Responses of tundra carbon cycling and storage to reindeer-induced vegetation shifts

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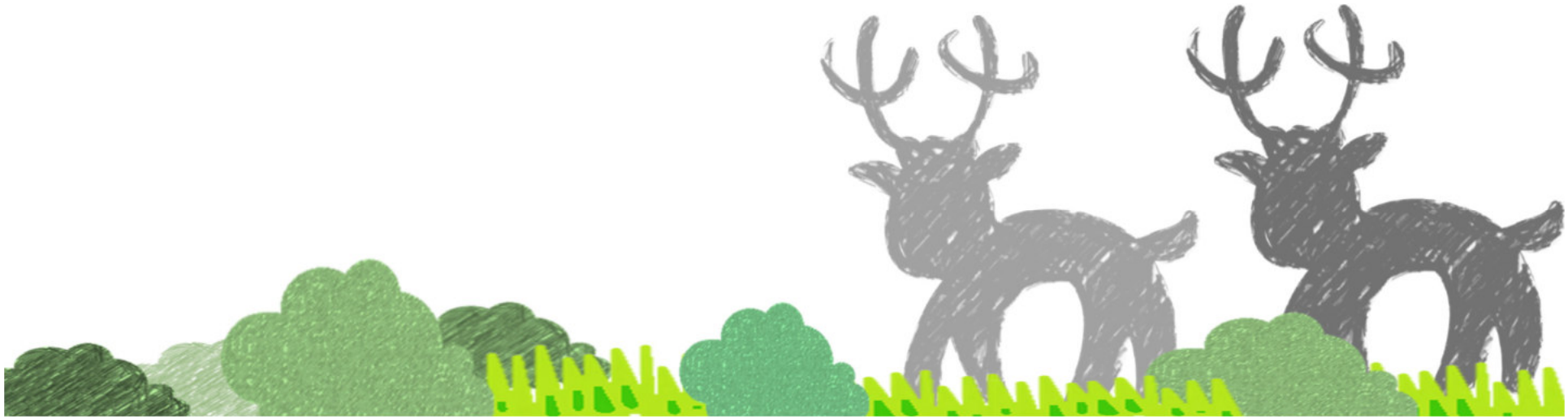


