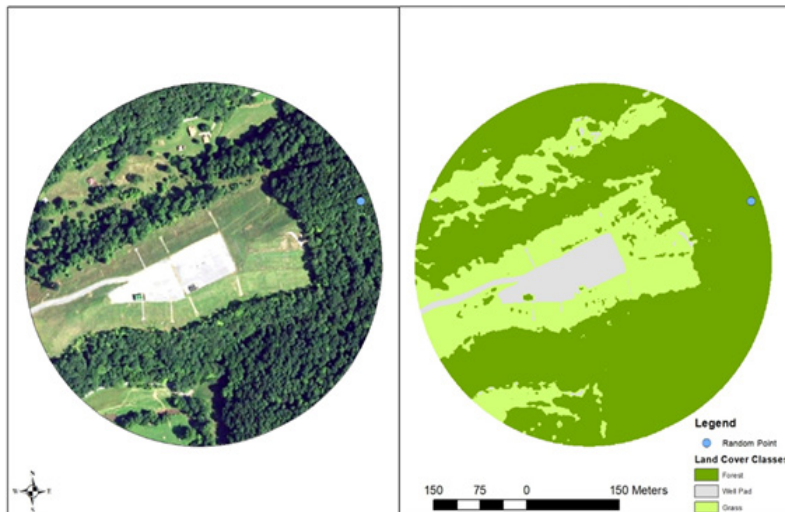


DIVISION OF FORESTRY AND NATURAL RESOURCES

 West Virginia University
DAVIS COLLEGE OF AGRICULTURE,
NATURAL RESOURCES AND DESIGN

MCINTIRE-STENNIS PROJECTS – 2019 REPORT



McIntire-Stennis, a USDA National Institute of Food and Agriculture administrated program, provides universities with capacity building funds to cultivate and deliver forestry and natural resource innovations for a better future. by advancing research and education that increases the understanding of emerging challenges and fosters the development of relevant solutions, the program has ensured healthy resilient forest and communities and an exceptional natural resources workforce since 1962.

This report provides a 2019 summary of the impacts of established and emerging McIntire-Stennis supported projects administered by West Virginia University, Davis College of Agriculture, Natural Resources and Design, Division of Forestry and Natural Resources.

McIntire-Stennis projects are 5 years in duration and are subjected to a review process to assure their scientific credibility and potential to generate knowledge useful in understanding and managing our forest systems and aligned resources. The individual McIntire-Stennis project reports compiled in this document encompass both established projects with significant accumulated impacts and descriptions and potential contributions of emerging projects.

IMPACTS OF WEST VIRGINIA UNIVERSITY PROJECTS

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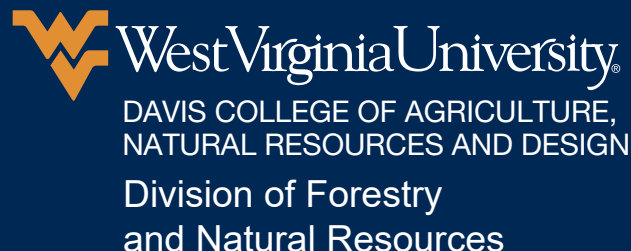
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MCINTIRE-STENNIS

Research at the West Virginia University



McIntire-Stennis provides capacity funding used at West Virginia University to drive significant work by 20 researchers to address issues critical to the conservation and use of West Virginia's forests and natural resources. This research effort also results in the development of graduate students providing scientific expertise to industry, agencies, non-profits, and universities to address issues critical to our state's environmental and economic well-being.

ECONOMIC AND ENVIRONMENTAL IMPACTS

Long-term McIntire-Stennis projects at the Division of Forestry and Natural Resources in the Davis College of Agriculture, Natural Resources and Design at West Virginia University have focused on forest, land use, recreation, wildlife, and bioproduct issues important to West Virginia, resulting in significant environmental and economic contributions.

About McIntire-Stennis



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180,000 acres

mixed hardwood forests harvested in West Virginia annually



2 million dry tons

total production potential of biomass in West Virginia annually



\$319 million

estimated market value of potential biochemicals and bioproducts annually



over 700 million board feet

lumber produced in West Virginia annually



publications

published database of 36 soil metagenome sequences, and 88 refereed papers

TRAINING PROFESSIONALS



McIntire-Stennis projects at West Virginia University, while yielding impactful science, also produce highly skilled professionals, includes numerous Ph.D., M.S., and undergraduate students, working in West Virginia and throughout the U.S., providing critically needed expertise to deal with increased pressures to our forests and natural resources.

SUMMARY

The McIntire-Stennis program provides research capacity funding that has and continues to be, fundamental to generating meaningful science and trained professionals. This combination allows us to tackle real work problems and improve the economic and environmental benefits from our forests and aligned natural resources.

CURRENT SURFACE USE CHARACTERISTICS AND FUTURE DEVELOPMENT PROJECTION FOR UNCONVENTIONAL NATURAL GAS PRODUCTION IN THE APPALACHIAN BASIN



West Virginia University

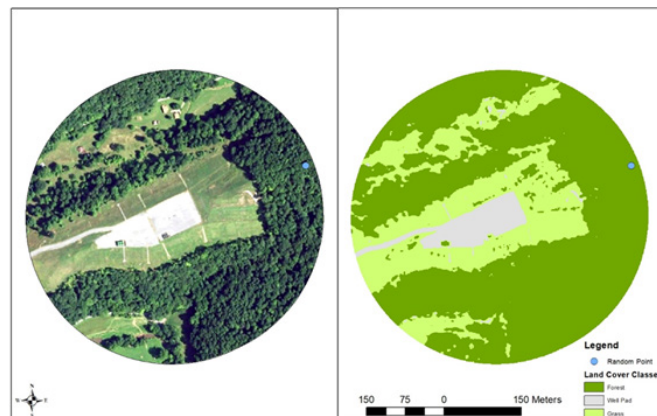
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and Natural Resources

A McIntire-Stennis supported project
Shawn Grushecky

The impacts of unconventional exploration on forest cover and forest-based economies of the Appalachian region have not been explored. Background data related to the impacts of unconventional development on forest operations and forest products markets in these regions are needed to understand the current trends and to help prepare for future shale gas development. Through this project, UOG information is collected annually in PA, WV, and OH. With these and allied data, the relationship between UOG development and surface disturbance, the forest products industry, and forest economies will be investigated.

