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Environment influence to variability of isolated wood vegetation

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Abstract

This article outline the basic possibilities of research of biogeographical regularities in cultural landscape of Českomoravská vrchovina highlands. Surveyed problem is study of variability of isolated wood vegetation and its relation to landscape structure and landuse. Theme of isolated wood vegetation has been studied especially in Belgium, Germany, Poland and Great Britain, studies upon this theme in Czech Republic are missing yet. This paper is based on phytocoenological recording in isolated wood vegetation, analysis of surrounding topography and landuse. Explication of biogeographical regularities in environment of disturbing anthropogenic influence is the aim of the research.

Keywords: vegetation 1; forest fragment 2; landscape 3; eutrophication 4

1. Introduction

The forest vegetation in cultural landscape is very important for preservation of biodiversity. Fragmented forests often forms a refuge for herb layer plant species, in markedly fragmented cultural landscape, formed of an agricultural land, woods (especially with derived tree species) and seats. Many foreign authors have been engaged in the research of the vegetation of forest fragments, by Dzwonko and Loster, 1992; Mikk and Mander, 1995 and Thomas et al., 1997 this vegetation is influenced by land use history, degree of habitat isolation and fragmentation. The influence of **land use history** on species richness of forest vascular plants has been studied by Brunet, 1993; Hermy et al., 1993; Thomas et al., 1997; Wulf, 1997 and Lawesson et al., 1998. **The edge effect** has been studied by e.g. De Schrijver et al., 1998.

Eutrophication is one of the most imporatant factors (e.g. Brunet, 1993; Thimonier et al., 1994; Brunet et al., 1997).
Outline of patterns a structure of the vegetation of the forest fragments depending on explicit geographical factors: segmentation of the relief, exposition, geological subsoil, soil substrate granulity, land use in surrounding landscapes and history of exploitation especially, is aim of this article. Preliminary findings, which precede the data evaluation collecting by field survey are presented in this article. Study of biodiversity of the habitats is important to understanding to

dynamism of the individual plant species not only, population and vegetation, but at the same time serve as instrument to nature conservation. Findings from the Czech Republic are missing yet.

2. Methods and material

2.1 Interest area

The interest area covers Českomoravská vrchovina highlands and neighbouring part of Třeboňská pánev basin. Minimal variability of the climatic characteristics, similar relief and mainly crystalline acid subsoil is presumption. The interest localities are situated at intervals altitude 450 – 620 m and pertains 3rd oak-beech and 4th beech vegetation belt (Zlatník 1976). Mostly studied localities are situated in the surrounding of Býšovec village and in the surrounding of Kunžak village. Both surveyed areas it is possible characterize as agricultural-wood landscapes with wood complex, that are forms especially derived spruce monoculture with common spruce (*Picea abies).* Agricultural soil is represented by fields, mainly poorer eutrophic meadows and pastures with small species richness. Forest fragments together with line green vegetation, balk and grass fragments forms harmonic character of these landscapes.

2.2 Selection of the localities

Minimal variability of relief, small slope, acid to neutral subsoil (gneiss, migmatite, granite), nature close deciduous and mixed stands, normal moisture regime, i. e. without waterloogged soil places, are presumptions of study of forest fragments. Next requirement was to choose the forest fragments of the various size and with round form for minimisation edge effect. Forest fragment was defined as isolated part of forest, minimally size of one vegetation survey 15 x 15 m, with tree species covering higher than 50%.

2.3 Field survey

Fieldwork included visit of the localities founded out from orthophoto maps. The list of all vascular plant species was drawn by vegetation survey, i. e. basic characteristics of environment like altitude, slope, exposition, salient rock cover, soil depth, drawn species of tree layer, shrub layer and herb layer with valuation of their cover were written in forest fragment, what answer all engaged criterion. Such a vegetation survey was done on whole forest fragment especially on area 15 x 15 m, in the middle of the forest fragment eventually on south and north part by edge too in accordance with size of the forest fragment. The individual lists were made for edge of the forest fragment too and they were complete by vegetation survey size 2 x 2 m on southern and northern part of the forest edge. Mixed sample of soil substrate to determination pH was taken from each area where the vegetation survey was done.

