

Two Red Algal Parasites New to China

Taiju Kitayama¹, Jin-Xin Han² and Hui-Ping Dai²

¹Department of Botany, National Science Museum,
4-1-1 Amakubo, Tsukuba, Ibaraki, 305 Japan

²Botanical Department, Shanghai Museum of Natural History,
1102 Long Wu Road, Shanghai, 200231 China

Abstract Two parasitic red algae (Rhodophyceae), *Sorellocolax stellaris* Yoshida et Mikami (Delesseriaceae, Ceramiales) and *Benzaitenia yenoshimensis* Yendo (Rhodomelaceae, Ceramiales) were first collected on the coasts of Zhou-shan Islands, Zhejiang Province, China. Both genera are recorded for the first time in China.

Key words: *Benzaitenia yenoshimensis*, Ceramiales, China, parasite, Rhodophyceae, *Sorellocolax stellaris*.

Since the discovery of the new genus *Choreocolax* by Reinsch (1874–1875) more than 50 genera and over 100 species of parasitic red algae have been described in the world (Goff, 1982; Yoshida & Mikami, 1996), and all of which are small, light-colored, occur only on the particular red algal hosts. In China two parasitic genera, *Gracilariophila* Setchell et Wilson in Wilson (1910) and *Janczewskia* Solms-Laubach (1877), had been recorded by Chang & Xia (1978) so far.

During the botanical expedition to China under the title of “Comparative floristic studies between Japan and SE Asia” started from 1995, we made a survey of seaweed flora of Zhoushan Islands, Zhejiang Province, China in June 1995, and presented a paper of the brown algal flora there (Kitayama *et al.*, 1995). In the survey, we collected two red algal parasites on *Sorella repens* (Okamura) Hollenberg and *Chondria crassicaulis* Harvey respectively from the coasts of the islands: Dongjigang, Miaozihu Isl. (30°11'N, 122°41'E); Nansha, Zhujiajian Isl. (29°52'N, 122°24'E); Xiangziao, Chengshan Isl. (30°43'N, 122°48'E). The materials collected were fixed in 5–20% Formalin-seawater within 12 hours for the examining their anatomy. The voucher dry or sheet specimens are deposited in the herbaria of the National Science Museum, Tokyo (TNS-AL) and the Shanghai Museum of Natural History (SHM).

Description

Sorellocolax stellaris Yoshida et Mikami, Phycological Research, 44: 127 (1996)
(Figs. 1, 2)

