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Changes in forest phytodiversity caused by alien woody plants in Štiavnické vrchy Mts.

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Abstract: Phytodiversity is the foundation of life on Earth. It underpins the functionig of ecosystems from which the human derive essential products and services (known as ecosystem services), such as oxygen, food, fresh water and medicine. Healthy phytodiversity is essential to human wellbeing, sustainable development, and poverty reduction. The introduction of alien woody species in forest ecosystems has been caused some problems and has, at the same time, substantially changed the phytodiversity as well as the aesthetic harmony of the landscape. The alien woody plants in Štiavnické vrchy Mts. was introduced on the end of 19. and the beginning of 20. century, thanks to the Professors of the Mining and Forestry Academy in Banská Štiavnica City. The goal of introduction was growth and production study for scientific purpose, for forestry teaching processes and for forest management. In 2009 on the territory of the School Forest District Kysihýbel near the Banská Štiavnica City was founded 10 research plots in the oak – beech vegetation belt with the alien woody plants: *Pseudotsuga menziesii*, *Pinus strobus, Picea abies, Abies alba, Larix decidua, Pinus sylvestris, Pinus nigra, Robinia pseudoacacia.* In the comparative (reference) plots the native trees *Quercus petraea* and *Fagus sylvatica* has been dominant presentation. Especially *Robinia pseudoacacia* woods radical change the phytodiversity of the orginal forest association. There were evaluated changes in phytodiversity caused by alien woody plants using ecological spectrum of phytocoenoses and ecological demands of plants on the basic environmental factors – light, temperature, continentality, moisture, soil reaction and nitrogen in soil. The similarity of research plots was evaluated by statictic methods.

Keywords: phytodiversity, alien woody plants, ecological spectrum, Štiavnické vrchy Mts.

Introduction

The Convention on Biological diversity recommends that its Contracting Parties prevent the introdution of and the control or eradication of those alien species that threaten ecosystems, habitats or species. A recent United Nations/Norway Conference on Alien Species (SANDLUNG et al. 1996) has rewieved the impact of alien invasive vertebrates, invertebrates, plants, and microbes on terrestrial and aquatic ecosystems, agricultural production, and human health. The Conference´s 180 participants from over 80 developing and developed countries concluded that alien species are a serious threat, and for some countries, the most serious threat to biodiversity conservation worldwide (WAAGE 1996).

People introduce species to new ecosystems in two ways: either unintentionally, as contaminant on other goods, or intentionally, as aesthetically or agriculturally desirable species. Intentional introductions include garden ornamentals, grasses to improve pastures, fast growing trees for forestry or agroforestry, and plants for stabilizing degraded areas. After many centuries , a small but significant proportion of the flora of particular regions is now alien, ranging from five to 15 percent in most continental and island areas (TURLINGS 2001).

The introduction of alien species by people transporting them across biogeographical boundaries has, along with habitat destruction, been a major cause of ecological change throughout the world in the past few hundred years. Not all alien species are harmful. Several now form the basis of agriculture, aquaculture, and forestry worldwide while others are successful agents of biological control (CLOUT & LOWE 1997).

Introduction of woody alien species in condition of Europe has long history. Its beginning was directed from east to west (Asia-Europe) and by Romans gradually from south to north (mainly *Juglans nigra, Castanea sativa, Morus nigra)*. After discovery of the America it started also in direction west-east (North America-Europe, mainly *Robinia pseudoacacia, Pinus strobus, Pseudotsuga menziesii*). Both direction continue (BENČAŤ, F. 2002). Black locust *Robinia pseudoacacia* L., also False – acacia, has been planted as an ornamental in Canada and has seeded itself in many localities (HOSIE 1969).

Introduction of alien woody species in Štiavnické vrchy Mts began in 19th century thanks to professors of Mining and Forestry Academy in Banská Štiavnica city. The goal of introduction was growth and production study for scientific purpose, for forestry teaching processes and for forest management.

