

SOIL CHEMICAL CHANGES ON TWO FORESTED WATERSHEDS IN WEST VIRGINIA WITH TIME AND ACIDIFICATION TREATMENT

Mary Beth Adams¹

Abstract.—Forest soil chemistry remains one of the least understood components of most ecosystem studies. This presentation describes exchangeable soil nutrient concentrations on two forested watersheds on the Fernow Experimental Forest in West Virginia. These two gauged watersheds, both containing stands of deciduous Appalachian hardwoods, form the backbone of the Fernow Watershed Acidification Study, which was initiated in 1989. Ammonium sulfate ($[\text{NH}_4]_2\text{SO}_4$) fertilizer has been applied to one of these watersheds at a rate of 35.5 kg N/ ha and 40.5 kg S/ ha since 1989. The second watershed, which supports an older stand (~100 years old) of mixed hardwoods, serves as the reference watershed for this study. Soils were sampled in 1994, 2002, and 2010 and were analyzed for chemical constituents. Significant changes in soil chemical properties were not detected after 12 years of treatment, and changes in soil chemistry at 21 years were also ambiguous. Hypotheses related to soil acidification are discussed and evaluated in light of the long-term data. Ancillary data on foliar nutrients and growth rates of trees are also included in this analysis.

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

¹Research Soil Scientist, U.S. Forest Service, Northern Research Station, P.O. Box 404, Parsons, WV 26287. To contact call 304-478-2000 or email mbadams@fs.fed.us.

RELATIONSHIP OF MINERAL STAIN IN RED OAK TO GROWTH SITE VARIABLES

Brian H. Bond and Lyn M. Resler¹

Abstract.—The presence of mineral stain in red oak (*Quercus rubra*) significantly reduces the value of the forest products that contain it. Mineral stain is also associated with reductions in the quality of the material. Although poor site quality has been cited as a probable cause of mineral stain in red oak, little is known about the specific site variables associated with site quality and high mineral stain severity. The goal of this study is to better understand environmental, geographic, and spatial correlates of mineral stain in red oak at eight study sites throughout the Appalachian Mountains of Virginia and West Virginia. Specific objectives were to (1) characterize the presence and severity of mineral stain in red oak trees at selected study sites, and among geographic locations; (2) determine the strongest site quality correlates (e.g., slope aspect, soil moisture, harvesting history) of mineral stain in red oak using field sampling and geospatial techniques; and (3) develop a model to predict mineral stain in red oak. Geographic and growth site factors were selected through a literature search and a survey of foresters who purchased stands for harvesting. Then, the presence and severity of mineral stain in red oak were sampled at eight locations and correlated to growth site variables collected in the field and derived from spatial datasets. A statistical model was developed to predict mineral stain presence. It was determined that elevation, slope angle, solar radiation, flow accumulation, and cardinal direction contribute the most to the presence or absence of mineral stain in red oak for the sites studied. The values of the model coefficients suggest that the probability of staining is highest when the tree is on a relatively flat part of the ground, which receives more water and little sunlight to evaporate the moisture. Although our model does explain a large amount of the important variables related to the presence and absence of mineral stain, it is clear that some important variables were not included or that some variables measured did not contain enough contrast to provide a clearer picture of their contribution.

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

¹Associate Professor (BHB), Virginia Tech University, Department of Wood Science and Forest Products, 1650 Research Center Drive, Blacksburg, VA 24061; and Associate Professor (LMR), Virginia Tech University. BHB is corresponding author: to contact, call 540-231-8752 or email at bbond@vt.edu.

