

Phycological observations—I.

Genus *Porphyra* of the Philippines, its species and their occurrences*

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Summary

This report, the first in a series of three, describes the three species of *Porphyra* (Bangiales: Rhodophyta) from the Philippine waters: *Porphyra crispata* KJELLMAN, *P. suborbiculata* KJELLMAN and *P. sp.* Of these, only *P. crispata* had previously been reported (GALUTIRA and VELASQUEZ²⁾) while the other two are newly recorded. The third, herein reported as *Porphyra sp.*, was compared with other materials from southern Japan.

Likewise, the following factors considered to be responsible for the establishment of the genus *Porphyra* in the Philippine waters, a considerably warm habitat, were tackled: the cooling of the northern water (Luzon Strait) in the winter season might be due to the fact that the sea current along the continent flows in different directions with the seasons, northerly in summer and southerly in winter. Moreover, the monsoon in the winter season comes from the northwest in the region thus considered. This suggests that the continental water can reach the Luzon Strait at least in the winter season. The dispersal of *Porphyra* spores from the Ilocos Norte and Cagayan provinces to the southern coast of Taiwan facing the Luzon Strait might have been done by the meander of the Kuroshio warm current.

The presence of *Porphyra* in the Philippines was noticed first by SULIT¹⁾. He found the plant in moderate growth in two of the country's northern coastal provinces—Ilocos Norte and Cagayan (lat. 18°4'N., long. 120°4'E, and lat. 18°4'N, long. 122°), respectively (Fig. 1), and reported it merely as *Porphyra sp.* GALUTIRA and VELASQUEZ²⁾ reported *Porphyra crispata* KJELLMAN (GALUTIRA's Nos. 11, 69, 89) collected from Ilocos

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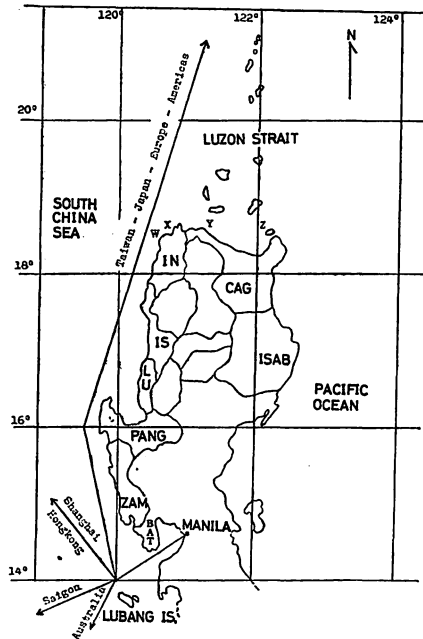


Fig. 1. Map of northern Philippines showing the collecting areas of *Porphyra* spp. Arrows indicate the routes taken by in-and-out going ships/steamers. (W; Cape Bojeador, X; Dirique Bay, Y; Claveria, Z; Palau Island, IN; Ilocos Norte, CAG; Cagayan, IS; Ilocos Sur, LU; La Union, Pang; Pangasinan, ZAM; Zambales, BAT; Bataan, ISAB; Isabela).

Norte, an area facing the South China Sea. They noted its abundance during the 'cold' months of November and December.

Other records of *Porphyra*, mostly unconfirmed, were those by DE LOS REYES³⁾ reportedly from Biliran Island, Leyte Province roughly lat. 11°6'N, long. 124°4'E and VELASQUEZ *et al.*⁴⁾ description of *Porphyra variegata* (KJELIMAN) HUS, gathered from Orion, Bataan Province, lat. 14°2'N, long. 120°2'E.

Probable factors for the distribution in the Philippines

Distribution-wise, genus *Porphyra* is undoubtedly 'confined' to the cooler waters well above the Tropic of Cancer (KJELLMAN⁵⁾, HUS⁶⁾, TANAKA^{7,13)}, UEDA⁸⁾, OKAMURA^{9,10,15)} and lately, KRISHNAMURTHY¹¹⁾). Therefore, the presence in warm habitats such as Taiwan (CHIANG¹²⁾), Vietnam

(TANAKA and PHAM-HOANG HO¹³; DAWSON¹⁴) and the Philippines (SULIT¹, GALUTIRA and VELASQUEZ²), is of great interest, especially so is the settlement of this plant in only two of the Philippines northernmost provinces.

