Prescribed fire heat intensity and other factors impacting the presence of smooth brome (*Bromus inermis*) within a grassland

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Purpose

Parks Canada has been using prescribed fires to restore ecological integrity within Riding Mountain National Park. The following objectives evaluate how these fires impact the control of smooth brome, an invasive:

1. Determine the overall composition of plant communities in fire treated areas.
2. Determine if there is a relationship between brome density post-fire and fire heat intensity.
3. Determine if abiotic factors such as elevation, soil moisture, soil texture might influence fire intensity and brome density following prescribed burns.

Methods

Figure 1. South Lake during the prescribed fire (Parks Canada) and one year post burn.

Field: Occurred in RMNP South Lake Unit. 24 sites, 48 subplots within 3 heat classes.

- Heat class categorized based on fire heat intensity from satellite (Parks Canada, 2023)
- Brome stem count and vegetation coverage percent in 50 x 50 cm plot
- 10cm^3 soil samples collected using a hand trowel and dried upon returning to the lab

Lab: Samples processed in RMNP; data compilation occurred at University of Manitoba.

- Soil texture based on hand texture into sand, silt and clay in percent (Thien, 1979)
- Soil moisture obtained using gravimetric method (GLOSOLAN, 2023)

Analysis: Processing happened in QGIS and Rstudio.

- Elevation from 1m DEM (Digital Elevation Model) in GIS (Government of Canada)
- Summarize DEM and landform in GIS using spatial join
- Yuen's test for trimmed means (ANOVA) for brome stem density by fire intensity, summarized using ggbetweenstats
- Multiple regression test of brome stem density by soil moisture and texture
- Correspondence analysis (unconstrained) of vegetation cover to examine trends

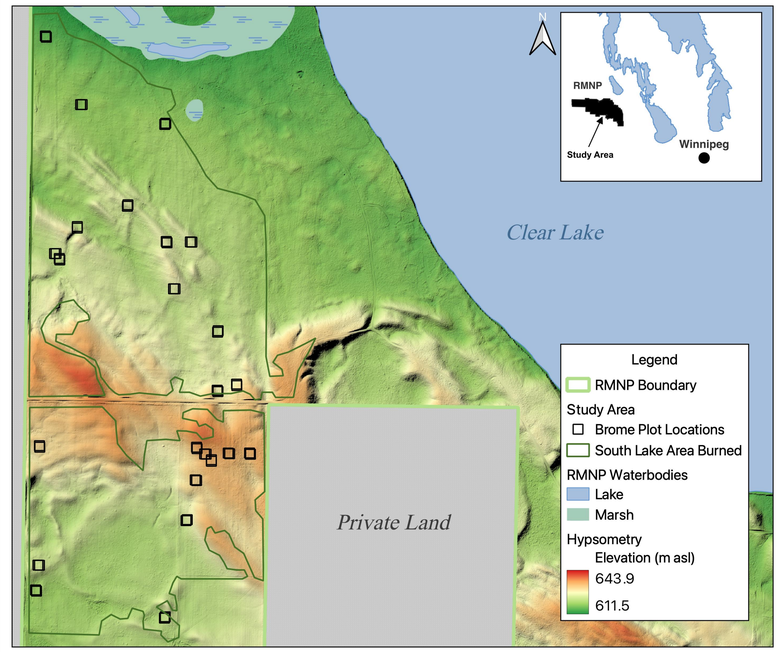

Figure 2. An elevation map of the South Lake region. The sites are identified within the area burned.

Table 1. A summary of the multiple regression model including moisture, sand, and silt.

Term	Estimate	Std. Error	t Value	Pr(>|t|)
(Intercept)	2.94	1.37	2.14	0.04
soil_water_p	0.04	0.03	1.35	0.19
soil_sand_p	-0.02	0.01	-1.31	0.21
soil_silt_p	-0.02	0.02	-0.89	0.38

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.7829 on 20 degrees of freedom
Multiple R-squared: 0.2338 , Adjusted R-squared: 0.1188
F-statistic: 2.03 on 3 and 20 DF, p-value: 0.14149

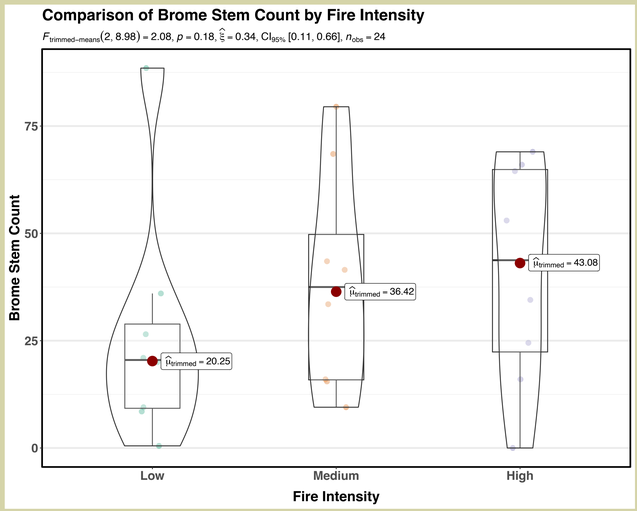

Figure 3. A direct comparison of brome stem count and fire intensity within the low, medium, and high categories.

Results

The relationship between brome stem count and fire intensity was **not significant** (Figure 3; p = 0.27) based on the Yuen's trimmed means test.

Soil factors such as moisture and texture (Table 1) tested by multiple regression also do not significantly influence brome stem density (p = 0.14; r2adj=0.12).

Patterns of species cover (Figure 4) examined using correspondence analysis, trend with fire intensity on the first axis. First axis ordination scores reflect a gradient, with high fire intensity plots scored negatively and low intensity plots positively on the axis. Species dominating the plots located in high fire intensity areas are primarily grasses, whereas broadleaf forbs are more common in low intensity plots.

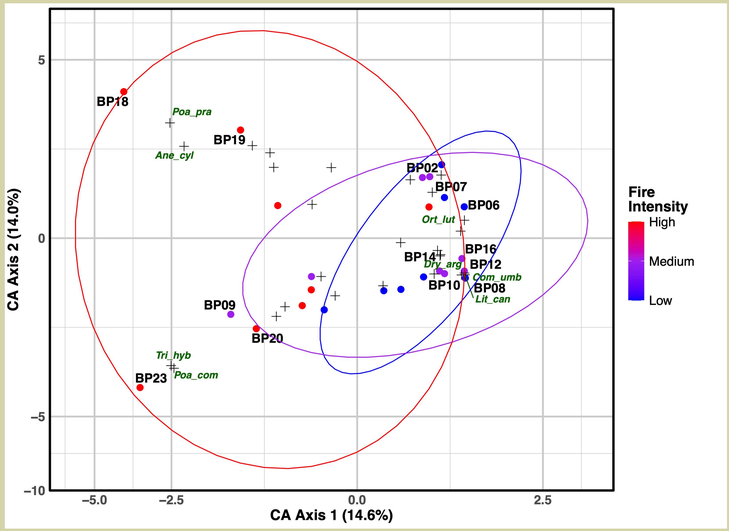

Figure 4. A correspondence analysis of vegetation species and fire intensity.

Next Steps

Spatial sampling of the DEM to develop a full set of environmental factors is necessary. These will be used for multiple regression of brome stem density and for canonical correspondence analysis to test if these factors influence vegetation community development post-fire.

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