Results from this research assist with the development energy resources in a sustainable fashion. This research also provides policy makers with up-to-date information on the development patterns of unconventional drilling in the Marcellus and Utica shales. Finally, this project provides both undergraduate and graduate students with educational and research experience as well as providing relevant information to local stakeholders.



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COLLABORATION



This project brings together natural resource professionals in energy development, forestry, wood science and natural resource economics. Project requires cooperation of industry partners and leverages their skillsets with those of governmental agencies including the USDA Forest Service, USGS, WVDEP, PADEP, OHDEP and others.

IMPACT

This research assessed unconventional shale development and the progression of development in the Appalachian basin. This includes determining the relationship between development and allied industries as well as employment and business operations in traditional wood products industry sectors.



21,997 sites

Site characteristic data collected for active unconventional wells in PA, WV, and OH.



33 BCF/Day

Total natural gas production from Appalachian basin included in this study.



73,323 acres

Approximate disturbed site acres included in this research.

QUANTITATIVE FOREST MANAGEMENT TO BUILD ADAPTIVE CAPACITY AGAINST CLIMATE CHANGE AND FOREST DISTURBANCES

A McIntire-Stennis supported project
Sophan Chhin

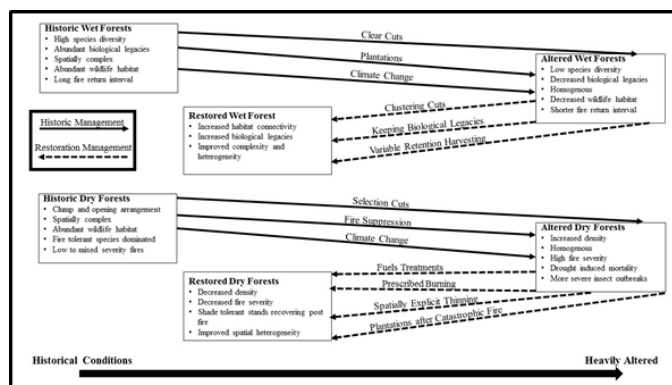


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The productivity and health of forest ecosystems in the 21st century will be threatened by the direct effects of climate change, primarily through the effects of elevated temperatures and increases in water stress leading to an increase and expansion of disturbance agents such as fire, insect pests, and fungal pathogens. This research project will address these environmental challenges in a proactive manner by identifying effective forest management practices that have the capacity to promote resiliency to environmental change. Effective adaptation to climate change and pressing forest health disturbances requires effective methods of long-term monitoring and early detection of these concerns which will be conducted in this project. The key forest regions that will be examined include pine, oak, and spruce forests in West Virginia; the Sierra Nevada region of the Western United States; poplar and pine forests in Canada; and tropical tree species in Africa and Asia. This research project will contribute to a mechanistic understanding of environmental and human influences on forest ecosystem processes to inform sustainable management and thus effective stewardship of forest resources under current and changing environmental conditions.



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COLLABORATION



Research has been done in collaboration with the US Forest Service in West Virginia, Wisconsin, and California. International collaboration has also been conducted in Canada with the Ontario Ministry of Natural Resources and the Government of Alberta, and in China with colleagues in the Chinese Academy of Forestry (Beijing), Central South University of Forest & Technology (Changsha), Nanjing Forestry University, State Forestry Administration on Forest Resources Management and Monitoring in Southern Area (Changsha), Central South Inventory and Planning Institute of National Forestry and Grassland Administration (Changsha).

IMPACT

This project was initiated in October 2018. The impact to date consists of improved understanding of the impact of climate change and disturbance agents on forests principally in West Virginia and California. Research has been disseminated via 7 peer-reviewed journal articles, and 5 presentations at conferences. Dr. Chhin is a recognized expert in the field of adaptation of forests to climate change and has been invited to serve as the Guest Editor of journals (i.e., Forests, Sustainability) examining the intersection of climate change and sustainable forest management. Research has also involved the mentoring of 4 graduate students, a research assistant, and undergraduate students.

USING DIGITAL IMAGE CORRELATION TO UNDERSTAND LOADING AND TISSUE DEFORMATION IN URBAN TREES

A McIntire-Stennis supported project

Gregory A. Dahle



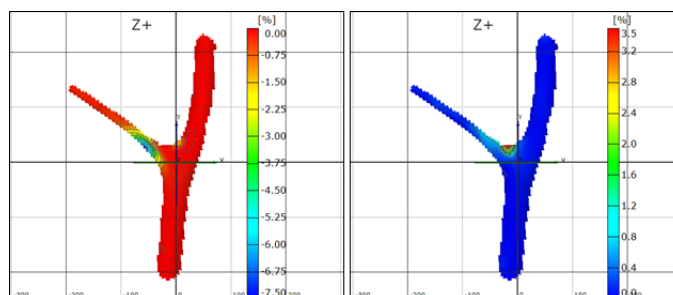
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Urban foresters manage trees to provide benefits to society including aesthetics, increased property values and ecosystem services. Arborists maintain trees to minimize the risks that failure will disrupt important services or cause personal or property damage. Knowledge of how trees contend with environmental loads is important to understanding how to minimize the risk of failure.