POTENTIAL FOR APPALACHIAN HARDWOOD PRODUCT UTILIZATION IN AFFORDABLE HOUSING PROJECTS

David B. DeVallance, Shawn T. Grushecky, and Greg Estep¹

Abstract.—The emerging green building sector has potential for becoming a significant market opportunity for Appalachian hardwood manufacturers. The amount of harvested and utilized Appalachian hardwoods will be impacted by the amount of hardwood products produced for green building projects. The affordable housing sector in the United States represents an important market for wood products. Many states, cities, and nonprofits are encouraging, and in many cases requiring, the use of green building practices under their affordable housing and financial incentive programs. Many of these green building practices differ from nationally recognized green building programs (e.g., Leadership in Energy and Environmental Design [LEED], National Association of Home Builders [NAHB]). Furthermore, there is little information related to how wood products, specifically those manufactured from Appalachian hardwoods, fit within the context of the varying green building incentive programs. The purpose of this study was to evaluate the use of green certified and noncertified wood materials in affordable housing projects within Central Appalachia. A randomized sampling method was used to select builders to survey within the region. Additionally, members of the Federation of Appalachian Housing Enterprises (FAHE) were surveyed separately. We report findings related to what type of green certified and noncertified wood products are used in affordable housing projects within Central Appalachia and will report on builders' perceptions of the local availability of certified wood products.

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

¹Assistant Professor (DBD), and Assistant Director (STG), West Virginia University, Appalachian Hardwood Center, Morgantown, WV 26505; and Graduate Research Assistant (GE), West Virginia University, Division of Forestry and Natural Resources. DBD is corresponding author: to contact, call 304-293-0029 or email at david.devallance@mail.wvu.edu.

SILVICULTURAL OPTIONS FOR FORESTS THREATENED BY HEMLOCK WOOLLY ADELGID (*ADELGES TSUGAE*)

Mary Ann Fajvan¹

Abstract.—Eastern hemlock (*Tsuga canadensis* [L.] Carr) is a common component of central hardwoods forests. Because hemlock tolerates low light, overstocked stands are common. The hemlock woolly adelgid (*Adelges tsugae*) (HWA), is a nonnative invasive insect that feeds on eastern hemlock. Currently, HWA is established in 17 states and is causing tree decline and wide-ranging mortality. Crown variables such as live crown ratio and crown density and transparency are accurate predictors of hemlock decline; more vigorous trees appear to be less vulnerable to HWA. We are experimentally applying silvicultural thinnings in stands prior to HWA invasion, as a means for improving crown vigor and increasing hemlock survival. Treated stands are located in the northern portion of eastern hemlock's range, where winter temperatures, combined with introduced biocontrols, may reduce the impacts of HWA. Current management guidelines recommend that thinning operations should remove at least 6 to 7 m²/ha of basal area; however, if stands are overstocked, basal area removal should not exceed more than one-third of the total in any given operation. This presentation will report the changes in post-thinning stand structures resulting from modifications of current guidelines. Five-year growth response of hemlock crop trees will be reported for three Pennsylvania stands.

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

¹Research Forester, U.S. Forest Service, Northern Research Station, 180 Canfield St., Morgantown, WV 26505. To contact, call 304-285-1575 or email at mfajvan@fs.fed.us.

DEVELOPMENT OF RED MAPLE REGENERATION 10 YEARS POST-HARVEST

Songlin Fei and Kim C. Steiner¹

Abstract.—Red maple (*Acer rubrum* L.) is becoming increasingly dominant in forest stands throughout the eastern United States. To investigate the reasons for the increase, we examined the development of red maple and oak (*Quercus* spp.) seedlings and stump sprouts following the harvest of oak-dominated stands. We monitored 5,692 plots in 52 mixed-oak stands before harvest and 1 yr, 4 yr, 7 yr, and 10 yr after harvest across Pennsylvania. Through stump sprouts alone, red maple fully recaptured the amount of growing space it had previously occupied in the overstory 7 years after harvest. Red maple surpassed all oaks combined in rapid site capture through both seed-origin and sprout-origin regeneration. Red maple's superior ability to regenerate by sprouts is particularly favored by timber harvesting following a history of management and disturbance regimes that permit the accumulation of suppressed, small-diameter red maple stems. Among the events and processes that promote stand conversion, timber harvesting may be the major proximal cause of the widespread, increasing dominance of red maple.

