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Conference Abstracts
HOW ALGAL ORGANIC MATTER DIFFERS IN SPECIES AND GROWTH PHASE OF PHYTOPLANKTON

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Keywords: Algal organic matter; molecular weight fractionation; protein content

INTRODUCTION
The study is aimed at the characterisation of algal organic matter (AOM) derived from the green alga Chlamydomonas geitleri, the diatom Fragilaria crotonensis and the cyanobacterium Microcystis aeruginosa. Metabolically produced extracellular organic matter (EOM), and also cellular organic matter (COM) deriving from the decay of phytoplankton cells, presents a significant component of natural organic matter in surface waters. In case of water reservoirs supplying drinking water plants, seasonally occurring high concentrations of AOM may affect the performance of drinking water treatment and the quality of water (reduction in coagulation efficiency, membrane fouling, presursors of disinfection by-products, etc.) (Pivokonsky et al., 2006; Henderson et al., 2008).

In previous studies, it was demonstrated that a quantity and a chemical structure of AOM is species specific and varies with the age of the culture (Pivokonsky et al., 2006, 2014; Henderson et al., 2008). Studies ascertained that low molecular weights and non-proteinaceous AOM are more difficult to remove than the high and the proteinaceous ones, respectively (Bernhardt et al., 1985; Pivokonsky et al., 2012). It is obvious that the removal efficiency of AOM in water treatment is closely related to their composition; therefore, it is necessary to investigate the influence of the species and growth phase of the microorganism on the composition of AOM. The purpose of this study is therefore to characterize EOM/COM isolated from three of the most abundant species of phytoplankton considering drinking water treatment.

METHODS
The green alga C. geitleri, the diatom F. crotonensis and the cyanobacterium M. aeruginosa were cultivated in this study. Growth of the strains was monitored by cell counting and measuring optical density. Microorganisms’ exudates (EOM) and COM were characterized in terms of the dissolved organic carbon concentration (DOC), protein and non-proteinaceous content (DOCp and DOCNP) and molecular weights (MW). Moreover, a division of EOM/COM into hydrophilic (HPI), hydrophobic (HPO) and transphilic (TPI) was carried out.

RESULTS AND DISCUSSION
The results show that HPI compounds dominate both EOM and COM of all the organisms. The HPI fractions constituted about 70 % of EOM at both exponential (EXP) and stationary (STAT) phases of the culture growths. In COM, HPI reaches even 90 % of DOC. The study confirms that the total amount of organics, and also the portion of proteins, increases as the cultures grow. The total DOC concentrations and the MW fractionations of protein (DOCp) and non-proteinaceous (DOCNP) matter in EOM–EXP, EOM–STAT and in COM are depicted in Fig. 1. The results of molecular fractionation demonstrate that the highest DOC portion of EOM, and also of COM, is contained in 10–30 kDa fraction of C. geitleri (91-100 %). Both EOM and COM of F. crotonensis and M. aeruginosa dominate with 3–10 kDa fractions (71-92 % and 38-78 %, respectively). C. geitleri and F. crotonensis show uniform MW composition, whereas M. aeruginosa exhibits broader MW diversity and a significant portion also in higher-MW fractions, particularly in >100 kDa (25 % and 22 % for EOM–STAT and COM, respectively). Compared to the protein content, the non-proteinaceous matter shows the same pattern for all the organisms. The largest portion of DOC is contained in 0–1 kDa fractions, which decreases with the age of culture with minimum in COM (51 % for C. geitleri, 47 % for F. crotonensis and 36 % for M. aeruginosa). On the contrary,
the second largest non-proteinaceous fraction (>100 kDa) increases with the age of culture and reaches its maximum in COM (22 % for C. geitleri, 22 % for F. crotonensis and 35 % for M. aeruginosa).

![Fig. 1 Total DOC and MW fractionations of protein (a) and non-proteinaceous (b) content in EOM/COM.](image)

**CONCLUSIONS**
The organic matter of all the observed microorganisms demonstrates several similarities, however, the composition and characteristics change with both the species and the growth phase.

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**REFERENCES**
Polycyclic aromatic hydrocarbons in size-segregated aerosol in Mladá Boleslav

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Keywords: Urban air, smog, aerosol mass size distribution, c-PAH

INTRODUCTION
Urban air pollution affects human well-being and causes premature deaths. One of the most dangerous pollutants from incomplete combustion are Polycyclic Aromatic Hydrocarbons (PAHs). Some of them are proven carcinogens like the Benzo(a)pyrene. These PAHs are called carcinogenic PAHs (c-PAHs). The ability of PAHs to penetrate to organisms depends on aerosol particles. If PAHs are adsorbed to aerosol particles PM₂.₅ and especially PM₁, they can easily come from lungs through capillaries directly to the blood and cause cancer or other disease. From this reason it is very useful to analyze PAHs from size-segregated aerosol. PAHs are in the air in two phases – in gas and particle phase. Distribution between these phases is dependent on the ambient temperature and vapor pressure of each PAH. PAHs with vapor pressure <10⁻⁵ Pa are mostly bond to atmospheric aerosol and PAHs with vapor pressure >10⁻⁵ Pa are mostly in the gas phase (Hovorka et al., 2012).

METHODS
Aerosol were sampled from 14th to 27th February 2013 in the central part of the city of Mladá Boleslav (50°25'32.661"N, 14°54'54.506"E) with High Volume Cascade Impactor BGI 900. This instrument separates aerosol into coarse fraction (1<dₐ<10 µm), upper accumulation (0.5<dₐ<1 µm), lower accumulation (0.17<dₐ<0.5 µm) and fine particles (<0.17um). First three fractions were sampled to polyurethane foam (PUF) and the fine fraction to the PTFE filers Pallflex TX40. Impactor was situated in the 3m height from the ground and aerosol was sampled for 23 hours every day.

Aerosol was analyzed for PAHs in the ALS Czech Republic s.r.o. laboratories (EN ISO CSN IEC 17025). PAHs were extracted from the PUF substrates and filters using dichlormethane. Extract were analyzed by the HPLC method with fluorometric detection (ISO 11338-2) (Hovorka et al., 2012). These eight carcinogenic PAHs were analyzed: benzo[a]anthracene (B[a]A), chrysene (CHRY), benzo[b]fluorantene (B[b]F), benzo[k]fluorantene (B[k]F), benzo[a]pyrene (B[a]P), dibenzo[a,h]anthracene (DB[ah]A), benzo[g,h,i]perylene (B[ghi]P), a indeno[1,2,3-cd]pyrene (I[cd]P).

RESULTS AND DISCUSSION
During the measurements was relatively sunny weather with the average temperature -2.3 ºC. Minimum were -12.8 ºC at 22th February and maximum 4.8 ºC. Wind were calm with average 1.2 ms⁻¹ so turbulent diffusion was dominant factor and air was well-mixed. Average concentration of sum of c-PAHs was 19.2 ngm⁻³ for the whole measured period. Concentrations of c-PAHs are in the table 1.
### Table 1: Medians of c-PAHs concentration in size-segregated aerosol (ng m\(^{-3}\)) at Mladá Boleslav, from 14\(^{th}\) to 27\(^{th}\) February 2013

<table>
<thead>
<tr>
<th>c-PAHs</th>
<th>1-10 µm</th>
<th>0.5-1 µm</th>
<th>0.17-0.5 µm</th>
<th>&lt;0.17 µm</th>
<th>All fractions</th>
</tr>
</thead>
<tbody>
<tr>
<td>B[a]A</td>
<td>0.61</td>
<td>1.34</td>
<td>0.51</td>
<td>0.16</td>
<td>2.69</td>
</tr>
<tr>
<td>CHRY</td>
<td>0.88</td>
<td>1.84</td>
<td>0.78</td>
<td>0.28</td>
<td>3.72</td>
</tr>
<tr>
<td>B[b]F</td>
<td>0.83</td>
<td>1.88</td>
<td>0.76</td>
<td>0.29</td>
<td>3.86</td>
</tr>
<tr>
<td>B[k]F</td>
<td>0.36</td>
<td>0.82</td>
<td>0.34</td>
<td>0.12</td>
<td>1.66</td>
</tr>
<tr>
<td>B[a]P</td>
<td>0.54</td>
<td>1.36</td>
<td>0.56</td>
<td>0.16</td>
<td>2.77</td>
</tr>
<tr>
<td>DB[ah]A</td>
<td>0.04</td>
<td>0.08</td>
<td>0.04</td>
<td>0.01</td>
<td>0.17</td>
</tr>
<tr>
<td>B[ghi]P</td>
<td>0.43</td>
<td>1.01</td>
<td>0.46</td>
<td>0.18</td>
<td>2.08</td>
</tr>
<tr>
<td>I[cd]P</td>
<td>0.41</td>
<td>0.98</td>
<td>0.43</td>
<td>0.16</td>
<td>2.02</td>
</tr>
<tr>
<td>∑ 8 k-PAU</td>
<td>4.14</td>
<td>9.37</td>
<td>3.86</td>
<td>1.33</td>
<td>19.15</td>
</tr>
</tbody>
</table>

B[a]P concentration in Mladá Boleslav was in average twenty times lower than in the similar winter time measurement in the Ostrava city at 2012 (Hovorka et al., 2012). Nevertheless, concentration was over the health limit of 1 ng m\(^{-3}\) except 19th. February 2013.

C-PAHs concentrations per aerosol mass in individual aerosol fractions ranged from 0.1 mg g\(^{-1}\) to 1 mg g\(^{-1}\), but from 22\(^{th}\) February to 25\(^{th}\) February 2013 concentration peaked up to 5 mg g\(^{-1}\) c-PAHs (fig. 1).

![Fig. 1: C-PAHs concentration per aerosol mass (mg g\(^{-1}\)) in Mladá Boleslav](image)

**CONCLUSIONS**

Concentration dynamics of eight types of carcinogenic polycyclic aromatic hydrocarbons c-PAH in the organic extracts from size-segregated aerosol were studied. Aerosol samples were collected in Mladá Boleslav locality from the 14th to 27st February 2013. In the coarse fraction (1<dae<10 µm) was in average 4.14 ng m\(^{-3}\), upper accumulation (0.5< dae<1 µm) 9.37 ng m\(^{-3}\), and lower accumulation (0.17< dae<0.5 µm), and in ultrafine (dae<0.17 µm) 1.33 ng m\(^{-3}\), C-PAH size distribution was always monomodal (peak 0.5-1 µm). Percentage of each c-PAH was: B[a]A 14; CHRY 20; B[b]F 20; B[k]F 9; B[a]P 15; DB[ah]A 1; B[ghi]P 11; I[cd]P 11 %. C-PAH concentrations in aerosol were high and ranged from 0.1 to 1 mg g\(^{-1}\) and for 5 days long period were concentrations from 1 to 5 mg g\(^{-1}\).

**ACKNOWLEDGEMENTS**

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REFERENCES
LONG-TERM DEVELOPMENT IN CHEMISTRY AND COMPOSITION OF BENTHIC MACROINVERTEBRATE COMMUNITY IN ACIDIFIED MOUNTAIN STREAMS

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Key words: acidification, benthic macroinvertebrates, recovery, mountain streams

INTRODUCTION

The most significant cause of anthropogenic acidification of surface waters in Central Europe was atmospheric deposition of sulphur and nitrogen oxides and partly of ammonia with the highest levels in 1970s and 1980s (Kopáček et al., 2001; Stuchlík et al., 2002). In the Czech Republic many of mountain streams with low neutralizing capacity were affected by anthropogenic acid deposition (Stuchlík et al., 1997; Veselý & Majer, 1998). The mobility of toxic metals, such as Al$^{3+}$ ions, increases in low pH. Al$^{3+}$ ions are toxic to several groups of benthic macroinvertebrates (Driscoll, 1985), which are used as good bioindicators for the assessment of the impact of acidification (e.g. Fjellheim & Raddum, 1990). Since 1990s many of acidified streams are recovering from acidification due to rapid decline in emissions of sulphur and nitrogen oxides (Kopáček et al., 2001). However, in some cases the hysteresis in chemical recovery has delayed biological recovery of streams from acidification (Kopáček et al., 2002) due to saturation of sulphur and nitrogen compounds in catchments. Hydrological conditions, such as flood (Feeley et al., 2012) or drought (Boulton, 2003), have often negative impacts on abundances and taxonomic richness of benthic macroinvertebrate community. On the other hand, clear-cut logging can sometimes have positive impact on composition of benthic macroinvertebrate community (Banks et al., 2007).

METHODS

Water samples for chemical analyses are filtered on-site through a 40 μm mesh-size polyamide filter. The macroinvertebrate samples are taken by a kicking technique (Frost et al., 1971) with a 500 μm mesh-size hand sieve from 6 different habitats for 30 seconds each, giving the adequate attention to all microhabitats. Collected macroinvertebrates are preserved with ca. 80% ethanol for further laboratory treatment. This is supplemented by qualitative sampling (collecting of larvae from stones and wood in the stream and collecting of adult individuals on the stream banks).

