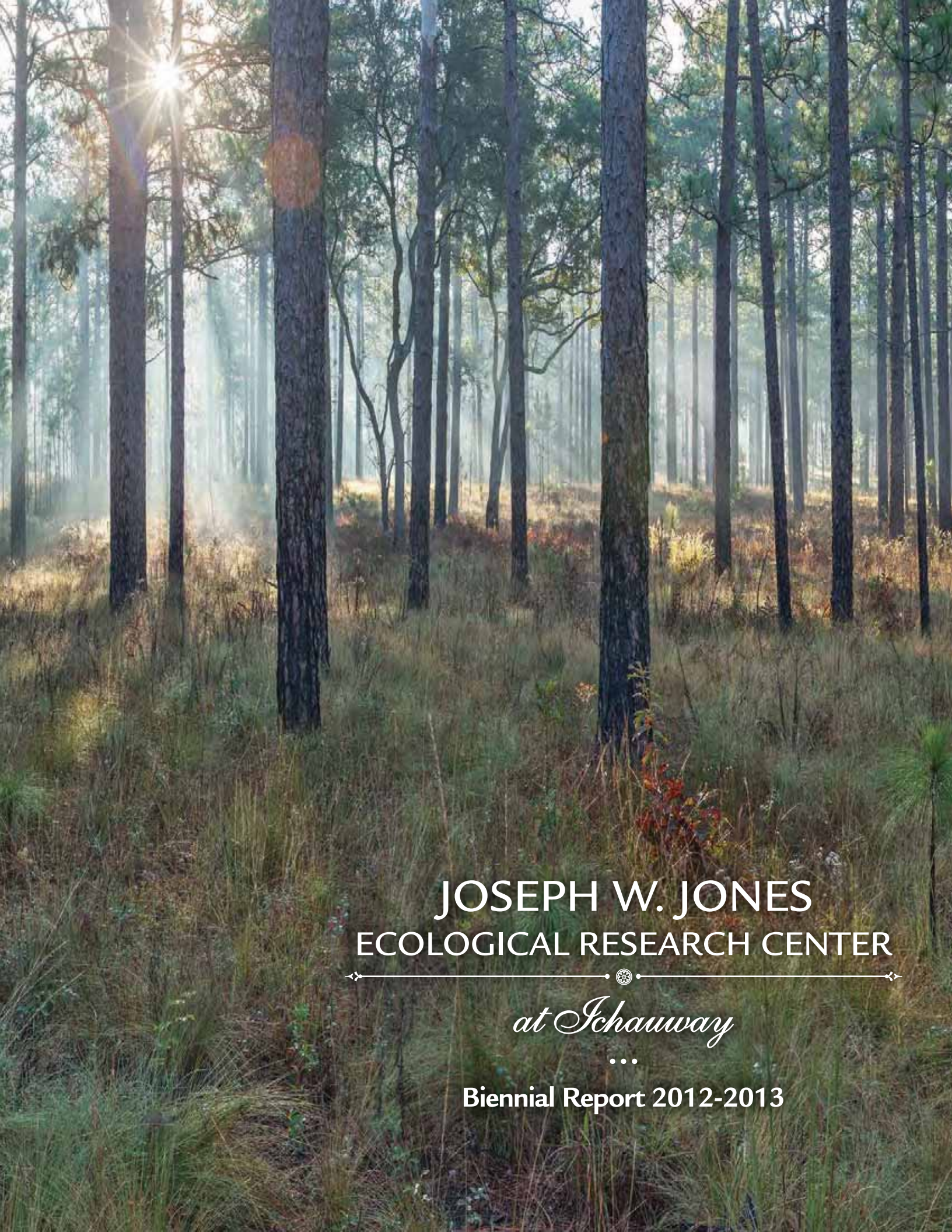

JOSEPH W. JONES
ECOLOGICAL RESEARCH CENTER

at Ichauway

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Biennial Report 2012-2013

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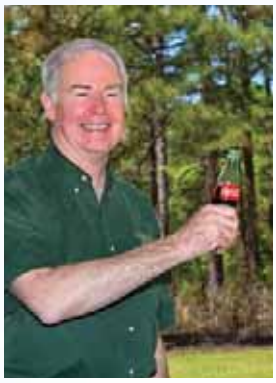


From the Director

This Biennial Report highlights current Jones Ecological Research Center programs and celebrates several milestones that mark our growth in this twentieth year of operations. Our research, education and conservation achievements are accomplished by a dedicated staff of 84 individuals. In addition, we have over 50 collaborators and visiting scientists who share much of the credit for our successful programs and productivity. Since 1995, we have supported over 100 M.S. and Ph.D. students from several cooperating universities, led by the University of Georgia and University of Florida. Our education and outreach programs have greatly expanded in recent years, with over 1,450 natural resource students and professionals participating in workshops, short courses and other events during 2012-2013. Our research continues to address long-term themes related to longleaf pine ecology and management, Flint River Basin hydrology, aquatic and wetland ecology and wildlife ecology. And, importantly, the people who work and study here also are a significant part of the legacy of Jones Center programs.

In the spring of 2013, we marked the twentieth anniversary of the Jones Center with a major celebration and homecoming weekend for former employees and students, followed at a later date by an awards luncheon to honor long-term employees with 20 or more years of service to Ichauway and the Jones Center. They were both memorable celebrations. The homecoming attendees who came back to Ichauway after several years had a great reunion and met a lot of relative "newcomers." At the awards luncheon, we honored long term staff from the Woodruff era of Ichauway as well as founding staff of the Jones Center. Both generations of employees share great credit in working all these years to make Ichauway a remarkable place and in contributing to a lasting legacy of conservation, research and education.

This report also highlights information on key initiatives such as the initial construction of field facilities to support the National Ecological Observatory Network site on Ichauway. We hosted a major ecological research conference in November 2013 with funding awarded from the National Science Foundation and the U.S. Forest Service. This report spans a time of transition for our Scientific Advisory Committee (SAC), now chaired by Robert Naiman with two new members, James Vose and Brian Richter. The role of the SAC continues to be critically important to Center staff, leadership and to the Robert W. Woodruff Foundation.

For over 20 years, we have had solid core support from the Robert W. Woodruff Foundation. We express our great appreciation for their generous support of staff, facilities and programs, and for their visionary commitment of Ichauway's exceptional natural resources for research, education and conservation.

DR. LINDSAY R. BORING, *Director*

Mission & Values

The Joseph W. Jones Ecological Research Center at Ichauway seeks to understand, to demonstrate and to promote excellence in natural resource management and conservation on the landscape of the southeastern Coastal Plain of the United States.

The Jones Center was founded on a long-standing ethic of conserving land and water resources. Ichauway is maintained as the tangible expression of this natural resource management philosophy. Central to this philosophy is the conviction that management and research inform each other and are partners in their contribution to knowledge. One of the Center's most important products is people who combine a rigorous understanding of ecological principles with proficiency in natural resource management.

To understand the natural systems of the southeastern Coastal Plain, the Center assembles information from respected practitioners and the scientific literature and conducts targeted research to expand the knowledge of the field. Through a rigorous and creative research program, the Center aspires to improve management and stewardship of resources of the southeastern Coastal Plain and also to contribute to natural resource science at the national and international levels.

To demonstrate excellence in natural resource management, the Center manages Ichauway to protect and enhance the diversity of natural communities and their component species. The practical and economic aspects of proper stewardship are fundamental considerations of this work.

