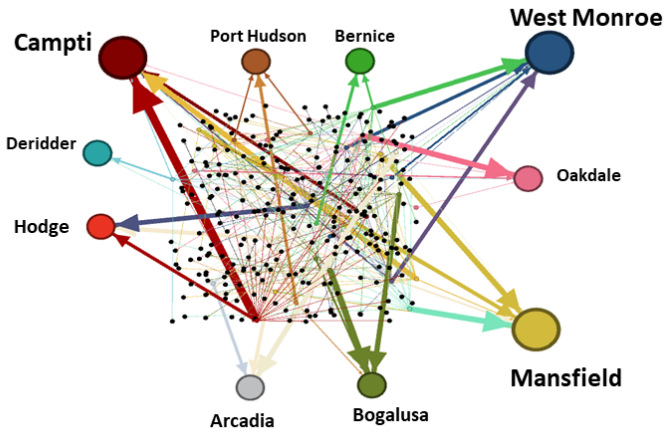
Louisiana Tech University

WOOD UTILIZATION IN A CHANGING ECONOMIC ENVIRONMENT: A SOCIAL ACCOUNTING PERSPECTIVE

A McIntire-Stennis supported project

The forestry complex underwent a rapid restructuring and reorganization as it emerged from the 2007-09 “Great Recession.” Recognizing intricate, and potentially messy, interactions between the environment, society, and economy in this post-recessional era requires novel levels of understanding. This is critical to transforming challenges into opportunities.

The studies associated with this project can provide interested parties – industry participants (landowners, loggers, mills), advocates (associations and organizations), as well as lawmakers – needed information when involved in policy and decision-making discussions. This could be particularly true in areas where forestry’s role may not be fully understood.



COLLABORATION

Sixteen collaborators across multiple institutions and states have contributed to research ventures associated with the project.

About McIntire-Stennis

The McIntire-Stennis program, a unique federal-state partnership, cultivates and delivers 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 McIntire-Stennis program has ensured healthy resilient forests and communities and an exceptional natural resources workforce since 1962.

IMPACT

Research and outreach efforts in in support of the project reached private forest landowners as well as individuals representing industry, government, and non-governmental organizations. Thirty technical publications have been published in multiple venues in support of the project. Thirty presentations have been provided to technical and non-technical audiences across the region. Quarterly meetings are held in conjunction with the North Louisiana Group of the Society of American Foresters.

Forest landowners received $385 million from the sale of timber in 2018.

Contractors were paid $485 million in 2018 to harvest and haul timber to wood-using facilities.

Total employment in Louisiana’s forest sector exceeds 25,000 jobs.

Louisiana Tech University

EVALUATING THE ROLE OF FUNGI IN FOREST HEALTH IN LOUISIANA

A McIntire-Stennis supported project

Fungi drive forest health and decline but remain largely unexamined within Louisiana's forest ecosystems with varying physical terrain and humid-subtropical climate. The great fungal diversity of Louisiana compliments and exceeds the diverse vegetation, and as the fungal flora has evolved an array of lifestyles, forms, and colors to align with their function and usefulness, they may also now outnumber plants six to one.

Fungi play major beneficial roles in the forest ecosystem and function by acting as decomposers, degrading the most complex chemical structures on earth (cellulose and lignin), providing nutrients and water to trees through mycorrhizal networks and protein-rich fruiting bodies for animals. Fungi also act as pathogens that can destroy forest products but serve to open forest canopies and create wildlife habitats. Regarding ecosystem function, fungi helped shape and influence the forest communities of the world, including those found across the Atlantic-Gulf Coastal Plain region, which encompasses Louisiana.

The destruction of forests and forest products by fungi will be much easier to handle, expect, and understand with baseline information on the players already found within the state. The goal is to improve our understanding of forest health in Louisiana by examining fungi in the state. The aims are to improve the identification of species attributed as the causes of decline / disease and evaluate fungal diversity, determine the parameters of health concerns, and with that knowledge develop best management practices to reduce the chance of forest disease outbreaks.

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COLLABORATION

One undergraduate and one graduate student are helping to process samples for this project. Louisiana Tech University and the LEAF organization are providing field site locations for sampling.

IMPACT

This project will improve the identification of species causing disease, assess fungal diversity, determine the parameters of health concerns, and use this knowledge to develop practices to reduce the chances of forest disease outbreaks.

This project will provide a broad overview of the fungal diversity in Louisiana forests.

We will help with forest health by defining the current fungal players at work in forests.

The project will improve understanding of the roles of fungi in forest ecosystems.

