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A BIOLOGICAL SURVEY OF SELECTED GROUPS OF PLANTS AND ANIMALS IN THE FLOODED SUBSIDENCE RESEROIRS IN UPPER SILESIA

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Abstract

The article deals issue selected flooded subsidence reservoirs in Upper Silesia, which were monitored species of amphibians, aquatic mollusca, macroinvertebrates, diatoms, aquatic and riparian plants within the project SV 511 33 F1. The selected sites were researched depending on the specified taxonomic groups on hydrochemical parameters. Monitored parametres included the conductivity, its value was higher. In some water bodies was measured value of conductivity higher than 1500 S/cm. In subsidence reservoir was detected total of 143 species of plants, 6 species of amphibians (like one species counts complex *Pelophylax esculentus*), 12 species of aquatic mollusca, 20 species of macroinvertebrates and 14 genus of diatoms. From the survey results it is clear that these habitats are inhabited species with wide ecological amplitude. Research will be continued within dissertation work of these authors.

Keywords: flooded subsidence reservoir in Upper Silesia, amphibians, diatoms, macroinvertebrates, aquatic mollusca, aquatic and riparian plants

1 INTRODUCTION

The mineral´s mining is greatly influence by hydrological cycle, groundwater and surface waters, which are contaminated or changed. In the Upper Silesian coal basin coal mining has a long tradition. During this period there was a signifiant relief alteration of mining landscape, began to manifest phenomena of deep mining (such as subsidence reservoirs, flooded subsidence reservoirs, heaps, sedimentation tanks and sludge lagoon). The flooded subsidence reservoirs are mainly characterized by shallowness, regular shape, gentle slopes of the banks and straight, shallow bottom (Jankowski & Molenda 2007). Basically there is stagnant water, in which almost can ´t control the inflow and outflow and its affect the physical, chemical and biological properties. The flooded subsidence reservoirs can be devided into subsidence lake (area more than 100 m^2 and depth greater than 3 m), subsidence ponds (up to 100 m^2 and max 3 m to depth), periodic pools. (Stalmachová, 2004) Subsidence reservoir are formed by deposits of mining minerals and subsequent of land subsidence and then is progressively flooded by high level of groundwater, often supplemented by retention water. Its created new habitants suitable for life range of animals and plants.

1.1 Research of subsidence reservoir in Upper Silesia

On the selected subsidence reservoirs was prepared research report, initiate the assessment of the natural ecosystems landscape undermined for the recovery process in Karviná region. (Sierka et al., 2012) Environmental monitoring of flooded subsidence reservoir, their hydrochemicals and hydrobiologicals paramters in Karviná region was preoccupied E. Pertile in her dissertation (Pertile, 2007). Other factors, which among others, will be included eutrophication or increased level of salinity on post-industrial sites in region Karviná, was preoccupied by Raclavská & Škrobánková (2007), Konečná (2007), Pierzchala et al. (2011) and Sierka & Sierka (2006). The accumulation of salts in the water can have a negative effects on many species on plants and animals, leads to limiting of diversity in the affected areas. In the Polish part of the Upper Silesia Basin issue of subsidence reservoir were interested Buszman et al., (1993) and Rostański (1996). Localities Pod Lesem and Bartošůvka has been identified as freshwater reservoirs (Raclavská & Škrobánková, 2007). On the contrary, the other flooded subsidence reservoirs as Barbora and U Cesty are characterized by higher level of disolved solids concentration Sierka et al., (2012), Pertile (2007), Konečná (2007), Kašovská (2012), Pierzchala (2012). Which is confirmed results of this project (tab. 1)

2 METHODS

For monitoring of water quality, aquatic and riparian plants, community of diatoms, community of macroinvertebrates, community of aquatic mollusca and community of amphibians were selected 8 flooded subsidence reservoirs in Upper Silesia (Fig. 1). Localities were seleceted according to previous researches (Sierka et al., 2012), Pertile (2007), Konečná (2007), Kašovská (2012) for continuity of monitoring and creating time series of observed parametres and biotic components. Water bodies differ in size, shape, depth and material of shores embankments. Common sign is only emergence and location in Karviná region, where the impact of underground mining is the biggest from the Upper Silesian Coal Basin.

