

Notes on some Marchantiales taxa from Rishiri Island, Japan

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Rishiri Island is located near the northernmost coast of Japan, and is of great botanical interest due to the presence of a high-altitude stratovolcano. Through our recent expeditions to this island, we provided notes on some noteworthy Marchantiales taxa. We speculated that human activities and climate changes may cause the decline or disappearance of the populations of the alpine species, such as *Peltolepis quadrata*, *Mannia gracilis* and *Sauteria alpina*, and allow the introduction of some species that prefer low-lying and/or man-made habitats. Since there are few reports on Japanese materials, we gave a detailed illustration of *Peltolepis quadrata* on its important distinguishing characters. *Marchantia polymorpha* L. subsp. *polymorpha* is reported as new to Hokkaido. The distribution and taxonomic status of Cleveaceae taxa in Japan requires further reevaluation.

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Introduction

Rishiri island (area 182.2 km²), located near the northernmost coast of Japan, is a botanically attractive place, including bryophytes, because of its unique geographical location and the presence of a famous stratovolcano mountain named Rishiri with over 1720m above sea level (Ishizuka & Nakagawa 1999; Satō 2011). The bryophytes of the island have been successively studied by Hattori and Shimizu (1955, mainly on complex thalloid liverworts), Hattori (1957, on liverworts), Iwatsuki (1962, on mosses), Oishi (2006, on endangered bryophytes), Nishida *et al.* (2006, on the collection of N. Takaki), Ishikawa *et al.* (2007–2009, on the collection of N. Takaki), Oishi and Sato (2010, on bryophytes on Tumuli) and Oishi *et al.* (2019, on specimens collected from the Otadomari-numa (pond) during 1970s). The

last well-documented comprehensive field trip on this island was conducted by the second author in 2007 (Oishi & Yamada 2008). However, the result of this investigation may not fully reflect the actual situation because fifteen years have passed and the island has been visited by a large number of tourists recently. Therefore, this year, the first and the third author conducted expeditions to the island in July and August, respectively. Due to time constraints, field work has been focused on the taxa of Marchantiales growing in Yamunai ravine, Oshidomari and part of Kutsugata climbing route of the Mt. Rishiri, where some rare Marchantiales species were previously recorded (*e.g.*, *Mannia gracilis* (F. Webber) Schill & D.G. Long, *Peltolepis quadrata* (Saut.) Müll. Frib. and *Sauteria alpina* (Nees) Nees) (Fig. 1).

In this study, we give notes on some noteworthy Marchantiales taxa previously recorded from

the Rishiri Island, hoping to provide updated information. In addition, a new Marchantiales taxa record for Hokkaido is also provided.

Results

1. *Mannia gracilis* (F.Weber) Schill & D.G.Long, Bryologist 113: 173. 2010.

Notes: This species has a complicated taxonomic history, which was first recorded in Japan by Stephani (1897) as “*Fimbriaria pilosa* Tayl.” from “Rebunshiri”. Shimizu and Hattori (1953) questioned this record because no one had reported its distribution in Japan since Stephani (1897). In 1955, Hattori and Shimizu confirmed the

occurrence of this species from Yamunai ravine of Rishiri Island and recorded it as “*Asterella ludwigii* (Schwager.) Limpr.”. Later, since Grolle (1975) noted that the name *A. ludwigii* has long been misapplied to represent *Asterella gracilis* (F.Weber) Underw. and Long (2006) considered *F. pilosa* to be an invalid name and conspecific with *A. gracilis*, the present species was started to be called as *A. gracilis* in Japan (Mizutani 1984; Furuki & Mizutani 2004). Oishi and Yamada (2008) regarded *A. ludwigii* as a controversial species and thus excluded it from the bryoflora of Rishiri Island. In 2010, Schill *et al.* conducted phylogenetic study and transferred *A. gracilis* to *Mannia gracilis* (F.Weber) Schill & D.G.Long as

