

# FOREST & WILDLIFE RESEARCH CENTER

# 2023

ANNUAL REPORT

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MISSISSIPPI STATE UNIVERSITY™  
FOREST AND WILDLIFE RESEARCH CENTER

# FOREST & WILDLIFE RESEARCH CENTER 2023 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:** Sustainable Bioproducts scientists are building corrugated panels from underutilized, small diameter trees to create new building products and markets. (Photo by David Ammon)

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FROM THE  
**DIRECTOR**

**T**HANK YOU for your support of the Forest and Wildlife Research Center at Mississippi State. We are honored to be the state's research leader in the conservation, management, and use of the forest, forest products, wildlife, and fisheries resources for the betterment of all Mississippians. We are fortunate to have many partners who support our mission and work alongside our scientists and students to protect and sustain Mississippi's natural resources.

Mississippi is blessed with abundant natural resources and so many of our state's residents help ensure that ecosystems and environments are enhanced and protected. The 19.2 million acres of our state's forest lands held by 125,000 forest landowners produced \$1.48 billion in production in 2023. Forest-related economic activity in the state generated 67,833 jobs and over \$3.37 billion in income. Our state ranks third in pine pulpwood production and fourth in pine lumber production in the United States. Mississippi has 3,900 certified tree farms in the American Tree Farm System and 22 cities bear the title of Tree City USA. Mississippi State University is a Tree Campus USA, thanks in large part to our forestry faculty, students, alumni, and partners.

Our state's residents value the environmental and economic impacts provided by natural resources.

In this annual report, we highlight our work in the areas of conservation across landscapes; healthy markets, healthy forests; clean water, clean energy; and one health. This is just a small sampling of the 157 projects that FWRC scientists are pursuing. FWRC is a relatively small unit but one of the most productive in the university, accounting for about 5 percent of the total MSU research portfolio. During 2023 our scientists generated more than \$650,000 in research grant dollars per full-time equivalent (FTE) and 8.6 scientific articles per research FTE. This extraordinary productivity by FWRC scientists places MSU 14th nationally in the NSF ranking for natural resources research. This is a testament to our renowned faculty who are often sought out to conduct research and collaborate on science that matters



across the globe and right here at home. Over 62 percent of our funding is from extramural grants. We take state dollars and more than double those with research grants, creating an economic impact in our state.

And our research attracts industry to our state while helping expand existing business. We work with many industries to understand problems and foster solutions to benefit companies and private landowners alike. We don't do this work in a vacuum. Working with many state partners, new industries are attracted to our state for the quality of resources and people.

In addition to the research our scientists conduct, we also train the next generation of natural resource professionals. In the Fall of 2023, we had 163 graduate students and 444 undergraduates. These students are an integral part of the FWRC research program. It's exciting to see these students grow into tomorrow's natural resource leaders.

I know you will enjoy delving deeper into our work and gaining a richer understanding of the impact we are making on the natural world in our state and beyond. As you read, you will see the passion that our faculty, staff, and students have for understanding, conserving, and utilizing our natural resources. We will continue in these endeavors and encourage your continued participation.

As we work together toward these shared priorities, I look forward to seeing you soon.

**L. WES BURGER**  
DIRECTOR



# CONSERVATION ACROSS LANDSCAPES



**F**rom 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.

Dr. Kristine Evans and Dr. Wes Burger adjust a Global Positioning System. (Photo by Grace Cockrell)

# STRATEGIC CONSERVATION

EMPOWERING FARMERS IN CONSERVATION

BY VANESSA BEESON

**N**EARLY HALF of the U.S. is agricultural land, and, as stewards of that land, farmers have a lot of ground to cover when it comes to conservation. Researchers in Mississippi State's Forest and Wildlife Research Center (FWRC) are designing a tool to make adopting conservation easier for farmers.

**DR. KRISTINE EVANS**, wildlife, fisheries and aquaculture associate professor and FWRC scientist, is part of a team developing a web-based tool called the CRP Menu tool for farmers to explore eligible conservation practices in the Farm Bill's Conservation Reserve Program (CRP).

"Farmers can create and compare portfolios of enrollment scenarios under their conservation and production objectives. We seek to create a centralized, user-friendly way for farmers to obtain conservation information that matches their interests, goals, and eligibility," Evans said.

The tool will be based off the Strategic Conservation Assessment (SCA) tool, which identifies potential areas for land

conservation projects along the Gulf Coast.

"We created the SCA tool to be transferable to any region and any conservation problem and can reconfigure it to meet our CRP Menu tool's objectives," Evans explained.

The team is using a social science research framework, where farmers and other stakeholders actively participate in the tool's creation.

"We will complete a sociological assessment of landowner motivation for enrolling in Farm Bill programs and have focal groups to get farmer and agency feedback on the tool," Evans said.

The first iteration of the tool will include feedback from stakeholders across 12 counties in eight pilot states: Arkansas, Illinois, Indiana, Iowa, Louisiana, Mississippi, Missouri, and Ohio. The team has conducted workshops in each of those counties to engage farmers and agencies in conversation to help develop the tool.

Brad Thornton, former research program manager for the project, said stakeholder engagement has been promising.

"We've been happy with the level of engagement with farmers, USDA staff, and other stakeholders. They're interested and invested in what we're trying to accomplish, especially when we explain how important it is to have their input during the development process. Their input helps us create a better tool. Having a resource that can really provide a menu of conservation options will be beneficial for farmers and conservation agencies alike."

After the tool is developed for the





pilot states, researchers hope to expand the tool to a national scale.

**“We hope to revolutionize engagement among landowners and technical service providers, break down barriers to enrollment and, ultimately, lead to meaningful program change with real conservation impacts,” Evans said. ■**

MSU collaborators include Dr. Mark McConnell, wildlife, fisheries and aquaculture assistant professor; Dr. Sathish Samiappan,

associate research professor in the Geosystems Research Institute (GRI); Reshma Devi Mandli, full stack web developer; Yong Liang, GIS developer; and Dixie Cartright, GRI training and external facilitator; former MSU wildlife, fisheries and aquaculture doctoral student Daniel Egerson; and computational engineering doctoral student Rishita Garg. Outside collaborators include Amanda Sesser, former Southeast Conservation Adaption Strategy partnership coordinator, and Shannon Westlake, a regional social

scientist for the U.S. Fish and Wildlife Service.

The project, funded by the U.S. Department of Agriculture, includes a steering committee of representatives from the USDA; the Mississippi Department of Wildlife, Fisheries and Parks; Pheasants Forever and Quail Forever; Missouri Department of Conservation; Wildlife Mississippi; Purdue University; MFA Incorporated; Bayer Crop Sciences; and American Farmland Trust.

# AFFORESTATION BENEFITING THE ENVIRONMENT

MEASURING THE CONSERVATION  
RESERVE PROGRAM'S ECOSYSTEM SERVICES

BY VANESSA BEESON

**T**HE U.S. DEPARTMENT OF AGRICULTURE'S Conservation Reserve Program, one of the largest private-lands conservation programs in the U.S., was signed into law nearly 40 years ago. Originally, the program's goals were to improve soil and water quality. As the program grew, and more farmers adopted CRP practices, the goals of the program expanded. Today, the program includes practices that mitigate climate change by reducing greenhouse gases through carbon sequestration. Scientists in Mississippi State's Forest and Wildlife Research Center (FWRC) are helping the USDA figure out just how much CRP forested land contributes to the reduction of greenhouse gases.

**DR. AUSTIN HIMES**, assistant forestry professor and FWRC scientist, heads up the \$3 million cooperative agreement with the USDA. The team, which includes researchers from Alabama A&M University, seeks to calibrate the DayCent model, which is used to simulate greenhouse gas influxes in the atmosphere. To do that, they must measure the net greenhouse gas exchange of CRP tracts compared to agriculture.

"We are assessing the total balance of

greenhouse gases in CRP forests, which includes the amount of carbon dioxide the trees absorb, or sequester, as well as the gases, including carbon dioxide, nitrous oxide, and methane, the forest emits," Himes explained. "Nitrous oxide and methane are potentially important to measure because many of the hardwood sites are in bottomlands where you have inundated soils, which tend to create more of these gases."

Thus far, the team has 49 hardwood and 24 pine sites in Mississippi, Alabama, Arkansas, and Louisiana. They hope to add additional forested and agricultural sites in the near future. They also hope to expand the site locations to Illinois, Kentucky, Missouri, and Tennessee.

"Pairing with the ag fields will let us calibrate what those background emissions would be like for given soil types under agricultural management, which is the previous use of all these sites," Himes said.

Himes said while DayCent has the potential to account for both sequestration and emissions, he suspects more calibration is necessary.

"We are quantifying how much those other greenhouse gases are potentially

offsetting the carbon sequestration. You must account for both to accurately assess how much these projects are impacting the total balance of the greenhouse gas and climate change mitigation."

Jianing Liang, a forestry doctoral student, is studying greenhouse gases in the soil.

"My focus is evaluating the factors impacting greenhouse gas fluxes in hardwood forests enrolled in the CRP program," she said.

The Beijing native received her master's at Beijing Forestry University and is intrigued by how small changes in the soil can have such a big impact.

"I can gather a lot of information from a little soil. I think this process is so amazing.





Dr. Austin Himes in a forested landscape. (Photo by Grace Cockrell)

CRP is a very important program contributing to forest ecology and climate change research. By estimating greenhouse gas flux and the tree biomass carbon storage, our data will help calibrate the DayCent model, and quantify the impact these forests have on climate change,” she said.

Himes said the project has had its challenges but that, overall, the work has been exciting.

“We’re learning things that will be helpful to the USDA in addition to more accurately accounting for greenhouse gas emissions and sequestration. We’re learning details and challenges

about the administration of the program that will help determine how best to implement these programs for the reduction of greenhouse gases,” Himes said. “Despite the challenges, the most exciting part has been collaborating with universities like Alabama A&M and giving students field experience. The opportunity to provide young people their first job or first professional experiences and help them through their educational process and closer toward earning their degree has been meaningful.” ■

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Himes is no longer with MSU. MSU

collaborators include Drs. Courtney Siegert and Heidi Renninger, associate forestry professors; Drs. Joshua Granger, Krishna Poudel, Adam Polinko, assistant forestry professors; and Dr. Mark McConnell, assistant wildlife, fisheries and aquaculture professor; Natalie Dearing, project manager; and Rebecca Holmes, project manager. Alabama A&M and Oklahoma State also collaborate on the work. The research is funded by the USDA.

Dr. Mark McConnell  
looks over an  
agricultural field.  
(Photo by Grace  
Cockrell)

# LIGHT A FIRE, SAVE A BIRD

SEASONAL FIRE AND ITS  
IMPACT ON SPECIES ABUNDANCE

BY VANESSA BEESON

**A** **SECRETIVE SPARROW** flits across the understory of a longleaf pine forest in Mississippi. These forests are biodiversity hotspots. Much of that biodiversity happens at the ground level, shaped by frequent fire. The Bachman's sparrow, a Partners in Flight Red Watch List species and ground-nesting bird, historically inhabited these forests, but their numbers have dwindled significantly in the last century, due to habitat loss from land development and fire exclusion. Mississippi State's Forest and Wildlife Research Center (FWRC) scientists look to the bird and the land in hopes of changing that.

**DR. MARK MCCONNELL**, assistant professor and FWRC scientist, hopes fire during the growing season, a more natural prescribed burn, can help bring more birds back to the landscape.

"Burning during the growing season is a major national discussion right now, especially in the Southeast where prescribed fire is a big management tool. While wildlife managers typically burn in late winter and early spring, the traditional dominant fire season was likely

much later, happening from lightning strikes during summer storms," he said.

McConnell—a quail expert—was excited to work with Bachman's sparrows.

"We knew there were Bachman's sparrows in the wildlife management area where we wanted to do the field study. They are a grassland songbird, endemic to the Southeastern U.S. A 2019 study published in *Science* reported that grassland songbirds have fallen 53 percent since 1970, more than any other bird," he said.

The team designed 15 burn plots across almost 1,800 acres. Eight plots were burned during the dormant season from February 24-April 6 and seven during the growing season from May 25-September 10. The study had its challenges, but the team determined a mix of dormant and growing season burns would be beneficial to the Bachman's sparrow.

The team evaluated the impacts of fire on the Bachman's sparrow, designing a prescribed fire plan for Marion County Wildlife Management Area, southwest of Hattiesburg. Prior to the burns, they conducted breeding and wintering bird surveys to estimate population number and

density. They captured 40 birds through mist netting; they banded and released them to observe their movement in relation to the burn timing. They also conducted vegetation surveys to quantify changes in the landscape based on whether the plot was burned during the dormant or growing season.

**DR. KRISTINE EVANS**, associate professor of wildlife, fisheries and aquaculture and associate director of Geosystems Research





Institute, provided research design and species expertise about the Bachman's sparrow, averaging 6 inches and weighing less than an ounce.

"This little brown bird confounds us all. It is so closely tied to fire, more so than nearly all the other bird species in the Southeast. Even though this bird has been the subject of research for decades, there is still so much we don't understand about Bachman's sparrow. This study helps us figure

out a very important unknown about this bird—are they responding to seasonality in fire, which will produce different ground cover conditions?" Evans said. "The timing of prescribed fire is an important driver of the ground cover. If we can have a better understanding of the best times of the year to burn to support healthy Bachman's sparrow populations and a healthy wildlife community, we'll have moved the needle substantially in our understanding

of how best to manage for this species." ■

In addition to Evans, collaborators included Michael Warren, wildlife, fisheries and aquaculture master's student, who graduated in May 2023; Rick Hamrick, small game biologist with the Mississippi Department of Wildlife, Fisheries and Parks (MDWFP) and Josh Maury, manager of the Marion County Wildlife Management Area. The Mississippi Museum of Natural Science, part of MDWFP, funded the research.



