THE ROLE OF LONGLEAF PINE IN THE CONSERVATION FRAMEWORK OF THE SOUTHEAST UNITED STATES

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ABSTRACT

If forests are considered within the overall conservation framework of our land use in the United States, the longleaf pine ecosystem is an oft overlooked component at the landscape scale. This is changing now as biological diversity is being recognized as an important component of a balanced ecosystem. Longleaf forests currently only occupy about 3% of their former extent due to many cultural practice changes, predominantly fire exclusion. Efforts are underway to restore longleaf as a larger proportion of our forested land base to diversify the portfolio of economic, ecological, and social conservation. This paper serves to summarize the resurgence of this ecosystem, identify some hurdles in its restoration, and present some logic on its importance.

INTRODUCTION

Since the introduction of agriculture to the New World that we now know as the United States, forests have been antithetical to most systems of food-based agriculture. Yet after the Dust Bowl days of the 1930s and the Clean Water Act of 1972 there became a greater appreciation of the role trees play in ameliorating soil erosion. In the decades since those realizations the challenges of finding the correct balance and spatial arrangement of types and ages of forests, grasslands, and open lands and agriculture within the landscape has been the challenge of conservationists. Many of the forestry conservation practices "ordained" by federal agencies have defaulted to a mixture of hardwood tree species, likely due to their successional stability and reduced maintenance requirements over a long time horizon. Since cooperative conservation is now being sought, more and more the conservation of multiple resources are being considered on a given area. Here enters the longleaf pine ecosystem as it has been long-abandoned and remains the "missing link" of conservation on the landscape-scale.

Longleaf pine (Pinus palustris Mill.) is estimated to have historically covered 60 million acres (Burns and Honkala 1990), with some estimates as much as 90 million acres (Frost 1993). Spatial arrangement of land types is important for ecosystem function as well as risk mitigation (i.e., fire, storm, insect, or disease). At one scale it is desirable to group longleaf together (i.e., for woodpecker habitat continuum over time), but at other scales it is necessary to segment this ecosystem into smaller units for firebreaks and to create microsites for habitat enhancement. It is this variability inherent within the fire-dependent longleaf communities that contribute to its great value for the conservation of flora, fauna, soil, water, and other natural resource values.

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Longleaf Values

Economic

Timber is a long-term investment, and as-such, either not given too much thought, or the thinking changes several times during the crop's rotation. Currently we may be wondering about the future of markets as a large amount of our manufacturing is moving overseas and many of our wood products are being imported. However, with increasing populations and overall wealth the basic principles of supply and demand seem to indicate that there will be a wood products market, especially for high quality materials. Aside from wood products, some of these ecologically important lands are achieving great prices for their ecosystem services. So, if we are going to obligate a portion of our land to forests, we might as well aim to optimize its overall return by growing trees that have a good chance of finding a market in the future rather than an unproductive thicket of invasive species.

<u>Stand Establishment and Regeneration</u>

Historically, planting bare-root has shown problems with survivability and delay caused by lack of competition control resulting in longleaf to remain too long in the grass stage. Shoulders 1989 showed longleaf survivability only at 32-63 percent compared to over 75% for other southern yellow pines. Though machine planting of bare root seedlings is viable, the planting of containerized stock by contract planting crews is currently the industry standard. This results in great success across a wider range of sites with an extended planting season (Demers and Long 2006) giving some insurance against drought (Hainds 2009). A region-wide survey in 1995 showed an 85% survival for containerized seedlings where bareroot only averaged 65%. It should be pointed out that this is highly contractor-dependent and many contractors can consistently average 90% survival with bare root depending on conditions (Georgia Forestry Commission 2009). Planting depth is critical as planting too shallow can result in moisture wicking (Sasnett et al. 1989) and too deep may cover the bud or cause inundation on wet sites. These reasons also add to containerized seedlings being favored to minimize drought problems and planting depth issues. The natural range of longleaf may have been limited to frost-heaving of seed, but this has perhaps been overcome with current planting strategies.

Early planting before January increases success (Hainds 2009). Ripping of the hardpan has been found to be beneficial, but planting directly in the ripped channel should be avoided due to excess air or water exposure. Planting adjacent to the rip is recommended as the root will find the rip as it grows. Fallowing for a year combined with herbicide site preparation, burning, and scalping is necessary if planting occurs in a recently active agricultural field. Brownspot needle blight is an associated disease, but this problem is economically alleviated with artificial regeneration of good disease-free stock.

