

FOREST & WILDLIFE RESEARCH CENTER 2024 ANNUAL REPORT

4 CONSERVATION
ACROSS
LANDSCAPES

12 HEALTHY
MARKETS,
HEALTHY
FORESTS

20 CLEAN WATER,
CLEAN ENERGY

28 ONE HEALTH



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FOREST AND WILDLIFE RESEARCH CENTER

FOREST & WILDLIFE RESEARCH CENTER 2024

ANNUAL REPORT

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The Forest and Wildlife Research Center is a unit in the Division of Agriculture, Forestry, and Veterinary Medicine at Mississippi State University.

The mission of the Forest and Wildlife Research Center is to promote, support, and enable the management, conservation, and utilization of forest and other natural resources to benefit the stakeholders of Mississippi, the nation, and the world.



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ON THE COVER: Biological communities are an indicator of forest health. FWRC scientists are studying how forest composition affects bird species. (Photo submitted)

CONTENTS

CONSERVATION ACROSS LANDSCAPES	4
LIFTING THE CROWN	6
BRANCHING OUT FOR BIRDS	8
A SECOND LIFELINE: THE AMAZON'S AERIAL RIVER	10
HEALTHY MARKETS, HEALTHY FORESTS	12
FORESTS FOR THE FUTURE	14
FORECASTING THE FOREST	16
PROTECT AND SERVE	18
CLEAN WATER, CLEAN ENERGY	20
SEEING BIOMASS DIFFERENTLY	22
BIOCHAR'S POTENTIAL	24
FUELING AN ENERGY-HUNGRY WORLD	26
ONE HEALTH	28
FIRST LINE OF DEFENSE	30
MAPPING TICKS	32
PIGS ON THE MOVE	34
GROWING LEADERS	36
ENDOWED CHAIRS	44
BUILDING CAPACITY	48
THESES AND DISSERTATIONS	52
FACULTY LISTING	56
BY THE NUMBERS	60

FROM THE DIRECTOR

THANK YOU for your support of the Forest and Wildlife Research Center (FWRC) at Mississippi State University. We are proud to serve as Mississippi's research leader in the conservation, management, and sustainable use of forests, forest products, wildlife, and fisheries for the benefit of all Mississippians. Our work is made possible by dedicated partners who collaborate with our scientists and students to protect and sustain the state's natural resources.

Mississippi's abundant natural resources are vital to both our environment and economy.

The state's 19.2 million acres of forestland generated \$1.48 billion in production in 2024. Forest-related industries supported 84,035 jobs and contributed more than \$4.42 billion in income. Mississippi ranks third nationally in pine pulpwood production and fifth in pine lumber production. With 3,900 certified tree farms and 22 Tree City USA communities, the state demonstrates a strong commitment to stewardship. Mississippi State University is also recognized as a Tree Campus Higher Education, thanks to the efforts of our forestry faculty, students, alumni, and partners.

In this annual report, we highlight FWRC's work in four key areas: conservation across landscapes; healthy markets, healthy forests; clean water, clean energy; and one health. These examples represent only a portion of the impactful research underway. Although FWRC is one of MSU's smaller research units, it is among the most productive—accounting for about 5 percent of the university's total research portfolio. In 2024 alone, our scientists secured more than \$14 million in research funding and published 184 scientific papers. This outstanding performance ranks MSU 14th nationally in the National Science Foundation's natural resources research category. More than 55% of our funding comes from external grants, allowing us to more than double our state investment and amplify our economic impact.

Our research not only advances science but also attracts and supports industry in Mississippi. We collaborate with companies and landowners to address challenges, develop solutions, and strengthen the state's natural resource economy.



Working alongside our state and industry partners, we help bring new business to Mississippi while supporting existing ones.

Equally important, we are training the next generation of natural resource professionals. In Fall 2024, FWRC supported 169 graduate students and 483 undergraduates who actively contribute to our research and outreach. Watching these students grow into future leaders of conservation and resource managers is one of our greatest rewards.

I invite you to explore this report and learn more about the depth and impact of our work. You will see the passion our faculty, staff, and students bring to understanding, conserving, and utilizing Mississippi's natural resources. Together, we will continue advancing these shared priorities. Thank you for your support.

L. WES BURGER

DIRECTOR



CONSERVATION ACROSS LANDSCAPES

CONSERVATION

APES

From bottomland hardwoods to open pine savannas to coastal marshes, Mississippi is home to some of the most biodiverse landscapes in America, and scientists in Mississippi State's Forest and Wildlife Research Center (FWRC) strive to protect the biodiverse hotspots in our own backyard and across the world. FWRC scientists develop tools that tackle conservation at the landscape level, finding ways to address environmental challenges, reduce nutrient transport, provide carbon storage, and improve best management practices in conservation. We lay the groundwork to protect and restore ecosystems in the region and around the world so those systems and the species they support can grow and thrive.

LIFTING THE CROWN

AN ALTERNATIVE AMID DECLINING PULP MARKETS

BY ANSLEE BOYD

WITH THE DECLINE of pulp markets, small forest landowners in Mississippi face challenges in managing loblolly pine plantations effectively. Traditionally, these pine stands are planted at high densities, allowing for mid-rotation thinning as a crucial practice to remove weaker trees, enhance stand quality, and sustain forest health. However, the shrinking pulp market has made thinning financially unfeasible for many of Mississippi's nonindustrial private forests, or NIPF, landowners.

DR. JOSHUA GRANGER, associate forestry professor and Forest and Wildlife Research Center, or FWRC, scientist, led a study, with the help of recent Mississippi State master's graduate Darcey Collins, to evaluate an alternative solution to costly thinning operations: reducing initial plant densities combined with manual pruning, known as crown lifting. Conducted at the Mississippi Agricultural and Forestry Experiment Station, or MAFES, Truck Crops Branch in Copiah County,

this strategy aimed to maintain forest health and timber values without requiring expensive thinning operations.

"A few years ago, landowners got paid to have their pine stands thinned," Granger explained. "Now, they have to pay out of pocket, which just isn't feasible for most people."

The declining pulp industry, primarily driven by reduced paper consumption and mill closures, has made traditional thinning operations difficult to maintain.

"If you have thousands of acres, thinning is still the best option," Granger explained. "But for the average small landowner in Mississippi with 10 to 30 acres, this novel approach is a great alternative. If the landowners are willing to put in the time and labor, they can keep their forest more productive."

This study also examined the benefits of lowering initial planting densities to reduce competition for resources, allowing trees to grow at a steady rate without the need for commercial thinning. The study indicated the development

of larger crowns, resulting in increased diameter growth, improved wood quality, and greater resistance to environmental stressors.

DR. ADAM POLINKO, assistant forestry professor and FWRC scientist, evaluated wood quality and growth implications in the study. The silviculturist elaborated on the core issue with the shift away from thinning.

"Overcrowded, stagnant stands are increasingly susceptible to disease and insect infestations. Without thinning,





lower quality trees remain, lowering the overall value of the stands,” he noted. “Without a viable thinning market, we have to find ways to control competition and maintain wood quality. Crown lifting starts with planting at lower densities, then artificially raising the crown by pruning to mimic higher densities that would otherwise need to be thinned. Crown lifting selectively reduces lower limbs and concentrates growth on upper portions of the tree.”

DR. KRISHNA POUDEL, associate

forestry professor and FWRC scientist, examined the feasibility of implementing crown lifting and highlighted its time-consuming nature.

“Pruning is labor intensive, but for small landowners, it provides an affordable alternative to commercial thinning and improves the wood quality,” Poudel stated.

While crown lifting requires effort, it allows landowners to maintain healthier forests and produce higher value timber without incurring the high costs of traditional thinning methods. Given the

unpredictability of timber markets, alternative practices like crown lifting and lower density planting offer promising avenues for maintaining productive and healthy forests. ■

This research was funded by the MSU Forest and Wildlife Research Center, Mississippi Agricultural and Forestry Experiment Station, and the USDA National Institute of Food and Agriculture.

BRANCHING OUT FOR BIRDS

FWRC SCIENTISTS EXPLORE HOW
MANAGED FORESTS SHAPE
AVIAN COMMUNITIES

BY KAITLYN CHURCH

WITH MORE THAN HALF of the land in Mississippi consisting of working forests, understanding the relationship between priority bird species and landscape composition is a key focus for researchers in Mississippi State University's Forest and Wildlife Research Center. Working alongside commercial timber companies, scientists are exploring how managed forests influence bird populations.

DR. KRISTINE EVANS, a wildlife, fisheries, and aquaculture associate professor and FWRC scientist, led the study, examining how the arrangement of working pine forest stands impacts key bird species. "This project tested an ecological hypothesis that suggests it's the total amount of habitat, and not its arrangement on the landscape, that drives wildlife species. We put that to the test through carefully designed field surveys and analyzed results from an altered system," Evans said.

With the support of member companies of the National Council for Air and Stream Improvement, the team evaluated tree stands managed by Weyerhaeuser Company, the largest corporate timberland owner in the United States.

"Research has been ongoing at one of these sites since the 1960s. Weyerhaeuser has been able to track wildlife and plant communities across full rotations

of timber, so it has always been a very positive relationship between the company and researchers," Evans added.

CRAIG SKLARCZYK, a recent MSU master's graduate, studied pine bird species for his thesis, leveraging the varied ages of trees in working pine forests.

"We were interested in the working pine systems because it creates this mosaic of different forest stages across the landscape. We can then compare how the size and configuration of timber forest patches affect bird species in the context of these theories," Sklarczyk said. "Birds are also amazing bioindicators as they are readily available to survey and are quickly responsive to environmental change, so how they react to forest change can have important implications."

The study focused on loblolly pine stands in Kemper, Noxubee, Webster, Chickasaw, and Calhoun counties. Sklarczyk noted the benefit of working with Weyerhaeuser-owned stands.

"Working pine forests offer a great framework to study these larger landscape ecosystems. Collaborating with Weyerhaeuser also provides other benefits, since we do not have to manipulate the stands ourselves, we can focus solely on the birds. Weyerhaeuser is doing all the harvesting and stand management, so we can passively survey the birds," Sklarczyk said.

Researchers used bird point counts

and vegetation surveys to assess bird species across different forest configurations.

"We found that configuration of forest patches in landscape is important, not just the amount of forest landscape available as stated in previous hypotheses," Sklarczyk explained. "When we graphed the data for individual bird species, we found species had a wide range of responses to the landscape pattern. However, when we analyzed the entire avian community, we found that these varying degrees of responses were neutral. This demonstrated that to understand how a landscape affects bird species, we must examine each species individually."

Findings could influence how private





Craig Sklarczyk holds a bird in a Weyerhaeuser managed forest. (Photo submitted)

timberlands support critical bird species across the Southeastern U.S.

“There are many bird populations in decline, particularly grassland and shrubland species, such as the Northern Bobwhite quail and Prairie Warbler, which prefer young forest patches. We found that these cutovers support many declining early successional species,” Sklarczyk said. “When people think of working forests, they might consider clear cuts to be harmful to wildlife, but we found that this turnover in forest vegetation to grassland and shrubland conditions can help several declining bird species.”

Evans notes opportunities for timber

companies to enhance bird conservation through small management adjustments.

“We could assist commercial timber companies to apply small adjustments to their systems in order to enhance these avian communities,” Evans explained. “Bird species are excellent ambassadors for conservation, but there is still much to learn about how landscape patterns impact their communities. We are committed to expanding our understanding.”

DR. DANIEL GREENE, a wildlife scientist for Weyerhaeuser Company’s Southern Environmental Research Program, said studying birds helps landowners guide forest management and

conservation plans.

“Birds are an excellent group of wildlife to study to improve our understanding of how forest management influences their abundance and richness. Studies like this allow us to include recommendations for certain species and their habitat in future forest management plans,” Greene said. ■

This research was done in collaboration with Weyerhaeuser Company. The Forest and Wildlife Research Center and the National Council for Air and Stream Improvement Inc. funded this research.

A SECOND LIFELINE: THE AMAZON'S AERIAL RIVER

FWRC SCIENTIST STUDIES THE AMAZON HYDROCLIMATE AND REFORESTATION TO PROTECT THE BASIN'S FUTURE

BY VANESSA BEESON

TWO RIVERS define the Amazon Basin—the well-known Amazon River, stretching nearly 4,000 miles across nine countries before reaching the Atlantic Ocean; and the lesser-known but equally vital aerial river, consisting of the water in the atmosphere that originates in the Atlantic and moves by trade winds back toward the Andes. This atmospheric system delivers the moisture that sustains the Amazon rainforest, and is also fed by the water that Amazon trees transpire back into the air. Together, these two rivers and their complex movements and transformations make up the Andes-Amazon-Atlantic (AAA) pathway. While much research has focused on the region's terrestrial ecosystems, its hydroclimate, notably the AAA pathway, remains understudied.

DR. SANDRA CORREA, a researcher in Mississippi State University's Forest and Wildlife Research Center and associate professor of aquatic ecology in the Department of Wildlife, Fisheries and Aquaculture, contributed to a collaborative study examining how changes in the AAA pathway impact the Amazon River Basin's social-ecological system. The research also provides recommendations

to support the pathway's sustainability.

"Half of all the freshwater that enters the Atlantic Ocean comes from the Amazon, and 40% of all the sediments from freshwater that enter the Atlantic originate in the Amazon Basin. We tend to think rivers only carry water, but they also transport nutrients and sediments that shape coastlines and store carbon in the oceans," Correa explained.

Dr. Claire Beveridge, a former post-doctoral researcher at Florida International University who coordinated the project, noted a significant shift in the AAA pathway due to increasing hydroclimate extremes.

"A major change is the rise in hydroclimate extremes, varying by region. The northern Amazon sees increased rainfall and flooding, while the south experiences reduced rainfall, lower streamflow, more droughts, and warming temperatures," Beveridge said.

The shifts, historically tied to El Niño and La Niña, now also stem from environmental and land use changes, including dam construction for hydropower, which disrupts river flows and connections.

