Historical landscape exploitation and its influence on a composition of herb layer in cultural forests in consider of ecotones

Petr Halas, Veronika Vlková

Abstract

Generic composition of herb layer of forests can reflect changes of ecological conditions. These conditions have been modified by the instrumentality of human being – forest management and agriculture already several centuries. Cultural forests reflect complicated history of incidence of human being throughout the country.

Key words: ecotons, herb layer, forest plant species, cultural landscape

Introduction

The landscape character around us is primary conditioned by natural conditions, especially on relief and vegetation. Mesoclimatic and soil conditions than determine the type of vegetation occuring in the ecotones. The aera of the Czech republic belongs to the Central European deciduous broad-leaved forest province, only a small part is a part of the Pannonia province (Udvardy 1975). Excluding the human interaction, the potential (natural) vegetation cover would envisage mostly the forest communities.

Forests started to grow with the regression of glacial period at the beginning of Holocene, and the composition of forest ecosystems was respond to climatic variations and the rate of forest tree species dispersal. We have not been able to define, when was the first human impact on the forest development up to the present. Some studies (Kasper 2003) reveal, that the forest growth was already intensively used as a wood resource in period 5000 – 7000 BP. Neolithic man, who was changing the forest soil to the agricultural soil, was the first most disturbing element to the predominant continuity of forest cover. However the original forest land was changed, the natural and near natural growths was preserved, outside of the old resident areas. The medieval colonisation probably formed landscape character of the wide areas (even in higher altitudes) to landscape similar present state. May traditional farming methods, for example grubbing, stumping, selective logging to of small parts and especially forest grazing, affected significantly species composition of the wood layer and also the herb layer, in contemporary cultivated forests. The traditional farming gave and advantage to some of heliophil plant species, typical for meadows and pastures, and on the other hand, some original species disappeared from underwood. The forest boundaries including both species of forests and meadows and also specific species of the forest mantle may constitute another example.

Traditional farming, when different phases were diversified on small areas, used mostly original tree species. And those farming methods did not allow existence of the occurence of the nature close species whit low regenerative capacity. For example, *Fagus sylvatica* (with lower rejuvenation capacity) was inhibited to prefer *Quercus sp*. in the beechoak and oakbeech vegetation belt (Zlatník 1976). *Picea abies* later on replaced the use of original wood species corresponding to the conditions at site in the wide forest areas. The spruce is a tree species, which is common as an addition from the 4th beech vegetation belt, the higher ratio is in the 6th sprucefirbeech belt and the spruce has dominant representation in the 7th spruce vegetation belt. The spruce, because of its fast-growing, has been artificially planted in all kinds of forests (also in low vegetation belts) and even in the site of its natural occurrence spruce has substantially increased during the 19th century. Large areas of former natural forests were converted to spruce plantations, which have supported changes of chemical soil character (by acid conifer fall) and also herb layer impoverishment. Both factors are the causes of impoverishment of herb layer also in the low vegetation belts, especially rare heliophil plants, which occurrence depends on traditional manners of farming, are threatened.

Metodology and outline of findings

Special attention was paid to forest mantles during the study of culture forests and ecotones. Ecotone represents transition zone, in which some species of one community decrease and the others from another community increase (Clements 1904). Development of ecotones is given by changes of climatic conditions determining the width of ecotones. Soil conditions (e.g. interface limestone – granite) and anthropogenic influence similar (e.g. interface field – forest) enable existence of clearly delineated narrow ecotones. On the other hand, climatic changes invoke wider and more extensive zones.

Forest mantles are created clearly or they are missing completely ant the possible explanation is not always unambiguous. The expositions of the forest fringe vegetation certainly play a big role. Ruderal species are probably not so competitive on the arid southwards exposed ecotones and subxerothermophytes and heliophytes can be present here. Relatively narrow border is created between associations with narrow – convergent transition zone (limes converges) (Leeuwen 1965). On the contrary, forest fringe vegetation orientated to the north are significant for dominant representation of ruderal species or low representation of heliophytes and subxerophytes than forest fringe vegetation of the opposite exposition. Transition of grazing forest – pasture may be the another example. This transition zone has not developed, change of plant species is slow and the margin between associations is relatively wide – divergent (limes divergens) (Leeuwen 1965). Another features are age of forest complex and specific constitution and structure of forest cover. Biodiversity of herbal undergrowth and possible ecotons community is also proportionately low in case of young wood complex without wood cover continuum. Species constitution and structure of wood layer is one of the most important factor of biodiversity of biodiversity of herbal undergrowth in the cultural forest, also forest mantle. It is a common forest management in the Czech Republic to artificially plant *Picea abies* from the 3rd vegetation belt, in conditions not natural to occurrence of spruce or, in case of higher vegetation belts, in conditions where the spruce would have low distribution. A decrease of species in spruce monoculture is given by even-aged stand and changes of chemistry owing to acid defoliate. A biodiversity of undergrowth in nature near overgrowth may be 4 times greater than in spruce monoculture, for example: phytocoenological recording in terms of STG 5B3 *Abieti-fageta typica* in Bohemian Forest mountains. It's difficult to differentiate natural and anthropogenic impacts in ecotons.

