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Notes on Marine Algae from Korea (III)

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韓國産 海藻類의 註解 (III)

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ABSTRACT

Four species of marine algae, 3 red and 1 brown algae, were newly found from southern coast of Korea including Cheju Island in the course of floristic study. *Amphiroa itonoi* Srimanobhas et Masaki and *Hypnea variabilis* Okamura were collected from intertidal zone and the others, *Aglaothamnion oosumiense* Itono and *Sphacelaria caespitosa* Takamatsu were from subtidal zone.

INTRODUCTION

To clarify taxonomic characteristics of Korean algae, this study was accomplished as one of the serial reports (Lee, 1972; Lee *et al.*, 1988). In this paper four species newly found to Korea were identified and described. The materials were collected from southern coast of Korea and Cheju island, and were preserved in the Herbarium, Department of Botany, Seoul National University (SNU).

Amphiroa itonoi Srimanobhas et Masaki (1987, p.1)
(Text-figs 1–2)
Korean name: 머부살이두층게발(nom. nov.)

Plants small, up to 6 mm high, issuing 3–6 erect fronds from crustose holdfast; holdfasts circular, 4–7 mm in diameter, partially embedded in intergenicular cortex of other *Amphiroa* by peg-like protrusions; fronds branching 1–2 times dichotomously, cylindrical to compressed above; epithallial concavities round to irregular, less than 7 μm in diameter; trichocytes frequent, lacking differentiated base; intergenicular medullae consisting of two different tiers, 10–25 μm high in short tiers, and 50–85 μm high in long tiers; genicula composed of two-celled tiers of unequal height, 15–25 μm high in upper tiers, 85–115 μm high in lower tiers, with oblique transverse walls between tiers; conceptacles occurring on erect and crustose

part, slightly protruding; tetrasporangial conceptacles 60–70 μm×100–110 μm in internal size; male conceptacles 30–40 μm×100–110 μm in internal size; carposporangial conceptacles 80–90 μm×130–140 μm in internal size, with 5–7 μm broad fusion cell.

Type locality: Ushinohama, Kagoshima Pref., Japan

Habitat: semi-endophytic on *A. dilatata, A. misakiensis* and *A. rigida* in upper sublittoral zone

Materials: Pyoson (May 14, 1987; Jan. 21, 1988), Gosan (Jan. 4, 1988), and Sungsan (Jan. 5, 1988) in Cheju Island

This plant was described for the first time by Srimanobhas and Masaki (1987) in upper sublittoral zone from Ushinohama located at the southern part of Japan. Comparing with related species, *A. currae* Gancsan (1971), *A. crustiformis* Dawson (1963), *A. rigida* Lamouroux (1816), and *A. verrucosa* Kützing (1858), Srimannobhas and Masaki (1987) introduced the new species by the following characters: a semi-endophytic habit, peg-like holdfasts and genicula always bearing two tiers of cells with oblique cross-wall between them.

Our plants were semi-endophytic on *A. misakiensis*. Three to six erect fronds generally arise from a holdfast and grow up to 6 mm high (Fig. 1A,B). The thallus is embedded in the cortex of the host plant by a wedge-shaped projection extending downward from crustose holdfast (Fig. 1D). The intergenicular medulla consists of alternating tiers of long and short cells (Fig. 1E). The intergenicular cortex is thin, consisting of one to four layers. Each geniculum consists of two tiers of cells, the longer lower tier and shorter upper tier (Fig. 1E,F).

The plants produce conceptacles on the intergenicula as well as on the holdfast (Fig. 2A). Such morphological and anatomical characters of thallus as well as reproductive structures of our plants accord well with those described by Srimanobhas and Masaki (1987).

Under Scanning Electron Microscopy (SEM), the intergenicular surface of *A. itonoi* has a series of pores separated by calcified regions (Fig. 1C). These epithallial concavities (cf. Garbary, 1978) are characterized by round to irregular outlines of the cell, showing less than 7 μm in diameter. Trichocytes are clearly observed as a simple pore lacking differentiated trichocyte base (Fig. 1C). They are usually conspicuous and common in our plants.

The species at present is found only from Cheju Island in Korea, except for the type locality.

Hypnea variabilis Okamura (1909, p. 21)

(Text-figs 3,4)

Okamura (1909) p. 21; Tanaka (1940) p. 227; Dawson (1961) p. 240; Abbott and Hollenberg (1976) p. 490.

Korean name: 통통가시우무 (nom. nov.)

