The Growing Dead: Warming Changes Plant Communities in the High and Low Arctic

Chelsea Little

Scientists around the world have come to the overwhelming conclusion that the earth's climate is changing. But what effect this will have on plants and animals is a more difficult question to answer. In order to address it, scientists experiment by manipulating the climate in natural communities using greenhouses or various warming apparatuses.

The Arctic and subarctic are being affected by climate particularly quickly, with large increases in temperature already recorded over the past decade. This, and the usually simpler structure of communities there due to the harsh physical conditions, make the areas ideal laboratories for investigating the effects of warming.

In this experiment, I measured responses of tundra plant communities in the High and Low Arctic to 11 and 21 years of experimental warming, respectively. My goal was to assess several aspects of responses to this warming: from the amount of living material produced by the whole community, to structural shifts within a community from one type of plants to another, to effects on biodiversity and finally the growth and reproduction of individual species.

I found that while long-term warming increased the amount of living plants growing in Low Arctic communities, this was not true in the High Arctic. Across all the communities, however, significantly more dead plant material accumulated in warmed plots than in unwarmed "control" plots. In addition, shifts in what types of plants were growing in the plots meant that warmed plots had a larger proportion of dead graminoids (grasses, sedges, and rushes) than shrubs, for example.

While I found few effects of long-term warming on biodiversity and a variety of different effects on growth and reproduction of individual species, this huge increase in dead material was the most striking result of my study. Short-term warming experiments have seldom found so drastic a response. An increase in dead plant material may change "ecosystem functioning" in these communities: since dead material is the main source for important building blocks of life like carbon and nutrients, a spike in dead material may eventually make these communities more productive. On the other hand, building up a deep mat of dead leaves and grasses may stifle growth of low-stature plants, and I did find that the ground layer of mosses and lichens was negatively affected by the warming treatment. All these changes have implications for other organisms as well, from bacteria and microbes growing in the soil which help decompose the dead material to herbivores like reindeer, rodents, and insects who forage on aboveground plants and lichens.

My results show that long-term climate change may transcend the short-term effects on one or several individual species, and cause drastic changes in the appearance and functioning of Arctic tundra species.

Degree project in Biology, Master of Science (2 years), 2014
Examensarbete i biologi 30 hp till magisterexamen, Uppsala universitet, 2014
Biology Education Center and Department of Plant Ecology and Genetics
Supervisors: Juha Alatalo and Elisabeth Cooper (University of Tromsø)