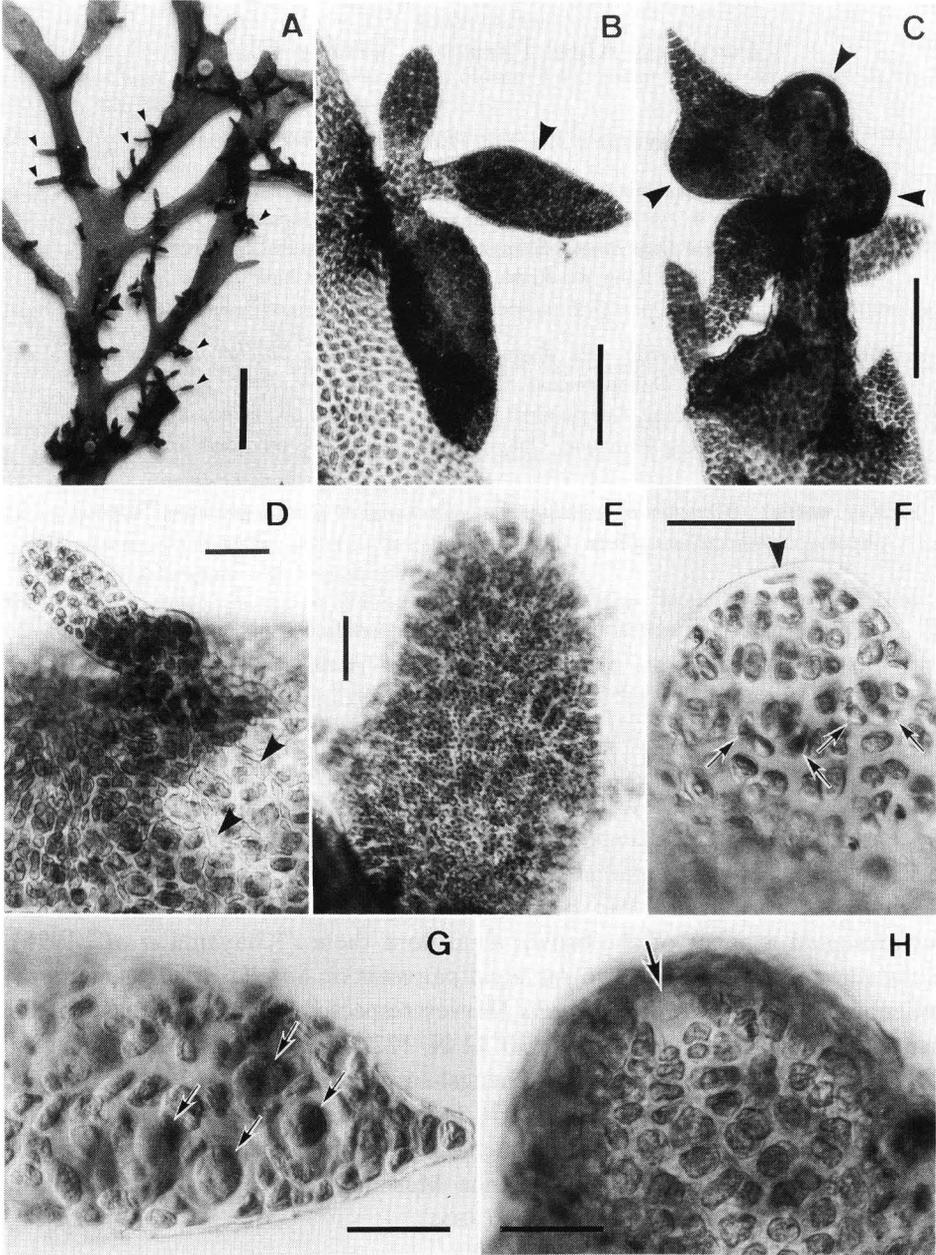


Fig. 1.

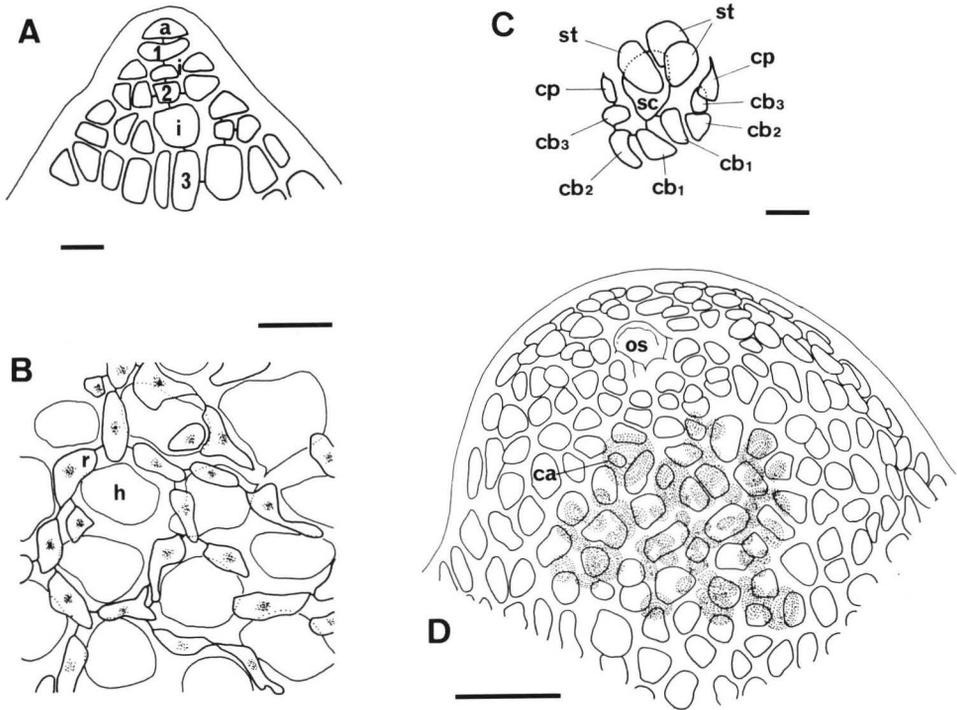


Fig. 2. *Sorellocolax stellaris* Yoshida et Mikami. A. Apex of blade. Scale bar = 10 μm . B. Rhizoid cells creeping between host cells. Scale bar = 20 μm . C. Procarp with two carpopogonial branches. Scale bar = 10 μm . D. Cystocarp. Scale bar = 40 μm . Abbreviations: 1–3, cells in the first-order cell row; a, apical cell; ca, carpopogonium; cb1–3, cells in carpopogonial branch; cp, carpopogonium; h, host cell; i, intercalary cell; os, ostiole; r, rhizoid cell; sc, supporting cell; st, sterile cell.