Plants 4–7 cm high, erect from stoloniferous rhizoids, subcartilaginous, purplish red; main branches commonly patent, dichotomous to partially pinnate, mostly blunt but sometimes acute in apex, compressed in mid portion, gradually narrow cylindrical towards upper part, 2–2.5 mm broad, 1 mm thick; branchlets arising from upper frond, spine-like, issued

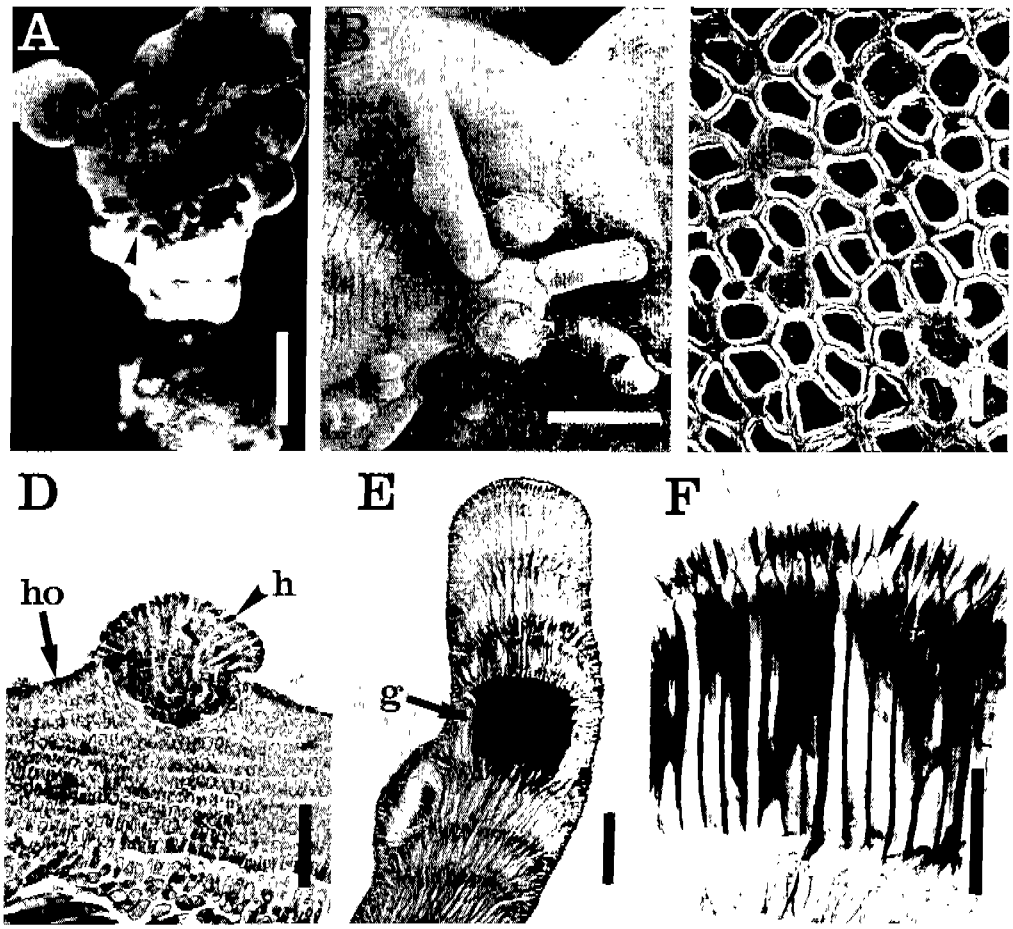

Fig. 1. *Amphiroa itonoi* Srimanobhas et Masaki.

A, B. *Amphiroa itonoi* (arrows) growing on host, other Amphiroan plant. C Surface view of intergeniculum. Note trichocytes (arrows) lacking differentiated base. D. Vertical section of holdfast. E. Longitudinal section of apical branch. F. Geniculum enlarged. Note two-celled tiers of unequal height with oblique transverse wall (arrow) between tiers. (g, geniculum; h, holdfast; ho, host plant. Scale: A, 0.5 cm; B, 500 μm; C, 5 μm; D,F, 50 μm; E, 100 μm).

irregularly all around branches, cylindrical, 0.5–1 mm thick; fronds in transverse section consisting of central core, medulla and cortex, without lenticular thickening in cells; tetrasporangial sori covering middle or lower portions of ultimate branchlets; tetrasporangia arising from 2nd to 3rd cortical cells from surface, dividing zonately, long elliptical, embedded in cortex, (20~) 25–30 (~35) μm broad, (50~) 55–70 (~80) μm long; plants not well adhering to paper in drying.

