

# The effect of light on forest understory in deciduous-coniferous mixed forests in Western Hungary

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## Introduction

Forest understory light is one of the most relevant environmental variables influencing understory vegetation, but the response to light can differ between plant groups and between species. Through the stand structure and tree species composition human management strongly determines understory light conditions and also the composition and diversity of different plant groups.

## Aims of the study

- Investigating the relationships between light and herbs, ground floor and trunk dwelling bryophytes and seedlings
- Creating plant groups according to their response to light

## Materials and methods

### Data collection:

34 forest stands in Órség National Park (Western Hungary)  
 30x30 m<sup>2</sup> sampling sites in each stands, divided to 5x5 m<sup>2</sup> plots

Absolut cover estimations for

- herbs
- bryophytes
- seedlings

Relative diffuse light estimation: LAI-2000 Plant Canopy Analyzer

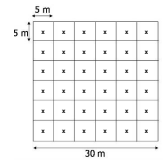
### Data analysis:

Redundancy analysis (RDA)

Spearman rank correlations between light and

- total cover
- species number
- cover of species

Using different spatial scales (from 5x5 to 25x25 m<sup>2</sup>)



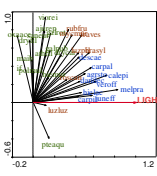
## Results

### Herbs

	Corr. coeff.	Scale of strongest correlation
Total cover	0.249	
Species number	0.348*	



Species	Corr. coeff.	Scale of strongest correlation
<b>Non-forest species / species of open forests</b>		
<i>Carex pallens</i>	0.486**	20x20
<i>Juncus effusus</i>	0.483**	30x30
<i>Agrostis stolonifera</i>	0.474**	20x20
<i>Deschampsia cespitosa</i>	0.450**	30x30
<i>Danthonia decumbens</i>	0.376*	30x30
<i>Calamagrostis epigeios</i>	0.646**	30x30
<i>Melampyrum pratense</i>	0.698**	30x30
<i>Veronica officinalis</i>	0.464**	30x30
<i>Carex pilulifera</i>	0.433*	30x30
<i>Hieracium lachenalii</i>	0.432*	30x30
<b>Species of small gaps</b>		
<i>Luzula pilosa</i>	0.578**	15x15
<i>Mycelis muralis</i>	0.469**	15x15
<i>Rubus fruticosus</i> agg.	0.458**	15x15
<i>Brachypodium sylvaticum</i>	0.404*	15x15
<i>Fragaria vesca</i>	0.372*	10x10
<i>Rosa canina</i> agg.	0.427*	5x5
<i>Luzula luzuloides</i>	0.386*	10x10
<b>Shade-tolerant species</b>		
<i>Galium rotundifolium</i>	0.273	15x15
<i>Oxalis acetosella</i>	0.219	5x5
<i>Dryopteris carthusiana</i>	0.200	15x15
<i>Galeopsis pubescens</i>	0.197	15x15
<i>Hieracium murorum</i>	0.191	5x5
<i>Sanicula europaea</i>	0.188	15x15
<i>Athyrium filix-femina</i>	0.186	5x5
<i>Viola reichenbachiana</i>	0.176	15x15
<i>Pteridium aquilinum</i>	0.148	5x5
<i>Polygonatum multiflorum</i>	0.126	15x15
<i>Ajuga reptans</i>	0.093	5x5
<i>Maianthemum bifolium</i>	-0.205	10x10
<i>Dryopteris filix-mas</i>	-0.313	10x10



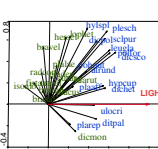
Percentage of variance explained by light: 19.2 %

