Multiple Value Management:

The Stoddard-Neel Approach to Ecological Forestry

In Longleaf Pine Grasslands

A Joseph W. Jones Ecological Research Center publication

Joseph W. Jones Ecological Research Center

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

To demonstrate excellence in natural resource management, the Jones 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 our 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 and landowners and managers. The Jones Center serves as a science-based resource for public officials, policymakers and the public.

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Open longleaf pine forests provide numerous benefits for landowners including wildlife, recreation, aesthetics and timber.

Introduction

Society recognizes a broader range of values from forests than in the past. In addition to supplying wood products, forestland is now seen as a multiple-value resource that provides wildlife habitat, recreational opportunities, a clean and abundant supply of water and a host of other non-timber goods and services. Today's forestland owner or manager often desires a balance of various combinations of these multiple values.

Private landowners, natural resource management agencies and conservation organizations have many common management objectives in addition to, but also including, timber production. Particularly in the southeastern Coastal Plain, forest management practices have generally emphasized timber production. Silvicultural alternatives that more fully balance multiple values are presented less often to forestland owners and managers that have broader management objectives. One of the best examples of an ecological model of forest management that incorporates multiple values is found in the Stoddard-Neel Approach for management of longleaf pine grasslands.

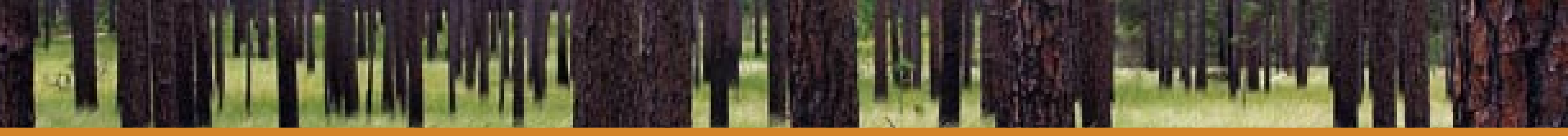
This publication will review the basic principles of ecological forestry for multiple values, their relevance to longleaf pine grasslands of the southeastern Coastal Plain and a case study of the Stoddard-Neel Approach as a model of ecological forestry in the region. While focused on the longleaf pine ecosystem, the information presented here can be adapted and applied to forests with other species of southern pine. This is not a comprehensive review of silvicultural systems or options, nor is it intended to provide management prescriptions or formulas as each property is unique. Instead, we hope to provide guidance for conservation-oriented forestland owners and managers who seek to balance economic and ecological values in a sustainable manner.

What is ecological forestry?

Ecological forestry uses patterns of **natural disturbance** and ecological processes to guide management decisions and silvicultural prescriptions for forests. It incorporates natural patterns of mortality, longevity, age structure and **regeneration** as well as processes such as fire and nutrient cycling. Ecological forestry embraces and works with the complexity of forest ecosystems rather than trying to simplify them. Although it relies on detailed knowledge of a particular forest system and even a particular tract of land, some general themes emerge.

Three general principles are common in ecological approaches to forest management: 1) retaining natural patterns and amounts of **biological legacies** following harvests and other management actions, 2) incorporating intermediate treatments that emulate natural stand development processes into silvicultural prescriptions and 3) allowing sufficient recovery periods between harvests to sustain biological diversity. These three principles make up what Dr. Jerry Franklin of the University of Washington has referred to as the "three legged stool" of ecological forestry (1). While ecological forestry requires that the unique characteristics of a given tract be considered, these general principles apply across forest types.

In longleaf pine grasslands, biological legacies include structural elements such as **snags**, fallen logs on the forest floor, stump holes and tip-up mounds. All of these features have well-documented structural and habitat values that add to forest complexity and biological richness. A feature that is not always immediately thought of as a "legacy" is the largely intact, multiple-age-class forest canopy that remains after small-scale disturbance events or harvesting operations that emulate these events. This perpetual forest cover is one of the primary characteristics of silvicultural approaches that utilize **single tree selection** methods and contrasts sharply with more common regional approaches to forest management that terminate the **stand** and replant. Other legacies that can be incorporated into an ecological approach to management of longleaf pine forests are the presence of a significant component of older trees in the stand as well as cohorts of advance regeneration established at multiple times and locations within the forest.