Measurements of pH and specific conductivity at 25°C (SC$_{25}$), measurements of alkalinity (ANC) by Gran titration, analyses of main ions (SO$_{4}^{2-}$, NO$_{3}^{-}$, Cl$^{-}$, F$^{-}$, H$^{+}$, Na$^{+}$, K$^{+}$, Ca$^{2+}$, Mg$^{2+}$ and NH$_{4}^{+}$) by ion chromatography, spectrophotometric analyses of reactive aluminium (R-Al) and analyses of total organic carbon (TOC) on Shimadzu TOC analyzer are conducted at the Hydrobiological laboratory of Charles University located in the vicinity of the Blatná town. Benthic macroinvertebrate larvae are sorted and identified at least to the genus level or species level, if possible. Hydrological and meteorological data from almost every site are measured automatically.

RESULTS AND DISCUSSION

A study of development and changes in chemistry and composition of macroinvertebrate community in a strongly acidified mountain stream in the Brdy Mountains (the Czech Republic) was performed one decade after the first study. Significant decline in concentrations of SO$_{4}^{2-}$ ions and reactive aluminium (R-Al) and other ions was detected over the period of 1999-2010. This fact refers to ongoing process of recovery from acidification of this stream, even though we did not detect any significant change in pH. Similar changes in water chemistry were recently detected in streams and lakes in the Bohemian Forest (the Czech Republic), too (Kopáček et al., 2013; Vrba et al., 2014). The fact of chemical recovery from acidification was supported with the occurrence of less acid-tolerant stonefly Diura bicaudata and caddisfly Rhyacophila sp. that indicates the first signs of biological recovery of the stream from acidification. Almost two-fold increase in taxonomic richness in 2010 compared to 1999 and quite significant increase of total organic carbon (TOC) over the period of 1999-2010 was observed. This can be partly attributed to the effect of logging (Banks et al., 2007).
CONCLUSION

Based on these and previously published results (Horecký et al., 2006, 2013; Hardekopf et al., 2008), we can expect similar development not only in the Brdy Mountains and in the Bohemian Forest, but also at other sites studied by our research group in the Czech Republic, such as the Jizera Mountains and the Slavkov Forest. In the future we can also expect a return of other less acid-tolerant taxa into strongly acidified streams at these study areas as the consequence of their recovery from acidification.

ACKNOWLEDGEMENTS

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REFERENCES


ECOLOGICAL TRAITS ACCOUNTING FOR BIRD SPECIES SENSITIVITY TO THE BLACK LOCUST INVASION

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Keywords: forest birds, black locust, habitat specialization, life-history strategy

INTRODUCTION

Biological invasions rank among the top threats to biodiversity worldwide. Here we focused on the impact of the black locust (Robinia pseudoacacia) invasion on birds in the Czech Republic. We investigated the ecological traits of bird species occupying invasive black locust and native oak tree stands to reveal which of them are the strongest predictors of bird sensitivity to the black locust invasion. Specifically, we used habitat specialization and life-history strategy in our analysis. We predicted that the species more closely associated with the invaded stands will be habitat generalists and species with fast life history strategies.

METHODS

We performed a detailed mapping of bird occurrence on 15 plots located in the native oak stands and on 15 plots in the invaded stands. Birds were counted using simplified spot mapping technique (Bibby et al. 2000) during three visits in the peak breeding season from April to June. Species’ habitat specialization was quantified using species specialization index (SSI, see Julliard et al. 2006) as a coefficient of variation of abundance of a given species across several habitat types. SSI of particular species recorded on our study plots was adopted from Reif et al. (2010). Species’ life-history strategy was expressed as its position along a gradient from “K-selected” to “r-selected” species describing the slow-fast continuum. The values determining species’ position along the gradient were extracted from Koleček & Reif (2011).

We expressed the relationship between birds and forest type using redundancy analysis (RDA). From this RDA, we extracted the species’ scores for the first axis quantifying particular bird species’ susceptibility to the black locust invasion. Subsequently we related the species scores to SSI and life-history strategy by the means of phylogenetic comparative analysis performed across species. We applied the phylogenetic generalized least-squares regression (PGLS) with model averaging based on Akaike's Information Criterion corrected for small sample sizes (AICc).

RESULTS AND DISCUSSION

The first axis of RDA explained 9.8 % of the variability in bird community composition. This part of variability in bird community structure accounted by the black locust invasion was statistically significant (pseudo-F = 3.04, p < 0.01) and provides evidence that the black locust invasion alters species composition in forest bird assemblages. The species most tightly associated with the oak stands were, for example, the Middle-spotted Woodpecker, the Black Woodpecker, the Wood Warbler or the Hawfinch. By contrast, the species such as the Chiffchaff, the Blackcap or the Song Thrush were those the most tightly associated with the black locust stands (Fig. 1).

In the next step, we explored the effects of the traits, i.e. SSI and life history strategy. From the five candidate models, only the model containing solely SSI received considerable support according to AICc. This best performing model explained 22 % of variation in birds’ susceptibility to the black locust invasion. The models containing life history strategy showed lower performance. The effect of SSI was significantly negative: slope = -0.30, SE = 0.11, t = -2.78, p = 0.011. It means that species with the lowest SSI are mostly associated with the black locust stands, whereas the species with the highest SSI are mostly associated with the oak stands (Fig. 2).

Lower abundance of habitat specialists in invaded stands could be the consequence of lack of some specific food types. It is possible that some insect species dependent on the plants supressed by the black locust can be missing in invaded habitat.
CONCLUSIONS
Habitat specialists were strongly associated with the native oak stands, while habitat generalists were associated with the black locust stands. Our study implies that the spread of invasive plants may significantly contribute to the frequently reported replacement of specialist bird species by habitat generalists in local communities.

REFERENCES
Influence of catchment characteristics on lake water chemistry in the Tatra Mountains (Slovakia)

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Keywords: water chemistry, catchment, digital elevation model, recovery from acidification

INTRODUCTION

The study deals with catchments of the alpine lakes in the High Tatra Mountains (Slovakia). The lakes were subject of a long-term monitoring to detect chemical and biotic composition changes of lake water induced by acid atmospheric deposition and by its decline (e.g. Stuchlík et al. 1985, Fott et al. 1994, Stuchlík et al., 2002, Hořická et al. 2006, Kopáček et al. 2006, Stuchlík et al. 2006, Sacherošová et al. 2006). The studied processes required a quantitative approach to describe the characteristics of the catchments. The concept of catchment influence on lake water quality is in agreement with findings of ongoing research. However, the definition and precision of lacking and estimated catchment parameters was not allowed without current technical and computing equipment because of the complexity of mountainous terrain.

METHODS

The key facility for studying relation between lake and its catchment was high resolution digital elevation model (2 × 2 m) of studied area. The morphological parameters (slope, altitude, aspect, real surface area) for 26 catchments were obtained by analysis of the digital elevation model using tools of geographic information system. The land cover was detected by aerial images. The catchment characteristics were correlated with water composition to response a different pace of recovering from acidification after the decline in acid deposition.

RESULTS AND DISCUSSION

One of the water quality indicators, sum of the base (Ca, Mg) cations, was positively correlated with the average slope of catchment that means the decrease in base cations leaching was pronounced in steeper catchments (Fig. 1). This pattern was observed only in southern hillside of the Tatra Mts range ($R^2 = 52$, $p < 0.01$), with exception of Malé Hincovo lake (empty circle). The decline of the lake water nitrate concentration was more advanced in a rock or moraine-rock type of catchment and with a lowering proportion of meadow and dwarf pine in catchment.

These results are not in contradiction with previous studies in this lake area, suggesting the role of type vegetation proportion and indirectly pool of soil in catchment as drivers of run-off composition (Kopáček et al. 2004).
**CONCLUSIONS**

This early results show the possibility of use the precisely derived catchment parameters from the digital elevation model in order to find out their effect on lake water chemistry in the process of recovery from acidification with a following prediction about the future change of lake communities with a focus on relict and rare species.

**ACKNOWLEDGEMENTS**

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**REFERENCES**


CARBON DIOXIDE AND METHANE EMISSIONS FROM WOOD ANT NESTS

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Keywords: temperate forest, CH₄ oxidation, respiration, metabolic activity, microorganisms

INTRODUCTION
Wood ants build large, long-lasting nests which are known as hot spots of CO₂ production in forest ecosystems due to ant and microbial respiration (Domisch et al. 2006; Jílková & Frouz 2014; Risch et al. 2005). Temperate forest soils are important sinks of CH₄ (Smith et al. 2003). Wood ant nests have even more favorable conditions for CH₄ oxidation, such as good porosity and low moisture content (Adamsen & King 1993; Borken et al. 2006; Dutaur & Verchot 2007; Le Mer & Roger 2001). However, little is known about CH₄ flux and seasonal changes in CO₂ production in wood ant nests.

METHODS
The study was carried out in a temperate spruce forest on the southern slope of Kleť mountain in South Bohemia. Gas samples were taken eight times (at 1- to 2-month intervals) from July 2013 to May 2014 from static chambers inserted into the slope of six ant nests and to the surrounding forest floor. Gas concentration was then analyzed in a laboratory using gas chromatography.

RESULTS AND DISCUSSION
Ant nest mounds oxidized less CH₄ (-16±19 µg CH₄ m⁻² h⁻¹) than the forest floor (-44±18µg CH₄ m⁻² h⁻¹) (Fig. 1a). CH₄ flux did not show a strong seasonal pattern and was negative in ant nest mounds and forest soil even in winter when the soil was frozen. The only exception occurred in ant nest mounds in summer, when CH₄ oxidation was lower. Apparently, there are some conditions in ant nests that hinder CH₄ oxidation or promote CH₄ production. Such conditions could be higher content of monoterpenes contained in coniferous litter used for nest construction (Maurer et al. 2008) or anaerobic conditions which arise around easily decomposable organic matter (Flessa & Beese 1995).

Fig. 1 Seasonal changes in CH₄ flux (a) and CO₂ flux (b) in wood ant nests and the surrounding soil.
Ant nests produced more CO$_2$ (189±204 µg CO$_2$ m$^{-2}$ h$^{-1}$) than the forest floor (105±80 µg CO$_2$ m$^{-2}$ h$^{-1}$) (Fig. 1b). The biggest difference in CO$_2$ flux occurred in July when it was almost six times higher in the ant nest mounds than in the forest floor. Ant nests clearly are hot spots of CO$_2$ production in forest ecosystems as mentioned earlier (Domisch et al. 2006; Jílková & Frouz 2014; Risch et al. 2005). The highest CO$_2$ production in July could be explained by higher numbers of ant workers occurring in ant nests in summer (Kwapich & Tschinkel 2013) and by higher activity of microorganisms which have enough nutrients and favorable temperature for the metabolic activity (Paul & Clark 1996).

CONCLUSIONS
Ant nest mounds do not significantly contribute to the CH$_4$ oxidation capacity of the forest soil. CO$_2$ production was higher in ant nest mounds than in the forest soil, especially in summer.

ACKNOWLEDGEMENTS
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REFERENCES
BEHAVIOUR OF ARTIFICIAL RADIONUCLIDES IN THE HYDROSPHERE

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Keywords: surface water, radioactive contamination, sediments, migration

INTRODUCTION

Artificial radionuclides, which are born in reactor during nuclear reactions, do not occur naturally in the environment (excluding tritium). They have been introduced into it by human activities, predominantly in the last century during atmospheric nuclear weapons tests and the Chernobyl accident. Nowadays, some of these radionuclides, namely caesium 137 (137Cs) and strontium 90 (90Sr), are still present in the water environment in low but measurable amounts (Maringer et al. 2009, Hanslík et al. 2013).

After the Fukushima nuclear accident in 2011, a great attention is focussed to the nuclear safety all over the world. It is not otherwise in the Czech Republic. Despite both Czech nuclear power plants are safe, as proved by stress tests, the nuclear safety concerns also a very improbable case of a severe accident, when radioactive material is released into surrounding environment. A proper estimation of radionuclide behaviour and transport in the water environment would be essential to ensure effective countermeasures.

In our study, we monitored and evaluated the residual contamination of hydrosphere, which represents a background of the accidental contamination. Experience with the old radioactive contamination indicate that sorption on solid particles plays a significant role in migration of radionuclides in the hydrosphere. That is why we focussed onto the characterization of the radionuclide sorption properties in components of hydrosphere, bottom sediments and suspended solids.