This research project will utilize digital image correlation to map strain in urban trees. Strain is a measurement of tissue deformation that results during loading, and we believe it can be used to understand how applied loads move through trees. We will measure how deformation in the region of the branch attachment and the primary roots. These regions are prone to failures and understanding how loads transfer from the branches into the trunk and then from the trunk to the roots will help arborist and urban foresters identify trees at higher risk of failure.



COLLABORATION

We have worked with international researchers during ISA Biomechanics Research week, researchers at the Morton Arboretum, Davey Tree Experts, Bartlett Tree Experts and NASA Glenn Research Center. As well as graduate students from West Virginia.



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IMPACT

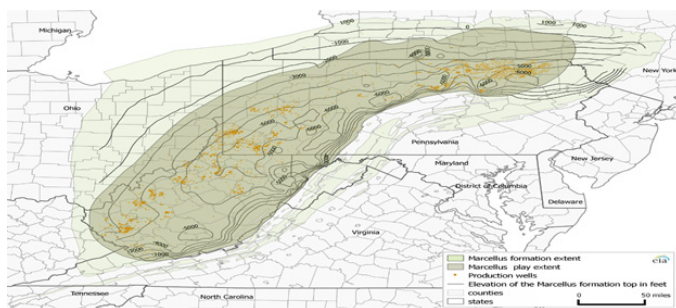
This research is helping urban tree managers better assess tree stability in order to minimize the likelihood of tree failure along streets, near homes and along electrical rights-of-ways.

MARCELLUS SHALE DRILLING IN WEST VIRGINIA: IMPACTS ON FOREST PRODUCTS INDUSTRY AND PRIVATE FOREST LANDOWNERS' BEHAVIOR

A McIntire-Stennis supported project
Kathryn Arano Gazal

 **West Virginia University**
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Natural gas extraction activities from the Marcellus Shale deposit have been increasing in recent years due to advancement in drilling technology leading to the boom in Marcellus shale drilling in West Virginia. While this has benefited the oil and gas industry, its impact on the forest products industry and on how private forest landowners managed their forest properties is unknown. The overall objective of this project is to evaluate the impact of Marcellus shale gas development on forest products industry employment and on private forest landowners' management behavior. The forest products industry is a significant component of West Virginia's economy and there has been evidence of movement of employment from the forestry sector to the oil and gas exploration sector. It is also important to examine how the boom in Marcellus shale drilling has influenced how private forest landowners manage their forest properties because this may impact future timber supply.



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COLLABORATION

The PI has collaborated with economists from Belmont University and Indiana University Southeast.



IMPACT

The impact to date consists



1 journal article published in the International Journal of Energy Sector Management




Another journal article was also submitted and is currently under review.



2 presentations in a professional conference in the field of forest economics and economics.

AMERICAN CHESTNUT AND SOIL CARBON AND NITROGEN DYNAMICS: IMPLICATIONS FOR ECOSYSTEM RESPONSE FOLLOWING RESTORATION

A McIntire-Stennis supported project
Charley Kelly

 **West Virginia University**
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The once dominant American chestnut tree (*Castanea dentata*) was essentially extirpated from the US eastern hardwood forest as a result the chestnut blight-fungus (*Cryphonectria parasitica*) in the early 1900's in what is thought to be one of the largest ecosystem disturbance events in the post-glacial era. The historic range of the American chestnut once covered more than 800,000 km² and could make up more than half of the basal area of a forest stand (Braun 1950). However, as a result of the successful backcross-breeding program (Hebard 2006), chestnut reintroduction throughout the eastern hardwood forest is considered "imminent" (Jacobs 2007). In the event of a successful reintroduction of the American chestnut, significant ecosystem changes in carbon and nutrient cycling and ecosystem water availability are expected (Ellison et al. 2005), but have yet to be quantified at a landscape level. Such quantification of changes to ecosystem biogeochemical cycles and water availability are absolutely imperative to inform ecosystem models of carbon sequestration and economic valuation of carbon storage, and water yield models.



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COLLABORATION



This project has built collaboration between researchers at West Virginia University (Forestry and Natural Resources, Department of Biology) with faculty at Purdue University, researcher now at the National Ecological Observatory Network (NEON), and program managers at US DOE Joint Genome Institute.

IMPACT

This research has quantified expected changes in carbon and nitrogen biogeochemistry process rates, as well as investigated changes in soil metagenomic function as affected by re-introduction of American chestnut. Research inspired additional support by DOE JGI for soil metagenomic analyses.



Database

Published database of 36 soil metagenome sequences.



2

Peer-reviewed publications.



4

Two oral and two poster presentations at various conferences.



2

Two graduate students have been trained in investigation of the role of tree species on soil and ecosystem processes.

MANAGEMENT AND REGENERATION OF EASTERN FORESTS FOR TRADITIONAL AND NON-TRADITIONAL FOREST PRODUCTS

A McIntire-Stennis supported project
Jamie Schuler



West Virginia University

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Many acres of forests are harvested annually without a strategic plan for regeneration resulting in less than optimal productivity and species composition of new forests. This project seeks to address some of these concerns by developing pre- and post-harvest management solutions focusing on upland oak and high elevation red spruce forests in central Appalachia. Despite a significant amount of work on oak regeneration, forests throughout the Appalachians continue to have reduced oak components following harvesting. My intent is to explore new oak regeneration methods that are more likely to be implemented on private land. As for, red spruce forests, many of these acres are preserved due to their rarity across the landscape. However, the area of red spruce forests is declining due to a lack of management. I will examine characteristics of naturally established red spruce forests to glean regenerative conditions that facilitate success, and apply operational scale treatments mimicking those conditions in an effort to increase the abundance and frequency of red spruce forest on the landscape. Lastly non-timber forest products are also important in central Appalachia. West Virginia and the surrounding area have significant maple resources, providing the opportunity for expansion of the maple syrup industry. To capitalize on the opportunities that forest resource presents will require increased knowledge of the maple resource in reference to maple (and other species) syrup making, and the dissemination of knowledge to producers and consumers about maple syrup processing and products.