Type locality: Japan (not specially designated)

Habitat: rocks in lower intertidal zone

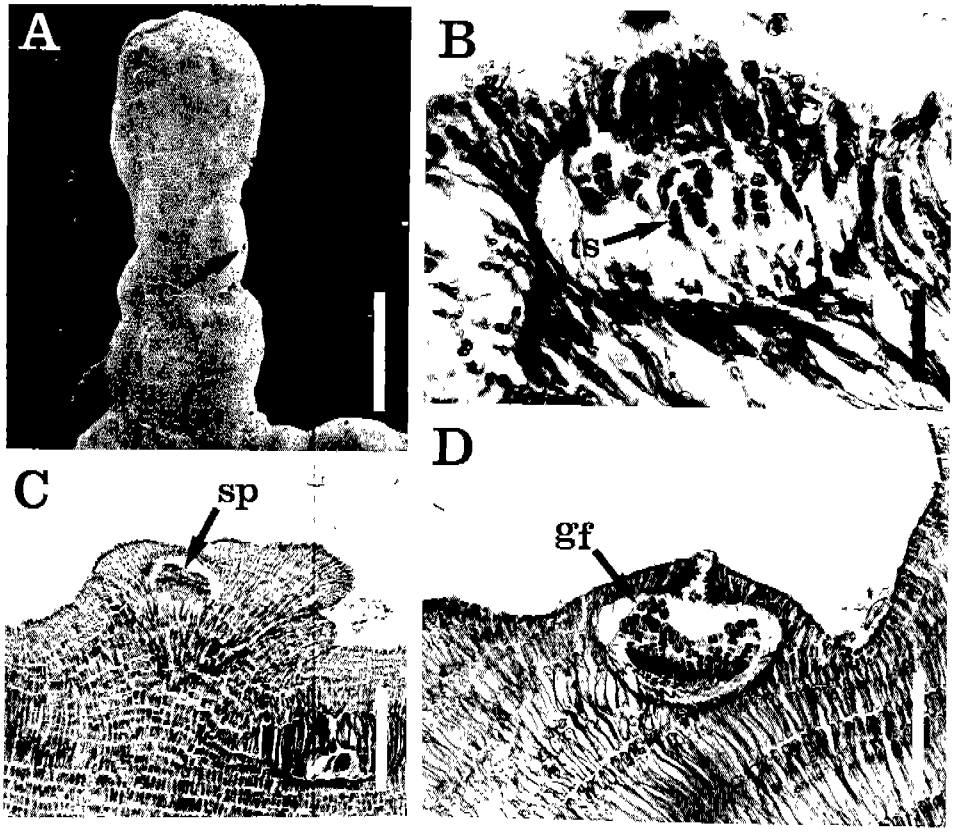

Fig. 2. *Amphiroa itonoi* Srimanobhas et Masaki.
A. Surface view of intergeniculum with conceptacles. B. Sectional view of tetrasporangial conceptacle. C. Sectional view of spermatangial conceptacle. D. Sectional view of carposporangial conceptacle. (c, conceptacle; gf, gonimoblast filament; sp, spermatangia; ts, tetrasporangia. Scale: A, 250 μm; B, 50 μm; C,D, 100 μm).

Distribution: Japan, California and Korea

Materials: Dongbaek Island, Pusan (Sept. 30, 1988; Aug. 15, 1989)

Okamura (1909) first reported this species from Japan, and placed it under the Section Virgatae established by J. Agardh (1852). According to him this species is much variable in ramification as shown in his figures (Okamura, 1909, Figs 1–5; Tanaka, 1941; Dawson, 1961). Our plants accord well with the Okamura's figure 3 in point of main dichotomo-pinnate branches with thicker ramuli (Fig. 3A). The other forms shown in Okamura (1909) are not collected yet. Thus, external compressed appearance of our specimens is seemed not so variable as implied by specific epithet.

