Cryptogams in Estonian alvar forests: species composition and their substrata in stands of different age and management intensity

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Introduction

Alvar forests represent one of the rarest forest types in Europe; their distribution is limited only with limestone areas in western and nothwestern Estonia (inclusive islands) and little in southern Sweden. Therefore, from the viewpoint of protection of biological diversity, these forests are the responsibility communities for Estonia. Only general overviews of forests include alvar forests as well but more detailed analyses are lacking, especially concerning cryptogams (bryophytes and lichens) in these forests. The aim of this study is

1) to describe the cryptogam species composition in alvar forests of different management and age groups and

2) to discuss the variation of species richness and composition on different substrata in these forests.

The study area

Material and methods

Alvar forests grow on shallow soils (with thickness less than 30 cm) formed on calcareous material. These forests are of low productivity and with a peculiar xeromesophilous ground vegetation reminding meadow-steppes. The tree layer is rather scarce.

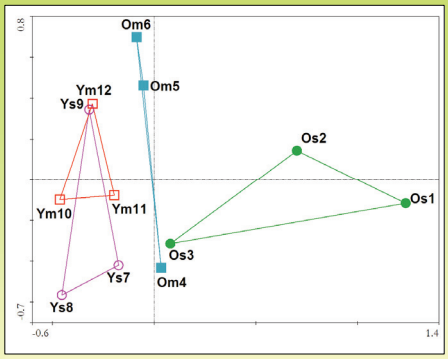
The sampling pattern was set up with 2×2×3 design, i.e. forests were represented with (i) intensively managed stands and, (ii) modestly managed subnatural stands; forests of every management class were further divided into two groups: (a) younger forests about 60--80 years of age, (b) forests older than 140 years. Each forest category (experiment variant) was replicated three times. In that way, 12 forests stands were included in the study.

Results

Altogether 101 bryophyte and 54 lichen species were recorded. Younger and older forests had different bryophyte and lichen species composition.

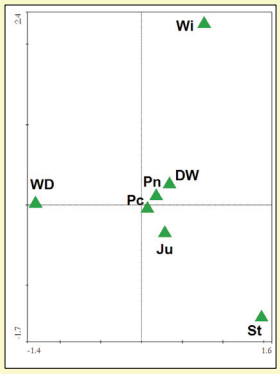
Substrata explained more species variance than stand age and management intensity. The variables best explaining bryophyte species variance were substrata ground, stone and windthrow. Forests age, management and age-management interaction also had significant effect on bryophyte vegetation. Fine woody debris, substrate stone and forest age were the variables best explaining lichen species variance.

Decaying wood was the richest in cryptogam species substratum. It had quite a unique bryophyte composition, including high amount of hepatics. It appeared that on *Juniperus communis* the lichen species richness was the highest among the studied trees though the number of these bushes or small trees was very low in comparison with the dominating trees. Bryophyte species composition appeared to be similar on tree bases of *Pinus sylvestris*, *Betula pendula* and *Picea abies* and different on *J. communis*. Most recorded threatened bryophyte species grew in old subnatural forests on stones or decaying wood.

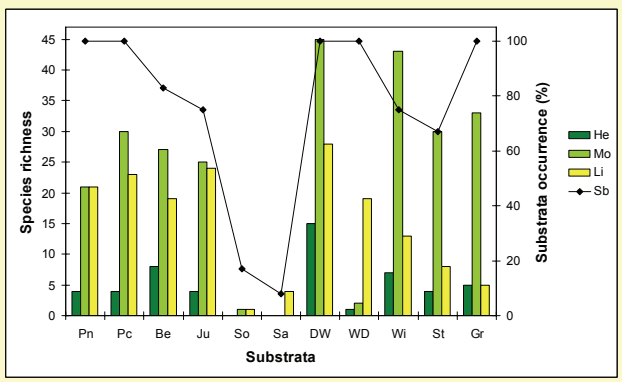


Ordination (PCA) of forest stands by bryophyte data.

Os – older subnatural, Om – older intensively managed, Ys – younger subnatural, Ym – younger intensively managed



DCCA of lichen species and substrata data.



Species richness on different substrata.

He – hepatics, Mo – mosses, Li – lichens, Sb – substata occurrence. Pn – *Pinus sylvestris*, Pc – *Picea abies*, Be – *Betula pendula*, Ju – *Juniperus communis*, So – *Sorbus aucuparia*, Sa – *Salix caprea*, DW – decaying wood, WD – fine woody debris, Wi – windthrow, St – stone, Gr – ground

Conclusions

We can recognise that while the results of our previous study confirmed the importance of forest management intensity on the bryophyte species richness, the current study reveals also the importance of forest age on both bryophyte and lichen species composition. Availability of different substrata appeared even more essential for cryptogam diversity and species composition. Decaying wood and *Juniperus communis* appeared to be important substrata for cryptogam species diversity in alvar forests.