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

¹Assistant Professor (SF), Purdue University, Department of Forestry and Natural Resources, 715 West State St., West Lafayette, IN 47907; and Professor (KCS), Pennsylvania State University, Department of Ecosystem Science and Management. SF is corresponding author: to contact, call 765-496-2199 or email at sfei@purdue.edu.

A GUIDE FOR MATCHING OAK SPECIES WITH SITES DURING BOTTOMLAND RESTORATION

David C. Mercker¹

Abstract.—Over the past several decades, federal incentive programs have encouraged the restoration of bottomland forests throughout the West Gulf Coastal Plain and the Lower Mississippi Alluvial Valley. Programs such as the Conservation Reserve Program and the Wetlands Reserve Program have been marginally successful (Stanturf et al. 2001). Foresters and contractors often follow conventional tree planting procedures that are well established for upland sites, but prove problematic in bottomlands. High water tables, soil drainage and compaction, overland flooding, and diverse soil properties make species selection difficult. Slight changes in topography and soil structure often have a dramatic effect on survival and growth of planted oak seedlings (Hodges and Switzer 1979). This project documented the survival and growth of 6-year-old seedlings that were established in 2004 on a bottomland site at the West Tennessee Research and Education Center, Jackson, Tennessee. The purpose was to determine how soil drainage as indicated by mottling (specifically, the point of >50 percent gray color throughout the soil profile) affects the survival and growth of bottomland oak species. The findings suggest that practitioners plant Nuttall, pin, and overcup oaks in poorly drained soils. As the drainage improves, begin mixing in willow oak. In the best drained soils (if they exist), finish by including water, swamp chestnut, swamp white, Shumard, cherrybark, and bur oaks. Potential species diversity should expand as the soil drainage improves.

LITERATURE CITED

- Hodges, J.D.; Switzer, G.L. 1979. **Some aspects of the ecology of southern bottomland hardwoods.** In: Proceedings, Society of American Foresters annual meeting; St. Louis, MO; 1978. Bethesda, MD: Society of American Foresters: 22-25.
- Stanturf, J.A.; Schoenholtz, S.H.; Schweitzer, C.J.; Shepard, J.P. 2001. **Achieving restoration success: myths in bottomland hardwood forests.** *Restoration Ecology*. 9: 189-200.

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

¹ Extension Forester, University of Tennessee, 605 Airways Blvd., Jackson, TN 38301. To contact, call 731-425-4703 or email at dcmercker@utk.edu.

AVIAN COMMUNITY RESPONSE TO HARDWOOD FOREST MANAGEMENT FOR CERULEAN WARBLERS

James Sheehan, Petra B. Wood, David A. Buehler, Patrick D. Keyser, Jeff L. Larkin, Amanda D. Rodewald, Tiffany A. Beachy, Than J. Boves, Marja H. Bakermans, Andrea Evans, Greg A. George, Molly E. McDermott, Felicity L. Newell, Kelly A. Perkins, and Matt White¹

Abstract.—We studied three silvicultural methods (single-tree selection, shelterwood, and deferment harvest) as potential tools to manage cerulean warbler populations on seven study areas in four Appalachian states from 2006 through 2010. We analyzed preharvest and 4 years post-harvest point count, territory mapping, and vegetation response data on plots treated with the three harvests and an unharvested reference plot to examine the broader implications of single-species management for cerulean warblers. Differences in harvest method and intensity led to differences in habitat structure and composition, with positive and negative consequences for other avian species.