The term „introduction“ first used by HANSEN in the world 1848. The introduction of plants is scientific-research direction examining methods of enrichment of landscapes or areas of the new species, hybrids, varieties and forms of wild flora and culture flora and exploring their bio-ecological well-being as well as their relationships to the domestic flora (BENČAŤ F. 2002).

Alien species (synonyms: non-native, non-indigenous, forein, exotic) is species, subspecies, or lower taxon introduced outside its normal past or present distribution; includes any part, gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce.

Native species (synonym: indigenous species) is a species, subspecies, or lower taxon living within its natural range (past or present), including the area which it can reach and occupy using its own legs, wings, wind/water-borne or other dispersal systems, even if it is seldom found there.

Naturalized species is alien species that reproduce consistently and sustain populations over more than one life cycle without direct intervention by humans (or in spite of human intervention); they often reproduce freely, and do not necessarily invade natural, semi-natural or human-made ecosystems (MCNEELY et al. 2001).

The issue of alien woody plant introduction in Slovakia to deal especially with BENČAŤ F. (1982, 2002), BENČAŤ T. (2009), BLATTNÝ & ŠŤASTNÝ (1959), BUBLINEC (2002), ELIÁŠ (1997), GOJDIČOVÁ et al. (2002), GRÜNWALD & JADAŠ (1978), HLAVÁČEK (1985), HOLUBČÍK (1960, 1968), JURKO (1963, 1963), KELBEL & ADAMČÍKOVÁ (2011), KONTRIŠ et al. (1995), KRUŽLICOVÁ & VOLOŠČUK (2010), LONGAUER et al. (2002), MAGIC (1997), PAGAN & RANDUŠKA (1988), SOKOL (1956), ŠÁLY (1954), ŠČEPKA (1982, 1983), ŠIMONOVIČ et. al. (2002), TOKÁR (2002), VOLOŠČUK (1981, 2002), VOLOŠČUK & KRUŽLICOVÁ (2010), WIEZIK (2005) and others. VOLOŠČUK (1981, 2002) was the first to deal with the issues of alien woody plants in Protected Areas of Slovakia. WIEZIK (2005) studied the effect of alien woody plants in the beetle communities of the Štiavnické Hills.

Foreign authors in relation to the alien woody species (the most attention gave to *Robinia pseudoacacia, Pseudotsuga menziesii* and *Pinus strobus*): BARTHA (2002), BERGMANS W. & BLOM E. (2001), BOHREN et al. (2011), BORING & SWANK (2001), CLOUT & LOWE (1997), DIESING & GÖDDE (1989), DZWONKO & LOSTER (1997), ELLENBERG (1982), FEJLÖLDI (1947), GÖHRE (1952), HOSIE (1969), CHMELÁŘ (1983), KERESTÉSI (1988), KLUCK (1986), KOHLER & SUKOPP (1964), KOHLER (1968), KOLBEK et al. (2004), MAJER (1968), MUCINA et al. (1993), NĚMEC (1981), OBERDORFER (1992), PACYNIAK (1981), PYŠEK et al. (2002), SVOBODA (1953), SWIERKOSZ (1993), VADAS (1914), VITKOVÁ (2004), VITKOVÁ et al. (2003, 2004), WAAGE (1997), WEBER, E. (1997).

The black locust *(Robinia pseudoacacia)* is considered as invasive introduced woody plant, because is distributed by seed spontaneously (SUPUKA 1997, BERGMANS & BLOM 2001, TURLINGS 2001). Invasive alien species is alien species whose establishment and spread threaten ecosystems, habitats or species with economic or environmental harm (MCNEELY et al. 2001).

In Štiavnické vrchy Mts. *Picea abies, Abies alba, Pinus sylvestris, Larix decidua* and *Pinus nigra* there are considered as alien (non native) woody species in relation with natural conditions of oak – beech vegetation belt (ZLATNÍK 1956, VOLOŠČUK 2004).

