

Ahnfeltiopsis (Gigartinales, Rhodophyta) in the western Pacific¹⁾

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Seven species of *Gymnogongrus* and two species of *Ahnfeltia* with internal cystocarps provided with specialized pores (carpostomes) from the western Pacific are transferred to *Ahnfeltiopsis* Silva et DeCew (Gigartinales, Rhodophyta). Tetrasporophytes of these species when known are crustose and form intercalary catenate series of tetrasporangia. A synoptical key to all known species of *Ahnfeltiopsis* from the western Pacific is given.

Key Index Words: Ahnfeltia—Ahnfeltiopsis—Gigartinales—Gymnogongrus—nomenclatural combination—Phyllophoraceae—Rhodophyta—western Pacific.

The red algal family Phyllophoraceae (Gigartinales) is characterized by multiaxial thalli with a compact and pseudoparenchymatous medulla, rod-shaped spermatia, a procarp consisting of a three-celled carpogonial branch provided with a sterile branchlet and a large supporting cell serving as an auxiliary cell, inward or outward development of gonimoblasts, unbranched chains of tetrasporangia, and iota- or iota-kappa carrageenans in gametophytes, lambda-carrageenans in sporophytes (Guiry *et al.* 1984). As recently as 1989, the Phyllophoraceae was assigned nine genera: *Ahnfeltia* Fries, *Besa* Setchell, *Ceratocolax* Rosenvinge, *Gymnogongrus* Martius, *Ozophora* J. Agardh, *Petroglossum* Hollenberg, *Phyllophora* Greville, *Schottera* Guiry et Hollenberg, and *Stenogramma* Harvey. In that year, *Ahnfeltia* was transferred to a new family, Ahnfeltiaceae, in a new order, Ahnfeltiales, characterized by unique compound external carposporophytes (Maggs and Pueschel 1989). Even more recently, two genera have been added to the Phyllophoraceae, *Erythrodermis* Batters (Guiry and Garbary 1990, Maggs 1990) and *Ahnfeltiopsis* Silva et DeCew (1992).

Ahnfeltiopsis was proposed by Silva and DeCew (in Silva 1979), but was not validly published until very recently (Silva and DeCew 1992). Meanwhile, the name has been used by various authors (McCandless *et al.* 1982, Masuda 1982, 1983, Maggs *et al.* 1989, Anderson and Bolton 1990, Maggs 1990, Lewis *et al.* 1991). The genus is characterized by internal cystocarps provided with specialized pores (carpostomes) and a heteromorphic-type of life history in which upright unisexual gametophytes alternate with a crustose tetrasporophyte. In contrast, *Gymnogongrus* has a tetrasporoblastic-type of life history in which gonimoblasts grow outwardly through the cortex of the thallus, giving rise to an external nemathelial structure over the surface of the bisexual gametophyte (Doubt 1935, Schotter 1968). Silva and DeCew (1992) transferred fourteen species previously assigned to *Ahnfeltia* or *Gymnogongrus* to *Ahnfeltiopsis*. Of these species, *Ahnfeltiopsis concinna* (J. Agardh) Silva et DeCew (= *Ahnfeltia concinna* J. Agardh), *A. densa* (J. Agardh) Silva et DeCew (= *G. densus* J. Agardh), *A. okamurae* Silva et DeCew (= *Ahnfeltia furcellata* Okamura), and *A. pygmaea* (J. Agardh) Silva et DeCew (= *G. pygmaeus* J. Agardh) are known from the western Pacific (Masuda, Zhang and Xia in preparation). The majori-

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ty of the western Pacific species, however, have not been transferred to the new genus. The following nine species are transferred to *Ahnfeltiopsis* herein. Abbreviations for herbaria follow Holmgren *et al.* (1990).

***Ahnfeltiopsis catenata* (Yendo) comb. nov.**

Basionym: *Gymnogongrus catenatus* Yendo 1920: 4 [lectotype locality: Ijika, Mie Prefecture, central Japan; lectotype specimen in TI (Masuda 1987, fig. 14)].

Japanese name: Hosobano-hira-saimi

Morphological features of gametophytes were described by Masuda (1987). Cystocarps are central in the medulla. Carpospore germlings of this species grew into crustose plants, but no reproduction was found about one year after germination.

***Ahnfeltiopsis chnoosporoides* (Tanaka et Pham) comb. nov.**

Basionym: *Gymnogongrus chnoosporoides* Tanaka et Pham 1962: 26, figs. 3, 4 [type locality: Con, Nha Trang, central Vietnam; holotype specimen in SAP (052162)].