Historically, the most common intermediate stand development process in longleaf pine grasslands was fire. Today, **prescribed fire** is the manager's tool for incorporating this disturbance into ecologically-based forest management. Silvicultural decisions have consequences for prescribed fire in longleaf pine forests and these considerations should be factored into an overall management perspective. Another important **intermediate stand treatment**, particularly to restore densely stocked, even-aged plantation stands, is **thinning** that moves the stand toward more complex, spatially variable multiple-age-class structure.

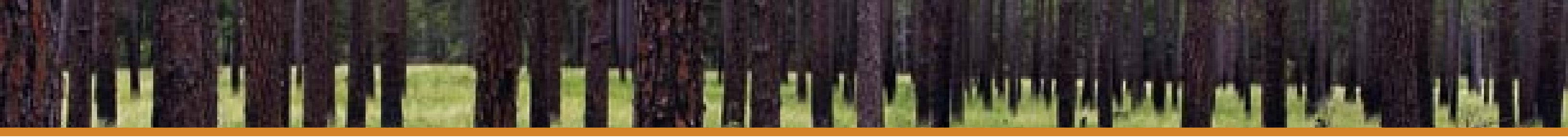
The third principle of ecological forestry is ensuring adequate recovery periods between harvests. In the longleaf pine ecosystem, adequate recovery periods are essential to maintain the integrity of **native groundcover**. The groundcover community is one of the most important components of the longleaf ecosystem for several reasons. It facilitates prescribed fire by supplying **fine fuels**, provides habitat and food resources for game and non-game wildlife and harbors many rare and endemic plant species. Adequate recovery periods should allow groundcover communities to return to these functional roles and build resilience between timber harvests. Recovery periods should also be long enough to build sufficient stocking of overstory longleaf pine to enable commercially viable harvest operations while also leaving adequate residual stocking to provide fine fuels for prescribed fire after the harvest.

Virgin longleaf pine forests had old trees (350 – 500 years old), trees of many ages and sizes and even-aged groves of regeneration among the matrix of all-aged canopy trees. These characteristics are best emulated by **uneven-aged** or multiple-age-class silvicultural systems. Two methods for multi-aged management, the BDq approach and irregular shelterwood, are often suggested as appropriate for longleaf forests.

The BDq method specifies a basal area (B), maximum diameter (D) and "q factor," or ratio of stems in successive size classes to define a structural target for forests following harvest. The diameter distribution of stands managed with the BDq method forms what silviculturists call a "reverse J" shape, with much greater numbers of smaller diameter trees. The primary goal of this system is to ensure a steady supply of timber for harvest by defining a "balanced" distribution of size classes in a stand. While it is an uneven-aged approach and does maintain forest cover, broader ecosystem values are not a specified management objective, the diameter distribution of trees does not necessarily reflect natural patterns and maximum diameter limits preclude a significant component of older trees in the stand.

The irregular shelterwood system specifies a rotation age at which the majority of trees are harvested, although substantial numbers of residual trees are left indefinitely. These trees are retained through subsequent rotations, thereby creating two or more age classes in the overstory. If applied with these objectives in mind, this system can reflect patterns of natural disturbance such as multiple age classes and the presence of older trees in the stand. Because of similarities to the natural disturbance patterns of hurricanes, this system is probably most appropriate in the coastal zones in the Southeast.

New cohorts of regeneration, such as the "dome" shown here, are continually recruited in multiple-age-class longleaf forests.



Over most of the range of the longleaf pine, however, single tree selection is the most appropriate analogue for the natural patterns of disturbance. An approach guided by ecological principles and volume regulation was developed by Herbert Stoddard and Leon Neel on quail shooting plantations in south Georgia and north Florida. It represents perhaps the best model of the application of ecological forestry concepts in longleaf pine grasslands. For more than 70 years, the Stoddard-Neel Approach (hereafter referred to as SNA) has demonstrated the ability to balance a broad range of ecosystem values while also realizing economic returns.

Historical roots of ecological forestry in longleaf pine

Growing up in late 19th century rural Florida, Herbert Stoddard was exposed at an early age to the intricate relationship between fire, pine grasslands and wildlife. Later, as a young biologist working in the Midwest, he was recruited by the U.S. Biological Survey for a contract project sponsored by the owners of shooting plantations in the Thomasville-Tallahassee area. Here he began the definitive study of the bobwhite quail and quickly connected the importance of frequent fire to maintaining the open woodland structure and early successional habitat necessary for quail to thrive. His classic volume on quail was considered a seminal work in the emerging discipline of wildlife biology, and he went on to a career of great renown in the field. The accomplishment for which he is less recognized, however, and that may be just as significant, was the development of a forest management system that integrated prescribed fire, **silviculture** and wildlife management.

