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Original Paper

Evaluation of the two biocorridor models in south-west part of Slovakia in agricultural landscape

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The aim of the research is to evaluate two different models of biocorridors in south-west part of Slovakia in intensively utilized agricultural landscape. The first biocorridor is a part of fragmented alluvial softwood forest along the Žitava's river in its unregulated part in cadastral territory Horný Ohaj, district Vráble. This biocorridor should be the representative biocorridor by its structure and plant composition in its area. The second biocorridor is biocorridor composed by *Robinia pseudoacacia* L. in the village Báb, district Nitra. The research analyzes the structure of the selected biocorridors by using the methods of phytocoenology, evaluate functional integrity by monitoring of their spatial parameters in terrain and by processing maps in the AutoCAD program. At the base of phytocoenological report evaluates occurence of alien species.

Keywords: agricultural landscape, alien species, alluvial forest, biocorridor, invasive plants, phytocoenology

1 Introduction

Agricultural produce belongs to the oldest human activities. It remarkably affects landscape image and landscape functioning. At the territory of Europe human-farmer creates a character of landscape country for already 8000 years. In the beginning, human agricultural interventions to the nature were not very visible, just because of primitive agricultural technologies. But, with increasing of residential density and their increasing needs in production influence of agriculture has grown and was intensified (Šarapatka et al., 2008).

Slovakia is covered up by forest at 1 991 463 ha (which is 40.61% of the Slovak Republic territory). With this number we are at the stage of most wood landed countries in the middle of Europe. Otherwise, the forest coverage at South-East of Slovakia doesn't even reach 10% (Demo, Bielek, Hronec, 1999) and intensive agricultural produce disturbs the stability of agroecosystems and causes habitat loading (Gábriš, 1998).

Intensive agricultural activities and urbanization cause the changes in landscape covering. This causes functional changes of ground usage. And this is the main purpose of landscape fragmentation (Baranec et al., 2007; Reháčková et al., 2007).

Anthropogenic activities, such as ground usage, recultivation, melioration, large-area deforestation, increase of built-up area causes differences in function of territory usage, landscape image, differences in ecological conditions and first able transformation or downfall of many natural landscape elements, from whose are many of them unique and non-recurring (Reháčková et al., 2007).

And so, it is the destruction of natural ecosystems and habitats (bio-centers), to which the men contributes significantly (by burning, deforestation, melioration, agricultural activity, emissions, fragmentation of the country) and is considered today as one of the most serious causes of extinction of organisms (Šteffek, 1995; Baranec et al., 2007).

Biocorridors are protected by Act of the National Council of the Slovak Republic No. 543/2002 on Nature and Landscape Protection, their meaning and manner of their protection deal with TSES, EECONET, PEEN, LANDEP, NATURA 2000. The reason why should we keep up and restore biological corridors is to provide Territorial system of ecological stability (TSES). While the diversity of flora of vascular plants in large-scale ecosystem of agricultural land use, is significantly affected by uniformity and the presence of synanthropic, invasive and expansive species, in the small-scale biotops, such as biocorridors, are able to survive populations of several phytogeographically important endangered species (Štrba and Kosár, 2012).

This is the reason to study and evaluate existing biocorridors in landscape. This article is focused at two biocorridors situated in south-west part of Slovakia. In the research we established the spatial parameters of

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biocorridor as the important structure parameter. Spatial parameters are the results of inserting ortophotomaps into AutoCAD program to obtain data about its length, width, perimeter and total area. Only hight of the trees were observed and reported in the terrain. Alien species are reported at 5 research plots in biocorridor of Žitava river and at 3 research plots in biocorridor Báb and are divided in the table. Those alien species has to be substitute by autochthonous species as follows.

2 Material and methods

2.1 Model bioccoridor of Žitava river

The first selected biocorridor is situated in cadastral territory of the village Horný Ohaj, district Vráble. It lies along the Žitava's river in its unregulated human part as the fragment of alluvial softwood forest. Evaluated part of biocorridor Horný Ohaj begins at the north end of village Horný Ohaj, direction to village Nová Ves nad Žitavou and ends at the south end of village Nová Ves nad Žitavou (Figure 1).

2.2 Model biocorridor Báb

The second biocorridor Báb is situated in cadastral territory of the village Veľký Báb, which is part of village Báb, district Nitra. Next to the studied biocorridor Báb is located valuable biocentrums. Biocentrum Bábsky les (National Nature Reserve with fifth degree of territorial protection) is located in cadastral territory of Veľký Báb village and biocentrum Bábsky Park (Protected Area with third degree of territorial protection). Biocentrum Bartov háj is located in cadastral territory of Malý Báb village.

