EFFECTS OF SIMULATED GRAZING ON FIRE-TREATED MINE TAILINGS FOR RESTORATION

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BACKGROUND

Reclamation is the process by which anthropogenic alterations caused by mining activities are reversed and returned to a pre-disturbed state or a beneficial state as laid out by an end use plan. The original primary reclamation objective at the Highmont site at the Highland Valley Copper mine (HVC) was to achieve a self-sustaining vegetative cover (Carson and Jones 1988) to reduce erosion and prevent site degradation. These efforts have resulted in the creation of monocultures of agronomic grasses with high litter cover that prevents establishment of seeded native species. Green does not equate to successful reclamation (Munro 1991) and removing agronomic cover to promote biodiversity is key to ecosystem stability and function. Through collaboration with the Nlaka'pamux communities, the end land use plan was updated in 2016 (Melaschenkno et al., 2018). This new vision for the site is based on a native vegetative community to support wildlife values and domestic grazing.

OBJECTIVES

This study was designed to address how disturbance may impact community structure in these sites by comparing how a moderate burn followed by seeding of native species alters community composition compared across three treatments:

- control (no clipping),
- moderate clipping (clipped twice to 7.5 cm stubble height), and
- heavy clipping (clipped twice to 3.5 cm stubble height).

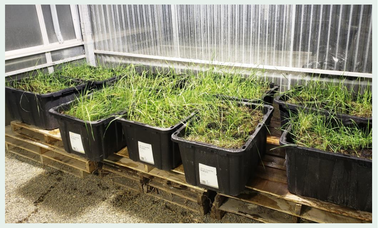
Specifically, how these three treatments effect:

- Biomass and cover of agronomic grass species and native grass species,
- Biomass and cover of forbs, and
- Overall species richness and diversity.

METHODS

In the fall of 2020, 18 turves were collected from HVC and all burned at moderate severity and then seeded with a selected native forb and grass seed mix. The control was not clipped, while clipping was applied in the moderate and heavy clipping treatments after 1 and 2 months, to a level of 3.75 cm and 7.5 cm respectively. This resulted in 6 replicates per treatment. At the end of 3 months cover was determined on all samples, all turves were harvested, and cumulative biomass was determined for agronomic grasses, native grasses, and all forbs. One-way ANOVA and posthoc tests were run for biomass and percent cover while Shannon's species diversity index was run to determine any significant difference in plant community variables between treatments.

Images clockwise from top right: Collecting turves from Highmont site. Right bank of turves after burning. Right bank of turves after one month. Right bank of turves after three months.



RESULTS

Agronomic grass biomass and cover was significantly lower in the moderate clipping treatment than the control (Fig. 1 and 2). Native grass biomass cover was not impacted by treatment although a trend was shown with higher biomass occurring under moderate clipping (Fig. 3). Native grass cover was higher for the moderate clipping treatment than heavy clipping (Fig. 4). Both forb biomass and cover were significantly higher in the moderate clipping treatment than the control (Fig. 5 and 6).

In all graphs the box represents the interquartile range of the data, the dots represent any outliers. Horizontal lines within each box represent the median value for that variable. NS represents no significance found and * represents a P value of < 0.05, and ** represents a P value of <0.01.

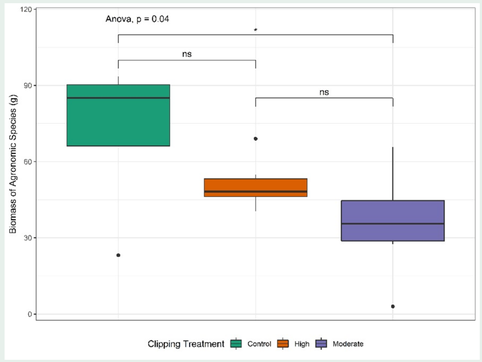


Figure 1. Total cumulative agronomic grass biomass at end of 3 months by treatment. n=6, p = 0.04.

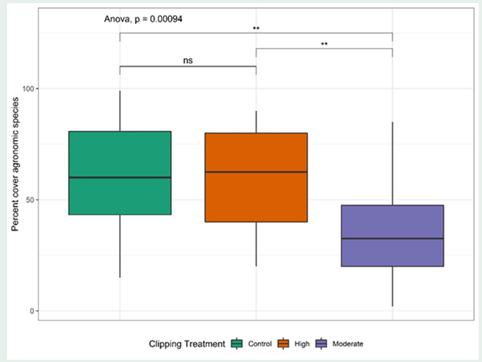


Figure 2. Cover (%) of agronomic grasses at end of 3 months by treatment. n = 24, P = 0.00094.