As Stoddard carried out his quail study, he became intimately familiar with the workings of the region's longleaf forests. Wishing to retain Stoddard in the area after the initial quail study was completed, the plantation owners formed a cooperative to support his ongoing work with wildlife management and research. Stoddard was soon dispensing advice about all aspects of land management, including forestry. His unique approach to forest management was likely the result of his synthesis of many different influences. These undoubtedly included his formative years growing up in the flatwoods of Florida as well as his great respect for traditional local knowledge of land management. Stoddard also had an intellectual side. One of his closest friends was Aldo Leopold, whom he knew as a colleague from his time in the Midwest. Leopold had great respect for the professional abilities of his friend, including the system of forest management he had refined.

Leon Neel and Herbert Stoddard, late 1950's.

Leopold's letter of 1939 (Figure 1) praises Stoddard's development of "conservation methods" and suggests broader applicability than just game preserves. By this time Stoddard had formed his own consulting business and was working with most of the 250,000-acre plantation community that had developed in the Thomasville area. The war years brought a new focus on the forestry aspect of his management system. The federal government asked owners of forestland to help supply timber as a contribution to the war effort, and the plantation community wanted to do their share. They saw the value in continuing to manage their forests after the war and the role of forestry in Stoddard's business remained strong, to the point that he soon required a full-time assistant to meet the demands. Leon Neel, a Thomasville native, had just finished his forestry degree at the University of Georgia in 1950 and signed on as Stoddard's protégé. Stoddard and Neel continued to refine this system of management until Stoddard's death in 1970, with Neel continuing to practice today. Their approach to forest management is a unique combination of conservation ethics, wildlife-habitat relationships and a deep understanding of the natural dynamics of the longleaf forest. Forests under their management for the last 70 years have persuasively demonstrated the utility of the SNA and inspired countless foresters, conservationists and wildlife biologists. The forest and wildlife management program implemented on Ichauway is an adaptation of the SNA, and research at the Jones Center has helped to quantify and understand the mechanisms underlying this system of management. The remainder of this document will illustrate the basis for this approach to ecological forestry in the longleaf pine ecosystem and outline the application of core principles and concepts of the SNA.

Division of Wildlife Management

424 University Farm Place
October 20, 1939

Mr. Daniel L. Hebard
1500 Walnut Street Building
Philadelphia, Pennsylvania

Dear Mr. Hebard:

My statement that the Club had lacked a clearly defined land policy was intended as a criticism of the membership rather than of the officers. It seemed pretty clear to me that the Club had never threshed out the question of what it was there for, and certainly no set of officers could pursue a policy without a mandate from the members. I am note sure that the members have really made up their minds even at this time what they wish the club to be. I seized the opportunity to lay a general proposal before them. Naturally I bent the proposal to cover the things I am interested in.

My visits to the club were too short to allow me to check up on the Ford logging. I have no reason to doubt that your appraisal of it is correct. However, I did check up on the logging at Dukes and was pleased with it. I admit that my suggestion of teaming up with the Ford organization was premature in the sense that I had not satisfied myself of the quality of their work.

I am glad you share my impressions of Smith. I am anxious to meet Manville, and he is coming down here next week to talk over his plans. He was selected by Dr. Dice and I have no notion of what sort of fellow he is.

I have just spent several days with Stoddard and came away with a conviction that he has been too modest about the conservation methods he has worked out for the Southeast. They are commonly regarded as applicable only to game preserves, but in my opinion he has developed principles which are equally applicable to lumber company holdings, national forests, and all other owners of coastal plain longleaf. It is a great satisfaction to me to know of your confidence in Stoddard. I of course am biased, for he is one of my closest personal friends. I am lecturing to my students Monday on the Stoddard method of handling Southeastern pine lands.

As you say, letters are inadequate as a means of talking over these questions. I was awfully sorry not to be able to come up last summer, and so was Stoddard. We both had our hands too full to arrange a date at short notice. You may be assured, however, that I am as anxious as ever to meet you and to thoroughly discuss all these questions.

Yours sincerely,

Aldo Leopold
Professor of Wildlife Management

Figure 1: Leopolds letter of 1939 praises Stoddard's management approach and stresses its broader applicability.

Wetlands and their ecotones, or transition zones, provide important habitat for rare plants and amphibians.

