

Taxonomic Account on the Scytosiphonaceae (Phaeophyta) from Ullungdo Island, Korea

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鬱陵島産 褐藻植物 고리매목에 대한 分類學的 檢討

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ABSTRACT

Taxonomic account is given to the five species of Scytosiphonaceae, *Colpomenia peregrina* (Sauvageau) Hamel, *Endarachne binghamiae* J. Agardh, *Hydroclathrus clathratus* (C. Agardh) Howe, *Petalonia fascia* (O. F. Müller) Kuntze, and *Scytosiphon lomentaria* (Lyngbye) Link, collected from Ullungdo Island, Korea. *C. peregrina*, introduced for the first time in Korea, is similar to *C. sinuosa* (Roth) Derbès et Solier in outer appearance but is distinguished by absence of cuticle over the plurilocular sporangial sori. *E. binghamiae* accords well with American plants but varies in height and width of the thallus according to seasons. *H. clathratus* has small cortical cells and large clear medullary cells. *P. fascia* is characterized by one to two celled small cortical layer and two to four celled large medullary layer. *S. lomentaria* shows variation in gross morphology, especially in height and width of thallus according to seasons

INTRODUCTION

The family Scytosiphonaceae Farlow belongs to Scytosiphonales, Phaeophyta and consists of six genera. Members of this taxon are winter annual and commonly collected in intertidal and subtidal zones. The family is characterized by unbranched, polystichous thallus and diffuse growth (Womersley, 1987).

In Korea, six species of Scytosiphonaceae are listed up to now (Lee and Kang, 1986). Most of them, however, have been recorded as floristic list without any taxonomic description. In this study, we attempt to clarify the taxonomic characteristics of five species collected from Ullungdo Island, Korea.

MATERIALS AND METHODS

Plants were collected in intertidal to subtidal zones

along the coast of Ullungdo Island from November, 1989 to September, 1991. They were fixed with 5-10% formalin seawater. Glycerin seawater (1:1) was used as mounting agent for microscopic observation. The specimens examined were preserved in the Herbarium, Department of Biology, Seoul National University (SNU).

KEY TO THE GENERA OF SCYTOSIPHONACEAE

1. Thallus solid and strap shaped 2
1. Thallus hollow and globular or tubular 3
 2. Medulla composed of hyphal cells, paraphyses absent *Endarachne*
 2. Medulla composed of large rectangular cell, paraphyses present *Petalonia*
3. Thallus erect and tubular *Scytosiphon*
3. Thallus irregularly globular and pulvinate 4

4. Thallus membranous, cortex composed of 2-4 small cells *Colpomenia*
 4. Thallus reticulately perforated, cortex composed of 1-2 small cells *Hydroclathrus*

DESCRIPTION OF TAXA

Genus *Colpomenia* (Endlicher) Derbès et Solier 1851

Korean name : 불레기말속 (Bulregimal-sok)

Type species : *Colpomenia sinuosa* (Mertens ex Roth) Derbès et Solier 1851

Plants epilithic or epiphytic, irregularly globular to convolute or elongate-ovoid, hallow, thin to crisp membranous, attached crustosely spreading in base, light golden brown, diffuse in growth, polystichous in structure; cortical cells small, pigmented; medullary cells large, clear; phaeophycean hairs scattered in groups, sunken within pits.

The genus *Colpomenia*, of which type species is *Colpomenia sinuosa* (Mertens ex Roth) Derbès et Solier, includes seven to eight species and widely distributed in temperate and tropical zones (Clayton, 1975; Parsons, 1982). *C. sinuosa* (Roth) Derbès et Solier and *C. bullosa* (Saunders) Yamada have been reported from all the coasts of Korea (Kang, 1966; Lee and Kang, 1986). *C. peregrina* (Sauvageau) Hamel is the species, recorded for the first time in Korea.

Colpomenia peregrina (Sauvageau) Hamel 1937

(Text-Figs: 1A-D, 6A-D)

Korean name : 불레기말사촌 (Bulregimalsachon, nom. nov.)

Basionym : *Colpomenia sinuosa* var. *peregrina* Sauvageau 1927

References : Hollenberg and Abbott, 1966, p. 22; Clayton, 1975, p. 185, figs. 8-11; Abbott and Hollenberg, 1976, p. 204, fig. 167; Parsons, 1982, p. 295-297, figs. 6-7; Womersley, 1987, p. 298, figs. 107B, 108G-H.

Plants epilithic or epiphytic, globular, folded, membranous, hollow, filled with water, 3-5 cm in diam., light brown to yellowish green, polystichous in structure; cortices (2-)-3-4 cell-layered; cortical cells small, pigmented, 15-20 μm in diam.; medullae 2-4(-6) celled layered; medullary cells large, 75-125 μm in diam.; plurilocular sporangia without cuticle; paraphyses one celled, 20-30 μm long, 10-20 μm broad, golden brown; phaeophycean hairs scattered in group.

