

MOFALE: *Mortierellaceae* Functional Diversity in Alpine Ecosystems

Mortierellaceae are abundant and ubiquitous soil fungi. Together with bacteria they drive soil forming processes and promote plant growth. Likely, their characteristic long-chain polyunsaturated fatty acids are important for nutrient enrichment, plant growth promotion and microbial interactions. In alpine regions *Mortierellaceae* are common but poorly studied. Research on their diversity, distribution, bacterial associations, and taxonomy is needed to further understand soil development and fungal ecology.

Therefore the aim of this research project is **to find, isolate, and describe currently unknown *Mortierellaceae* and to perform functional characterization of this important fungal group in threatened alpine habitats** using culture-dependent and independent approaches. We hypothesize the following: i) alpine habitats contain a rich, undiscovered *Mortierellaceae* diversity, ii) habitat-specific *Mortierellaceae* communities are formed by soil properties and plant presence, iii) *Mortierellaceae*-bacteria associations are species-specific for bacterial taxa, but general for *Mortierellaceae*, iv) fungal lipid production is central for *Mortierellaceae*-bacteria interactions, v) *Mortierellaceae*-bacterial interactions enhance their plant beneficial effect.

To achieve these goals, expertise of researchers from the University of Innsbrück, experienced in *Mortierellaceae* taxonomy and alpine ecology, will be combined with research on fungal evolutionary biology and fungus-bacterial interactions carried out at the University of Warsaw. UW group will also study genomes and transcriptomes of fungi and bacteria, and, by integrating gathered data, try to understand the physiology and ecological role of these organisms. Samples will be collected from 3 calcareous and 3 siliceous glacier forefields. Their threatened diversity will be preserved in public culture collections. Taxonomic clarity will be achieved through multigene phylogeny and morphology, enabling the formal description of new taxa. Diversity, distribution, and bacterial associations of *Mortierellaceae* will be predicted from soil microbiome data and compared with cultivation results. The plant beneficial effect of 20 representative fungal strains will be tested on *Arabidopsis arenosa* (alpine ecotype). Genomics and lipidomics analyses will be performed on strains with and without associated bacteria. Using transcriptomics, the regulation and potential molecular mechanisms underlying the plant beneficial effect will be studied for the most efficient strain and its associated bacterium.

The project explores *Mortierellaceae*-bacterial interactions in alpine regions. Its goal is to better assess their diversity, distribution, function, and taxonomy. We will use classical cultivation techniques, a multi-omics approach, and bioassays to estimate potential plant beneficial effects. The results will reveal bacterial-fungal co-evolutionary patterns and ecological functions of *Mortierellaceae*, advance the fields of genomics and lipidomics, and push the boundaries of knowledge about fungal ecology. Additionally, this project will consolidate *Mortierellaceae* taxonomy, preserve endangered species, and map the alpine distribution of *Mortierellaceae* and their bacterial associations.