Post-fire succession of ant communities in boreal Alaska

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Introduction

Climate change will cause an increase in fire frequency and severity in Alaskan boreal forests, increasing the proportion of younger successional forests over time, and shifting forests previously dominated by black spruce (*Picea mariana*) to forests dominated by deciduous species (Johnstone *et al.* 2010 a,b). These changes have the potential to cause widespread changes in arthropod communities throughout boreal interior Alaska, specifically ant communities. Ants play important roles in boreal forest communities by preying on herbivores and modifying soil properties.

We predict that heterogeneity in understory vegetation and microclimate associated with young forests will foster a diverse prey base, promoting a rich community of predatory Hymenoptera, specifically ants. Additionally, we hypothesize that an increase in deciduous trembling aspen (*Populus tremuloides*) will increase the diversity of ants; aspen is highly palatable in comparison to black spruce (Bryant *et al*. 1983), which may increase the diversity and abundance of available prey, and also produces extrafloral nectar, which mediates an indirect defense by attracting and nourishing ants (Bentley 1977).

Objectives.

1) Characterize changes in the boreal ant community during post-fire succession
2) Test the hypothesis that aspen fosters higher diversity and abundance of ants than black spruce

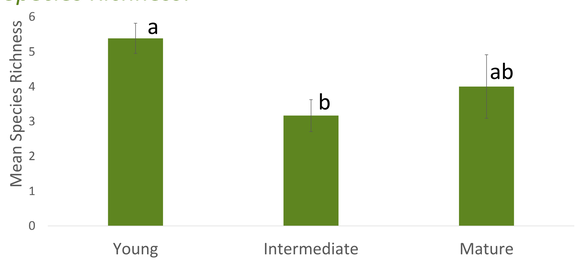
Methods

Study sites. We chose twenty-nine study sites from the Bonanza Creek (BNZ) Long Term Ecological Research (LTER) extensive site network based on their age and dominant tree species. Sites were categorized into “intermediate”, “young”, or “mature” age class based on date of last burn. Young sites all burned most recently in 2004, intermediate sites burned between 1947 and 1971, and mature sites burned prior to 1935. We characterized sites based their dominant tree species as aspen, black spruce, or a mix of the two species for the young and intermediate age classes, ensuring all three successional trajectories were represented within each age class. The mature age class contains only sites dominated by black spruce.

Pitfall trapping. We sampled ants using pitfall traps containing propylene glycol. Each site was sampled three times during the summer months of 2014 and 2015. For each site and sampling period, 12 traps were placed every 10 meters within a 20x30m grid and deployed for 7 days.

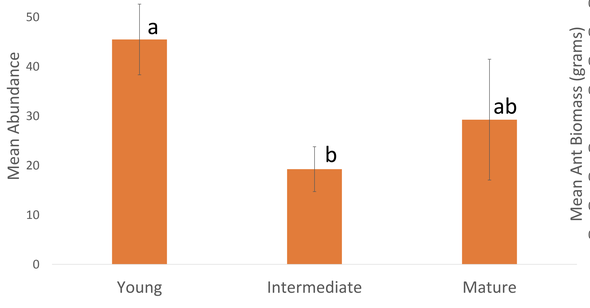
Preliminary Results

Species Richness.



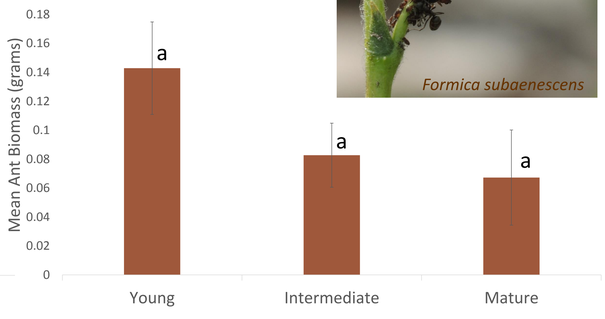
Species richness. Overall, young sites were significantly more species rich than the intermediate sites (p=0.005), but not significantly richer than mature sites. Patterns of species diversity as measured by the Inverse Simpson’s Index mirrored those of species richness, but there were no significant differences in species evenness among age classes. There was no difference in richness, diversity, or evenness among successional trajectories.

Abundance.



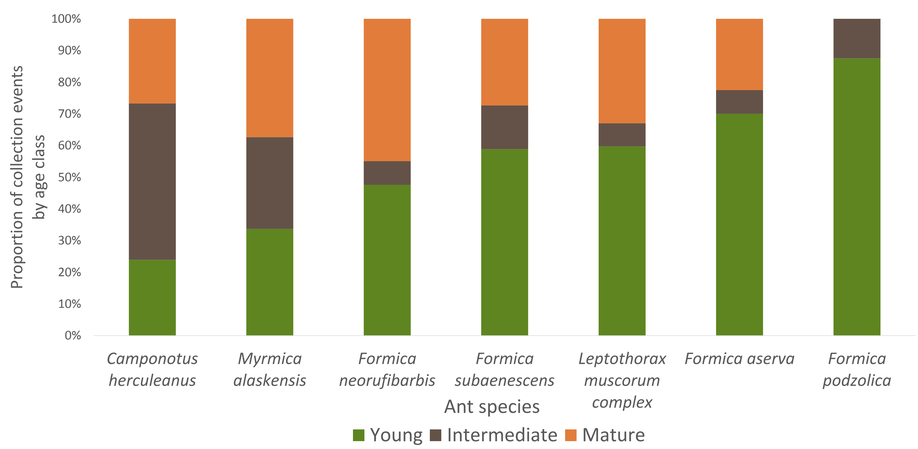
Abundance. We collected 2,556 individual ants (939 collection events). There were significantly more ants in the young sites than the intermediate sites (p=0.02), but no difference between young and mature sites. There were no significant differences among successional trajectories (aspen, black spruce, and mixed sites).

Biomass.



Biomass. There were no significant differences in total ant dry biomass at sites of different age classes or among successional trajectories (aspen, black spruce, and mixed sites).

Community composition.



Community composition. *Formica* and *Leptothorax* species tended to be captured in young sites, while *Camponotus* and *Myrmica* were more frequently collected in intermediate and mature sites than young sites. This suggests that *Leptothorax* and most *Formica* species specialize on younger successional habitats, whereas *Camponotus*, *Myrmica,* and *F. neorufibarbis* appear to become established in young sites but persist as succession proceeds.

Conclusions

The preliminary results support the existence of strong successional changes in ant communities following fire, but do not support the hypothesis that aspen fosters higher diversity and abundance of ants than black spruce. In the ten years following fire, ant species diversity and abundance are relatively high. Over the next three to five decades, a significant portion of that diversity and abundance is lost. We are currently investigating environmental factors that may drive this loss. Both diversity and abundance may recover somewhat as black spruce forest matures, but because relatively few mature sites were sampled, more data is needed to address this hypothesis.

Younger successional sites contain more ant individuals than intermediate-aged sites, but not more ant biomass. Young sites are dominated by many, smaller *Formica* and *Leptothorax* individuals, whereas the most common ant species in intermediate-aged sites is the large-bodied *Camponotus herculeanus*. The *L. muscorum complex* species*, F. aserva, F. podzolica, and F. subaenescens* nest in soil in open forests, whereas *C. herculeanus, M. alaskensis*, and *F. neorufibarbis* nest in wood, above or below ground (Francoeur 1997). Differences in nesting habitat may explain why *C. herculeanus*, *M. alaskensis*, and *F. neorufibarbis* persist in intermediate and mature successional forests.

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