Material and methods

Štiavnické vrchy Mts belong to the Slovak Central Highlands, the phytogeographic area *Carpaticum occidentale*, circuit *Praecarpaticum* (PLESNÍK 2002). From landscape complex dominated highlands (MAZÚR & LUKNIŠ 1986). Štiavnické Hills are our largest volcanic mountain range with representation from all phases neovolcanic rocks. Cambisoils are predominant. Kysihýbel model territory belongs to the cold climate zone C, moderately cold region C_1 (MIKLOS et al. 2002).

During 2009 and 2010 on the territory of the School Forest District Kysihýbel near the Banská Štiavnica City was founded 10 research plots in the oak – beech vegetation belt with the alien woody plants. Plot 1: *Pinus sylvestris* L*.,* plot 2: *Quercus petraea* (Matt.) Lieb., plot 3: *Picea abies* (L.) H. Karst*,* plot 4: *Larix decidua* Mill*.,* plot 5: *Abies alba L.,* plot 6: *Pinus strobus* L*.,* plot 7: *Pseudotsuga menziesii* (Mirb.) Franco, plot 8: Fagus sylvatica L., plot 9: *Robinia pseudoacacia* L*.,* plot 10: *Pinus nigra* Arn. Altitude of research plots is in the range of 470 – 680 m. Slope gradient is mainly 5-15^0. Soil type is modal cambisol on the andesite bedrock (VOLOŠČUK & KRUŽLICOVÁ 2011).

Geographical locations (using GPSMAP 60CSx) of research plots: plot 1: N 48° 26.189, E 18° 57.429, plot 2: N 48° 26.302, E 1 8° 57.482, plot 3: N 48° 26.390, E 18°57.176, plot 4: N 48°26.365, E 18°5 7.207, plot 5: N 48°27.876, E 18° 56.872, plot 6: N 48° 27.876, E 18° 56.872, plo t 7: N 48° 27.864, E 18° 56.788, plot 8: N 48°27.784, E 18°56.792, plot 9: N 48°26.824, E 18°56.711, plot 10: N 48°29.324, E 18°56.768.

In comparative (reference) plots 2 and 8 the native trees *Quercus petraea* (Matt.) Lieb. and *Fagus sylvatica* L. has been dominant presentation. Phytosociological records were made in the summer (July-August) 2009 and 2010. Area of recorded plots was 20x20 m. Abundance and dominance of the herb species and sociological status of the woody plants under layers were evaluated by ZLATNÍK (1978). Names of plant species, according to work MARHOLD & HINDÁK (1998). Name of group of forest types was according ZLATNÍK (1956) and name of group of forest geobiocenoses under ZLATNÍK (1978). Abundance of plants in phytocenoses, Jaccard and Sörensen index are presented in Tab. 1.

Forest communities of research plots belong to the group of forest types *Querceto-Fagetum* (ZLATNÍK 1956) and group of geobiocenoses *Fagi querceta typica* (ZLATNÍK 1976). According the Zürich-Montpellier vegetation classification the investigated forest phytocenoses belong into class *Fagetea* and order *Luzulo-Fagion*. Autochton trees of this forest group of types are predominantly *Fagus sylvatica, Quercus petraea, Carpinus betulus* with lower presentation of *Acer platanoides, A. pseudoplatanus, Tilia cordata* and *T. platyphillos* (VOLOŠČUK 2004).

Tab. 1. Plant cover; Jaccard index; Sörensen index; Index of dominance; Dry biomass of plants.

Research plot	Plant cover	Jaccard index	Sörensen index	Index of dominance	Dry biomass (g/m^2)
1 *Pinus sylvestris*	+ - 5	33.35	50.00	78.35	11.45
2 *Quercus petraea*	80	-	-	86.09	109.30
3 *Picea abies*	30	5.00	9.52	81.64	17.30
4 *Larix decidua*	80	27.27	42.86	89.29	124.96
5 *Abies alba*	80	20.83	34.48	65.20	84.60
6 *Pinus strobus*	+ - 10	18.52	31.32	45.22	16.94
7 *Pseudotsuga menziesii*	80	16.00	27.59	37.31	87.42
8 *Fagus sylvatica*	75	11.76	21.05	87.03	234.07
9 *Robinia pseudoacacia*	95	8.11	13.63	69.95	-
10 *Pinus nigra*	+	0	0	1,00	-