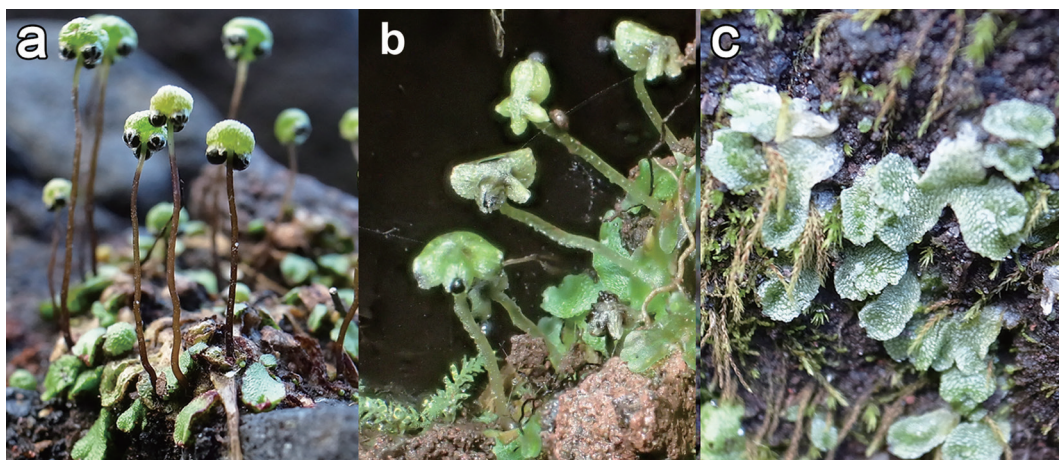


Fig. 1. Some rare Marchantiales taxa growing in Rishiri Island. (a) *Mannia gracilis* (F.Weber) Schill & D.G.Long. (b) *Peltolepis quadrata* (Saut.) Müll. Frib. (c) *Sauteria alpina* (Nees) Nees. All photos were taken by Y. Oishi.

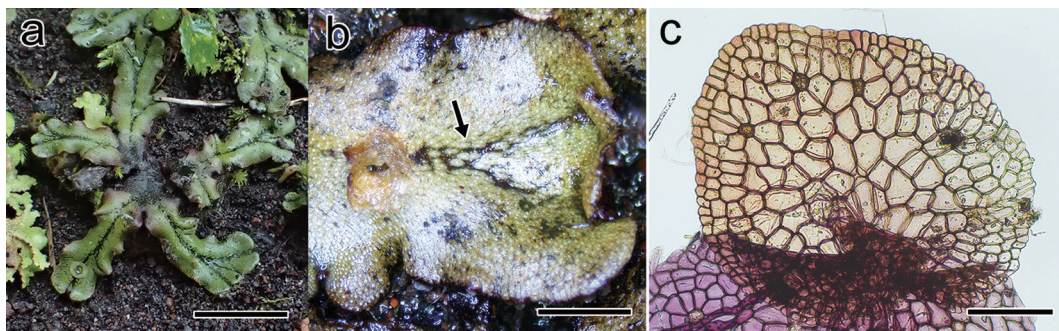


Fig. 2. *Marchantia polymorpha* L. subsp. *polymorpha*. (a) Plants with typical characteristics, forming a thick, blackish median band in the center of the thallus. (b) Atypical thallus with a discontinuous blackish median band. (c) Appendage of ventral median scale. Scale bar: 10 mm for (a), 2 mm for (b) and 100 μ m for (c). (b) and (c) from T.-X. Zheng 10462 (NICH).

a new combination. This treatment is followed in recent Japanese studies (Katagiri & Furuki 2012, 2018). Among the taxa of Marchantiales in Rishiri Island, this species can be readily distinguished by (1) present pseudoperianth, (2) compact thalli and (3) sometimes two apical appendages of ventral scales.

In 2013, the second author confirmed this species from the Oniwaki, Rishiri Island. However, during the expedition this time, we did not find *Mannia gracilis* in the place where it was previously recorded (Hattori & Shimizu 1955, Yamunai ravine). Due to the presence of several voucher specimens of their Japanese record deposited in NICH (Hattori & Shimizu 1955) and the specimen collected in 2013, we replace its status to the bryoflora of Rishiri Island.

Specimens examined: Hokkaido, Rishiri County, Oniwaki, *Y. Oishi 13000*, *D. Shimizu s.n.* (NICH 53644, 53647).

2. *Marchantia polymorpha* L. subsp. *polymorpha*, Spec. Pl. ed. 1: 1137. 1753.

