SPECIAL SESSION: Northern Hardwoods Silviculture Experiment to Enhance Diversity (NH-SEED)

Clearcuts Drive Dissimilar Small Mammal Assemblages in Northern Hardwood Forests

Jared D. Wolfe, Breanna R. Gusick, Kristin E. Brzeski, and Yvette L. Dickinson[1]

Composition and diversity of small mammal communities are sensitive to bottom-up effects where variation in vegetative structure, climate, and microclimates affect the food resources upon which small mammals depend (Pinotti et al. 2011). Sensitivity to changes in forest structure reflect the close trophic linkages between herbivorous, granivorous, and insectivorous small mammals and the surrounding vegetation they use as food resources and cover (Niedziałkowska et al. 2010). Subsequent variation in small mammal community structure and abundance can result in cascading effects on carnivores, such as fisher (*Pekania pennanti*) and American marten (*Martes americana*), two forest dwelling carnivores valued by trappers throughout the Midwest (Buskirk and McDonald 1989). Given the role of small mammals in supporting a functional forest ecosystem, understanding how different silviculture prescriptions and subsequent changes in vegetative structure affect small mammal community assemblage is an important step toward sustainable forest management. Renowned for its forested and working landscapes, Michigan's Upper Peninsula is 72 percent forested, dominated by northern hardwood forest, with a third of the land privately owned by individuals and families. Coupled with natural disturbances (e.g., fire, winter, windthrow), the patchwork of private ownership across the Upper Peninsula of Michigan has created a heterogenous landscape where conflicting objectives of timber extraction and maintenance of wildlife habitat affect a diversity of mammalian species. Forests in the Upper Peninsula hosts 23 species of volant and nonvolant mammals, including shrews, moles, voles, mice, rats, lemmings, chipmunks, and squirrels.

The diversity of small mammals in the Upper Peninsula represents a collection of dissimilar life history strategies and ecological guilds that support a variety of ecosystem functions. To determine how different forest management strategies affect small mammals in the Upper Peninsula, we captured small mammals across multiple experimental silvicultural treatments at the Northern Hardwood Silvicultural Experiment to Enhance Diversity (NH-SEED) experimental forest located at the Ford Center and Forest, in Michigan's Upper Peninsula. As of 2019, the NH-SEED included the following four silviculture canopy prescriptions: clearcut (n = 9 sites), single-tree selection (n = 9 sites), shelterwood-high residual (n = 18 sites), and shelterwood-low residual (n = 18 sites). Each treatment was divided into three levels of site preparation treatments, encompassing approximately 15 ha each—control (n = 18 sites), scarification (n = 18 sites), and artificial tip-up (n = 18 sites)—for a total of 54 sites. At each site, four Sherman traps (H.B. Sherman Traps, Inc., Tallahassee, FL) were deployed, in which two traps were placed in the center of the site, and two additional traps placed 25 m due north from the center of the site. Each trap was baited with peanut butter and sunflower seeds and provisioned with batting for warmth. Our goal was to determine how specific silviculture techniques increased, or diminished, small mammal richness. Additionally, we aimed to measure how silviculture techniques shifted patterns of small-mammal community structure.

[1] Assistant Professor (JDW), Graduate Student (BRG), Assistant Professor (KEB), and Silvicultural Scientist (YLD), Scion (New Zealand Forest Research Institute Ltd), Rotorua, New Zealand. JDW is corresponding author: to contact, call 262-443-6866 or email jdwolfe@mtu.edu.

