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# PRODUCTION ECOLOGY OF SOME RARE FOREST COMMUNITIES ON THE BORSKÁ NÍŽINA LOWLAND

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Abstract

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The aim of this contribution is a more detailed information on the herb layer biomass (aboveground, belowground, total) of two rare plant communities – birch-oak and birch alder forests. Results were obtained from the Borská nížina lowland blown, silicate sands.

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

## Introduction

The Borská nížina lowland is prevailingly a flat part of Slovakia with an expressive natural phenomenon – the eolic sands. They are prevailing geological substrate of the lowland and although its areal distribution in Slovakia represents only a small part (1.2%) from the total area, its ecological landscape-ecological and botanical significance is essentially higher. Regarding to specifity of substrate, climate and in last but not in the least also long-date influence of man, separate forest communities were developed on the blown sands of the Borská nížina lowland – as original ones within the frame of the lowest oak vegetation degree, as secondary ones represented by pine monocultures (in more detail see Šomšák, Kubíček, 1994, 1995, 2000; Kubíček, 2003).

The aim of this paper is the basic information on the ecology and herb layer biomass of two rare forest communities developed on blown sands of the lowland – birch-oak forests occurred in small depressions and on flat terrains and original peaty birch-alder forests located in deep inter-dune depressions.

## Methods

The estimation of the herb layer biomass was made on selected sample areas according to the principle of an indirect sampling method (Kubíček, Brechtl, 1970) modified for non-reccurent sampling (Kubíček, Jurko, 1975). More details on the applied method may also be found elsewhere (Kubíček, Šimonovič, 1991; Kubíček, Šomšák, 1982). Phytocoenological relevés in field and classification of communities were done according to method of the Zürich-Montpellier School, the names of plants are according to Dostál, Červenka (1991, 1992).

## Characteristics of studied forest communities

The extent of present birch-oak forests is about 10% and birch-alder forests only up to 5% of the whole forested area on the Borská nížina lowland (Kubíček, 2003). Some more details of studied communities are as follows:

**1. Birch–oak forests** (association *Molinio arundinaceae-Quercetum* Samek 1962, *Betuleto-Quercetum* according to Zlatník forest typological school (1959)

These forests are mosaically occurred on the whole territory of the Borská nížina lowland on smaller areas, its widening is influenced by the groundwater level and higher acidity of environment. They cover places in vicinity of brooks, on deeper shapes and on shallower depressions. As typical soils, especially acid and poor Haplic-Gleyic Chernozems, eventually Gleysols and Histosols are to be mentioned. Černáková (2001) observed for Haplic-Gleyic Chernozems, being localized close to sample plots, pH(H2O) 3.9 and pH(KCL) 2.8.

Oak (*Quercus robur)* had a high representation in original stands with a mixture of birch (*Betula pendula, B. pubescens)* on more wetted places and pine (*Pinus sylvestris)*. Generally, the shrub layer is negligible, only some individuals of *Frangula alnus* or *Sorbus aucuparia* are scattered here. The herb layer is developed distinctly. It consists of two well-covered levels. The higher one is formed by predominant *Molinia caerulea* agg., while the lower one is typical by various species of acid forests (e.g. *Luzula pilosa, Vaccinium myrtillus, V. vitis-idaea, Calamagrostis arundinacea).* According to mosses, some species of genus *Sphagnum (S. palustre)* as well as *Polytrichum (P. formosum, P. communae)* are to be found, especially in the stands being close to alder forests. Birch-oak forests are a part of managed forests with an average wood production.

The sample plot is characterized by following relevé:

7. 8. 2003, by road from Borský Mikuláš village to the military area Záhorie, larger depression, E3 70%, E2 0% E1 90%, E0 20%, height of the tree layer 25 m, number of species 24, partially man-affected stand (planted pine and spruce).

E3: *Pinus sylvestris* 2, *Quercus robur* 2, *Betula pendula* +, *Picea abies* +

E1: *Molinia caerulea* agg. 5, *Calamagrostis arundinacea* 1, *Carex acutuformis* 1, *Lysimachia vulgaris* 1, *Pteridium aquilinium* 1, *Athyrium filix-femina* +, *Betula pendula* +, *Dryopteris carthusiana* +, *Frangula alnus* +, *Luzula pilosa* +, *Lycopus europaeus* +, *Picea abies* +, *Pinus sylvestris* +, *Poa palustris* +, *Rubus fruticosus* agg. +, *Tithymalus villosus* r, *Galium palustre* r

E0: *Polytrichum formosum* 2, *Hypnum cupressiforme* 1, *Leucobryum glaucum* 1, *Pleurozium schreberi* +

**2. Birch–alder forests** (association *Carici elongatae-Alnetum glutinosae* (W. K o c h 1926) R. T x . et B o d e u x 1955, *Betuleto-Alnetum* according to Zlatník forest typological school (1959)

The characteristic mark for this forest group is its occurrence in terrain depressions and deeper inter-dune depressions, where is accumulated water and its discharge is only gradual. The groundwater level varies in the depth between 20–50 cm. Humification is very unfavorable, it is created a quite thick layer of peaty humus with a big content of organic material. Therefore various Gleysols, Histosols and Haplic-Gleyic Chernozems belong to the typical soils of these forests, pH is in the range 4.6–6.25 (Šomšák, 2000).

