

A Note on Two Species of *Ramalina* (Ascomycotina) in Eastern Asia

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Abstract As a result of our taxonomic studies for the genus *Ramalina*, *R. seawardii* Aptroot & Sipman and *R. yasudae* Räsänen are reduced to synonyms of *R. pollinaria* (Westr. ex Ach.) Ach., and *R. throwerae* Aptroot & Sipman to a synonym of *R. litoralis* Asahina.

Key words: *Ramalina pollinaria*, *Ramalina litoralis*, taxonomy, eastern Asia.

Ramalina is a fruticose lichen genus known quite well throughout the world. Although several groups of the genus have been revised by Kashiwadani and other lichenologists (Kashiwadani, 1986, 1987, 1988, 1992, 1996; Stevens & Kashiwadani, 1987; Kashiwadani & Moon, 2002, etc.), certain species found in Japan and its neighboring countries are to be studied taxonomically more precisely.

Among the species of *Ramalina* in eastern Asia, *R. yasudae* Räsänen is one of the most common saxicolous species distributed in China, Japan, and Korea. However, the recent studies by the authors reveal that it should be reduced to a synonym of *R. pollinaria* which is widely distributed in temperate regions in the Northern Hemisphere.

Recently, Aptroot and Sipman (2001) described two new species, *Ramalina seawardii* Aptroot & Sipman and *R. throwerae* Aptroot & Sipman from Hong Kong, China. The results of our morphological and chemical studies of them indicate that they should be reduced to synonyms of *R. pollinaria* (Westr. ex Ach.) Ach. and *R. litoralis* Asahina respectively.

Materials and methods. This study is mainly based on the collections made by the authors and other lichenologists and preserved in the National Science Museum, Tokyo (TNS) unless other-

wise cited. All specimens were studied by means of thin-layer chromatography (C. Culberson & Johnson, 1982). Sections of thalli and apothecia were cut by hand-razor and mounted in GAW solutions, in which thalli and spores were measured.

1) ***Ramalina litoralis*** Asahina, in J. Jpn. Bot., **15**: 220 (1939).

Type collection: Japan, Shikoku, Prov. Tosa (Pref. Kochi), Isa. August 25, 1931, Y. Asahina s.n.—lectotype in TNS designated together with chemical data (*tlc*: usnic, divaricatic, 4'-O-demethyldivaricatic and salazinic acids) by Kashiwadani (1987).

Ramalina seawardii Aptroot & Sipman, J. Hattori Bot., Lab., **91**: 338 (2001). Type collection: China, Hong Kong, Lantau Island, Tai Shui Hang mountain near Discovery Bay, 200–250 m alt, July 7, 2000, Aptroot 48528—holotype in B!, syn. nov. (*tlc*: usnic, divaricatic and 4'-O-demethyldivaricatic acids).

Ramalina litoralis is characterized by 1) the saxicolous and maritime habit, 2) the caespitose thallus growing from a common holdfast, up to 3 cm long, 3) the subcylindrical or more or less dorsiventral branches with irregular thickness ending in branchlets with nodules, 4) the ellipsoid pseudocyphellae, 5) the absence of soredia, 6) the shortly ellipsoid ascospores (10–13 ×

3.5–4.5 μm) and 7) the presence of divaricatic or sekikaic acids as a major chemical substance.

Although the holotype specimen of *R. seawardii* is sterile, it has characteristic features cited above, and can be regarded to be synonymous with *R. litoralis*.

R. litoralis has been reported from northern Honshu to Kyushu in Japan (Kashiwadani, 1987) and Korea (Kashiwadani *et al.*, 2002). Not only the type of *R. seawardii* but also specimens collected in China and Taiwan are identified with the present species. Therefore, the distribution of this species now extends to southern China.

Specimens examined. China. Zhejiang Sang: Cape Toyu, Nanji Island. On rock. March 17, 1996, T. Kitayama s.n. (TNS). Taiwan. Prov. Taitung: Lan-hsu Island. June 1926, S. Sasaki s.n. (TNS).