Natural History

Coastal plain upland communities

An important baseline for the application of ecological forestry today is the natural forest community that historically occurred on a given site. The historical vegetation of the southeastern **Coastal Plain** was largely structured by the interaction of two elements — fire and water. Fire was a dominant ecological process across the landscape and originated from both natural ignitions by lightning and human ignitions by Native Americans and European settlers. Because of the continuity of fuels across a landscape unbroken by modern man's development, a single ignition might burn for weeks across hundreds of square miles until it reached a natural firebreak such as a river. The frequency, or return interval, of these fires is believed to have ranged from one to five years depending on site conditions. Based on what we know about historical climate conditions, this pattern of disturbance had been in place for millennia when European explorers first saw and described the great pine savannas of the Southeast.

Because of frequent fire, longleaf pine communities dominated the upland portions of the Coastal Plain landscape from southeastern Virginia to eastern Texas. Longleaf is the most fire tolerant of the southern pines and is the only species in which young trees can survive fire. It can thrive in a variety of site conditions, from very dry to moderately wet. As conditions moved to the wetter end of that range, slash pine was more common and typically dominated the wetter soils of flatwood regions within its range.

While longleaf dominated the uplands of the region, the broader landscape was a rich mosaic of embedded wetlands, linear drainages and streams and riparian systems with hardwood-dominated floodplain forests. These features played a vital role in the region's biological diversity and still harbor many of the Coastal Plain's rare species and natural communities, making them an important focus for conservation. Transition zones, or ecotones, between these wetland systems and the uplands were defined by fire and hydrology, with some degree of variation over time through climate cycles of drought and wetness. These ecotones are especially significant as habitat for rare plants and amphibians.

Silvics of longleaf pine

Longleaf pine has many qualities that make it suited to long-term management under an ecological forestry model based on patterns of natural disturbance. It is the longest lived of the southern pine species, with a life span of 400 or more years. It produces seed in widespread regional **masting events** on an average five to ten year interval, allowing managers to continually incorporate regeneration into a stand. Longleaf seeds require bare mineral soil to germinate and successfully establish, which can be provided by any type of soil disturbance or, preferably, a recent fire event prior to seedcast. Fire prior to seedcast also reduces fuel loading for the fire season following germination, thus making it more likely that seedlings will survive subsequent fires. Seedcast occurs in late fall, with seeds germinating quickly after soil contact. For several months after germinating, young seedlings are quite vulnerable to fire. Those that are growing in more suitable conditions soon begin root collar diameter growth, developing a thick flush of needles that insulate the terminal bud from fire.

The grass stage, named for the fact that the young longleaf resemble a tuft of bunchgrass growing low to the ground, may last for two to ten years or more. During this time, the trees put energy into developing a root system. In a masting event, seedlings are distributed fairly evenly across the forest, assuming there is adequate mineral soil for germination. Seedlings that survive through the grass stage and eventually initiate height growth are found in small groups located in **canopy gaps**. Several factors interact to produce this spatial pattern: heavier fuel loading, thus hotter fires, results in higher mortality of seedlings underneath canopy trees; competition for water and nutrients is greater close to canopy trees; and additional available resources such as light and nutrients are found in gaps. Using gap fraction (i.e., percent open sky) as an index of these collective factors, regeneration can be thought of as a three-stage process. Research at the Jones Center has shown that with a gap fraction of <35 percent, seedlings germinate but rarely survive to the grass stage. Between 35 and 60 percent, they establish and persist in the grass stage. In areas with gap fraction greater than 60 percent, seedlings emerge from the grass stage and initiate height growth (2). While longleaf pine is often thought of as a shade intolerant tree, the successful establishment and persistence of seedlings in moderately shaded conditions (35–60 percent gap fraction) suggests qualities of a tolerant species. These seedlings function as advance regeneration in that they are established and waiting to be released as openings develop in the canopy.

Longleaf pine germinant.

Grass stage longleaf pine.

The patches of regeneration that survive in gaps can be quite dense. Measurements in gaps on Ichauway have shown densities of 1,500–3,000 trees or more per acre. As the seedlings emerge from the grass stage, they grow in height quite rapidly. As time goes on, some saplings in the gap begin to show dominance while others die in a self-thinning process. Some seedlings are killed by fires that occur when their buds are elongating in the late spring. As mature canopy trees surrounding these regeneration gaps die or are harvested, younger trees that have persisted in the gaps are released. Longleaf is unique among the southern pines because it can grow slowly in a suppressed state for long periods of time and then respond quickly when released. This periodic masting and gap regeneration pattern of natural longleaf forests produces a multiple-age-class forest that is basically comprised of many small even-aged patches.

