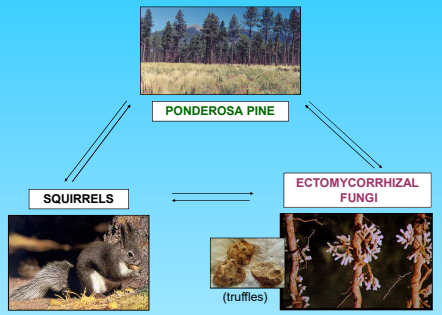
Ectomycorrhizal fungal responses to management practices in a southwest ponderosa pine forest

Kevin Beiler, Catherine Gehring, and Tad Theimer
Department of Biological Sciences, Northern Arizona University
Flagstaff, AZ 86001



Introduction

Ectomycorrhizal fungi (EMF) are a vital component of ponderosa pine forests because of their role as mutualists that assist plants in obtaining water and nutrients from the soil. Many species of EMF produce belowground (hypogeous) truffles or false truffles that are important food resources for mammals. The purpose of this study was to determine the effects of forest thinning and burning in northern Arizona on the EMF community and to infer potential impacts on tassel-eared squirrels (*Sciurus aberti*).

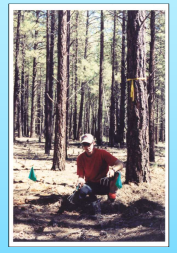
Research Questions

1) What are the effects of forest thinning and burning on **truffle production**?
2) What are the effects of thinning and burning on the **EMF community**?
3) How does thinning and burning affect tassel-eared squirrel **mycophagy** and foraging activities?

Study Site

We compared sites on the Coconino National Forest near Flagstaff, Arizona that were thinned and burned in 2000 (T/B) with adjacent sites that were not thinned or burned (controls: C). Thinning involved removal of trees such that 1.5 to 3 trees remained for every pre-settlement tree on the 40 acre plots. Two pairs of plots (T/B + C) were studied.


Thinned and burned (T/B)


Control (C)

Methods

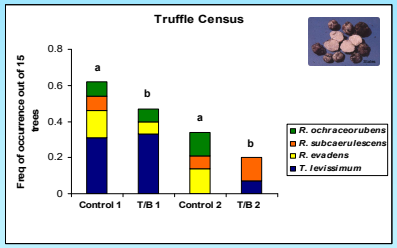
Truffle production: Hypogeous sporocarp (truffle) production was estimated by sampling 8 m^2 under 15 semi-randomly selected trees in each site using a truffle rake.

Ectomycorrhizal community: Tree roots tips were isolated from soil cores (1 core per tree, n= 15 at each site) and scored for presence of EMF and relative abundance of morphological types. Restriction Fragment-Length Polymorphism (RFLP) analysis was used to further define the EMF community, particularly the component of the community that produces truffles.

Squirrel response: Evidence of squirrel activity in the form of fall mycophagy (digs) and winter tree herbivory (clippings) was recorded along transects covering each site.

Results

Question 1) Truffle production: Both abundance and richness of truffles was lower in T/B forest sites than adjacent control sites. The bars below represent the frequency of occurrence of 5 species of truffles beneath 15 trees per plot.



Question 2) Ectomycorrhizal community: Control sites had greater EMF root tip abundance than T/B sites (Figure A), but had similar numbers of morphological types of EMF (Figure B). This suggests that all species may persist in T/B sites, but that low abundance may result in reduced truffle production by some species.

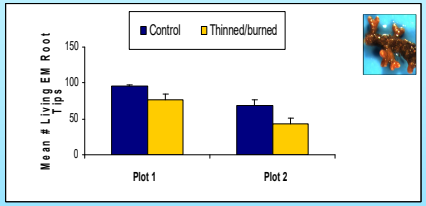


Figure A. Relative abundance of living ectomycorrhizal root tips from root cores collected in control versus thinned and burned sites. Control plots had significantly more EMF than thinned and burned plots at both sites ($P < 0.05$).

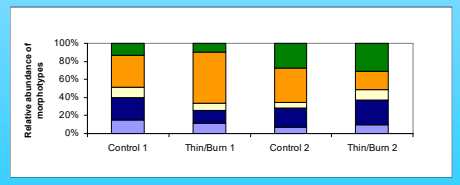
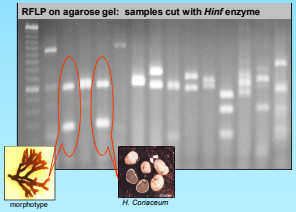


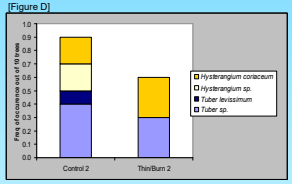
Figure B. Relative abundance of ectomycorrhizal morphotypes on control versus thinned and burned sites. Each color represents a different morphotype.

RFLP analysis linked ectomycorrhizal root tip morphotypes with known fruiting bodies of truffles, for example the genera *Hysterangium* and *Tuber* (Figure C). Three of four species showed the same pattern of reduced mycorrhizal abundance on treated plots as observed in the truffle collections (Figure D).

[Figure C]



[Figure D]



Question 3) Squirrel Response: Squirrels exhibit little or no digging activity in T/B forest sites consistent with reduced sporocarp production in these areas. Squirrels continued to use one of the T/B sites to clip twigs for consumption of the inner bark, but not the other.

Plot ID	*# Squirrel Digs*	*# Herbivory signs*
Control-1	11	4
Thin/Burn-1	1	6
Control-2	15	8
Thin/Burn-2	0	0

Conclusions

- Truffle productivity was lower in thinned and burned sites than control sites.
- Reduced productivity on treated plots may be explained by a decrease in ectomycorrhizal root tip abundance but not by a decrease in ectomycorrhizal species richness.
- The number of truffles recovered by tassel-eared squirrels as evidenced by dig sites reflected the lower abundance of truffles on thinned and burned sites. Given that truffles are an important component of the diet of these squirrels, thinning and burning could significantly reduce habitat quality by reducing mycorrhizal colonization and thereby reducing truffle abundance.

Acknowledgements

This project was funded by Hooper Undergraduate Research Award, NASA Space Grant, and the Gehring lab at NAU. Special thanks to Kris Haskins, Galena Nelson, Regina Alvarez, Melissa Dunseath, Craig Newsome, and Pete Fule for their assistance.

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NASA Space Grant at Northern Arizona University
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