Jpn. J. Phycol. (Sôrui) **36**: 138–142, June 20, 1988

Taxonomic notes on *Polysiphonia senticulosa* HARVEY and *P. pungens* HOLLENBERG (Ceramiales, Rhodophyta)

Toshihiko KUDO and Michio MASUDA

Department of Botany, Faculty of Science, Hokkaido University, Sapporo, 060 Japan

KUDO, T. and MASUDA, M. 1988. Taxonomic notes on *Polysiphonia senticulosa* HARVEY and *P. pungens* HOLLENBERG (Ceramiales, Rhodophyta). Jpn. J. Phycol. **36**: 138–142.

The holotype specimens of *Polysiphonia senticulosa* HARVEY and *P. pungens* HOLLENBERG were examined. These specimens have the following features in common: the thallus is slender and profusely branched; it has four pericentral cells; it lacks cortical cells; axillary branches are formed endogenously from the central axial cells; and ultimate branchlets are sharply pointed. The similarity between the two species warrants the reduction of *P. pungens* to a synonym of *P. senticulosa*. This species is similar to *P. morrowii* HARVEY in many of the above features. However, *P. morrowii* is distinguished from *P. senticulosa* by its thicker thalli and greater number of axillary tetrasporangial branchlets.

Key Index Words: Ceramiales—Polysiphonia—P. morrowii—P. pungens—P. senticulosa—*Rhodomelaceae—Rhodophyta—taxonomy.*

Polysiphonia senticulosa was first described by HARVEY (1862) on the basis of materials collected at Orcas Island, Washington, U.S.A. Since then, it has been reported from several localities in the north-eastern and north-western Pacific (KYLIN 1941, SEGI 1951), although its reported occurrence in Japan was discounted later by KUDO and MASUDA (1981).

KYLIN (1941) described a new genus, *Orcasia,* based on *P. senticulosa*. He believed that the presence of endogenously derived indeterminate axillary branches separated species in the genus *Orcasia* from those in *Polysiphonia*, though this distinction has not been recognized at the generic level (SEGI 1951, KUDO and MASUDA 1981, LINDSTROM *et al.* 1986). The occurrence of axillary branches arising endogenously from central axial cells is characteristic of two additional species: *Polysiphonia morrowii* HARVEY (KYLIN 1941, SEGI 1951, KUDO and MASUDA 1981, YOON 1986) and *P. pungens* HOLLENBERG (WOMERSLEY 1979).

P. morrowii was originally described by HARVEY (1856) from specimens collected at Hakodate, Hokkaido, Japan. This species is characterized by thick main axes and tufts of axillary tetrasporangial branchlets (SEGI 1951, KUDO and MASUDA 1981).

P. pungens was first described by HOLLENBERG (1942) on the basis of materials collected from Gravina Island, Alaska. This species is characterized by slender main axes and sharply pointed determinate branchlets. WOMERSLEY (1979) reported the presence of axillary branches in the holotype specimen, although HOLLENBERG (1942) did not mention this feature.

The geographical range of *P. pungens* overlaps that of *P. senticulosa* except in Australia, where *P. pungens* may have been introduced on the hulls of ships (WOMERSLEY 1979). Similarities between *P. senticulosa* and *P. pungens* have been noted by LINDSTROM *et al.* (1986). In this paper we demonstrate the conspecificity of these two species based on an examination of the

holotype specimens.

Materials and Methods

The holotype specimen of *Polysiphonia senticulosa* collected from Orcas Island (48° 40'N, 122°55'W) in April 1858 by D. LYALL and now preserved in the British Museum (Natural History) (BM) was examined on loan with the kind help of Mrs. L.M. IRVINE and Mr. S.I. HONEY. Three herbarium specimens of *P. pungens* determined by G.J. HOLLENBERG and now deposited in the Herbarium of the University of California, Berkeley were examined on loan with the kind help of Dr. P.C. SILVA: 1) the holotype specimen (tetrasporangial) collected at Vallenar Rock, Gravina Island (55°20'N, 131°45'W), Alaska in May 1913 by R.B. WYLIE (UC 314925); 2) tetrasporangial specimen collected at Qualicum, Vancouver Island, British Columbia by J. MACOUN (without date, UC 90940); and 3) vegetative specimen collected from Vancouver Island by J. MACOUN (No. 93, without date; UC 276575). The latter two specimens are also cited in the original description (HOLLENBERG 1942).