To promote excellence in natural resource management and conservation, the Center develops and conducts education and outreach programs for undergraduate and graduate students, interns, land owners and managers. The Center serves as a science-based resource for public officials, policymakers and the public.

Highlights 2012-2013

- Ichauway was designated as a National Ecological Observatory Network site by the National Science Foundation-sponsored NEON program. Construction was completed and instrumentation installed on a state-of-the-art eddy flux and meteorological tower. Field sampling was initiated in 2013.

- Education and outreach continued to provide leadership and support for regional and national collaborative conservation initiatives including prescribed fire outreach (Georgia Prescribed Fire Council, Coalition of Prescribed Fire Councils), range-wide longleaf pine restoration (Longleaf Partnership Council, America's Longleaf Local Implementation Teams) and water resource management (Apalachicola-Chattahoochee-Flint Stakeholders).

- Approximately 1,450 natural resource professionals and university students participated in Jones Center education and outreach activities as part of 76 educational programs that included field tours, short courses, workshops and professional conferences. Approximately 1,000 visitors from the region attended two Open House events.

- Thirty-four graduate students from seven cooperating universities conducted their research at Ichauway as part of our cooperative graduate student program. Three individuals participated in the Center's conservation apprentice program during this time.

- The Center's herpetology lab continued to gain regional recognition for their research and conservation work with the gopher tortoise, a species of conservation concern. Center staff developed and validated refined survey methodology that has been adopted throughout the region, hosted training workshops for natural resource professionals,

conducted contract surveys throughout the animal's range in Georgia, served in leadership roles with the Gopher Tortoise Council, advised state and federal officials, researched tortoise diseases and assessed potential impacts of land management activities on tortoise burrows.

- Wildlife ecology staff continued predator-prey research with our 10-year-old predator exclosure project, now the longest experiment of its kind in the U.S. This work continues to yield valuable data and new insights into wildlife interactions, food webs and community ecology.

- Research and conservation staff initiated a new project on ecological restoration of longleaf pine. First thinnings of longleaf plantations established 15 to 20 years ago will allow us to explore best practices for restoration treatments that move these stands toward mature, uneven-aged structure while assessing groundcover development and wildlife responses.

- Research staff hosted nine visiting scientists from six universities and agencies during summer residencies at Ichauway and collaborated with 46 other scientists and cooperators.

- Research staff published 23 articles in peer-reviewed journals in 2012 and 19 in 2013. Center staff also produced 10 technology transfer and other publications in 2012 and 7 in 2013. There are an additional 11 "in press" publications for 2013.

- The Center was awarded $790,951 in new externally-funded research and outreach projects. Seven externally-funded projects totaling $2,124,696 were continued from awards prior to 2012.

Overview of Research, Education And Conservation Programs

The Joseph W. Jones Ecological Research Center at Ichauway is a research and conservation site of regional, national and international significance. Ichauway's 29,000 acres contain approximately 17,000 acres of mature longleaf pine woodlands, 4,000 acres of young restoration plantings of longleaf pine, numerous depressional wetlands, 25 miles of rivers and streams and 3,000 acres of field habitat. Most of Ichauway is used for research and educational demonstrations. This land base is complemented by 50,000 square feet of research and education facilities and a full-time staff of 84.

RESEARCH

Our research programs focus on two broad themes: the ecology, restoration and management of the longleaf pine ecosystem; and water resources, wetlands and aquatic ecosystems of the southeastern Coastal Plain. These areas of focus reflect the Center's location and the information needs of the region. Ichauway is situated in the heart of the historic range of longleaf pine. The longleaf pine ecosystem is one of the most biologically diverse in North America and, with less than 3% of the original extent remaining, increasingly a focus of conservation efforts. Southwest Georgia is also a hydrologically unique karst region that serves as the major recharge area for one of the most prolific and heavily used aquifers on earth, the Upper Floridan aquifer.

We balance basic research of these systems with applied work of relevance to the natural resource management and conservation communities. Much of the Center's research is integrated under five long-term projects that incorporate various components of terrestrial, aquatic and wildlife research in an interdisciplinary approach. Research collaborations include new technologies such as eddy flux towers, ecosystem models and remote sensing.

Information generated from our research program is disseminated through peer-reviewed journal articles, technology-transfer products, popular publications and by participation in local, regional, state and national scientific meetings. Our approach to research is based on collaboration between scientific staff and information users. Our work seeks to address relevant natural resource management questions so that policymakers and land owners can utilize science to support the development of sound resource management plans and policies.

CONSERVATION

The Center's conservation program is charged with the stewardship and management of the Ichauway land base. It also serves as a technical information resource for the Center and as an example of sound resource management in the region.

Integration of research and natural resource management at the Jones Center presents a unique opportunity for these programs to inform one another. Information from our research programs can be scaled up to an operational level for implementation and demonstration on Ichauway. These management applications provide valuable feedback and generate additional questions for researchers.

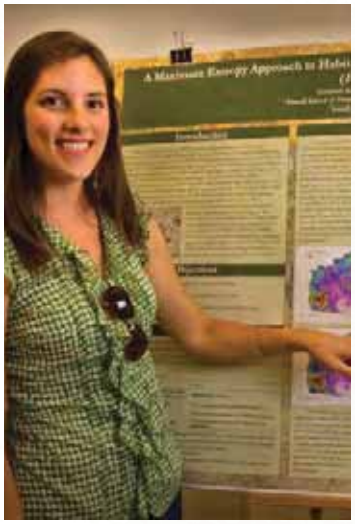
The Center's conservation program incorporates a diverse range of activities into a management model that balances multiple values in the context of a deeply-rooted land ethic. Land management activities include an extensive prescribed fire program, conservation-based forest management and restoration of the longleaf pine ecosystem across the Ichauway landscape. Our wildlife program includes game management for species such as bobwhite quail and white-tailed deer as well as management and monitoring of nongame and endangered species characteristic of the longleaf pine ecosystem such as the red-cockaded woodpecker and gopher tortoise.

EDUCATION AND OUTREACH

The results of our scientific research, as well as information generated from our conservation and land management programs, are shared with a diverse constituency including natural resource management agencies, policymakers, private land owners, conservation organizations and university classes. These audiences visit Ichauway for field tours, short courses and workshops, while Center staff also work collaboratively at other sites in Georgia and across the Coastal Plain of the southeastern U.S.

Our primary constituents include practicing natural resource professionals and those actively involved in making decisions that influence the management of natural resources. Our work with university students helps prepare the next generation of professionals. Through our outreach efforts, the Center influences conservation and management at a range of scales. Center staff are actively engaged in collaborative partnerships at the state, regional and national level, complementing our work onsite at Ichauway.

Approximately 100 students from regional research universities have completed advanced degrees through our cooperative graduate education program, and 21 students are actively pursuing degrees at this time. Key cooperating institutions include the University of Georgia, University of Florida, University of Alabama and seven other nationally-ranked programs. The development of well-trained professionals through our cooperative graduate program is one of the Center's most important contributions. It provides a unique legacy that continues to influence the management and conservation of natural resources through the course of these individuals' careers in conservation, research and education.



20th ANNIVERSARY

2013 marked the 20th anniversary of the development of programs of the Joseph W. Jones Ecological Research Center. In January of 1993, after several years of preparation, the Center hired its initial group of scientists, technicians and support staff. Thus began this chapter in Ichauway's history, building on the rich tradition of stewardship and conservation established during the tenure of Robert W. Woodruff. Over the last 20 years, the Center has become a nationally recognized leader in natural resource science and conservation, fulfilling the vision of its founders. To recognize this milestone, a celebratory "Homecoming" event was held at Ichauway in April 2013.

