MISSISSIPPI STATE UNIVERSITY EXTENSION

Mississippi Wet Pine Savannas

Figure 1. Wet pine savanna in the Mississippi Sandhill Crane National Wildlife Refuge in Jackson County, Mississippi. Photo by Jonathan Pitchford

Wet pine savannas make up most of the natural vegetation in southern Mississippi. These savannas, which lie within 10 to 20 miles of the Gulf Coast, are biodiversity hot spots. They harbor a wealth of plants and animals—some of them, such as the Mississippi Sandhill Crane, are rare and only found in this area. Although much of the region has undergone development, wet pine savannas can still be found at the Mississippi Sandhill Crane National Wildlife Refuge, the Grand Bay National Estuarine Research Reserve, and the Grand Bay National Wildlife Refuge, each in Jackson County (Figure 1). These wet pine savannas are wetlands that are briefly and shallowly flooded after heavy rainfall events, and their loamy soils remain saturated or nearly so for much of the year. Clay strata beneath the topsoil prevent the infiltration of rainfall and groundwater runoff from more elevated inland regions.

History of Wet Pine Savannas Along the Gulf Coast

Wet pine savannas historically occupied land near the coast from the Apalachicola River in Florida westward to the Mississippi River embayment. Sands underlay the savannas in Florida and Alabama rather than the loamy soils in Mississippi. Some Florida sites are treeless wet prairies. Over the past two centuries, fire suppression, road construction, pine harvest, agricultural practices, and urban development have degraded or destroyed almost all the original wet pine savannas.

We are fortunate to have evidence of what Mississippi's wet savannas were like in the 19th century before extensive development began. During that time, Eugene Hilgard, a professor at the University of Mississippi and state geologist, mapped Mississippi's pine savanna region and described the vegetation with the eye of a well-rounded naturalist. He described what he called "pine meadows" just south of present-day Vancleave, Mississippi, in Jackson County, as follows:

> After ascending the bluff [of Bluff Creek], we strike a level meadowland, in which there is scarcely any distinction into upland and lowland. The ground is densely covered with a growth of sedge-grasses (Cyperaceae), cordrushes (*Eriocaulon villosum*), and a small species of Xyris; in the shallow depressions, both species of *Sarracenia* (side-saddle flower and pitcher-plant), the larger *Eriocaulon* (E. *decangulare*), the *Dichromena*, the long-leaved and the short-leaved sundew, several species of bright-tinted Orchideae, and some larger species of sedge-grasses and pond-rushes (*Juncus*) are seen; and with these, occasionally, the milkweed of the sea-coast marshes (*Asclepias paupercula*) with its bright orange flowers. The undergrowth is formed exclusively by the gallberry, which does not grow to the same height that we find it in Wayne and Greene counties, but is on the other hand, so overcrowded with blossoms at the proper season, that the leaves entirely disappear beneath them. The timber is formed altogether by diminutive longleaf pines, averaging about 25 feet in height by 2.5 to 4 inches in thickness, which stand at considerable distances (40 or 50 feet) apart, so that their sparse tops scarcely interfere, with the view of the observer.

Hilgard continued with the following:

> As we approach within about a mile of the beach, the pine timber rapidly improves in quality; the same is the case within about half a mile of Pascagoula River. The trees are stouter, but not very tall; and mixed with the longleaf pine (*Pinus palustris*) there appears another species of pine, common all along the coast, and forming almost exclusively the larger timber of the islands of the Mississippi Sound. It is generally distinguished from the longleaf pine, in being called "pitch pine" (slash pine), on account of the extreme "fatness" of its wood. It is probably identical in species with the common "bottom pine" (P. *taeda*), of South Mississippi. [Slash pine was known as P. *taeda* var. *heterophylla* in the 19th century.] Within a quarter to half mile from the beach, we find other timber mingling with the pine, to-wit: live oak (*Quercus virginiana*), and Spanish ("red") oak (*Quercus falcata*). A part of the land thus timbered, which extends inland from the beach in strips and bands, has for its undergrowth the gallberry (*Prinos glaber* equals *Ilex glabra*); such constitute the "gallberry flats" of the coast, which are said to be very poor, and not to produce [crops] without manure."

From Hilgard's description, we learn that the pine savanna region consisted of an herbaceous "meadow" dominated by grasses and sedges and mixed with numerous forbs and gallberry, which is a low-growing shrub. Trees were absent except for "stunted" and widely scattered longleaf pines (*Pinus palustris*). We cannot be sure that all longleaf pines growing on pine savannas were diminutive, or small, as Hilgard described. The Mississippi Gulf Coast had served as a settlement for the French and later the English throughout the 18th century. Perhaps larger pines had been harvested before Hilgard arrived. He headed south toward the coast on a road near the Pascagoula River, and from there westward through Ocean Springs and Biloxi. It is not known if the "stunted" longleaf pines occurred throughout the region that he mapped as coast Pliocene. He mentioned that stunted longleaf pines had been harvested to produce charcoal and therefore may have characterized the entire region.

