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Comment on bg-2021-227

Anonymous Referee #1

Referee comment on "Large Herbivores on Permafrost - a Pilot Study on Potential Impacts of Grazing on Permafrost Soil Carbon Storage in Northeastern Siberia" by Torben Windirsch et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-227-RC1>, 2021

This manuscript presents observations of soil cores from different landscape units and disturbance histories, and aims to answer an interesting and relevant question, "does grazing by large mammals impact permafrost carbon storage?" Unfortunately, the experimental design is fundamentally flawed, making any conclusions about the impact of herbivory on soil carbon storage impossible.

The main issue is lack of replication – the study relies on a single soil core for each combination of environment (drained lake basin or upland) and grazing (intensive or no grazing), which is insufficient given the variability of soil composition and the presence of confounding variables. We know that soil core properties are highly variable in permafrost environments due to cryoturbation, so any variation from one site to another could be due to natural spatial variability or the variable of interest, herbivory. Without replication within sites to account for spatial variability of permafrost soils there is no way to discern between those two possibilities. Additionally, soil moisture is a confounding variable that cannot be accounted for without additional samples in a wider range of environmental conditions. The authors showed that soil organic carbon varied with water/ice content and mentioned that the grazed sites in the drained lake basin flooded seasonally, while none of the other sites flood regularly. This means that patterns in soil organic carbon may be due primarily to variation in soil moisture rather than herbivory, because soil moisture and herbivory covary. Another potential confounding variable is the site history. The authors mentioned that the non-grazed drained lake site was cleared of forest a few years prior to the study while none of the other sites underwent the same treatment.

While the underlying soil core data are sound and could be used to describe some of the variability of the site, the flawed study design makes it impossible to disentangle the effects of spatial heterogeneity, soil moisture regime, site history, and herbivory. Therefore, I suggest that this manuscript be rejected and the authors reconsider the scope of question that can be answered with these data for a new submission.