Ecological evaluation of the pytocenoses influenced by alien woody species in oak-beech vegetation belt (group of forest types *Querceto-Fagetum*) held by analysis of ecological groups of species and ecological profile of the communities using ecological Ellenberg numbers characterizing the relationship of species to environmental factors – light (L), temperature (T), moisture (M), continentality (C), soil reaction (R) and soil nitrogen (N). Methods folow KRIŽOVÁ & NIČ (2002), KRIŽOVÁ, UJHÁZY &. NIČ (2010). Soil properties were evaluated based on laboratory analysis of soil samples taken from research plots (pH/H_2O, pH/KCl). Plant samples (1 m^2) of research plots were dried (Tab. 1).

The result of the ecological analysis of research plots phytocenoses is the ecological spectrum, which gives an owerview of the variation of plant species rights in relation to environmental factors. Ecological indexes was used by ELLENBERG (1982). The calculation was performed according the metods of KRIŽOVÁ & NIČ (2001), and KRIŽOVÁ, UJHÁZY & NIČ (2010). The everage ecological numbers of research plots characterize their habitats. There are listed in Tab. 2. For statistical analysis of the research plots ecological numbers were used descriptive statistics – mean, median, standard deviation and coefficient of variation – COV (Tab. 3). Spearman correlation coeficient was used to find the interdependencies between ecological numbers. The similarity between the surfaces is found by using Euclidean distance of research plots in space of everage econumbers (Tab. 4). For ease of interpretation and graphical representation of the methods has been applied to major components of everage econumbers of environmental factors (Tab. 5). To view the data was used boxplots of everage econumbers (Fig. 1, 2). The similarity of research plots, calculation and graphs were done in statistic system SPSS version 18 and MYSTAT version 12.

Chemical analyzes of soil samples from research plots were done in the Laboratory of the National Forest Centre in Zvolen. Determined the ratio of C/N values and pH/H_2O, pH/KCl (Tab. 6).

Tab. 2. Average ecological numbers for environmental factors L – light, T – temperature, C – continentality, M – moisture, R – soil reaction, N – nitrogen in soil

Research plot	L	T	C	M	R	N
1 *Pinus sylvestris*	3.06	4.99	2.29	5.00	6.02	5.93
2 *Quercus petraea*	2.95	5.02	2.63	5.01	6.32	5.89
3 *Picea abies*	2.61	5,03	2.30	4.98	5.98	5.12
4 *Larix decidua*	6.55	4.10	3.83	5.00	6.20	5.40
5 *Abies alba*	3.39	5.00	2.66	5.04	5.78	5.51
6 *Pinus strobus*	3.00	5.35	3,90	5.08	6.36	5.84
7 *Pseudotsuga menziesii*	3.10	5.22	3.46	5.07	6.31	5.56
8 *Fagus sylvatica*	3.59	5.68	4.44	5.01	5.60	5.28
9 *Robinia pseudoacacia*	5.26	5.36	3.94	5.08	6.55	6.26
10 *Pinus nigra*	6.00	5.00	4.50	5.00	5.00	5.00

Tab. 3. Basic statistical characteristics

Environmental factor	Minimum	Maximum	Mean	Std. Dev.	Skewness		Median	COV
Light	2.61	6.55	3.95	1.43	1.08	0.69	3.25	0.361
Temperature	4.10	5.68	5.08	0.41	-1.32	0.69	5.03	0.081
Moisture	4.98	5.08	5.03	0.04	0.55	0.69	5.01	0.007
Continentality	2.29	4.50	3.40	0.86	-0.14	0.69	3.65	0.252
Soil Reaction	5.00	6.55	6.01	0.46	-1.25	0.69	6.11	0.076
Soil Nitrogen	5.00	6.26	5.58	0.40	0.18	0.69	5.54	0.071

