Snowbed Biocomplexity: a journey from community to landscape

Robert G. Björk

Department of Plant and Environmental Sciences
Göteborg University
2007

ABSTRACT

Global climate change is expected to have a great impact on arctic and alpine areas. Predictions suggest increased temperature combined with increases in precipitation, generally expected to be greatest in autumn and winter and smallest in summer. In higher alpine terrain the increased precipitation will lead to more snow accumulation and even though winter precipitation will increase, associated temperature increases will probably result in a shorter period of snow cover. Snowbed habitats develop in areas that accumulate large amounts of winter snow and these habitats make up a notable component of the tundra biome, particularly in alpine areas due to the rugged topography and wind re-distribution of snow. As there are species and communities restricted to the snowbed habitats, these habitats make up a unique component of alpine biodiversity. In connection with forecasts of global warming, snowbed ecosystems are described as particularly vulnerable in the 2005 Arctic Climate Impact Assessment scientific report. In **Paper I** the ecosystems of alpine snowbed habitats are reviewed with emphasis on ecosystem functioning and their ability to adapt to current and predicted global change; this is the foundation upon which this thesis is built. Furthermore, several ecosystem services that snowbeds provide in the alpine landscape are identified; for instance they provide a steady water and nutrient supply to adjacent plant communities and offer newly emerged high quality food for herbivores late in the growing season. **Papers II** and **III** report on the dynamics of plant diversity and community structure along the internal snow-gradient within the snowbeds and how these are affected by increased nitrogen (N) deposition. The results are support each other and show that diversity increases in the heath snowbeds with earlier melt-out and increased N deposition, whereas the meadow snowbeds were unaffected. However, the snowbed specialists will suffer from any lengthening of the growing season and increased N deposition. In **Paper IV** two seasonal shifts in soil microbial composition are described; these are greater than the differences that can be attributed to plant community type. The first shift in the microbial community was from a winter community, dominated by fungi, to a spring/early summer community dominated by gram-positive bacteria. The second shift occurred over the growing season, and is associated with a switch from shorter (C15 and C16) to longer (C17 and C18) fatty acids and an increase in $18{:}1\omega7$ (a biomarker for gram-negative bacteria). However, **Paper V** clearly distinguishes the plant communities as separate entities with respect to N turnover and partitioning, and also points out the importance of links between soil biota and plant community structure in determining N turnover in tundra ecosystems. The results show