COLLABORATION

This project works with scientists from West Virginia University, the USDA Forest Service, Ohio State University, and Future Generations University. I also work with state WV Division of Forestry and WV Department of Agriculture personnel as well as private industry and local associations.



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IMPACT

This research addresses concerns of resource availability into the future. As WV forests are harvested, our goal is to ensure we are harvesting sustainably and regenerating the desired species.



180 Million

WV harvests roughly 180 million cuft annually. With these harvests we hope to reverse the current trends of conversion of our oak forests to more mesophytic species.



14,000 Gallons

The maple syrup industry is developing in WV. The most recent survey statistics reported by NASS estimated production at 14,000 gallons. Interestingly, WV ranks 6th in the U.S. for the total number of tappable maple trees, which is greater than Vermont. Despite this, WV makes only a small fraction of the total maple syrup.

THE ROLE OF UNDERSTORY NITROGEN METABOLISM IN WATERSHED-LEVEL NITROGEN RETENTION IN AN APPALACHIAN HARDWOOD FOREST

A McIntire-Stennis supported project

Kirsten Stephan



West Virginia University

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Short-term disturbances (e.g. logging, fire), long-term (chronic) stress (e.g. pollution, drought), and physical characteristics (e.g. aspect) in the watershed can have significant impacts on ecosystem function and, subsequently, the goods and services forested watersheds provide. While trees are the prominent aspect of the forest, herbaceous vegetation, disproportionately to their small stature, can have a large impact on forest ecosystem processes. Of particular importance for ecosystem productivity is nitrogen cycling. This research project quantified nitrogen uptake by herb layer species and overstory trees and investigated if individual tree species affect the composition and abundance of the herb layer around them. The study sites represent contemporary watershed conditions in eastern hardwood forests by comprising watersheds of differing stand ages, aspects, and nitrogen input levels. A better understanding of all components of the forest will therefore contribute to improved forest management in the Appalachian Mountains of West Virginia and beyond.



COLLABORATION

The project is supported by the collaborations with the USDA Forest Service scientists and staff at the Fernow Experimental Forest, Northern Research Station, the West Virginia University (WVU) Department of Biology, and the WVU Institute of Water Security and Science.



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IMPACT

The anticipated outcome of the study is science-based information that supports natural resources management practices that maximize ecosystem health. Specifically, this study seeks to identify factors that maximize biodiversity of herbaceous plants and the retention of nitrogen on the land, thus sustaining forest growth while minimizing nitrogen leaching losses to drinking water sources.

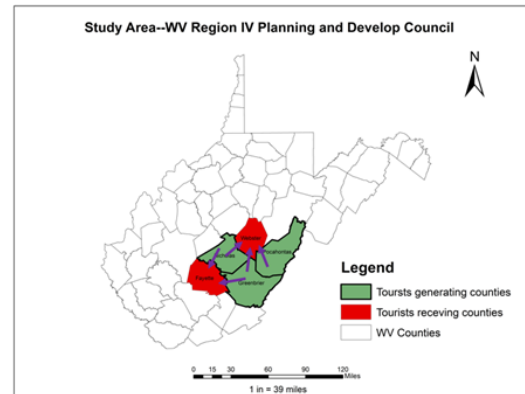
To date, the project has generated new scientific knowledge, resulted in one highly skilled professional with a Master's degree entering the natural resource management workforce, and several conference presentations.

UNDERSTANDING THE NATURAL RESOURCES AND GEOLOGICAL INTERFACE THROUGH THE DEVELOPMENT OF THE APPALACHIAN GEOPARK

A McIntire-Stennis supported project
Robert C. Burns

 **West Virginia University**
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The Appalachian region is rife with deep gorges and ancient rivers that drove the rise of the US industrial revolution of the late 1800s— with the rivers used to transport people and goods, to power processing and manufacturing, and to support the communities that mined coal, harvested crops and timber, and built the economy. There are heritage aspects linked with railroad, historical and military history, rural communities, WV State Parks and US National Forests. Tourism in the area is well developed and the proposed setting is strategically located. Over 60% of the US population and virtually all major cities in the eastern half of the US is within a day's drive on a high-quality road network. With this Project, the Geopark concept can be linked to a revitalization effort in southern WV, offer new opportunities to develop the communities, and forge a sustainable future.



COLLABORATION



Researchers have worked with the United States Geological Survey (USGS), West Virginia Geological and Economic Survey (WVGES), National Coal Heritage Area (Oak Hill, WV), the National Park Service (New River Gorge NSA), and numerous local communities in West Virginia.

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IMPACT

Initiated in 2018, the impact to date consists of



Geo-STEM Camp
the development of a Geo-STEM Camp for youth in West Virginia




10
two journal articles and 8 presentations



Leader in Geoheritage
recognition that the state of WV is a leader in Geoheritage

AN ASSESSMENT OF TOURISM CLUSTERS IN THE APPALACHIAN REGION

A McIntire-Stennis supported project
Jinyang Deng

 West Virginia University
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Tourism has been used as an effective means for rural economic diversification and growth in the Appalachian Region in the past decades. A recent trend of economic development in the region is to promote tourism in the form of clusters or networks. Since regional tourism clusters have been less examined in the literature as compared to other industry clusters, an overall assessment of tourism cluster initiatives and practices in the region is needed so that best practices of existing tourism clusters can be used to guide future tourism development in the region.

Therefore, this McIntire-Stennis supported research at West Virginia University School of Natural Resources aims to investigate the formation, operation, effectiveness, challenges, and prospects of tourism clusters in the Appalachian Region.



