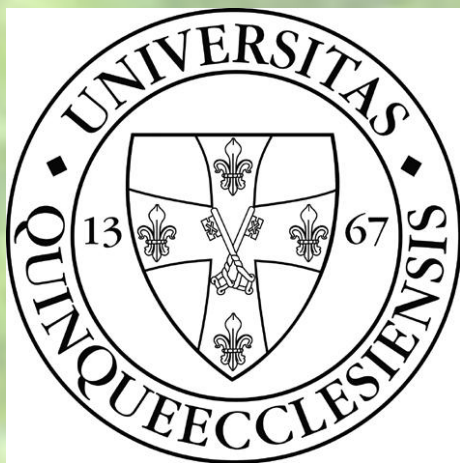


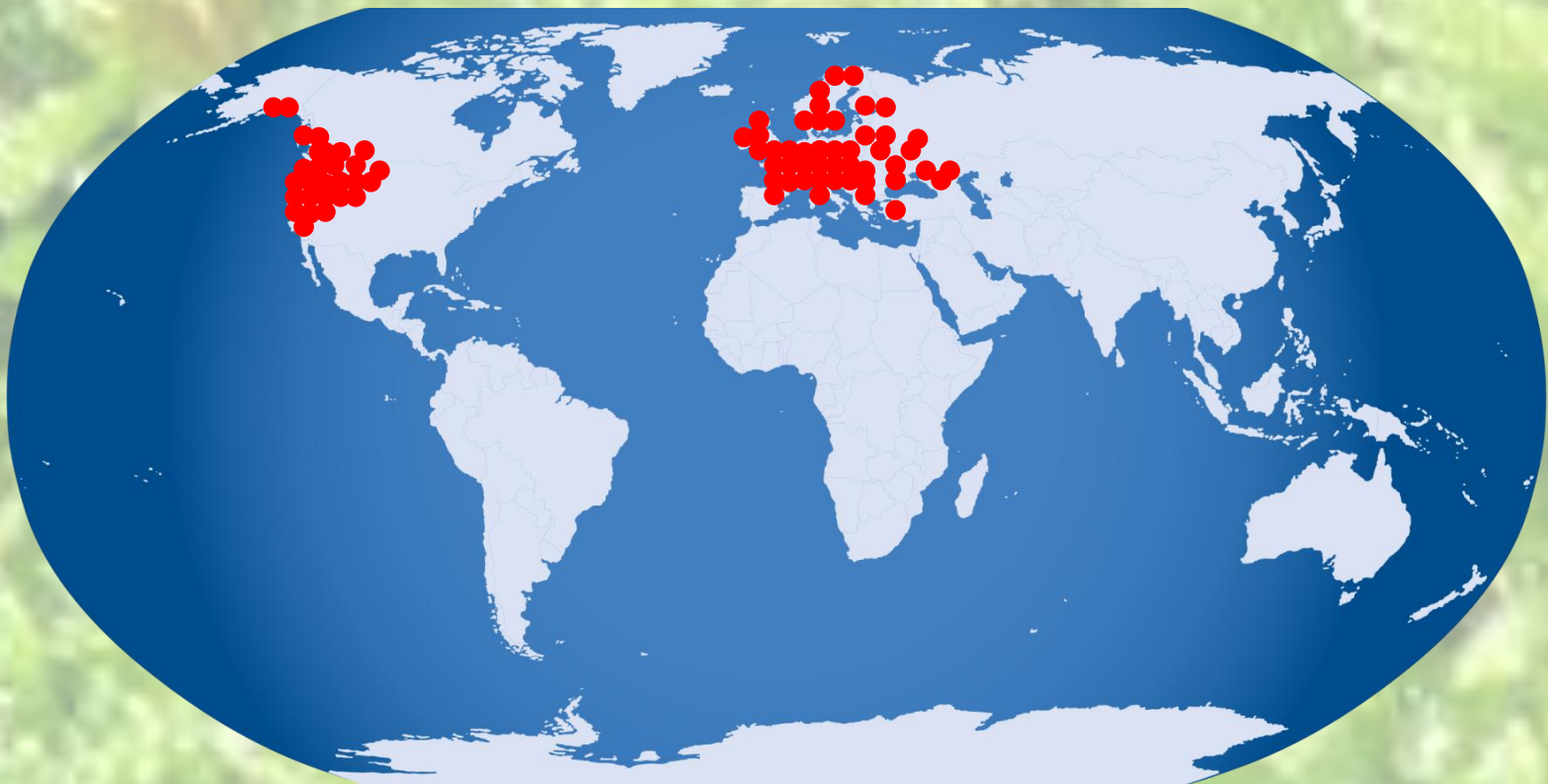
An expanding moss species: *Dicranum tauricum*

Sapjegin stands with sporophytes in Hungary



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D. tauricum is a noteworthy moss with a disjunct area and expansion tendency. Its European and North-American populations are separated not only by the oceans, but by the Eastern parts of North-America and Asia as well. It can spread and expand locally well, but species with so little archive data is a hard task to deduct or explain how such an area could form. It's noteworthy, that at the Northern Hemisphere the invasive *Campylopus introflexus* has a rather similar disjunct area. Similarities in the two areas may be traced back to overlapping ecological (e.g. climatic) preferences.