The occurrence of these forests on the Borská nížina lowland is only very sporadic (e.g. in vicinity of the village Šajdíkove Humence, Šaštín, Lakšárska Nová Ves, even elsewhere), they represent the rest of original peaty birch-alder and alder forests. These forests have preserved also at present an original feature with prevailing alder (*Alnus glutinosa)* under other tree species in the tree layer – oak (*Quercus robur)* and birch *(Betula pendula, B. pubescens)*, only somewhere is share of birch or pine (*Pinus sylvestris)* higher, oak (*Quercus petraea)* and aspen *(Populus tremula)* are somewhere occurred. The shrub layer is mostly formed by species as *Frangula alnus, Sorbus aucuparia* and *Padus avium.*

The herb layer consists of hygro- and hydrophilous species as *Galium palustre, Iris pseudacorus, Solanum dulcamara, Circaea lutetiana, Myosotis palustris* agg., *Symphytum officinale, Scutellaria galericulata, Carex riparia, C. gracilis, C. pseudocyperus, C. acutiformis, C. elongata, C. elata, Phellandrium aquaticum, Hottonia palustris* etc. On the other hand, higher sites (drier conditions) are occupied by various nitro- and mesophilous species as ferns (*Athyrium filix-femina, Dryopteris filix-mas, D. carthusiana),* or grasses and herbs as *Brachypodium sylvaticum, Ajuga reptans, Glechoma hederacea, Geum urbanum, Urtica dioica* and others. The moss layer is developed variously. In more moisten stands they are limited to the tree bases or fallen timber. However, in successionally advanced stands, mosses (especially *Brachythecium rutabulum, Polytrichum formosum, Plagiomnium rostratum, Calliergonella cuspidata, Sphagnum* sp.*)* can be quite abundant.

The sampled plot is characterized by relévе as follows:

7. 8. 2003, along creek southwest of the Šajdíkové Humence village, E3 85%, E2 5%, E1 100%, height of the tree layer 20 m, number of species 47.

E3: *Alnus glutinosa* 5,

E2: *Frangula alnus* 1*, Alnus glutinosa* +*,*

E1: *Carex acutiformis* 2*, Carex remota* 2*, Carex riparia* 2*, Geranium robertianum* 2*, Glechoma hederacea agg.* 2*, Oxalis acetosella* 2*, Scutellaria galericulata* 2*, Stachys sylvatica* 2*, Athyrium filix-femina* 1*, Carex appropinquata* 1*, Carex elongata* 1*, Dryopteris carthusiana* 1*, Equisetum arvense* 1*, Frangula alnus* 1*, Holcus lanatus* 1*, Impatiens nolitangere* 1*, Iris pseudacorus* 1*, Juncus effusus* 1*, Lysimachia nummularia* 1*, Lysimachia vulgaris* 1*, Myosoton aquaticum* 1*, Poa palustris* 1*, Scirpus sylvaticus* 1*, Solanum dulcamara* 1*, Urtica dioica* 1*, Calystegia sepium* +*, Cardamine amara* +*, Carex brizoides* +*, Circaea*

T a b l e 1. Herb layer biomass of two studied communities.

| | Birch–oak forest | | | | Birch–alder forest | | | |
|---|---|---|---|---|---|---|---|---|
| Species | Biomass (kg.ha$^{-1}$) | | | | Biomass (kg.ha$^{-1}$) | | | |
| | Aboveground (A) | Belowground (B) | Total (C) | Ratio A/B | Aboveground (A) | Belowground (B) | Total (C) | Ratio A/B |
| **Dominant species** | | | | | | | | |
| *Molinia caerulea agg.* | 2339 | 7695 | 10034 | 0.3 | – | – | – | – |
| *Pteridium aquilinum* | 237 | 160 | 392 | 1.5 | – | – | – | – |
| *Calamagrostis arundinacea* | 155 | 50 | 205 | 3.1 | – | – | – | – |
| *Carex acutiformis* | 46 | 61 | 107 | 0.7 | 195 | 121 | 316 | 1.6 |
| *Iris pseudacorus* | – | – | – | – | 200 | 342 | 542 | 0.6 |
| *Urtica dioica* | – | – | – | – | 470 | 59 | 529 | 7.9 |
| *Scirpus sylvatica* | – | – | – | – | 251 | 87 | 338 | 2.9 |
| *Dryopteris carthusiana* | – | – | – | – | 85 | 112 | 197 | 0.8 |
| *Carex appropinquata* | – | – | – | – | 101 | 68 | 169 | 0.8 |
| *Carex remota* | – | – | – | – | 78 | 71 | 149 | 1.1 |
| *Athyrium filix-femina* | – | – | – | – | 50 | 42 | 92 | 1.2 |
| **Other species** | | | | | | | | |
| *Lysimachia vulgaris* | 18 | 12 | 30 | 1.5 | – | – | – | – |
| *Betula pendula* | 2 | 1 | 3 | 2.0 | – | – | – | – |
| *Oxalis acetosella* | – | – | – | – | 25 | 40 | 65 | 0.6 |
| *Impatiens noli-tangere* | – | – | – | – | 53 | 7 | 60 | 7.0 |
| *Lysimachia nummularia* | – | – | – | – | 33 | 8 | 41 | 4.2 |
| *Equisetum arvense* | – | – | – | – | 27 | 12 | 39 | 2.1 |
| *Poa palustris* | – | – | – | – | 23 | 13 | 36 | 1.8 |
| *Scutellaria galericulata* | – | – | – | – | 30 | 4 | 34 | 8.4 |
| *Glechoma hederacea* | – | – | – | – | 19 | 5 | 24 | 3.8 |
| *Juncus effusus* | – | – | – | – | 13 | 11 | 24 | 1.2 |
| *Geranium robertianum* | – | – | – | – | 5 | 1 | 6 | 5.0 |
| *Calystegia sepium* | – | – | – | – | 3 | 3 | 6 | 1.0 |
| *Holcus lanatus* | – | – | – | – | 2 | 1 | 3 | 2.0 |
| *Carex hirta* | – | – | – | – | 1 | 1 | 2 | 1.0 |
| **Total** | **2797** | **7979** | **10776** | **0.35** | **1664** | **1008** | **2672** | **1.65** |

