ECOLOGICAL ANALYSIS OF THE OAK FORESTS ON THE MORAVA RIVER TERRACE

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Abstract

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The contribution is focused upon detail production-ecological analysis of the herb layer biomass in three oak forests types (the association *Carici fritschii-Quercetum roboris*) – type with *Molinia caerulea* agg., secondary forest with *Pinus sylvestris* and xerophilous type. Obtained results (Table 2) are compared and discussed.

Key words: herb layer biomass, production ecology, oak forest

Introduction

The aim of this paper is to offer the basic information on the ecology and herb layer biomass of several oak forests located on the Morava river terrace. These forests were the best preserved on the contact with the Morava river alluvium on the triangle Kúty–Gbely–Kopčany with a relatively higher groundwater level. Oaks (*Quercus robur*, rarely *Quercus petraea*) in various share are dominating in tree composition with a mixture of hornbeam (*Carpinus betulus)* and also planted pine (*Pinus sylvestris)*. Present stands in the region of the villages Kúty, Gbely and Kopčany have their original tree composition on numerous localities, elsewhere again prevails pine with a mixture of oak, birch and on other localities mixture of these three species with other broad-leaved trees – hornbeam, maple *(Acer campestre),* lime tree *(Tilia cordata)* and others. These forests represent the most productive types of forests on the Borská nížina lowland, where an economical interest of forest manager is concentrated to a higher representation of pine and somewhere also oaks.

The observed stands occupy the terraces of the Morava river so the substrate consists of sandy gravel sediments. The relief is flat or moderately undulated. The groundwater level is in the depth of 1–2 m. Soils are acidic and affected by groundwater – there were recorded Enti-Gleyic Podzol and Areni-Gleyic Umbrisol occurring along the relief gradient.

Methods

Phytocoenological relevés in the field and classification of the forest communities (Table 1) were done according to the method of the Zurich-Montpellier school, the names of plants are according to Dostál, Červenka (1991, 1992). Soil conditions were characterized on the base of selected profiles. Estimation of the herb layer of the aboveground biomass was made on selected sample plots applying the method of indirect sampling (Kubíček, Brechtl, 1970) modified for non-recurrent sampling (Kubíček, Jurko, 1975; Kubíček, Šimonovič, 1975; Kubíček, Šomšák, 1982).

Syntaxonomical remark and floristic character

Classification of the observed vegetation is different – some authors consider it as a part of widely understood *Potentillo albae-Quercetum* association L i b b e r t 1933 or *Potentillo albae-Quercion* alliance (Michalko et al. 1986; Michalko, 1991; Šomšák, Kubíček, 2000) while other authors distinguish it as a special association *Carici fritschii-Quercetum roboris* C h y t r ý et H o r á k 1997 (Roleček, 2004, 2005). As the latter gave detail syntaxonomical explanation based on wide synthesis we accept the concept of *Carici fritschii-Quercetum roboris* association for the paper purposes.

As for floristic characteristic the tree layer is formed by monodominant *Quercus robur*, frequently replaced by planted *Pinus sylvestris*. The shrub layer is developed weakly – it is made of scattered individuals of *Frangula alnus, Ligustrum vulgare, Crataegus monogyna, Rosa* sp., etc. The herb layer is rich in species and mainly consists of the species of intermittently wet soils (*Molinia caerulea* agg., *Serratula tinctoria, Potentilla alba, Betonica officinalis)*, mesophilous species (*Dactylis polygama, Convallaria majalis, Brachypodium sylvaticum, Polygonatum odoratum)*, heliophilous species (*Arrhenatherum elatius, Poa angustifolia, Veronica chamaedrys, Clinopodium vulgare),* acidophytes (*Luzula divulgata, Melampyrum pratense)* and some others. For the whole association, the occurrence of relict *Carex fritschii* is characteristic. Complying with Roleček (2004, 2005), there can be distinguished the type with dominant *Molinia caerulea* agg. occupying the moistest sites and resembling the association *Molinio arundinaceae-Quercetum* S a m e k 1962 and xerophilous type being transition to psamo- and acidophilous oak forests (*Festuco ovinae-Quercetum roboris* Š m a r d a 1961 association). However, contrary to Roleček (2004), we did not record *Carex fritschii* here and generally there are distinct floristic differences in comparing with more hygrophilous type with *Molinia caerulea* agg. Differences are vividly expressed also by edaphic conditions – hygrophilous type occupies Areni-Gleyic Umbrisol, while xerophilous one Enti-Gleyic Podzol. But as classification is not the subject of the paper we follow the idea of one community.

Results and discussion

The basic results of the production – ecological measurements obtained of three studied sample plots within the range of the association *Carici fritschii-Quercetum* (1 – hygrophilous type with *Molinia caerulea* agg., 2 – secondary pine-oak forest, 3 – xerophilous type with *Dactylis polygama*) are summarized in Table 2. It contains the following information: type of forest community, above-belowground-total herb layer biomass in kg.ha^{-1} and ratio aboveground/belowground (A/B) biomass.