Approximately 330 current and former employees, graduate students and their families attended the event. Festivities began with an opening reception Friday evening and continued throughout the day on Saturday. Wagon tours of the Ichauway property and Research Campus, meals on the grounds and a backdrop of gospel, folk and bluegrass music provided by Jones Center alumni were highlights of the full day's activities. Following on the heels of the successful Homecoming event, an awards luncheon was held to recognize long-term employees of Ichauway and the Jones Center. Three staff members were honored for over 50 years of service on Ichauway, with four others marking over 30 years. Twelve current employees who were founding Jones Center staff were recognized for their 20 year anniversaries. These events commemorated 20 years of progress in research and education, and a continuing legacy of Woodruff stewardship and conservation of Ichauway. We look forward to building on these achievements over the next 20 years.

Pictured top to bottom, left to right:
20th anniversary wagon tour, Frog Hudson's retirement, graduate student poster session, David Varnadoe's native azaleas, Jerry Wade's service award, 20th anniversary luncheon.

Monitoring creek water levels

Long-Term Research Projects

WETLANDS RESEARCH

Principal Investigators: L.K. Kirkman, L.L. Smith, S.W. Golladay and D.W. Hicks
Lead Technicians: Lisa Giencke, Jen Howze, Nathalie Smith and Brian Clayton

Isolated wetlands of the southeastern Coastal Plain are widely recognized for their conservation values, such as biological diversity and wildlife habitat. Perhaps less well known are the important ecosystem services that natural wetlands provide, such as water storage and nutrient absorption. The Center's long-term research on wetlands seeks to broaden knowledge of these ecosystems, assess their status across the landscape and deepen our understanding of their contributions to ecosystem services and human health. This line of inquiry has historical connections to Ichauway that date back to the Emory Field Station (1939-1958) when Robert W. Woodruff sponsored research and public health outreach to eradicate malaria in southwestern Georgia.

Healthy isolated wetlands support unique communities of plants and animals adapted to cycles of flooding and dry-down largely driven by rainfall. The biological significance of isolated wetlands is much greater than their size would indicate; while wetlands comprise less than 5% of Ichauway's acreage, they harbor almost 30% of the plant species found on the property and provide habitat for many rare and protected plants and animals, especially amphibians. Across the southeastern Coastal Plain, however, ongoing human development, agricultural conversion and altered hydrology are causing the cumulative loss or significant alteration of isolated wetlands. A more complete understanding of wetlands and how they function is needed to address policy, management and restoration issues. The relatively pristine wetlands found on Ichauway offer a unique opportunity to gain that understanding through their use as a reference with which to compare more disturbed wetlands.

Significant achievements in 2012-2013 include ongoing research projects at Ichauway as well as establishment of collaborative partnerships at regional and national levels. On Ichauway, we completed a study examining patterns of genetic diversity in wetland amphibians. Results showed that genetic diversity is highest in wetlands located in landscapes with fewer roads and greater forest cover, suggesting that altered landscapes restrict movement of these animals and thus exchange of genetic material. We also established a site-wide monitoring program for amphibians to document long-term population trends.

Mosquito research continued with an expanded scope that compared disturbed wetlands in agricultural fields with relatively undisturbed wetlands found on Ichauway. There were mosquito species strongly associated with each wetland type, suggesting that larval mosquitoes may be very good indicators of wetland water and habitat quality. Several mosquito species known to host arboviruses were abundant in agricultural wetlands, suggesting a link between human land use and potential disease outbreaks. Another project characterized wetland condition relative to current and historic land use and documented impacts to ecological function and habitat suitability for wetland biota. An ongoing study is building a GIS connectivity model that will identify potential subsurface hydrological connections between isolated wetlands and streams. This model will be validated using standard hydrologic monitoring and soil surveys to better understand wetland connectivity.

Center scientists have partnered with the U.S. Environmental Protection Agency National Exposure Research Laboratory to bring in additional expertise and expand our wetland research capacity. An initial project is a collaborative study of potential impacts of agricultural chemicals on isolated wetlands and associated wildlife. Another initiative is the formation of an isolated wetland working group to summarize current understanding of wetland benefits and function and to develop further collaborative studies. The goal of this effort is to foster broader efforts to better understand ecosystem services of wetlands at regional and national scales. This group held its inaugural meeting with a workshop of 30 wetland scientists and policy experts at Ichauway. Center scientists also organized a symposium on benefits and services of isolated wetlands at the 2013 Society of Wetland Scientists meeting in Duluth, MN.

Just as they did 70 years ago when scientists from the Emory Field Station began to study the ecology of malaria, the natural wetlands found on Ichauway provide a rich research opportunity. The Jones Center's work builds on this tradition as we continue to refine our understanding of how to manage, restore and conserve these unique ecosystems for both societal and conservation values.

WATER RESOURCES RESEARCH

Principal Investigators: S.W. Golladay, P.V. McCormick, L.L. Smith and D.W. Hicks
Lead Technicians: Nathalie Smith, Lisa Cowart, Jen Howze and Brian Clayton

The Center's water resources studies seek to better understand the relationship between human use of land and water and the health of streams, rivers and aquifers in the Apalachicola-Chattahoochee-Flint (ACF) Basin. Integrating historical datasets and new research, this work explores the patterns and drivers of water quantity and quality in the ACF Basin. Reliable supplies of clean water are essential for human health and well-being and our work helps provide a scientific foundation for informed decisions about water resource management and policy.

As a shared resource between the states of Alabama, Florida and Georgia, the ACF Basin faces many demands from diverse stakeholders. Water resource interests include municipal use for human consumption, agricultural use for irrigation, adequate flows for stream health and sufficient flow into Apalachicola Bay to support an important regional seafood fishery. Adequate water quantity is the critical link in supporting these shared social, economic and ecological interests. In 2012, we expanded research efforts related to water quantity with a new project

focused on environmental flows that significantly expands the Center's ongoing work in this area.

The environmental flow regime is the seasonal and interannual variation in water quantity required to maintain healthy streams and rivers. Most streams and rivers in the southeastern U.S. have altered flows as a result of human activity. In the ACF Basin, particularly the lower Flint River and its tributaries, watershed development and increased human demand for water have raised concerns about adequate stream flows. Analyses of long-term data by Center scientists demonstrated diminished stream and river flows in recent decades, particularly during the growing season. Our new work moves beyond hydrologic analyses and will document the ecological effects of reduced seasonal flows and identify potential flow thresholds that cause long-term harm to stream health. For this project, a network of long-term stream sampling locations has been established throughout the lower Flint watershed. Detailed hydrologic data are being correlated with habitat condition and biological responses to more fully characterize altered flows and their impact on stream health.

Research on water quality in 2012-2013 showed long-term increases in nitrate concentration in groundwater discharging into the Flint River. This raises concerns about fertilizer and waste water discharges and their long-term consequences for regional water supply. Ongoing studies of Lake Seminole suggest that it mitigates nutrient runoff from upstream land use, discharging higher quality water than it receives. This ability appears linked to a nuisance aquatic plant *(Hydrilla spp)*, an exotic clam *(Corbicula spp)* and a cyanobacterium *(Lyngbea spp)*. This research is addressing the role of Lake Seminole in regional water quality and attempting to determine the limits of its ability to absorb nutrients.

Water is a finite resource that must be managed in a holistic and sustainable way to meet the multiple demands of society. Recognition of this concept is a relatively recent development in the southeastern U.S. An adequate supply of high quality water is a common denominator that links human health with stream health. The Center's work in water resources provides an important scientific foundation to support the development of policies that balance human and environmental needs.