The preharvest avian community was similar on all study plots. By 4 years postharvest, the four treatments had differentiated in avian composition with most change in the shelterwood and deferment harvests, primarily from positive responses of shrub-associated species such as hooded warbler, Kentucky warbler, and indigo bunting. Some forest interior species declined in all treatments (e.g., ovenbird), whereas others declined only in the heaviest harvest (e.g., worm-eating warbler). Most species remained at or near pretreatment levels in the selection harvest. Stand-specific variation in habitat and avian measures also were found, likely due to factors such as topography and within-region differences in vegetation and avian composition. A gradient of residual basal area on the harvest treatments strongly influenced the avian community. Forest management can benefit cerulean warblers as well as other avian species or assemblages of management interest. Tradeoffs among species need to be considered when selecting type of management implemented.

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

¹Graduate Research Assistant (JS, GAG, MEM, KAP) and Research Wildlife Biologist (PBW), U.S. Geological Survey, West Virginia Cooperative Fish and Wildlife Research Unit, West Virginia University, P.O. Box 6125, Morgantown, WV 26506; Professor (DAB, PDK) and Graduate Research Assistant (TJB, TAB), University of Tennessee, Department of Forestry, Wildlife, and Fisheries; Professor (JLL) and Graduate Research Assistant (AE, MW), Indiana University of Pennsylvania, Department of Biology; and Professor (ADR) and Graduate Research Assistant (MHB, FLN), Ohio State University, School of Environment and Natural Resources. PBW is corresponding author: to contact, call 304-293-5090 or email at pbwood@wvu.edu.

CERULEAN WARBLER RESPONSE TO HARDWOOD FOREST MANAGEMENT IN THE CENTRAL APPALACHIANS

Petra B. Wood, Than J. Boves, James Sheehan, David A. Buehler, Patrick D. Keyser, Jeff L. Larkin, Amanda D. Rodewald, Tiffany A. Beachy, Marja H. Bakermans, Andrea Evans, Greg A. George, Molly E. McDermott, Felicity L. Newell, Kelly A. Perkins, and Matt White¹

Abstract.—Cerulean warblers (*Dendroica cerulea*), one of the fastest declining avian species in North America, are associated with heterogeneous canopies in mature hardwood forests. We examined three silvicultural methods with varying degrees of canopy disturbance (single-tree selection, shelterwood, and deferment harvests) as potential tools to manage habitat for cerulean warblers. The three harvest treatments and an unharvested reference plot were replicated on seven study areas in four Appalachian states from 2005 through 2010. The four treatments were applied randomly on each study area and harvests were implemented between the 2006 and 2007 growing seasons. We quantified cerulean warbler territory density, nest survival, and age structure on each plot in each year to examine preharvest and 4 years post-harvest response. Over all study areas, cerulean warbler territory density remained stable in unharvested plots and increased significantly in the first year post-harvest on intermediate shelterwood treatments. By 3 years post-harvest, all three harvest treatments had significantly higher territory density than unharvested plots.

Nest survival rates were influenced by study site, year, and treatment. After accounting for regional and annual differences, nests in the unharvested treatment had greater nest survival and more fledglings per successful nest than in harvested treatments. However, the number of nests found was generally higher in harvested treatments. Male age structure did not differ among treatments, but body condition was better in harvested stands. Forest management can benefit cerulean warbler density. Shelterwood harvests provide the greatest positive response of the three harvest types; however, nest success can be reduced.

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

¹Research Wildlife Biologist (PBW), U.S. Geological Survey, West Virginia Cooperative Fish and Wildlife Research Unit, West Virginia University, P.O. Box 6125, Morgantown, WV 26506; Graduate Research Assistant (TJB, TAB) and Professor (DAB, PDK), University of Tennessee, Department of Forestry, Wildlife, and Fisheries; Graduate Research Assistant (JS, GAG, MEM, KAP), West Virginia Cooperative Fish and Wildlife Research Unit, West Virginia University; Professor (JLL) and Graduate Research Assistant (AE, MW), Indiana University of Pennsylvania, Department of Biology; and Professor (ADR) and Graduate Research Assistant (MHB, FLN), Ohio State University, School of Environment and Natural Resources. PBW is corresponding author: to contact, call 304-293-5090 or email at pbwood@wvu.edu.