One of the probable hydrographical factors for this is that the northern waters of the Archipelago is notably cooler than in the central and southern parts. The temperature drops to 15° (-18°C) in the northern waters in the winter season, but remains at about 25 to 28°C in the central and southern waters. As the latitudinal difference in the tropical region between the northern and central parts of Luzon Island is insignificant, this remarkable temperature difference must be brought about by some special hydrographic state in the northern waters in winter. It is well-known fact that the sea current along the continent flows in different directions with the seasons, northerly in summer and southerly in winter. Moreover, the monsoon in the winter season comes from the northwest in the region under consideration. This suggests that the continental water can reach the Luzon Strait at least in the winter season. This might be responsible for the settlement of *Porphyra* on the coasts of Ilocos Norte and Cagayan in the Philippines and on the southernmost coast of Taiwan facing the strait, though this cannot explain the 'absence' of this alga throughout the west coast of Taiwan, where some marked plankters of the continental waters are known to occur in the winter season.

Observations on four localities

Cape Bojeador and Dirique Bay (Ilocos Norte)

The marine floras of these areas are almost the same and thus they will be described together. The littoral zone of the areas is built of sharp-edged rocks which drop off seawardly. The upper part of the zone is generally poor in vegetation, except for the presence of *Porphyra suborbiculata*, *P. crispata* and *P. sp.*, growing together with *Ulva pertusa* and traces of *Laurencia* spp. Still upwardly, in the splash zone, *Porphyra* spp. are still to be seen in rock pools exposed for a certain length of time each day. The lower part of the zone and shallow sublittoral parts are inhabited by a blend of red and brown algal species.

Claveria (Cagayan)

Our knowledge of the algal vegetation, type of habitat and substratum is based on SULIT's¹ report. There, *Porphyra* plants are growing on rocks exposed to strong waves and in association with a few ulvoid species.

Palau Island (Cagayan)

This region, like Claveria, faces the Luzon Strait. The water is rough all the year round and the area shows only few growths of brown and red algae. *Porphyra suborbiculata* is found densely almost clothing the surface of rocks, its location could still be lower littoral, and it is most luxuriant in the months from November to February—the ‘coolest’ part of the year.

Possible species present

Preliminary taxonomic and morphological examinations of *Porphyra* specimens at hand reveal at most three distinct species from the Philippines. These species, however, bear some peculiar features common to all: presence of microscopic denticulate marginal growths, monoecious as well as the monostromatic type of thallus. Further, the three species differ greatly from each other in their gross morphological and internal structure. Key to the species of the Philippine *Porphyra*, basing on the examined specimens.

- A) Leafy-thallus linear-lanceolate, branched; to 14 cm tall; microscopic denticulate marginal processes densely distributed; margin distinctly crenulate...*Porphyra* sp.
- A) Leafy-thallus obovate or reniform, unbranched; to 6 cm tall;

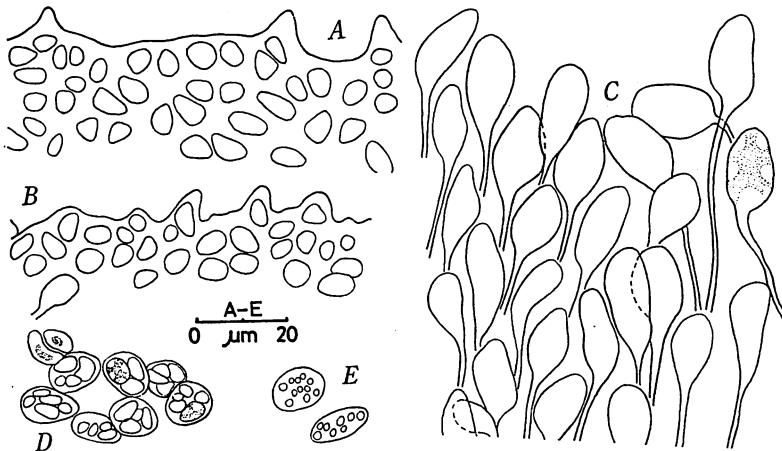


Fig. 2. *Porphyra crispata* KJELLMAN

A and B. Marginal portion of frond, showing microscopic denticulate processes and shape of vegetative cells. C. Rhizoidal filament-borne cells. D. Surface view of cystocarpic frond. E. Surface view of two antheridia.

microscopic denticulate marginal processes moderately distributed; margin slightly undulate...B.

- B) Plant clustered; formula for the division of antheridia 128 ($a/4$ $b/4$ $c/8$)...*P. crispata*
 B) Plant growing 'singly'; formula for the division of antheridia 64 ($a/4$ $b/4$ $c/4$)...*P. suborbiculata*

Systematic treatment:

- 1) *Porphyra crispata* KJELLMAN. Fig. 2. A-E.