Tab. 4. Euclidean distance of research plots in space of average econumbers

Plots	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	0.000	0.469	0.929	3.957	0.694	1.690	1.284	2.445	2.845	3.928
2	0.469	0.000	0.966	3.937	0.795	1.317	0.930	2.239	2.713	3.916
3	0.929	0.966	0.000	4.342	0.967	1.867	1.390	2.477	3.385	4.160
4	3.957	3.937	4.342	0.000	3.515	3.794	3.652	3.465	2.033	1.778
5	0.694	0.795	0.967	3.515	0.000	1.503	1.028	1.938	2.534	3.327
6	1.690	1.317	1.867	3.794	1.503	0.000	0.549	1.282	2.307	3.470
7	1.284	0.930	1.390	3.652	1.028	0.549	0.000	1.414	2.337	3.402
8	2.445	2.239	2.477	3.465	1.938	1.282	1.414	0.000	2.238	2.591
9	2.845	2.713	3.385	2.033	2.534	2.307	2.337	2.238	0.000	2.233
10	3.928	3.916	4.160	1.778	3.327	3.470	3.402	2.591	2.233	0.000

Tab. 5. The basic components of average econumbers

Component		Initial Eigenvalues			Extraction Sums of Squared Loadings
		Total	% of Variance	Cumulative %	Total
dimension	1	2.511	41.856	41.856	2.511
	2	1.637	27.289	69.145	1.637
	3	1.333	22.223	91.369	1.333
	4	0.287	4.782	96.150	
	5	0.187	3.114	99.264	
	6	0.044	0.736	100.000	

Tab. 6. C/N ratio and value of pH/H_20, pH/KCl in soil horizont 0 – 5 cm.

Research plot	C/N	pH/H_20	pH/KCl
1 *Pinus sylvestris*	18.92	5.02	4.33
2 *Quercus petraea*	13.96	5.66	5.10
3 *Picea abies*	17.14	4.55	3.92
4 *Larix decidua*	16.44	5.53	4.97
5 *Abies alba*	16.48	5.55	4.91
6 *Pinus strobus*	13.77	5.18	4.64
7 *Pseudotsuga menziesii*	14.79	5.54	4.69
8 *Fagus sylvatica*	14.92	5.81	5.07
9 *Robinia pseudoacacia*	14.00	6.00	5.45
10 *Pinus nigra*	23.50	4.10	3.55