# HEALTHY MARKETS, HEALTHY FORESTS



**T**he relationship between our forests and markets is symbiotic. Access to healthy markets empowers forest landowners to actively managed their forest lands, leading to healthy forests. As a renewable resource, a well-managed healthy forest also raises the value of our forest products markets. We aid the forests through sustainable forest management practices, but how do healthy forests help us? Mississippi State's Forest and Wildlife Research Center (FWRC) researchers are leading an initiative to explore how these practices benefit timber producers and consumers alike. Whether by increasing the value of underused forest materials or addressing the cumulative value of timber harvesting, FWRC researchers are addressing the vitality of every aspect of the forest products industry to ensure our forests and our markets stay healthy.

# OPERATING IN THE SOUTH

ADDRESSING TIMBER PRODUCTION CHALLENGES IN THE SOUTH

BY LEXI HOLDINESS

**H**OW MUCH DOES IT COST to produce a 2x4? Calculating the total price of dimensional lumber is not as easy as one might think. Since the mid-2000s, the forest products industry has been unable to estimate an overall, cumulative cost from planting to production to finished product. Multiple forest operations have experienced economic fluctuations over the past decade; creating variation or statistical noise, that hinders the ability to quantify cost on a general scale.

**DR. ERIC MCCONNELL**, associate forestry professor and Mississippi State Forest and Wildlife Research Center (FWRC) scientist, is leading an initiative to address those issues and estimate the cost of doing business in Mississippi's forest products industry. Under a large umbrella, McConnell's team researches many aspects of forest operations, including timber growing and harvesting as well as logging and transportation.

"Timber is a time-intensive commodity, so we must assess the time-value of money. A dollar tomorrow is not worth as much to me as a dollar today. When results are closer to you in time, you place more value on them than if they are years away," McConnell said. "Understanding the costs in terms of the time-dimension

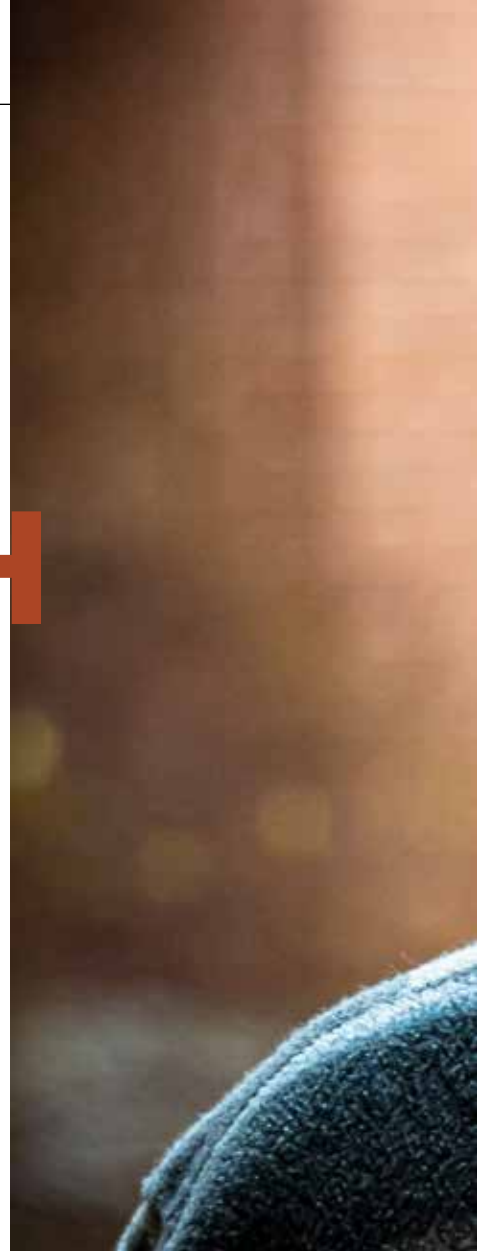
will help timber producers understand the risks and make decisions under uncertainty in the future."

McConnell's research addresses many locales across Mississippi and the South. Since the start of his research in 2020, he has discovered multiple ways for producers to optimize profit in the timber and logging sectors and aims to find more. For example, McConnell notes that taking advantage of state cost-share incentives and federal income tax deductions can save nonindustrial private landowners up to \$250 per acre when artificially regenerating hardwood stands. Furthermore, his research showed that 159 square bales of slash pine straw per acre would be required for a landowner to break even on a pine straw business venture and still earn at least a 5 percent rate of return. Net income from slash pine timber and straw could reach \$2,000 per acre or be completely lost due to straw production variability alone.

McConnell also found that participating in Mississippi's Forest Resource Development Program—a cost-share program where landowners receive partial reimbursements for their forest management expenses—was the most important factor a landowner controls to influence net income generated from their timberlands. Landowners requiring higher rates

of return, owning poorer quality lands, and receiving lower stumpage value could expect a relatively larger net income increment from state cost-share incentives.

McConnell's team is also addressing the high costs of log trucking in Mississippi. McConnell has found the average insurance premium for log trucks in Mississippi is \$11,360. Over \$4,300 of the yearly average can be attributed to safety and weight violations of trucks, placing trucking firms at a financial handicap. Moreover, restricted weight and closed bridges alone add \$4 million in trucking costs for pine sawlogs to be delivered to sawmills. James Shannon, a doctoral student and





Eric McConnell outside Thompson Hall. (Photo by David Ammon)

MSU Extension Service specialist based at the North Mississippi Research and Extension Center in Verona., is helping with that work.

“We’re working with the log-trucking industry, which is facing challenges from rising insurance rates, hiring drivers, and inflation. There has been research done on this in other states, but nothing has isolated Mississippi like we have,” Shannon said. “Our research is verifying the needs of the trucking industry in Mississippi, which positively benefits everyone involved.”

Shannon’s team is working to both verify issues in the industry and raise awareness to combat the costly

nature of log trucking in Mississippi.

“We’re focusing on promoting education, especially safety education, for drivers and firms. Keeping drivers safety aware through repeated training keeps it fresh on their minds so that they can react positively to adverse situations,” Shannon said.

With safety protocols at the forefront of both firms’ and drivers’ minds, violating regulations and receiving consequential fines will decrease. Shannon’s work aims to support trucking companies and their employees in Mississippi and lower the lofty price of the industry. ■

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MSU collaborators include Dr. James Henderson,

forestry professor and head of MSU’s Coastal Research and Extension Center; Dr. Mohammad Marufuzzaman, Department of Industrial and Systems Engineering associate professor and graduate coordinator; and master’s students Sakar Nepal, Suchana Aryal, and Swagat Attreya, who all graduated in 2023. Outside of Mississippi State, McConnell collaborated with Dr. Michael Crosby, Louisiana Tech University; Dr. Shaun Tanger, University of Arkansas at Monticello; Dr. Bruno da Silva, University of Georgia; and David Livingston, Mississippi Loggers Association. The research is funded by the USDA’s McIntire-Stennis grant, the USDA Forest Service, and the Sustainable Forestry Initiative’s Standards Implementation Committee.

# MARKET BARRIERS

SWEETER SOLUTIONS TO MISSISSIPPI'S UNDERVALUED TIMBER

BY LEXI HOLDINESS

**T**HE SHINING GOLD MEDALIST of Mississippi's timber is often the sun-soaked pine trees standing tall in the forests. While abundant and versatile, the pines aren't the only trees that deserve attention. Mississippi's forests are also bountiful in hardwoods, including the tulip-bearing yellow poplar and the producer of everyone's favorite spiky ball, the sweet gum.

While hardwoods are highly valued, yellow poplar and sweet gum are often undervalued. These species have piqued the interest of **DR. DAN SEALE**. A Warren S. Thompson Professor of Wood Science and Technology and Mississippi State Forest and Wildlife Research Center (FWRC) scientist, Seale is mapping out the forests in the eastern U.S. and plotting where the undervalued materials are located. Through a USDA Forest Service Forest Products Laboratory grant, Seale's team has

developed a database for every state in the eastern U.S. that identifies areas with sufficient harvestable volumes of these trees.

"We're trying to highlight the volumes we have by state and county. So, when we identify uses for trees like sweet gum and yellow poplar, whoever would be willing to build a processing facility would know exactly where to put it," Seale said. "When you look at our state, trees are worth money, and the more processing we have of those trees the more money our landowners get. We're all about increasing the value of our timberland, which increases the value of the land and therefore the state of Mississippi. We were specifically asked by mills to help them locate regions with dense populations of hardwoods and that is what we are doing."

Finding uses for the undervalued materials is the second arm of Seale's research. **KEITH WARD**, a forest resources doctoral

student under Seale's direction, played an instrumental role in determining the high-volume areas and alternative uses for hardwoods. The Engineered Wood Association (formerly American Plywood Association, or APA for short) publishes performance standards for the use of engineered wood, including how much weight a beam might hold. The USDA Forest Service's Forest Products Laboratory publishes the physical and mechanical properties for many species. Ward cross-checks the properties of a species from the USDA with







Keith Ward and Dr. Don Seale with engineered lumber. (Photo by Dominique Belcher)

the Performance Standards from APA to see if the species can be manufactured into certain engineered products.

“Products include I-Joists used in roofing, rim boards used in flooring, and structural panels used for roofs, floors, and walls,” Ward said. “My role involves comparing the published properties of each of the species to the performance standards to ensure the species meets the requirements to be used in manufacturing engineered products.”

By creating viable products and

building a market for undervalued hardwoods, several entities in the supply chain from landowner to manufacturer will benefit. Landowners will have better utilization of typically lower-valued species, existing mills can utilize these species more readily to manufacture products, and companies can consider new locations for mills by knowing the distribution and availability of the species.

“It’s a ripple effect. Mills will have something to process and sell and

therefore employ people. The loggers and anyone selling gas, oil, and lubrication will also have jobs. The truckers who haul lumber to mills will also benefit,” Seale said. ■

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The research is funded by the USDA’s McIntire-Stennis grant, and the USDA Forest Service Forest Products Laboratory.

# USING THE RESOURCES

CREATING MARKETS FOR SMALL-DIAMETER MATERIAL

BY LEXI HOLDINESS

**A** S FORESTS BECOME CROWDED and dense, they simultaneously develop a higher risk to insect and disease outbreaks and wildfires. The best preventative measure foresters can take to keep forests healthy is thinning—the selective removal of trees from a forest. Small-diameter and underutilized materials (SDUs) are often removed by thinning that can cause problems for our forests and climate.

SDUs have virtually no market value in the forest products industry. Although they are a prime source for papermaking, foresters barely break even between the cost transporting SDUs to paper mills and the selling-price of paper. Due to the high costs of transportation, SDUs are often left on the forest floor, building fuel for wildfire. The other alternative is burning the chopped wood and increasing the carbon dioxide emissions into the atmosphere and climate. SDUs have long been underutilized; however, new research has found that these low value logging remains may have a viable future.

**DR. MOSTAFA MOHAMMADABADI**, sustainable bioproducts assistant professor and Mississippi State Forest and Wildlife Research Center (FWRC) researcher, is studying creative alternatives for SDUs. His

project focuses on creating wood materials with SDUs and building a strong market for the products. Modeled after cross-laminated timber (CLT) and glue-laminated timber (glulam), the SDU products will be glued and sealed to be made applicable for construction. By utilizing the SDUs in construction, there is potential to massively sequester carbon and improve the health and resilience of the forests.

“The small diameter trees can be used in the same way as glulam and CLT. We are going to develop a strong product out of those small diameter trees. We’re using engineering concepts to develop products like glulam, but we’ll call them engineered cellular beams. They can compete with steel and concrete in both residential and commercial construction,” Mohammadabadi said. “Using the small diameter trees means we’ll implement sustainable forest management practices, and we won’t exhaust our lumber.”

The impacts of finding alternative products directly affect the Earth’s climate. All the carbon dioxide trees absorb while they are alive is continually stored in them after they’ve been cut. This makes wood materials carbon-negative compared to non-carbon storing materials, which are carbon-positive, like concrete, steel, or oil.



Aadarsha Lamichhane and Dr. Mostafa Mohammadabadi measure corrugated panels made from underutilized, small diameter trees. (Photo by David Ammon)

“To manufacture steel or concrete products means we use energy, and the energy means we release carbon. Wood products, however, sequester carbon through their life and after a tree is cut, it continues to store 50 percent of its weight as carbon. As long as the wood continues to store carbon, it doesn’t contribute to carbon emissions,” Mohammadabadi said.

**DR. RUBIN SHMULSKY**, professor and head of the Department of Sustainable Bioproducts, contributes to




Mohammadabadi's research as co-project investigator. According to Shmulsky, finding viability and building a strong market for SDUs will aid the timber industry and, consequentially, the environment. "Forestland owners need to derive value from their land," Shmulsky said. "Our goal is to keep as much timberland as possible for as long as possible. Economic markets for small diameter trees are needed to help foster this notion of keeping timberland in perpetuity."

This project is addressing issues in forestry, construction, and conservation on multiple fronts, including education. Through collaboration with MSU's Extension Service, Mohammadabadi's project will have a great emphasis on building student interest and opportunities. "Creating sustainable bioproducts requires individuals from an array of disciplines. I want students to see, no matter their education or interest, that they can work in wood products. We need chemists

and engineers; we need many areas of expertise to combat the world's pressing problems," Mohammadabadi said. "One of the most important parts of research is educating future generations. We need young people to take an interest in finding green solutions to create a brighter future." ■

This research is funded by the USDA's McIntire-Stennis grant.

# CLEAN WATER, CLEAN ENERGY



**T**he need to embrace sustainability is more urgent now than ever, and Mississippi State's Forest and Wildlife Research Center is at the forefront of creating technology to achieve global conservation goals. When we look at problems, our scope extends from the outer limits of Earth's atmosphere down to some of the smallest particles of a plant. Forest and Wildlife Research Center (FWRC) scientists are working with NASA using satellite technology to help address water availability and turning to agricultural waste products to treat our wastewater, lower CO<sub>2</sub> emissions, and reduce our reliance on nonrenewable construction materials. As we collectively work toward a more sustainable future, the big picture matters, but the small ones matter, too.

