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HERB LAYER BIOMASS OF SOME BROAD-LEAVED FOREST ECOSYSTEMS NEAR SKALICA (BIELE KARPATY MTS)

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Abstract

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The paper is focused upon detail production-ecological analysis of the total herb layer biomass (above- and belowground) in four broad-leaved forest ecosystems (*Carici pilosae-Carpinetum, Carici pilosae-Fagetum, Aceri-Carpinetum* and *Stellario-Alnetum*) near Skalica (Zlatnícka dolina valley) in the Biele Karpaty Mts. Results (Table 2) are discussed and compared with other ones obtained from similar forest ecosystems of Slovakia.

Key words: broad-leaved forest ecosystem, herb layer biomass

Introduction

The aim of this contribution is to provide basic information on the ecology and herb layer of several broad-leaved forest ecosystems in the vicinity of the city of Skalica in the Zlatnícka dolina valley belonging to the Biele Karpaty Mts. Oak (*Quercus petraea* agg.) and hornbeam (*Carpinus betulus*) are dominating in the lower parts of the valley (300–400 m a.s.l.) with a mixture of various broad-leaved trees – especially maple (*Acer pseudoplatanus*), lime tree (*Tilia cordata)* and some others. Along streams black alder (*Alnus glutinosa*) prevails absolutely. Beech (*Fagus sylvatica*) predominates in the upper parts of the valley (above 400 m a.s.l.). From the forest management point of view these forests represent the productive broad-leaved ones with high wood quality (mainly oak and beech).

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 (Braun-Blanquet 1964), the names of plants follow Dostál, Červenka (1991, 1992). Soil conditions were characterized on the base of selected profiles. Estimation of the herb

T a b l e 1. Phytocoenological table of the observed plots.

Relevè number	1	2	3	4
Type	SA	AC	CCm	CF
Trees				
Carpinus betulus	+	4	.	r
Fraxinus excelsior	1	+	.	.
Acer pseudoplatanus	+	.	.	+
Tilia cordata	.	+	.	+
Quercus petraea agg.	.	.	4	+
Alnus glutinosa	3	.	.	.
Fagus sylvatica	.	.	.	4
Betula pendula	.	r	.	.
Shrubs				
Sambucus nigra	+	.	.	.
Tilia cordata	.	.	+	.
Carpinus betulus	.	.	+	.
Herbs				
Impatiens parviflora	+	+	1	2
Galium odoratum	+	1	1	+
Mercurialis perennis	4	+	.	1
Brachypodium sylvaticum	+	+	+	.
Tithymalus amygdaloides	r	1	.	+
Ulmus glabra	r	r	.	+
Crataegus monogyna	r	.	+	r
Hacquetia epipactis	r	+	+	.
Carex pilosa	.	3	+	4
Viola reichenbachiana	.	1	+	+
Melica uniflora	.	+	3	+
Tilia cordata	.	+	+	+
Mycelis muralis	.	r	+	+
Galeobdolon luteum agg.	+	+	.	+
Asarum europaeum	1	3	.	.
Acer pseudoplatanus	+	1	.	.
Fraxinus excelsior	+	+	.	.
Polygonatum multiflorum	+	+	.	.
Paris quadrifolia	+	+	.	.
Dentaria bulbifera	+	+	.	.
Arum alpinum	+	+	.	.
Aegopodium podagraria	+	+	.	.
Actaea spicata	+	+	.	.
Aconitum lycoctonum	+	r	.	.
Scrophularia nodosa	r	.	r	.
Oxalis acetosella	.	+	.	+
Hordelymus europaeus	.	+	.	+
Carpinus betulus	.	.	+	+
Ajuga reptans	.	+	.	r
Rubus fruticosus agg.	.	+	.	r
Daphne mezereum	.	r	.	r
Lathyrus vernus	.	.	+	r
Lathyrus niger	.	.	+	r
Melica nutans	.	+	1	.
Dactylis polygama	.	+	1	.
Galium sylvaticum	.	+	+	.
Pulmonaria obscura	.	+	+	.
Fragaria vesca	.	+	+	.
Acer campestre	.	+	r	.