Hilgard noted that slash pines were common within a mile of the coast, including in the Pascagoula estuary. Slash pines did not occur elsewhere in Mississippi's wet pine savannas. Currently, slash pines are the abundant tree throughout the wet pine savannas, and longleaf pines are less common. Hilgard suggested that coastal slash pines could be identified with those found in bottomlands (swamps) inland from the coast, which he referred to them by their former name, P. *taeda* var. *heterophylla*. Slash pine is now known as P. *elliottii*.

Is the coastal slash pine distinct from the interior slash pine? That possibility was entertained at length by Elbert Luther Little Jr. and Keith W. Dorman, and botanical consensus has not yet been achieved.

Hilgard's contemporary, Charles T. Mohr, described the "pine meadows" as they occurred in neighboring Alabama. Mohr wrote:

> Open forests of longleaf pine sparsely interspersed with Cuban pine and loblolly pine once covered the plain. After the removal of the original timber growth the longleaf pine was to a large extent superseded by the Cuban pine, groves of which in every stage of development occupy the clearings. Upon these clearings, made scarcely two-thirds of a century ago, Cuban pine has already attained the dimensions of useful timber, the trees averaging from 18 to 21 inches in diameter, with a height of from 85 to 100 feet.

Mohr recognized the presence of both Cuban pine, which was probably the coastal slash pine mentioned by Hilgard, and loblolly pine (P. *taeda* var. *heterophylla*), which was the bottomland slash pine from the interior. Mohr's description suggests that longleaf pines indeed occupied pine meadows as Hilgard described for Mississippi. Mohr confirmed Hilgard's contention that slash pines were sparse or absent until after longleaf pines were harvested.

Fire in Wet Pine Savannas

Wet pine savannas are maintained by frequent surface fires. In the past, fires were ignited by lightning. The fuel for these fires consists of numerous grasses, sedges, and other perennial herbs that make up the dense ground cover. The heat of fire rises and does not increase soil temperature, at least not to lethal levels for underground plant structures. Following fire, herbaceous vegetation resprouts as if it had been mowed. In pre-colonial times, fires were landscape-scale and spread across wide areas until they reached wet swamps and drainage basins. Fire scars on the annual rings of old-growth longleaf pines revealed an average fire return interval of less than two years.

Frequent fires prevent competitive trees and shrubs in nearby swamps from inhabiting wet pine savannas. These swamp species are fire sensitive. If fire frequency is reduced, colonization happens quickly, suppressing flammable grasses with shade and root competition. Slash pines growing in bottomlands contribute substantially to this colonization. In the continued absence of fire, wet pine savanna is converted to forest. Since well into the distant past, frequent fires have likely been a regular event without interruption. Otherwise, the savannas would have become forested prior to historical times.

As seedlings and saplings, slash pines are intolerant of fire but are tolerant of competition. In contrast, longleaf pines are fire-tolerant and competition-intolerant. Longleaf pine seedlings spend their first two years or longer in a grass stage developing an extensive root system. The terminal bud of the stem remains at ground level and is insulated from the heat of fire by numerous bud scales and green needles (Figure 2).

Figure 2. The grass stage of longleaf pine (*Pinus palustris*). A terminal bud is protected from fire by the long, abundant pine needles. The tree will enter the "bottlebrush" or "candlestick" phase of rapid stem elongation after the next fire occurs. Photo by Jonathan Pitchford

When aerial growth begins, the thick stem is protected from fire by well-developed bark and green needles that grow so densely that the stem resembles a bottlebrush.

As full-grown trees, longleaf pines are intolerant of their own competition at the root level. Competition-intolerance is an adaptation that facilitates fire. If longleaf pines grew close to each other, their crowns would shade flammable grasses and sedges and prevent the production of fuels to carry fires. Another fire-survival adaptation is thick branches, which take longer to heat to a lethal temperature than those of thin-stemmed species like slash pine. The branches in the crowns of longleaf pines are spaced far apart, so that if one catches fire, the heat of fire is not likely to ignite the branches above it.

Grasses comprise the most important fuels for carrying fires. In eastern Jackson County, where many remaining and well-preserved wet pine savannas are located, wiregrass is the most abundant fuel. Wiregrass has long been known as *Aristida stricta*. Some botanists isolate the southern element of wiregrass into a separate species, A. *beyrichiana*. Wiregrass is widespread in the Southeast and reaches its western limit of distribution abruptly in Jackson County at Old Fort Bayou (Figure 3).

