 41; Uchida and Soyama, 2001, p. 82.

Urticina coriacea: Hartog, 1986, p. 87; Kostina, 1988, p. 18; Cairns *et al.*, 1991, p. 41; Zamponi and Acuna, 1996, p. 2; Kozloff, 1996, p. 75.

Materials examined. Jukdo, 13 July 1982, 2 inds. (SNU); Jumunjin, 2 Mar. 1999, 2 inds. (SJ Yun), fishing nets, 70 m deep.

Description. Leathery anemone. Actiniidae with broad base. Column covered with well developed verrucae and sometimes encrusted with small pieces of shells. Verrucae usually arranged in longitudinal rows. Collar and fosse well developed. Shapes not variable, usually low and broad in expansion. In contracted state, column 40-52 mm long, pedal disc 28-35 mm wide, most wide diameter along column 33-38 mm. In expanded specimens, column 32-58 mm long, oral disc 25-45 mm and pedal disc 33-65 mm wide. Tentacles short, cylindrical and blunt tips. Tentacles pentamerously arranged in 5 cycles, up to 155 (5+10+20+40+80).

Longitudinal muscles developed, mesogloeal. At distal part of tentacles, white striped pattern existed. Perfect mesenteries numerous. Complete mesenteries sterile. Two well developed

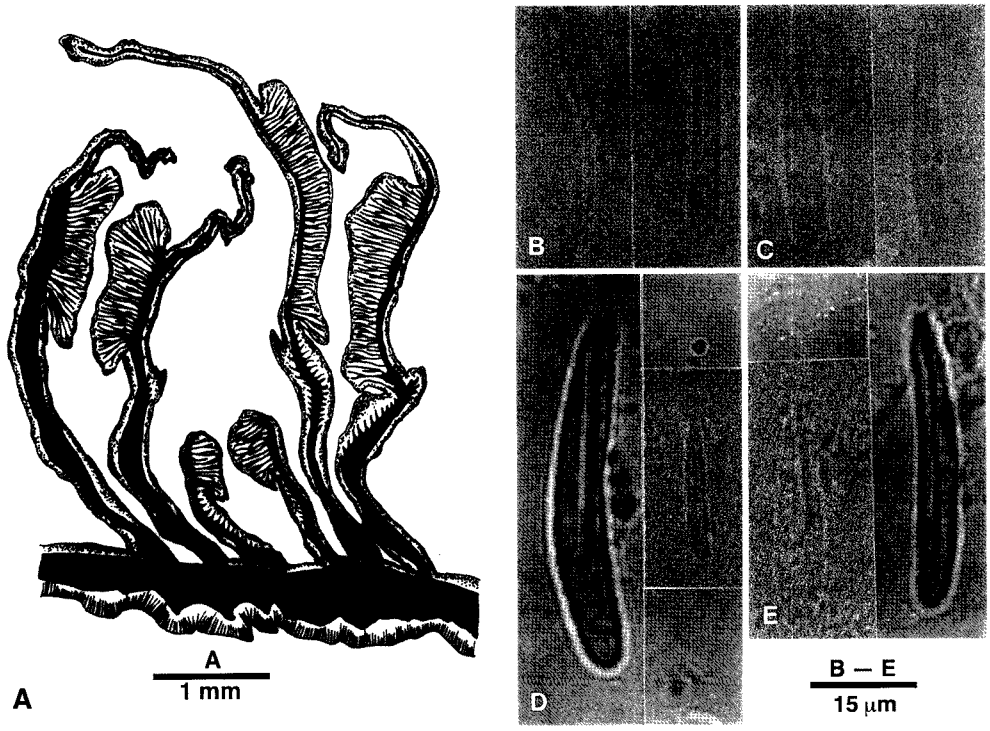

Fig. 4. Mesenteries and cnidae of Urticina coriacea. A, 1st, 2nd and 3rd mesenteries; B, tentacle; C, column; D, actinopharynx; E, mesenteric filament.

siphonoglyhs. Sphincter circumscribed and strong. Retractor, parieto-basilar and basilar muscles well developed. Basitrichs of actinopharynx and mesenteric filament much larger than those of tentacles. No cinclides or pores.

