Changes in Berry and Leaf Production Following a Tundra Wildfire

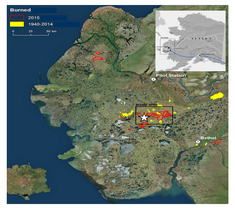
Ellis Lyles[1], Susan Natali[2], Sarah Ludwig[3], Seeta Sistla[4], John Schade[2], Rhys MacArthur[5], Natalie Baillargeon[6]
[1]Loyola University of Chicago, [2]Woods Hole Research Center, [3]Columbia University,
[4]California Polytechnic State University, [5]Hampshire College, [6]Smith College

Introduction

Climate change is causing rapid changes to Arctic ecosystems. As the climate warms, permafrost soils have begun thawing and wildfires continue to increase in frequency and severity. These changes have substantial consequences for the structure of Arctic ecosystems and for the people that rely on these ecosystems for their livelihood. Our objective in this research was to investigate berry and leaf production of culturally important tundra plants four years following a wildfire in the Yukon Kuskokwim (YK) Delta, Alaska.

Study area

This study was conducted in the YK Delta, a sub-Arctic region of Alaska comprised of peat plateau tundra and wetlands. In July 2019, we sampled vegetation on plateaus that have not burned in the past 70+ years and areas that burned in 2015, the biggest wildfire season on record in the YK Delta.



Methods

- Ten unburned and ten 2015 burned sites
- Three 0.25 m^2 plots (15 m apart) per site
- Counted stems, berries, and flowers
- Collected leaves for %C and %N analyses
- Leaves dried at 60°C for 48 hours and analyzed on an elemental analyzer
- 5-10 leaves collected per plot for specific leaf area (SLA; area per dry mass)

Species: Common use & cultural relevance

- ***Empetrum nigrum*** (Crowberry) Can be used to relieve eye sores and alleviate thirst. Berries are used to dye grass baskets. Yup'ik: *kavlakuaratt* ("little bearberry")
- ***Rhododendron tomentosum*** *(*formerly *Ledum palustre*; Labrador tea) Anti- inflammatory, antiviral, and analgesic properties; spiritual essence used to reduce stress, illness and negative energy.
- ***Rubus chamaemorus*** (Salmonberry/cloudberry) High in Vit. C, iron, zinc, calcium. Berries picked late July-Aug. Used in jams and other traditional Alaskan meals (e.g., *akutaq*, "something mixed"). Also used as a laxative.
- ***Vaccinium uliginosum*** (Blueberry) High in Vit. C, flavonoids, and flavonols; antioxidant. Used in jams, yogurts, and *akutaq*.
- ***Vaccinium vitis-idaea*** (Cranberry) High in Vits. A & C. Used in jams, *akutaq*, salads, fish dishes. Used to boost the immune system and to fight illnesses (e.g., cold/flu, liver problems, eye soreness, stomach aches).

Results

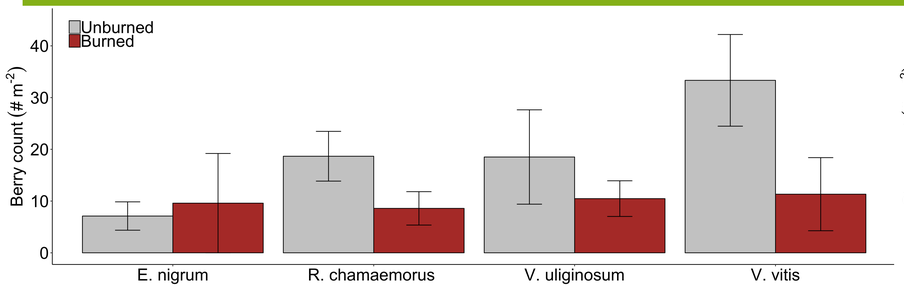


Figure 1. Average berry count (standard error, SE) in burned and unburned plots. Overall, there were significantly fewer berries in burned plots ($p < 0.05$).

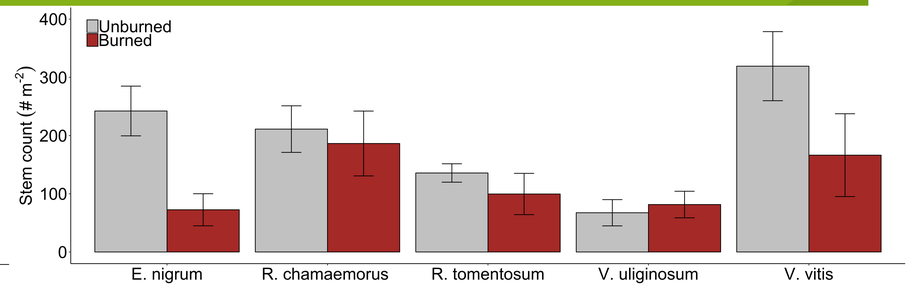


Figure 2. Average stem count (SE) in burned and unburned plots. *V. vitis* and *E. nigrum* stem counts were lower in burned plots ($p < 0.05$).

