

Master thesis project

## **Contrasting the germination rate of silver fir and European provenances in climate chambers, in forestry nurseries, and in the forest**

### Background:

In temperate and boreal zones, the most common forest restoration method is planting of seedlings or, occasionally, using direct seeding. Planted seedlings are raised in nurseries, where germination capacity and early survival are optimized by choosing the most adapted provenance, collecting seeds in mast years, species-specific dormancy-breaking stratification treatment, as well as watering and fertilizer regimes. However, most of these protocols have been established using a limited number of provenances and strong assumptions about the environmental requirements of germination and its interaction with provenance effects. Thus, little is known whether they truly optimize the germination capacity and early survival.

### Objectives:

In 2023, in the framework of the European project "MyGardenOfTrees", the germination rate of 14 European beech (*Fagus sylvatica* L.) and 18 silver fir (*Abies alba* Mill.) provenances were tested in a climate chamber, under two stratification treatments and temperature regimes. Then, in spring 2024, 300 regeneration and 25 provenance trials were established across Europe for the same provenances. The aim of this MSc project is to contrast the germination rates of provenances across different seedling production methods from natural to highly controlled methods: in the forest (direct seeding), in forestry nurseries, and in climate chambers. The different production methods will be characterized based on the specific dormancy-breaking stratification period applied, the temperature and watering regimes applied, as well as the availability of nutrients in the soil. The MSc student will identify the environmental drivers of germination and its interaction with provenance effects across these three methods. Although the three seedling production methods are not strictly comparable, the exact number of seeds that were used as a starting material is known in each case, which will allow us to discover and speculate about other factors inherent to the methods that may influence seed germination, such as seedling density or access to mycorrhiza.

### Methods:

The MSc student will contribute to the collection of germination data from forestry nurseries based in Switzerland and combine them with already collected and cleaned field and climate chamber data. A major part of this MSc will be data analyses using survival analysis and mixed-effects models in R. The results of this MSc thesis will contribute towards a scientific publication.

### Prerequisites:

Interest in forest restoration and seedling production methods, and in applied statistics using R.

### Location and supervision:

The MSc student will be based at Department of Geography of the University of Zurich or the Evolutionary Genetics Group at the Swiss Federal Research Institute WSL in Birmensdorf and co-supervised by Dr Katalin Csilléry (WSL group leader) and Sofia van Moorsel (UZH group leader).

Contact: [sofia.vanmoorsel@geo.uzh.ch](mailto:sofia.vanmoorsel@geo.uzh.ch), [katalin.csillery@wsl.ch](mailto:katalin.csillery@wsl.ch)

Project website: <https://www.mygardenoftrees.eu/the-trials/macro-gardens>