Louisiana Tech University

NATAL DEN SELECTION BY PARTURIENT FEMALE LOUISIANA BLACK BEARS IN LOUISIANA

A McIntire-Stennis supported project

Despite being removed from the Federal List of Endangered and Threatened Wildlife in 2016, efforts persist to increase Louisiana black bear (Ursus americanus luteolus) occupation throughout their historical range. Reproductive habitat is a necessary component of these efforts because of the bears' inclination to return to the area of their birthplaces to breed.

Our objectives were to determine which land cover variables are important predictors of natal den site selection and how forest type influences the type of established natal den in the four subpopulations in Louisiana. Using natal den data from 1993 to 2017, land cover from the National Land Cover Database (NLCD), and road data from the United States Census Bureau, we conducted analyses and logistic regressions to generate models describing the natal den site selection and den type establishment. The amount of woody wetlands around an area increased the likelihood of female Louisiana black bears to select a site as a natal den and most often resulted in the establishment of a natal tree den.

More agricultural land tended to increase the likelihood of natal den site selection, possibly due to the availability of a food resource. More deciduous forests also increased natal den site selection likelihood in the Upper Atchafalaya River Basin subpopulation but decreased likelihood in the Tensas River Basin subpopulation.

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COLLABORATION

Collaboration with graduate student Christopher D. Stelly was crucial to the success of this project.

IMPACT

Results from our study may be used to manage habitats in and around the four Louisiana black bear subpopulations as well as increase habitat connectivity between the subpopulations within the state of Louisiana and nearby states.

The Louisiana Black Bear was federally listed as an endangered species in 1992; its low population size was attributed to habitat loss and fragmentation.

Because of conservation efforts that increased habitat availability in its native home range, the Louisiana Black Bear was delisted in 2016.

It is estimated the probability of the Louisiana black bear becoming extinct in Louisiana is less than 1 percent over the next 100 years.

Louisiana Tech University

URBAN FOREST ASSESSMENT

A McIntire-Stennis supported project

This study assessed seven land cover classes for 10 small (population 20,000-50,000) cities in Louisiana in an attempt to understand urban tree canopy benefits for small cities within the state.

iTree Canopy was used to evaluate land cover and its positive influence on carbon monoxide, carbon dioxide, nitrogen dioxide, ozone, sulfur dioxide, and particulate matter. There are financial benefits to the removal of ozone, carbon dioxide, and small particulate matter. The benefits range from less than $100 to greater than $1,000,000 for various gases and particulate matter.

These estimates were generated to compare across time periods and determine the impacts of disturbance events or land use changes in small municipalities.

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COLLABORATION

Three researchers at Louisiana Tech are currently collaborating on the project. This is a new project and we hope to reach out to scientists in Louisiana and throughout the southeast. Together we can determine threats to urban tree canopy following disturbance events.

IMPACT

Determination of tree canopy benefits in small urban areas is important and should garner consideration for planning and management in municipal budgets.

Satellite-based change detection provides a rapid assessment of disturbance-induced changes.

Imagery is freely available, at multiple spatial and temporal resolutions, with multiple open-source or freely available software packages.

Satellite-based monitoring programs should carefully consider spatial resolution or supplementary data collection.

Lousiana Tech University

ADVANCED POPLAR PATHWAYS ACROSS THE SOUTHEAST

A McIntire-Stennis supported project

This project will assess *Populus* species adaptability to upland sites through a series of clonally replicated trials established over a two-year period using a diversity of Populus taxa.

The approach will quantify the pattern of adaptability in eastern cottonwood and inter-specific hybrids and the expected rate of improvement in biomass production and wood chemistry attainable through controlled breeding and vegetative propagation of elite selections. We will also demonstrate the cost of biomass production under alternate management practices while quantifying water and nutrient consumption to assess ecosystem services and assess potential forest health pitfalls. Data such as specific clone productivity based on soil conditions, water use efficiency, N uptake rates, and specific genetic markers for future taxa selection will be assessed. Specifically at Louisiana Tech, research is underway to assess the genomes of the various taxa that might provide paths for selecting for disease resistance, productivity, and water use.

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COLLABORATION

This project involves two researchers and several undergraduates at Louisiana Tech in collaboration with Mississippi State University, the University of Tennessee, and Greenwood Resources.

IMPACT

This research can provide information that will benefit southeastern, rural landowners by providing recommendations for short rotation poplar planting stock.

Poplar is the fastest growing, native tree in North America.

Forest landowners can incorporate woody biofuel crops on their land to provide an additional income opportunity with high frequency of income generation compared with traditional timber products.

In-depth evaluation of eastern cottonwood and various hybrid poplar taxa and clones planted across a variety of upland sites will inform landowners from increased productivity.

Louisiana Tech University

PHYSIOLOGY OF SHORT ROTATION POPLAR

A McIntire-Stennis supported project

This study was established to assess physiological characteristics of three eastern cottonwood clones and three hybrid poplar clones across two alluvial and one upland site in Mississippi and Louisiana.