Upper fronds in transection consist of 4–5 layered small cells in central core, 3–5 layered large cells in medulla surrounding core, and 1–2 layered small cells in cortex (Fig. 3B), while

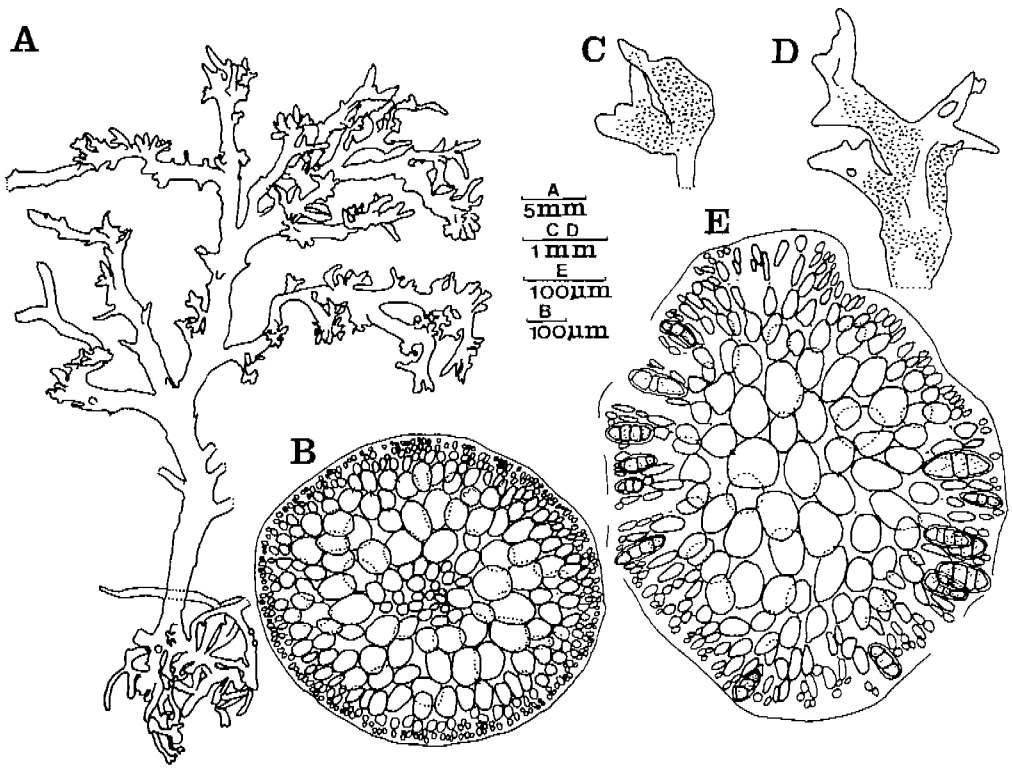

Fig. 3. *Hypnea variabilis* Okamura.
A. A part of tetrasporophytic plant; B, Upper frond in cross setion; C and D. Parts of branches bearing tetrasporangial sori; E. Tetrasporangial sori in cross section.

mid fronds consist of 4–5 layered small cells in central core, 4–5 layered large cells in medulla surrounding core, and 1–2 layered small cells in cortex (Fig. 4A). As in Californian plants, the lenticular thickening in cell wall is not observed in our material (Figs 3B, 4A: Dawson, 1961), although Tanaka (1941) observed such thickening rarely in Japanese plants.

The cortical cells in surface view are round to ovoid and, compactly arranged. They are 16–33 μm in diameter in lower (Fig. 4D), 13–33 μm in middle (Fig. 4C) and 13–25 μm in upper fronds (Fig. 4B). Secondary pit-connections among cortical cells are observed frequently in lower fronds, or often in mid and upper fronds (Fig. 4B,C and D).

Tetrasporangial sori are observed in ultimate branchlets in summer (Fig. 3C,D). Tetrasporangia arise from 2nd to 3rd cortical cells from surface (Fig. 4E). The divisions take place successively (Fig. 4F–H), and at the same time neighbouring vegetative cells become elongate slender in shape. Mature tetrasporangia are nearly two times larger than those of Californian plants (Figs. 3E, 4I: Dawson, 1961; Abbott and Hollenberg, 1976).

