



Mississippi State University

2010 Annual Report

FOREST AND WILDLIFE RESEARCH CENTER



FROM THE DIRECTOR



The purpose of the Forest and Wildlife Research Center at Mississippi State University is to foster conservation, management and utilization, and protection of the forests, forest products, wildlife, fisheries and water resources of Mississippi for the betterment of our citizens. The faculty, staff and students are dedicated to this mission.

This 2010 annual report highlights a few of the research accomplishments of the Center and its employees. We are pleased to serve the people of Mississippi and to improve our state's economy while conserving our natural resources.

Forestry, the forest products industry, hunting, fishing, wildlife-watching, and other natural resource recreational activities are vital to Mississippi's financial outlook. A new research study has documented that these industries contributed \$21.9 billion to the state's economy this past year. Given the current economic situation, it is clear how important the Forest and Wildlife Research Center is to future rural and economic development in our state and region. Conserving and sustaining these resources not only ensures their existence for future generations, but also contributes to the economic well-being of Mississippi today.

During difficult times, prudent decisions must be made to fund areas which have the greatest impact, socially, economically and environmentally. I am pleased to report that the MSU Forest and Wildlife Research Center has been a great investment for Mississippi taxpayers. In 2010, the Forest and Wildlife Research Center generated an additional \$2.50 in grant funding for each state dollar received.

Research conducted in the center has had a positive impact for all natural resource industries within the State and its citizens. As you review this annual report, I am confident that you will agree that the Forest and Wildlife Research Center is, indeed, a good investment for Mississippi. We are generating results which will conserve and sustain natural resources for future generations and make our industries more competitive and profitable locally as well as globally.

I appreciate your participation in these endeavors and the generosity of our many supporters. Thank you for your continued encouragement, advice and support.

Sincerely,

A handwritten signature in blue ink that reads "George M. Hopper". The signature is fluid and cursive, written in a professional style.

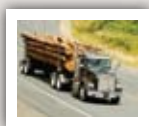
George M. Hopper
Director

ECONOMIC IMPACTS

FORESTRY, FOREST PRODUCTS, HUNTING,
FISHING, AND WILDLIFE WATCHING

Mississippi's
\$21.9
Billion Dollar Industry

189,830 JOBS | **\$9.5 BILLION** | **\$5.9 BILLION**
full- and part-time | value-added | wages



LOGGING

\$2.6 Billion total output



SOLID WOOD PRODUCTS

\$6.9 Billion total output



PULP AND PAPER

\$4.6 Billion total output



WOOD FURNITURE MANUFACTURING

\$6.1 Billion total output



FISHING

\$772 Million total output



HUNTING

\$1.14 Billion total output



WILDLIFE WATCHING

\$829 Million total output

Based on 2006 data, monetary values expressed in 2010 dollars.

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MISSION

The mission of the Forest and Wildlife Research Center is to expand through research the fundamental and applied knowledge upon which forestry, forest products, and wildlife and fisheries disciplines are based; to assist in conserving, developing, and using the forest, forest products, wildlife and fisheries resources of Mississippi, the nation, and other countries through research, technology transfer and other service activities.



Utilization

Since 1964, the department of forest products has discovered new ways to **convert timber** into wood-based materials, **extend the service life** of wood and **enhance the properties** of lumber.

CONVERT TIMBER INTO WOOD-BASED MATERIALS

Mississippi State University scientists have found a new way to turn wood into highly absorbent charcoal and parts for automobiles. While wood has been used to manufacture charcoal since the early 1600s, the new technique can create charcoal and other carbon-based products with a higher absorption capacity.

Charcoal has been used widely to treat water and clean up chemicals, but the production of magnetic charcoal creates new possibilities. The magnetic charcoal is more efficient in cleaning environmentally hazardous chemicals.

The process takes advantage of nanotechnology, which involves the creation, exploration and manipulation of materials measured in nanometers, or billionths of a meter.

The unique process was developed in MSU's Forest and Wildlife Research Center by **Sheldon Shi**, forest products assistant professor and Dongmao Zhang, an assistant chemistry professor. The process produces a variety of new products including high-crystal carbon fibers, magnetic charcoal, magnetic wood, and other new carbon-based materials.

The list of products that can be made from wood or agricultural-based materials and nanoparticles is almost unlimited. Anti-radiation materials can be created to combat a nuclear accident or detoxification materials to assist in environmental cleanup.

FOREST PRODUCTS



The new technique also produces wood-carbon materials that can be used in high-performance applications. The process uses wood and agricultural-based materials to develop specialty natural fiber-polymer composite. The treated natural fibers can be formed into sheets or compressed into a mold.

Working with MSU's Center for Advanced Vehicular Systems, scientists have developed sheets and molded pieces that can be used by the automotive industry. Funding provided by the Department of Energy is allowing researchers to explore the use of the new materials to further develop lightweight vehicle design.

EXTEND THE SERVICE LIFE OF WOOD

Mississippi State University scientists are gaining a better understanding of how microorganisms decay wood. The primary wood decay microorganisms belong to a group of fungi known as basidiomycetes. Basidiomycetes fungi produce enzymes that degrade the cellular components of wood: cellulose, hemicelluloses and lignin which leads to wood decay.

The research, led by assistant forest products research professor **Lynn Prewitt**, recently identified microorganisms present on pine, cedar and ACQ-treated pine during a 30-month soil bed decay test. One basidiomycete fungi, *Phlebia radiata*, identified by DNA sequencing was found on all three wood types after four months of decay. Genes for the production of wood

decay enzymes by this fungus were detected on pine and ACQ-treated pine but not on naturally durable cedar at four months of decay and throughout the study.