Type locality : Brittany, France (Hollenberg and Abbott, 1966).

Habitat : On rocks or other plants in subtidal zone.

Distribution : California (Hollenberg and Abbott, 1966), Southern Australia (Parsons, 1982; Womersley, 1987).

Collections examined : Dodong (16 Sep. 1990; 26 Feb. 1991), Hyunpo (11 May 1990), Naesujeon (10 May 1990), Tonggumi (21 May 1990).

Colpomenia peregrina was first described as a form of *C. sinuosa* (Mertens ex Roth) Derbès et Solier by Sauvageau (1927) and elevated as a species by Hamel (1937). It has been confused with *C. sinuosa* because they are very similar to each other in outer appearance (Hollenberg and Abbott, 1966; Abbott and Hollenberg, 1976; Parsons, 1982). In description of the plants from the Monterey Peninsula, Hollenberg and Abbott (1966) distinguished this species from *C. sinuosa* by a thinner, smoother, and smaller size of thallus. Clayton (1975), however, using a hybrid index method and analysis of variance, compared *C. peregrina* with *C. sinuosa* and concluded that these two species could be distinguished by the shape of sorus, the absence or presence of cuticle over plurilocular sporangia, and the number of colourless medullary cells in the thallus. Parsons (1982) accepted Clayton's criteria in descriptions of the plants from New Zealand.

Until now, only *C. sinuosa* has been reported from Korea and Japan (Okamura, 1936; Kang, 1966; Lee and Kang, 1986; Yoshida *et al.*, 1990). Therefore, this is the first record of the species from north-eastern countries.

C. peregrina collected from Ullungdo Island accords well with Parsons (1982), and is distinguished from *C. sinuosa* by sorus shape and absence of cuticle over the plurilocular sporangial sori (Figs. 1D, 6B-C; Table 1). We could not examine all the specimens indentified as *C. sinuosa* from other localities in Korea. However, we think that many reports on *C. sinuosa* in Korea may be based on the specimens of *C. peregrina* or mixtures of the both species depending on localities.

Genus *Endarachne* J. Agardh 1896

Korean name : 미역쇠속 (Miyeoksoi-sok)

Type species : *Endarachne binghamiae* J. Agardh 1896

Plants epilithic, plane, attached by small discoid holdfast, dark brown, polystichous in structure; medullae densely interwoven by branched hyphal cells; paraphyses unknown; phaeophycean hairs scattered on surface of plants.

Endarachne is a monotypic genus and distributes along the North Pacific coasts (Abbott and Hollenberg, 1976). *E. binghamiae* J. Agardh has been reported from the coa-

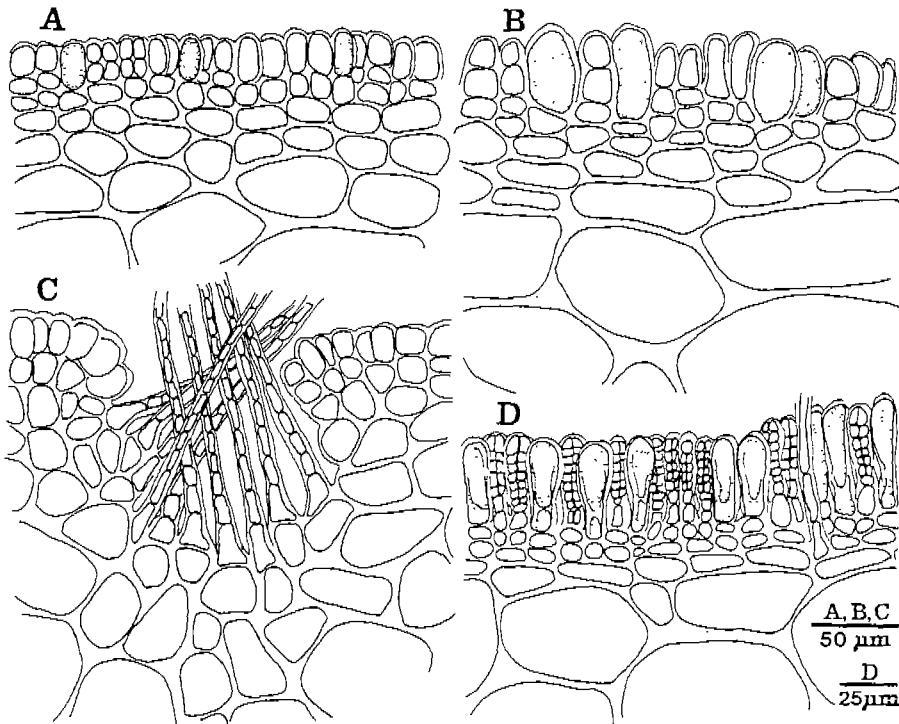


Fig. 1. *Colpomenia peregrina* (Sauvageau) Hemel. A, cross-section of vegetative plant; B, younger paraphyses; C, phaeophyceyan hairs originated from internal cortical layer; D, plurilocular sporangia and paraphyses without cuticle.