In terms of study of cultivated forests we used the biogeocoenological standardization of vegetation (Zlatník 1976, Buček 1999), which allows extended knowledge of natural condition of vegetative cover. Biogeocoenological standardization differentiates potential vegetation cover according to climatic conditions in vegetation belt and according to soil conditions (soil reaction, soil moisture regime, mineral composition) in trophic series and inter-series and hydric series. In the Czech republic was distinquished 9 vegetation belts: 1st oak, 2nd beechoak, 3rd oakbeech, 4th beech, 5th firbeech, 6th sprucefirbeech, 7th spruce, 8th scrube and 9th alpine vegetation belt. Soil conditions define trophic series: A – oligotrophic (low-productive and acid), B – mezotrophic (medium-prolific), C – nitrophic (abundant in nitrogen), D – basic (calcicphil) and inter-series: AB, BC, BD and CD. Soil conditions define trophic series: A – oligotrophic (low-productive and acid), B – mezotrophic (medium-prolific), C – nitrophic (abundant in nitrogen), D – basic (calcicphil) and inter-series: AB, BC, BD and CD. With soil moisture regime are classified hydric series: 1 – low-growing (draught), 2 – limited, 3 – normal, 4 – waterlogged, 5 – wet (2 varieties), 5a – with flow water, 5b – with stagnation water and 6 – moor. The particular vegetation belt, trophic and hydric series (inter-series) constitute the frame of ecological conditions, which assess the particular natural (potential) community. This is the basic unit of the biogeocoenological standartization; describe the unity of abiotic environment and living nature, also natural and substitute (made or changed by human activities) communities; which is expertly called group of types of biogeocen. These groups are determinated with biogecenological formula, in which there are numbers of vegetation belts in the first position, the second are letters of trophic series (inter-series) and the third numbers of hydric series.

As it's said here, tendencies of implementation non-original species has extended to the natural species composition of forests and the herbal undergrowth has been significantly changed. It's especailly caused wit cultivation of *Picea abies*, less *Larix decidua* and the other non-original conifers; in the lower altitudes *Robinia pseudacacia*, which has origin in the North-America, has been planted.

In the frame of the 1st oak vegetation belt we researched these groups of types of biogeocoen: 1B3 *Querceta typica*, 1BD3 *Ligustri-querceta*, 1D 2-3 *Corni-querceta petraeae-pubescentis inferiora*. Typical wood plants here are *Quercus petraea agg.*; an addition is represented with *Carpinus betulus, Tilia cordata, Sorbus torminalis, Acer campestre, Euonymus verrucosa, Prunus fruticosa, Rosa galica, Viburnum lantana* and others. Exacting thermophilic series assert in the undergrowth, e.g. *Poa nemoralis, Melica uniflora, Chamaecytisus austriacus, Serratula tinctoria, Carex humilis, C. montana,*

Lathyrus niger, Verbascum phoeniceum, Trifolium alpestre, Betonica officinalis, Tanacetum corymbosum, Polygonatum odoratum, Vincetoxicum hirundinaria, Convallaria majalis, Genista germanica, Bupleurum falcatum, Euphorbia polychroma; in the abundant substrates there are especially *Viola mirabilis, Viola hirta Iris graminea, Melittis melissophyllum, Teucrium chamaedrys, Anthericum ramosum*, rare *Echium maculatum, Trigonella monspeliaca*. In ecotones there are represented *Dictamnus albus, Lithospermum purpurocaeruleum, Vincetoxicum hirundinaria, Melittis melissophyllum, Clematis recta, Teucrium chamaedrys* and others.

Quercus petraea agg. is dominant in the 2nd beechoak vegetation belt, as an addition there is *Fagus sylvatica, Carpinus betulus, Acer platanoides, Ulmus minor, Sorbus torminalis,* and *Pinus sylvestris* on a dry soil. In groups of types of biogeocoen In the undergrowth of 2B3 *Fagi-querceta typica* and 2AB3 *Fagi-querceta*, which were researched, there are developed thermophyllic series - *Lathyrus niger, , Campanula persicifolia, Cytisus nigricans, Melittis melissophyllum, Vicia cassubica, Hieracium bauhinii, Carex montana, C. michelii, Poa nemoralis, P. angustifolia* and others; *Luzula luzuloides, Galium odoratum, Mercurialis perennis, Polygonatum multiflorum* and *Peucedanum cervaria* go down from the higher altitudes. In ecotones of forest mantles there are asserted the similar species as we can found in th 1st vegetation belt. The influence of eutrophication is quite high, sometimes, especially in case of shady marginal forest, and there are dominant species - *Urtica dioica, Arrhenatherum elatius, Artemisia vulgaris, Galium aparine* and others. *Robinia pseudacacia*, which is common articifially planted here, produces substances inhibiting seed germination capacity and the growing of some plants and it cause the soil eutrophication. The herbal undergrowth is changed and impoverished significantly to prefer eutrophil and nitrophil species.