Fig. 1 Herb layer plant species in studied forest fragments

herb layer plant species	presence	relation to edge
Anemone nemorosa	f	
Asarum europaeum	f	
Avenella flexuosa	f	
Campanula perscifolia	f	
Carex muricata agg.	f	
Convallaria majalis	f	
Corydalis intermedia	f	
Dryopteris carthusiana	f	
Dryopteris filix-mas	f	
Galeobdolon montanum	f	
Geranium robertianum	f	
Geum urbanum	f	
Grossularia uva-crispa	f	
Hedera helix	f	
Hieracium laevigatum	f	
Hieracium lachenalii	f	
Hieracium murorum	f	
Hieracium sabaudum	f	
Chelidonium majus	f	
Impatiens parviflora	f	
Juniperus communis	f	
Luzula luzulloides	f	
Maianthemum bifolium	f	
Mercurialis perennis	f	
Moehringia trinervia	f	
Mycelis muralis	f	
Paris quadrifolia	f	
Polygonatum multiflorum	f	
Polypodium vulgare	f	
Rubus idaeus	f	
Scrophullaria nodosa	f	
Senecio ovatus	f	
Stachys sylvatica	f	
Vaccinium myrtillus	f	
Viola rechenbachiana	f	
Viola riviniana	f	
Calamagrostis epigejos	f, e	n
Fallopia convolvulus	f, e	i
Fragaria moschata	f, e	i
Fragaria vesca	f, e	i
Galeopsis pubescens	f, e	i
Poa nemoralis	f, e	n

Solidago virgaurea	f, e	i
Veronica officinalis	f, e	s
Aegopodium podagraria	e	n
Agrostis capillaris	e	i
Achillea milefolium agg.	e	s
Alchemilla sp.	e	n
Allium oleraceum	e	s
Angelica sylvestris	e	n
Anthoxanthum odoratum	e	i
Anthriscus sylvestris	e	n
Apera spica-venti	e	i
Arrhenatherum elatius	e	i
Artemisia vulgaris	e	n
Astragallus glycyphyllos	e	i
Atriplex patula	e	n
Ballota nigra	e	n
Briza media	e	s
Calluna vulgaris	e	s
Campanula rotndifolia	e	s
Capsella bursa-pastoris	e	i
Carlina aculis	e	s
Centaurea cyanus	e	i
Centaurea jacea	e	s
Cerastium arvense	e	s
Cerastium holosteoides	e	i
Cirsium arvense	e	n
Clinopodium vulgare	e	i
Convolvulus arvensis	e	i
Conyza canadensis	e	i
Cytisus nigricans	e	_
Dactylis glomerata	e	n
Dianthus carthusianorum	e	s
Dianthus deltoides	e	s
Elytrigia repens	e	i
Epilobium angustifolium	e	_
Epilobium montanum	e	_
Euphorbia esula	e	i
Euphorbia peplus	e	i
Falcaria vulgaris	e	s
Festuca rubra	e	i
Festuca rupicola	e	i
Filipendula ulmaria	e	_
Fragaria viridis	e	i
Galinsoga quadriradiata	e	i
Galium album	e	i
Galium aparine	e	n
Galium verum	e	s
Genista germanica	e	_
Genista tinctoria	e	s
Glechoma hederacea	e	n
Gnaphalium sylvaticum	e	s
Helianthemum grandiflorum	e	s
Heracleum sphondylium	e	n
Hieracium pilosella	e	s
Holcus mollis	e	i
Hylotelephium maximum	e	s
Hypericum perforatum	e	s
Chaerophyllum aromaticum	e	_
Chenopodium album agg.	e	i
Jovibarba globifera	e	_
Knautia arvensis	e	i
Lactuca serriola	e	_
Lamium album	e	n
Lapsana communis	e	n
Leontodon hispidus	e	i
Leucosynapis albus	e	_
Lichnis viscaria	e	s
Linaria vulgaris	e	s
Lotus corniculatus	e	s
Lupinus polyphyllus	e	_
Luzula campestris	e	s
Lysimachia vulgaris	e	_
Malva neglecta	e	_
Myosotis arvensis	e	n
Nardus stricta	e	_
Oentohera sp.	e	_
Origanum vulgare	e	s
Persicaria maculosa	e	_
Phleum pratense	e	n
Pimpinella saxifraga	e	s
Plantago lanceolata	e	s
Plantago major	e	i
Poa angustifolia	e	i
Poa compressa	e	s
Potentilla anserina	e	_
Potentilla argentea	e	s
Potentilla erecta	e	_
Potentilla tabernaemontanii	e	s
Ranunculus acris	e	_
Ranunculus repens	e	_
Rosa canina agg.	e	i
Rubus caesius	e	i
Rubus fruticosus	e	i
Rumex acetosella	e	s
Rumex crispus	e	n
Rumex obtusifolius	e	n
Sanguisorba officinalis	e	_
Sarothamnus scoparius	e	_
Scleranthus annuus	e	_
Secale cereale	e	_
Securigera varia	e	s
Sedum sexangulare	e	s
Silerne alba	e	n
Solanum nigrum	e	_
Stellaria graminea	e	_
Stellaria media	e	_
Stellaria nemorum	e	_
Taraxacum Sect. Ruderalia	e	n
Thlaspi arvense	e	i
Thymus pulegioides	e	s
Trifolium medium	e	_
Trifolium pratense	e	i
Trifolium repens	e	i
Triticum aestivum	e	_
Urtica dioica	e	n
Verbascum chaixii ssp. austriacum	e	s
Verbascum thapsus	e	_
Veronica chamaedrys	e	n
Vicia cracca	e	i
Vicia hirsuta	e	_
Vicia sepium	e	_
Vicia tetrasperma	e	_
Viola arvensis	e	n
Viola canina	e	_
Viola odorata	e	_

Presence: e=forest edge; f=forest. Relation to edge: n=northern edge; s=southern edge;_=under 10 records; i=indiferent presence.