Correa said these extreme weather patterns directly impact communities that

depend on the river system for survival.

"In the Amazon, rivers are the roads. When droughts hit, they become intermittent, even drying out completely in some places. That means communities become isolated—people can't reach towns to buy supplies, and, suddenly, we're having to bring bottled water into the Amazon, which makes no sense," Correa said.

To address these challenges, the research team outlined key recommendations including expanding monitoring efforts across the region, improving data collection and management through





Adrian Munoz Veloz
maps fruit bearing
trees in the Amazon.
(Photo submitted)

cross-border collaboration, and strengthening interdisciplinary partnerships. They also emphasized the urgent need for climate change mitigation efforts.

One such initiative involves reforestation, which directly supports not only the AAA pathway but also the Amazon's fisheries. Correa and her master's student, **ADRIAN MUNOZ VELOZA**, are studying how fruit-bearing trees help sustain fish populations in floodplain forests.

"In tropical wetlands, fruit-eating fish play a critical role in maintaining biodiversity and ecosystem function

through seed dispersal. In turn, floodplain forests provide essential food sources that sustain thriving fisheries. Research shows that trees are key to conserving and increasing fish diversity and abundance in these flooded environments," Correa said.

The team is conducting research in the Yahuaraca lake system in the Colombian Amazon to identify tree species that produce fruit consumed by fish. By mapping these trees along the floodplain's elevation gradient, they aim to support restoration efforts that enhance

fruit availability, ultimately benefiting fish populations. Their findings will provide a foundation for expanding restoration initiatives in similar ecosystems. ■

This research was a collaboration between researchers from Florida International University, Mississippi State University, Cornell University, University of São Paulo, Lancaster University, University Grenoble Alpes, Pontificia Universidad Católica del Perú, Université de Toulouse, and Wildlife Conservation Society, with funding from the Gordon & Betty Moore Foundation.

HEALTHY MARKETS, HEALTHY FORESTS



Mississippi State's Forest and Wildlife Research Center scientists advance sustainable forest management strengthening both forests and markets. Their work ranges from studying how conservation easements impact land use to developing cutting-edge tools that combine satellite imagery and AI to detect southern pine beetle damage in real time. In partnership with the U.S. Department of Defense, they're also testing and improving mass timber products like cross-laminated timber and glulam to enhance durability, strength, and longevity, ensuring the future of forestry remains both innovative and resilient.

FORESTS FOR THE FUTURE

PROTECTING LAND WITH CONSERVATION EASEMENTS

BY ANSLEE BOYD

CONSERVATION EASEMENTS have emerged as a critical tool for keeping working forest lands forested. Mississippi State University's Forest and Wildlife Research Center, or FWRC, scientists are exploring the economic and legal complexities of conservation easements and their impacts on private landowners.

This ongoing research led by **DR. CHANGYOU "EDWIN" SUN**, a George L. Switzer Professor of Forestry and FWRC scientist, focuses on the implications of property rights encumbered by conservation easements. With the grant spanning from 2022-2026, this study aims to shed light on how these easements influence landowners' financial decisions, property values, and the long-term viability of working forests.

Conservation easements serve as a legal tool to balance land development with environmental stewardship. These agreements, which have grown in popularity over the past four decades, place long-term restrictions on land use to protect conservation values.

Currently, around 2.9 percent, or 66 million acres, of land in the United States is under a conservation easement. For many landowners, the key financial benefit of conservation easements is tax benefits. Conservation easements provide a landowner financial incentives, either direct payments or tax credits, in exchange for giving up certain future developmental rights.

"These easements help balance the tension between development and the condition of forestland and residential areas," Sun said. "When land is placed in a conservation easement, the property value is reduced, and they can receive federal and state income tax benefits if the agreement meets the requirements of tax laws."

However, conservation easements also come with long-term financial and operational constraints.

"Because these agreements are often permanent, they can limit traditional revenue streams such as timber harvesting," Sun noted. "Landowners need to weigh the benefits of tax incentives against potential restrictions on land use."

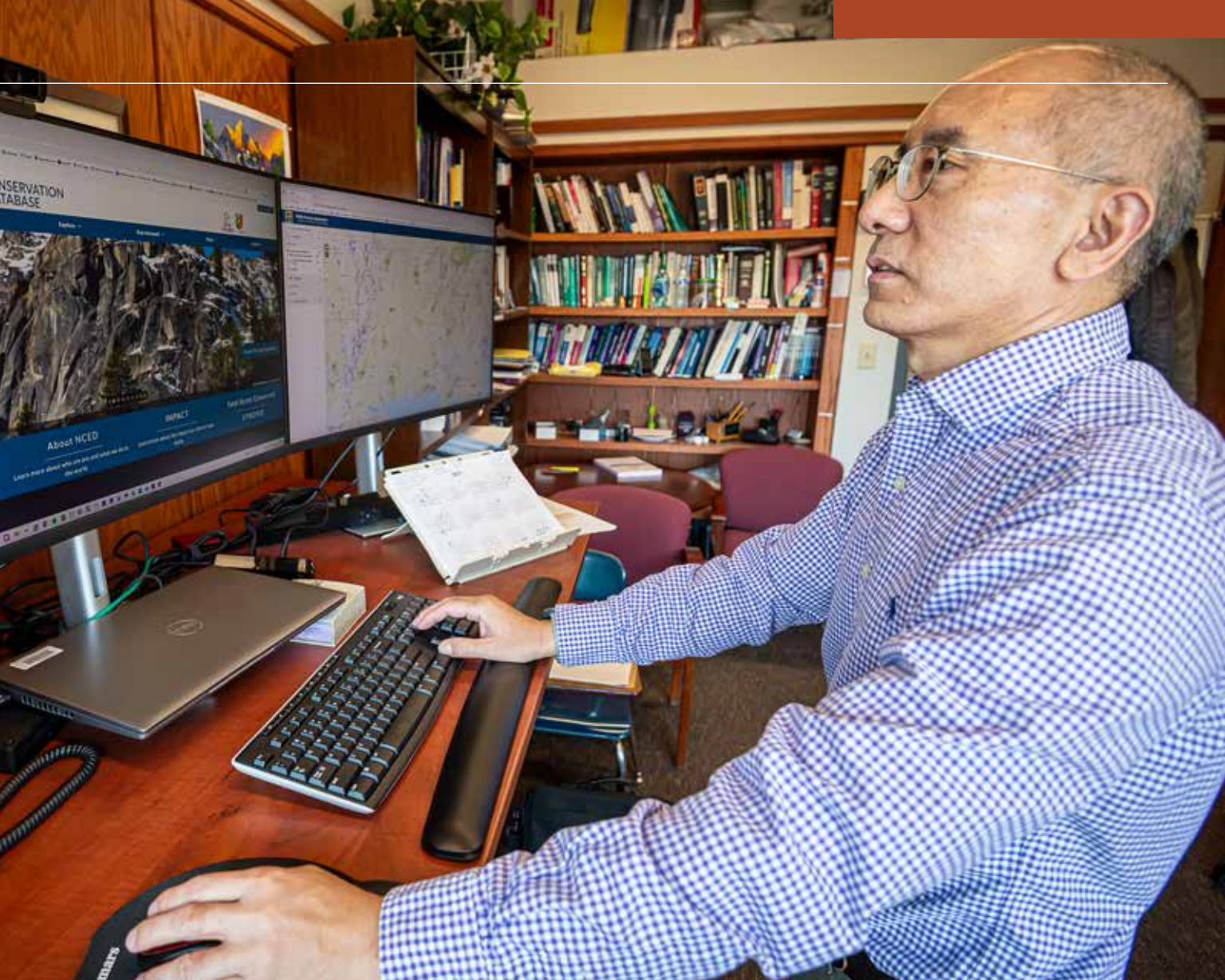


Dr. Edwin Sun looks over properties in conservation easements.
(Photo by David Ammon)

The legal implications of conservation easements are another major focus of the study. Sun and his team have analyzed over 340 legal cases related to conservation easements, finding that nearly 40% of disputes involve taxation benefits, while 60% are centered on land-use restrictions.

"Some landowners don't realize the full extent of the restrictions until years later, especially when land is passed down through generations," Sun explained. "Many second- or third-generation owners find themselves restricted by specific clauses they were not aware or did not expect, leading to legal disputes over land rights."

He further noted, "Owners often feel



regret. Some of them want to get rid of or revise the easement terms, sometimes years or even decades later. However, these restrictions are generally permanent, making it difficult to alter them.”

The economic impact of conservation easements varies by region. In high-growth areas around major cities, these agreements help manage development. In rural areas like Mississippi, the benefits are less clear-cut.

“Unlike urban areas, rural regions don’t face the same development pressures, so the financial benefits of conservation easements may be less substantial,” Sun said. “In some cases, the land value before and after adopting

the conservation agreement remains largely the same, reducing the overall financial return for landowners.”

As conservation easements continue to shape landownership across the United States, Sun and his team aim to provide landowners with comprehensive information to make informed decisions.

“Our goal is to answer the fundamental questions surrounding conservation easements. With the right information, landowners can better navigate the complexity of these agreements,” Sun said. “Data remains a major constraint in this research because these are private agreements. Landowners don’t always make these agreements

public, which makes it difficult to assess their true economic impacts.”

By evaluating the long-term effects of conservation easements, this study will help shape policies that support both landowners and environmental conservation efforts in the future.

“We are still in the middle of this research,” Sun said. “But early findings suggest that tax benefits are a major driver, while long-term land-use restrictions remain a key source of conflict.” ■

This research was funded by the MSU Forest and Wildlife Research Center, Mississippi Agricultural and Forestry Experiment Station, and the USDA National Institute of Food and Agriculture.

FORECASTING THE FOREST

SATELLITES AND AI TEAM UP TO FIGHT PINE BEETLE OUTBREAKS

BY MEG HENDERSON

THE SOUTHERN PINE BEETLE, or SPB, silently spreads through forests, causing damage long before it is visible to the naked eye. SPB outbreaks are difficult to contain. Each year, they lead to over \$40 million in damage in six Southeastern states. Mississippi's last major outbreak, 30 years ago, destroyed over 10,000 acres and \$23 million of Mississippi timber.

Traditional monitoring methods including site visits, pheromone traps, and aerial photography are still used today. But deploying experts to walk through or fly over an area is costly and time-consuming. NASA's Landsat imagery, publicly available since 2008, gave scientists a groundbreaking tool for viewing large, forested areas, capturing a satellite image of a given location every 16 days. But, while Landsat was a game-changer at the time, it still lacked the detail and immediacy to spot signs of early beetle damage.

Mississippi State University's Forest and Wildlife Research Center, or FWRC, recently collaborated with scientists from Louisiana Tech University, Northwest Missouri State University, and the U.S. Forest

Service to investigate beetle damage in the Bienville National Forest using leading-edge tools. They combined existing technologies—next-generation satellite imagery and AI-powered remote sensing software—to work in a novel collaboration allowing foresters to pinpoint the location and extent of damage throughout an entire forest in real time.

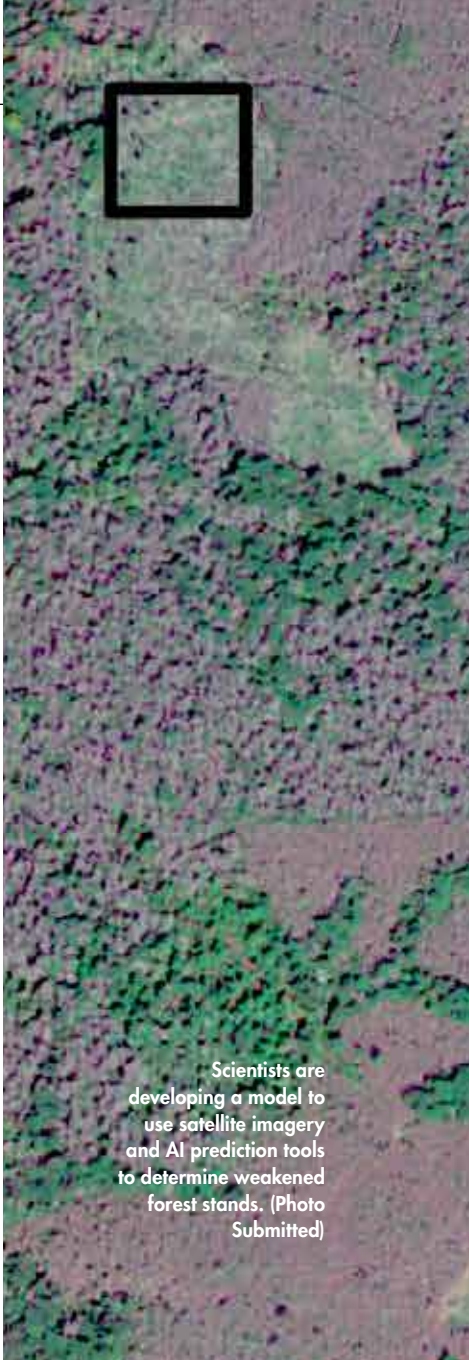
Principal investigator Michael Crosby, an associate professor of geographic information science at Louisiana Tech University, gathered images from WorldView-2, a satellite that captures on-demand, high-resolution photographs of any given location on Earth. Crosby, also an alumnus of MSU's College of Forest Resources, used a deep learning software program called Erdas Imagine to sharpen and "stitch together" the 21 images to create a single picture covering the 178,000-acre Bienville forest, home to some of central Mississippi's largest old-growth pine trees. He then applied a data processing technique called Principal Component Analysis (PCA) to detect patterns based on combinations of spectral bands in these large image datasets.

