JOSEPH W. JONES
ECOLOGICAL RESEARCH CENTER

at Ichauway

Biennial Report 2016-2017

Core Staff

Research

Dr. Seth W. Bigelow
Assistant Scientist, Forest Ecology

Dr. Lindsay R. Boring (Retired 2017)
Director, Forest Ecology

Dr. Steven T. Brantley
Assistant Scientist, Ecohydrology

Dr. L. Michael Conner
Scientist, Wildlife Ecology

Dr. Stephen W. Golladay
Associate Scientist, Aquatic Ecology

Dr. L. Katherine Kirkman (Retired 2017)
Scientist, Plant Ecology

Dr. Kier D. Klepzig (2017-present)
Director, Forest Ecology

Dr. Lora L. Smith
Scientist, Herpetology

Education

Kevin McIntyre
Education Coordinator

Mark Melvin
Conservation Management/Education Technician

Conservation

James B. Atkinson, Jr.
Natural Resources Manager

Dr. Steven B. Jack
Conservation Ecologist, Silviculture/Forest Restoration

Brandon Rutledge
Conservation Monitoring Biologist

Scott Smith
Assistant Natural Resources Manager

Support

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GIS & Information Technology Manager

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Central Analytical Lab Technician

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Founding Jones Center Advisory Committee Member
Founding Director and President Emeritus, Cary Institute of Ecosystem Studies

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.

From the Director

This 2016-2017 Biennial Report provides informative updates on our research, education, and conservation programs, sharing the ways we understand the natural ecosystems of the southeastern Coastal Plain, and demonstrate and promote their management and conservation. Our conservation work, informed by our own best available science, serves as a model for natural resource management. Our education and outreach program continues to extend the results of our research and conservation to users, stakeholders, and decision makers. This work, along with key achievements by our staff, students, and collaborators is highlighted within.

The past two years have been very eventful:

- We have honored the retirement of our former Director Lindsay Boring and senior Scientist Kay Kirkman. We are very grateful for the vision and hard work of both of these outstanding scientists and leaders in establishing and growing this great institution.
- In late 2017, we received the first hardcopies of our CRC Press book *Ecological Restoration and Management of Longleaf Pine Forests*; a comprehensive effort to get this book into the hands of those who can use it will follow.
- We have added two new postdoctoral scientists. Dr. Angela Holland is leading the effort to analyze our extensive long-term monitoring data and help us draw the maximum value from it. Dr. Jill Qi has already begun her work addressing our needs around physically based hydrologic modeling. This will help us optimize the Center's unique advantages as a long-term regional leader in water resources research.
- Finally, I have greatly appreciated the very warm welcome I received in starting my tenure as the new Director of the Joseph W. Jones Ecological Research Center. My initial efforts have focused on developing a formal strategic plan, to include implementation plans and accountability measures. I continue to engage with current and prospective partners, to build on the relationships that are key to our success. I have begun to establish my own research program here, hiring a new lead technician and equipping my laboratory with equipment and supplies needed for entomological and microbiological research.

As always, we are grateful for the strong core support of our programs from the Robert W. Woodruff Foundation. This support, along with the visionary work and counsel of the leaders of the Foundation and the Center, allows us to continue to lead the way in conservation, research, and education programs.

Dr. Kier D. Klepzig, Director

Highlights 2016-2017

- The Center reached its restoration goal for the federally endangered red-cockaded woodpecker (RCW) of 30 breeding pairs, with 31 potential breeding groups documented on Ichauway in 2017. Through the dedicated work of our Conservation staff, the overall population has grown from 1 bird in 1999 to our current estimate of approximately 100 birds. Active management for RCW, including artificial nest cavities, translocation, and habitat restoration, has resulted in a secure population that is now dispersing across Ichauway and constructing natural nest cavities.
- Center staff, in collaboration with a diverse group of external cooperators, published a book entitled *Ecological Restoration and Management of Longleaf Pine Forests*. This book, three years in the making, provides a synthesis of much of the Center's work on longleaf pine since its founding. Dr. Kay Kirkman and Dr. Steve Jack served as editors for the book, which was published by CRC Press and is now available from CRC and other book sellers.
- The Center was awarded $482,615 in externally funded research and outreach projects during 2016 and $147,084 during 2017. Of those amounts, $67,823 (2016) and $41,760 (2017) were paid to outside institutions collaborating on the projects. Twelve externally funded projects were continued from awards prior to 2016.
- Two post doctoral scholars have joined the Center staff to advance our work on specific topics. Dr. Jill Qi will be working with our water program on hydrologic modeling in the lower Flint River Basin. Dr. Angela Holland is working on analysis of data from the Center's long-term monitoring program.
- The Center, in collaboration with the Wildland Fire Leadership Council, hosted the third biennial Prescribed Fire and Smoke Management Summit in 2017. This conference brings air quality and prescribed fire agency managers from across the South together with federal air quality regulators to foster communication and collaboration.
- The Center continued to engage in regional and national collaborative conservation initiatives. Kevin McIntyre completed a three-year term on the leadership team of the Longleaf Partnership Council, serving as 2016 Past Chair. This is a regional initiative to implement a range-wide conservation plan for longleaf pine, in which we have been involved for several years. Mark Melvin served as 2016 Chair of the Georgia Prescribed Fire Council, of which the Center was a founding member, and also serves as Chair of the Coalition of Prescribed Fire Councils.
- Approximately 1,200 natural resource professionals, university students, and other visitors participated in Jones Center education and outreach activities during 2016-2017 as part of 56 educational programs that included field tours, short courses, workshops, and professional conferences. In addition, approximately 900 visitors from the region attended our 2017 Open House event.
- Twenty-seven graduate students from ten universities conducted their research at Ichauway during 2016-2017 as part of our cooperative graduate student program. As of 2017, 110 individuals have completed advanced degrees at the Jones Center under co-advisement with our cooperators.
- Research staff hosted six visiting scientists from five universities during one- to two-week residencies at Ichauway during 2016-2017 and collaborated with 82 other scientists and cooperators.
- Research staff published 29 articles in peer-reviewed journals in 2016 and 34 in 2017. Center staff also produced 4 technology transfer and other publications in 2016 and 1 in 2017. There are an additional 9 in-press publications for 2017.

Overview of Research, Education, & 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 almost 18,000 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 95.

Research

Research programs at the Jones Center focus on two broad themes: the ecology, restoration, and management of the longleaf pine ecosystem and its associated wildlife; 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 located in the heart of the historic range of longleaf pine. Longleaf pine ecosystems are among the rarest and most biologically diverse in North America and are 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 nation's most prolific and heavily used aquifers, 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 several long-term projects

that incorporate elements of terrestrial, aquatic, and wildlife research in an interdisciplinary approach. Research collaborations extend beyond the Center and include colleagues at academic institutions and conservation organizations across the Southeast. Our work incorporates new technologies such as eddy flux towers 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 important natural resource management questions so that policymakers and land managers can utilize science to support the development of sound resource management plans and policies.

Conservation

The Center's conservation program is responsible for the stewardship and management of the Ichauway land base. It also serves as a technical information resource for Center staff and visitors as well as a demonstration 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 further research.

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 species of concern associated with the longleaf pine ecosystem such as the red-cockaded woodpecker and gopher tortoise.

Education & Outreach

Information from our scientific research, as well as our conservation and land management programs, is 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 110 students from regional research universities have completed advanced degrees through our cooperative graduate education program, and 18 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. Our graduate student alumni provide a unique legacy that continues to influence the management and conservation of natural resources through the course of these individuals' careers.

RESEARCH

Forests

Longleaf pine ecosystems were once one of the most extensive forest types in North America, encompassing more than 92 million acres across the Southeast. Reduced to less than 5% of their historic extent, longleaf pine and its associated wildlife communities are now a priority for conservation efforts across the region. In addition to habitat for both game and nongame wildlife, longleaf pine forests provide a range of other values such as biological diversity, high-quality timber products, societal goods and services (e.g., water yield and carbon storage), recreational opportunities, and aesthetic values. Ichauway – with almost 18,000 acres of century-old longleaf pine forests, a large portion of which harbors undisturbed native ground cover – provides an unparalleled opportunity to better understand these important ecosystems. Compared to other species of southern pine, the ecology and management of longleaf pine has, until recently, received less attention from researchers because it was not a priority species for commercial purposes. Since the founding of the Jones Center, the ecology, management, and restoration of longleaf pine has been a central focus of our programs, with several flagship long-term projects in place.

