Arthropod Communities in Various Successional Loblolly Pine Forests

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Abstract

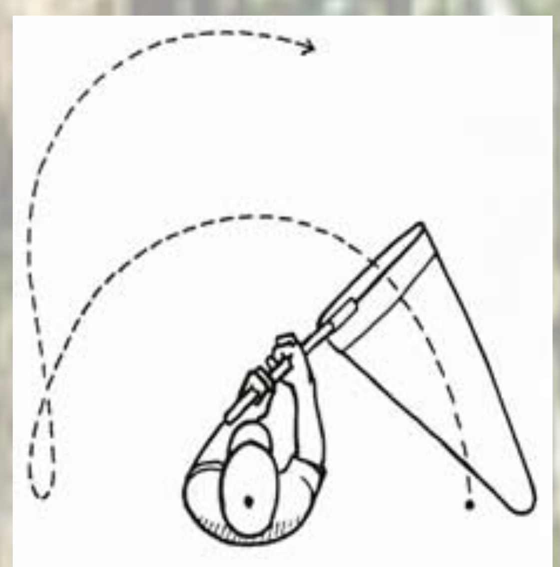
Logging schemes can result in numerous habitats that arthropods utilize. The type of logging (e.g. clear-cutting, select-harvesting, etc.) and state of succession can result in very different arthropod communities. Arthropods play an integral role in ecological balance and utilize logged areas. This project examined the effects of various logging management schemes on insect abundance and diversity. Sweep net samples of arthropods were collected from loblolly pine forests in Mississippi. Four different forest treatments were studied: (1) 1-3 years since re-planting, (2) 3-5 years since re-planting, (3) 5-10 years since re-planting, (4) >6 years since thinning. Collected arthropods were counted and classified to the lowest taxonomic level possible. Samples from the early successional forests had greater insect abundance than those collected from the later successional forests. Beneficial and pest species of arthropods can be affected by the type of logging and the age of the logged area, which can have a cascade of effects on vertebrate organisms that utilize them for food.

Introduction

Constant worldwide demand for wood-based products, such as furniture, paper, and lumber, drive the logging industry. Certain logging methods, such as clear cutting, have been shown to destroy habitats, thus decreasing colonization of plants and other organisms. However, as forests are re-planted, plant and animal communities colonize the newly grown areas.

The purpose of this study was to observe the effects of different ages of loblolly pine plantations and successional habitats on arthropod abundance and species richness.

Figure 1.



http://diagnostics.montana.edu/MTAlfalfa/

Figure 2.

Methods

- The study site was located in Mississippi (Figure 1).
- 20 study plots (~25 acres each) comprising 4 treatments were utilized. Treatments included:
  1. 1-3 years since re-planting; early successional habitat
  2. 3-5 years since re-planting; early successional habitat
  3. 5-10 years since re-planting; mid successional habitat
  4. >6 years post-thin; late successional habitat
- Samples were collected walking transect lines with sweep nets (Figure 2).
- Samples were collected between July 8-July 22, 2014.
- A completely randomized design was used. ANOVAS were conducted with treatments as the independent variable and the arthropod groups as dependent variables.
- Tukey's test was utilized to determine differences between the four treatments.

Key

1-3 ES: 1-3 years since re-planting; early successional habitat
3-5 ES: 3-5 years since re-planting; early successional habitat
5-10 PT: 5-10 years since re-planting; mid successional habitat
>6 LS: >6 years post thin; late successional habitat
*Different letters above each bar represents a significant difference ($p \leq 0.05$)

