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*Received 14. 5. 2003*

Witkowski Z.J., Michalik S., Adamski P.: **Ochrana okrajových území v chránených oblastiach: prípadová štúdia Národného parku Ojców.**

Na základe štúdia literatúry zaoberajúcej sa flórou a faunou Národného parku Ojców možno rekonštruovať zmeny za posledných 150 rokov. Ľudskou činnosťou sa zvýšil počet a diverzita ekosystémov (rastlinných spoločenstiev). Faktom, že toto stanovište sa stalo chráneným, znížila sa priestorová diferenciácia a počet ekosystémov, hlavne poloprírodných kriedových lúk a poloотvorených krovinných habitatov, čo vo flóre a faune zapríčinilo veľké zmeny. Významný pokles sme zaznamenali v počte druhov bažinných a xerotermných stanovíšť a mierny pokles v tieňomilných a oligotermných druhov. V posledných rokoch sa zvýšil počet druhov iba na lúkach a pasienkoch. Krajinárske a environmentálne zmeny sa uskutočnili okolo a vo vnútri Národného parku Ojców a viedli k zvyšujúcej sa izolácii miestnej prírody a k tendencii vyhynutia autochtónnych druhov. Mieru imigrácie druhov do Parku nemožno ovplyvňovať tak, ako predpokladali autori, že ochranné práce by mali znížiť mieru vyhynutia druhov v území.

Autori navrhujú:

- udržať značnú diverzitu ekosystému v Parku so zvláštnym zreteľom na poloprírodné ekosystémy
- vytvoriť a udržať miestne stanovištia podporujúce populácie
- vytvoriť koridory na "zachytávanie druhov"
- vytvoriť tzv. prechádzkové miesta pre druhy ekosystémov kriedových lúk v rámci koridoru.





# ECOLOGICAL PARAMETERS OF OAK AND OAK-HORNBEAM FORESTS IN THE LUČENECKÁ KOTLINA BASIN

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Abstract

Žarnovičan H.: Ecological parameters of oak and oak-hornbeam forests in the Lučenecká kotlina basin. Ekológia (Bratislava), Vol. 23, No. 1, 57-64, 2004.

This paper deals with ecological characteristics of oak and oak-hornbeam forests in selected areas of the Lučenecká kotlina basin. It gives more exact information on requirements of such communities for ecological factors of the environment in sense of Ellenberg's opinions (Ellenberg, 1974). The relations estimated between individual vascular plants and soil reaction using ecological values of Ellenberg seem to the most interesting ones. These results show that the association *Genisto pilosae-Quercetum* has the highest number of acidophilous or extremely acidophilous species. Moreover, it well suits to synecological characteristics of this phytocoenose, which is typical for its affinity to podzols. Associations *Querco petraeae-Carpinetum* and *Aceri tatarici-Quercetum* are typical for the occurrence of slightly acidophilous species.

## Introduction

A phytocoenological work on basin oak forests from the alliance *Aceri tatarici-Quercion* Jakucs et Fekete 1957, Zólyomi 1957 and oak-hornbeam forests from the alliance *Carpinion betuli* Issler 1931 em Meyer 1937 was created in 1999-2001. The phytocoenoses of acidophilous oak forests from the alliance *Genisto germanicae-Quercion* Neuhäusl et Neuhäuslová-Novotná 1967 were described. As for the first alliance, the association *Aceri tatarici-Quercetum* Zólyomi 1957 was syntaxonomically defined. It has relatively rich characteristic species combination (constant and characteristic species) which accounts relatively abundant *Acer tataricum* in the shrub as well herb layer, then *Swida sanguinea, Ligustrum vulgare, Euonymus europaeus, Brachypodium pinnatum, Melica uniflora, Cruciata glabra, Stellaria holostea, Fragaria vesca, Pulmonaria obscura, Viola hirta, Viola reichenbachiana. Quercus cerris* dominates in the tree layer of this association, *Q. dalechampii* is less abundant and *Carpinus betulus* is only sporadically admixed. According to soil analyses of samples from representative probe as well as from its morphology Albic Luvisol could be proved in coppice of this community (Žarnovičan, 1999, 2002).