Initial results have found that fungal communities that colonize and decay different woods are influenced by the durability of the wood.

The research was funded through the National Science Foundation and the Lucas Biodeterioration Laboratory.

ENHANCE THE PROPERTIES OF LUMBER

Softwood lumber prices play an important role in timber prices, but there is not a one-to-one relationship. Other factors such as housing starts, volume of lumber in the distribution system, weather as it impacts construction, imports and exports, and interest rates also impact lumber prices. This is largely because not all lumber is equal. Depending on the grade of the individual boards, the price per board foot is different. In general, bigger and stronger boards are worth more money.

As with many products with varying measures of quality, the lower the grade, the lower the value of the product. Lumber is graded as either No. 1, demanding the highest price, No. 2 which represents a mid-range price, and No. 3 which is the lowest price of lumber grades. This decrease in value is related to the usefulness of the lumber. Because No. 1 is stronger by design, it brings a higher value. With decreases in



FOREST PRODUCTS

strength and stiffness, the lumber becomes less valuable for construction because the applications for which it can be used are limited. That is, more pieces and larger pieces must be utilized to carry the same structural loads.

Approximately 50 percent of the pine lumber that is produced goes into the No. 2 grade. This lumber is the main material used for home construction, because of cost, strength, and availability. This product mix of lumber grades is dependent on the quality and properties of trees/logs that enter the mill. As forestry practices change, associated wood quality changes, and subsequently lumber grade and value mixes can also change. For example, a decline in general wood quality and properties causes a greater proportion of lumber to rate lower than No. 2. In such a case, the intrinsic value of the lumber is less and mills become less profitable. Such a change would then decrease the amount that mills are able to pay for standing timber and logs. This potential shift would be felt by both the mills and landowners, as well as by others who make their livelihood from buying or selling wood.

Approximately 25 years ago, a major national-level in-grade testing program was performed. The results of that program were used to generate engineering properties for pine lumber. Currently there is an ongoing national discussion regarding a revisit and recalibration of those engineering properties. Assistant Extension professor **David Jones** and other MSU scientists are actively working to ensure that southern pine lumber receives the fairest possible treatment throughout this process.

The university's Forest and Wildlife Research Center houses a fully-equipped strength testing facility. At the encouragement of many pine lumber manufacturers, scientists in the center are performing preliminary tests to determine the extent to which a recalibration of national engineering values might be advisable.

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Utilization



Renewable

Since 1954, the department of forestry has been developing practices to **expand the growth** of timber resources, demonstrate **alternative plantings**, and increase awareness of the **economic importance** of natural resources.

EXPAND THE GROWTH OF TIMBER RESOURCES

A Pasadena, Texas-based company plans to build five plants in Mississippi to convert wood chips into a petroleum replacement. The company has committed to creating 1,000 direct and indirect jobs within five years and spending \$85 million in payroll and in the purchase of Mississippi timber.

This development is not a surprise to Mississippi State University scientists who have studied the availability of the woody biomass for alternative fuel development over the last five years.

Mississippi forests, which cover 20 million acres or 65 percent of the state, have changed in the last decade. Many lands have been planted with trees for the first time or been reforested, often with the assistance of incentive payments. Marginal agricultural lands have also been converted to forest. These new plantings are primarily in the form of pine plantations.

As pine plantations spring up across the Magnolia State, scientists in the Forest and Wildlife Research Center began to examine the availability of woody biomass for fuel production. This biomass is often from the first thinning of small-diameter trees, but also from logging and mill residues and urban waste.

Forestry scientists, led by professor **Donald Grebner**, have found the total standing biomass in Mississippi to be nearly 720 million dry tons with an approximate 18 million dry tons added each year. Up to four million dry

FORESTRY



tons are available each year, which could produce 318 million gallons of ethanol, 470 million gallons of raw bio-oil or 300 million gallons of petroleum diesel.

The study also found that the economic impacts of a new wood to energy industry are significant to the State. The recovery of four million dry tons of woody biomass such as logging residues would create 585 direct jobs and generate \$152 million of net output. Another 481 indirect jobs and 646 induced jobs would be generated as a result of logging operations. The total value-added, which is the sum of employee compensation, proprietor income, other property income, and indirect business taxes, provides \$37.3 million in direct impacts and \$23.4 million in indirect impacts.

Not only will the State profit from this new economic activity, private landowners who own 70 percent of the forest land are expected to reap the benefits. New markets have the potential to increase the price of biomass or pulp wood relative to the price of saw timber. It is further expected that as the price of biomass rises, availability will increase as will the intensity of pine plantation management.

DEMONSTRATE ALTERNATIVE PLANTINGS

Growing crops and trees together, in an integrated system, has the potential to enhance producer markets and wildlife habitat. Scientists in Mississippi State University's Forest and Wildlife Research Center are

exploring the possibility of this multiple land use by growing southern pine trees with corn, milo, soybeans, and switchgrass.

Working under the direction of associate forestry professor **John Kushla**, scientists and graduate students have planted loblolly pines and switchgrass in a silvopasture system. They also planted loblolly and shortleaf pines in a 2-row agroforestry system along with corn, grain milo, soybeans and switchgrass.

The study examined the crop plots yield from 2007 through 2009. While corn produced a measurable yield in 2007, wild hogs devastated the corn crop in 2009. Grain sorghum or milo showed the greatest potential, producing measurable yields in both 2007 and 2008.