Table. 1. A comparison of some taxonomic characters to distinguish *Colpomenia peregrina* from *C. sinuosa*

Characters	<i>C. sinuosa</i>	<i>C. peregrina</i>	<i>C. peregrina</i>
Colour	light brown	yellowish green	light brown yellowish green
Thallus shape	globular folded	globular	globular to irregular
Hair origin	epidermal cortex	internal cortex	internal cortex
Medullary layer	4-5-(6) celled	2-4-5 celled	2-4-(6) celled
Sorus shape	punctate	extensive	extensive
Cuticle on sorus	present	absent	absent
	Parsons(1982) Womersley(1987)	Parsons(1982)	this study

sts of Korea and Japan (Kang, 1966; Lee and Kang, 1986; Yoshida *et al.*, 1990).

Endarachne binghamiae J. Agardh 1896

(Text-Figs: 2A-D, 6D, E)

Korean name : 미역취 (Miyeoksoi)

References : Setchell and Gardner, 1925, p. 538, plate 38, figs. 37, 38; Okamura, 1936, p. 233, fig. 126; Abbott and Hollenberg, 1976, p. 200-202, fig. 164; Rhew and Boo, 1991, p. 45-51.

Plants epilithic, aggregated, attached by discoid holdfast, 10-20 cm high, 1-3 cm broad, 130-250 μm thick, light brown to dark brown, polystichous in structure; cortices composed of 2-4 cells; cortical cells small, pigmented, 15-20 μm in diam.; medullae interwoven by hyphal cells; plurilocular sporangia uniseriate to biseriate, in (4-)8-18 rows of compartment, 40-50 μm broad; phaeophyceyan hairs scattered on thallus surface in group.

Type locality : Santa Babara, California (Setchell and Gardner, 1925).

Habitat : On rocks in intertidal to subtidal zones.

Distribution : Pacific North America (Abbott and Hollenberg, 1976), Japan (Okamura, 1936), Korea (Lee and Kang, 1986).

Collections examined : Cheonbu (27 Nov. 1989; 10 May 1990), Dodong (16 Feb. 1991; 16 Sep. 1990), Hyunpo (11

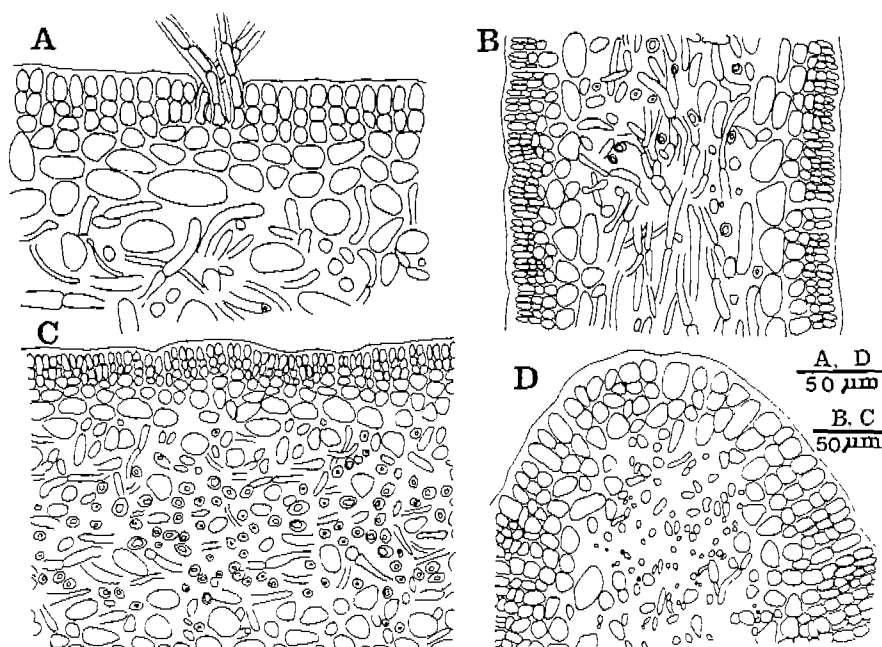


Fig. 2. *Endrarchne binghamiae* J. Agardh. A, phaeophycean hairs on vegetative plant; B, longitudinal section of vegetative plant; C, the same in cross-section; D, cross-section of marginal part of plant.

May 1990), Jeodong (26 Nov. 1991), Sadong (29 Nov. 1989), Sommok (17 Feb. 1990).

