

# The role of seeds in a changing climate

## – linking germination ecophysiology to population and community ecology

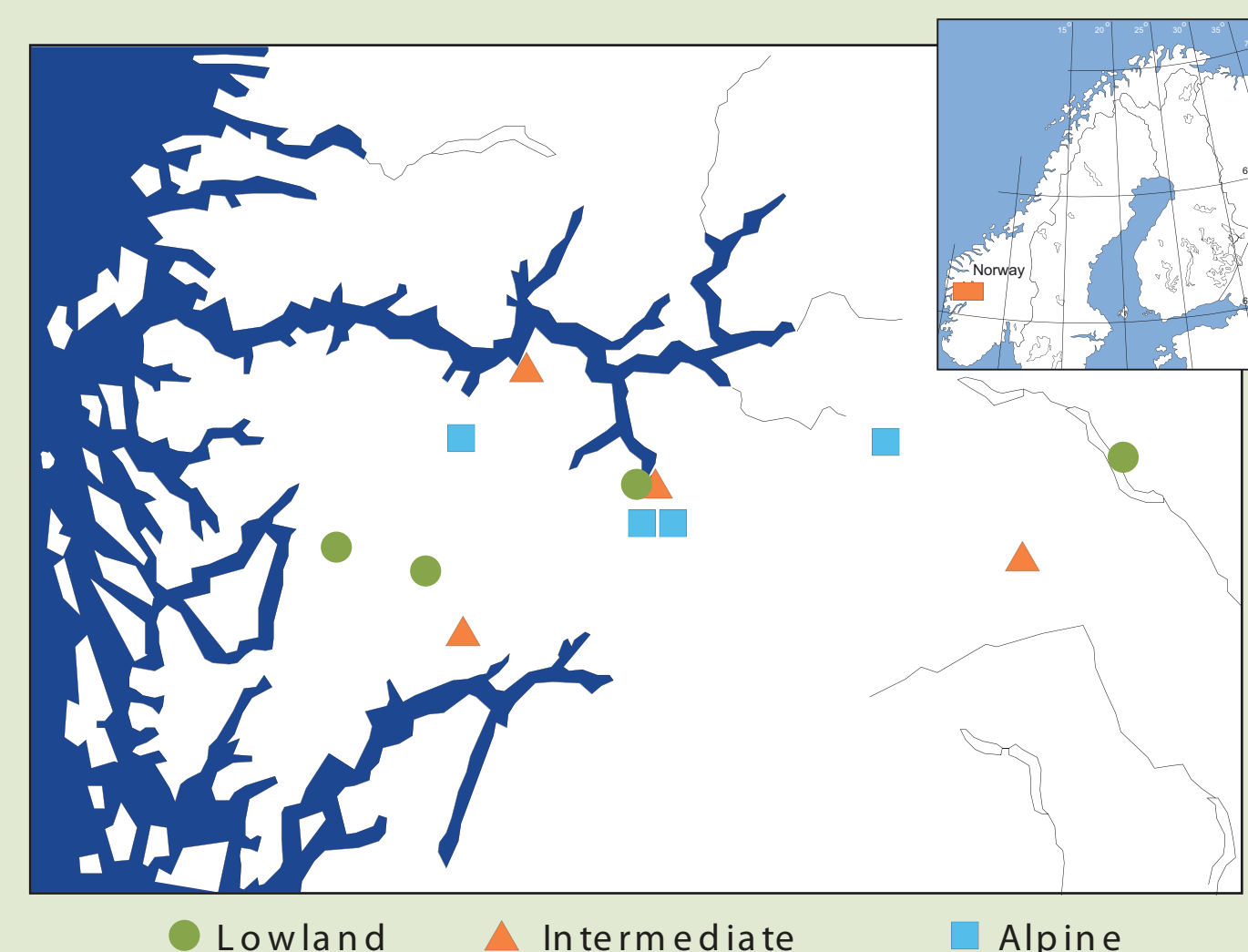


**Seed Clim**  
NFR NORKLIMA 2008-2012

Regeneration from seed is a key event in the life-histories of plants; affecting their ability to disperse, to evolve, and to persist under unfavourable conditions. Consequently, impacts of climate change on the probability of successful recruitment from seed are likely to affect the fate of local populations and communities. This project integrates observational and experimental approaches across broad-scale climate gradients in Norway to explore how climate, and climate change, affects the role of seed recruitment across four levels of organization - from direct physiological effects via demographic responses to population and community dynamics.