While crop growth was sporadic, the growth of both loblolly and shortleaf pines was not affected by any of the alley crops. Spring bird abundance revealed a higher abundance in the agroforestry system, where crops were planted, than the pasture land.

The research has important implications because management alternatives will allow landowners to increase their revenues and improve cash flows. The potential revenues from carbon credits and/or enhanced wildlife use will help improve environmental and financial sustainability of farm operations, provide important environmental benefits, and make these operations more robust to fluctuation in prices of agricultural and wood products.

FORESTRY

INCREASE AWARENESS OF THE ECONOMIC IMPORTANCE OF NATURAL RESOURCES

Forestry is a 17.4 billion dollar industry in Mississippi, and in 2006 forestry-related employment accounted for 8.5 percent of all jobs in Mississippi. While the economic contribution of forestry at the state level is well documented, information on the importance of forestry to Mississippi counties is not readily available.

Mississippi State University scientists are addressing this issue with a new publication series focused on each of the 82 Mississippi counties and the economic impact of forestry and forest products within their boundaries. The series is critical with the recent economic decline and hardships faced by many in the forestry community. Also as counties face lean years, it is important to recognize and promote the economic importance of natural resource sectors to the local economy.

Assistant Extension forestry professor **James Henderson** and professor **Ian Munn** used IMPLAN software and data to complete county level economic input-output analyses. This approach estimates how spending by one sector of the economy generates activity across other sectors of the economy. Quantifying the total economic activity generated by forestry and forest products provides a greater appreciation for their importance to a county's economy.

The new publication series will be useful to local forestry communities seeking support from state and local governments or in demonstrating how actions damaging to forestry or forest products can result in harm to the local economy.





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Mike Wiseman

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Chris Zinkhan

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Sustainable

Since the late 1960s, the department of wildlife, fisheries and aquaculture has been conducting research to sustain and **improve wildlife, fisheries, and aquatic resources** in the state and region.

IMPROVE WILDLIFE RESOURCES

A Forest and Wildlife Research Center project to convert trail camera photographs into management tools has led to new software that could improve the deer population “picture.”

Wildlife biologists take age and antler measurements from harvested deer because the physical collection of data is relatively easy. Until recently, harvested deer were the only source of such data, so it provided no information on the remaining deer.

Using information from harvested deer however, does not accurately represent the deer population because of antler-based harvest regulations and hunters’ selectivity.

Professor **Steve Demarais** and assistant Extension professor **Bronson Strickland** supervised wildlife graduate student Jeremy Flinn as he developed an age and antler estimation software program.

While a properly conducted camera survey can accurately reflect the herd’s true composition, photos are not foolproof because they are two-dimensional, making antler measurements more difficult.

The software uses equations that transform the two-dimensional measurement into a three-dimensional estimate.

Digital images can be loaded into the software and the deer will receive an antler score. The software also allows a user to select the state or region where the deer was photographed. The software then accesses a unique

WILDLIFE, FISHERIES AND AQUACULTURE



set of physical features collected from that area. This ensures that antler size estimates are accurate by region.

Future versions of the software will allow users to age deer. Age is one of the most important factors in correlating biological data to determine the condition of the deer herd.

NBFog obtained a license agreement from MSU to market the software as BuckScore. The software will be available to educators, scientists and hunters to age and score antlers of white-tailed deer. Interested individuals can visit www.buckscore.com for more information.

IMPROVE FISHERIES RESOURCES

Fisheries graduate students are fishing trotlines in the Mississippi River south of Rosedale in hopes of landing pallid sturgeon. The fish, often referred to as a “river sturgeon” grows to lengths of five feet. Its native range is 3,500 miles from the headwaters of the Missouri River in Montana to the mouth of the Mississippi River in New Orleans.

The pallid sturgeon, like the shovelnose sturgeon with which it shares its range, is referred to as river sturgeon because, unlike most other sturgeon species, they complete their life cycle entirely in the large rivers where they live. The pallid sturgeon was listed as a federally endangered species in 1990 after biologists learned that dams in the middle Missouri River stopped recruitment.

Extensive studies and hatchery propagation are

ongoing in an effort to sustain the species in the Missouri River. Little is known about the pallid sturgeon in the lower Mississippi River, but limited fisheries research suggests the population is successfully reproducing. Information about habitat use and critical population metrics such as growth and mortality rates are needed to effectively conserve and restore this Mississippi River native.

Forest and Wildlife Research Center professor **Hal Schramm** and graduate students under his direction are refining capture techniques and developing models that predict seasons and habitats with higher probability of capturing these rare fish. These models can be used to increase the efficiency of collecting pallid sturgeon and also guide standard sampling to assess their abundance.

Acoustic telemetry studies on the Atchafalaya River have demonstrated that pallid sturgeon make long migrations on a two-year cycle but tend to remain rather sedentary between their migratory swims. Preferred habitats in the Mississippi River are rock wing dikes, the upstream entrances to secondary channels, and the main channel border at the downstream ends of islands. The information collected from this study is being used by federal and state fisheries management agencies to guide engineering modifications on the lower Mississippi River.

The information gained in present and future studies will also contribute to sustaining and restoring this ancient, large-river fish. The studies are a result of a



WILDLIFE, FISHERIES & AQUACULTURE

productive partnership between Mississippi State University, Arkansas Game and Fish Commission, Louisiana Hydroelectric, U.S. Fish and Wildlife Service, and U.S. Geological Survey.