Dynamics of Frequent-Fire Longleaf Pine Ecosystems

Principal Investigators: L.R. Boring, S.T. Brantley, L.M. Conner, and L.K. Kirkman

This work is primarily focused on the basic ecology of longleaf pine ecosystems and is our oldest long-term research project at the Center. The project initially explored fundamental patterns and processes of topics that were poorly understood for native longleaf forests, such as productivity and biodiversity. Subsequent studies investigated the effects of complex feedbacks between soil moisture, water and nutrient availability, and fire regime. In 2016-2017, several of the original studies associated with this project were completed. Our work on ecosystem productivity and biodiversity across a soil moisture gradient concluded, and the results of this work were published in the journal *Ecology*. Findings from these studies have been central to our current understanding of longleaf ecosystem structure and function, and have informed the growing interest in longleaf restoration and management. Work from this project related to fire exclusion and subsequent reintroduction across a soil moisture gradient will continue, and will serve as a foundation for new work on forest health and forest water use.

Our carbon balance studies utilizing eddy flux towers continued in 2016-2017, in collaboration with cooperators from the University of Alabama. Results of the first seven years of this work were published and represent an important contribution to the understanding of

carbon dynamics in longleaf pine forests. This ongoing work will help refine our understanding of carbon cycling by building a more rigorous dataset that incorporates variation over longer periods of time.

Work continued on our collaborative project with the National Ecological Observatory Network (NEON) program of the National Science Foundation. The Jones Center has both a terrestrial and aquatic component to the onsite NEON installation. Although the instrument tower for the terrestrial component of the installation has been in service since 2013, the aquatic station was constructed in 2017 and will become fully operational in 2018. Portions of Ichauway were also surveyed using LIDAR technology from the NEON Aerial Observation Platform, with overflights in both 2016 and 2017.

Ecological Forestry and Restoration

Principal Investigators: S.B. Jack, L.K. Kirkman, R.K. McIntyre, L.L. Smith, L.M. Conner, S.W. Bigelow, and A.M. Holland

This long-term project addresses several aspects of ecologically based management and restoration of longleaf pine forests. Over the last two decades, interest in the restoration and management of longleaf pine ecosystems has increased substantially among both public and private land managers. America's Longleaf Restoration Initiative, a diverse coalition of public agencies, nongovernmental conservation organizations, and private sector stakeholders, has set a goal of doubling the acreage of longleaf pine across the Southeast, as well as improving the stewardship of existing longleaf pine. Although much of the current focus of longleaf restoration is on tree establishment on new acres, there is growing recognition that meaningful restoration of longleaf pine ecosystems and their associated values will require a long-term, holistic approach that incorporates all elements of the ecosystem. This comprehensive perspective highlights the need for increased understanding and documentation of techniques for restoration and management of these complex ecosystems.

The extensive longleaf forests found on Ichauway, ranging from mature second-growth forest to young restoration plantings in various stages of development, provide a unique opportunity to study questions related

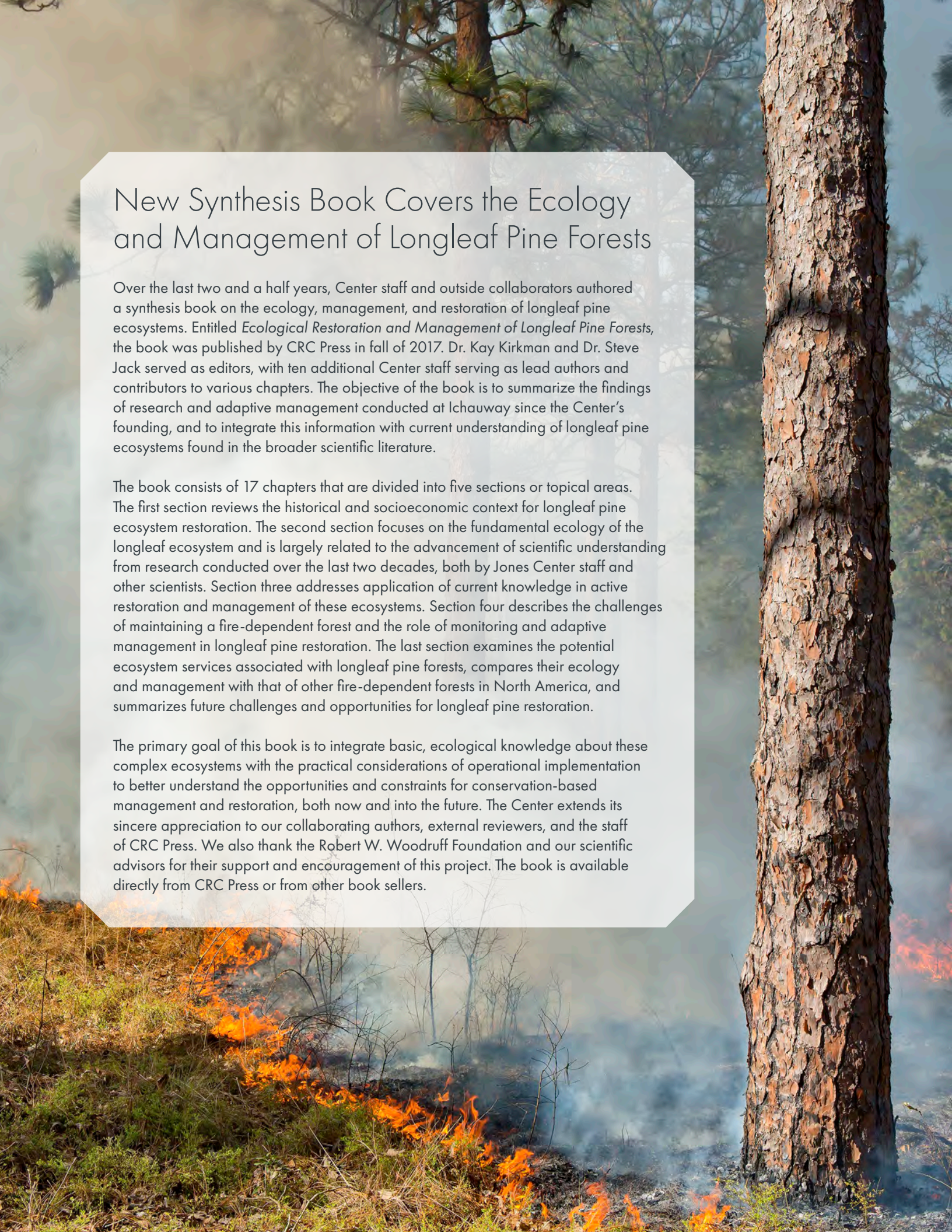
to application of a holistic approach to active management. A substantial body of research from the Center has increased the basic knowledge of how these forests function, and the exemplary management of longleaf ecosystems on Ichauway has demonstrated an applied understanding of these ecosystems. The goal for this project is to bridge these two perspectives to meet the challenge of providing sound management information supported by a strong scientific understanding of ecological process and function. Two focal areas of this long-term project are: 1) management of existing longleaf forests for multiple values using an ecological forestry approach and 2) management practices to restore recently established longleaf plantations to multi-aged forests with diverse plant and animal communities.

Ecological forestry is an approach to forest management that uses patterns of natural disturbance and demographics as a guide to silvicultural prescriptions, stand development, and desired forest structure. Our ecological forestry research in natural, mature longleaf forests addresses the following questions: 1) How do natural disturbances in longleaf pine ecosystems shape forest structure and how do managed disturbances, such as harvest, compare to those patterns? 2) What are the relationships between patterns of overstory retention, prescribed fire behavior, and forest demographics? and 3) What are the dynamics of recovery of the system, particularly the ground cover plant community, after harvesting disturbance? The basic framework for the project is a series of three different harvest treatments: 1) single-tree selection, 2) group selection that retains select trees within group openings, and 3) group selection.

Because of the long-term nature of this project, results to date are preliminary, but analyses in 2016-2017 suggest some trends. A study comparing different intensities of equipment traffic during timber harvest suggests that major impacts at any one location occur after only a few passes of logging equipment. However, the sandy soils at Ichauway seem relatively resilient when looking at long-term effects of compaction. The heavy-traffic treatment (high numbers of passes) showed the most immediate impact on ground cover, mostly due to soil scarification. Another component of this project is examining the spacing and density of overstory trees and the relationship of those patterns to fuels and fire intensity to determine how those factors influence the resprouting of small hardwood stems. Preliminary results suggest that hardwood sprouts were most effectively controlled by overstory patterns that result from the single-tree selection treatment, with lower levels of control in group selection with reserves, and group selection treatments, in that order.

The second general area of emphasis for this project is longleaf ecosystem restoration. Across the range of longleaf pine, a variety of site conditions and starting points exist from which to begin the restoration process. This long-term experiment is intended to address several questions including: 1) How do management actions affect the direction and rate of changes in stand and landscape conditions and how do these trajectories vary at different scales? 2) What is the relative effect of past management practices, compared to the direct effect of present actions, on future stand and landscape condition? and 3) How do wildlife communities respond to changing conditions at different scales, and how well can we "direct" these responses? We are examining these questions on different sites and at different stages of forest stand development, including recently established plantations on former agricultural lands, cutover forest sites, intermediate-aged stands that were recently thinned for the first time, and mature stands of offsite pine in which longleaf seedlings have been underplanted. In addition to questions related to forest structure, we are looking at dynamics of herbaceous ground cover, wildlife responses, and soil characteristics related to restoration.

