Memorandum 2/11/2018

CC2: : Biodiversity and climate change: impacts on non-marine ecosystems

This memo provides a summary of reports submitted on the session CC2 organized at the Arctic Biodiversity Session in Rovaniemi, Finland, October 9-12 organized by the Russian Institute of Geography, (RAS) and the US National Parks Service.

Attendance: 60

Arctic Biodiversity Assessment recommendation themes most prominently addressed in the session:

- Climate change
- Ecosystem-based Management
- Addressing stressors

Key points raised in the session that were important to note:

- Effects of climate change in the Arctic vary greatly at landscapes scales - microclimates exert a large control on disturbances processes, soils, etc.
- Water and soil moisture are critical drivers in in how tundra vegetation responds.
- Snow cover is an under-represented factor in climate models and may drive threshold shifts in high latitudes as climate warms.
- We need to keep track of other land use changes as well as climate change when evaluating adaptation response.
- There is huge amount of carbon stored in the Arctic soils. Current patterns of reindeer grazing can alter tundra carbon storage and the rates of soil and plant driven processes. The role of herbivory suggests that the grazing has a beneficial effect on carbon storage.
- The herds of grazing herbivores in Russia are getting defragmented and changing, the forest line is moving to the North and so is the distribution of boreal animals. There are changes in the composition and structure of the vegetation, with the increasing shrub cover, accumulation of snow and decrease of permafrost and soil regime. There are increasing numbers of invasive alien species, centred around human settlements.
- Incorporation of geomorphological processes improves the accuracy of vegetation models in a high latitude mountain system. Geomorphological processes are on average as important (if not more important) than topography-climate-soil variables in the vegetation models.
- Soil moisture controls tundra vegetation and it matters even more than temperatures for vascular plants and mosses.
- The plants and animals in the Arctic have to be adapted to frost and snow. Snow can both give shelter during the winter and limit the growing season. The winter microclimate is showing more spatial variations than the summers. Uneven snow accumulation enables coexistence of large number of ecologically distinct species. The snow is also an important pathway on how climate warming alters and threatens the Arctic biodiversity. When the snow cover duration changes 30-40% during the season, the total plant species richness decreases. Depending on the snow scenario, the snow will either buffer or catalyse the biodiversity changes in the Arctic tundra.

- Climate change proceeds substantially faster in Arctic than in lower latitudes. And there is an increasing risk of passing environmental tipping-points.
- Climatic and land-use forcing are able to shift lakes from oligotrophic and benthic energy dominated systems to eutrophic systems run by phytoplankton energy. Dietary guilds may stay similar at this gradient, but assimilated energy of consumers shift to pelagic due to increasing pelagic benthic coupling. Regime shift from benthic to pelagic energy dominated system likely lower the structural complexity and stability of these systems. Regime shift could be beneficial to warmer and more turbid water adapted species. The relative abundance of sensitive visually foraging piscivores will reduce. The intraspecific divergence below species level will decrease in warming climate and productivity.

Recommendations/actions identified for how to deal with the issues raised in the session:

- For the Arctic- researchers tend to group and there needs to be more interaction among them. Canadians are separate from Europeans are separate from Alaskans for example. Russians are really hurting in this regard. Their data is sparse and tends to be old. We are parallel tracking but not interacting much.
- Result indicates the possibilities to mitigate warming-induced soil carbon losses through management of grazing herbivores. The role of herbivory on the carbon stock needs an improved understanding across the Arctic.
- The Russian Arctic is changing, and it is necessary to adapt activities of monitoring, biodiversity conservation, natural resources development and traditional land use to the new conditions. This applies to the Arctic in whole.
- There is a need for including data on earth surface processes in the Arctic vegetation models. This calls for integrated ecological and geophysical approaches to advance the understanding of the impacts of global change on high-latitude ecosystems.
- Ignoring the importance of the snow cover during winter may cause biased predictions for the future of the Arctic ecosystems.
- Cryogenic land surface processes constrain Arctic vegetation biomass under climate warming -> high potential for tipping point. Cryogenic ground components are needed in the next generation ecosystem and land surface models. More resources are required to develop continuous monitoring of Arctic ecosystem.

Take home message from the session:

- We would greatly benefit from an Arctic climate change workshop that brings together scientists from different countries to compare results and techniques. We could learn a lot from each other.
- Future vegetation may be affected by both increasing temperatures and decreasing disturbance frequency with potential synergistic effects.
- Winter is a missing season and snow a neglected driver in the Arctic environmental studies.