The genus *Endrarchne* has been easily confused with *Petalonia* in taxonomic criteria. However, the former is distinguished by densely interwoven hyphal cells in medullary tissue (Setchell and Gardner, 1925) and absence of paraphyses between plurilocular sporangia (Abbott and Hollenberg, 1976). In morphological study of *E. binghamiae* from the east coast of Korea, Rhew and Boo (1991) reported that this species showed large morphological variations according to seasons and localities and suggested that *Petalonia zostericola* which often has hyphal cells might be classified in genus *Endrarchne*.

Most of the plants from Ullungdo Island were collected at intertidal and subtidal zones from September to next May. They show a similar phenology with plants from Sinnam, Hupo and Ganggu, eastern coasts of Korea (Rhew and Boo, 1991). They accord well with the American plants (Setchell and Gardner, 1925; Abbott and Hollenberg, 1976) and Japanese plants (Okamura, 1936). Most plants collected in May have plurilocular sporangia and short and wide blades, 5-15 cm height and 2-3 cm width. However, plants in September and November have slender blades, 10-25 cm height and 1-2 cm width (Fig. 6D, E). The cortex is composed of 2-4 rectangular cells

and is 5-10 μm in diameter. The medullary tissue has distinctive hyphal cells which are densely interwoven and run toward longitudinal direction (Fig. 2).

Genus *Hydroclathrus* Bory 1825

Korean name : 그물바구니속 (Gmulbaguni-sok)

Type species : *Hydroclathrus clathratus* (C. Agardh) Howe 1920 (Womersley, 1987).

Plants irregularly globular, convolute, hollow, perforated, membranous, light brown; plurilocular sporangia scattered over surface of thallus; phaeophycean hairs scattered in group.

Two species, the type species *Hydroclathrus clathratus* (C. Agardh) Howe and *H. tenuis* Tseng and Lu, have been reported (Womersley, 1987). The former species only has been reported from the coasts of Korea (Kang, 1966; Lee and Kang, 1986).

Hydroclathrus clathratus (C. Agardh) Howe 1920

(Text-Figs; 3A-C, 6F)

Korean name : 그물바구니 (Gmulbaguni)

Basionym : *Fucus clathratus* Bory ex C. Agardh 1822 (Earle, 1969)

References : C. Agardh, 1822, p. 412; Setchell and Gardner, 1925, p. 543; Okamura, 1936, p. 232, fig. 125; Lin-

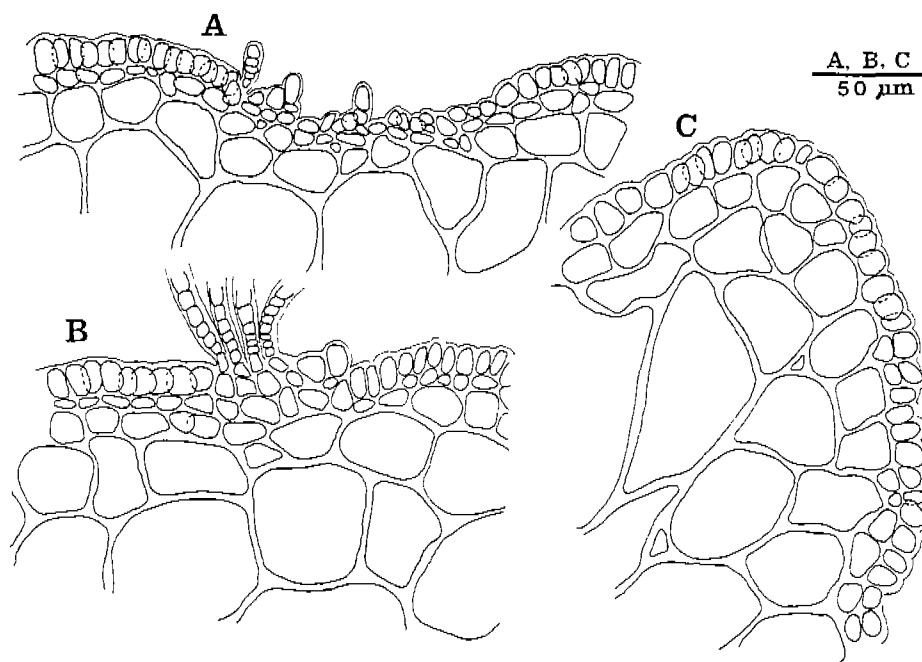


Fig. 3. *Hydroclathrus clathratus* (C. Agardh) Howe. A, longitudinal section of vegetative plant; B, phaeophyceyan hairs originated from cortical cells; C, cross-section of marginal part of plant.

dauer *et al.*, 1961, p. 262, fig. 65; Earle, 1969, p. 202, fig. 103; Womersley, 1987, p. 300, figs. 109A, 110A-B.

Plants epilithic, globular, folded, perforated, hollow, 1-5 cm high, 2-10 cm in diam., dark brown, polystichous in structure; cortices one to two cell-layered; cortical cells small, pigmented, 5-10 μm in diam.; medullae multi-cell-layered; medullary cells large, 50-150 μm in diam., thick walled; phaeophyceyan hairs scattered in group over thallus surface.