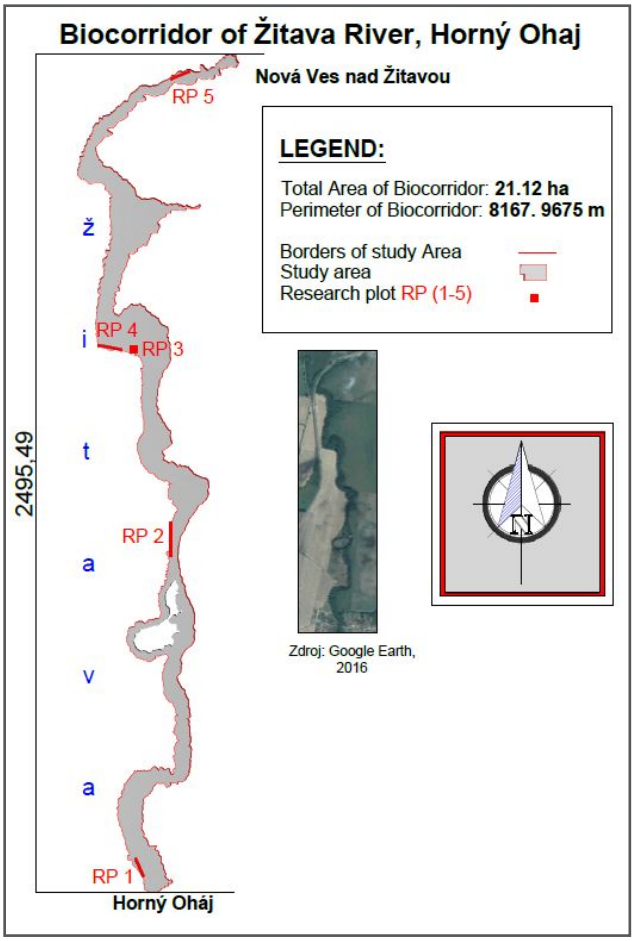

Figure 1 Spatial characteristics of Horný Ohaj biocorridor

The surrounded matrix of chosen biocorridors is made by intensively utilized agricultural landscape.

The first model of biocorridor of Žitava river has five research plots (Figure 1) and the second model of biocorridor Báb has three research plots (Figure 3).

The size of research plots in both biocorridors is about 400 m^2 (Zlatník, 1978; Mueller-Domboise and Ellenberg, 2003), with the respect of biocorridors shape. Phytocoenological reports with cover-abundance scale based on Zürich-Montpellier school were used during research (Braun-Blanquet, 1964).

Plant cover is determined from estimates of vertical plant shoots area projection as a percentage of quadrant area (Mueller-Domboise and Ellenberg, 2003). This article contains floristic output based on phytocoenological records. Scientific names of plants noted in report are used by Marhold and Hindák (1998). Maps of biocorridors have been processed in AutoCAD program to obtain research data about their spatial parameters (Figure 1, 3). Occurrence of the alien flora founded in research plots in both biocorridors is summarized into the table (Table 1). Alien species are divided at the base of inventory of alien species in Slovakia (Medvecká et al., 2012).

3 Results and discussion

Total area of biocorridor Horný Ohaj along the Žitava's river in its unregulated part between the villages Horný Ohaj and Nová Ves nad Žitavou occupies 21.12 ha and its perimeter is 8168 m, while the total area of research plots is 2024 m^2 (Figure 1). Biocorridor has curvy shape, based on river flow, with different width along the flow. Its length (measured straightly) is 2495 m and height is about 18 m (highest trees). Ecoton of this biocorridor is almost all around engaged with only some small missing parts closed to villages, where the anthropogenic influence is stronger.

