

## The identity of *Gigartina prolifera* HARIOT (Rhodophyta)

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The original specimens of the red alga *Gigartina prolifera* HARIOT collected in Japan were examined to clarify its identity and a lectotype was designated. Solitary tetrasporangia cut off as side branches from the cortical cells were found in the lectotype specimen; this feature distinguishes the species from *Gigartina* species which have catenate tetrasporangia. The species is most similar to the alga currently known in Japan as *Carpopeltis flabellata* (HOLMES) OKAMURA in gross morphological, anatomical and tetrasporangial features. *Gigartina prolifera* HARIOT has nomenclatural priority over *Grateloupia flabellata* HOLMES, the basionym of *Carpopeltis flabellata* (HOLMES) OKAMURA. Accordingly, the new combination *Carpopeltis prolifera* (HARIOT) KAWAGUCHI et MASUDA is proposed.

**Key Index Words:** *Carpopeltis*; *Carpopeltis flabellata*; *Carpopeltis prolifera*; *Gigartina*; *Gigartina prolifera*; *Halymeniaceae*; *Rhodophyta*; *taxonomy*; *typification*.

*Gigartina prolifera* HARIOT (1891) was first described on the basis of material collected at Yokosuka, Kanagawa Prefecture, on the Pacific coast of central Japan by SAVATIER, but details of the reproductive features were not given. Later, COTTON (1907) reported this species from Korea and stated that the cystocarps were embedded in more or less regularly arranged marginal proliferations. OKAMURA (1902 1916) pointed out that this species might not be referable to the genus *Gigartina*, although he did not give any further information. Since then, the species has not been mentioned in the literature. KIM (1976), who published a taxonomic revision of the family Gigartinaeae, overlooked this binomial and made the illegitimate combination, *Gigartina prolifera* (J. AGARDH) KIM for *Rhodoglossum proli-*

*ferum* J. AGARDH (1884)\*.

HARIOT (1891) and COTTON (1907) stated that in general habit *Gigartina prolifera* resembles *G. mammillosa* (GOODENOUGH et WOODWARD) J. AGARDH, which is a synonym of *G. stellata* (STACKHOUSE et WITHERING) BATTERS. Four species of *Gigartina* subgenus *Mastocarpus*, including *G. stellata*, were recently separated from *Gigartina* STACKHOUSE and transferred to the reinstated genus *Mastocarpus* KÜTZING (GUIRY et al. 1984). The descriptions of the vegetative and reproductive features of *G. prolifera* given by HARIOT (1891) and COTTON (1907) are insufficient to decide whether the alga belongs to *Mastocarpus*, *Gigartina* or another genus. In the present paper the taxonomic status of the alga is examined based on observation of HARIOT's voucher specimens.

### Materials and Methods

Fifteen specimens of *Gigartina prolifera* HARIOT collected by SAVATIER and deter-

\* As KIM's (1976) merging of the genus *Rhodoglossum* J. AGARDH with *Gigartina* STACKHOUSE has not been widely accepted (SILVA 1979) it would be entirely inappropriate to make any proposals regarding the status of *Gigartina prolifera* (J. AGARDH) KIM.

mined by HARIOT are now preserved in the Laboratoire de Cryptogamie, Muséum National d'Histoire Naturelle, Paris (PC) (ARDRÉ, pers. comm.). Of these, 8 specimens on loan from PC were examined with the kind help of Dr. F. ARDRÉ. Sections were made by hand using a razor blade, stained with 0.5% (w/v) cotton blue in a lactic acid/phenol/glycerol/water (1:1:1:1) solution and mounted in 50% glycerol-seawater on

microscope slides. Voucher slides are deposited in PC and SAP (the Herbarium of Faculty of Science, Hokkaido University, Sapporo).

### Results and Discussion

Morphological and anatomical features of the specimens examined are in agreement with HARIOT's (1891) description. We found,