The association *Querco petraeae-Carpinetum* Soó et Pócs (1931) 1957 with subassociations *Querco petraeae-Carpinetum caricetosum pilosae* and *poetusum nemoralis* were described within the alliance *Carpinion betuli* (suballiance *Carici pilosae-Carpinenion*). The stands are characterised by the *Carpinus betulus* dominance in all the layers as well as by the occurrence of common species of *Carpinenion* (*Carex pilosa, Stellaria holostea, Poa nemoralis, Dactylis polygama* etc.) but *Acer tataricum* is absent here. Based on representative soil profile and its analyses, Haplic Cambisol was determined as typical for the subassociation *Querco petraeae-Carpinetum caricetosum pilosae* and Cambic Podzol for the subassociation *Querco petraeae-Carpinetum poetosum nemoralis* (Žarnovičan, 1999, 2002).

The alliance *Genisto germanicae-Quercion* Neuhäusl et Neuhäuslová-Novotná 1967 is represented by the stands of association *Genisto pilosae-Quercetum petraeae* Zólyomi at al. Zólyomi et Jakucs 1957 in the study area. Characteristic species combination is created mostly by oligotrophic species such as *Vaccinium myrtillus, Avenella flexuosa, Hieracium murorum, Hieracium sabaudum, Luzula luzuloides, Genista pilosa* and sporadically also *Cytisus nigricans*. From two representative soil profiles and their analyses it can be summarised, that Podzols accompanied by Luvic Cambisols dominate there (Žarnovičan, 1999, 2002). The detailed syntaxonomical and pedological evaluation of oak and oak-hornbeam forests in the whole Lučenecká kotlina basin are nowadays in progress. Brief phytocoenological description of three syntaxons supported by their affinities to individual soil types and subtypes (Collective, 2000) is also accompanied by ecological analysis of relations between present vascular plants and commonly dealt ecological factors (Ellenberg, 1974, Jurko, 1990).

## Aim of contribution

This contribution is focused on evaluation of relations of floristic composition of three communities (*Genisto pilosae-Quercetum, Querco petraeae-Carpinetum, Aceri tatarici-Quercetum*) to ecological factors, namely to light, temperature, continentality, soil humidity, soil reaction and soil nitrogen. Ecological values proposed by Ellenberg (1974) were used for this purpose.

## Material and methods

Evaluated ecological material (manuscripts of Žarnovičan, 1999, 2002) includes 24 phytocoenological relevés and four typical soil profiles, which were analysed for their basic physical and chemical parameters.

In the ecological analysis software PHYTEC of Černušák et Černušák (1989) was used, which in accordance to Ellenberg's tables (Ellenberg, 1974; Jurko, 1990) incorporates these ecological factors: light, temperature, continentality, humidity, soil reaction and soil nitrogen. Any from these factors can be expressed through ecoindex from a scale of 10, for humidity of 12. Value "x" refers to indifference of the class to measured ecological factor. Odd numbers show corresponding degree, even numbers show changeover between two odd degrees.

This software at the same time evaluates for every class average value of abundance, dominance and multiplies it by the constancy level. The end-result is weighted arithmetic average (middle econumber), that shows demands of the community to different ecological factors.

The values of weighted arithmetic average (middle econumber) have been used for creation of graphs that compare ecological demands of all three communities.



## Results

### *Association Aceri tatarici-Quercetum* Zólyomi 1957

From the point of view of light demand this community is rich on semisciophilous up to semiheliophilous plants (index 6), that create up to 30% of vegetation. Higher abundance (16.8%) comes of semiheliophilous plants with the main spread at fully enlighten places, but they can withstand temporary moderate shade. Though these results do not fully correspond to the relatively high tree canopy cover (75%) (Fig. 1).

