RESEARCH BRIEF

Effects of fire intensity on litter arthropod communities in Ozark oak forests, Arkansas, U.S.A.

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Fire is frequently used for ecosystem restoration and to reduce fuel loading in the forests of the Arkansas Ozark region. The effects of fire may be more or less intense depending on the spatial scale of observation. Variations in fire intensity due to fuel loading and type, forest structure, and soil moisture, at a local spatial scale may not affect larger animals. Microfauna, however, like insects (e.g., arachnids, millipedes, and centipedes), known collectively as arthropods, may be more susceptible to fire's effects. Many of these organisms live in the leaf litter and have limited mobility, (i.e., no wings, small size) making escape from a disturbance difficult. In forests, arthropods occur ubiquitously and abundantly in leaf litter and occupy several functional niches. As predators, detritivores, and microbivores they control other arthropod and microbial populations and aid in decomposition of organic matter. Also, litter arthropods serve as food for herpetofauna, birds and small mammals.

This study asks whether local-scale variation in fuel loading and fire intensity affects abundance (number of individuals) and species richness (number of species) of selected, common litter arthropod taxa (ants, beetles, spiders and springtails) and quantifies their post-fire recovery rates. To answer these questions, arthropod populations were sampled (1m^2 plots) in areas with low and high fire intensity and unburned areas. Samples were taken immediately after burns and resampled every week for 4 weeks post burn. Prior to the burn, litter depths were altered to manipulate fire intensity (verified using thermal indicator plates). Litter depth treatments were: coarse litter removed, litter depth added to 3 times normal depth, and control (litter depth unchanged). This manner of fire intensity manipulation was used because fuel loads can be correlated with fire intensity in temperate forests (see Myers and Harms 2011 for more information on this point).

MANAGEMENT IMPLICATIONS

- Increased fire intensity lead to reduced abundance in arthropod populations and less species richness in ant populations immediately after fire
- Fire may have selected for those arthropods that are better at seeking refugia and can therefore affect community structure and composition

Overall, arthropods were found to be at least 66% less abundant immediately after fire when compared to pre-fire abundance. Arthropod mortality is likely to occur after a burn due to high temperatures and the combustion of leaf litter. As expected, arthropod abundance was higher with lower intensity fires (coarse leaf litter removed). Knowing that fire was historically frequent on the landscape in the Arkansas Ozarks, burning possibly selected for litter dwelling arthropods that were more effective at escaping fire by burrowing and seeking moisture in litter and soil, or those which could rapidly recolonize burned sites. Further, historical widespread frequent burning may have caused decreased arthropod abundance over long time periods and large extents.

Species richness was determined for ant species only. More species of ants were found after lower intensity fires and fewer

Photo courtesy of Dr. Robin Verble-Pearson

Increased fire intensity leads to reduced abundance in arthropod populations and less species richness in ant populations immediately after fire. Here the first author collects samples directly after the prescribed burn.