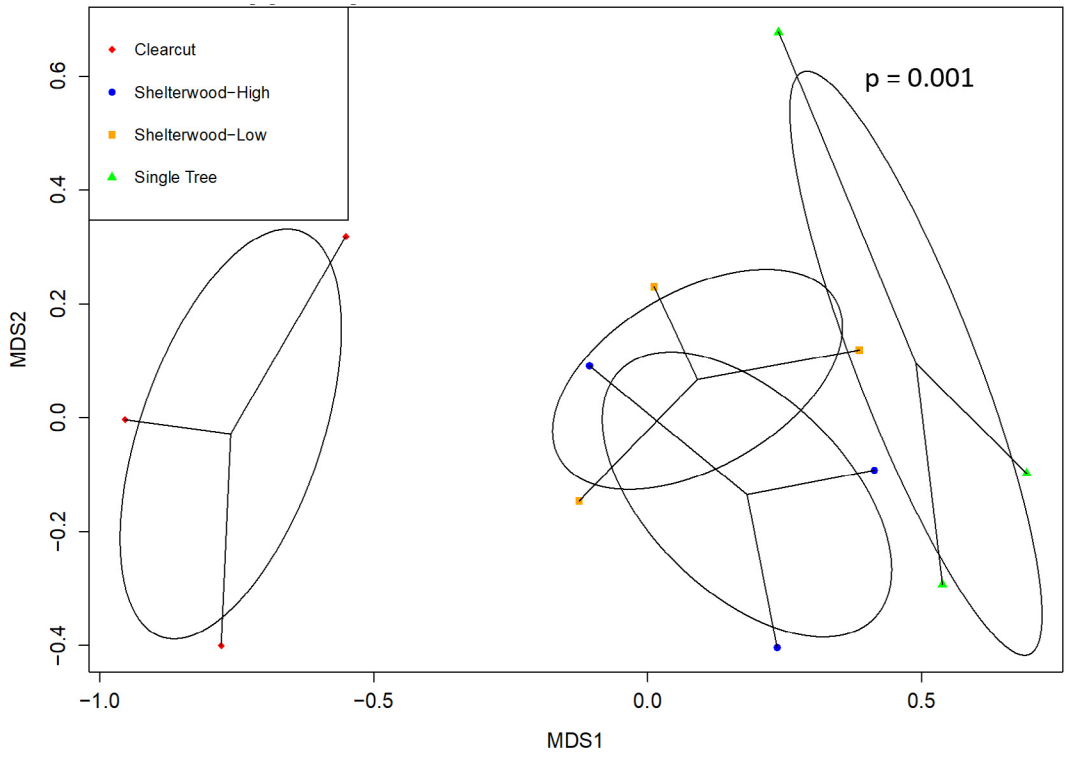

Figure 1.—NDMS ordination demonstrating differences in small mammal community structure based on 129 individual captures, representing 11 different small mammal species, in four different experimental canopy treatments at NH-SEED experimental forest, Alberta, MI.

A total of 525 animals (including 129 recaptures), representing 11 species, were captured at the NH-SEED during 1387 trap nights, between June through September of 2019. The four most captured small-mammal species were the southern red-backed vole (*Myodes gapperi*, n = 150), white-footed mouse (*Peromyscus leucopus*, n = 131), deer mouse (*Peromyscus maniculatus*, n = 128), and meadow-jumping mouse (*Zapus hudsonius*, n = 38); all of which were marked or tagged. Of the recaptured mammals, *P. leucopus* had 66 recaptures, *P. maniculatus* had 50 recaptures, *M. gapperi* had 13 recaptures, and Z. *hudsonius* had zero recaptures. Small mammal community composition was assessed across canopy and site preparations using nonmetric multidimensional scaling (NMDS) ordinations (Fig. 1). Based on a bootstrapping analysis, we found no statistically significant difference between small mammal community assemblage across site preparation treatments (p = 0.702); however, we did find that canopy preparation had a significant effect on community assemblage (p = 0.001), with clearcut and single-tree selection treatments driving variation among communities. Species richness was estimated by rarefaction and extrapolation for sample-based incidence data. Across canopy preparations, clearcut treatments had the greatest estimated number of species with 10.84 (± 1.46 SD) and single-tree selection treatments had the lowest estimated species with 7.86 (± 1.42 SD). Estimated species richness across site preparations was 11.21 (± 1.33 SD) throughout scarification treatments and 9.06 (± 0.70 SD) within tip-up treatments (Fig 2). Our results suggest that clearcuts result in species rich mammal communities that are significantly different than those treatments that maintain variable amounts of canopy cover. This probably reflects stark differences in vegetative structure and microclimate conditions that exclude some forest-obligate mammal species, while creating niche space for generalists and nonforest species. Given substantial variation in community composition across canopy treatments, maintaining a diversity of forested stands with variable amounts of canopy cover across the landscape is necessary to optimize small mammal diversity. This "diversity of diversity" forest management strategy may represent an important consideration when managing for diverse assemblages of small mammals, and the forest carnivores that depend on them.