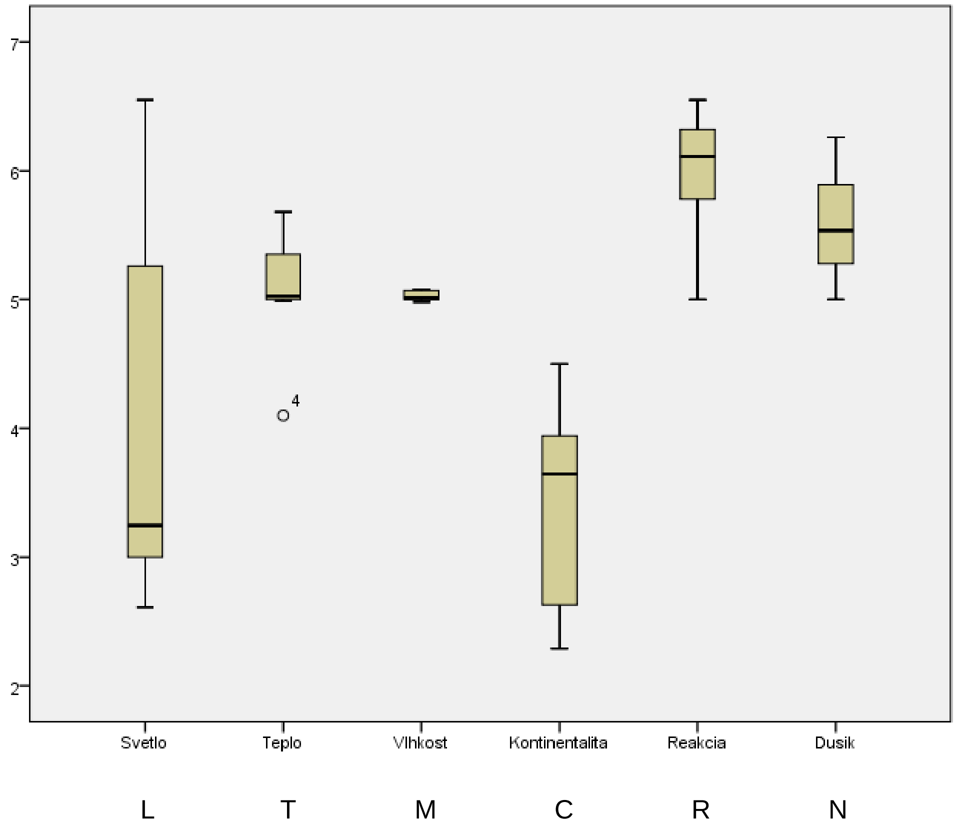

Fig. 1. Boxplots of average econumbers

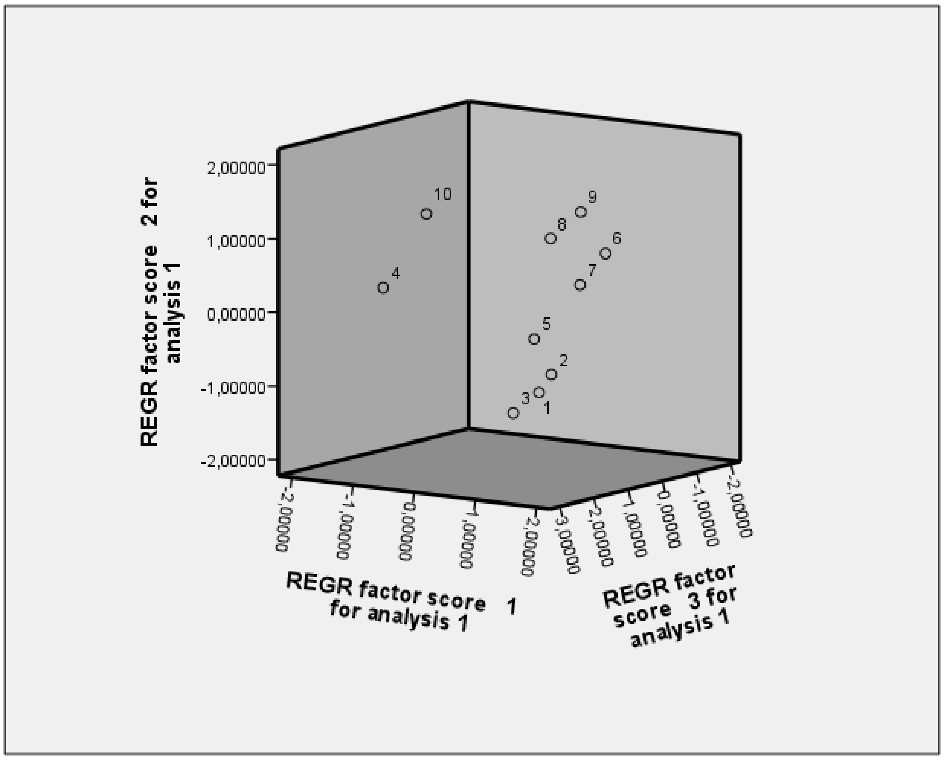

Fig. 2. Research plots in space of the first three basic components

Results and Discussion

Biodiversity of Štiavnické vrchy Mts. on all its levels in the past most affected mining activity and metalurgy. Forests of this region are moreover modified by clearing, conversion to cropland, pasture, and urbanisation. The diversity of plant and animal communities of the native mixed hardwood forest ecosystems dominated by oak and beach in past centuries was significantly exploated and impoverished of new afforestation often non-native woody plants and introduced alien trees.