"Spectral bands, including color and

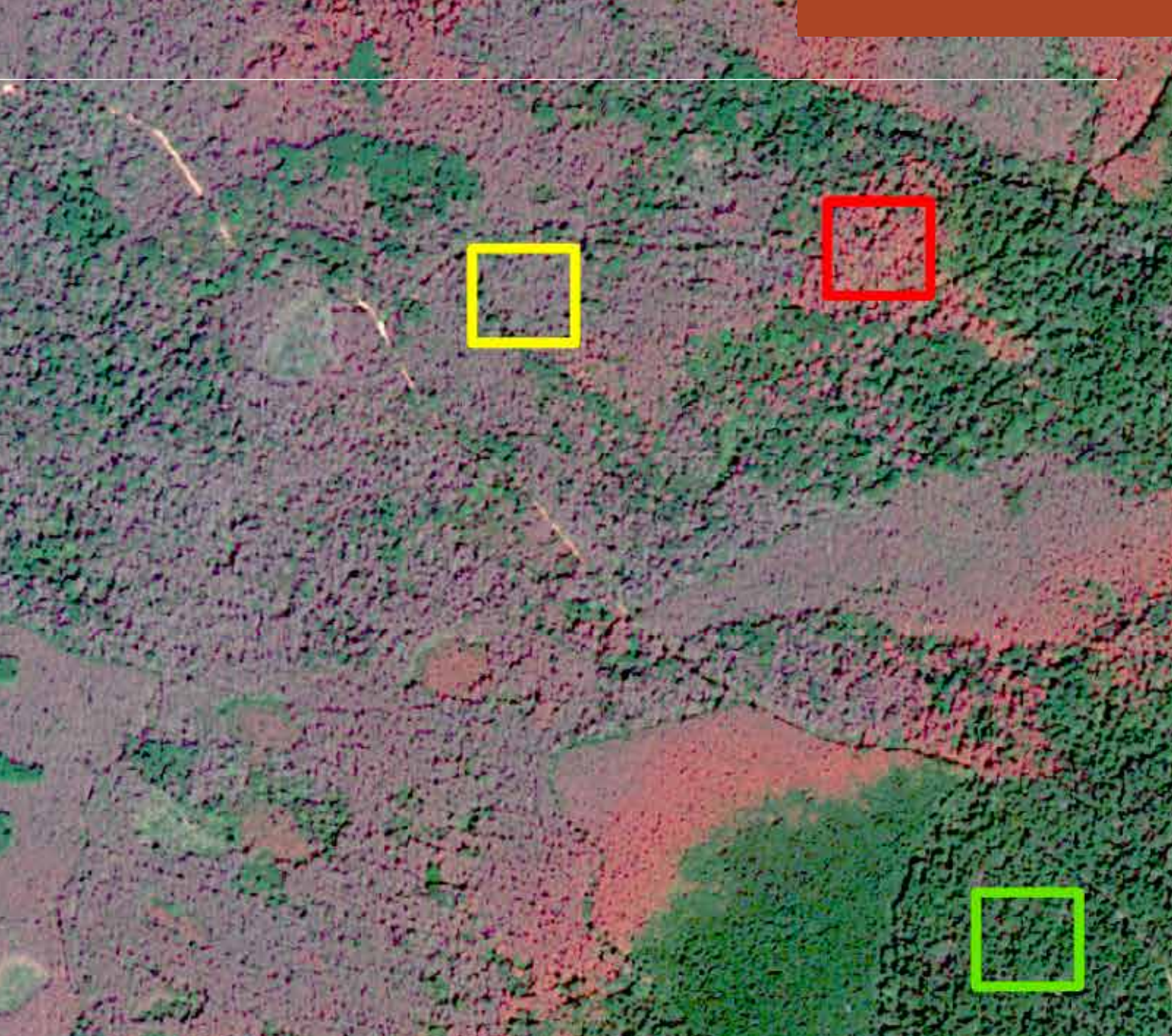
near-infrared, can detect various stages of vegetation stress," Crosby said. "By analyzing the different wavelengths in the images, we can pinpoint early signs of infestation before trees begin showing symptoms."

Managed by the U.S. Forest Service—a partner in and funder of the study—many parts of the Bienville forest have become overcrowded due to decades-old practices that favored closer planting. Overstocking—a term used by foresters—has made these pines easy targets for beetles.

Co-principal investigator **ERIC**



Scientists are developing a model to use satellite imagery and AI prediction tools to determine weakened forest stands. (Photo Submitted)



MCCONNELL, an associate professor in MSU's Department of Forestry and FWRC scientist, explained that these Q-tip shaped "dog hair" trees increasingly compete for resources—light, water, and nutrients—thus their spindly appearance and weakened health and vigor over time. Early detection can better inform managers when and where to cut trees to stop beetle damage in its tracks and minimize economic loss for the owner.

"In forestry, we use growth and yield models to predict when to thin a stand,

which is usually 16 to 20 years," said McConnell. "This study will allow us to compare those models with what we observe in real time to identify danger spots and protect forest ecosystems and economic investments."

Crosby and McConnell have considered broader applications of their research, which benefits both the timber industry and conservation efforts. With greater computing power, their methods could be scaled up to monitor an entire state or region. Additionally, the

process could be adapted to analyze tree damage from other natural disasters, such as drought, fire, hurricanes, and tornadoes. "When we can better monitor and forecast damage, we can avoid risking extensive ecological and economic loss," said McConnell. "We can't outsmart biology, but we can minimize widespread epidemics." ■

This project, funded by the U.S. Forest Service, includes collaborators from Louisiana Tech University, Northwest Missouri State University, and the U.S. Forest Service.

PROTECT AND SERVE

FWRC RESEARCHERS PARTNER TO MEET DOD BUILDING NEEDS

BY VANESSA BEESON

MISSISSIPPI STATE UNIVERSITY'S FOREST and Wildlife Research Center leads a \$3.3 million partnership with the Department of Defense enhancing the durability, performance, and rapid testing of key wood products used in military infrastructure.

The project focuses on cross-laminated timber (CLT) and glulam—two mass timber products increasingly used in commercial and tall wood construction. Researchers are conducting durability testing; evaluating strength, stiffness, and dimensional stability; and developing a rapid test to assess railway ties for replacement.

DR. RUBIN SHMULSKY, professor and head of MSU's Department of Sustainable Bioproducts, emphasized the project's national impact.

"I am excited that Mississippi State gets to do work that will be impactful at the national and international scale and that the DoD has chosen us for this work.

We're humbled by and committed to this opportunity," said Shmulsky, who is also an FWRC scientist.

The first phase of the research will establish durability testing protocols for glulam and CLT, based on wood species and product type.

"The durability and protection of wood from decay, termites, fire, and other detractors is of critical importance," Shmulsky said.

A second phase will improve railway infrastructure by developing a faster test for determining when rail ties need replacement. The current method takes 30 seconds per tie—MSU scientists aim to develop a test capable of analyzing up to 15,000 ties per hour.

"The United States has approximately 140,000 miles of railway. The DoD owns and operates several thousand miles of track. Most of the track rests on wood ties; approximately 3,200 ties per mile. These railways are used to move equipment and

supplies safely and quickly from 'fort to port,' particularly in times of geopolitical uncertainty. The ability to quickly and accurately detect ties that need replacement is a critical issue as it fosters railway safety not just for the DoD but for all rail lines," Shmulsky explained.

The final phase of the project explores how mass timber, including glulam beams and CLT panels, can support DoD facility needs.

"The Department of Defense is the



Drs. Rubin Shmulsky and Dan Seale at the controls of the FWRC's commercial CLT press. (Photo by David Ammon)



federal government's biggest owner and operator of buildings, and they have ongoing needs for new construction and rapid response rebuilding," Shmulsky said. "For example, if a hurricane hits a state like Florida and destroys thousands of buildings, many federal structures may be affected as well. The ability to rebuild quickly is critical, and wood construction—specifically glulam and CLT—offers that advantage. These materials also provide energy absorption properties, including blast

resistance, which is essential for DoD facilities."

DR. DAN SEALE, Emeritus Warren S. Thompson Professor of Wood Science and Technology and recently retired FWRC scientist, said the work also has major implications for the U.S. lumber industry.

"The military has many applications where CLT could be a game-changer, especially in base housing and other infrastructure needs. This project allows us to explore how different grades of lumber

perform in CLT panels while advancing solutions that could ultimately expand the demand for southern yellow pine," he said.

Through topnotch research and strategic partnerships, Mississippi State is driving innovation in military infrastructure while strengthening the nation's timber industry. ■

This research is supported by the Department of Defense and the MSU Forest and Wildlife Research Center.

CLEAN WATER, CLEAN ENERGY



Sustainability drives discovery in Mississippi State's Forest and Wildlife Research Center, where scientists are developing technologies that address global conservation challenges from the ground up. Researchers use lidar to study short-rotation woody crops like eastern cottonwoods and hybrid poplars for their potential as renewable bioenergy sources. They're exploring biochar production as a tool to help prevent wildfires and finding innovative ways to convert rice waste into biofuel. Together, these efforts reflect a comprehensive, solutions-driven approach to sustainability—one that looks to forests, fields, and even agricultural byproducts to power a cleaner, more resilient future.

SEEING BIOMASS DIFFERENTLY

USING LIDAR TECHNOLOGY
TO MAP WOODY BIOMASS

BY KAITLYN CHURCH

A **S DEMAND** for renewable bio-energy grows, researchers in Mississippi State University's Forest and Wildlife Research Center, or FWRC, use mobile terrestrial LiDAR—light detection and ranging—to estimate woody aboveground biomass, or AGB, in short-rotation poplar plantations. Traditionally, AGB is measured using mathematical equations requiring labor-intensive field data, including manual measurements of tree dimensions. FWRC scientists are using LiDAR as a faster and more efficient alternative.

DR. HEIDI RENNINGER, a forestry associate professor and FWRC scientist, led a study examining the effectiveness of measuring biomass levels with a mobile terrestrial LiDAR system rather than by hand.

"We are studying short rotation woody crops, primarily eastern cottonwoods and hybrid poplars in terms of growing them for bioenergy," Renninger said. "Biomass is important because that is what you can

burn for energy from purpose-grown plantations of fast-growing trees. The more trees available, the more biomass and energy you have stored in the system. We needed a fast and efficient way for people to quickly calculate how much biomass they have on their land."

Renninger and her team measured poplar species due to their sustainability as a bioenergy feedstock.

"Researchers have been working to identify trees that can be used for bioenergy, such as trees with high growth rates and the correct chemical makeup. This research has led them to look at eastern cottonwoods and hybrid poplars as a sustainable energy source," Renninger said.

DR. KRISHNA POUDEL, a forestry associate professor, elaborated on the other advantages of studying poplars for bioenergy and bioproduct production.

"We can grow these trees repetitively from cuttings every two to three years, unlike most other trees that only produce

one harvest. The fact that we can grow these sprouts so easily and quickly is what makes poplars so important in terms of bioenergy," Poudel said.

Researchers used backpack LiDAR systems to measure AGB of eastern cottonwood and hybrid poplar at the Mississippi Agricultural and Forestry Experiment Station's Pontotoc Ridge-Flatwoods Branch and the Bearden Dairy Research Center.

"It is essentially a backpack with a sensor on top," Renninger explained. "The



Drs. Heidi Renninger and Krishna Poudel measuring trees in a cottonwood plantation. (Photo by David Ammon)



sensor sends out pulses of energy, and by measuring the angle and time of return of the energy pulse, the LiDAR system creates a three-dimensional map of everything around you. By using LiDAR, we were able to measure thousands of trees in only a few hours.”

Poudel explained how the use of LiDAR improves the accuracy of biomass estimations.

“When we manually measure trees, we do not measure every tree. We only

measure a sample of the trees. When we use LiDAR and create models from it, the system allows us to measure every single tree in the stand, inevitably improving our estimate,” Poudel said.

Renninger explained the importance of testing LiDAR measuring capabilities against manual measurements.

“LiDAR and sensor technologies, in addition to field measurements, allow researchers to have more tools to use to characterize forest stands as

accurately as possible. We found that measuring with LiDAR is just as accurate, if not more, as manually measuring biomass. This is more proof that the concept of using LiDAR as a means of measurement is accurate and can be done,” Renninger said. ■

This research was funded by the U.S. Department of Energy’s Bioenergy Technologies Office and the MSU Forest and Wildlife Research Center.

BIOCHAR'S POTENTIAL

FROM WILDFIRE PREVENTION TO TIMBER ECONOMY

BY VANESSA BEESON

ACROSS NEW MEXICO'S DRY LANDSCAPES, wildfire risk is a persistent challenge. Years of drought, dense forests, and limited commercial logging create conditions that fuel catastrophic wildfires, threatening communities and ecosystems. A new study led by **DR. RAM ADHIKARI**, assistant professor of forestry and scientist in Mississippi State University's Forest and Wildlife Research Center, explores an innovative solution—biochar production.

Biochar, a carbon-rich material created by burning biomass in the absence of oxygen, plays a critical role in carbon storage and sustainability. With applications in bioplastics, renewable energy, agriculture, and wastewater treatment, biochar is gaining traction across industries. While this study focuses on New Mexico, its findings could have significant implications for Mississippi, where biochar could strengthen the state's forestry sector and address environmental challenges.

The research team developed a spatial framework to determine optimal biochar facility locations in New Mexico.

"For any business, location is key to minimizing costs and maximizing revenue," Adhikari said. "We used a cost-minimization approach, factoring in raw material availability, transportation networks, soil conditions, and cropland distribution to identify the best locations."

New Mexico has nearly 25 million acres of forests and woodlands, though only 17% is classified as timberland. The study identified nearly 300,000 dry tons of biomass available annually, with practical considerations reducing that to about 100,000 dry tons. Researchers determined that this could support 23 medium-sized biochar facilities or one large-scale operation in the state.

Adhikari noted that this methodology could be applied in Mississippi, where the forest products industry is well-established.

"Unlike New Mexico, Mississippi's sawmills, plywood, and pulp mills

already compete for wood resources," he said. "However, biochar could be a complementary product—adding economic value while reducing waste."

With Mississippi's abundant timber resources, biochar presents an opportunity to enhance forest management, reduce waste, and support agriculture. The Southeast is home to a high concentration of forest products companies, many of which could integrate this technology.