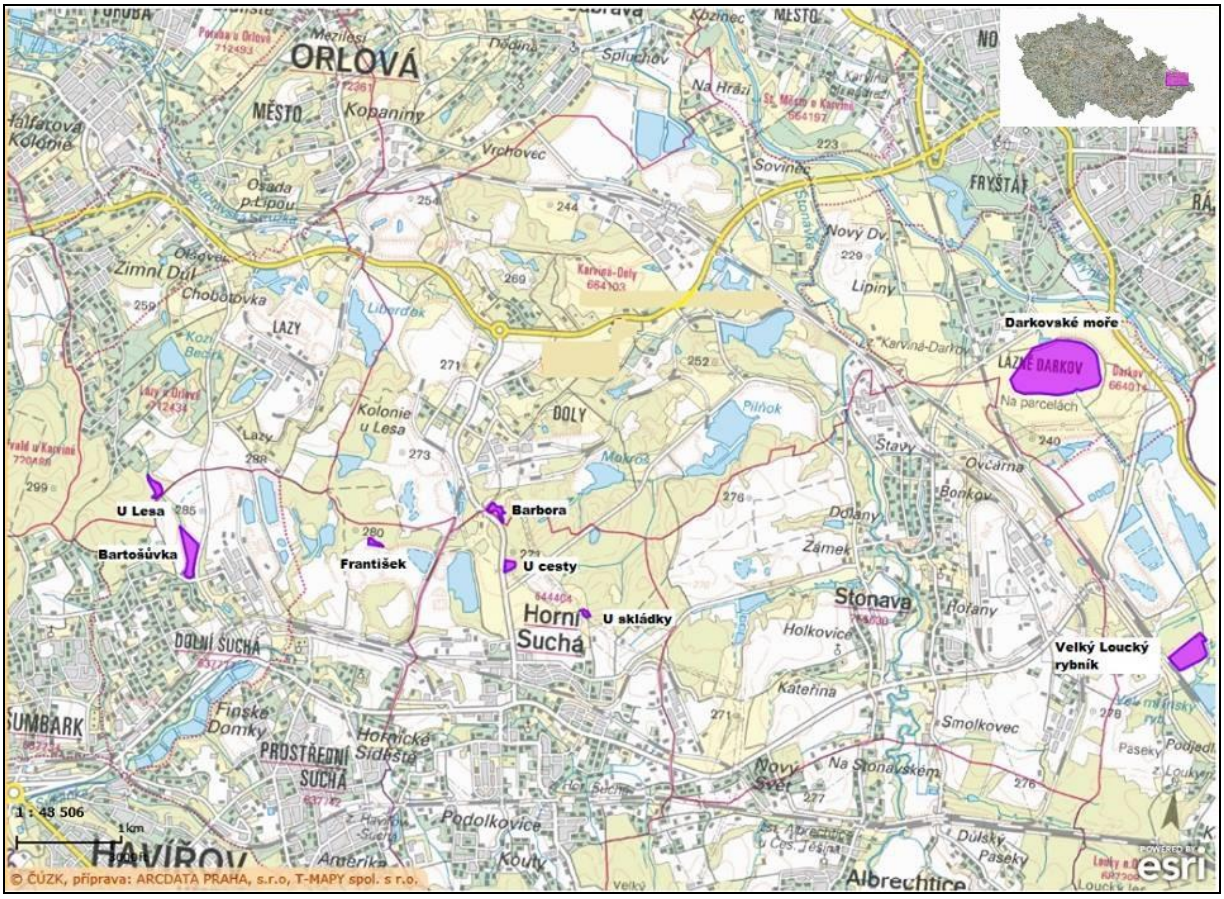

Figure 1. Localization of selected flooded subsidence reservoirs in Karviná region (from www.AOPK.cz, 2014)

2.1 Determination quality of water

To determinate the quality of water has been used terrain multimetr YSI Professional Plus. Monitoring quality of water was conduceted regularly for 1 month (from April 2013 to November 2013). Water for measurement was always collected 1-2 metres from shores, depending on the approach terrain. To a plastic container with a volume 1 litre with wide mouth for insertion. Among the measurements parameters included temperature (ºC), dissolved oxygen (%, mg/l), atmospheric pressure (mmHg), pH and conductivity (S/cm). During the measurement, there was no more variation between values, changed only pH and conductivity.

2.2 Monitoring aquatic and riparian plants

On each research plots were developed relevés by semiobjective method, depending on the size of water bodies and the species differentiation. Subsequently, on all surfaces conducted phytosociological surveys by Zurich-Montpellier school. (Braun-Blanquet, 1932) It was used the combined scale of abundance and dominance expanded by Westhoff and van der Maarel on the nine range scale (Westhoff &Van der Maarel, 1978). Also, littoral on the individual flooded subsidence reservoirs was mapped. Analysis of littoral

vegetation was conducted in August 2013. The determination of species was recognized from atlas of plants (Deyl & Hísek, 2001) and Flora key of the Czech Republic (Kubát, 2010). Subsequently, all relevés were rewritten in database of TURBOWEG for Windows and Juice 7.0, where was calculated species diversity by Shannon-Wiener index. Relevés from transect of aquatic and riparian plants were rewritten into electronic format in Microsoft Excel 2010. Coverage of scale was labeled r, + 1, 2m, 2a, 2b, 3, 4, 5 (it was transformed to a scale of value from 1 to 10 for export to CANOCO for Windows 4.5.