Dicranum tauricum stand with sporophytes occur on a fallen log in the vicinity of Pécs (Szabolcs)

Accompanying species of *D. tauricum* occur on various substrates (Hungary, original data). In some cases where the moss pillow covered the border of the root and soil, covering multiple substrates is labelled with “mixed” denomination. More species grow on decaying wood then soil, but more threatened species (PAPP et al. 2000) however occur in the vicinity of stands developing on soil. Species marked with **red** can be found in stands with sporophytes. Hungarian epixylic stands differ greatly in regard of species composition from the *Tetraphido-Orthodicranetum stricti* Hebrard 1972/73 (Marstaller 1983) that was described in South-East-France.

	soil	dec. wood	bark	mixed	Red List
<i>Amblystegium serpens</i>	+				LC
<i>Buxbaumia aphylla</i>	+				VU
<i>Campylopus flexuosus</i>	+				-
<i>Dicranowelsia cirrata</i>		+		+	LC-att
<i>Dicranum montanum</i>		+		+	LC
<i>Dicranum scoparium</i>	+	+			LC
<i>Gymnocolea inflata</i>	+				EN
<i>Hypnum cupressiforme</i>	+	+	+	+	LC
<i>Lepidozia reptans</i>				+	LC-att
<i>Leucobryum glaucum</i>	+	+			LC-att
<i>Leucodon sciurioides</i>			+		LC
<i>Lophocolea heterophylla</i>	+	+	+		LC
<i>Nowellia curvifolia</i>		+			VU
<i>Paraleucobryum longifolium</i>		+			LC
<i>Plagiothecium curvifolium</i>				+	LC
<i>Platygyrium repens</i>		+		+	LC
<i>Pohlia cruda</i>				+	LC-att
<i>Pohlia nutans</i>	+	+			LC
<i>Polytrichum formosum</i>	+	+			LC
<i>Pseudotaxiphyllum elegans</i>	+			+	NT
<i>Ptilidium pulcherrimum</i>		+			NT
<i>Cladonia sp.</i>		+		+	-
	11	13	3	9	

Introduction

In the „Old World” *Dicranum tauricum* was considered to be a south-eastern species, mostly thanks to being relatively understudied. Recently however it started to spread all across Europe, and it is proven to appear or became widely distributed where former studies have failed to prove its presence. Many considered that the reason behind its successful invasive tendencies is the vegetative reproductive organs (e.g. brittle leaf apex and gemmae). Others think that these organs can only explain its local spread, and a continent-wide rapid expansion should be traced back to changes in ecological and moss-floristical factors (e.g. air pollution, acidic rains, habitat alterations). The plausibility of these explanations is questioned by numerous studies, because most of the indigenous and Central-European stand originates from near-natural habitats, also the overall air quality is improving Europe-wise. A recent thought/hypothesis to explain the Hungarian spread of the species relates an increase in the pine-plantation age and the frequent presence of decayed wood of pine species (*Pinus* spp.), as a substrate. More comprehensive European studies points out that *D. tauricum* has no preference towards coniferous forests at all, and it's more typical in moisty closed beech-, hornbeam-oak- and planted mixed forests. This moss is weakly associated with other species and usually forms pure stands. According to the Hungarian literature it occurs with no more than 10-20 different moss species, none of them are threatened. To determine the invasive or expansive nature we exclusively rely on paleobotanical data. In this respect the amount of available information is quite limited for now.

Stands with sporophytes in Hungary

For large scale dispersal mosses usually form spores. In Europe however the dioecious *D. tauricum* develops quite few sporophytes. In Hungary the species known to have around 250 occurrences, this data density compared with the middle-eastern-European data (STEBEL 2012), emerges among every other country. This is not the only speciality of Hungarian data; in the above mentioned countries other than Crimea, stands with sporophyte have only been found at a single Polish habitat, while in Hungary thanks to a non-systematic surveys in the past two years we counted 11 locations (W-Mecsek 4, Middle-Mecsek 2, E-Mecsek 1, Buda Mts. 1, Pilis basins 2, Bakonyalja 1) where more sporofitic stand turned up (CSIKY-DEME ined., CSIKY et al. 2014, Szűcs 2015).

Habitat preferences, conclusion

Stands with sporophytes occur less frequently on the foot of the tree, where they can develop on soil and on bark as well, but usually they grow on decayed wood (fallen trunks and stumps) in carpet like layers. These stands mostly occur in humid, damp habitats, in valleys, in hollows, at northern exposition, on acidic sand and sandstones. Based on national and international data the species occurrence as epiphyte is 60%, but in 40% it prefers epixylic habitats (STEBEL et al. 2012, Szűcs et al. 2013). Although even literature emphasizes *D. tauricum*'s epiphytic character, in Hungary the sporophytes are all observable with one exception in epixyl pillows with a single exception (on foot of trees). In the case of a species the ecological optimum is marked by the ability to live through the whole life cycle in place, it is possible that despite the large occurrence as being epiphytic *D. tauricum* can be considered to be rather epixylic species. This statement is further supported by the fact that in Hungary the largest gametophyton stands (>50 dm²) are regularly found on decayed wood.