Type locality: Bell Isl. France (Womersley, 1987).

Habitat: On rocks in intertidal zones and subtidal zones (1-2 m in depth).

Distribution: Pacific North America (Setchell and Gardner, 1925); Japan (Okamura, 1936), New Zealand (Lindauer *et al.*, 1961), Eastern Gulf of Mexico (Earle, 1969), Southern Australia (Womersley, 1987), Korea (Lee and Kang, 1986).

Collections examined: Tonggumi (27 Nov. 1989; 2 Nov. 1991), Dodong (16 Sep. 1990).

Hydroclathrus clathratus is distinctive in morphology and has been reported from tropical to warm temperate regions (Earle, 1969; Womersley, 1987). It has been reported from all the coasts of Korea (Kang, 1966).

A few plants were collected on the subtidal rocks (1-

2 m in depth) from Ullungdo Island in September and November. Most plants in September are small in size, 2-5 cm in diam. and 1-2 cm in height. However, the plants collected in November are 5-10 cm in diam. and 3-5 cm in height. They are all vegetative without any reproductive structures and have one to two pigmented globular cortical cells. Medullary cells are irregular in shape and size and 30-50 μm in diam (Fig. 3). Phaeophyceyan hairs, originated from outmost cortical cells, are scattered on the thallus surfaces (Fig. 3).

Genus *Petalonia* Derbès et Solier 1850 nom. cons.

Korean name: 개미역쇠속 (Gaemiyeoksoi-sok)

Type species: *Petalonia debilis* (C. Agardh) Derbès et Solier 1850)

Plants epilithic, erect, arising from discoid holdfast, light brown; cortices two to three cell-layered; cortical cells small, pigmented; medullae composed of large colourless cells, thick walled; phaeophyceyan hairs scattered on both sides surface of thallus.

The genus *Petalonia* is widely distributed in temperate waters and includes two to three species (Womersley, 1987). *P. fascia* only has been reported from the coasts of Korea (Kang, 1966; Lee and Kang, 1986).

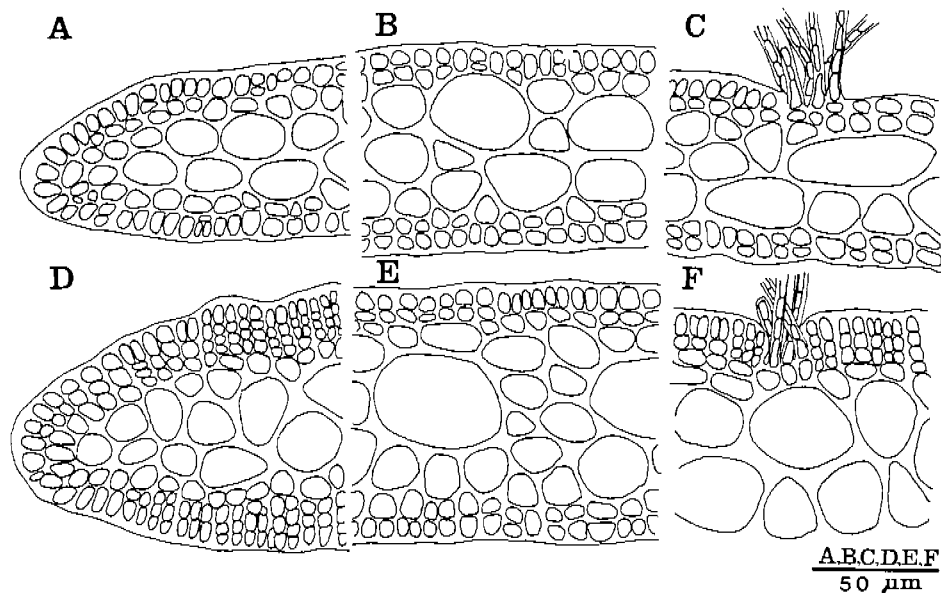


Fig. 4. The vegetative structures of *Petalonia fascia* (Müller) Kuntze. A-C, structures of upper part of plant (A,B: cross-section; C, longitudinal section); D-F, structures of lower part of plant (D,E: cross-section; F, longitudinal section).

***Petalonia fascia* (Müller) Kuntze 1898**

(Text-Figs: 4A-F, 6G)

Korean name : 개미역취 (Gaemiyeoksoi)

Basionym : *Fucus fascia* Müller 1778 (Earle, 1969)

Synonym : *Ilea fascia* (Müller) Fries in Setchell and Gardner, 1925; Okamura, 1936; Tokida, 1954.

