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Species Composition Changes of the Herb Layer and Epigeic Spider Communities in Oak-Hornbeam Forest in Báb after 40 Years (Slovakia)

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Abstract

Authors studied herb layer and ground living spider communities of the lowland forest in the permanent research site Báb (one of the Slovak ILTER site) during 2007-2011. This research is continuation of research realised in programmes IBP and MaB in years 1967-1974 using the same permanent plot of size 100x100 m which was divided into 100 sub-plots of size 10x10m. Typical forest species dominate in the herb layer, but quite high number of synanthrop plants and expansive spiders were recorded as well. This reflects recent disturbance when part of the research plot was cut and open space is colonised especially by ruderal invasive and expansive species. The changes of species composition and dynamics of the herb layer in the forest influenced by the clear-cut were evaluated. Also aim of the research was to assess changes of the current structure of vegetation and selected animal groups (spider) and with their structure in 1967-1974. This comparison showed big changes during studied 40 years that could be caused by the climate changes - gradual drying out of the studied locality were documented by CUNEV & ŠIŠKA (2006). Authors demonstrate this fact mainly by increasing many xerotermophilous and on other hand by decreasing of the abundance or absolute disappearing of the several more hygrophilous species.

Keywords

vascular plants, spiders, Araneae, oak-hornbeam forest, diversity, climate changes

Introduction

The research site Báb near Nitra (SW Slovakia) was established in 1967 to study the production, energy and material flows of the lowland oak-hornbeam forest ecosystem in intensively used agricultural land. The site was part of the International Biological Programme (IBP). The permanent research plot (TVP) of size 1 ha was established and permanently marked with metal bars (BISKUPSKÝ 1975). Part of the TVP was felled in 2006; in 2007 we renewed the research in the TVP.

In this paper we present the results of a study of herb layer of the forest community in the TVP and results of the study of epigeic spiders. Apart from the spiders studied in frame of the project, our research also included other invertebrate communities namely harvestmen (MIHÁL &GAJDOŠ 2010), neuroproid insects (VIDLIČKA 2010), beetles (MAJZLAN 2010; CUNEV & ŠIŠKA 2010), etc.

Material and methods

Study area

The study was carried out at the permanent research site Báb which is partly located in the National Natural Reserve Báb. The locality is situated approximately 15 km from Nitra city (south western Slovakia). It represents the fragment of natural Pannonia oak - hornbeam forest situated in intensively used agricultural landscape. The research site is included in the list of long-term ecosystem research sites within the international network ILTER.

Sampling and study sites

The vegetation was studied in the permanent plot (TVP) of size 100x100 m that is divided into 100 sub-plots of size 10x10 m. Because of the clear-cut in 2006 in part of the permanent plots, we classified individual 10x10 m plots into 4 groups: L – forest in the Nature Reserve (41 plots); H – production forest outside Nature Reserve (17 plots), R – glades (21 plots) and forest margin (21 plots). The phytosociological records of the herb layer were taken in each sub-plot in spring and early summer using standard phytosociological methods, the species abundance was recorded in the 9-member ordinal scale (WESTHOF & VAN DER MAAREL 1978). We analysed the proportion of native and non-native plant taxa using the classification of HALADA (1996). The native taxa included proantopophytes (native taxa living exclusively in natural and semi-natural communities) and apophytes (native taxa, penetrating synanthrop communities). Archaeophytes (non-native immigrants before 1500) and neophytes (non-native immigrants since 1500) were classified as non-native taxa.

In 2007 we launched monitoring epigeic fauna. For this purpose we installed 5 pitfall traps in 3 study areas in the permanent plot (TVP) from 1967 (clear-cut, edge of oak-hornbeam forest and clear-cut and oak-hornbeam forest, in total 15, on April 4, 2007). The traps were emptied monthly during warm seasons and once or two times during

the winter period. Each pitfall trap consisted of a 0.7-litre jar (diameter 10 cm) with an antifreeze substance Fridex as a conservation medium. The trapping period was until April 4, 2010. When research was repeated the traps were placed approximately to same position and type of habitat as was used earlier in 1967-1971.