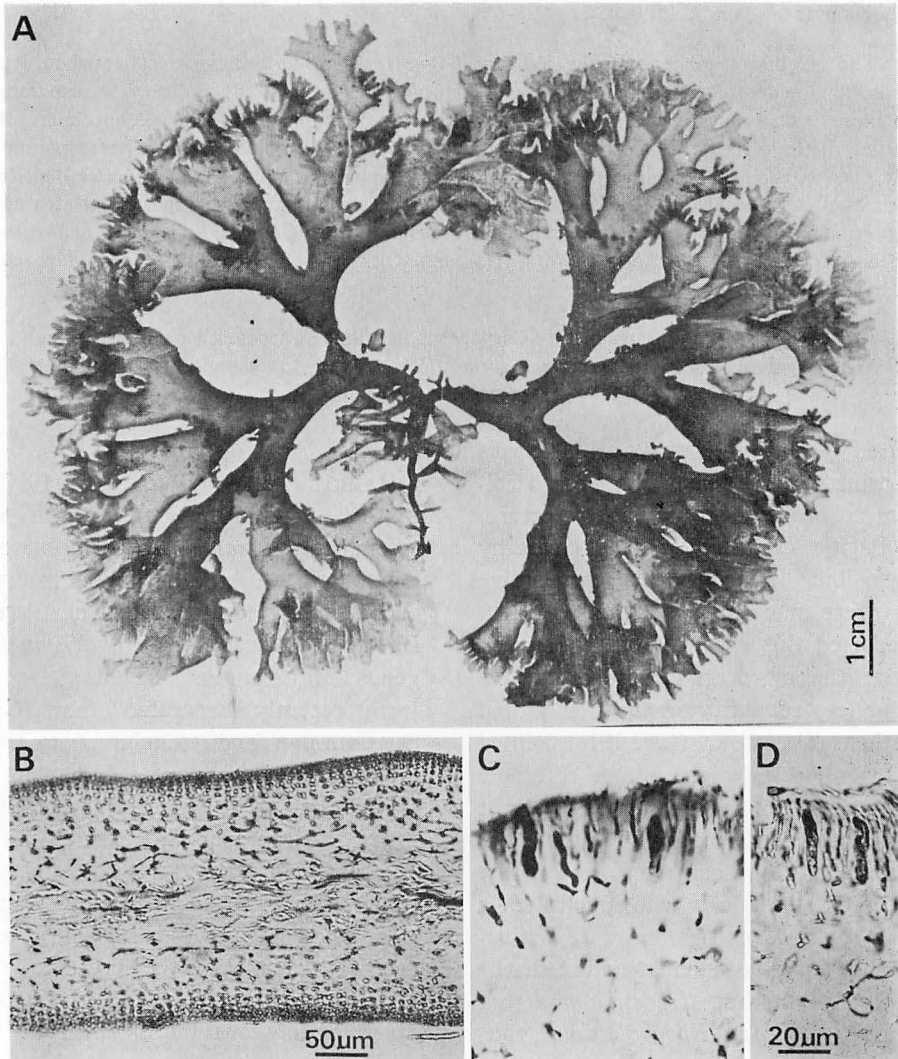


Fig. 1. *Carpopeltis prolifera* (HARIOT) KAWAGUCHI et MASUDA. A. Lectotype specimen collected at Yokosuka, Kanagawa Prefecture, by SAVATIER and deposited in PC. B. Transverse section of the upper portion of the lectotype; note that both the cortex and medulla are reduced. C, D. Transverse sections of the proliferations borne on the lectotype, showing young tetrasporangia cut off as side branches from the cortical cells; note that the cortex and tetrasporangia are reduced. Scale in D applies also to C.

however, that a single specimen has tetrasporangia, although HARIOT (1891) stated that "fructificatio deest". We have selected this specimen as the lectotype (Fig. 1, A) according to Article 7.5 of the International Code of Botanical Nomenclature (ICBN, Voss *et al.* 1983).

The following description is based on the

lectotype specimen. As this specimen is faded we are unable to comment on its original color. The upright thallus is 7 cm high, terete at the base and becoming gradually flattened. It is repeatedly dichotomously divided with rounded axils and bears flabelately expanded branches. The branches are up to 1 cm wide and somewhat obtuse

