The Effect of Wildfire on the Abundance of Soil Arthropods

Ana-Lee Dyck, Lisa Lumley, & Victoria Giacobbo
Alberta Biodiversity Monitoring Institute (ABMI), University of Alberta

Introduction

- Soil arthropods are invertebrates (including insects, springtails, and mites) that live within the soil. Soil arthropods are integral to maintaining soil health and ecosystems (Menta & Remelli 2020).
- When there are disturbances, such as wildfires, biodiversity is decreased and soil degradation is increased (Castro-Huerta et al., 2021).
- Duffield, Alberta experienced a wildfire in 2016. The fire's progress was stopped by a bulldozer, creating a unique line between burned area and unburned area.

Purpose

- The goal of this study was to investigate the differences in the abundance and responsiveness of soil arthropods in an area affected by wildfire compared to an adjacent area not affected by wildfire.

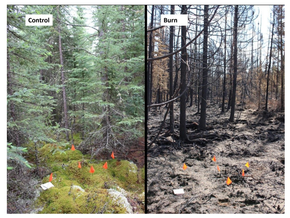

Figure 1. Control (unburned) area compared to burned area

Methods

- The ABMI Terrestrial Invertebrates team selected seven sites from the unburned (control) area and seven samples from the burned area. Soil samples were collected monthly for seven consecutive months.
- Soil samples were brought back to the lab and invertebrates were extracted using a Berlese-Tullgren funnel apparatus and preserved in 95% ethyl alcohol.
- Invertebrates were then sorted based on size class (50-300µm and greater than 300µm) using sieves and stored in 20 mL scintillation vials.
- Using a petri dish, stereo microscope and micro-probe, invertebrates greater than 300µm were identified to their respective Orders and were tallied.

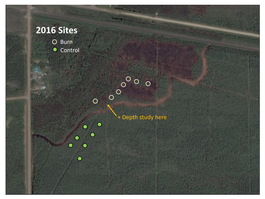

Figure 2. Map of collection sites in Duffield, Alberta.

Figure 3. Soil sample before invertebrates are extracted.

Figure 4. Berlese-Tullgren funnel apparatus in use.

Figure 5. Top view of Berlese-Tullgren funnel apparatus in use.

Figure 6. Site LML00278 (burned site) through a stereo microscope

Results

- It was found that overall there was an insignificant difference in abundance of soil invertebrates between the burned and unburned soil sites (t-test, $P > 0.05$).
- However, within the Coleoptera (beetles) there was a significant difference in abundance (t-test, $P < 0.05$).

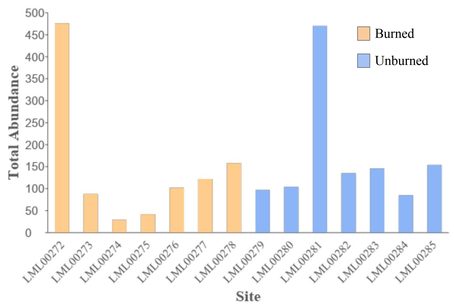

Figure 7. Total abundance of soil invertebrates per site during the month of June. No statistical significance was found between control and burned sites (t-test, $P = 0.7521$).

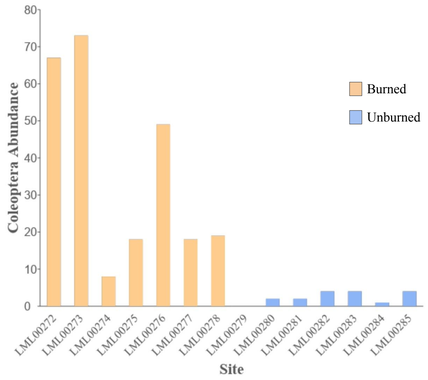

Figure 8. Total abundance of Coleoptera per site during the month of June. There was statistical significance found between burned and control sites (t-test, $P = 0.005856$).

Conclusions

- This study showed no significant differences between the total amount of soil arthropods in the burned and control samples. This may be because fire has been shown to conserve both environmental conditions and the seeds of host plants which are necessary for arthropod life (Siemann et al., 1997).
- Although there were no significant overall differences there were two noticeably distinct sites (one burned, one unburned) that differed from the other sites.
  - Both of the distinct sites contained high numbers of Collembola (springtails). This may be due to high moisture and organic carbon levels in the soil (Bhagawati et al., 2020). The organic carbon levels were not measured, however the moisture levels were collected. The recorded moisture levels did not reflect higher moisture levels at these sites but this may have been due to a faulty moisture meter.
- There were significant differences found within Coleopteran abundance; the burned area contained a statistically higher number than the control.
  - This may have been due to the amount of fallen and decaying trees found in the burned area. It has been shown that different families of Coleopteran larvae feed on dead wood, playing an important role in decomposition of wood (Menta & Remelli, 2020), This suggests that dead wood may be an important food source for Coleopteran larvae.

Figure 9. Fallen and decaying trees in burned area.

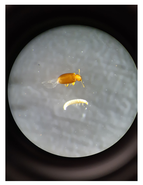

Figure 10. Coleopteran through a stereo microscope.

Acknowledgements

I would like to thank Dr. Lisa Lumley and Victoria Giacobbo for making this project possible, as well as, Women in Scholarship, Engineering, and Technology (WISEST) and the Alberta Government for their sponsorship.

Literature Cited

Bhagawati S., Bhattacharyya B., Medhi B. K., Bhattacharjee S., & Mishra H. (2020, November).Diversity and density of Collembola as influenced by soil physico-chemical properties in fallow land ecosystem of Assam, India. *Journal of Environmental Biology,* 41(6),1626-1631. http://doi.org/10.22438/jeb/41/6/SI-229

Castro-Huerta R., Morales C., Gajardo J., Mundaca E. A., & Yáñez M. (2021, October). Soil mesofauna responses to fire severity in a sclerophyllous forest in central Chile. *Forests,* 12(11), 1444. https://doi.org/10.3390/f12111444

Menta C. & Remelli S. (2020, January). Soil health and arthropods: from complex system to worthwhile investigation. *Insects,* 11(1), 54. https://doi.org/10.3390/insects11010054

Siemann E., Haarstad J., & Tilman D. (1997, April). Short-term and long-term effects of burning on oak savanna arthropods. *The American Midland Naturalist,* 137(2), 349-361. https://doi.org/10.2307/2426854