METHODS

To set the background conditions, the 90Sr and 137Cs activity concentrations were monitored in hydrosphere at four sites in the Vltava River catchment. The 137Cs concentrations were analysed according to Standard ČSN ISO 10 703 (2008) using gamma-ray spectrometry. 90Sr was determined in water using a standard method after radiochemical separation (Eaton et al. 2005). The evaluated data include also earlier collected results; the data set covers period 1990 (1994) – 2014. The temporal changes in the radionuclide concentrations were evaluated using an equation, adopted from a relationship suggested by Smith & Beresford (2005):

\[
c = c_0 \left( \alpha \cdot e^{-\frac{\ln2}{T_{eff1}}} + (1 - \alpha) \cdot e^{-\frac{\ln2}{T_{eff2}}} \right)
\]

where \( c \) is radionuclide activity concentration in surface water (Bq·l\(^{-1}\))
\( t \) time elapsed from the beginning of the monitoring (y),
\( c_0 \) activity concentration at the beginning of the observation (Bq·l\(^{-1}\)),
\( \alpha \) empirically determined constant,
\( T_{eff1}, T_{eff2} \) effective ecological half-lives of the radionuclide decline (y\(^{-1}\)).

To characterize sorption properties in the Vltava and Labe hydrosphere, series of batch experiments were conducted in the laboratory. To prepare the experimental batch, assortment of artificial radionuclides was added to surface water containing suspended solids or to a mixture of bottom sediment and water. After the sorption process reached a steady state, the solid phase was separated from the water and analysed using gammaspectrometry. Based on the analysis results, the distribution coefficients were calculated as a ratio of the radionuclide activity in the solid and water phase.
RESULTS AND DISCUSSION

As the collected data indicate, the effective rate of radionuclide decline changes during the monitoring interval. In the beginning of the observation, the radionuclide concentration is faster (has a shorter effective ecological half-life). Shortly after the contaminating event, fast removal of the radionuclide prevails, such as rapid wash out and run off the site. Later, slower processes become predominant, as most of the radionuclide is tightly bound in the environment and its removal is reluctant.

For both radionuclides, $^{90}$Sr and $^{137}$Cs, the removal process can be described with two effective ecological half-lives (include also the radiological decay of $^{90}$Sr and $^{137}$Cs): $T_{eff1}$ is not higher than 3.0 years, $T_{eff2}$ is between 8.1 to 17 years. Nowadays, the residual activity concentrations decrease slowly, which reflects the fact that the radionuclides are tightly fixed in the environment. On the other hand, the decrease is still faster than the radioactive decay itself, which means that the ecological processes are yet significant.

To estimate the radioactive contamination behaviour after a hypothetic recent nuclear accident, distribution coefficients were determined for sediment-surface water and suspended solids-surface water systems, sampled along the Vltava and Labe Rivers. Overall, the results were fluctuating in a wide range, depending on the sampling site and the tested radionuclide itself, too. The average value of the sediment-water distribution coefficient was decreasing in the sequence: $^{139}$Ce > $^{134}$Cs > $^{133}$Ba > $^{241}$Am > $^{60}$Co > $^{85}$Sr > $^{131}$I, in case of suspended solids-water system it was: $^{60}$Co > $^{139}$Ce > $^{241}$Am > $^{133}$Ba > $^{131}$I > $^{134}$Cs > $^{85}$Sr, but this order can vary slightly in particular sites. The evaluated distribution coefficients correspond well the data collected by International Atomic Energy Agency (2010) with respect to their natural variances.

CONCLUSIONS

The $^{137}$Cs and $^{90}$Sr residual contamination from global fallout and the Chernobyl accident is present in low amounts that are further decreasing at all monitored sites. The decline rate of these radionuclides has slowed down; nowadays, long-term processes of their removal from the water environment dominate. Slow sorption/desorption processes influence the activity decrease at present.

Under the simulated accidental conditions, the experimental results show that sorption onto solid phase is an important factor influencing fate of radioactive substances in hydrosphere, even in an early stage of a nuclear accident. The determined distribution coefficients should enable estimating of the radioactive contamination fate in the hydrosphere of the Vltava and Labe Rivers.

ACKNOWLEDGEMENTS

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REFERENCES


Impact of climatic change on bird populations

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Keywords: Birds, Climate change, Range shift, Ecological niche, Population trend

INTRODUCTION
Climate plays an important role in population changes of birds. Such changes result in the geographic range shift, which tell us about future assembly of ecological communities. Species ecological traits may explain a proportion of interspecific variability in range shifts. Based on relationship between current species distribution and climatic conditions we can model potential species range expected under given climatic conditions and therefore measure changes in distribution. We can expect shifts will be much larger in a future and we assume that for the conservation is important to know the bird’s reaction on emerging climate changes to avoid the double pressure. Our aim is to know which traits are typical for species shifting their range further and which for species with smaller range shift.

METHODS
We counted potential shift in the breeding range for 298 bird species from A Climatic Atlas Of European Breeding birds (Huntley et al. 2007). By digitalizing we obtained the coordinates from which we estimated both area centres (current and future) and we counted the predicted range shift and its direction. Both we related to species ecological traits: habitat variables (niche, specialisation, position on humidity gradient), diet, migration strategy, life history, geographical position of the current range and relatedness to urban areas.

In the next step we included the magnitude of the shift between predictors. We related population trends of 106 species breeding in central Europe to the magnitude because we expect this area will undergo significant changes due to colonization and extinction induced by the climatic changes.

RESULTS AND DISCUSSION
The largest shift was recorded to the north direction whereas the smallest to north-west. Breeding habitat type showed as the strongest predictor for the potential range shift. Largest shift displayed forest and wetland species. Dietary niche proved to be significant after removing the influence of habitat.

Interaction of the magnitude of the shift and the distribution type proved to be significant to. That implies that species shifting the range most with the northern type of distribution have more negative trends in central European populations, than southern species.

Our results highlight the potential limitations because geographical position strongly limits the possibility of the range shift

REFERENCES
URBAN AND SUBURBAN INTERMODAL FRACTION OF ATMOSPHERIC AEROSOL IN WINTER 2014

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Keywords: Intermodal fraction, PM₂.₅, Sioutas impactor

INTRODUCTION

Fine (PM₁) and coarse (PM₁₀₋₂₅) aerosols differ not only in size but also in the chemical composition, health effects, type of sources, and others. A dividing line between fine and coarse aerosol is not clearly defined. These fractions overlap in the aerodynamic particle size range 1-2.5 µm, also called the intermodal fraction. Sources of both coarse and fine aerosols contribute to the intermodal fraction to a different extent relating to different meteorological conditions and types of locations. According to several studies, the intermodal fraction highly correlated with coarse aerosol in dry areas during high wind speed episodes (Kegler et al. 2001, Claiborn et al. 2011). In contrast, other studies have shown higher or comparable correlation with fine aerosol (Geller et al. 2012, Jalava et al. 2006).

The aim of this study is to characterize the intermodal fraction in urban and suburban localities and estimate to what extent fine/coarse aerosol sources contribute to this fraction.

METHODS

The measuring campaign took place from 5.2.-7.3.2014 at an urban site (Ostrava Radvanice) and a suburban site (Plesná), Czech Republic. The urban site Radvanice is the residential area near a large industrial zone (southwest of the site) and traffic roads. The suburban site Plesná is the residential area situated on the northwestern outskirts of the Ostrava city. At both sites, we measured with various online and offline instruments. The results obtained daily using Personal Cascade Impactor Sampler (PCIS) are presented in this abstract.

RESULTS AND DISCUSSION

The results from PCIS showed that the intermodal fraction represented 3 - 26% of the total PM₁₀ in both sites. In contrast, PM₁ represented 64 - 93% and PM₁₀₋₂₅ 3 - 29% of the total PM₁₀. The Table 1 summarizes the statistic characterization of 24 hours concentrations from PCIS.

<table>
<thead>
<tr>
<th></th>
<th>Radvanice</th>
<th>Plesná</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM₁₂₅</td>
<td>40.4</td>
<td>38.5</td>
</tr>
<tr>
<td>PM₂₅⁻⁵</td>
<td>3.5</td>
<td>3.0</td>
</tr>
<tr>
<td>PM₁₀⁻₂₅</td>
<td>5.1</td>
<td>4.1</td>
</tr>
<tr>
<td>PM₁₀</td>
<td>31.9</td>
<td>27.7</td>
</tr>
<tr>
<td>PM₂₅⁻₁</td>
<td>2.9</td>
<td>2.7</td>
</tr>
<tr>
<td>PM₁₀⁻₂₅</td>
<td>2.4</td>
<td>2.1</td>
</tr>
</tbody>
</table>

The higher average concentrations of all three fractions were observed in Radvanice how we expected due to the large industrial source. PM₂₅⁻₁ was associated with the coarse fraction in Radvanice and with fine and coarse fractions in Plesná.

Statistical dependence between the intermodal fraction and other monitored variables can be determined with Spearman correlation coefficients (Fig. 1).
A certain positive association was observed also between PM$_{2.5-1}$ and wind speed in Radvanice despite of the result of the test - not statistically significant dependence (p-value 0.06). During days with SW prevailing wind direction (from the industrial source) in Radvanice we observed higher wind speed (1.7 times) and lower PM$_1$ concentrations (1.6 times) than for days with other prevailing wind direction. It did not apply to the intermodal and coarse fraction (SW prevailing wind direction and higher wind speed - higher concentrations).

In-depth aerosol source identification of the intermodal fraction will be conducted with the help of ion chromatography (IC), inductively coupled plasma mass spectrometry (ICP-MS) and scanning electron microscopy (SEM) applied to aerosol samples.

ACKNOWLEDGEMENT
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COMPARISON OF SUMMER AND WINTER SUBMICRON AEROSOL COMPOSITION STUDIED BY THE AEROSOL MASS SPECTROMETER

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Keywords: Atmospheric aerosol, Chemical composition, Aerosol Mass Spectrometer, PM1

INTRODUCTION
Aerosol particles are proven to affect climate change, visibility, and human health. To gain a better understanding of their origin and behavior, it is necessary to describe their chemical composition and number size distribution with a high time-resolution. In the Czech Republic or any of its neighboring countries except Germany, no results have been published from high time-resolution measurement of carbonaceous aerosol yet.

This abstract summarizes the results of two measurement campaigns conducted at a Prague background station Suchdol with focus on data from the compact-Time of Flight-Aerosol Mass Spectrometer (c-ToF-AMS). The data were collected during summer 2012 and winter 2013.

METHODS
The measurements were done at Prague Suchdol suburban site, which is located approximately six kilometers north west from the Prague city center. During the two measurement campaigns, we deployed the compact Time of Flight Aerosol Mass Spectrometer(c-ToF-AMS), field Organic Carbon/Elemental Carbon (OC/EC) analyzer and PM1 filter sampling analyzed by Ion Chromatography (IC). The c-ToF-AMS provided us with highly time resolved chemical composition and size distribution of aerosol particles (Drewnick 2005). The aerosol was analyzed with one minute time resolution. The vaporization and ionization occurred at 600°C and 70eV, respectively. To calculate air mass trajectories, we used the HYSPLIT model (Draxler & Hess 1998). Daily trends and wind roses were calculated using the OPENAIR software (Ropkins & Carslaw, 2012).

RESULTS AND DISCUSSION
To obtain correct mass concentration using the AMS, it is necessary to set correct Collection Efficiency (CE), i.e. the fraction of particles that are detected by the instrument from all particles introduced to the system. In order to determine an appropriate value of CE for our measurement, we compared AMS data with results from Ion Chromatography (IC). We found that for our summer and winter campaign the appropriate CEs were 0.29 and 0.35, respectively. This result was justified by further comparison of AMS data with data obtained by Scanning Mobility Particle Sizer (SMPS) and field OC/EC analyzer.

By comparison of the c-ToF-AMS data with the results of the HYSPLIT model, we found a clear inverse relation between the boundary layer thickness and the level of pollution. Furthermore, we selected episodes of significantly higher and lower pollution level from the whole measurement campaign and compared them with the air mass trajectories. Episodes of higher pollution were connected with arrival of continental air masses whereas episodes of lower pollution with arrival of marine air masses.

Next, we calculated the diurnal cycles and wind roses using the OpenAir Software. The diurnal cycles of total aerosol concentration measured by the c-ToF-AMS had maxima in the morning and minima in the afternoon. The maxima coincided with the morning traffic whereas the minima was caused mainly by the dilution effect of the boundary layer height. This trend applied to all species except sulphate. Sulphate showed two maxima in the afternoon which we explain as products of photochemical reactions and long range transport from upper parts of the atmosphere as the boundary layer increases.
We also carried out the analysis of organic fragments f43, f44, and f60, i.e. the ratio of particular mass to charge fragment versus the total organic mass. The values of f43 and f44 point to the oxidation state of the aerosol, whereas the value of f60 indicates the influence of biomass burning. We found that winter organic aerosol was influenced by biomass burning (unlike the summer one) and it was of local origin.