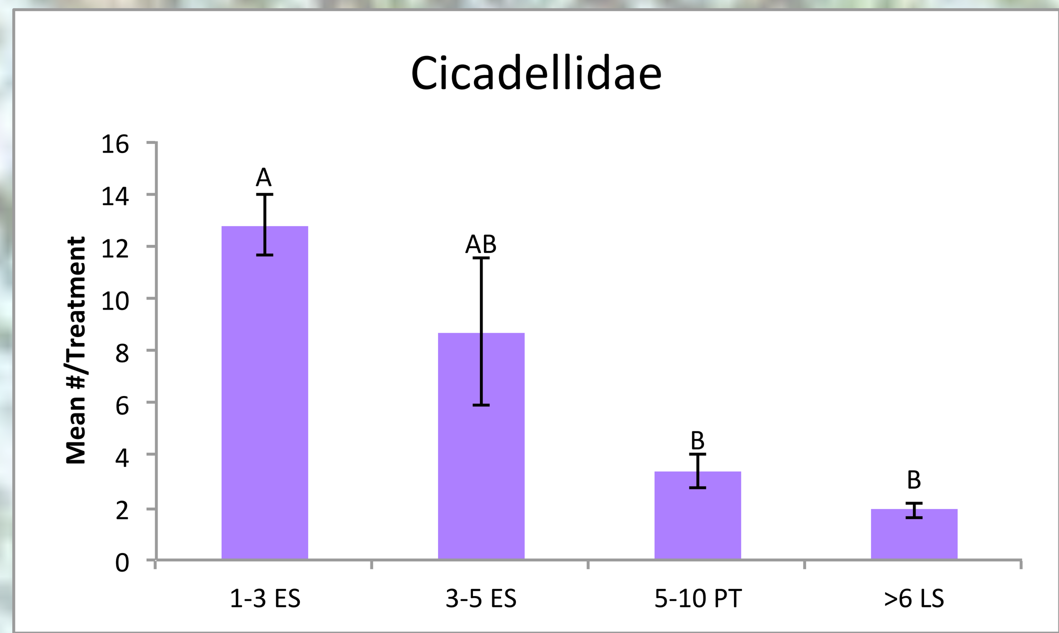


Figure 3. Mean number of Cicadellidae per treatment. A minimum of 23 species comprised this data set.

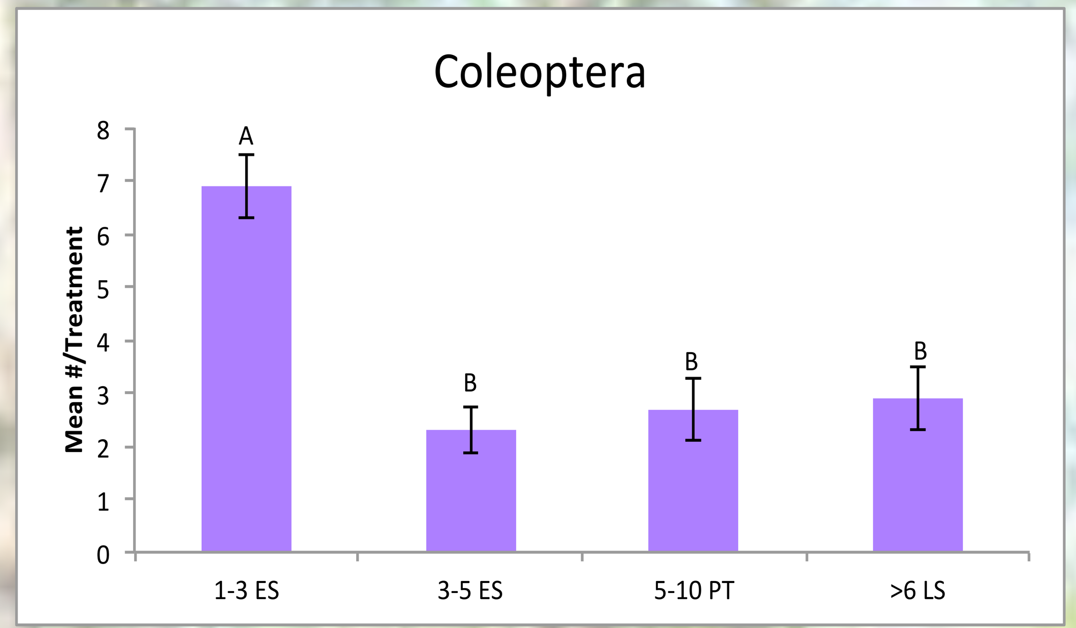


Figure 4. Mean number of Coleoptera per treatment. A minimum of 36 species comprised this data set.