Longleaf has a reputation for being a slow growing tree compared to other southern pine species. This reputation comes in large part from the slower growth in the early years of its life. Given similar site conditions, and assuming that the longleaf is not suppressed by competing trees, growth becomes equivalent to loblolly and slash pine at about age 20–25 (3). Longleaf will also continue to grow for much longer than other southern pines, continuing to produce value-added products such as heart pine in older trees.

As gaps are created through mortality of mature trees, additional resources allow grass stage seedlings to begin height growth.

Lightning is the most common agent of mortality in longleaf forests.

Collectively, these factors contribute to the suitability of longleaf pine for a long-term approach to management based on single-tree selection. The potential longevity of the species enables a long-term perspective on management. The frequent small gaps found in natural longleaf forests suggest that single-tree selection is a good fit for the spatial patterns of the most common natural disturbances. The fact that longleaf regeneration shows some degree of tolerance for shade allows for a single-tree selection approach while facilitating ingrowth and perpetuation of the forest canopy. Finally, while natural disturbances occur infrequently at large spatial scales, small scale frequently occurring events are much more common, suggesting that this is a more appropriate model to emulate.

Natural disturbance patterns

An understanding of the natural disturbance agents that shape forest structure is central to the application of ecologically-based management of forests. Disturbances that cause mortality in longleaf pine include lightning, wind, insects and fire. The size and frequency of dominant disturbance events can vary by type and geography, ranging from infrequent large-scale tropical cyclones in the coastal zone to single-tree mortality events that are much more frequent and widespread such as lightning.

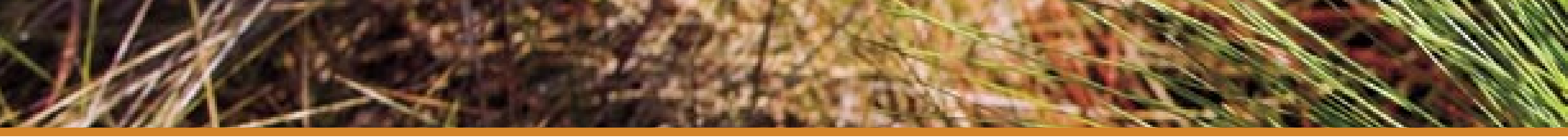
Although examples of large-scale disturbances, such as hurricanes, are often cited as a basis for even-aged silvicultural systems, such a model is restricted to the coastal zone and is perhaps overemphasized. After all but the most severe storms, a portion of the pre-storm forest remains alive, contributing biological legacies and greater structural complexity than typical even-aged harvests. Research also suggests that storms of stand-replacing intensity only occur in a given location on average every 260–400 years, much longer than any even-aged rotation (4). In the intervening period between these infrequent disturbances, the much more common small-scale disturbances are the primary drivers of forest structure and dynamics.

Lightning and wind are the most common agents of mortality in natural longleaf forests. The southern portion of the longleaf range experiences some of the highest lightning frequencies in North America. Lightning strikes typically result in the death of single trees, but can also impact small groups of trees. Studies of mortality from natural causes on Ichauway documented the loss of one tree per acre over a five-year period, with the majority of the mortality caused by lightning (5).

Mortality from wind can range from windthrow or snapping of single trees, to larger blowdowns from thunderstorm downdrafts and tornados, to hurricanes that impact large landscapes. Generally, smaller scale disturbances occur more frequently on a given site. Larger wind disturbances often leave some portion of trees within the disturbed area alive. These trees provide an example of a biological legacy of the disturbance and, over time, contribute to the structural complexity we associate with natural stands.

Fire and insects are less frequent agents of mortality. Although not often regarded as a cause of mortality in longleaf pine, fire can kill longleaf as germinants and as saplings when buds are elongating in the spring. Mature trees can also be killed by excessively hot fires or improper reintroduction of fire after it has been excluded from a site for some time. Death from insects such as bark beetle occurs infrequently, tends to be relatively isolated and is often found in combination with other disturbances such as lightning.

Small-scale windthrow events can also kill individual trees.