Wiregrass is a bunch grass that produces hundreds of fine, highly fibrous leaves that readily burn. After one growing season, those leaves die, dry out, and remain attached to the plant base for two or more years. The dead leaves of one wiregrass plant overlap with those of neighboring plants, creating fuel continuity for carrying fires evenly over large areas of savanna. Wiregrass grows as a slowly expanding circular clump, shaped like a donut. The clump eventually separates, and each fragment becomes a new wiregrass plant that grows and forms its own 'donut' which, in turn, fragments. In this manner, a wiregrass plant found in the field may have originated from a seed that sprouted centuries ago.

To the west of Old Fort Bayou, wiregrass is replaced as the principal fuel by little bluestem (*Schizachrium tenerum*) and several other grasses, including species of *Andropogon* and *Schizachrium*. Many other species contribute significantly to the fuel load, including diminutive witchgrasses (*Dichanthelium*) and wire-stemmed beakrushes (*Rhynchospora*). Plants of those two genera are important fine fuels that help ensure that surface fires burn evenly and completely. In sites that are particularly wet, toothache grass (*Ctenium aromaticum*) serves as the principal fuel.

Wet pine savannas are pyrogenic ecosystems, meaning they developed in response to fire. They have evolved adaptations, such as those mentioned above for longleaf pine and wiregrass, allowing them to survive and flourish in a fire environment and to attract the ignition and spread of fires. Adaptations of that magnitude take time to evolve. Therefore, pyrogenic ecosystems, like wet pine savannas, did not organize spontaneously. They assembled incrementally over evolutionary time.

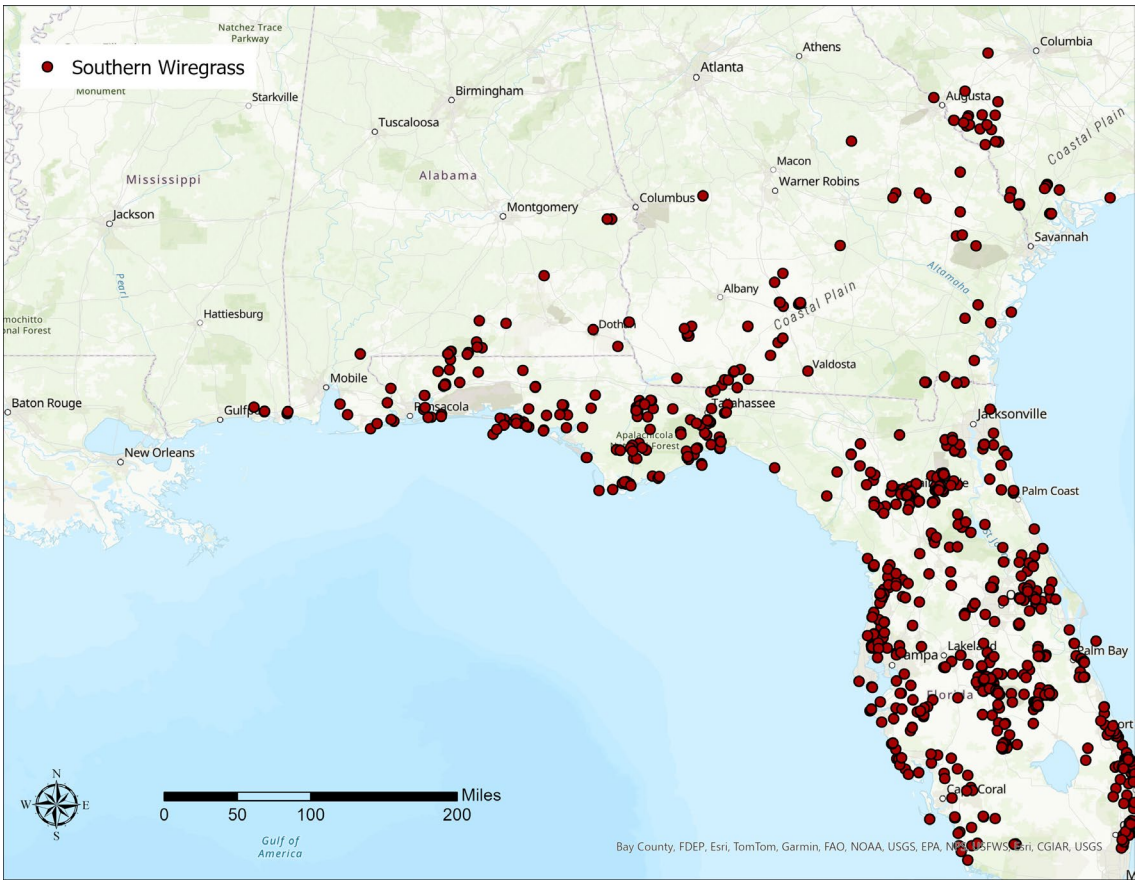

Figure 3. Spatial distribution of southern wiregrass (*Aristida beyrichiana*) along the northern Gulf coast. The western extent of southern wiregrass ends near Old Fort Bayou in Jackson County, MS. Wiregrass location information for this map was obtained from iNaturalist.