Results and discussion

Vegetation

We documented 69 taxa of vascular plants by spring record; this number included 48 herbs and 21 woody plants (seedlings and juveniles). Spring geophytes *Anemone ranunculoides, Corydalis solida* and *Gage lutea* dominated, abundant were also other species of the spring ephemerals Fica*ria bulbifera* and *Pulmonaria officinalis*. From other herbs, high frequency had *Mercurialis perennis, Polygonatum multiflorum, Melica uniflora, Galium odoratum, G. aparine* and *Galeobdolon luteum*. Abundant was also a liana *Hedera helix*. The listed species document that mainly the native species of forest communities form the spring aspect of the herb layer. *Corydalis cava, Dentaria bulbifera, Arum alpinum, Brachypodium sylvaticum,* and *Campanula rapunculoides* occurred only in plots located in the Nature Reserve while *Cirsium arvense* occurred only in the glade.

In the early summer we recorded 130 taxa of vascular plants: 104 herbs and 26 woody species. The abundance of herb layer varied from 25 to 100%. The time of recording in early summer is reflected in the frequency of individual species. The geophyte *Anemone ranunculoides* remained dominant followed by species *Viola odorata, Melica uniflora, Ficaria bulbifera, Galium aparine, Mercurialis perennis* and *Pulmonaria officinalis*. High frequency (over 80%) had taxa *Galium odoratum, Geum urbanum, Hedera helix, galeobdolon luteum, Glechoma hirsuta, Polygonatum multiflorum, Alliaria petiolata* and *Impatiens parviflora*.

Only in a forest plots we observed species *Anthriscus cerefolium, Campanula rapunculoides, Corydalis cava, Dentaria bulbifera, Lathyrus niger, L. vernus, Melica nutans*, and *Lithospermum purpurocaeruleum*. For the forest margins were typical species *Dactylis polygama, Chenopodium album agg., Sanicula europaea, Stenactis annua and Urtica dioica*. Quite a number of taxa (24) were recorded only in a glade: *Achillea millefolium, Aster lanceolatus, Astragalus glycyphyllos, Capsella bursa-pastoris, Dactylis glomerata, Echinops sphaerocephalus, Epilobium lamyi, Gnaphalium sp., Hypericum perforatum, Lamium amplexicaule, Lathyrus pisiformis, Lythrum salicaria, Myosotis sp., Plantago major, Polygonum aviculare, Rumex obtusifolius, Sambucus ebulus, Silene dioica, Solidago sp., Sonchus arvensis, Trifolium pratense, Tripleurospermum perforatum, Tussilago farfara* and *Veronica chamaedrys* as well as the woody plants *Ailanthus altissima, Humulus lupulus* and *Lonicera tatari*ca. As can be seen from this list, there is a high proportion of synathrop taxa observed in glades only. This confirmed also the Figure 1 showing distribution of non-native taxa on the permanent plot.

The data presented here can be used for monitoring of further development of the herb layer structure in the permanent because after the felling the significant changes in the community structure during secondary succession are expected. The possibilities for comparison of the species composition in TVP with the first research period (70's and 80's of the 20th century – JURKO & DUDA 1970) are limited, since published data (e.g. KUBÍČEK & BRECHTL 1970) are related to the whole forest complex Bábsky les, not to permanent research plots.

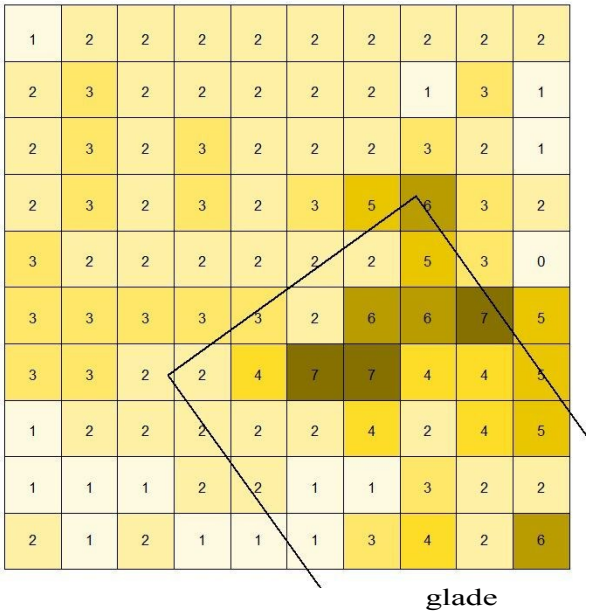

Figure 1: Distribution of the non-native taxa in the permanent plot. (Author: L. Halada)

Epigeic spider communities

We compared changes in the composition of the epigeic spider communities in oak-hornbeam forest located in Báb research plot in long time horizon of nearly 40 years. In past the research of the epigeic spider fauna in this locality was realised by Žitňanská in 1967-1971 (ŽITŇANSKÁ 1970, 1973, 1981). Repeated research was done on the same study area from April 2007 to April 2010. Žitňanská found out 45 spider species belonging to 16 families. During our research in 2007-2010 there were documented 103 spider species belonging to 24 families.