The SNA bases its harvest patterns on the most common and frequent agents of natural mortality: lightning and small-scale wind events. These disturbances in natural longleaf pine forests tend to result in small openings in the canopy that may expand over time. Thus, at the forest scale, the result is a multi-aged forest consisting of many even-aged patches of varying sizes. Whereas even-aged silvicultural systems have analogues in larger, infrequent, catastrophic disturbances, the SNA, which utilizes individual tree selection, attempts to mimic the small-scale, frequent natural disturbances. The rationale for this approach is that since the indigenous biota evolved under the most common local disturbance regimes, mimicking as closely as possible these more common disturbance patterns will best maintain ecosystem integrity. Although timber marking is based upon natural disturbance regimes, it is not a fixed process and is often modified as changes in the forest condition are encountered, even within a single stand. This flexibility helps to foster structural diversity in the forest.

Philosophy of the Stoddard-Neel Approach

Rather than a formal silvicultural system, the SNA is as much a philosophy of how a forest ecosystem — in its entirety — should be managed and nurtured while still deriving economic benefit. Inherent in a landowner or manager's decision to practice ecological forestry is a strong land ethic and an appreciation of the multiple values of the forest ecosystem. Perhaps no one has summarized the dichotomy of perspectives on forest management better than Aldo Leopold in his classic Sand County Almanac.

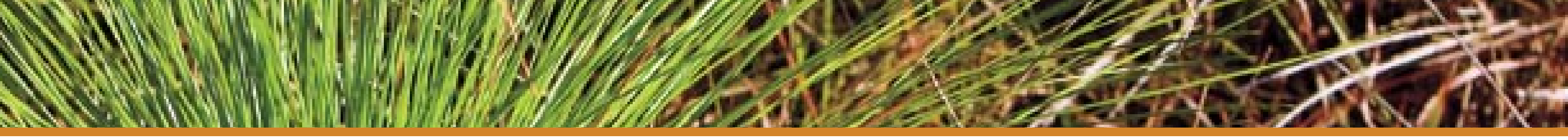
> *"In my own field, forestry, group A is quite content to grow trees like cabbages… its ideology is agronomic. Group B on the other hand, sees forestry as fundamentally different from agronomy because it employs natural species, and manages a natural environment rather than creating an artificial one… It worries about whole series of secondary forest functions: wildlife, recreation, watersheds, wilderness areas. To my mind, Group B feels the stirrings of an ecological conscience."*

Gopher tortoise.

The agronomic model of managing southern pine forests has emphasized economic productivity first and then identified ancillary benefits such as wildlife or water and the degree to which they can be incorporated in that model. The alternative perspective is a better fit for ecological forestry. When managing for the ecosystem as a whole, what economic benefits can be derived from this approach to management?

This perspective encapsulates one of the central tenets of the SNA. It seeks to balance a range of attributes of the forest ecosystem rather than trying to maximize any one aspect, such as timber or wildlife. Tradeoffs are an inherent part of the matrix of land management decisions. When management seeks to maximize any one attribute of the forest, other elements suffer.

Because the SNA seeks to preserve all aspects of complex forest systems, it integrates consideration of all resources and all facets of forest management (e.g., prescribed fire, silviculture and wildlife management, timber marking and harvest operations) into all management decisions and at several different scales (stands to landscapes). This implies that a practitioner of the SNA must have an appreciation of all these characteristics and practices, and their administration cannot be split along disciplinary lines. When multiple people are responsible for making the management decisions and carrying out the on-the-ground management, there must be true cooperation and all must ascribe to a similar land ethic.



The SNA views the forest as a perpetual entity that maintains continuous canopy cover. It incorporates time as an ecological factor and recognizes the long temporal scales at which longleaf forests operate, as well as the long-term perspective that management decisions must incorporate. It values the investment in time that mature forests represent and takes a patient approach in achieving management objectives. Periodic harvests emulate natural patterns of mortality found in native longleaf forests by utilizing single tree selection to harvest a relatively small percentage of the standing volume at any given entry. Managers pay careful attention to regeneration opportunities to ensure ongoing recruitment of new cohorts of trees into the stand. Most importantly, the management perspective of the SNA goes beyond just the trees to embrace the broader ecosystem and landscape scales. One of the hallmarks of the system is to identify species and communities within the management area that are rare or declining and place management emphasis on them. This is one aspect of the SNA that has contributed to its ability to sustain rare and endangered biota while simultaneously managing for consumptive use.

Philosophy of the Stoddard-Neel Approach

» The foundation of the SNA is a strong land ethic and a conservation-based perspective on management and stewardship of the land.

» The SNA incorporates time as an ecological factor and recognizes the long time scales at which longleaf forests operate. It takes a patient approach in achieving objectives through management.