COLLABORATION

Researchers have worked with Monongahela National Forest, Garrett County Chamber of Commerce, West Virginia Environmental Protection Agency, and U.S. Army Corps of Engineers.



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IMPACT

A phone interview will be conducted in December 2019 and January 2020 to target participants who are involved in the development and management of tourism clusters in Appalachia.



5

Five journal articles were published.




2

Two presentations were made to the national and international audience.

RESTORATIVE BENEFITS OF HUMAN-NATURE INTERACTION IN URBAN FORESTS

A McIntire-Stennis supported project
Chad D. Pierskalla

 West Virginia University
DAVIS COLLEGE OF AGRICULTURE,
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According to Attention Restoration Theory (ART), proposed by Kaplan (1995), involuntary attention to events that are interesting (automatically hold our attention) and non-threatening has a reprise from the burden of directed attention (allowing the neurons to restore). Consequently, outdoor recreation is metaphorically similar to sharpening a dull pencil (recovery from directed attention fatigue) rather than destroying the pencil and creating a new one (crisis management). Providing background support for ART, over 100 studies of recreation experiences in wilderness and urban nature areas indicate that restoration is one of the most important verbally expressed benefit opportunities afforded by nature. Ulrich (1984) published evidence suggesting views of nature through a window may influence recovery time in hospitals. Perhaps the most recent research linking child performance with the physical environment was conducted by the Landscape and Human Health Laboratory, University of Illinois at Urbana-Champaign. The purpose of this study is to build on past research by validating a global measure of restorative benefits and identifying significant indicators (i.e., using the modified Perceived Restorativeness Scale including Fascination, Being Away, Coherence, Scope, and Compatibility) in various urban and rural environments.



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COLLABORATION

Researchers have worked with the US Forest Service, the Monongahela National Forest, and the National Institutes of Health.



IMPACT

This research is to build on past research by validating a global measure of restorative benefits and identifying significant indicators in various urban and rural environments.



4

Since 2017, researchers have published four journal articles.



2

Since 2017, researchers have given two presentations.

SUSTAINABLE RECREATION MANAGEMENT ACROSS FEDERAL PUBLIC LANDS: BUILDING CAPACITY THROUGH RESEARCH- MANAGEMENT PARTNERSHIPS

A McIntire-Stennis supported project
Steven W. Selin

 **West Virginia University**
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The purpose of this McIntire-Stennis proposal has been to convene an interdisciplinary working group of social scientists, resource specialists, and recreation professionals to critically examine the future trajectory of sustainable recreation management on federal lands. This sustainable recreation working group will be convened twice over the course of this project to examine current recreation trends, identify pressing planning and management priorities, and synthesize a framework to organize future research and technical assistance strategies. This national dialogue will result in several scholarly outputs including a Forest Service General Technical Report, two special issues of research journals, a Research Agenda, and several conference presentations.



COLLABORATION



Collaborative work under this McIntire-Stennis project has included the following institutional partners: Forest Service Pacific Northwest Research Station, Forest Service Washington Office, Forest Service Southwestern Region Headquarters, National Park Service, and Bureau of Land Management. Participating universities have included the University of Washington, Oregon State University, University of Montana, Colorado State, Utah State University, North Carolina State, Auburn, and the University of Florida. Participating nonprofit organizations have included the Outdoor Alliance.

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IMPACT


As part of this McIntire-Stennis project, Dr. Steven Selin continues to serve as a co-founder, coordinating team member and editor of a national-level, Forest-Service-led, strategic initiative called Igniting the Science of Outdoor Recreation—Linking Science, Policy, and Action (ISOR).

Also, as part of this McIntire-Stennis research, Dr. Selin also recently received a grant from the Southwestern Region of the Forest Service to conduct a five-year evaluation of the Region's Sustainable Recreation Strategy. Several refereed journal articles are planned from this research.

Finally, In October 2019, Dr. Selin presented outcomes of the ISOR Research Strategy and Agenda at the International Union of Forest Research Organizations (IUFRO) conference in Curitiba, Brazil.

STRATEGIES FOR IMPROVING COMMUNICATION WITH AUDIENCES ABOUT COMPLEX AND CONTROVERSIAL SCIENCE TOPICS ON PUBLIC LANDS

A McIntire-Stennis supported project
David Smaldone

 **West Virginia University**
DAVIS COLLEGE OF AGRICULTURE,
NATURAL RESOURCES AND DESIGN
Division of Forestry
and Natural Resources

The overall goal of this project is to learn about, and then strengthen, the confidence and ability of public land managers and employees to research, understand, develop, and deliver informal science communication products and programs about complex and controversial science topics. Although targeted at communication related to climate change, other relevant complex and controversial science topics will be addressed as this project moves forward (e.g., wildfire management, water quality and management, invasive species, species reintroduction, energy and forest management, etc.). Land managers confront numerous barriers in their public communication efforts. This study will seek to address some of these barriers faced in communication with internal and external audiences. Data is also being collected related to their targeted audiences to inform communication efforts.



COLLABORATION

Researchers have collaborated with the Environmental Protection Agency, United States Geological Survey (USGS), Boy Scouts of America and stakeholders in West Virginia.