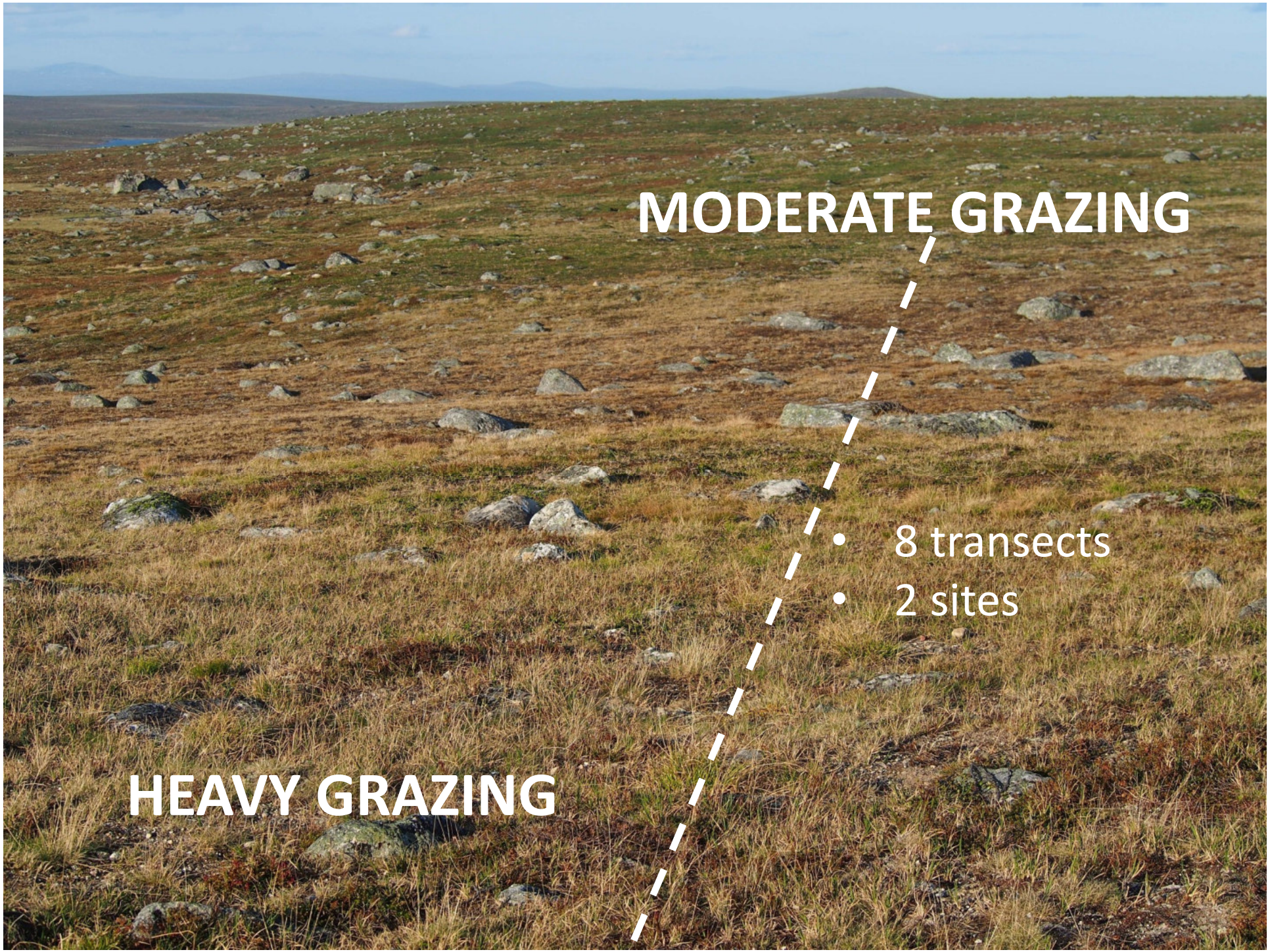
Can reindeer alter how much carbon tundra ecosystems store?

Study questions

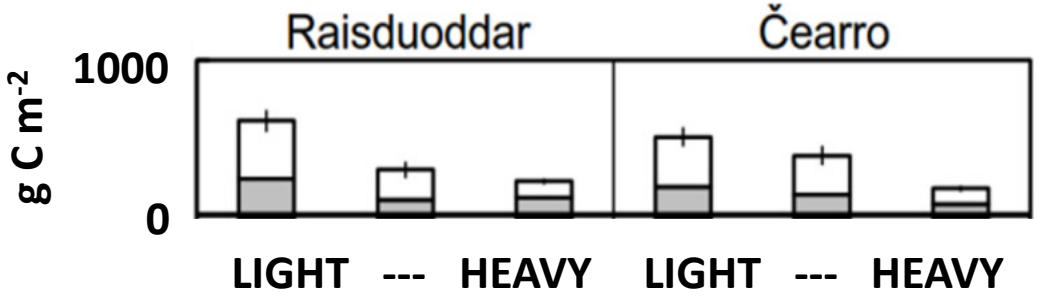
1. How does reindeer grazing induced *grassification* alter carbon storage in subarctic tundra ecosystems?