"Mississippi is in the heart of the U.S. wood basket, where raw material availability isn't an issue," Adhikari said. "Biochar

Dr. Ram Adhikari
with biochar. (Photo by
David Ammon)





has the potential to support rural farming communities in a variety of ways, from soil amendments for row crops to poultry litter management. Additionally, the South's proximity to metropolitan areas offers expanded markets for biochar applications, such as landscaping and wastewater treatment."

High production costs and limited awareness remain barriers to a viable biochar industry in both New Mexico and Mississippi. Adhikari emphasized that addressing these challenges is

essential to realizing its full potential.

While Mississippi does not face the same wildfire risks as the western U.S., managing timber waste remains a significant challenge. Thinning and logging operations generate massive amounts of leftover biomass, much of which is discarded. Biochar offers a sustainable solution—converting this material into a high-value product with broad industry applications.

"Healthy forests are the foundation of Mississippi's timber economy,"

Adhikari said. "By incorporating biochar production, we can enhance industry competitiveness, create new markets for forest landowners, and turn underutilized wood resources into economic opportunities." ■

This research was funded by New Mexico Highlands University.

FUELING AN ENERGY-HUNGRY WORLD

FWRC SCIENTISTS TEST NEW METHODS TO PRODUCE BIO-OIL FROM RICE WASTE

BY MEG HENDERSON

RICE HAS BEEN a worldwide diet staple and a symbol of abundance for millennia. Today, rice agriculture also produces an abundance of waste, to the tune of 800 million tons of rice straw each year. At season's end, rice straw is typically burned to clear fields for the next crop.

However, a new method of disposal might offer a remedy for both a warming planet and an increasingly energy-hungry world.

Scientists in Mississippi State's Forest and Wildlife Research Center, or FWRC, are exploring rice straw as a viable bio-fuel. In its raw form, rice straw bio-oil is not a usable fuel. For this reason, an FWRC team developed a novel catalyst to improve the raw oil's properties and performance. Their discovery proposes a sustainable solution to repurpose agricultural waste and a new alternative to fossil fuels.

DR. EL BARBARY HASSAN, a professor in the Department of Sustainable

Bioproducts, has extensive experience in biofuel research. For this study, the FWRC scientist was joined by departmental colleague **ISLAM ELSAYED**, also an FWRC scientist and assistant research professor, and then-doctoral student Alhasan Ibrahim.

"Rice straw is an ideal biomass feedstock—abundant, low-cost, and capable of producing multiple biofuels while emitting fewer greenhouse gases than fossil fuels," Hassan said.

Harnessing the power of rice straw to produce energy comes with a set of challenges unique to the material's chemical properties. Scientists convert rice straw into raw bio-oil through fast pyrolysis—a process that heats the straw to high temperatures, breaking it down into a liquid bio-oil, a mixture of gases, and biochar. In its raw state, it is not ready to be used in engines for electricity and heat generation or as fuel in vehicles.

"The biggest problem with converting

rice straw to bio-oil is the significant amounts of silica, potassium, and other inorganic compounds, which lead to ash-related problems, such as catalyst deactivation, poor bio-oil stability, and high oxygen content," Elsayed said.

Raw bio-oil is typically acidic, containing water and a high oxygen content, rendering it unstable and incompatible with conventional fuels. Producing a viable biofuel requires upgrading the raw bio-oil with a catalyst, removing the water and acids and lowering the oxygen content.

The team developed and tested a novel bimetallic biochar-based catalyst added



Drs. El Barbary Hassan (right) and Islam Elsayed measure bio oil developed from rice straw. (Photo by David Ammon)



to rice straw feedstock collected from MSU's Delta Research and Extension Center in Stoneville. First, they used fast pyrolysis to produce the raw bio-oil. They activated rice straw biochar with their unique bimetallic catalyst and mixed it with ethanol for processing, and, when complete, separated products into liquid, solid, and gas.

Further trials introduced a novel upgrading method replacing ethanol with butanol, which further reduced the bio-oil's undesirable traits to yield a stable, effective biofuel. Moreover, the catalyst's magnetic properties allowed it

to be separated from the mixture after processing and reused for four additional reaction cycles.

Currently, Hassan and Elsayed plan to extend their research into bio-oil production from other crop residues.

"We'll be shifting our focus to working with agricultural waste from crops more widely available in the U.S.," Hassan said. "The current projects we're pursuing include corn stover and corn straw, non-edible parts of the corn plant left after harvesting."

Converting rice straw into bio-oil represents a major leap in sustainable energy

production—one that could reshape waste management and reduce our reliance on fossil fuels. As these FWRC scientists turn to more regionally available waste products from crops like corn, they continue to position Mississippi as a leader in innovative bio-fuel research. ■

This study was funded by The U.S.–Egypt Science and Technology Joint Fund and the McIntire-Stennis Cooperative Forestry Research Program. Former Sustainable Bioproducts graduate student Alhassan Ibrahim, is currently a postdoctoral associate at Oregon State University.

ONE HEALTH



Human populations are growing and expanding into new geographic areas, altering the natural environment, and forcing wildlife to relocate or limit their habitat. As a result, more people live in closer contact with wild and domestic animals, both livestock and pets, than in years past, providing more opportunities for diseases to pass between animals and people. According to the Centers for Disease Control and Prevention (CDC), 60 percent of known human infectious diseases can be spread from animals, and 75 percent of new or emerging infectious diseases in people come from animals.

One Health is a disease control and prevention approach recognizing the connection between humans, animals, and environmental health. CDC uses the One Health approach to monitor and mitigate public health threats. Scientists in Mississippi State University's Forest and Wildlife Research Center (FWRC) are working in One Health to achieve the best health outcomes for people, animals, and plants in a shared environment.

FIRST LINE OF DEFENSE

FWRC COMBATS ILLEGAL LOGGING
BY VANESSA BEESON

ILLEGAL LOGGING isn't just an environmental issue—it's a socio-economic challenge that fractures communities and endangers public health. When forests are fragmented to fuel illegal logging, animals lose their habitat, and local communities lose access to vital resources. Illegal logging can even indirectly spur infectious disease, making the issue a One Health priority. Scientists in Mississippi State's Forest and Wildlife Research Center, or FWRC, are helping strengthen a first line of defense against this pressing issue.

"Illegal logging triggers a vicious cycle, depleting valuable resources and disrupting forest ecosystems. The loss of critical habitats damages biodiversity, impacting species like bats, which might increase human-wildlife contact, and, ultimately, the risk of disease in livestock and humans," said **DR. MANUEL RUIZ-ARAVENA**, FWRC scientist and assistant professor in the Department of Wildlife, Fisheries and Aquaculture.

To combat illegal logging, FWRC researchers, led by **DR. FRANK OWENS**, sustainable bioproducts associate professor, are refining an artificial intelligence model developed in cooperation with the USDA Forest Products Laboratory. The model puts the power of wood identification into the hands of timber inspectors and customs officials.

The XyloTron, a computer vision-based system, allows non-experts to rapidly identify wood species with the click of a button. In cases where harvesting or trade of the identified species is protected or controlled under local laws or international treaties, the material can be flagged for forensic investigation. Owens and his team are investigating how human and hardware-related factors impact the model's accuracy.

"The XyloTron's AI model is trained to recognize common wood species by analyzing thousands of images," Owens said. "In the field, an inspector simply prepares a wood sample, takes a magnified

digital photo of the end grain, and the system outputs its best estimate based on probability. This helps enforcement agencies detect protected or endangered wood before it enters the supply chain."

Unlike traditional wood identification methods that require years of specialized training, the XyloTron can be operated with very simple instructions, making it a game-changer for conservation and law enforcement.

While AI-powered wood identification is a promising tool, its effectiveness depends on how it is used. Last year, Owens and his team conducted a study on how poor sanding of wood samples



Drs. Frank Owens (left) and Adriana Costa (right) work with Asi Ebeheakey, sustainable bioproducts doctoral student, to identify wood using the XyloTron. (Photo by David Ammon)



could negatively impact the system's performance. Their latest study builds on that research, exploring how poor focus, scratches, image resizing, and color distortions impact the model's performance.

The findings showed that while the model adequately tolerated some changes, like digital scratches, red color shifts, and smaller areas of slight-to-moderate blurring, it struggled with image resizing, blue color shifts, and larger areas of moderate-to-severe blurring.

"The results highlight the need for training models with real-world conditions in mind, demonstrating the importance of reducing operator inconsistencies

and improperly calibrated hardware to developing commercially viable computer vision wood identification models," Owens said. "Introducing digitally perturbed images into training datasets can help improve model robustness."

ADRIANA COSTA, FWRC scientist and sustainable bioproducts assistant professor, said the technology enables law enforcement to better identify illegal logging at the source, noting that the team is developing a model for law enforcement in Brazil to combat illegal logging of the tree that produces the Brazil nut.

"By using tools like XyloTron, we can pinpoint illegal activities affecting species

like the Brazil nut, helping law enforcement protect habitats and local communities that rely on these resources for survival," Costa said.

Owens said sustainable forestry practices are essential to balancing economic interests with environmental conservation.

"Properly managed forests ensure that trees can be harvested today without jeopardizing future generations," Owens said. "Overharvesting may provide short-term gains, but it leads to devastating long-term consequences." ■

The research was funded by the U.S. Department of Agriculture's Agricultural Research Service.

MAPPING TICKS

LEVERAGING DATA TO TRACK TICKBORNE ILLNESS

BY KAITLYN CHURCH

AS CLIMATE PATTERNS SHIFT, so do the populations of disease-carrying pests—bringing new challenges to animal and public health. Mississippi State Forest and Wildlife Research Center scientists are on a mission to track and understand tick populations, particularly those transmitting anaplasmosis, a bacterial disease that affects dogs, cattle, and humans. By creating a comprehensive database of tick hotspots, scientists aim to provide valuable insights into disease dynamics and mitigate risks.

DR. MANUEL RUIZ, an assistant professor in the Department of Wildlife, Fisheries and Aquaculture and FWRC scientist, explained the importance of understanding tick populations.

“We do not know much about the tick distributions in Mississippi. Ticks have a significant impact on industries and public health when infections are transmitted to livestock and humans. We want to better understand the disease dynamics,” Ruiz said. “We know diseases such as anaplasmosis are a problem, but how big of a problem and where? That is what we hope to answer and track.”

Tickborne diseases, such as anaplasmosis, affects the health of individuals and the cattle industry.

“Anaplasmosis in cattle, which is caused

by the bacteria *Anaplasma marginale*, can cause major issues for ranchers,” Ruiz said. “Anaplasmosis can cause fever, anemia, and weight loss in cattle, costing ranchers millions of dollars in losses annually.”

The database of hot-spots is designed to help prevent the spread of disease, instead of relying on treatments alone.

“Regardless of having a treatment available, it is a big issue to treat the infected animals. Anaplasmosis can be so widespread in a population that treating every animal becomes very costly. You can treat this infection with antibiotics, but these antibiotics come with their own issues. After antibiotic treatment, there is a period in which you cannot consume the meat or milk from those animals,” Ruiz explained. “This affects the bottom line of ranchers and might affect prices for the consumer. People who are not directly involved with the cattle industry have a stake in controlling this disease. It is not only a matter of animal and public health, but also food security.”

JAI FRONTERA, a research technician on the project, plans to use two methods to trap ticks in the field.

“One method we will use for tick collection is dragging a white flag throughout the field. This will allow us to collect data on any ticks attached to the material,” Frontera said. “The second method

we will use is taking a cooler with small holes and filling it with carbon dioxide, which attracts ticks. We will line the trap with tape, which will capture the ticks as they crawl across.”

The database will include mapping coordinates through field sampling. From this information, new maps and models of tick distribution will be created.

“We will conduct our field sampling by choosing 50 to 100 sites across Mississippi, focusing on areas with gaps in tick distribution data and areas that represent different land uses and natural habitats,” Frontera said. “After trapping ticks, we will test them for the presence of the anaplasma





Jai Frontera, research technician, collects ticks using a cooler filled with carbon dioxide. (Photo by David Ammon)

bacteria. This will help us build updated maps, not only of tick distribution but of the pathogen presence to support better disease management practices.”

DR. FERNANDO ARCE, a postdoctoral research associate on the project, is leading the data organization and quantitative data analyses to create maps of tick distribution and risk of infection.

“For the data aspect of this research, we are compiling tick data from small scope local datasets and scientific journals on PubMed and compiling them into one large database,” Arce said. “This process becomes difficult because different

data types require different analyses in order to produce meaningful results.”

Frontera hopes this research will not only better aid in the tracking of anaplasmosis but also act as a tool for the public.

“A product that we will get from this research is creating tools for the public. Tick identification is difficult for the untrained, especially in Mississippi where there are about 19 different species of ticks. Once we have the tick distributions mapped, the public will also be able to use this data as an aid in identifying and understanding the tick populations in their area. With this, we can potentially

slow the spread of anaplasmosis,” Frontera said. “While our focus is anaplasmosis, the data from our research can help us understand how other tick-related diseases, like Lyme disease, may behave in the landscape. Knowing where tick populations are high is valuable information for understanding the risk of tickborne diseases across the state, the region, and the country.” ■

This research is funded by the U.S. Department of Agriculture Geospatial and Environmental Epidemiology Research Unit, the U.S. Forest Service International Programs, and MSU Forest and Wildlife Research Center.

PIGS ON THE MOVE

FWRC SCIENTISTS MAP WILD PIG MOVEMENT

BY KAITLYN CHURCH

AS INVASIVE WILD PIG populations continue increasing, researchers in Mississippi State University's Forest and Wildlife Research Center, or FWRC, apply advanced process-based modeling techniques to better understand their movement patterns. Using step-selection analysis—a statistical tool to describe animals' movement and habitat preferences—scientists investigate how social interactions and landscape features influence the space use of wild pigs across the Mississippi Alluvial Valley.

Traditional models often focus solely on environmental factors, not considering the space use of destructive swine. **DR. GARRETT STREET**, an associate professor in the Department of Wildlife, Fisheries and Aquaculture and FWRC scientist, and his team incorporate social behavior into their analysis, providing a more comprehensive understanding of what's driving invasive species movement.