2) ***R. pollinaria*** (Westr. ex Ach.) Ach., Lich. Univ.: 608 (1810).

Basionym. *Lichen pollinarius* Westr., Kgl. Vitensk. Acad. Nya Handl., 16: 56 (1795). Type collection: Suesia (H-Ach. 1831D!—neotype designated and chemical data (evernic acid agg.) was given by Krog & James (1977).

Ramalina ligulata sens Asahina, J. Jpn. Bot. 15: 217 (1939) [non (Ach.) Brandt].

Ramalina yasudae Räsänen, J. Jpn. Bot. 16: 87 (1940). Type collection: Japan, Prov. Rikuzen: Sendai, A. Yasuda 369—holotype in H!, isotype in TNS!, syn. nov., *tlc*: usnic, evernic and obtusatic acids.

Ramalina throwerae Aptroot & Sipman, J. Hattori Bot. Lab., 91: 339 (2001). Type collection: China, Hong Kong, Lantau Island, Ngong Ping (Big Buddha), near Cemetery, 400–450 m, on rock outcrops in dwarf scrub on rocky soil, July 8, 2000, H. Sipman 45106—holotype in B!, syn. nov., *tlc*: usnic, evernic and obtusatic acids.

Thallus saxicolous or very rarely corticolous, fruticose, growing from a delimited or more or less expanded holdfast, up to 3 cm high (Fig. 1a). Laciniae greenish yellow, solid, simple to sparingly branched, bilateral, flattened or partly terete, often dissected and bearing small prolifer-

ations or nodules (Fig. 1b) near the apices in aged specimens, up to 3 mm wide; surface flat, foveolate, with faint longitudinal laminal striation. Soralia mainly terminal, but also laminal or marginal, ellipsoid, becoming confluent, appearing sublabriform at the apices of branches; soredia granular, usually covered with a thin cortical layer. Pseudocypheellae sparse, restricted on basal branches, ellipsoid, flat. Laciniae 150–300 μm thick; cortex more or less distinct, 20–25 μm thick; chondroid strands continuous, smooth, thicker (50–100 μm) below the upper surface but thinner (20–60 μm) inside of the lower surface; medulla loose.

Apothecia very rare, laminal or submarginal, up to 0.7 mm in diam.; margin entire; disc flat to convex without white margin; thalline exciple entire; ascospores narrowly fusiform, 12.8–14 $\times$ 3.5–4.5 μm . Pycnidia not seen.

Chemistry: usnic, evernic and obtusatic acids.

Ramalina pollinaria was first reported from Japan by J. Müller (1891), basing on a collection by M. Miyoshi. Since then no report of this species has been published from Japan. When Asahina (1939) studied Japanese species of *Ramalina*, he reported this species under *R. ligulata* (Ach.) Brandt which is synonymous with *Ramalina polymorpha* (Ach.) Ach. as reported by Krog & James (1977). Most specimens referred to this species by Asahina are identified with *R. pollinaria*.

In Japan this species has been well known under the name of *R. yasudae* Räsänen. However, type specimens of *R. yasudae* (Fig. 1c) has discrete, sparingly branched and bilateral laciniae, terminal and laminal soralia, granular and slightly corticate soredia and produces evernic and obtusatic acids as major chemical substances. This specimen is quite identical with the type of *R. pollinaria*.

Recently Aptroot and Sipman (2001) described *Ramalina throwerae* Aptroot & Sipman from Hong Kong, China. The holotype specimen of this species is quite identical morphologically and chemically with *R. pollinaria* and should be reduced to a synonym of the latter species.