References : Setchell and Gardner, 1925, p. 535, figs. 69-71, 73, pl. 44; Okamura, 1936, p. 134; Tokida, 1954, p. 107; Kang, 1966, p. 48; Lindauer *et al.*, 1961, p. 225, fig. 64(5-7); Earle, 1969, p. 255, fig. 64; Womersley, 1987, p. 282, figs. 106A, 108A-B.

Plants epilithic, erect, lanceolate, 5-15 cm high, 1-2 cm broad, light brown, polystichous in structure; cortices 1-2 cell-layered; cortical cells small, pigmented, 5-10 μm in diam.; medullae 2-4 cell-layered; medullary cells large, not pigmented, irregularly composed, thickened in cell wall, 25-230 μm in diam.; phaeophyccan hairs rare, single or in small group, scattered on both surfaces of thallus.

Type locality : Christiansund, Norway (Womersley, 1987).

Habitat : On rocks in the intertidal to subtidal zones.

Distributions : Pacific North America (Setchell and Gardner, 1925); Japan (Okamura, 1936; Tokida, 1954), New Zealand (Lindauer *et al.*, 1961), Eastern Gulf of Mexico (Earle, 1969), Southern Australia (Womersley, 1987), Korea (Lee and Kang, 1986).

Collections examined : Sommok (17 Feb. 1990), Thaeha (12 Dec. 1990), Tonnggumi (28 Nov. 1989; 16 Feb. 1990).

Petalonia fascia was first described as a species of *Fucus* by Müller (1778). Fries (1835), however, removed this species to the genus *Ilea*, which had been usually accepted by others (Setchell and Gardner, 1925; Okamura, 1936; Tokida, 1954) until *Petalonia* was conserved against it. Setchell and Gardner (1925) suggested five forms of this species by the shape of thallus and stipe. Tokida (1954) also described two forms from Saghalien. However, Womersley (1987) did not accept these forms in description of Australian plants.

It has been collected from all the coasts of Korea (Kang, 1966; Lee and Kang, 1986). The plants from Ullungdo Island were collected at intertidal and subtidal zones from November to February, growing together with *Endarachne binghamiae*. The cortex of thallus is 1-2 cell-layered in upper part and 3-4 in lower part (Fig. 4). Plants from Ullungdo Island have short slender thallus, 5-15 cm height and 1-2 cm width, compared with Australian plants (Womersley, 1987) and American plants (Schneider and Searles, 1991). Most of them were sterile with little morphological variations in height and width of thallus as well as stipe length. Therefore, the forms suggested by Setchell and Gardner (1925) were not recognizable in Ullungdo Island.

Genus *Scytosiphon* C. Agardh 1820 nom. cons.

Korean name : 고리메속 (Gorimae-sok)

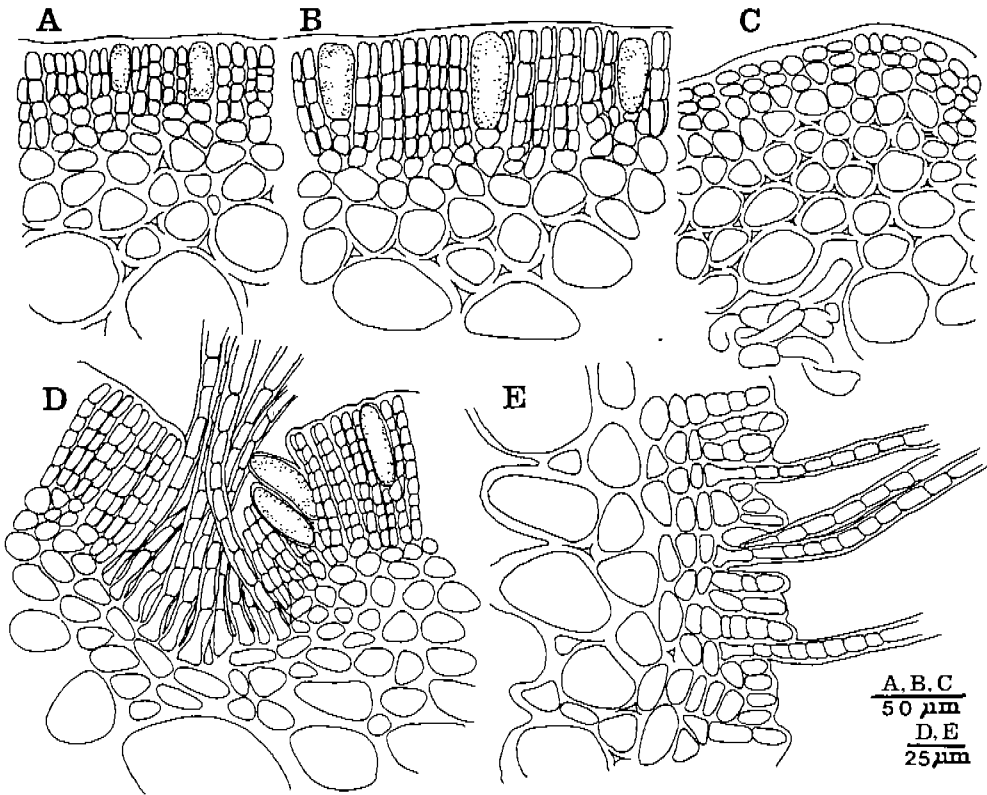


Fig. 5. *Scytosiphon lomentaria* (Lyngbye) Link. A, younger paraphyses of vegetative plant; B, cross-section of plant; C, cross-section of constricted part of plant; D, phaeophycecan hairs; E, longitudinal section of plant.

