

Distribution of *Schistostega pennata* in Latvia

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Abstract: Information on *Schistostega pennata* is limited in the Baltic countries. In Latvia *S. pennata* is listed as ‘rare’ in the Red data book but still little is known about the species distribution in relation to habitat and substrate. A search of all available literature and unpublished records provided information on about 21 *S. pennata* records in Latvia from 1924 until 2010 from different habitats and substrates. In total 18 records of *S. pennata* were found from protected areas. The latest records suggest that it is more common in Woodland Key Habitats on *Picea abies* root mass, than on sandstone in Latvia.

Kokkuvõte: *Schistostega pennata* levik Lätis

Balti riikides on *Schistostega pennata* levikust vähe teada. Läti Punases nimestikus on ta arvatud haruldaste liikide hulka, kuid andmestik liigi levikust erinevates kasvukohtades ja erinevatel substraatidel oli seni puudulik. Kirjanduse ja publitseerimata andmete alusel ajavahemikust 1924 kuni 2010 saadi Läti leiukohtade koguarvuks 21. Neist kaheksateist leiukohta paiknevad kaitsealadel. Leidude analüüs näitas, et Lätis esineb liik kõige sagedamini metsa vääriselupaikades harilikku kuuse tuuleheite juuremätastel, seejärel liivakivil.

INTRODUCTION

Schistostega pennata (Hedw.) F. Weber & D. Mohr is a particularly interesting moss. This interest can be attributed to its protonema that reputedly shines in the dark. ‘Goblin’s Gold’ is one of several folk names of this intriguing moss. Protonemal cells of *S. pennata* are lens-shaped and their surface is curved in such a way to focus the light on the interior of the cell. This structure develops when *S. pennata* occurs in a location exposed to light only from one direction. Chloroplasts are located within the cell in the most illuminated spot. If the direction of light exposure changes during a season, the affected chloroplasts may change their orientation. Similar characteristics have also been attributed to some other bryophytes such as the subtropical and tropical liverwort *Cyathodium* and Australian moss *Mittenia plumula* (Glime, 2007).

Schistostega pennata is pseudodioicous. Shoots are up to 1.5 cm long and spore size is about 8–12 µm (Smith, 2004). It disperses sexually by spores, or vegetatively mostly by fragmentation of protonemal branches (Āboliņa, 1968a).

The distribution of *Schistostega pennata* is classed as ‘Suboceanic Boreo-temperate’ distributed in Europe north to Fennoscandia, in Asia in Amur and Japan, and in North America. The

species has been found on deeply shaded often mineral soils, in old rabbit burrows, mine shafts, crevices in rocks, caves, also on boulders, on the root mass of fallen trees, and also in empty bottles (Smith, 2004; Glime, 2007; Harpel & Helliwell, 2005). The substrate is usually acidic (Āboliņa, 1968a). Threats to *S. pennata* include destabilization of soil as a result of removal of logs, stand thinning and fire. *Schistostega pennata* is listed as ‘sensitive’ in the Pacific North West of the U.S.A. (Harpel & Helliwell, 2005). In Northern Europe the species can also be found in dry and shady habitats, where the air is humid, but where the moss is sheltered from the rain, in old chalets, earth cellars and abandoned stone quarries in the lowlands. Still, suitably dark habitats may be often too wet for *S. pennata* (Atherton et al., 2010). *Schistostega pennata* is fairly common in Northern Europe (Hallingbäck et al., 2007).

In Latvia, *Schistostega pennata* was first recorded in 1924 by K. R. Kupffer on sandstone (Āboliņa, 1968a). It is a specially protected species (LRMK, 2000), and a Red-listed species classified as ‘rare’, (Āboliņa, 1994). In Latvia the species can be found in old-growth boreal coniferous forests (wet *Picea abies*, mixed and

wet *Pinus sylvestris* forests) on the root masses of fallen trees (Āboliņa & Bambe, 2005), sometimes on open soil on roadsides, and in riparian sandstone caves along the Gauja and Salaca rivers (Āboliņa, 1968b; Bambe, 1989; Opmanis, 1996; Suško, 1997). *Schistostega pennata* is classified as 'rather rare' in Estonia (Ingerpuu et al., 2005), as 'endangered' in Lithuania (Anonymus, 2003), but 'rather common' in Russia (Ignatov & Ignatova, 2001).