In accordance to temperature demands of plants of the community there fully absent plants with indices 1–4. Approximately the same percentage (26%) falls to middle xerophilous (index 5), middle to xerophilous (index 6) and xerophilous to extremely xerophilous plants with the index 8.21% of classes is indifferent to this factor. I would like to add, that vegetation of the Lučenecká kotlina basin is according to Dostál (1964, in Suran 1970) in the area of xerothermophilous middle- and south-eastern flora (*Pannonicum*), the proof of which is the occurrence of species like *Quercus cerris* or *Acer campestre* (Fig. 2).

Nearly 50% are suboceanic plants with the centre of occurrence in central Europe. 15.7% are oceanic-suboceanic plants. Michalko et al. (1986) describes this community to be rich in flora with submediterranean species. There were only 17.5% indifferent species (Fig. 3).

From the title of the community (oak xeromorphic pontic-pannonian forests) it could seem that there is richer occurrence of xerothermous species. 32% plants of the vegetation show xerophilous to mezophilous parameters, but 25.6% are plants with occurrence on middle humid soils like e.g. *Acer campestre, Melica uniflora* and *Stellaria holostea* (Fig. 4).

Approximately the half of the plants is indifferent to the factor of soil reaction. The highest proportion is there of moderate acidophilous to neutrophilous species with index 6 (21.77%). Higher is also the occurrence of neutrophilous to calciphilous species with index 8 (12.98%) (Fig. 5).

The community does not demand higher content of nitrogen in soil which is proved more than 77% of indifferent classes to this factor. The highest percentage 6.9% is represented by species with index 5, plants that occur mainly in moderate poor to moderate rich soils. There are also species of other indices, but their occurrence is relatively low (Fig. 6).

*Association Quercο petraeae-Carpinetum S o ó et P ó c s* (1931) 1957. *Subasociations caricetosum pilosae* and *poetosum nemoralis*

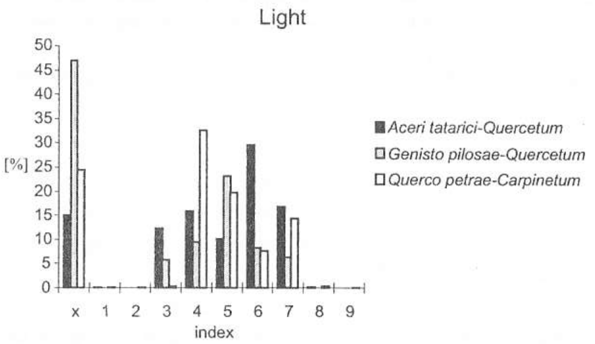


Fig. 1.

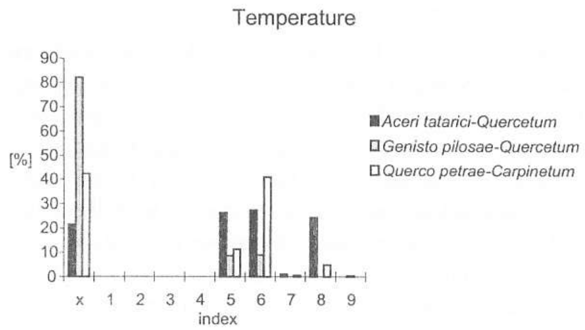


Fig. 2.

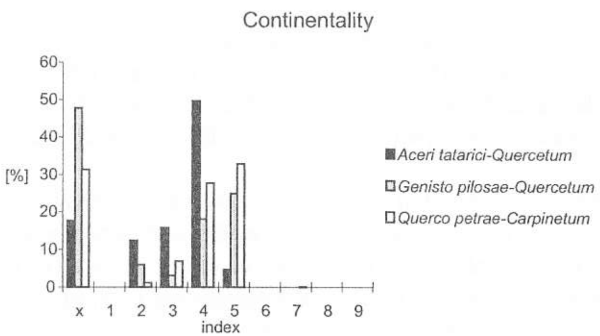


Fig. 3.

In this community is the highest percentage of sciophilous to semisciophilous species with ecoindex 4. Their percentage of 32.6 shows only partial lighting of the community with nearly 80% of tree canopy cover. 19.8% are semisciophilous plants (index 5). Relatively low is the occurrence of 24% of indifferent species (Fig. 1).