IMPROVE AQUATIC RESOURCES

A Forest and Wildlife Research Center study has confirmed the success of a new technique to reduce nutrients in runoff water and protect downstream waters, including the Gulf of Mexico.

Weirs, also known as check dams, are small dams used to collect water runoff from agricultural fields. Weirs are often the size of a drainage ditch, with a 2-foot channel in the center for water drainage. The weirs are concrete but can be moved to various locations in a drainage ditch.

As water from agricultural fields drains, high concentrations of fertilizer nutrients, such as nitrogen and phosphorus, can be carried downstream. These nutrients promote algal production and microbial decomposition in downstream coastal ecosystems like the Gulf of Mexico, which in turn decreases vital oxygen levels.

Drainage ditches on farms filter and alter nutrients before water reaches rivers. Weirs can provide numerous locations along the drainage ditch for nutrients to be absorbed and transformed. Several weirs can be stair-stepped throughout the drainage ditch to provide maximum nutrient retention.

Wherever a weir is installed, water collects to form a miniature wetland, which may improve crop yields by adding moisture to the field.

Funded by the Mississippi-Alabama Sea Grant Consortium, assistant professor **Robbie Kröger** evaluated the impact of low-grade weirs in an experimental design. The objective of the study was to compare weired and slotted-pipe systems for nutrient reduction during simulated storm runoff events.

Results indicated that the weirs removed contaminants effectively. Weirs and outlets alone, however, cannot reduce nutrients. Vegetation is also needed to absorb and retain nutrients.



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Coexistence

The Berryman Institute is a national organization dedicated to improving human-wildlife relationships and **resolving human-wildlife conflicts** through teaching, research, and extension. The Berryman Institute is committed to **training natural resources students** and **providing real world experience** in the field of human-wildlife conflicts.

In 2008, the Berryman Institute launched a cooperative program with the USDA/APHIS/WS National Wildlife Research Center to provide opportunities for undergraduate summer internships.

RESOLVING HUMAN-WILDLIFE CONFLICTS

For **Jessica Brown**, an internship in Florida meant working with invasive species. A Mississippi State University student, Brown gained invaluable lab experience during the summer stint, however, the most rewarding part of her adventure was **resolving human-wildlife conflict**. The sunshine state has had problems with invasive species such as iguanas and vultures.

Brown traveled throughout the state to resolve problems with vultures roosting in the middle of neighborhoods. The vultures were chasing cats and also leaving a bad smell in the neighborhood. To solve this problem, Brown and research wildlife biologist Michael Avery, met with homeowners on site and hung a vulture effigy from their roosting sight, which is designed to scare the birds away. They also showed the residents how to use pyrotechnics to scare the massive birds. Brown also worked with invasive black spiny-tailed iguanas and Burmese pythons which are creating problems for native wildlife in the state.

BERRYMAN INSTITUTE



TRAINING NATURAL RESOURCES STUDENTS

Training can come in many forms, however, perhaps the best, most impressionable comes in the form of hands-on-experiences. For **Matt Rick**, a University of Wisconsin student, his training included a summer in Fort Collins, Colorado as a product registration intern for coyote predation management. Rick gained valuable experience, **training** and knowledge in scientific research, data collection and submissions. He conducted background literature searches for data and then drafted data submissions. These submissions were then used to develop the submission of a registration application to the Environmental Protection Agency for a new toxicant for canine predation on livestock. Rick also spent time in Utah learning to handle and care for coyotes.

Overall, the experience allowed Rick to have a better understanding of his career goals, strengths, and weaknesses. The training left Rick with a new sense of confidence as he prepares for the future.

PROVIDING REAL WORLD EXPERIENCE

Keith Porter, a Colorado State University student, spent the summer working on numerous projects including disease suppression of animals in Michigan and Texas. Porter assisted with the design and construction of a cattle only gate that excludes deer to stop the spread of diseases such as Tuberculosis. Three designs were built and tested at a local cattle pasture for a month. At the

end of the experiment, Porter and his supervisors found a solution with a rubber mat gate. Porter then journeyed to Texas to study the tuberculosis transmission of hogs from Mexico entering the southwestern state. Finally, Porter trapped raccoons in Colorado to test for different hormones that are present which increase trapping success.

Porter stated, "this internship allowed me to gain a lot of knowledge about a possible career pathway and gain some very necessary **field experience** that I can use on my resume in the future."

Since 2008, Berryman East has funded 12 human-wildlife conflict internships from Florida to Colorado. Other interns include:

- *Kathryn Allen, Colorado State University*
- *Mary Annala, Michigan Technological University*
- *Gregory Backus, Washington State University*
- *Travis Bryan, Sul Ross State University*
- *Erica Kelly, University of California – Davis*
- *Kody Kubala, Sul Ross State University*
- *Crysta Robertson, Texas A&M University-Kingsville*
- *Tara Thomson, University of Georgia*
- *Brent Vander Pol, Front Range Community College*



Economical

The Franklin Furniture Institute strives to **increase competitiveness** of the state's furniture industries by providing economical business solutions, export assistance, lean manufacturing, **workforce training** and **testing services**.

INCREASE COMPETITIVENESS

Competing in today's constantly changing global business environment becomes more challenging every day. The international marketplace is characterized by uncertainty and complexity primarily from increased competition, hyper-communication speeds, compressed product life cycles and the need for faster decision making.