# BIG PICTURE

ASSESSING CROP WATER USAGE WITH SATELLITE IMAGERY

BY MEG HENDERSON

**S**ATELLITE TECHNOLOGY has aided scientists in monitoring, understanding, and managing Earth's natural resources for the last five decades. In 1972, NASA launched Landsat 1—the first satellite of the Landsat program. Two years ago, NASA launched its latest iteration, Landsat 9.

Mississippi State Forest and Wildlife Research Center (FWRC) scientist and assistant forestry professor **DR. YUN YANG** is utilizing Landsat images to manage declining water resources—doing her part to contribute to NASA's most recent initiative to address agricultural and food security challenges.

Yang is part of the NASA Acres project, a national consortium of scientists contributing to a five-year, \$15 million grant led by the University of Maryland. Along with more than 30 other scientists and partners, she is conducting research to advance understanding of U.S. agriculture

and improve current agricultural strategies to ensure the efficient use of natural resources.

Yang's expertise lies in using satellite data to study evapotranspiration—the combined processes of evaporation and transpiration—which moves water from the earth's surface into the atmosphere. She and her graduate student, Gaurav Baral, are assessing crop water usage in the lower Mississippi Alluvial Plain, or Mississippi Delta, from detailed satellite imagery.

“This region has some of the most productive agricultural land in the country. Recently, we've seen a quick decline of the groundwater table, so we want to assess where the water is used and how we can better manage our water resources and keep our groundwater table sustainable and the land productive for the future,” said Yang.

Although commercial enterprises also

offer services that monitor and support agricultural land, there are some key differences between their approach and NASA's.

“NASA is making a long-term commitment to open science, and the models we build through this project will be made available to the public for the benefit of society,” said Yang. “Also, this is a large-scale project. NASA Acres brings together





Dr. Yun Yang (right) looks over a map with graduate student, Weina Duan. (Photo by David Ammon)

more than 30 experienced scientists from different institutions and components of agriculture to find solutions.”

Earlier this year, Yang’s research was accepted for publication in two of the most highly respected journals in environmental science—*Nature Water* and *Nature Ecology and Evolution*. She also presented her work

to a global audience at professional meetings in San Francisco; Lisbon, Portugal; and Rome, Italy.

Forestry department head and George L. Switzer Professor of Forestry **DONALD GREBNER** added, “Dr. Yang’s work on the NASA Acres project is an excellent example of MSU’s forestry department leading the way

in developing technology that helps monitor and better manage our natural resources.” ■

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This research is funded by the National Aeronautics and Space Administration (NASA).

# WATER AND OIL

TURNING AGRICULTURAL WASTE  
INTO TREASURED RENEWABLE RESOURCES

BY MEG HENDERSON

**WHEN DR. EL BARBARY HASSAN** thinks about crop waste, he sees green—from both environmental and economic standpoints. Hassan, a professor in the Mississippi State Department of Sustainable Bioproducts and Forest and Wildlife Research Center (FWRC) scientist, is collaborating with Mohamed El-Sakhawy, a scientist from Egypt's National Research Center, on a study aiming to produce renewable biofuels and wastewater treatment adsorbents from agricultural waste. This two-to-three-year \$200,000 study, which began in 2021, is funded by the National Academy of Sciences' U.S.-Egypt

Science and Technology Joint Fund.

"Dr. El-Sakhawy and I worked together at the National Research Center in Egypt, before I came to Mississippi State, and have known each other for many years," Hassan said. "We believe that making this a bi-national study will increase the strength of scientific collaboration and unify the efforts of scientists around the world to solve global challenges that all countries face."

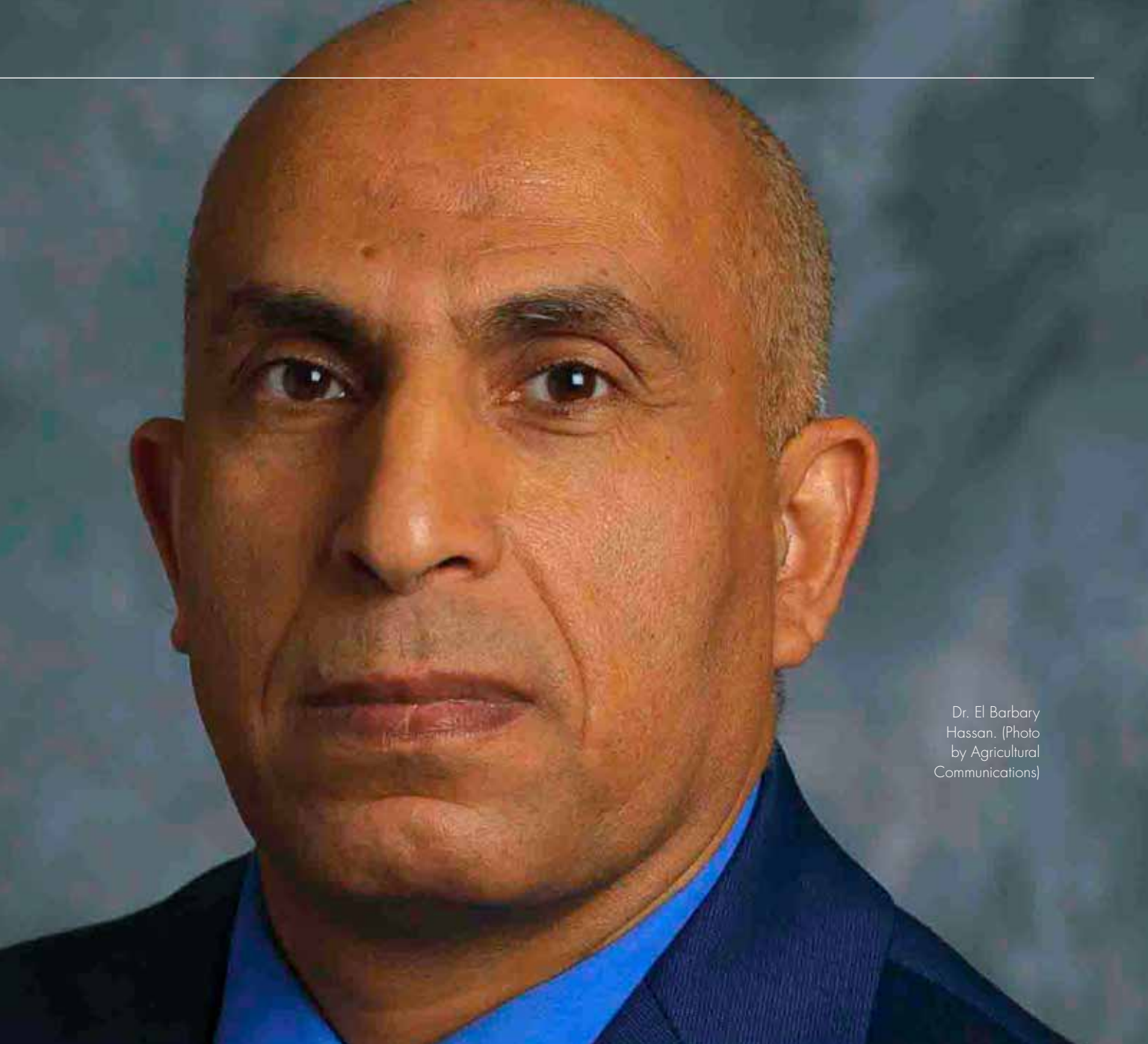
Disposing of agricultural waste creates an environmental problem for many countries as the waste material is primarily burned, sending large amounts of carbon dioxide into the atmosphere. Hassan and El-Sakhawy are seeking ways to utilize agricultural waste for product

development while shrinking its environmental footprint. To this end, these scientists are working to develop agricultural waste from rice—an abundant crop in both the United States and Egypt—to produce renewable biofuels and low-cost biochar adsorbents for wastewater treatment applications.

"Burning agricultural waste releases large amounts of greenhouse gases, which damage the atmosphere and cause a number of severe health problems,"







Dr. El Barbary Hassan. (Photo by Agricultural Communications)

said Hassan. “We’re trying to find a way to reduce emissions and create valuable products at the same time.”

The U.S. research team, led by Hassan, is focused on producing a viable renewable biofuel. They begin by converting the rice straw to bio-oil and biochar through pyrolysis—a process where materials are broken down by heating them at high temperatures in the absence of oxygen. From there, they will develop a novel biochar-based catalyst to produce a renewable

biofuel from the bio-oil and biochar.

The Egyptian team is working on producing various low-cost and effective adsorbents for wastewater treatment from the rice straw-derived biochar. El-Sakhawy’s team will test the efficiency of the adsorbents on the removal of different water pollutants, such as heavy metals, anions, and dyes. Hassan will train his Egyptian counterparts on producing the biochar from his fast pyrolysis conversion process.

This project is on the front line of new

trends in renewable energy and wastewater management and reuse. Demand for renewable and bio-based products will continue to grow in the coming years, and these highly serviceable products will highlight the viability and economic importance of agricultural waste in the energy and wastewater management industries. ■

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This research is funded by the National Academy of Sciences’ U.S.-Egypt Science and Technology Joint Fund.



Dr. Jilei Zhang (right) works with Sijin Guo, graduate student, to create lignin-based graphene. (Photo by David Ammon)

# GREEN IS THE NEW BLACK

A RENEWABLE ALTERNATIVE TO A VERSATILE CARBON-BASED MATERIAL

BY MEG HENDERSON

**G**RAPHITE—a carbon-based mineral used in pencils—comes from the Greek verb *graphein*, meaning “to write.” Today, it is also found in lubricants, polishes, and lithium-ion batteries, the latter accounting for 25 percent of the world’s demand.

**DR. JILEI ZHANG**, a Mississippi State Forest and Wildlife Research Center (FWRC) scientist, worked on a groundbreaking study producing a lignin-based graphene—the honeycomb-shaped atomic-level layers that form graphite—which is chemically similar to its nonrenewable counterpart.

Lignin, an adhesive-like organic polymer, is what gives the cell walls of plants their shape and strength. In trees, this water-resistant and protective material makes up part of their woody biomass. At a paper mill, lignin is removed from the wood fiber by a process called kraft pulping, which results in a liquid byproduct. Sometimes referred to as “black liquor,” the lignin, considered a waste product, is concentrated and burned in an onsite recovery boiler to produce steam energy for the mill.

“Although this process allows us to reuse the extracted lignin, it is not the most efficient fuel source, and there are potentially higher-value applications,” said the Warren S. Thompson Professor of Wood Science and Technology. “If we can produce graphene from lignin, it opens up more profitable applications for this waste product.”

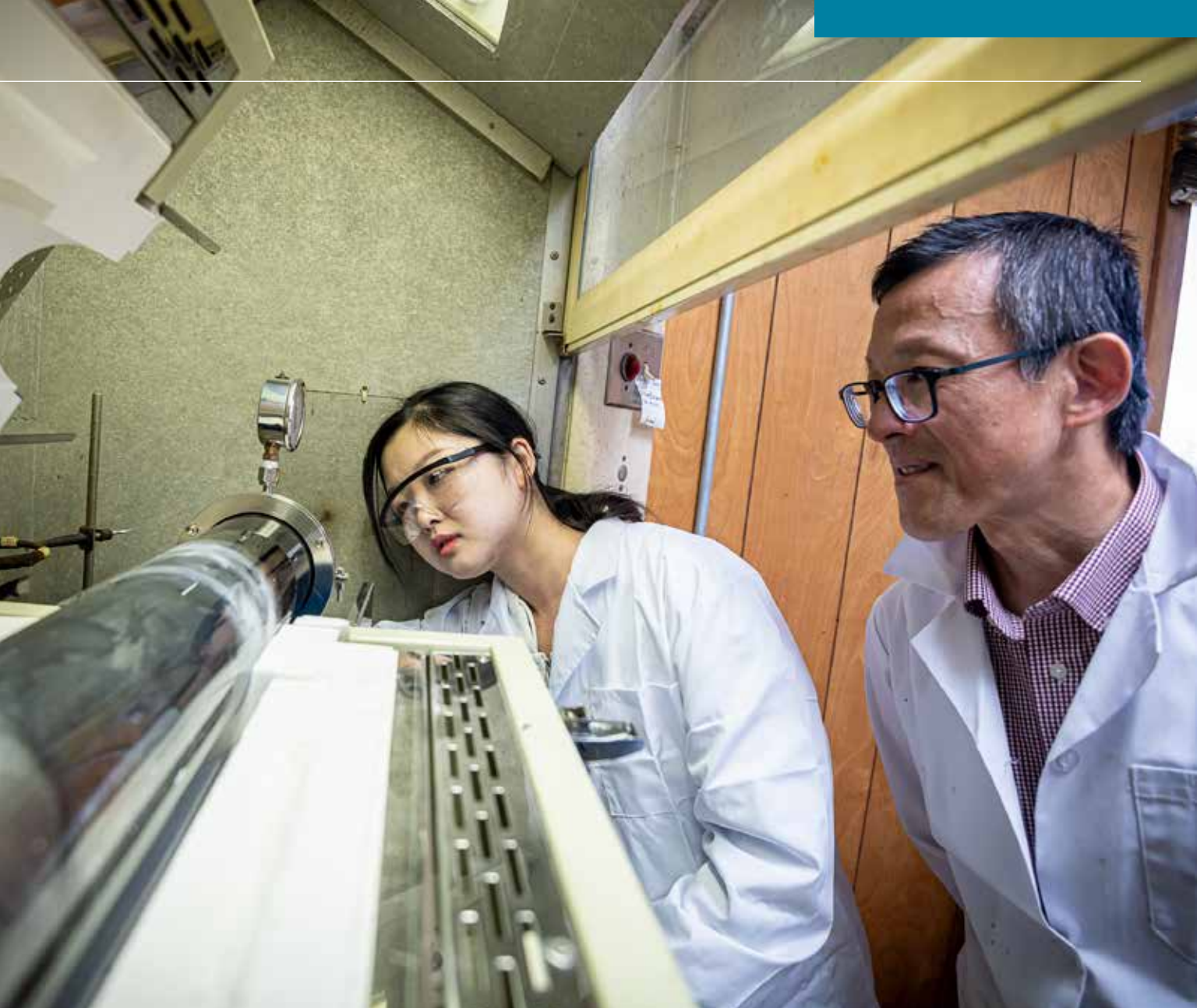
Zhang’s work began with a collaborative study with scientists from the USDA’s Forest Products Laboratory and Ligsteel LLC, both based in Madison, Wisconsin, to research the chemical processes that turn lignin into bio-graphene oxide materials. Zhang and his team were successful and have two patents for their methods of synthesizing graphene from lignin, the original 2017 patent belonging to MSU.