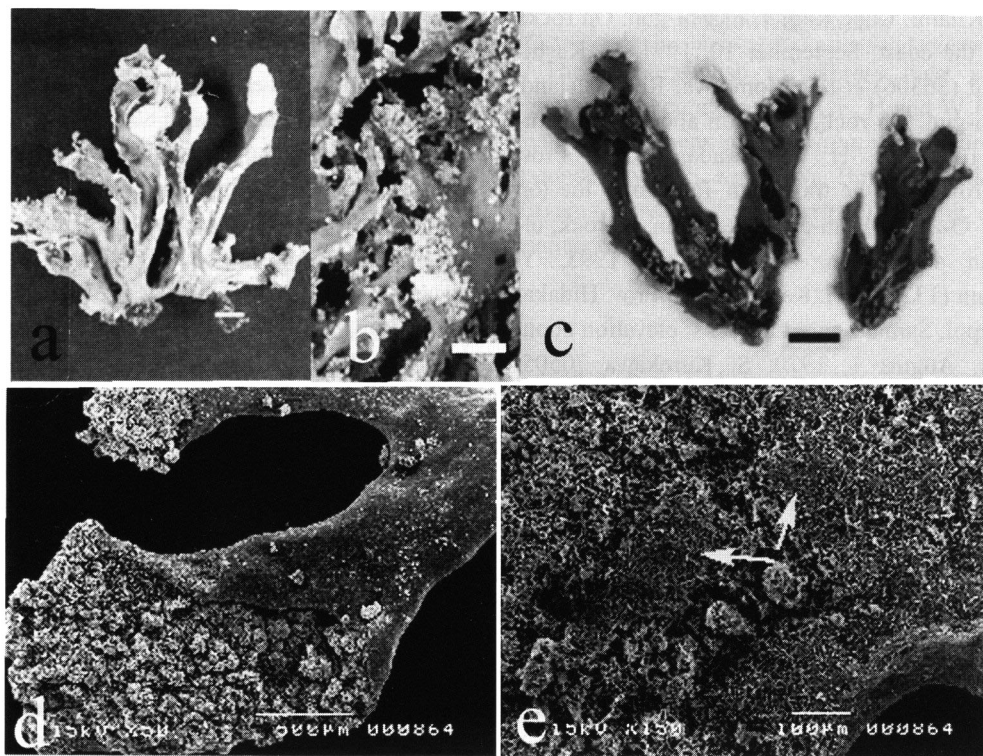


Fig. 1. *Ramalina pollinaria* (Westr.) Ach. a) a plant with terminal soralia, b) apical branches bearing soredia with branchlets and nodules (a & b, H. Kashiwadani 14979, TNS), c) isotype of *R. yasudae* Räsänen (Yasuda 369, TNS), d) apical soralia with granular soredia, e) soredia with cortices in initial stages; arrows indicate upper cortices which are common to a few masses of gonidia and fungal hyphae. Bars: a=3 mm, b=1 mm, c=2 mm.

R. pollinaria is unique in having sublabriform soralia consisting of numerous soredia usually bearing fragments of upper cortex (Fig. 1d). In initial stages of soredia formation near the apices of lobes, upper cortex is separated into fragments (Fig. 1e, arrows), which are common to a few masses of gonidia and fungal hyphae. These fragments of cortex seem to be retained, even when soredia are matured and soralia are formed as discrete structures on over rather large areas. Similar soredia were reported from *R. coreana* Kashiw. & Moon (Kashiwadani & Moon, 2002).

R. pollinaria might be confused with *R. intermedia* (Del. ex Nyl.) Nyl., another saxicolous species distributed in the Northern Hemisphere, which differs in having cracked chondroid strands and in producing homosekikaic and sekikaic acids as major chemical substances.

Morphologically it very much resembles *R. sekika* Asahina, a species endemic to Manchuria, which differs in producing sekikaic and salazinic acids as major chemical substances.

Although this species grows both on rocks and on barks in Europe and North America, it almost always grows on rocks in Japan and adjacent countries in Asia. However, it was often found to grow on narrow branches of *Trachelospermum asiaticum* in Japan.

Distribution. The present species is known from Japan, Korea and China.

Exsiccata examined. Y. Asahina: Lich. Jap. Exs. 4 (TNS); S. Kurokawa & H. Kashiwadani: Lich. Rar. Crit. Exs. 134, 190, 191 and 434 (TNS); H. Kashiwadani: Lich. Minus Cogn. Exs. 97 & 195 (TNS). (All reported as *R. yasudae*).