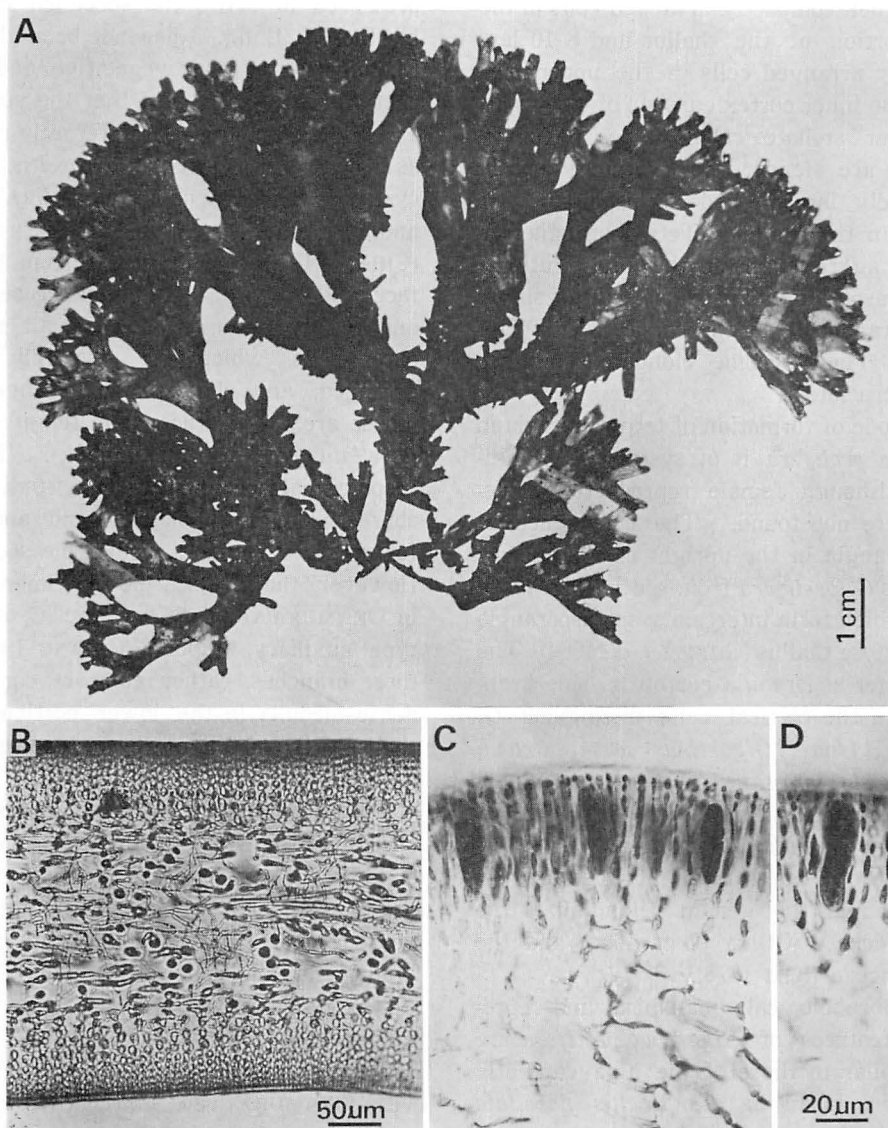


Fig. 2. *Carpopeltis prolifera*. A. Cystocarpic specimen collected at Kamiura, Oita Prefecture, on June 7, 1982 by KAWAGUCHI (SAP 044612). B. Transverse section of the upper portion of the specimen shown in A. C, D. Transverse sections of proliferations formed on a plant collected at Oohama, Oita Prefecture, on June 6, 1982, showing elongated tetrasporangia cut off as side branches from the cortical cells. Scale in D applies also to C.

at the apex and bear many short proliferations on the uppermost parts. Proliferations issue also from both the margin and surface of the thallus. The thallus is of multiaxial construction which is composed of a pseudo-parenchymatous cortex and a filamentous medulla (Fig. 1, B). The outer cortex is composed of small roundish cells arranged in anticlinal cell-rows, each consisting of 20-30 rather compactly arranged cells in the lower portion of the thallus and 8-10 less compactly arranged cells in the upper portion. The inner cortex consists of 4-5 layers of slender stellate cells. The medullary filaments are slender and relatively densely or sparsely intermeshed according to their position in the thallus. Tetrasporangia are borne in aggregations in the proliferations. The tetrasporangial initials are cut off singly as side branches from the cortical cells (Fig. 1, C, D). They become elongated and are divided cruciately.

The mode of formation of tetrasporangia in *Gigartina prolifera* is of systematic significance, although female reproductive structures were not found. The occurrence of tetrasporangia in the upright thallus clearly separates *G. prolifera* from species of *Mastocarpus* which form intercalary tetrasporangia on a crustose thallus (GUIRY *et al.* 1984). The solitary tetrasporangia cut off as side branches from the cortical cells distinguish *G. prolifera* from *Gigartina sensu stricto*, *Iridaea*, *Rhodoglossum* and *Chondrus* which have catenate tetrasporangia formed in an accessory or intercalary position (KIM 1976). Thus, there is no close affinity between *G. prolifera* and the genera belonging to the Petrocelidaceae (GUIRY *et al.* 1984) and the Gigartinaceae (KIM 1976).

