Biodiversity in Soils of Major Forest Types in Central Europe

Zechmeister-Boltenstern S.[1], Bruckner A.[2], Hackl E.[3], Foissner W.[4], Kopeszki H.[5], Sessitsch A.[3], Waitzbauer W.[6]


Fig. 1.: Oak hornbeam forest, Vienna


Fig. 2.: Woodruff beech forest, Vienna


Fig. 3.: Acid. Beech forest, Dürnstein


Fig. 4.: Spruce-fir-beech forest, Rothwald


Fig. 5.: Floodplain forest, Beugenau


Fig. 6.: Pine forest, Merkenstein

Introduction and Methodology

Twelve natural forest stands were selected in order to study below-ground biodiversity and to characterise the decomposer system and relate it to nutrient turnover rates and stand properties. The stands are situated in eastern Austria and comprise six dominant forest types, including oak and beech forests, spruce-fir-beech forests, floodplain forests and pine forests (Figs. 1-6). Macrofauna (earthworms, carabid beetles, spiders, diptera larvae), mesofauna (springtails, oribatid and gamasid mites) and microfauna (protozoa) are investigated in addition to the microbial community (by analysis of phospholipid fatty acids (PLFAs) and DNA-based techniques such as T-RFLP analysis of 16S rDNA). The major aims of this project are to select a combination of bioindicators for forest soil biodiversity, to single out forest types harbouring rich decomposer communities, and to find relationships between biocoenoses at different trophical levels.

Results and Discussion

PLFA analysis showed that the microbial communities of zonal forest types (oak, beech and spruce-fir-beech forests) are more closely related to each other than to those of azonal forest types (Austrian pine and floodplain forests). Major determinants for bacterial and protozoa communities seemed to be pH and C:N ratios of the soil. The forest which showed by far highest nutrient turnover and largest microbial biomass is a montane spruce-fir-beech forest which has never been managed before (Fig. 4). This forest showed highest species numbers of springtails (Fig. 11) and highest abundance of oribatid mites (Fig. 8). A large number of specialised carabid beetles (Fig. 12) demonstrated the old age of this forest. However, the species richness of different faunal groups varied among forest types. E.g., we found high numbers of protozoa (Fig. 9) and earthworms in floodplain forests and an astonishingly high diversity of predatory mites (Gamasina) in a very nutrient-poor acidic beech forest.

So far, several new species could be identified and are presently described (33 ciliates, 1 springtail (Fig. 11), 1 spider), which proves the importance of natural forest reserves as a retreat for rare species and the role of soils as gene banks. The final step in this project will be to compare natural forests with data from managed forests. By this we hope to learn about forest management techniques which are appropriate to conserve soil biodiversity and promote sustainable land use.

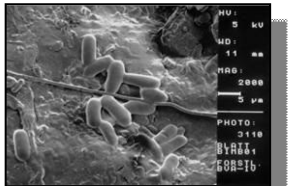
Fig. 7: Bacteria by Brandstetter, BFW


Fig. 8: Oribatid mite by Christian, Boku


Fig. 9: Ciliat by Foissner, Salzburg


Fig. 10: Diptera larva by Christian, Boku

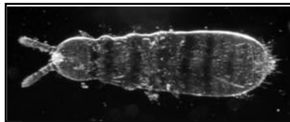
Fig. 11: New springtail species by Leithner and Christian, Boku


Fig. 12: Carabid beetle by Waitzbauer, IECB

[1]Federal Office and Research Centre for Forests (BFW), Seckendorff-Gudent Weg 8, A-1131 Wien, Austria

[2]Institute for Zoology, University of Agriculture (BOKU), Gregor Mendel Straße 33, A-1180 Wien, Austria

[3]Biotechnology, Environmental and Life Sciences, Seibersdorf Research GmbH (ARC), A-2444 Seibersdorf, Austria

[4]Institute for Zoology, University of Salzburg, Hellbrunnerstr. 34, A-5020 Salzburg, Austria

[5]Heiligenbergstraße 26, A-3001 Mauerbach, Austria

[6]Institute of Ecology and Conservation Biology, University of Vienna, Althanstraße 14, A-1090 Wien, Austria

Funded by