2.3 Monitoring communities of Diatoms

Methods of sampling was performed according ČSN EN 13 946 Water quality – Guidance for routine sampling and treatment of samples of benthic diatoms from rivers and ČSN EN Water quality – Guidance for identification and quantification of benthic diatoms from watercourses and for data interpretation. Approximate sampling period was from April to October 2013. In the first sampling was defined sampling profile, depending on the terrain of water bodies. The sampling points were targeted by GPS. The sampling container was flushed by water from water bodies and then filled. Samples were taken to 1l PET bottles. Subsequently, were processed in the laboratory within 24 hours. Not concentrated samples were centrifuged; prepared burned samples by immersion determine process. The determination literature and web sites were used to samples determination.

2.4 Monitoring communities of macroinvertebrates

The principle of sampling was based on the removal and separating bottom organism from substrates, their classification and determination. The sample was formed by separate individual samples. In littoral areas, sampling were conducted by benthic net canned procedure similar as "kick sampling", it was interrupted muddy sediment by feet, then collected organism by net (width 25 cm) (Kokeš & Vojtíšková, 1999). Also, it were browsed a different types of aquatic plants by net. Furthermore, were used method of sampling soft sediment by grap Ekman-Birge (Adámek, 2014). Sampling was composed of minimum of 5 separate samples from the bottom. Samples from all catches were washed in mild phosphoric-bronze sieve with a mesch (size 250 μm), to separate detritus. Trapped substrated with samples was preserved by 4% formaldehyde. Data were analyzed by Canoco for Windows and methods of quatitative ecology.

2.5 Monitoring communities of aquatic Mollusca

The survey focused on aquatic species, which were obtained using a metal sieve (diameter 20 cm with a mesh size 0.8 x 0,8 mm). Littoral vegetation and bottom sediments were washed by net. On all localities were defined transect – strips parallel with perimeter of subsidence reservoirs (sublittoral and littoral zone). The samples collection was carried out for 10 minutes inside transects; within the locality 60 minutes/per person. Aquatic mollusca were picked up manually by tweezers from the partially submerged objects (garbage, litter, branches) and subsequently determinated. The detail determination of samples were preserved in 70% ethanol. The samples were determinated by Beran (1998) and nomenclature of work Horsák et al., 2010.

2.6 Monitoring communities of Amphibian

Amphibian monitoring was form April to November 2013 (period of breeding and metamorphosis). It was selected Jeřábková methodology (Jeřábková, 2014), which is used in mapping species in Czech Republic. For monitoring Amphibians were used non-invasive methods, ie. visual and acoustic observation. Visual observation consisted of circumvention shoreline water areas with a concentration on littoral vegetation serving as a refuge for adults Amphbian and all their development stages. It were recorded species and their abundance (in the breeding season were calculated broods). Acoustic observation were performed on the shorelines water bodies and recorded on the dictaphone (for exact species identification vocalized males and for their estimate numbers). Brood, larvae and adult Amphibian were determinate by Maštera (2014), Zwach (1990, 2009).

3 RESULTS AND DISCUSSION

The hydrochemical parameters on all flooded subsidence reservoirs differs their conductivity. The highest conductivity was in declines Barbora and U Cesty, thats indicate higher levels of dissolved solids (sulphates, chlorides, nitrates). The substance in the water can get either by extraction from spoil rock or from gritting salts from sites near roads. The minimum of conductivity was recorded in the localities Pod Lesem a U Skládky. These sites are located off road and U Skládky subsidence contains a large amount of *Phragmites australis*, which may higher conductivity neutralized by their roots.