CONCLUSIONS
We analyzed data from summer and winter campaign measured by the c-ToF-AMS. The data were compared with results from the HYSPLIT model. We found a clear inverse relationship between total level of pollutants and the boundary layer height. The episodes of low pollution were connected with arrival of maritime air masses and episodes of high pollution with arrival of continental air masses. Calculated daily cycles revealed influence of daily traffic, dilution effect and transport from upper parts of the atmosphere. The analysis of organic fragments revealed that winter organic aerosol was of local origin and strongly influenced by biomass burning compared to the summer organics.

ACKNOWLEDGEMENTS
The authors of this work gratefully appreciate financial support by the Czech Science Foundation under project No. CSF P209/11/1342.

REFERENCES
INTERACTION OF MICROBIAL COMMUNITY AND LITTER QUALITY AND ITS ROLE ON SOIL ORGANIC MATTER DECOMPOSITION

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Keywords: decomposition, litter, microbial community, soil

INTRODUCTION
Litter decomposition, a major determinant of ecosystem functioning, is strongly influenced by the litter quality of different species. We aim to explore controls on litter decomposition dynamics and soil microbial community composition. Microbial biomass, microbial respiration, and litter leaf decomposition were quantified in chronosequences in post-mining sites located in the Sokolov brown-coal mining area.

METHODS
For study of decomposition we used Litterbag method which is widely used in decomposition studies. A large number of litterbags are installed at the start of the experiment and sampled periodically over time. The decomposition rates are determined from the mass loss of the newly shed litter included in the bag (Berg and McClaugherty, 2008). For quantification and composition of soil microbial community we used PLFA (phospholipid-derived fatty acids) method. PLFA analysis is a technique widely used for estimation of the total biomass and to observe broad changes in the soil microbial community (Frostegard and Baath, 1996). We also follow C-to-N ratio. For the measuring of soil respiration was used the ADC BioScientific LCi Analyser. In the soil samples we also used TOC (total organic carbon), HWC (hot water carbon) and fumigation methods.

RESULTS AND DISCUSSION
Three sampling of litterbags were done. Litterbags weight measurement was indicated and showed in Fig. 1. The results look like typical leaf litter decomposition rate (Zhang et al., 2008). For accurate results we need to wait for more sampling.

![Graph showing weight loss of different types of leaf litter in time.](image)

Fig. 1 Different types of leaf litter and its weight loss in time in the Sokolov area. All of these four types of samples were collected in the same day (31, 62, 157).
CONCLUSIONS
We started the experiment which is still going on and we suppose that it will have been finished in 24 months. During the experiment we collect samples. In this time we prepare samples for a chemical analysis and for analysis by GC-MS (Gas chromatography–mass spectrometry).

REFERENCES


INTRODUCTION
The study area is Šumava National Park (ŠNP), the largest of the four national parks (68,064 hectares) located in the south-west of Czech Republic, on the border with Germany. Since 1990 it has been the protected Biospherical Reserve of UNESCO (Bilek et al. 1990). Being a unique mosaic of natural and secondary habitats of exceptional natural value of European-wide significance, the components of the ŠNP represent is the largest terrestrial significant part of the Natura 2000 network in Czech Republic and Germany. For instance, the fauna species of ŠNP include protected important examples, such as e.g. lynx, otter and peregrine (Bláha et al. 2013). The ŠNP is established as a special regime of environmental protection with unique biological communities that are the most precious objects of protection. The area is represented by the vast wooded areas, mountain spruce and mixed forests of various ages, peat bogs, meadows biotops, moors and lakes. Altogether, they create a unique mosaic of biotopes, which encompass a variety of rare, endemic and endangered species, e.g. lynx, pearl mussel, owls, songbirds, etc (Jolecek et al. 1994; Semotanova 1998.). Geobotanically, the ŠNP belongs to the Bohemian Forest, which is split into two national parks, located in Czech Republic and in the adjacent Germany. It forms a unique protected forested area in Central Europe and one of the largest forested areas between the Atlantic Ocean and the Ural (Křenová and Hruska 2012). Geomorphologically, it covers Šumava plains, uplands Železnorudsko, Boubínská, Želnavauskou, the Šumava mountains and Vltava furrow ( Barešová & Hanusová 2010; Chabera 1998). However, some parts of the ŠNP experienced changes in the landscapes due to both natural climate changes and human impacts which is demonstrated in the undertaken modifications of the environmental zoning of the territory. Thus, since 1991 via 1995 and up to now, the zonation of ŠNP undergone changes, which resulted in the significant (almost double) decrease of Zone I (strictly conserved), slight increase of Zone II and increase of Zone III as well (Křenová and Hruska 2012). Some parts of ŠNP were previously deforested and used for agriculture since the last decades (mainly, from the middle of 20th century). Most of the fields and meadow areas have been abandoned. At the same time, many species are threatened by land-use changes (Bucharová et al. 2012). Other anthropogenic activities in Šumava area include treatments of mountain meadows and soils regularly practiced in the ŠNP: mowing, mulching and leaving fallow. The effects of such treatments includes significantly affected plant species diversity, shifts of dominance among certain species, decrease of the species richness (Maskova et al. 2009). Other triggers of ecosystems changes and ecological community dynamics include multi-year variation of climatic parameters and natural vegetation succession. For example, climate change increases the extinction probability of very small populations (Bucharová et al. 2012). As a result, the vegetation within the mountain ecosystems is gradually changing and degrading due both to anthropogenic effects and natural impacts. At the same time, the character of the rural landscape, strongly influenced by agricultural activity should be maintained in view of decreasing agricultural production. This question of environmentally sustainable management is highly important in the area of Šumava mountains (Cudlinová et al. 1999).

METHODS
The research aim was to analyse how the ecosystem landscapes located within the study area changed since 1991 until 2009 (18-year time span) using remote sensing data and GIS. The data include GIS layers in two forms: raster layers as Landsat TM images with 18-years interval (1991 and 2009), and vector thematic layers in ArcGIS shape-file format. The data were stored in a GIS project. Technically, the GIS project were generated in Quantum GIS (QGIS) software. Methodologically, the applied workflow used in this research included following steps: 1) Data capture, unpacking and storage. 2) Organizing GIS project. 3) Geo-referencing and re-projection. 4) Activating GDAL and GRASS remote sensing plugins. 5) Preliminary data processing. 6) Generating contour layers from DEM. 7) Colour composition from 3 Landsat TM bands. 8) Defining Region of Interest: raster mosaicing and clipping. 9) False colour composites (bands 4-3-2). 10)
Setting up parameters for classification. 11) Image classification using K-Means algorithm. 12) Pattern recognition. 13) Spatial analysis. The detailed illustrations of these steps are shown in the proposed presentation. The GIS analysis is used to test the importance of the natural and human-induced land used changes for survival of the important floristic locations in several case studies. Thus, landscape level predictors of commons (their location, size, borders) are evaluated using geospatial data: vector GIS layers and aerial images. The information received from these data includes digital model of the terrain (altitudes), vertical heterogeneity, slope, topographical related moisture index, heat load index and solar radiation index. The information on local geology and soil conditions (based on soil profiles), history of the colonization of the study area, and borders of land cadasters and private properties is taken from the auxiliary data. The land cover structure is calculated using Patch Analyst function embedded into the ArcGIS which is used to describe various aspects of landscape heterogeneity, habitat diversity and fragmentation.

RESULTS AND DISCUSSION
The outcomes are illustrated by two maps showing geographic distribution of land cover types within the study area in given time periods of 18-year time span. The results demonstrate visualization of the ecosystems in 1991 and 2009 showing dynamics of land cover types in the given time. The work demonstrated effective application of QGIS software combined with multi-source data (remote sensing and geoinformatics) for the purpose of environmental protection of precious areas of the Šumava National Park. The importance of the GIS and remote sensing (RS) data were successfully used for the environmental monitoring since 1970s (rapid development of Earth observation satellite systems and launch of the Landsat TM program). Therefore, the combination of remote sensing data and GIS tool for pattern recognition is proved to be effective tool for geo-botanical research, which is demonstrated in the current research.

CONCLUSIONS
The spatial analysis performed by means of QGIS in combination with remote sensing data (satellite images Landsat TM) for geobotanical studies. The spatio-temporal analysis was applied to raster images taken at 1991 and 2009. Built-in functions of the mathematical algorithms of QGIS enabled to process geospatial data and to derive information for geoeological modelling. The images classification was used to analyse changes in the ŠNP area that consist in different geobotanical land cover types. The results of spatial analysis demonstrated that structure, shape and configuration of landscapes in ŠNP changed since 1991.

ACKNOWLEDGEMENTS
The GIS data (thematic layers of ArcGIS .shp format) which were used in the current work have been generously provided by Dušan Ramportl from Charles University in Prague, Faculty of Science.

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Aerosol particles concentration and size distribution in urban and suburban location

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Keywords: Air pollution, Aerosol size distribution, Ultrafine particles, Industrial Plume

INTRODUCTION

Ostrava is one of the most polluted cities in the Czech Republic and it is considered an hot spot for air pollution in Europe (Sram \textit{et al.}, 2013). In the residential district of Ostrava Radvanice and Bartovice the \(P M_{10}\) annual limits are often surpassed during winter: daily average concentration of 50 \(\mu g m^{-3}\) was exceeded 87, 116, 118, 148, 113, 109, 202 and 172 times, from 2013 to 2006, respectively (CHMI). In consequence of the alarming situation, investigation on air pollutants is needed. This presentation reports field campaign results on: (1) number and volume concentration, and (2) size distribution of particles and (3) relationship with meteorology. The aim of this work is the source identification of the particulate pollutants in Ostrava Radvanice and Bartovice district.

METHODS

A sampling campaign was carried out from the 5th of February to the 7th of March 2014. Ostrava Radvanice and Bartovice (S1) is located at the south-west of Ostrava near a large steel and iron factory (1.5 km distance). The factory is equipped with a sintering plant, three coke batteries, three operative blast furnaces, and four tandem furnaces. 5-minutes integration time particle concentration and size distribution were measured using SMPS model 3936L25 (TSI Inc., size range: 14-723 nm) and APS model 3321 (TSI Inc., size range 0.54-20 \(\mu m\)). The meteorological parameters, including wind speed and direction, were also registered (WindSonic M, Gill). Gaseous components were measured only in S1 with 5 minutes integration time (Horiba analyzers). Aerosol particle concentration, size distribution and meteorological parameters were measured also in a suburban residential area, Plesná (S2) located at the north-east, 15 km far from Ostrava city centre, in the countryside.

RESULTS AND DISCUSSION

In S1 the average particle concentration in the lower submicrometer range (SMPS size range, with mobility diameter 14-723 nm) was \(1.72 \times 10^4\) #cm\(^{-3}\). The average particle volume concentration in the upper submicrometer and in the supermicrometer range (APS size range, with aerodynamic diameter 0.5-20 \(\mu m\)) was 42 \(\mu m^3\cdot cm^{-3}\). The dominant size fraction by volume is the coarse fraction from 5 to 20 \(\mu m\). Both particle number and volume concentration are 3 times higher in S1 than in S2. Peaks of CO and SO\(_2\) were registered in S1 at the same time with peaks of ultrafine particles, with the size range of 30-40 nm, and of coarse particles (8 \(\mu m\)). The peaks of particle number, volume, SO\(_2\) and CO were respectively 2.8, 4, 7, and 4 times higher than the off-peak. The peaks of pollutants are always related with south-western (180°-270°) wind direction and wind speed higher than 1 ms\(^{-1}\). The size distribution differs in the two sites (\textit{Figure 1}). The fine particles number size distribution was often bimodal with a mode in the accumulation size range (>100 nm) overlapped by the Aitken mode at 30 nm. In S2 the size distribution was mainly unimodal, dominated by an accumulation mode in the size range 80-100 nm. On the contrary, the volume size distribution showed a similar shape in both locations, with bimodal peaks (0.5 and 8 \(\mu m\)).
**Fig. 1** Aerosol particle number size distribution (left) and volume size distribution (right).

**CONCLUSIONS**
In S1 the ultrafine particle higher concentration suggests the presence of a nearby source, which is not found in S2. The peaks are strongly wind direction dependent and associated with CO and SO₂, indicating the steelworks plume as the main source. Higher concentration of fine and ultrafine particles near steelworks are registered in previous studies (Marris et al., 2012; Dall’Osto et al., 2008; Cheng et al., 2008; Moreno et al., 2004; Oravisjarvi et al., 2003). Sintering process and raw iron production were found as the major sources of coarse PM₁.₁₅⁻₁₀ at the same location (Pokorná et al., 2015).