2. What is the time frame when changes take place?

Study 1: *Grassification* and carbon storage


MODERATE GRAZING
8 transects
2 sites
HEAVY GRAZING

Grazing decreased aboveground carbon

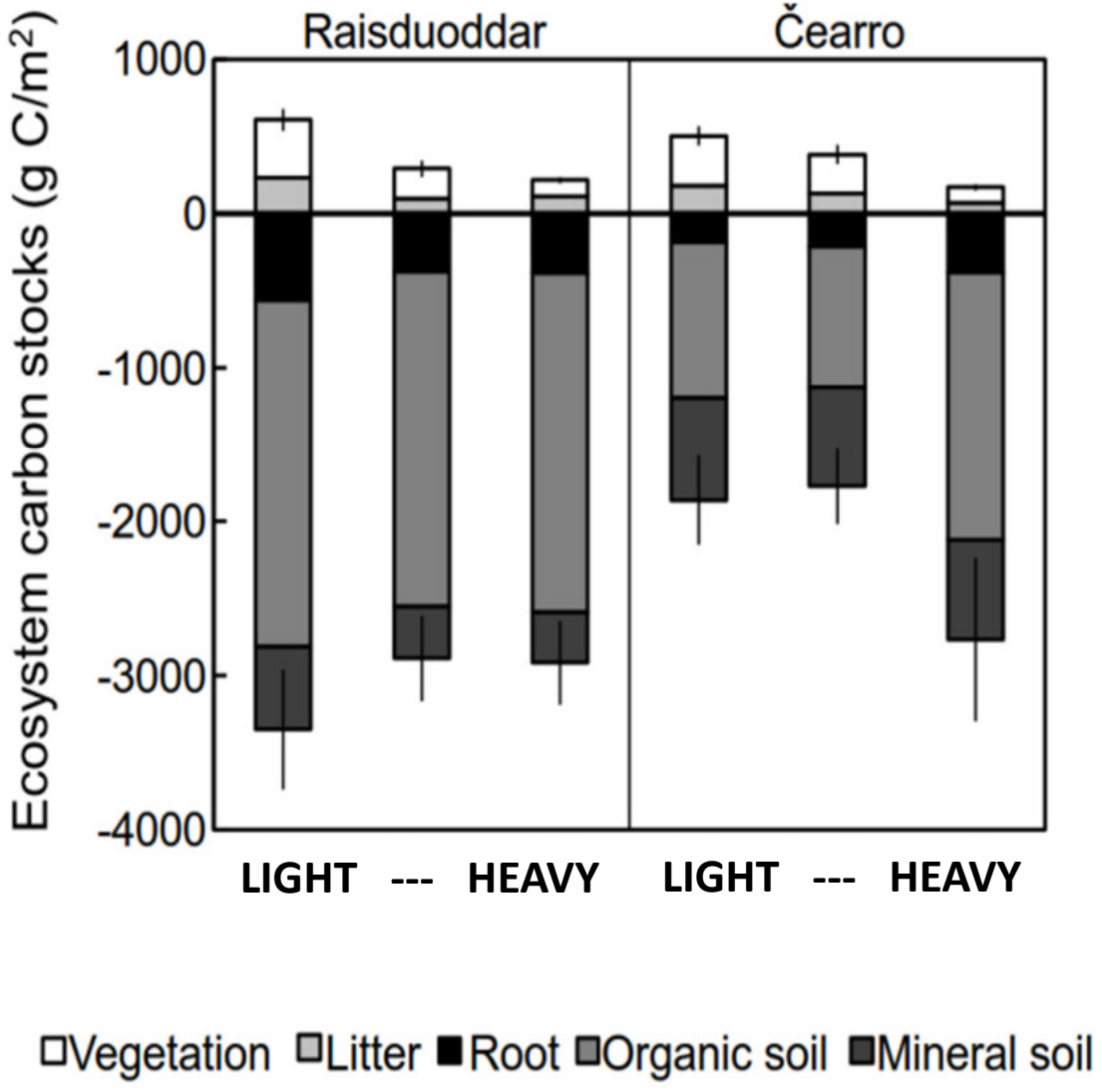


- On both areas carbon in vascular vegetation ($P = 0.006$; $P < 0.001$), cryptograms ($P = 0.005$; $P = 0.003$) and litter ($P = 0.04$; $P = 0.01$) was decreased by grazing

Ylänne, Olofsson, Oksanen & Stark, 2018, Functional Ecology

…but most of the ecosystem carbon in soils

- No effect in Raisduoddar
- In Cearro, grazing increased carbon in roots (P = 0.05) and organic soil (P = 0.02)