This green resource has potential to transform the construction industry. When graphene is added to concrete, using the right process, it improves concrete’s strength and resistance to stress and cracking, making it possible to use less concrete in total. Zhang read a published study that claimed to find a successful process using traditional graphene.

He replicated the study in his lab using the authors’ methods as the control and followed the same procedure with his lignin-based graphene as the experiment.

“Although we replicated the study down to the smallest detail, we did not get the same results, even in the control, so we are now testing alternative methods to successfully add our bio-graphene to concrete,” Zhang said. “Testing the concrete is a 30-day process, so this part of our research takes time.”

Despite the slow and laborious process, Zhang has confidence that his bio-graphene has promising industrial



potential. In 2021, he received a \$150,000 grant from MSU's SMART Business Act Accelerator Initiative to scale up production of the university's patented bio-graphene and work with Saturn Materials in Columbus, Mississippi, to develop it as an additive to strengthen concrete. And last year, the Mississippi Development Authority awarded him \$20,000 to further advance this research toward potential commercial applications.

"Commercially, there are a number of possible applications—it could be water treatment, concrete, batteries, composite panels for planes and automobiles, or other

uses," he said. "For now, we're focusing on continuing the research to see if we can have a breakthrough. All these applications are possible, but the work is difficult."

Zhang, keen on authoring the story of this polymer's future, has looked at further uses for lignin-based graphene. Last year, he completed a three-year study supported by a National Institute of Food and Agriculture (NIFA) grant, where he explored using bio-graphene as a potential means of removing toxic heavy metals from water and plans to apply for more NIFA funding this year to continue that research.

"When you're working with a newly discovered substance, there are more questions than answers, but we have to challenge ourselves and stay curious," he said. "Our main goal with this study was to produce the graphene, and we will continue to explore methodologies for its applications." ■

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This research is funded, in part, by MSU's SMART Business Act Accelerator Initiative, Mississippi Development Authority, and the USDA National Institute of Food and Agriculture.

# ONE HEALTH



**H**uman 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. Mississippi State University's Forest and Wildlife Research Center (FWRC) is working in the area of One Health to achieve the best health outcomes for people, animals, and plants in a shared environment.

# WHAT'S FOR DINNER?

IDENTIFYING THE IMPACT OF BIRD PREDATION ON SOUTHERN AQUACULTURE

BY SAMUEL HUGHES

**S**OUTHERN AQUACULTURE contributes millions of dollars to state economies, but this industry faces a lofty challenge: birds. Many aquaculture farms are established in the middle of the Mississippi Flyway, a migration route for hundreds of species of waterbirds. **DR. BRIAN DAVIS**, a Mississippi State Forest and Wildlife Research Center (FWRC) scientist and the James C. Kennedy Endowed Professor in Waterfowl and Wetlands Conservation, has been involved in several studies focused on examining the multi-million-dollar impact of these birds on U.S. aquaculture.

“Within the natural world, these birds have always been around, but now we have artificial systems. In Mississippi, we have these square catfish ponds with a high density of fish,” Davis said. “I imagine, from a birds’ perspective, it’s like shooting fish in a barrel.”

The catfish industry is the biggest fish in U.S. aquaculture, generating 24 percent of the nation’s aquaculture output. In 2023, Mississippi produced more than half of the nation’s catfish—a \$252 million industry. In one study, Davis and other FWRC researchers identified the

impact of the double-crested cormorant on catfish farms. These cormorants roost in trees along the Mississippi River and will travel more than 40 miles to dive into the shallow ponds of catfish farms, and the bird’s populations are rising.

The study found that these migratory, fish-eating birds consumed between \$5 and \$12 million in catfish each year. Factoring in bird deterrent costs—one of the top five costs catfish producers face—annual cormorant predation causes a revenue loss of \$64.7 million on average.

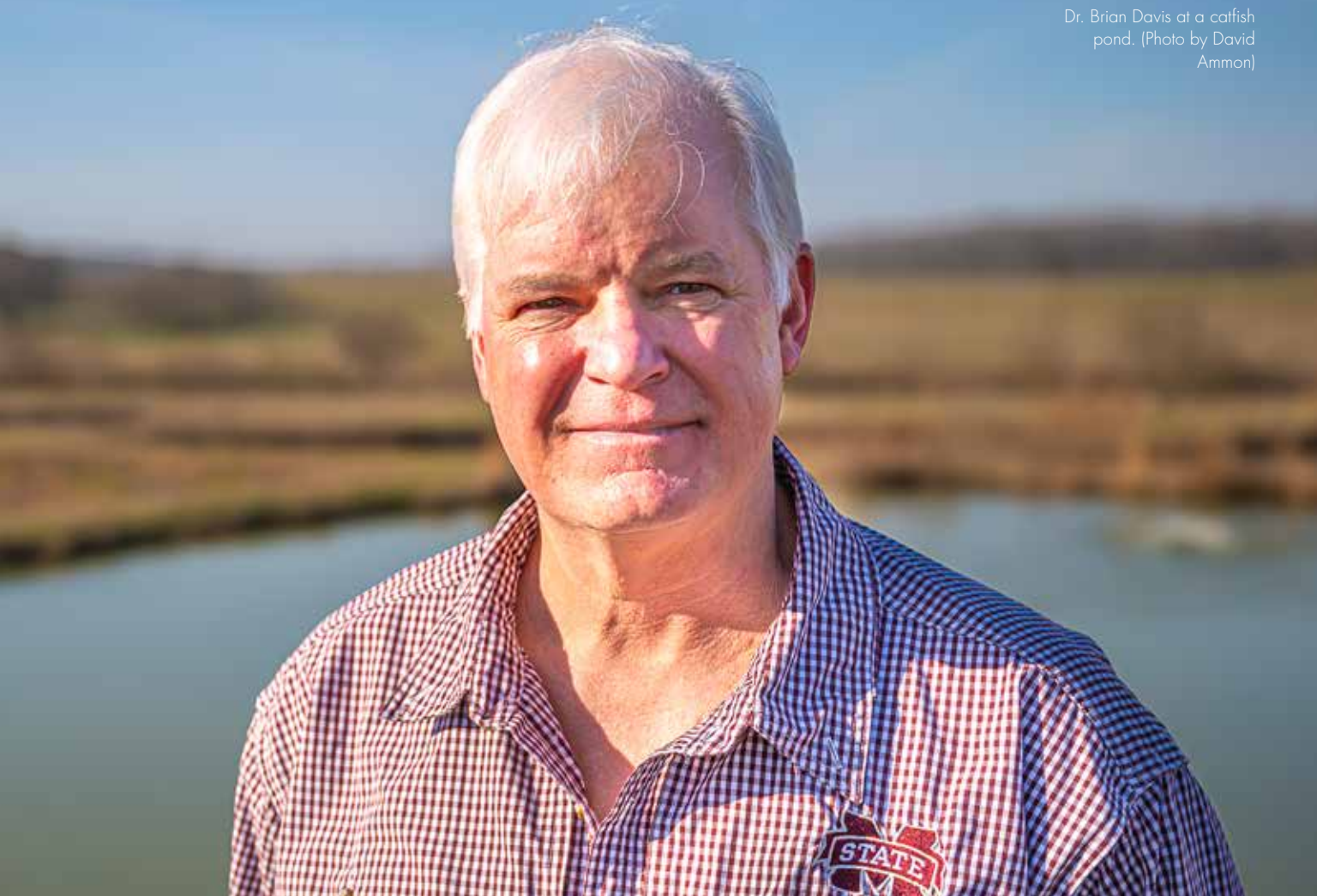
“One of the main techniques people have used has been disrupting them from their roosts, but it takes so much money and manpower. There are many studies on that, and there’s no silver lining,” Davis said. “Who knows what future research holds, but it’s still a problem.”

Dr. Brian Dorr, management research wildlife biologist at the USDA Animal and Plant Health Inspection Service Wildlife Services National Wildlife Research Center, collaborates with the FWRC on waterbird research. Dorr said avian conflicts within aquaculture are likely to continue, and that the nature of these conflicts will continue to evolve

as changes occur within industry practices, bird management, and regulations.

“Aquaculture worldwide is a rapidly growing agricultural sector and is predicted to become the largest source of seafood, overtaking wild-caught fish in the future,” Dorr said. “Aquaculture is a constantly changing industry. Production practices, and even species produced, change over time. Methods for addressing bird-aquaculture conflict are also constantly changing, with new methods, such as drones, being investigated. These factors combined with changes in bird interactions within aquaculture, and changes in their populations, require continued

Dr. Brian Davis at a catfish pond. (Photo by David Ammon)



research and development of methods to address bird conflict within aquaculture.”

Another FWRC study highlighted the nuance of this aquaculture-wildlife conflict. After reports that scaup were eating fish on baitfish farms, FWRC researchers visited Arkansas—the nation’s second-largest aquaculture producer—to study the impact of this duck species.

After an examination of the scaups’ stomach contents on baitfish farms, the study found that fish comprised a minority of the birds’ overall diet and that scaup may shift to fish as a food source in colder winters.

“When farmers see ducks, they may


automatically think that they might be eating fish. One of the management recommendations from this study is not to worry about it in milder winters, because they’re probably not eating a lot of your fish. Save your money and time for colder winters when they are probably shifting to fish,” Davis added.

Many studies examining the role of waterbirds in agriculture are decades old. Davis said that, as agriculture management techniques and aquaculture production methods shift, new studies that examine the role of wildlife within agriculture are necessary.

“Bird populations aren’t influenced

by one thing but by many variables. It’s predators, it’s habitat disturbance, it’s disease, and hunting, but in the case of cormorants and other birds, artificial food systems have a lot to do with it,” Davis said. “Our goal is to study the problem and then develop management practices that help producers succeed.” ■

MSU collaborators include Dr. Mark McConnell, wildlife, fisheries and aquaculture assistant professor; and Dr. Sathish Samiappan, associate research professor in the Geosystems Research Institute.



Dr. Steve Demarais takes measurements of a buck at the Forest and Wildlife Research Center Deer Unit. (Photo by Logan Kirkland)

# ENVIRONMENTAL SENTINELS

INVESTIGATING THE USE OF BUCK SCRAPES IN DETECTING CHRONIC WASTING DISEASE

BY SAMUEL HUGHES

**M**ISSISSIPPI STATE UNIVERSITY RESEARCHERS are pioneering a new way to detect the local presence of chronic wasting disease (CWD), a contagious, fatal, neurological disease threatening the nation's deer populations.

**DR. STEVE DEMARAIS**, Taylor Chair in Applied Big Game Research and Instruction in Mississippi State's Forest and Wildlife Research Center (FWRC), leads a team studying how scrapes could be used in detecting CWD before noticeable symptoms surface. Scrapes are social cues bucks use to alert other deer of their presence, such as chewing an overhanging branch leaving saliva and pawing the ground to expose soil and urinating in the pawed area.

Since the state's first case of CWD was reported in 2018, MSU Deer Ecology and Management Laboratory scientists have been at the forefront of CWD research, addressing the needs of wildlife agencies combating this disease. One of the key needs is to know where the

disease is located as early as possible.

"As bucks chew on overhanging branches and urinate on the scrape, prions—abnormally formed proteins—are released if a deer is CWD positive," Demarais said. "Camera traps show us that, on average, every scrape is visited by 12 bucks, each of which may or may not have CWD."

Research has shown that prions—the infectious agents of CWD—can remain in the environment for many years. Currently, the primary way of diagnosing CWD is testing a deceased deer's lymph nodes, an expensive and labor-intensive method which may not identify where the disease is located until the prevalence is too great to be impacted through management actions.

"We wanted to see if we could use scrapes as a sentinel, an early warning signal that did not require sampling an individual deer," he said. "If one of those 12 bucks visiting a scrape is positive for CWD, we can detect CWD in an area even if no positive deer have been submitted by hunters.

"Our success in detecting CWD prion contamination in scrapes shows that sampling has potential as a new tool for CWD surveillance, which can better detect disease in new areas through grouping samples compared to testing individuals," Demarais continued. "For example, we found CWD prion contamination in scrapes tested in Mississippi wildlife management areas up to 19 miles





from the nearest positive deer detection.”

The University of Minnesota and the MSU Veterinary Research and Diagnostic Lab are partnering with the Deer Lab to develop tests to detect prions in the soil and on branches gathered during sampling.

Stuart Lichtenberg, a researcher at the University of Minnesota and the Minnesota Center for Prion Research and Outreach, leads the

laboratory analysis of scrape samples.

“It can take years for an animal to show symptoms of CWD. Even before that happens, animals can spread the disease and deposit prions into the environment. Because of this, early detection is critical for management decision making,” Lichtenberg said.

Demarais said scrape sampling results won’t cause an area to be entered into an

agency’s CWD Management Zone, but positive results inform local hunters they may want to seriously consider testing harvested deer before bringing venison home to feed their family. ■

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The research is funded by the U.S.D.A.’s Animal and Plant Health Inspection Service Wildlife Services and the Mississippi Department of Wildlife, Fisheries, and Parks.