It is crucial to control competing vegetation in a young longleaf stand, still in its grass-phase. Most other tree species sharing the longleaf habitat will outgrow these young seedlings, emphasizing their dependence on the presence of fire. On many sites it may also be necessary to remove much of the native loblolly seedlings which may seed in during the pre-canopy cover years. Longleaf typically exhibits a lack of uniformity based on differing timing from coming out of grass stage. This breaks the stand into number of crown classes reducing the need for precommercial thinning.

Establishment Costs and Incentives

At the present time, there are many avenues of financial assistance available to a landowner aspiring to establish a longleaf stand. Cost-share incentive payments from Farm Service Agency (FSA) were allocated for 250,000 acres in 2006 (Jenkins 2007). The Natural Resources Conservation Service (NRCS) provides technical and financial assistance for site preparation, establishment, and maintenance of longleaf stands. There are also funds available to states within the Southern Pine Beetle (SPB) (*Dendroctonus frontalis* Zimmerman) prevention programs (Nowak et al. 2008) and even private partnerships like the Longleaf Legacy Program (NFWF 2009) sponsored by the Southern Company which gains carbon offset credits from funding longleaf pine restoration. Many of these incentive programs pay for a proportion of site preparation, planting, and stand establishment costs helping absorb some of the expenses involved in managing this ecosystem.

Pine straw production

Pine straw can provide \$100 to \$500 per acre per year (Johnson 2009) which can also encourage the choice to grow longleaf pine. Straw is sold baled, by volume to contractors who collect onsite, or loose at buying stations. Yields of 50-100 bales per acre are typical (every 2 years after crown closure ~ age 15). Commercial pine straw production is most efficient where the understory is free from hardwood brush and where sufficient space available for equipment maneuvering. As straw raking precludes burning, many of the ecological benefits of this ecosystem are reduced by intensive pine straw production. Because of this, landowner objectives should be carefully considered and careful attention paid to cost-share provisions, many of which disallow straw raking during the contract period.

High-value wood products

Trees that qualify for pole timber bring much greater prices, sometimes as much as 50% more per unit volume. Since much wood is currently bought by weight, it has been noted by some that there can be as much as a 20% "premium" gained for the same volume due to the higher specific gravity of longleaf. Williston et al. (1989) showed that in one forest area of similar site and management, 63% of longleaf pines qualified as poles compared to 25% of slash and only 3% of loblolly. Less than 35% of longleaf grown on site index 60 or less qualify for poles at any age, however at site index 70 over 50% poletimber can be attained by age 40. There is also a precipitous drop over age 60, assumedly due to decay or lack of plantation-grown longleaf (Williston et al. 1989). However Williston makes clear that proper management is required for this level of results, which would likely not be met under low planting densities (< 55 square feet of basal area). This emphasizes the need to examine the cost-share parameters to make sure it is compatible with other objectives. Most of the cost-share planting densities are between 300-500 trees per acre. Recommended planting densities are decreasing under falling pulpwood and chip markets. Introduction of biomass energy could change this, but longleaf would not be well suited for this purpose.

It is historically documented that longleaf pine has better characteristics for lumber. While this may have been true with the naturally-grown trees that were the victors on poor sites over long time horizons, if longleaf is managed intensively to grow for volume, it will likely more closely resemble the wood characteristics of any rapidly grown conifer more so than its dense-ringed ancestors from which it garnered its illustrious reputation.

High-value products (poles), annual pine straw, increased wildlife, and future conservation values can all offset the extended timeframe between harvests. Cubbage & Hodges (1989) found that, under their assumptions, longer rotations for longleaf were better than shorter rotations, this would definitely be borne out where there are premiums for high-quality timber.

Risk reduction

Risks are reduced as longleaf is less susceptible to SPB (Nowak et al. 2008), fire (Franklin 1997), and hurricane damage (South Carolina 2006). Twenty year-old loblollys and longleafs growing on the same site, thinned 4 years prior to Hurricane Katrina showed remarkable evidence of this risk reduction. A startling 84% of the loblolly pines were damaged in the storm, yet only 36% of the longleaf pines were damaged. And for the longleaf pines damaged, more were just blown over or leaning rather than snapped (South Carolina 2006). This risk reduction, coupled with a longer lifespan and higher likelihood of durable solid wood products gives longleaf an advantage for longer-term carbon sequestration (Kush et al. 2004).