**ACKNOWLEDGEMENTS**
This work was supported by the Czech Grant Agency (P503/12/G147).

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Composting for ex situ/on site decontamination of POPs contaminated soils

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Keywords: composting, biodegradation, POPs, contaminated soil, compost substrate

INTRODUCTION

Composting is a process known from ancient times which is widely used nowadays for the stabilization of biodegradable municipal/agro-industrial wastes and the preparation of organic fertilizers. A number of different organic materials can be utilized as compost substrates. The microbial consortia that develop in the composting pile during the process are responsible for the breakdown of organic matter as well as for the degradation of more amenable environmental contaminants (petroleum-derived products, monoaromatics, organic solvents etc.) (US EPA 1998, McNabb et al. 1994). In recent years the degradation of more persistent organic pollutants (PAHs, PCBs and chlorinated pesticides) during composting treatments has been proved (Michael Jr. et al. 1995; Semple et al. 1995, Cajthaml et al. 2002; Šašek et al. 2003). In bioremediation practices, composting consists of mixing of polluted soils with typical compost substrates in order to achieve the decontamination/detoxification of such contaminated matrices. Although co-composting approaches have been already used for remediation at full scale (e.g. by the US Army for the treatment of TNT contaminated soils (US EPA 1997) in case of pollution with POPs there are still some limitations that needs to be overcome to make this an established technology. This presentation will focus mainly on the tests performed to optimize the composting of PAHs contaminated soils so that it could be used in practice.

METHODS

A first set of experiments was aimed at evaluating the suitability of various waste materials and mixtures for the co-composting of PAHs contaminated soils. Two different soils (1st ΣPAHs 370 mg kg⁻¹, the highest concentration of pyrene and fluoranthene; 2nd ΣPAHs 6000 mg kg⁻¹, the highest concentration of phenanthrene and anthracene) and 5 different organic waste mixtures were tested. The volume of each compost pile was approx. 0.75 m³ and the ratio of soil to organic waste was 1:1 (w/w dry basis). Compost piles were aerated by re-digging the whole content of composters 4 times a year.

Since the beginning of the experiment, temperature in the piles’ core, air quality and respiratory gases, were monitored continuously, while concentration of PAHs and microbial parameters (PLFA) were assessed during the thermophilic, cooling and maturation phase throughout a period of 2 years. When the concentrations of PAHs dropped significantly and composts were mature a battery of ecotoxicological and leachate tests was performed.

RESULTS AND DISCUSSION

The analyses proved that PAHs were degraded effectively during the composting process as their degradation in both soils varied from 95 to 98 % after 2 years (with more than 90 % of the initial PAHs content was degraded within the first year). Ecotoxicological tests suggested that no toxic metabolites were produced as there was no toxicity associated to the mature composts. According to our results, the composition of the organic waste does not play a substantial role on the extent of PAHs degradation if suitable humidity and carbon to nitrogen ratio are provided, although some differences in the rate of contaminants degradation were observed.

Next table shows composition of different compost mixtures. And the graphs below show the time development of the PAHs concentration in the compost mixtures. Only one of the prepared mixtures – compost II. did not show significant degradation of PAHs. This was due to the lack of the air in the mixture. Therefore samples of this mixture were not taken in the later phases of the test.

Ecotoxicological tests suggested that no toxic metabolites were produced as there was no toxicity associated to the mature composts.
Table 1: Composition of different compost mixtures

<table>
<thead>
<tr>
<th>Compost</th>
<th>I.</th>
<th>II.</th>
<th>III.</th>
<th>IV.</th>
<th>V.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Character</td>
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<td>Grass</td>
<td>Sludge</td>
<td>Chicken litter</td>
<td>Fruits and Vegetables</td>
</tr>
<tr>
<td>C/N</td>
<td>14,0</td>
<td>14,0</td>
<td>26,0</td>
<td>28,5</td>
<td>29,7</td>
</tr>
<tr>
<td>humidity (%)</td>
<td>51,7</td>
<td>62,4</td>
<td>53,8</td>
<td>28,8</td>
<td>37,6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Component</th>
<th>% of dry matter</th>
<th>Component</th>
<th>% of dry matter</th>
<th>Component</th>
<th>% of dry matter</th>
<th>Component</th>
<th>% of dry matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td>50</td>
<td>Soil</td>
<td>50</td>
<td>Sludge</td>
<td>23</td>
<td>Woodchips</td>
<td>25</td>
</tr>
<tr>
<td>BRKO</td>
<td>40</td>
<td>Grass</td>
<td>50</td>
<td>Straw</td>
<td>8</td>
<td>Chicken litter</td>
<td>17</td>
</tr>
<tr>
<td>Woodchips</td>
<td>10</td>
<td>x x</td>
<td>x x</td>
<td>Sawdust</td>
<td>5</td>
<td>Straw</td>
<td>8</td>
</tr>
<tr>
<td>x x</td>
<td>x</td>
<td>x x</td>
<td>horse manure</td>
<td>14</td>
<td>x</td>
<td>Woodchips</td>
<td>25</td>
</tr>
</tbody>
</table>

Fig. 1 Time development of the PAHs concentration in different compost mixtures in the 1<sup>st</sup> soil

Fig. 2 Time development of the PAHs concentration in different compost mixtures in the 2<sup>nd</sup> soil
CONCLUSIONS

According to our results, the composition of the organic waste does not play a substantial role on the extent of PAHs degradation if suitable humidity and carbon to nitrogen ratio are provided, although some differences in the rate of contaminants degradation were observed.

ACKNOWLEDGEMENTS

The project was supported by the Technology agency of the Czech Republic (project No. TE01020218).

REFERENCES


DEPARTMENT OF EURASIAN OTTER (Lutra lutra) IN RELATION TO THE STOCKING OF RAINBOW TROUT (Oncorhynchus mykiss), BROWN TROUT (Salmo trutta m. fario) AND GRAYLING (Thymallus thymallus)

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Keywords: Lutra lutra, hatchery – reared trout, spraint analysis, fish loss, daily food intake

INTRODUCTION

The Eurasian otter (Lutra lutra) is one of the most important piscivorous predators in the Czech Republic. Otters compete with humans for similar natural resources (fish) and are therefore considered a threat to fish farms, ponds and running waters stocked with hatchery-reared fish. With rising number of otters in the central Europe, conflicts between environmental protection and fishermen begin to escalate. Stocking and fish farms create perfect environment for fish-eating predators (including otters) and, together with decreased water contamination, lead to relatively high population densities of these predators that may even turn into local overgrowth (for example in pond-rich areas in south Bohemia, see Hlaváč and Toman 1995). While the great cormorant is considered the primary source of conflict in aquatic industry (Kranz 1995), otters can cause severe damage to fish populations on smaller streams, especially during rather cold winters when ponds and lakes freeze over. This study is quite unique in a way that it estimates predation on allochthon fish populations and therefore provides some insight on success of this stocking program while also gives information about predation of local native species. The aim of this study is to analyze otter diet during winter season and evaluate predation on local fish populations in Chotýšanka stream a few months after stocking brown trout yearlings, grayling yearlings and rainbow trout adults into the stream. We hypothesized that stocked trout and grayling will occur in diet of otter in non-negligible numbers.

METHODS

The study was carried out on Chotýšanka stream, situated in central Bohemia (Czech Republic), located approximately between cities Vlašim and Benešov. We examined one part of the stream, listed as Chotýšanka 1, located between pond Smikov and river Blanice. The stream is natural, rather shallow and narrow, with many meandering sections and variety of attached pools. Stream banks are of natural soil, surrounded by meadows (being cut once per year) or by forest and are easily accessible only during winter and rather overgrown by flora during summer. Although Chotýšanka is listed as typical trout water, natural conditions of the stream are rather poor and inappropriate for trout and grayling populations. Water is marginally slow, warm and eutrophic, mostly because of presence of large ponds above the stream. Therefore, trout and grayling stocking is rather questionable in this area. Diet composition was determined by spraint (faecal) analysis. Otter spraints were collected in winter season 2005/2006. Altogether we collected about 2 700 ml of spraints, which makes about 260 – 300 individual spraints. Collected spraints were soaked in a mixture of water and detergent (Jar) to separate individual bones from the remaining material and then washed through a 0.5 mm sieve and dried on direct sunlight. We separated all recognizable prey remains (fish diagnostic bones, scales, amphibian bones, crayfish exoskeleton remains) using a binocular loupe and a Petri dish. Fish species were identified to the lowest taxon possible based on morphological differences of diagnostic bones. We calculated L₁ (Longitudo totalis) and weight of fish. We estimated total fish consumption by otters on the studied stream for the whole winter season (ninety days).

RESULTS AND DISCUSSION

We found and identified a total of 1531 individual fish with total weight of 18 066 g. Fish was the most common prey item recovered in spraints, representing 83.75 % of the overall biomass. Amphibians (frogs from Rana family) represented 12.5 % of biomass and crayfish (Astacus fluviatilis) represented 3.75 % of
biomass. We found no trace of birds, mammals or non–crayfish invertebrates in the spraints and no corpses in the studied area. Diet of otters composed of 12 fish taxa. The most important prey item was gudgeon (Gobio gobio) by both numbers and biomass. Chub (Leuciscus cephalus) was the second most important prey by numbers and biomass. Brown trout (Salmo trutta m. fario) was important only by numbers of fish consumed whereas inversely rainbow trout (Oncorhynchus mykiss) and common carp (Cyprinus carpio) were important only by biomass. We found no diagnostic bones or any other signs of grayling (Thymallus thymallus) in spraints. We calculated that fish made 83.75 % of total biomass in otter diet. Rainbow trout makes 10.90 % and brown trout 1.80 % of biomass.

In the past, otter predation on wild salmonids populations has been studied on several occasions. Otters may have a huge impact on salmonid populations by consuming large portion of the annual production of juvenile trout and salmon (up to 60 %, see Kruuk et. al. 1993). Carss et al. (1990) found out that otters prey upon Atlantic salmon during spawning season in rivers in Scotland. Otter predation on trout fish farms and trout stocked rivers had been proved before (Ludwig et. al. 2002). Mink predation can also heavily influence trout and salmon populations (Heggens and Borgstrom 1988). Trout predation may also depend on presence of local trout population as well as alternative fish prey. Hatchery – reared trout might be vulnerable to otter predation when stocked into a river with existing trout population and a lack of other easier – to – catch fish species (Jacobsen 2005). Unlike this study, otters in stream Chotýšanka preyed upon stocked trout even though there was clearly no native trout population. This may be because the stream is rather small, stocked fish are hatchery – reared and “naive” and other fish available are of smaller size. The main prey item was fish (almost 84 %). Such number is quite common for otters on small watercourses, streams and channels in moderate climate (Clavero et al. 2003). Alternative prey consisted of amphibians (frogs from Rana family) and crayfish, which is fairly common (Brzezinski et. al. 2006).

CONCLUSIONS
This study shows that otters can be important predators of newly stocked trout. Both trout and grayling stocking on stream Chotýšanka proved to be not so effective.

REFERENCES
INTRODUCTION
Organic aerosol (OA) is the most abundant but still poorly characterized component of airborne particulate matter. This situation is even more complicated in large cities where many anthropogenic sources of primary organic aerosol (POA) are situated. In recent years, aerosol mass spectrometry has been increasingly applied to obtain highly time-resolved chemical composition of ambient aerosol. This is considerably important for clarification of organic aerosol life cycles and sources. Two measuring campaigns, which lasted about six weeks in summer 2012 and in winter 2013, were performed at suburban site Prague – Suchdol. Aerosol data were measured by Aerodyne compact time-of-flight aerosol mass spectrometer (AMS) which is able to characterize the size resolved chemical composition of non-refractory submicron (PM$_{1}$) fraction.

METHODS
Organic aerosol data were averaged to 30 min. intervals and analyzed by receptor modelling based on positive matrix factorization. Firstly, a set of factors is identified by unconstrained technique using Multi-linear engine (ME-2) (Paatero, 1999). Mass spectra of these factors correspond both to primary organic aerosol (POA) sources and secondary organic aerosol (SOA) sources. We distinguished various primary sources depending on season. In summer season we identified hydrocarbon-like organic aerosol (HOA) from traffic and OA emitted by and biomass burning (BBOA). In winter season we found two types of POA both connected with local heating: Wood burning (WBOA) and Coal burning (COAL) aerosols. POA portion was ranging from 10% to 20% of total organic aerosol in summer and from 10% to 40% in winter season. In both parts of the year SOA consists of two types of oxygenated organic aerosol varying in volatility and degree of oxidation. Semi-volatile oxygenated organic aerosol (SV-OOA) shows maximal concentration during the night and minima in the afternoon. Low-volatile oxygenated organic aerosol (LV-OOA) has an opposite daily pattern and is more oxidized than SV-OOA. Mass spectra of all detected POA factors were then put more precisely by ME-2 partially constrained technique: a-value approach (Canonaco, 2013)

![Fig. 1: Comparison of summer and winter LVOA mass spectra](Image)
RESULTS AND DISCUSSION
In both seasons ME-2 analysis resolves two POA sources and two SOA sources. The same SOA sources were identified in summer and winter. Pearson’s correlation coefficient R showed high degree of similarity ($R_{LVOA\text{summer}, LVOA\text{winter}} = 0.99$, $R_{SVOA\text{summer}, SVOA \text{winter}} = 0.79$). During winter season we were not able to resolve HOA factor clearly. We may assume that the low amount of HOA was included in COAL factor due to high similarity of HOA to COAL factor ($R_{HOA, COAL} = 0.81$). Summer BBOA factor showed high similarity to WBOA factor ($R_{BBOA, WBOA} = 0.81$).

