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SANDPIT LAKES VEGETATION IN THE TŘEBOŇ BIOSPHERE RESERVE: EFFECT OF ANTHROPOGENIC ACTIVITIES

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Abstract

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Eleven lakes belonging to four freshwater systems were investigated in the Třeboň Basin Area (Cep, Tušť, Halámky and Veselí) in 2004. These lakes, some over ten meters deep were formed after completion of mining activities under the groundwater level. The majority of them are slow flow rate systems and have oligotrophic to mesotrophic character. The succession of plant and animal associations was affected by various types of post-mining activities (recreation, angling and forestry). Phytocoenological relevés of littoral stands and floristic lists of plants concluded that the sandpit lakes are suitable localities not only for plant species common in other wetland biotopes (i.e. fishpond littorals) but also for species protected by the Environmental Law – CZ No. 395/1992. The presence of endangered species of plants and animals has been recorded in a number of sandpit lakes after discontinuation the sand mining.

Key words: sandpit lakes, vegetation, succession, *Illecebrum verticillatum, Lycopodiella inundata, Drosera rotundifolia, Lysimachia thyrsiflora*

Introduction

The landscape of the Třeboň area is a typical anthropogenic and well balanced system formed during the centuries of human activity (Jeník et al., 1996). The Lužnice river with its large alluvium and rich winding stream is a natural axis of the whole area. The extensive fishpond ecosystems (Dykyjová, Květ, 1978) and new freshwater and marsh ecosystems of sandpit lakes are connected through the Lužnice river. The sandpit lakes are man-made, but semi natural lakes sometimes tens of meters deep and with an area from several hec-

tares to more than hundred hectares. The littoral of the sandpit lakes present a large variety of habitats. They differ by the thickness (presence) of organic soil horizon, availability of water, dynamic of ingrowths macrophytic vegetation and different degree of trophic conditions – from oligotrophic to eutrophic. Such diversity of conditions allows for studying of the general processes of formation of water and marsh ecosystems in the anthropogenically impacted area (sand extraction, recreation and angling).

It is possible to trace back the origin of lake vegetation through the vegetation of marshes, periodic alluvia, pools and flowing waters. The basic characteristic of freshwater macrovegetation occuring in natural habitats is its high adaptability to water level fluctuation, for periodic exposure of bottom and for different levels of nutrients (Hejný et al., 1996). The specific combination of biotic and abiotic factors determines the plant composition within the specific biotopes. It is important to understand the specific conditions of flooded areas because of its importance for survival of endangered species. Eventually all communities that are disappearing as a result of the anthropogenic disturbances of the surrounding landscape.

The sandpit lakes are substantially neglected biotopes in comparison with other types of wetlands. The only methodical study accomplished in the 1990, studied the sandpit lakes as new water areas with various types of human use (Krupauer et al., 1990). There was a need to accomplish the actual comparative vegetation study of individual lakes at the present moment and compare it with the vegetation of other wetland biotopes.

The objective of this work was to describe the present situation of these ecosystems in terms of functioning, basic processes and trends in association with marsh vegetation. The experiences respecting the development of associations and water quality could be used for prediction and planning of newly originating flooded areas. This knowledge could be considered as a principle for management and protection of these ecologically important biotopes.

Materials and methods

Site description

Several study sites are situated within four systems along Lužnice river (Table 1, Fig. 1).

Halámky system on the right shore of the Lužnice river includes four lakes near Halámky village: North, Middle, South and East lake. Intensive extraction of gravel sand was not done within this system. The shores, which were not forested (in contrast to other sites), are unique in terms of succession of littoral plant associations.

Cep system on the left shore of the Lužnice river (near Cep village) is formed by the lake Cep (the largest of all) and southern lake Cep I in 2000. In 2001, the gravel sand bar between the lakes was removed and a great deal of the water subsequently flew from Cep I into Cep.

Tušť system includes lakes Tušť and Františkov on the right shore of the Lužnice river in the cadastral area the village of Františkov. The extraction of this locality ended in 2000.

Veselí system includes five lakes situated in the alluvium of the Lužnice river. Two lakes (Horusice and Horusice I) are situated on the left shore. These lakes are highly eutrophic by inflow from the near fishponds and run-off from the agricultural land. The other three lakes (Veselí, Veselí I, Vlkov) are situated on the right shore of the Lužnice river.