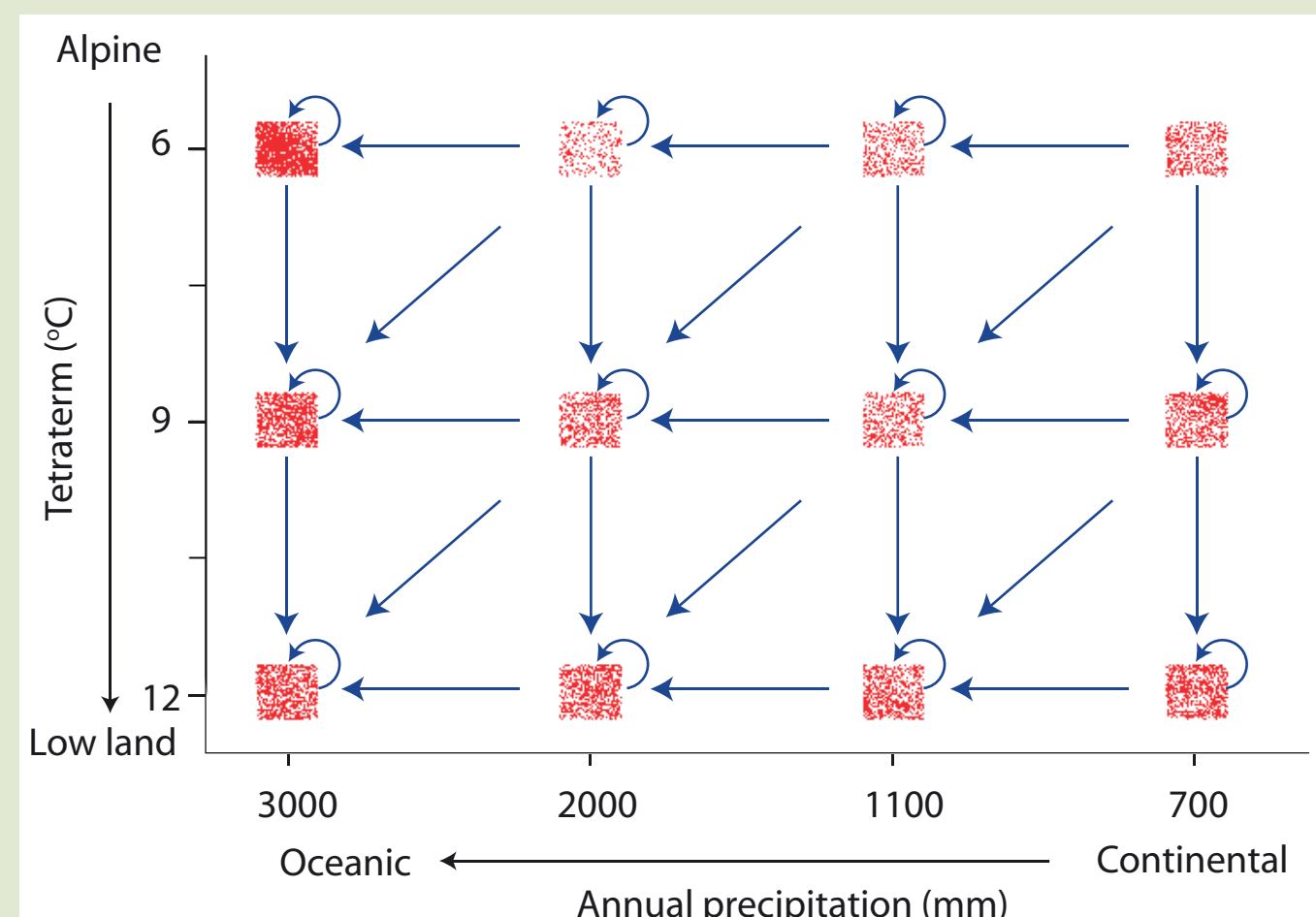
### Questions

1. Does climate affect seed recruitment in any systematic way?
2. To what extent do differences among populations reflect local adaptations, and to what extent do they reflect plastic responses to the environment?
3. At what levels of organization, from individual performance via demographic responses to population and community dynamics, do climate effects appear?
4. And how do climate effects link across these levels?
5. How will these relationships affect the susceptibility of local communities to climate change
  - the invasiveness of lowland species?
  - the invasibility of alpine communities?



### Study area

In the fjord landscape, precipitation increases from the continental inner fjords to the oceanic west coast, and temperature increases from high to low altitudes. We selected 12 sites which provide a climate grid where effects of precipitation and temperature can be explored independently.

