

A NEW SYNONYM OF *DILUTINEURON CORRUGATUM* (GRIMMIACEAE, BRYOPHYTA) FROM JAPAN

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Abstract. The type material of *Racomitrium canescens* (Hedw.) Brid. fo. *erythrophyllum* Sakurai from Japan is taxonomically evaluated. This form perfectly falls within the range of variation of *Dilutineuron corrugatum* (Bednarek-Ochyra) Bednarek-Ochyra, Sawicki, Ochyra, Szczecińska & Plášek and, accordingly, *R. canescens* fo. *erythrophyllum* is reduced to synonymy with this species name.

Key words: Asia, China, *Codriophorus*, Musci, nomenclature, *Racomitrium*, taxonomy, typification

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Racomitrium canescens (Hedw.) Brid. fo. *erythrophyllum* Sakurai was described by Sakurai (1937) from a single collection from Mount Daisetsu on the island of Hokkaido, Japan. A characteristic feature of this form, which was emphasised in the diagnosis, is weakly rusty-red coloration of the plants [‘in toto dilute rubiginosa’]. However, this colour is never predominant in plants of the *Racomitrium canescens* group, especially in *N. canescens* (Hedw.) Bednarek-Ochyra & Ochyra, whose type subspecies has a wide pan-Holarctic boreal-temperate distribution (Frisvoll 1983; Bednarek-Ochyra 1995). It is coupled with epilose leaves that are narrowly lanceolate, lacking auricles, and leaf cells that are epapillose and narrowly rectangular to linear throughout the lamina. These traits immediately eliminate this form from any relationship with the *R. canescens* complex and, in fact, the only character which *R. canescens* fo. *erythrophyllum* shares with the typical expressions of *N. canescens* is a single costa which is occasionally laterally spurred or forked at the apex and vanishes in mid-leaf or only somewhat above.

The taxonomic status of *Racomitrium canescens* fo. *erythrophyllum* has remained unresolved for a long time; this taxon was accepted, with no

comment, in the first catalogue of Japanese mosses (Iwatsuki & Noguchi 1973). In his revision of the broadly conceived genus *Racomitrium* Brid. in Japan, Noguchi (1974) placed this form, again with no explanation, in synonymy with *R. canescens* var. *canescens*. This status of *R. canescens* fo. *erythrophyllum* was subsequently accepted in the supplement to the catalogue of Japanese mosses (Iwatsuki & Noguchi 1979) and then it was consolidated by Noguchi (1988) in his *Illustrated Moss Flora of Japan*.

During completing his worldwide monograph of the *Racomitrium canescens* complex, Frisvoll (1983) thoroughly examined the original material of *R. canescens* fo. *erythrophyllum* and concluded that this taxon has nothing to do with this group but matched the concept of *R. fasciculare* (Hedw.) Brid., treating these two names as synonyms. This new taxonomic idea regarding the status of this form was adopted in subsequent catalogues of Japanese mosses (Iwatsuki 1991, 2004; Suzuki 2016), alternatively with the contrasting concept of Noguchi (1974). Surprisingly, *R. canescens* fo. *erythrophyllum* is missing from the TROPICOS database, so this name appears to have been entirely forgotten. Unfortunately, this taxon was also overlooked by Bednarek-Ochyra (2006) in her monograph of the genus *Codriophorus* P. Beauv.,

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to which *Racomitrium fasciculare* correctly belongs. This error is corrected in the present account.

The type material of *Racomitrium canescens* fo. *erythrophyllum* (Fig. 1) was located in the Sakurai Herbarium, which is deposited in the Makino Herbarium in Tokyo (MAK). Even a cursory examination of this specimen revealed that Frisvoll (1983) was entirely correct to exclude any alliance of this moss with *R. canescens* and to associate it with *R. fasciculare*. These species are very distantly related and actually belong to two different genera which are characterised by suites of several structural traits. The former is recognised in the separate genus *Niphotrichum* Bednarek-Ochyra & Ochyra (Ochyra *et al.* 2003; Bednarek-Ochyra *et al.* 2014; Sawicki *et al.* 2015), characterised by having, among other traits, prominent leaf auricles composed of large, hyaline, thin-walled and pellucid cells, laminal cells that are densely covered with tall conical papillae situated over the cell lumina, and papillose hyaline leaf hair-points.