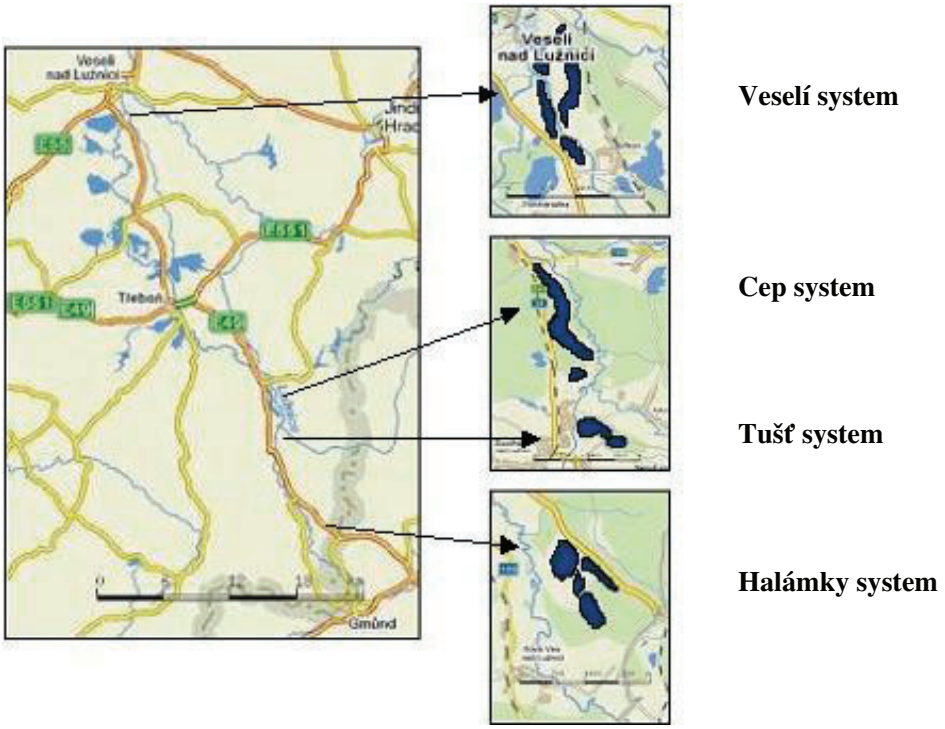

Fig. 1. Map of sites of study sandpit systems in Třeboň Biosphere Reserve.

T a b l e 1. The overview of several sandpit lakes parameters (Rajchard, Procházka, 2001)

Sandpit lake	System	Water table area (ha)	Average depth (m)	Exploitation in
Cep	2	123	7	1949–2006
Cep I	2	40	6.5	1983–2006
Tušť	3	39.5	5	1955–2000
Františkov	3	9	4.5	1970–1975
Halámky North lake	1	33.47	16	1970–1994
Halámky South lake	1	18.75	4	1976–1985
Halámky Middle lake	1	22.74	14	1976–1979
Halámky East lake	1	Mining	17	1976–2006
Horusice I	4	15	2.5	1977–1986
Horusice	4	23	6.5	1972–1983
Veselí I	4	24	3.5	1981–1986
Veselí	4	10	3.5	1963–1986
Vlkov	4	46	2.8	1963–1986

Vegetation of the sandpit lakes

The state of the vegetation was documented on 11 sandpit lakes in 2004. The data included two types of vegetation records:

The first kind of records was focused at documenting the main features of the vegetation with respect to vertical structure and dominant plant species, as related to main environmental characteristics and human impact. Records were taken in squares placed at regular distances along the shores of each sandpit lake during the summer of 2004. The distances between squares were set separately for each lake in order to obtain similar numbers of records (15 to 18) per lake. The area (5x5 m) and position of the squares on the elevation gradient were selected so that the squares included all types of the shore vegetation, from aquatic to terrestrial. Total vegetation cover, total height of the vegetation and dominant plant species and cover of single vegetation layers were recorded for each square (E1, E2a, E2b, E3). If woody plants were present in the square, their probable origin was characterised by categories "natural succession", "plantation", or "original wood". In addition, the following characteristics were assessed for each square: slope exposition, the shore profile and main types of human impact (sand extraction, angling, bathing, paths).

