Iemasa YAMADA* & Munenao KUROGI*: **_Prasiola delicata_ Setch. et Gardn. (Chlorophyta) found at Akkeshi in eastern Hokkaido****

山田家正*・黒木宗尚*: 北海道東部の厚岸大黒島でみつかった緑藻ヒメイソカワノリ(新称)**

Five taxa of *Prasiola*, three species, one subspecies and one variety, have been reported from Japan and its vicinity. Of these taxa, three are fresh water algae, *P. japonica* Yatabe (1891) indigenous to Japan, *P. formosana* Okada (1936) from Formosa and *P. formosana* var. *coreana* Okada (1939) from Korea; one aerial alga, *P. crispa* subsp. *eucrispa* Knebel from Robben Isl. of South Saghalien (Tokida, 1932, 1954); and the other one is a marine species, *P. borealis* Reed from Paramushiru Isl. of North Kuriles (Nagai, 1940).

We found another marine species of *Prasiola*, referable to *P. delicata* Setchell et Gardner, at Daikoku-jima Islet located at the entrance of

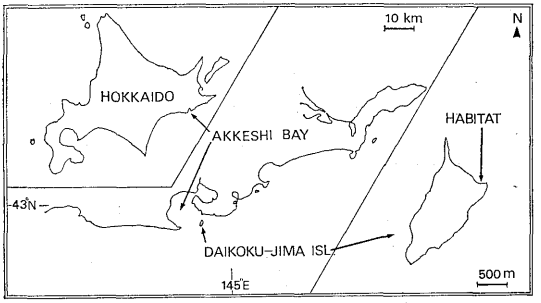

Fig. 1. Map of Daikoku-jima Isl. of Akkeshi Bay showing where *P. delicata* was collected.

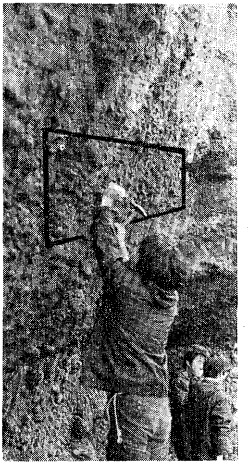

Fig. 2. Habitat of *P. delicata* in the supratidal zone of a vertical cliff.

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Akkeshi Bay on the Pacific coast of eastern Hokkaido in early July, 1970. The plant has been found there every summer since then. This species has been reported only from Sitka, Alaska in the northeastern Pacific by Setchell and Gardner (1920, 1920a) as far as we know, and is new to Japan. The habitat and morphology of the plant are described in this paper.

Morphological observations were made on both living and fixed materials mainly collected in early July, 1973. The measurement of morphological characters was made with the material fixed with 5% formalin solution.

Habitat The plant grows densely to form a green-mat with an area of about 3 m² (growing in a belt 1–1.5 m high and 2 m wide) in the

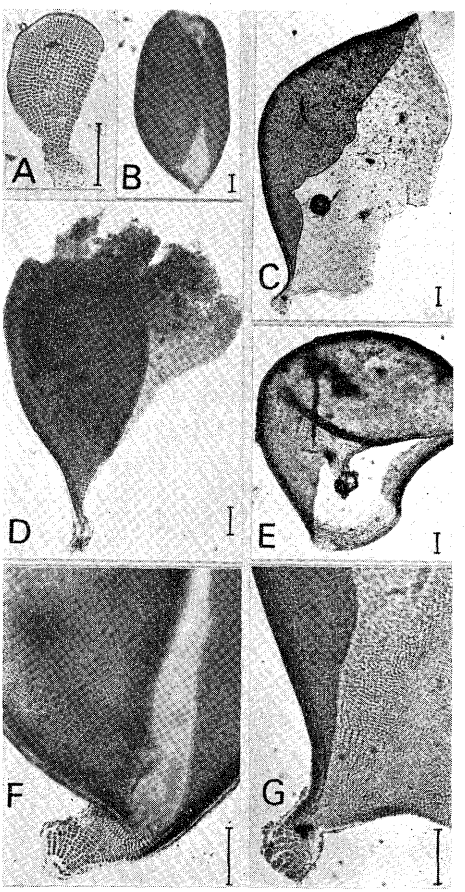

Fig. 3. Photomicrographs of *P. delicata*. A-E: Habits. A: young flat form. B: inrolled form. C: cup-shaped form. D: old form with broken upper portion. E: cucullate form. F-G: basal portions showing holdfast. Each of the scales equals 100 μm.