From the total area of biocorridor 21.12 ha, at the 5 research plots with their size of 2024 m2 was founded total number 58 species in the year 2015. Three of those species are invasive alien species. Two of them *Negundo aceroides* Moench., *Robinia pseudoacacia* L. presents tree etage and *Impatiens parviflora* DC. presents herb layer. Those 3 invasive species (5% of all species) presents danger for biocorridor. Other 10 species (23% of all species) presents alien species which are naturalized

Table 1 Alien species of biocorridors Horný Ohaj along Žitava's river and Báb

	Species	IS	F	RT	TI	AB	O	LF	RP
1	*Arctium lappa* L.	nat	Asteraceae	arch	–	5	Eu, As	He	H.O. 1, 2, 3; B 2
2	*Balotta nigra* L.	nat	Lamiaceae	arch	–	5	Eu, As, Af	He	H.O. 4, 5
3	*Bryonia alba* L.	nat	Cucurbitaceae	arch	M	4	Eu, As	He, G	H.O. 1, 2, 3
4	*Carduus acanthoides* L.	nat	Asteraceae	arch	–	5	Eu	He	H.O. 1, 2, 3; B 1, 2, 3
5	*Conium maculatum* L.	nat	Apiaceae	arch	M	4	Eu, As	He, Th	H.O. 1, 5; B 3
6	*Convolvulus arvensis* L.	nat	Convonvulaceae	arch	I	5	Eu, As, Af	He, G	H.O. 5; B 2
7	*Chelidonium majus* L.	nat	Papaveraceae	arch	R	5	Eu, As	He	H.O. 5
8	*Impatiens parviflora* DC.	inv	Balsaminaceae	neo	1897	5	As	Th	H.O. 4, 5
9	*Juglans regia* L.	nat	Juglandaceae	neo	M	4	Eu, As	Ph	H.O. 5
10	*Lactuca serriola* L.	nat	Asteraceae	arch	M	5	Eu, As, Af	Th, He	H.O. 5 B 2
11	*Negundo aceroides* Moench.	inv	Aceraceae	neo	1794 (1830)	4	N. A.	Ph	H.O. 1, 3, 4, 5
12	*Prunus cerasifera* Ehrh.	nat	Rosaceae	neo	1890 (1940)	2	Eu, As	Ph	H.O. 3, 4; B 1
13	*Robinia pseudoacacia* L.	inv	Fabaceae	neo	1720 (1830)	5	N. A.	Ph	H.O. 1, 2, 3, 4, 5; B 1, 2, 3

Legend: IS – invasive status: inv – invasive, nat – naturalized; F – family; RT – residence time: arch – archaeophyte, neo – neophyte; Neophytes: first known occurrence of the taxon within the Slovakia and the year of the first known occurrence in the wild (brackets); Archaeophytes: N – Neolithic and Aeneolithic era (5700–1900 BC), I – Iron Age (700–0 BC), M – Medieval period (565–1500 AD), R – Roman and Migration period (0–565 AD); TI – time of introduction; AB – abundance of alien species in Slovakia (1 = 1–4 localities, 2 = 5–14 localities, 3 = 15–49 localities, 4 = 50–499 localities, 5 = more than 500 localities); O – origin of the taxon (N. A. – North America, Eu – Europe, As – Asia, Af – Africa); LF – life form (He – Hemicryptophyte, Ph – Phanerophyte, Th – Therophyte, G – Geophyte); RP – research plot of locality: B – Báb, H.O. – Horný Ohaj (Figure 1, 3 and Table 1)

(Table 1, Figure 2). None from alien casual species were recorded in biocorridor.

Total area of biocorridor Báb occupies almost 1 ha (0.9641 ha) and perimeter of evaluated biocorridor is 1485 m. Total area of research plots in biocorridor Báb is 1350 m^2 (Figure 3).

Biocorridor has the shape of strictly straight thin line, with almost equal width through the whole bioccorridor of 9 m, and its length of 700 m and its height of 10 m. Biocorridor has none ecotone.

From the total area 0.9461 ha, covers 1350 m^2 of research plots. At this plot size, through the 2015 year, was recorded occurrence of total 26 species. From the total number 26 of founded species, 19 presents autochthonous species (73%). Other 7 are allochthonous species (27%). Only one of them (4%) is invasive *Robinia pseudoacacia* L., other 6 are naturalized (23%) (Table 1, Figure 4).