ACKNOWLEDGEMENTS
This work was supported by the Czech Science Foundation under grant P209/11/1342.

REFERENCES
MICROHABITAT DETECTABLE DIFFERENCES AMONG SOIL FAUNA POPULATION IN SOKOLOV UNRECLAIMED POST MINING SITES: POTENTIAL OF FUNGAL BASED TERRESTRIAL FOOD WEB

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Keywords: Unreclaimed sites, Fermentation layer, Soil fauna, F/B ratio, Soil food web

INTRODUCTION

Spontaneous primary succession is considered a low cost reclamation strategy in post mining sites. To further understand this process in last several years numerous studies have been done in Sokolov post mining discrete over unreclaimed sites dealing with different aspects of biological successions in the area. Rest on the previous studies we were interested to know whether there are some explainable patterns of diversity and population of soil Diptera and Coleoptera population under different vegetation coverages in unreclaimed sites.

METHODS

In 2012 a sampling have been conducted over the unreclaimed sites with different vegetation coverage (i.e. Bare, Grass and Woody coverage) and age (10, 18, 28, 55 years). Samples for extracting PLFA and chemical analysis has been taken at the same time (data in not completed yet).

RESULTS AND DISCUSSION

Highest diversity and population based on the results was mostly predicted by Grass coverage and age (Figure 1). Previous studies in the same site indicate over a clear difference using fermentation layer (Oe) among sites that is significantly in correlation with the coverage in the way that in Grass stage we have the thickest fermentation layer and highest levels of Fungal/Bacterial ratio in the soil. The high amount of organic matter in Oe layer as well as higher ratios of fungi/bacteria in the soil makes it reasonable to conclude that fungal based food web in Grass coverage system is connected with upper trophic levels namely micro and macro arthropods directly (as well as indirectly) comparing to bacterial based food web.

![Fig 1. RDA analysis biplot showing the relationship between Coleoptera and Diptera with the environmental variables](image-url)
This can lead to more energy transforming with less connections among trophic levels which is a sensible reason for higher population and diversity among coleopteran and dipteran soil fauna. Results as well shows that this stage is a temporary stage in the transition from bare to woody system during succession which itself is affected by the faunal activities in the soil.

CONCLUSION

According to a recently proposed hypothesis (Ponge, 2013), several lines of evidence point to a wider perspective for ecosystem selection with the involvement of humus form. Achieving the highest diversity and population seems not to be always the only destination for decision making because of the existence dynamic in the different levels of environment. The higher F/B ratio can be related to the superiority of Fungi and fungal based food web in relation to the higher diversity observed in the grass coverage. Testing the idea of fungal based preference in the presence of thick fermentation layer and its effects over population through laboratory and field experiments using C15 and N14 isotopes can be of great help with more understanding in this regard.
Identification of key factors during biodrying sewage sludge and digestate from biogas stations

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Contact: Vojtech.Pilnacek@gmail.com

Introduction
It is no doubt, that literature author well known to most of waste management experts is Jan Neruda. All of them all the time speak the same “nerudian” question. „Where with him?”. And waste is meant on this place. One of many ways of waste disposal is waste to energy. In this case lower calorific value plays title role. And here another in imaginative literature not so often asked question rises. „How to reach the best values of low calorific value?“ One of methods is certainly biodrying.

Past work
Biodrying is process, which utilizes heat generated by aerobic decomposition of organic matter for substrate drying. Main agent of whole process is air artificially blasted to dried substrate. The air is firstly source of oxygen for aerobic decomposition processes, secondly it functions as medium for evaporated moisture transport. On the other hand it is simultaneously cooling medium and energy consumed negatively impacts energetic balance of the process. In past work we tried to find how to set the air supply to reach optimal drying performance.

In past work municipal solid waste was used as a substrate.

Methods
Waste was processed in model biodrying reactor. Two regimes of aeration were investigated: regime controlled by oxygen concentration (concentration between 16 and 20% was maintained) and regime controlled by temperature in upper layer of the reactor (temperature between 42°C a 45°C and oxygen concentration between 16 a 20% was maintained). Drying effectiveness was measured as change in substrate moisture and low calorific value.
Results

Table 1 - Values of moisture before and after the process

<table>
<thead>
<tr>
<th>Run</th>
<th>Moisture before (%)</th>
<th>Moisture after upper layer (%)</th>
<th>Moisture after lower layer (%)</th>
<th>Desiccation upper layer (%)</th>
<th>Desiccation lower layer (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature 1</td>
<td>41,28 ± 1,88</td>
<td>23,87 ± 3,20</td>
<td>13,74 ± 2,79</td>
<td>17,41</td>
<td>27,54</td>
</tr>
<tr>
<td>Temperature 2</td>
<td>43,64 ± 1,16</td>
<td>25,08 ± 0,65</td>
<td>22,87 ± 1,60</td>
<td>18,56</td>
<td>20,77</td>
</tr>
<tr>
<td>Oxygen 1</td>
<td>36,88 ± 1,61</td>
<td>37,82 ± 2,12</td>
<td>21,76 ± 0,65</td>
<td>-0,94</td>
<td>15,12</td>
</tr>
<tr>
<td>Oxygen 2</td>
<td>38,52 ± 1,26</td>
<td>15,81 ± 0,43</td>
<td>16,09 ± 0,80</td>
<td>22,71</td>
<td>22,43</td>
</tr>
</tbody>
</table>

Table 2 - Low calorific value before and after the process

<table>
<thead>
<tr>
<th>Run</th>
<th>LCV before (MJ/t)</th>
<th>LCV after upper layer (MJ/t)</th>
<th>LCV after lower layer (MJ/t)</th>
<th>LCV change upper layer (%)</th>
<th>LCV change lower layer (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature 1</td>
<td>9 077,12 ± 73,78</td>
<td>13 818,18 ± 344,23</td>
<td>15 415,33 ± 253,22</td>
<td>34,31</td>
<td>41,12</td>
</tr>
<tr>
<td>Temperature 2</td>
<td>9 835,66 ± 21,21</td>
<td>13 610,96 ± 772,26</td>
<td>14 817,38 ± 668,71</td>
<td>27,74</td>
<td>33,62</td>
</tr>
<tr>
<td>Oxygen 1</td>
<td>12 358,60 ± 219,74</td>
<td>11 314,05 ± 51,51</td>
<td>14 548,64 ± 95,82</td>
<td>-9,23</td>
<td>15,05</td>
</tr>
<tr>
<td>Oxygen 2</td>
<td>11 102,23 ± 123,71</td>
<td>14 982,44 ± 197,09</td>
<td>17 001,06 ± 180,99</td>
<td>25,90</td>
<td>34,70</td>
</tr>
</tbody>
</table>

LCV - Lower calorific value

Energetic balance of the process was reviewed as:

$$E = \left( \frac{H_{after\ upper} + H_{after\ lower}}{2} - H_{before} \right) \cdot m_{waste} - P \cdot t$$

Where: $E$ - energetic balance, $H_{after\ upper}$ - LCV after drying in upper layer, $H_{after\ lower}$ - LCV after drying in lower layer, $H_{before}$ - LCV before drying, $m_{waste}$ - waste mass, $P$ - energy input of air supply, $t$ - air supply operational time

Table 3 Energetic balance of the process

<table>
<thead>
<tr>
<th>Run</th>
<th>Air supply operational time (s)</th>
<th>Energy consumed (MJ)</th>
<th>LCV average before drying (MJ/t)</th>
<th>LCV average after drying (MJ/t)</th>
<th>Energetic balance (MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature 1</td>
<td>439338</td>
<td>28,12</td>
<td>9077</td>
<td>14617</td>
<td>138,07</td>
</tr>
<tr>
<td>Temperature 2</td>
<td>342441</td>
<td>21,92</td>
<td>9836</td>
<td>14214</td>
<td>122,14</td>
</tr>
<tr>
<td>Oxygen 1</td>
<td>64231</td>
<td>4,11</td>
<td>12359</td>
<td>12931</td>
<td>13,07</td>
</tr>
<tr>
<td>Oxygen 2</td>
<td>101854</td>
<td>6,52</td>
<td>11102</td>
<td>15992</td>
<td>140,17</td>
</tr>
</tbody>
</table>

Conclusions

- Under given conditions it was not possible to directly compare both regimes. Drying effectiveness does not depend only on aeration rate, but also on other factors (amount and...
composition of organic fraction, ambient air properties). Many yet in literature undiscovered questions rises: How is the process affected by amount and composition of the organic fraction? How is the process affected by ambient air characteristics?

- Energetic balance was every time positive. It seems that optimal is process controlled by oxygen concentration. Question is, in how many cases will be composition of dried waste suitable for this controlling regime.

**Future work**

In future work we want to have sewage sludge and digestate from biogas stations as a substrate. We want to answer some of questions defined by past work.

- How is the process affected by ambient air characteristics?

  Simultaneously we define additional questions.

- How is the process affected by pH and C/N ratio?
- How is optimal amount of bulking agent to assure sufficient aeration?
- Quantification of microorganism groups participating on decomposition processes in phases of the process and find methods how to affect them.
- How are characteristics of produced fuel?
- How part has the biodrying effect on overall drying process?

  For these purposes we will upgrade model biodrying reactor, for quantification of microorganisms groups Phospholipids fatty acids analysis (PLFA) will be used, for investigation of fuel characteristic combustion test will be performed and for investigation of biodrying effect chemical sterilization of dried substrate before and during the process will be utilized.
Picture 1 - Upgraded reactor scheme

1 - Air supply
2 - Plexiglass column with silicagel
3 - Plexiglass column with water
4 - Temperature and moisture sensor
5 - Flow meter
6 - Electronic balance
7 - Flask for leachate
8 - Drenage layer
9 - Temperature and moisture sensor
10 - Temperature and moisture sensor
11 - Temperature and moisture sensor
12 - Gas analyzator sond
13 - O2 sensor
14 - CO2 sensor
15 - VOC sensor
16 - NH3 sensor
17 - Convertor THT2
18 - Convertor THT2
19 - Convertor THT2
20 - Convertor THT2
21 - Convertor AD4
22 - Gas analyzator
23 - USB Convertor
24 - Convertor AD4
25 - Nutrient solution for biofilter
26 - Peristaltic pump
27 - Flask for condensate
28 - Biofilter
29 - Notebook
30 - I/O modul Quido 2/2
31 - Performance regulator
32 - Relay

- Air distribution
- Interconnection of electronic
- Hose for nutrient solution
Preliminary results on the status of snow leopard through camera trap technique in Annapurna, Nepal

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Keywords: Annapurna, Camera trapping, Himalayas, Snow leopard

INTRODUCTION
Snow leopard (Panthera uncia) is a critically endangered species, found in the mountains of Central Asia and widely but patchily distributed along the alpine and subalpine zones of Nepal's Himalaya. The snow leopards inhabit some of the world’s most rugged landscape, exemplified by the Himalaya, where they prefer steep, rugged terrain well broken by cliffs, ridges, gullies and rocky outcrops (Schaller 1977; Jackson & Ahlborn 1989). Annapurna Conservation Area, a part of Nepal Himalaya, dominated by some of the world’s tallest mountains, supports a significant proportion of Nepal’s Snow Leopards estimated at 350–500 individuals (Jackson & Ahlborn 1990). A large portion of this lies within Mustang District covering c. 47% of the Annapurna Conservation Area (7,629km²) (NTNC 2008). Snow Leopards have been reported from the adjoining districts, Manang (Oli 1994) to the east and Dolpo (Jackson & Ahlborn 1990) to the west, but little is known about the population in Mustang except for anecdotal accounts of livestock losses allegedly killed by this large feline. Our specific aim of the study was to determine the minimum number of snow leopards in Lower Mustang and Upper Mustang of Annapurna Conservation Area.

METHODS (FOR POSTER)
We have performed a pilot study, in which we used indirect sign method, that is, the SLIMS – the Snow Leopard Information Management System – in Lower Mustang in 2010 (one survey) and 2011 (two survey) to study snow leopard and its prey species. In 2011 (October-December), we used nine remotely triggered cameras (Bushnell and ScoutGuard passive infrared detector) to get a lower limit for leopard population size and to correlate this with presence sign abundance in Lower Mustang. Results from 2011 were published in the journal Threatened Taxa: at least 3 snow leopards were found in ca. 75 km² (Ale et al. 2014). During 2012-2013, we used three cameras in Lower Mustang during October to December. In 2012, we used 5 cameras in the Manang district over ca. 100 km² and 11 cameras in 2013 over 131km² during October to December. We located suitable camera-trap sites along high, well-defined and narrow ridgelines or valley bottoms at or immediately adjacent to frequently scent-sprayed rocks and scrapes (Jackson et al. 2006). In each location, we deployed one camera trap at a distance of 2.3 metres from the anticipated travel path of snow leopard. These camera traps were checked approximately every 12 to 15 days, and batteries were changed if necessary. We used pelage patterning, specifically spots on the flanks, dorsal surface of the tail, and on forehead to identify individual Snow Leopards. Abundance index was analysed based on indices of encounter snow leopard photographs (no. of capture events/per 100 trap nights).