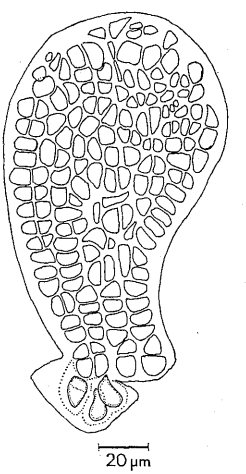

Fig. 4. Microscopic young plant, showing the early development of holdfast cells.

supratidal zone on vertical rocks of exposed cliff facing north at the northeast coast of Daikoku-jima (Figs. 1, 2). The lower limit of the belt is about 50 cm above the upper limit of the *Gloiopeltis furcata*-belt, corresponding to the height of about 2.5 m above the mean low water level. It is supposed that the growth area of *Prasiola* is washed by the spray of sea water under stormy conditions, and is affected by rain or by freezing during winter.

Morphology Thalli are leafy, obovate or irregularly round when young, becoming spoon-like, cup-shaped or cucullate later as a result of curling inwards of the margin (Fig. 3A–E), shortly stipitate, and attached by a small mass of colored cells to the substratum (Fig. 3F, G; Fig. 4). The size is small, mostly 0.6–1.5 mm high and 1 mm wide, sometimes becoming up to 2 mm high and 2.5 mm wide. The curling inwards begins at a size of 0.2–0.3 mm.

Fronds are monostromatic when young, when adult monostromatic only in the lower portion, and polystromatic in the upper portion where "aplanosporangia" are formed (Figs. 5, 6). The thickness is about 18–28 μm in the lower monostromatic portion, becoming thicker up to 40 μm or more in the upper polystromatic portion, but is generally thin in the young plant. The thickness and other measurements of three plants in different stages are represented in Table 1.

Vegetative cells are quadrate or rectangular in surface view, generally forming a group of four cells (Fig. 6A), provided with an axile massive or stellate chloroplast with one pyrenoid in the center. Occasionally areolation caused by the grouping of a certain number of cells is found in some plants of which growth

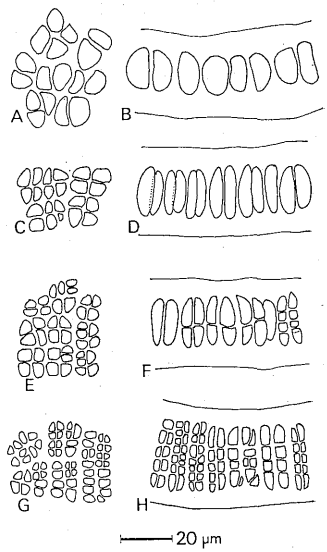

Fig. 5. Structure of a fully matured plant (Material C in Table 1). A, B: lowest monostromatic portion near the base. C, D: lower monostromatic portion. E, F: central 2-4 layered portion. G, H: upper 4-8 layered portion. A, C, E, G: surface view. B, D, F, H: cross sectional view.

Table 1. Thickness and layer of thallus, and sizes of cells and sporangia of three plants in different stages in μm. Material A: Young sterile plant (670 μm in height). B: Fairly matured plant (1.6 mm in height). C: Fully matured plant (1.4 mm in height). L, length; W, width; H, height.