Spermatangial and cystocarpic specimens of *Ahnfeltiopsis chnoosporoides* collected at the type locality on 5 March 1992 were examined. Spermatangia are anticlinally elongated. Cystocarps are internal, hemispherical, protruding, and provided with multiple carpostomes. Tetrasporophytes are crustose (Masuda, Huynh and Nguyen unpublished observations).

***Ahnfeltiopsis divaricata* (Holmes) comb. nov.**

Basionym: *Gymnogongrus divaricatus* Holmes 1896: 255, pl. 8: figs. 3a, 3b [type locality: Shimoda, Shizuoka Prefecture, central Japan; holotype specimen in BM (Masuda 1987, fig. 10A)].

Japanese name: Oomata-okitsunori

Morphological features of gametophytes were reported by Masuda (1987). Cystocarps are central in the medulla and provided with multiple carpostomes. Tetrasporophytes are crustose (Masuda unpublished).

***Ahnfeltiopsis flabelliformis* (Harvey) comb. nov.**

Basionym: *Gymnogongrus flabelliformis* Harvey 1857: 332 [type locality: Shimoda, Shizuoka Prefecture, central Japan; lectotype specimen in TCD (Masuda 1987, fig. 1A)].

Synonym: *Gymnogongrus japonicus* Suringar 1867: 259.

Japanese name: Okitsunori

Morphological features of gametophytes were described by several investigators (Okamura 1921, 1936, Tokida and Masaki 1959, Mikami 1965, Masuda 1987). Cystocarps are central in the medulla and provided with multiple carpostomes. Field-collected and cultured crustose tetrasporophytes were reported by Masuda *et al.* (1979) and Masuda (1981).

***Ahnfeltiopsis gracilis* (Yamada) comb. nov.**

Basionym: *Besa gracilis* Yamada 1931: 73, fig. 3 [type locality: Enoshima, Kanagawa Prefecture, central Japan; holotype specimen in SAP (9798)].

Synonym: *Ahnfeltia gracilis* (Yamada) Yamada et Mikami in Mikami 1965: 198, pl. 4 (1), text-figs. 11, 12.

Japanese name: Besa

This species has internal cystocarps which are central in the medulla (Mikami 1965). Because the holotype specimen shows only young stages of cystocarp development, carpostomes are not evident. Tetrasporophytes are unknown.

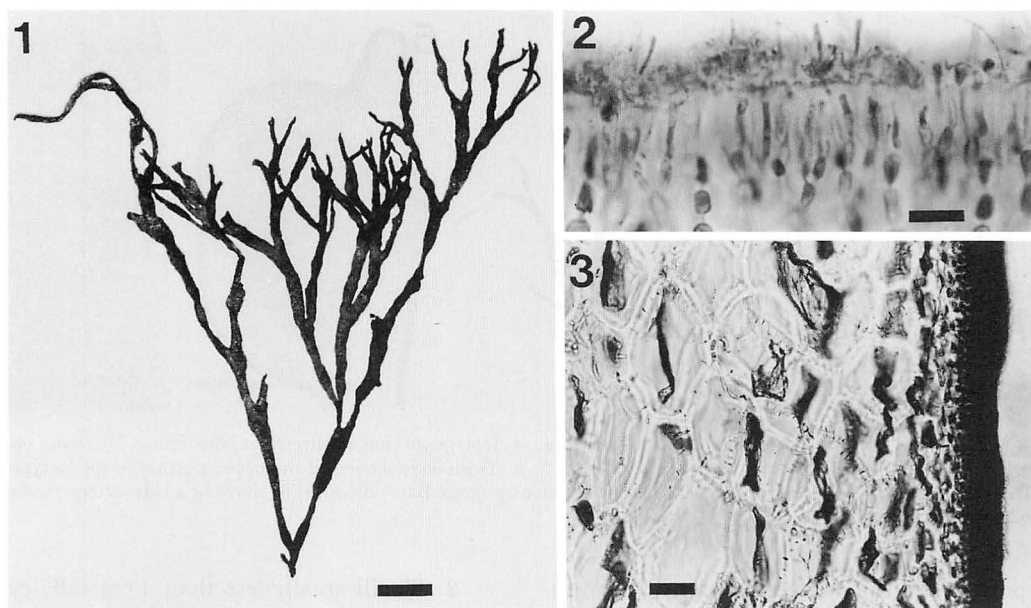
***Ahnfeltiopsis paradoxa* (Suringar) comb. nov.**

Basionym: *Gymnogongrus paradoxus* Suringar 1874: 13, pls. 8, 9 [type locality: One of Izu Seven Islands, central Japan; holotype specimen in L (942. 69. 48) (Masuda 1987, fig. 5)].