Plants grow on branches of *Sorella repens* (Fig. 1A). They are dark red in color, bladelike, flattened, branched once or twice, with one to several acute or obtuse apices. In the apex an apical cell is present and intercalary cell divisions occurred in the first-order cell row (Fig. 2A). Holdfast projects numerous endophytic rhizoids penetrated into the tissue of the host (Fig. 1D). Rhizoid cells

Fig. 1. *Sorellocolax stellaris* Yoshida et Mikami. A. Habit of plants (arrowheads) on *Sorella repens* (Okamura) Hollenberg. Scale bar = 1 mm. B. Male plant with spermatangial sori covering up the branches (arrowhead). Scale bar = 200 μm . C. Female plant with three cystocarps. Scale bar = 200 μm . D. Young plant with endophytic filaments (arrowheads) penetrated into the cortical layer of *Sorella repens*. Scale bar = 50 μm . E. Detail of male plant with spermatangial sorus. Scale bar = 50 μm . F. Detail of female plant with an apical cell (arrowhead) and procarpis showing carpopogonial branches (arrows). Scale bar = 50 μm . G. Tetrasporangial sorus showing tetrasporangia (arrows). Scale bar = 40 μm . H. Cystocarp with an ostiole (arrow). Scale bar = 40 μm .

creep among the host cells (Fig. 2B). Gametangial plants are dioecious. Male plants are up to 750 μm in length, 70–340 μm in width (Fig. 1B). Spermatangial sori are formed at the surface of the thallus (Fig. 1E), sometimes covering the whole surface it except the apex (Fig. 1B, arrowhead). Spermatangia are ellipsoid, about 10 μm in length, about 4 μm in diameter. Female plants are up to 1.8 mm in length, 120–300 μm in width, having procarps scattering over the upper portion of the thallus and one to four cystocarps on the lower portion (Fig. 1C, F). The procarp is composed of a supporting cell, two carpogonial branches, and a group of sterile cells (Fig. 2C). The carpogonial branch is four-celled with a carpogonium (we could not observe a distinct trichogyne). The cystocarps are hemispherical, 18–240 μm in diameter, with a small ostiole when mature (Figs. 1H, 2D). Tetrasporangia are formed in a thallus, spherical, 22–34 μm in diameter, divided tetrahedrally when mature (Fig. 1G).

Specimens examined: Xiangziao, Chengshan Isl. 10 June 1995 (TNS-AL-44950, 44951, SHM-1002056, 1002057).

Geographical distribution: China, Japan.

Chinese name: Xiaoshezao 小舌藻.

Sorellocolax stellaris was found recently on *Sorella repens* (Okamura) Holtenberg (Delesseriaceae, Ceramiales) collected from the Pacific coast of Japan and recognized as a new adelphoparasitic genus and species by Yoshida & Mikami (1996). They pointed out that this species belongs to the *Phycodrys* group, by possessing the intercalary divisions of the first-order in the cell row, the *Polyneura*-type procarp with two carpogonial branches and a group of sterile cells on a supporting cell, and carposporangia borne in short chains. Our observations agree with their opinion of this new member of the *Phycodrys* group, though we could not observe the inner structure of cystocarps. This is the second record for the species.

In our materials with mature plants we could observe spermatangial sori covering up branches of the plants including marginal area and an ostiole on a cystocarp, which have not been found in the Japanese plants.

Benzaitenia yenoshimensis Yendo, Nytt Mag. for Naturvidenskaberne, **51**: 283 (1913) (Fig. 3)

Plants grow on branches of *Chondria crassicaulis*. They are yellow in color,

Fig. 3. *Benzaitenia yenoshimensis* Yendo. A–C. Habit of plants on *Chondria crassicaulis* Harvey. A. Male plant. Scale bar = 1 mm. B. Female plant. Scale bar = 1 mm. C. Tetrasporophyte. Scale bar = 1 mm. D, E. Spermatangial branches. D. Transverse section showing spermatangia (arrowheads). Scale bar = 50 μm . E. Surface view. Scale bar = 50 μm . F. Longitudinal section of cystocarp. Scale bar = 200 μm . G. Tetrasporangia. Scale bar = 20 μm . H. Surface view of tetrasporangial plant projecting numerous stichidia. Scale bar = 0.5 mm. I. Stichidia. Scale bar = 50 μm .