Specimens examined. JAPAN. HOKKAIDO.

Prov. Kitami: Cape Kamui, Esashi-gun. On rocks along the coast, September 10, 1991, H. Kashiwadani (36306) *et al.*; Momoiwa, Rebun Island, Rebun-gun. On rock, elevation about 70 m, August 10, 1970, H. Kashiwadani 8214. Prov. Kushiro: along the trail from Taro-ko to the top of Mt. O-akan, Akan-cho, Akan-gun, on rock; elevation 430–700 m, September 5, 1995, Y. Ohmura (1324) & H. Kashiwadani. Prov. Hidaka: Mt. Apoi, Samani-gun. On rocks; elevation about 680 m, August 1, 1970, S. Kurokawa 70505. Prov. Ishikari: Mt. Yubari, September 5, 1972, S. Kurokawa 72175.

HONSHU. Prov. Mutsu: Asamushi Seashore, August 5, 1924, Y. Asahina 4; anesashi Seashore, Hachinohe City, on rock along the coast, May 28, 1989, S. Matsumoto s.n. Prov. Rikuchu: Mt. Hayachine, Hienuki-gun, en route from Dake to Mt. Hayachine via Mt. Keito, on rock, elevation about 1300 m, August 10, 1971, H. Kashiwadani 9006. Prov. Uzen: Yamadera, Yamagata-city, July 3, 1937, M. Sato s.n. Prov. Iwashiro: Mt. Ryozen, Ryozen-cho, Date-gun, on rocks, elevation about 600 m, August 27, 1990, H. Kashiwadani 36179. Prov. Hitachi: Jaketsu, Daigo-cho, Kuji-gun, elevation about 340 m, February 21, 1982, H. Kashiwadani 17028; Mt. Tsukuba, on rock, elevation about 300 m, June 9, 1993, H. Kashiwadani 37515. Prov. Musashi: Mt. Kobushi-dake, Ohtaki-mura, Chichibu-gun, on rock (chart); elevation about 1600 m, August 18, 1992, H. Shibuichi 9031; Mt. Mitake, Hikawa-mura, October 29, 1922, Y. Asahina 96. Prov. Shinano: Azusayama, Kawakami-mura, Minamisaku-gun, on rocks, elevation about 1300 m, June 13, 1983, H. Kashiwadani 19886; on summit of Yatsugatake Mts., May 1926, Y. Asahina s.n. Prov. Kai: Goten-niwa, Mt. Fuji, elevation about 970 m, April 11, 1970, S. Kurokawa 70087. Prov. Izu: at the foot of Mt. Shiro-yama, Tanaka-mura, Tagata-gun, December 28, 195, Y. Asahina s.n.; Yagiyama, Matsuzaki-cho, Kamo-gun, on tombstone, elevation about 20 m, February 15, 1979, H. Kashiwadani 38832. Prov. Suruga: Mt. Kunosan, July 8, 1951, S. Kurokawa 51102. Prov. Mikawa: Mt. Myojin, Minamishitara-gun, eleva-