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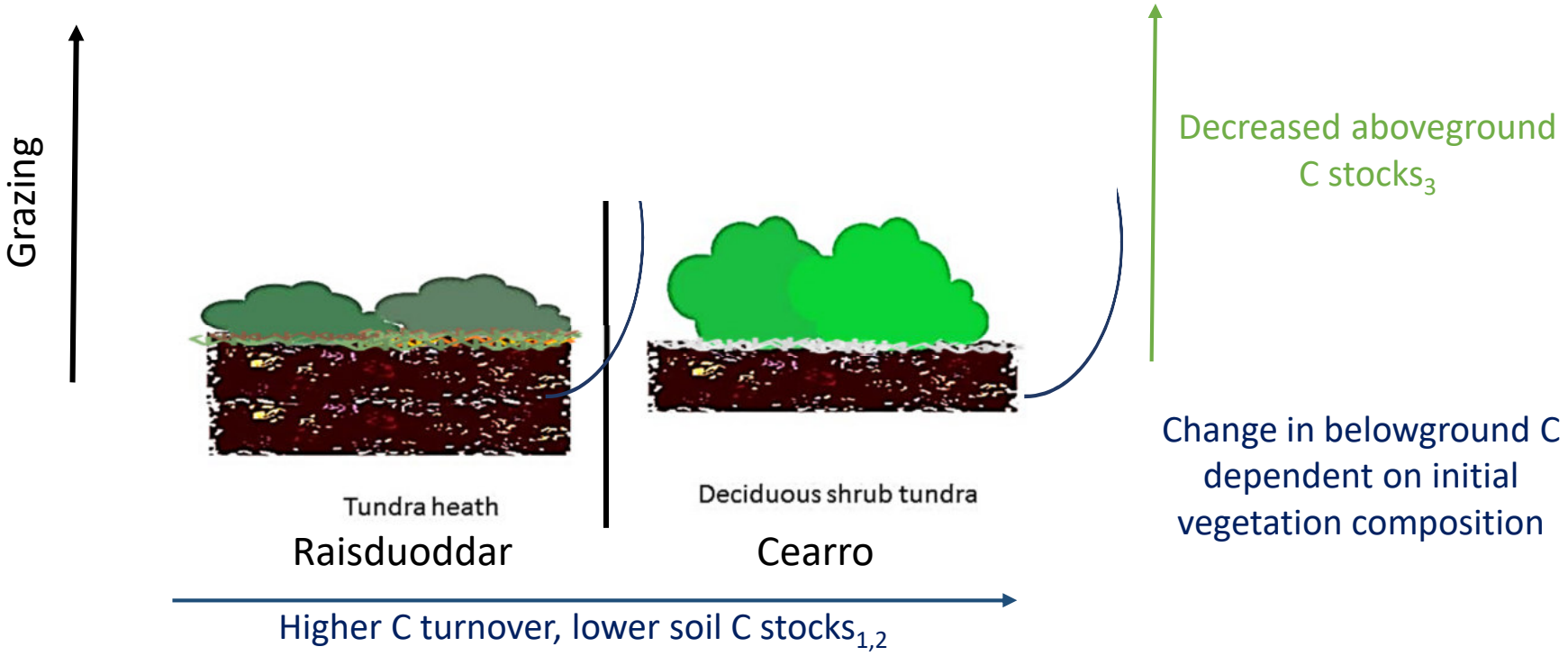
Responses of ecosystem C storage to grazing dependent on the prior vegetation?



1. Parker *et al.* 2015 *GCB*; 2. Clemmensen *et al.* 2015 *New Phytol.* 3. Tanentzap & Coomes 2012 *Biol. Rev.*

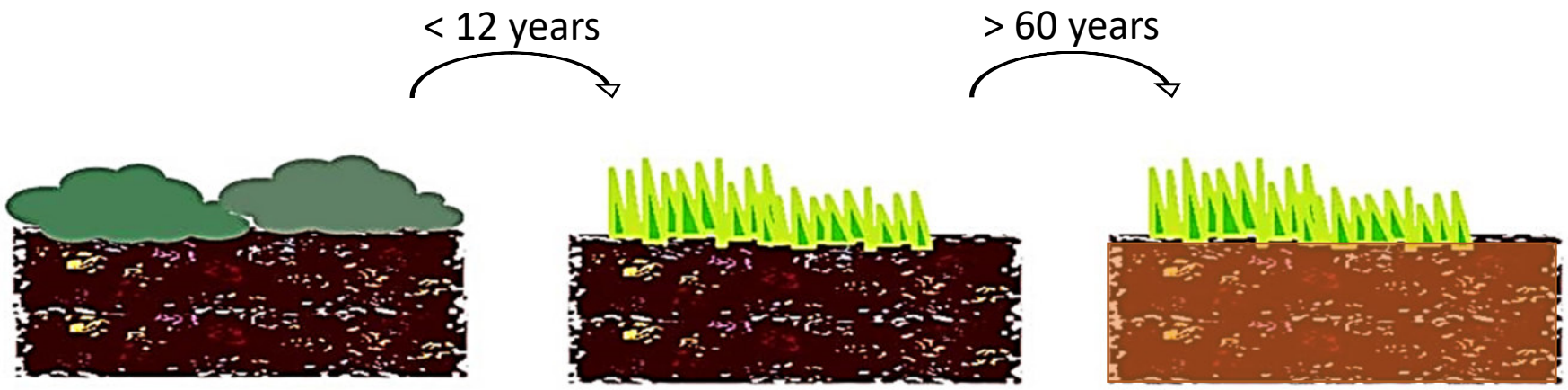
Additional finding:

…along the other fence, the moderately grazed area had experienced a **vegetation shift from shrubs to graminoids** within the past 12 years

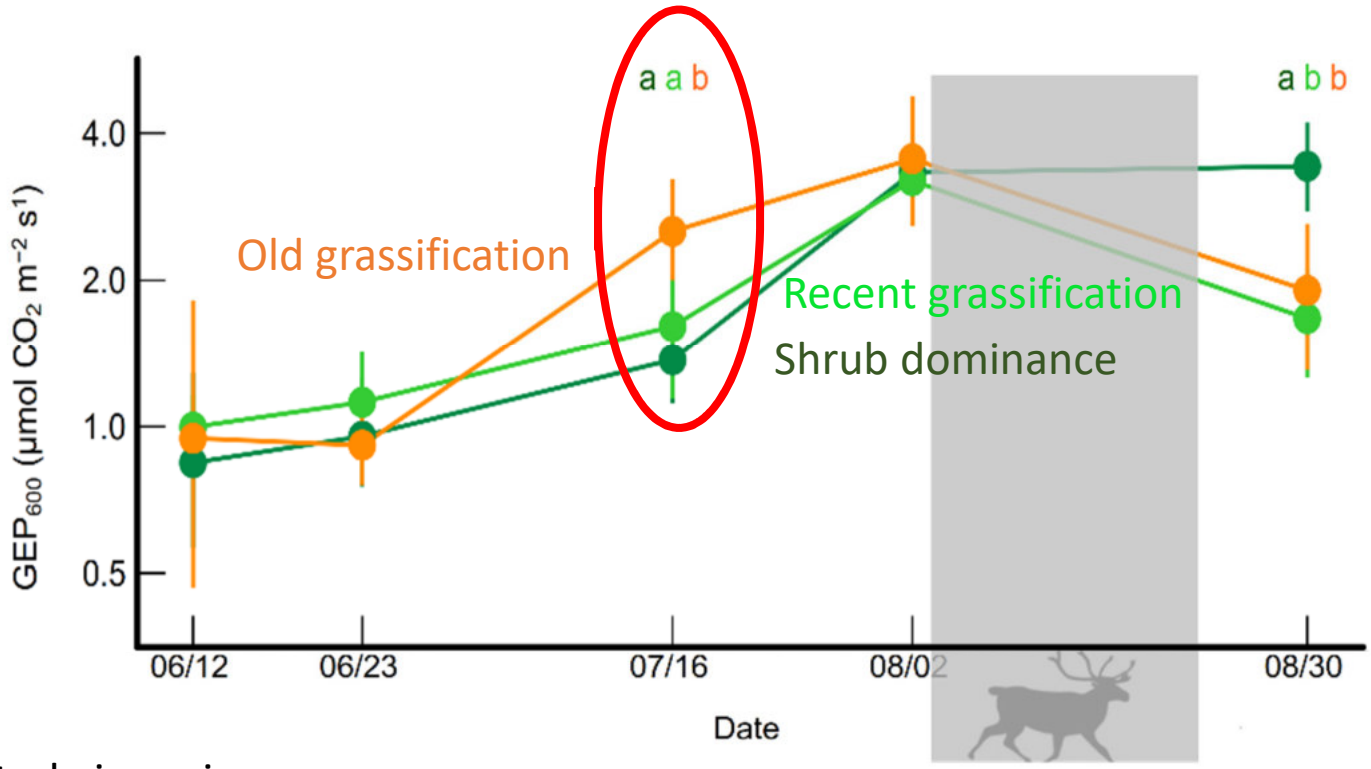
- What carbon cycling processes have changed alongside the vegetation shift?