# MONITORING RESISTANCE

ASSESSING THE ROLE OF WILDLIFE IN THE MOVEMENT OF ANTIMICROBIAL RESISTANCE

BY SAMUEL HUGHES

**M**ICROBES—bacteria, viruses, fungi, and parasites—are developing increased levels of protection from medications and chemicals meant to eliminate them, creating antimicrobial resistance (AMR). This makes infections harder to treat, presenting an unprecedented medical challenge.

Understanding the prevalence and transmission of AMR is a critical facet of One Health, a research approach that recognizes that human health is closely connected to animal health and our shared environment. Wildlife can serve as AMR reservoirs in the environment, but their role in AMR distribution and spread is poorly understood. Different animal species have different ecologies that can influence their propensity to spread AMR.

**DR. DANA MORIN**, a wildlife assistant professor in the Mississippi State Forest and Wildlife Research Center (FWRC), strives to fill this knowledge gap.

“Black bears travel a lot and are very tolerant of human interactions. Deer come into people’s yards and have interactions, and ducks have huge migratory patterns,” Morin said. “We’re evaluating multiple species to identify important factors that indicate whether they’re going to be an AMR spreader.”

Morin is collaborating with Dr. John Brooks, a USDA Agricultural Research Service microbiologist, who collects data through examination of live bacterial cultures.

“We’re assaying *Enterococcus*, *E. coli* and *Salmonella* through a culture approach, to try and get a live isolate,” Brooks said. “Once we have the live isolate, we can take a deep dive into its DNA to understand what genes might make it more resilient in the environment, any genes that might make it more associated with wildlife carriage, and of course, antibiotic resistance genes as well.”

By taking samples from animals’ fecal

matter during concurrent FWRC projects, the team gathers broad-based data on antimicrobial resistance from multiple species. In wet and humid areas like Mississippi, fecal samples disappear quickly. To address this challenge, Morin plans to collect dung beetles that have fed on and burrowed in fecal samples, using them as a quick and inexpensive sampling method to identify hotspots of AMR accumulation.

One research site is behind a rural retailer in Virginia. Due to poor waste disposal practices, bears have access to



Dr. Dana Morin works with students in the lab to determine sources of antimicrobial resistance. (Photo by David Ammon)



human garbage there. Morin and Brooks are analyzing the fecal samples of these bears.

“People find the bears to be a nuisance because they are spreading garbage around, but they may not be realizing the health risks associated with that as well,” Morin said. “That’s the main pathway we’re interested in right now—how does wildlife interactions with humans then start to allow the spread of antimicrobial resistance from non-natural, anthropogenic sources?”

Once DNA is collected from fecal samples, Morin can use this DNA to identify individual animals, eventually creating a model of where these animals move on the landscape. Depending on these animals’ loads of AMR, the model could predict what areas are at greater risk to the spread of AMR.

“We don’t know how wildlife might play a role in the spread of antimicrobial resistance and in the spread of bacteria like *Salmonella*,” Morin said. “From a One Health perspective, that

makes it very difficult to understand where we might find AMR in the environment. We’ve been collaborating to try and use fecal DNA samples and what John is able to culture to see if we can predict how wildlife might move microbes around the environment.” ■

The research is funded by U.S.D.A.’s Agricultural Research Service.

# GROWING LEADERS



**U**ndergraduate 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 (FWRC). 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

OLIVIA  
BURDINE

HAYDEN, ALABAMA

BY VANESSA BEESON

**W**HEN OLIVIA BURDINE walked across the stage in May 2024, she became one of the first in her family to graduate with a four-year degree. The Hayden, Alabama, native grew up on seven acres in rural Alabama along two forks of the Black Warrior River. Free time outdoors was spent kayaking the river, horseback riding, gardening, and exploring the natural world. She grew to love the environment with a strong call to protect the place she called home.

“Growing up, I saw people around me not caring for the environment and even damaging our natural resources. I saw the river and woods I love start to slowly change, and I wanted to prevent further damage,” she said. “I decided that the best thing I could do was educate myself in conservation so that I could educate others.”

When touring colleges, she was drawn to Mississippi State University’s excellent conservation program and the strong sense of community she felt on campus.

“I toured a couple universities before MSU, but when I toured here, I knew that I didn’t need to look any further because this was home for me. All the steps fell into place,” she said.

Burdine arrived in the fall of 2020 and majored in natural resource and environmental conservation in the Department of Forestry. She is working as an undergraduate research scholar under the direction of **DRS. CHRISTINE FORTUIN** and **ESTEBAN GALEANO**, assistant forestry professors, studying plant-pollinator associations.

“Our goal is to investigate floral resource usage by bees and other pollinators in forests and to build a plant-pollinator network to better understand plant-pollinator relationships in southern forests for conservation purposes.

Previously, I was working with Dr. Galeano studying genetic crossings of Eastern cottonwoods. He knew of my interest in entomology and alerted me about the research project focused on pollinators,” she said.

Thus far, she has collected 93 specimens of bees in Starkville and Blount County, Alabama. She is in the process of identifying each species. The team also collected pollen from these specimens and will conduct DNA analysis

to determine the pollen’s plant sources. From there, they will build a map that describes the understory pollinator network within the two geographical areas.

“I love beneficial insects. I think that nature has a way of balancing itself until sometimes we get in there and mess it up a little bit. We think we’re helping and maybe we’re not, but I think that nature already has the solution, and bees offer so much we don’t even see. I am passionate about learning more about them and helping them thrive,” she said.

The project is helping prepare her for the next step in her academic career. In fall of 2024, she plans to begin a doctoral program at the University of Arkansas studying forest entomology.

“This research project was a big part of me getting accepted into the University of Arkansas forest entomology doctoral program. It’s also given me the chance to use the knowledge and skills I’ve gained over the last four years to advance conservation in two subjects I love most: forestry and entomology,” she said.

Burdine has a clear passion to one day teach natural resource and environmental conservation.

“I will never get bored of learning. I just think it’s exciting to discover new things. I think conservation education, particularly, is incredibly important. The lack of awareness in environmental conservation is part of our problem. If people better understood the importance of the things that we do, they could do more to make the world a better place. My main goal is to teach that at the collegiate level,” she said. ■

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The Undergraduate Research Scholars Program is funded through the Forest and Wildlife Research Center.



GRADUATE STUDENT

# LANDON GREENE

ALBANY, GEORGIA

BY MEG HENDERSON

**G**RADUATE STUDENT **LANDON GREENE** is discovering that an ounce of prevention is not only worth a pound of cure, but it also results in more sustainable use of lumber in the construction industry.

Well into the second year of his master's program working under **DR. TAMARA FRANÇA**, sustainable bioproducts assistant professor and scientist in the Mississippi State Forest and Wildlife Research Center (FWRC), Greene is focused on identifying and preventing biodeterioration in Southern yellow pine lumber—one of the most widely used sources of lumber in the U.S. construction market. Being a softwood, Southern yellow pine is subject to deterioration when exposed to brown rot fungus, and significant forest resources are needed to repair or replace rot-damaged boards.

To examine the effects of this fungus, Green cut several strips from a 2" x 6" Southern yellow pine board and exposed them to brown rot fungus in order to catch decay at its earliest stages. Greene's research points out the need for early testing to prevent future damage to structures built with Southern yellow pine lumber.

"At these early stages, we can't see the decay with the naked eye, but if the wood is losing 2 to 10 percent of its mass, that loss affects its mechanical properties," he said. "If we can test early, we can replace the few affected boards—keeping the rest of the original



boards in service for as long as possible and the structure of the building intact."

An Albany, Georgia, native, Greene moved with his family to Vicksburg as he was entering high school. He attended Hinds Community College for two years before transferring to MSU's forestry program to complete his bachelor's degree. Greene didn't have his eye on graduate work at the time, but that changed when he took a student job in the sustainable bioproducts department.

"At first, I didn't know anything about sustainable bioproducts, but I really enjoyed my work in the department and was interested in the research going on over there," he said.

For the moment, Greene is dedicated to his master's project and is also assisting

França with a termite damage study in cooperation with Oregon State University. As he contemplates the future, Greene is keeping his career options open but thinks that he would like to work in some aspect of quality control management—treating and testing products and making sure they meet industry standards.

"Between my bachelor's degree in forestry with a concentration in wildlife and a master's degree in sustainable bioproducts, I have a broad range of skills that will prepare me for a wide variety of jobs. I want to be open to all the possibilities," he said. ■

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The Undergraduate Research Scholars Program is funded through the Forest and Wildlife Research Center.

## UNDERGRADUATE STUDENT

GRANT  
PETERSON

STARKVILLE, MISSISSIPPI

BY SAMUEL HUGHES

**A** STARKVILLE NATIVE, GRANT PETERSON searched for alligators at Sam D. Hamilton Noxubee National Wildlife Refuge throughout his childhood. He walked under blooming dogwoods while bald eagles perched in their nests. He learned of the success of Noxubee, how it once was overworked farmland and fragmented forest before it was restored starting in the 1930s.



“Seeing how degraded land can be turned back into something beautiful, something biodiverse and ecologically friendly was very inspiring to me,” Peterson said. “That’s when I knew I was professionally interested in wildlife conservation.”

Peterson, a senior wildlife, fisheries, and aquaculture major at Mississippi State University, has delved deep into his life-long passion for conservation, focusing

his studies on restoring wetland and forest ecosystems. During his sophomore year, he began research within the Forest and Wildlife Research Center (FWRC) under **DR. SANDRA CORREA**, assistant professor in wildlife, fisheries and aquaculture.

Peterson, Correa, and student volunteers made monthly excursions to the Pascagoula River in 2021 and 2022, collecting fish and water quality samples in hopes of identifying the significance of the river’s floodplain forests to the early life stages of fish.

“The Pascagoula River is the longest unaltered river in the U.S. with natural flooding and is a perfect study area because it is so natural. That also means that it is at risk of people wanting to disrupt the flow of the river,” Peterson said.

“Collecting this ecological data about the biodiversity of fish and how important the river is as they grow from larvae to adults will help make a case to land managers that this river and other seasonally flooded forests need to be protected.”

More recently, Peterson has collaborated with other FWRC researchers to analyze the diversity of woody plants within his familiar Noxubee National Wildlife Refuge.

“We will present this data to land managers at the wildlife refuge to provide a more accurate estimation of tree and shrub species present at the site,” Peterson said. “This can have implications for management such as invasive plant removal as well as public outreach regarding plant diversity and conservation.”

Now president of Students for Sustainable Campus and an active member of the MSU student chapter of The Wildlife Society, Peterson said his experience in undergraduate research has provided him with valuable skills for a career within wildlife management.

“It is very inspiring to know that professors believe I can do this kind of research early in my career. It’s been impactful to get experience that I need to continue research throughout my career, such as data collection and organization,” Peterson said. “This was also my first opportunity to learn fieldwork techniques, like learning how to drive a boat, setup fish traps, and use water quality measurement tools. These are all skills that I will use in a future career in wetland restoration.” ■

The Undergraduate Research Scholars Program is funded through the Forest and Wildlife Research Center. Peterson graduated and is pursuing a master’s at Yale University.



GRADUATE STUDENT

# EMMA SCHULTZ

SILVER SPRING, MARYLAND

BY VANESSA BEESON

**D**IVING INTO A MARINE BIOLOGY course as an undergraduate student ignited a passion for wildlife in **EMMA SCHULTZ**. That passion would eventually lead her inland to Mississippi State University to pursue a doctorate in wildlife, fisheries and aquaculture.

“At first, I thought I wanted to be a veterinarian,” Schultz remembered. “After that class, though, I fell in love with marine biology and was hooked.”

Schultz earned a bachelor’s in biology with a pre-veterinary concentration from Queens University of Charlotte and a master’s in marine sciences from Savannah State University where she studied genetic analyses, nesting, and movement patterns of green sea turtles in St. Croix, U.S. Virgin Islands.

After her master’s, she worked as a science educator at Tybee Island Marine Center in Georgia, a sea turtle biologist for South Carolina Department of Natural Resources and, most recently, assistant coordinator of the Mississippi Sea Turtle Stranding and Salvage Network.

While on the Mississippi Gulf Coast, she collaborated with MSU’s Geosystems Research Institute on a proof-of-concept study using drones to survey remote areas for sea turtle and marine mammal strandings. Soon after, she came to MSU to pursue her doctoral degree where she is building a model to simulate wildlife behavior to establish best practices for drone use in wildlife monitoring. She is under the direction of **DR. RAY IGLAY** and **DR. KRISTINE EVANS**.

“Drone software can have



preprogrammed flight patterns that are easy to use, but animals move differently across landscapes, which standard flight patterns may not account for. I am simulating different animal movements within various environments to help establish best practices in drone survey patterns for wildlife monitoring,” she said.

In 2022, Schultz participated in the MSU/USDA Graduate Summer Research Experience, a nine-week program for graduate students where students utilize geospatial technologies and high-performance computing to advance agricultural research.

“I worked under Dr. Garrett Street, an associate professor and his post-docs at the time, Drs. Melanie Boudreau and Natasha Ellison. I studied the concept of evaluating animal movements and behavior and how they influence survey methods,” she said.

Schultz, who was invited back as co-coordinator of the 2023 research experience, said the work was a

springboard for her doctoral research.

“I learned so much about the Python computer program, which I’m using to build my model. Another benefit was access to the Atlas supercomputer that can process complicated data in a matter of hours compared to weeks on a traditional computer,” she said.

Most recently, Schultz was selected as a Minorities in Natural Resources Conservation Fellow by the Southeastern Association of Fish and Wildlife Agencies and attended the group’s annual conference held in Corpus Christi, Texas.

“I am excited to represent not only women, but also the LGBTQ community, and I hope to spearhead diversification in the natural resources and wildlife fields,” she said. ■

This research is funded by the Forest and Wildlife Research Center.

