HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI
BIO- JA YMPÄRISTÖTIETEELLINEN TIEDEKUNTA
BIO- OCH MILJÖVETENSKAPLIGA FAKULTETEN
FACULTY OF BIOLOGICAL AND ENVIRONMENTAL SCIENCES

Juha Mikola
Department of Environmental Sciences
University of Helsinki
Tarja Silfver
Department of Environmental Sciences
University of Helsinki
Matti Rousi
Natural Resources Institute Finland
Vantaa Unit
Elina Oksanen
Department of Biology
University of Eastern Finland

MONITORING THE EFFECTS OF WARMING ON A SUBARCTIC TREELINE ECOSYSTEM

Figure 1. The warming experiment will be established near the Kevo Subarctic Research Station, located in Utsjoki at the northernmost tip of Finland (69°45' N, 27°01' E) right next to the Kevo Strict Nature Reserve.

INTRODUCTION

Northern ecosystems will be subjected to major climate warming in the near future. This is likely to have consequences on the distribution of species, their interactions, functioning of ecosystems, and eventually, the climate impact of these ecosystems.

To study (1) the response of northern ecosystems to climate warming, with a special emphasis on boreal and Arctic *Betula* shrubs and trees, and (2) the role of herbivory in these responses, we have designed a fully controlled, replicated warming experiment to be established in a treeline mountain birch forest.

EXPERIMENT AND MEASUREMENTS

The experiment will be established near the Kevo Subarctic Research Station (Fig. 1) in the summer 2016. Altogether 20 plots (1×2 m), containing intact ground layer vegetation, will be established and saplings of *B. pendula*, *B. pubescens, B. nana* and *B. pubescens* subsp. *czerepanovii*, cloned from their northern populations, will be planted into each plot. The plots will then be exposed to **warming** (half of the plots will be heated 1-2 °C above the ambient temperature using infrared ceramic heaters) and **herbivore removal** (half of the plots will be weekly sprayed using an insecticide) in a fully factorial 2×2 experimental design. In this design, the heating × herbivore removal interaction will reveal the role of herbivores in ecosystem responses and in the ability of birches to acclimatize to warming. The responses of *B. pendula* and *B. pubescens*, which currently have a more southern distribution, will tell of their future ability to colonize the treeline environments.

We will study the effects of warming: (1) at individual level by following the N uptake and physiology of planted birch saplings; (2) at population and community level by following plant growth (birches and indigenous vegetation) and herbivore damage (birches); and (3) at ecosystem level by measuring the decomposition and N release of leaf litter of different birch species, CO_2 exchange between the ecosystem and the atmosphere, VOC (volatile organic compound) production and the consequent climatic impact of the treated field plots.

Air and soil temperature, soil moisture and plant leaf temperature will be constantly monitored in control and warming plots, and the heaters will be controlled using real-time measurements of temperature in control plots.

HYPOTHESES

We hypothesize that warming will: (1) enhance the growth and N uptake of plants, (2) increase herbivore damage in birch leaves (relatively less in *B. nana*); (3) accelerate litter decomposition and N release; (4) increase CO2 exchange; and (5) increase the total VOC production of the ecosystem (with a positive impact on the formation of secondary organic aerosol particles, having a cooling effect on the climate).

We also predict that insect herbivores will have a fundamental role in the response of the ecosystem to warming: herbivore removal is likely to (6) intensify warming effects on plant growth, plant N uptake and ecosystem CO2 exchange, but (7) dampen the effects on ecosystem-level VOC production.

Turun yliopisto
University of Turku
UNIVERSITY OF EASTERN FINLAND
Luke
LUONNONVARAKESKUS