tion 750–1010 m, December 11, 1974, H. Kashiwadani 13015. Prov. Mino: Kirii, Shirakawamachi, Kamo-gun, elevation about 500 m, April 26–27, 1968, S. Kurokawa 68021. Prov. Owari: Kiso-gawa River, Inuyama, August 26, 1938, Y. Asahina s.n. Prov. Ohmi: Mt. Ibuki, May 24, 1951, M. Togashi 335. Prov. Iga: Kohchi-kyo Gorge, Nabari-city, July 26, 1978, H. Kashiwadani 14703. Prov. Ise: Yachi, Misugi-mura, Ichishi-gun, elevation about 120 m, March 18, 1976, H. Kashiwadani 13244. Prov. Kii: Mt. Koya, elevation about 800 m, November 7, 1957, S. Kurokawa 57283. Prov. Wakasa: Mt. Aobasan, elevation about 600 m, November 7, 1965, M. Togashi s.n. Prov. Tango: Mt. Aoba, Maizuru city, on rock, elevation about 550–690 m, June 3, 1967, H. Kashiwadani 2904. Prov. Tamba: Ohyama-mura, Taki-gun, July 14, 1924, Y. Asahina 60. Prov. Settsu: Nishi-Rokko, Mt. Rokko, August 1, 1956, H. Muroi s.n. Prov. Shimotsuke: Ca 1 km W of Meotobuchi Hot Spring, Kuriyama-mura, Shioya-gun, on rocks along stream, elevation about 1200 m, November 23, 1999, H. Kashiwadani 42189. Prov. Bitchu: Kokoge, Takahashi-city, March 25, 1979, H. Kashiwadani 14979. Prov. Harima: Mt. Seppiko, Shikama-gun, on rock, elevation 550–730 m, June 7, 1969, H. Kashiwadani 5691. Prov. Hohki: Mt. Mitoku, on rocks, June 24, 1950, Y. Ikoma 3181. Prov. Izumo: Kiyomizu Shrine, Yasugi city, on rock, elevation about 80 m, May 30, 1969, H. Kashiwadani 5957. Prov. Oku: Fuku-ura, Goka-mura, on twigs of *Trachelospermum asiaticum*, elevation about 3 m, December 1, 1984, H. Kashiwadani 21029. Prov. Iwami: Tsuwano, Kanoashi-gun, on rock, elevation about 220 m, July 8, 1973, H. Kashiwadani 10376. Prov. Aki: Haji, Yachio-cho, Takata-gun, on rock, elevation about 260 m, April 10, 1971, H. Kashiwadani 8678; Haradani, Saeki-gun, on rock, elevation about 400 m, March 14, 1970, H. Kashiwadani 7194; Matsunaga, Kochi-cho, Kamo-gun, on rock, elevation about 230 m, November 25, 1972, H. Kashiwadani 10202; Mt. Komagabayashi-dake (Miyajima Island), Saeki-gun, on rock, elevation about 20 m, May 12, 1969, H. Kashiwadani

5654. SHIKOKU. Prov. Awa: Ohboke, Miyoshi-gun, on rock, August 15, 1969, H. Kashiwadani 7028. Prov. Iyo: Mt. Ishizuchi, Kamiukena-gun, on rock, elevation about 1600 m, November 13, 1972, H. Kashiwadani 10346. Prov. Sanuki: Choshikei, Tonosho-cho, Shodo-gun, on stone works of paddy field, elevation about 320 m, December 19, 1998, H. Kashiwadani 41743. Prov. Tosa: Mt. Shiraga, en route from Fuyunose to the summit of Mt. Shiraga, on serpentine rock, elevation 1100–1470 m, November 2, 1974, H. Kashiwadani 12585. KYUSHU. Prov. Buzen: Bonji-iwa, SW slope of Mt. Hikosan, Soeda-cho, Tagawa-gun, on rock, elevation about 800–850 m, October 9, 1996, H. Kashiwadani (39895) & Y. Umezu. Prov. Bungo: Keya-mura, Yamakuni-cho, Shimoge-gun, on bark of *Acer nikoense*, elevation about 500 m, October 27, 1996, Y. Umezu 332. Prov. Hizen: Tsubute-iwa, Shijikimura, Hirato Island, elevation about 300 m, April 26, 1969, M. Togashi s.n. Prov. Higo: Isshochi, Kuma-gun, August 10, 1933, F. Fujikawa s.n. No precise locality given: Yenoura, M. Miyoshi 152 (GE). RUSSIA. Kurile Archipelago: Shikotan, on rock, August 12, 1998, S.L. Joneson 386A. Sakhalin: Mereya, August 1908, U. Faurie 388. KOREA. Prov. Cheju: Mt. Dansan, Sagye-ri, Andok-myon, Namcheju-gun, Cheju Island, on rock along stream, elevation about 85 m, May 27, 2001, K.H. Moon 5863. Prov. Chungchungbuk-do (Chuseihokudo): Mt. Kinshu, Ryokori, Susisan-men, Raisen-gun, August 23, 1939, Y. Kimura 336. Prov. Kangwon-do: around Paektam bus stop, Mt. Sorak, Inje-gun, on rock along stream, elevation about 420 m, October 6, 1995, K.H. Moon (358) & H. Kashiwadani. Prov. Kyongsangbuk-do: Mt. Choijong, June 20, 1959, S.Y. Oh s.n. CHINA. Manchuria. Prov. He bei: Chang-li, on rocks, March 13, 1941, T. Kaneshiro s.n. Prov. Beijing: 9 km N of Nandulehe, on Great Wall, November 25, 1991, C.M. Wetmore 69782. Prov. Pinkan: Shoho, May 23, 1943, S. Asahina s.n. Prov. Nanking: Mt. Shikin-zan, July 8, 1939, A. Hashimoto s.n.