"This research had multiple purposes, the main one being getting a better understanding of how wild pigs are using space and moving through the landscape. Aside from that, we also want to better understand what causes them to move, how do we mitigate invasion, and how do we

implement our trapping efforts to make sure these animals are going to be locally extirpated, removed completely, if possible," Street said.

Wild pigs increasingly damage both natural environments and agricultural interests as they spread across the Southeast.

"The most recent estimate that I have seen from the USDA is around \$2 billion per year every year across the United States that we lose in agricultural products because of wild pig damage, and that's not just direct damage to crops. This loss also includes things like infrastructure damage and soil erosion," Street said. "Making sure we have a solid understanding of their movements is the first step to ease some of this loss."

Researchers trapped and GPS-collared 16 adult wild pigs in the Mississippi Alluvial Valley. After 60 days, the data was analyzed using R and Python, two coding programs, to build models, run simulations, and uncover patterns.

"A GPS collar is going to tell you at a regular interval where the animal is exactly down to a couple yards of latitude and longitude. Once this data is collected, there is no end to the number of things you can do with a model, but I have already done a lot of fundamental things such as

thinking about the home range and habitat preferences. This was the first time, however, we incorporated sociality," Street said. "They might be attracted to other areas because there are other pigs there, which could be a clue that a valuable resource is present, but too many other pigs present could drive one away from the area, in hopes of not entering a competitive space. We are trying to think about viewing the world through the eyes of the animal, considering their cognitive ecology."

Street elaborated on the many predictions that were supported by the research,



Wild hogs cause an estimated \$2 billion in damage annually in the U.S. (Stock Photo)



just not always in the ways they expected.

“One of the biggest things we saw was that the landscape matters. For example, pigs cannot thermoregulate well on their own. They need shade, water sources, and room for wallowing,” Street said. “But we also found that in many circumstances, landscape did not matter as much as the social aspect did. We found that there was an attractive force if there were a smaller number of pigs present, but a repelling force if there were more pigs present. Another main point we found was how landscape composition mattered.

What was attractive to pigs is the overall structure of a landscape having a mix of attractive components, such as some corn, water, and bottomland hardwood areas.”

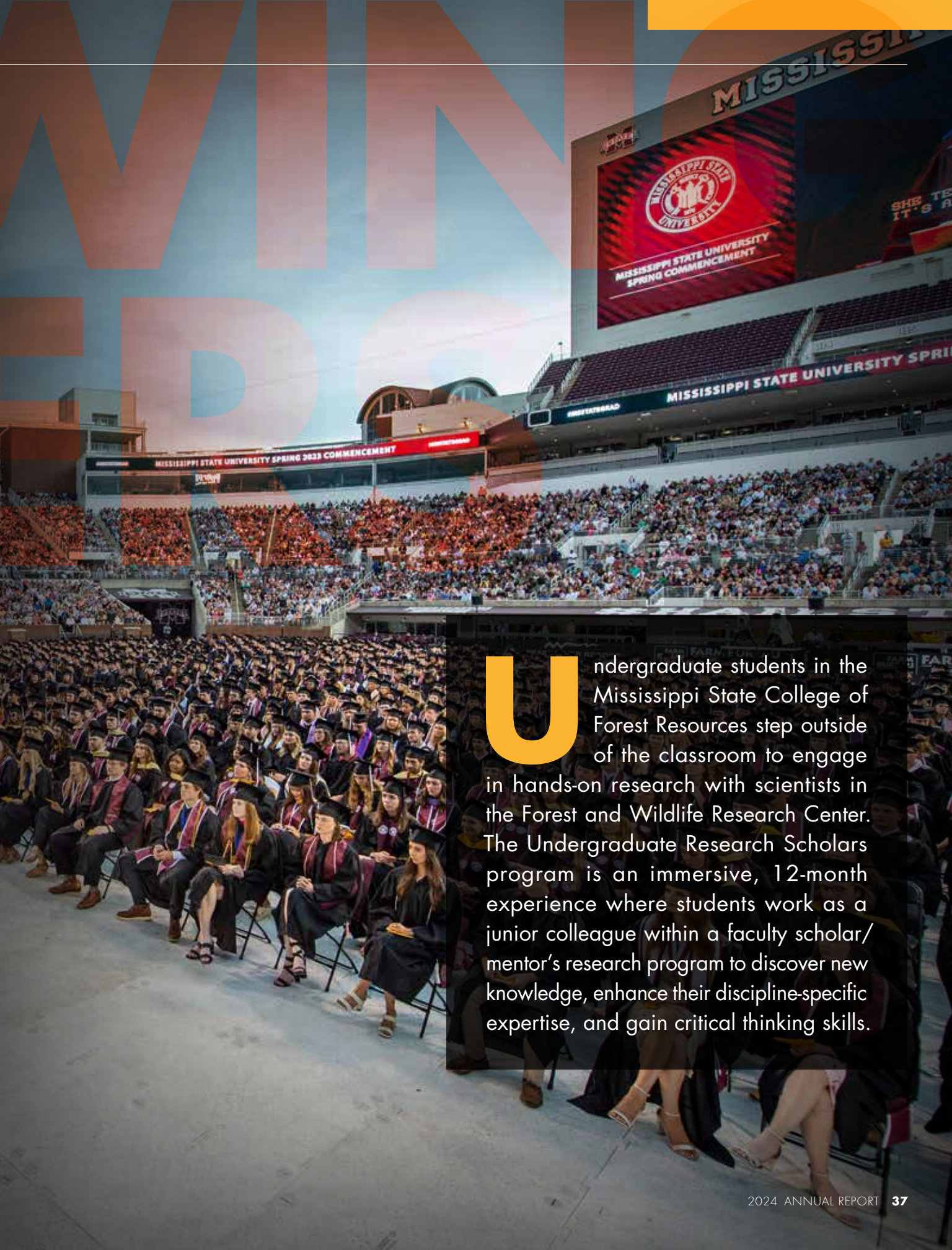
Street hopes this research can aid trappers and landowners in how they manage wild pigs, as well as allow scientists, like himself, to learn from trappers and landowners.

“The dream is working alongside trappers and landowners to improve what we all know about these animals and how we do things. We all have a vested societal, economic, and environmental interest in managing these animals. Removing them

from the landscape entirely is going to be extremely difficult, especially in the Southeast where they are so entrenched, but that does not mean we shouldn’t try. This research is meant to help move us in that direction,” Street said. ■

This research was funded by USDA Agricultural Research Service, USDA Animal and Plant Health Inspection Service Wildlife Services, the Mississippi Agricultural and Forestry Experimental Station, and the Forest and Wildlife Research Center.

GROWING LEADERS



Undergraduate students in the Mississippi State College of Forest Resources step outside of the classroom to engage in hands-on research with scientists in the Forest and Wildlife Research Center. The Undergraduate Research Scholars program is an immersive, 12-month experience where students work as a junior colleague within a faculty scholar/mentor's research program to discover new knowledge, enhance their discipline-specific expertise, and gain critical thinking skills.

UNDERGRADUATE STUDENT

ANNA JENKINS

ATHENS, ALABAMA

BY KAITLYN CHURCH

GROWING UP ON 20 acres of land, half of it forested, was all it took for **ANNA JENKINS** to grow an interest in the natural world. Jenkins hails from Athens, Alabama, with a love for hiking, camping, and anything outdoors. While Jenkins studies forestry with a concentration in wildlife management, this was not her original plan at Mississippi State.

"I started as an animal and dairy sciences major, wanting to go to veterinary school. I changed my major after freshman year, realizing I am not an indoor person," she explained. "One of the things I was told that helped me with this switch was that changing course is not quitting. Never be afraid to change direction."

It turns out finding a major that better suited her interests was closer to home than she thought.

"My mother and my grandfather were both forestry majors. My grandfather went

to the same graduate school that I plan to attend, studying biometrics like me. A love of forestry runs in our genes," she said.

Jenkins fell in love with the atmosphere of Mississippi State University.

"I was choosing between three schools, but after I came and visited this campus, it was decided, I am going to Mississippi State. Everyone here is so personable and friendly, and the campus is so beautiful and surrounded by forested areas. I couldn't say no," she said.

During her third year at MSU, she became involved in research with **DR. ESTEBAN GALEANO**, focusing on the propagation of eastern cottonwood saplings under drought conditions.

"My father works in genetics, so I decided to investigate genetics under Dr. Galeano," Jenkins said. "We took small cuttings from eastern cottonwoods during a drought season and studied the growth and resilience of these cuttings under drought conditions. My job was to care for and monitor the plants."

She explained how multiple plants and sizes of cuttings were used to create a sound research project.

"We grew 11 cloned plants using propagation, with 16 cuttings per clone. The cuttings were divided into two size groups: thin and thick. To track their growth and resilience, we measured them every two weeks for a total of six times. We recorded the height and stem diameter of

the top bud and counted the number of live buds on each cutting. Over time, the survival of cuttings decreased. At the end of the project, most clones had three or fewer cuttings still alive."

Through this research, she presented her findings at the undergraduate student research showcase at Mississippi State University.

"After we gathered all the data needed, such as water amount, foliage growth, stem growth, and growth over a certain time period, I was able to write a report on the research and present the findings," she said.

Jenkins said the research showed how growing rates can be affected in drought-stressed trees, which aids in the understanding of vegetation health.

"This project provided insight into the Eastern cottonwood's ability to withstand drought and heat. The findings can help us better understand how the well-being and growth ability of trees can be affected by drought conditions. What we found was that plant propagation is rarely viable under drought conditions. This raises concern for water security and its impact on vegetation health," she said.

This project helps prepare her for graduate school at the University of Georgia upon graduation, working under Dr. Bronson Bullock, a leading forestry biometrician.

"We have a measurement book that acts as a handbook for all forestry students, Forest Measurements 6th Edition. Bronson Bullock helped write this year's measurement book, so being able to learn directly under him is such a great opportunity," she said. ■

Jenkins is an undergraduate research scholar funded through the MSU Forest and Wildlife Research Center.



GRADUATE STUDENT

JaBRYAN PEGUES

POTTS CAMP, MS

BY MEG HENDERSON

YOU NEVER KNOW what might spark an interest in a career path. For **JaBRYAN PEGUES**, a work experience in his hometown of Potts Camp ignited a passion for studying forestry. As a high school student, Pegues spent time working in the Holly Springs National Forest through the Youth Conservation Corps, a U.S. Forest Service youth employment program that provides purposeful work experiences at national parks and forests.

“I started off doing jobs like cutting grass and cleaning bathrooms. Later on, I was brought in to help prepare and implement prescribed burns, and experiencing the work foresters do every day really drew me in,” he said. “I also took classes to become a firefighter, which is something I’d wanted to do since I was a kid.”

After graduating valedictorian of his high school, Pegues enrolled at Mississippi State and earned his bachelor’s degree in biological sciences. Now a second-year master’s student, he is completing his research on longleaf pine trees planted on marginal agricultural land, whose soil and terrain qualities are suboptimal.

Working with adviser **DR. ADAM POLINKO**, assistant professor of forestry and FWRC scientist, Pegues is building site index curves for planted stands in the nearly 30,000-acre forest at the Jones Center at Ichauway in Newton County, Georgia. Site index curves provide analysis that can help forest managers and landowners predict growth trends of stands over time. He is also studying growth efficiency—how volume varies with leaf area—and other attributes.

“The research JaBryan is doing is particularly important for landowners who have established pine plantations on marginal ag land and wish to evaluate the next



management option,” Polinko said. “Site index curves give managers another tool in their management toolbox.”

In the case of longleaf pines, those calculations are useful to restoration efforts, especially for stands planted on marginal agricultural land. Pegues has also investigated stand development theory and dynamics to understand growth efficiency and site productivity better.

“The longleaf pine species was greatly reduced in the early 1900s, and efforts are being made today to restore them,” Pegues said. “Building site index curves allows us to better understand how well these trees grow throughout their life span.”

Conducting research at a remote site has its challenges. Pegues can’t be in the lab every day and remain on campus for his classes, so he has taken occasional trips to Georgia, sometimes staying as long as two weeks, to collect data while working around his class schedule.

Pegues is also active on campus outside of the classroom. He is the vice-president of the Forestry Graduate Student Association and an active member of MSU’s chapter of Minorities in Agriculture, Natural Resources, and Related Sciences, or

MANRRS—a national organization whose mission is to develop academic and professional advancement for students majoring in agriculture, natural resources, and related fields.

“MSU’s clubs have given me opportunities to volunteer on campus and in the Starkville community and to socialize with my classmates outside of the classroom,” he said. “Our forestry graduate student group has gone camping, and this semester we’ve started meeting for monthly dinners. Having those experiences is important to me.”

As he thinks about what comes next after graduating later this year, Pegues is considering enrolling in a doctoral program but also has reached out to the U.S. Forest Service and the Mississippi Forestry Commission to learn about jobs in the industry.

“Right now, I’m focusing on finishing my master’s work and trying to publish it,” he said. “I need to be patient, consider all of my options, and know that the right answers will come.” ■

This research is funded through the MSU Forest and Wildlife Research Center.

UNDERGRADUATE STUDENT

EMILY LAWSON

LEBANON, TENNESSEE

BY ANSLEE BOYD

FOR EMILY LAWSON, the journey into sustainable bioproducts at MSU was an unexpected yet rewarding shift from her initial aspirations to become an engineer.

“This major is really just engineering with wood,” she said. “It has been exciting to learn different ways we can make wood more durable without relying on harmful chemicals.”

The Lebanon, Tennessee, native enjoys being a part of the Department of Sustainable Bioproducts for the close-knit learning environment with small classes and a 100% job placement rate, making it an appealing choice for students interested in renewable materials and environmental sustainability.

“When I toured MSU, they told me that companies would be asking for me before I would even graduate,” Lawson noted. “That made me feel really confident about choosing to major in sustainable bioproducts.”

