Effectiveness of sheep grazing to control competing vegetation in white spruce reforestation

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Abstract: Changes in public attitudes toward glyphosate use on public lands for vegetation control in reforestation has spurred investigations into vegetation management techniques that do not use chemical herbicides. Sheep grazing is a potential alternative to glyphosate use, but its effectiveness has not been evaluated in boreal forests. This study compares the short-term outcomes of sheep grazing on vegetation control at four regenerating clear cuts that were divided into experimental units of low grazing intensity (200 sheep × days × ha^{-1}), high grazing intensity (400) and a fenced control treatment. A total of 75 Comeau competition index plots were used to assess light competition, 45 biomass sample plots were used to evaluate grazing effects on forbs, grasses, shrubs, and deciduous tree vegetation. The heavy grazing treatment proved effective, reducing light competition by 44% ($p = 0.005$), while the light grazing treatment at 8% reduction was statistically non-significant. Sheep showed a strong preference for forbs with 50-60% in competition and biomass reduction for both light and heavy grazing treatments ($p < 0.05$). Only the heavy grazing treatment reduced grass and deciduous vegetation by approx. 30% ($p = 0.10$), while shrubs were not affected. The heavy grazing treatment did cause 6% trampling damage to regenerating conifer seedlings, while the light grazing resulted in 3% damage across all plots. We conclude that the high intensity sheep grazing is effective in reducing light competition, unless deciduous tree competition is already beyond the sheep's reach. Additional research is required to determine whether and how long the treatment effects persist through subsequent growing seasons, or whether the grazing needs to be repeated until conifers reach a "free-to-grow" threshold, where light competition is no longer a concern.

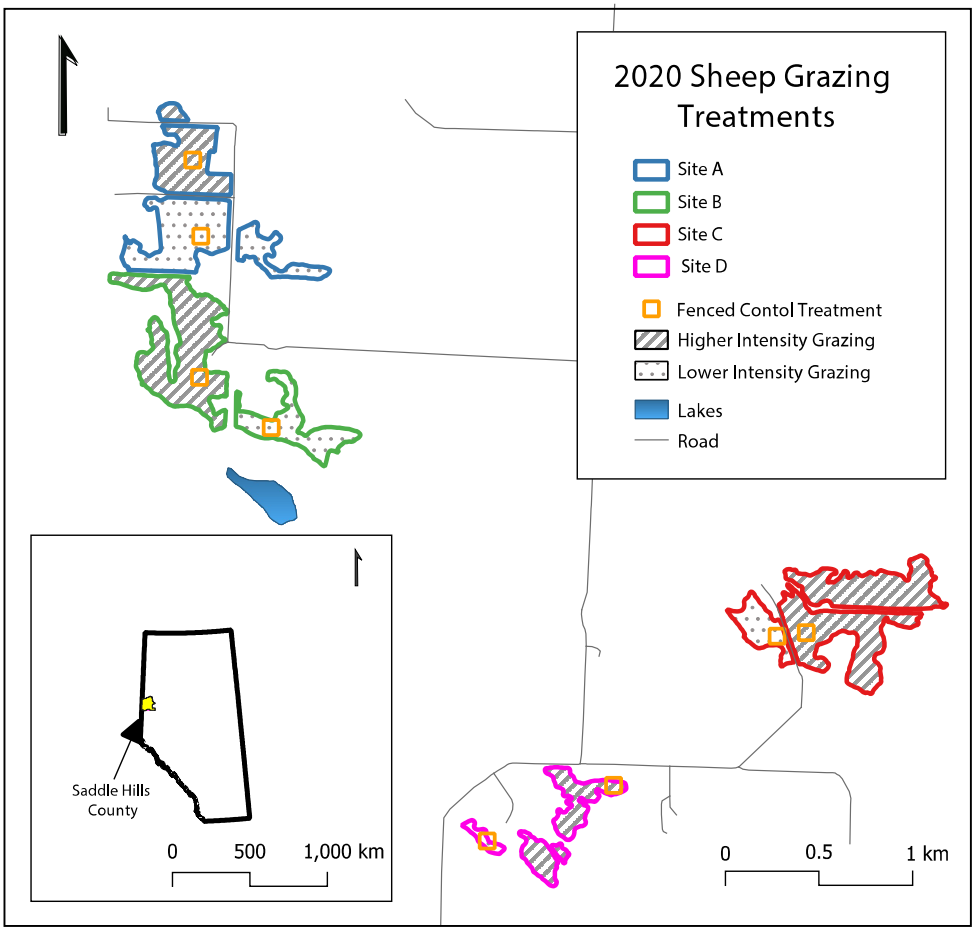

Figure 1. Overview of the arrangement of sampled clear cuts (blocks A, B, C, D) and treatments (control, low- and high-intensity grazing). The inset shows a map of Alberta and Saddle Hills County where the study site is located at approximately 55.64°N and 119.44°W. Base map features were obtained from the Government of Alberta (2021).

