

Linking belowground biodiversity and ecosystem function in European forests – the 5th meeting of the COST Action FP1305 in Průhonice

Soils belong to the most complex and heterogeneous components of ecosystems. They exhibit a great abundance and diversity of soil organisms, e.g. up to 10^6 species of bacteria were identified per gram of soil. There is currently much interest in the relationship between soil microbial diversity and ecosystem functioning. The main question is whether diverse microbial community is better adapted to promote ecosystem functioning in comparison to species poor microbial communities. This is also one of the reasons why in May 2014 the COST Action FP1305 “Linking belowground biodiversity and ecosystem function in European forests (Biolink)” started. Biolink is aimed to create a forum where current understanding of functional belowground biodiversity at different scales and trophic levels in European forests can guide development of prescriptions for sustainable forests and tree crop management.

The 5th meeting of Biolink carried out during 24–26 October 2016 in Průhonice near Prague. The meeting attended over 90 participants from 26 countries of Europa, Near East and Africa. The introduction of the meeting was carried out on Monday, 24 October 2016, late afternoon by **Martin Lukáč** from the University of Reading (UK), the COST Action Chair, and **Pavel Cudlin** from the Czech Academy of Sciences in Prague (CZ) as the main local organizer, who shortly presented the aim and program of the meeting and opened a poster session where especially young researchers could present their work and discuss it with others.

The plenary lectures in next two days were organized in five sessions and twenty oral communications. On Tuesday, 12 researchers including three invited speakers presented their results during three sessions. **Miroslav Vosátka**, the director of the Institute of Botany by the Czech Academy of Sciences, informed shortly about the history and focus of the Institute. As he stated, the Institute of Botany is located in the Průhonice Castle since 1962. It performs research on vegetation at the level of organism, population, communities of plants and ecosystems, and in the whole scope of disciplines such as taxonomy, biosystematics and phytogeography of higher and lower plants including selected groups of fungi, plant ecology, mycorrhizal symbioses etc. Currently,

the institute is especially concerned on biodiversity and evolutionary trends among plants, ecology of invasive species, responses of plants and vegetation to environmental changes and the mechanisms that enable species to coexist in ecosystems.

Matty Berg (NL), the first invited speaker, pointed during his presentation “Reaction of communities and ecosystems to environmental change: a trait approach” that the prediction of species distribution across time and space is very difficult and we need more information to understand the link between stress – community response to stress – community effect on processes – ecosystem function. On the example of snails and isopods he demonstrated a trait approach, the linkage between response and effect traits and a need for quality trait databases. The presentation of **Christoph Rosinger** (AT) dealt with ectomycorrhiza (ECM), especially with the significance of rare ECM species for biodiversity. As he stated, 20–25 thousands of ECM species were globally identified until now. The study in 72 stands of beech, spruce and pine forests showed that while 67% of ECM species were found solely on one site, only 4% of species were found on more than five sites. The most important driver of ECM occurrence seems to be the host taxon; there is only a few rare multi-host species. **Elena Vanguelova** (UK) discussed the effect of tree species on soil microbial community in young as well as mature stands. The results showed that in young stands soil movement during site preparation and planting might have a major effect on soil microbial community during first five years of stand development. In mature stands, the effect of trees was identified, but it differed depending on soil type and climate. **Paolo Nannipieri** (IT), the second invited speaker, pointed that by knowing microbial diversity it may be possible to manipulate soil and the capacity of soil to resist to stress may depend on microbial diversity. While there is a redundancy for C and N-mineralisation (different species have the same role), some soil processes, e.g. nitrification depend only on some microbial species. He pointed also on the role of omics in analysing microbial community. **Johannes Rousk** (SE) investigated how warming (+1.1 °C) and litter addition treatments in the subarctic influence the



Fig. 1. A group of the participants at the COST meeting (photo by Peter Železnik).

susceptibility of soil organic matter (SOM) mineralization to priming. He showed that labile C appeared to initiate catabolic responses of the microbial community that shifted the SOM mining to N-rich components, an effect that increased with higher fungal dominance. **Petr Baldrian (CZ)** pointed that tree harvest changes the functioning of forest soils as 31% decrease in root dry mass was found six months after harvest. While in died roots the fungal biomass as well as activity increased, in rhizosphere the decrease of fungal biomass and activity (except Mn-peroxidase) was observed. At the same time, changes in the composition of fungal community were observed. **Tereza Mašínová (CZ)** presented results of a soil yeast communities study in the topsoil of beech, oak and spruce stands. The results showed that yeast represents a significant proportion of fungal community in forest soils. They are dominant in mineral soil unlike of litter; on the other hand, in soil they are less diverse than in litter. While the effect of dominant trees on yeast was more pronounced in the litter, the effect of soil chemical properties was distinct in the mineral horizons. Generally, vegetation had lower effect on yeast than other fungi. **Flavia Pinzari (IT)**, the third invited speaker, highlighted that metals and microelements in plant and microbial uptake receive less attention than carbon or nitrogen. Metals mobilise K release, contrasting results are about Ca, Mg and Mn mobility. Fungi accumulate more minerals than foliage; significant differences were observed in the accumulation of metals also between oak and beech. **Ina C. Meier (DE)** in her presentation dealt with the type of mycorrhization on root functions of temperate forests. She pointed on the differences between ectomycorrhiza (ECM) and arbuscular mycorrhiza (AM) and showed that increased root exudation in ECM tree species especially under drought stress lead to the increase in the decomposition of less bioavailable C sources. Also greater variability in ECM than AM communities was found. According to the presentation of **Taina Pennanen (FI)**, spruce clonal trial demonstrated that ECM diversity correlates with the host tree growth. In the last presentation on Tuesday, **Evsey Kosman (IL)** explained how to understand and express the characteristics such as dispersion (amount of dispersion, evenness of dispersion), species richness etc. used in the description of the diversity and variability in communities and populations.