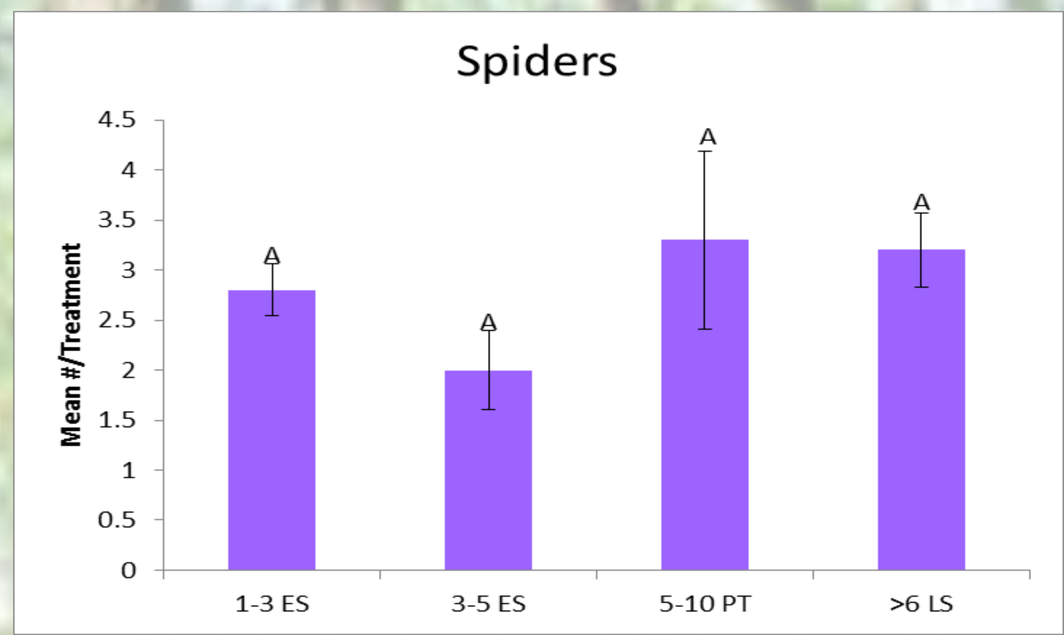


Figure 5. Mean number of Spiders per treatment.

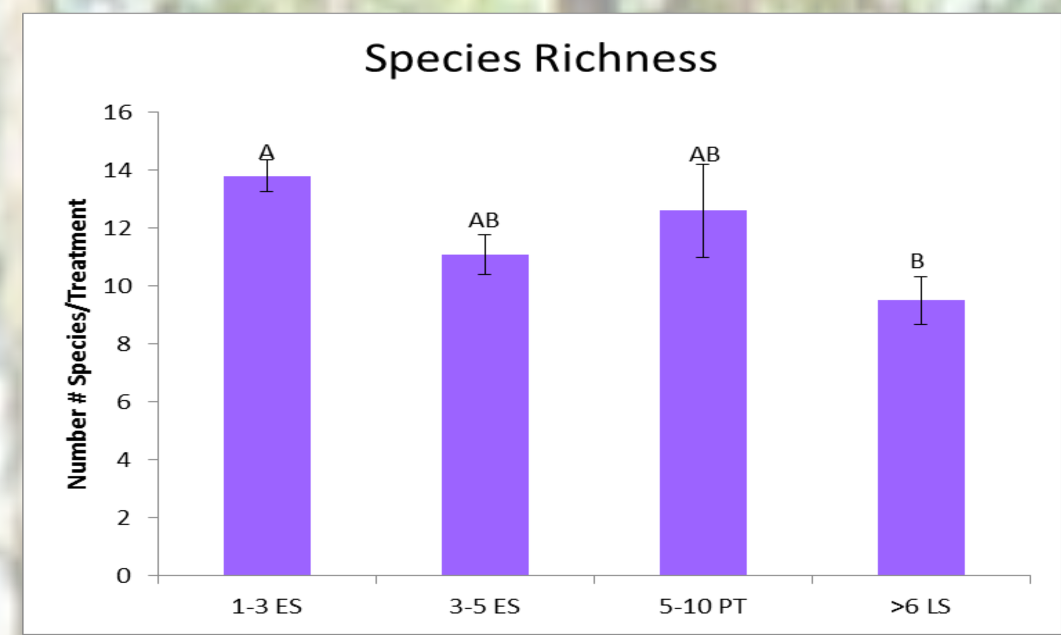


Figure 6. Mean number of species per treatment. A minimum of 196 morphospecies comprised this data set.

		1-3 yrs	3-5 yrs	5-10 yrs	>6 yrs
Homoptera		4.2 (.56) a	1.5 (.52) ab	3.3 (1.3) ab	1.7 (.31) b
	Cicadellidae	12.8 (1.2) a	8.7 (2.8) ab	3.3 (.63) b	1.9 (.31) b
	Cercopidae	4.4 (.70) a	2.1 (.46) ab	0.43 (.14) b	0.29 (.10) b
Hymenoptera		3.1 (.32) a	1.7 (.31) ab	5.3 (1.8) b	5.6 (1.5) b
Orthoptera		1.6 (.17) a	1.8 (.37) a	2.5 (.49) a	1.2 (.22) a
Diptera		3.7 (.66) a	3.1 (.81) b	10.0 (3.3) b	1.8 (.34) b
Coleoptera		6.9 (.60) a	2.3 (.44) b	2.7 (.60) b	2.9 (.59) b
Arachnids		2.8 (.26) a	2.0 (.39) a	3.3 (.89) a	3.2 (.37) a

Table 1. Mean number (+/-SE) of common arthropods collected per treatment. Different letters within each row indicate a significant difference ($p \leq 0.05$)

