

Porphyra fallax, a new species of Rhodophyta from British Columbia and northern Washington*

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Porphyra fallax sp. nov. is described from British Columbia and northern Washington. This species, like *Porphyra perforata* with which it has been confused, is a monoecious, monostromatic species with one chloroplast per cell. It differs from *P. perforata* in thallus shape, color, thickness, vegetative cell size and shape, and arrangement of spermatangia and carposporangia. It has a haploid chromosome number of $n=2$ compared to $n=3$ for *P. perforata*.

Key Index Words: British Columbia—chromosome number—new species—*Porphyra fallax*—Rhodophyta—Washington.

The genus *Porphyra* currently boasts 20 species in British Columbia and northern Washington (SCAGEL *et al.* 1989). These species have been distinguished primarily on morphological features—size, shape, color, and thickness of the thallus, number of cell layers, numbers of chloroplasts per cell, and arrangement of sporangia and sporangial packets (CONWAY *et al.* 1975). Habitat and seasonality have also been used (GARBAR *et al.* 1980), and chromosome counts have helped confirm the distinctness of some species (MUMFORD and COLE 1977, COLE 1990).

During a recent electrophoretic survey of the species of *Porphyra* in British Columbia, it became obvious that one well-known species in the local flora was incorrectly identified (LINDSTROM and COLE 1990). This species is described below and compared with the species with which it had been confused.

Porphyra fallax sp. nov. Figs. 1, 3, 5, 7

Thallus lanceolatus; margo undulatus.

Ubi iuvenis viridulus in medio, maturitate porphyrus usque ad chalybeum factus. Monoecius. Carposporangia matura in stratis 4 aut raro 8 ordinatis. Spermatangia in stratis 8 ordinatis, in maculis irregularibus aut in lineis. Unum stroma formans, uno chloroplasto per cellulam. Chromosomata 2 (haploidea). In saxis in zona interaestuali e media usque ad superam, in regionibus moderate umbritilibus, crescens.

Thallus lanceolate, margin ruffled. Initially greenish in center with reddish margin, becoming reddish-brown to steel blue-gray at maturity. Monoecious. Mature carposporangia in tiers of four or rarely eight. Spermatangia in tiers of eight, in irregular patches or streaks. Monostromatic, one chloroplast per cell. Two chromosomes (haploid number). Occurring on mid to upper intertidal rock in moderately sheltered areas.

This species has been confused with *Porphyra perforata* J. AGARDH, the first-described species of *Porphyra* from the Pacific coast of North America. Both are monostromatic and monoecious, with a single chloroplast per cell. *Porphyra fallax* differs from *P. perforata* in thallus shape, color, thickness, vegetative cell

* Dedicated to the memory of the late Dr. Munenao KUROGI (1921-1988), Professor Emeritus, Hokkaido University.