## GRADUATE STUDENT

## JIAXIN WANG

LU'AN CITY, ANHUI PROVINCE, CHINA

BY MEG HENDERSON

**W**HEN JIAXIN WANG began his doctoral program in forestry, he never envisioned his research on trees forging a path to software development.

Growing up in the Chinese countryside inspired Wang's fascination with trees, plants, and wildlife. He spent his early years exploring the outdoors and taking in the beauty of nature, and, over time, his childhood love for the environment developed into a deeper curiosity about ecosystems and plant life.

While working on his master's degree at South China Agricultural University, Wang received an opportunity to come to Mississippi State as a visiting scholar supervised by Dr. Ying Ouyang, research hydrologist with the USDA Forest Service. Wang assisted Ouyang with his study in

forest ecohydrology, using sap flow sensors to measure pine trees' water use.

"This project opened my eyes to the challenges forests face, like deforestation or climate change," Wang said.

As he was finishing his master's program, Wang sought an opportunity to remain at MSU and enroll in a doctoral program working for **DR. HEIDI RENNINGER**, associate professor in the forestry department.

Wang's doctoral research broadly focuses on studying the response of poplar trees, often used as bioenergy crops, to anticipated future climate conditions. Facing environmental impacts such as soil moisture stress and increased leaf temperatures, he measured photosynthesis, water transport, and physiological performance across 100 unique poplar genotypes. A critical part of the study

involved examining the stomata—tiny openings in leaves that are essential to facilitating the way plants breathe and respond to different weather conditions.

"I was intrigued by how these small leaf parts could have such a large impact on the whole plant's health," he said.

Studying the stomata, however, proved to be laborious and time-consuming. He searched for a software program that could help do this work, but to no avail.

That's when Wang had a vision—computer vision, to be precise—leading him to develop StoManager1, an AI-based program that does the work of automatically viewing and measuring each stoma. In late 2021, with no background in programming or coding, he began to build the foundation for his vision.

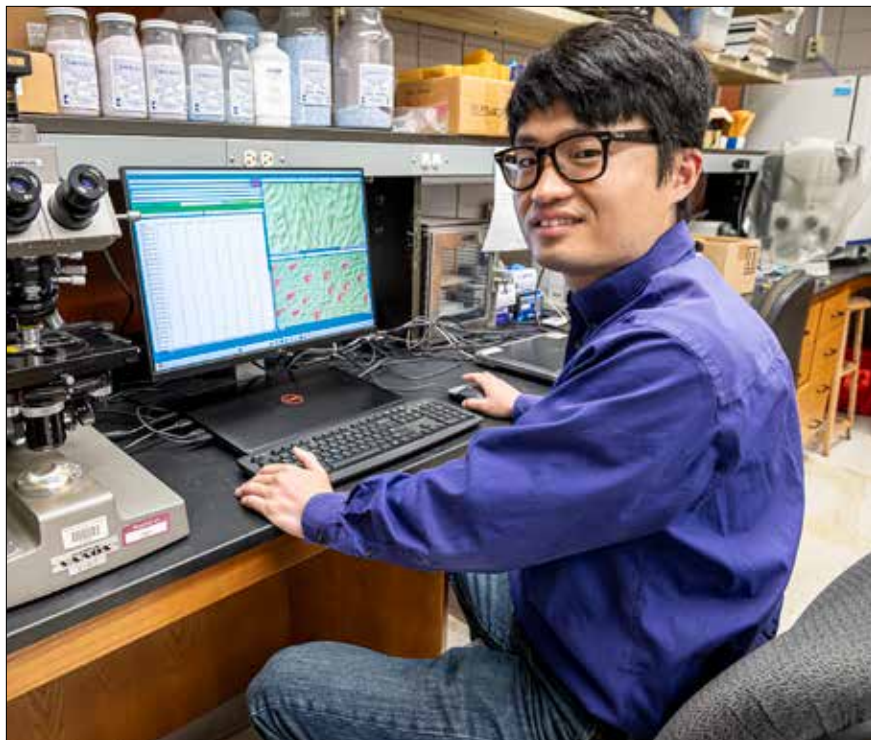
"I bought a computer and a GPU—graphics processing unit—and told myself that I had three years to make this work," he said.

Wang's progress and determination led to a series of successes, and those small victories drove him to continue developing and refining the program.

Three years of doing this work—alongside his primary research project, classes, and extracurricular life—has resulted in a program that can view detailed leaf images and take accurate stoma measurements in a fraction of the time it would take to do so manually.

"Jiixin has been a wonderful addition to my lab. The stomatal detection software will likely have a large impact on the plant biology community and our ability to measure leaf stomatal traits quickly and easily," Renninger said. ■

The research is funded by the U.S.D.A. National Institute of Food and Agriculture.



UNDERGRADUATE STUDENT

# BENJAMIN WILEY

STARKVILLE, MISSISSIPPI

BY LEXI HOLDINESS

**S**OMETIMES THE WINDING ROAD to your next great adventure doesn't have to be far from home. At least that was the case for **BENJAMIN WILEY**, who grew up in Oktoc, ten miles from Mississippi State. For Wiley, the land-grant university has always felt like home.

While Wiley began as a mechanical engineering major, the Department of Sustainable Bioproducts in the College of Forest Resources is where he ultimately found his place. Small class size, one-on-one mentoring, and hands-on experience drew him to the major that helps support Mississippi's \$13.12 billion dollar forestry and forest products industry.

"I started looking at the different majors in CFR and sustainable bioproducts stuck out to me. I just thought it was interesting and all the concepts you can apply to it," Wiley said. "In sustainable bioproducts, the classes are specialized, and you get to know the teachers and professors well. They're more like good friends, and they can give you insight and attention that you can't get in large classes. Everybody here is welcoming."

Alongside a degree in sustainable bioproducts, Wiley is pursuing a master's degree in business administration (MBA) through the university's MBA Venture Pathway (MVP) program — a five-year invitation-only program designed for students in majors outside of the College of



Business interested in business administration. Wiley plans to use both backgrounds in his future career.

"I hope to use the MVP program to get my MBA and pair it with my sustainable bioproducts degree to work in the lumber industry and lead a business. My end goal is to start a business related to sustainable bioproducts. My dad started his own business, and it worked out well, so I want to follow in his footsteps," Wiley said.

Aside from his classwork, Wiley is active in the College of Forest Resources. He was selected for the 2023-2024 College of Forest Resources Ambassador program where he gets to promote the sustainable bioproducts department to other students on campus.

As an ambassador, Wiley said the limitless support and attention he receives

is a perk of being in a small major, but he doesn't want other students to miss out on the opportunities the College of Forest Resources and sustainable bioproducts can offer.

"The reason I became an ambassador was because I really wanted to get plugged in and know more people, but I also wanted to get more students to know about our department. It's a hidden gem where engineering, environmental sustainability, and business intersect," Wiley said. "Being in the CFR ambassador program gives me the chance to spread the word about the sustainable bioproducts department and get more students involved." ■

# 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

**DR. MARK MCCONNELL** oversees both the Bryan Endowment for Bobwhite Habitat Restoration program and the James C. Kennedy Endowed Chair in Upland Gamebird Ecology in MSU's College of Forest Resources and Forest and Wildlife Research Center. Jimmy Bryan, Prairie Wildlife founder and lifelong farmer and quail hunter, established an endowment in 2018 with the mission to "advance restoration of bobwhite quail populations and southeastern native grasslands as a component of working agricultural landscapes through research, conservation, and education." The James C. Kennedy Endowed Chair in Upland Gamebird Ecology was established by a media executive, conservationist, and philanthropist who resides in Atlanta and pursues his passion of hunting waterfowl on his 5,500-acre property in Tallahatchie County. The endowment in his name supports cutting-edge research and training students in upland game bird restoration throughout the Midsouth. McConnell has led a myriad of research projects under both programs, working with regional and national partners to conduct impactful research. Combined, the programs graduated three master's students, published five peer-reviewed manuscripts, helped secure approximately \$1.5 million in funding, and presented at more than a dozen conferences across the country.

"We look forward to continuing our progress towards advancing game bird research and management at MSU," McConnell said. "Bobwhite quail populations have declined over the last few decades, primarily due to habitat loss. This endowment allows us to continue research and training on this important game bird to improve populations and management."

## MARK MCCONNELL





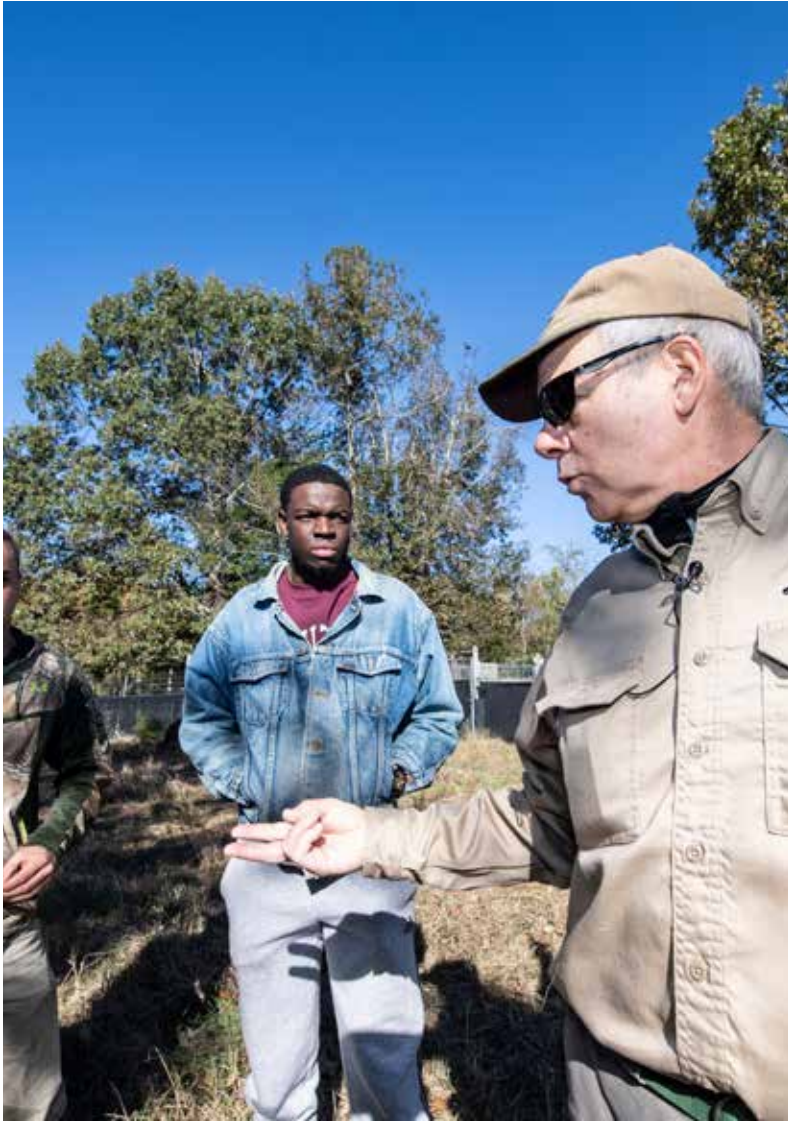
## BRONSON STRICKLAND

### ST. JOHN FAMILY ENDOWED PROFESSOR OF WILDLIFE MANAGEMENT

**THE ST. JOHN FAMILY ENDOWED PROFESSOR** of Wildlife Management professorship holder is **DR. BRONSON STRICKLAND**, who specializes in wildlife management and co-directs Mississippi State's Deer Ecology and Management Lab. MSU alumni Drew and Kathy St. John are wildlife enthusiasts and conservationists who live in Madison and maintain a family farm near Louise in the Mississippi Delta. They understand the importance of management practices that maximize wildlife habitat. The endowment supports Dr. Strickland's work delivering science-based research that addresses the needs of Mississippi landowners and hunters and provides educational programming to help them manage their natural resources. The program's social media presence is reaching a wide audience, with over 65,000

followers on Facebook and 17,000 on Instagram, and over 100,000 video hours watched on MSU Deer Lab's YouTube channel—including a new series on Chronic Wasting Disease. Strickland and his team also launched the Natural Resources University Podcast Network, a collection of educational podcasts on wildlife and habitat management topics. The Online Deer Management Seminar series was also launched, offering information to the public and to those interested in receiving professional credit hours. Graduate students contribute to Deer Lab research, including the effects of weather on deer movements, location and frequency of bedding sites, the effects of prescribed fire on plants and wildlife, and a study on the use of regenerative agriculture techniques for wildlife food plots.

"It is an honor to serve as chair of the St. John Family endowment. We're grateful for alumni like the St. Johns who give back to the university in support of wildlife management research and conservation education," Strickland said



## STEVE DEMARAIS

### TAYLOR CHAIR IN APPLIED BIG GAME RESEARCH AND INSTRUCTION

**THE TAYLOR CHAIR** in Applied Big Game Research and Instruction is **DR. STEVE DEMARAIS**, co-director of the Mississippi State Deer Lab. Donors Phyllis Taylor and the late Patrick Taylor made the gift in appreciation of Dr. Harry Jacobson, professor emeritus in the College of Forest Resources, who conducted research on their Mississippi and New Mexico properties and provided advice on how to manage their land to support big game. Demarais is one of the world's leading scholars on deer ecology, and, in his role as endowed chair, he co-directs the MSU Deer Lab's efforts to generate and disseminate research addressing contemporary problems for landowners, agencies, and hunters and train tomorrow's leaders in wildlife biology. His most recent efforts

focus on combatting chronic wasting disease (CWD), which has been likened to cancer for deer populations. The Taylor Chair research team sampled scrapes, which are social cues bucks use to alert other deer of their presence. Bucks mark scrapes by chewing an overhanging branch leaving saliva and pawing the ground to expose soil and urinating in the pawed area. The team found that sampling scrapes is an early signal of an infection. Positive scrapes have been found as far as nineteen miles from the nearest positive harvested deer, and the method should improve the early detection of the disease across the landscape.