		Thickness of thallus	Size of cells			Size of sporangia			Layer of thallus
			Surface L×W	Cross		Surface L×W	Cross		
				H	H/W		H	H/W	
Material A	Lower portion	(18–)20.2–22.6	6.2–8.5 (–10.1)×5.4–6.2	8.5–10	1/1–2/1				monostromatic
	Central portion	24.9	3.9–6.2×3.9–4.6	14.8	3/1				monostromatic
	Upper portion	24.9	3.9–5.4×2.4–3.9	14.8	3/1	3.9–5.4×3.9–4.6	15.6	3/1	partly 2-layered
Material B	Lower portion	21.0–26.5	7.0–7.8×3.9–6.2	12.4–15.6	2/1				monostromatic
	Central portion	29.6–31.2	5.4–7.0×4.6–5.4			7.0×5.2–7.0	20.2–21.8	4/1–3/1	mostly 2-layered
	Upper portion	32.7–34.3	3.1–3.9×2.4–3.9			7.0×5.4–7.0	20.2–24.9	4/1–3/1	4- or more (–8) layered
Material C	Lower portion	28.0–37.4	7.8–12.4×4.6–8.5	10.9–19.4	2/1				monostromatic
	Central portion	37.4–40.4				7.0×5.4	22.5	4/1	2- or 4-layered
	Upper portion	40.4–42.0				6.2–7.8×7.0	28.7–29.6	4/1	4- or more (–8) layered

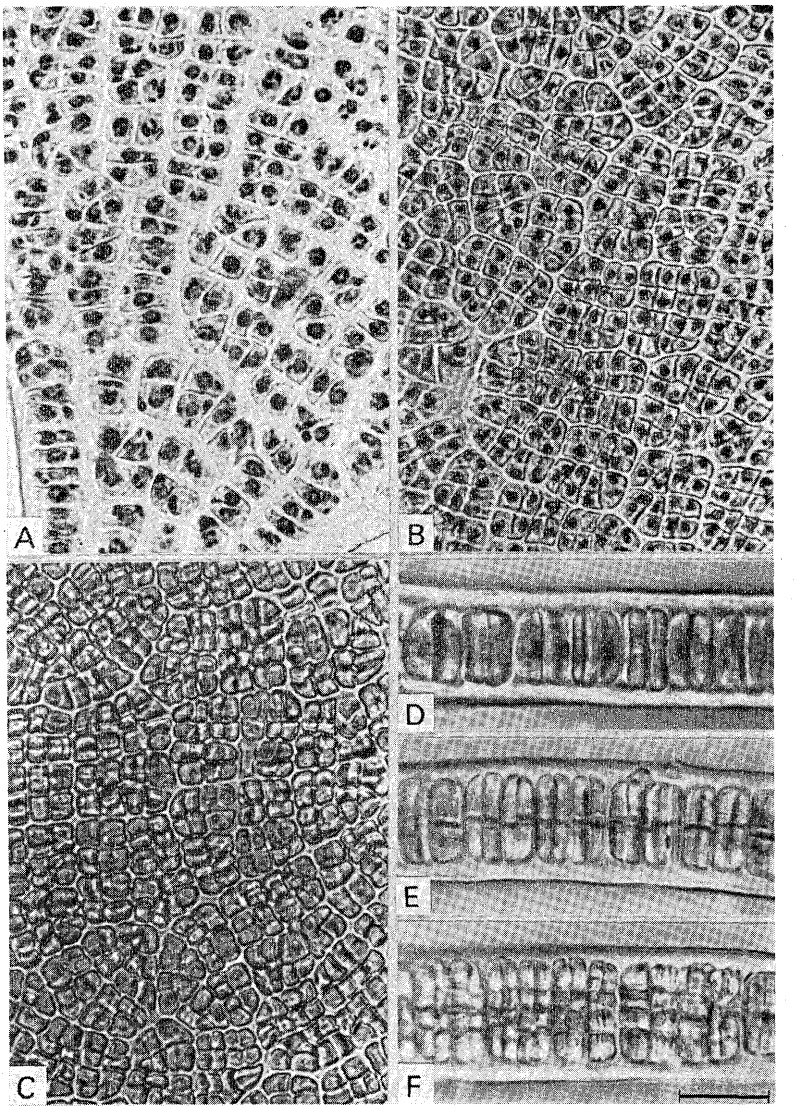

Fig. 6. Photomicrographs showing the structure of a fairly matured plant (Material B in Table 1). A, D: lower monostromatic portion. B, E: mostly 2 layered central portion. C, F: 4 or more layered upper portion. A, B, C: surface view. D, E, F: cross sectional view. Scale equals 20 μm.