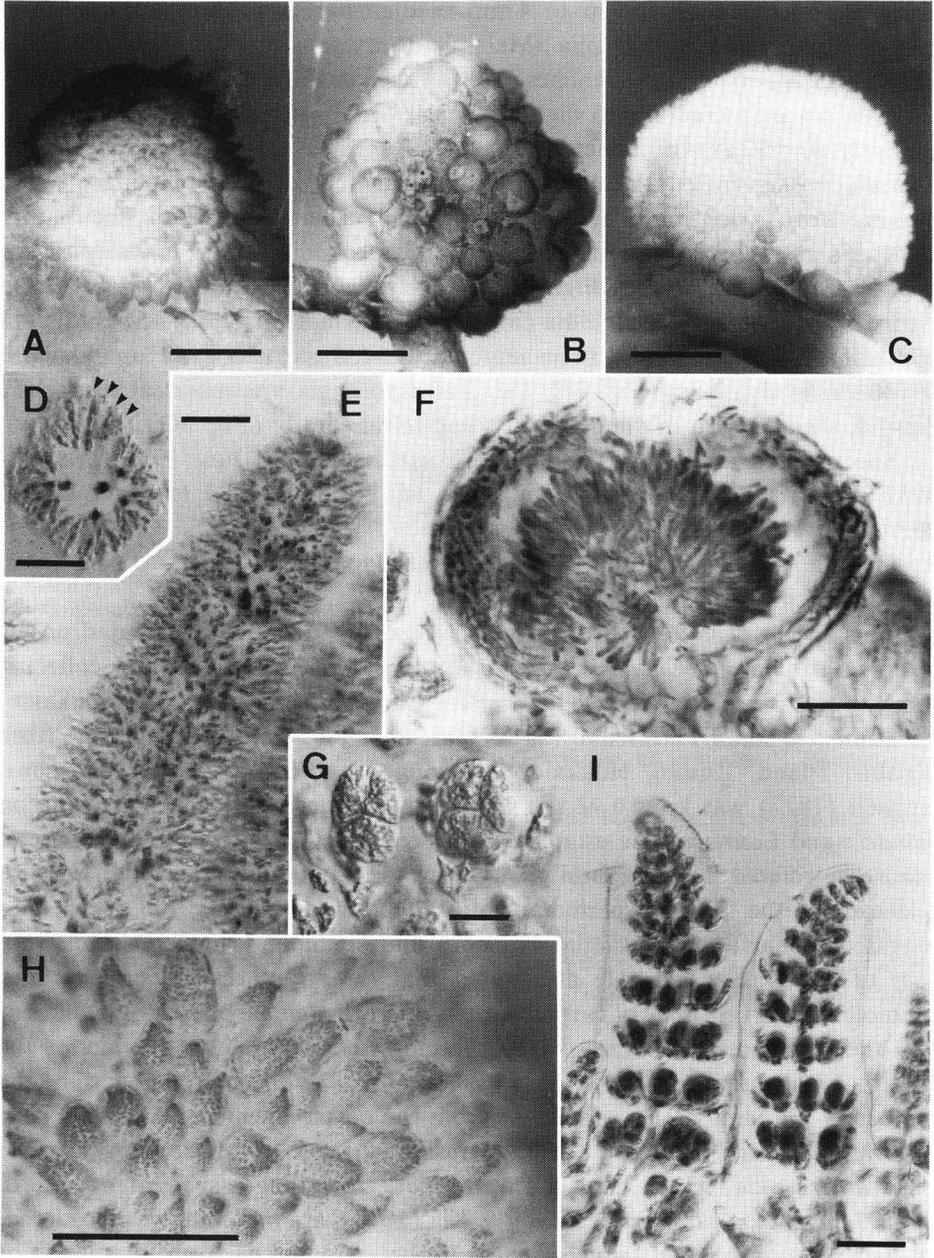


Fig. 3.

hemispherical to reniform, up to 4 mm in diameter, granular in the surface. Gametangial plants are dioecious. Male plants are prickly when mature, having a number of spermatangial branches over the surface (Fig. 3A). The spermatangial branches are cylindrical to slightly conical with a rounded apex, 160–520 μm in length, 80–150 μm in diameter (Fig. 3D, E). Spermatangia are spherical to ellipsoid, 5–9 μm in length, about 5 μm in diameter. Female plants are warty when mature, having many cystocarps over the surface (Fig. 3B). The mature cystocarps are spherical to ellipsoid, 320–800 μm in diameter. Each cystocarp when mature has an ostiole (Fig. 3F). Tetrasporangial plants are prickly when mature, having numerous stichidia covering the surface (Fig. 3C). Stichidia are cylindrical to slightly conical with an acute to rounded apex, 120–440 μm in length, 50–130 μm in diameter (Fig. 3H, I). Tetrasporangia are spherical to slightly ellipsoid, about 32 μm in diameter, dividing tetrahedrally (Fig. 3G).

