Patterns of Millipede Community Structure Across Habitat Types

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ABSTRACT

Diplopoda, a diverse class of arthropods, is composed of millipede species that are pertinent to soil health. Millipede diversity is more understudied in comparison to many other invertebrates in the terrestrial environments of southeastern North America. As an integral part of ecosystem functionality, millipede species vary depending upon habitat composition. The current study focused on the millipede bycatch from a previous study conducted at the Savannah River Site in South Carolina, just southeast of Augusta; this study focused on the linyphiid spiders. We identified millipedes from preserved millipede specimens from eight pitfall sites traversing contrasting habitats, ranging from xeric to mesic habitats and various dominant overstory species. Millipedes were collected in 10 pitfall traps at each site. Traps were run continuously, over the course of a year, while being emptied every two weeks. Results of the study exhibit Polydesmida were dominant in mesic habitats with longleaf pine, whereas Julida were dominant in drier conditions, particularly the xeric sandhill upland sites. Julida abundance prevailed during this study making up just under 60% of the total collected sample population.

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INTRODUCTION

Millipedes live in fairly diverse communities, and within these communities many Orders remain underneath the soil's surface carrying out decomposition. They are amongst the most important group of decomposers in the ecosystem; comprising more than 12,000 cataloged species (Brewer et al., 2012). Millipedes generally seek out areas within a habitat that have ample amounts of moisture. This moisture not only is retrieved from precipitation, but also from the presence of decaying matter, typically plants, that the millipedes consume. These moisture-rich plants are found at low elevation and in nutrient rich soils where the millipedes tend to gravitate towards (Stašiov et al. 2019). Millipedes often have to adapt ways to counteract natural moisture loss through their process of cuticular transpiration (Hopkin and Read, 1992). Fundamentally, across every habitat, millipedes assist in breaking down decaying plant matter and spreading these recycled nutrients throughout their environment to promote further plant growth (Coleman et al., 2004).

EXPERIMENTAL DESIGN

- Draney (1997) collected millipedes in the following sample design:
- Study area: Savannah River Site (Department of Energy) in South Carolina, just southeast of Augusta, GA
- Sites: 1. Old Field, 2. Young Pine, 3. Medium Pines, 4. Large Pines, 5. Scrub Oak/Pines, 6. Upland Hardwood, 7. Riparian Hardwood, 8. Riparian Old Growth.
- Millipedes were collected in 10 pitfall traps at each location.
- Transferred from formaldehyde in water solution to Isopropyl alcohol (70%).
- A total of 366 trap days at each site with an average trap period of 14 days.
- 4,074 millipedes were collected and identified to order using Milli-peet Order keys of the Field Museum.
- Analysis of these millipede specimens began at the order level to determine collections consisting of Julida, Polydesmida, Spirobolida, and Chordeumatida.
- Specimens were labeled and preserved in ethanol; then sorted by date collected, order, site, and designated pitfall number.

Figure 4. Savannah River Site specimen vials.

RESULTS

The pitfalls located in xeric conditions, at Old field and Scrub Oak/Pines site in particular, contained more millipedes of the order Julida. A total of 1,047 Julida were found in these drier habitats, whereas pitfall collections at Large Pines, Upland Hardwood, and Riparian Hardwood, where conditions were not as dry, the Polydesmida (1,567) and Spirobolida (3) were in abundance. Julida were also found in these mesic environments but in fewer numbers compared to that of Polydesmida (Figure 1). The order Chordeumatida was the least retrieved order in both xeric and mesic habitats, with none being collected in xeric conditions (Figure 2). Amongst all orders at the Savannah River Site, Julida are the most adaptable order, being found at every site. Julida made up 59.4% of the total preserved millipede sample population (Figure 3).

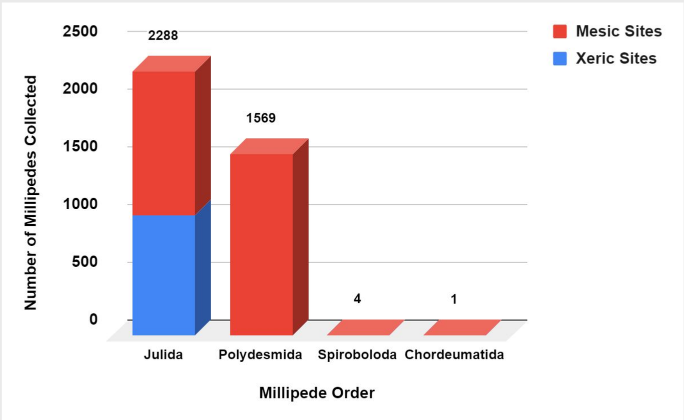

Figure 1. Abundance of millipedes by Order in xeric (Old Field and Scrub Oak/Pines), and mesic (Large Pines, Upland Hardwood, and Riparian Hardwood) habitat conditions in Savannah River Site pitfall traps.