Study 2: Depicting how recent vegetation shift reflects on carbon cycling processes

- Compare recent reindeer-induced *grassification* to old *grassification* and shrub dominance
- 8 transects

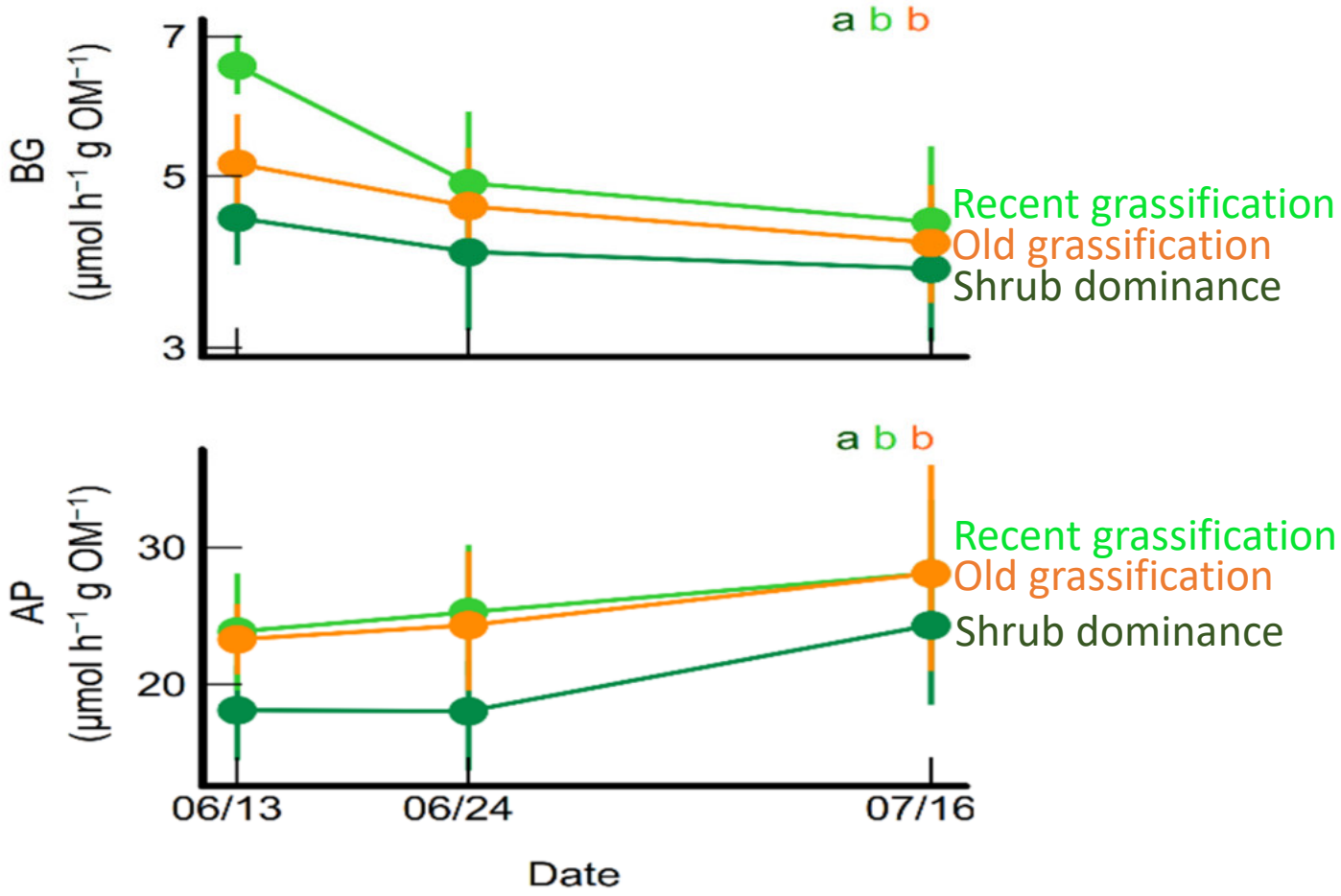


Peak growing season productivity (GEP) higher under old graminoid-dominance than under recent grassification