Notes: In Japan, this taxon was recorded in Miyagi (Zheng & Shimamura 2019), Fukushima (Horikawa 1954), Nagano (Yoshidomi et al. 2020) and Gifu (Zheng & Shimamura 2022). Plants with a typical morphology, forming a thick, blackish median band in the center of the thallus are widely distributed in Yamunai ravine (Fig. 2a). During the field work, we found a *polymorpha*-like specimen near the entrance of Yamunai ravine. This specimen has discontinuous blackish median band on dorsal surface of the thalli and the appendage of ventral median scales with entire or crenulate margin (Fig. 2b & 2c). The former character indicated that this specimen may share closer relationship with *Marchantia polymorpha* subsp. *ruderalis* Bischl. & Boissel.-Dub. However, Zheng & Shimamura (2019, 2022) noted that this feature varies under different environments and the appendage of median scales is a reliable distinguishing character among the taxa of *M. polymorpha* complex. We identified this specimen as *M. polymorpha* subsp. *polymorpha*. We update the previous record of *M. polymorpha* complex in Rishiri Island to the subspecific level (Hattori 1957; Oishi & Yamada 2008).

Specimens examined: Hokkaido, Rishiri Co., Oniwaki, *T.-X. Zheng 10462* (NICH).

3. *Marchantia polymorpha* subsp. *ruderalis* Bischl. & Boissel.-Dub., J. Bryol. 16: 364. 1991.

Notes: This taxon is thought to be found only in anthropogenic region (Zheng & Shimamura 2019, 2022). A specimen belonging to *M. polymorpha* complex was collected near the city area (40 m altitude) in 2007 (Oishi & Yamada 2008). After the morphological examination of the second author, we identified this specimen as *M. polymorpha* subsp. *ruderalis*. Notably, this time, we also found numerous populations of this subspecies in Yamunai ravine and the climbing road after 9th station of Mt. Rishiri (altitude about 1500–1600 m). This issue will be discussed in detail in the following part.

Specimens examined: Hokkaido, Rishiri Co., Oshidomari, *Y. Oishi 9516*, *T.-X. Zheng 10469* (NICH).

4. *Peltolepis quadrata* (Saut.) Müll. Frib., Hedwigia 79: 74. 1940.

Notes: *Peltolepis quadrata* (Saut.) Müll. Frib. was originally described from the Austrian specimens (Sauter 1860). Its first Japanese record was provided by Hattori and Shimizu (1955) based on the specimens collected near the top of Mt. Rishiri. This species can be readily distinguished from all other Marchantiales taxa in Rishiri Island by (1) two rhizoid furrows in carpocephalum stalk, (2) ventral scales without oil body containing cells and (3) androcial ostioles in well-defined disc.

Since there are few reports of *Peltolepis quadrata* based on Japanese materials, here we provided a detailed illustration on its important distinguishing characters (Fig. 3). It is noted that the female receptacle of *Peltolepis quadrata* in Japan was illustrated with a hat or lid-shaped organ and a convex center on its dorsal surface (Shimizu & Hattori 1954). However, we did not find such organ in our voucher specimens, which was also not shown in the illustration of Borovichev and Bakalin (2013). Instead, the female receptacles similar to *Peltolepis japonica* (Shimizu & S.Hatt.) S.Hatt. (\equiv *Peltolepis quadrata* (Saut.) Müll. Frib. var. *japonica* Shimizu & S.Hatt.) were present in our specimen. Due to the lack of fresh materials, at the present stage, we are not able to determine whether this feature is species-specified. Currently, although *P. japonica* was considered conspecific with *P. quadrata*, Hattori and Shimizu

(1955) noted that the chromosome number is a decisive character to distinguish them from each other, based on which Hattori and Shimizu (1955) elevated *P. quadrata* var. *japonica* as an independent species *P. japonica*. This taxonomic problem will be discussed separately when more specimens become available.

Specimens examined: Hokkaido, Rishiri Co., Oshidomari, *Y. Oishi 9425, D. Shimizu s.n.* (NICH 53472, 55652), coll. *M. Shimamura* in hb. *T.-X. Zheng 10480* (NICH).

5. *Preissia quadrata* (Scop.) Nees, Naturgesch. Eur. Leberm 4: 135. 1838.

Notes: In 2016, this species was phylogenetically reduced under *Marchantia* L. as *Marchantia quadrata* Scop. (Long *et al.* 2016). Zheng and Shimamura (2022) transferred it back to *Preissia* Corda based on sound morphological and ecological evidences. The present species can be readily found in the shadow places sheltered by stones and stairs after 9th station of climbing route of Mt. Rishiri. Its alpine distribution differs from all *Marchantia* s. str. taxa and this difference also supports the segregation proposed by Zheng and

Shimamura (2022).

Specimens examined: Hokkaido, Rishiri Co., Oshidomari, *Y. Oishi 9350, T.-X. Zheng 10468* (NICH).