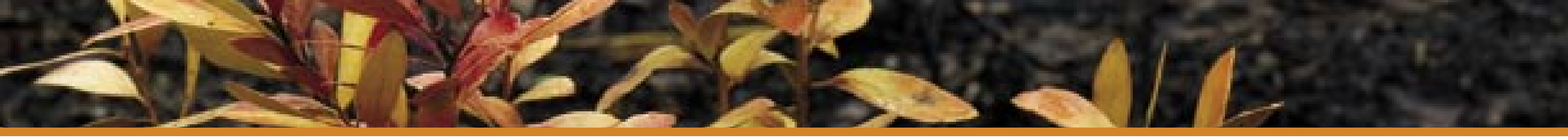
» Rather than thinking in terms of rotations of set length, the forest is viewed as a perpetual entity that is never terminated.

» The SNA seeks to maintain the forest ecosystem in its entirety, including all species and communities, as well as ecological processes and interactions

» An overarching goal is to balance a range of values from the land. The SNA does not seek to maximize any one amenity, recognizing the inherent tradeoffs in managing for multiple objectives.

» The SNA identifies species and communities within the management area that are rare or declining and prioritizes their stewardship. This facilitates conservation of rare elements while pursuing other land management objectives.

» The SNA is not a preservationist approach; it utilizes the resources and derives some economic return, although that is not the primary management objective.



Application of the Stoddard-Neel Approach

The practice of silviculture involves both the art and science of managing a forest to meet particular objectives. The science results from a thorough understanding of supporting disciplines and research while the art comes from the practitioner's experience and judgment regarding which practices most effectively meet the stated objectives. Within this general framework, the SNA balances the qualitative "art" aspects of the silvicultural practice with a keen understanding of the underlying forest ecology (i.e., the quantitative, "science" end of the spectrum).

Because the SNA embraces the complexity of the longleaf ecosystem and works with that complexity, understanding and application of the approach is inherently more complex than other silvicultural systems practiced in the region. It has been criticized for the lack of a concise formula or easily transferable prescriptions. In reality, there are principles and quantitative guidelines for application of the SNA that managers can adapt to their own properties. While the finer points of the artistic side of this approach to silviculture come with time and practice, application of these basic principles and guidelines outlined in the following pages goes a long way to achieving the goals of the system and are not difficult to grasp.

Prescribed fire

Prescribed fire is the unifying theme of many aspects of the SNA. Needlecast from overstory pine is the most important component of the fuel bed in longleaf pine grasslands (6). The SNA is unique because it is the only silvicultural system in which maintenance of fine fuels for prescribed fire is consistently factored into management decisions. The role that stocking levels and distribution of overstory trees will play in providing fuels, as well as continuity of fuels, for prescribed fire is critical and is considered when marking trees for harvest. Other factors interact with these variables to determine fuel loading and fire behavior, such as understory composition, hardwood stocking and overall site productivity. For instance, all other factors being equal, a stand with native groundcover dominated by bunchgrasses can provide adequate fuels for frequent fire with lower overstory stocking than is required for an oldfield site with few grasses and many hardwoods in the understory. This suite of interacting variables is unique to the land use history and current condition of each site, thus making formulaic fire prescriptions difficult. However, some generalities apply.

Frequency is regarded as the most important aspect of a prescribed fire regime. In general, the application of prescribed fire as frequently as fuels will allow is desirable from both the standpoint of biodiversity and habitat structure (7). For most sites, a fire return interval of no longer than two to three years should be a management goal. Prescriptions should be based on clearly stated goals and objectives for a given burn unit or stand. Within these general guidelines, some variation in prescribed fire regimes is desirable, as natural fire cycles were undoubtedly variable. As the land responds to fire through time, conditions will change, objectives will evolve and prescriptions will of necessity be modified. While the effects of individual fires are easily discernable, fire should be thought of as a recurring process or regime rather than a discrete event.

There has been much debate about the merits of growing season versus dormant season fire, and these debates will continue. While growing season fire is a useful tool for extending the number of quality burn days and meeting some management objectives, it is not necessarily an ecological imperative (8). Restricting prescribed fire exclusively to either the dormant or growing season will limit the number of days available to burn, which inevitably leads to less frequent fire across the landscape. By utilizing both seasons to meet specific objectives, managers give themselves a greater number of optimal burn days and can introduce variation of season over time on a given site. In addition to the maintenance of the overall structure of open longleaf pine grasslands, prescribed fire is an essential component of a strategy to capture longleaf regeneration, ultimately influencing the overall demographics and stand dynamics of a site.