In contrast, *Racomitrium fasciculare* was initially positioned in the genus *Codriophorus* P. Beauv. (Bednarek-Ochyra *et al.* 2001), as *C. fascicularis* (Hedw.) Bednarek-Ochyra & Ochyra, which is primarily diagnosed by a peculiar ornamentation of the laminal cells, which are covered on both abaxial and adaxial surfaces by prominent, large, flat, cuticular thickenings distributed over both the longitudinal walls and most of the lumina, leaving only a narrow slit in the centre. In this character *Codriophorus* is similar to *Racomitrium* s. str. but it differs in having the apical portion of the calyptra densely papillose, epilose innermost perichaetial leaves and an entirely smooth, dextrorse seta (with the exception of one to several twists to the right immediately below the capsule and further down being twisted to the left in *C. fascicularis*). This taxonomic conclusion, based upon morphology, is well supported by phylogenomic analyses based upon complete plastomes and mitogenomes, as well as nuclear rRNA gene clusters (Bednarek-Ochyra *et al.* 2014; Sawicki *et al.* 2015). Additionally, an analysis of nuclear ITS and plastid *rps4-trnL* and *trnK/matK-psbA* sequences

(Larraín *et al.* 2013) revealed the polyphyly of *Codriophorus*, which, accordingly, was split into two genera, including the monotypic *Frisvollia* Sawicki, Szczecińska, Bednarek-Ochyra & Ochyra and the oligotypic *Dilutineuron* Bednarek-Ochyra, Sawicki, Ochyra, Szczecińska & Plášek (Bednarek-Ochyra *et al.* 2015).

The genus *Dilutineuron* is primarily characterised by its peculiar costal anatomy. The costa is usually situated at the bottom of a shallow and wide-angled or deep and narrow-angled furrow and is partly enclosed by the plicae of the leaf base. In cross-section it is bistratose, except for the extreme base where it has tristratose patches, and both adaxial and abaxial costal layers are composed of uniform cells. The costa is flat or convex on the adaxial side and not prominently convex and crescent-shaped or flattened on the abaxial side, and is nearly of the same thickness as the lamina. It is usually concolorous with and rather poorly delimited from the laminal cells and to this alludes the genus name *Dilutineuron*.

All these features are typical of *Racomitrium canescens* fo. *erythrophyllum*, so Frisvoll (1983) was entirely correct to associate this taxon with this complex, yet it is not identical with *Dilutineuron fasciculare* (Hedw.) Bednarek-Ochyra, Sawicki, Ochyra, Szczecińska & Plášek. In this species the costa is unbranched, extends to $(\frac{2}{3})^{\frac{3}{4}}-5\%$ of the way up the leaf and is situated in a shallow and wide-angled groove; the leaf apex is entire, plane and straight; and the peristome teeth are generally shorter, to 600 μm long. Conversely, in *R. canescens* fo. *erythrophyllum* the costa is distinctly spurred, vanishes in mid-leaf or only slightly above, and is situated on the bottom of a deep and narrow-angled groove. However, the most peculiar feature of this form is the leaf subula, with its characteristic corrugated and wavy shape of the acumen and the dentate-cristate and/or papillose-crenulate leaf apex. Unfortunately, the type material of this form is sterile and the length of the peristome teeth cannot be verified. Still, all gametophyte characters clearly indicate that the type material of *R. canescens* fo. *erythrophyllum* perfectly matches *D. corrugatum* (Bednarek-Ochyra) Bednarek-Ochyra, Sawicki, Ochyra, Szczecińska

A

Makino Herbarium
The collection of Dr. Kyuichi Sakurai

Holotype of
Racomitrium canescens (Hedw.) Brid.
f. *erythrophyllum* Sakurai

北海道, 石狩, 大雪山 (上川郡) (70122)
July 14, 1936 Det.: [redacted]
辻部正信 K. Sakurai (1937)
共立薬科大学寄贈

B

大雪山
辻部君採
1936. 7. 14.

北海道, 石狩, 大雪山.
辻部正信採

C

Makino Herbarium
Tokyo Metropolitan University

Loc.: Mt. Daisetsu, Kamikawa-gun, Hokkaido

Coll.: Masanobu Tsujibe

D

9263 *canescens*, f. *erythrophyllum*.