The aim of the present study is to evaluate the distribution of *S. pennata* in Latvia in different habitats and substrates.

MATERIALS AND METHODS

Records of *Schistostega pennata* in different habitats and substrates in Latvia were obtained from the available literature (Āboliņa, 1968a; Āboliņa, 1968b; Bambe, 1989; Opmanis, 1996; Suško, 1997; Suško, 2010) and also from the author's unpublished data (Fig. 1). These data were collected during several projects using different methods (survey, inventory, monitoring). The precise geographical coordinates for most

of these records are missing, due to the traditions of particular collectors, their study aim, methods, and different time periods of records. Survey and inventory data (14 records) derive from projects conducted during 1989 to 2010. Monitoring data, collected by modified random walk procedure (Kent & Coker, 1992), proved the presence of the species repeatedly at the localities (seven records).

To describe the distribution of *S. pennata* we used presence in 5×5 km squares (Standard Latvian Botanical square map; Fig. 1). Presence in one square may represent more than one record, in more than one habitat and substrate. The following data about each record were collected – botanical square, habitat and substrate, year of record and locality.

RESULTS AND DISCUSSION

Schistostega pennata has been recorded (Table 1) in different habitats: spruce and mixed spruce wetland Woodland Key Habitat (WKH), mixed coniferous – deciduous WKH, black alder wetland WKH, coniferous WKH, pine and birch wetland

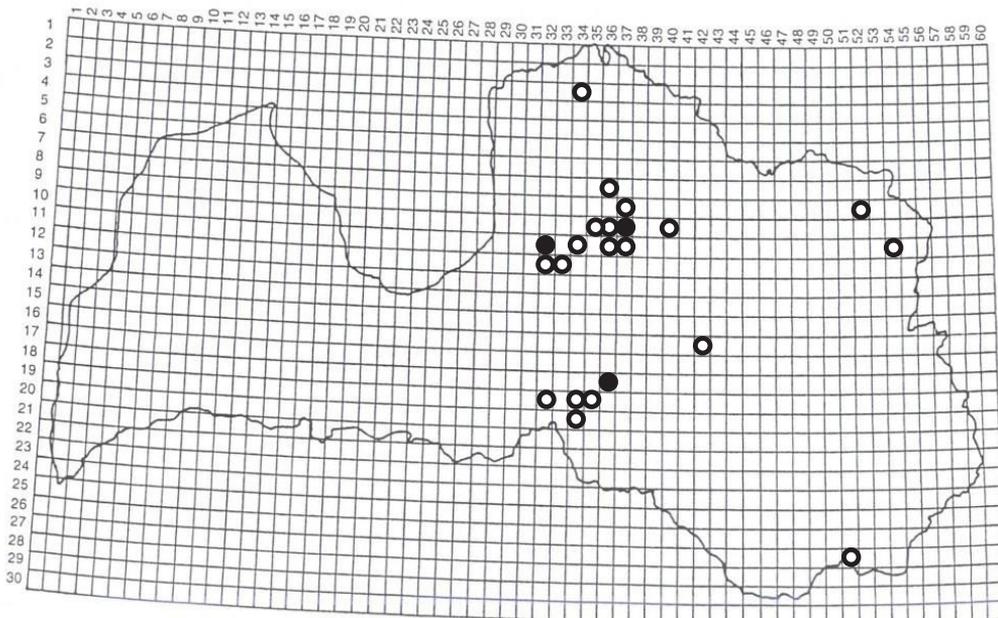


Fig. 1. Distribution of *Schistostega pennata* in Latvia (Standard Latvian Botanical square map). *S. pennata* present – open circles, disappeared – black circles.

Table 1. Characteristics of habitats and substrates for *Schistostega pennata*. Abbreviations: GNP – Gauja National Park, NR – Nature Reserve, WKH – Woodland Key Habitat, * – disappeared record