Up to 41% of plants are mezothermophilous to thermophilous with index 6. Nearly the same proportion of plants (42.5%) is indifferent to temperature conditions. Apart from these groups there is more important the occurrence of 11.3% of species with index 5. These are middle thermophilous plants spread in upland level often into submountain level e.g. *Dactylis polygama, Crataegus laevigata, Viola reichenbachiana* (Fig. 2).

32.87% of the species have defined demands as for the factor of continentality. These are *Fragaria vesca, Poa nemoralis* or *Carex pilosa* with index 5 and those are intermediate species. There is higher percentage of suboceanic species with the centre of occurrence in the east of central Europe and close east Europe. 31.2% of species is indifferent to the factor of continentality (Fig. 3).



As for the factor humidity there dominate mezophilous species with index 5. Their percentage of 44.3% fit to statement about the mezophility of mixed broad-leaved forest by Michalko et al.(1986). Similar to the factor temperature is the percentage of indifferent species relatively high (43.5%) (Fig. 4).

Nearly 50% of the vegetation of the community is indifferent to soil reaction. Apart from them there was the highest percentage of moderate acidophilous species (33.2%) e.g. *Poa nemoralis, Carex pilosa, Dactylis polygama* (Fig. 5).

From the point of view of content of nitrogen the occurrence of mezonitrophilous species with index 5 (22.37%) is important. 16.9% of plants are plants spread mainly on soils poor on nutriment (index 3), but more than the half of the species is indifferent to this factor (50.47%) (Fig. 6).

Association *Genisto pilosae-Quercetum petraeae* Z ó l y o m i et al. in Z ó l y o m i et J a k u c s 1957

In this phytocoenose dominate with percentage 23.19% semisciophilous plants (index 5) rare in the full light 9.42% of species with index 4 are scio-semisciophilous plants from the point of view of light demands. Apart from these there are also plants with indices from 2 to 8 with variable percentages (Fig. 1).

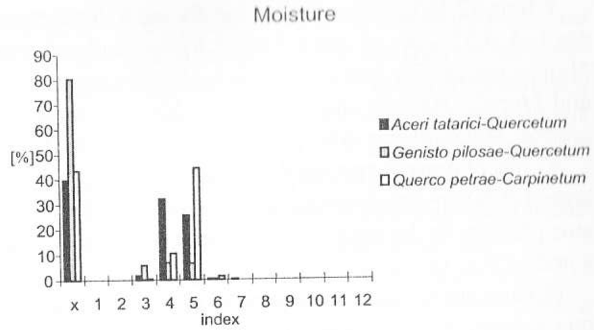


Fig. 4.

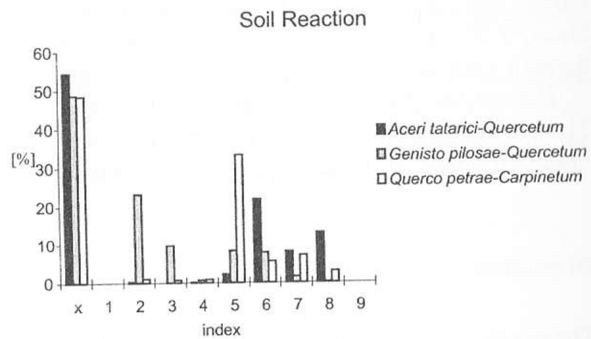


Fig. 5.

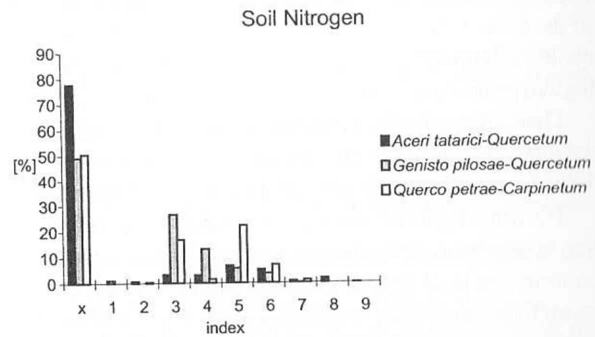


Fig. 6.

