The role of herbivores in mediating responses of tundra ecosystems to climate change

Elina Kaarlejärvi

Akademisk avhandling

som med vederbörligt tillstånd av Rektor vid Umeå universitet för avläggande av filosofie doktorsexamen framläggs till offentligt förvar i Stora hörsalen (KB3B1), KBC, fredagen den 21 februari, kl. 10:00. Avhandlingen kommer att förvaras på engelska.

Fakultetsopponent: Professor Eric Post, Penn State University, Pennsylvania, USA.
Abstract
The Arctic areas are warming more rapidly than other parts of the world. Increasing temperatures are predicted to result in shrubification, higher productivity, declining species diversity and new species invasions to the tundra. Changes in species diversity and plant community composition are likely to alter ecosystem functions with potential consequences for human population also at lower latitudes. Thus, in order to better predict the effects of the rapid arctic warming, we need knowledge on how plant communities respond to a warmer climate. Here, I investigate the effects of climate warming on tundra plant communities and focus on the role of mammalian herbivores in mediating these responses. I examined the role of herbivores by incorporating herbivore manipulations to short- and long-term warming experiments as well as along altitudinal gradients. I measured how individual plants and plant communities respond to warming with and without herbivores.

Results of my PhD Thesis illustrate several ways how herbivores modify the responses of plants to warming. I found that herbivores (reindeer, hare, voles, lemmings) may prevent lowland forbs from invading open tundra. Herbivores might also protect small tundra forbs from being outcompeted by taller and denser vegetation under climate warming. Thus, different herbivore pressures may lead to differing plant abundances and distribution shifts in different areas. Furthermore, my results show that high herbivore pressure can reverse the effects of long-term climate warming very rapidly, even in one year. This finding suggests that well-planned targeted reindeer grazing episodes could potentially be used as a conservation tool to keep selected tundra habitats open. Sudden cessation of grazing may initiate rapid changes in plant community, especially if it coincides with warm temperatures. Taken together, I show that herbivores counteract the effects of climate warming by slowing down or preventing vegetation changes in tundra. Therefore, it is important to consider mammalian herbivores when predicting tundra plant community responses to changing climate.

Keywords
Climate change, warming, grazer, Rangifer, Lemmus lemmus, species distribution, biotic interactions, altitude