Gametophytic plants with either spermatangia or cystocarps have not been collected in California (Dawson, 1961) and Korea. According to Tanaka (1941), the cystocarps are almost

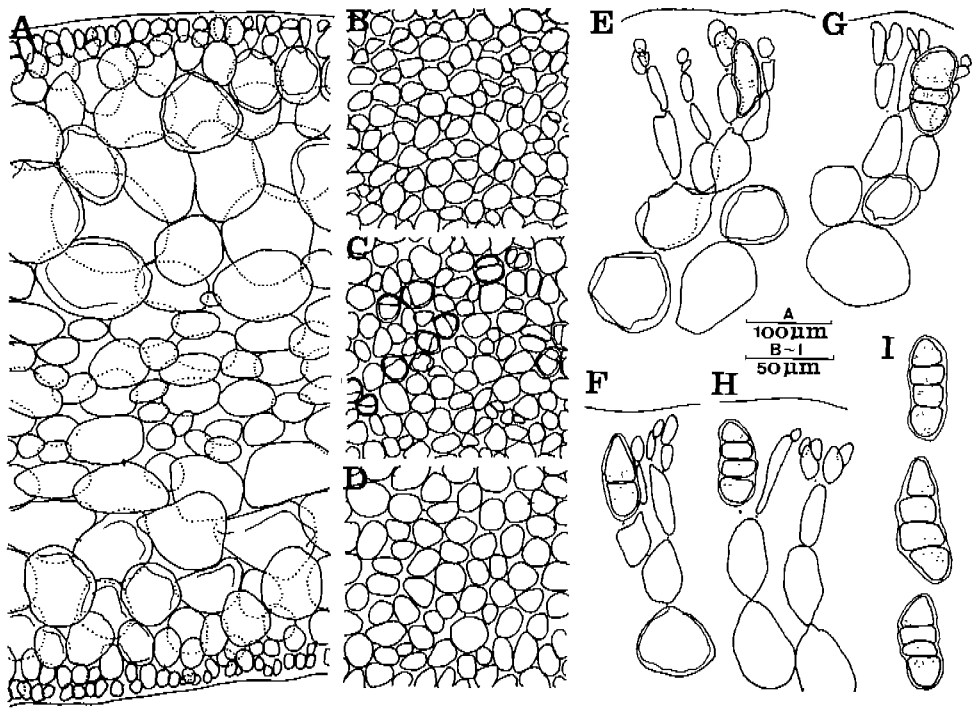

Fig. 4. *Hypnea variabilis* Okamura. A. Mid frond in cross section; B, C and D. Surface view of upper, mid and lower frond respectively; E and H. Tetrasporangium development; I. Mature tetrasporangia.

globular, sessile, and 500–1,000 μm in diameter on the portion of branches. The spermatangial mother cell is borne by a division of the superficial cortical cell and produces spermatangia terminally (Tazawa, 1975).

Aglaothamnion oosumiense Itono (1971, p. 217)
(Text-fig. 5)
Itono(1977) pp. 135–136, 205, 233, 275–276, figs. 19, 41, 62.
Korean name: 외깃말사촌 (nom. nov.)

Plants about 5 mm high, erect, epiphytic to epilithic; rhizoids multicellular, developing from lower axial cells, sparsely branched, ending with digitate holdfast; axis percurrent, ecorticated, producing alternate to subdichotomous branches; axial cells cylindrical, 50 μm×150 μm, 2–3:1 L/B; lateral branches arising from upper side of axial cell, alternate, 2–3 ordered, curved slightly towards main axis; gland cells absent; indeterminate branches produced at irregular intervals on axial segments, replacing lateral determinate branches, blunt in tip; branches and branchlets arranged on same plane; tetrasporangia subspherical to oblong, sessile, seriate, divided tetrahedrally, produced on adaxial side, rarely terminal portion of lateral branches, ca.