6. *Sauteria alpina* (Nees) Nees, Naturgesch. Eur. Leberm. 4: 143. 1838.

Notes: Current morphological understanding in terms of *Sauteria alpina* (Nees) Nees is still in controversial, which is reflected in its synonyms treated by different bryologists. Rubasinghe (2011) conducted a revision of Cleveaceae worldwide and treated only one taxon, *S. alpina* var. *angustifrons* Kaal. as its synonym. In contrast to that, Borovichev *et al.* (2012) synonymized three names under *S. alpina*, namely *S. alpina* var. *angustifrons*, *S. japonica* (Shimizu & S.Hatt.) S.Hatt. (\equiv *Sauchia japonica* Shimizu & S.Hatt.) and *Sauteria. yatsuensis* S.Hatt. (\equiv *S. alpina* var. *japonica* Shimizu & S.Hatt.). Among them, the latter two species were considered conspecific with *S. spongiosa* (Kashyap) S.Hatt. by Rubasinghe (2011). The definition of the present species and its congener needs to be reviewed carefully.

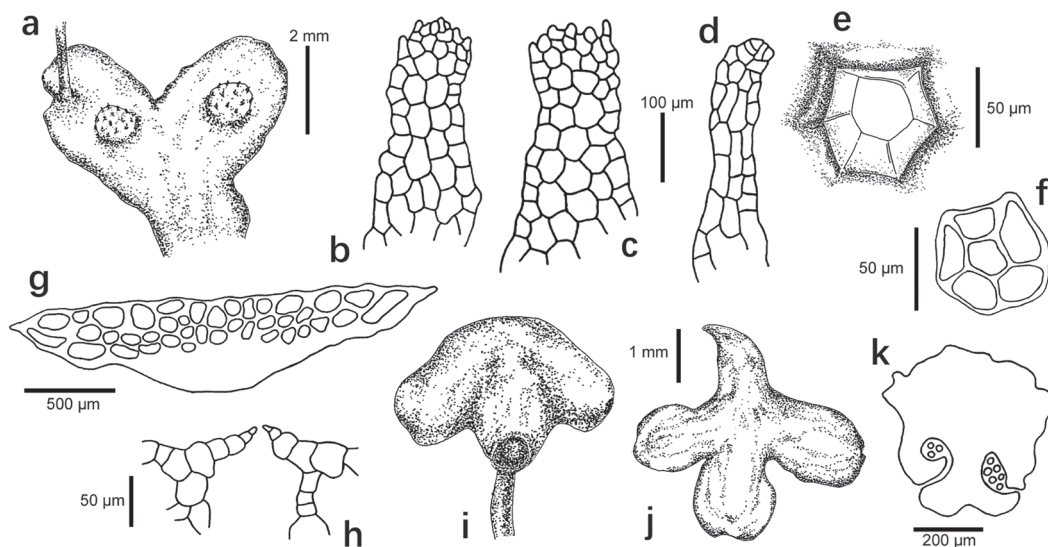


Fig. 3. *Peltolepis quadrata* (Saut.) Müll. Frib. (a) thallus with androcial ostioles in well-defined disc and stalked female receptacle (not shown), dorsal view. (b)–(d) appendage of ventral median scales. (e) air pores, dorsal view. (f) inner opening of air pores. (g) section of thallus. (h) cross section of air pores. (i) female receptacle. (j) female receptacle, dorsal view. (k) section of carpocephalum stalk. All drawn from *T.-X. Zheng 10480* (NICH).

The first Japanese record of *Sauteria alpina* was given by Hattori and Shimizu (1955) based on the collections from Mt. Rishiri. In NICH, we found another specimen of *S. alpina* from Yamunai ravine (*D. Shimizu s.n.* (NICH 53658). However, unfortunately, we failed to confirm its occurrence in these places.

Specimens examined: Hokkaido, Rishiri Co., Oniwaki, *Y. Oishi 3637*, *D. Shimizu s.n.* (NICH 53658), *Z. Iwatsuki 1978* (NICH). Hokkaido, Rishiri Co., Oshidomari, *D. Shimizu s.n.* (NICH 53661).