E

Makino Herbarium

Racomitrium canescens (Timm.) Brid.
forma *erythrophyllum* Sakurai

Det.: K. Sakurai

Date for det.:

F

Makino Herbarium

Holotype specimen of
Racomitrium canescens (Hedw.)
Brid.
forma *erythrophyllum* Sakurai

Annotated by U. Mizushima
Feb. 26, 1965

Fig. 1. The holotype specimen of *Racomitrium canescens* (Hedw.) Brid. fo. *erythrophyllum* Sakurai in the Sakurai herbarium (MAK). A – herbarium label on the cover, B – original label in Japanese; C – translation of the locality, D – original handwritten name of the type specimen, E – typed name of the type specimen, F – annotation label of U. Mizushima.

& Plásek, a species only recently described as *Codriophorus corrugatus* Bednarek-Ochyra (Bednarek-Ochyra 2004).

The shorter costa ceasing well below the leaf apex and the dentate and cristate leaf apex are

also characteristic for *Dilutineuron canaliculatum* (Cardot) Bednarek-Ochyra & Ochyra, an East Asian species better known as *D. anomodontoides* (Cardot) Bednarek-Ochyra & Ochyra (Bednarek-Ochyra & Ochyra 2017). However, this species is

at once recognised from *D. corrugatus* by its costa being generally longer and extending to $\frac{2}{3}$ of the way up the leaf, and it is distinctly convex adaxially, as clearly seen in transverse sections of the leaves. Moreover, the peristome teeth are shorter in *D. canaliculatum* and do not exceed 300 μm .

Finally, the third East Asian species of *Dilutineuron*, *D. brevisetum* (Lindb.) Bednarek-Ochyra & Ochyra, shares with *D. corrugatum* the shape of the costa in transverse section, but is at once distinct in its variously bistratose leaf margins in the distal portion and the long costa that extends to at least $\frac{3}{4}$ of the way up the leaf and usually ceases a short distance from the apex.

The corrugated and wavy leaf apices are known in some populations of the final species of this genus, namely the southern South American *Dilutineuron laevigatum*, but this species is unlikely to be mistaken for *D. corrugatum* and not just for phytogeographical reasons. It is at a glance distinct by having hyaline to yellowish hyaline leaf hair-points, distinctly multiplicate leaves and well differentiated auricles composed of large, isodiametric to shortly rectangular, yellowish-brown to orange-brown cells with moderately thick to strongly incrassate walls, usually forming distinct decurrencies.

As a result, *Racomitrium canescens* fo. *erythrophyllum* is herein reduced to synonymy with *Dilutineuron corrugatum*.

Dilutineuron corrugatum (Bednarek-Ochyra) Bednarek-Ochyra, Sawicki, Ochyra, Szczecińska & Plášek

Racomitrium canescens (Hedw.) Brid. fo. *erythrophyllum* Sakurai, Bot. Mag (Tokyo) **51**: 141. 1937. TYPE CITATION: [JAPAN] Hokkaido: Prov. Ishikari, Berg Daisetsu in alpine Lage (Leg. M. Tsujibe in Herb. K. Sakurai Nr. 9213 Juli 1930). HOLOTYPE: 'Makino Herbarium The collection of Dr. Kyuichi Sakurai 9213 canescens, f. erythrophyllum Mt. Daisetsu, Kamikawa-gun, Hokkaido Coll. Masanobu Tsujibe (70122) July 14, 1936 Det.: K. Sakurai (1937)' – MAK-Sakurai B-9213!, *syn. nov.*

Dilutineuron corrugatum is an East Asian–Northwestern North American disjunct boreal-temperate-montane species, occasionally penetrating into the Arctic and extending southward to the

mountains in the Chinese provinces of Qinghai, Shaanxi and Sichuan, where it occurs at high elevations from 3040 to 4200 m. However, the species has the main centre of its occurrence in Japan, where it is widespread and locally abundant on Hokkaido and northern Honshu, where it has maximum occurrence at elevations from 1000 to 2300 m (Bednarek-Ochyra 2004, 2006). Paradoxically, this species is ignored in the latest catalogue of Japanese mosses (Suzuki 2016), although, after *D. canaliculatum*, it is the second most frequent and abundant species of *Dilutineuron* in this insular country.

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