### Bryophytes

	Corr. coeff.	Substrate
Total cover	0.554**	
Species number	0.170	



Species	Corr. coeff.	Substrate
<b>Light-flexible species</b>		
<i>Polytrichum formosum</i>	0.586**	soil
<i>Dicranum polysetum</i>	0.494**	soil
<i>Scelopodium purum</i>	0.403*	soil
<i>Hylocomium splendens</i>	0.360*	soil
<i>Pleurozium schreberi</i>	0.526**	soil
<i>Leucobryum glaucum</i>	0.454**	soil
<i>Plagiommium affine</i>	0.430*	soil
<i>Dicranella heteromalla</i>	0.509**	soil
<i>Pohlia nutans</i>	0.493**	mineral soil
<i>Atrichum undulatum</i>	0.457**	mineral soil
<i>Ditrichum pallidum</i>	0.363	mineral soil
<i>Dicranum scoparium</i>	0.563**	opportunist
<i>Ulota crispa</i>	0.340*	opportunist
<i>Hypnum cupressiforme</i>	0.617**	wood
<i>Platygyrium repens</i>	0.358*	wood
<b>Shade-tolerant species</b>		
<i>Isoetes macrospora</i>	-0.290	epiphytic
<i>Dicranum montanum</i>	0.285	epiphytic
<i>Radula complanata</i>	0.283	epiphytic
<i>Tetraphis pellucida</i>	-0.326	epiphytic
<i>Herzogia seligeri</i>	0.109	epiphytic
<i>Lophocolea heterophylla</i>	0.309	epiphytic
<i>Brachyeteum salebrosum</i>	-0.204	wood
<i>Plagiommium cuspidatum</i>	0.168	wood
<i>Plagiothecium denticulatum</i>	-0.213	wood
<i>Plagiothecium laetum</i>	0.234	wood
<i>Fissidens taxifolius</i>	-0.232	mineral soil
<i>Bryum rubens</i>	-0.162	mineral soil
<i>Eurhynchium angustirete</i>	0.273	soil
<i>Brachyeteum rutabulum</i>	0.206	opportunist
<i>Brachyeteum velutinum</i>	0.229	opportunist



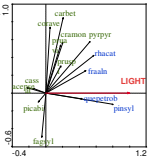
Percentage of variance explained by light: 19.0 %

### Seedlings

	Corr. coeff.	Scale of strongest correlation
Total cover	0.370**	
Species number	0.382**	



Species	Corr. coeff.	Scale of strongest correlation
<b>Light-flexible species</b>		
<i>Pinus sylvestris</i>	0.728**	20x20
<i>Quercus petraea</i> et <i>robur</i>	0.686**	20x20
<i>Frangula alnus</i>	0.452**	30x30
<i>Rhamnus catharticus</i>	0.412*	30x30
<b>Shade-tolerant species</b>		
<i>Carpinus betulus</i>	0.212	20x20
<i>Fagus sylvatica</i>	0.128	5x5
<i>Picea abies</i>	-0.309	15x15
<i>Prunus avium</i>	-0.309	5x5
<i>Acer pseudoplatanus</i>	-0.311	30x30
<i>Castanea sativa</i>	-0.205	30x30
<i>Pyrus pyrastr</i>	0.350	20x20
<i>Corylus avellana</i>	-0.115	15x15
<i>Prunus spinosa</i>	-0.191	10x10
<i>Crataegus monogyna</i>	-0.258	5x5



Percentage of variance explained by light: 8.6 %

Both cover and species number of seedlings correlated with light.

However, among species only pine and oak seedlings and some shrubs needed big bright areas, other seedling were not related to light.

Light explained a relatively high proportion of the variance in all cases, and it had a considerable effect on species richness and total cover of the groups.

Species within each plant group could be classified based on their correlation with light. These groups could be discriminated also on the RDA plots.

At higher light more herb species could find their life requirements, but their cover does not increase with light, probably because of the acidic soil. Within light-demanding species two finer groups could be discriminated according to the spatial scale of their relationship to light: "species of open areas" and "gap species".

Light influenced the total cover of bryophytes, but their species number was rather determined by the available substrate types.

For bryophytes living on soil or mineral soil light was more important factor than species inhabiting woody substrates.

## Conclusions

Different components of the forest understory respond to light in different ways, concerning the strength, direction and spatial scale of the relationships.

Herbs of gaps are related to light on a finer scales than species of open forests.

Bryophytes are usually considered determined by substrate, but for soil-inhabiting species the relative light is also an important environmental factor.

Forest management should consider these to maintain high diversity of understory vegetation.

## Literature

Tinya, F., Márialigeti, S., Király, I., Németh, B. & Ódor, P. (2009): The effect of light conditions on herbs, bryophytes and seedlings of temperate mixed forests in Órség, Western Hungary – *Plant Ecology*, 204: 69-81.

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