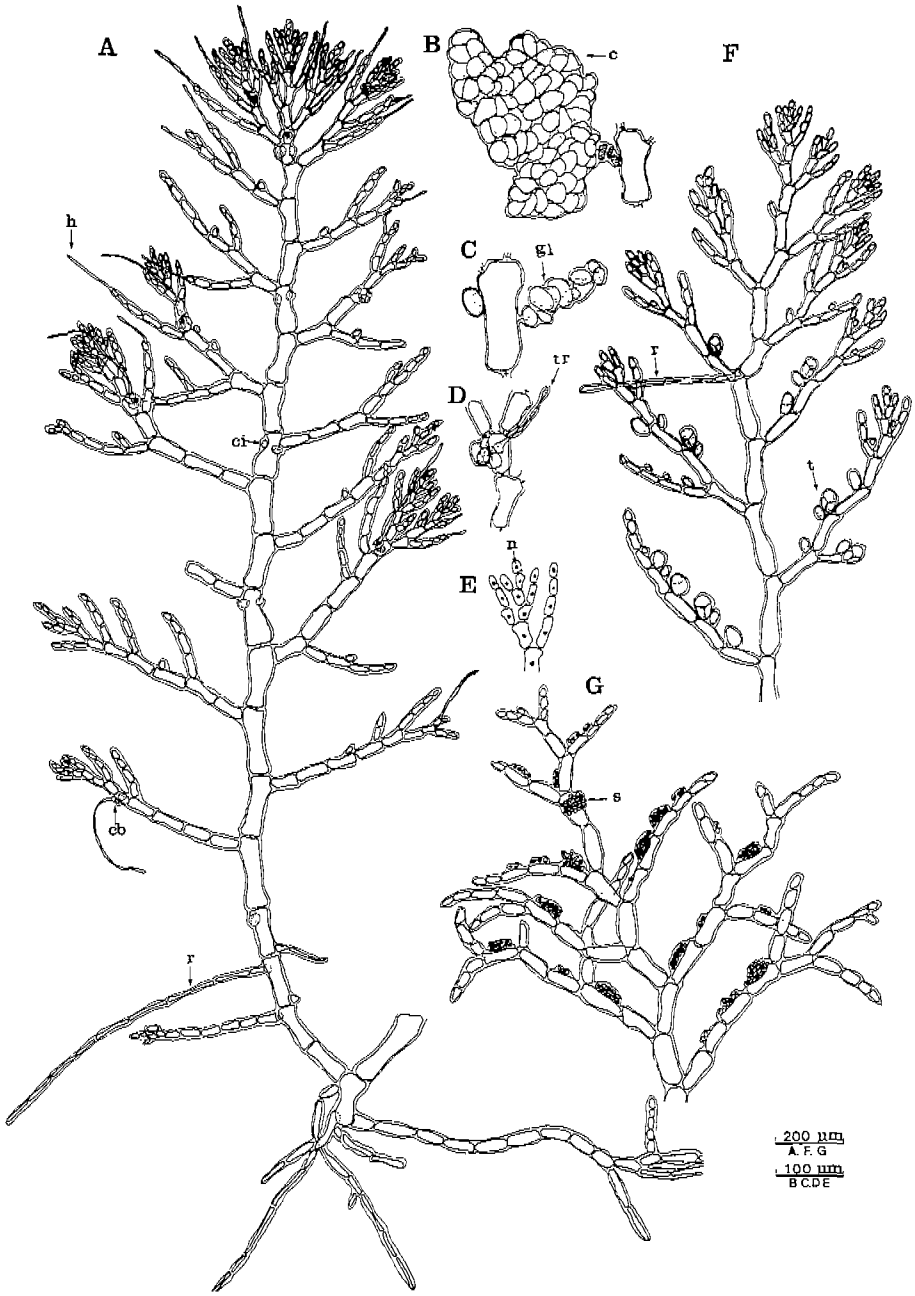

Fig. 5. *Aglaothamnion oosumiense* Itono. A. Female gametophyte. B. Cystocarp. C. Gonimoblast. D. Zig-zag type carpogonial branch. E. Apical portion stained with aceto-carmine. F. Tetrasporophyte. G. Male gametophyte. (c, cystocarp; cb, carpogonial branch; ci, carpogonium initial cell; h, hyaline hair; gl. gonimoblast; n, nucleus; r, rhizoid; s, spermatium; t, tetrasporangium; tr, trichogyne).

50 μm×70 μm; spermatangia clustered, adaxial on cells of lateral branches, seriate; lateral determinate branches in male plants recurved in fully mature condition; procarps zig-zag type; cystocarps lobed or irregular.

Type locality: Oosumi peninsula, Japan

Habitat: growing on other algae in 5–10 m depth

Materials: Moon islet in Cheju Island (Jan. 24, 1987)

Itono (1971) first reported this species from the Oosumi peninsula in southern part of Japan. He mentioned that this species was similar to *Callithamnion paschale* Børgesen in vegetative thallus but was distinguished by its three ordered lateral branching. Feldmann-Mazoyer (1940) separated the genus *Aglaothamnion* from *Callithamnion* by the characters of uninucleate cells and zig-zag type of procarps which developed into spherical to subspherical cystocarps. Kylin (1956), Dawson (1962) and Itono (1971, 1977) agreed with him, whereas Boddecke (1958) and Harris (1962) did not accept this genus, because the characters between both genera were overlapping and the number of nucleus was not generally accepted as a main character of genus until then. Boo (1984) also agreed with Feldmann-Mazoyer (1940) and mentioned that *C. paschale* Børg., *C. callophyllidicola* Yamada and this species were very similar to each other. Therefore, he suggested that according to the genus concept of *Aglaothamnion, C. callophyllidicola* should be transferred to the genus *Aglaothamnion.*