In 2016-2017, we completed a reciprocal transplant experiment in which we compared six species of ground cover plants grown with seeds sourced from five distinct ecoregions of the Southeast Coastal Plain (SECP) as defined by The Nature Conservancy. At four of the source locations, seed from all five sources as well as seeds from outside the historic range of longleaf pine, were planted to assess differences in phenology, morphology, and genetic makeup. The goal of this project was to better understand the distance that plant material can be moved from its source location and still be ecologically appropriate for ground cover restoration. Results varied by species, but general trends suggest that native SECP plant material can be moved within terrestrial ecoregion boundaries, and these seed sources are far preferable to those from outside the range of the longleaf pine ecosystem.



New Synthesis Book Covers the Ecology and Management of Longleaf Pine Forests

Over the last two and a half years, Center staff and outside collaborators authored a synthesis book on the ecology, management, and restoration of longleaf pine ecosystems. Entitled *Ecological Restoration and Management of Longleaf Pine Forests,* the book was published by CRC Press in fall of 2017. Dr. Kay Kirkman and Dr. Steve Jack served as editors, with ten additional Center staff serving as lead authors and contributors to various chapters. The objective of the book is to summarize the findings of research and adaptive management conducted at Ichauway since the Center's founding, and to integrate this information with current understanding of longleaf pine ecosystems found in the broader scientific literature.

The book consists of 17 chapters that are divided into five sections or topical areas. The first section reviews the historical and socioeconomic context for longleaf pine ecosystem restoration. The second section focuses on the fundamental ecology of the longleaf ecosystem and is largely related to the advancement of scientific understanding from research conducted over the last two decades, both by Jones Center staff and other scientists. Section three addresses application of current knowledge in active restoration and management of these ecosystems. Section four describes the challenges of maintaining a fire-dependent forest and the role of monitoring and adaptive management in longleaf pine restoration. The last section examines the potential ecosystem services associated with longleaf pine forests, compares their ecology and management with that of other fire-dependent forests in North America, and summarizes future challenges and opportunities for longleaf pine restoration.

The primary goal of this book is to integrate basic, ecological knowledge about these complex ecosystems with the practical considerations of operational implementation to better understand the opportunities and constraints for conservation-based management and restoration, both now and into the future. The Center extends its sincere appreciation to our collaborating authors, external reviewers, and the staff of CRC Press. We also thank the Robert W. Woodruff Foundation and our scientific advisors for their support and encouragement of this project. The book is available directly from CRC Press or from other book sellers.

A primary motivation for many interested in longleaf pine restoration is wildlife habitat enhancement. Significant acreages of old agricultural fields on Ichauway were planted in longleaf pine throughout the 1990s and are now undergoing initial thinnings. One component of the restoration project is measuring wildlife response to treatments such as thinning, burning, and ground cover enhancement. Initial data from monitoring of breeding birds are counterintuitive; early surveys suggest that species diversity in recently thinned stands is actually lower than in either young or intermediate-aged unthinned longleaf pine plantations. More definitive results will emerge as these thinned stands develop structure more characteristic of mature longleaf forests.

A more recent component of the Ecological Forestry and Restoration project is the establishment of a set of experimental plots as part of the Adaptive Silviculture for Climate Change project, a national network of research sites. This project is intended to test the effect of different silvicultural treatments on the ability of forests to adapt to changing climatic conditions. In the Southeast, most models predict more severe and frequent droughts, more periods of overabundant rainfall, and stress from higher summer temperatures. On Ichauway, our treatment harvests will vary the stocking and composition of longleaf pine and oak species, and measure variables related to forest health, water use, utilization by wildlife, and ground cover plant community composition. In 2016-2017, a workshop was held to solicit stakeholder input, prescriptions were developed for different treatments, plots surveyed, pretreatment data collected, and harvests planned to implement the treatments.

Ecosystem Services and Forest Health

Principal Investigators: L.R. Boring, S.T. Brantley, and J. Qi

There is increasing recognition of the role that healthy ecosystems play in providing societal goods and services. One of the foremost examples of this is the function that forests serve in maintaining water quantity and quality. Our long-term project examining ecosystem services and forest health focuses on ecohydrology, the study of interactions between water and ecosystems. The general themes of this project examine how water use is related to forest structure and how forests respond to water stress such as drought.

One goal of this project is to build and refine stand-level water budgets to better understand how the forests on Ichauway utilize water, and thus determine how specific forest management actions can affect water budgets. This is done by measuring the movement of water through individual tree stems using sap flux data and scaling that up to the stand level. This approach also presents opportunities to study other questions related to forests and water. In fall of 2016, most of Southwest Georgia went more than 70 days without measurable rainfall, presenting a unique opportunity to look at how trees respond to drought stress. Another example employing these techniques is a project that allowed us to assess changes in water use when mesic oaks were removed from mixed longleaf/oak stands. Removal of these mesic oak species, while leaving upland and xeric oaks for wildlife, is a common tool employed in restoration of longleaf-dominated stands. Analysis of data from our long-term monitoring program, along with data on water use of different tree species, showed that stand-level water use declined substantially as a result of hardwood removal. These results suggest that some level of hardwood removal may help to reduce water use, and thus increase water yield, when that is a management goal.

A second component of this project addresses questions related to forest health, with a particular emphasis on how insect communities respond to forest management, especially prescribed fire. One project is examining the response of insects, particularly Ips beetles, both to long-term fire regimes (i.e., biennial prescribed fire, fire suppression, and fire reintroduction for restoration) as well as short-term tree-defense responses to individual fires. We are also addressing questions related to the intersection of management and tree physiology in fire-suppressed stands of longleaf pine, focusing on the response of trees to increased levels of competition for water, light, and nutrients that occurs when fires are absent.

Water

The Center's water-related research has two primary topical areas, water resources and wetlands. Our water resources work focuses on the Apalachicola-Chattahoochee-Flint (ACF) river system, particularly the lower Flint River Basin. Our work with wetlands studies both the hydrological and biological aspects of these unique ecosystems.

Wetlands

Principal Investigators: L.L. Smith, S.W. Golladay, S.T. Brantley, and L.K. Kirkman

The many wetlands scattered across Ichauway are a relatively minor element of the landscape, comprising only about three percent of the property's acreage. However, the importance of these unique ecosystems is disproportionate to their extent. On Ichauway, 27% of our vascular plant species are found in and around wetlands, and they provide critical habitat for several amphibian species of conservation concern as well as other types of wildlife. Wetland complexes across the range of the longleaf pine ecosystem share similar attributes and have been under-valued for their vital role in maintaining regional biodiversity.

Known more broadly as geographically isolated wetlands (GIWs), they share the common characteristic of being completely surrounded by uplands and lacking obvious connections to larger nearby aquatic systems. In addition to harboring biodiversity, they provide many of the same services and functions as other types of wetlands and headwater streams, such as helping to regulate the export of water and pollutants from their watersheds to downstream waters. The apparent physical separation of GIWs from stream networks has led to a gap in their regulatory protection under the U.S. Clean Water Act. Cumulative impacts to GIWs due to the large-scale changes in timing, magnitude, and flow of water, as well as nutrients and organisms, are significant, but poorly understood and quantified. This long-term research project has explored the functional role of wetlands in the region, specifically: 1) linkages of isolated wetlands to the regional watershed and jurisdictional waters, 2) the relationship of wetland condition to ecosystem services as well as linkages to human health and well-being, and 3) the role of isolated wetlands as habitat for rare and endemic species. Information from this research can help inform management and policy to protect and enhance wetland functions and watershed integrity.