In addition, the following herbarium specimens of Alaskan *P. senticulosa* collected by S.C. LINDSTROM and deposited in the Phycological Herbarium, the University of British Columbia were examined on loan with the kind help of Mrs. J.C. OLIVEIRA: 1) tetrasporangial specimens from Campsite, Sea Otter Sound (55°48'40"N, 133°29'36" W) on June 1, 1981 (UBC A18303); 2) cystocarpic and tetrasporangial specimens from Southern Sea Otter Sound (55°47'54" N, 133°28'52"W) on June 1, 1981 (UBC A32726, 32727); and 3) cystocarpic and tetrasporangial specimens from Bridget Cove (58°38'N, 134°57'W) on July 24, 1979 (UBC A66021).

The specimens cited above were examined under a dissecting microscope. Small portions were mounted in 50% glycerol-seawater on microscope slides.

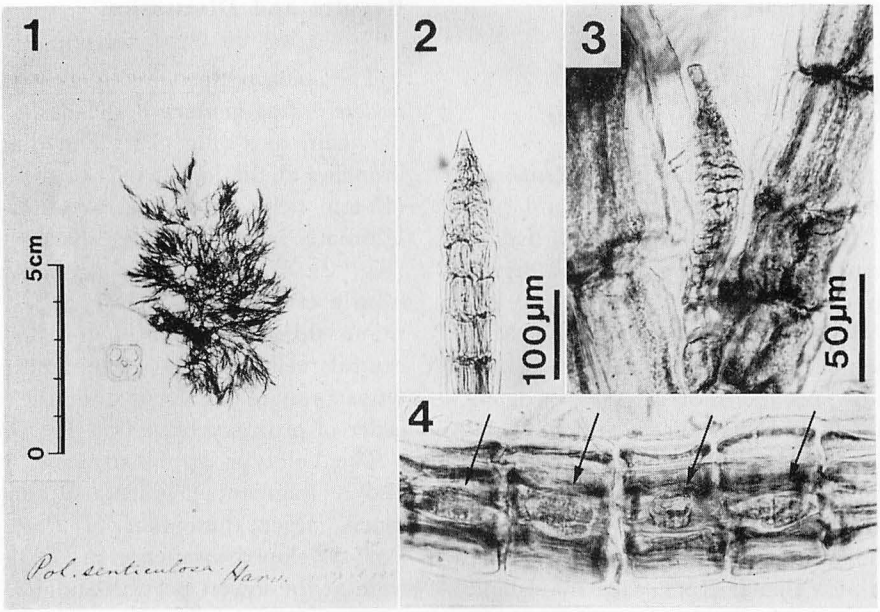
Results and Discussion

The holotype specimen of *Polysiphonia senticulosa* is fragmentary and lacks a discernible main axis (Fig. 1). The diameter of branches at the lowest part of the specimen (45 mm below the apex) are 200–215 μm. Ultimate branchlets are sharply pointed (Fig. 2). Each axillary branch develops from a central axial cell (Fig. 3). Adventitious rhizoids may arise from lower pericentral cells without septations. Young tetrasporangia are formed in the ultimate order of ordinary branches (Fig. 4).

