Implications of silvicultural disturbance in Appalachian forests: Results from the Southern Appalachian Silviculture and Biodiversity (SASAB) project

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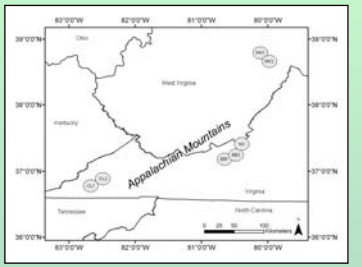
Conserving and sustaining Appalachian forests requires understanding how management activities and altered disturbance regimes affect a suite of biotic and abiotic ecosystem components. Since 1993, we have been investigating the effects of seven silvicultural oak-regeneration methods (which represent a disturbance gradient from uncut control to silvicultural clearcut) on vascular plant diversity, salamander populations, tree regeneration, and soil resource availability in a replicated experimental design within the mountains of Virginia and West Virginia.







FLORAL DIVERSITY

We have monitored species richness at three nested spatial scales before treatment application, one year after, and 9-12 years after application to understand how many and which species responded positively or negatively to disturbance.

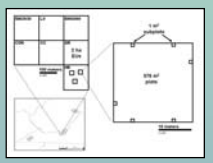
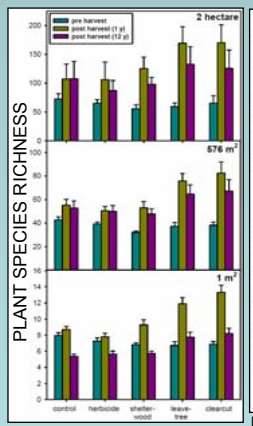



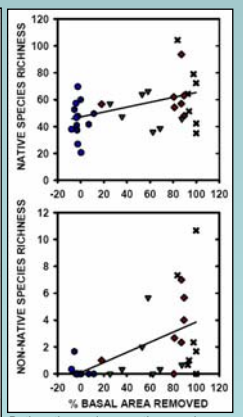
Figure above shows the vegetation sampling design to monitor floral diversity.

RESULTS

Plant diversity initially increased with disturbance intensity through colonization and invasion by native and non-native species and tended to decrease 10 years after treatment application and following canopy closure.



Species richness across five treatments and through time at three scales



Both native and non-native species richness increased with disturbance intensity following timber harvesting ($P \leq 0.01$). Symbols represent treatments: uncut control (blue circles) through clearcut (×).

For more information please visit the project website: **http://www.fw.vt.edu/fisheries/haas/**

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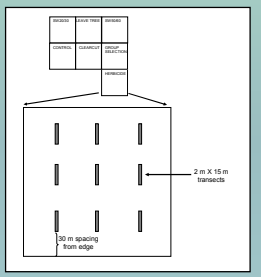
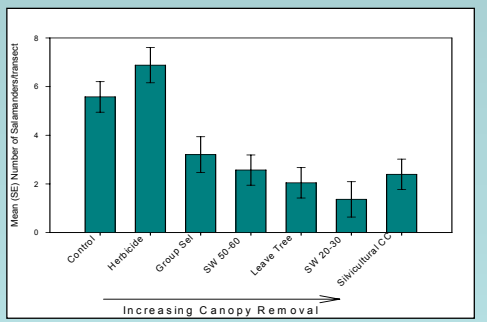
TERRESTRIAL SALAMANDERS

Terrestrial salamanders serve important roles in forested ecosystems, including as high-quality prey for a variety of birds, mammals, and reptiles and as a top-predator in the detrital environment. Since 1994, we have estimated the relative abundance of terrestrial salamanders at 6 study sites.



We estimated relative abundance of salamanders on randomly selected transects with area-constrained counts on warm rainy nights, spring-fall.

RESULTS: Initial results indicated that the relative abundance of terrestrial salamanders was lower in all silvicultural treatments that disturbed the canopy (group selection through silvicultural clearcut). Our current research focuses on estimating the length of time until salamander populations rebound to pre-harvest levels and understanding the factors (e.g., habitat, prey, population demography) that may be limiting recovery.



Differences in the relative abundance of terrestrial salamanders among silvicultural treatments are long-term, and persisted up to 13-years post-harvest. In general, relative abundances remain lower in treatments with canopy disturbance, which are currently at 40-60% of pre-treatment abundance.

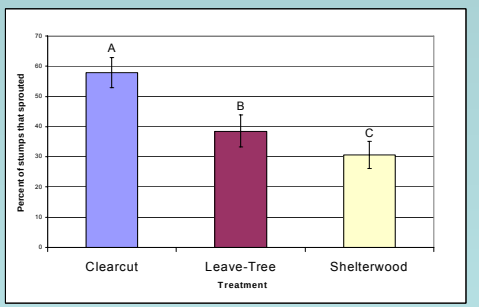
OAK REGENERATION

Partial harvesting systems, such as the shelterwood and leave-tree systems, have become common alternatives to clearcutting in southern Appalachians forests. However little is known about the stump sprouting of oaks following alternative harvesting systems. Stump sprouts are a very important source of oak regeneration in this area. This investigation looked at stump sprout regeneration differences between the clearcut, leave-tree, and shelterwood treatments at all seven sites.


Aerial photo showing tree plot location within the three treatment blocks 9 years post harvest (left). Photo taken immediately after treatments were implemented showing the difference between the (1) clearcut and the (2) shelterwood (right).

RESULTS

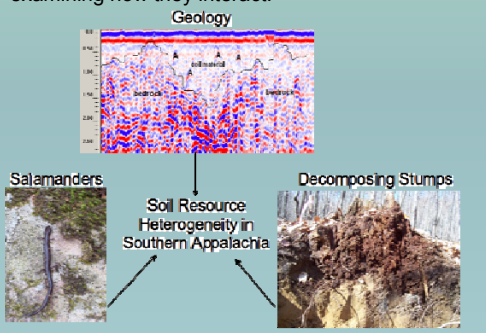
Oaks showed a significant decline in stump sprouting as residual basal area increased (below). Percent sprouting in the clearcut (58%) was higher ($p<.01$) than sprouting in both the leave-tree (39%) and the shelterwood (31%). Sprouting in the leave-tree also was higher ($p=.025$) than in the shelterwood.



Average percent of oak stumps that sprouted as affected by silvicultural treatment. Bars with different letters are significantly different (α=0.05; n=1575).

SOIL NUTRIENTS

Soil nutrient availability varies both temporally and spatially. In southern Appalachia, there are three factors that contribute substantially to this heterogeneity: 1) decomposing stumps, 2) salamanders and 3) geology. Three extensive research projects have been developed to determine how these three factors affect soil resource heterogeneity independently as well as examining how they interact.



The objective of these projects include: 1) quantifying the total amount of soil volume occupied by decomposing stumps and determining the contribution of decaying stumps to overall soil nutrient availability and total soil nutrient pools, 2) use ^{15}N labeled leaf litter to trace and quantify potential salamander-mediated effects on N-cycling dynamics, and 3) use ground-penetrating radar (GPR) to determine total soil volume and soil depth.

RESULTS

Decomposing stumps occupy about 1.2% of the total soil volume (A- and B-horizons only), but account for 27% and 37% of the total nitrogen and carbon, respectively.

	Soil Volume ($m^3 ha^{-1}$)	Total Contribution Soil Volume	Total Contribution Total N	Total Contribution Total C
A- Horizon	1125	13.5%	9.6%	6.4%
B-Horizon	7100	85.3%	63.4%	57.1%
Decomposed Stumps	103	1.2%	27.0%	36.5%