Do Tip-up Mounds Provide a Refugia For Some Native Plants?

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ABSTRACT

Tip-up mounds are formed after wind storms blow down trees knockings them, leaving gaps in mature forest. In 2016 a severe windstorm caused large blow down areas resulting in many tip-up mounds. Since the opening from the gap increases sunlight it can encourage higher plant growth and unique diversity on tip-up mounds and in blow down gaps. I found on each three study sites some mounds differ from one another although. Most vegetation found on the tip up mounds we sampled are native only one plant species was non native yet each tip-up mound had their own unique biome. My hypothesis to find out if there is significant difference between vegetation on tip-up mound and undisturbed ground level vegetation was not supported. Using a nonparametric sign test we found a p-value of $p< 0.3438$ when comparing Shannon-Wiener diversity index of the plots. The results shown there is no significant relationship between two communities on top of tip-up mound and undisturbed ground level. However, some species showed significant differences between the top communities and the ground community (*Acer saccharum*: $p < 0.016$; ferns: $p<0.0625$; *Rubus idaeus*: $p<0.0156$).

INTRODUCTION

Tip-up mounds result from wind throws causing trees to lose anchorage from the ground therefore exposing roots. This natural disturbance effect in forests creates gaps for shade intolerant species allowing sunlight to penetrate the forest floor on to uproot blowdown tree. Some but not tip up mounds will host new seedling or sapling; these seeds may give rise to many of the pioneers colonizing the disturb soil(Putz, 1983) such species I found on tip up mounds are Rubus idaeus, Sambucus racemosa, and Galeopsis tetrahit. Mounds are elliptical for the most

part (Lyron and Mclean, 1966) with the amount of roots vary depending diameter and height of trees

Species that rapidly become established on soil disturbed by uprooted trees are generally abundant but are in the seed bank waiting for a disturbance event (Putz, 1983). The tip-up mounds serve as refugia for communities of browse preferred species. These areas provide protection from browse by White-tail deer (*Odocoileus virginianus*), and Snowshoe Hare (*Lepus americanus*) because these species can not get on top of the mounds and only browse on understory vegetation. *Rubus idaeus* and *Sambucus racemosa* where mostly abundant on many of tip-up mounds on each around three locations I had conducted my study. Previous studies of tip-up mounds suggest that they can provide refugia to plants preferred to herbivores (Spicer, 2018). This can allow different vegetation communities to form on top of tip-up mounds

METHODS

The area on top of tip-up mounds was equal in area to plots sampled on the forest floor. The total of thirteen control sites were chosen randomly from a 360 degrees around the tip-up mounds with measured distance of two meters from the mound.Using only observation I made estimates for vegetation coverage. Many plots were elliptical in shape. The reason for this specific measurement is due in part to the top of tip-up mounds having width that is usually one meter or less and it provided maximum area to sample. Carefully measuring each mound because the soil can be fragile or unstable and did not want disturb any vegetation or seedling they may germinate in the future. Photographs were taken at each site and undisturbed ground level. To aid to in coverage estimations. The ground was dominated by two species *Acer saccharum* and *Fraxinus pennsylvanica* on some sites yet only *Rubus idaeu*s was only found on top of mounds.

Although I found seeds they had not germinated therefore was not able to ID them. Shannon-Wiener Diversity Index was use to find significance to determine the if there was relationship between the top and ground.

RESULTS

My data was not normally distributed (Shapiro-Wilkes $p < 0.00234$). I ran a non-parametric sign test on species cover (*Acer saccharum* $p < 0.01563$, $\mu_{top}=0$, $SE_{top}=0$, $\mu_{ground}=0.1338$, $SE_{grouhd}=0.06247$; Fern $p < 0.0625$,$\mu_{top}=0$, $SE_{top}=0$, $\mu_{ground}=0.1769$, $SE_{grouhd}=0.08409$.;*Sambucus racemosa* $p < 0.50$, $\mu_{top}=0.03077$, $SE_{top}=0.0237$, $\mu_{ground}= 0$, $SE_{grouhd}= 0$; *Galeopsis tetrahit* $p < 0.2187$, $\mu_{top}=0.07846$, $SE_{top}=0.05053$, $\mu_{ground}=0.0476$., $SE_{grouhd}=0.02392$; *Fraxinus pennsylvanica* $p < 0.250$, $\mu_{top}=0$, $SE_{top}=0$, $\mu_{ground}=0.05153$, $SE_{grouhd}=0.03381$; *Ilex verticillata* $p < 0.5$, $\mu_{top}=0.0192$, $SE_{top}=0.01332$, $\mu_{ground}=0$, $SE_{grouhd}=0$; *Rubus idaeus* $p < 0.0156$$\mu_{top}=0.1523$, $SE_{top}=.0561$, $\mu_{ground}=0$, $SE_{grouhd}=0$; *Ostrya virginiana* $p < 1.0$, $\mu_{top}=0$, $SE_{top}=0$, $\mu_{ground}=0$, $SE_{grouhd}=0$; *Fallopia scandens* $p < 0.6250$, $\mu_{top}=0.07307$, $SE_{top}=0.0410$, $\mu_{ground}=0.01153$, $SE_{grouhd}=0.01153$; Figure 1).