It is often a misconception that longleaf pines prefer poor sites with acidic, sandy soils. In fact, they are simply more apt to survive in these locations than many other tree species sharing their native range. A longleaf can thrive in fertile soils, yet the increased competition of other vegetation growing on these sites calls for a higher regime of management; mainly fire. If competition is controlled during establishment and into the height-growth stage and fire is not over-applied in the formative years, its productivity is comparable to other southern pines (Shoulders 1989).

Ecological

The diverse ecosystem of the longleaf pine sets it apart from its profuse cousin, the loblolly pine. Though it is possible for a loblolly stand on a prescribed burn regime to attain similar ecological functions as the longleaf, there are certain characteristics setting the two apart. The variations of individual longleaf specimen growth rates results in a mimicked variation of its neighboring vegetation. Certain areas of undergrowth in a longleaf stand receive more sunlight, while other areas may see a higher concentration of needle cover from a mature canopy. It is this variability, coupled with the renewing effects of fire generated from the natural fuel produced by these trees (long needles) that create such a great diversity within a longleaf stand.

Multiple-use management has long recognized that trade-offs exist and that management for one element sometimes precludes another. The unique components of a fire-dependent longleaf forest are the longer rotation, irregular stand structure, lack of dominant midstory, and greater canopy openings allowing increased grasses and forbs. Irregular thinning and cutting of irregular patches (Franklin 1997) are techniques can be used as a tool to create canopy openings as the stand matures creating an uneven-aged forest of multiple age classes.

Fire

Fire is the keystone to a functional longleaf pine ecosystem. If wildlife and ecosystem services are the primary objectives this element needs to be incorporated and will limit some of the economic gains from growth and pine straw income. Herbicide site prep and release may be used for stand establishment for fire-restricted areas, but will limit many of the fire-related benefits for wildlife and threatened and endangered species. Frequent burning and large canopy openings provide soft mast producing understory.

Though fire is a necessity for this ecosystem function, it is becoming increasingly difficult to implement in our current culture. Air quality laws, smoke and property damage liability concerns, and increasing numbers of structures and population pressures all threaten to limit the use of fire as a tool. Most states have responded by establishing legislation and training individuals to become prescribed burn managers. Some states have even formed prescribed fire strike teams to overcome the lack of service providers in this sector (America's Longleaf Initiative 2009). This will allow fires for these ecological purposes and protect the owners and agents from some of the associated risks.

Frequently managers are too timid with the intensity of burning. Scrub components will return if the burn was a little more severe than estimated, but ground cover may not return after too much midstory gets established (Landers et al. 1989). Occasional growing season burns are essential for setting back the midstory shrub species, and necessary for wiregrass seed production (Miller and Miller 1999). This can be done in patches and with ring around shrubby clumps to not disrupt ground nesting species which incorporate over 30% of the species of concern (Landers et al. 1989).

Wildlife

Twenty-seven threatened and endangered plant and animal species as well as 99 additional candidate species (Noss et al. 1995) are associated with functional longleaf pine ecosystems. Some of these species are listed in Table 1. Additionally, culturally important species, such as the northern bobwhite quail (*Colinus virginianus*) and wild turkey (*Meleagris gallopavo*) will thrive in this fire-managed community (Godbois et al. 2004).

Table 1. Sampling of Species of Concern Associated with Longleaf Pine Ecotypes.

Red-cockaded Woodpecker (*Picoides borealis*)
Gopher Tortoise (*Gopherus polyphemus*)
Bachman's Sparrow (*Aimophila aestivalis*)
Chuck-will's-widow (*Caprimulgus carolinensis*)
Red-headed Woodpecker (*Melanerpes erythrocephalus*)
Brown-headed Nuthatch (*Sitta pusilla*)
Henslow's Sparrow (*Ammodramus henslowii*)
Southeastern American Kestrel (*Falco sparverius* paulus)
Loggerhead Shrike (*Lanius ludovicianus*)
Eastern Indigo Snake(*Drymarchon corais couperi*)
Frosted Flatwoods Salamander (*Ambystoma cingulatum*)
Reticulated Flatwoods Salamander (*Ambystoma bishopi*)
Mississippi Gopher Frog (*Rana capito sevosa*)
Striped Newt (*Notophthalmus perstriatus*)
Black Pine Snake (*Pituophis melanoleucus* lodingi)
Louisiana Pine Snake (*Pituophis ruthveni*)
Southern Hognose Snake (*Heterodon simus*)
Gopher Frogs (*Rana capito Rana capito* aesopus *Rana capito* capito)
Eastern Diamond-backed Rattlesnake (*Crotalus adamanteus*)
Panama City Crayfish (*Procambarus econfinae*)
Camp Shelby Burrowing Crayfish (*Fallicambarus gordoni*)
Beautiful Pawpaw (*Deeringothamnus pulchellus*)
Rugel's Pawpaw (*Deeringothamnus rugelii*)
Chapman's Rododendron (*Rhododendron chapmanii*)
American Chaffseed (*Schwalbea americana*)
Hairy Rattleweed (*Baptisia arachnifera*)
Navasota Ladies'-tresses (*Spiranthes parksii*)
Texas-trailing phlox (*Phlox nivalis* ssp. texensis)

