A brown alga referable to *Spatoglossum asperum* J. Agardh (Dictyotaceae, Dictyotales, Phaeophyceae) was collected from the coasts of the western Japan. This species has a wide distribution in the Indian Ocean and the west side of the Pacific Ocean, though this is the first report from the East Asia because the scarcity of macroscopic characters in this genus makes identification difficult. The *Spatoglossum* Kützing (1843, p. 339) is a macroalgal genus placed under the tribe Zonarieae with *Dictyopteris*, *Distromium*, *Padina*, *Zonaria*, etc., that have marginal rows of apical meristematic cells. The *Spatoglossum* species have flattened thalli lacking midribs and veins in surface view, and the thalli are composed of cortical and medullary cells irregularly arranged in transverse view. In the genus, twenty species are currently recognized from the tropical and temperate waters of the Indian Ocean, the Pacific Ocean and the Atlantic Ocean (Guiry and Guiry, 2010). In Japan, six species had been recorded so far: *Spatolossum cornigerum* J. Agardh (Yendo, 1916), *S. solieri* (Chauvin ex Montagne) Kützing (Yendo, 1916), *S. variabile* Figari et De Notaris (Yendo, 1916), *S. pacificum* Yendo (Yendo, 1920), *S. crassum* J. Tanaka (Tanaka, 1991), *S. latum* J. Tanaka (Tanaka, 1992). However, *S. cornigerum* sensu Yendo and *S. variabile* sensu Yendo were correctly referred to *S. pacificum* and *S. crassum* respectively by Yoshida et al. (1995) based on the personal communication with Dr. Jiro Tanaka and *S. solieri* sensu Yendo was treated as a synonym of *S. pacificum* by Tanaka and Yoshida in Yoshida (1998). In consequence, Yoshida and Yoshinaga (2010) listed three species as Japanese *Spatoglossum*: *S. crassum*, *S. latum* and *S. pacificum*. However, Hwang et al. (2004) transferred *S. pacificum* to the genus *Dictyopteris* based on the material from Korea.

In this study, to confirm the identity of the present plants collected from West Japan and to clarify the morphological characters for the species of *Spatoglossum* in Japan, anatomical observations were made on the material using a microscope. For preservation, the material was dried on sheets of paper or fixed in 10% Formalin-seawater. Voucher specimens were deposited in the algal herbarium of the National Museum of Nature and Science (TNS).
Descriptions

Dictyotales Kjellman in Engler et Prantl, 1896
Dictyotaceae J.V. Lamouroux ex Dumortier, 1822

*Spatoglossum asperum* J. Agardh

Plants erect, up to 28 cm in height, epilithic, attached by a stipe with rhizoids on subtidal rocks. Thalli light to medium brown in color, flattened, irregularly or subdichotomously divided 2–5 times into spreading blades. Blades lanceolate to obovate, 1–6 cm in width, lacking entire midribs and veins (Fig. 1). Margins of blade dentate or irregularly proliferous (Fig. 2). Apical marginal meristems narrow, composed of 4–12 cells (Figs. 3 and 10). Blades thin, 110–150 μm in thickness, composed of 1- or 2-layered cortex and 1–3 layered of medulla or lacking medulla. Cortical cells roundly quadrangular, 24–48 μm in width, 34–70 μm in height, pigmented, possessing many chloroplasts. Medullary cells irregularly arranged, 30–74 μm in width, 22–50 μm in height, colourless. Phaeophycean hair tufts scattered on both surfaces of the thalli, arising from depressions (Fig. 4).

Sporangia scattered over both sides of the blades (Figs. 5 and 6), embedded in the cortical layer (Fig. 7), without stalk cells (Fig. 8), transformed directly from cortical cells (Fig. 9), spherical, 72–98 μm in height, 64–105 μm in width. Sexual reproductive organs not seen in the Japanese specimens.


Japanese name: Monnashi-gusa (nom. nov.).


Remarks: The present *Spatoglossum* plants from Hyogo Prefecture, the western Japan are in strikingly morphological agreement with Australian plants of *Spatoglossum asperum* J. Agardh described by Kraft (2009, p. 233, fig. 76) in both of vegetative and reproductive morphology (Table 1). In addition, the Pakistan plants of *S. asperum* described by Nizamuddin and Perveen (1986) is also similar to the Japanese plants, though there are a couple of differences in morphology of reproductive organs: conical sporangia with stalk-like cells (Table 1), though it seems that the cells are not real stalk cells because there are two cells under the sporangium judging from the illustration (Nizamuddin and Perveen, 1986, f. 2D). However, the Mauritius plants of *S. asperum* illustrated by Børgesen (1941, 1957) differ from the Japanese plants in having thick medulla composed of over 10 layers of cells (Børgesen, 1957, f. 2). Although more information about the entity of the species are required, I regard the present Japanese plants as *S. asperum* because it has a distribution in the tropical to warm temperate Indo-West Pacific and broad thin thalli with dentate margins and spherical sporangia without stalk cells.