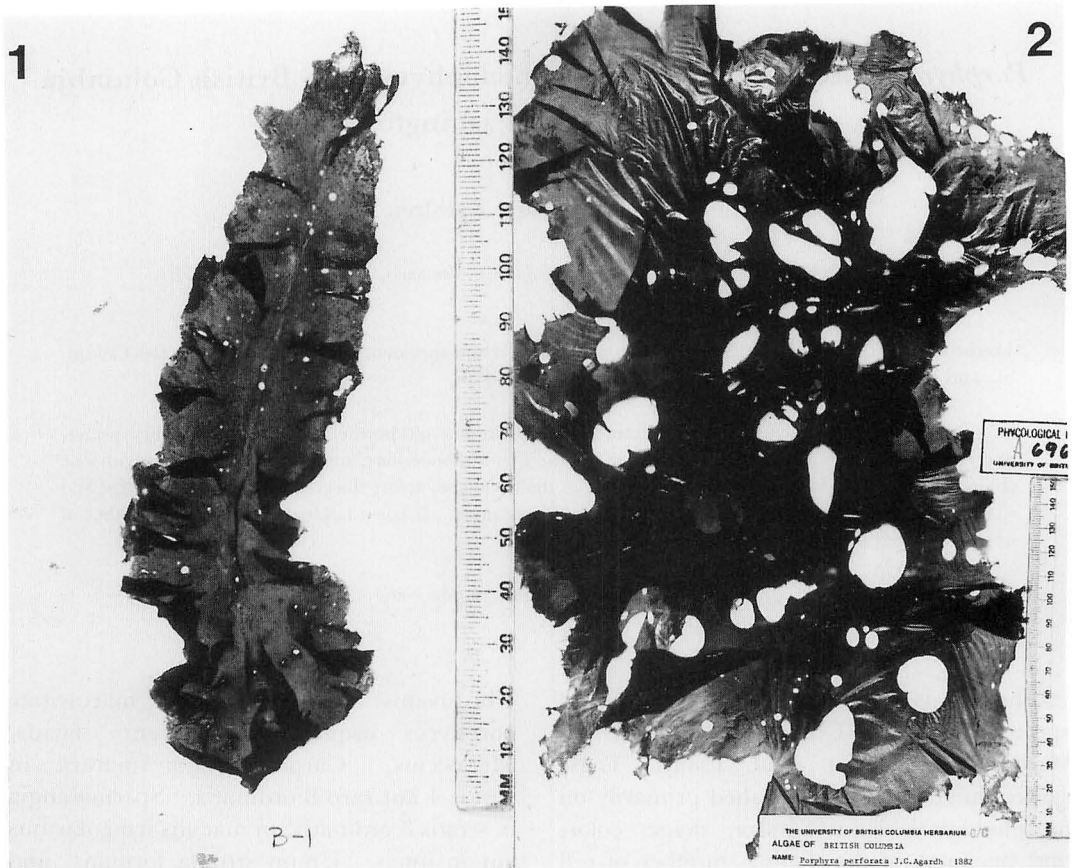


Fig. 1. *Porphyra fallax* holotype. UBC A69860. Golden Gardens, Seattle, Washington. 5 April 1983. Leg. E.C.S. DUFFIELD.

Fig. 2. *Porphyra perforata*. UBC A69678. Miracle Beach, Vancouver Island, British Columbia. 9 October 1988. Leg. M.W. HAWKES.

size and shape, and arrangement of spermatangia and carposporangia (Table 1). Differences in thallus morphology and size between *P. fallax* and *P. perforata* are evident in Figs. 1 and 2. Another difference can be seen in Figs. 3-6. Spermatangia in *P. perforata* occur in discrete packets (probably due to the relatively thick cell wall) that are recognizable in both surface view (Fig. 4) and transverse section (Fig. 6). In contrast, spermatangia in *P. fallax* reveal confluent cells when viewed superficially (Fig. 3) and a nearly indistinguishable mass when viewed transversely (Fig. 5). These male reproductive units are arranged a/(1)2, b/2(4), c/8 in *P. fallax* and a/(2)4, b/4, c/(8)16 in *P. perforata* according to Hus' (1902) formula.

Porphyra fallax occurs primarily on upper intertidal rock in moderately protected habitats as a winter-spring (Strait of Georgia) or spring-summer (other locations) species. It becomes reproductive within a month or two of its appearance on the shore. *Porphyra perforata* occurs on moderately exposed to protected mid intertidal rock, between ~1.5 and 3.5 m; it can occur epiphytically, primarily on *Fucus*. *Porphyra perforata* is found year-round: young thalli are most abundant in fall-winter, and reproductive thalli are evident in late summer-late fall. Whereas *P. fallax* is known with certainty only from northern Washington to northern British Columbia (see Appendix: Representative specimens examined), *P. perforata* has a recorded range

