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Pohlia nutans subsp. *schimperi* (Müll.Hal.) Nyholm, a neglected Nordic moss in Central Europe

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SUMMARY

Pohlia nutans subsp. *schimperi* is recognized as a distinct taxon, differing from ssp. *nutans* by the pink to purple coloration of its leaves and a dioicous or polyoicous, rather than paroicous, sexual condition. We review the contrasting reports about the sexuality of these plants, as well as their nomenclatural history, and demonstrate their synonymy with *P. nutans* subsp. *purpurascens* Latzel. The subspecies shows a mainly arctic–subarctic distribution, with relict Central European occurrences in the Eastern Alps, the Sudetes and the western Carpathians, probably reflecting migratory events during the Pleistocene. The ecology and phytosociological affinities of the taxon in Central Europe are discussed in detail.

KEYWORDS: *Pohlia schimperi*, *P. nutans*, taxonomy, ecology, glacial relict, Austria, Czech Republic, Poland.

Introduction

In 1993, HK discovered a purplish-coloured *Pohlia* in the Eastern Alps in Austria, which proved to be identical to *Pohlia schimperi* in the sense of Nyholm (1993). Intensive bryofloristic investigation brought many additional localities in subsequent years and revealed a distinctly eastern distribution, characteristic for a group of vascular plants with an Eastern Alpine–Carpathian distribution pattern. Although at that time there were no literature reports of the taxon from the Carpathians and the Sudetes, its presence in these regions was expected. Indeed, in 1998, AS independently found *P. schimperi* in Poland in the Beskid Wysoki range of the Western Carpathians and, in 2001, the taxon was discovered during a detailed bryofloristic inventory of the glacial cirques of the High Sudetes by JK and co-workers (Kučera *et al*., 2004a, b). The aim of this paper is to bring this poorly known taxon to the attention of a wider audience so that its distribution can be properly assessed.

Taxonomy

Pohlia nutans subsp. *schimperi* has not been generally recognized. In fact, only Nyholm (1993) accepted it at the specific level. It has been included in the check-lists for Poland (Ochyra, Żarnowiec & Bednarek-Ochyra, 2003) and the Czech Republic (Kučera & Váňa, 2003) at the subspecific level, based on information provided by JK and AS. Other authors either did not mention it (e.g. Nordhorn-Richter, 1982; Frey *et al*., 1995) or failed to recognize it as distinct from *P. nutans* (Corley *et al*., 1981; Shaw, 1982).

Pohlia schimperi and *P. nutans* appear to be closely related. In our understanding, *P. schimperi* is principally characterized by a distinct, reddish to purple coloration which makes it easy to distinguish it from the green *P. nutans*. Plants of intermediate coloration are rare and we found them only within the regional distribution area of *P. schimperi*. The typical colour of *P. schimperi* is not only expressed in sun-exposed habitats but also develops in plants growing in deep shade, e.g. in cavities of boulder screes. However, it should be noted that young, immature parts of the shoots in late spring or summer are pale green, only developing the typical colour after a few weeks. The frequent occurrence of mixed stands of red *P. schimperi* and green *P. nutans* supports our conviction that the pigmentation of *P. schimperi* is fixed genetically.

There has been some confusion regarding the sexuality of *P. schimperi*. The taxon was described as dioicous but, according to literature reports and our own findings from central Europe, it is predominantly paroicous, and only rarely polyoicous. We have not seen the type material