Synonym: *Gymnogongrus furcellatus* (C. Agardh) J. Agardh var. *japonicus* Holmes 1896: 256, pl. 11: fig. 2. *Ahnfeltia paradoxa* (Suringar) Okamura 1933: 13. pls. 309, 310 (11-16).

Japanese name: Harigane

This species has internal cystocarps which



Figs. 1–3. *Ahnfeltiopsis quinhonensis* (Pham) Masuda. 1. Spermatangial specimen collected at Qui Nhon, Vietnam, in May 1992 and deposited in SAP (058000) (scale bar=1 cm). 2. Longitudinal section of upper portion of thallus, showing an anticlinally elongated, superficial spermatangial layer (scale bar=10 μm). 3. Longitudinal section of lower portion of thallus, showing internal structure (scale bar=50 μm).

are central in the medulla and provided with multiple carpostomes (Masuda 1987). It has crustose tetrasporophytes (Masuda and Shimizu unpublished observations).

***Ahnfeltiopsis quinhonensis* (Pham) comb. nov.**

Basionym: *Gymnogongrus quinhonensis* Pham 1969: 201, fig. 2. 133 [type locality: Qui Nhon, central Vietnam; holotype specimen unknown].

This species has unisexual upright gametophytes as do other species of the genus. Only male gametophytes collected at the type locality in May 1992 (SAP 058000) were available for study (Figs. 1–3). Pham (1969) reported female gametophytes with cystocarps similar in nature to those of *A. serenei*.

***Ahnfeltiopsis serenei* (Dawson) comb. nov.**

Basionym: *Gymnogongrus serenei* Dawson 1954: 5, pl. 3: fig. 6 [type locality: Hon Tre, Nha Trang, central Vietnam; holotype specimen in US].

Re-examination of an isotype specimen

(Fig. 4) in BISH (499793) revealed that it has protruding hemispherical internal cystocarps provided with multiple carpostomes (Figs. 5, 6). Tetrasporophytes are unknown.

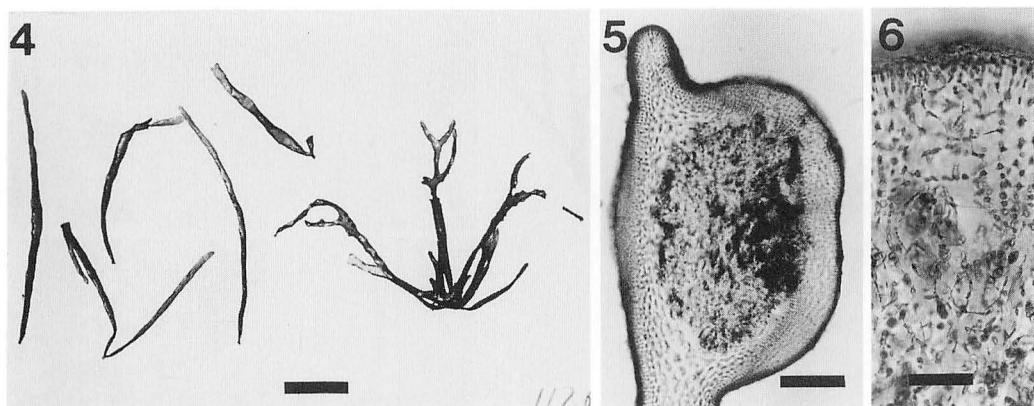
***Ahnfeltiopsis yamadae* (Segawa) comb. nov.**

Basionym: *Chondrus yamadae* Segawa 1941: 262, pl. 57, text-fig. 9 [type locality: Shirahama, Shimoda, Shizuoka Prefecture, central Japan; holotype specimen in the herbarium, Faculty of Agriculture, Kyushu University, Fukuoka.].

Synonym: *Ahnfeltia yamadae* (Segawa) Mikami 1965: 201, pl. 1, text-fig. 13.