T a b l e 1. (Continued)

Geum urbanum	.	+	r	.
Cephalanthera longifolia	.	r	+	.
Rosa canina agg.	.	r	r	.
Salvia glutinosa	1	.	.	.
Stachys sylvatica	1	.	.	.
Glechoma hederacea	+	.	.	.
Urtica dioica	+	.	.	.
Circaea lutetiana	+	.	.	.
Clematis vitalba	+	.	.	.
Rubus caesius	+	.	.	.
Impatiens noli-tangere	+	.	.	.
Alnus glutinosa	+	.	.	.
Sambucus nigra	r	.	.	.
Arctium sp.	r	.	.	.
Fagus sylvatica	.	.	.	+
Festuca altissima	.	.	.	+
Cardamine impatiens	.	.	.	r
Primula elatior	.	+	.	.
Convallaria majalis	.	+	.	.
Campanula trachelium	.	+	.	.
Maianthemum bifolium	.	+	.	.
Calamagrostis arundinacea	.	.	1	.
Hedera helix	.	+	.	.
Orchis pallens	.	r	.	.
Euonymus europaeus	.	r	.	.
Neottia nidus-avis	.	r	.	.
Epipactis helleborine agg.	.	r	.	.
Poa nemoralis	.	.	1	.
Carex digitata	.	.	+	.
Alliaria petiolata	.	.	+	.
Carex montana	.	.	+	.
Melittis melissophyllum	.	.	+	.
Ligustrum vulgare	.	.	+	.
Digitalis grandiflora	.	.	+	.
Quercus petraea agg.	.	.	+	.
Symphytum tuberosum	.	.	+	.
Vincetoxicum hirundinaria	.	.	+	.
Festuca heterophylla	.	.	+	.
Campanula persicifolia	.	.	+	.
Hieracium racemosum	.	.	r	.
Hieracium lachenalii	.	.	r	.
Platanthera bifolia	.	.	r	.
Ranunculus auricomus s.lat.	.	.	r	.
Lapsana communis	.	.	r	.
Clinopodium vulgare	.	.	r	.
Chaerophyllum temulum	.	.	r	.

Abbreviations: SA – *Stellario-Alnetum*, AC – *Aceri-Carpinetum,* CCm – *Carici pilosae-Carpinetum melicetosum,* CF – *Carici pilosae-Fagetum*

Head to the table:

Relevè number, Date (year/month/day), Relevé area (m2), Altitude (m), Aspect (degrees), Slope, (degrees), Cover tree layer (%), Cover shrub layer (%), Cover herb layer (%), Height (high) tree layer (m), Locality, Longitude, Latitude

1. 20060614, 240, 306, 0, 0, 65, 2, 100, 20, Biele Karpaty, Zlatnícka dolina, 17°18'13.2, 48°49'13.1"
2. 20060621, 400, 324, 90, 10, 65, 0, 70, 0, Biele Karpaty, Zlatnícka dolina, 17°19'38.3, 48°50'05.6"
3. 20060621, 300, -, 315, 2, 60, 5, 90, 20, Biele Karpaty, Zlatnícka dolina, 17°19'03.5, 48°50'29.7"
4. 20060614, 400, 565, 180, 2, 65, 0,70, 25, Biele Karpaty, Zlatnícka dolina, 18°21'10, 48°48'40.8"

layer biomass (aboveground-belowground) was made on selected sample plots applying the methods of indirect sampling (Kubíček, Brechtl, 1970) modified for non-recurrent sampling (Kubíček, Jurko, 1975; Kubíček, Šomšák, 1982). Geographical coordinates are listed in WGS 84 system.

Characteristic of the sampled vegetation

1. *Carici pilosae-Carpinetum melicetosum* (Klika ex Futák 1974) Neuhäusl in Moravec et al. 1982 (*Fageto-Quercetum* according to Zlatník (1959))

Site condition

The unit is typical for well-lighted slopes and plateaus, where Cambisols on the flysch substrate are developed.

Floristic composition

The tree layer is formed by oak and hornbeam (*Quercus petraea* agg. and *Carpinus betulus*). The shrub layer is poor and made of the species forming the tree layer. The herb layer is a mixture of the mesophilous species, namely *Dactylis polygama, Carex pilosa, Galium odoratum, Carex montana* etc. and species indicating higher light income (*Melica uniflora, Poa nemoralis, Vincetoxicum hirundinaria*).

2. *Carici pilosae–Fagetum* Oberdorfer 1957 (*Querceto-Fagetum* according to Zlatník (1959))

Site condition

Such forests are typical for higher altitudes, both slopes and plateaus, where Cambisols on the flysch substrate are developed

Floristic composition

The unit includes monodominant beech forests. As they contact oak-hornbeam forest, there is also some admixture of *Carpinus betulus* and *Quercus petraea* agg. High ratio of scree species is indicated by *Acer pseudoplatanus* and *Tilia cordata* (in the herb layer also by *Mercurialis perennis*). The herb layer is made of mesophilous forest species, first of all *Carex pilosa* accompanied by e.g. *Hordelymus europaeus, Tithymalus amygdaloides, Viola reichenbachiana* etc. The invasion of *Impatiens parviflora* is obvious, too.