The morphological, anatomical and reproductive features of *Gigartina prolifera* are most similar to those of the alga currently known in Japan as *Carpopeltis flabellata* (HOLMES) OKAMURA (Halymeniaceae) (Fig. 2, A-D). It was first described as *Grateloupia flabellata* by HOLMES (1896) on the basis of material collected at Enoshima (near Yokosuka), Kanagawa Prefecture. This species

was subsequently transferred to *Carpopeltis* by OKAMURA (1935). *C. flabellata* has been reported from various localities along the coasts of Japan and Korea (OKAMURA 1935, 1936, KANG 1966). We examined the specimens illustrated by OKAMURA in his *Icones of Japanese algae* (OKAMURA 1935, Pl. 321) and deposited in SAP. Five of the 6 specimens illustrated by OKAMURA (1935) are preserved in SAP; the specimen shown in his Plate 321, fig. 3 has not been detected. Examination of their vegetative and reproductive features revealed that the specimens are referable to what are presently regarded as 3 distinct species of *Carpopeltis*. The 2 cystocarpic specimens in OKAMURA's figs 2 and 6 have the *Aeodes*-type auxiliary ampulla (CHIANG 1970), proliferations from the surface and margin, broad cuneate segments, and a cortex composed of small roundish outer cells, which are relatively loosely arranged, and slender stellate inner cells. These are the characteristic features of *C. flabellata* (KAWAGUCHI, unpubl.). The tetrasporangial specimen in OKAMURA's fig. 1 shares gross morphological and anatomical features with the 2 cystocarpic specimens. However, the cystocarpic specimen shown in OKAMURA's fig. 5 has the *Grateloupia*-type auxiliary ampulla (CHIANG 1970), tortuose branches, rather compact cortex and dense medulla in the lower portion of the thallus. By means of these features it can be identified as *C. crispata* OKAMURA (KAWAGUCHI, unpubl.). The tetrasporangial specimen shown in OKAMURA's fig. 4 is similar to *C. divaricata* OKAMURA in having linear segments arranged in a single plane, very compact cortex with large, roundish inner cells, and a dense medulla (KAWAGUCHI, unpubl.). OKAMURA's confusion of these species was probably due to his original circumscription of *Grateloupia affinis* (HARVEY) OKAMURA var. *lata* OKAMURA (1893) which was later elevated to specific rank as *G. lata* (OKAMURA) OKAMURA (1902). This species was reduced to a synonym of *Grateloupia flabellata* HOLMES by OKAMURA (1916). Later, OKAMURA (1934) separated his *G. lata*

into 2 new species of *Carpopeltis*, *C. divaricata* OKAMURA and *C. crispata* OKAMURA. Judging from OKAMURA'S original description (1893) of *G. affinis* var. *lata* that it has cuneate segments and proliferations from the margin and surface, and from the anatomical features shown in his Pl. 5, figs 8 and 10, *C. flabellata* is also included in his circumscription of *G. lata*. OKAMURA (1934) cited *G. lata* and *G. affinis* var. *lata* ("partim as syn. of *G. flabellata* HOLMES") (p. 31) as synonyms of both *C. divaricata* and *C. crispata*. However, in transferring *G. flabellata* to *Carpopeltis* OKAMURA (1935) did not cite *G. lata* and *G. affinis* var. *lata* as synonyms of it and the resultant binomial was accompanied by a Japanese name, Komenori. The original description of *G. affinis* var. *lata* was accompanied by the same Japanese name and *C. divaricata* and *C. crispata* were accompanied by different Japanese names. This strongly suggests that OKAMURA (1935 1936) probably accidentally omitted *G. affinis* var. *lata* and *G. lata* from

the synonymy list of *C. flabellata*. Thus, it may be concluded that two components of *Grateloupia lata* were described as 2 new species and the remainder, *G. lata sensu stricto* (=Komenori) was reduced to a synonym of *C. flabellata* by OKAMURA (1934 1935). This interpretation is in accordance with Article 53.1 ICBN (Voss *et al.* 1983).