KJELLMAN⁵); TANAKA⁷); UEDA⁸); OKAMURA^{9,10,15}); DAWSON¹⁴); GALUTIRA and VELASQUEZ²); SEGAWA¹⁶).

Frond purplish-red, obovate or roundish, membranous, in clusters of up to 7 sheets, to 15 mm tall, to 6 mm broad; stipitate; rhizoidal attachment of minute adhesive disc; marginal spinulate processes moderately distributed; base cuneate; rhizoidal filament-borne cells usually oblong-capitate, 11.4 μ m broad, to 70.6 μ m long; chromatophore strongly stellate with one centrally located pyrenoid; vegetative cells irregularly arranged, oblong-elliptical in surface section, 7.6 to 11.4 μ m in diameter; surface jelly to 11.4 μ m thick; monoecious; antheridia (yellow streaks) and sporocarps (purplish) marginally located, each occupying definite areas.

The antheridial mother cell follows the divisional formula of 128 ($a/4$ $b/4$ $c/8$), while carpospores are formed following the formula 32 ($a/2$ $b/4$ $c/4$).

Habitat: Cape Bojeador, Burgos, Ilocos Norte; GALUTIRA No. 67, collected by E. G. GALUTIRA, April 20, 1960.

Geographical distribution: Japan and China (TANAKA⁷); South Vietnam (DAWSON¹⁴); Kotosho, Taiwan (OKAMURA⁹).

- 2) *Porphyra suborbiculata* KJELLMAN. Fig. 3. F-N.

KJELLMAN⁵); OKAMURA^{10,15}); UEDA⁸); TANAKA⁷); SEGAWA¹⁶).

Frond purplish, membranous, reniform, to 6 cm tall, to 3.5 cm broad, monostromatic; mode of attachment by rhizines; margin slightly undulate; microscopic denticulate processes intense; base cordate; frond in cross section shows surface jelly 22.8 to 30.4 μ m in thickness; rhizoidal filament-borne cells oblong to angulato-capitate, 11.4 to 26.6 μ m at its broadest part, to 30.2 μ m long; vegetative cells 7.6 to 11.4 μ m in diameter regularly arranged, angular with rounded angles in cross section; chromatophore one per cell with centrally located pyrenoid; monoecious; antheridial patch yellowish; cystocarpic areas reddish, both located marginally oftentimes alternating.

The antheridial mother cell divides according to the formula 64 ($a/4$ $b/4$ $c/4$). The formula followed in the development of carpospores

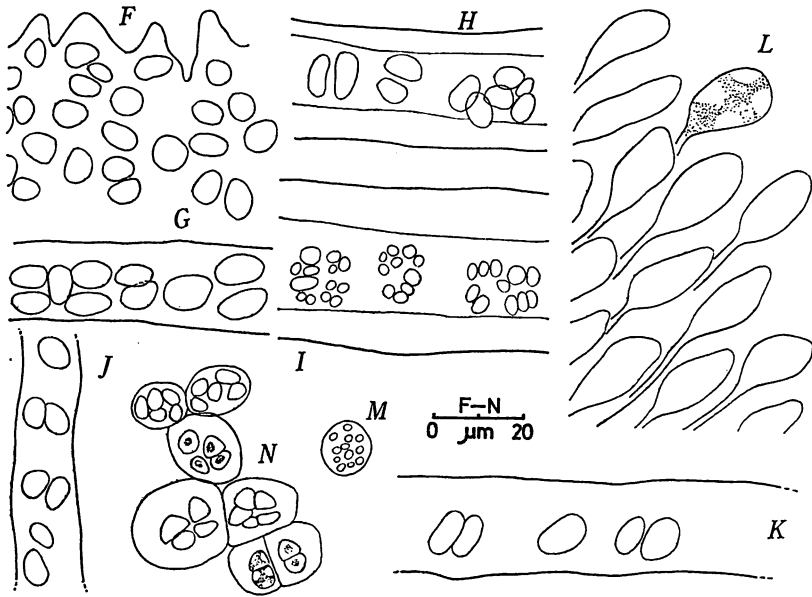


Fig. 3. *Porphyra suborbiculata* KJELIMAN

F. Microscopic denticulate processes and vegetative cells. G, H and J. Cross section of a cystocarpic frond. I. Cross section of an antheridial frond. K. Cross section of a vegetative frond. L. Lowermost cells of the frond, showing the rhizoidal filament-borne cells. M. Surface view of an antheridium. N. Surface view of a cystocarpic frond.

is 32 (a/2 b/4 c/4).