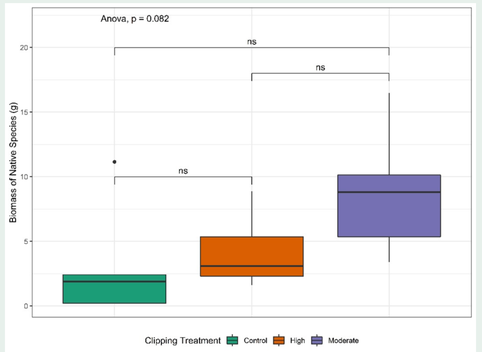


Figure 3. Total cumulative native grass biomass at end of 3 months by treatment. n = 5, P = 0.082.

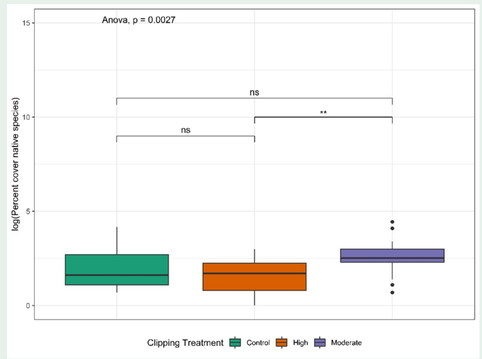


Figure 4. Log of cover (%) of native grasses at end of 3 month by treatment. n = 24, P = 0.0027.

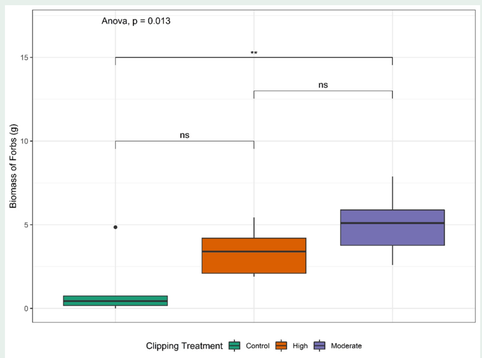


Figure 5. Total cumulative biomass of forbs at end of 3 months by treatment. n = 6, P = 0.013

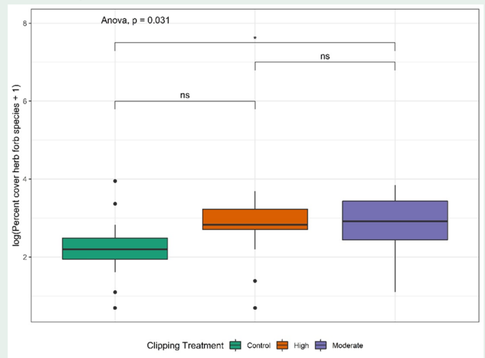


Figure 6. Log (x+1) forb cover at end of 3 months by treatment. n = 24, P = 0.031.

RESULTS CONT.

Species richness was not significantly changed over treatments but did increase post burning and seeding (Fig. 7). Species diversity was calculated using Shannon's Species Diversity model (Fig. 8) and showed that time was the driving factor for diversity.

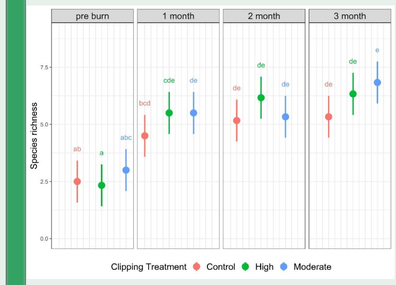


Figure 7. Species richness of treatments at each time interval.

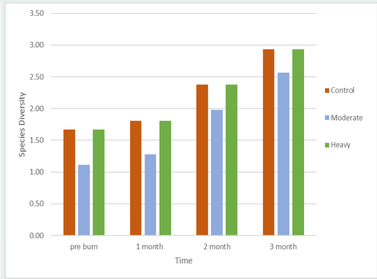


Figure 8. Shannon's Species Diversity Index of treatments at each time interval.

DISCUSSION AND IMPLICATIONS

To facilitate successional reclamation and allow native vegetation to replace the current agronomic monocultures, the existing stand must be open enough for invasion of the secondary species to occur (Polster 1989). The use of fire as an initial form of disturbance followed by seeding of desirable species and implementing further disturbance through moderate clipping was found to be the most successful treatment at reducing agronomic grass cover and biomass as well as increasing forb production. While moderate clipping predominantly removed the taller, more abundant agronomic grasses, the heavy clipping may have been too severe a treatment, removing native grasses below their growing point and forcing energy to be transferred to root production for survival.

In terms of species richness and diversity clipping did not have a clear impact but it appears fire followed by seeding of natives did increase both variables. Fire on grasslands increases species diversity beyond what would be seen in its absence, while moderate levels of grazing have been found to result in higher species diversity and increased productivity (Wilson and Peter 1988).

Overall, the application of these types of disturbances appears to alter the vegetative community in a positive way, moving from an agronomic dominated system to one open enough to allow some increase in native grass cover and a significant increase in seeded and unseeded forb species. It is possible that a disturbance regime involving fire, seeding of desirable species, and clipping or grazing could be used to meet modern reclamation and land use objectives.

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