appears to be arrested. The size of cells is about 4–12×4–8.5 μm, generally larger in the lower portion of the frond and also in matured plants (Table 1). Cells in cross section are mostly rectangular and 2–3 times as high as wide (Fig. 5B, D; Fig. 6D). Nearly quadrate cells are frequent in the lower portion of the young plant, but mostly becoming rectangular upwards in the frond. The height measured with the section embedded in dilute glycerin is about 8.5–19.5 μm, generally smaller in young plants. Cells of the holdfast are developed from the lowest cells of the frond and are spherical, hemispherical or ellipsoid in shape (Fig. 4). Rhizoidal cells are not developed.

"Aplanosporangia" arise by repeated parallel and perpendicular divisions of original vegetative cells. They are usually first formed in the upper portion of the frond and then over the entire frond except the lower portion. The initial formation occurs by a division parallel to the frond surface, followed by two perpendicular divisions at right angle to each other and to the frond surface and finally by repeated parallel and perpendicular divisions. Thus the mature sporangium is divided into 4 (up to 16) in surface view and in 4 (up to 8) tiers in cross section, producing 16 (up to 128) "aplanospores". The size of sporangia is about 6–8×5–7 μm in surface view and about 20–30 μm high in cross section. The loculus is 2.4–3.9×2.4–3.9 μm in surface view and 1.5–3.1(–6.2) μm high in cross section.

The circumference of one sporangium in surface view is indistinct in living condition, but in fixed state sporangia appear to be frequently grouped four by four. The definition of the circumference of one sporangium is indistinct, and it is determined by the interpretation on whether the first division in the formation of sporangium is parallel or perpendicular. When the perpendicular division as seen in the monostromatic portion of frond is regarded as the first division, the sporangium is taken to be larger and more divided in surface view than that mentioned by us. But we believe that it is natural to regard the parallel division as the first division judging from the comparison of the size of sporangia with that of vegetative cells.

There is no occurrence of mosaic patches caused by "microgametangia" and "macrogametangia" as seen in *P. japonica* (Yabe, 1932; Migita, 1948; Fujiyama, 1955), *P. stipitata* (Friedmann, 1959) or *P. meridionalis* (Cole and

Akintobi, 1963; Bravo, 1965). Motile reproductive cells were not observed. A few celled germlings possibly originated from aplanospores were frequently observed. But the development of the spores was not investigated.

Discussion The plant agrees well with *P. delicata* described by Setchell and Gardner (1920, 1920a) in its habit growing in supratidal zone, small thin thallus with margin curling inwards, and the formation of aplanosporangia. The lower vegetative portion of the frond is of nearly similar thickness to the Alaskan plant, but the upper fertile portion is up to twice as thick as that plant. The number of spores produced in a sporangium is fewer than in *P. delicata*. However, the difference in number of spores seems to be caused by a different interpretation of circumference of one sporangium as mentioned before.

On the other hand, this plant resembles the European aerial species, *P. furfuracea* (Mert.) Meneghini in having small and concave to cucullate fronds. But the rectangular shape of cells of *P. furfuracea* in surface view (14–16×4–6 μm, by Knebel, 1935) seems to differ from that of our plant. The thickness of the frond was not reported.

More detailed studies on the limits of aerial and marine habitats of *P. furfuracea* are apparently required. At present, however, we refer our plant to *P. delicata* because of the close similarity in its morphology, habitat and distribution in the north Pacific, though further investigations on the phenology and reproduction are required.

A new Japanese name, "Himeiso-kawanori", is given to this species.

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アラスカの太平洋岸に面する Sitka から Setchell and Gardner (1920) によって報告され，その後どこからも報告されていなかった海産のカワノリ属の一種 *Prasiola delicata* Setch. et Gardn. に同定できる植物が厚岸湾口の大黒島でみつかった。

本植物は外海に面する飛沫帯にマット状をなして群生し，体は 1 mm 内外で小さく，縁辺が内方に彎曲して匙形，椀形あるいは筒形をなし，不動胞子を形成する。これらの特徴について詳しい観察をなし，原記載および近縁種との比較検討を行った。