In 2016, Center staff were among a group of scientists that published a paper on GIWs in the Proceedings of the National Academy of Sciences. This publication resulted from a collaboration among wetland scientists from across the U.S. that convened at Ichauway for a workshop several years ago. The group has continued to work together, and this publication represents a synthesis of current understanding of GIW science, particularly as it relates to connectivity and landscape

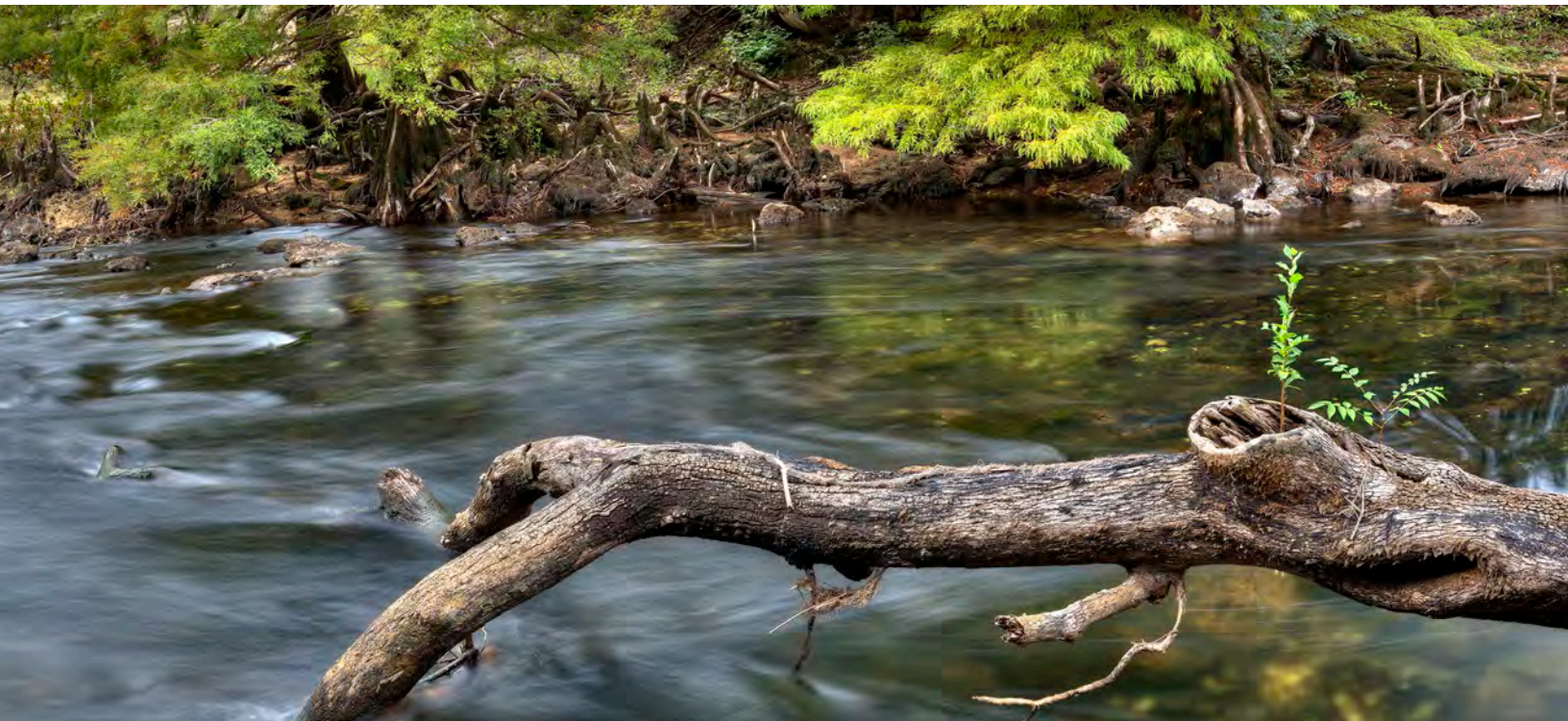
function. Center scientists also continue to study the function and connectivity of GIWs through research on Ichauway. A new initiative seeks to better understand the role of wetlands in the movement and storage of water in the larger watershed. We have instrumented a number of wetlands on Ichauway to inform a landscape hydrologic budget and a new collaboration with Louisiana State University is using ground-penetrating radar to better understand wetland connectivity to the Floridan aquifer. This technology will enable us to map the structure of the limestone bedrock found beneath the soils and identify conduits in our karst landscape that might connect GIWs and the aquifer.

Water Resources

Principal Investigators: S.W. Golladay, S.T. Brantley, and J. Qi.

The ACF river system begins in the mountains of northeastern Georgia and drains over 20,000 square miles of Georgia, Alabama, and Florida before discharging into the Gulf of Mexico in the Florida Panhandle. The ACF Basin serves as a case study of competing demands for water in the Southeast; it constitutes the primary water supply for Atlanta, the largest metropolitan area in the Southeast, as well as several downstream municipalities. The Basin also serves the needs of one of the largest areas of irrigated agriculture in the South, and supplies substantial freshwater flow into the eastern Gulf of Mexico, supporting a near-shore marine fishery that is an important part of the regional economy. The Center's water resources long-term research project seeks to better understand the relationship between human land use, water withdrawals, climate change, and the health of streams, rivers, and aquifers in the ACF Basin. Reliable supplies of fresh water are essential for human and environmental health and well-being; our work provides a scientific foundation that can be used for informed decisions about water resource management and policy.

Although the Center has been engaged throughout the ACF Basin over the years, the bulk of our ongoing research is focused on assessing the effect of water withdrawals and land use on water resources of the lower Flint River Basin (FRB). Population shifts, reforestation, and intensification of irrigated agriculture in southwestern Georgia have led to increased water demands. These increased demands have stressed regional water resources, particularly during droughts, and have potentially had negative impacts on aquatic biota and ecosystem services. Our research addresses three fundamental questions associated with human activity in the lower FRB: 1) How does human land use and water use influence water quality and quantity in the lower FRB? 2) How does temporal

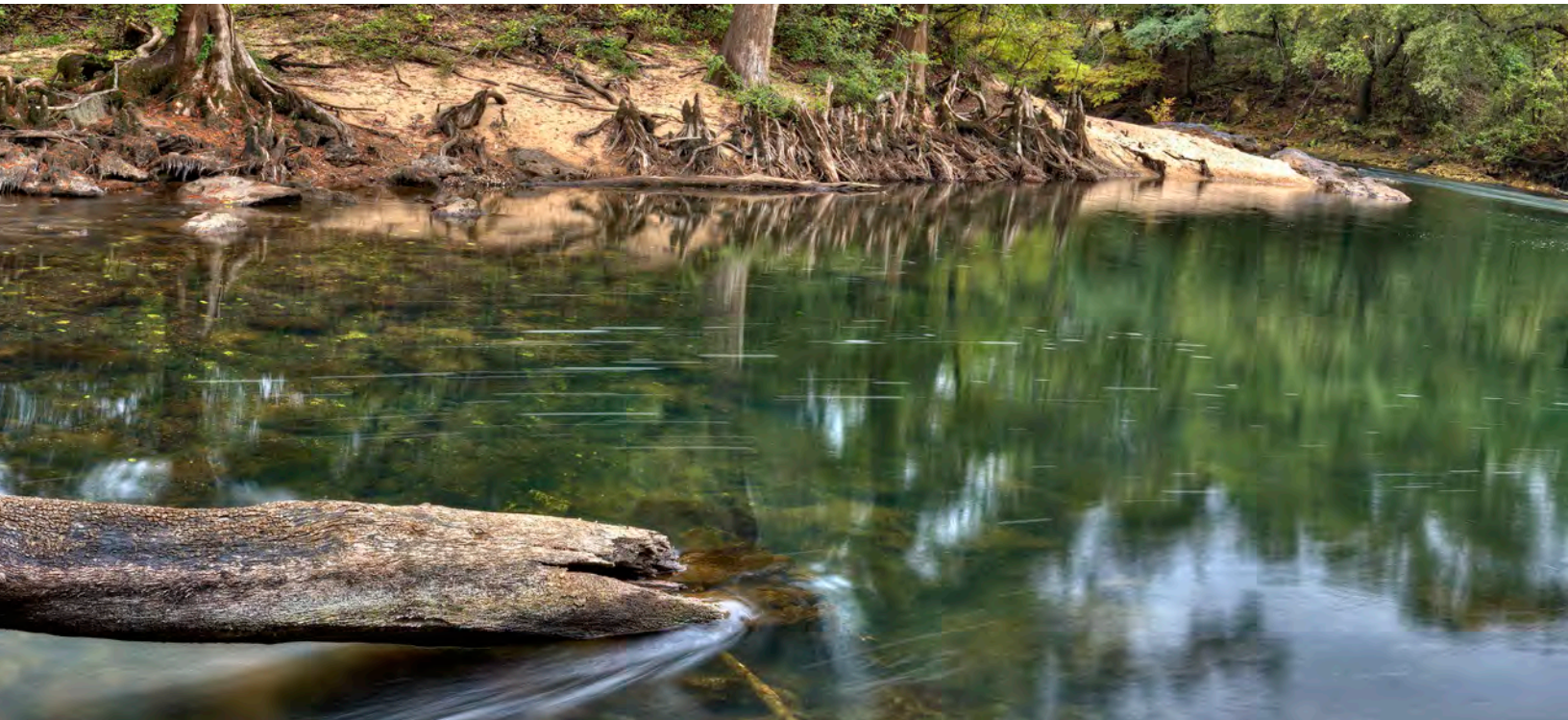


variation in water availability affect aquatic ecosystems of the lower FRB? and 3) What management actions are necessary to provide for human needs while maintaining ecosystem services?