RESULTS AND DISCUSSION
In Lower Mustang, we obtained a total of 42 pictures of snow leopards during nine capture events resulting in a capture success of 2.3 individuals per 100 traps nights in 2011, 77 pictures during 11 capture events resulting in a capture success of 3 individuals per 100 trap nights in 2012 and 14 pictures during five capture events resulting in a capture success of 4 individual per 100 trap nights in 2013. In Upper Manang, we obtained a total of 84 pictures of snow leopards during 8 capture events resulting in a capture success of 6 individual per 100 trap nights in 2012 and 105 pictures during 18 capture events resulting in a capture success of three individual per 100 trap nights in 2013 (Table 1). Lower Mustang (an area of ca. 75 km²) supported a minimum of four adult snow leopards with one cub and Upper Manang (an area of ca. 131 km²) supported three adult individuals with one cub during the period of observation. Jackson et al. (2006) reported 66 and 49 capture events (capture success 8.9 and 5.6 per 100 trap-nights) in two consecutive years of 2003 and 2004 in Hemis National Park in India. An indication that our camera locations and/or site set-up parameters were not ideal is the large number of false images (e.g., moving vegetation) and photos of non-targeted species such as livestock, birds, and other mammals. However, unlike survey by Jackson et al.(2006) in Hemis, our objective was simply to determine the minimum number of snow leopards in selected sites as pilot survey.
Table 1: 2011-2013 results of camera-traps in Annapurna

<table>
<thead>
<tr>
<th></th>
<th>Trapping effort</th>
<th>Images</th>
<th>Total</th>
<th>Full</th>
<th>Partial</th>
<th>Non-target</th>
<th>False</th>
<th>Capture events</th>
<th>Individual SL identified</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(trap nights)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2011 results of camera-traps in Lower Mustang (cameras traps=9, camera location=9, survey area=ca. 75 km²)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>400</td>
<td>42</td>
<td>19</td>
<td>23</td>
<td>779</td>
<td>26661</td>
<td></td>
<td></td>
<td>3 individuals (LM-SL1, LM-SL2, LM-SL3)</td>
</tr>
<tr>
<td>Per 100 trap nights</td>
<td>10.5</td>
<td>4.75</td>
<td>5.75</td>
<td>195</td>
<td>6665</td>
<td>23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2012 results of camera-traps in Lower Mustang, (cameras traps=2, camera location=2, survey area=ca. 75 km²)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>140</td>
<td>77</td>
<td>41</td>
<td>36</td>
<td>262</td>
<td>2508</td>
<td>11</td>
<td></td>
<td>3 individuals with one cub (LM-SL1, LM-SL3 with cub, LM-SL4)</td>
</tr>
<tr>
<td>Per 100 trap nights</td>
<td>24</td>
<td>13</td>
<td>11</td>
<td>81</td>
<td>779</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2013 results of camera-traps in Lower Mustang, (cameras traps=2, camera location=2, survey area=ca. 75 km²)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>125</td>
<td>14</td>
<td>8</td>
<td>6</td>
<td>560</td>
<td>955</td>
<td>5</td>
<td></td>
<td>3 individuals (LM-SL1, LM-SL3, LM-SL4)</td>
</tr>
<tr>
<td>Per 100 trap nights</td>
<td>11</td>
<td>6</td>
<td>5</td>
<td>448</td>
<td>764</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2012 results of camera-traps in Upper Manang, (cameras traps=5, camera location=7, survey area=ca. 100 km²)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>140</td>
<td>84</td>
<td>46</td>
<td>38</td>
<td>79</td>
<td>67</td>
<td>8</td>
<td></td>
<td>1 individual (UM-SL1)</td>
</tr>
<tr>
<td>Per 100 trap nights</td>
<td>60</td>
<td>33</td>
<td>27</td>
<td>56</td>
<td>48</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2013 results of camera-traps in Upper Manang, (cameras traps=11, camera location=11, survey area=ca. 131 km²)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>636</td>
<td>105</td>
<td>87</td>
<td>36</td>
<td>1378</td>
<td>34773</td>
<td>18</td>
<td></td>
<td>3 individuals with one cub (UM-SL1 with cub, UM-SL2, UM-SL3)</td>
</tr>
<tr>
<td>Per 100 trap nights</td>
<td>17</td>
<td>14</td>
<td>6</td>
<td>217</td>
<td>5467</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CONCLUSIONS
We conclude that our study sites Lower Mustang harbours at least four adult snow leopards and Upper Manang harbours at least three adult snow leopards. One female with one cub were captured in both study areas.

ACKNOWLEDGEMENTS
We thank National Trust for Nature Conservation (Nepal), Snow Leopard Conservancy (US), CzechGlobe-Global Change Research Center AS CR and Tshering Lama O’Gorman for supporting the field work.

REFERENCES
NITROGEN AND PHOSPHORUS LEACHING FROM BIOMASS OF CALAMAGROSTIS EPIGEJOS DURING THE VEGETATION SEASON

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Keywords: Plant litter, Nitrogen, Phosphorus, Biomass, Post mining sites

INTRODUCTION
Decomposition of plant litter plays an important role in the formation of soil organic matter (Austin & Ballaré 2010). For understanding initial stages of litter decomposition was used a common aggressive tall grass Calamagrostis epigejos that usually grows in many disturbed habitats at succession stages. Enhanced availability of nitrogen from atmosphere deposition can accelerate the expansion of tall grasses (Holub et al. 2012). C. epigejos let in after senescence a large proportion of dead biomass standing for many months with limited contact with soil and microbial breakdown (Rebele & Lehmann 2001).

Lot of attention is still focused only in organic carbon accumulation and transformation but a little attention is dedicated to other nutrients. The aim of this study was to access the role of dead standing biomass on the leaching of nitrogen and phosphorus from plant aboveground biomass of C. epigejos and we observed losses nutrients from biomass during the whole vegetation season in two different old sites at the post-mining areas.

METHODS
The experiment was established in unreclaimed sites at heaps near Sokolov (CZ), where C. epigejos is a common grass at all succession stages (Frouz et al. 2008). It was used two sites: the first site was about 15 years old (young poor site) and the second site was 45 years old (old rich site). We collected plant biomass of C. epigejos every other month for one year. Plant biomass was categorize into the three pools: living, dead lying and dead standing biomass. The first part of initial litter was stored in a dark and dry place. The other part was placed in litterbags in the field exposition for 1 year buried in the soil or on the surface or hanging above soil surface. Total nitrogen concentration was determined in biomass by combustion gas chromatography (Elemental Analyser 1108, Carbo Erba, Italy). Total phosphorus was analysed in mixed samples by mineralization with perchloric acid (Sommers & Nelson 1972) and determination of orthophosphate ions by ascorbic acid and ammonium molybdate (Watanabe & Olsen 1965).

RESULTS AND DISCUSSION
Results showed that the standing biomass led to faster leaching of nutrients while the most of dead biomass remained not decomposed. Losses of nitrogen were observed during vegetation season, but the greatest losses were immediately after senescence in august and consequent losses were slower. In young site was content of nitrogen in dead plant biomass closed to the lowest values in living plant biomass and it does not changed during vegetation season. It can indicate reabsortion of nitrogen from living biomass before senescence and preservation of nitrogen in dead standing biomass like in previous studies Holub et al. (2012). Table 1 shows significant differences between young and old sites in changes of phosphorus content in plant biomass. The retranslocation of phosphorus from living leaves to senescent leaves were observed especially at the end of vegetation season (Fig. 1) when the content of phosphorus in living biomass was close to values of dead biomass in the middle of the season at the old site. The ability to recycle of nutrient can play important role in biomass recovery at the beginning of the next growing season (Holub et al. 2012).
Table 1 Differences in content of phosphorus between young and old site shows results by factorial ANOVA. Significant results are indicated in italics.

<table>
<thead>
<tr>
<th>Effect</th>
<th>DF</th>
<th>F-ratio</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pool x Month</td>
<td>8</td>
<td>9,6</td>
<td>0,000</td>
</tr>
<tr>
<td>Site x Month</td>
<td>4</td>
<td>6,3</td>
<td>0,000</td>
</tr>
<tr>
<td>Pool x Site x Month</td>
<td>8</td>
<td>2,9</td>
<td>0,011</td>
</tr>
</tbody>
</table>

Fig. 1 Changes of phosphorus content in biomass of Calamagrostis epigeios during vegetation season at young and old site. Statistical homogenous group are marked by the same letter (ANOVA, LSD test, \( P<0.05 \)).

CONCLUSIONS
We can conclude that the greatest losses of nutrients are subsequently before senescence of leaves and than leaching of nutrients are very slow.

ACKNOWLEDGEMENTS
This study was supported by the Charles University in Prague, and by the Czech Science Foundation Grant No. P504/12/1288).

REFERENCES
DETERMINANTS OF ORCHID SPECIES DIVERSITY

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Keywords: connectivity, orchid, diversity

INTRODUCTION
Currently there are studies which suggest that the number of orchid species on islands is except their size and latitude also positively correlated with their connectivity on other islands. This may be due to the fact that higher locality connectivity means also higher colonization probability of a new species thanks to higher probability of species seed dispersal. This dependence could apply also in a smaller scale within a single continent or country, but this has not been tested so far (Schödelbauerová et al. 2009).

Probability of occurrence of a single orchid species on locality can be also affected by the history of locality (Janečková et al. 2006). On sites unaffected by human (by ploughing or fertilization) it is possible to expect a higher probability of occurrence of a single orchid species than on anthropogenic sites. The effect of anthropogenic influence can decline in time because the locality can return to natural state and can be recolonized from surrounding living populations again. The effect of these opposing opinions on the orchid occurrence is not known.

The aim of this study is to test the following hypotheses: 1) The probability of occurrence of a single terrestrial orchid species depend on connectivity of selected locality. 2) The probability of occurrence of a single terrestrial orchid species depend on history of selected locality.

METHODS
We used existing historical and recent databases of terrestrial orchid species occurrence on a selected area to determine historical localities of selected orchid species. We started with localities present in South Bohemia. At each of these localities we looked for orchid species and, if present, we counted their number. We also monitored vegetation cover (e.g. dominant species on the locality), adjusted exact GPS coordinates and too a photo.

RESULTS AND DISCUSSION
We have visited a total of 192 localities during the summer season of 2014. For specific numbers of visited localities of five most abundant species see Table 1. The numbers of living, dead and undiscovered localities are shown in Fig. 1.

Table 1 Number of visited localities of five most abundant species.

<table>
<thead>
<tr>
<th>Species</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dactylorhiza majalis</td>
<td>121</td>
</tr>
<tr>
<td>Epipactis helleborine</td>
<td>28</td>
</tr>
<tr>
<td>Epipactis palustris</td>
<td>6</td>
</tr>
<tr>
<td>Orchis morio</td>
<td>12</td>
</tr>
<tr>
<td>Platanthera bifolia</td>
<td>25</td>
</tr>
</tbody>
</table>
From Fig. 1 it follows that the most abundant species in South Bohemia is *Dactylorhiza majalis*. The largest percentage of living localities was found for *D. majalis*, the lowest one for *Orchis morio* and *Epipactis palustris* (Fig. 1). It can be due to low demands on environmental conditions of *D. majalis* compared to other species.

We also analyzed: (1) the reasons of extinction of orchids in dead localities and reasons why certain localities were not found, (2) number of new localities we found in 2014, (3) percentage of living localities, (4) numbers of new localities found in individual time intervals (before 1950, 1951-1999, 2000-2009, 2010-2013, 2014) and several other values.

**CONCLUSIONS**

The situation is not yet critical, but except of the commonest species like *D. majalis*, their fate should be closely monitored. E. g., one worrying result is that all historical localities of all species, except for *Dactylorhiza majalis*, are dead now. For further study to continue we need to collect more data on more species to evaluate our hypotheses.

**ACKNOWLEDGEMENTS**

Supported by grant No. 14-36098G of the GA CR.