Whole 82.16% of species are indifferent to temperature conditions and none are of indices 1–3. 8.52% are of index 5 and 8.87% of index 6 hence mezothermophilous to thermophilous plants. For index 5 there are *Hieracium murorum, Genista pilosa, Melica uniflora* and *Mycelis muralis* and for index 6 *Hieracium sabaudum, Carpinus betulus, Cruciata glabra, Melampyrum nemorosum* and some other (Fig. 2).

47.8% of present species do not have special demands to continentality. Higher percentages (25%) are intermediate plants with index 5. There should be mentioned also suboceanic plants with the centre of occurrence in central Europe, but spreading to east with index 4 and 18% (Fig. 3).

Phytocoenose has low demands to humidity which can be proved by 80.3% of indifferent species. 6.92% are xerophilous to mezophilous and these are *Hieracium sabaudum, Melampyrum nemorosum* and some other. In the locality there are also xerophilous plants with index 3 (5.76%) and plants occurring on fresh ground with index 5 (6.63%) (Fig. 4).

23.1% of species are extremely acidophilous to acidophilous and these are *Frangula alnus, Avenella flexuosa, Genista pilosa, Vaccinium myrtillus* and *Veronica officinalis.* With index 3 there occur acidophilous species with the main occurrence in acid bottom (9.7%). Nearly 8.5% are moderate acidophilous species with index 5 that occur from highly acid through weak acid, neutral up to weak alkaline bottom (Fig. 5).

The community has low demand on nitrogen. 26.72% of species are nitrophobic (index 3) with main spread on soil poor on nutriment, 13.27% of species are nitrophobic to mezonitrophobic with index 4. There are nearly 50% indifferent to this factor (Fig. 6).

## Discussion

The results of ecological analyses in sense of Ellenberg (1974) or Jurko (1990) are generally well known from ecosystem evaluations in Slovakia. Cognate approach in evaluation of oak and oak-hornbeam forests, which are similar to those described in this paper, is used by Ciriaková (1999), Hegedüšová-Kučerová (2000) or Balkovič (2001). Mentioned contributions describe ecological situation in oak and oak-hornbeam forests in the northern part of the Štiavnické vrchy mountains. The results of this contribution are in good accord with results obtained by these authors, moreover, they offer a new piece of knowledge on ecological properties of association *Genisto pilosae-Quercetum* and *Aceri tatarici-Quercetum.*

There arise chiefly differences in values of soil reaction and soil nitrogen from ecological analysis mainly in phytocoenoses of community *Aceri tatarici-Quercetum* Z ó l y o m i 1957 on one hand and acidophilous oak and oak-hornbeam forests on the other hand.

The most light-demanding community is *Aceri tatarici-Quercetum*, with the highest number of semiscio-heliophilous plants. Community *Querco petraeae-Carpinetum* is on the contrary the least light demanding from examined communities with the highest numbers of sciophilous and even semisciophilous plants. From the point of view of temperature demands there are middle to thermophilous plants most frequent and in the community *Aceri tatarici-Quercetum* there come up also middle and thermophilous up to extremely thermophilous species. The least demanding as for the temperature is the community *Genisto pilosae-Quercetum*. In the communities *Genisto pilosae-Quercetum* and *Querco petraeae-Carpinetum* there are intermediate species dominant from the point of view of continentality, just in the community *Aceri tatarici-Quercetum* there evidently dominate suboceanic plants with the centre of occurrence in central Europe but spreading to east as well. The community *Genisto pilosae-Quercetum* has low humidity demands. With two other communities there dominate plants seen on fresh ground mainly middle humid types, with the community *Aceri tatarici-Quercetum* are joined xerophilous up to mezophilous species.