In 2016-2017, the Center began a new research initiative that seeks to understand how altered flow regimes relate to changes in land cover and how alternatives for future watershed management might contribute to flow restoration. A time-series of land cover data was used along with published values for evapotranspiration (ET), the combined consumption of water by plants and direct evaporation, to estimate changes in ET in the Ichawaynochaway watershed since 1948. These estimates were validated using historical climate and streamflow records, which show significant reductions in water yield beginning in 1981. To compare future scenarios of land cover and water yield, the Soil Water Assessment Tool (SWAT), a watershed simulation computer model, was calibrated for the Ichawaynochaway Creek watershed. Preliminary SWAT simulations suggest small increases (<20%) in monthly stream runoff from increases in forest cover and changes in forest type, with the greatest gains obtained from longleaf pine restoration. A post-doctoral researcher has joined the Center staff to add expertise in modeling the effects of land cover change on streamflow, as well as other water-related research.

Our work on Lake Seminole continues, with several projects completed in 2016-2017. Hydrilla, an invasive aquatic plant, has become established over much of the lake and is considered problematic by many stakeholders. A Ph.D. graduate student project showed that normal turbidity from growing season flow pulses in the Chattahoochee and Flint Rivers could reduce submerged aquatic vegetation growth in the lake by limiting light availability. This research suggests that manipulating the timing and magnitude of releases from upriver impoundments and reducing growing season withdrawals of water in the lower Flint may be an effective management tool for invasive aquatic plants in Lake Seminole. Other studies looking at the broader community of invasive species in the lake validated preliminary findings that a novel combination of invasive vegetation and invasive mollusks is reducing concentrations of nutrients and contaminants from upstream runoff and improving the quality of water discharged into the Apalachicola River from the Lake Seminole dam.

In 2016, Center staff organized a workshop entitled Hydrologic Connectivity: Bridging Terrestrial and Aquatic Ecosystems in a Karst Landscape. The workshop shaped a vision for future priorities for regional water resources research with well-defined applications to management and conservation challenges. Participants included Jones Center staff, collaborators from universities, representatives of state and regional agencies, and stakeholder partners. The workshop report clearly identified a suite of activities that uniquely complement the Center's mission.



Wildlife

The Ichauway landscape provides a unique setting for wildlife research. The extensive acreage of longleaf pine ranges from mature woodlands with native ground cover to recently planted stands of young trees in different stages along a restoration pathway. Undisturbed isolated wetlands, agricultural fields managed for wildlife, and riparian systems add to the diversity of the property. This wide range of conditions allow Jones Center scientists the opportunity to study how different species of wildlife interact with the landscape and with each other. The Center's wildlife research program is primarily focused on two broadly overlapping topics: predator-prey relationships and wildlife-habitat interactions.

Predation

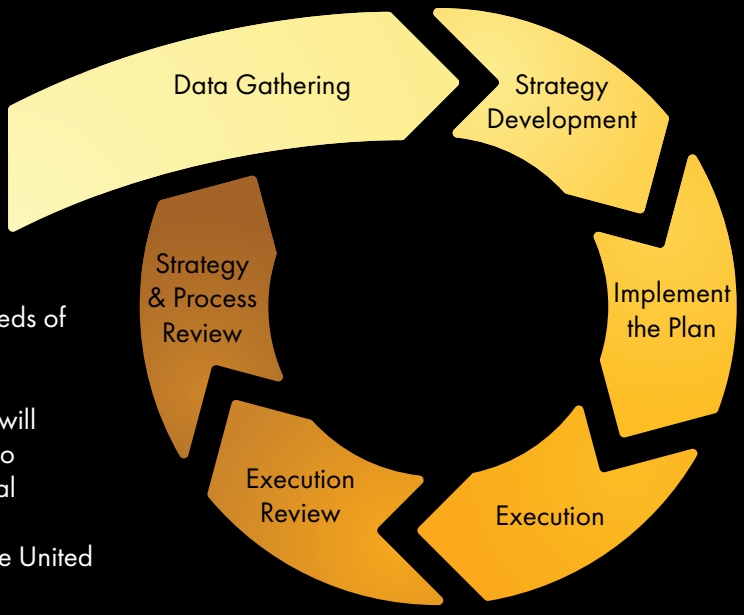
Principal Investigators: L.M. Conner, L.L. Smith, and L.K. Kirkman

The predator community found in the southeastern U.S. today has been altered by a number of factors. These factors include the elimination of large predators (e.g., cougars and red wolves), the reduction of sport hunting and trapping of medium-sized mammalian predators (mesopredators), as well as changes in the landscape (e.g., fragmentation) that favor certain mesopredators and concentrate prey, rendering them more susceptible to predation. Much of the existing research on predator-prey interactions in the Southeast has been driven by game management considerations and has been focused at the species level rather than at the community level. In addition, little research has been of sufficient duration to fully understand the long-term effects of predator management efforts.

The predator exclusion long-term research project, in place for more than 14 years, is now the longest-running study of its kind in the U.S. and perhaps the world. This experiment excludes mesopredators from four 100-acre fenced exclosures and is designed to measure the impacts of mesopredators on selected prey (avian ground and shrub nests, gopher tortoise nests and hatchlings, small mammals) and on alternative predator species (snakes, birds of prey). Early findings of the study revealed that one of the greatest impacts from mammalian predators was on nests of the gopher tortoise, a candidate for listing under the Endangered Species Act (ESA). This project also demonstrated that red imported fire ants were a primary predator of shrub-nesting birds. This led to additional work to explore community-level impacts of fire ants on small mammals and herpetofauna, with several papers on this topic published in 2016-2017.

These publications further documented negative impacts of fire ants on herpetofauna, including fence lizards and gopher tortoise hatchlings. Fire ants were shown to be attracted to soil disturbance, such as the "apron" of sand resulting from the excavation of a gopher tortoise burrow. A majority of gopher tortoise nests are found on this apron, increasing rates of predation on hatchlings from fire ants.

Strategic Planning



Strategic planning - defining our purpose and pursuits and the methods for achieving them. We are, for the first time in our history, going through a formal process to develop a strategic plan for the Center, to meet current and future needs of our stakeholders.

We will keep doing what we do excellently. We will not stray from our central mission 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.

In fall 2017, we began the process using the model depicted above, and worked to refine our mission, values, goals, and objectives through the end of the year. Implementation and execution processes will be defined by early 2018.

Our vision: We are an effective, impactful, trusted broker of natural resource knowledge.

Where we change it will be in the service of three goals that push us forward. We will: 1) ensure that all who come in contact with Ichauway will appreciate the unique features that define Ichauway, our land, knowledge, and people, so that they become inspired advocates for our conservation ethic and commitment to learning, 2) focus everything we do on increased impact and influence with decision makers, experts, and relevant consumers to maximize the impact of our learning on the land, and 3) capitalize on the resources and culture of Ichauway to draw people in and increase our role as a crossroads for thinkers and practitioners.

The Joseph W. Jones Ecological Research Center at Ichauway has a storied, impressive, and recognized history of achievement and impact. To paraphrase *Field of Dreams*, we built it and they have come. In our next phase, we will build our impact, and more will come. Attracted by our zeal, energized by our insights, inspired by our commitment to our heritage, excellence, and calling, they will come and be changed by it. And that change will go with them as they address the challenges we all face.

Management practices that provide within-stand openings in longleaf forests, such as frequent prescribed fire and maintaining heterogeneous patterns of overstory stocking, are important for providing alternate nest sites to burrow aprons. These studies also showed that fire ant impacts on small mammals were significant, with fire ant impacts on cotton rats equal to the impacts of all other predators combined. In addition to direct impacts, cotton rats exposed to fire ants had significantly higher levels of stress hormones compared to those that were not. This suggests that indirect impacts of fire ants can negatively affect physiological processes such as reproduction and growth in small mammals, which are a critical component of southeastern food webs.

Several papers from our research on the impacts of coyote predation were published in 2016-2017. Coyote populations have increased substantially in the Southeast over the last decade compared to historic levels, with coyotes now essentially occupying the niche of an upper-level predator. Our research has found negative, although indirect, impacts of coyote on white-tailed deer reproduction, with decreasing fecundity of deer associated with higher coyote populations. This work also documented direct effects of coyote predation on deer. A related project showed that gray foxes preferentially utilize habitat close to human habitation, presumably due to coyotes' avoidance of these areas. We are currently conducting research on interactions between Florida panthers and deer in South Florida through a collaborative project with the University of Georgia, Virginia Tech, Florida Fish and Wildlife Commission, and the U.S. Fish and Wildlife Service. Similar dynamics of predation pressure, reproductive behavior, and risk avoidance are being studied in this ongoing project.