We recorded only 30 species that were found in both periods of study. From them only 15 ones were occurring in the same categories of dominance in both studied periods (expect *Pardosa hortensis* all ones are recedent occurring species). Dominances of other common species in the epigeic communities were different. In present the eudominant species *Pardosa alacris* (D-40.53%) has shown the greatest change in its abundance. In 1971 this species was presented in category as subdominant (D=2-5%). Similarly, presently dominant species *Trochosa terricola* (D-7.48%) was occurring in past as recedent (D until 2%). On other hand dominant species in 1971 as *Pisaura mirabilis* and *Microneta viaria* were documented during current research as subrecedent (D-0.24% and D-0,08%). Also abundance other dominant sowbug-eating spiders *Dysdera erythrina* and *Harpactea rubicunda* from 1971 were markedly lower in 2007-2011 (recedent representation- D- 1.46% and 1.98%). Last dominant species from 1971 crab spider *Ozyptila blackwalli* was documented as subdominant in 2007-2010 (D-3.21%). From 73 species captured only during current research *Urocoras longispinus* (D-11,01%), *Drassyllus villicus* (D-5.21%), *Tenuiphantes flavipes* (D-4,43%), *Scotina celans* (D-4.38%), *Ozyptila praticola* (D-2.72%), *Diplostyla concolor* (D-1,62%) and *Ceratinella brevis* (D-1,22%). Totally 15 species were not confirmed after 40 years. From them species *Entelecara acuminata* was occurring in the samples from 1971 as dominant and other 5 species (*Robertus lividus*, *Dicymbium nigrum brevisetosum*, *Pardosa amentata*, *Agelena labyrinthica* and *Drassodes lapidosus*) were subdominant.

Also we compared the occurrence of threatened species in spider communities in 1967-73 and in the current research. Within the identified species we recorded 6 threatened species (*Bathyphantes similis*, *Enoplognatha oelandica*, *Macrargus carpenteri Megalepthyphantes pseudocollinus*, *Metopobactrus ascitus* and *Segestria bavarica*) which are listed in the Red List of Spiders of Slovakia (GAJDOŠ & SVATOŇ 2001) in different categories of threat (Tab.1). No threatened species was documented in previous research.

Table 1: Abundance (A) and dominance (D) of the threatened species in epigeal spider communities on individual study site. RL – Red list of spiders of Slovakia (GAJDOŠ & SVATOŇ 2001). Categories of threat: CR - critically endangered, EN – endangered, LR - lower risk (nt - near threatened, DD – data deficient (Author: P. Gajdoš)

RL		Abundance	Dominance (%)
	Segestridae		
LR(nt)	*Segestria bavarica*	1	0,009
	Theridiidae		
EN	*Enoplognatha oelandica* (Thorell, 1875)	1	0,009
	Linyphiidae		
CR	*Bathyphantes similis* Kulczyński, 1894	1	0,009
EN	*Macrargus carpenteri* (O.P.-Cambridge, 1894)	4	0,035
DD	*Megalepthyphantes pseudocollinus* (L.Koch, 1872)	40	0,346
LR(nt)	*Metopobactrus ascitus*	1	0,009

On bases of results very great changes in the composition of the epigeic spider communities in the studied forest were documented in time horizon nearly 40 years. It was demonstrated mainly by increasing many xerotermophilous species (e.g. species from family Gnaphosidae) on other hand by decreasing of abundance or absolute disappearing of some hygrophilous species (e.g. *Microneta viaria*, *Pachygnatha degeerii*, *Pardosa amentata*, etc). Provided changes in species composition can be reflection on climate changes documented by CUNEV & ŠIŠKA (2006) who indicated gradual drying out of the studied locality. On basis of climatologic monitoring from 1960 to 2004 realised on meteorological station close to Báb it is possible to observe increase of average annual air temperature from 9.3°C to 10.7°C. According to this trend we can observe tendency of this increase mainly in last decade of 20 century with continuation in the first years in following decade, as well as 60-ties years of the last century. According to CUNEV & ŠIŠKA (2006) the atmospheric precipitation represents in our latitudes main received component of water balance in ecosystem. Amounts of precipitation in time interval 1960 – 2003 decreased from 570 mm on level of 510 mm what is more than 10%.

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