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Soil Macroinvertebrate Responses to Wildfires in the Blue Ridge Mountains, USA

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Introduction:

- Fire is categorized as one of the most widespread disturbances globally (Abrantes 2019)
- Fire has direct and indirect effects on the ecosystem
- Direct effects make up direct mortality and injury to organisms
- Indirect effects includes changes to habitat and food resources which can include changes to soil composition (Abrantes 2019, Callaham et al. 2012)
- Forest fire such as the fires from 2016 remove large portions of the organic soil horizon which is home to leaflitter-dwelling organisms such as millipedes (Coyle et la. 2017)
- Most of the current research on fire effects focuses on changes to plant community structure (Bond et al 20015)
- There have only been two studies on soil invertebrate responses in deciduous forests of the eastern United States, which have focused on prescribed fire not wildland fire (Kalisz and Powell 2000, and Coleman and Rieske 2006)
- Fall of 2016, there were numerous wildland fires on the eastern coast of the United States
- The Southeast was hit especially hard which is in part due to the severe drought condition pre-fire
- Total precipitation for September and October was 2.4 cm (Miniat et al. 2018)
- Due to the little data on soil invertebrate responses to wildland fires in deciduous forests, the 2016 wildland fires in northern Georgia and Tennessee offered a unique opportunity to conduct research

Objectives and Hypotheses:

Evaluate what the soil and litter invertebrate communities are doing post-fire

1. Soil fauna richness and abundance will be lower in burned areas compared to unburned areas
2. Litter fauna richness and abundance will be lower in burned areas compared to unburned areas

Study Sites:

1. Chimney Tops 2 Fire located in Great Smoky Mountains National Park in Gatlinburg, Tennessee
2. Rock Mountain Fire located in the Southern Nantahala Wilderness Area near Dillard, Georgia
3. Rough Ridge Fire in the Cohutta Wilderness Area near Crandall, Georgia

Figure 1. Map of the three study sites.

Methodology:

- At each study site
  - 5 burned plots and 5 unburned plots
- Each plot was 30 m apart
- Sampling occurred seasonally
  - From Fall 2017 to Fall 2019
- Collection Methods:
  - Leaflitter-Dwelling Organisms:
    - Timed hand collection for 30-person minutes
    - Within in a 2 m radius of each plot center (Snyder et al. 2006)
  - Soil-Dwelling Organisms:
    - Timed hand sorting for 30-person minutes
    - 30x30x30 cm soil monolith
  - All invertebrates collected were stored in 70% ethanol
- All specimens were sorted to a coarse taxonomic level using
  - Focal Taxa:
    - Millipedes
      - Identified to lowest taxonomic level possible
      - Most were identified to genera

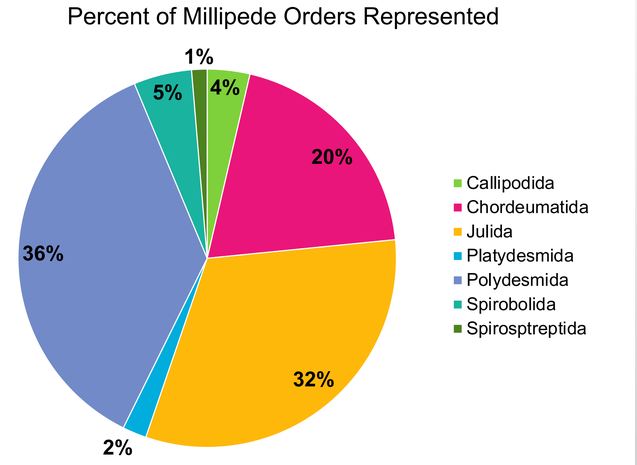

Figure 2. Represents the present of each Order of millipede out of the total 1,511 millipedes collected through the course of the project.