The second kind of records was aimed to document the species richness of the littoral vegetation. Standard phytosociological relevés were placed on species-rich sites of varying slope exposition. Eight relevés were taken at each lake. The size of the relevés was determined by the width of the belt of the littoral vegetation and a distance of 5 m of the shoreline. All plant species were recorded using the seven-degree abundance-dominance scale according to Braun-Blanquet (Dierschke, 1994). The following characteristics were recorded in the same manner as in the first kind of records: total vegetation height and cover of particular vegetation layers, slope exposition, the shore profile, main types and extent of human impact. In addition, thickness of organic horizon, degree of shading, water level and water transparency were recorded.

Gradients in vegetation and the environment were reconstructed using the DCA algorithms of the CANOCO 4.5 package (ter Braak, Šmilauer, 2002). The percent frequency of the species was used and rare species were downweighted. The vegetation data set was subjected first to Detrended Correspondence Analysis (DCA), in order to assess the overall variation patterns in species composition. Ordination site scores were correlated to environmental factors using Pearson´s correlation coefficient. All environmental variables were plotted onto DCA ordination diagrams as supplementary environmental data for better ecological interpretation of the axes.

Results and discussion

Vegetation structure and species composion

A total of 196 relevés, evaluated on eleven sandpit lakes, documented the dominant plant species, total vertical structure and the degree of human impact. 10 to 70% of the area of the studied localities were affected by human activities. The sandpit lakes in Veselí system were the least affected lakes. In sandpit lakes where the sand extraction is still running or has recently been ended, the human affects about 50% area. The sandpit lake Cep I is extremely affected (almost 70% of its area). The types of human impacts were closely associated with the history of the sandpit lakes. Veselí and Tušť systems were especially affected by recreation (bathing and angling). Cep and Halámky systems were influenced by the current or recently completed extraction. Neither the monitored activities, nor the characteristics of vertical structure had a significant relation to the lake age (defined as a number of years from beginning of the sand extraction). The number of years from the start of the sand extraction had a significant relation to the growth of E2b layer. The hard

littoral flora usually dominated there. The recreational activities were inversely corelated with the total vegetation cover and the growth of E2b layer. All of 14 tree species and 59 herbaceous plant species with a minimum cover of 5% were documented on the 11 monitored sandpit lakes. The most frequent trees were *Betula pendula* and *Populus tremula*, particularly in Veselí system. *Pinus sylvestris* and various willow species (*Salix* spp.) were detected in most sandpit lakes disregarding their age. The most frequent herbaceous plant species were *Calamagrostis epigejos*, *Tanacetum vulgare* and *Rubus* spp. in sunny areas of terrestrial ecophases and *Agrostis stolonifera* in shaded areas. The hard littoral vegetation dominated in limosal and littoral ecophases. It included *Phalaris arundinacea*, *Phragmites australis* and *Carex acuta* especially on Veselí system. *Phragmites australis* and *Carex acuta* were documented as often as *Pinus sylvestris* on every sandpit lake disregaring of the age. *Juncus* spp. dominated littoral habitats especially in Tušť and Halámky systems.

Total of 158 plant species of littoral vegetation were detected. The highest species abundance was found on lakes Horusice I (78 species) and Cep (72 species). The lowest species abundance was found on lakes Frantoškov and Halámky – South lake (41 species). The tree

T a b l e 2. The main human activities and vegetation structure of 11 sandpit lakes in Třeboň Biosphere Reserve

Sand-pit	Hor	Hor I	Veselí	Veselí I	Vlkov	Cep	Cep I	Františkov	Tušť	HSJ	HJJ
Start of mining	1972	1977	1963	1981	1963	1949	1983	1970	1955	1970	1976
End of mining	1983	1986	1986	1986	1986	2005	2005	1975	2000	1994	1985
Effect of human activities											
Mean area affected (% total area)	27	11	16	15	19	22	72	54	58	50	32
Occurrence of human impact (% of total number of relevés)											
Paths	31	59	53	18	12	65	38	24	33	25	11
Angling	13	26	24	24	6	6	6	18	33	0	0
Bathing	31	19	18	24	24	24	38	59	72	50	22
Mining	0	0	0	0	0	0	75	0	22	50	28
Vegetation structure											
Mean canopy height (m)	6.8	11.0	11.8	8.9	7.2	11.9	0.9	2.8	3.0	9.8	3.4
Mean total vegetation cover (% area)	44	85	68	87	70	39	28	34	43	31	49
Mean cover of E1a layer (% area)	13	39	16	14	14	20	11	13	19	11	5
Mean cover of E1b layer (% area)	15	29	27	12	18	12	9	3	15	10	3
Mean cover of E2 layer (% area)	17	23	25	59	37	7	8	18	10	10	41
Mean cover of E3 layer (% area)	23	31	17	6	10	39	0	6	8	26	9