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(from Norway's Dovre Mts) but A. J. Shaw (pers. comm.) investigated a specimen of *B. rutilans* Bruch & Schimp. (for nomenclature of the taxon, see below) from Schimper's herbarium in BM during his revisionary work on *Pohlia* in North America (Shaw, 1982), which he designated as the lectotype. He was able to confirm the dioicous sexuality. Should we accept only dioicous plants as *P. schimperi*, it would perhaps constitute, together with the red coloration, a clear-cut taxon. However, even in subarctic areas, morphologically otherwise identical paroicous or polyoicous plants are more frequent. Andrews (1935) found that 'it may be in part paroicous, in part with separate gemmiform antheridial heads, at first regarded as dioicous'. Generally, dioicous (or perhaps seemingly dioicous) populations may be more frequent in the far north. Thus, Brassard (1971) noted that 'all three' specimens [of *P. nutans*, in his view synonymous with *P. schimperi*] from Ellesmere Island are 'dioicous'. According to Mårtensson (1956), sporophyte-bearing specimens are rare in the Scandes, which may result from paroicous plants being rarer in Scandinavia than in Central Europe, where sporophytes occur frequently. Polyploidy, known for *P. nutans*, according to the chromosome numbers given by Fritsch (1991, 1999), may be a reason for the predominance of paroicous plants in Central Europe.

Pohlia schimperi has furthermore been said to differ from *P. nutans* in having smaller lamina cells (Müller, 1848; Amann & Meylan, 1918). The cell size is, however, extremely variable in both taxa, and therefore this character is useless for practical identification.

The many differences in sporophytic characters mentioned by Andrews (1935) are mainly based on the fact that Andrews compared more or less xeromorphic *P. schimperi* with the typical lowland morphs of *P. nutans* from mesic habitats, ignoring that the latter species is much more variable. We could not find any reliable difference in the sporophytes of the taxa. The spore diameter of *P. schimperi* is relatively invariable, ranging between 16 and 20 μm in specimens from central Europe and Norway. The spores of *P. nutans* are somewhat larger (according to the literature, 18–24 μm) but the overlap is considerable.

The apparently inherited difference in colour between *P. nutans* and *P. schimperi*, together with the distinctive distribution pattern of the latter taxon (see below), constitutes a sound basis for the taxonomic recognition of *P. schimperi*. The rank of variety is not suitable for a taxon with a unique distributional history (see below) and ecology, but the species level is unsuitable too, as the differences between the two taxa are indeed slight and hybridization between the two taxa may occur where populations grow in close proximity. Therefore, we have selected the subspecific rank, as proposed by Kindberg (1883) and later by Nyholm (1969), as a reasoned solution until a refined judgement can be made using molecular methods.

Nomenclature

Pohlia schimperi was first described as *Bryum rutilans* Bruch & Schimp. (Bryol. Eur. 4: 157, 1846), an illegitimate later homonym of *B. rutilans* Brid. The homonymy was recognized by C. Müller, who therefore established a new name, *B. schimperi* (Synopsis 1: 334, 1848). *Pohlia schimperi* is not known to have any previous heterotypic synonyms. However, Latzel (1926) described *P. nutans* var. *purpurascens*, a paroicous taxon differing from the typical variety by its more or less intense purple colour, based on three specimens collected by F. Pehr in the Eastern Alps of Carinthia and Styria in the Eastern Alps. Remarkably, Latzel noted that the new variety was very close to *P. schimperi*. We did not see type material but as we were able to re-locate identical morphs at each of Pehr's localities, we have no doubt that Latzel's var. *purpurascens* is identical to *P. nutans* subsp. *schimperi*. Therefore we propose here the formal synonymy of the two taxa:

Pohlia nutans* subsp. *schimperi (Müll.Hal.) Nyholm, Illustrated Moss Flora of Fennoscandia. II. Musci, Fasc. 6: 775, 1969

Pohlia nutans var. *purpurascens* Latzel, Hedwigia 66: 141, 1926, **syn. nov.**

Ecology

Pohlia nutans ssp. *schimperi* is a pronounced acidophyte, occurring on rock and soil in Central Europe. It prefers subalpine and alpine vegetation types such as open woods of *Picea abies* (in the Alps also with *Larix decidua* or *Pinus cembra*), subalpine thickets of *Pinus mugo* and *Alnus viridis* (Alps), dwarf shrub heaths with *Vaccinium myrtillus* and *V. vitis-idaea* (in the Alps also with *Rhododendron ferrugineum*), subalpine meadows of *Nardus stricta* and, in the alpine belt of the Eastern Alps, mainly stony meadows of *Carex curvula*. Within these vegetation types it grows on acid soil (rich or poor in humus), frequently on soil-covered rock ledges and boulder tops, more rarely in cavities of boulder screes, rock crevices and sloping rock faces, generally of poor siliceous rock like granite or phyllite (Sudetes), sandstone (Western Carpathians), gneiss and mica schist (Alps).