About McIntire-Stennis

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IMPACT

Started in 2017, the impact to date consists of



Curriculum & project

developing, delivering, and evaluating environmental STEM curriculum for youth at different camps in West Virginia (over 500 youth), developing and implementing a natural resource focused citizen science project



Interpretive signs

developing 2 interpretive signs




Articles & presentations

one peer-reviewed journal article and 7 conference presentations

CLIMATE CHANGE IMPACTS ON SURVIVAL, GROWTH, AND COMPETITION OF PLETHODONTID SALAMANDERS IN THE CENTRAL APPALACHIANS

A McIntire-Stennis supported project
Donald Brown

 **West Virginia University**
DAVIS COLLEGE OF AGRICULTURE,
NATURAL RESOURCES AND DESIGN
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Climate change adaptation strategies for vulnerable species and communities are currently being created and implemented on federal and state-managed lands. Proactive management requires an understanding and quantification of the mechanisms driving both fundamental and realized niches, as both can be impacted by climate change. In the Central Appalachian region, this information is particularly important for salamanders restricted to high elevation habitats, as the ability to track changes in climate suitability through dispersal is limited. This McIntire-Stennis supported research seeks to improve our understanding of the vulnerability of salamanders in the Central Appalachian region to climate change through empirical studies focused on quantifying historical changes in local salamander distributions and quantifying climatic niches of salamanders, and modeling studies focused on projecting future changes in species distributions and interactions. Results from this research will assist with management of vulnerable species under changing environmental conditions.



COLLABORATION

Researchers at West Virginia University are collaborating with the USDA Forest Service Monongahela National Forest, George Washington-Jefferson National Forest, and Northern Research Station, as well as Marshall University.



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IMPACT

This research will assist the USDA Forest Service and West Virginia Division of Natural Resources with species protection and management actions.



Publications

One MS thesis and peer-reviewed journal article.



11

Since 2016, researchers have given eleven presentations.




Maps

Creation of contemporary and future species distribution maps for the threatened Cow Knob Salamander (*Plethodon punctatus*).

UNDERSTANDING POPULATION RESISTANCE AND RESILIENCE OF BROOK TROUT: LONG TERM STUDIES OF FORESTED HEADWATER STREAMS

A McIntire-Stennis supported project
Kyle Hartman

 **West Virginia University**
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A better understanding of critical habitat requirements and a better understanding of Brook Trout population dynamics in relation to stream habitat is needed to improve aquatic and land-use management. This study builds upon earlier work by developing long-term study of the spatial and temporal variability of stream habitat and brook trout populations in the Central Appalachian Mountains of West Virginia. Such studies are needed to identify limiting and controlling factors of brook trout in this region and the relative impacts of each upon overall population resilience. Knowledge of these factors within the context of land-use practices and determination of the habitat attributes controlling the abundance of all life stages of brook trout will enable better land-use and restoration guidelines to be established for the region. Major goals of this research are to: (1) establish science-based goals for brook trout restoration and conservation in the Appalachians, (2) determine population resistance and resilience following perturbations, and (3) to develop mechanistic models to predict brook trout response to changes in landscape/land use and climate change. This research builds on a continuous 17-year long-term study of habitat and Brook Trout populations in 25 central Appalachian streams.



COLLABORATION

This long-term research brings together federal and state partners as well as private industry. In addition to USDA NIFA, the USDA Forest Service, West Virginia Division of Wildlife, NFWF, West Virginia University, and MeadWestvaco have collaborated on this research.



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IMPACT

Increased knowledge of the interactions between available stream habitat, its relationship with the surrounding riparian area and watershed attributes, brook trout densities, and population dynamics will allow refinement of watershed and fisheries management practices and recommendations, as well as serving as more appropriate guidelines for restoration efforts in the central Appalachians.



30
peer-reviewed
journal publications



> \$200,000
funding has been
leveraged from partners
since 2014



15
7 Ph.D. and 8 M.S.
students

ENERGY DEVELOPMENT, GRAZING, AND FOREST REGENERATION: IMPACTS ON GRASSLAND AND EARLY SUCCESSIONAL BIRD LIFE-CYCLES AND POPULATIONS

A McIntire-Stennis supported project

Christopher M. Lituma

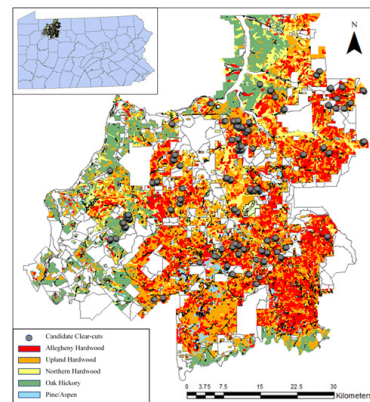


West Virginia University

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Within agricultural settings, Spotted Wing Drosophila (SWD; *Drosophila suzukii*) is a recently established fruit crop pest. It has caused ~20% loss of yield and an estimated 500 million dollars (US) worth of economic damage to various fruit crops including: Cherry (*Prunus avium*), raspberry and blackberry (*Rubus* spp.), strawberry (*Fragaria ananassa*), and blueberry (*Vaccinium* spp.). In 2018 it expanded to Allegheny National Forest (ANF), Pennsylvania where it was discovered affecting black cherry (*Prunus serotina*) and Allegheny blackberry (*Rubus allegheniensis*) in a forested ecosystem. Consequently, there is growing concern that SWD may be an emerging forest pest in the eastern U.S., threatening ecosystem forest health. Early-successional habitat in the form of forest harvests are dominated by Allegheny blackberry, and provide critical food resources to post-breeding and migrating songbirds. Infestation by SWD could be affecting these food resources, reflected in changes in songbird patch use, songbird abundance, and songbird fruit consumption. My first objective is to collect baseline SWD distribution data by developing surveys across the ANF. My second objective is to relate SWD distribution and density in early-successional forest harvests to bird occupancy, abundance, fruit consumption, and health, during the post-breeding and migration seasons. This research fills a critical knowledge gap about the effects of a novel non-native invasive insect pest (SWD), on early-successional songbirds within forested ecosystems.



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COLLABORATION

Researchers from WVU are working with the United States Forest Service (USFS) State and Private Forestry and Northern Research Station, and Pennsylvania Department of Conservation and Natural Resources.



IMPACT

Initiated in 2019, the researchers collected data from Allegheny National Forest which consisted of >1500 individually sampled songbirds, >50 fruit samples, and >150 insect (SWD) samples. Data processing and analyses are ongoing. This is the first research in the eastern US investigating the impacts of SWD in non-agricultural forested ecosystems.