*lutetiana* +, *Deschampsia caespitosa* +, *Epilobeum roseum* +, *Eupatorium cannabinum* +, *Festuca gigantea* +, *Fraxinus excelsior* +, *Geum urbanum* +, *Lamium maculatum* +, *Lycopus*

*europaeus* +, *Moehringia trinervia* +, *Paris quadrifolia* +, *Persicaria mitis* +, *Ranunculus repens* +, *Stellaria nemorum* +, *Symphytum officinale* +, *Sambucus nigra* r.
Typical mark for these stands is a mosaic changing of forest areas with non-forest ones, which causes the height of groundwater level and various thickness of peat. For specific edaphic conditions stands of this type belong to the special water-protected forests with a low wood production. Regarding to their originality, sporadic occurrence and representation of numerous scarce plant species, it is necessary a strong protection of present stands.

## Results and discussion

The basic results of the production-ecological measurements obtained of two studied communities are summarized in Table 1. It contains the following information: Type of forest ecosystem, above- belowground- total herb layer biomass in kg.ha$^{-1}$, dry weight and ratio aboveground/belowground (A/B) biomass.

The floristic structure of studied birch-oak forest is relatively pure, but the herb layer biomass (aboveground and belowground one) of this community is very high even if it is build only by one dominant species – *Molinia caerulea* agg. (more than 10 t.ha$^{-1}$ ). The total herb layer biomass of the others from the dominant block varies only about 100–300 kg.ha$^{-1}$ (*Pteridium aquilinum*, *Calamagrostis arundinacea*, *Carex acutiformis*). For this forest community is characteristic as very high cover (up to 100%) as very typical grassy feature and in final consequence also a very high total herb layer biomass. The share of simple parts of biomass is in benefit of the root biomass, which is almost thrice higher than aboveground one.

On the other hand, birch-alder forest is typical by a high number of species, high cover of the herb layer and also high total herb layer biomass – 2.7 t.ha$^{-1}$, with a high share of the aboveground biomass. Regarding to species, the block of dominants is essentially wider than in previous evaluated community, it has 8 species with a higher dominancy of *Carex* (*C. acutiformis*, *C. appropinquata*, *C. remota*) and some tall species – *Iris pseudacorus*, *Urtica dioica*, *Scirpus sylvatica* and ferns (*Athyrium filix-femina, Dryopteris carthusiana*).

The total aboveground herb layer biomass of the birch-alder forest is quite comparable with our previous results from similar oak forests (even if oak forests have always lower values) on the Borská nížina lowland, mainly *Frangulo alni-Quercetum robori-petraea* – 310–870 kg.ha$^{-1}$ (Šomšák, Kubíček, 2000), the Malé Karpaty Mts (Kubíček, Jurko, 1975, oak-hornbeam or mixed oak forests, 476–691 kg), the Báb forest (Kubíček, 1983, oak-hornbeam and mixed oak forest 403–768 kg.ha$^{-1}$), the Silická planina plateau (Jurko, Kubíček, 1979, oak or mixed oak forests, 2201–909 kg.ha$^{-1}$), at which some differences in biomass values depend on different floristic structure of the compared communities. As for birch-alder forest, they are the new, original information about the herb layer biomass, obtained in our country and probably also in the middle Europe.

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Kubíček F., Šimonovič V., Kollár J., Kanka R.: **Produkčná ekológia niektorých zriedkavých lesných spoločenstiev Borskej nížiny.**

Cieľom príspevku je podať podrobnejšiu informáciu o biomase bylinnej vrstvy (nadzemnej, podzemnej, celkovej) zriedkavejších, konkrétne brezovo-dubových a brezovo-jelšových porastov Borskej nížiny.