T a b l e 3. Correlation coefficients between environmental variables and DCA ordination axes (see Fig. 2). P < 0.05, n.s – not significant

	AX1	AX2	AX3	AX4
Area (m2)	n.s.	n.s.	0.48	n.s.
Water level (cm)	-0.24	-0.21	n.s.	n.s.
HeighE	0.22	n.s.	-0.34	-0.38
Shore P	n.s.	-0.27	0.22	n.s.
E0 %	n.s.	n.s.	n.s.	0.27
E2 %	n.s.	n.s.	n.s.	-0.36
E3 %	0.34	n.s.	-0.31	n.s.
Shadow	0.43	n.s.	-0.30	n.s.
Depth of organic horizon (cm)	0.27	n.s.	n.s.	n.s.
Percent area with human impact	-0.26	n.s.	n.s.	n.s.
Diversity	n.s.	n.s.	n.s.	0.28

vegetation was represented mostly by willows (*Salix fragilis*, *S. caprea*, *S. cinerea*), almost on each locality. *Lythrum salicaria*, *Lysimachia vulgaris*, *Ranunculus repens* and *Gallium palustre* made up significan rate in species abundance of vascular plants.

The DCA analysis of 88 relevés of littoral vegetation showed a significant correlation between the plant species structure and environmental characteristics. The first DCA axis was significantly correlated with maximum water level in the littoral belt, total height of the vegetation, cover of E3 layer, shading, depth of organic horizon and extent of human impact (Table 3, Fig. 2). The maximum water level and the type of shore profile were correlated with the second DCA axis (Table 3).

The first and the second DCA axes explained 6.7% and 5.4% of the total species variability. Water transparency was affected by ongoing sand extraction (causing a mechanical turbidity) or, alternatively, by the density of planktonic algae in older lakes with a higher trophic status.

The vegetation development is associated with accumulation of organic material, as indicated by the significance of the organic horizon in the DCA analysis. The development of the organic soil horizon coincides with the development of the tree and the upper shrub layer, occurring on flat or stair-like shores (the significance of the organic horizon on the first DCA axis).

Plant communities

The recorded associations of the littoral vegetation were:

1) Alliance *Phragmition communis,* association *Phragmitetum communis* – mostly monotypic reed belt associations with different physiognomy occuring in littoral vegetation of standing water. These associations occur from lowlands to cental lands with

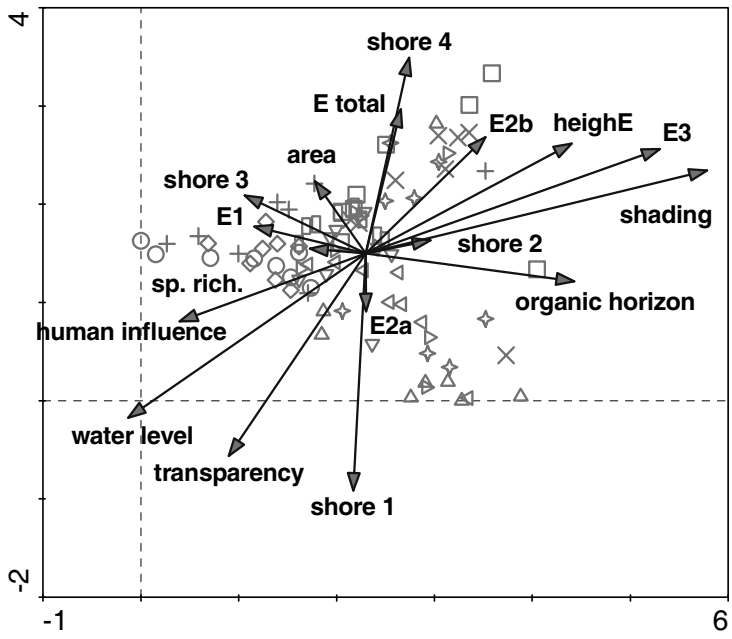

Fig. 2. DCA ordination diagram of vegetation samples with passive environmental variables.