Cnidae: spirocyst, basitrichs, microbasic p-mastigophors

Distribution and size (μm) of cnidae are as follows:

Tentacle	Spirocyst	21.5–41.0×2.2–4.0
	Basitrichs	11.0–14.0×2.5–3.5(rare), 19.5–31.0×2.5–4.0
Actinopharynx	Basitrichs	31.0–35.5×2.0–3.0, 73.0–79.0×6.0–7.0
	Microbasic p-mastigophors (rare)	23.5–28.0×6.0–7.0
Column	Spirocyst (rare)	19.0–25.5×2.5–3.0
	Basitrichs	10.0–14.0×2.5–3.5, 19.0–25.0×2.5–3.5
	Microbasic p-mastigophors (very rare)	25.5–26.0×7.0
Mesenteric filament	Basitrichs	13.0–23.0×2.5–3.5(rare), 66.0–69.0×6.0–7.0
	Microbasic p-mastigophors	24.0–39.0×6.0–7.0

Table 2. Comparison of size (mm) in relation to state of specimens

State / Parts	Expanded		Contracted	
	length	width	length	width
Column	32-58	25-50	35-52	28-38
Tentacle	5-11	3-4		
Oral disc		25-45		
Pedal disc		33-65		28-64

Coloration. Variable. Column red or greenish blue, irregularly blotched with red. Tentacles same color with column and white striped bands existed. Pedal disc and actinopharynx yellow. The conserved specimens yellowish white in formalin.

Remarks. Our oviparous specimens are coincided with *Urticina coriacea* which was reviewed as oviparous-pelagic-lecithotrophic in sexual reproductive pattern by Chia (1976).

Distribution. Korea (East Sea), Japan (Northern parts of Hokkaido, Akkeshi, Muroran, Usu), North Atlantic coast of Europe, Pacific Ocean (Kuril Islands, Alaska to Monterey).

***10. *Urticina crassicornis* (O. F. Muller, 1776)** 민가죽해변말미잘 (신칭)
(Fig. 5A-E, Fig. 6D, Table 3)

Urticina crassicornis: Carlgren, 1893, p. 58, pl. 1, fig. 20, text-fig. 9-13; Kostina, 1988, p. 18; Cairns *et al.*, 1991, p. 41; Zampani and Acuna, 1996, p. 2; Kozloff, 1996, p. 76.

Urticina felina crassicornis: Carlgren, 1921, p. 162.

Tealia crassicornis: Stephenson, 1922, p. 272; Hand, 1955, p. 77, text-figs. 16-17; 1975, p. 92; Rickettes and Calvin, 1968, p. 464; Chia, 1976, p. 265; Sebens and Laakso, 1978, p. 165; Morris *et al.*, 1980, pl. 22, fig. 3.33.

Tealia felina var. *crassicornis*: Stephenson, 1935, p. 139, pl. 12, fig. 2, pl. 13, fig.1; Pax, 1936, p. 97; Uchida, 1940, p. 270; Carlgren, 1934, p. 349; 1949, p. 63, pl. 3, fig. 9.

Urticina felina: Manuel, 1988, p. 106.

Urticina felina kurile: Uchida and Soyama, 2001, p. 82.

Materials examined. Pohang, 24 Jun. 1968, 3 inds. (BJ Rho); Chuksan, 10 Aug. 1971, 2 inds. (BJ Rho); Mipo, 2 Aug. 1980, 1 ind. (JI Song); Geojin, 15 Aug. 1980, 1 ind. (SJ Yun); Guryongpo, May 1981, 2 inds. (JI Song); Mipo, 23 May 1982, 1 ind. (JI Song); Mipo, 12 Jan. 1984, 1 ind. (HS Han); Mipo, 27 Dec. 1986, 17 inds. (JI Song), with 3 young anemones in adult gastrovascular cavity; Ulgi, 30 Jun. 1997, 1 ind. (JI Song).