Type species: *Scytosiphon lomentaria* (Lyngbye) Link 1833 (type cons.)

Plants epilithic, tubular, unbranched, constricted at intervals or compressed, erected from discoid holdfast, dark brown, polystichous in structure; cortical cells small, pigmented; medullae hyaline, consisted of 2-4(6) large cells; phaeophycecan hairs abundant, scattered in group.

The genus *Scytosiphon* has been reported from temperate to tropical regions (Womersley, 1987). *S. lomentaria* has been reported from the coasts of Korea and Japan including several forms (Lee and Kang, 1986; Yoshida *et al.*, 1990).

***Scytosiphon lomentaria* (Lyngbye) Link 1833**

(Text-Figs: 5A-E, 6H, I)

Korean name: 고리매 (Gorimae)

Basionym: *Chorda lomentaria* Lyngbye 1819 (Lindauer *et al.*, 1961)

References: Setchell and Gardner, 1925, p. 531, pls. 44, figs. 72, 74, 75; Okamura, 1936, p. 227-228, fig. 121;

Tokida, 1954, p. 103; Kang, 1966, p. 46; Lindauer *et al.*, 1961, p. 256, fig. 65; Womersley, 1987, p. 246.

Plants epilithic, erect, unbranched, tubular, constricted at intervals of several centimeters, 15-30 cm high, 1-5 mm broad, dark brown, polystichous in structure; cortices 2-3 cell-layered; cortical cells small, pigmented, 5-10 μm diam.; medullae 5-7 cell-layered; medullary cells large, hyaline, enlarged toward pith, 20-80 μm in diam.; phaeophycecan hairs scattered in group.

Type locality: Quivig, Faroe Island (Womersley, 1987).

Habitat: On rocks in intertidal zone and in tide pools.

Distribution: Pacific coasts from Alaska to Southern California (Setchell and Gardner, 1925), Japan (Okamura, 1936; Tokida, 1954), Australia and New Zealand (Lindauer *et al.*, 1961), Korea (Lee and Kang, 1986).

Collections examined: Cheonbu (24 May 1991), Dodong (22 Feb. 1991), Naesujeon (10 May 1990), Summok (17 Feb. 1990), Taeha (22 Dec. 1990), Tonggumi (10 May 1990).