WILDLIFE RESEARCH

Principal Investigators: L.M. Conner and L.L. Smith
Lead Technicians: Gail Morris and Jen Howze

The Jones Center's wildlife research program focuses on two general themes; predator-prey relationships and wildlife-habitat interactions. Within these areas of study, our scientists work on questions that further our understanding of basic wildlife ecology in longleaf pine ecosystems as well as applied issues related to conservation and management. While our wildlife research is conducted in all areas and habitats on Ichauway, much of our predation work has focused on a manipulative experiment in which medium-sized mammalian predators were excluded from 100-acre fenced enclosures. Our wildlife habitat work seeks to better understand how wildlife responds to habitat structure in natural longleaf pine forests as well as responses to manipulation of that structure through management actions.

The predator exclusion project, in place for 10 years, is now the longest running study of its kind in the U.S. Some of the early findings of this work showed that red imported fire ants were a primary predator of shrub-nesting birds, which has led to additional projects currently underway that are exploring community-level impacts of fire ants on small mammals and herpetofauna. The study also revealed that one of the greatest impacts from mammalian predators was on gopher tortoise nests. This has led us to initiate work that will examine longer term changes in the demography of tortoise populations in the absence of mammalian predators as well as relationships between habitat structure and predation rates.

GOPHER TORTOISE

The gopher tortoise is one of the iconic wildlife species of the southeastern Coastal Plain. Found from southern South Carolina to southeastern Louisiana, the greatest concentration of populations remains in southern Georgia and northern Florida. Most commonly associated with open-canopied longleaf forests, gopher tortoises are declining across their range and are increasingly a species of conservation concern. Gopher tortoise populations west of the Mobile River are listed as Threatened under the Endangered Species Act, while populations in the eastern portion of the range are classified as a candidate species for listing, with their status currently under active review by the U.S. Fish and Wildlife Service.

Ichauway has a robust population of gopher tortoises, estimated at approximately 5,000 individuals. Our scientists, graduate students and research technicians have been studying this species since the Center's founding. Early research efforts focused on the basic ecology of gopher tortoises such as preferred habitat, food selection and movement patterns. More recently, our work has centered on conservation issues including the development of more rigorous population survey protocols, habitat assessment, tortoise disease and population demographics.

Education and outreach efforts across the region were a growing part of our work with this species in 2012-2013. Georgia Department of Natural Resources contracted with the Center to conduct surveys on state-owned lands as well as properties in the region under conservation easement. Center staff have served in leadership roles with the Gopher Tortoise Council and hosted the annual meeting of this conservation group in 2012. We hosted training workshops in survey methodology at Ichauway as well as conducted workshops offsite for U.S. Fish and Wildlife Service personnel. In 2012, we became a signatory on the gopher tortoise Candidate Conservation Agreement (CCA). The CCA is a cooperative effort among state, federal, non-governmental and private organizations designed to facilitate collective implementation of proactive gopher tortoise conservation measures across its eastern range.

Because of our extensive work with this species, the Center is regarded as one of the leading authorities on gopher tortoises. While there is growing concern over the rarity and declining status of the gopher tortoise, much of our work is directed at better understanding effective conservation solutions for this species that will help stabilize and reverse its decline. Collaborative platforms such as the CCA provide a unique opportunity to develop creative solutions that can serve the interests of conservation agencies and organizations, private land owners and wildlife.

Early work suggested that coyotes were directly impacting white-tailed deer populations through predation of fawns. This led to more detailed study of coyote-deer interactions in the context of the predator exclosures as well as at larger spatial scales. Further study has demonstrated higher densities of does in exclosures during fawning season, significantly higher fawn survival within exclosures and site-wide correlation between doe weight and coyote abundance. We also found evidence for trophic cascades in food webs. Trophic cascades occur when predators suppress populations of their prey, thereby releasing the next lower trophic level. In this case, coyotes appear to have impacted foraging behavior of deer, thus altering vegetative composition and structure. Within exclosures, deer grazed more heavily on legumes, which grow lower to the ground and require more effort to locate. In the control plots outside of the exclosures, deer preferentially browsed on oak saplings, presumably because this allowed them to be more vigilant for coyotes. These dissimilar foraging strategies have resulted in differences in abundance for both legumes and oaks between the control plots and the exclosures.

In 2010, the Center's wildlife research program, in collaboration with the University of Georgia, Georgia Department of Natural Resources and the National Wild Turkey Federation, began a project to better understand how wild turkeys utilize longleaf pine forests, their population dynamics in these systems and how they respond to seasonal and spatial aspects of prescribed fire. The project has supported five graduate students, with three Master's level projects coming to completion in 2013. Some of the initial findings of this project run counter to many commonly held beliefs about frequently-burned, open-canopied longleaf pine forests as turkey habitat. The longleaf pine forests of Ichauway showed comparable nest productivity to a companion study site with greater hardwood dominance, with opposing trends in nest survival versus poult survival between sites that yielded similar rates of success. Also, prescribed fire, particularly growing season fire, does not appear to have the degree of impact on turkey nest productivity once thought. While these results are preliminary, they do suggest that longleaf pine forests managed with prescribed fire can provide good habitat for wild turkey and support healthy populations of this species.

The Center's wildlife program continues to explore basic scientific questions related to wildlife populations in longleaf pine ecosystems while also addressing applied wildlife issues of importance to the management and conservation community. This work underscores the importance of Ichauway as a long-term study site and the value of the Center's work in furthering wildlife conservation and management.

ECOLOGICAL FORESTRY AND RESTORATION OF LONGLEAF PINE ECOSYSTEMS

Principal Investigators: S.B. Jack, R.J. Mitchell, L.K. Kirkman, R.K. McIntyre, L.L. Smith and L.M. Conner
Lead Technicians: Noah Jansen, Jason McGee, Lisa Giencke, Jen Howze and Gail Morris

Interest in conservation and restoration of longleaf pine ecosystems in the southeastern U.S. continues to build. Land owners and managers are drawn to longleaf pine for the multiple amenities the forest type provides, including wildlife values, high-quality timber products, aesthetics and recreational values. A regional conservation plan seeks to double the existing acreage of longleaf pine through the efforts of a diverse coalition of private and public sector stakeholders. While the current focus of most longleaf restoration efforts across the Southeast is primarily on the establishment of new acres, there is a growing realization that the desired multiple values will require a long-term, holistic approach to restoration and management. The extensive mature longleaf forests on Ichauway provide both an opportunity to further understanding of how these forests function and how to manage them well, and also provide a model to guide restoration of younger forests.

The Center has been a leader in advocating for the broader utilization of the ecological forestry concept, where appropriate and justified by objectives, through an integrated program of research, management and outreach. Ecological forestry is an approach to forest management that uses natural disturbances and ecological processes as a guide to silvicultural prescriptions and desired forest structure. The goal of this project is to deepen the scientific understanding of ecological mechanisms upon which the practical application of ecological forestry in longleaf forests is based. Ecological forestry in the longleaf pine ecosystem is best exemplified by the Stoddard-Neel philosophy of forest management, which balances consumptive use and conservation values. While the Stoddard-Neel approach is most commonly associated with management of mature forests, this holistic philosophy is also applicable throughout the restoration process at all phases of stand development. This project brings together several diverse study components including native groundcover restoration, phased conversion of offsite pine species to longleaf, intermediate stand manipulations such as thinning and management of hardwood competition, wildlife responses to restoration and ongoing maintenance of mature longleaf forests. These different aspects are united by a common element: each can play an important role in moving a given stand or tract towards the desired structure of multi-aged, open pine grasslands maintained by frequent fire.