**REFERENCES**


THE EFFECT OF FUEL TYPE AND SPARK IGNITION ENGINE TECHNOLOGY ON CAR PARTICLE EMISSIONS IN THE CONTEXT OF URBAN AIR POLLUTION

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Keywords: nanoparticles, traffic, spark ignition engine, urban air pollution

INTRODUCTION
Internal combustion engines are often a dominant source of fine particles in urban air, which cause several times more premature deaths than traffic accidents (Yim & Barrett 2012; Caiazzo et al. 2013, EEA 2013). The smallest particles, nanoparticles, are directly emitted by the engines in the vicinity of the roads, where people live.
Nanoparticles have short lifespan caused by aggregation into larger particles and dilution the air, their concentrations decrease to background level only several hundred meters from the road (Zhu et al. 2002). Therefore, the spatial distribution of these nanoparticles is highly heterogeneous depending on distance from the source, meteorological condition, etc. Nanoparticle emissions are highly variable in dependence on internal combustion engine type, fuel, and current and prior engine operating conditions.
The work shows a difference in particle emissions between two cars with spark ignition (gasoline) engines using different engine technologies, a Skoda Fabia with a port injection 1.4-liter MPI engine, and a Ford Focus with a direct injection 1.0-liter EcoBoost engine.

METHODS
Two cars were used to measure the difference in emission between old engine technology represented by Skoda Fabia 1.4 MPI and new engine technology represented by Ford Focus EcoBoost 1.0 DISI. Cars were mounted on a dynamometer. Exhaust gases were diluted by constant volume sampler (set on 11m³/min). Diluted exhaust gases were then sampled on 47mm PTFE coated borosilicate glass filters (45l/min) and analyzed by exhaust engine particle counter (EEPS, TSI corporation) equipped with an additional diluter.
The cars were driven through Worldwide harmonized Light vehicles Test Procedure (WLTP), a global harmonized standard for determining the levels of pollutants, and Common Artemis Driving Cycles (CADC). CADC were driven through its three parts: Urban, Rural, Motorway 130. All tests were started with the engine at operating temperature.

PRELIMINARY RESULTS AND DISCUSSION
Particle number distributions of both cars are present in Fig. 1. Older engine technology MPI produced the vast majority of particles up to 20nm with peak around 8 nm. Larger particles were rare and constitute less than 15% of the total number concentration. DISI engine had its maximum of number concentration shift to smaller sizes, less than 12.5nm, with indistinguishable peak caused by instrument limitation. Larger particles formed 44% of total particles and had peak in 60nm in particle diameter.
Number concentration is higher in all measured fractions for DISI with lower difference up to 11 nm which had around two times higher concentrations than MPI, except for 6 nm (eleven times higher). Larger particles had from ten times to several orders of magnitude higher concentrations. This fact is confirmed by total particle mass per cycle showed in Table 1.

Addition of 15% ethanol by volume into gasoline influenced particles emissions of the engines conversely. MPI emissions were higher in opposite of DISI which decreased in comparison with pure gasoline. Adding 25% of butanol (either 1-butanol or isobutanol) by volume into gasoline has led to decrease of particle mass within both cars (not presented).
Fig. 1: Particles distribution during WLTP with hot engine, pure gasoline

Table 1: Particle mass produced during cycles [mg].

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Cycle</th>
<th>1.4 MPI</th>
<th>1.0 DISI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure gasoline</td>
<td>WLTP</td>
<td>6.83</td>
<td>25.86</td>
</tr>
<tr>
<td></td>
<td>Artemis Urban</td>
<td>6.59</td>
<td>12.93</td>
</tr>
<tr>
<td></td>
<td>Artemis Rural</td>
<td>9.76</td>
<td>25.86</td>
</tr>
<tr>
<td></td>
<td>Artemis Motorway 130</td>
<td>16.35</td>
<td>74.91</td>
</tr>
<tr>
<td>Pure gasoline + 15% ethanol</td>
<td>WLTP</td>
<td>9.52</td>
<td>31.48</td>
</tr>
<tr>
<td></td>
<td>Artemis Urban</td>
<td>9.27</td>
<td>21.47</td>
</tr>
<tr>
<td></td>
<td>Artemis Rural</td>
<td>13.18</td>
<td>21.96</td>
</tr>
<tr>
<td></td>
<td>Artemis Motorway 130</td>
<td>16.59</td>
<td>55.63</td>
</tr>
</tbody>
</table>

CONCLUSIONS
Newer direct injection technology (DISI) used in the Ford Focus EcoBoost, achieving lower CO₂ emissions due to higher thermal efficiency, had higher both mass and number particles concentrations in comparison with the “traditional” port injection technology used in the Škoda Fabia MPI. Younger gasoline car fleet could lead to worsen ambient air in places with dense traffic.

FUTURE
Future work would be focused on toxicological effects of particle emissions from gasoline and diesel (not presented) engines powered by different fuel types, including blends of biofuels.

ACKNOWLEDGEMENTS
The work was funded by the Czech Science Foundation, project BIOTOX - Mechanisms of toxicity of biofuel particulate emissions (13-01438S).

REFERENCES
Contribution of HNO$_3$ (g) to nitrogen deposition

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Keywords: HNO$_3$, nitrogen deposition

**INTRODUCTION**

The accurate quantification of atmospheric deposition is very important for assessment of ambient air pollution impacts on ecosystems. Atmospheric deposition of nitrogen, particularly the dry deposition, however, is likely to be underestimated due to unavailability of measurements of certain nitrogen species, such as HNO$_3$(g) and NH$_3$. It is known that HNO$_3$ (g) may contribute significantly to the dry deposition of nitrogen even in regions with relatively low concentrations (Flechard et al. 2011).

**METHODS**

Atmospheric deposition of several different nitrogen species including HNO$_3$ (g) was calculated using Eulerian photochemical dispersion model CAMx based on emissions and weather data. Verification of outcome data was based on well-known and measured nitrogen species such as NO$_3^-$ and NH$_4^+$.

**RESULTS AND DISCUSSION**

Results (Table 1) show that nitrogen deposition based on measured nitrogen species is underestimated. Real nitrogen deposition could be even two or three times bigger.

<table>
<thead>
<tr>
<th>Nitrogen species</th>
<th>annual deposition [g.m$^{-2}$]</th>
</tr>
</thead>
<tbody>
<tr>
<td>based on CAMx model</td>
<td></td>
</tr>
<tr>
<td>N/NH$_3$</td>
<td>1.6</td>
</tr>
<tr>
<td>N/HNO$_3$</td>
<td>1.0</td>
</tr>
<tr>
<td>N/PAN</td>
<td>0.007</td>
</tr>
<tr>
<td>N/HNO$_2$</td>
<td>0.001</td>
</tr>
<tr>
<td>measured deposition (Ostatnická 2009)</td>
<td></td>
</tr>
<tr>
<td>dry (N/NO$_3^-$)</td>
<td>0.5</td>
</tr>
<tr>
<td>wet (N/NO$_3^-$ and N/NH$_4^+$)</td>
<td>0.5 – 1.0</td>
</tr>
</tbody>
</table>

**CONCLUSIONS**

Preliminary comparison of measured and modeled wet deposition (N/NO$_3^-$ and N/NH$_4^+$) indicated that modeled values were lower as compared to measured values, but more or less similar. Substitution of unmeasured nitrogen species by values modeled by CAMx seems to be a plausible way for approximation of total nitrogen deposition, and providing more realistic spatial pattern for further studies of likely nitrogen impacts on ecosystems. On the other hand real measurement is still irreplaceable.

**ACKNOWLEDGEMENTS**

I would like to acknowledge the grant NAZV QI112A168 (ForSoil) of the Czech Ministry for Agriculture for partial support of this contribution and the Czech Hydrometeorological Institute for providing data used in analysis.
REFERENCES
Epiphytic orchids: diversity and host-species relationship

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Keywords: Epiphytic orchids, diversity, distribution, species richness

INTRODUCTION

Factors influencing the distribution of epiphytic orchids are aspect, slope, altitude and characteristics of the individual host trees or shrubs (e.g., strata, height, evergreen/deciduous nature, bark surface, bark rugosity, bark water holding capacity, age, growth, bark pH, through fall, sunlight intensity) (O’Malley 2009, Adhikari and Fischer 2011).

Studies related to orchid species in Himalayan region, especially Nepal; focus mainly on taxonomy, phylogenetics, ecology, anatomy, ethnobotany and distribution pattern (e.g., Raskoti 2010, Subedi 2011, etc). However, there is no data, or any other information on orchids in factors influencing the distribution and composition of epiphytic orchids in Nepal. Thus, the aim of this study is to understand the factors driving epiphytic orchid diversity which would be useful for their effective conservation.

METHODS

The study was carried out in five different sites in Nepal: Annapurna region, Chitwan district, Upper Tamakoshi valley, The Shivapuri area, and Palpa district. In total, we sampled more than 23000 trees and shrubs individuals in different sites. Orchid and host species were counted by using walk transect method over the region to cover the maximum areas.

RESULTS AND DISCUSSION

We recorded 142 species of orchid growing on 192 host species in different regions. There were highest number of epiphytic orchid species in Annapurna (67 species) followed by Chitwan (64), Tamakoshi (50), Palpa (46) and Shivapuri (41). The total data showed a high correlation between number of orchid species and host individuals (p < 0.05, R² = 0.879) (Fig. 1).

The species richness of epiphytic orchid’s species was dependent on host individuals, different localities, and bark texture of host individuals (Table 1).
Fig. 1 The correlation between number of orchid species and host individuals in different study sites.

Table 1 Results of generalized linear model (glm) testing the effects of host individual, locality, host strata, bark texture, host habit and nature (evergreen/deciduous) on availability of epiphytic orchid. Significant p-values (p ≤ 0.05) are bold.

<table>
<thead>
<tr>
<th></th>
<th>Df</th>
<th>Deviance</th>
<th>Resid. Df</th>
<th>Resid. Dev</th>
<th>F Value</th>
<th>Pr(F)</th>
<th>R^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host individuals (log)</td>
<td>1</td>
<td>5.75952</td>
<td>272</td>
<td>74.75576</td>
<td>26.39302</td>
<td>&lt;0.001</td>
<td>0.0715</td>
</tr>
<tr>
<td>Locality</td>
<td>4</td>
<td>7.264898</td>
<td>268</td>
<td>67.49087</td>
<td>8.32285</td>
<td>&lt;0.001</td>
<td>0.0902</td>
</tr>
<tr>
<td>Host strata</td>
<td>1</td>
<td>0.356266</td>
<td>267</td>
<td>67.1346</td>
<td>1.63259</td>
<td>0.202</td>
<td>-</td>
</tr>
<tr>
<td>Bark texture</td>
<td>1</td>
<td>1.495924</td>
<td>266</td>
<td>65.63868</td>
<td>6.85508</td>
<td>0.009</td>
<td>0.0186</td>
</tr>
<tr>
<td>Host habit</td>
<td>1</td>
<td>0.28085</td>
<td>265</td>
<td>65.35783</td>
<td>1.287</td>
<td>0.258</td>
<td>-</td>
</tr>
<tr>
<td>Nature (evergreen/deciduous)</td>
<td>1</td>
<td>0.11148</td>
<td>264</td>
<td>65.24635</td>
<td>0.51086</td>
<td>0.475</td>
<td>-</td>
</tr>
</tbody>
</table>

CONCLUSIONS
The number of epiphytic orchid species is directly proportional to the number of tree and shrub individuals in different localities. Bark texture of host species significantly influence the species richness of epiphytic orchids in Nepal.

ACKNOWLEDGEMENTS
The study was supported by GAČR 13-10850P and the grant No. CZ.1.05/1.1.00/02.0073 of the MSMT.

REFERENCES
Carbon sequestration in soils developing on landslides in the Flysch Carpathians

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Keywords: soil organic matter, accumulation, phosphorus

INTRODUCTION
Accumulation of soil organic matter improves many soil properties and also leads to carbon sequestration (i.e., storage of CO₂)(Lal 2004). Therefore, processes affecting soil organic matter accumulation are of great interest to soil scientists.

Landslides located in one area – as well as sites after retreating glaciers or post-mining sites – represent useful study sites, because they develop on similar substrate under comparable climatic conditions and the age of the soils can be determined. After occurrence of landslide, the surface of fresh landslide scar contains low to zero amount of organic carbon. With time as carbon inputs from remnant patches of vegetation and new plant colonists enter the soil, soil organic matter accumulates (Walker and Shiels 2013).

In this study we focus on landslides in the Flysch Belt of the Outer Western Carpathians, especially in eastern Czech Republic and western Slovakia. The age of landslides was previously determined by radiocarbon dating of organic material obtained either directly from the landslide debris or, more frequently, from related lacustrine or fluvio-lacustrine sediments (Pánek et al. 2013). As the oldest site is older than 10 000 yrs and the youngest is only 5 years old, this chronosequence provides an unique opportunity to study soil carbon dynamics on a millenial timescale.

We hypothesize that the carbon sequestered in landslides is correlated with age, with the highest rates of accumulation found in the intermediate age of the site. We hypothesize that in the oldest sites, rate of carbon accumulation is limited by phosphorus availability.

REFERENCES