The plants of *Spatoglossum asperum* can be distinguished from the other two Japanese species, *S. crassum* J. Tanaka and *S. latum* J. Tanaka, by the following morphological characters: 1) conspicuous dentate margins, 2) narrow apical marginal meristems consisting of 4–12 apical cells, 3) thin medulla composed of 1 to 3 layers of irregularly rectangular cells, 4) spherical sporangia lacking stalk cells. In particular, formation of spherical sporangia embedded without stalk cells can be regarded as a notable feature of the species. The initial cells of sporangia become spherical slightly increasing the size when mature, and the adjoining cortical cells tend to decrease their size. Thus the exposure
areas of the mature sporangia on the surface of cortex are considerably small (Fig. 7). In *S. asperum* the sporangia are considered to be developed directly from the cortical cells inside the cortex, without producing any new reproductive cells and any supporting or stalk cells outside the initial cells (Fig. 9). According to the original descriptions (Tanaka, 1991, p. 577, 1992, p. 29), in
Figs. 7–10. *Spatoglossum asperum* from Kasumi, Hyogo, Japan (TNS-AL 158690). 7. Surface view of the thallus showing a mature sporangium (ms) embedded in a cortical layer and two initial cells of sporangium (ic). 8–9. Transverse section of blades showing a mature sporangium (ms), an immature sporangium (is) and initial cell of sporangium (ic); chloroplasts (c) clustered in the outer side of the cortical cells, while the initial cell of sporangium (ic) filled with scattered many reduced chloroplasts. 10. Surface view of a tooth in dentate margin of the thallus showing apical cells (ac).
S. crassum and S. latum, flat stalk cells are formed by transverse division of the sporangial initials, though Tanaka and Yoshida in Yoshida (1998, p. 232) described that the stalk cells are absent in S. latum. It is considered in general that differences in manner of forming sporangia are useful for distinction among these species. In an outward appearance, however, S. asperum shares a close similarity with S. latum because of the broad and thin thalli. Thus it is not easy to distinguish the both species without anatomical observation on the apical and medullary cells using a microscope. It may be possible that distributional records of S. latum include the ones of S. asperum. On the other hand, S. crassum differs strikingly from S. asperum and S. latum in having linear thalli and thick thalli with small cortical cells (under 20 µm in width) (Table 1).

Spatoglossum asperum J. Agardh also differs from the four species of Spatoglossum recorded from the Japanese coasts by Yendo (1916, 1920): S. cornigerum J. Agardh, S. solieri (Chauvin ex Montagne) Kützing, S. variabile Figari et De Notaris and S. pacificum Yendo. Of these, the occurrence of S. cornigerum, S. solieri and S. variabile in Japan had been pointed out to be doubtful by Okamura (1936) and Tanaka (1991, 1992). The Australian species S. cornigerum was synonymized to S. macrodontum J. Agardh by Allen-dor and Kraft (1983). S. macrodontum, which is also Australian species, is different from S. asperum in lacking stalk and attaching by prostrate strap-like holdfast (Kraft, 2009). The type species of the genus, S. solieri, which is distributed in the Mediterranean Sea and Africa, has no dentate margins (N’Yeu rt and Payri, 2006). Also S. variabile, which is distributed in the Indian Ocean and Africa, has no dentation on the margin, according to the description by Nizamuddin and Perveen (1986). However, information on these species is insufficient to discuss on the relationships with S. asperum. S. pacificum is different from not only S. asperum but also probably all members of Spatoglossum in having protruberant reproductive organs on the outside cortex.

Lee and Lee (1996) noted that S. pacificum from Korea has a partial midrib-like structure on the lower part of the thalli. Furthermore, Hwang et al. (2004) showed that S. pacificum has a strong relationship with Dictyopteris divaricata and D. undulata based on molecular analyses using plastid genes and anatomical observations on several species, esp....
species of *Spatoglossum* and *Dictyopteris*. As a result, they proposed a new combination, *Dictyopteris pacifica* (Yendo) I.-K. Hwang, H.-S. Kim et W. J. Therefore, three species are currently listed for *Spatoglossum* in the Japanese flora: *S. asperum*, *S. crassum* and *S. latum*.

**Key to the species of *Spatoglossum* in Japan**

1a. Thalli narrow, linear, straplike, up to 2 cm in width; cortical cells slender, smaller than 20 μm in width; phaeophycean hair tufts absent .......................... *S. crassum*

1b. Thalli broad, lanceolate to obovate, mostly 1–8 cm in width; cortical cells cubic, mostly 20–40 μm in width; phaeophycean hair tufts present ........................................ 2

2a. Margins of blades entire; blades thick, mostly 260–350 μm in thickness; marginal apical growth regions broad, with 20–40 apical cells; medulla thick, 3–6 layered; sporangia conical, with stalk cells ............................................................ *S. latum*

2b. Margins of blades dentate; blades thin, mostly up to 200 μm in thickness; marginal apical growth regions narrow, with up to 12 apical cells; medulla thin, 1–3 layered; sporangia spherical, lacking stalk cells ............................................................ *S. asperum*

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**References**