Table 1: Average values measured by the device YSI Professional Plus

	František	Bartošůvka	U Skládky	Velký Myškovec	Pod Lesem	Barbora	U Cesty	Darkovské moře
Temperature (°C)	20,3	19,6	18,9	20,5	19,5	20,6	20,6	20,5
pH	8,6	8,4	6,8	8,3	7,5	8,1	8,1	8,5
Conductivity (µS/cm)	707,9	772,4	318,7	464,4	221,4	1962,8	1741,6	1221,1
Dissolved oxygen (mg/l)	10,4	7,4	4,1	11,2	6,7	7,3	8	10,2

Total amount of species on all localities was found 143 species of plants. The largest abundance was at localities Velký Myškovec and U Cesty. At least species have been recorded in the localities Barbora and František. Among the dominant species occurring in most of localities were especially *Camagrostis epigejos, Ceratophyllum demersum, Typha angustifolia, Salix caprea, Potentilla anserina, Phragmites australis, Phalaris arundinacea, Myriophyllum spicatum, Lythrum salicaria, Lycopus europaeus, Lysimachia nummularia, Lemna minor* and *Juncus effusus*. In contrast, rarely species occured in some localities were *Arabidopis thaliana, Aster lanceolatus, Bromus hordeaceus, Carlina vulgaris, Centaurea jacea, Clenopodium hybridum, Crepis paludosa, Galeopsis speciosa, Galium odoratu, Lamium purpureum* and *Lunaria rediviva*.

There were found 28 littoral species. The largest number of species was found at the localitities U Cesty (20 species) with a large contribution of *Najas minor* and at Velký Myškovec (19 species) with high diversity of *Potamageton lucens* and *Nyphaea album*. At least species was recorded at localities František (3 species) and at locality Barbora (5 species), where was occurred Nuphar lutea (only on one flooded subsidence reservoir). Most types of species conforms lower level of conductivity. Differences between the occurrences some species is not very significant. All of species show similar ecological amplitude in relation with conductivity.

Amphibian occurred at 7 localities of total 8.It was total detected 860 individuals, classified to 6 species. At all 7 localities was confirmed presence of edible "water" frog, which are most depend on the water resources. Subsidence reservoirs U Skládky were found 6 detected species. There was measured the lowest pH and conductivity compared to other monitored localities.

The high abundance of Amphibians could be attributed to a richly developed littoral zone and suitable location, where are the goods conditions for wintering aquatic and terestric Amphibians. The only locality, where there no confirmation of Amphibians occurrence was Darkovské moře. Locality Darkovské moře is especially like recreational water body, so it is not suitable habitat for Amphibians. The values of pH and conductivity at selected localities are not limiting for Amphibians, as evidenced by their presence on localities with high values of conductivity.

Mollusca in all localities was represented a total of 12 aquatic species. By Ložek (1964) and Lisický (1991), there are species of wetland (PALUDICOLAE) and species of larger permanent standing water (STAGNICOLAE). The most important findings are (*Aplexa hypnorum*) as nearly threatened species (NT). High abudance of Aplexa hypnorum on locality Velký Myškovec with small size, depth and richly overgrown littoral zone is most similar to wetlands, prefers by this species. According Kašovská &Kupka 2011, today´s snail population is lower, compared to snail population before fifty years ago. There is still monitor 10 from 12 aquatic species yet. Alien species as *Potamopyrgus antipodarum* and *Physella cf. acuta*, identified on localities Barbora and František, inclined to strongly influenced conditions, such as relatively steep slopes of banks shaped by spoil rock.

On the based monitoring of macroinvertebrates can be described similar types of areas, that satisfy the greatest numbers of species, which are U Skládky, Barbora and Velký Myškovec. On all of this locations, there are species determining eutrophic and oligotrophic waters. Among dominant orders are particularly Empheroptera, occurrence is not typical for this habitat. Exceptions are areas Bartošůvka and Pod Lesem,

represent variability data for poor species community. Prerequisite differences are mainly composed on different substrates and conductivity. On this sites begin to mix different kind of classes, especially Brachyptera sp. (NEWPORT), Epeorus assimilis (EATON), Limnodrilus sp. (CLAPARÉDE), Ormosia sp. (RONDANI), Habrophlebia fusca (CURTIS), Nais communis (PIGUET) etc. Primarily, the biggest influence on community was conductivity (based on the higher conductivity of water, there were species with numerous community).

On all locations, there were found 14 genera of Diatoms. The most representative genera of Diatoms was *Cymbella, Craticula, Cymbopleur* and *Diatoma.* In all researches areas was genera typical for clean waters.

4 CONCLUSION

As results continuous decline in undermining area in Karviná region, may continue to created new water bodies on this localities, are for this organism prerequisite for survival and development. The problem is once populated subsidence, influence succession gradually overgrown by littoral vegetation and subsequently exposed to a drying. With time, diversion decreases on minimum. For these reasons is important to create a prediction for future development of these properties and localities, that may be potential habitat and refuges for the settlement of other species of animals and plants. For following periods is scheduled to monitoring taxa and localities with the extension of water birds and reptiles.

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