Ichauway began restoration plantings of longleaf pine in the late 1980s. With these plantings now approaching the age for first and, in some cases, second thinnings, we have a unique opportunity to investigate best practices for moving these stands towards the characteristic structure of mature, open pine savanna with grass-dominated understories. In 2012, Center scientists developed the first phase of an experimental design that will explore understory development, wildlife response and structural attributes of thinned longleaf plantations. Pretreatment data were collected in 2013, with thinning scheduled for early 2014. Whereas most research efforts in longleaf pine have focused on either mature forests or establishment of new plantings, this research will further our understanding of the largely unexplored transition phase between plantations and multi-aged forest, and assist owners and managers of longleaf forests in achieving their long-term land management objectives.

Center conservation staff and scientists also continued work related to the gradual conversion of slash pine stands to longleaf. Three younger stands of slash pine were thinned in early 2012, treated with herbicide, and longleaf seedlings were planted in canopy gaps in January 2013 to begin transitioning the stands to longleaf. Another harvest was conducted in 2013 in the mature slash pine stand at the Center entrance, and a second phase of additional gaps will be planted with longleaf and wiregrass. Our native seed production garden project continues, with Center staff receiving a grant to be part of a regional collaborative with researchers across the Southeast to further the development of seed supplies for regional ecotypes of native understory plants.

Our ecological forestry work in mature longleaf forests continues in three focal areas: 1) how natural disturbances in longleaf pine ecosystems shape forest structure and how managed disturbances, such as harvest, compare to those patterns; 2) the relationships between patterns of overstory retention, prescribed fire and forest demographics; and 3) recovery of the system, particularly understory communities, after harvesting disturbance. Canopy harvest treatments include control (no cut), single-tree selection and two gap-based approaches. Research results during the next few years will help refine understanding of the critical issues and questions related to sustainable management of longleaf pine ecosystems. An experimental harvest was conducted in mature longleaf stands in 2009, and since then research efforts have concentrated on documenting impacts and recovery from the harvest such as soil compaction, longleaf seedling development and understory recovery following harvest. In

2012, we collected data that will help us better understand the demography of longleaf forests, including cone predation, seedfall, recruitment of longleaf germinants and demography of hardwood sprouts.

Ichauway's extraordinary natural longleaf pine and wiregrass stands, as well as the varying stages of longleaf restoration sites, provide both a living laboratory and an outstanding demonstration site for those interested in this ecosystem. As interest in longleaf conservation and restoration grows across the Southeast, our efforts and land base put us in a unique position to contribute new information to refine management and conservation of this ecosystem.

PRODUCTIVITY, BIODIVERSITY AND CARBON DYNAMICS OF LONGLEAF FORESTS

Principal Investigators: R.J. Mitchell, L.K. Kirkman and L.R. Boring
Lead Technicians: Jason McGee, Lisa Giencke, Scott Taylor and Andres Baron

Since the Center's founding in the early 1990s, our research has maintained a strong focus on addressing information gaps in the basic ecology of longleaf pine. Our first long-term research effort, the Productivity and Biodiversity Project, explored fundamental topics related to longleaf pine forests, such as net primary productivity, patterns of plant species composition and nutrient cycling. Many of the studies associated with this project included components that assessed both above-ground and below-ground cycling of carbon through the fire-maintained longleaf ecosystem.

Carbon, like currency in an economy, is a basic building block of ecological systems. Through photosynthesis, plants take carbon from the atmosphere and water from rainfall and soils, and produce carbohydrates and oxygen. Focus on the carbon cycle has increased dramatically in recent years in response to concerns about climate change. There is currently great interest in the ability of forests to capture and sequester carbon, particularly highly productive forests such as southeastern U.S. pine forests, as one strategy to reduce atmospheric carbon dioxide (CO_2). However, many questions remain in our understanding of the carbon cycle and how management may influence carbon storage in both above- and below-ground pools.

Over the last few years, new technologies have been employed that build on the Center's long-term research into patterns, controls and gradients of productivity from wet to dry longleaf sites. These tools greatly enhance our ability to estimate carbon dynamics at multiple scales. A collaborative effort with the University of Alabama and the University of Edinburgh has generated a carbon model for longleaf pine forests and validated the model through field data collected at Ichauway. Three eddy flux towers are used across a moisture gradient on Ichauway to assess productivity and carbon dynamics, with these data augmented by traditional field measurements. This project was ongoing in 2012-2013, with results being published in major journals. The research continues under a three-year working agreement between the Center and the University of Alabama that will continue to utilize the eddy flux towers to refine our knowledge of carbon allocation, variability with climate and CO_2 emmissions from prescribed burning.

In conjunction with the adaptation of the carbon model, the Center partnered with the Pacific Forest Trust on a pilot project to apply the California Climate Action Registry (CAR) protocols for carbon markets to mature, fire-maintained longleaf pine forests in the Southeast. Using growth models from an earlier project on Ichauway that examined economics of longleaf management and the guidelines in the CAR, scenarios were modeled to explore how mature longleaf forests would perform in a carbon market. This exercise suggested that several provisions of the CAR would need to be adapted to equitably assess carbon sequestration in southeastern pine forests. The results of this effort were published in the Journal of Forestry.

In 2013, construction was completed on a sensing tower for the National Ecological Observatory Network (NEON). NEON is a continental-scale ecological observation system for examining critical ecological issues sponsored by the National Science Foundation. The Jones Center is one of 60 terrestrial NEON sites across the country that were strategically selected to represent different regions of vegetation, landforms, climate and ecosystems. This program will combine site-level field measurements and tower data with remote sensing and continental scale datasets to monitor ecological change at large scales. The Center is fortunate to be a part of this exciting new program and to have the opportunity to augment our programs with some of the latest technological tools for scientific research.

As one of the Center's original long-term research projects, elements of this work have now been in place for almost 20 years. Results from various components of this project have filled many gaps in our knowledge of the basic ecology of longleaf pine ecosystems and how they function. This foundational understanding allows us to address issues such as carbon dynamics, emissions from prescribed burning and effects of fire suppression in a more scientifically rigorous way, demonstrating the value of a long-term perspective on research.

NEON tower

Education

Education and outreach programs at the Jones Center target natural resource professionals and university students that will enter the natural resource profession. This focus represents the best opportunity for application of new information and best practices generated from the Center's research and conservation programs. Approximately 1,450 visitors participated in 76 events such as short courses, workshops and field tours in 2012-2013. Approximately two-thirds of these individuals were professionals and one-third were students. Center staff members are increasingly engaged in collaborative partnerships at state and regional levels. Our graduate education and conservation apprentice programs continue to produce highly skilled young professionals who carry the Ichauway legacy through their careers in natural resource research, management and conservation.

Throughout the Center's history, one of its primary areas of focus has been the ecology, management and restoration of the longleaf pine ecosystem. Historically neglected in both research and management because of its perceived shortcomings economically, longleaf pine is now enjoying a renaissance. The Center's long-term commitment to understanding both the science and management of this ecosystem puts us in a unique position to contribute to the growing interest in longleaf as a conservation priority at the regional and national levels. Center staff served in the collaborative group that developed the rangewide conservation plan for longleaf pine, America's Longleaf Restoration Initiative, and continue to work with the ongoing implementation effort for the plan, the Longleaf Partnership Council. This is a collaborative partnership of federal and state natural resource agencies, nongovernmental conservation organizations and the private sector working to achieve the goals of the rangewide plan, which include doubling the current acreage of longleaf pine and improving the condition of existing longleaf forests. These efforts are viewed as a national model for regional collaborative conservation partnerships and as a result of their success, longleaf pine was recognized in 2012 as one of five regional collaborative conservation efforts in the White House's America's Great Outdoors program. Center staff also serve on several local implementation teams for the rangewide conservation plan. These teams are collaborative groups conducting on-the-ground longleaf restoration in targeted priority areas across the Southeast.