Vegetation of Wet Pine Savannas

The vegetation of wet pine savannas may seem uniform and monotonous at a distance but up close it is diverse and spectacular. In Jackson County, 200 or more species of plants make up the vegetation of frequently burned, undisturbed sites. Many other herbs are showy and include spectacular wildflowers such as lilies and orchids. In autumn, a wide array of aster varieties graces the savannas. Pitcher plants and several other kinds of insectivorous species (e.g., sundews [*Drosera*], butterworts [*Pinguicula*]) kindle fascination. Gallberry and several other low-growing rhizomatous shrubs grow commonly among the herbaceous species.

Most herbaceous species are not uniformly distributed. Instead, they are scattered in patches or as isolated individuals. Recent monitoring information suggests that some species vary considerably in abundance from year to year. Monitoring data also suggests spatial (place-related) variation—a species disappears from one wet pine savanna site and is recruited to another site. The reasons for spatial variation and temporal (time-related) variation are unknown. Moisture availability, competition, and consumption of living plant tissue by animals are possible explanations.

On wetter sites, particularly near headwater streams, pond cypress trees (*Taxodium ascendens*) are scattered in wet pine savannas and survive surface fires. Many of these pond cypress trees have very narrow annual rings, and some trees are more than a century old. As such, pond cypress deserves careful protection and best management practices.

Soil organisms play an important ecological role in wet pine savannas, although little is known about that domain. The role of fungi is critical. It is known that the mycorrhizal soil fungi of wet pine savannas differ from the saprophytic soil fungi that occur in typically unburned ecosystems. The importance of soil fungi to ecosystem health should encourage managers to be cautious of practices that upset the fungal flora in wet pine savannas.

On elevated sites with less soil moisture, the pine savannas grade into pine flatwoods, dominated by longleaf pines and densely growing saw palmettos (*Serenoa repens*). The pine flatwoods ecosystem, like wet pine savannas, is pyrogenic, where grasses provide the fuel for carrying fires. Wet pine savannas share some but not all their herbaceous species with pine flatwoods. Pine flatwoods predominate the DeSoto National Forest and other areas north of the coastal Mississippi wet pine savanna region. Within the wet pine savannas, saw palmettos occur only occasionally in patches on slightly elevated lands.

Conservation and Ecological Restoration of Wet Pine Savannas

After decades of fire suppression, wet pine savannas across the Gulf Coast have seen an increase in slash pine density. Many sites are now too densely covered with trees to be considered savannas and would be better referred to as slash pine woodlands or even forests. Other woody species that colonized savannas from adjacent streamside swamps in the absence of fire, include titi (*Cliftonia monophyla*, *Cyrilla racemiflora*), large gallberry (*Ilex coriacea*), yaupon (*Ilex vomitoria*), fetterbush (*Lyonia lucida*), wax myrtle (*Morella cerifera*), smooth sumac (*Rhus copallina*), bamboo vine (*Smilax* spp.), and blackberries (*Rubus flagellaris*). Once established, these woody plants sprout after surface fires and persist.

Another factor impacting wet pine savannas are changes in hydrology. Jon W. Teaford, Peter L. Lewis, and David B. Johnson noted that widespread ditching and drainage had shortened the hydroperiod in wet savannas. The subsequent rise of slash pine increased transpiration and further lowered the groundwater table. They estimated that every increase of 40 square feet in the basal area of overstory pines caused the water table to fall 12 inches from increased transpiration.

Although wet pine savannas are in steep decline, ecological restoration efforts are in progress. Momentum in favor of restoration will continue as public understanding grows regarding what has been lost and how it can be recovered. Natural resources managers on public and private lands across the Gulf Coast continue to work to reintroduce fire within the constraints of an increasing urban interface. These restoration efforts sometimes include mechanical and herbicide treatments of woody plants and invasive species that have colonized wet pine savannas. While challenging, this important work must continue for the sake of many endemic species that depend on wet pine savannas, and so that future generations can experience and enjoy their beauty.

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Notes

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