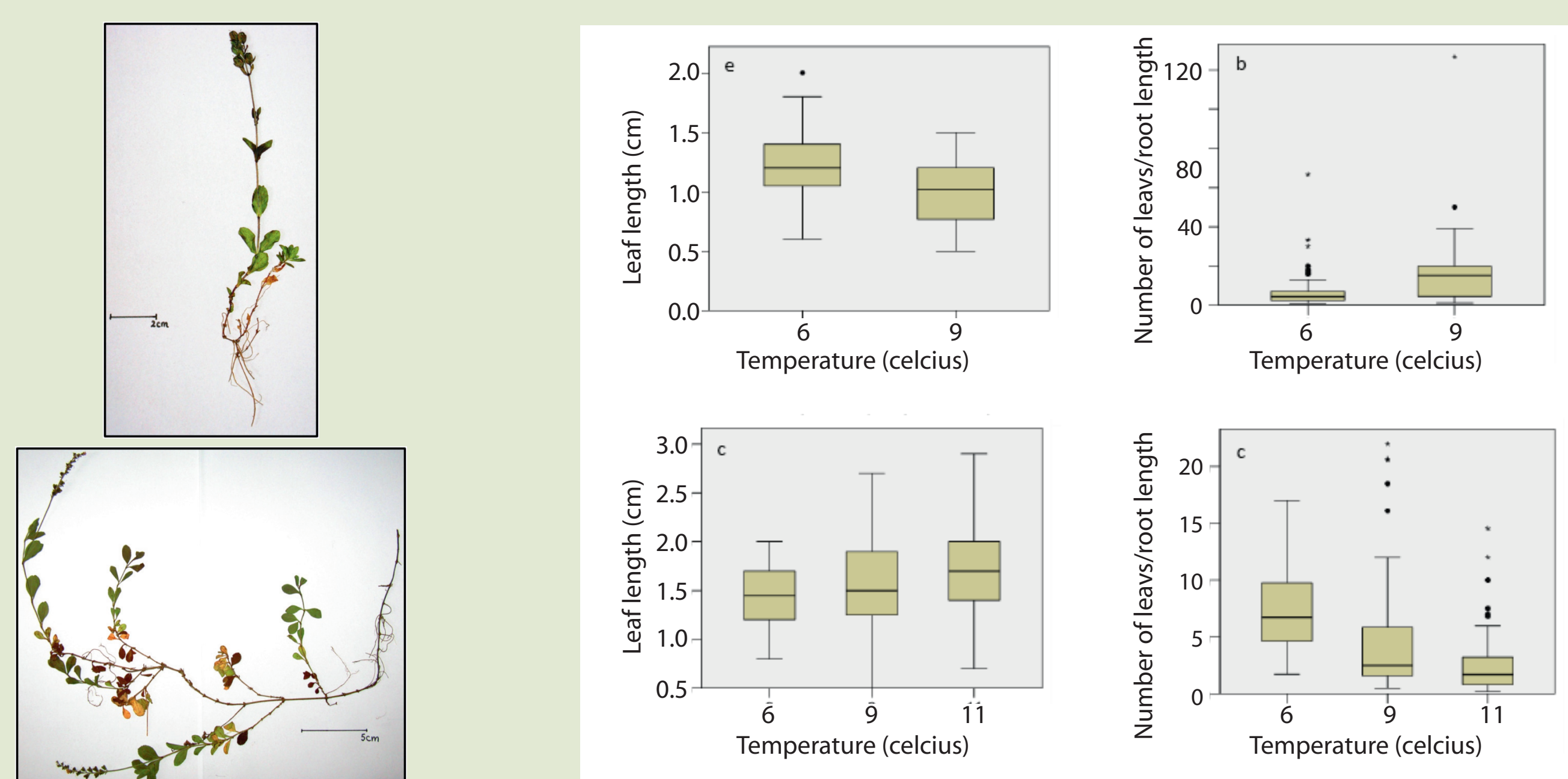


**The SeedClim approach:** experiments along natural gradients. We will measure climate effects on extant grassland communities, seeds and populations of focal species in the grid, and also transplant from cold and dry to warmer and wetter sites in this grid.

Local adaptations vs. plastic responses to climate will be tested by comparing responses of local vs. transplanted communities and individuals.