These oak forests are typical by a high cover of relatively wide scale of plants. For the type with *Molinia caerulea* agg., as far as 11 species act as the dominant in biomass, in secondary forest with *Molinia caerulea* agg. (in the tree layer prevails *Pinus sylvestris)* 8 species and in *Dactylis polygama type* 7 species.

T a b l e 1. Phytocoenological table of sampled vegetation.

Relevé	1	2	3
Date	2.6.2004	2.6.2004	29.6.2004
E3	70	75	70
E2	5	1	5
E1	95	95	95
Area	400	400	400
Number of species	59	35	33
Tree layer			
Quercus robur	4	4	1
Pinus sylvestris	.	.	3
Shrubs			
Frangula alnus	1	.	1
Crataegus monogyna	.	+	+
Rosa canina agg.	+	.	.
Herb layer			
Melampyrum pratense	1	+	+
Dactylis polygama	+	3	+
Quercus robur	+	+	+
Rubus fruticosus agg.	+	+	+
Arrhenatherum elatius	+	+	+
Festuca ovina	+	+	+
Mycelis muralis	+	+	+
Convallaria majalis	3	.	3
Potentilla alba	2	.	+
Brachypodium sylvaticum	1	1	.
Poa compressa	1	+	.
Lysimachia vulgaris	1	.	+
Campanula patula	+	+	.
Veronica chamaedrys	+	+	.
Hieracium murorum	+	+	.
Crataegus monogyna	+	+	.
Luzula divulgata	+	+	.
Tithymalus cyparissias	+	+	.
Clinopodium vulgare	+	+	.
Urtica dioica	+	+	.
Festuca rubra agg.	+	+	.
Hypericum perforatum	+	+	.
Veronica officinalis	+	+	.
Molinia caerulea agg.	2	.	5
Deschampsia cespitosa	.	+	+
Frangula alnus	.	+	+
Carex hirta	.	+	+
Chamaecytisus supinus	+	.	+
Sanguisorba officinalis	+	.	+
Potentilla erecta	+	.	+
Carex fritschii	+	.	+
Fraxinus excelsior	+	.	+
Anthoxanthum odoratum	+	.	+
Polygonatum odoratum	+	.	+

T a b l e 1. (Continued)

Carex pallescens	+	.	+
Vincetoxicum hirundinaria	+	.	+
Ligustrum vulgare	+	.	+
Impatiens parviflora	+	.	+
Solidago virgaurea	+	.	r
Hieracium umbellatum	+	.	r
Viola canina	r	+	.
Serratula tinctoria	r	.	+
Silene nutans	1	.	.
Vicia sepium	+	.	.
Trifolium alpestre	+	.	.
Selinum carvifolia	+	.	.
Valeriana wallrothii	+	.	.
Genista tinctoria	+	.	.
Galeopsis speciosa	+	.	.
Clematis recta	+	.	.
Sieglingia decumbens	+	.	.
Geranium sanguineum	+	.	.
Steris viscaria	+	.	.
Eupatorium cannabinum	+	.	.
Ornithogalum kochii	+	.	.
Betonica officinalis	+	.	.
Acetosa pratensis	+	.	.
Pimpinella saxifraga	+	.	.
Agrostis capillaris	+	.	.
Peucedanum oreoselinum	+	.	.
Hylotelephium maximum	r	.	.
Campanula trachelium	r	.	.
Scrophularia nodosa	.	+	.
Torilis japonica	.	+	.
Tilia cordata	.	+	.
Poa nemoralis	.	+	.
Brachypodium pinnatum	.	+	.
Solidago canadensis	.	+	.
Lotus corniculatus	.	+	.
Glechoma hederacea agg.	.	+	.
Moehringia trinervia	.	+	.
Poa angustifolia	.	+	.
Viburnum opulus	.	r	.
Melampyrum cristatum	.	r	.
Rubus caesius	.	.	+
Rosa canina agg.	.	.	+
Poa trivialis	.	.	+
Holcus lanatus	.	.	+
Bistorta major	.	.	r

Notes: 1 – *Carici fritschii-Quercetum* type with *Molinia caerulea* agg., 2 – *Carici fritschii-Quercetum* – xerophilous type, 3 – *Carici fritschii-Quercetum* – secondary forest with *Pinus sylvestris*
E1 – herb layer, E2 – shrubs, E3 – tree layer

All relevés were sampled in the forest complex located on the left side of the road Adamov – Kopčany.

T a b l e 2. Herb layer biomass of three observed sample plots.

