The effect of reduced snow cover and summer drought on temperate grasslands in the Southern Interior of British Columbia

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Introduction
Grasslands are a carbon sink and are biodiversity hotspots so it is essential to preserve these land bases. Extreme weather events, such as drought, are predicted to rise due to global climate change. When faced with drought, some plants reduce their stomatal conductance to preserve water and must rely on stored reserves to meet their energy requirements. This can increase plant susceptibility to mortality after long periods of time. In addition, climate change may decrease the proportion of precipitation as snow. This can alter the severity of frost stress as there is less snow cover to provide insulation against cold air.

A phenomenon called “ecological stress memory” may influence how stress events interact and affect how a plant responds to future stress.

My goal was to test for the effect of snow removal and drought on grassland communities and, understand better if frost exposure will positively or negatively impact drought tolerance.

Methods
A 2x2 factorial design was established, with three replicates. Six split-plots were set up, each with a control and a rain-out shelter to reduce rainfall by 50%. In winter 2015, snow was removed from half of plots to stimulate frost stress. Soil moisture and temperature were recorded every 15 minutes by field data loggers. Aboveground biomass and soil samples were collected in November 2015. Frost Stress Degree Days (FSDD) was calculated using a formula based on Growing Degree Days (GDD) = $T_{\text{max}} + T_{\text{min}} - T_{\text{base}}$. I did two 2-way ANOVAs to test the effect of snow removal (present/absent) and drought (rain-out/control) on biomass and soil moisture.

Results
Fig 1. A comparison of snow depth and temperature. Snow removal caused a steep reduction in temperature.

Fig 2. The accumulation of frost stress. There was a significant difference between the treatment and control plots ($p = <0.022$).

Fig 3. There was no significant difference in aboveground biomass between any treatments and controls.

Fig 4. Rain-out shelters plots had a significantly lower soil moisture content (%) than the control plots ($F=11.73, p=0.009, df=1$).

Conclusions
Snow removal plots had less snow insulation and were exposed to colder air temperatures. This likely resulted in the treatment plots accumulating more stress at a faster rate than the control plots.

Despite the treatment effects on temperature, I found no difference in aboveground biomass due to snow removal. However, the rain-out shelters reduced soil moisture content by at least 50% resulting in a simulated drought.

The shelters built for this project are expected to last at least 5 years. Additional years of data collection will help us better understand the interactions between snow removal and drought.

Literature Cited

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