The Franklin Furniture Institute created the Export Resource Service to assist domestic furniture manufacturers in developing and expanding export markets and sales. This service is a collaborative effort among the Institute, the U.S. Department of Commerce's Mississippi Export Assistance Center, and the Mississippi Development Authority's International Trade Office. The overall goal is to provide the furniture industry with information and opportunities to help them begin and/or build on exporting activities to increase sales, **increase competitiveness** and grow their international market. This service is targeted towards Mississippi furniture manufacturers, suppliers, and stakeholders included in the furniture value chain. The service serves as a central distribution point for furniture-related export opportunities and links to current trade data, statistics and sources of assistance to the local, regional, and national furniture industry. Through this service, Institute staff notify the industry of upcoming webinars and furniture exhibitions offering them the opportunity to

FRANKLIN FURNITURE INSTITUTE



gain knowledge on specific countries, to increase global exposure and to provide venues for product display.

By disseminating relevant trade leads and trade information, a link is being created between potential foreign customers and domestic manufacturers. This resource center offers manufacturers comprehensive assistance with market assessment, problem solving, and logistical issues.

WORKFORCE TRAINING

As new markets become available and sales increase, many furniture manufacturers have found a need for manager education and training within their organizations. The Franklin Furniture Institute has recognized this need by designing specialized **workforce training** for first-line supervisors.

First-line supervisors are responsible for managing workers and coordinating all of the activities to make, ship, sell and deliver thousands of pieces of furniture. These individuals have moved into their positions, usually from a line position, because of their inherent skills, work ethic and abilities. However, they need training to become effective leaders and supervisors.

Developed and taught by Chip Bailey, a specialist in industrial engineering, the program offers participants instruction in leadership, motivation, communication, management skills, team building, job analysis, time management, industrial safety, the principles of motion

economy, manufacturing assessment and techniques, and changeover and set-up techniques. The curriculum is divided into four topic areas that are further divided into four three-hour modules. The modules are offered on-site at the company's facilities and can be delivered in one three-hour session or three one-hour sessions, all at the request of the participating company.

TESTING SERVICES

To ensure that the products the industry delivers is of superior quality at a competitive price, the Franklin Furniture Institute provides furniture testing services. Working with forest products faculty in the furniture testing laboratory, the Institute provides a non-biased third party assessment of components, frames, packaging, foam and fillers. Fabric **testing services** are now offered which include abrasion testing, fabric seam integrity, fabric tensile strength, fabric tearing strength, and flammability.

Manufacturers throughout the country have used the testing services offered through the Institute and the Forest and Wildlife Research Center. Recliners and sofas are pushed, punched, pulled, jiggled, shaken and more to make sure they will withstand the heavy demand of consumers. Tests are performed according to standards set by the Government Services Administration or the Business and Institutional Furniture Manufacturer's Association.



Preservation

Mississippi's Water Resources Research Institute provides research and outreach designed to **improve water quality, preserve water resources, and protect the water supply.**

IMPROVE WATER QUALITY

Wetlands are ecologically, environmentally, and economically valuable worldwide. Natural moist-soil emergent vegetated wetlands, abundant in the Lower Mississippi Alluvial Valley, are generally flooded during fall-winter and then drawn down naturally by evaporation or by managers during spring-summer to promote growth of annual grasses and sedges. The life-history strategies of these plants are adapted for production of abundant seeds or tubers that are used by a wide diversity of waterfowl and other wetland wildlife. Within agricultural landscapes, strategic location of moist-soil wetlands amid farmed lands can reduce dispersal of sediments and other nutrients into surrounding watersheds and **improve water quality**. Additionally, seasonal decay of native vegetation in wetlands sustains nutrient cycling and is the foundation of disintegrated-based food webs in these systems.

Crayfish (*Procambarus* spp.) and other aquatic invertebrates inhabiting moist-soil wetlands are bio-indicators of quality freshwater wetlands. Crayfish can also provide additional economic gain and food for landowners. Research in the Institute is seeking to increase the awareness and use of moist-soil wetlands while also assessing the economic potential of sustainable harvest of crayfish for consumption. The research is generating baseline water quality data for describing potential watershed improvements provided

MISSISSIPPI WATER RESOURCES RESEARCH INSTITUTE



by moist-soil management. Factors which contribute to the formation of a disintegrated-based food web of crayfish and other invertebrates within these managed wetlands is also being modeled. Results will provide a new tool to promote these natural wetlands which significantly contribute to water quality.

PRESERVE WATER RESOURCES

As wetlands improve water quality, so also do forests which act as a filtration system. However, forest activities, such as logging and planting can have significant impacts on water quality. Forest management activities can potentially affect 20 million acres in Mississippi, much of which is in headwater catchments. Headwater streams contribute water and nutrients to downstream fluvial environments, however the sediment, organic matter, and nutrients (particularly nitrogen) from these streams most often lead to the impaired designation for rivers in Mississippi. Many studies of non-mountainous systems have focused on the quantity of particulate or dissolved forms of material, however, few have examined the source of this material.

Scientists in the Institute are conducting research to address the transport and source/sink behavior of sediment and both dissolved and particulate forms of organic matter in the form of nitrogen (N) and organic carbon, over a range of hydrographic conditions and scales. Their objective is to quantify the yield, source,

and transport processes of organic carbon and nutrients within managed, forested watersheds in Mississippi. The research will allow forest-watershed managers to have a better understanding of how to **preserve water resources** while also managing the forest.

PROTECT THE WATER SUPPLY

As scientists work to improve and preserve water resources, municipalities must also be proactive to **protect the water supply** for future generations. This includes water and wastewater infrastructure which are important for promoting economic development, maintaining public health, and protecting the environment.