Japanese name: Hane-saimi

The holotype specimen was not indicated in the original publication, but it was designated as “type” by Segawa in the above-mentioned herbarium. The specimen collected at Shirahama by Segawa on 31 July 1937 is shown in his Plate 57, although Mikami (1965: 203) erroneously cited Susaki as type locality. Elongate, large, internal cystocarps were found in a specimen collected at Shirahama on 6 October 1936 by S. Segawa and



Figs. 4-6. *Ahnfeltiopsis serenei* (Dawson) Masuda. 4. Isotype specimen collected at Nha Trang, Vietnam, on 6 February 1953 and deposited in BISH (499793). 5, 6. Transverse section of the upper portion of the isotype specimen: 5, showing a protruding hemispherical cystocarp (scale bar=200 μm); 6, showing a carpostome (scale bar=50 μm).

deposited in the above-mentioned herbarium. These cystocarps are central in the medulla and provided with multiple carpostomes. Tetrasporophytes are unknown.

Other species of *Gymnogongrus* and *Ahnfeltia*

Pham (1969) reported *Gymnogongrus griffithsiae* (Turner) Martius from Vietnam. However, the occurrence of this species in the western Pacific is uncertain, as his description lacks information on reproductive features. Two species of the genuine *Ahnfeltia*, *A. plicata* (Hudson) Fries and *A. fastigiata* (Postels et Ruprecht) Makienko, have been reported from the western Pacific (Maggs *et al.* 1989).

Key to the western Pacific species of *Ahnfeltiopsis*

Thirteen species are present along the coast of the western Pacific, including the South China Sea, the East China Sea, the Yellow Sea, the Sea of Japan, and the Sea of Okhotsk.

1. Upright thalli terete to subterete throughout; hyphalike filaments absent in the medulla 2
1. Upright thalli compressed at least at the middle portion; hyphalike filaments present or absent in the medulla 3

2. Thalli small, less than 1 cm tall, cystocarps central in the medulla *A. gracilis*
2. Thalli large, 3-11 cm tall, cystocarps hemispherical, protruding *A. concinna*
3. Upper portions of thalli terete to subterete 4
3. Upper portions of thalli compressed 5
4. Thalli small and narrow (to 3 cm tall and 700 μm wide); proliferations common, secund, pinnate, or fasciculate; hyphalike filaments absent in the medulla *A. densa*
4. Thalli large and broad (more than 5 cm tall and 1.2 mm wide); proliferations rare; hyphalike filaments abundant in the medulla *A. okamurae*
5. Cystocarps hemispherical, protruding 6
5. Cystocarps central in the medulla 8
6. Axes divided up to three times *A. serenei*
6. Axes divided more than four times 7
7. Axes 700-800 μm thick *A. quinhonensis*
7. Axes 300-600 μm thick *A. chnoosporoides*
8. Axes conspicuously channeled in living and fixed material; hyphalike filaments abundant in the medulla *A. yamadae*
8. Axes not channeled; hyphalike fila-

- ments absent in the medulla 9
9. Axes less than 1 mm wide 10
9. Axes more than 1 mm wide 11
10. Thalli large, 6–14 cm tall; cortex of axes thick, with 10–18 layers
..... *A. catenata*
10. Thalli small, up to 4 cm tall; cortex of axes thin, with 5–9 layers *A. pygmaea*
11. Thalli large, 20–80 cm tall; axes sparsely branched at long intervals, with many, large, simple to flabellate proliferations *A. paradoxa*
11. Thalli less than 15 cm tall; axes profusely branched at short intervals, with or without small proliferations 12
12. Thalli pale red; axes 2.0–2.5 mm wide except at forks *A. divaricata*
12. Thalli dark red to purplish red; axes less than 2 mm wide except at forks *A. flabelliformis*

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増田道夫：西太平洋産紅藻オキツノリ属（スギノリ目）

西太平洋沿岸に生育する紅藻スギノリ目オキツノリ属 (*Gymnogongrus*) 7種とサイミ (*Ahnfeltia*) 属 2種を *Ahnfeltiopsis* Silva et DeCew へ移した。これらの種はオキツノリ科 (Phyllophoraceae) の特徴に加えて、以下の特徴を共有する。嚢果は髄層内に埋没し、皮層には果胞子の放出孔が形成される。四分胞子体は配偶体の基部組織に似た殻状体で、鎖状に連なった四分胞子嚢を生じる。これらの移行に伴って、和名の変更が必要になる。*Ahnfeltiopsis* をオキツノリ属とし、*Ahnfeltia* をイタニグサ属とする。後者の所属する目と科の和名をイタニグサ目 (*Ahnfeltiales*) とイタニグサ科 (*Ahnfeltiaceae*) と改める。なお、*Gymnogongrus* については本邦に生育が認められるまで和名を付すことを留保する。西太平洋沿岸から報告されている全13種の検索表を示した。(060 札幌市北区北10条西8丁目 北海道大学理学部植物学教室)