In figures (Figure 2, Figure 4) is shown the ratio of autochthonous and allochthonous plant species. The highest ratio in both model biocorridors has

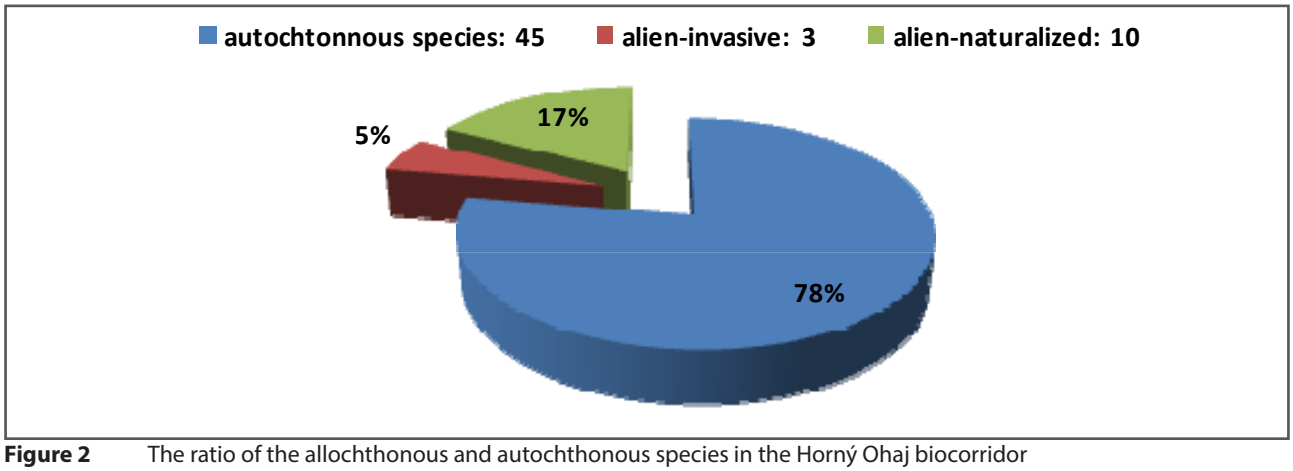

Figure 2 The ratio of the allochthonous and autochthonous species in the Horný Ohaj biocorridor

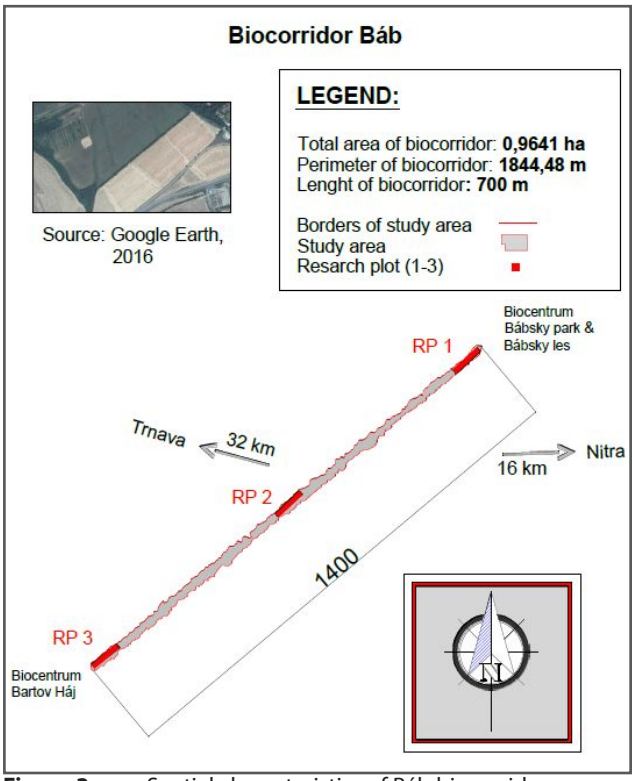

Figure 3 Spatial characteristics of Báb biocorridor

autochthonous plant species. In biocorridor Horný Ohaj (Figure 2) it is 45 autochthonous species (78% of all species). In biocorridor Báb (Figure 4) it is 19 autochthonous species (73% of all species). With total number of 58 species with occurrence in research plots, with its total area 2024 m^2, is the plant diversity higher in biocorridor Horný Ohaj. In biocorridor Báb has recorded 26 species at total area of research plots 1350 m^2. Those results give us an image about phytocoenological structure in biocorridors.

Most of the founded alien species in biocorridors come with the status naturalized (10 species) other three are invasive (Table 1). The highest ratio of alien species (23%) has the family Asteraceae (*Arctium lappa* L., *Carduus acanthoides* L., *Lactuca serriola* L). Total number of founded families in biocorridor is eleven (Table 1). Most of the plant species are archaeophytes (8 species). Other 5 species are neophytes.

Time of introduction refers the differences between the dates of introduction. As seen in table, the latest introducted alien species plant is *Impatiens parviflora* DC. through the year 1897 (Table 1, column TI). Most of the alien species were introducted from other parts of Europe and Asia. But the alien invasive species with the highest abundance number in Slovakia are introduced from North America. North America is represented by two most dangerous alien species founded in biocorridors *Robinia pseudoacacia* L. and *Negundo aceroides* Moench.