Community	*Carici fritschii-Quercetum* *Molinia caerulea* type				*Carici fritschii-Quercetum* – secondary forest with *Pinus sylvestris*				*Carici fritschii-Quercetum* – xerophilous type			
Species	Biomass kg.ha^{-1} (dry weight)				Biomass kg.ha^{-1} (dry weight)				Biomass kg.ha^{-1} (dry weight)			
	A	B	C	A/B	A	B	C	A/B	A	B	C	A/B
Dominants												
Molina caerulea agg.	9	30	39	0.29	33	188	221	0.17	-	-	-	-
Carex fritschii	6	11	17	0.34	8	39	47	0.18	-	-	-	-
Frangula alnus	26	13	39	2.02	17	14	31	1.20	13	2	15	5.5
Convallaria majalis	7	14	21	0.50	5	18	23	0.29	-	-	-	-
Potentilla alba	4	9	13	0.44	2	10	12	0.21	-	-	-	-
Crataegus monogyna	33	30	63	1.10	-	-	-	-	-	-	-	-
Fraxinus excelsior	11	28	39	0.38	-	-	-	-	-	-	-	-
Geranium sanguineum	8	18	26	0.42	-	-	-	-	-	-	-	-
Potentilla erecta	5	13	18	0.36	3	10	13	0.36	-	-	-	-
Rubus fruticosus agg.	-	-	-	-	9	31	40	0.31	33	33	66	1.00
Carex hirta	-	-	-	-	14	14	28	1.00	4	5	9	0.80
Anthoxantum odoratum	-	-	-	-	-	-	-	-	12	9	21	1.25
Dactylis polygama	9	5	14	1.72	-	-	-	-	9	5	14	1.72
Brachypodium sylvaticum	3	1	4	3.00	-	-	-	-	4	7	11	0.54
Agrostis capillaris	-	-	-	-	-	-	-	-	4	6	10	0.60
Geum urbanum	-	-	-	-	-	-	-	-	12	5	17	2.56
Others												
Fragaria vesca	5	3	8	1.57	-	-	-	-	-	-	-	-
Selinum carvifolia	15	4	19	3.79	-	-	-	-	-	-	-	-
Polygonatum odoratum	2	5	7	0.36	3	6	9	0.50	-	-	-	-
Clinopodium vulgare	3	1	4	3.00	-	-	-	-	-	-	-	-
Scrophularia nodosa	1	2	3	0.50	-	-	-	-	-	-	-	-
Quercus robur	3	12	15	0.27	-	-	-	-	2	4	6	0.50
Poa nemoralis	3	2	5	1.50	-	-	-	-	-	-	-	-
Melampyrum pratense	5	1	6	5.00	-	-	-	-	-	-	-	-
Carex pallescens	2	2	4	1.00	-	-	-	-	-	-	-	-
Lysimachia vulgaris	8	8	16	1.00	3	3	6	1.00	-	-	-	-
Festuca rubra agg.	2	1	3	2.00	-	-	-	-	-	-	-	-
Impatiens parviflora	-	-	-	-	2	2	4	1.00	-	-	-	-
Mycelis muralis	-	-	-	-	-	-	-	-	7	3	10	2.44
Viola reichenbachiana	-	-	-	-	-	-	-	-	1	3	4	0.33
Moehringia trinervia	-	-	-	-	-	-	-	-	4	1	5	4.00
Glechoma hederacea	-	-	-	-	-	-	-	-	2	1	3	2.00
Total	170	213	383	0.79	99	335	434	0.29	107	84	191	1.27

The basic dominants in 1 and 2 type is *Molinia caerulea* agg., the total biomass values are ranged from 39 (1) up to 221 (2) kg.ha^{-1}. From other dominant species, the following ones have relatively high biomass at both types: *Crataegus monogyna, Frangula alnus, Convallaria majalis, Carex fritschii, Potentilla alba* and others, total biomass value are between 12–47 kg .ha^{-1}. An interesting fact is, that in both hygrophilous sample plots, belowground biomass prevailed aboveground one, especially in type 2. Regarding that the highest total biomass we estimated in the second type (434 kg.ha^{-1}) followed by typical *Molinia caerulea* agg. type (383 kg.ha^{-1}).

A little different result we obtained in the third xerophilous type. Grasses prevail in floristic structure and it is reflected also on biomass values, which are essentially less than in previous types – they are between 10–66 kg. ha^{-1} and the total biomass value is about 200 kg.ha^{-1}. But the difference is in the ratio of aboveground/belowground biomass. Meanwhile previous types yield higher mean belowground biomass values (1–0.79, 2–0.29), in the third xerophilous type it is opposite – the higher mean biomass values are in the aboveground part.

The total aboveground herb layer biomass of these oak forests is comparable with our previous results from similar communities of the Borská nížina lowland (Šomšák, Kubíček, 1995, oak-lime tree forests, 361 kg.ha^{-1}; Šomšák, Kubíček, 2000, *Frangulo alni-Quercetum robori-petraea, Convallario-Quercetum,* 310–870 kg.ha $^{-1}$), the Malé Karpaty Mts (Kubíček, Jurko, 1975, oak-hornbeam resp. mixed oak forests 403–768 kg.ha^{-1}), the Silická planina plateau (Jurko, Kubíček, 1979, oak resp. mixed oak forests, 201–909 kg.ha^{-1}), the Báb forest (Kubíček, 1983, oak-hornbeam forest and mixed oak forest, 403–768 kg.ha^{-1}). Some differences in biomass values depend on the different floristic structure of the compared communities.

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