Although each of the species listed in Table 1 have a unique life cycle with specific needs, adequate management of a longleaf stand should simply strive to create variability using strategic harvesting times and patterns, burning, creating snags and openings, and restoring native plants. Clumps of shrubs and unscathed vegetation should be formed by exclusion areas or moist areas during burning (Franklin 1997).

Restoration of native grass such as wiregrass (*Aristida beyrichiana* Trin. & Rupr.), bluestem (*Andropogon* spp.), as well as other important grasses and native forbs such as partridge pea (*Chamaecrista fasciculata*), and lespedeza (GNPG 2008) is important for ecosystem function. Currently much of the native seed needed for longleaf restoration is unavailable or in limited supply, but work is being done to address this (America's Longleaf Initiative 2009). Legumes and chufa are encouraged for wildlife plantings Franklin (1997).

Control of invasive and colonizing species (America's Longleaf Initiative 2009) is also essential for long-term native ecosystem success. Wild hog (*Sus scrofa*) control is essential during the early regeneration years (Franklin 1997). One favorite food on which wild hogs fed voraciously during the times of early American settlement was the soft root system of young longleaf pine seedlings. These animals, introduced by the settlers, have been said to be one of the main destructors of native longleaf stock. One hog can destroy hundreds of seedlings per day. In the absence of large predators, mid-sized mammals (raccoons, fox, Mustelids, etc.) as well as deer, should be kept at desired population limits to achieve the ecosystem functions desired.

Social

Social aspects are on the push and pull of land use and conservation efforts from the federal to local levels. People desire a high quality of living and a safe environment free from air, water, noise, and blight pollution. There are sometimes conflicting objectives, such as the need for prescribed fire to promote a functional longleaf ecosystem which creates some amount of air quality degradation and some economic and safety risk. Other conflicts result from perspective values of land and public funds uses. Much of the land base in the longleaf range is increasingly being controlled by exurban, absentee owners and forest industry ownership has reverted to real estate investment trusts (REITs) and timberland investment management organizations (TIMOs). There is increasing pressure for food and fiber products to attain certification standards to assure consumers that they were grown by certain sustainability practices. Climate change is currently a critical topic that may have wide-ranging effects on agriculture and forestry as well as manufacturing and overall energy production and consumption. Ecosystem services markets may soon be integrated into a compliance framework and certain agriculture and forestry practices may earn credits. There is some understandable fear inherent in growing long rotation timber that may be host to threatened and endangered species, which has been involved in many investments being jeopardized by the Endangered Species Act in the recent past. Safe harbor agreements (America's Longleaf Initiative 2009, Miller et al. 2003) have been established in attempts to alleviate these fears while at the same time removing perverse incentives to avoid providing habitat for these rare species. Many of these social aspects are quite complex but are too ephemeral or value-laden to elaborate on in a scientific manner without presenting survey results.

CONCLUSIONS

A typical landowner will not likely be able to provide the land management attention that a staff of managers would perform on public lands. With a personal desire, coupled with technical and financial assistance from State and Federal agency professionals as well as private consultants, a landowner can make great strides in longleaf ecosystem restoration among the southeastern U.S.'s privately held lands.

Though industrial "free market" economics have borne out that longleaf pine does not produce the hassle-free economic returns of other southern yellow pine species, its addition to the biodiversity of the landscape alone is enough reason to expand its presence over more of the landscape, adding the better risk management, carbon sequestration (Kush et al. 2004), wildlife values, in addition to the core ecosystem conservation values.

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