

**SRS-4158 -- Restoring and Managing Longleaf Pine Ecosystems**  
**Auburn, AL; Pineville, LA; and Clemson, SC**  
**Project Leader: Kristina Connor**

**Mission:** Our mission is to provide knowledge and strategies for restoring, managing, and sustaining longleaf pine ecosystems in the southeastern United States.

**Area of Research Applicability:** Longleaf pine ecosystems once dominated up to 90 million acres in the southeastern United States. The 3 million acres of remaining longleaf pine ecosystems are refuges for hundreds of threatened and endangered plants and animals. Restoring longleaf pine ecosystems across its range is critical for the long-term survival of these threatened and endangered species. Although longleaf pine is not normally managed outside its native range, we can also make comparative relationships in ecology and management with other pine-dominated forest types in the United States and worldwide.

**Problem 1.** We need fundamental biological knowledge to understand the processes that affect the fecundity, establishment, and development of plants and plant communities in longleaf pine ecosystems. We will then better understand how native vegetation responds to natural disturbances in terms of growth, vigor, disease resistance, and longevity. This improved understanding will enable us to better restore and manage longleaf pine ecosystems.

We will use our expertise in the biology of seeds, seedlings, trees, and rare plants to study the basic biology, physiology, and ecology of longleaf pine and its associated plant species. Specific problem areas are as follows:

**Problem 1a.** We will discover and develop knowledge of the reproductive and population biology of ground-layer and at-risk plant species, and will use that knowledge to maintain and restore plant communities and to understand the synergies among plants within frequently burned longleaf pine ecosystems.

**Problem 1b.** We will quantify the physiological and developmental strategies that sustain longleaf pine in frequently burned systems, so that we can better understand the consequences of resource limitations in frequently burned systems on longleaf pine health and sustainability.

**Problem 1c.** We will discover and develop knowledge of root system support (i.e. soil resource uptake and morphology) of aboveground processes during the establishment and development of longleaf pine, and will use that knowledge to better establish tree plantings and insure their long-term success and to link physiological performance to soil physical and chemical properties.

**Problem 1d.** We will discover and develop knowledge of the physiological and morphological control of longleaf pine in the grass stage, and will use that knowledge to lessen the time longleaf pine is in the grass stage helping to better establish longleaf pine plantings and leading to greater acceptance of longleaf pine as the species of choice.

Anticipated outcomes in Problem 1:

- Restore and sustain diverse understory plant communities in open longleaf pine forests
- Discover why diversity is important to plant community well being
- Determine population and community processes that affect threatened and endangered plant species in the ground layer of longleaf pine ecosystems
- Discover the physiological processes that determine how and why longleaf pine responds successfully to loss of needle mass from heat injury by rapidly refoliating after intense fires so that managers can plan prescribed fires based on the physiological state of the trees
- Learn how site limitations in terms of water and nutrient availability influence the ability of longleaf pine to successfully recover after intense heat injury
- Discover the physiological processes that affect establishment, growth, and development of longleaf pine seedlings specifically through a better understanding of how longleaf pine begins height growth, how seedlings utilize soil resources, and through a better understanding of root system morphology

**Problem 2. We need practices, strategies, and models to quantify and predict the impacts of management and disturbance on maintaining and restoring longleaf pine ecosystems. This knowledge will help land managers to better establish and manage longleaf pine forests and thereby expand the acreage of longleaf pine and increase the habitat for threatened and endangered plants and animals in the southeastern United States.**

We will use our expertise in the structure and function of longleaf pine ecosystems, and our skills at predictive model development and database management, to conduct an integrated research program for restoring longleaf pine ecosystems across a range of conditions. Specific problem areas are as follows:

Problem 2a. We will quantify and evaluate fire as a management tool in longleaf pine ecosystems--specifically the introduction or reintroduction of fire to long-unburned longleaf pine forests, the use of fire in conjunction with other silvicultural treatments to establish longleaf pine forests, and the use of such practices to minimize wildfire risk. This will provide landowners with the tools to manage healthy, diverse, and productive longleaf pine ecosystems.

Problem 2b. We will develop knowledge of even-aged and uneven-aged silvicultural methods used to regenerate longleaf pine forests; apply new biological knowledge to silvicultural methods used for stand conversion from offsite overstory species to longleaf pine, and develop silvicultural methods to manage understory species as a way of restoring ground-layer and at-risk plant species on degraded sites. This will allow us to comprehensively address the silviculture of longleaf pine ecosystems and provide land managers with the tools to manage these forests.