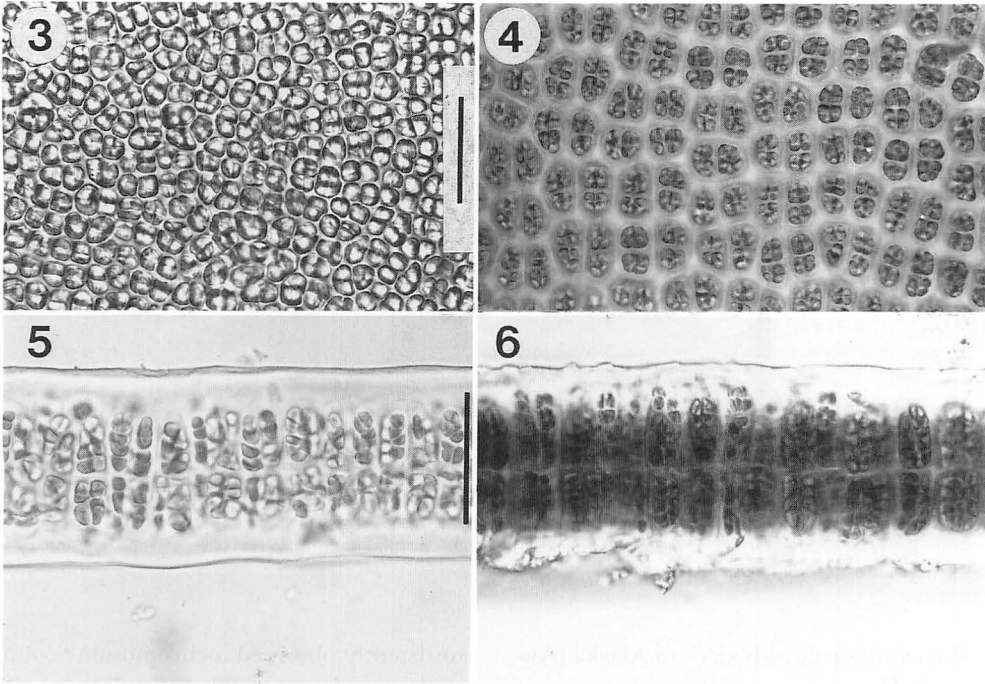


Fig. 3. *Porphyra fallax*. Surface view of spermatangia. UBC A70140. Wreck Beach, B. C. 26 Jan. 1988. Leg. S.C. LINDSTROM. Scale bar = 50 μm
 Fig. 4. *Porphyra perforata*. Surface view of spermatangia. Bamfield, B. C. 4 Nov. 1989. Leg. S.C. LINDSTROM. Scale bar same as Fig. 3.
 Fig. 5. *Porphyra fallax*. Transverse section of spermatangia. Same specimen as Fig. 3. Scale bar = 50 μm
 Fig. 6. *Porphyra perforata*. Transverse section of spermatangia. Same specimen as Fig. 4. Scale bar same as Fig. 5.

Table 1. Comparison of *Porphyra fallax* and *P. perforata*.

	<i>Porphyra fallax</i>	<i>Porphyra perforata</i>
Shape of thallus	Lanceolate, margin ruffled, can become expanded and flattened at maturity	Orbiculate, broadly expanded, not ruffled
Base of mature thallus	Slightly to distinctly umbilicate	Distinctly umbilicate
Color of fresh thallus	Greenish center, reddish margin, becoming reddish brown to steel blue-gray at maturity	Brown(ish) purple, sometimes dark olive green, but uniform color throughout
Maximum thallus size	~30 cm long	~40 cm diam.
Thallus thickness (vegetative)	49–66 μm	73–81 μm
Vegetative cell size and shape	16–20 μm wide \times 20–24 μm long, nearly quadrate	4–20 μm wide \times 28–43 μm long, oblong
Macroscopic arrangement of spermatangia	Patches or streaks	Squares, patches, streaks
Microscopic arrangement of spermatangia	Packets indistinguishable	Packets clearly distinguishable
Maximum tiers of spermatangia	8	16
Macroscopic arrangement of carposporangia	Submarginal patches, mottles, streaks and hieroglyphs	Continuous marginal zone, submarginal streaks
Maximum tiers of carposporangia	4 (8)	8
Chromosome number	n=2	n=3

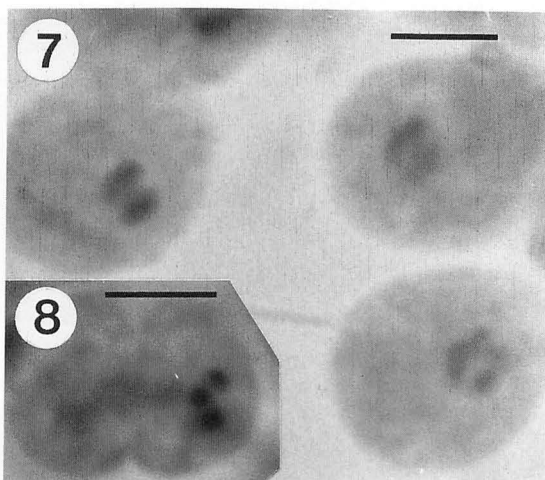


Fig. 7. *Porphyra fallax*. Spermatangial mother cells stained with WITTMANN'S iron haematoxylin. Two medium-sized "lumpy" chromosomes. Scale bar=3 μ m

Fig. 8. *Porphyra perforata*. Spermatangial mother cell(s) stained with WITTMANN'S iron haematoxylin. Three short chromosomes. Scale bar=3 μ m

from Baja California, Mexico, to Alaska (ABBOTT and HOLLENBERG 1976). LINDSTROM and COLE (1990) have shown, moreover, that the two species have distinct banding patterns for 13 of 15 loci examined using starch gel electrophoresis.