### Population level responses to climate (i) growth and allocation

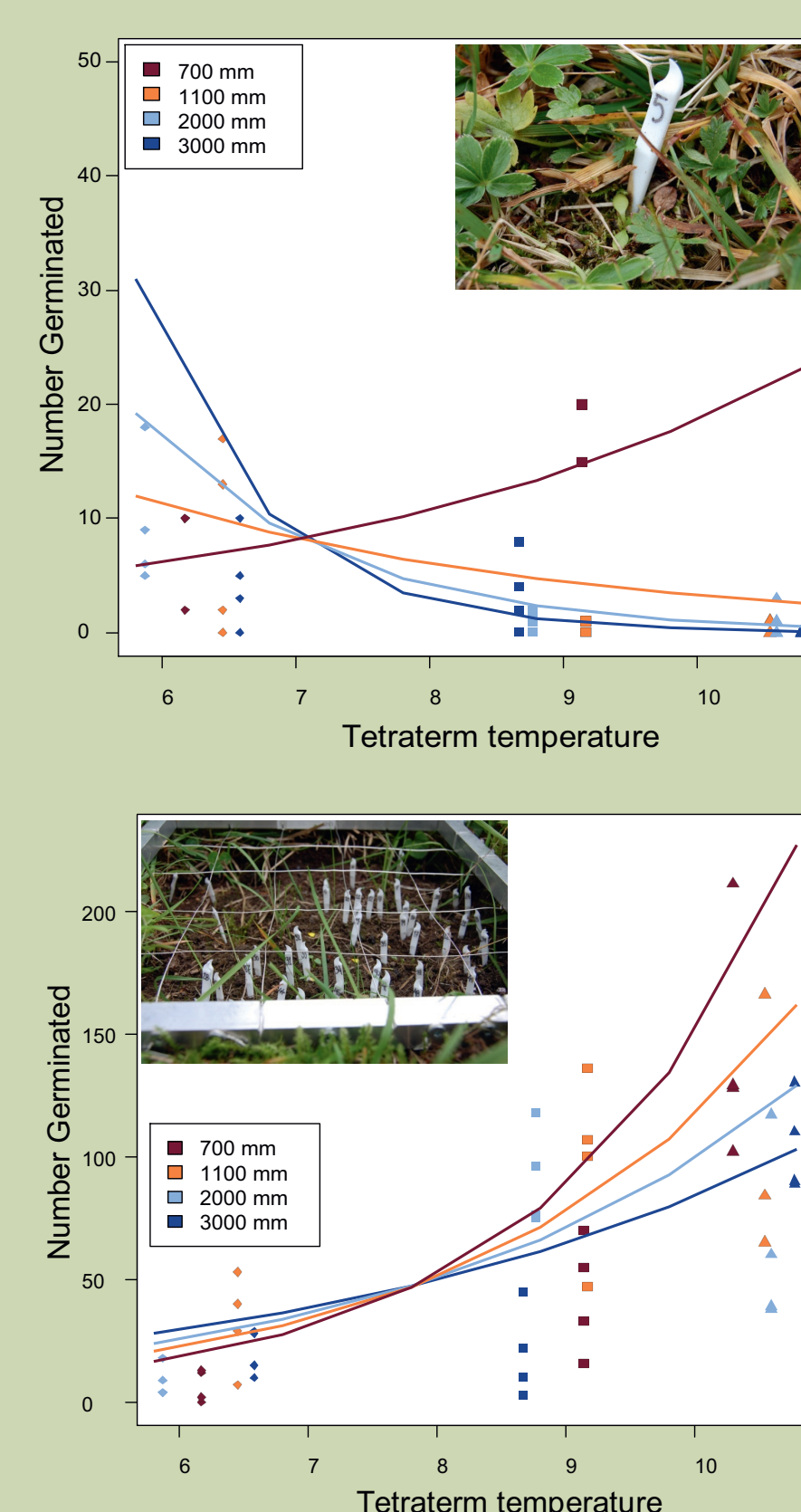


Studies of three species pairs of cogenetic alpine specialists vs. lowland generalists: *Viola biflora* vs. *V. palustris*, *Veronica alpina* vs. *V. officinalis*, and *Carex capillaris* vs. *C. pallescens*.

**Responses to climate:** Both temperature and precipitation affect growth and resource allocation, but alpine and lowland species respond differently to climate.

**Implications:** Species will not move in concert in response to future climate change; this might lead to changes in species interactions.

### Community level responses to climate (i) seedling recruitment



Seedling recruitment in intact vegetation is highest in cold or dry climates

2050: warmer, wetter climate: seed recruitment reduced by 27%

Implications: dispersal, colonisation inhibited

Seedling recruitment in gaps is highest in warm and dry climates

2050: warmer, wetter climate: seed recruitment increased by 51%

Implications: dispersal, colonisation facilitated

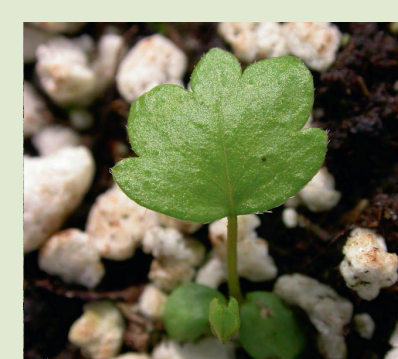
In SEEDCLIM, we measure a wide range of response variables along the temperature and precipitation gradients, and in the transplant experiments, including:



**Physiology**  
Seed germination  
Seed persistence in the soil



**Population dynamics**  
Population growth rates,  
role of seed regeneration  
Genetic analyses of clonal diversity



**Demography**  
Individual growth and survival  
Seedbank persistence in the soil



**Community dynamics**  
Species composition  
Seedling recruitment  
Dispersal  
Seedbank composition and density

<sup>1</sup>Department of Biology, University of Bergen, Allégaten 41, N-5007 Bergen, Norway (correspondence: vigdis.vandvik@bio.uib.no)

<sup>2</sup>Norwegian Institute for Nature Research (NINA), N-0313 Oslo, <sup>3</sup>Høgskulen i Sogn og Fjordane (HiSF), N-6851 Sogndal, <sup>4</sup>Meteorological Institute, N-0313 Oslo, <sup>5</sup>Dept. of Ecology and Evolutionary Biology, University of Michigan, Ann Arbor, MI 48109-1048, US, <sup>6</sup>Department of Botany, Faculty of Science, Charles University, Prague, Czech Republic, <sup>7</sup>Earth, Water, Life (EWL) Sciences Pty Ltd. Darwin, NT 0800