Physiological and growth potentials are being compared across clones and sites. Furthermore, a new pelleted endophyte is being tested to potentially increase some growth traits and disease resistance.

Specifically, we are exploring whether the total leaf area of these trees is a stronger driver of aboveground productivity rather than photosynthetic rates or lean Nitrogen content. Potentially the most productive clones may be the most water efficient. Furthermore, across clones and sites, we are determining if there are detectable whole-tree water use efficiency differences using carbon isotope estimates and above-ground productivity.

COLLABORATION

One researcher at Louisiana Tech and three researchers at Mississippi State are currently collaborating on the project. Two master's level students have been involved in the planting and measurements as well as 10 undergraduate students.

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IMPACT

The direct impact of the project will be assess the particular clones as being viable for biomass production in upland and bottomland areas. Any effect of inoculation may also point to a pathway to increase productivity. Finally, the physiological connections elucidated will aid in future selections of clones that meet both biomass productivity needs while under increasing water availability concerns.

Growth rates up to 20 dry metric tons per hectare per year are possible.

Availability of versatile crops that can supply raw material to diverse industries that manufacture a range of products for various markets is central to strategic deployment of the bioeconomy.

The Southeast will provide most of the woody biomass for energy use, starting at 55 percent in 2010 and increasing to more than 68 percent by 2040.

Louisiana Tech University

SWEETGUM VARIETIES PRODUCTIVITY ON UPLAND SITES

A McIntire-Stennis supported project

This study was designed to assess the productivity and silviculture techniques of native and hybrid sweetgum on upland sites. These stocks may provide ready sources of fiber on an array of sites and offer landowners a diversified crop in the future from traditional pine plantations. In 2015, six sweetgum genotypes were planted at two sites in North Louisiana in Homer at LSU Hill Farm Research Station and Ruston at Louisiana Tech University. Genotypes consisted of four elite hybrid clones and two superior native sweetgum full-sibling families. These planting actually are divided into a traditional genotype study and an herbicide coppice study. The genotype is planted to directly camporee hybrid and superior native genotypes in growth and will soon provide data for longer term model projections. The second study was used to elucidate herbicide recommendations in the first two years of plantation establishment.

COLLABORATION

Four researchers at Louisiana Tech are currently collaborating on the project and one researcher at Louisiana State University. One master's level student is also basing a thesis on the study. Germplasm is co-owned by the company Arborgen and University of Georgia which collaborate on project objectives.

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IMPACT

This will offer new insight into species selection of forest plantations planted for pulp and paper. More specifically, growth rates of the species will be elucidated and various silviculture techniques will be fined tuned as a result of this study.

Sweetgum represents 6.9 percent of all timber harvested in Louisiana.

Sweetgum comprises 28.9 percent of the total hardwood timber harvest in Louisiana.

Sweetgum ranks second to only loblolly pine among all species harvested in Louisiana

Louisiana Tech University

ASSESSING THE LIKELIHOOD OF DETECTING CHANGE FOLLOWING DISTURBANCE

A McIntire-Stennis supported project

The Hill Farm research station in Homer, Louisiana is conducting a study to understand the drought tolerance of both native and genetically improved loblolly pine trees. Summer droughts can cause growth reductions and death in pine trees. As the trees become more stressed due to drought, they can attract fungus and bark beetles. Understanding how pine trees respond to reduced rainfall is critical for maintaining high plantation productivity despite summer drought.

This research is the result of a partnership between Louisiana Tech University and Louisiana State University. Native and improved pines were planted in 2005 to establish a forest stand and these 15 year old trees will be the subjects of the study. Drought was simulated at this site by using a ditch witch to trench around each plot. Plastic sheets were put into the trenches and wrapped around tree plots to prevent lateral water flow. Plastic shelters were constructed around each tree to stop vertical water flow during rainy days. The effect of drought mitigation techniques will also be evaluated. Thinning is a common forestry practice where poor performing trees are culled to give robust trees more room to grow. A portion of our tree plots were thinned to see if reduced resource competition could increase pine tree drought tolerance during dry periods. Height and diameter of each tree will be measured throughout of the study. The photosynthesis and gas exchange rates will be tracked and compared between the native and improved pine trees to determine which genotypes are the most efficient.

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COLLABORATION

Researchers from Louisiana Tech, LSU, Indiana University of Pennsylvania, and the Forest Service work together with numerous LaTech undergraduate and graduate students to make this project a success.

IMPACT

This project will inform state landowners on drought effects to their forests. The extreme summer drought of 2010 caused to experience reduced growth and mortality. Not all trees were affected equally. Assessing genotypes for drought tolerance among growth traits may be recommended for forest landowners who want to prepare assets for any future drought. Using thinning may help in reducing effects of drought. This study will illustrate how loblolly pine trees grow best in our region and whether thinning should be used to alleviate drought stress.