With the highest numbers of abundance (4–5) in Slovakia of the occurred species in biocorridor is *Prunus cerasifera* Ehrh., with the number of abundance 2 in Slovakia, exception. This means its occurrence is not as often in wildlife as the occurence of other alien species founded in our two model biocorridors. The only alien species founded in all research plots in both bocorridors is *Robinia pseudoacacia* L. Next most occurred tree, but only in locality Horný Ohaj, at almost all research plots is *Negundo aceroides* Moench. and the most occured plant from herb layer in the both biocorridors is *Carduus acanthoides* L. Most of the alien plants have the life form of hemicryptophyte.

These results refer us that the spreading of alien species is more remarkable in biocorridor along Žitava's river in natural biocorridor. As refers other authors – disturbed area (Žabka et al., 2015), near the watercourse (Pyšek and Prach, 1993; 1994; Säumel and Kowarik, 2010; Gális and Straňák, 2013a), contact area of city (Gális and Straňák, 2013b) and global climate changes make good conditions for spreading alien species, acclimatisation and naturalisation (Kramárová, 2004; Štrba and Gogoláková, 2008; Štrba, 2015).

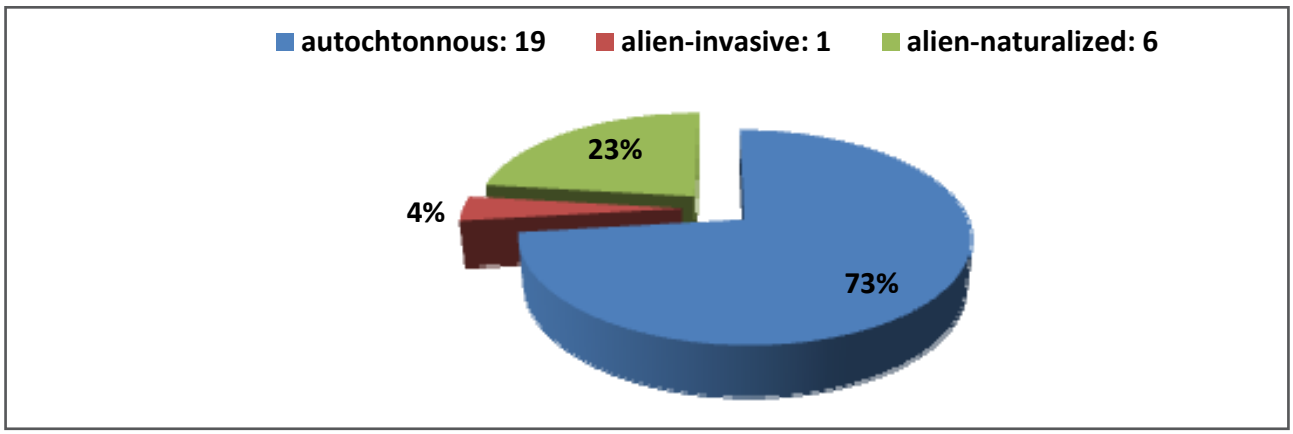

Figure 4 The ratio of the allochthonous and autochthonous species in the Báb biocorridor

4 Conclusions

The Žitava's river biocorridor as the fragment of alluvial softwood forest should by the representative biocorridor by its phytocoenological structure. With the recorded results it needs help to be proved as the representative bioccoridor in its area by removing alien species at first place. Spatial characteristics of this biocorridor meet the standard of regional biocorridor. At some part, where ecotone is missed, has to be restored.

Otherwise, Báb biocorridor presented by *Robinia pseudoacacia* L. in its all structure shouldn't be the representative biocorridor but from the results is obvious, that with its phytocoenological structure this biocorridor has even less alien species in compare with natural biocorridor of Žitava's river while the opportunity for invasion exists in surrounded areas. Adjacent biocentrums includes alien species, potential invasive weeds of agroecosystem. The only alien species *Robinia pseudoacacia* L. is the most representative species of biocorridor structure. This might be a good expectance for the biocorridor's future. And what do we expect is a total lost of alien species and bring back autochthonous plants. What has to be donne further is to layout absented ecotone to achieve biocorridors spatial parameters of the local biocorridor. This way ecotone would fulfill its protective function.

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