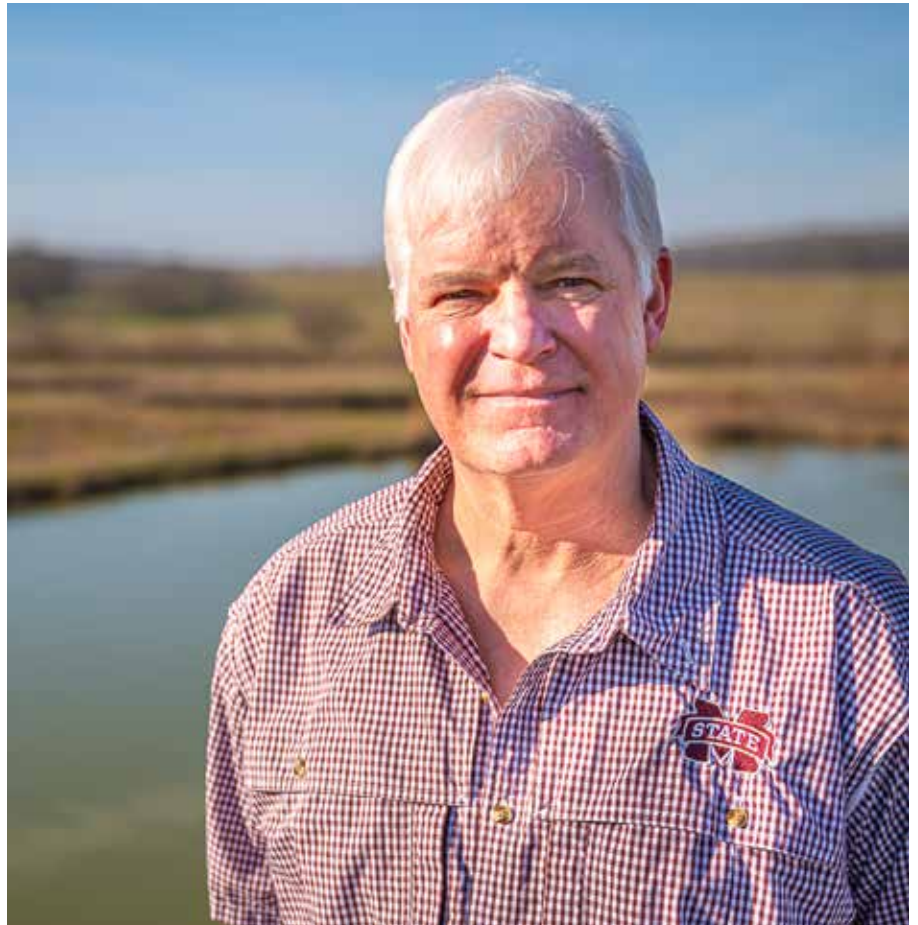
"Traditional identification relies heavily on reports from hunters, but environmental sampling of places where deer naturally concentrate holds promise to find CWD much earlier," Demarais said. "With support from the Taylor Chair program and USDA-Wildlife Services, we're able to continue our efforts to refine the technique with nine state wildlife agencies across the eastern U.S."

JAMES C. KENNEDY  
WATERFOWL AND WETLANDS  
CONSERVATION PROGRAM

**IN 2008**, James C. Kennedy funded an endowed chair at Mississippi State—the James C. Kennedy Waterfowl and Wetlands Conservation Program, which focuses on teaching, research, and service in conservation of wetland wildlife and habitats. **DR. J. BRIAN DAVIS**, who serves as chair of the program, has extensive experience researching ducks and delivering conservation programs in academic and nonprofit settings. His objectives include teaching courses in waterfowl and wetlands ecology and management and maintaining a robust research and outreach program in those areas of study. In the past year, the team has focused on multistate, long-term collaborative studies, including a wood duck recruitment study along the Atlantic and Mississippi Flyways; work with game-farm and wild mallards in the lower Mississippi Flyway; and an investigation of waterfowl diets and winter foraging habits in the Carolinas. In 2021, the team—including graduate students—joined an Alaskan study of box-nesting Common Goldeneyes that is now 26 years and counting. Closer to home, they are testing eggshell strength in Mississippi cavity-nesting ducks and assessing native bee diversity in managed wetlands in the Delta, among other studies. They provided private landowners and stakeholders with habitat management and technical assistance. And the team's graduate and undergraduate students gained valuable professional experience presenting posters and presentations at conferences, publishing in peer-reviewed journals, and taking summer internships across the country.

“We thank Mr. Jim Kennedy and all the waterfowl program supporters, including the state, federal, and non-governmental organizations that make our work possible,” Davis said.

**BRIAN  
DAVIS**



# BUILDING CAPACITY

Mississippi State University Forest and Wildlife Research Center (FWRC) scientists continue to lead the way in pushing relevant and transformative scientific knowledge forward. But equally vital are the facilities and tools that support our scientists in conducting innovative research. The FWRC has engaged in several new capacity-building projects that touch on diverse and critical areas of research under our umbrella.

## AVIAN SCIENCE CENTER

**FIVE YEARS AGO**, the FWRC identified a pressing need for a facility to conduct bird research, particularly for scientists in the James C. Kennedy Endowed Chair in Waterfowl and Wetlands Conservation, Bryan Endowment for Bobwhite Restoration, and the James C. Kennedy Endowed Chair in Upland Gamebird

Ecology. The Avian Science Center is located at the FWRC's Blackjack Research Facilities—a research park for the Mississippi State College of Forest Resources (CFR) just a few minutes from the main campus. The center has a laboratory in front for specialty research on avian physiology and endocrinology, office space, and a series of equally-sized experimental facilities rooms—10 of which are open-air and netted so birds can be exposed to the natural elements and four which are closed to manipulate environmental conditions. **DR. MARK MCCONNELL**, assistant professor and FWRC scientist, is using the facility to study diet composition of quail chicks on different forage crops, which attract different types of insects. **DR. KRISTINE EVANS**, associate professor and FWRC scientist, is conducting a behavior study with zebra finches. Temporarily, the center is hosting some Eastern hellbenders, the country's largest amphibian, while Dorman Hall—home of the Amphibian Genome Resource Bank—undergoes renovations.





# FORESTRY GREENHOUSE

**IN 2021**, the Blackjack Research Facilities welcomed a state-of-the-art greenhouse that allows Mississippi State Forest and Wildlife Research Center (FWRC) scientists to conduct research in a plethora of environmental conditions. Three greenhouse bays provide a total of 4,000 square feet and feature automatic and programmable controls for temperature, light, watering, and other functions. All bays contain a wet wall, exhaust fans, heaters, grow lights, sliding tables, and a retractable shade cloth. Two have an open-roof system to quickly evacuate heat. An outside irrigation area, a headhouse for mixing and storing planting media, and laboratories near the greenhouse complete the facility. **DR. COURTNEY SIEGERT**, associate professor and FWRC scientist, and her doctoral student Casey Iwamoto are using the greenhouses to study improving soil conditions with biochar and microbial inoculants to enhance native shortleaf pine restoration. **DR. ESTEBAN GALEANO GOMEZ**, assistant professor and FWRC scientist, is propagating eastern cottonwood trees to produce climate change-resilient plants that are better adapted to heat and drought.





## BULLDOG FOREST

**THE BULLDOG FOREST** continues its healthy growth, adding to the acreage that funds programs and scholarships for Mississippi State and serves as outdoor laboratories for FWRC research and demonstration, and CFR teaching space. Since its establishment in the 1930s,

the forest—jointly owned by the university and the MSU Foundation—has amassed a total of 30,000 acres across 28 properties throughout the state. This year, 1970 graduate and lifelong MSU athletics fan **BRUCE THORNTON** donated 80 acres of timberland in Jasper County to MSU in a unique agreement between the CFR, MSU Foundation, and MSU Athletics. Thornton's gift established the Student-Athlete Development Fund, which supports professional and personal development, community engagement, and life skills to prepare student-athletes for life after college. In addition, the MSU Foundation has established agreements with donors who wish to include the Bulldog Forest in their estate plans. These future donations, known as legacy properties, will one day add a total of 8,100 acres to the Bulldog Forest.

## WOLF RIVER

**THIS YEAR,** Mississippi State's College of Forest Resources received funding to acquire over 14,000 acres of land along the Wolf River in Harrison County, whose geographic location is key to coastal resilience, flood management, and longleaf pine restoration. The Mississippi Coastal Headwaters Project, a coastal waters restoration initiative, is a robust partnership between MSU; the Nature Conservancy; Mississippi Department of Environmental Quality; National Fish and Wildlife Foundation Gulf Environmental Benefits Fund; Mississippi Forestry Commission; U.S. Forest Service; and Weyerhaeuser.

The partners have leveraged funding from the Deepwater Horizon oil spill to purchase the property, which MSU will own and manage as a coastal forest research station and demonstration site for longleaf pine restoration, while conserving over 100 miles of riparian buffers along both banks of the Wolf River and its tributaries. Revenue generated from timber management on the tract will support continued research, K-12 environmental education and outreach, and scholarship opportunities for students enrolled in CFR degree programs.



## DEER LAB

**LOOKING AHEAD,** MSU has developed plans to upgrade its Deer Lab. The original facility, established in 1977, is located on the Blackjack Research Facilities property near the new aviary and greenhouses. The current lab consists of five main pens, seven small holding pens, and a handling area. Although the facilities meet USDA regulations, the pens need to be upgraded to keep pace with the world-class deer research happening at MSU. The forthcoming facility will expand the lab's existing footprint and provide the caliber of research facilities that Deer Lab scientists need to study their subjects in 21st century working landscapes. The lab will also offer educational facilities, from a conference center and outdoor classroom to a youth interaction and conservation pen.

MSU faculty and students are at the center of these expansion projects. Building capacity supports faculty and students in scientific research that meets the needs of today and tomorrow—taking care of what matters. ■



## FACULTY REFEREED PUBLICATIONS

Mississippi State Forest and Wildlife Research Center faculty produced 155 refereed publications during 2023. For a complete list of publications, visit <https://www.fwrc.msstate.edu/publications>.

## THESES

Arko, A. D. 2023. The effects of a moderate severity hurricane on landscape-scale heterogeneity in a longleaf pine woodland. Thesis, Department of Forestry, Mississippi State University.

Aryal, S. 2023. Modeling yield and aboveground live tree carbon dynamics in oak-gum-cypress bottomland hardwood forests. Thesis, Department of Forestry, Mississippi State University.

Beam, C. 2022. Seasonal comparison on the effectiveness of control methods for *Microstegium vimineum* in the North Carolina Piedmont. Thesis, Department of Forestry, Mississippi State University.

Besson, J. 2023. Patterns of distribution and dispersion of Silver Carp in an oxbow lake. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Chandler, Z. A. 2022. Effects of post-fire disturbance responses of *Microstegium vimineum* on native hardwood seedling growth and survival. Thesis, Department of Forestry, Mississippi State University.

Coffill-Rivera, M. E. 2022. Effects of temperature on growth, metabolic rate, and lower dissolved oxygen tolerance of Speckled Peacock Bass *Cichla temensis*. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Collins, D. A. 2022. Novel silviculture practices for non-industrial private forest landowners. Thesis, Department of Forestry, Mississippi State University.

Gerhart, B. 2022. The effects of moderate and high temperatures on growth, metabolism, and blood-oxygen affinity in *Ictalurus spp.* Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Goodfellow, S. W. 2022. Disease resistance and productivity in genetically improved loblolly pine: Results from a resistance screening trial and a midrotation comparison of genetic improvement levels. Thesis, Department of Forestry, Mississippi State University.

Hoffman, V. E. 2023. The impact of environmental education delivery methods and outreach messaging on attitudes, interests, and intended-behavior changes toward nature. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Ichu, I. G. 2022. Evaluating non-invasive environmental methods for detecting tropical African pangolin species to inform conservation actions. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Lappin, O. A. 2023. Northern bobwhite (*Colinus virginianus*) breeding season calling behavior and roost site selection in a working agricultural landscape in Clay County, Mississippi. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Moreland, J. A. 2023. Understanding dietary and thermal influences on invasive cichlids in Puerto Rico reservoir systems. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

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Neary, J. 2022. The use of  $^{87}\text{Sr}/^{86}\text{Sr}$  isotopic ratios to assess natal areas and movement of juvenile Gulf Sturgeon *Acipenser oxyrinchus desotoi* in the Pascagoula and Pearl River systems. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.  
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Nepal, S. 2023. The Mississippi timber severance tax: Its economic impacts to forestry and the state economy. Thesis, Department of Forestry, Mississippi State University.  
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Oliveira, R. F. 2022. Assessing wood failure in plywood by deep learning/semantic segmentation. Thesis, Department of Sustainable Bioproducts, Mississippi State University.  
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Pace, K. 2023. Interactive effects of bark beetles, Ophiostomatoid fungi, and subterranean termites on wood decomposition and the biogeochemical cycling of pine forests. Thesis, Department of Forestry, Mississippi State University.  
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Rai, N. 2022. Mapping forest structure in Mississippi using LiDAR remote sensing. Thesis, Department of Forestry, Mississippi State University.  
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Resch, B. S. 2022. Evaluating functional zoning based on site index to achieve competing objectives held by family forest owners on southern U.S. pine forest tracts. Thesis, Department of Forestry, Mississippi State University  
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Ripa, G.N. 2022 Vegetation and nutritional changes over 20 years of white-tailed deer exclusion. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.  
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Thomas, M. 2023. Determining the impact of post-harvest water management on chironomid abundance, agrochemical biomass and potential trophic biomagnification. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.  
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Thornton, B. S. 2023. Spatial conservation planning in the southeastern United States: Alignments and opportunities. Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.  
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Tiwari, P. 2023. Marginal agricultural land identification in the Lower Mississippi Alluvial Valley. Thesis, Department of Forestry, Mississippi State University.  
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Vaughn, A. 2022. Understanding the relationship among cool temperatures, growth, metabolism, and energy use of *Ictalurus spp.* Thesis, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.  
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## DISSERTATIONS

Aldridge, C. A. 2022. Towards structured planning and learning at the state fisheries agency scale. Dissertation, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Bracken, R. D. 2023. The response of an avian community to intercropping and forest management practices in a private working pine forest. Dissertation, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Entsminger, E. D. 2022. Improvement value of forest resources by use of cottonseed protein meal as a bio-based wood adhesive for hardwood plywood products. Dissertation, Department of Sustainable Bioproducts, Mississippi State University.