In this study, we collected lots of both the gametophytes and tetrasporophytes from the Moon islet in the southern part of Korea. Our plants are characteristic in having seriate tetrasporangia (Fig. 5F), much smaller thallus (4–5 mm) and conspicuously recurved spermatangiate lateral branches (Fig. 5G). The cells of branches are uninucleate (Fig. 5E). However, the vegetative morphology and female reproductive organs (Fig. 5A–D) of our plants are very similar to that of *C. callophyllidicola.* Thus, some further comparative studies should be neccessary for clarifing the taxonomic criterion between the both species.

Sphacelaria caespitosa Takamatsu (1943, p. 167)

(Text-fig. 6)

Korean name: 송이갯쇠털(nom. nov.)

Plants 2–5 mm high, epiphytic to parasitic, tufted to expanded, olive brown in color; basal strata small, adhering firmly to host plants; erect filaments attenuate towards base, slightly curved, 20 μm broad at base, 30–40 μm broad at middle portion of main axes; apical segments unicellular, cylindrical, round at apex, more or less long; rhizoids developed from basal portion of erect filaments, irregularly ramified; hairs not observed; propagules branched dichotomously, not curved, long stalked, commonly unilateral at middle portion of branches; unilocular sporangia globular, usually borne at lower portion, unilateral, always pedicellate with 1–2 cells, thickly walled, 60–100 μm in diameter; plurilocular sporangia oblong, borne unilaterally at upper portion, singly pedicellated, thin walled.

