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Simulating the effects of soil organic nitrogen and grazing on arctic tundra vegetation dynamics on the Yamal Peninsula, Russia

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Sustainability of tundra vegetation under changing climate on the Yamal Peninsula, northwestern Siberia, home to the world's largest area of reindeer husbandry, is of crucial importance to the local native community. An integrated investigation is needed for better understanding of the effects of soils, climate change and grazing on tundra vegetation in the Yamal region. In this study we applied a nutrient-based plant community model (ArcVeg) to evaluate how two factors (soil organic nitrogen [SON] levels and grazing) interact to affect tundra responses to climate warming across a latitudinal climatic gradient on the Yamal Peninsula. Model simulations were driven by field-collected soil data and expected grazing patterns along the Yamal Arctic Transect (YAT), within bioclimate subzones C (High Arctic), D (northern Low Arctic) and E (southern Low Arctic). Plant biomass and NPP (net primary productivity) were significantly increased with warmer bioclimate subzones, greater soil nutrient levels and temporal climate warming, while they declined with higher grazing frequency. Temporal climate warming of 2 °C caused an increase of 665 g/m2 in total biomass at the high SON site in subzone E, while only 298 g/m2 in the low SON site. When grazing frequency was also increased, total biomass increased by only 369 g/m2 in the high SON site in contrast to 184 g/m2 in the low SON site in subzone E. When comparing low grazing to high grazing effects on soil organic nitrogen pools over time (Figure 1), higher grazing frequency led to either slower SON accumulation rates or more rapid SON depletion rates. Warming accentuated these differences caused by grazing, suggesting the interaction between grazing and warming may yield greater differences in SON levels across sites. Our results suggest that low SON and grazing may limit plant response to climate change. Interactions among bioclimate subzones, soils, grazing and warming significantly affect plant biomass and productivity in the arctic tundra and should not be ignored in regional scale studies.

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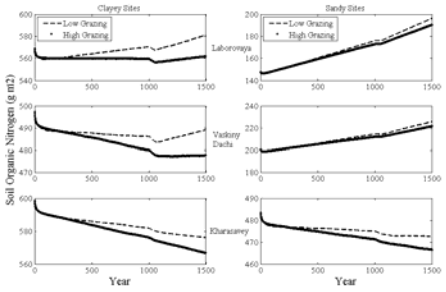

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