Discussion

Japanese taxa of the Cleveaceae (including *Clevea Lindb.*, *Peltolepis Lindb.* and *Sauteria Nees*) distribute in limited alpine region and included in the Red Data Book of Japan with VU (vulnerable) or higher reservation level (Ministry of the Environment 2015, 2020). This time, we found a relatively small population of *Peltolepis quadrata* and some thalloid taxa that prefer lowland or artificial environments, such as *Marchantia polymorpha* subsp. *runderarlis* and *Sandea japonica* Steph. ex Yoshin. (\equiv *Conocephalum japonicum*) around the terminus of Kutsugata route (altitude 1554 m) near the top of Mt. Rishiri

unexpectedly. It may be partly attributed to the climate warming and excessive human activity. According to the report of Japan Meteorological Agency (2022), annual average temperature of Japan is increasing at a rate of 1.28 °C per 100 years and high-temperature years have also occurred very frequently since the 1990s. Global warming has been proved to have varying impact on alpine plants (Watai *et al.* 2007; Wessely *et al.* 2022). Recently, artificial warming experiment, such as OTC (open top chamber), have been widely carried out in alpine and polar ecosystems (Tanaka *et al.* 2013) and part of such studies have proved that climate warming has negative effects on alpine bryophytes and lichens (Elmendorf *et al.* 2012). In addition, around the 9th station near the summit, we noticed that numerous man-made steps are built for the convenience of tourists on the climbing road by artificial materials (Fig. 4a). As for Yamunai ravine, increasing sediment disaster have not only led to the continuous construction of check dam (Fig. 4b) but also greatly restricted the habitats of *Sauteria alpina*. Judging from the habitat of *Peltolepis quadrata* and *S. alpina* in Rishiri Island, we speculate that the distribution of Cleveaceae taxa in Japan is in sharp decline and their reservation is facing a more serious situation than previously thought

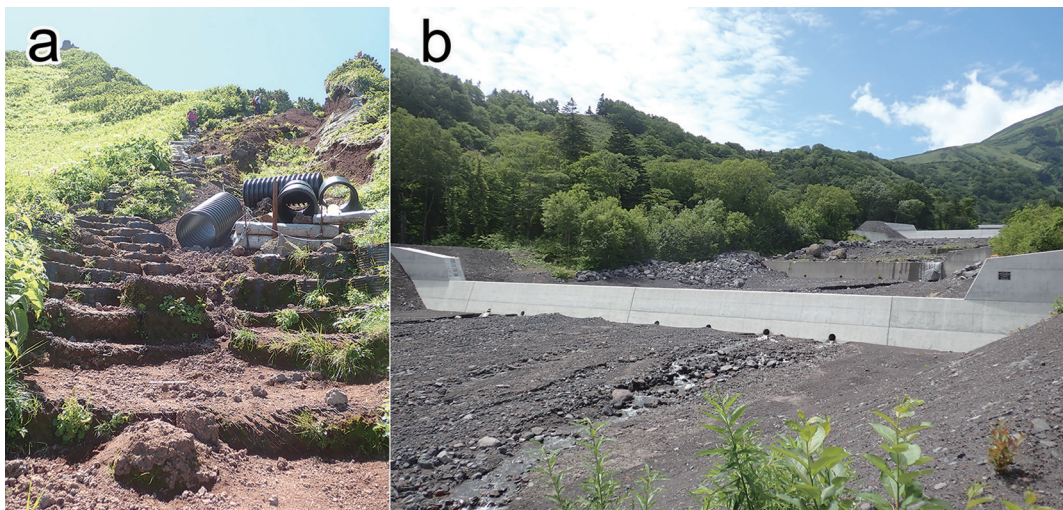


Fig. 4. Human activities in Mt. Rishiri. (a) Climbing road after 9th station of Mt. Rishiri. Several man-made steps were built by artificial barrel materials for the convenience of tourists, which may greatly decrease the habitat of *Peltolepis quadrata* (Saut.) Müll. Frib. (b) Entrance of the Yamunai ravine. The gravel was refurbished and over 15 check dams were built along the ravine to prevent sediment disaster.

(Ministry of the Environment 2015, 2020). Taking these into consideration, we speculate that human activity introduced the competitive species to the alpine ecosystem and climate changes also created suitable environments for these species while limited the distribution of residual alpine taxa. Under the severe situation mentioned above, their previous and current distribution are needed to be evaluated carefully.

The taxonomic treatments of several species of Cleveaceae still remains controversial (Rubasinghe 2011; Rubasinghe *et al.* 2011; Borovichev *et al.* 2012; Borovichev & Bakalin 2013; Long & Crandall-Stotler 2016). As an important type locality of Cleveaceae taxa, Japan has not been comprehensively investigated for this family to date. Therefore, there are urgent needs to survey the previous and current distribution, appropriately protect the habitats, and conduct the taxonomic revision.

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