Habitat: Bubon, Burgos, Ilocos Norte, PNH 103607, collected by H. G. GUTIERREZ and R. ESPIRITU, June 12-19, 1970; Palau Island, Sta. Ana, Cagayan, PNH 112306 and PNH 112307; Bubon, Ilocos Norte, PNH 112182, all collections of H. G. GUTIERREZ, P. A. CORDERO, JR., and E. J. REYNOSO, February-March 1973.

Geographical distribution: Japan, China, Korea (TANAKA²⁾).

3) *Porphyra* sp.

Fig. 4. O-U

Frond monostromatic, membranaceous, linear-lanceolate, laterally or very rarely basally branched, light purplish or brownish red, 0.8 mm to 10 mm broad, 10 to 14 cm in height; jelly-like substance 11.4 to 26.6 μm thick; margin decidedly crenulate; base cordate; holdfast small and disc-shaped; rhizoidal filament-borne cells angulato-capitate others oblongo-capitate 5.6 to 19 μm broad, 19 to 60.8 μm long; chromatophore stellate, arms pointing to different directions, with central pyrenoid;

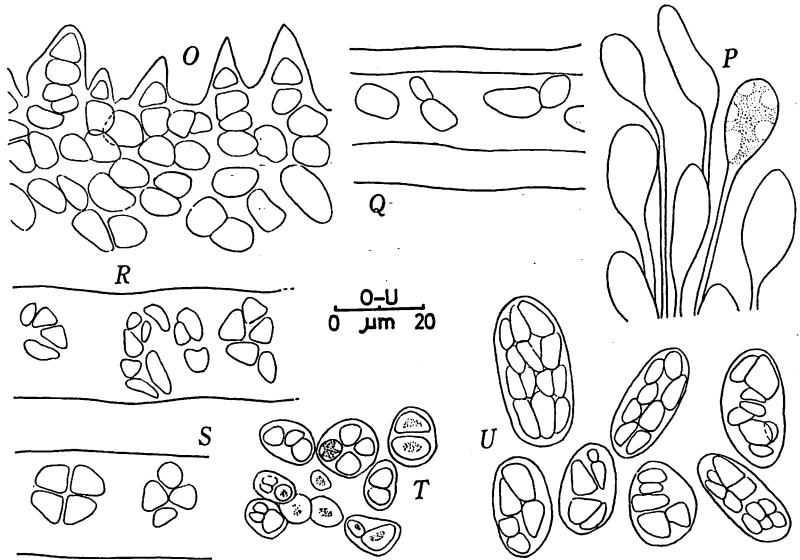


Fig. 4. *Porphyra* sp.

O. Sharpish, intensely paced marginal denticulate processes and angular with rounded angles vegetative cells. P. Rhizoidal filament-borne cells. Q. Cross section of frond (basal) showing the thickness of jelly-like substance. R. Cross section of an antherinal frond. S. Cross section of a cystocarpic frond. T. Surface view of a cystocarpic frond. U. Surface view of an antheridial frond.

microscopic denticulate processes well-developed; vegetative cells 9.5 to 15.2 μm in diameter, angular with rounded angles in surface view, more or less irregularly arranged upon maturity, with stellate chromatophore; monoecious; sporocarpic and antheridial patches heavily occupying the marginal and apical portions of thallus.

The antheridium mother cell, following a cruciate and perpendicular to the surface of the frond divisions, gives rise to four antheridia. Each antheridium undergoes a division parallel to the surface of the frond followed by another parallel division in all segments. The antheridium is now divided into sixteen parts, each of which by a cruciate division, gives rise to four antherozoids. The whole antheridium now consists of sixty-four antherozoids arranged in four tiers of sixteen each, or a formula of $64 (a/4 b/4 c/4)$. The development of carpospores starts off with the division of the sporocarp cruciately and perpendicularly to the surface of the frond. This is followed by a division parallel to the surface of the frond. This type of division produces two tiers

of four carpospores each. Thus, the final count of carpospores produced is eight, or a formula $8 (a/2 b/2 c/2)$.

Habitat: Dirique Bay, Burgos, Ilocos Norte, PNH 98660, collected by H. G. GUTIERREZ, January 20, 1963.

Geographical distribution: Philippines (endemic?).

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