The Tombigbee River Valley Water Management District recognized the vital role of infrastructure and water supply issues in the future of Northeast Mississippi. The district recently created two new multi-county water and wastewater districts within their twelve member counties. The Institute assisted the district in organizing and drafting a water management plan for Itawamba, Prentiss, and Tishomingo Counties to better position them for future economic development opportunities. The water management plan and the efforts of the district to establish a new multi-county water and wastewater region move the area a step closer in planning for future water supply and infrastructure needs.



Stewardship

The Natural Resource Enterprises program provides research on **management of wildlife and habitat**. The program teaches landowners how to **increase income through enterprises**, and demonstrates the **benefits of good land stewardship**.

MANAGEMENT OF WILDLIFE AND HABITAT

Hunting leases, primarily for white-tailed deer, are prevalent on forest industry lands, which occupy approximately 40 million acres in the southern U.S. Nationally, hunters spent \$4.4 billion during 2006 for land leasing or land ownership. Such investments in hunting leases provide for consistent annual revenues to landowners, improve access control, and create public relations opportunities with sports persons. Because hunters have clearly shown a willingness-to-pay higher lease rates to maintain access to quality hunting land, there may be opportunities for landowners to charge higher lease prices by providing higher quality hunting experiences.

Quality deer management is a program designed to improve deer herd and buck quality, as well as provide for quality habitat. Quality deer management has been proven to increase hunter satisfaction and provide economic incentives to landowners who implement the program. However, implementation of the program is more effective on a land base larger than a typical lease holding.

Scientists in the Forest and Wildlife Research Center examined the application of quality deer management principles on hunting leases. Led by forestry professor **Stephen Grado**, the study implemented quality deer management on a hunting club cooperative which consisted of six hunting clubs encompassing 11,500 contiguous acres. To understand hunter's attitudes

NATURAL RESOURCE ENTERPRISES



toward the implementation of quality deer management, scientists surveyed those in the hunting club cooperative as well as other hunters who leased land not contained in the cooperative.

In general, there were few differences between hunting club cooperative members and other hunting club members on their willingness-to-pay for establishing the cooperatives and quality deer management, which would improve both habitat and game quality, provide larger contiguous areas for hunting, allow for greater club control on non-club member access, and establish more opportunities to hunt species other than deer. Over 50 percent of hunting club cooperative members and non members indicated a willingness to pay more per acre for hunting leases where quality deer management was implemented.

INCREASE INCOME THROUGH ENTERPRISES

Hunting, fishing and wildlife watching provide significant income for landowners as well as the state. Recent research by the Forest and Wildlife Research Center has found that wildlife-associated recreation generated \$2.7 billion in total economic impact in Mississippi. This also resulted in the creation of \$1.6 billion in new wealth (value-added) for the Mississippi economy. In addition, wildlife-associated recreation generated 66,171 full- and part-time jobs and over \$1.14 billion in wages and salaries for Mississippians.

Hunting generated the highest impact at \$1.14 billion followed by wildlife watching at \$829 million and fishing at \$773 million. Clearly, wildlife-associated recreation contribute to the State's economy and can **increase income for landowners through natural resource enterprises**. A separate study found that outdoor recreation increased the value of private lands used for recreation by 52 percent.

BENEFITS OF GOOD LAND STEWARDSHIP

Landowners who would like to develop natural resource enterprises on their lands can now see a demonstration of the concepts in action at the Natural Resource Research and Education Center in Newton. The area provides five demonstration areas including a nature trail and lake, backyard habitat, wildlife management, agriculture, and forestry. The center provides tangible examples for landowners on how to manage natural resource enterprises and demonstrates the **benefits of good land stewardship**. Each demonstration area is equipped with informative educational signage covering topics from green landscape design to farm pond management.

The center not only serves as a one-stop demonstration sight, it also provides a place for learning through workshops, short courses, and a comprehensive natural resource educational curriculum for adult, youth and professionals.



Conservation

The James C. Kennedy Endowed Chair in Waterfowl and Wetlands Conservation conducts research to gain ecological knowledge and guide **conservation and management of waterfowl habitat and populations.**

MANAGEMENT OF WATERFOWL HABITAT

Moist-soil wetlands that contain abundant grasses and sedges are important natural resources for migrating and wintering waterfowl in the Mississippi Alluvial Valley. **Moist-soil wetlands provide habitat** for waterfowl and abundant foods. To determine the best management practices for these areas, scientists sampled seeds and tubers, aquatic invertebrates, and waterfowl use in moist-soil wetlands in the Mississippi Alluvial Valley during winters 2006–2009. In autumn of each year, openings in dense vegetation were created by mowing or disking, forming “hemi-marsh” conditions—an equal mix of open water and emergent vegetation desirable to waterfowl—after the wetlands were shallowly flooded in early winter.

Dabbling ducks used mowed plots most, followed by disking and non-manipulated areas. Mowed and control plots had the greatest seed, tuber, and invertebrate abundance in late fall and least seed decomposition during winter. Thus, scientists recommend mowing strips or irregular openings in tall, dense stands of moist-soil vegetation in autumn and then flood shallowly (less than 12 inches) to increase waterfowl use and food availability.

CONSERVATION OF BOTTOMLAND HARDWOODS

Acorns and aquatic invertebrates are critical foods for mallards, wood ducks, and other wildlife and fish in flooded hardwood bottomlands. Scientists are estimating red oak acorn and aquatic invertebrate

JAMES C. KENNEDY ENDOWED CHAIR IN WATERFOWL AND WETLANDS



production and abundance in bottomland hardwood forests across the Mississippi Alluvial Valley. Research has been previously conducted on acorns and invertebrates on a small scale in the Mississippi Alluvial Valley but not regionally and over several years.