3. Results

25 forest fragments was worked as a whole, 17 – 70 m diameter size (most to 25 m). Dominant forest-tree species are hornbeam (*Carpinus betulus*), beech (*Fagus sylvatica*), small-leaf linden (*Tilia cordata*), broadleaved linden (*Tilia platyphyllos*), namely, add gean (*Prunus avium*), sycamore maple (*Acer pseudoplatanus*), European ash (*Fraxinus*

excelsior), common spruce (*Picea abies*), oaks (Quercus petraea, Q. robur), common birch (*Betula pendula*) and aspen (*Populus tremula*). Dominant forest-tree species are beech, hornbean or lindens, most often within the context of the historical management. Age structure of tree layer is individual for each forest fragment or near groups of forest fragments. The oldest individuals achieve age about 200 years and they indicate long continuum of forest environment relatively, what affect migration of forest plants. Mainly hornbeam forest fragments are relict of grown out of 50 – 70 years leave sprout forests. It is probable that some forest fragments were partly disforested for point of time at the least. Persistence of the forest plant species was enabled by specific conditions of environment. Among those conditions pertain: shrubs on salient rocks and on amased stones; tree solitaire; stone line – environment with different moisture regime, biotope of nitrophytes (e.g. *Mercurialis perennis*); existence of dump biotope – place of persistance of forest plant species (e.g. *Anemone nemorosa*) near forest fragment. There were noted 167 herb layer plant species in all forest fragments. 36 species were noted inside forest, 8 species inside and in the edge of the forest fragments and mostly – 123 species – in the edge.

Vegetation and its affinity to environment factors

Environment factor like **relief variability** rises with size of forest fragment. Small quarry or stone heap e.g. rised relief heterogenity among studied mostly smaller forest fragments. Some pteridophyte ferns (*Dryopteris filix-mas* and *Polypodoium vulgare*) shown significance affinity to these elemets. **Exposition** is relatively important factor for edge vegetation especially. The diference between northern and southern part of the forest fragment is patent of most of vegetation surveys. Whereas northern side is smaller species richness in general with ruderal plants, nitrophytes (e.g. *Urtica dioica, Galium aparine, Geranium robertianum, Dactylis glomerata, Cirsium arvense, Anthriscus sylvestris*), southern side has often higher species richness with heliophilous and subxerophilous plants species (e.g. *Genista tinctoria, Festuca rupicola, Hylotelephium maximum, Lichnis viscaria, Silene vulgaris, Campanula rotundifolia, Dianthus deltoides, Briza media, Melampyrum nemorosum*). The diference of plant species composition results from diferent insolation of cardinal points. North is less arid, the nutrients are more available for plant somewhat. South has enough sun shine, it is arid, competeitive advantage of ruderals and nitrophyts is small. **Geological subsoil** and **soil granulity** are very important environment factors. The type of rock work quantity of soil nutrients and granulity of soil then ability of soil to absorb moisture. Special interest forest fragments are often situated on acid rocks. Acidity and absence of the nutrients is wiped away by eutrophication from surrounding agricultural areas. **Eutrphication** is the biggest in the edge vegetation of forest fragments, it is smaller on coarse-grained rocks and convex form of the relief due to ability of soil to become dry. **Landuse** is one of the most important factors. Agricultural eutrophication influences surrouding vegetation, edge of neighbouring vegetation types especially. Eutrophication is emphasize in the middle and lower parts of slopes because of fertiliser runoff.

4. Discussion

Many herb layer plant species are marked as ancient woodland indicators (Wulf, 1997) which ilustrate forest envirnonment continuum. Some plant species abound in another vegetation growth (line vegetation, shrub) too, those are not studied in terms of forest fragments. Another problem is small number of herb layer plant species which are perennial and they survive unfavourable conditions for a long time. Their predicative value is misrepresented.

5. Conclusions

Vegetation is always reflection of the environment conditions. Although physiography conditions are constant, the changes of vegetation due to another important factors like capacity of nutrients in

environment or disturbance of vegetation may happen. Human activities often exceed abiotic environment influence. Study of vegetation in small forest fragments may imply the answers to the questions about population plant ecology, dispersal ability and biotope conservation in terms of small-area reservations.

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