The high quality examples of the longleaf ecosystem found on Ichauway, as well as our exemplary management and restoration programs, provide a rich context for onsite educational programs. Our ecological forestry workshops continue to be one of our primary longleaf outreach programs, with two workshops held in 2012-2013. Center staff also worked with the National Fish and Wildlife Foundation to refine habitat goals for their Longleaf Stewardship Fund grant program, which provides approximately 3 million dollars annually to facilitate implementation of the rangewide conservation plan. Another longleaf-related achievement was the development and implementation of a week-long onsite Maymester short course for the University of Georgia and the University of Florida.

Prescribed fire continues to be an important component of the Center's education and outreach mission. Our efforts in this area include onsite training and demonstration as well as participation in regional and national collaborative partnerships. Center staff continued to serve in leadership roles in the Georgia Prescribed Fire Council and the national-level Coalition of Prescribed Fire Councils. These efforts promote the use of prescribed fire and educate the public and policy makers about the valuable role prescribed fire plays in both human health and healthy forests. A highlight of our regional outreach was the convening of a workshop at Ichauway for air quality regulators and fire directors from state agencies in all eight southeastern states, as well as Region 4 Environmental Protection Agency administrators. Training courses held onsite provide hands-on experience with prescribed

fire for Jones Center personnel and university students through our employee prescribed fire course and our Maymester prescribed fire course offered through the University of Georgia. In addition, demonstration burns are conducted on Ichauway for strategic visiting groups, many of whom have never had experience with prescribed fire. Center staff also served as instructors for the Georgia Forestry Commission's certified prescribed burner course. The Center represented the private sector as a contributor to the development of the Cohesive Strategy, a national fire plan led by the Wildland Fire Leadership Council, a working group of federal agency fire management leaders.

Outreach in water resources during 2012-2013 focused heavily on resolution of the water appropriation issues in the Apalachicola-Chattahoochee-Flint (ACF) Basin through our work with the ACF Stakeholder process. Center staff served in leadership roles in the ACF Stakeholders, a multi-state group with diverse representation seeking equitable, science-based policy and solutions to water resource conflicts in the ACF basin. Private grant funding of more than $1.3 million has allowed the group to engage the professional services of private consulting firms and regional universities to gain knowledge and guide the stakeholder process forward. Various water management alternatives are being tested with numerical models to evaluate impacts on water sustainability in the river basins, as well as impacts on the salinity gradients and distribution within the Apalachicola Bay. Sufficient freshwater flow rates and durations are critical to maintaining a healthy aquatic bay environment.

Jones Center staff are also engaged in a collaborative partnership to improve agricultural water use efficiency in the lower Flint River Basin. This scientific collaborative was awarded a Conservation Innovation Grant from the Natural Resources Conservation Service and the project has begun working with farmers in the region to develop more efficient irrigation practices. Jones Center aquatic scientists continue to provide support to Georgia Department of Natural

Resources Environmental Protection Division on issues related to the water resources, aquatic habitat and aquatic species within the lower Flint River Basin.

Conservation

Robert Woodruff's acquisition of the Ichauway property in the late 1920s began a long tradition of excellence in land management. The unique landscape found on Ichauway today is the result of decades of careful stewardship and wise resource management. The founding of the Jones Center 20 years ago launched a new chapter in the stewardship of the property in which science and management are more fully integrated and collaborative. The extensive longleaf pine forests found on Ichauway are known across the Southeast as one of the finest remaining examples of this rare forest type and as a model for exemplary land management. The Jones Center's conservation staff is responsible for the day-to-day natural resource management on Ichauway.

Professional staff in the Center's conservation program includes resource managers, wildlife biologists and foresters. This group is responsible for a wide range of projects such as forest management, silviculture and restoration; management of game species such as bobwhite quail and white-tailed deer; conservation of endangered, threatened and special concern species such as red-cockaded woodpeckers and gopher tortoises; long-term habitat monitoring; and control of invasive, non-native plant and animal species. Their work includes ongoing activities, such as using prescribed fire as a management tool as well as targeted efforts to restore or improve forest or wildlife habitat based on sound science. Significant effort is spent in support of the Center's research and education programs.

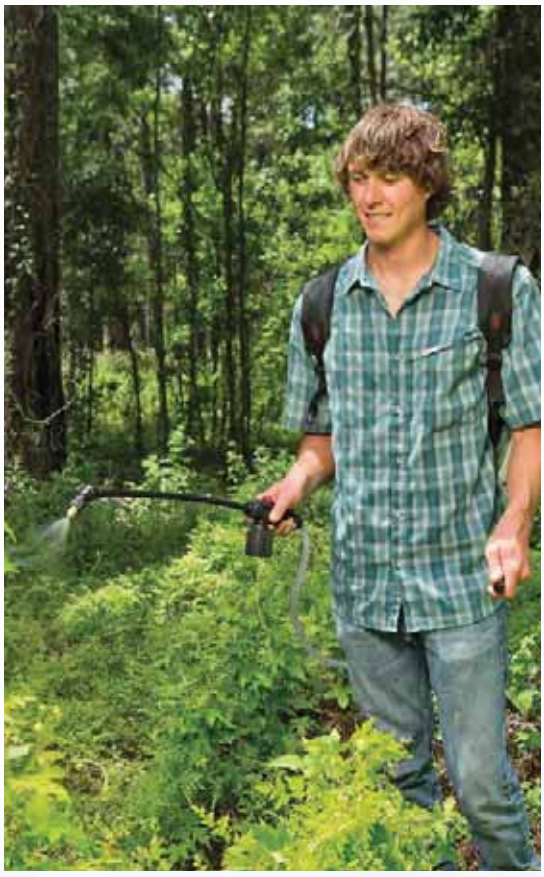
Highlights of activities over the last two years include the following:

The most essential tool for management of the longleaf pine ecosystem and its associated wildlife is prescribed fire. The Center maintains a model prescribed fire program that sustains the longleaf ecosystem and also minimizes wildfire danger. The long history of prescribed fire on Ichauway demonstrates the critical role of fire in maintaining the values of longleaf forests. In 2012, Center staff burned approximately 11,941 acres, and in 2013 approximately 11,662 acres were burned for management, research and education objectives.

Exotic species control efforts in 2012-2013 focused on herbicide treatment of Japanese climbing fern. This prolific vine-like fern spreads rapidly by spores and is becoming increasingly problematic in the Southeast. This plant seems to establish most readily in lower, wetter areas and then spreads into uplands. Treatments in 2012 were targeted along the Flint River corridor, with 2013 treatments primarily along roadways and in drainages. Treated areas are monitored to determine the need for additional treatments as well as to better understand recovery of the understory plant community. We also continue to monitor and aggressively remove feral hogs, although far fewer were encountered in 2012-2013, suggesting that our control efforts in previous years were successful in bringing hog numbers back down to manageable levels.