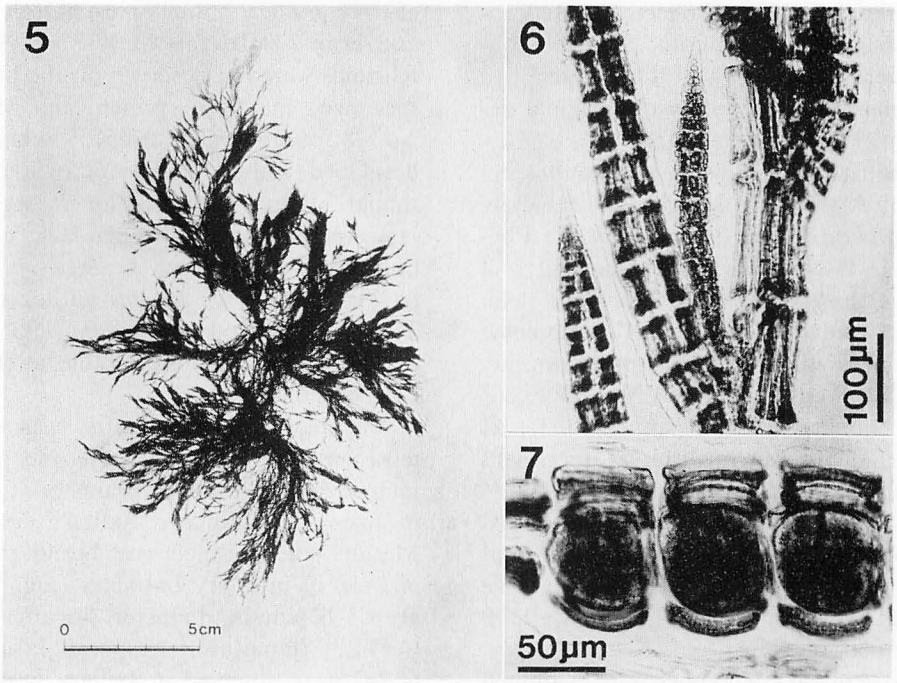
The holotype specimen of *P. pungens* is also a fragment (Fig. 5), although it is much larger than that of *P. senticulosa*. Well-developed branches are 235–240 μm wide at the lowest portion and 190–200 μm wide at 45 mm below the apex. Ultimate branchlets are sharply pointed as shown in the original illustration (HOLLENBERG 1942). One to three axillary branches develop from a single central axial cell (Fig. 6). Some of these axillary branches are indeterminate and bear 7–8 laterals in a spiral manner. Rhizoids were not observed on the holotype specimen, but were present on MACOUN No. 93 specimen (UC 276575), where they developed without septations in a manner similar to that described for *P. senticulosa*. However, since this specimen lacks ultimate branch tips and axillary branches, it cannot be identified as *P. pungens* with certainty. The other MACOUN specimen (UC 90940) is more complete and referable to the species concerned.

The holotype specimen of *P. pungens* bears tetrasporangia in the ultimate and penultimate orders of ordinary branches as well as in one of unbranched axillary branches. Mature tetrasporangia are borne in series of 2–12 in ordinary branches (Fig. 7) and are 65–85 μm in diameter (mean=73 μm, n=44). Immature tetrasporangia in series of 2–7 were observed in axillary branches.

The entire holotype specimen of *P. senticulosa* resembles the upper portion of the holotype of *P. pungens*. The more profuse



Figs 1–4. *Polysiphonia senticulosa* HARVEY. 1. Holotype specimen collected at Orcas Island in April 1858 by D. LYALL and deposited in BM. 2. Sharply pointed ultimate branchlet. 3. Young axillary branch arising endogenously from a central axial cell. 4. Young tetrasporangia (arrows) formed in an ordinary branch of the ultimate order. Figs 2–4 from the holotype specimen shown in Fig. 1. Scale in Fig. 3 applies also to Fig. 4.