Wildlife-Habitat Relationships

Principal Investigators: L.M. Conner and L.L. Smith

The Center's other primary area of wildlife research is focused on how species respond to habitat structure in a longleaf pine-dominated landscape as well as responses to manipulation of that structure through active management. We work at a range of scales, from stand level to landscapes, with particular focus on species of conservation concern and management interest. Current research in this area is largely devoted to understanding wildlife-vegetation associations, but at a finer scale than in the past using new remote sensing technology, cutting-edge animal tracking technology, and unmanned aerial vehicles. This information is used in developing models to predict habitat suitability for various species of interest, and documenting the response of wildlife communities to various restoration activities.

With a long history of working with the gopher tortoise, the Center is regarded as one of the leading authorities on this species in the Southeast. Center scientists and students continue to conduct research on this species as well as contribute to the region-wide conservation efforts for the gopher tortoise. In 2016-2017, our wildlife program staff, using refined methodology developed at the Center, completed a contract to conduct surveys to assess gopher tortoise populations for the Florida Fish and Wildlife Commission. A periodic site-wide survey of gopher tortoises on Ichauway was completed and showed an ongoing upward trend for our population, suggesting that our land management continues to benefit this species of conservation concern.

The Center also worked with the Georgia Department of Natural Resources to assess the status of aquatic turtles in Southwest Georgia for the U.S. Fish and Wildlife Service. This project focused on two species, the alligator snapping turtle and the Barbour's map turtle, both of which have been proposed for listing under the ESA. This work showed that the alligator snapping turtle population in the Flint River has not yet recovered from past commercial harvest despite 25 years of protection. However, Barbour's map turtle was one of the most frequently documented species in the area's creeks and rivers, and populations appear to be healthy.

The Center's wildlife program continues to explore scientific questions related to wildlife populations in longleaf pine ecosystems while also addressing applied 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.

Conservation

The Jones Center's conservation program is responsible for the stewardship and management of Ichauway. This work builds on the legacy of Robert W. Woodruff's tenure, which dates back to the late 1920s when he began to acquire the properties that comprise Ichauway today. The extensive acreage of century-old, second-growth longleaf pine forest, much of which contains undisturbed native ground cover, is widely recognized as one of the best remaining examples of the longleaf pine ecosystem. Along with the many natural features of Ichauway, the excellent condition of the property serves as an on-the-ground demonstration of exemplary management of the longleaf pine ecosystem.

Our conservation staff includes natural resource professionals with expertise in land management, prescribed fire, wildlife biology, and silviculture. This program is responsible for all aspects of managing Ichauway: habitat management for both game and nongame species; conservation of endangered, threatened, and at-risk species; our long-term monitoring program; and control of invasive, non-native plants and animals. Conservation staff conduct many ongoing activities, such as operational prescribed fire, maintenance of the property's roads and fire breaks, and targeted efforts to restore or improve forest or wildlife habitat based on sound science. In addition to stewarding the natural resources of Ichauway, conservation staff make significant contributions to the Center's research and education programs.

Notable Activities

Longleaf pine ecosystems and the flora and fauna that inhabit them depend on a regime of frequent, low-intensity fire. These fires were historically ignited by lightning strikes and Native Americans. Today, prescribed fire is the surrogate for this ecological process and is the cornerstone of our land management program at Ichauway, providing habitat values and a reduced risk of wildfire. In 2016, Center staff burned approximately 13,091 acres, and in 2017 approximately 12,871 acres were burned for management, research, and education objectives. The long history of prescribed fire on Ichauway demonstrates the critical role of fire in maintaining the values of longleaf forests and continues to play a key role in our programs.

2017 tornado damage

On January 2, 2017, an EF1 tornado touched down just to the west of Ichauway and cut a swath starting in the southwest corner of the property and moving toward the northeast. Damage was highly variable along the storm track. One area of approximately 150 acres had almost complete blowdown, with patchy impacts over a much larger section as the tornado began to lift up and touch down intermittently as it continued its trek to the northeast. Conservation and Maintenance staff immediately went to work assessing the damage and clearing roads for travel. Fortunately, we were able to get a logging crew in quickly to salvage some of the less-damaged timber; however, the tremendous amount of debris and non-salvageable trees created a months-long workload to clean up the affected areas. A few of the more isolated patches of damage and single trees were salvaged by our staff and processed using our small onsite sawmill for future use in projects on Ichauway. The tornado damage also presented a research opportunity, with data collected both from areas that were cleaned up and from areas where debris was left for comparison going forward.

Many of the earliest longleaf pine restoration plantings on former agricultural fields on Ichauway were thinned for the first time in 2014. After a round of prescribed fire and cleanup of logging debris, native warm season grass

seed and legumes were planted in these stands to move them along a restoration pathway towards a multi-aged forest structure with grass-dominated ground cover.

Over the years, the Center has selectively removed semi-deciduous oaks from stands that would otherwise be dominated by longleaf pine. These species of oak suppress prescribed fire and provide habitat for egg predators such as raccoon, negatively affecting the reproductive success of many species of birds as well as the gopher tortoise. Conservation staff continued this restoration practice in 2016-2017, treating approximately 200 acres with in-house equipment. These operations reestablish the dominance of longleaf pine and quickly move the stand toward the characteristic open structure of healthy longleaf pine forests.

Conservation staff contributed to the 2017 implementation of the Adaptive Silviculture for Climate Change project, assisting with plot layout, collection of pretreatment data, and marking of trees for harvest. In addition to pine removals, harvest prescriptions in the treatment plots included selective removal of different hardwood species to manipulate their composition and density. While the pines were sold and harvested by a contract logging crew, the hardwoods were removed by Conservation crews. In addition to having no commercial market for the hardwoods that were removed, utilizing our equipment and staff helps to minimize impacts and provides the higher level of precision required by the research project. An operational, commercial pine harvest was also conducted in the areas adjacent to the research plots, using the same contracted logging crews, to meet ongoing management objectives in the affected burn units.

Red-cockaded Woodpeckers

The red cockaded woodpecker (RCW) population on Ichauway reached a milestone in 2017, with 31 potential breeding groups (PBGs) documented on the property. The federal recovery plan for the species, listed as endangered, suggests that a population of 30 or more PBGs is more likely to address concerns regarding demographic or environmental variability. In addition to reaching this goal, this year we successfully fledged 36 young birds, and we estimate our total population to now contain approximately 100 birds.

The Center's RCW program began in the late 1990s, when a dwindling population was reduced to one single male. We began to explore options for restoring our population, working with partners from the Georgia Department of Natural Resources and the U.S. Fish and Wildlife Service. Ichauway was designated as the state's private lands mitigation site for RCW and became the first property in Georgia enrolled in a Safe Harbor agreement. Safe Harbor is a program designed to relieve landowners of liability under the Endangered Species Act that could arise from managing their forests in a manner that might eventually provide habitat for RCW. The RCW is unique in that it excavates its cavity in living trees, which may take anywhere from two to eight years to complete. To prepare for receiving birds, Conservation staff installed artificial cavities in trees across an area of the property with suitable habitat. Over the winter of 1999-2000, eleven birds were translocated from Fort Benning, Fort Stewart, and the Piedmont National Wildlife Refuge.

Over the years, we have received 81 birds from both federal and private lands around the region. Ichauway has had a remarkably high retention rate of translocated birds, with 70 percent remaining on the property through one breeding season, compared to a regional average of about 50 percent. In 2009, we documented the first natural cavity on Ichauway since restoration of the population. We expanded the distribution of RCW by installing artificial cavities in several sites across the property in 2014. In 2015, we translocated two pairs of birds and do not anticipate translocating birds in the future. We plan to augment natural population growth with the maintenance of current artificial cavities and strategic implementation of new clusters.

By all measures, the RCW restoration program has been a success. We have reached our goals for bringing RCW back from the brink of extirpation on Ichauway to a secure population status and the population is thriving, now largely on its own. This program has also demonstrated that maintaining endangered species can be compatible with a range of other uses of private property, including timber harvest. This program's success can be attributed to the commitment of the Robert W. Woodruff Foundation and the Joseph W. Jones Ecological Research Center, as well as the hard work and determination of many Jones Center employees.

EDUCATION

Information generated from the Jones Center's research and land management is disseminated through our education and outreach activities. These programs are targeted primarily at practicing natural resource professionals and university students enrolled in natural resource programs such as forestry, wildlife biology, and ecology. These audiences represent the best opportunity for application of new information generated from the Center's research and conservation programs. In addition to education and outreach programs held at Ichauway, Center staff are also engaged in collaborative partnerships at state and regional levels.

In 2016-2017, approximately 1,200 visitors participated in 56 events such as short courses, workshops, and field tours at Ichauway. Approximately 60% of these individuals were professionals and 40% were university students. In addition, approximately 900 visitors attended our 2017 Open House. Our graduate education program continues to produce highly skilled young professionals who carry the Ichauway legacy through their careers in natural resource research, management, and conservation.