different types of mineral soils. The organogenic soils often acumulate in reed stands as a result of detritus acumulation. The initial stage corresponds to conditions of stabilized water level in hydrolittoral ecoperiod. Only random stands of dominant (*Phragmites communis)* develop the invesive stage of reed corresponds to stabilized conditions in littoral ecoperiod. The homogenous and stable dominant populations are detected by optimal advancement and optimal conditions whereas they colonize relatively large areas. Other associations are: *Typhatum angustifoliae, Glycerietum maximae, Typhetum latifoliae, Sparganietum erecti, Acoretum calami.*

2) Alliance *Caricion gracilis* is the most often detected in eulittoral vegetation with very narrow hydrophases and littoral ecophases but the transition between limosal and terrestrial ecophases is very large, mostly on mineral sediments. Associations are for example: *Caricetum gracilis* (with founded species *C. gracilis, C. vesicaria, Naumburgia thyrsiflora*). This association was developed in the limosal ecophase but it occured only in small fragments in the narrow shore. That is the difference between the littoral vegetation on sandpit lakes and fishponds where the shore profile is more moderate and subsequently there is much larger area in the limosal ecophases.
3) Alliance *Nymphaeion albae,* association *Potamogetoneto natantis-Nymphaeetum candidae*. It belongs to water slope associations often occuring in oligo- to mesotrophic

waters (it corresponds with sandpit lakes conditions – Františkov, Veselí, Veselí I and south lake Halámky). The indicating species *Elodea canadensis* was detected within the association *Elodeetum canadensis* which created a monodominant stand on Vlkov and Veselí lake. *Potamogeton crispus* created monodominant stands on sandpit lakes too (total area about tens m^2 on South Lake Halámky). According to Hejný and Husák (1978) the habitat of association *Potamogetonetum crispi* is characterised from eutrophic to hypertrophic water conditions with a thick organic silt layer on the bottom and a water depth from 0.8 to 1.5 m. These habitat conditions do not correspond with condions on the studied lake habitats where oligo- to mesotrophic conditions prevail silt layer is absent and the water depth is upto 4.5 m.

4) Alliance *Batrachion aquatilis,* association *Batrachietum aquatilis-peltatae,* with the dominant species *Batrachium aquatile.* This species was found in both aquatic and terrestial form on Tušť, Františkov and Vlkov lakes and Middle and South lake Halámky. This association was found on all systems in disregard of its age.
5) Alliance *Oenanthion aquaticae*, association *Glycerio fluitantis-Oenanthemum aquaticae*, *Sagittario-Sparganietum emersi* (*Sagittaria sagittifolia* – was found on place at Horusice I, *Alisma plantago-aqutica*), *Eleocharitetum palustris*. It occurs in the limosal ecophase of narrow shores similarly as the associations of alliance *Caricion gracilis.*
6) Alliance *Bidention tripartiti*, association *Ranunculo scelerati-Rumicetum maritimi (Ranunculus sceleratus, Rumex maritimus, Epilobium hirsutum), Bidentetum cernui (Bidens cernuus, Epilobium balustre)* was determined from limosal to terrestrial ecophases on all sandpit lakes.

Rare and endangered species

The extracted sandpit lakes are classified as important biotopes of Europe No. 3130 and 2330 according to the European Union guidline 92/43/EHS (Chytrý et al., 2001). Some endangered species of vascular plants occur in these localities (public notice of the Czech Republic 395/1992 Sb., Red list of endangered species of the Czech Republic). The critically endangered species *Illecebrum vercillatum* was determined on exposed sandy shores on steep slopes down to the water level on locality Tušť. The site is exposed to dirrect sushine and it is well dry. *I. vercillatum* is documented on several localities of Třeboň Basin Area only, especially on periodically exposed fishponds bottoms and sandy shore (Jeník et al., 1996). This rare weed species of poor sandy soils has became extinct presently in all of the Central Europe already. Several endangered specimens of *I. vercillatum* were found on a site near the village of Vlkov.