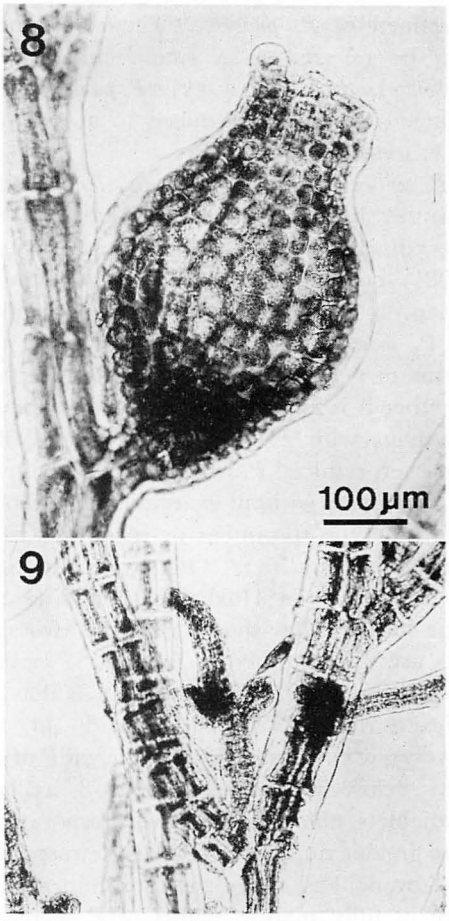


Figs 5–7. *Polysiphonia pungens* HOLLENBERG. 5. Holotype specimen collected at Vallenar Rock, Gravina Island in May 1913 by R. B. WYLIE and deposited in UC (90940). 6. Axillary branch arising endogenously from a central axial cell. 7. Mature tetrasporangia formed in an ordinary branch of the ultimate order. Figs 6, 7 from the holotype specimen shown in Fig. 5.

development of axillary branches in the May specimen of *P. pungens* suggests that the specimen represents more mature plants than the April specimen of *P. senticulosa*. The Alaskan specimens of *P. senticulosa* in UBC, collected in June and July near the type locality of *P. pungens*, show a development of axillary branches similar to that of the holotype of *P. pungens*.

The Alaskan specimens examined appear to be damaged, their uppermost portions were lacking. Adventitious branches are developed from some of the injured branches and from other positions on the plants. These Alaskan specimens are 130–150 μm wide at the lowest portion and have sharply pointed ultimate branchlets. One to three axillary branches originate from the central axial cell and are 320–750 μm long. Adventitious rhizoids develop from some of lower pericentral cells which are not cut off by septa from their parent cells. Tetrasporangia are formed both in ordinary branches in 2–9 series and in axillary branches in 2–7 series (sometimes individually). June tetrasporangial specimens bear three axillary branches, but only one of them form tetrasporangia. The majority of tetrasporangia in ordinary branches have already released their spores, but those in axillary branches bear both mature and immature sporangia. Mature sporangia are 65–80 μm in diameter. The maturation of tetrasporangia and occurrence of adventitious branches suggest that the Alaskan specimens examined were older than the holotype specimens of *P. senticulosa* and *P. pungens*.

Cystocarps of the Alaskan specimens are formed on the upper portions of ordinary branches. They are usually individually formed 2–4 segments apart. Mature cystocarps are urceolate and 430–560 μm long × 300–460 μm wide. Their ostiolar rims are 140–230 μm wide and almost equal to the diameter of necks (Fig. 8). Cystocarpic plants also bear single axillary branches (Fig. 9). These axillary branches are 250–550 μm long and bear procarpic trichoblasts and young cystocarps. They also form vegetative trichoblasts. Scar cells (the basal cells of fallen trichoblasts) are found at their proximal end.



Figs 8, 9. *Polysiphonia senticulosa* collected at Southern Sea Otter Sound, Alaska on June 1, 1981 by S. C. Lindstrom and deposited in UBC (A32726). 8. Mature cystocarp. 9. Axillary branch bearing young cystocarps. Scale in Fig. 8 applies also to Fig. 9.

All the specimens examined, except Macoun No. 93 (UC 276575), possess the following features in common: (1) the thallus is slender and profusely branched; (2) it has four pericentral cells; (3) it lacks cortical cells; (4) axillary branches originate endogenously from the central axial cells and contribute to reproductive activity; and (5) ultimate branchlets with limited growth are sharply pointed. The holotype

specimen of *P. senticulosa* is youngest among the specimens examined and bears young tetrasporangia only in ordinary branches. With age tetrasporangia may be formed in axillary branches as found in the holotype specimen of *P. pungens*. These specimens can be referred to a single entity, *Polysiphonia senticulosa* HARVEY. *P. pungens* HOLLENBERG should be reduced to a synonym of *P. senticulosa*.