Ylänne & Stark, in review

Soil enzyme activities similar under recent and old grassification



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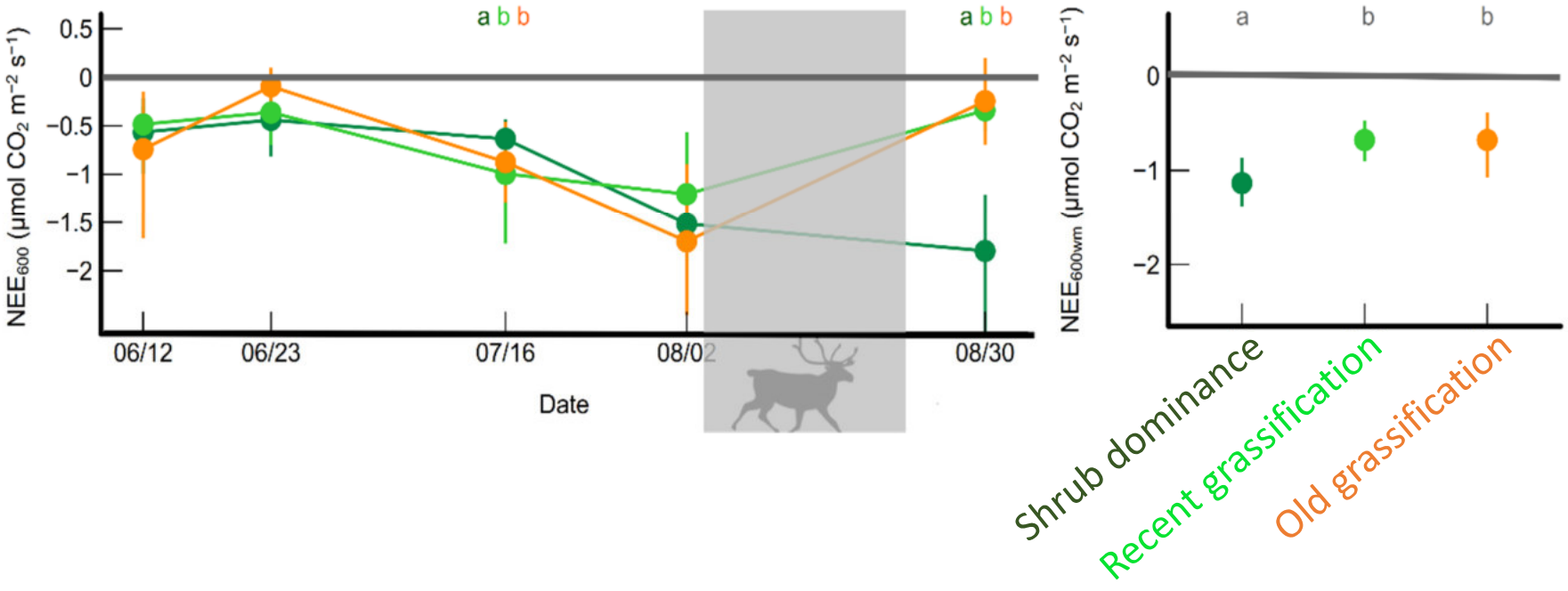
The plant and microbial part sum up to affect net ecosystem exchange

Both recent and old grassification have lower NEE than the shrub dominated site



Ylänne & Stark, in review

Implications

- The studies revealed that **current patterns of grazing can alter tundra carbon storage** and that **on each occasion the rates of soil and plant-driven processes could present just a time frame under a constant change driven by herbivory.**

- With more studies on various sites and time frames
  - Possibility to mitigate warming-induced soil carbon losses through management of grazers?
  - Possibility to include grazing to the ecosystem models: predict species occurence and processes in the future – and their feedbacks on climate?