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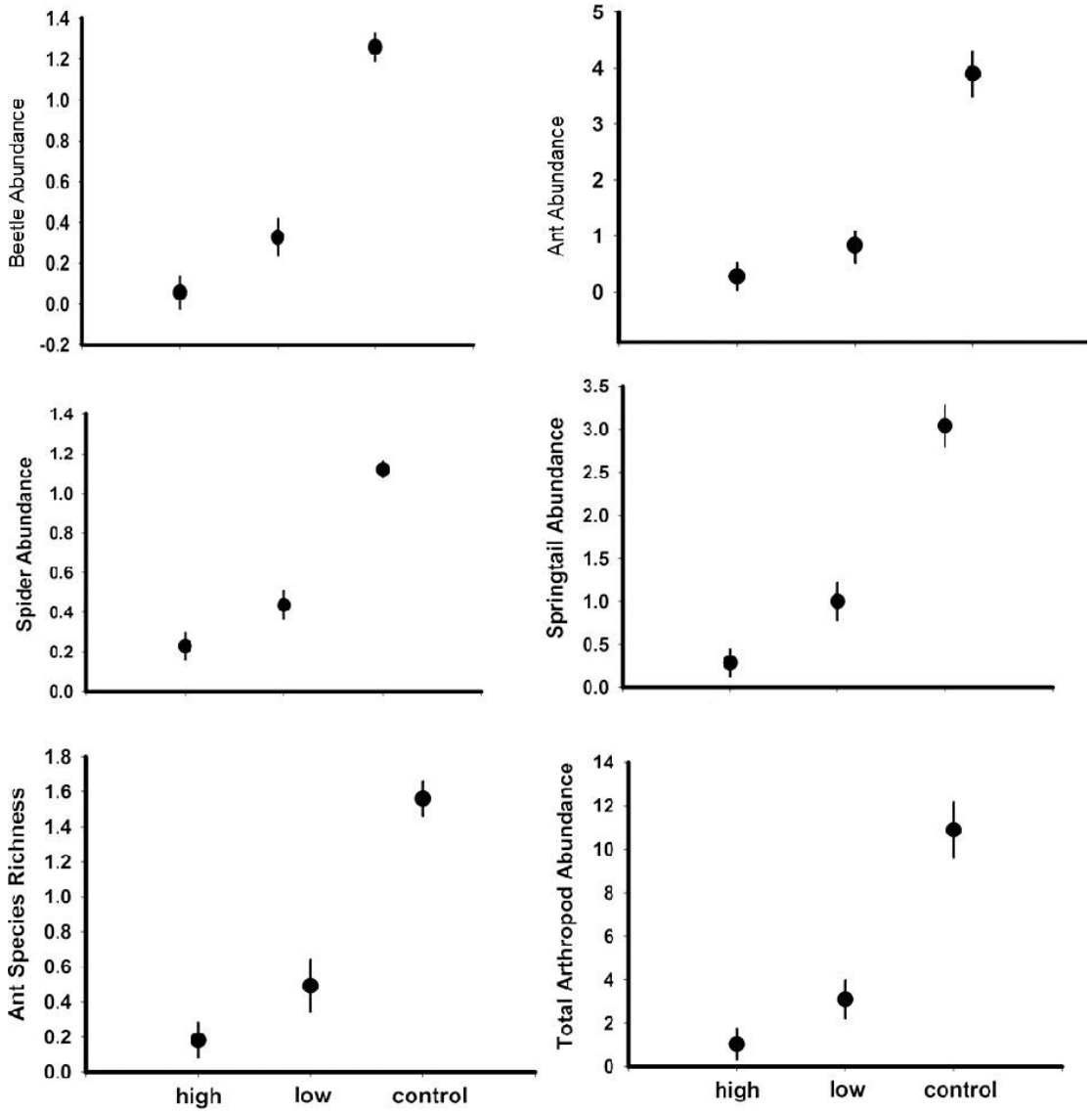
Fire effects on arthropod communities

species after higher intensity fires. Unburned areas had the greatest species richness. Surprisingly, no ants appeared at bait traps, a common method used to sample ants. The authors suggest that this may be related to the diets of certain ant species being altered due to fire. Similarly, few ants were found in pitfall traps, a collecting mechanism that samples arthropods on the forest floor. Other studies point to ash toxicity as a cause for such inactivity in ants post-burn (see Edwards and Schwarz 1981). Populations of beetles, ants, spiders and springtails did not fully recover in the time frame of the study (4 weeks post-fire), suggesting that the fire effects are longer lasting. Although statistically different, recovery time did not vary dramatically between low and high intensity burns for all taxa; it seems that the mobility of the individual taxa may determine recovery rate. For instance, beetles, the only winged arthropods considered, recovered fastest. This research shows that fire intensity affects leaf litter arthropod abundance and species richness of ants, but not recovery rate. The authors recommend that future studies examine the effects of simplified habitat conditions, food availability and ash toxicity on arthropod communities to more accurately determine the mechanism behind changes in abundances post-burn.



Abundance of beetles, ants, spiders, springtails and total abundance decrease with increasing fire intensity immediately after a fire. Ant species richness is also reduced with higher fire intensity.

FOR FURTHER READING

Edwards, J.S. and L.E. Schwartz. 1981. Mount St. Helens ash: a natural insecticide. Canadian Journal of Zoology. 59(4): 714-715.

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This research brief was funded by ***The Joint Fire Science Program.*** *http://www.firescience.gov/*