As already mentioned soil reaction of these three communities differs quite a lot. Extremely acidophilous up to acidophilous species are typical for the community *Genisto pilosae-Quercetum*. More akin is the soil reaction of communities *Querco petraeae-Carpinetum* and *Aceri tatarici-Quercetum*. The first one includes moderate acidophilous species and community *Aceri tatarici-Quercetum* moderate to weak acidophilous species, which are accompanied by weak alkaline to calciphilous species of plants.

The most demanding as for the content of soil nitrogen is the community *Aceri tatarici-Quercetum*. With other two phytocoenoses there dominate nitrophobic up to mezonitrophobic plants.

The results that were acquired by ecological analysis characterize plant communities and at the same time show locality conditions of these communities. Though it is impossible to accept the results with absolute validity because of the fact, that measured values have limited geographical validity and the results are to be understood and explained in this manner.

*Translated by the author*

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Žarnovičan H.: **Ekologické parametre dubových a dubovohrabových lesov v Lučeneckej kotline.**

V rokoch 1999-2001 sme na vybratých lokalitách Lučenskej kotliny opísali a fytocenologicky spracovali asociácie *Aceri tatarici-Quercetum* Z ó l y o m i 1957, *Querco petraeae-Carpinetum* S o ó et P ó c s (1931) 1957 so subasociáciami *Querco petraeae-Carpinetum caricetosum pilosae* a *poetusum nemoralis* a asociáciu *Genisto pilosae-Quercetum petraeae* Z ó l y o m i et al. in Z ó l y o m i et J a k u c s 1957. Definované lesné spoločenstvá sme podopreli aj pedologickým výskumom. V príspevku uvádzame výsledky ekologickej analýzy, ktorá podáva presnejšie informácie o nárokoch opísaných spoločenstiev na ekologické faktory prostredia: svetlo, teplotu, kontinentalitu, vlhkosť, pôdnu reakciu a pôdny dusík. Ich konkrétny priebeh vidieť na obr. 1-6.





# SOIL AND GENOTYPE INFLUENCES ON HEAVY METALS STATUS IN MAIZE

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Abstract

Kovacevic V., Antunovic M., Bukvic G., Rastija M., Kadar I.: Soil and genotype influences on heavy metals status in maize. Ekológia (Bratislava), Vol. 23, No.1, 65-70, 2004.

Ten maize hybrids were grown under fields conditions on two soils type: Calcaric Fluvisols (caFL) and Stagnic Albe Luvisol (stAB), during two growing seasons in four replicates. Both soils are situated of Drava valley and they are mutually distanced about 2 km. Cd, Pb, Cr and Ni concentrations in ear-leaves (beginning of silking) and soil were measured by ICP-AES technique after their microwave digestion using concentrated $HNO_3$+$H_2O_2$. Maize yields on stAB were about 25% lower in comparison with caFL. Also, there were found differences among the hybrids. In general, we found low concentrations of heavy metals in maize with significant differences among the hybrids as follows (mg. kg$^{-1}$ in dry matter): from 0.112 to 0.224 (Cd), from 0.73 to 1.04 (Pb) and from 0.303 to 0.391 (Pb), while Ni values were similar (mean 1.58). These values are very low with aspects of harmful influences on environment. For this reason, production of healthy food is possible in Croatia. By growing of genotype characterizing lower uptake of heavy metals, especially under contaminated conditions, is possible to alleviate environmental problem.

*Key words*: soil type, maize hybrids, cadmium, chrom, lead, nickel

## Introduction

Contamination of soil with heavy metals is result human, industrial and agricultural activities. The accumulation, mobility and availability of heavy metals in the soil depend on soil factors such as acidity, humus content, clay mineral content, and their binding capacity (Szabo, 1995). Source of soil contamination is in close connection with metal fractions content in soil: exchangeable or organic (Boruvka et al., 1997). Tillage systems can affect on concentration and distribution heavy metals in plants (Lavado et al., 2001). Uptake heavy metals depend also on pH value, soil moisture and plant species (Bujnovský, 2001). In general, there are inadequate information concerning heavy metals status on fields in Croatia.