Preliminary findings suggest that peak acorn and invertebrate abundances in flooded bottomland hardwood forests occur during December and January. Concurrently, food resources for waterfowl in harvested croplands and moist-soil wetlands are often depleted by mid-winter. Thus, bottomland hardwood forests can serve as an important mid- and late-winter food source for acorns and protein-rich invertebrates for ducks before spring migration and nesting.

Results from this research will guide planning and **conservation of hardwood bottomlands** in the Mississippi Alluvial Valley for waterfowl and other wildlife. Additionally, wildlife scientists are collaborating in research with the U.S. Forest Service scientists to study acorn survival during winter, germination rates in spring, and subsequent seedling survival to better understand the role of acorns in recruitment of new red oak forests.

CONSERVATION AND MANAGEMENT OF WATERFOWL POPULATIONS

The American black duck has declined in much of its range in eastern North America since the 1950s. Loss of wintering habitat may be a factor contributing to

population decreases. Although black ducks wintering along the Atlantic coast have been studied extensively, less is known about black ducks wintering in interior regions of the Mississippi Flyway. Information about this population is important because of differences between coastal and interior habitats where the ducks winter. Tennessee and Cross Creeks National Wildlife Refuges and surrounding public and private lands in Tennessee provide wintering habitat for most black ducks in the Mississippi Flyway.

Scientists in the Forest and Wildlife Research Center, the University of Tennessee-Knoxville, and the U.S. Fish and Wildlife Service have initiated a study of black duck winter ecology. As black ducks arrive at Tennessee wildlife refuges, scientists will trap, band and attach radio transmitters to approximately 100 females. The radio marked ducks will be followed daily by vehicle and semiweekly by airplane to record movements, habitat use, and estimate survival of these birds during winter.

This information will be critical for a better understanding of wintering ecology and will guide habitat and **population management** of black ducks on public and private lands in Tennessee, helping to sustain this mid-continent population of black ducks.



Environment

The Wood Utilization Research Center was created to find new ways to **extend the use of wood products**, to **ensure competitiveness** of the wood products industries, and to **create new uses for wood** in an economical and environmentally friendly manner.

EXTEND THE USE OF WOOD PRODUCTS

Wood products which are used in outdoor exposures are usually treated with a preservative to prevent degradation by decay fungi and/or insects. New wood preservative systems require many years of testing in the laboratory and the field. These tests are usually duplicated in different geographic areas and serve as a precursor to determine if further long-term and expensive testing must be done. Short-term testing in the laboratory and field can also be costly and time consuming.

Scientists in the Forest and Wildlife Research Center are working on new field test methods to accelerate the testing. Led by forest products professors **Tor Schultz** and **Darrel Nicholas**, the scientists are modifying the test protocol for each preservative system examined. This includes employing a variable incubation time and using a different method to inoculate wood with fungi. The scientists are also using soils with different properties to speed up the decay process. By making the soil block test harsher, scientists can compare systems quicker and the initial results are comparable to long-term field tests. Scientists have also developed a proposed accelerated ground-contact field test so that data can be rapidly compared. Accelerating the testing from years of exposure to only weeks and months will not only provide cost savings but also allow for the rapid commercialization of new wood preservatives.

WOOD UTILIZATION RESEARCH CENTER



ENSURE COMPETITIVENESS OF FOREST PRODUCTS INDUSTRIES

Relatively high labor and wood costs are important challenges that must be faced if the U.S. forest products industry is to increase its competitiveness in global trade. In particular, the cost share of unskilled labor in the U.S. wood products sector is significantly greater than its global competitors, and is a major barrier to increasing market share in world markets. Technological innovation is one way to offset high input costs.

Scientists in the Forest and Wildlife Research Center are researching the impact of reductions in input and unskilled labor costs through technological innovation on the global competitiveness of the U.S. forest products industry. Led by forestry professor **Ian Munn**, the analysis found that U.S. output of wood products and net exports increase under a number of scenarios in which technology improvements reducing the relative cost of labor and other inputs were modeled. Gains in unskilled labor efficiency had greater impacts than did increases in wood utilization efficiency. Relatively minor increases in efficiency (1–2%) through technological innovations would substantially increase the competitiveness of the U.S. forest products industry in global markets. This study emphasizes the continuing need for research and development to remain competitive in global markets.