*Gigartina prolifera* Hariot is identical with *C. flabellata* as circumscribed here in that it has wide cuneate segments, proliferations, a cortex composed of small roundish outer cells and slender stellate inner cells, and narrowly ellipsoid tetrasporangia. HOLMES (1896) illustrated the tetrasporangia of *Grateloupia flabellata* as being broadly ellipsoid. However, species of *Carpopeltis* possess narrowly ellipsoid tetrasporangia as shown in our Fig. 2, C and D (OKAMURA 1893 1909 1934). We examined the holotype specimen of *G. flabellata* on loan from the British Museum (Natural History). The gross morphological and anatomical features are similar to those of *C. flabellata* as circumscribed in the present

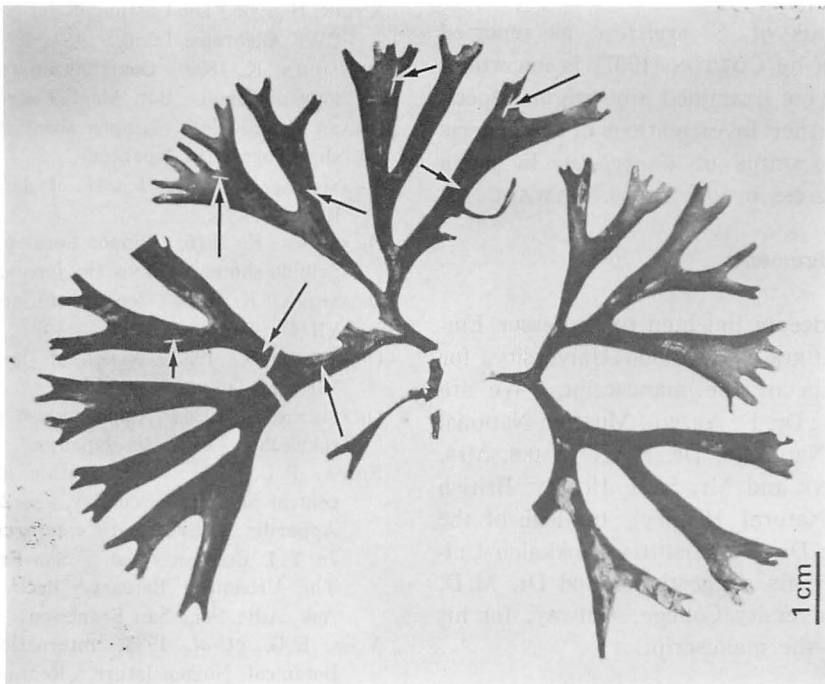


Fig. 3. The holotype specimen of *Grateloupia flabellata* HOLMES collected at Enoshima, Kanagawa Prefecture, on March 20, 1894 and deposited in BM; note the arrows that indicate the positions in which sections were made.

paper. We carefully sectioned many portions of the holotype (Fig. 3, arrows), but we could not find tetrasporangia. Thus, it was not possible to decide the taxonomic relationship between *Grateloupia flabellata* HOLMES and *Gigartina prolifera* HARIOT with any certainty. However, *Gigartina prolifera* is within the circumscription of the genus *Carpopeltis* as currently accepted (KYLIN 1956). *Gigartina prolifera* HARIOT (1891) has nomenclatural priority over *Grateloupia flabellata* and, even though the two species may not be conspecific, we propose the following combination for the alga currently known in Japan as *Carpopeltis flabellata* (HOLMES) OKAMURA:

***Carpopeltis prolifera* (HARIOT) KAWAGUCHI et MASUDA, comb. nov.**

Basionym: *Gigartina prolifera* HARIOT [1891: 220]

Synonyms: *Grateloupia affinis* (HARVEY) OKAMURA var. *lata* OKAMURA [1893 (pro parte): 101, pl. 5, f. 8, 10]. *Grateloupia lata* (OKAMURA) OKAMURA [1902 (pro parte): 87].

The status of *G. prolifera* as reported from Korea by COTTON (1907) is uncertain, as we have not examined any original specimens. Further investigations of the generic and specific status of *Carpopeltis* in Japan are in progress by one of us, KAWAGUCHI.

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川口栄男・増田道夫：紅藻 *Gigartina prolifera* HARIOT の所属

神奈川県横須賀市の材料に基づいて記載された *Gigartina prolifera* HARIOT の所属を明らかにするために、HARIOT が観察に用いた標本を調査した。タイプ標本とされている複数個体の中から、四分孢子囊を有する個体を選定基準標本に指定して記載を行った。本種の四分孢子囊は皮層細胞から1個の側枝として切り出されてくる点で、スキノリ属 *Gigartina* 及びその近縁属のそれとは明らかに異なる。外部形態、内部構造及び四分孢子囊の位置と形状を検討した結果、本種はわが国でコモノリ *Carpopeltis flabellata* (HOLMES) OKAMURA とされてきた種と同一であるという結論に達した。本種をキントキ属に移して、*Carpopeltis prolifera* (HARIOT) comb. nov. とする。*C. prolifera* はコモノリの学名として *C. flabellata* に対して先取権をもつ。(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)