The Future of Mountain Forests: Responses to a Drier Climate

PhD Position

Legacy effects of drought and forest fires on energy metabolism and defence mechanisms

Background

Mountains play an essential role in global geo-chemical cycles, are extraordinarily rich in biological and socio-cultural diversity and provide manifold ecosystem services. Climatic changes, which are especially pronounced in mountain regions, will particularly affect mountain forests due to the long life-span of trees, which does not allow for rapid adaptation. Drought stress may substantially limit mountain forest vitality, socio-economic and especially protective functions and interrelate with further risks, such as forest fires. The project "The Future of Mountain Forests" aims at analysing if and how drier conditions (i) influence carbon and water balances from tree to forest level, (ii) change plant stress responses and interactions with microbial communities, and (iii) affect ecosystem services. It will enable a better understanding of mountain forests and their complex processes under current and future conditions, and create knowledge highly relevant to future forest management strategies.

The project is funded in the frame of the doc.funds program of the Austrian Science Funds FWF. It is based on eight PhD theses focusing on closely interlinked aspects at cellular, tree and forest level. The PhD students are supervised in teams and are embedded in the Doctoral College "Alpine Biology and Global Change" as well as the internationally recognised Research Area "Mountain Regions" of the University of Innsbruck. They will benefit from the interdisciplinary exchange with other PhD students and close cooperation with renowned international scientific partners, availability of highly-instrumented field sites, a comprehensive training program, a search tool for mountain literature, involvement in the "International Mountain Conference" and the associated international summer school as well as alumni programs. PhD students can expect promising career perspectives based on their methodical and organisational skills, embedment in the international scientific community and the expected excellent publication record.

PhD Project

The hypothesis will be tested that recurrent droughts and sub-lethal fire damage have legacy effects on the signalling network of hormones and redox-active compounds, with downstream effects on energy metabolism and molecular protection mechanisms (e.g., antioxidants, pathogen defence), enabling acclimation ("eustress") or leading to deteriorating plant health ("distress"). Plant stress response will be assessed according to a triphasic stress model (Kranner et al. 2010): an "alarm phase" (stress perception via the signalling network) activates stress response systems, followed by "resistance" (functional protection and repair systems) and then "exhaustion" (failure of protection and repair mechanisms). As yet, the molecular mechanisms that cause a switch from neutral or beneficial "eustress" to detrimental "distress" are poorly understood. Generally, there is a lack of field studies, and this project will provide deep insights into plant response to drought and fire, far beyond the Arabidopsis and crop models available so far. Responses of trees to a) a one-off drought, b) a subsequent drought event, c) multiple recurrent droughts and d) fire damage will be analyzed using a powerful combination of targeted analyses (UHPLC-MS/MS, UHPLC) with an untargeted GC-MS-based metabolomics approach. The project is expected to provide deep insights into the effects of a) to d) on energy metabolism (untargeted metabolite profiling and photosynthetic pigments), and signalling and protective compounds (antioxidants, hormones, phenolic compounds).

Schedule

Year	2023		2024				2025				2026				2027	
Organisation, Recruitment, Methodical training																
Set-up of common garden experiment																
Drought experiments (forest and common garden)																
GC-MS-based metabolite profiling																
UHPLC and LC-MS-based analysis of metabolites																
Data analysis and publications																
PhD position																

Supervision

Ilse Kranner (ilse.kranner@uibk.ac.at)

Co-Supervision: Michael Bahn, Ursula Peintner, Stefan Mayr, Thomas Karl

Cooperation

Christine Foyer, University of Birmingham

The PhD project will finance a research stay (ca. 1 month) at the partner institution.

Details Position

University of Innsbruck
FWF PhD-position 4 years (initial contract 3 months)
30h per week, gross salary € 2.464,80 per month (14x per year)
Start: July 2023 to September 2023

Requirements

Master Botany, Biology, Biochemistry or converging sciences such as Bioinformatics
Interest in plant biochemistry, chromatographic techniques (HPLC; GC-MS, LC-MS)
Experience with biochemical methods and data analyses desirable
Interest in cooperation with international partner(s)
Ability to work independently

Application

Please send your application to **MountainForests@uibk.ac.at** until **2023-06-05**. We ask to indicate the PhD project applied for in the mail text. You can apply for up to 3 PhD projects with one application (in case mention preferred project). Please prepare and attach the following pdf documents (with chapters in the given order):

1. NAME_application.pdf

- 1. Motivation Letter: 1-2 pages; description of why you want to participate in "The Future of Mountain Forests" and the selected PhD project(s)
- 2. Research Outline: 1-2 pages; description of your research approaches and ideas for the PhD project(s)
- 3. CV: 1-2 pages; including publication list if available

2. NAME_documents.pdf

- 1. BSc-diploma and transcript (translated to English)
- 2. MSc-diploma and transcript (translated to English)
- 3. MSc-thesis abstract (in English)
- 4. Certificate of English skills (level B2 or higher; TOEFL: >87 points, IELTS: >6.5 points)

Further information

https://www.uibk.ac.at/en/projects/mountainforests
or contact MountainForests@uibk.ac.at

universität innsbruck

FWF Der Wissenschaftsfonds.