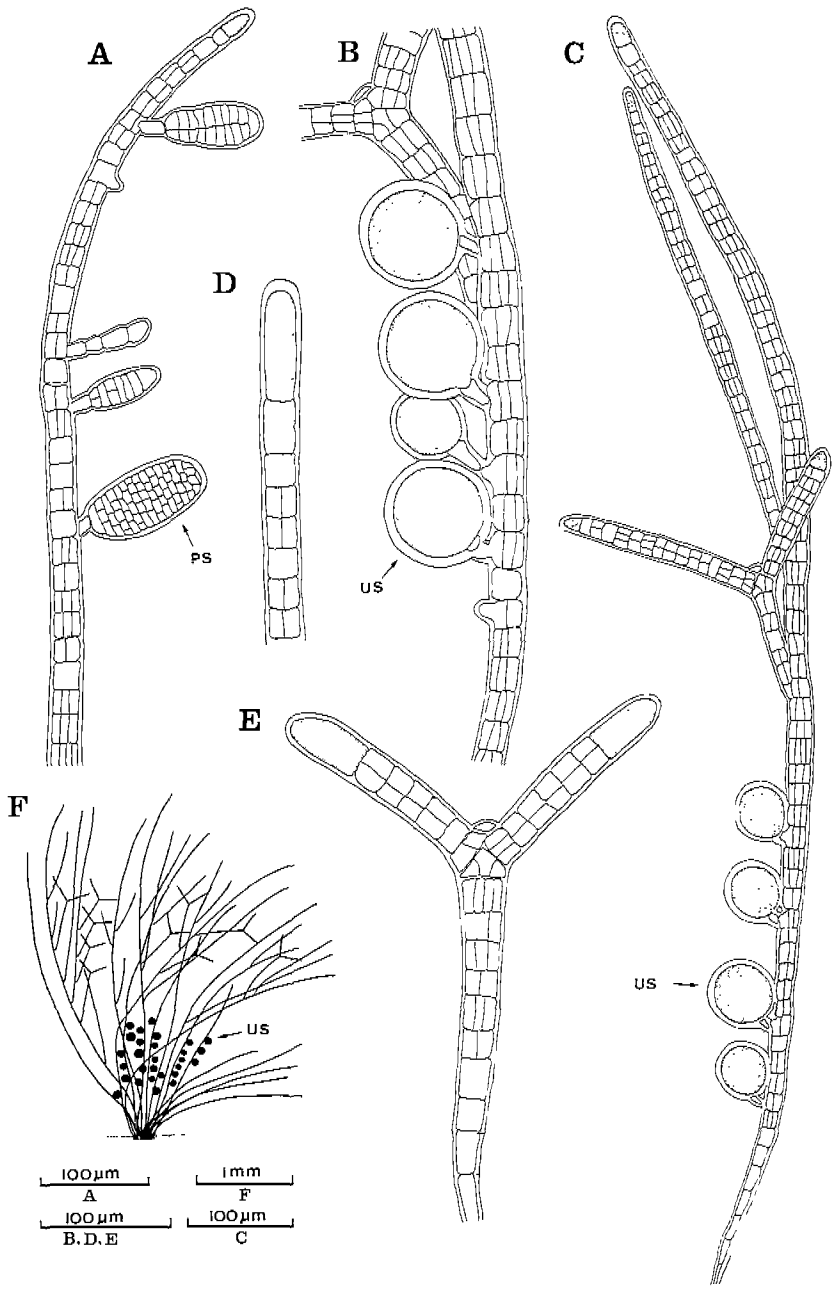

Fig. 6. *Sphacelaria caespitosa* Takamatsu.

A. Plurilocular sporangia borne unilaterally at upper portion of filament. B. Unilocular sporangia borne unilaterally at basal portion of filament. C. A habit of filament with unilocular sporangia. D. Terminal portion of erect filament. E. Propagule. F. Outlines of habit. (ps, plurilocular sporangia; us, unilocular sporangia).

Type locality: Mutsu Bay, Asamushi Province, Japan
Habitat: epiphytic on other algae in subtidal zone
Materials: Chaguido Islets in Cheju Island (Jan. 18, 1987)

In Korea twelve taxa of *Sphacelaria* are listed up to now (Lee and Kang, 1986). Among them taxonomic descriptions were given to the following 5 species; *S. fusca* Agardh and *S. californica* Sauvageau from the east coast (Boo and Choi, 1986), and *S. tribuloides* Meneghini, *S. subfusca* Setchell et Gardner, and *S. yamadae* Segawa from Cheju Island (Lee and Lee, 1987).

This minute plant *S. caespitosa* was firstly described by Takamatsu (1943) from the shore of Mutsu Bay, Asamushi and Sai Provinces in Japan. He identified it as a new species based on the following characters; olive brown colored filaments with strong ramification at upper portion, gradual attenuation towards the base, and especially dense and unilateral unilocular sporangia at lower portion of the branches. According to him, this species was closely related with *S. cirrhosa* Agardh (Sauvageau, 1902), except for the shape of propagules and the position of unilocular sporangia.

The plants from Cheju Island show caespitose and fascicular habit (Fig. 6F), and accord basically with the original description by Takamatsu (1943). Some differences, however, between the two plants are found such as habit, dimensions of filaments and unilocular sporangia. Our plants are smaller (2–5 mm high, 30–40 μm broad) than Japanese ones (5–11 mm high, 35–45 μm broad), and branch out unilaterally or rarely alternately (Fig. 6F), while no unilateral branches in Japanese plants. They are epiphytic on old thalli of *Sargassum* sp. at 5 m depth in subtidal zone, while the Takamatsu's plants were on the frond of *Coccophora langsdorfii* colleted from the lower intertidal zone.

The unilocular sporangia, one of the major criteria for determination of this species, arise densely and unilaterally at the lower portion of filaments (Fig. 6E). They are pedicellate with 1 or 2 cells in our plants (Fig. 6B), while are single-celled in Japanese plants. The size of unilocular sporangia becomes almost same between the two plants; 60–100 μm in Korea and 65–82 μm in Japan. The lower unilocular sporangia are also found in *S. linearis* Takamatsu (1943), but they occur sparsely in the latter.

Although there was no mention of plurilocular sporangia in original description, we could rarely observe single-celled pedicellate plurilocular sporangia. They were borne unilaterally and sparsely at the upper portion of main branches (Fig. 6A). The propagules occur at the middle portion of branches, which are produced in unilateral to dichotomous manner (Fig. 6E,F).

적 요

한국 해산 미기록 식물 4종, 홍조류 3종과 갈조류 1종, *Amphiroa itonoi* Srimanobhas et Masaki(너부살이 두층게발), *Hypnea variabilis* Okamura(동통가시우무), *Aglaothamnion oosumiense* Itono(외깃맞사촌) 및 *Sphacelaria caespitosa* Takamatsu(송이갯솔털)에 대하여 분류학적 검토와 기재를 하였다. *Amphiroa itonoi*

Srimanobhas et Masaki와 *Hypnea variabilis* Okamura는 조간대에서 채집된 재료이며 *Aglaothamnion oosumiense* Itono와 *Sphacelaria caespitosa* Takamatsu는 조하대에서 채집된 재료들이다.

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