\$15,000

Faculty Senate
dollars from
WVU.



~ \$73,000

USFS dollars
to support the
project.




3

There have been
three presentations at
national conferences.

HABITAT USE AND SPATIAL DEMOGRAPHY OF CANADA WARBLER (*CARDELLINA CANADENSIS*) IN THE CENTRAL APPALACHIANS

A McIntire-Stennis supported project
Christopher T. Rota

 West Virginia University
DAVIS COLLEGE OF AGRICULTURE,
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Division of Forestry
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Effective conservation action requires knowledge of how habitat influences survival, reproduction, and population growth rates. Canada Warblers (*Cardellina canadensis*) are a species of conservation concern within the eastern United States and Canada, but little is known about habitat use within the Central Appalachians, or how habitat use influences demography within this region. I am studying habitat use and survival of Canada Warblers along an elevation gradient within the central Appalachians in order to understand spatial demography of this sensitive species. Such information will help prioritize conservation decisions. Over the past 3 years, we have conducted over 800 point-count surveys within the Monongahela National Forest (MNF) to understand habitat use of this species. We determined that Canada Warblers are mostly likely to use mid-elevation sites within the MNF, and are currently conducting a mark-recapture study to understand how demography varies along this elevation gradient. We have individually marked 104 birds to date and will estimate survival probability over the next two summers.



COLLABORATION



This project has been conducted in conjunction with scientists at the Monongahela National Forest (MNF) and the West Virginia Cooperative Fish and Wildlife Research Unit. We have contributed to and incorporated long-term bird monitoring data collected over more than 20 years within the MNF to more fully understand patterns of Canada Warbler habitat use within the region.

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IMPACT

Graduate student Gordon Dimmig completed his MS at West Virginia University studying habitat use of Canada Warblers and occupancy dynamics of songbirds along an elevation gradient within the Monongahela National Forest. While an MS student, Gordon presented his research to both the WV Chapter of the Wildlife Society (where he won best student presentation award) and the Wildlife Society Annual Conference. Additionally, I shared this research during an invited symposium focused on conservation of Appalachian songbirds at the Association of Field Ornithologists and Wilson Ornithological Society Joint Meeting. We are currently preparing manuscripts from Gordon's MS thesis for submission to peer-reviewed journals. Finally, I have used data arising from this research for several grant proposals and I expect to use the foundation developed from this McIntire-Stennis project for long-term research on spatial demography of Canada Warblers in the Central Appalachians.

VALORIZATION OF BIOMASS WASTE-STREAMS

A McIntire-Stennis supported project
Benjamin Dawson-Andoh

Forest Products Industry, like many other industries, is currently dominated by “linear economy”, where biomass such as trees are harvested; converted to primary and secondary products (lumber, pulp and paper, wood composites, furniture, etc.) and the resulting waste-streams combusted; land-filled or used for a myriad of low-value products. This proposal seeks to develop methods for adding value to biomass waste-streams to “support the transformation from a linear on-way cradle to grave manufacturing model toward to a “circular economy”. This approach will reduce the carbon footprint of wood processing and increase resource efficiency and conservation of carbon resources. The specific objectives of this study are (1) to convert biomass-waste streams, black liquor (lignin), hemicelluloses, condensed tannins to “green” carbon foams” which has a myriad of industrial applications (insulation, fire resistance), (2) to evaluate betulinol, an extractive from the outer bark of birch and beech, for evaluation as potential insecticides, coatings and some medical applications, and (3) to evaluate suberin fatty acids (SFA) from the outer bark of birch and beech as potential moisture barrier for packages and wood products.



Carbon foam

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COLLABORATION

None.



IMPACT

This research is (1) to produce “green carbon foams” from biomass waste-streams, black liquor, hemicelluloses, and tannins; (2) to evaluate betulinol, an extractive from outer bark of birch and beech as an insecticide; and (3) to evaluate suberin fatty acids from the outer bark of birch and beech as moisture-barriers for packages and wood products



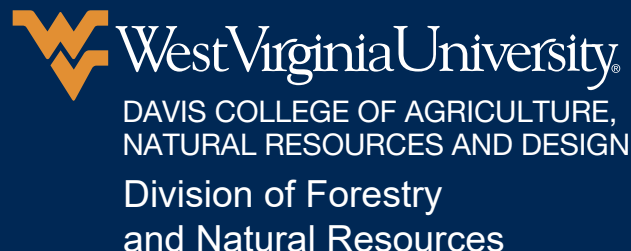
Forest products
industry



Chemical industry
products

PROMOTING NATURAL RESOURCE BASED RESEARCH IN WEST VIRGINIA AND THE APPALACHIAN REGION

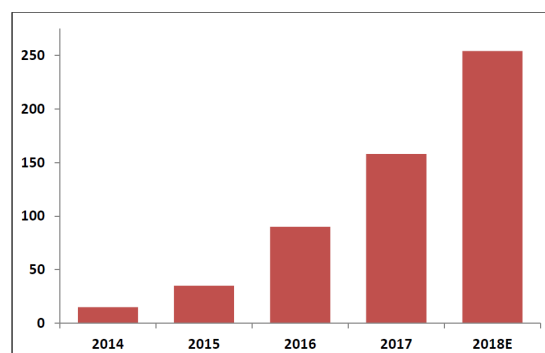
A McIntire-Stennis supported project
Joseph F. McNeel



This project will identify the required steps necessary to request that the American Panel Association (APA) approve key Appalachian hardwood species like Yellow Poplar (*Liriodendron tulipifera*) and soft Maple (*Acer rubrum*), for use in the manufacture of commercial grade Cross Laminated Timber (CLT) panels. This approval should lead to significant amounts of low-grade hardwood lumber consumed for this expanding manufacturing sector. Additionally, we will examine the potential for hardwoods to serve as raw material for a new approach to timber mat construction that also uses modified CLT panels directly as mats. Timber mat manufacturing and use involves no federal manufacturing regulation, unlike commercial building construction. Thus, efforts to produce viable timber mats from hardwoods can proceed much more rapidly with a broad array of species considered in the production process.

