

Climatic and biotic controls of shrub expansion
Interim Report

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Objectives of project

Climate warming is occurring rapidly in northern ecosystems. This allows plants to grow better and faster, causing a “greening” of the tundra. Over the last 50 years, rapid shrub expansion has been documented in Alaska, Yukon and the Northwest Territories using repeat photography, warming experiments and growth-ring studies. However, shrub expansion rates vary from site to site and among species, because non-climatic factors also control vegetation dynamics.

One factor that could mitigate the climate response of shrubs is plant-plant competition for resources such as water and nutrients. This hypothesis is supported by studies at the treeline, but has never been tested on tundra vegetation. We therefore aim to determine whether competition alters the climate sensitivity and the expansion potential of shrub communities in the Kluane Region.

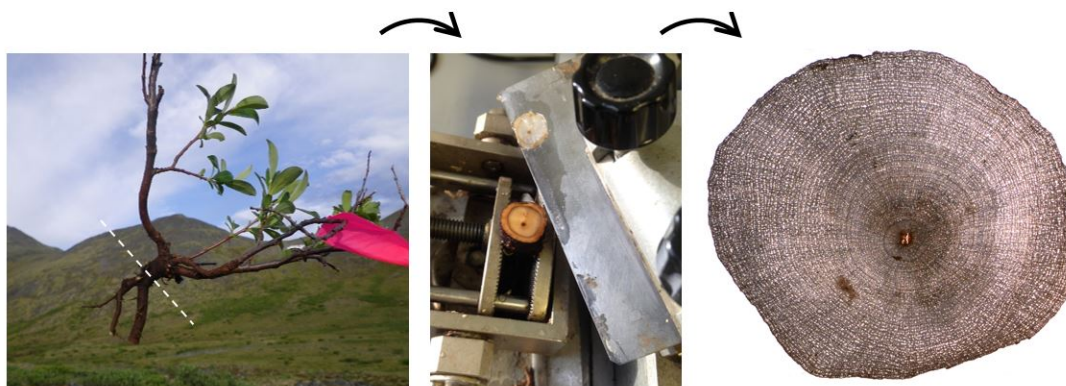
The objectives of this project are:

1. To assess whether the growth rate of shrubs has changed following a removal experiment.
2. To investigate how the climate response of shrubs vary according to the number, size and proximity of competitors
3. To determine whether the availability of suitable seedbeds and the production of toxic compounds by other plants could prevent upslope migration of tall shrubs

This project is ongoing and expected to be completed in 2017. This report focuses on the first two objectives, for which fieldwork was conducted in the summer 2015.

Progress and current findings

1. Removal experiment



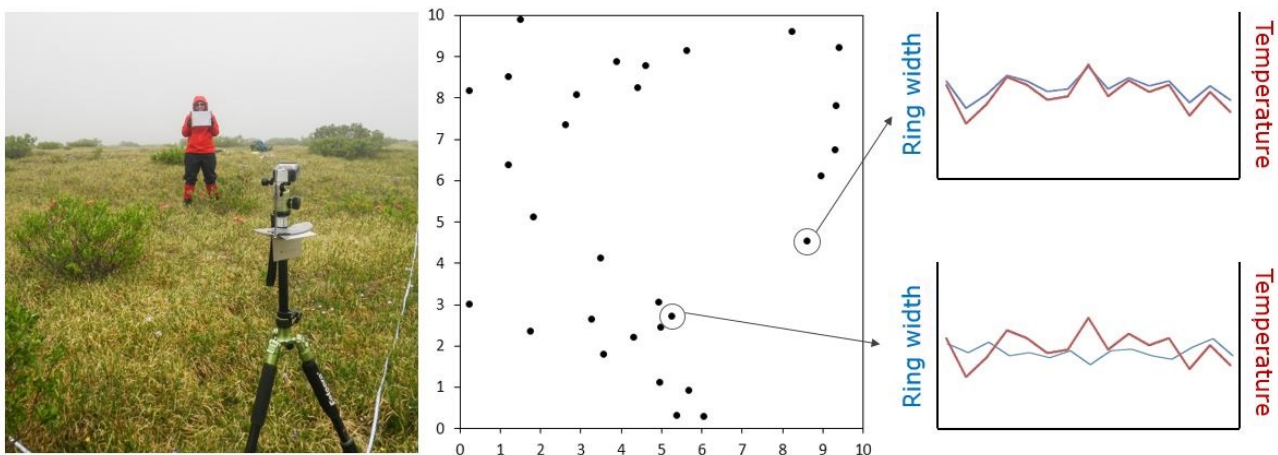
Preparation of samples for growth-ring analysis Preparation of samples for growth-ring analyses, from sampling (left) to preparation of thin sections (center) that can be photographed under the microscope (right). Growth rings can then be measured on the computer.

A shrub removal experiment was conducted and maintained in 2007-2009 in the Pika Valley (61.1°, -138.7°) by Myers-Smith and Hik (2013). In 2015, we found the 6 experimental plots and their associated control plots. We collected 4-10 stems around the edges of each the experimental plots, and as many in the paired plots.

The stem discs are currently being processed in the lab. The annual growth rings will be measured to see if shrubs near the removal plots have experienced a release from competition, resulting in better growth. These analyses will be done in the spring 2016.

2. Influence of competition on the climate response of shrubs

We mapped and sampled 6 plots in the Pika Valley (61.1°, -138.7°: 3 plots) and on the Kluane Plateau (60.9°, -138.4°: 3 plots). These are part of a larger sampling efforts with 17 other plots located on Herschel Island, in Umiujaq (QC) and in Salluit (QC). Every shrub in a plot was mapped with a laser distance measurer and measured before we collected a wood sample at the root collar (the oldest part) to conduct growth-ring analyses. A total of 216 samples were collected in the Kluane region.



Sampling of shrubs to estimate the importance of competition on the climate sensitivity of growth Field mapping of shrubs in a 10 m x 10 m plot (left), the resulting map (centre), and expected climate-growth relationships (right). Isolated individuals that are not competing for resources are expected to have a more consistent growth response to variations in temperature (upper right) than shrubs that are competing with their neighbours (lower right).

The growth rings are currently being counted and measured. The width of the rings will be linked to local climate data to determine how strongly growth is influenced by climate. This sensitivity will then be linked back to the spatial data, which will tell us if an individual with many neighbours responds less to warming than an isolated individual.

Additional information:

Team Shrub at the University of Edinburgh <https://teamshrub.wordpress.com/>

Blogs about this research project

<http://stories.rbge.org.uk/archives/18776>

<https://teamshrub.wordpress.com/2015/08/21/time-to-fly/>

<https://teamshrub.wordpress.com/2015/08/10/sites-and-sights-in-northern-quebec/>