Alien woody plants were planted in the model area Kysihýbel the original oak-beech stands in front of about 80 to 100 years ago. The first generation of *Pinus strobus, Pseudotsuga menziesii, Picea abies, Abies alba, Pinus sylvestris* only partially affected the process of humus, resulting in the herb layer are preserved and beech mesophyt mesotrophic species. In plots with *Pinus sylvestris* (1), *Quercus petraea* (2) and *Fagus sylvatica* (8), most occur *Melica uniflora* and *Carex pilosa*. In plots with *Picea abies* (3), *Larix decidua* (4), *Abies alba* (5), *Pinus strobus* (6) and *Pseudotsuga menziesii* (7) predominate beeches species such as *Galium odoratum, Dentaria bulbifera* and *Viola reichenbachiana*. On the plot with *Larix decidua* (4) dominated *Rubus hirtus*. According to our research in spruce monoculture first generation significantly reduced cover of herbs, but keep the beeches species *Galium odoratum*. Soil reaction of cambisols on research plots reaches similar values as the ŠÁLY (1978, 1998) for cambisols Slovakia. The shift to more acidic reaction was observed in plots dominated by *Pinus sylvestris, Picea abies, Larix decidua* and *Abies alba*.

The value of pH/$H_2$0 and pH/KCl in humus horizont ranged from 4.55 to 5.81, respectively 3.92 to 5.07 and the ratio C/N from 13.77 to 18.92 (23.5) basically correspond with those ŠÁLY (1998), BUBLINEC (2002), TOKÁR (2002) and shows a relatively high quality of humus forms.

Robinia pseudoacacia L. – Black Locust

However, special attention should be given to effects of *Robinia pseudoacacia* (plot 9) to the herbal layer. Statistical analyzes show that the black lokust causes a shift to neutral soil reaction values with high levels of nitrogen in the soil, which correspond with BUBLINEC (2002) and TOKÁR (2002). Characteristics of Euclid distance shows that according to the values of econumbers of phytocenoses biggest differences from referring plot with *Quercus petraea* shows the plot with *Larix decidua* (3.937), *Pinus nigra* (3.916) and *Robinia pseudoacacia* (2.713).

The introduction of alien species has been the cause of many problems and has, at the same time, substancially changed the biological character as well as the aesthetic harmony of the landscape. This is especially the case with the *Robinia pseudoacacia* where a radical change has set in the original forest associations (JURKO 1963). Although there is a general consensus regarding the negative effect of alien species, studies that quantify community – level effects of alien species are still scarce (BERGMANS & BLOM 2001, BOHREN ET AL. 2011, BORING & SWANK 1984). Alien exotic species and habitat destruction are the major causes of biodiversity loss (CLOUT & LOWE 1997, DZVONKO & LOSTER 1997, DIESING & GÖDDE 1989, JURKO 1965, KERESZTÉSI 1988, KLUCK 1986, KOHLER 1968, KOHLER & SUKOPP 1964). Some alien species become invasive by modifying the structure of mycorrhizal community, soil microbial activity and by disturbing native plant regeneration in the host ecosystems. Perturbations caused by alien species on native plants regeneration and on soil microbial dynamics are the MAYOR PROBLEM IN TERMS OF BIODIVERSITY CONSERVATION (BUBLINEC 2002, ELIÁŠ 1997, KELBEL & ADAMČÍKOVÁ 2011, KOLBEK et al. 2004, KONTRIŠ et al. 1995, GÖRE 1952, FEJLÖDY 1947, CHMELÁŘ 1983, KRUŽLICOVÁ & VOLOŠČUK 2010, MAGIC 1997, NĚMEC 1981, PACYNIAK 1981, SWIERKOSZ 1993, ŠÁLY 1963, ŠČEPKA 1982, 1983, ŠIMONOVIČ et al. 2002, TURLINGS 2001, VADAS 1914, VITKOVÁ et al. 2004, VITKOVÁ 2004, VOLOŠČUK 1981, 2002, WIEZIK 2005).

The black locust is native in the inner part of Eastern North America. The area is crumbled into more patches. The largest is the central area in the Appalachian Mountains where the species finds its optimum between 150 and 1500 meters above see level and common in the species rich forests. The Eastern part of the area extends from Central Pennsylvania South Ohio to North-East Alabama and

North –Georgia. To West and South from here it can be found at smaller and isolated spots (BARTHA 2002).