I ran a non-parametric sign test on Shannon-Weiner Diversity Index values for each plot ($p < 0.3438$,$\mu_{top}=o.4371$,$SE_{top}=0.1018$, ,$\mu_{ground}=0.2304$, $SE_{grouhd}= 0.1111$)

I ran all statistical tests using SYSTAT Ver. 13

DISCUSSION

The comparison of Shannon-Wiener Indexes on each site had no significant relationship in vegetation communities. This means that vegetation communities between top of tip-mounds and ground plots are statistically the same as one another. However, we found each tip-up mound

had different communities of species on top of mounds and ground there were statistical difference for three. Two species were significantly higher on ground plots and one species higher on tip-up mound plots.

Some tip-up mounds had to be excluded from the study due to the factors of lacking vegetation, the mound being weather heavily, bumble bees inhabiting the mound, or the ground being frequently flooded in some site areas. Some mounds had little or no vegetation. Over time mounds will begin to be eroded by weather which may explain some mounds low vegetation coverage.Tip-up mound also often provide habitat to other species which I observed during my study I found frogs, ants, snakes, and birds. I had noted that on tip-ups there is a seed bank and when taking a closer look there are numerous seeds buried or seen on the surface of mounds. These seeds will provide future vegetation communities. Other aspects that may affect the vegetation communities may be plants preferred by herbivores. Species such as *Sambucus racemosa*, *Rubus idaeus*, and *Acer rubrum* are often browsed heavily. Tip-up mounds may provide an area of refugia for species such as these. I recommend the tip-up mounds serve as a long term study for another individual who could create control plots using cages around the tip up mound to study the effects undisturbed vegetation communities with protection from certain species that may browse around the mounds.

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REFERENCES

Rich R L, Frelich L E, and Reich P B. 2007. Wind-throw mortality in the southern boreal forest: effects of species, diameter and stand age. *Journal of Ecology,* 95:1261-1273.

Peterson C J, and Leach A D. 2007. Salvage logging after windthrow alters microsite diversity, abundance and environment, but not vegetation. *Forestry*, 81(3).

Putz F E. 1983. Tree Falls pits and mounds, Buried seeds, and the importance of soil disturbance to pioneer trees on Barro Colorado Island, Panama. *Ecology,* 64(5):1069-1074.

Long Z T, Carson, W P, and Peterson, C J. 1998. Can disturbance create refugia from herbivores: An example with Hemlock regeneration on treefall mounds. *Journal of the Torrey Botanical Society,* 125(2):165-168.

Plotkin A B, Schoonmaker P, Leon Bt, and Foster D. 2017. Microtopography and ecology of pit-mound structures in second verus old growth forests. *Forest Ecology and Management*, 404: 14-23.

Lyford W H and McLEAN D W. 1966. Mound and pit microrelief in relation to soil disturbance in New Brunswick, Canada. *Harvard Forest Paper*. No.15.

Kern C C, Burton J I, Raymond P, D'Amato A W, Keeton W S, Royo, A A, Walters, M B, Webster C R, and Willis J L. 2016. Challenges facing gap-based silviculture and possible solutions for mesic northern forests in North America. *Forestry*, 90:4-17.

Poznanovic S K, Webster, C R, and Bump, J K. 2013. Maintaining mid-tolerant tree species with uneven-aged management: 9-year results from a novel group-selection experiment. *Forestry*, 86:555-567.

Spicer M E, Suess K F, Wenzel J W, and Carson W P. 2018. Does salvage logging erase a key physical legacy of a tornado blowndown? A case study of tree tip-up mounds. *Canadian*

Journal of Forest Research, 48(999):1-7.