Holotype: UBC A69860. Golden Gardens, Seattle, Washington, collected 5 April 1983 by E.C.S. DUFFIELD. Isotype in WTU. (Herbarium abbreviations after HOLMGREN *et al.* 1981)

Known Distribution: Northern British Columbia to northern Washington.

Etymology: The species epithet, from the Latin word meaning deceptive or fallacious, commemorates the lengthy success of this species in remaining confused with *Porphyra perforata*.

Chromosomes were examined in specimens of *P. fallax* from Wreck Beach, B. C. (Leg. S. LINDSTROM, 1 Dec. 1988) and specimens of *P. perforata* from Bamfield, B. C. (Leg. S. LINDSTROM, 4 Nov. 1989) using WITTMANN'S aceto-iron-haematoxylin-chloral hydrate technique (MUMFORD and COLE 1977). Haploid *P. fallax* clearly has two chromosomes of medium length (Fig. 7) whereas haploid *P. perforata* has three small chromosomes (Fig. 8). WAALAND and co-workers (pers. comm.) have

consistently observed a chromosome count of $n=2$ in specimens of *P. fallax* from the type locality.

Discussion

A chromosome number of $n=2$ distinguishes *Porphyra fallax* from most other species of *Porphyra*. Only *Porphyra schizophylla* HOLLENBERG, among the species that have been studied, has been consistently reported to have a haploid chromosome count of 2, but the large size of its chromosomes clearly distinguishes it from its congeners that have been studied to date. Although *Porphyra fucicola* KRISHNAMURTHY, *P. kuniedae* KUROGI, and *P. suborbiculata* KJELLMAN have been reported to have a haploid chromosome number of 2, these species have also been reported to have other, haploid chromosome counts (COLE 1990). Moreover, none of these species conforms morphologically to the species under consideration. It seems unlikely, therefore, that our new species corresponds to any that has been described previously.

Acknowledgments

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Appendix: Representative specimens examined.

<i>Porphyra fallax</i>		
UBC A70148 Lion's Bay, B. C.	13 Jan. 1989	Leg. S.C. LINDSTROM
UBC A50188 Lion's Bay, B. C.	17 Jan. 1974	Leg. J.N.C. WHYTE
UBC A70140 Wreck Beach, B. C.	26 Jan. 1988	Leg. S.C. LINDSTROM
UBC A66905 Pt. Atkinson, B. C.	2 Feb. 1981	Leg. D. GARBARY, L. GOLDEN
UBC A63492 Wreck Beach, B. C.	22 Mar. 1981	Leg. D. GARBARY
UBC A1496 Whytecliffe, B. C.	8 Apr. 1949	Leg. R.F. SCAGEL
UBC A70136 Ridley I., B. C.	15 May 1988	Leg. S.C. LINDSTROM
UBC A69053 West Beach, Deception Pass State Park, Wash.	17 May 1987	Leg. S.C. LINDSTROM
UBC A64279 Tsawwassen, B. C.	30 June 1981	Leg. C. LOWTHER
UBC A51068 Cattle Point, Wash.	1 July 1974	Leg. T.F. MUMFORD, Jr.
UBC A70142 Wreck Beach, B. C.	28 Dec. 1987	Leg. S.C. LINDSTROM
<i>Porphyra perforata</i>		
UBC A15346 Sointula, B. C.	30 June 1962	Leg. T.B. WIDDOWSON
UBC A69655 Moss Beach, Calif.	29 July 1988	Leg. S.C. LINDSTROM
UBC A37663 Nootka I., B. C.	24 Aug. 1968	Leg. J. MARKHAM
UBC A69672 Miracle Beach, Vancouver I., B. C.	9 Oct. 1988	Leg. M.W. HAWKES
Unnumbered Bamfield, B. C.	4 Nov. 1989	Leg. S.C. LINDSTROM

S. C. LINDSTROM · K. M. COLE: ブリティッシュコロンビア州および
北部ワシントン州産の新種 *Porphyra fallax* (紅藻)

ブリティッシュコロンビア州および北部ワシントン州産の新種 *Porphyra fallax* (紅藻) を記載した。本種は、これまで混同されていた *Porphyra perforata* と同様に、葉状体は雌雄同株で単層であり、1細胞に1個の葉緑体をもつ。*P. perforata* とは、葉状体の形状、色彩、厚さ、栄養細胞の大きさや形状、精子嚢群および果孢子嚢群の配列などにおいて異なる。染色体数は、*P. perforata* の $n=3$ に対して $n=2$ である。(Department of Botany, University of British Columbia, Vancouver, B.C., Canada V6T 2B1)