Effects of warmer and rainier arctic winters: differences in energy allocation trade-offs between shoot growth and reproduction in two contrasting high-arctic shrubs.

Future arctic winters are expected to be rain- instead of snow-dominated. Milder winters with frequent rain-on-snow events encapsulate the vegetation in thick basal ice for several months. This ice-covering of the tundra is known to control the population dynamics of Svalbard overwintering herbivores by limiting food availability, but little is known on icing effects on the vegetation itself. In a pilot field experiment in Svalbard, Milner et al. (2016) encased plots of the evergreen shrub *Cassiope tetragona* in basal ice, resulting in mortality of apical buds and entire shoots. Nevertheless, plants invested more in the growth of surviving shoots the following summer, at the cost of reproductive structures, i.e., reduced flower production. **This thesis aim to investigate if such trade-offs in energy allocation to growth or reproduction also exists in the dwarf shrub *Salix polaris*.** The latter species is widespread across Svalbard and – contrary to *C. tetragona* – compose a large part of the Svalbard reindeer diet. *S. polaris* is a deciduous shrub where buds produced in the autumn lie dormant under the insolating snow pack close to the ground (i.e. chamæphyte). In contrast, evergreen shrubs maintain vital structures well above-ground, which can be particularly sensitive to snowpack conditions and subject to direct damage from icing. The differing overwintering strategies of these shrubs may lead to dissimilar responses to basal ice encasement.

In 2018, an icing experiment was set up in the proximity of Longyearbyen, transplanting vegetation turves from mesic and wet habitats dominated by *S. polaris* and turves of *C. tetragona* (Figure 1). Icing treatments are applied in winter and shrub traits such as flower counts, relative biomass, leaf size and shoot survival are measured the following summer. This project would reconstruct longitudinal shoot growth increment over the past 3-4 years, using winter marks visible under the microscope, and this for both species. Thereafter, field and lab work is planned for summer 2021. The student will get familiar with the use of generalized linear mixed-effects models and dendrochronology standardizing methods. Anterior data collection makes it possible to start this master project already now.

You will work in an active research team, from the INSYNC project at UNIS and the Centre for Biodiversity Dynamics at NTNU.

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Further readings:

Le Moullec et al. 2019, MET report https://www.met.no/publikasjoner/met-report/met-report-2019

Milner et al. 2016, Evol. Ecol. https://onlinelibrary.wiley.com/doi/full/10.1002/ece3.2023

NTNU, Centre for Biodiversity Dynamics: https://www.ntnu.edu/cbd/

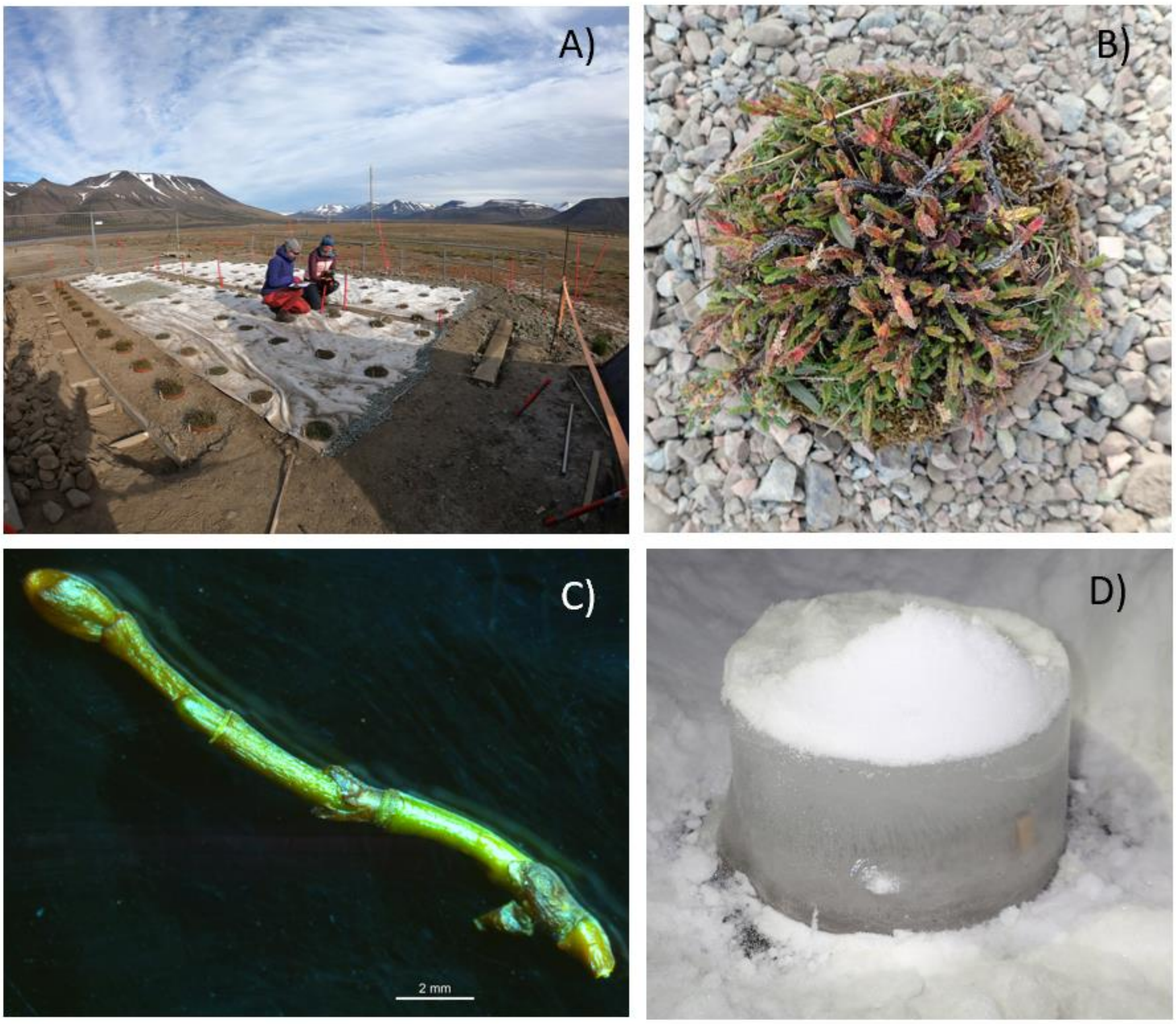

Figure 1. Overview of the icing experiment (A), where vegetation pots from different vegetation communities have been transplanted, dominated by *S. polaris* or *C. tertagona* (B). In both species, longitudinal shoot growth can be measured back in time with the help of winter marks, visible on microscope images (C for *S. polaris*). The treated pots have been encased in a block of ice (D) to simulate basal ice after rain-on-snow events.