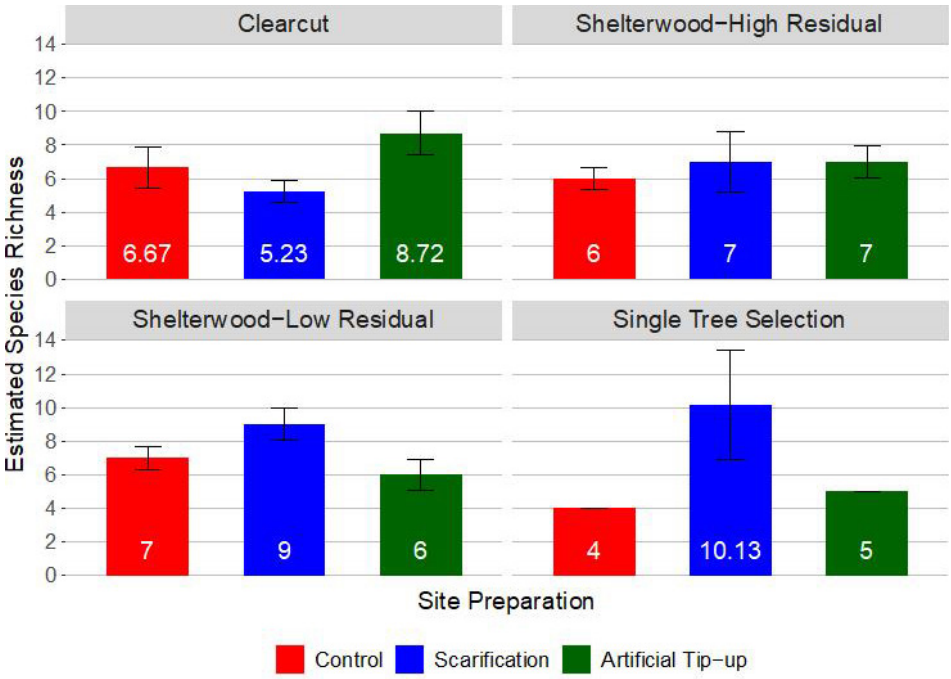

Figure 2.—Estimated species richness, based on rarefaction, of small mammal communities captured in 12 different experimental silviculture treatments at NH-SEED experimental forest, Alberta, MI.

LITERATURE CITED

Buskirk, S.W.; McDonald, L.L. 1989. **Analysis of variability in home-range size of the American marten.** Journal of Wildlife Management. 53(4): 997–1004. https://doi.org/10.2307/3809601.

Niedziałkowska, M.; Kończak, J.; Czarnomska, S; Jędrzejewska, B. 2010. **Species diversity and abundance of small mammals in relation to forest productivity in northeast Poland.** Écoscience. 17(1): 109–119. https://doi.org/10.2980/17-1-3310.

Pinotti, B.T.; Naxara, L; Pardini, R. 2011. **Diet and food selection by small mammals in an old-growth Atlantic forest of south-eastern Brazil.** Studies on Neotropical Fauna and Environment. 46(1): 1–9. https://doi.org/10.1080/01650521.2010.535250.

The content of this paper reflects the views of the author(s), who are responsible for the facts and accuracy of the information presented herein.

CITATION: Wolfe, Jared D.; Gusick, Breanna R.; Brzeski, Kristin E.; Dickinson, Yvette L. 2023. **Clearcuts Drive Dissimilar Small Mammal Assemblages in Northern Hardwood Forests.** In: Kern, Christel C.; Dickinson, Yvette L., eds. Proceedings of the first biennial Northern Hardwood Conference 2021: Bridging science and management for the future. Gen. Tech. Rep. NRS-P-211. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station: 213–215. https://doi.org/10.2737/NRS-GTR-P-211-paper43.