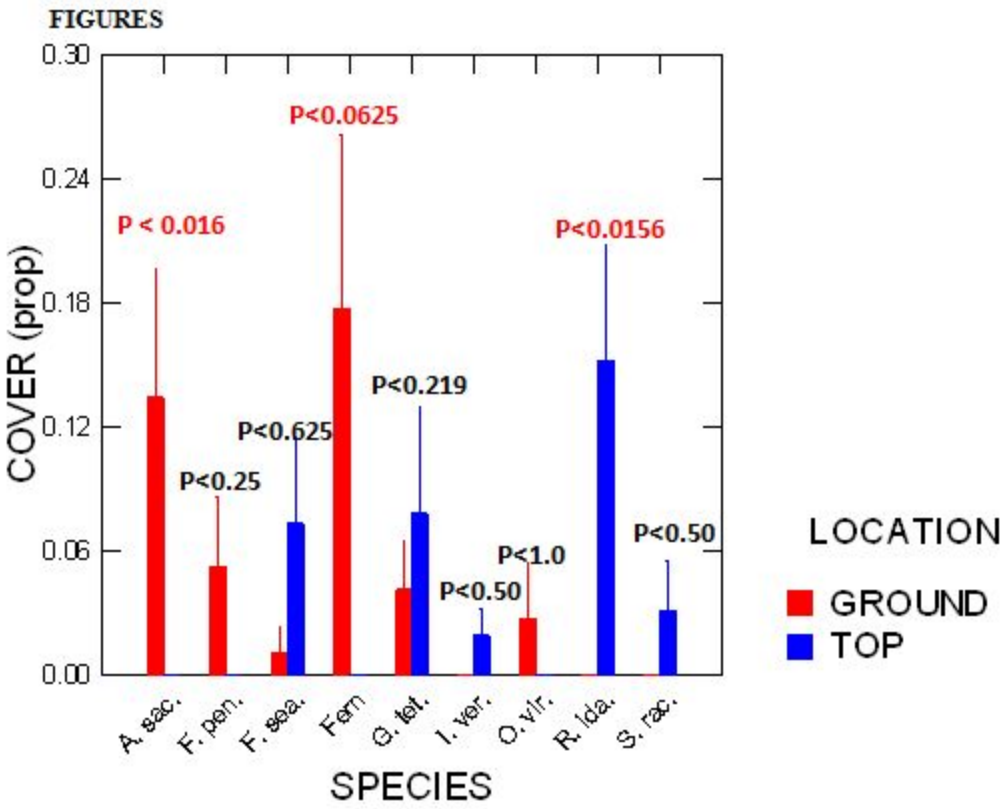

Figure 1. Show the comparison of 9 species of plants between top and ground. 3 species show significant differences in abundance between the two locations.

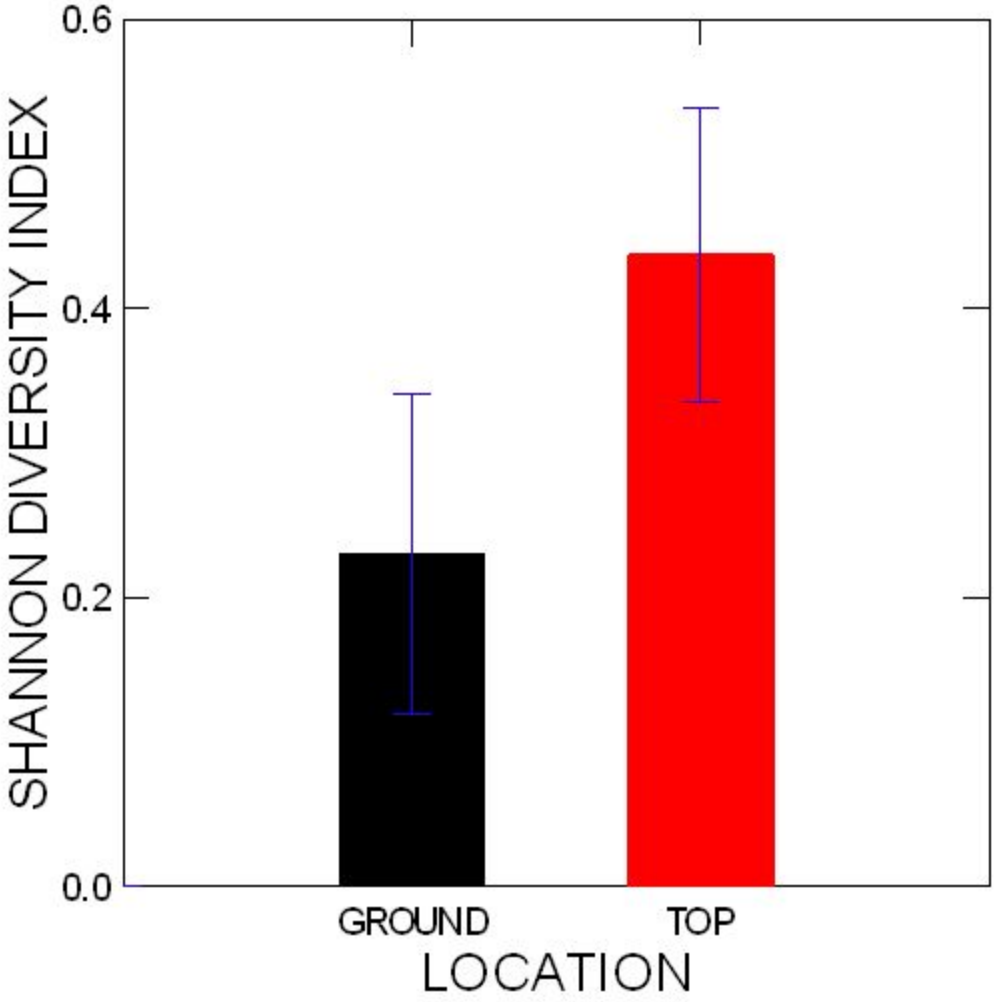

Figure 2. Results show no significant relationship between top and ground vegetation ($p < 0.3438$).