It does not show a preference for a particular exposure. In south-facing habitats on soil it is frequently associated with common xerophytic mosses including *Polytrichum piliferum* and *Ceratodon purpureus*, as well as *P. nutans* subsp. *nutans*. As soon as a thin soil layer accumulates, it follows rock pioneers like *Racomitrium sudeticum* (at lower altitudes *R. affine* or *Hedwigia ciliata*), often occurring with *Cynodontium polycarpum*, *Campylopus schimperi*, *Bartramia ithyphylla*, or lichens (mainly *Cladonia* spp.). On north-facing slopes it can be found associated with liverworts, including *Diplophyllum taxifolium*, *Bazzania tricrenata*, *Anastrophyllum minutum*, *Lophozia sudetica*, *L. ventricosa* var. *silvicola* and the moss *Polytrichum alpinum*. It avoids permanently moist to wet rocky habitats

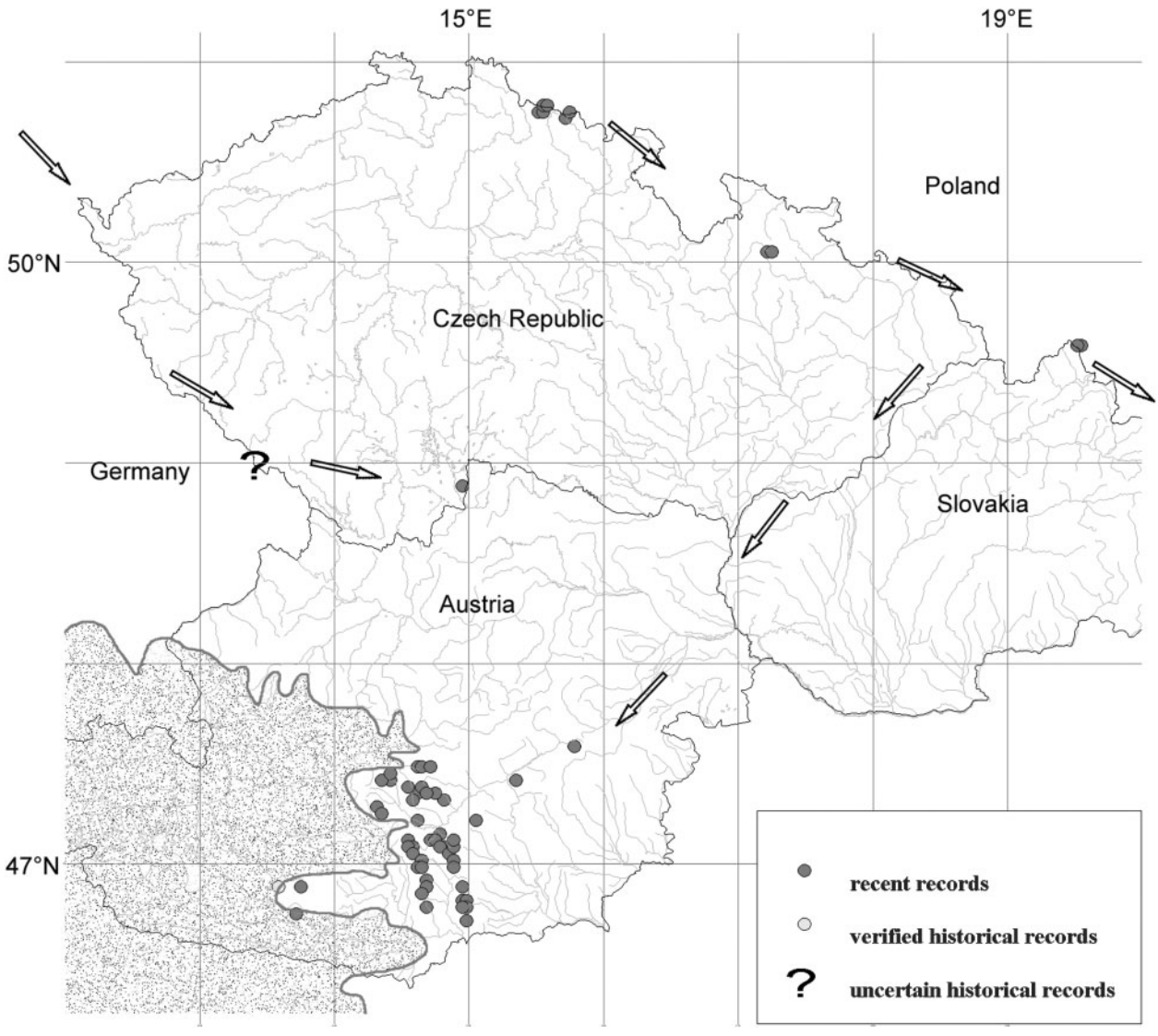

Figure 1. Distribution of *Pohlia nutans* subsp. *schimperi* in Austria, the Czech Republic and Poland, based on recent collections and herbarium revisions. The list of specimens is available upon request from the authors. The grey area demarcates the maximum extent of the Alpic ice shield during the last glaciation period (modified after van Husen, 1987). The arrows indicate the putative migration tracks of Nordic biota during the Pleistocene.

but can sometimes be found on south-facing, periodically irrigated, sloping rock faces, which dry out frequently (often with e.g. *Marsupella sphacelata*).

Pohlia nutans subsp. *schimperi* needs a certain amount of sandy siliceous detritus in the substratum. This is probably the main reason why it avoids, unlike *P. nutans* subsp. *nutans*, decaying wood, tree bases and peat, and why it is absent from limestone areas. According to the literature, in arctic and subarctic areas it also occurs in mires. Although such habitats are frequent in the subalpine belt of the Alps and the Sudetes, it has not yet been found in bogs or fens in the region.