Figure 2. Photograph of Site B after a light grazing treatment. Some deciduous trees are partially stripped of leaves, and there is visible ungrazed area in the background.

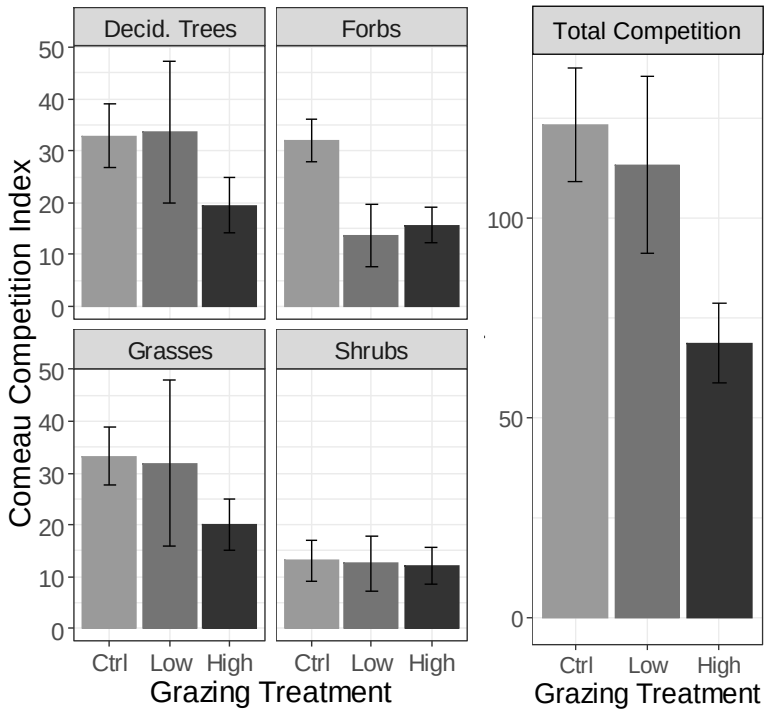

Figure 3. Comeau Competition Index results for four vegetation functional groups (left) and total competition (right). The treatments are high-intensity grazing (High), low-intensity grazing (Low), and a fenced control treatment without grazing (Ctrl). Error bars represent standard errors of the mean.

Figure 4. Site A after a high intensity grazing treatment (a), and an example of a balsam poplar clump having had its leaves stripped as high as the sheep could easily reach (b). Grazing efficacy for vegetation control appears compromised once deciduous tree competition has exceeded the reach of sheep.

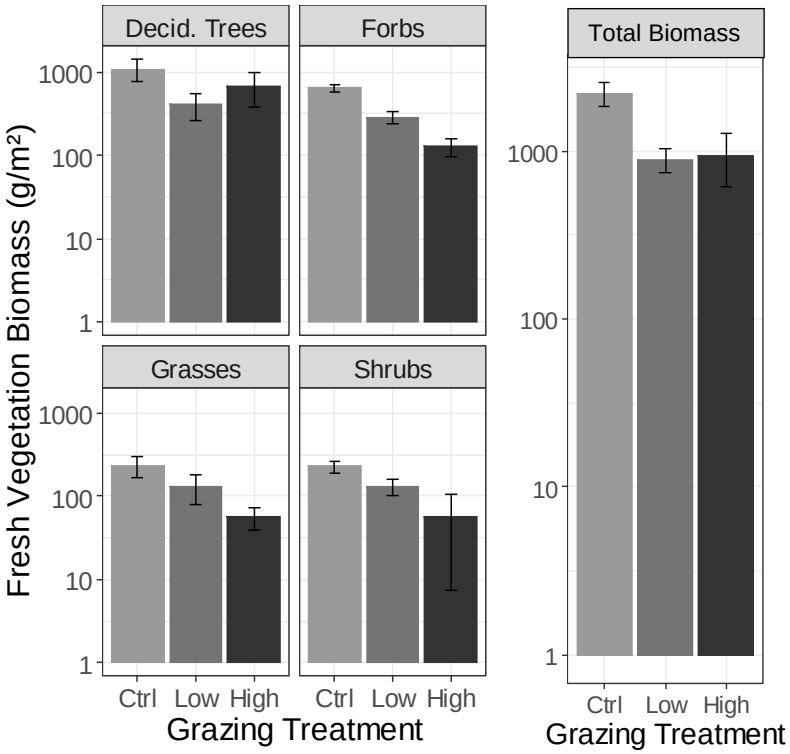

Figure 5. Fresh weights of vegetation collected in 50cm x 50cm square plots for four vegetation functional groups (left) and total biomass (right). The treatments are high-intensity grazing (High), low-intensity grazing (Low), and a fenced control treatment without grazing (Ctrl). Error bars represent standard errors of the mean. Note that the y-axis is on a $\log_{10}$ transformed.