Description. Mottled anemone. Actiniidae with broad base and smooth column. Column without adherent materials. Sometimes a few weakly developed verrucae can attach small particles of gravel or broken shells. Fosse well developed. Actinopharynx smooth and two well developeded siphonoglyhs. Shapes not variable, usually low and broad in expansion. In contracted state, column 37-68 mm long, pedal disc 32-64 mm wide, most wide diameter along column 30-35 mm. In expanded specimens, column 8-17 mm long, oral disc 8-20 mm and pedal disc 10-29 mm wide. Tentacles short, cylindrical and blunt tips. Arranged pentamerously, up to 5 cycles (160 tentacles),

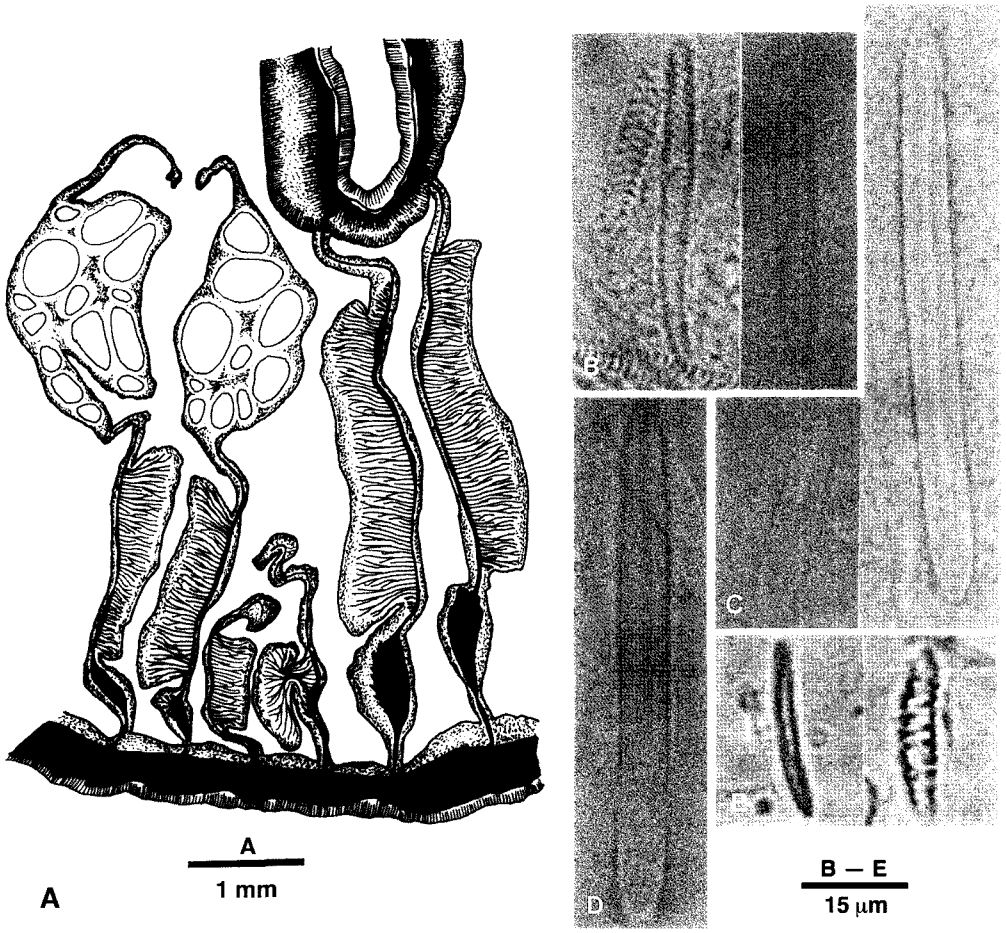

Fig. 5. Mesenteries and cnidae of *Urticina crassicornis*. A directive, 2nd and 3rd mesenteries; B, tentacle; C, mesenteric filament; D, actinopharynx; E, column.

although most specimens possess only 4 cycles. Longitudinal muscles well developed, mesogloeal. At distal part of tentacles, white striped pattern existed. Perfect mesenteries numerous and pentamerously arranged. Complete mesenteries sterile. Mesenteric filaments of young individuals hexamerously arranged. Sphincter circumscribed and strong. Retractor, parieto-basilar and basilar muscles well developed. Basitrichs of the actinopharynx and mesenteric filament much larger than those of tentacles.