Distribution

Previously, *P. nutans* subsp. *schimperi*, circumpolar in its general distribution, was understood to be more or less confined within Europe to the Scandinavian mountain range and the European Arctic (Nyholm, 1993). There have been only a few doubtful reports from Central Europe. Mönkemeyer (1927) mentioned two collections from central and south-eastern Germany (as *P. rutilans* (Schimp.) Lindb.) and Głowacki (1905) noted the occurrence of the taxon on Mt Tschirnock in Central Carinthia (Austria). Głowacki's identification was correct. We were able to locate the specimen (GJO) and confirm its identity. German specimens should be critically checked, but may well belong to this taxon for ecological and phytogeographical reasons (see below). No other historical reports from Central Europe are known except for the later records of *P. nutans* var. *purpurascens* from the mountains of Koralpe and Stubalpe in Austria, already mentioned.

Extensive investigation of the Eastern Alps in Austria by HK over the past decade has revealed a compact distribution area for *P. nutans* subsp. *schimperi* (Fig. 1).

In Styria it includes the eastern part of the Niedere Tauern Mts with a sharp western boundary. East of this range it occurs rarely in the Eisenerzer Alpen, being restricted to the few siliceous mountains within this limestone-dominated mountain range. South of the Mur valley it is rather widespread in the mountain ranges of the Seetaler Alpen and the Stubalpe. To the east the taxon becomes scattered, mainly due to the decreasing altitude of the mountains. The southernmost occurrences are known from Koralpe and Saualpe in Carinthia, the westernmost finds are located in the southern part of the Carinthian Gurktaler Alpen. The taxon is obviously absent from the northern part of this mountain range and also from the adjacent, well-explored Hohe Tauern Mts, as well as from the ranges lying further west.