Restoration efforts for the endangered red-cockaded woodpecker on Ichauway continue to make progress toward our long-term population goal of 30 active clusters with at least 25 potential breeding pairs. After minor declines in 2007-2009, presumably related to low nestling survival during drought, our population is again growing. In 2012, there were 22 active clusters with 17 breeding pairs. In 2013, these numbers grew to 25 active clusters with 19 breeding pairs. Much of our past success with this program is attributable to careful stewardship, including the installation of artificial nest cavity boxes. In 2012, conservation staff documented the first instance of red-cockaded woodpeckers creating and using their own natural cavities.

The Center continues to practice active forest management on Ichauway using an adaptation of the Stoddard-Neel system of selection harvest. Three younger slash pine plantations, all planted in 1987, were thinned in 2012. Canopy gaps were intentionally created during the marking of these stands and these gaps were planted with 15,000 longleaf seedlings to begin the gradual conversion of these stands to longleaf pine. Another 550 acres were harvested in 75-year-old stands of planted slash pine and in mixed species natural stands. The harvest in the mature slash pine plantation continued the gradual conversion process to longleaf pine (begun with a harvest in 1998) by creating canopy gaps that will be planted with longleaf pine seedlings. Harvests in the natural stands were conducted using an individual tree selection approach with the objectives of stand improvement, forest health and promotion of longleaf pine regeneration to develop multi-aged forest structure.



Conservation Apprentice treating invasive exotic plants




GRADUATE STUDENT PROGRAM

In 2013, the Jones Center reached a significant milestone in having supported over 100 graduate students onsite conducting research to complete M.S. and Ph.D. degrees. When the Center began in 1993, the newly hired scientists brought a few graduate students along from their positions as faculty at universities. Over the next few years, the Center negotiated cooperative agreements with University of Georgia, University of Florida and Auburn University and others to share the costs of graduate assistantships, research costs and housing, leveraging resources to achieve both research and education objectives.

The program provides a unique opportunity for Center scientists, university faculty and the sponsored students. Scientists are able to increase their productivity and grow research programs through mentoring the bright students who come to the Center to work on advanced degrees. The structure of the program, in which a Center scientist teams with a faculty member from a regional university as co-advisor, builds professional relationships at both the individual and institutional levels. Center scientists apply for adjunct university faculty status as part of the process. For the students, the Ichauway experience is immeasurably richer than a typical graduate program in which the student continues to live in a university town and commutes to a study site periodically to conduct field work.

Becoming a graduate student at Ichauway is an immersive experience. Students live in the ecosystem they study, share that experience with a small cadre of fellow students, have broad learning experiences about natural history and natural resource management and join the diverse community of people who live and work at the Jones Center.

This program has grown to include students and faculty from 11 institutions. Students are attracted to the strong support of the Jones Center graduate program at cooperating universities. On average, 20 or more students are in the process of working on advanced degrees at any given time, with the number of doctoral students showing steady growth over the last few years. This program is leaving a significant legacy for natural resource research, management and conservation in the Southeast as students matriculate and take their Jones Center experiences with them. Most of the individuals who have gone through our graduate program now work in positions of responsibility with federal and state agencies, non-governmental conservation organizations, universities or private consultants. While the accomplishments of the Center are many, the impact of this program, through the careers of our graduate students, is one of our most enduring legacies.

Graduate student projects, left to right: *predator exclosure, wetland characterization, wildlife wetland linkages, pocket gopher ecology*

Externally Funded Research

Conner, L.M. Breeding bird response to longleaf pine restoration. National Wild Turkey Federation. 2011-2016. $35,700.

Conner, L.M. Prescribed fire and ecology of turkeys, coyotes and deer. Georgia Department of Natural Resources (University of Georgia). 2012-2013. $91,466.

Golladay, S.W. Instream assessment of stream habitat and mussel populations adjacent to AAWCM sites in the lower Flint River Basin. The Nature Conservancy - Georgia. 2012-2013. $59,687.

Golladay, S.W., R.J. Mitchell. A workshop on conservation and natural resource management in an uncertain future: using the southeastern U.S. as a model for managing change. U.S. Department of Agriculture - Forest Service. 2012-2014. $15,000.

Golladay, S.W., R.J. Mitchell. A workshop on conservation and natural resource management in an uncertain future: using the southeastern U.S. as a model for managing change. National Science Foundation. 2012-2014. $49,000.

Hicks, D.W. Grand Bay-Banks Lake long-term wetland evaluation. U.S. Army - Moody AFB. 2009-2013. $78,548.

Kirkman, L.K., L.M. Conner, R.K. McIntyre. Longleaf pine understory restoration III. National Fish and Wildlife Foundation. 2007-2013. $196,500.

Kirkman, L.K., R.K. McIntyre. Enhancing longleaf ecosystem understory. National Fish and Wildlife Foundation. 2007-2013. $82,000.

Kirkman, L.K. Population survey and analysis for federally-listed or petitioned plants and the threatened Gulf sturgeon. U.S. Fish and Wildlife Service. 2012-2015. $50,000.

Kirkman, L.K. Evaluation of longleaf pine undercover ecotype seed sources. R. Howard Dobbs Jr. Foundation. 2012-No End Date. $65,000.

McIntyre, R.K. Developing Metrics for Longleaf Pine Restoration. National Fish and Wildlife Foundation. 2012. $29,720.

McIntyre, R.K., S.B. Jack. Collaborative management and restoration of longleaf pine in lowcountry South Carolina. The Nature Conservancy - South Carolina. 2013-2014. $24,375.

Mitchell, R.J., L.K. Kirkman, L.M. Conner, L.L. Smith. Developing dynamic reference models and a decision support framework for southeastern ecosystems: an integrated approach. Strategic Environmental Research and Development Program (U.S. Department of Defense). 2009-2014. $1,351,138.

Mitchell, R.J. Does increased precipitation alter belowground allocation and carbon storage by fine roots and mycorrhiza fungi in pine savannas? Department of Energy National Institute for Climatic Change Research (Duke University). 2008-2012. $375,000.

Mitchell, R.J. Patterns and processes: monitoring and understanding plant diversity in frequently burned longleaf pine landscapes. Strategic Environmental Research and Development Program (U.S. Department of Defense) Subcontract. 2012-2013. $123,946.

Mitchell, R.J. Range-wide meta-analysis of red-cockaded woodpecker foraging habitat suitability. Department of the Army (Curators of the University of Missouri). 2012-2013. $1,708.

Mitchell, R.J., L.R. Boring. Building forest management into Earth system modeling: scaling from stand to continent. National Science Foundation Subcontract. 2013-2015. $170,872.

Smith, L.L. Linkages between upland habitat condition, burrowing vertebrates and snake richness on protected areas in Georgia. Georgia Department of Natural Resources. 2011-2013. $5,810.

Smith, L.L. Gopher tortoise surveys and population evaluation. U.S. Fish and Wildlife Service. 2012-2013. $40,000.

Smith, L.L. Gopher tortoise surveys and population evaluation. Georgia Department of Natural Resources. 2012-2013. $66,637.

Smith, L.L. An evaluation of direct effects of heavy equipment use on gopher tortoise burrows. Georgia Department of Natural Resources. 2013-2014. $3,540.