Faucheux, N. M. 2022. Assessing the legacy of erosion and flood control management efforts on the fish assemblages and physical conditions of Yazoo Basin bluff hill streams. Dissertation, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Franco, K. V. C. 2023. Macroecological patterns of frugivorous fishes' diversity (*Serrasalminidae*) in the Amazon drainage basin. Dissertation, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Karunaratne, T. N. 2023. Synthesis of biomass-based graphene nanomaterials for aqueous heavy metal removal and cement-based composite property enhancement. Dissertation, Department of Sustainable Bioproducts, Mississippi State University.

Kaya, M. N. 2022. Evaluation of flood damage on cross laminated timber wall configurations. Dissertation, Department of Sustainable Bioproducts, Mississippi State University.

Kyaw, T. Y. 2022. Assessing the flood tolerance, physiological mechanism, and nutrient mitigation potential of short rotation woody crops planted on seasonally flooded marginal land of the Lower Mississippi Alluvial Valley. Dissertation, Department of Forestry, Mississippi State University.

Parsons, I. L. 2022. Animal husbandry in the 21st century: Application of ecological theory and precision technology to inform understanding of modern grazing systems. Dissertation, Department of Wildlife, Fisheries and Aquaculture, Mississippi State University.

Quin Jr., F. 2023. Expanding the market of biomaterials. Dissertation, Department of Sustainable Bioproducts, Mississippi State University.

Sedhain, G. 2023. Surface modification of wood using nano-sized titania particles coated by liquid-precursor flame spray pyrolysis. Dissertation, Department of Sustainable Bioproducts, Mississippi State University.

Uzategui, M. G. C. 2022. Nondestructive assessment of flexural and tensile properties for southern pine structural lumber. Dissertation, Department of Sustainable Bioproducts, Mississippi State University.

Wade, A. C. 2022. Advancement of field-deployable, computer-vision wood identification technology. Dissertation, Department of Sustainable Bioproducts, Mississippi State University.

# FORESTRY & FOREST PRODUCTS IN MISSISSIPPI

**JOBS** (FULL AND PART-TIME)

**61,619**

**VALUE-ADDED**

**\$4.99** BILLION

**PAYROLL**

**\$2.96** BILLION

**TOTAL FORESTLAND ACRES**

**19,244,571**

**PRIVATE OWNERSHIP ACRES**

**17,080,876**

**PUBLIC OWNERSHIP ACRES**

**2,163,692**

**TAX REVENUE**

**\$925.73** MILLION

**TOTAL OUTPUT**

**\$13.12** BILLION

Based on 2018 data generated by Dr. Shaun M. Tanger, former forestry assistant extension professor, and Mr. Marc Measells, former senior forestry extension associate.

# FACULTY

## FORESTRY

### DONALD L. GREBNER

*Head and George L. Switzer Professor of Forestry*

#### BUTCH BAILEY

*Extension Instructor I*

#### STEVE BULLARD

*Associate Dean and  
Associate Director*

#### CHRISTINE FORTUIN

*Assistant Professor*

#### ESTEBAN GALEANO

*Assistant Professor*

#### STEPHEN C. GRADO

*George L. Switzer Professor  
of Forestry*

#### ROBERT GRALA

*George L. Switzer Professor  
of Forestry, James R.  
Moreton Fellow in Forestry*

#### JOSHUA GRANGER

*Assistant Professor*

#### JAMES E. HENDERSON

*Professor and Head,  
Coastal Research and  
Extension Center*

#### AUSTIN HIMES

*Assistant Professor*

#### SABHYATA LAMICHHANE

*Assistant Professor*

#### ERIC MCCONNELL

*Associate Professor*

#### ADAM POLINKO

*Assistant Professor*

#### KRISHNA POUDEL

*Assistant Professor*

#### HEIDI RENNINGER

*Associate Professor*

#### ASHLEY SCHULZ

*Assistant Professor*

#### BRADY SELF

*Extension Professor*

#### COURTNEY SIEGERT

*Associate Professor*

#### CHANGYOU "EDWIN" SUN

*George L. Switzer Professor  
of Forestry*

#### CURTIS VANDERSCHAAF

*Assistant Professor*

#### YUN YANG

*Assistant Professor*

#### EMERITUS

#### STEPHEN G. DICKE

#### WILLIAM ELAM

#### DAVID L. EVANS

#### ANDREW W. EZELL

#### JOHN E. GUNTER

#### GEORGE M. HOPPER

#### H. GLENN HUGHES

#### BOB KARR

#### SAMUEL LAND

#### TOM MONAGHAN

#### TIM TRAUOGOTT

#### WILLIAM WATSON

#### ADJUNCT

#### DAVID N. APPEL

#### QUANG V. CAO

#### DANIEL C. DEY

#### ZHAOFEI (JOSEPH) FAN

#### MATTHEW A. FREEMAN

#### EMILE S. GARDINER

#### JEFF A. HATTEN

#### TRACY S. HAWKINS

#### RICHARD F. KEIM

#### JOHN S. KUSH

#### THEODOR D. LEININGER

#### MICHAEL M. LORANTY

#### ALBERT MAYFIELD III

#### RYAN MCEWAN

#### JAMES S. MEADOWS

#### YING OUYANG

#### REBECCA L. SCHEWE

#### STEPHEN H. SCHOENHOLTZ

#### RAY A. SOUTER

#### MARTIN A. SPETICH

#### MIKE R. STRUB

#### JESSICA L. TEGT

#### J. MORGAN VARNER



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# SUSTAINABLE BIOPRODUCTS

## RUBIN SHMULSKY

*Head and Warren S. Thompson Professor of  
Wood Science and Technology*

### GWENDOLYN BOYD-SHIELDS

*Associate Professor*

### ADRIANA COSTA

*Assistant Professor*

### FREDERICO FRANÇA

*Assistant Professor*

### TAMARA FRANÇA

*Assistant Professor*

### EL BARBARY HASSAN

*Professor*

### LAYA KHADEMIBAMI

*Assistant Research Professor*

### YUN SANG KIM

*Assistant Professor*

### MOSTAFA MOHAMMADABADI

*Assistant Professor*

### FRANK OWENS

*Assistant Professor*

### KEVIN RAGON

*Assistant Extension Professor*

### R. DAN SEALE

*Warren S. Thompson Professor of  
Wood Science and Technology;  
James R. Moreton Fellow in  
Sustainable Bioproducts*

### LAURICE SPINELLI CORREA

*Assistant Research Professor*

### C. ELIZABETH "BETH" STOKES

*Associate Professor*

### JASON STREET

*Associate Professor*

### JILEI ZHANG

*Warren S. Thompson Professor of  
Wood Science and Technology*

## EMERITUS

**ABDOLHAMID BORAZJANI**

**SUSAN V. DIEHL**

**LEONARD L. INGRAM JR.**

**MOON KIM**

**DUANE LYON**

**PHILIP H. STEELE**

## ADJUNCT

**RACHEL ARANGO**

**ZHIYONG CAI**

**NATHAN IRBY**

**GRANT KIRKER**

**IRIS MONTAGUE**

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**ROBERT ROSS**

**ADAM SENALIK**

**XIPING WANG**

**ALEX WIEDENHOEFT**

**BONNIE YANG**

**XUEFENG "JASON" ZHANG**

# WILDLIFE, FISHERIES AND AQUACULTURE

## ANDREW KOUBA

*Head and Dale H. Arner Professor of Wildlife Ecology and Management*

### PETER ALLEN

*Professor*

### JIMMY AVERY

*Extension Professor;  
Director, Southern Regional  
Aquaculture Center*

### CHRISTOPHER AYERS

*Instructor I; Curator of  
Collections*

### BETH BAKER

*Associate Extension Professor*

### MELANIE BOUDREAU

*Assistant Research Professor*

### LESLIE BURGER

*Associate Teaching Professor;  
Conservation Education  
Graduate Coordinator*

### LOREN W. (WES) BURGER

*Dale H. Arner Professor  
of Wildlife Ecology and  
Management; Dean, College of  
Forest Resources;  
Director, Forest and Wildlife  
Research Center*

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### JAMES CALLICUTT

*Extension Instructor I*

### SANDRA B. CORREA

*Assistant Professor*

### CHAD DACUS

*Extension Instructor II*

### J. BRIAN DAVIS

*James C. Kennedy Endowed  
Chair in Waterfowl and  
Wetlands Conservation*

### STEVE DEMARAIS

*Taylor Chair in Applied Big  
Game Research and Instruction,  
Dale H. Arner Professor  
of Wildlife Ecology and  
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### MARCUS DRYMON

*Assistant Extension Professor*

### SCOTT EDWARDS

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Director, Geosystems Research  
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### W. DARYL JONES

*Extension Professor*

### GANESH KARUNAKARAN

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*Assistant Professor, Coordinator  
of the James Kennedy and Bryan  
Endowed Program for Upland  
Birds and Prairie Conservation*

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MIRANDA**  
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MS Cooperative Fish and  
Wildlife Research Unit*

**CHARLES MISCHKE**  
*Research Professor*

**DANA MORIN**  
*Assistant Professor*

**WES NEAL**  
*Extension/Research Professor*

**RAINER NICHOLS**  
*Instructor I*

**JONATHAN PITCHFORD**  
*Assistant Extension Professor*

**ADAM ROHNKE**  
*Assistant Extension Professor*

**MANUEL RUIZ ARAVENA**  
*Assistant Professor*

**SCOTT RUSH**  
*Associate Professor*

**MICHAEL SANDEL**  
*Assistant Professor*

**ANDREW SMITH**  
*Extension Instructor I*

**ERIC SPARKS**  
*Associate Extension Professor*

**GARRETT M. STREET**  
*Associate Professor*

**BRONSON STRICKLAND**  
*St. John Family Endowed  
Professor of Wildlife  
Management*

**T. ADAM TULLOS**  
*Extension Instructor*

**FRANCISCO VILELLA**  
*Professor; Assistant Leader,  
USGS MS Cooperative Fish  
and Wildlife Research Unit*

**GUIMING WANG**  
*Dale H. Arner Professor  
of Wildlife Ecology and  
Management*

**DAVID WISE**  
*Research Professor;  
Director, Thad Cochran  
National Warmwater  
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**MARK WOODREY**  
*Assistant Research Professor*

**FERNANDO YAMAMOTO**  
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DONALD C. JACKSON  
HARRY JACOBSON  
JEANNE C. JONES  
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MENGHI LI  
H. RANDALL ROBINETT'E  
HAROLD SCHRAMM  
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FRED CUNNINGHAM  
TRAVIS DEVAULT  
BRIAN DORR  
KRIS GODWIN  
CURTIS HOPKINS  
DARREN MILLER  
BRAD RICHARDSON  
LILY SWEIKERT**

# BY THE NUMBERS

## PEOPLE

104

Master's students (Fall 2023)

59

Doctoral students (Fall 2023)

43

Faculty (Fall 2023)

## RESEARCH PROJECTS

157

Projects Active (FY23)

64

Research Sponsors (FY23)

155

Refereed Publications (CY23)

\$11,863,657

Total Sponsored Research Funding (FY23)

## RESEARCH SPONSORS

Alabama A&M University

Alabama Audubon/National Audubon Society

Alcorn State University

Arch Wood Protection, Inc. (a Lonza company)

Christmas Tree Promotion Board

Cryptobranchid Interest Group

Delta Wildlife

Duff Real Estate, LLC.

EDM International Inc.

Florida International University

FuturaGene

Institute of Museum and Library Services

Kop-Coat, Inc.

Lonza Wood Protection

Michigan Department of Natural Resources

Mississippi Department of Environmental Quality

## TOTAL FWRC FUNDING, FY23

\$19.02M

32.8%

STATE APPROPRIATIONS

4.8%

FEDERAL APPROPRIATIONS

62.4%

GRANTS AND CONTRACTS

Mississippi Department of Wildlife, Fisheries, and Parks  
Mississippi Development Authority  
Mississippi Wildlife, Fisheries, and Parks Foundation  
Missouri Department of Conservation  
Montana Fish Wildlife & Parks  
National Academy of Sciences  
National Aeronautics and Space Administration  
National Council for Air and Stream Improvement, Inc.  
National Fish and Wildlife Foundation  
National Science Foundation  
Nisus Corporation  
North Carolina State University  
North Carolina Wildlife Resources Commission  
Taylor Land and Cattle  
Tennessee Valley Authority  
Texas A&M University  
The Eppley Foundation for Research  
The Jones Center at Ichauway  
Timber Products Inspection  
U.S. Department of the Interior  
U.S. Endowment for Forestry & Communities, Inc.  
U.S. Environmental Protection Agency  
U.S. Fish and Wildlife Service  
U.S. Geological Survey

U.S. National Park Service  
University of Arkansas at Pine Bluff (UAPB)  
University of Georgia  
University of Maryland  
University of Puerto Rico  
University of Southern Mississippi  
University of Tennessee  
USDA Farm Service Agency  
USDA Agricultural Research Service  
USDA Animal and Plant Health Inspection Service  
USDA Forest Service  
USDA Forest Products Laboratory  
USDA National Institute of Food and Agriculture  
USDA National Wildlife Research Center  
USDA Natural Resources Conservation Service  
Viance, LLC  
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