Specimens examined: Dongjigang, Miaozihu Isl., 10 June 1995 (TNS-AL-44952, SHM-1002050); Nansha, Zhujiajian Isl., 14 June 1995 (TNS-AL-44953-44956, SHM-1002051-1002055).

Geographical distribution: China, Korea, Japan.

Chinese name: Tunangzao 突囊藻.

This species was described at first in Japan by Yendo (1913) based on his materials growing on *Chondria crassicaulis* Harvey (Rhodomelaceae) collected from the Enoshima Island, Kanagawa Pref. and Oshoro Bay, Otaru, Hokkaido, and *Laurencia saitoi* Perestenko (as *L. paniculata* (J. Agardh) J. Agardh) from Yagishiri Island, Rumoi, Hokkaido. Although the genus *Janczewskia* Solms-Laubach (1877) was known at the time as the sole parasitic genus growing on *Chondria* and *Laurencia*, he established a new genus *Benzaitenia* for this species because he referred it to the family Dasyaceae (as subfamily Dasyeae in Rhodomelaceae) by the form of spermatangial branches and stichidia: this species has elongated, conical spermatangial branches and stichidia, which are similar to those of the Dasyaceae. He also noted that the structures of pericarps and gonimolobes (fertile tissue of carposporophyte) of the female plants were different from the structures of *Janczewskia verrucaeformis* Solms-Laubach, which is the type species of the genus. However, *B. yenoshimensis* is considered now to be the member of the family Rhodomelaceae from the development pattern of procarp (Segawa 1962), and then to be adelphoparasitic algae. While more surveys on the genus *Janczewskia*, which has about ten species including a species endemic to China, *Janczewskia ramiformis* Chang & Xia (1978), are required, we considered, for the present, that *Benzaitenia yenoshimensis* is different from all species of *Janczewskia* in having spermatangial branches and stichidia projecting over the surface of thallus without conceptacles.

We found an ostiole on mature cystocarps, which were once considered to be lacking in the species by Yendo (1913).

surface of thallus without conceptacles.

We found an ostiole on mature cystocarps, which were once considered to be lacking in the species by Yendo (1913).

Acknowledgments

We are grateful to Ass. Prof. Z.-L. Liu and staff of Shanghai Museum of Natural History for their cooperation in collecting the materials. We also thank to Prof. T. Yoshida, Hokkaido University, for critical reading of this manuscript. This study was supported by the Grant-in-Aid for Scientific Research, Ministry of Education, Science, Sport and Culture, Japan (International Scientific Research Program: Field Research no. 07041151).

References

- Chang, C. F. & B. M. Xia, 1978. Studies on the parasitic red algae of China. *Studia Marina Sinica*, **14**: 121–127. (in Chinese).
- Goff, L. J. 1982. The biology of parasitic red algae. In F. E. Round & D. J. Chapman (eds.), *Progress in Phycological Research*, Vol. 1. Elsevier Biomedical Press, Amsterdam, pp. 289–369.
- Kitayama, T., H.-P. Dai & J.-X. Han, 1995. Brown algae from Zhoushan Islands, Zhejiang Province, China. *Bull. Natn. Sci. Mus., Tokyo, Ser. B*, **21**(4): 169–178.
- Reinsch, P. F. 1874–75. Contributiones ad algologiam et fungologiam I. T.O. Weigel, Lipsiae.
- Segawa, S. 1962. Bentenmo no Nouka no Dekikata to Sono Bunruigakuteki-Ichi. In Commemoration Papers on Biology Celebrating Sexagenary Birthdays of Professor H. Matsuura and Professor Y. Yamada. (in Japanese).
- Solms-Laubach, H. 1877. Note sur le *Janczewskia* nouvelle Floridèe Parasite du *Chondria obtusa*. *Mem. Soc. Sci. Nat. Cherbourg*, **21**: 209–224.
- Wilson, H. L. 1910. *Gracilariophila*, a new parasite in *Gracilaria confervoides*. *Univ. Calif. Publ. Bot.*, **4**: 75–84.
- Yendo, K. 1913. Some new algae from Japan. *Nyt Mag. for Naturvidenskaberne*, **51**: 276–288, 2 pl.
- Yoshida, T. & H. Mikami, 1996. *Sorellocolax stellaris* gen. et sp. nov., a hemiparasitic alga (Delesseriaceae, Rhodophyta) from the east coast of Hoshu, Japan. *Phycological Research*, **44**(3): 125–128.