Cnidae: Spirocyst, basitrichs, microbasic p-mastigophors

Distribution and size (μm) of cnidae are as follows:

Tentacle	Spirocyst	29.0–53.0×4.0–5.0
	Basitrichs	19.5–27.4×2.5–4.0, 46.0–66.0×4.0–5.0
Actinopharynx	Spirocyst	23.0–46.0×3.5–6.0

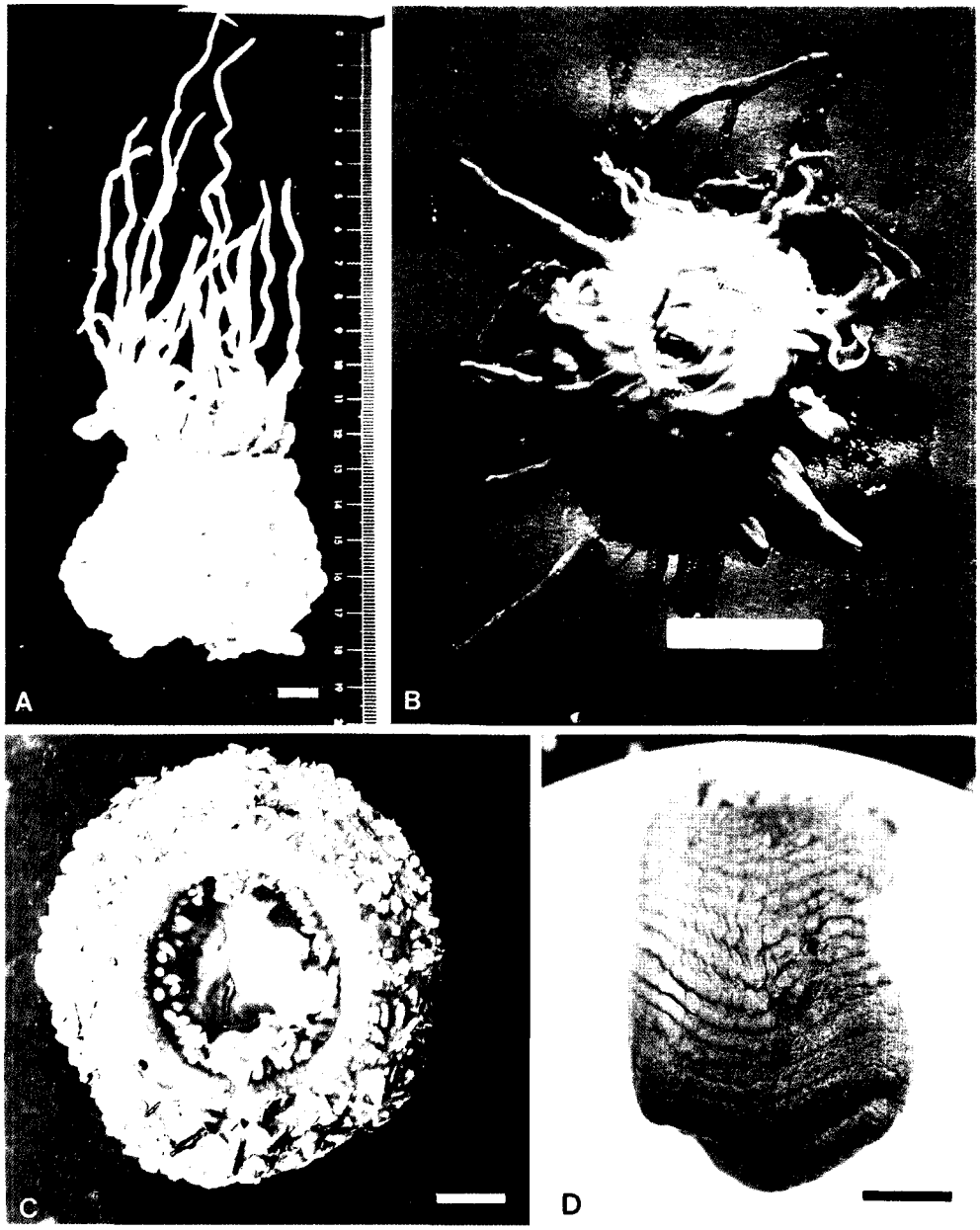

Fig. 6. External features. A-B, *Dofleinia armata*; C, *Urticina coriacea*; D, *U. crassicornis* (scale bars = 1 cm).