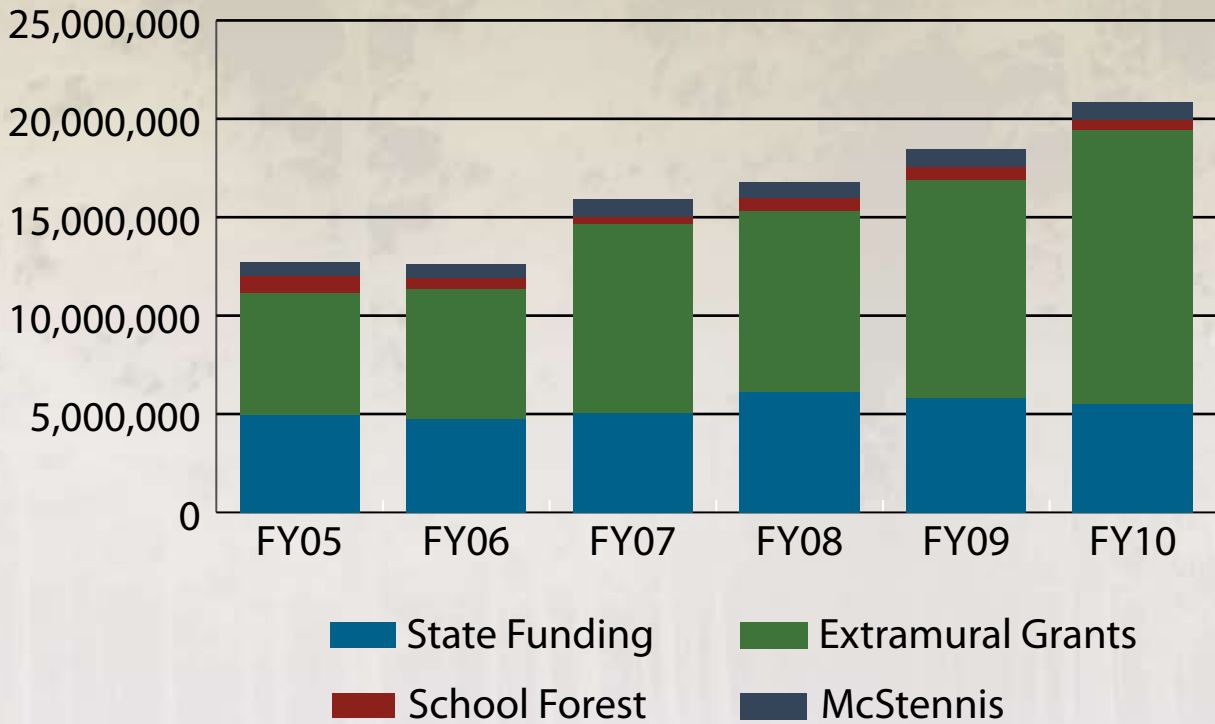
CREATE NEW USES FOR WOOD

Urea-formaldehyde resins are the standard binders for particleboard, medium density fiberboard, and hardwood plywood, with an annual usage of 3.3 billion pounds in North America and 15.8 billion pounds worldwide. However, these resins produce formaldehyde emission problems in homes. California has recently issued a new regulation requiring 50 percent less formaldehyde emissions from composite products and a similar reduction will soon be implemented in the U.S.

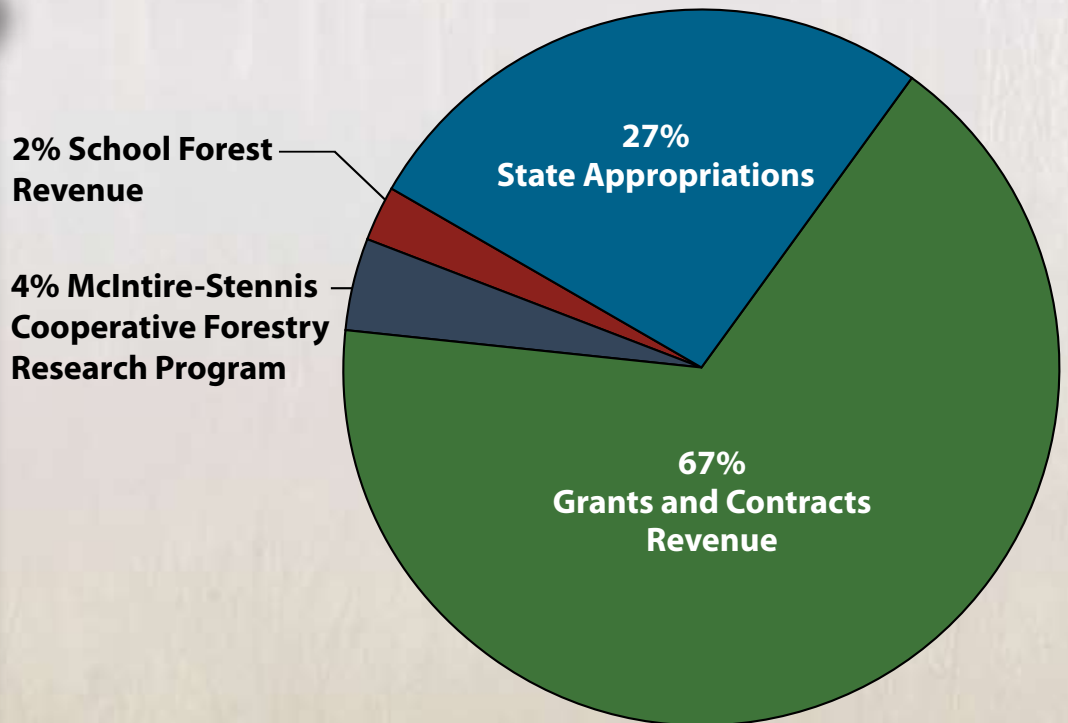
To address this problem, scientists in the Forest and Wildlife Research Center have developed a new resin with a significant lower formaldehyde emission than the urea-based resin. Forest products professor **Moon Kim** has developed the product which will meet emission levels and bind wood composite materials. The development of an environmentally-friendly resin will not only provide benefits to wood products companies but also improve public health from lower formaldehyde emissions.

REVENUES

Financial Highlights, July 1, 2009–June 30, 2010



For every \$1 in state funding, the FWRC generated an additional \$2.50 in extramural grants. The FWRC provides a solid return on the state's investment.



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U.S. Department of Defense, Army Engineer Research and Development Center
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