Acknowledgements

The authors wish to express their sincere thanks to the curators of B, GE, H and W for the loan of specimens of *Ramalina*. Thanks are also extended to Dr. S. Kurokawa, Botanic Gardens of Toyama, Toyama for his critical reading of the manuscript.

References

- Aptroot A. & H. J. M. Sipman, 2001. New Hong Kong lichens, Ascomycetes and lichenicolous fungi. *J. Hattori Bot. Lab.*, **91**: 317–343.
- Culberson, C. & A. Johnson, 1982. Substitution of methyl ter.-butyl ether for diethyl ether in the standardized thin-layer chromatographic method for lichen products. *J. Chromatogr.*, **238**: 483–487.
- Kashiwadani, H., 1986. Genus *Ramalina* (Lichens) in Japan (1) On *Ramalina calicaris* (L.) Fr. in Japan. *Bull. Natn. Sci. Mus., Ser. B*, **12**: 89–98.
- Kashiwadani, H., 1986. Genus *Ramalina* (Lichens) in Japan (2) On *Ramalina pacifica* Asahina and its allies. *Bull. Natn. Sci. Mus., Ser. B*, **12**: 117–125.
- Kashiwadani, H., 1987. Genus *Ramalina* (Lichens) in Japan (1) *Ramalina exilis* Asahina and its allies. *Bull. Natn. Sci. Mus., Ser. B*, **13**: 133–140.
- Kashiwadani, H., 1988. *Ramalina hossei* Vain. (lichen) found in Bhutan and Formosa. *Bull. Natn. Sci. Mus., Ser. B*, **14**: 129–133.
- Kashiwadani, H., 1992. *Ramalina siliquosa* (Huds.) A.L. Sm. and *R. subbreviscula* Asahina. in Japan. *Mem. Natn. Sci. Mus. Tokyo*, (25): 63–69.
- Kashiwadani, H., 1996. *Ramalina kurokawae* Kashiw., a new lichen species from Japan. *Bull. Natn. Sci. Mus., Ser. B*, **28**: 1–6.
- Kashiwadani, H. & K. H. Moon, 2002. A new or interesting species of the genus *Ramalina* (Ascomycotina: Ramalinaceae) from Korea and Japan. *Bull. Natn. Sci. Mus., Ser. B*, **28**: 1–6.
- Kashiwadani, H., K. H. Moon, M. Inoue, G. Thor & Y. S. Kim, 2002. Lichens of the Cheju Island, Republic of Korea I. The Macrolichens. In Proc. 3rd & 4th Symp. Collection Building Nat. Hist. Stud. in Asia and the Pacific Rim (Ed. T. Kubodera *et al.*), *Natn. Sci. Mus. Monogr.*, (22): 115–135.
- Krog, H. & P. W. James, 1977. The genus *Ramalina* in Fennoscandia and the British Isles. *Norw. J. Bot.*, **24**: 15–43.
- Müller, J, 1891. Lichens Miyoshiani in Japonia a cl. Miyoshi lecti et a cl. professore Yatabe communicate. *Nuovo Giorn. Bot. Ital.*, **23**: 120–131.
- Stevens, G. N. & H. Kashiwadani, 1987. Synonymy of *Ramalina intermediella* Vain. with *R. peruviana* Ach. *J. Jpn. Bot.*, **62**: 373–376.