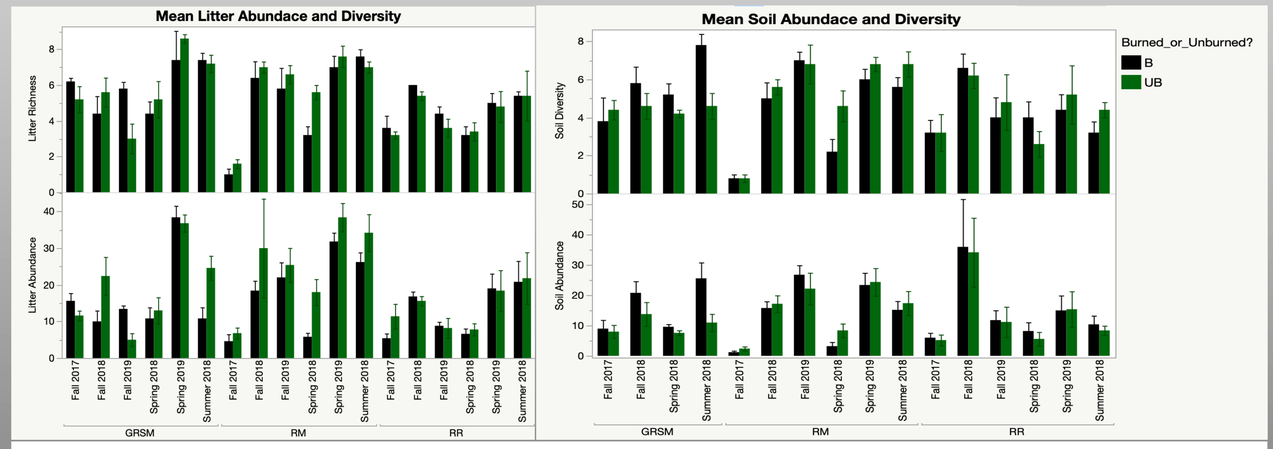

Figure 3 and 4. Showcase the changes in the values of mean abundance and diversity across the three study sites and at each collection data. The error bars are constructed using 1 standard error from the mean.

Results:

- A total of 5,425 invertebrate specimens were collected over the course of the project in 7 invertebrate classes.
- A total of 1,511 millipedes were collected over the course of the project. The total number represented 7 different orders and 12 different families
- T-tests were performed to compare burned and unburned plots of the soil-dwelling fauna and leaflitter-dwelling fauna
  - We defined diversity as a modified species richness that encompasses the coarse taxonomic groups of invertebrates found in the study
- It was found that there was a significant difference in abundance of leaflitter-dwelling fauna (P= 0.029) between the burned and unburned plots
- We plan to a three-factor ANOVA of the soil and litter data.
  - For the ANOVAs, the factors we will use are : Burn status (burned vs. unburned), site name, and time since fire.
  - The dependent variables for these ANOVAs will be soil richness, soil abundance, litter richness, litter abundance.
- We also plan to repeat these statistics for the millipede data
- We will also be creating millipede species lists for each of the three sites to analyze the distribution of the species.

Conclusion:

- Based off the preliminary statistical analyses we have run, there fire does seem to have an impact on the abundance of leaflitter-dwelling organisms
- This seems to align with our hypotheses and based of other similar studies conducted (Buckingham et al 2015 and. 2019).
- The fire consumed most of the leaf-litter and organic layer of the soil profile (Carpenter et al. 2020)
- Additional statistical analyses will be needed to further elucidate these results
- Based off the results from prior studies seasonality seems to also play into effect. The three-factor ANOVAs will be able to tell us if that is the case as well for our data (Silveira et al. 2010).
- We can see already from the graphs that there are some seasonal patterns, especially when looking at our summer collection.
- We anticipate that fire will have an impact on millipede abundance since they are leaflitter-dwelling organisms and the results of the T-Test show that fire does have a significant impact on all leaflitter-dwelling organisms
- The creation of the millipede species list will also contribute to the knowledge of their distributions and records of what species are found at each location.
- There were several undescribed species of millipedes (*Nannaria* sp. and *Cleidogona* sp.) that colleagues are currently working on describing

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