Next day, on Wednesday 26th October 2016, the presentations continued in two sessions. **Marie Spohn (IT)**, invited speaker from Italy, analysed the phosphorus cycling in *Fagus sylvatica* forests. It was shown that while there are seasonal differences in the P uptake by beech with distinct increase in June, the P uptake by microorganisms and ECM was on the same level during the whole period of observation. Phosphatase activity in the rhizosphere depends on P availability and is stimulated by root exudates. The results also reflect the direct competition between microbe and plant uptakes. **Katarzyna Hryniewicz (PL)** evaluated the total metabolic activity as well as siderophore producing bacterial strains in forest stands with birch and alder located in areas contaminated with heavy metals and their potential in phytoremediation. **Iftekhar U. Ahmed (ET)** introduced the participants into the Ethiopian Highland where the effect of changes in land use on soil microbial community were evaluated. Soil microbial biomass C and N, as well as enzyme activities were

determined in soil samples taken from the natural forest, plantation forest and grazing land. The results showed that the natural forest exhibited the highest microbial biomass as well as activity, the lowest microbial biomass was found in grazing land. The effect of tree species was most pronounced in the plantation forest. **Edda Sigurdís Oddsdóttir** from Iceland pointed out that while several hundred years ago 25% of Iceland was covered by forest, the situation in present is quite different and forest is present only on 2% of the Iceland area. Last decades there is a trend of afforestation, ca 1/3 of forest stands are formed by birch, the rest by introduced trees. The earthquake in 2008 caused a shift in the fault line and as the Iceland is known by hot springs, this shift caused also heat increment in a new area under a forest. The changes enabled to study the effect of heat increment on forest stands and also on rhizosphere and ECM. It was found that the heat increment leads to the decline of root tips. Increased temperature did not affect ECM growth and fungal composition, however, ECM on root tips declined.

The last invited speaker **Brian Pickles (UK)** highlighted the importance of mycorrhiza and pointed that mycorrhiza occurs on 93% of angiosperms and 82% of vascular plants. It is able to respond to environmental changes more rapidly than its host. In past climate changes, changes in glaciation caused plant migration in North America and the question is the changes are reflected also in ECM. The study in British Columbia showed that inside the host distribution similar fungal communities occur but with low richness; outside the host distribution lower colonisation with local fungi, but with higher richness was observed. **Irena Maček** from Slovenia pointed on a rare phenomenon of “terrestrial mofettes” which are natural sites with constant geogenic CO₂ exhalations and consequent soil hypoxia. They can be used as a model ecosystem for the study of ecosystem responses to potential CO₂ increase. They used mofettes to determine whether a long-term directional pressure could change AM fungal community structure and drive the selection of particular AM fungal phylotypes. Numerical dominance of two AM fungal phylotypes in hypoxic soils was found. The presentations of Mathias Mayer (AT) and Martina Vašúťová (CZ) were focused on soil microorganisms at the windthrow plots. **Mathias Mayer** presented the results from the Austrian Alps where they studied microbial biomass, enzyme activities and soil organic matter decomposition in gaps with and without tree recruitment. Generally, increased soil temperature and moisture was observed in gaps; however, tree recruitment in gaps kept temperature and soil moisture at stand levels. The CO₂ release did not change in gaps as the increase in microbial respiration due to higher temperature was balanced by a decline in root respiration as a consequence of tree death. The formation of gaps after windthrow led to an increase in litter and soil organic matter decomposition. The presence of tree recruitment retarded this process, what indicates that sufficient pre-disturbance tree recruitments could potentially increase ecosystem resilience after forest disturbance. **Martina Vašúťová** analysed the management effect on ECM species community ten years after the windthrow. The research was carried out at four plots with different management established after the windthrow in 2004 in the Tatra National Park (Slovakia) when a large part of spruce forests

was strongly damaged. She also compared two approaches in the ECM estimation which offered a bit different results. The plenary lectures finished by the presentation of **Tobias Guldberg Froslev** (DK) regarding the “BIOWIDE” project on biodiversity.

Each day after the plenary lectures, the participants continued scientific work in four working groups (WG), focusing specific topics: WG1 link diversity to function, WG2 look at the structure of belowground food webs and WG3 assess the importance of belowground diversity in intensively managed forest ecosystems. WG4 utilise the information gathered by other working groups to evaluate novel modelling concepts to include biodiversity and functional diversity indices.

The participants had also an opportunity to visit Průhonice Park as the meeting took place in its immediate vicinity. During the tour, Mr. M. Vosátka and J. Burda informed about its history and current status. As it was mentioned, Průhonice Park was founded in 1885 by Count Arnošt Emanuel Silva-

Tarouca. He introduced tree species of domestic origin uniquely combined with imported foreign species. The combination of groups of different trees with meadows, ponds and streams offers unique park composition, an original landscape architecture of worldwide importance. This was the reason why it became a UNESCO world Heritage Site and Czech National Historic Landmark. The park is also of high dendrological value because of a collection of about 1,600 species of local and exotic plants and of 8.000 rhododendrons with 100 taxa and cultivars.

The three day program provided an opportunity to bring experts in biodiversity, tree ecology, modellers etc. together and exchange knowledge. The next meeting will be on 26–29 June 2017 at the University of Tartu in Estonia.

Erika Gömörýová
*Technical University in Zvolen, Forestry Faculty,
T. G. Masaryka 24, SK – 960 53 Zvolen, Slovak Republic,
e-mail: gomoryova@tuzvo.sk*