3. *Aceri-Carpinetum* Klika 1941 (*Tilieto-Aceretum* according to Zlatník (1959))

Site condition

The site has scree-like character, where Cambisols on the flysch substrate being rich in nutrients are developed.

Floristic composition

The tree layer is relatively rich in species. Sampled stand is contacting oak-hornbeam forest, therefore, *Carpinus betulus* and *Quercus petraea* agg. accompanied by some scree species (*Tilia cordata, Fraxinus excelsior*) form the tree layer. Of other scree tree species, there is also *Acer pseudoplatanus* and *Ulmus glabra,* but recorded only in the herb layer. The shrub

layer is very poor. Concerning the site character, the herb layer is rich in species, mainly of those indicating well-supplied soils, e.g. *Asarum europaeum, Carex pilosa, Mercurialis perennis, Dentaria bulbifera, Aegopodium podagraria* etc. The occurrence of *Orchis pallens* is interesting here.

4. Stellario-Alnetum Lohmeyer 1957 (*Fraxineto-Alnetum* according to Zlatník (1959))
Site conditions

Such stands occupy inundations along the streams being flooded during spring mainly. Of the soils, Gleyic Fluvisols and Gleysols are to be found here.
Floristic composition

Black alder (*Alnus glutinosa*) presents typical monodominant species forming the tree layer. The shrub layer is developed poorly. As for the herb layer, nitrophilous species prevail, such as *Mercurialis perennis, Salvia glutinosa, Asarum europaeum, Aegopodium podagraria, Stachys sylvatica, Paris quadrifolia* etc. Within this floodplain association, these stands present relatively xerophilous type (see Table 1).

Results and discussion

The basic results of the production-ecological measurements obtained from four studied sample plots – 1 *Carici pilosae-Carpinetum melicetosum,* 2 *Carici pilosae-Fagetum,* 3 *Aceri-Carpinetum* 4 *Stellario-Alnetum* **–** are summarized in Table 2, which contains the following information: type of forest community, above-belowground-total biomass in $kg.ha^{-1}$and ratio aboveground/belowground (A/B) biomass.

All selected broad-leaved forests of the Zlatnícka dolina valley have relatively high number of dominant species in biomass – about five, but several of them are dominant for two communities. Only one species (*Galium odorarum*) appears in all studied communities. Grasses as *Melica uniflora, Melica nutans* and *Calamagrostis arundinacea* are the decisive species in the biomass of a typical oak-hornbeam forest (*Carici pilosae-Carpinetum melicetosum*). Therefore, the total biomass is also high **–** 1186 $kg.ha^{-1}$ of which the aboveground biomass is 566 $kg.ha^{-1}$ (a little less than belowground one – 620 $kg.ha^{-1}$; the ratio A/B is 0.90).

The other two communities have one or four decisive species in biomass. *Carex pilosa* is the only dominant species in the beech forest (*Carici pilosae-Fagetum*). The total biomass regarding poor cover of the herb layer is only 262 $kg.ha^{-1}$, ratio between aboveground/belowground biomass is slightly on the behalf of aboveground one (1.05). In the scree broad-leaved forest (*Aceri-Carpinetum)*, being relatively rich in species both in tree and herb layer, *Asarum europaeum* presents major biomass species accompanied by several others (*Carex pilosa, Mercurialis perennis, Tilia cordata*). The total biomass is relatively higher, mainly belowground one **–** the total biomass value is 596 $kg.ha^{-1}$.

The richest community regarding to the herb layer is the typical black alder forest (*Stellario-Alnetum* association) with monodominant black alder (*Alnus glutinosa*) in the tree layer. In the herb layer nitrophilous species prevail, which is also visible on their higher

T a b l e 2. Herb layer biomass of selected communities (kg.ha^{-1}, dry weight).