The highly endangered species *Lysimachia thyrsiflora* was detected on the studied localities (Middle lake Halámky, East lake Halámky, Veselí, Cep and Horusice lakes), on permanently moist stands, near water or in small marshes around the sandpit lakes. *L. thyrsiflora* is documented on a lot of sites in Třeboň Basin Area. It prefers flood-plain forests, alder carrs, river flood plains and old fishponds shores (Jeník et al., 1996). *L. thyrsiflora* is classified as a specie of endangered biotopes of transition peat bogs, silt

substrates with mesotrophic vegetation and vegetation of high sedges No. 7140 after the Biotopes register of Czech Republic (Chytrý et al., 2001). *L. thyrsiflora* occured relatively often on all studied localities.

The Middle lake of Halámky was the only locality cohere a highly endangered species *Lycopodiella inundata* was found. It occured in a shallow marsh between three lakes (Middle, South and East lakes). The marsh, however, does not exist any more because the area was destroyed by sand extraction. *L. inundata* was documented also on other several localities of Třeboň Basin Area (Jeník et al., 1996; Chytrý et al., 2001).

The highly endangered species *Drosera rotundifolia* occured in marshes of the northern part of Veselí I and Halámky system. *D. rotundifolia* is an abundant species on many localities in the Třeboň Basin Area. Similarly as *Lycopodiella inundata* it prefers sedge stands and peat bog meadows (Jeník et al., 1996). It is possible to find it on nonlimy moss fens, transition peat bog No. 7140, peat soils with *Rhynchospora alba* No. 7150, on open raised bog No. 7110, and on degraded raised bogs No. 7120 after the Biotopes register of Czech Republic (Chytrý et al., 2001).

According to our results, the studied localities provide appropriate habitat conditions for the growth of several rare marsh plant species. However, at the same time, their presence is endangered by intensive human impact. Most sandpit lakes are affected by considerable human impact, such as recreation, the gravelsand extraction and angling. During the field study, some indirect extraction impacts were observed, i.e. inorganic water turbidity, colour, and mechanical shore disturbance by waves from the sand pump dredger. The interesting finding is the frequent occurrence of important species according to NATURA 2000 on studied lakes. The species of hard littoral flora commonly occurring in fishponds dominated also the littoral associations of sandpit lakes. The sandpit lakes differed from fishponds above all by the management, lower age, canopy density of shore vegetation, and less of organic sediment on the bottom. Organic sediment provides source of nutrients for shore and water vegetation. The acumulation of organic matter is the cause of the oxygen depletion in the sediment and the bottom layer in the fishponds. Owing to the oxygen defficiency, anaerobic decomposition of organic matter prevails there (Čížková et al., 1996; Šantrůčková et al., 2001). The organic sediment layer is thin in sandpits so far, and owing to their steep slopes it acumalates in greater depths. Therefore, its influence is not visible in the littoral conditions. Consequently, the littoral vegetation of sandpit lakes largely depends on the available nutrients and is not exposed to the toxic impact effect from the anaerobic sediment.

In contrast to fishponds where the continual littoral belt is formed the typical littoral zonation is not developed in sandpit lakes. The short existence of sandpit lake biotopes and the steep shore gradient almost all sites is the main reason for it. The width of the littoral belt (max. 8 m) is particularly important. The width of littoral belt is limited by forest on the shores. The forest was characterised as a natural succession, plantation, or original wood. Another limitation is the absence of water. It relates to the slope and low retention of water in the sandy soil profile.

Two individual succession series proceed in sandpit lakes. Within xerosere, psamosere take place elevated parts of the sandy shores. Olson (1958) mentioned the length of psamosere over 1000 years. The second successional sere detected on sandpit lakes is the freshwater hydrosere of eutrophic waters. It starts by submerged plants stage and continues from reed stage or high sedge and willow shrub stage eventually to flood-plain forest associations (Moravec et al., 1994).