Loblolly pine is the dominant timber species in the southeast US

Intergovernmental Panel on Climate Change (IPCC) estimates the Western Gulf states will experience a 5-10 percent decrease in summertime precipitation by the end of the 21st century.

Improving the drought tolerance of loblolly pine is critical to withstand droughts that occur over at least a 20- to 30-year rotation age.

Louisiana Tech University

IMPROVING SAMPLING EFFICIENCY AND ACCURACY OF WESTERN GULF FORESTS - VANDER-MODELING

A McIntire-Stennis supported project

A variety of sampling methods have been examined to determine which techniques result in accurate and precise estimates of stand attributes while minimizing costs and time. Due to economic and logistic constraints, only a few forest types can be examined using actual field data. In order to conduct examinations of many forest types in a short amount of time, computer simulated data has also been used. Simulation data also has the advantage that the actual population values are known.

Likely errors associated with estimates due to sampling from a population have commonly been quantified using confidence intervals based on frequentist inference, or the concept of repeated random sampling from the same population. Inference in this case is based only on the current sample and statistical theory. However, a newer inferential method referred to as Bayesian inference allows for a user to include “prior” information into quantifying uncertainty about their estimate. Hence, experience inventorying timber in similar stands can be combined along with the current inventory that can help to address extremely low or high estimates calculated from current samples not representative of the population. This research has showed that using Bayesian inference can help a forester better determine the likely range of the actual amount of resource existing on a site.

An initial draft of an Excel spreadsheet to summarize forest inventories has been developed. This program has been reviewed by students and professional foresters. Work is continuing to make a finished product that will be freely available.

COLLABORATION

Field inventories conducted by students during classes are one source of data. Data through collaborative efforts are also used that include inventories conducted by the USDA Forest Service Forest Inventory and Analysis program, by forest industry, on university managed lands, and private consultants. Hence a variety of virtual-world forests representative of actual forest stand conditions are created and field data also helps to conduct this research. The sharing of data and transfer of ideas helps everyone in this region gain a better understanding of how to conduct more efficient forest inventories.

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IMPACT

Several papers have been developed and presentations have been given. These papers and presentations allow for foresters and planners to gain a better understanding of how various inventory methods can either increase sampling efficiency or to maintain the same level of sampling efficiency but at a lower cost. By sharing data and getting feedback from foresters I can also gain a better understanding of what issues should be examined to increase sampling efficiency of forests in the Western Gulf. Once finished the Excel forest inventory summary program will provide a freely available program for foresters to use.

Optimal silvicultural and forest management decisions require accurate inventory.

Forest inventories can give insight into amount of timber, wildlife habitat, degree of insect damage, and quantifying recreational opportunities.

Natural resource inventories encompass a wide-range of spatial scales, from microsites within a forested stand, to stands, to inventories at the state level, to regional, national, and even global level inventories.

Louisiana Tech University

AVIAN USE OF A BOTTOMLAND HARDWOOD AFFORESTATION SITE IN THE RED RIVER ALLUVIAL VALLEY

A McIntire-Stennis supported project

Bottomland hardwood forests (BHF) cover about 2.8 million hectares of the original 10 million hectares that once existed in the southeastern United States. These losses have led to an emphasis on afforestation of retired agricultural land.

Research was needed to evaluate changes in wildlife communities as these afforested stands progress through succession. To assess the avian community at this 25-year-old afforested BHF, we conducted point count surveys at 28 locations across seven forest types, six times during the 2016–2018 avian breeding seasons.

Our research objectives were to determine

- if avian density and diversity varied among the dominant forest types that have developed in the research site
- how this BHF compared to mature BHFs of the southeastern United States that were at least 50 years old

Results indicated that avian density varied among forest types showing five statistical groupings, with ranges in density from 22.836 to 6.634 birds/ha among forest types. Avian diversity analyses indicated no significant difference among the seven forest types. Results of comparative analyses indicated that the research site was 68 percent similar in avian species composition to mature BHFs in the southeastern United States, thus not meeting the goal of 75–85 percent similarity.

Our management recommendation is to allow this site to continue on its current path of increasing in similarity as it has shown to have done over the past three breeding seasons, with forest management only taking place if non-native tree species begin to establish in open canopy areas.

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IMPACT

The results of this study may give direction to other land managers around the Red River Alluvial Valley who are interested in avian bottom land hardwood habitat management.

Bottomland hardwood forests cover about 2.8 million hectares of the original 10 million hectares that once existed in the southeastern United States.

Prothonotary warblers and wood thrushes are two examples of bird species experiencing population declines due to BHF habitat loss.

The Farm Bill's Conservation Reserve Program increased monetary incentives for farmers to return land to a more natural state providing future BHF for birds.