Plan to study: Acclimation of artic peatlands – through reindeer grazing – to a changing climate

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Background

In artic peatlands, global warming causes profound changes in their hydrology leading to shrubification. This affects surface energy balance control (albedo) due to changes in vegetation cover and induces earlier snowmelt thus prolonging the growing season. Therefore ecosystem services provided by these peatlands, such as C sequestration and microbial control of greenhouse gas (GHG) release, are affected. As arctic peatlands serve as spring and summer grazing areas for reindeer, these large animals are in an important role to control shrubification.

Study site plan

The project will focus on arctic peatlands north of the limits of extensive forestry (ca. 66° 40' N), where reindeer herding is by far the most abundant anthropogenic form of peatland use. The combined influence of grazing and climate change is studied through a combination of fencing, ditching and warming by open top chambers (OTC; Peltoniemi et al. 2015; Peltoniemi et al. 2016) as, in addition to direct warming, warming will lower the peatland water table. The treatments include: a control and a ditching treatment both with and without the warming (OTC) treatment. The set-up is both inside and outside the fence to obtain a full-factorial design of climate change and grazing exclusion/inclusion impacts.

Variables to be measured

We will measure (1) C-fluxes through CO_2 and CH_4 exchange, (2) plant derived above and belowground C inputs, (3) microbial activity (C and N cycle), (4) microbial community structure trough PLFA and Illumina based high-throughput sequencing methods (MiSeq platform) and qPCR of mcrA and pmoA (CH_4-cycle) as well as nirK, nirS and nosZ (N_2O flux through denitrification) and (5) albedo through Landsat satellite images.

Hypothesis

H1: reindeer grazing will diminish the impacts of climate change on vegetation by restricting shrubification

H2: permanent overgrazing influences the C flow into the peat through plant vegetation changes

H3: feces addition influences the microbial mediated biogeochemical cycles due to acting as a fertilizer

H2 and H3 can out rule H1

WHAT you read is the summary of a proposal which will be sent to the Academy of Finland by end of Sept. 2016. Here we are to learn and search for networks, partners, ideas, similar set ups which still can be written into this and future joint proposals (hannu.fritze@luke.fi)

Lompolojänkkä in Pallasjärvi; Finnish Lapland. Open top chamber (OTC) study site to measure future artic climate change on GHG exchange and the microbes mediating it.

Peltoniemi K, Laiho R, Juottonen H, Kiikkilä H, Mäkiranta P, Minkkinen K, Pennanen T, Penttilä T, Sarjala T, Tuittila E-S, Tuomivirta T & Fritze H 2015. Microbial ecology in future climate: effects of temperature and moisture on microbial communities of two boreal fens. FEMS Microbiology Ecology 91 fiv062: http://dx.doi.org/10.1093/femsec/fiv062

Peltoniemi K, Laiho R, Juottonen H, Bodrossy L, Kell D, Minkkinen K, Mäkiranta P, Penttilä T, Siljanen H, Tuittila E-S, Tuomivirta T & Fritze H 2016. Active methanogenic and methanotrophic communities under a warming in moisture regime of two boreal peatlands Soil Biology & Biochemistry 97: 144-156

As reindeer have access to nearly everywhere in the Finnish arctic region, the only habitats excluded from the grazing pressure since at least 70 years are to be found at the eastern borderline of Finland where there is a border fence that frequently runs on the Finnish side, leaving a non-grazed zone between the fence and the national border line.