Its distribution area in the Czech Republic is less compact, including suitable habitats of the High Sudetes (at present known from the summit parts of the Krkonoše Mts, Hrubý Jeseník Mts and likely to be present on Mt Králický Sněžník), with one remarkable disjunct outpost in South Bohemia. The latter locality, an unusually canyon-shaped valley in the lowland basin, is known for the occurrence of several other glacial relicts including *Daphne cneorum*, *Pulsatilla vernalis*, *Ajuga pyramidalis*, *Thesium alpinum* and others (Ambrož, 1949).

In Poland, AS discovered subsp. *schimperi* at a few sites in the Beskid Wysoki Range (Babia Góra, Pilsko) of the Western Carpathians but it probably also occurs in the Tatra Mts, as well as in the Polish part of the High Sudetan mountain ranges.

The taxon seems to be absent further west outside the described region of Central Europe, based on our field experience, literature reports and personal requests to our colleagues. The only available note of a similar plant can be found in Smith (1978, 2004), who mentioned (under *Pohlia nutans*) 'a curious plant, reddish in colour and dioicous … on several heaths in Berkshire'. This plant, however, proved to be *P. marchica* Osterwald (reddish and dioicous as well but with narrower leaves and excurrent costa), which probably had not been considered. This novel record for the British Isles will be published separately.

Phytogeographical Notes

The Central European distribution of *P. nutans* subsp. *schimperi* appears to be relict, reflecting migratory events during the Pleistocene. Remarkably, the western border of its Alpic distribution area faithfully picks out the easternmost extent of the Alpic ice shield during the last glacial maximum (Fig. 1). The mountains of the present distribution area possessed only local glaciers. We reason that during the Pleistocene maxima, *P. nutans* subsp. *schimperi* had a more or less continuous distribution in siliceous regions of the eastern part of Central Europe. The isolated refuge in South Bohemia provides evidence of such a wide distribution. During the glacial intervals, the taxon probably survived only in isolated populations on the highest mountains. Astonishingly, despite copious spore production, the taxon seems to have been unable to colonize post-glacially the formerly glaciated parts of the Alps, despite large areas with suitable environments. Its inability to spread effectively via long-distance dispersal indicates that subsp. *schimperi* reached the easternmost Alps through step-by-step dispersal along a migratory track used by other Nordic biota. This track began shortly south of the Pleistocene Nordic ice shield in the Harz Mt, extended along the mountain ranges of the Sudetes to the east with a division into two branches. The eastern branch reached the Carpathians, the southern branch extended via the Bílé and Malé Karpaty Mts to the north-easternmost foothills of the Alps, east of Vienna. This migration track was especially important for silicicolous plants without long-distance dispersal capabilities, as these were unable to cross the dry loess plains or the barrier of the limestone ranges of the Northern Alps. Among vascular plants, other examples include *Saxifraga hieraciifolia,* which has an eastern Alpic distribution comparable to that of *P. nutans* subsp. *schimperi* and re-occurs in the Carpathians, and *Carex bigelowii* with a Central European area reaching from the Harz Mts via the Giant Mts to the Carpathians and Alps, which shows a highly restricted refugium in Styria and Carinthia. Nearly identical in its range to *P. nutans* subsp. *schimperi* is the Eastern Alpic distribution area of *P. crudoides* (H. Köckinger, in prep.), which may also be discovered in the Carpathians. A further similar example is the arctic moss *Aulacomnium turgidum* confined in Central Europe to the easternmost part of the central Alps and to a small Carpathian refugium in the High Tatras.

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Taxonomic Addtitions and Changes: *Pohlia nutans* subsp. *schimperi* (Müll.Hal.) Nyholm (syn. *P. nutans* var. *purpurascens* Latzel).

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