The primary succession runs in newly originating biotopes without their own diaspore reserve. Within the primary succession, the biocoenosis is formed. It takes place in association with soil formation. The areas without vegetation and organic soil horizon are frequent on sandpit shores. Within the primary succession the species richness, the height of vegetation, the plants age, total biomass, number of vegetation layers, nutrient abundance, organic matter abundance and total cover increase rate. The rate of mineral nutrient cycling, total production and total biomass decrease. The secondary succession runs as a vegetation resumption after its destruction by natural factors or human activity (Moravec et al., 1994).

Different stages of primary succession take place in most of the sandpit lakes. Secondary succession proceeds on several lakes or their parts. They include periodically disturbed stands (human activities – mining, recreation). One hypothesis of this study was to document the significance of the relation between the age of lakes and successional stage. The following characteristics were considered as indicative of successional stage: the cover of vegetation and its height, species richness, organic horizon and vegetative turbidity that can indicate the trophic level. The relation between trophic level, water transparency and water vegetation structure is well known (Pokorný et al., 1990; Hejný et al., 1996). With increasing trophic level, the light intensity in the water column attenuated by growth of phytoplancton. The development of macrophyte associations could be expected on newer and only moderately eutrophied sandpit lakes.

Different plant species have different demands on their environment. Several rare species of sandpit lakes (*Drosera rotundifolia, Lycopodiella inundata* and *Illecebrum verticillatum*) were detected in relatively early successional stages. The habitat character change with progressive succession and establishment of more competitive species that are lost during the time. The tree vegetation looks like an old forest on older lakes. Tetter (1990) studied the spontaneous succession of herbaceous vegetation on the sandpit lakes shores. He analysed 29 species in an early succession stage, all of which were altogether confirmed in our study.

The shading of trees is a conspicuous trait of the littoral vegetation around sandpit lakes. While the littoral belt is generally narrow, the stands are often shaded by forest reaching to the shore. The situation on fishponds is different; litoral belts are formed very well, because of the mostly flat gradient (Hroudová, 1988; Hroudová, Zákravský, 2002).

The human influence (extraction, sand transfer and transport by trucks, recreation with angling and bathing) affects the species richness markedly.

The results of the work Suchá et al. (2005) confirm these conclusions. The sandpit lake biotopes behave as potentional refuges for plant species passed from other marsh habitats in the region. The aim of the management is to set the priority (recreation or the landscape protection) on particular parts of lakes.

Conclusion

The sandpit lakes are new man-made biotopes affecting the landscape physique on one hand, and biotopes with a high ecological value on the other hand. It is possible to document the primary succession from the very beginning. Some endangered species of vascular plants (*Illecebrum verticillatum, Drosera rotundifolia, Lysimachia thyrsiflora* and *Lycopodiella inundata*) occure in a lot of sites in the area of sandpit lakes (Vlkov, Tušť, Cep). These localities should be protected as genofond areas. The sandpit lakes afford an area for new populations of water and marsh plants. The dominant species of Southbohemian fishponds and lakes is *Phragmites australis*. The plant species diversity of the lakes seems to be as rich as of the fishponds, only the littoral belt is not as wide. The sandpit lake biotopes behave as potentional refuges for plant species passed from other marsh habitats in the region.

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Křiváčková O., Pecharová E., Čížková H. **Vegetace vytěžených pískoven Biosférické rezervace Třeboňsko: Vliv antropogenních aktivit.**

Vytěžené pískovny tvoří významný prvek Třeboňské pánve. Po vytěžení štěrkopísku pod hladinu spodní vody vznikají zcela nové biotopy – poměrně hluboká jezera (desítky metrů). Většina pískoven je mírně průtočná a mají oligotrofní až mezotrofní charakter. Sukcesi rostlinných a živočišných společenstev ovlivňuje kromě jiného také různorodé využití pískoven po ukončení těžby (rekreace, rybářství a lesní hospodářství).

Do sledování v roce 2004 bylo zařazeno 13 nádrží 4 hlavních soustav na Třeboňsku (Cep, Tušť, Halámky a Veselí). Vypracováním fytocenologických snímků litorálních porostů a floristickými seznamy rostlin bylo zjištěno, že vytěžené pískovny jsou lokalitami vyhovujícími svým charakterem nejen druhům vyskytujícím se běžně na jihočeských rybnících, ale i druhům chráněným dle vyhlášky 395/1992 Sb. Na řadě míst je na pískovnách po ukončení těžby písku evidován výskyt ohrožených rostlin a živočichů.