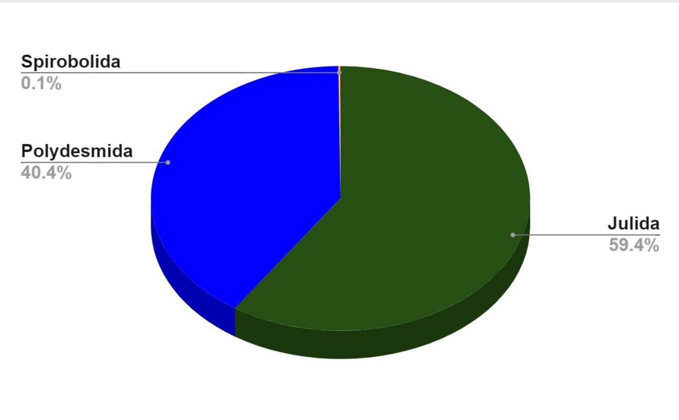

Figure 3. Relative abundance of millipede orders (Julida, Polydesmida, Spirobolida) collected across habitats in Savannah River Site.Data displays the loss of Chordeumatida as the sample population was minuscule.

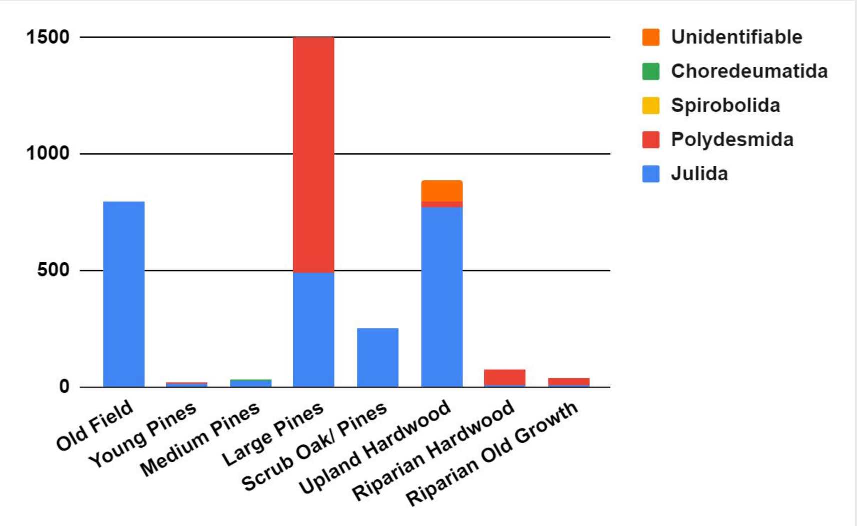

Figure 2. Millipede community structure at each sampling location at the Savannah River Site. Large Pines collection data reached a total of 1,980 millipedes.

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DISCUSSION

The primary focus of the experiment was to gain a better understanding of what millipede communities exist in a range of habitats. Order level identification revealed noticeable patterns of existing millipedes within the Savannah River Site. The Order Julida displayed data of widespread abundance, and adaptability to both xeric and mesic habitats. However, Polydesmida were more suited for mesic conditions, and were much larger in number. There were not enough samples collected of Spirobolida, and Chordeumatida to draw conclusive data on their abundance in this region. Future research will allow further identification to species level, exposing more patterns of millipede community structure.

Collection at these pitfalls took place every two weeks, and data could have been affected by precipitation and temperature during these time frames. Millipede's general prosperity is very dependent upon moisture levels. Moisture in the environment is critical for their survival; most of this moisture being received through consumption of detritus. Lack of moisture results in further burrowing into the soil or migration to more suitable areas.. Pitfall trapping relies heavily on millipede activity, and if conditions are unfavorable the millipedes will burrow down into the soil and avoid collection. Additional analyses can look at phenology or the relationships between millipede community structures and weather conditions.

Figure 5. Spirobolida in ethanol under light microscope.

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