The last significant occurence of *Quercus petraea agg*. is in the 3rd oakbeech vegetation belt, but *Fagus sylvatica* is here as a dominant. Forest management (preference *Quercus petraea agg*. to *Fagus sylvatica*) has been enabled predominance of the heliophil oak and currently other heliophil species in the herbal undergrowth. From the other wood plants there are *Carpinus betulus* as an addition in th 3rd vegetation belt and *Fraxinus excelsior, Acer pseudoplatanus, Tilia platyhpyllos, Ulmus glabra,* according to site conditions. In herbal undergrowth of the exploring groups of types of biogeocoen 3AB3 *Querci-fageta*, 3B3 *Querci-fageta typica* and 3BD3 *Querci-fageta tiliae* there are dominat species of the Central European deciduous broad-leaved forest - *Galium odoratum, Dentaria bulbifera, Stellaria holostea, Actaea spicata, Mercurialis perennis, Galium sylvaticum, G. schultesii, Melica uniflora, Mycelis muralis, Hepatica nobilis; Lathyrus niger* and *Lithospermum purpurocaeruleum* intervene from the lower altitudes. In ecotones of forest mantles there are with the highest occurence thermophilic shrubs - *Prunus fruticosa, Prunus mahaleb, Cornus mas, Euonymus verrucosa, Ligustrum vulgare, Rosa galica* and *Viburnum lantana*. E.g. *Centaurea scabiosa, C. jacea, Vincetoxicum hirundinaria, Rumex acetosella* represent species of forest mantles (on the south edges).

From next vegetation belts we researched the 4th beech and the 5th firbeech vegetation belts. In the 4th vegetation belt there is natural dominant *Fagus sylvatica*, as an addition there are *Quercus petraea, Acer pseudplatanus, A. platanoides, Fraxinus excelsior, Abies alba, Ulmus glabra* and others. In the undergrowth there are asserted *Maianthemum bifolium, Galeobdolon montanum, Milium effusum, Actaea spicata, Gymnocarpium dryopteris, Mercurialis perennis, Luzula luzuloides, Vaccinium myrtillus, Dentaria bulbifera, Lunaria rediviva, Prenanthes purpurea* and *Polygonatum verticillatum*. Species composition has been impoverished in dependence on the opening of non-original spruce plantations or it's been changed with an addition of original wood plants and other plants, which are able to migrate from the near natural growth. In ecotones of the exploring groups of types of biogeocoen 4AB3 *Fageta abietino-quercina* and 4B3 *Fageta typica* there are (often on the sunny edges) *Thymus pulegioides, Avenella flexuosa, Steris viscaria, Rumex acetosella, Centaurea jacea, Galium album, Genista tinctoria, Plantago lanceolata, Anthoxanthum odoratum, Caluna vulgaris, Potentilla erecta* and others, the most abundant shrub is *Frangula alnus*.

In the 5th firbeech vegetation belt there are dominant wood plants *Fagus sylvatica* and *Abies alba*, an addition is made with *Picea abies*. According to site conditions there are occured *Acer pseudoplatanus, Sorbus aucuparia, Fraxinus excelsior* or *Tilia platyhpyllos*. Most of forests has been changed to spruce plantations in this vegetation belt. In natural or close by natural forests there are *Rubus hirtus, Festuca altissima, Impatiens noli-tangere, Lysimachia nemorum, Prenanthes purpurea, Polygonatum verticillatum, Lunaria rediviva, Calamagrostis villosa* and others in the undergrowth. We can consider transits between spruce monocultures and natural forest communities as ecotones, where an amount of species in the herbal undergrowth rises up from the spruce monoculture to the natural growth.

Conclusions

Species composition of herbal undergrowth of culture forests was probably changed in the other ways, than today. At the present especially planting of spruce plantations, with the eutrophication and the decrease of traditional farming, contribute to low species diversity. Typical traditional farming for the low altitudes (the 1st – 3rd vegetation belt) was the stumping (together with forest grazing), which ensured intermittently open stand of forests and also heliophil herbal plants. The decrease of the traditional farming today cause screening of the wood layer and heliophobic *Carpinus betulus* can increase. The articiffialy planting of *Robinia pseudacacia* play i big role, it cause the eutrophication and the competive removal of species of the natural growth. Nevertheless, cultivate oakwoods preserve in some segments up to the present with guite high biodiversity. The substitution of original forest growth with spruce monocultures meant a large reduction of species of origainal beech and firbeech forests (e.g. *Actaea spicata, Dentaria bulbifera, Festuca altissima*) and an expansion of species typical for spruce forests. In consequence of the substituion wide forest areas to agriculture soil forest species (sciophyts) decreased and heliophyl species increased unusualy.

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Mgr. Petr Halas, Institute of Geonics, Czech Academy of Sciences, Brno Branch, address: Drobného 28, 602 00 Brno, Czech Republic, email halas@geonika.cz

Mgr. Veronika Vlková, Masaryk University - Faculty of Science, Geographical Department, Kotlářská 2, 611 37 Brno, email verca.vlk@seznam.cz