P. senticulosa is similar to *P. morrowii* HARVEY in many of features stated in the preceding paragraph. KUDO and MASUDA (1981) concluded that *P. senticulosa* auct. japon. is included in the circumscription of *P. morrowii*, and pointed out that the status of genuine *P. senticulosa* is uncertain whether it is an independent species or synonymous with *P. morrowii*. YOON (1986), however, reduced *P. senticulosa* to a synonym of *P. morrowii* without examining the respective holotype specimens or specimens from their type localities. Our examination of *P. morrowii* from Hokkaido, including the type locality, has shown that the two species are distinguished as follows. *P. morrowii* differs from *P. senticulosa* in having thicker thalli (320–550 μm wide at the lower portion and 280–370 μm wide at 45 mm below the apex) and 7–8 axillary branchlets, all of which bear tetrasporangia. The greater number of axillary tetrasporangial branchlets is the most prominent feature of fully mature plants of *P. morrowii*, although their number varies according to season and ontogeny (KUDO and MASUDA 1981). On the other hand, the number of axillary tetrasporangial branchlets is 3 or less for fully mature plants of *P. senticulosa* and one of such branchlets is functional.

Acknowledgements

We are grateful to Professor T. YOSHIDA and Dr. K.A. MILLER for their criticism of the manuscirpt. We are also indebted to the Curators of BM, UC and UBC for loan of the specimens.

References

HARVEY, W.H. 1856. Algae. *In* A. GRAY, List of dried plants collected in Japan by S. Wells WILLIAMS, Esq., and Dr. James MORROW. Mem. Amer. Acad. Art. Sci. **2**: 331–332.

HARVEY, W.H. 1862. Notice of a collection of algae made on the north-west coast of North America, chiefly at Vancouver's Island, by David LYALL, Esq., M.D., R.N., in the years 1859–61. J. Proc. Linn. Soc. Bot. **6**: 157–177.

HOLLENBERG, G.J. 1942. An account of the species of *Polysiphonia* on the Pacific coast of North America. I. *Oligosiphonia*. Amer. J. Bot. **29**: 772–785.

KUDO, T. and MASUDA, M. 1981. A taxonomic study of *Polysiphonia morrowii* Harvey (Rhodophyta, Ceramiales). Jap. J. Phycol. **29**: 263–272.

KYLIN, H. 1941. Californische Rhodophyceen. Lunds Univ. Arsskr. N.F. Avd. 2, **37**(2): 1–51, Taf. 1–13.

LINDSTROM, S.C., CALVIN, N.I. and ELLIS, R.J. 1986. Benthic marine algae of the Juneau, Alaska area. Cont. Nat. Sci. **6**: 1–10.

SEGI, T. 1951. Systematic study of the genus *Polysiphonia* from Japan and its vicinity. J. Fac. Fish. Pref. Univ. Mie **1**: 169–272, pls. 1–16.

WOMERSLEY, H.B.S. 1979. Southern Australian species of *Polysiphonia* Greville (Rhodophyta). Aust. J. Bot. **27**: 459–528.

YOON, H.-Y. 1986. A taxonomic study of genus *Polysiphonia* (Rhodophyta) from Korea. Korean J. Phycol. **1**: 3–86.

工藤利彦・増田道夫：紅藻 *Polysiphonia senticulosa* HARVEY と *P. pungens* HOLLENBERG（イギス目フジマツモ科）について

Polysiphonia senticulosa HARVEY と *P. pungens* HOLLENBERG の正基準標本を調査した。これらの標本は以下の共通する特徴を持っている。(1) 藻体は細く，多数の枝を生じる。(2) 各節間には4個の周心細胞がある。(3) 皮層細胞を欠く。(4) 中心細胞から内生的に形成される枝が通常枝の腋から発達する（axillary branch）。(5) 限定生長する最末小枝の先端は鋭く尖る。このような類似から両者は同一種として扱われるべきであり，*P. pungens* は *P. senticulosa* の異名となる。上述したこの種の特徴の多くはモロイトグサ *P. morrowii* HARVEY とも共通する。しかし，モロイトグサは太い藻体を持つこと及び四分胞子嚢を形成する axillary branchlets が多数生じることで区別される。（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）