At present the black locust is the second most frequently cultivated broad leaved tree species in the world. Jean Robin the royal gardener of Louis XIII brought it in 1601 from Virginia, the USA, to France where it is attracted great attention for a long time. Nowadays the overall estimated area of the black locust plantations is 3,35 million hectares. The black locust is planted to avoid erosion in the steep slopes and chasmy hillsides in South-East Europe and Asia at many locations (BARTHA 2002, JURKO 1963). It was introduced to Austro-Hungarian Monarchy between 1710 and 1720 and planted in the beginning as ornamental tree in parks and alley. It was used firstly for forestation in 1750 around the Fortification of Komárno on 290 hectares. The forestation proved successful and it was started to plant on the most different soils like alkali soils, blowing sand (BUBLINEC 2002). In the national afforesting started after the 2nd World War the black locust became one of the leading species (BARTHA 2002). Black locust woods in the warm regions of Central Europe have taken possession of enormous areas and will remain permanent components of landscapes (BENČAŤ 1982, 2002, JURKO 1963, HOLUBČÍK 1960, 1968, HADAČ & SOFRON 1980, LONGAUER et al. 2002, MUCINA et al. 1993, OBERDORFER 1992, SOKOL 1956, SVOBODA 1953).

The black locust is very demanding to the air of the soil and cannot bear the too high soil moisture. Above the up most level of the optimal ground water needed 100-120 cm soil (BENČAŤ 2009). If the soil is compacted and the water not drained therefore the water can accumulating on the surface the conditions not favorable and if the water is stagnating the black locust cannot survive. The black locust need for nutrients is low and it has the largest demands at the beginning of the vegetation period. The black locust gives relatively small amounts of organic matters to the soil and therefore not serve good base to the forming of humus. The annually falling foliage and other organic matters are not decomposed in one year. In the case of the black locust the limiting factor are the water supply meanwhile the soil nutrient content plays secondary role (BUBLINEC 2002).

Where the black locust settles, practically not possible to eliminate, its ability to form off shoots the colony forming vegetative propagation and the accumulating minimum for a half century vital seeds assure not only the regeneration but exceptional conservation and gain on area of the species (JURKO 1963).

The black locust converts its habitat considerably. To the very intense evaporation the expanded root age ensure the water and by this way decrease the possibilities of the neighboring plants for water intake. The mass of the leaves is small and decompose fast, it gives nitrogen and calcium abundantly but phosphorus and potassium in very small quantities to the soil. Partly due to the high nitrogen content of the falling litter around the black locust individuals the nitrogen content of the topsoil is high. At the most habitat types the repeated cultivation of the black locust results considerable fallback in growth what can be caused by the soil exploitation of the species or by the unfavorable microbiologic processes (BUBLINEC 2002, JURKO 1963).

Pinus strobus L. - Eastern White Pine, Weymouth Pine

This species produces the most valuable softwood lumber in USA and Eastern Canada. The name Weymouth Pine comes from Lord Weymouth who planted large areas of his estate in Wiltshire, England, with seedlings which he imported into England during the 18th Century. Eastern White Pine is found on many different soils, from dry sandy and rocky ridges to sphagnum bogs, but it makes its best growth on moist sandy or loamy soils (HOSIE 1969). It may grow in pure stands or in association with other conifers and hardwoods.

Pseudotsuga menziesii (Mirb.) Franco – Douglas Fir

One of the best known timber-producing trees in the world market, not only used for structural purposes (for which it is noted) but also for ship-building, interior and exterior finishing, box making, flooring, silos, veneer, plywood, railway ties, poles, piling, harboard, pulp and barrel - making, to mention only a few of the many uses of this valuable tree. Douglas – fir is found on a variety of soils, but makes its best growth on deep well-drained, sandy loams where both soil moisture and atmospheric moisture are plentiful. The tree is characterized by a long, branch-free, cylindrical trunk and a short, columnar and fiat-topped crown. Young trees are very attractive, with narrowly conical crowns that extend to the ground (HOSIE 1969).

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