Her interest in hands-on work and sustainable materials led her to seek research opportunities, which she found through **DR. BETH STOKES**, associate sustainable bioproducts professor. During her sophomore year, Lawson joined a Forest and Wildlife Research Center, or FWRC, research project funded by Smart Green Utility Poles.

Lawson and Stokes began to explore whether naturally occurring resin extracted from the guayule plant, native to desert areas in North America, could be an eco-friendly protective treatment for pine used in interior settings.

The research involves mixing the resin with Smart Green’s oil-based products, applying it to pine samples, then testing the samples’ durability under different conditions. They have conducted scratch tests to evaluate paint adhesion, weathering tests to observe color changes under UV exposure and moisture and are

now preparing for biological durability tests to protect against fungi and termites.

“We’re testing whether natural resins can improve wood’s durability and resistance to decay like fungi and termites,” Lawson said. “If successful, this could provide a more sustainable treatment for wood products.”

“We are hoping to test if the resin provides termite resistance,” she explained. “The resin has natural termiticidal properties, but we want to see if it still has that effect after being removed from the tree and applied to wood.”

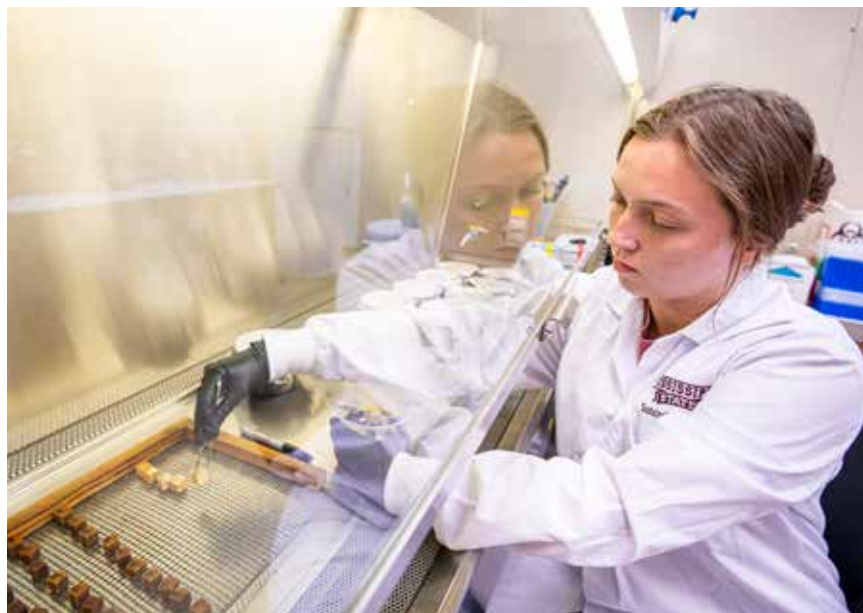
What began as an extra credit hour quickly turned into a project that could shape her career path. With two more years left in her undergraduate studies, Lawson is eager to continue exploring research opportunities and hopefully expand into composite testing and mechanical durability studies.

“Hopefully, we can explore using resin in composite board production, like particle board or OSB,” she said. “There’s also interest in mechanical testing to see how the treated wood holds up under different stresses.”

These additional tests could further validate the plant resin’s potential as a commercially viable treatment, paving the way for an environmentally friendly alternative to traditional wood treatments.

As industries look for safer, more sustainable building materials, research like Lawson’s will play a role in developing alternatives.

“If we can find a way to make wood more durable without harmful chemicals, that’s a huge step forward,” she said. ■



This research is funded by the Forest and Wildlife Research Center and Smart Green Utility Products.

GRADUATE STUDENT

SAMUEL BARTON

BURGETTSTOWN, PENNSYLVANIA

BY KAITLYN CHURCH

RECENT GRADUATE SAMUEL BARTON discovered his niche in sustainable materials by using biopolymers to give wood non-toxic and naturally-available antifungal and antimicrobial protection. His research explores how certain biopolymers can be utilized to protect wood from harmful microorganisms and extend the life of wood products without relying on harsh chemicals or synthetic treatments.

Barton graduated in August from his master's program working under **DR. GWENDOLYN BOYD-SHIELDS**, an associate professor in the Department of Sustainable Bioproducts. He examined how wood treatments of a chitosan and citric acid mixture can improve wood resistance to fungi and water damage. Chitosan is a natural substance with strong antifungal and antibacterial properties derived from chitin, a polymer that can be found within the exoskeletons of crustaceans and the cell walls of mushrooms. However, it only provides temporary protection. To combat this issue, citric acid—a natural and non-toxic compound—acts as a binding agent to help the chitosan stay attached to the wood longer.

Barton applied different solutions of the mixture to samples and evaluated fungal resistance using an agar plate test. Additional tests, like the AWPA E10 soil-block test for decay resistance and the AWPA E4 water repellency test, helped determine treatment effectiveness against water.

“When I mixed different levels of chitosan on a test plate, I found that the more chitosan applied the less fungus grew on the treatment area. As well as with citric



acid, the more surface area covered, the more water repellency the test wood exhibited,” he said.

Barton hopes this research aids in determining whether the combination of chitosan and citric acid can effectively protect wood from fungal decay while also improving its water resistance. If successful, this treatment could provide a more natural and environmentally friendly way to extend the lifespan of wood.

“I love working with fungi and extracting natural pigments from organic materials. It’s a funky job, but that’s what I love about it. It’s not very run-of-the-mill, and with chitosan being the second most abundant biopolymer, its uses could be unlimited. While more research is warranted, these compounds have potential to be used short term or as a cheaper, non-toxic additive to the industry,” he said.

Growing up on rural farmland in

Pennsylvania led Barton into the world of conservation.

“I stumbled my way into the world of sustainable bioproducts. As a kid I didn’t know what sustainable bioproducts were. I grew up on a farm, so we were always working with wood while doing farm work. Through this experience, I found my appreciation for natural resources.

After completing his master’s program, Barton plans on entering the forest products industry.

“Many wood preservatives are being phased out or restricted due to toxicity concerns for human health and the environment. I believe the industry has already done great work in adapting a more non-toxic approach, and I would like to help promote that anyway I can,” he said. ■

This research is funded by the U.S. Endowment for Forestry and Communities.

UNDERGRADUATE STUDENT

GRACE BELLEW

ONEONTA, ALABAMA

BY ANSLEE BOYD

FOR GRACE BELLEW, choosing Mississippi State University wasn't just about finding a school—it was about finding her purpose.

"Honestly, it was just kind of pure luck," she admitted. "I was accepted into a couple of other colleges, but my mom actually found Mississippi State and their wildlife program, one of the top programs in the nation," Bellew said.

As a wildlife, fisheries, and aquaculture major with a concentration in wildlife agriculture conservation, Bellew quickly found herself immersed in both campus involvement and hands-on research. Her coursework introduced her to private land management, where she developed a deep appreciation for helping landowners reach their conservation goals.

"This specific concentration really channels people into private land management jobs," she explained. "If someone has a specific objective for their land, we're the people who help them achieve it."

Bellew's work as an undergraduate research scholar was under **DR. MELANIE BOUDREAU**, wildlife, fisheries, and aquaculture assistant research professor, and focused on compiling long-term ecological research in North America. For researchers, having access to long-term data is crucial for understanding environmental changes and guiding future studies. This study compiled and analyzed extensive datasets from various sources, and searched for deficits in long-term ecological research, aiming to highlight which areas of study have sufficient data and where more research is needed.

Her current project is a northern bobwhite quail study under **DR. MARK MCCONNELL**, wildlife, fisheries, and aquaculture assistant professor, and coordinator of the



Bryan Endowment for Bobwhite Restoration and the James C. Kennedy Endowed Chair in Upland Gamebird Ecology.

A key aspect of Bellew's research focuses on chick imprinting studies, using a fascinating behavioral research method to examine how bobwhite chicks move through different vegetation types.

"We imprint little bobwhite chicks to humans and sounds," she explained.

This process involves training chicks to recall a specific sound through a reward system. Each time the chick responds to the sound, it is rewarded with food. After training, researchers release chicks to feed within various vegetation types. After thirty minutes, the researchers recall them with the sound they have imprinted. They then dissect their crops to determine what the birds ate. The study provides insights into how quail chicks interact with their environment, which can better inform management strategies for conservation.

Research has played a crucial role in her academic journey, from collecting insect data in forests with **DR. RAY IGLAY**, wildlife, fisheries and aquaculture assistant

professor, to soil sampling with **DR. COURTNEY SIEGERT**, forestry associate professor. Bellew has developed a strong foundation of learning proper scientific procedures and field methodologies.

Beyond her research, Bellew is president of MSU's student chapter of The Wildlife Society. She said she values the role the organization plays in fostering professional networking and hands-on learning experiences.

Through her involvement in campus organizations, field research, and mentorship opportunities, Bellew found her calling in conservation and land management. She credits Mississippi State with providing the experiences that shaped her future.

"MSU gave me the tools to combine science with real-world impact," she said. "I'm excited to take what I've learned and help people make the most of their land while protecting the ecosystems we all depend on." ■

The Undergraduate Research Scholars program in the MSU College of Forest Resources is funded by the MSU Forest and Wildlife Research Center.

GRADUATE STUDENT

KARA HALL

CLEVELAND, OHIO

BY KAITLYN CHURCH

GRADUATE STUDENT **KARA HALL** spends a lot of time sludging through water and vegetation in her pursuit to assess and monitor wetlands ... estimating bird and macroinvertebrate abundance and overall landscape health.

Well into the second year of her master's program, Hall works under the direction of **DR. J. BRIAN DAVIS**, James C. Kennedy Endowed Professor in Waterfowl and Wetlands Conservation, and **DR. BETH BAKER**, MSU Extension assistant director for environmental stewardship and associate professor in wildlife, fisheries and aquaculture. Hall's research focuses on the health of wetlands and the avian species they support. Wetlands are decreasing at an alarming rate due to development, agriculture, and invasive species, among other factors. Working in wetlands surrounded by varying landscapes—farmland, grassland, forested areas, and more—she is recording the effects of these ecosystems on bird communities, water quality,

aquatic macroinvertebrates, and vegetation structure within the wetland.

Hall assesses wetland health using waterbird surveys, point-count surveys, and macroinvertebrate sampling. Using point count surveys, researchers record and monitor the species present within the bird communities. To assess water quality, she measures the abundance and diversity of macroinvertebrates present in the water, which can be used as an indicator of water quality due to their varying sensitivity to pollution. Vegetation abundance and diversity is measured by simple vegetation surveys of the landscapes.

"Overall, I am monitoring 28 Wetland Reserve Easements—a conservation agreement between a landowner and the USDA Natural Resources Conservation Service that helps protect, restore, and improve wetlands on private lands; five reference sites, which are historic bottomland hardwood forest sites; and five crop sites. Every two weeks I visit the sites and record data

about the birds, water presence, and site vegetation structure," she said. "The theme of this whole project is restoration. Is there one method that might be most helpful to see restoration efforts? What communities are using these restored wetlands? That is what we want to track."

Growing up around Lake Erie and being exposed to nature her whole life, Hall knew she wanted to work with wildlife since she was young. Choosing schools based on this interest, led Hall to attend Mississippi State University to begin her master's in wildlife, fisheries and aquaculture.

"When I was looking for graduate schools, I knew I wanted to work with birds and wetlands, but I wanted something broader than just that. When I saw the position advertised here, which dealt with wetlands but also included studying birds, soils, vegetation, and water quality, these were all things I hadn't been able to do before. I was excited to apply and experience new things while still exploring my passions," she said.

For the moment, Hall is dedicated to her master's project, but she looks forward to the future. She hopes continue working with wetlands and is interested in pursuing a management role—being able to educate others about the importance of wetlands and work on building more wetland areas, as well as managing the landscapes for preferred avian species and wildlife.

"I hope my research supports the conclusion that wetland reserve easements are extremely important. Historically, we have lost a large portion of wetlands, and I hope I can help combat this." ■



This research is funded by the USDA Natural Resources Conservation Services.

ENDOWED CHAIRS AND PROFESSORS

Endowed faculty professors and chairs allow Mississippi State to recruit and retain the best faculty. Endowed positions allow the university to conduct meaningful research in perpetuity in the donor's chosen area. Endowed positions also enhance our ability to train the next generation of natural resource professionals. We are fortunate to have donors who support our mission of conservation and sustainability through the establishment of these positions.

BRYAN ENDOWMENT FOR BOBWHITE HABITAT RESTORATION AND THE JAMES C. KENNEDY ENDOWED CHAIR IN UPLAND GAMEBIRD ECOLOGY

THE BRYAN ENDOWMENT FOR BOBWHITE HABITAT RESTORATION and the **JAMES C. KENNEDY ENDOWED CHAIR IN UPLAND GAMEBIRD ECOLOGY** programs have seen an active year of research in 2024. The Bryan endowment, established in 2018 by Prairie Wildlife founder Jimmy Bryan, aims to advance restoration of bobwhite quail populations and southeastern native grasslands through research, conservation, and education. And in 2020, the Kennedy endowment was founded to support cutting-edge research and training students in upland bird game restoration throughout the Midsouth.

Chair **DR. MARK MCCONNELL** has overseen research by four graduate students, one postdoc researcher, and two undergraduate student workers this year. Their projects include conducting over 500 northern bobwhite surveys on lands across Mississippi to investigate the influence of landcover characteristics on quail abundance; tracking bobwhites to learn how they use resources; examining over 20 years of crop yield patterns across the bobwhite range to identify economic opportunities for bobwhite restoration; providing technical assistance to Mississippi landowners for integrating precision technology into their conservation management plans; understanding landowner motivations and barriers to enrolling in the Conservation Reserve Program; and quantifying avian diversity in conservation plantings across the Southeast.

The programs also made impacts academically and professionally. McConnell and his team submitted five papers and co-authored 18 presentations. McConnell was elected to serve on the board of directors for the Conservation Technology Information Center and asked to serve on Quail Forever's Science Advisory Committee.