Over the last decade, longleaf pine ecosystems and their associated wildlife have emerged as a conservation priority for public and private landowners across the Southeast. Understanding both the ecology and management of this ecosystem has been a primary focus of the Center since its founding. This puts us in a unique position to contribute to the growing interest in longleaf pine as a trusted source of information grounded in science. In 2016-2017, we held three longleaf pine ecological forestry workshops, with participants from federal and state agencies as well as nongovernmental conservation organizations and private landowners. These workshops focus on an approach to longleaf pine management and restoration that balances multiple values from the forest. Since beginning these programs in 2007, over 250 participants have attended these ecological forestry workshops. In 2017, we conducted a Maymester short course on longleaf pine management and restoration for graduate students and upper-level undergraduates from the University of Georgia and University of Florida. In addition to classroom lectures and field tours at Ichauway, the class spent two days at other iconic longleaf pine sites in southwestern Georgia and the panhandle of Florida.

The Center held several educational programs related to the gopher tortoise, a candidate for federal listing under the Endangered Species Act that is closely associated with longleaf pine. These activities integrate with our active research program on this species, with several training sessions for natural resource professionals on population survey techniques developed here at the Jones Center. We also collaborated with the Natural Resources Conservation Service and the U.S. Fish and Wildlife Service on a workshop to refine gopher tortoise conservation efforts under the Working Lands for Wildlife program.

We continue to be engaged in partnerships across the region. Center staff served in the collaborative group that developed the range-wide 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 (LPC). This is a 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. Kevin McIntyre completed a three-year appointment on the leadership team of the LPC, serving as Past Chair in 2016.

The Center continues to play a leadership role in collaborative work related to prescribed fire. Mark Melvin served as Chair of the Georgia Prescribed Fire Council in 2016, and currently serves as permanent Vice Chair. We are also involved in collaborative work on prescribed fire at regional and national levels, with Center staff serving as Chair on the board of the Coalition of Prescribed Fire Councils as well as working with the Wildland Fire Leadership Council (WFLC). Our partnership with the WFLC, along with collaborators at the Environmental Protection Agency (EPA), brought the third biennial Prescribed Fire and Air Quality Summit to Ichauway in 2017. This workshop brings together state-level fire management and air quality staff with select regional partners, as well as EPA staff, to work collaboratively on air quality issues and policy related to prescribed fire. Additionally, the Coalition partnered with the WFLC to develop a new workgroup called the National Prescribed Fire Alliance. This group is made up of national organizations with interests in prescribed fire that participate

on quarterly calls to discuss fire-related topics of national significance. A 2016 meeting hosted staff from the Centers for Disease Control and Prevention (CDC) and the U.S. Forest Service Southern Research Station to develop a research agenda to study the public health implications of smoke from wildfire and prescribed fire. This was especially meaningful for the Center given that the Emory University Field Station, located on Ichauway from 1939 to 1958, was one of several organizations that came together to found the CDC after its work in Southwest Georgia concluded.

The Center's water resources education and outreach efforts complement our research focus on the lower Flint River Basin and the Apalachicola-Chattahoochee-Flint (ACF) watershed. The Jones Center was a sponsor of the 2017 Georgia Water Resources Conference, held biennially at the University of Georgia. Dr. Steve Golladay provided the plenary speech for the conference, which used the ACF as a case study for the need to better understand and address river health. We also co-organized a special session on the characteristics of isolated wetlands in agricultural settings in Georgia.

Water resources staff have served as a long-term technical advisor to Georgia Adopt-A-Stream. This is a program of the Georgia Environmental Protection Division designed to educate citizens on water quality and provide them with tools for evaluating streams in their communities. In 2017, Center staff organized a special session at the annual Adopt-A-Stream Confluence Conference. The session, entitled "Boots in the Water: the Role of Citizen Science in Water Management," was designed to inform participants of the value of citizen science in contributing to Georgia's future planning. Other water-related advisement activities include participation as technical advisors for the NOAA Drought Early Warning System being implemented in the ACF River Basin as well as strategic planning efforts for the U.S. Geological Survey Southeastern Climate Science Center.

Visiting Scientists

Dr. Andrea Darracq, North Georgia College (2016)
Dr. Kamal Gandhi, University of Georgia (2016)
Dr. Carla Atkinson, University of Alabama (2017)
Dr. Doug Aubrey, University of Georgia/SREL (2017)
Dr. Michael Stambaugh, University of Missouri (2017)
Dr. Carol Wicks, Louisiana State University (2017)

Other Collaborating Scientists & Graduate Co-Advisors

Dr. Carla Atkinson, University of Alabama
Dr. Larry Band, UNC-Chapel Hill
Dr. Michael Battaglia, U.S. Forest Service
Dr. Joel Brown, University of Illinois at Chicago
Dr. Steven Castleberry, University of Georgia
Dr. Michael Chamberlain, University of Georgia
Dr. Richard Chandler, University of Georgia
Dr. Mike Cherry, Virginia Tech
Dr. Matt Cohen, University of Florida
Dr. Alan Covich, University of Georgia
Ms. Casey Cox, Flint River Soil and Water Conservation District
Mr. James Cox, Tall Timbers Research Station
Mr. John Cox, Lolly Creek Consultants
Dr. Irena Creed, University of Western Ontario
Ms. Colette DeGarady, The Nature Conservancy
Ms. Carol Denhof, The Longleaf Alliance
Mr. Troy Ettel, The Nature Conservancy
Dr. Rob Fletcher, University of Florida
Dr. Jerry Franklin, University of Washington
Dr. Mary Freeman, U.S. Geological Survey/University of Georgia
Dr. Kamal Gandhi, University of Georgia
Dr. Dale Gawlik, Florida Atlantic University
Mr. Rick Gillam, U.S. Environmental Protection Agency
Dr. Bob Gitzen, Auburn University
Dr. Heather Golden, U.S. Environmental Protection Agency
Ms. Sara Gottlieb, The Nature Conservancy
Dr. Jim Guldin, U.S. Forest Service
Dr. Craig Guyer, Auburn University
Dr. Joseph Hendricks, University of West Georgia
Dr. Jeff Hepinstall-Cymerman, University of Georgia
Mr. Kevin Hiers, Tall Timbers Research Station
Mr. John Holman, Forest Soils Consultant
Dr. Rhett Jackson, University of Georgia
Dr. Stephen Jackson, University of Arizona/U.S. Geological Survey
Mr. Noah Jansen, Little Traverse Bay Bands of Odawa Indians
Dr. Eric Jokela, University of Florida
Mr. Kyle Jones, U.S. Forest Service
Ms. Melanie Kaeser, U.S. Fish and Wildlife Service
Dr. Benjamin Knapp, University of Missouri
Dr. Charles Lane, U.S. Environmental Protection Agency
Dr. Andrew Larson, University of Montana
Dr. Hank Loescher, National Environmental Observatory Network
Dr. Louise Loudermilk, U.S. Forest Service
Dr. Marguerite Madden, University of Georgia
Dr. John Maerz, University of Georgia
Dr. Daniel Markewitz, University of Georgia
Dr. Katherine Martin, North Carolina State University
Mr. Barrett McCall, Larson and McGowin Forestry Consultants
Dr. Robert McCleery, University of Florida
Dr. Jessica McGuire, Georgia Dept. of Natural Resources
Dr. Anna McKee, U.S. Geological Survey
Dr. Mary Mendonca, Auburn University
Dr. Karl Miller, University of Georgia
Dr. Chelcy Miniat, U.S. Forest Service
Dr. Clint Moore, University of Georgia
Dr. Lisa Muller, University of Tennessee
Dr. Jonathan Myers, Washington University in St. Louis
Dr. Linda Nagel, University of Colorado
Dr. Bryan Nuse, University of Georgia
Dr. Joseph O'Brien, University of Georgia
Mr. Ken Parker, Georgia Forestry Commission
Mr. Stephen Pecot, Larson and McGowin Forestry Consultants
Mr. Michael Prevost, White Oak Forestry
Dr. Todd Rasmussen, University of Georgia
Ms. Elizabeth Schlimm, Maryland Dept. of Natural Resources
Mr. John Seymour, Roundstone Seed Company
Dr. Michael Sheriff, Penn State
Dr. Greg Starr, University of Alabama
Dr. Christina Staudhammer, University of Alabama
Dr. David Steen, Auburn University
Mr. Jonathan Stober, U.S. Forest Service
Dr. Amanda Subalusky, Cary Institute of Ecosystem Studies
Mr. Rob Sutter, Enduring Conservation Outcomes Consulting
Dr. John Van Stan, Georgia Southern University
Dr. Morgan Varner, U.S. Forest Service Pacific Wildland Fire Sciences Laboratory
Dr. Jason Vogel, University of Florida
Dr. James Vose, U.S. Forest Service
Mr. Clay Ware, U.S. Fish and Wildlife Service
Dr. Matthew Waters, Auburn University
Dr. David Wear, U.S. Forest Service
Mr. Michael Zupko, Wildland Fire Leadership Council

Externally Funded Research

Boring, L.R. Long-term ecosystem inventories: Assessing availability and scalability of C and N data for ecosystem models to inform scope of future proposals. Strategic Environmental Research and Development Program (U.S. Department of Agriculture - Forest Service). 2014-2016. $125,000. Received in 2016, $50,206. No funds received in 2017.