Problem 2c. We will combine information on longleaf pine silviculture with existing and new biological knowledge to develop models that predict the restoration success, production, and sustainability of longleaf pine ecosystems, and concurrently, we will develop long-term databases on plant communities as well as amphibian and reptile populations in longleaf pine

ecosystems and their responses to disturbances such as hydrological fluctuations, silvicultural practices, fire, and climate change. As a result, land managers will have valuable tools to manage longleaf pine ecosystems across the southeastern United States.

Problem 2d. We will use our expertise in seed and seedling biology and physiology to develop nursery and field protocols that meet the demand for high quality planting stock because landowners need better quality seedlings and innovative establishment techniques for restoration efforts than currently exist and this problem will directly address that need.

Problem 2e. We will evaluate longleaf pine and its associated plant species as potential feedstocks for bioenergy production and the influence of such activities on longleaf pine ecosystems. Bioenergy feedstocks is seen as a way to help offset dependence on foreign oil, but land managers need information on how this process will affect longleaf pine ecosystems.

Anticipated outcomes in Problem 2:

- Develop reliable models for longleaf pine stands that account for both evenaged and unevenaged regeneration systems, how understory plant communities respond to different management options, and provide information on bioenergy potential
- Refine models to include season of burning and the use of fire with other silvicultural practices
- Develop brochures and other written and web-based materials that provide the public and policy makers with information on longleaf pine ecosystem restoration and management
- Conduct tours and workshops primarily for non-industrial private landowners but also for land management professionals to help them solve their longleaf pine restoration and management problems
- Work closely with other longleaf pine technology transfer efforts to effectively restore and sustain longleaf pine ecosystems so that products and amenities will be available to future generations while maintaining habitats for dependent plants and animals

**Environmental Considerations**

RWU-4158's program of research includes activities that are generally limited in context and intensity and are not expected to have a significant adverse effect on the quality of the human environment. The environmental effects of specific actions will be considered during the development of study plans, at which time the existence of extraordinary circumstances related to the proposed action and any categorical exclusions will be documented as a part of the study plan as described in FSH 1909.15, Chapter 30. For research involving the use of toxicants, environmental considerations will be further evaluated through Environmental Assessments or Environmental Impact Statements prepared with and reviewed by the cooperating District or Forest staffs. For research having the potential to affect a plant or animal species that is federally listed as endangered or threatened or proposed for such listing, RWU-4158 will consult with District or Forest biologists and the U.S. Fish and Wildlife Service as per Section 7 of the Endangered Species Act of 1973, as amended.

**Key Cooperators:** We will collaborate with professional resource managers and academic colleagues from public and private organizations across the Region to address invasive plants, destructive insects and pathogens, the effects of fire on forest structure, function, and processes, and to study the effects of prescribed fire on root health and decline syndrome in longleaf pine. We will collaborate with research scientists to study threatened and endangered plants and animals, alternative management approaches like agroforestry and the production of various alternative commodities and services, such as pine straw, biofuels, carbon sequestration, ecotourism, and wildlife habitat. We will collaborate with government and private organizations to develop tours, field trips, publish brochures and other written and web-based materials, and to develop reliable prediction models. Key cooperators would include the following organizations:

Southern Research Station: SRS-4156--Center for Disturbance Science  
SRS-4159--Southern Pine Ecology and Management  
SRS-4352--National Agroforestry Center  
SRS-4552--Insects, Diseases, and Invasive Plants of Southern Forests  
SRS-4703--Forest Operations  
SRS-4704--Utilization of Southern Forest Resources  
SRS-4801--Forest Inventory and Analysis  
SRS-4804--Forest Health Monitoring  
SRS-4854--Eastern Forest Environmental Threat Assessment Center  
SRS-4952--Integrating Human and Natural Systems

Federal Agencies: Kisatchie National Forest, Louisiana  
Region 8, Regional Office, USDA Forest Service  
Region 8, State and Private Forestry, Forest Health Protection  
Department of Defense  
U.S. Fish and Wildlife Service

Universities: Auburn  
Clemson  
Louisiana State  
Louisiana Tech

State Agencies: Alabama Cooperative Extension Service  
Alabama Forestry Commission  
Louisiana Cooperative Extension Service  
Louisiana Department of Agriculture and Forestry

Private organizations: Joseph Jones Ecological Research Center  
Tall Timbers Research Station  
The Nature Conservancy  
Alabama Forestry Association  
Louisiana Forestry Association  
Longleaf Alliance  
Cedar Creek Land and Timber Co, Alabama  
Martin Timber Co, Louisiana