In the coming year, McConnell anticipates adding two new graduate students, who will study northern bobwhite survival and reproduction in different landscapes.

MARK MCCONNELL





BRONSON STRICKLAND

ST. JOHN FAMILY ENDOWED
PROFESSOR OF WILDLIFE
MANAGEMENT

THE ST. JOHN FAMILY ENDOWED PROFESSOR OF WILDLIFE MANAGEMENT provides leadership in education on wildlife conservation, serving landowners and hunters in Mississippi and beyond. **DR. BRONSON STRICKLAND** has shepherded the program since its establishment in 2017 by alumni Drew and Kathy St. John, wildlife enthusiasts who live in Madison and maintain a family farm in Mississippi. The St. Johns have donated generously to departments across the university since graduating in the late 1970s, and they value the importance of management practices that optimize wildlife habitat.

As endowed chair, Strickland leads science-based research addressing the needs of Mississippi landowners and hunters—caring for their natural resources and implementing best management practices. A recent study conducted by Strickland and his team includes researching new ways to test for the presence of Chronic Wasting Disease by sampling the environment, rather than testing deer carcasses. These innovations will allow our state wildlife agencies to sample for CWD without having to rely on road-killed or hunter-killed carcasses. In addition, research associates and graduate students continue studies examining the effects of weather on deer movements; the effects of moon phase

and position on buck activity, location, and frequency of bedding sites; the effects of prescribed fire on plants and wildlife; and a study on using regenerative agriculture techniques for wildlife food plots.

The program is also reaching an ever-growing audience on social media. The MSU Deer Lab's Facebook page has amassed 67,000 followers, and 17,000 follow their Instagram account. Viewers watch over 300,000 hours annually on the Deer Lab's YouTube channel, which includes a series on Chronic Wasting Disease. Strickland and his team are also reaching new audiences through their Natural Resources University podcast network, a collection of educational podcasts on wildlife and habitat management topics, and their Online Deer Management Seminar series, which offers both information and professional credit hours.

"It is an honor to have served as the St. John Endowed Professor of Wildlife Management for the last seven years," Strickland said. "I am so thankful to the St. John family for supporting essential wildlife education for Mississippians today and into the future."



ERIC MICHEL

TAYLOR CHAIR IN APPLIED BIG GAME RESEARCH AND INSTRUCTION

AFTER FIVE YEARS OF SERVICE as chair of the Taylor endowed program, **DR. STEVE DEMARAIS**, who was with the university for 28 years, retired in 2024, prompting a search for a new professional to fill the chair position. The endowment was established in 2019 by Phyllis and the late Patrick F. Taylor to honor CFR professor emeritus Dr. Harry Jacobsen, who conducted research on, and provided big game management guidance for, their Mississippi and New Mexico properties.

Mississippi State alumnus **DR. ERIC MICHEL** was selected to lead the program, beginning January 2025. Originally from Wisconsin, Michel earned his bachelor's degree from the University of Wisconsin—Steven's Point and his master's and Ph.D. from Mississippi State. His graduate work involved working at the deer pens for MSU's Deer Lab. Michel comes to the position from the Minnesota Department of Natural Resources.

This year marked a second turning point, an effort to secure capital for rebuilding the university's captive deer research facility. With funding now in place, plans for construction began in 2025, and as co-director of the lab, along with the St. John Family chair, Michel will provide input and guidance in the planning process.

"The Johnnie R. Dawkins Memorial Captive Deer Handling facility significantly impacts our ability to improve deer management and better understand deer ecology," Michel said. "Having a high-quality, renovated facility will allow us to continue this legacy of research."

Michel continues to co-advise a project with a graduate student from the University of Minnesota tracking fawns with GPS units to study movement. Michel currently has a graduate student at Mississippi State researching how populations of deer differ between privately and publicly owned lands in northeastern Minnesota. He is co-advising a student with Dr. Jacob Dykes, the new coordinator for the St. John Family Endowed Professor of Wildlife Management, who is using DNA analysis to assess the diet composition of white-tailed deer from four study sites in Mississippi. Michel is also working with the Mississippi Department of Wildlife, Fisheries, and Parks to expand current research on chronic wasting disease.

"My biggest goal for the Taylor program is to continue the legacy of applied deer management work, making sure that the work we conduct will be used on the landscape by our state and regional biologists and private landowners," Michel said. "I'm equally excited to continue the high-quality training that graduate and undergraduate students receive, just as I received from my mentor, Dr. Steve Demarais."

JAMES C. KENNEDY
WATERFOWL AND WETLANDS
CONSERVATION PROGRAM

IT WAS A BANNER YEAR for the James C. Kennedy Waterfowl and Wetlands Conservation program, founded in 2008 to support teaching, research, and service in conservation of waterfowl and other wetland wildlife and their habitats. **DR. J. BRIAN DAVIS**, chair and endowed professor, reported 10 active or funded graduate research projects and two undergraduate research projects, plus numerous cross-institutional collaborations, some of which were completed or ongoing.

A multi-year study of box-nesting common goldeneyes along the Chena River near Fairbanks, Alaska, was wrapped up this year. Begun in 1997, the team from MSU collaborated in this project during summers 2021-2023. The team also completed a cross-departmental study, working with MSU's Geosystems Research Institute to monitor soil erosion and hydrology and to establish best practices in building marsh terraces. Work continued on a four-year, eight-state study on recruitment of box-nesting wood ducks in the Eastern and Southeastern U.S. The team is also contributing to an ongoing investigation of waterfowl diets and winter foraging habitats along the Atlantic Flyway. Current in-state projects include a wetlands study of interactions between native bees, fire ants, and traditional wetland management practices, and another study monitoring shorebirds on restored and non-restored Mississippi wetlands. A new program launched this year, with the MSU team collaborating with five other universities to research ecological values of wetland reserve easement lands in Mississippi.

The program's students have been as active in academics and professional endeavors as they have been in their field studies. Nine students received CFR scholarships. Collectively, Davis and his students presented 32 oral and seven poster presentations at professional meetings; published eight peer-reviewed publications; and produced five podcasts and other reports outlining their work in 2024. They provided private landowners and other stakeholders in the state with requests for waterfowl and wetlands technical assistance. And undergraduate and graduate students in the Bulldog chapter of Ducks Unlimited helped facilitate the organization's local fall and spring events.

Davis looks forward to the year ahead, studying genetics of mallards, habitat use by non-breeding mallards, waterfowl abundance and migrations to the Mississippi Alluvial Valley, and wind energy and waterfowl interactions.

"I feel very fortunate to be able to work with so many outstanding students and faculty researchers here at MSU and around the country," he said. "We've had some incredible opportunities this year, and I look forward to what the new year holds."

**BRIAN
DAVIS**



BUILDING CAPACITY

MSU's College of Forest Resources and the Forest and Wildlife Research Center fosters the management, conservation, and sustainable use of forest, wildlife, and aquatic resources to benefit the people of Mississippi, the nation and the world. Central to accomplishing that mission are the state-of-the-art facilities that help drive exemplary research and experiential learning in natural resource conservation and management.

WOLF RIVER COASTAL FOREST RESEARCH AND EDUCATION CENTER ENTERS PLANNING STAGE

MISSISSIPPI STATE UNIVERSITY'S FOREST AND WILDLIFE RESEARCH CENTER (FWRC) has acquired 14,071 acres of coastal forestland to establish the Wolf River Coastal Forest Research and Education Center, ensuring the long-term protection of this critical ecosystem. This acquisition strengthens MSU's commitment to conservation, research, and education while complementing the John W. Starr Memorial Forest in Starkville. Unlike the Starr Forest, which follows an industrial forestry model, the Wolf River site will be managed through an ecological forestry approach.

This acquisition was made possible through strategic partnerships with the Mississippi Department of Environmental Quality, National Fish and Wildlife Foundation, Mississippi Forestry Commission, Weyerhaeuser, U.S. Forest Service, and the Nature Conservancy. As part of the Coastal Headwaters Protection Initiative, FWRC will manage the site's bottomland hardwood and upland forests to safeguard the Wolf River watershed, which flows into the Bay of St. Louis.

MSU's comprehensive multi-resource management plan will protect more than 10 miles

of the Wolf River's main stem and 100 miles of tributaries, preserving water quality, aquatic habitats, and marine life in the bay. Conservation strategies include sustainable management of aquatic systems, bottomland hardwoods, and upland pines to enhance biodiversity and ecosystem resilience.

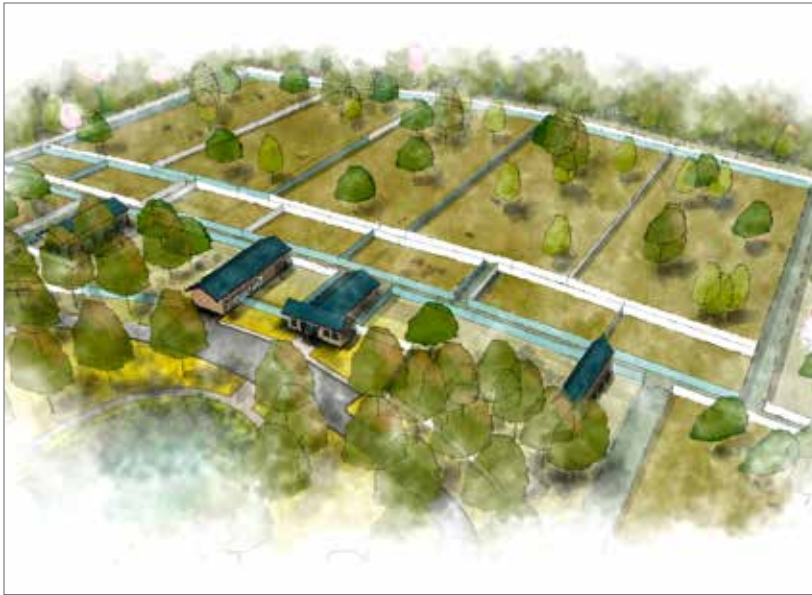
Serving as a living laboratory for research, teaching, and outreach, the center will advance studies in forest health and economics, management and restoration, environmental services, fire ecology, forest hydrology, water quality, aquatic biodiversity, carbon sequestration, and wildlife conservation. It will also

support research on population responses to ecosystem restoration and the reintroduction of species of conservation concern.

Outreach initiatives will provide forest landowner workshops and environmental literacy programs for K-12 students, educators, and the public. Hands-on learning opportunities, including outdoor labs, will give students at all levels a deeper understanding of coastal ecosystems.

In the coming months, Mississippi State will host public meetings along the Gulf Coast to engage local communities and stakeholders, ensuring the center's management plan aligns with both conservation goals and community interests.





FWRC DEER RESEARCH PROGRAM RECEIVES FUNDS FOR UPGRADES

FWRC'S WORLD-CLASS white-tailed deer research and outreach program is getting a much-needed upgrade, thanks to critical support from the Mississippi legislature. With \$1.7 million secured toward a \$5 million renovation, the captive deer research facility—originally built in the 1970s—is undergoing significant improvements.

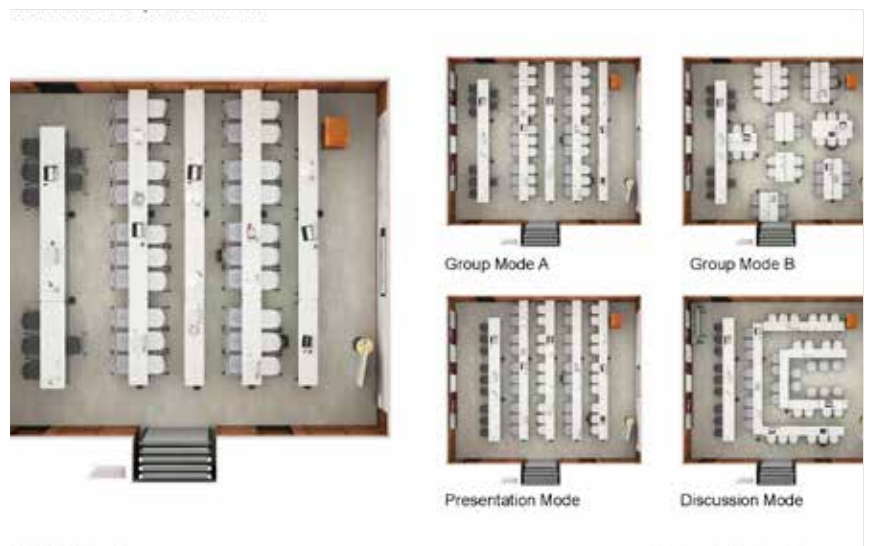
Upgrades include a 2,000-square-foot educational center and five new main deer pens, complete with chute and lane systems to transport and handle deer. Enhanced facilities will allow MSU researchers to advance studies in foraging, nutrition, reproduction, and behavior, strengthening our role as a leader in deer research.

ENHANCING LEARNING SPACES TO SUPPORT TOMORROW'S NATURAL RESOURCE LEADERS

AT MISSISSIPPI STATE'S COLLEGE OF FOREST RESOURCES AND THE FOREST AND WILDLIFE RESEARCH CENTER, hands-on learning and collaboration are essential to preparing future leaders in natural resource management. As part of CFR's commitment to serving the whole student, Thompson Hall is undergoing renovations to create dynamic, active learning spaces that foster engagement and teamwork.

Updates to large classrooms TH118 and TH208A include reconfigurable tables and chairs, allowing for flexible learning environments, along with AC power access at every student workstation. Additionally, the TH137 computer lab is being redesigned to better support small group collaboration and interactive learning.

These enhancements were completed in summer 2025, provided our students with access to modern, adaptable spaces that support innovative learning and real-world problem-solving.