Brantley, S.T., S.W. Golladay. Soil and Water Assessment Tool. The Nature Conservancy. 2016-2017. $38,000. No funds received in 2016. Received in 2017, $38,000.

Conner, L.M. Breeding bird response to longleaf pine restoration. National Wild Turkey Federation. 2011-2016. $35,700. Received in 2016, $4,990. No funds received in 2017.

Conner, L.M. Collaborative Research: EAGER-NEON: NEON Sites as a Platform for Transformative Wildlife Research. National Science Foundation. 2015-2017. $167,148. Received in 2016, $101,407. Received in 2017, $26,992.

Conner, L.M. Development and evaluation of an unbaited camera survey technique for estimating relative abundance and demographic parameters of white-tailed deer. Georgia Department of Natural Resources (University of Georgia). 2014-2018. $145,140. Received in 2016, $55,054. Received in 2017, $19,904.

Conner, L.M. Effects of hydrology, hunting, and predation on white-tailed deer dynamics in South Florida. Florida Fish and Wildlife Conservation Commission (University of Georgia). 2014-2017. $184,733. Received in 2016, $66,184. Received in 2017, $1,042.

Conner, L.M. Gray fox spatial movement tracking. Department of Defense. 2013-2016. $86,812. Received in 2016, $17,101. No funds received in 2017.

Conner, L.M. Movement ecology of female wild turkeys during nesting and brooding seasons on Silver Lake Wildlife Management Area. Georgia Department of Natural Resources (University of Georgia). 2014-2017. $153,400. Received in 2016, $9,561. No funds received in 2017.

Conner, L.M. Using an ecosystem engineer to restore functionality of natural pinelands in the southeastern United States. Georgia Department of Natural Resources. 2016-2018. $187,153. Received in 2016, $56,897. Received in 2017, $49,261.

Conner, L.M., L.L. Smith. Using wildlife habitat models to evaluate management endpoints for open pine woodland and savanna. U.S. Fish and Wildlife Service (Mississippi State University). 2014-2016. $132,104. Received in 2016, $6,906. No funds received in 2017.

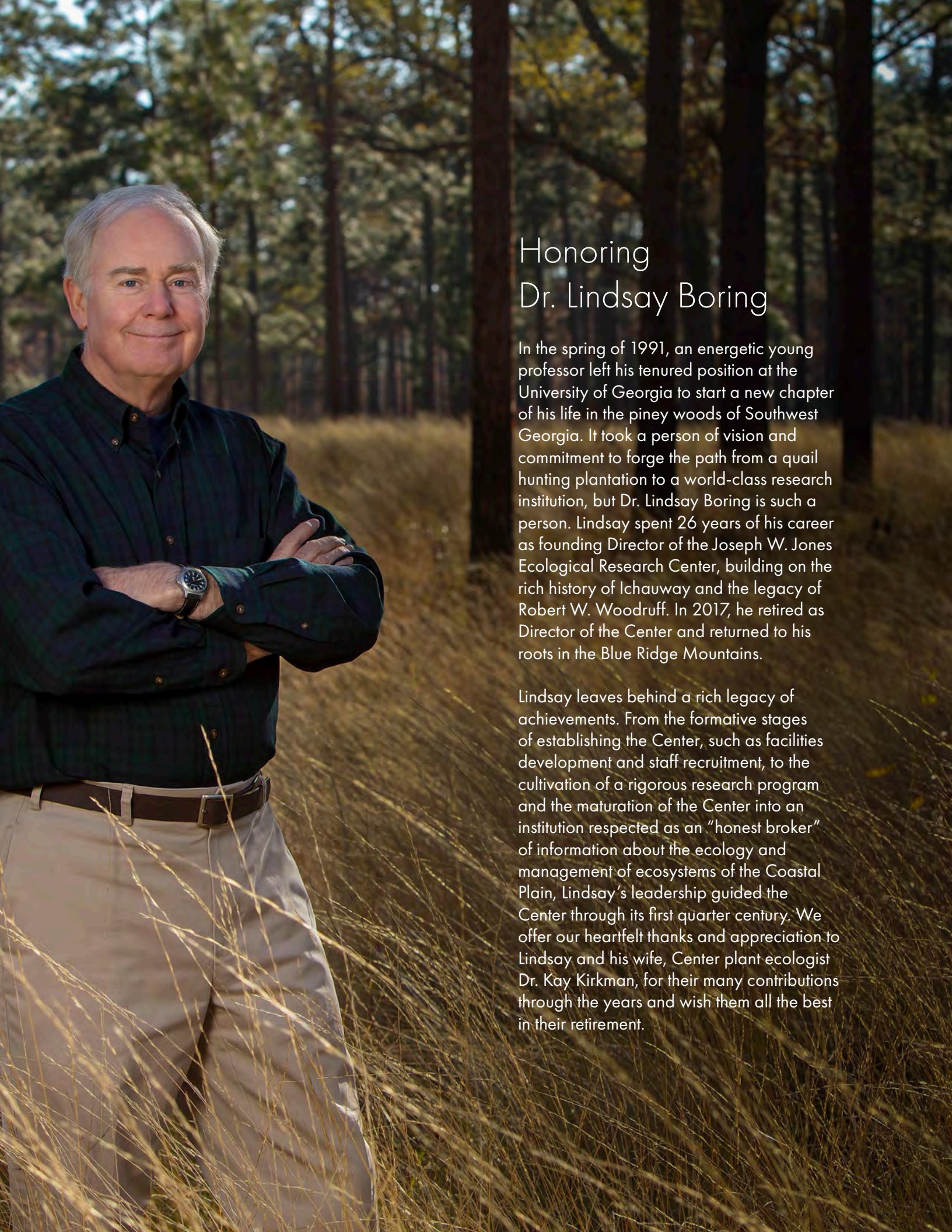
Kirkman, L.K. Evaluation of longleaf pine undercover ecotype seed sources. R. Howard Dobbs Jr. Foundation. 2012-2016. $65,000. Received in 2016, $24,927. No funds received in 2017.

McIntyre, R.K., S.B. Jack. Collaborative management and restoration of longleaf pine in lowcountry South Carolina. The Nature Conservancy – South Carolina. 2014-2017. $21,596. Received in 2016, $12,663. No funds received in 2017.

Mitchell, R.J., L.R. Boring. Building forest management into Earth system modeling: scaling from stand to continent. National Science Foundation. 2013-2017. $170,872. Received in 2016, $50,713. Received in 2017, $11,885.

Smith, L.L. Gopher tortoise surveys and population evaluation. Florida Fish and Wildlife Conservation Commission. 2014-2016. $300,000. Received in 2016, $26,006. No funds received in 2017.

Photography by Richard T. Bryant. Photography by James T. Johnson: pages 5, 22; back cover. Photography by Jessica D. McCorvey: page 25.



Honoring Dr. Lindsay Boring

In the spring of 1991, an energetic young professor left his tenured position at the University of Georgia to start a new chapter of his life in the piney woods of Southwest Georgia. It took a person of vision and commitment to forge the path from a quail hunting plantation to a world-class research institution, but Dr. Lindsay Boring is such a person. Lindsay spent 26 years of his career as founding Director of the Joseph W. Jones Ecological Research Center, building on the rich history of Ichauway and the legacy of Robert W. Woodruff. In 2017, he retired as Director of the Center and returned to his roots in the Blue Ridge Mountains.

Lindsay leaves behind a rich legacy of achievements. From the formative stages of establishing the Center, such as facilities development and staff recruitment, to the cultivation of a rigorous research program and the maturation of the Center into an institution respected as an "honest broker" of information about the ecology and management of ecosystems of the Coastal Plain, Lindsay's leadership guided the Center through its first quarter century. We offer our heartfelt thanks and appreciation to Lindsay and his wife, Center plant ecologist Dr. Kay Kirkman, for their many contributions through the years and wish them all the best in their retirement.

JOSEPH W. JONES
ECOLOGICAL RESEARCH CENTER

at Ichauway

3988 JONES CENTER DRIVE
NEWTON, GEORGIA 39870
(229) 734-4706
WWW.JONESCTR.ORG