Nr. of record	Botanical quadrat	Habitat	Substrate	Year of record	Locality
1	19/35	spruce and mixed spruce wetland WKH	<i>Picea abies</i> and <i>Pinus sylvestris</i> root mass	2010	Aklais purvs NR
2	10/40	mixed coniferous – deciduous WKH	<i>Picea abies</i> root mass	1996, 1998	Kapusils at Mežole NR
3	19/34			2010	Aklais purvs NR
4	16/42		coniferous root mass	1989	Krustkalnu NR
5	11/54	black alder wetland WKH	<i>Picea abies</i> root mass	2009	Gruzdovas meži NR
6	27/51	dry <i>Picea abies</i> dominating forest		2006	Subotjalovka ravine
7	9/52			2008	Forest stand in Mālupe
8*	18/36	managed deciduous forest		1995	Aizkraukles purvs un meži NR
9	20/34	coniferous WKH		2010	Aklais purvs NR
10	19/32			2010	Seržu tīrelis NR
11	11/37		<i>Pinus sylvestris</i> root mass	1998	Lode railway station at GNP
12	8/36	pine and birch wetland WKH		1999	Vaidava forest district
13	10/35			1998	GNP
14	11/36	sandstone cave	sandstone	1996	Red cave at GNP
15*	10/37			1978, 1992	Berlīne rock cave, Ramātu cliff, Spulgsūnu cave at GNP
16	11/34			1930, 1967, 1986, 1992, 1995	GNP
17	3/34			1930, 1992, 1996	GNP
18	9/37			1990, 1991	Baižu cave at GNP
19*	11/32			1924, 1936	Gūtmaņala, Velnala at GNP
20	12/33			2010	Pētera cave at GNP
21	10/36	sandstone outcrop		1978, 1995	Ramātu and Ērgļu cliffs at GNP

WKH (Ek et al., 2002), dry *Picea abies* dominated forest, managed deciduous forest, sandstone cave, sandstone outcrop and on different substrates (root mass and sandstone). All WKHs as well as sandstone outcrops and sandstone caves mentioned in the present study are protected

habitats under European Union legislation (EU, 2007). In total 21 records of *S. pennata* were found in Latvia from 1924 until the end of 2010 (Fig. 1). *S. pennata* has been found in Central and Eastern Latvia, but no records are known from Western Latvia. This might be due

to the management intensity, lack of suitable coniferous forests or lack of potential substrates in Western Latvia. The most common habitats for *S. pennata* were different types of WKHs (13 records), especially coniferous WKH (four records) and the most common substrate was *Picea abies* root mass (nine records), followed by sandstone (seven records in caves, one on an outcrop; Table 1). This species has disappeared from squares where it has been recorded previously (square 11/32 (the first *S. pennata* record in 1924 and not found later), record in square 10/37 not found in 1994 and record in square 18/36 not found in 2010), probably because of natural succession or anthropogenic influence. In all other localities of *S. pennata* the species has thrived until the present time. In total 18 records of *S. pennata* are located in protected territories such as Nature Reserves or Gauja National Park (Table 1) ensuring long-term protection. Perspectives of three *S. pennata* sites in Subatjolvka ravine, forest stands in Mālupe and Vaidava forest district are uncertain. The site in a forest stand in Mālupe is especially vulnerable as a clearcut was crossing this forest stand.

Schistostega pennata in Latvia is common in rather deep caves, where due to the lack of light, it is not outcompeted by other bryophytes (Opmanis, 1996). *Schistostega pennata* was found in dry caves, but with high relative air humidity. The entrances of all caves were found to have a North to North-East aspect, where direct sunlight never penetrated. The reasons for the rarity of *S. pennata* are thought to be either (a) non-suitable geological conditions (cave entrances exposed to south, proximity of creeks and active erosion processes limiting vegetation establishment on sandstones) or (b) human disturbance (degradation of cave walls, fire sites). Due to these reasons several former sites for *S. pennata* in Latvia have been destroyed (Opmanis, 1996).

More careful and wider investigations are necessary for a more thorough evaluation of the distribution of *Schistostega pennata* in Latvia. Up to now investigations were based on projects with a broader focus on overall biodiversity evaluations or speleological surveys in specific conservation areas. The lack of *S. pennata* records in the Western part of Latvia may be due to limitation of suitable habitats (*Picea abies* dominated forests).

Due to its unique morphology, anatomy, establishment and ecological requirements, *Schistostega pennata* is an attractive and important bryophyte to study in the future. Such studies need to focus on population ecology and attempt to answer the following questions: (1) for how long is a root mass suitable for *S. pennata* (evaluation of substrate pH, light conditions, forest stand age)? (2) how far can spores of this species disperse? (3) is the disappearance of *S. pennata* in some places due to human disturbance, succession or competition? Long term monitoring is necessary to evaluate the distribution of this species and answer these questions.

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