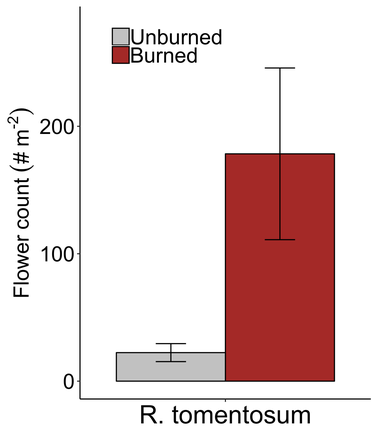


Figure 3. Average flower count (SE) for *R. tomentosum* was higher in burned than unburned plots ($p < 0.05$). Other species were not flowering during our sample period.

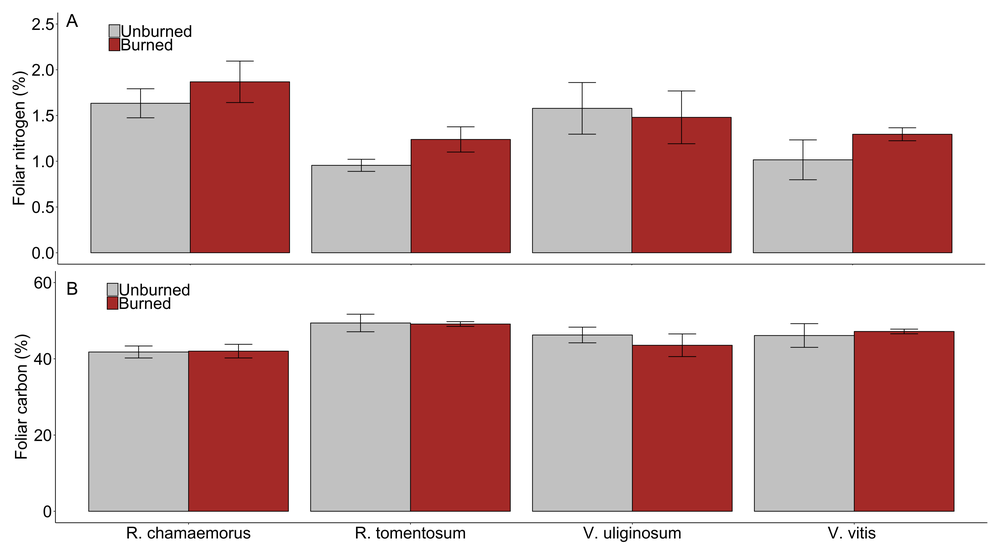


Figure 4. Foliar %N (A) and %C (B) in burned and unburned plots.

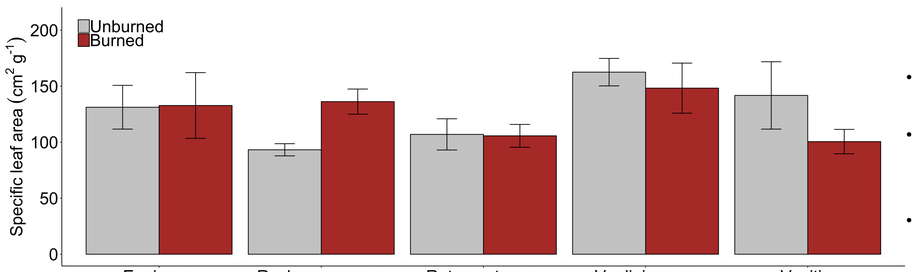


Figure 5. Specific leaf area (SE) in burned and unburned plots.

Summary & Conclusions

- There was a significant decline in stems and berries four years following wildfire (Figs 1-2), but an increase in *R. tomentosum* flower count (Fig 3).
- The reduction in berry production may have been partly affected by loss of moss, and the resulting changes in environmental conditions (e.g., moisture), following fire.
- We did not detect significant differences in C and N content of leaves, but % N was slightly higher in leaves from burned areas (Fig 4).
- *R. chamaemorus* in burned plots had higher SLA than in unburned areas; the increase in leaf size and decrease in berry production may represent a change in how this plant allocates resources following fire.
- This study shows that fire is an important regulator of culturally relevant tundra plant communities. Changes in plant growth and berry production may affect the wildlife and human communities that depend on these resources for consumption and medical purposes.

Acknowledgments: *YK Delta Ethnobotany Guide; Aquanette Sanders, Gabe Duran, Bianca Rodriguez-Cardona, and the Polaris 2019 team; funding from* NSF-1624927.