This effort is predominantly focused on enhancing emerging economic opportunities and the commercial development of new value-added products in Appalachia.

U.S. Mass Timber Projects by Year



COLLABORATION



Partners in this effort include the West Virginia University (WVU) Appalachian Hardwood Center (AHC), the WVU Hardwood Research Trust (WVU HRT), the WVU Division of Forestry & Natural Resources Wood Science Program, the USDA Forest Service State & Private Forestry Program, Appalachian Hardwood Manufacturers, Inc. (AHMI), and Allegheny Wood Products Company (AWP) as part of this research. Additional funds for this effort will be provided through the USDA Forest Service, the Appalachian Regional Commission (ARC), WVU AHC, and the WVU HRT. In-kind matching and material will be provided through AHMI and AWP, as well as by member companies working through AHMI.

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IMPACT

The impact of mass timber (CLT) construction projects contracted in the US has been dramatically increased since 2014.



~9 million cubic feet

The market for CLT in the CWSF region is estimated to be 9 million cubic feet in 2020.



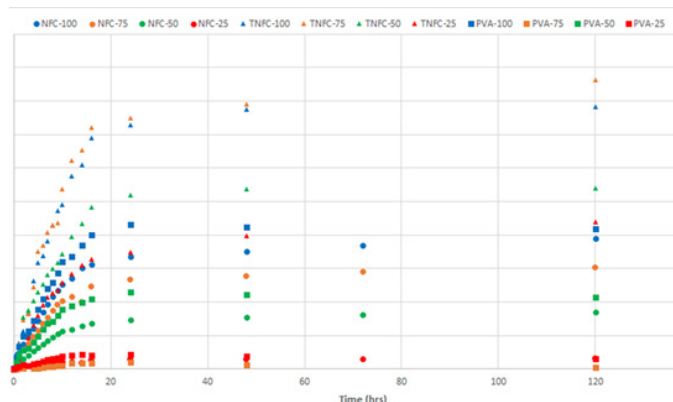
Hardwood CLT

The potential impact of the mass timber or CLT market in the Appalachian region if the project succeeds in having Yellow Poplar and other hardwoods certified for use in construction grade CLT panels.

ADVANCED APPLICATIONS FOR NANOMATERIALS FROM LIGNOCELLULOSIC SOURCES

A McIntire-Stennis supported project
Gloria S. Oporto-Velasquez

Nanotechnology is currently used as a transformational tool to develop and enhance high value products from renewable raw materials such as wood. Cellulose, as the most important skeletal component of wood, can be utilized not only in fields where biocompatibility and biodegradability are relevant, but also can potentially be used as a support structure for nanoparticles in promoting novel applications. The focus of this investigation is on using nanocellulose for the development of hybrids of TEMPO nanofibrillated cellulose (TNFC) and pharmaceutical drugs for their effective and controlled release in the medical field.



COLLABORATION

Researchers from Animal and Nutritional Sciences, Biology, Pharmaceutical Sciences and Forensic and Investigative Science Departments from WVU have been cooperating with Dr. Oporto. Likewise, the Chemical Engineering department from Villanova University, PA, has also supported this initiative.



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IMPACT

Initiated in 2015, the impact of this research consists of



8

8 peer reviewed journal articles



6

3 chapter books and 3 conference proceedings.



20

12 oral presentations and 8 poster presentations.

WOODY BIOMASS UTILIZATION FOR VALUE-ADDED CHEMICALS AND BIOPRODUCTS

A McIntire-Stennis supported project
Jingxin Wang



West Virginia University

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Woody biomass (forest residues and short rotation woody crops) has great potential for value-added bioproducts (BTX, biofuels, bioadhesives, bio-carbons, and bicarbonates), which can significantly benefit local economy and environment. Therefore, further investigation of economic and environmental impacts of biomass utilization is essential to promote this novel bio-based industry for sustainable development of regional rural economy. This McIntire-Stennis supported research has developed cost-effective harvesting and logistics approaches for different biomass feedstocks, configured and optimized/de-risked multiple-feedstock supply chains, assessed the environmental impacts from feedstock development to bioproduct production, and estimated the economic potentials of woody biomass-based chemicals and other products at industrial scale.

Results from this research assist with the development of analysis and management tools and provide technical and business strategies and decision support for local farmers, landowners and stakeholders. Additionally, this project provides educational and research opportunities for undergraduate and graduate students as well as the general public.



COLLABORATION



This is a high-skill, data-intensive and long-term project that brings together expertise in forestry and natural resources, engineering, environmental science, and economics. Researchers at West Virginia University are working in partnership with USDA NIFA, USDA Forest Service, USDOE National Labs, regional industries and universities.

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IMPACT

This research assessed the economic feasibility and environmental impacts of biomass utilization to provide critical strategies for the development of this innovative industry.



25.64 Million
dry tons/year

The total production potential of biomass in the Northeastern U.S.



\$319 Million

The estimated market value of potential chemicals and bioproducts annually.



Highly skilled

Students trained in the research can practice and lead the development of local biomass economy.

DIVISION OF FORESTRY AND NATURAL RESOURCES

MCINTIRE-STENNIS PROJECTS

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NATURAL RESOURCES AND DESIGN



For more information, please contact:

Dr. Robert Burns
Professor and Director
Robert.Burns@mail.wvu.edu

Dr. Jingxin Wang
Professor and Associate Director for Research
Jingxin.Wang@mail.wvu.edu