	Carici pilosae-Carpinetum melicetosum					*Carici pilosae-Fagetum*					*Aceri-Carpinetum*					*Stellario-Alnetum*				
Species																				
	N	A	B	T	A/B	N	A	B	T	A/B	N	A	B	T	A/B	N	A	B	T	A/B
Dominant species																				
Calamagrostis arundinacea	696	117	126	243	0.92															
Melittis melisophyllum	10	7	16	23	0.43															
Carex montana	166	5	37	42	0.14															
Ligustrum vulgare	4	19	94	113	0.20															
Poa nemoralis	342	28	8	36	3.56															
Impatiens parviflora	72	24	2	26	13.56	4	1	1	2	1						62	6	1	7	6
Melica nutans	444	103	57	160	1.79						8	1	1	2	1					
Melica uniflora	1146	81	95	176	0.85	56	6	5	11	1.31										
Quercus petraea agg.	258	112	110	222	1.01	14	7	10	17	0.64										
Carpinus betulus	18	27	19	46	1.37						34	7	2	9	3.86					
Tilia cordata	8	5	4	9	1.63	26	8	14	22	0.55	18	17	24	41	0.68					
Gaium odoratum	124	10	15	25	0.6	70	4	4	8	1.0	86	6	7	13	0.87	130	18	6	24	3.04
Carex pilosa						366	94	83	177	1.13	212	28	18	46	1.53					
Asarum europaeum											1084	112	179	291	0.62	282	13	30	43	0.64
Mercurialis perennis											44	10	28	38	0.36	602	353	762	1115	0.46
Galeobdolon luteum											28	5	3	8	2.12	184	115	86	201	1.33
Aegopodium podagraria																78	46	42	88	1.11
Salvia glutinosa																22	42	34	76	1.20
Acer pseudoplatanus						2	1	1	2	1.0	32	22	36	58	0.61	28	12	5	17	2.24
Other species																				
Festuca heterophylla	164	1	3	4	0.15															
Dactylis polygama	20	3	3	6	1.0															
Pulmonaria obscura	14	3	3	6	1.0						4	1	1	2	1.0	10	4	6	10	0.68

T a b l e 2. (Continued)

Viola reichenbachiana	16	4	6	10	0.65						60	11	12	23	1.70	2	1	1	2	1.0
Lathyrus vernuus	10	3	9	12	0.33						12	3	10	13	0.34					
Fragaria vesca	4	1	1	2	1.0															
Lathyrus niger	6	2	6	8	0.4															
Galium schultesii	8	1	1	2	1.0															
Symphytum tuberosum	2	1	1	2	1.0															
Crataegus monogyna	2	7	4	11	1.76															
Veronica officinalis						2	1	1	2	1.0										
Fagus sylvatica						24	9	9	18	1.0										
Dentaria bulbifera						2	1	1	2	1.0										
Tithymalus amygdaloides											48	12	4	16	3.0					
Oxalis acetosellla											222	3	4	7	0.82	12	1	1	2	1.0
Fraxinus excelsior											44	8	7	15	1.21					
Paris quadrifolia											2	2	2	4	1.0	10	8	12	20	0.64
Hacquetia epipactis											34	3	12	15	0.4					
Brachypodium sylvaticum																36	4	1	5	4.0
Geranium robertianum																2	1	1	2	1.0
Glechoma hederacea																14	1	1	2	1.0
Urtica dioica																18	7	8	15	0.85
Rubus caesius																4	3	2	5	1.20
Arum alpinum																2	2	6	8	0.30
Summary	3534	566	620	1186	-	566	134	128	262	-	1472	242	349	596	-	1490	637	1005	1641	-

Legend: A – aboveground biomass, B – belowground biomass, T – total biomass (A+B), R – ratio aboveground/belowground biomass (A/B), N – number of individuals in 103.ha^{-1}

biomass values. The main dominant is *Mercurialis perennis* with some other ones: *Galeobdolon luteum, Aegopodium podagraria, Salvia glutinosa, Asarum europaeum.* The total biomass values are high, which corresponds with similar values obtained in other alder communities in Slovakia (Kubíček, 1983). Belowground biomass is prevailing; the total biomass value is 1641 kg.ha^{-1}.

The total aboveground herb layer biomass of these broad-leaved forests is comparable with our previous results from Slovakia as follows: the Borská nižina 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}, Kubíček et al., 2006 birch-oak and birch-alder forests,1664–2797 kg.ha^{-1}, Kollár et al ., 2008, oak forests, 107–335 kg. ha^{-1}), the Malé Karpaty Mts (Kubíček, Jurko, 1975, oak-hornbeam or mixed oak forests, 403–768 kg.ha^{-1}, alder forests, 1364 kg.ha^{-1} , Kubíček, 1983, alder forests 1014 kg.ha^{-1}, oak-hornbeam and mixed oak forests, 406–1385 kg.ha^{-1}, scree forests, 153–848 kg.ha^{-1}, beech forests, 58–492 kg.ha^{-1}) the Silická planina plateau (Jurko, Kubíček, 1979, oak and mixed oak forests, 403–768 kg. ha^{-1}), the Báb forest (Kubíček, 1983, oak-hornbeam and mixed oak forest, 372–506 kg.ha^{-1}, scree forest 476 kg.ha^{-1}). Some differences in biomass values depend on different floristic structure of the compared communities.

Similar data on deciduous forest ecosystem herb layer production were published by mainly Polish (Kazmierczaková, 1971; Jankowska, 1978; Banasik, 1978; Izdebski et al., 1974 Tumidajowicz, 1976 and others) and Hungarian (Jakucs, Papp, 1974; Isépy, 1976; Papp, 1977) authors.

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