Visiting Scientists

Dr. Doug Aubrey, Georgia Southern University (2013)
Dr. John Bailey, Oregon State University (2013)
Dr. Alan Covich, University of Georgia (2012)
Dr. Kamal Gandhi, University of Georgia (2013)
Dr. Bob McCleery, University of Florida (2012)
Dr. Madan Oli, University of Florida (2012)
Dr. Greg Starr, University of Alabama (2012)
Dr. Christine Staudhammer, University of Alabama (2012)
Dr. Matt Waters, Valdosta State University (2012, 2013)

Other Collaborating Scientists and Graduate Co-advisors

Ms. Analie Barnett, The Nature Conservancy
Dr. Jim Beasley, Savannah River Ecology Lab
Ms. Connie Best, Pacific Forest Trust
Dr. Michael Binford, University of Florida
Dr. Mark Blackmore, Valdosta State University
Dr. Steven Castleberry, University of Georgia
Dr. Ron Carroll, University of Georgia
Dr. Mike Chamberlain, University of Georgia
Mr. John Cox, Lolly Creek Consultants
Dr. Wendell Cropper, University of Florida
Ms. Carol Denhof, The Longleaf Alliance
Dr. Rob Fletcher, University of Florida
Dr. Chelcy Ford, U.S. Forest Service
Dr. Heather Golden, U.S. Environmental Protection Agency
Dr. Barry Grand, Auburn University
Dr. Craig Guyer, Auburn University
Dr. Jeff Hepinstall-Cymerman, University of Georgia
Mr. Kevin Hiers, Eglin Air Force Base
Dr. Erik Hobbie, University of New Hampshire
Mr. John Holman, Forest Soils Consultant
Dr. Steve Johnson, University of Florida
Dr. Eric Jokela, University of Florida
Dr. Charles Lane, U.S. Environmental Protection Agency
Dr. Michelle Mack, University of Florida
Dr. John Maerz, University of Georgia
Dr. Daniel Markewitz, University of Georgia
Dr. Anna McKee, U.S. Geological Survey
Dr. Karl Miller, University of Georgia
Dr. Emily Moriarty Lemon, Florida State University
Dr. Lisa Muller, University of Tennessee
Dr. Joe Nairn, University of Georgia
Dr. Joe O'Brien, U.S. Forest Service
Dr. Tom Purucker, U.S. Environmental Protection Agency
Dr. Todd Rasmussen, University of Georgia
Mr. Michael Prevost, White Oak Forestry
Mr. John Seymour, Roundstone Native Seed
Mr. Rob Sutter, Enduring Conservation Outcomes Consulting
Dr. Robert Teskey, University of Georgia
Dr. Robin Van Meter, Environmental Protection Agency
Dr. Jeff Walters, Virginia Tech
Dr. Susan Walls, U.S. Geological Survey
Dr. Bob Warren, University of Georgia
Ms. Laurie Wayburn, Pacific Forest Trust
Dr. Matthew Williams, University of Edinburgh
Dr. Mike Wooten, Auburn University
Dr. Michael Yabsley, University of Georgia

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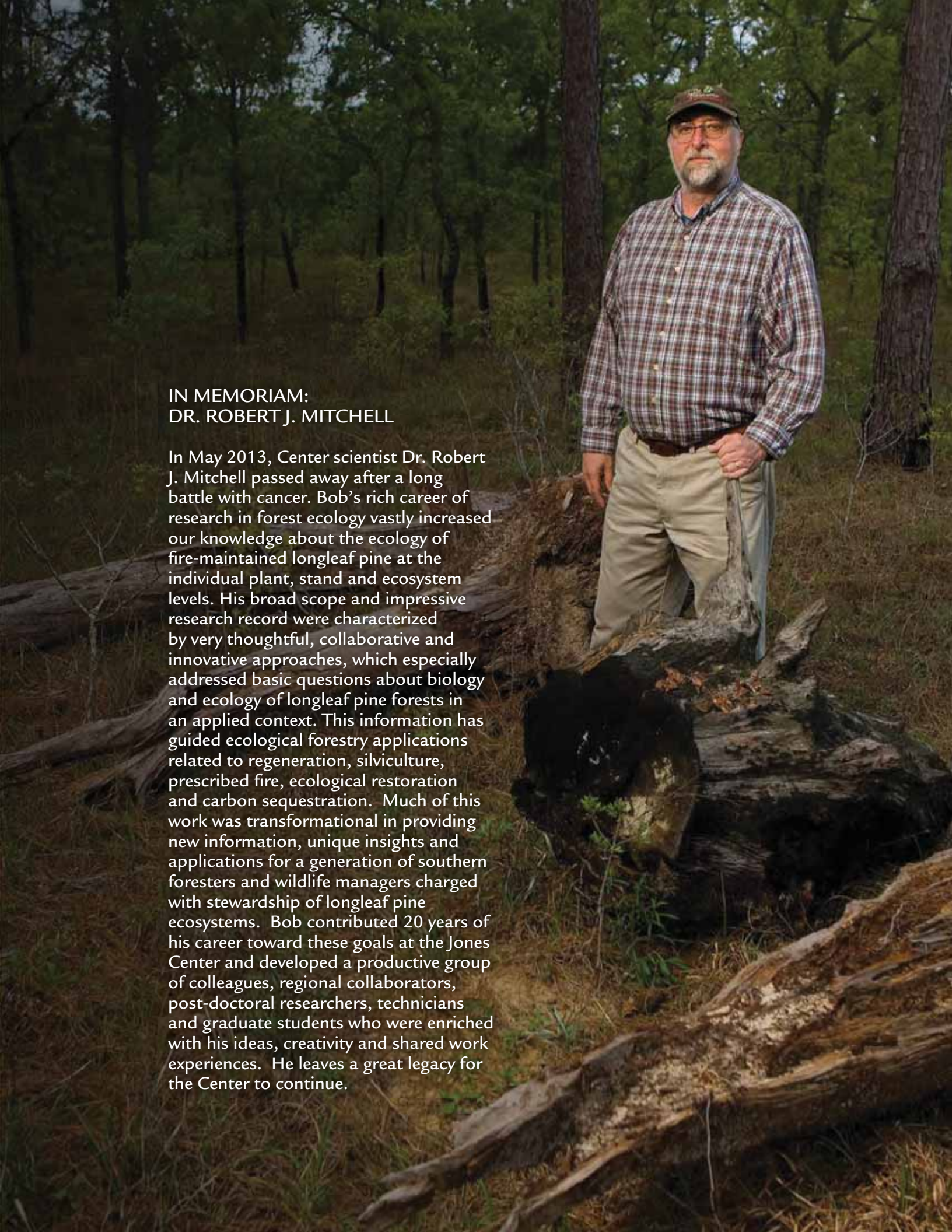

IN MEMORIAM: DR. ROBERT J. MITCHELL

In May 2013, Center scientist Dr. Robert J. Mitchell passed away after a long battle with cancer. Bob's rich career of research in forest ecology vastly increased our knowledge about the ecology of fire-maintained longleaf pine at the individual plant, stand and ecosystem levels. His broad scope and impressive research record were characterized by very thoughtful, collaborative and innovative approaches, which especially addressed basic questions about biology and ecology of longleaf pine forests in an applied context. This information has guided ecological forestry applications related to regeneration, silviculture, prescribed fire, ecological restoration and carbon sequestration. Much of this work was transformational in providing new information, unique insights and applications for a generation of southern foresters and wildlife managers charged with stewardship of longleaf pine ecosystems. Bob contributed 20 years of his career toward these goals at the Jones Center and developed a productive group of colleagues, regional collaborators, post-doctoral researchers, technicians and graduate students who were enriched with his ideas, creativity and shared work experiences. He leaves a great legacy for the Center to continue.

JOSEPH W. JONES
ECOLOGICAL RESEARCH CENTER

at Ichauway

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Biennial Report 2012-2013

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