CLT: TIMBER, TRANSFORMED

THE FOREST AND WILDLIFE RESEARCH CENTER leads mass timber innovation, driving research that is shaping the future of sustainable construction. Stronger, more resilient, and more visually appealing, mass timber offers a cleaner alternative to traditional building materials and is poised to revolutionize commercial construction. Our scientists are setting the standards and best practices needed for widespread adoption across industries—regionally, nationally, and globally. Two key initiatives further solidify our leadership in this field: the Mississippi Lumber Manufacturers Association Endowed Professorship, teaching tomorrow’s wood scientists and architects how to produce, manufacture, and design with mass timber and the acquisition and refurbishment of a commercial CLT press, which expands research and industry collaboration.

FWRC BUILDS CLT PRESS

Depending on the size and capacity of cross-laminated timber (CLT) presses, costs can range from \$2 million to more than \$25 million. When the opportunity arose to refurbish an existing press for CLT production, scientists at the MSU Forest and Wildlife Research Center, or FWRC, saw a chance to significantly enhance research capabilities. Their efforts secured a press for Mississippi State University’s Department of Sustainable Bioproducts, providing vital equipment for CLT research.

“The opportunity to purchase a press like this might come along once in a career,” said **DR. DAN SEALE**, Emeritus Warren S. Thompson Professor of Wood Science and Technology and James R. Moreton Fellow in Sustainable Bioproducts.

Seale drove the initiative to acquire the press from the University of Minnesota Duluth, where it had originally been used for oriented strand board development. Built in the 1960s, the press had been sitting disassembled in a parking lot when MSU expressed interest in purchasing it.

Transporting the massive equipment required meticulous planning, as it arrived in three semi-truck loads and had to be carefully offloaded, moved, and reassembled in the research facility.

Refurbishing the press was an extensive process. The team had to reattach hydraulic cylinders, pressure and heat plates, and control systems while addressing missing insulation components and installing a new control system. The final transformation included automating glue application for CLT production, allowing the press to manufacture full 4x8 panels—a critical need in the Southern U.S., where industry partners previously struggled to obtain marketing samples and prototypes.



Drs. Rubin Shmulsky and Dan Seale walk beside the commercial CLT press. (Photo by David Ammon)

FWRC MASS TIMBER RESEARCH PORTFOLIO

FWRC is driving the future of mass timber research with nearly \$19.7 million in funded projects aimed at advancing the durability, sustainability, and structural performance of wood-based materials. From pioneering cross-laminated timber (CLT) technology to developing bio-based adhesives and coatings, MSU researchers are setting the industry standard for innovation. By optimizing engineered beams, enhancing wood treatments, and exploring new structural applications, our experts are ensuring mass timber’s viability across industries.

Our research spans multiple facets of cross-laminated lumber and includes:

- Mass timber and engineered wood products
- Nondestructive evaluation and material testing
- Infrastructure applications and durability
- Bio-based and sustainable materials
- Coatings, decay, and weathering resistance
- Market and policy studies
- Matting, railroad, and industrial applications
- Specialty wood applications
- Innovative wood product development



MISSISSIPPI LUMBER MANUFACTURERS ASSOCIATION PARTNERS WITH MSU TO ADVANCE MASS TIMBER THROUGH ENDOWED PROFESSORSHIP

MISSISSIPPI STATE UNIVERSITY is strengthening its position as a leader in forest products innovation through a new partnership with the Mississippi Lumber Manufacturers Association. MLMA has established the Mississippi Lumber Manufacturers Association Endowed Professorship in Innovative Wood Construction and Design at MSU, housed in the College of Forest Resources' Department of Sustainable Bioproducts with a joint appointment in the College of Architecture, Art and Design's School

of Architecture. This endowment advances research in mass timber manufacturing, construction, and design, with a focus on sustainable wood construction, strength, and durability.

Mass timber is rapidly gaining traction as a renewable, sustainable alternative to concrete and steel, offering fire resistance, seismic durability, and faster installation while significantly reducing carbon emissions.

Trey Hankins, MLMA vice president and chief financial officer of Hankins Lumber, emphasized the importance of exposing Mississippi students to cutting-edge wood construction technologies to drive economic growth for landowners, loggers, and sawmill workers across the state. "Since forestry is such an important

part of Mississippi's economy, MLMA felt it was worth the investment to ensure our state's students become familiar with innovative wood technologies. That way, Mississippi's landowners, loggers, and sawmill workers can all benefit from the economic growth these innovations will bring," he said.

DR. WES BURGER, FWRC director and College of Forest Resources dean, said the investment will have lasting benefits for the university, the industry, and the state.

"This partnership empowers MSU to equip future professionals in wood science, architectural design, and construction science with the knowledge and skills needed to drive economic development and environmental stewardship," he said.

FACULTY REFEREED PUBLICATIONS

Mississippi State Forest and Wildlife Research Center faculty produced 184 refereed publications during 2024. For a complete list of publications, visit <https://www.fwrc.msstate.edu/publications>.

THESES

Adhikari, S. 2023. Leaf area index and aboveground biomass estimation of *Populus* and its hybrids using terrestrial LiDAR. Thesis, Department of Forestry, Mississippi State University.

Adjaye, D. 2024. Developing non-invasive molecular sampling methods for effective wildlife monitoring. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Ahmad, H. 2024. Hydrologic connectivity between oxbow lakes and rivers within the Lower Mississippi Alluvial Valley. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Alegbeleye, O.M. 2023. Small area estimation of county-level forest attributes using forest inventory data and remotely sensed auxiliary information. Thesis, Department of Forestry, Mississippi State University.

Attreya, S. 2023. Identifying the shortest log trucking routes and optimizing those constrained by low-weight bridges in Mississippi. Thesis, Department of Forestry, Mississippi State University.

Blake, C.M. 2024. Motivations for habitat management of private lands in the southeastern United States: Implications for at-risk species. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Cook, A. 2023. Investigating potential indicators of soil health through microbiome response to environmental and anthropogenic stressors. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Dues, K.R. 2023. A silvicultural approach to increase drought resistance and resilience in longleaf pine. Thesis, Department of Forestry, Mississippi State University.

Gosselaar, M. 2023. Gene expression effects on productivity and stress tolerance in polyclonal plantings of *Populus deltoides*. Thesis, Department of Forestry, Mississippi State University.

Grayum, J.M. 2024. Assessing northern bobwhite habitat use and short-term response to prescribed fire in an intensively managed longleaf pine ecosystem. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Greene, J.L. 2024. Assessment of the results decay has on the perpendicular grain properties of wood. Thesis, Department of Sustainable Bioproducts, Mississippi State University.

Helferich, J. 2023. Of changing climate and habitat: Range-wide individual growth and local patterns of phenology and landscape use in a threatened pit-viper. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Henfield, B.T. Effects of adding graphene-based nano materials on cure time and bond strength of adhesives. Thesis, Department of Sustainable Bioproducts, Mississippi State University.

Hill, M. 2023. Optimizing edge-of-field water quality monitoring methods to determine the effects of best management practices on nutrient and sediment runoff. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Johnson, T. 2023. Condition assessment of the northern climatic research house at the USDA Forest Service Forest Products Laboratory. Thesis, Department of Sustainable Bioproducts, Mississippi State University.

Kimura, R.H.S.A. 2023. Insights into the challenges posed by climate change and land competition to Brazil's Midwest pulpwood market. Thesis, Department of Forestry, Mississippi State University.

Naing, H.L. 2023. Modeling the effect of neighborhood competition on tree diameter growth in the Pacific Northwest Coast Range. Thesis, Department of Forestry, Mississippi State University.

Norman, T.F. 2023. Green wood composites with natural preservatives. Thesis, Department of Sustainable Bioproducts, Mississippi State University.

Ogunraku, M.I. 2023. Evaluating selected properties of underutilized hardwood species for fabrication of cross-laminated timber industrial mats. Thesis, Department of Sustainable Bioproducts, Mississippi State University.

Perera, W.K.G. 2024. Dynamic evolution patterns of legislative efforts on forestry-prescribed fires. Thesis, Department of Forestry, Mississippi State University.

Resop, L.M. 2023. Timing is everything: Impacts of firing technique and season on plant communities in the southeastern United States. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Sartain, A.N. 2023. The response of bats and their insect prey to different coastal upland habitat management techniques. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Schrimpf, M.R. 2023. Maximum size-density relationships in mixed-species and monospecific stands of the southeastern United States. Thesis, Department of Forestry, Mississippi State University.

Stafford, J. 2024. Evaluating efficacy of modified barrier operations to limit Silver Carp movements in the Mississippi Alluvial Valley. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Stoecker, M. 2024. Forest structure and edge effects on bee functional diversity in private, working pine forests. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Story, A. 2024. Photocatalytic disinfection of microbes in water by using titanium dioxide (TiO₂)-decorated biochar. Thesis, Department of Sustainable Bioproducts, Mississippi State University.

Sublett, J. 2023. Developing a precision agriculture framework to assess financial viability of decisions in farming and conservation. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Taiwo, D.M. 2023. An assessment of loblolly pine (*Pinus taeda* L.) mortality and impact of habitat fragmentation on southern pine beetle (*Dendroctonus frontalis* Zimmerman) infestation in Mississippi, USA. Thesis, Department of Forestry, Mississippi State University.

Tiwari, M.P. 2023. Heirs' property disputes on forestlands, partition actions, and the determinants of court verdicts. Thesis, Department of Forestry, Mississippi State University.

Warren, M.D. 2023. Effects of fire seasonality on Bachman's Sparrows in the longleaf pine forests of Southern Mississippi. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

DISSERTATIONS

Amen, R. 2024. Removal of emerging contaminants from water using green adsorbents. Dissertation, Department of Sustainable Bioproducts, Mississippi State University.	Chen, D.M. 2023. Advancing salamander conservation efforts in zoos and aquaria through assisted reproductive technologies (ART). Dissertation, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.	Mudiyanselage, O.N.R. 2023. Development of hydrophobic paper and wood products via metal ion modification. Dissertation, Department of Sustainable Bioproducts, Mississippi State University.
Ayanleye, S.O. 2023. Development of preservative-treated cross-laminated timber and lignin-reinforced polyurethane-adhesive for glued laminated timber. Dissertation, Department of Sustainable Bioproducts, Mississippi State University.	Evans, T.S. 2023. A four-pronged approach to addressing a wild pig invasion in a bottomland and update forested landscape. Dissertation, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.	Murphy, N.K. 2023. Towards understanding the interactions between Ospreys and human-made structures in the Tennessee River Valley. Dissertation, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.
Cheatham, M.C. 2024. Economics and risk of catfish production strategies. Dissertation, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.	Ibrahim, A. 2024. Catalytic upgrading of rice straw bio-oil with alcohols using different bimetallic magnetic nanocatalysts. Dissertation, Department of Sustainable Bioproducts, Mississippi State University.	Naveda-Rodriquez, A.J. 2023. The migration ecology of North American turkey vultures wintering in the Neotropics: Spatial and population dynamics. Dissertation, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

FORESTRY & FOREST PRODUCTS IN MISSISSIPPI

JOBS (FULL AND PART-TIME)

84,024

VALUE-ADDED

\$7.44 BILLION

PAYROLL

\$4.42 BILLION

TOTAL FORESTLAND ACRES

19,008,846

**PRIVATE
OWNERSHIP
ACRES**

13,306,192

**FOREST
LANDOWNERS**

130,000

TAX REVENUE

\$944.75 MILLION

TOTAL OUTPUT

\$19.09 BILLION

SOURCE:

Lamichhane, S., J. Henderson, D. Grebner. 2025. The economic contribution of Mississippi's forestry and forest products industry: an input output analysis. Forest and Wildlife Research Center, Mississippi State University, Bulletin FO476. 16 pp.

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FRANKLIN QUIN

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BY THE NUMBERS

PEOPLE

109

Master's students (Fall 2024)

60

Doctoral students (Fall 2024)

41

Faculty (Fall 2024)

RESEARCH PROJECTS

79

Research Sponsors (FY24)

184

Refereed Publications (CY24)

\$14,114,096

Total Sponsored Research Funding (FY24)

RESEARCH SPONSORS

Alabama A&M University

Alabama Audubon

Alabama Department of Conservation

Alcorn State University

American Bird Conservancy

Arch Wood Protection, Inc.

Austin Peay State University

BASF Corporation

Christmas Tree Promotion Board

Delta Wildlife

Duff Real Estate, LLC

EDM International, Inc.

Ensafe, Inc.

Environmental Defense Fund

Florida International University

FuturaGene

Genics Incorporated

Gulf of Mexico Alliance

International Paper

Kop-Coat, Inc.

Lonza Wood Protection

TOTAL FWRC FUNDING, FY24

\$16.43M

39%

6%

55%

STATE APPROPRIATIONS

FEDERAL APPROPRIATIONS

GRANTS AND CONTRACTS

Michigan Department of Natural Resources
Michigan State University
Mississippi Department of Environmental Quality
Mississippi Department of Revenue
Mississippi Department of Wildlife, Fisheries, & Parks
Mississippi Development Authority
Mississippi Forestry Commission
Mississippi Wildlife Fisheries and Parks Foundation
Missouri Department of Conservation
Montana Fish Wildlife and Parks
National Academy of Sciences
National Aeronautics and Space Administration
National Council for Air and Stream Improvement, Inc.
National Fish and Wildlife Foundation
National Oceanic and Atmospheric Administration
National Wild Turkey Federation
New Mexico State University
Nisus Corporation
North Carolina State University
North Carolina Wildlife Resources Commission
OpenET
Railroad Tie Association
Railway Tie Association
Southern Ionics
Southern Pressure Treaters Association
Stairbuilders and Manufacturers Association
Taylor Land and Cattle
Tennessee Valley Authority
Texas A&M University
The Eppley Foundation

The Jones Center at Ichauway
The Morton Arboretum
U.S. Agency for International Development
U.S. Army Engineer Research and Development Center
U.S. Department of Energy
U.S. Department of Interior
U.S. Endowment for Forestry and Communities, Inc.
U.S. Fish and Wildlife Service
U.S. Geological Survey
U.S. National Park Service
U.S. National Science Foundation
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University of Arkansas at Pine Bluff
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University of Mississippi
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