The species of *Scytosiphon* have been reported all over

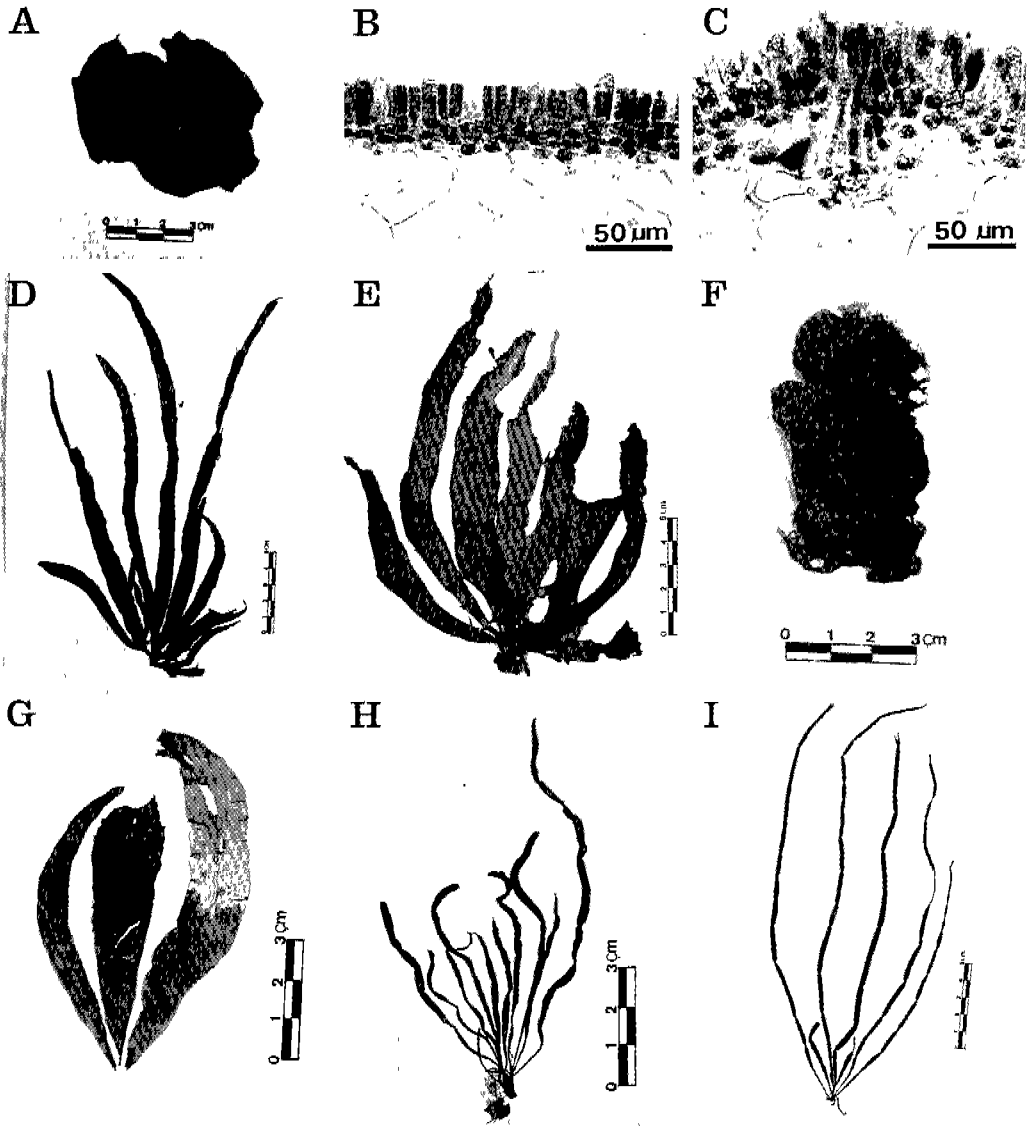


Fig. 6. The morphologies of Scytosiphonaceae from Ullungdo Island. A, *Colpomenia peregrina* (Sauvageau) Hamel; B, plurilocular sporangia without cuticle in *C. peregrina*; C, phaeophyceyan hairs originated from interal cortical layer of *C. peregrina*; D, *Endrarchne binghamiae* J. Agardh collected in November; E, *E. binghamiae* collected in May; F, *Hydroclathrus clathratus* (C. Agardh) Howe; G, *Petalonia fascia* (Müller) Kuntze; H, *Scytosiphon lomentaria* (Lyngbye) Link collected in November; I, *S. lomentaria* collected in May.

the world (Womersley, 1987). One species, *S. lomentaria* including two forms, has been collected along the coasts of Korea (Kang, 1969; Lee and Kang, 1986). It was reported to vary easily in height and width of thallus, in frequency of constriction of thallus, and in cell size. Therefore, Setchell and Gardner (1925) suggested six forms in this species from the Pacific North America. In Japan

and Korea, these criteria have been generally accepted (Okamura, 1936; Tokida, 1954; Kang, 1966). However, Womersley (1987) pointed out that such characters were variable according to communities and seasonal condition, and did not accept the criteria in description of Australian plants.

The plants from Ullungdo Island were collected on

the intertidal rocks from September to next May. Thallus is composed of 2-3 globular cortical cells all over the parts and 4-5 large medullary cells with thickened wall (Fig. 5). The plants collected in May are larger in height by 10-30 cm height and 3-5 mm width than those in November and February, 5-10 cm height, 2-5 mm width (Fig. 6H, I). The thallus is hollow and often constricted at intervals of 1-5 cm.

They accord with the plants of Okamura (1936), Tokida (1954) and Setchell and Gardner (1925), although no forms are recognizable except for the typical one.

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摘 要

鬱陵島 갈조식물 고리매과(Scytosiphonaceae)의 5종에 대한 分類學的 檢討를 수행하였다. *Colpomenia peregrina* (블레기말사촌)은 한국 미기록 식물이며 외부 형태에서는 *C. sinuosa*와 매우 유사하지만 前者는 복자낭을 싸고 있는 cuticle을 갖지 않는다는 점에서 後者와 구분되었다. *Endarachne binghamiae*(미역쇠)는 북미산 식물들과 그 분류형질에서 잘 일치하지만 체장과 체폭이 계절에 따라 차이를 보였다. *Hydroclathrus clathratus*(그물바구니)는 1-2개의 색소가 침적된 皮層細胞와 크고 불규칙하게 배열된 內皮層細胞를 갖는 특징을 보였다. *Petalonia fascia*(개미역쇠)는 1-2개의 皮層細胞를 가지며 2-4개의 크고 불규칙한 內皮層細胞를 갖는 특징을 보였다. *Scytosiphonia lomentaria* (고리매)는 계절에 따라 체형에서 다양성을 보이며 특히 체장, 체폭에서 차이를 보였다.

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