Tree species as substrate wise occurrence frequency of sporophytic stands are: *Quercus* spp., *Pinus* spp., *Castanea sativa*, *Fagus sylvatica*.

It's also worth to note that we managed to find stands with sporophyte at an urban area (city-park) in Pécs.

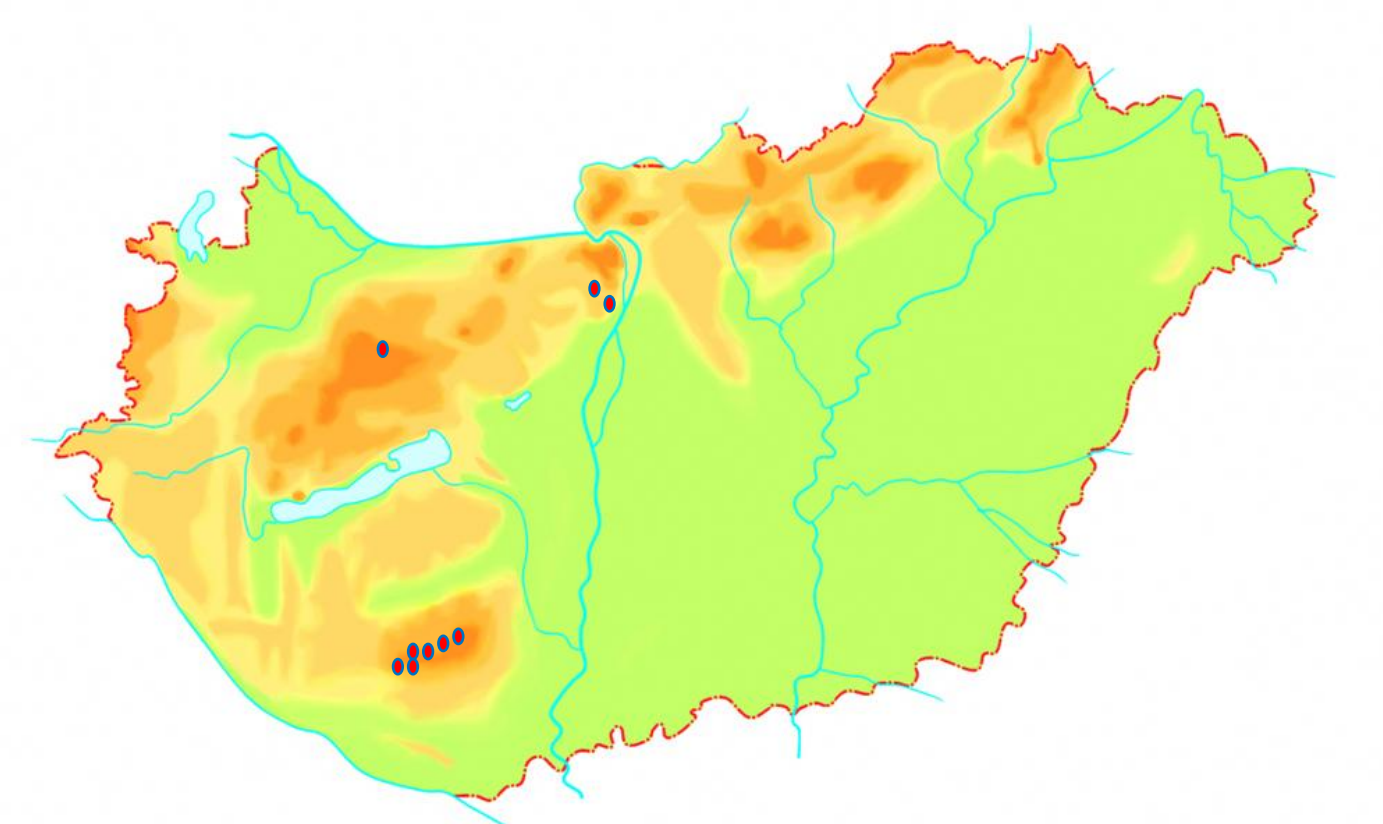
In our opinion, only with international cooperation a Europe wise survey along with multi criteria evaluation of the sporophytic stands can point out the true reasons behind the rapid expansion which are currently under debate.



Dicranum tauricum stands with sporophytes. A) Piliscsaba: a species-poor carpet on a fallen log (3 species), B) Pesthidegkút: pure stand on decaying stump (4 species) C) Pécs: a species-rich carpet on decaying log (8 species). The sporophytes usually grows at the side of the logs/stumps, in northern exposition.



Dicranum tauricum stands with sporophytes in a beech forest growing on leached soil (Mecsek Mts). Unlike in oak forests where the largest pillows grow on bark, here it occur at the edge of the main root on the ground and usually found on soil rich in decaying organic materials. Accompanying species are characteristic taxa of acidic beech forests accordingly.



The area distribution of known *D. tauricum* stands (red circles with a blue margin) in Hungary 2015. The stand in Fenyőfő was discovered by Péter Szűcs in 2015.

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