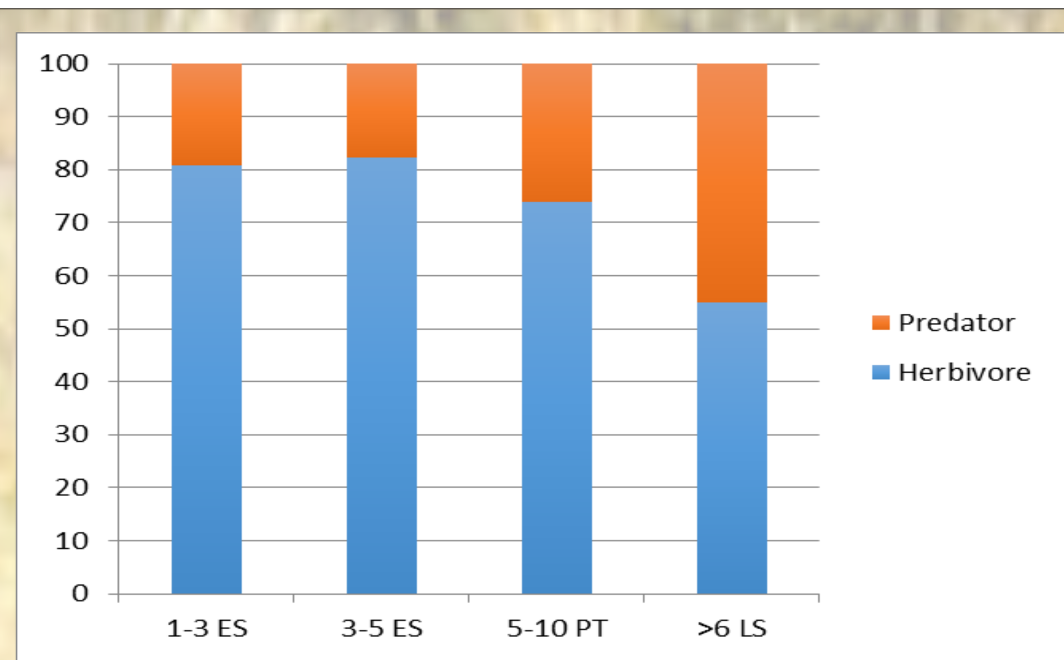


Figure 7. Mean percentage of herbivores and predators per treatment. Herbivores also included detrivores, fungivores, and pollinators. Predators also included parasites and parasitoids.

Figure 8. Pentatomidae species collected in study

Figure 9. Cicadellidae species collected in study.

Results

Overall, 7,720 arthropods were collected and classified (7,126 insects and 594 arachnids). The most common Family of insects was Cicadellidae (2,005 individuals, 26% of all samples), in which we collected a minimum of 23 species. The most common Family of spiders collected was Oxyopidae (185 individuals, 2.4 % of all samples). A minimum of 196 species were collected and analyzed during this study.

Cicadellidae abundance (Figure 3) was significantly greater in re-planted pines 1-3 years old than in those 5-10 years old and >6 years post-thin ($p \leq 0.0001$).

Coleoptera abundance (Figure 4) was significantly greater in re-planted pines 1-3 years old than in any other treatment ($p \leq 0.0001$).

Spider abundance (Figure 5) was not significant different in any treatment ($p = 0.38$).

Species Richness (Figure 6) was significantly greater in re-planted pines 1-3 years old than in those >6 years post-thin ($p = 0.0005$).

Orthoptera abundance (Table 1) was not significantly different in any treatment ($p = 0.11$).

Cercopidae abundance (Table 1) was significantly greater in re-planted pines 1-3 years old than in those 5-10 years old and >6 years post-thin ($p = 0.0005$).

Hymenoptera abundance (Table 1) was significantly greater in re-planted pines 1-3 years old than in those 5-10 years old and >6 years post-thin ($p = 0.019$).

Herbivore proportion (Figure 7) was greater than predator proportion in all four treatments, but decreased as the pines aged.

Discussion

Overall, ages and successional states of pines did affect arthropod abundance and species richness. Samples taken from pines 1-3 ES contained a greater number of arthropods and a greater number of species than any other treatment. Because the pines in this treatment are young, it is very easy for a myriad of species to colonize them. The branching of young pines is not very dense, thus making sunlight and other resources easily accessible for other plants and arthropod inhabiting the treatments. However, as pines grow, their branches become longer and more dense. This growth shades the understory, causing vegetation growth to slow. Because of this, many arthropods are less likely to inhabit later successional pine forests. This process decreased both the number of arthropods but also the species richness in the studied loblolly pine forests.

Because herbivore presence, such as Cicadellidae presence, decreased in late successional habitats, it was hypothesized that arachnids and other predators would follow the same pattern. However, statistically significant differences in arachnid abundance were not observed in any of the treatments. We think this is due to a decrease of understory vegetation, making prey easier to find. Although herbivore and overall insect abundance decreased as pines aged, spiders still had access to enough food to maintain a steady presence.

Acknowledgments

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