	Basitrichs	14.0–24.0 × 2.5–4.0, 31.0–66.0 × 4.0–6.0 96.5–98.8 × 4.0–5.5
Column	Spirocyst (rare)	23.0–25.5 × 2.5–3.0
	Basitrichs	19.0–29.0 × 2.5–4.0

Table 3. Comparison of size (mm) in relation to state of specimens

State / Parts	Expanded		Contracted	
	length	width	length	width
Column	8-17	9-18	37-68	
Tentacle	2-13			
Oral disc		8-20		30-55
Pedal disc		10-29		32-64

Mesenteric filament ..... Spirocyst ..... 21.0–29.0×3.5–4.0
Basitrichs ..... 13.0–29.0×2.5–4.0,
35.0–63.0×3.8–4.8,
93.2–98.0×3.8–4.8
Microbasic p-mastigophors ..... 24.0–36.5×6.0–7.0

Coloration. Column variable patterns of pale colors of green, blue and red. Tentacles same color with column and white striped bands existed. The tips of tentacles are usually white, and commonly a rose-colored band occurs around the middle of each. Pedal disc and actinopharynx ivory. The conserved specimens yellowish white in formalin.

Remarks. Our specimens with young anemones in the gastrovascular cavity of their adult on December are included in *Urticina crassicornis* which was reviewed as oviparous-pelagic-lecithotrophic, larviparous-pelagic-lecithotrophic and viviparous in sexual reproductive pattern by Chia (1976).

Distribution. Korea (East Sea), Japan (Northern parts of Hokkaido), both coasts of North Atlantic, Pacific Ocean (Alaska to Monterey).

DISCUSSION

In this study, we revaluate the distribution and diversity of Korean actinians with ten species belonging to six genera. The distribution of them in terms of four regions of Korean waters is shown at Table 4. It shows that eight species are occurred from East Sea and Korea Strait. The result means the great diversity of these two regions. Remaining two regions, Yellow Sea and Cheju Is. area, respectively comprised six and three species.

That two species, *Anthopleura kurogane* and *Anthopleura midori* occurred at every coastal line of four regions, suggests their abundance and their highly adaptive ability to live within Korean waters. In terms of the number of individuals collected and examined of *Anthopleura kurogane* and *Anthopleura midori*, the former is more dominant species in Korean waters. *Actinia equina* is distributed in Cheju Is. area, Korea Strait and Ullungdo within East Sea influenced by the Tsuchima Warm Current. *Anthopleura japonica* and *Anthopleura pacifica* distributed along the coastal line of Korea except for Cheju Is. area are assumed as the temperate species. The distribution of *Urticina coriacea* and *Urticina crassicornis* being occured at East Sea and the

Table 4. Distribution of Korean actinians according to regions and habitat

Species	Regions				Habitat	
	Yellow Sea	East Sea	Korea Strait	Cheju Is. area	Intertidal	Subtidal
Actinia equina		+	+	+	o	
Anthopleura japonica	+	+	+		o	
Anthopleura kurogane	+	+	+	+	o	
Anthopleura midori	+	+	+	+	o	
Anthopleura pacifica	+	+	+		o	
Paracondylactis hertwigi	+		+		o	
**Dofleinia armata*			+			o (20 m deep)
Epiactis japonica	+	+			o	
**Urticina coriacea*		+				o (70 m deep)
**Urticina crassicornis*		+	+			o (70 m deep)
Total	6	8	8	3	7	3

* The actinian species newly recorded in this study.

eastern coast of Korea Strait (Mipo) have deep relationships with previous papers of other countries which reported these species as boreal species. As the water of East Sea can be assumed as cold environment affected by the Liman Cold Current, our results are coincided with previous studies.

Those ten species can be divided into intertidal or subtidal zones by habitat differences, based on the depth of the water (Table 4). Seven species previously recorded from Korean waters are found in intertidal zone only (Song, 1984, 1992, 1998). On the other hand, the three newly recorded species, *Dofleinia armata, Urticina coriacea* and *Urticina crassisornis* are occurred from subtidal zone. The latter two subspecies, *Urticina coriacea* and *Urticina crassisornis*, have been collected from downwards to 70 m deep of a same region and were collected by fishing nets as abyssal species.

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한국산 해변말미잘과 (산호충강, 해변말미잘목, 족반족, 내근아족)의 분류

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(이화여자대학교 자연과학대학 생명과학과)

요 약

한국산 해변말미잘류는 1962년부터 2000년까지 우리나라 삼면연안의 91개 지점에서 채집되었다. 해변말미잘과 내에 6속 10종이 동정 · 분류되었으며, 그 중 모래해변말미잘(*Dofleinia armata*), 가죽해변말미잘(*Urticina coriacea*) 및 민가죽해변말미잘(*Urticina crassicornis*)은 한국미기록종으로 밝혀졌다.