Frequent prescribed fire is the unifying theme of many aspects of the SNA.

The SNA utilizes single tree selection as a principal tool in managing forests for multiple values.

Timber management

The SNA is unique not for the specific silvicultural tools utilized, but rather for the focus on maintaining the forest ecosystem with all its components, intact and in perpetuity. It is an inherently conservative approach to forest management with no one factor or amenity maximized at the expense of other attributes of the ecosystem. The SNA utilizes classic silvicultural tools that may seem novel to some, simply because they are all but forgotten in the context of the intensive management commonly practiced today. In reality, it is not a distinct silvicultural system in the strictest sense, but rather a unique mix of conservative silviculture, a strong land ethic and a philosophy of conservation and stewardship.

The SNA relies on single tree selection as its basic tool. Timber marking and harvesting in the SNA are conservative, with trees selected for removal based on improving the overall stand condition, both immediately and over the long term and with regard to maintaining the overall ecosystem. Small groups of trees may ultimately be marked for removal, but only after each has been carefully evaluated for its role in the stand as a whole. Forest cover is maintained in perpetuity, incorporating multiple age classes as new cohorts of regeneration are continually recruited into the stand. The forest is viewed as an investment, in which the "principal" is maintained or built in the form of standing timber and only a portion of the "interest," or growth of the forest since the last harvest, is taken at any time. Long time scales are incorporated into forests managed under this system; managers think in terms of centuries rather than decades.

In preparing to implement the SNA, the amount of timber present is an essential piece of information. A standard 10 percent timber inventory should be conducted initially and every 10 years (or before the next harvest) to determine the volume of timber present. Harvests are typically conducted in a given stand on average every 10 years. This timing may be modified to some degree as stand and market conditions warrant. The allowable cut for a property is some percentage of the growth during the period between harvests. In determining the allowable cut, growth is determined for the property as a whole and the allowable cut calculated for the total area, even though harvest may occur in only a portion of the stands (i.e., those up for harvest). Thus, one may cut more volume than the growth increment in any particular stand, but not from the property as a whole. This allowance helps to prevent a specific stand from exceeding the maximum carrying capacity for that site and suffering poor individual tree growth and mortality. For long-term sustainability, however, timber volumes across the entire property should not decrease, nor should the diameter distribution of the forest show a decline in individual tree sizes. The percentage of growth that is chosen for harvest will vary with stand condition, stocking, age and structure, as well as ownership objectives, but will typically range from 60 – 80 percent. Harvesting less than the cumulative growth provides a buffer for natural mortality and allows volume to build over time, providing more options for the future.

The visual appearance of patches of young saplings in canopy gaps may imply that these openings are necessary to capture regeneration, leading managers to create gaps in order to incorporate regeneration into the stand. Because of the random and sometimes infrequent timing of masting events, creating gaps before grass stage seedlings are established may only serve to release existing understory hardwoods, thus making future recruitment of longleaf regeneration difficult. Before creating gaps, advance regeneration in the form of grass stage longleaf seedlings should be present. Creating larger gaps with hard edges can also cause wind eddies that make it difficult for prescribed fire to move across the gap, exacerbating hardwood control problems.

Young saplings in a canopy gap.

It is perhaps more accurate to characterize the SNA perspective on regeneration as working with existing canopy openings and variation in overstory stocking rather than artificially creating gaps, especially in established longleaf forests. Longleaf pine tends to reproduce in masting events. Because cone development takes two years, managers are able to anticipate good seed crops well in advance. The fire regime should be modified to capture regeneration during these mast years in areas where recruitment of seedlings is needed. Low-intensity, late-season burns preceding mast seed crops will prepare a bare mineral seedbed and reduce fuel loading in the following year, as seedlings should not be burned the year following establishment.

Research suggests that longleaf germinants can survive under moderate canopy cover. As long as there are places throughout the stand where gap fraction is adequate (>35 percent) to allow germinants to survive, grass stage seedlings should be able to become established. These can persist in the grass stage until canopy openings are created either naturally or through harvest, allowing seedlings to initiate height growth and form the classic dome-shaped patches of saplings. In most cases, the openings that allow this transition from grass stage to sapling are relatively small, approximating the footprint of one or two mature tree crowns, and the removal of one or two trees in a harvest can provide adequate openings in the canopy to release regeneration. Longleaf pine seedlings can grow well in canopy openings as small as 0.25 acres. Thus, canopy openings created to release regeneration should not greatly exceed that size, normally ranging from a single tree to 0.5 acres (10).

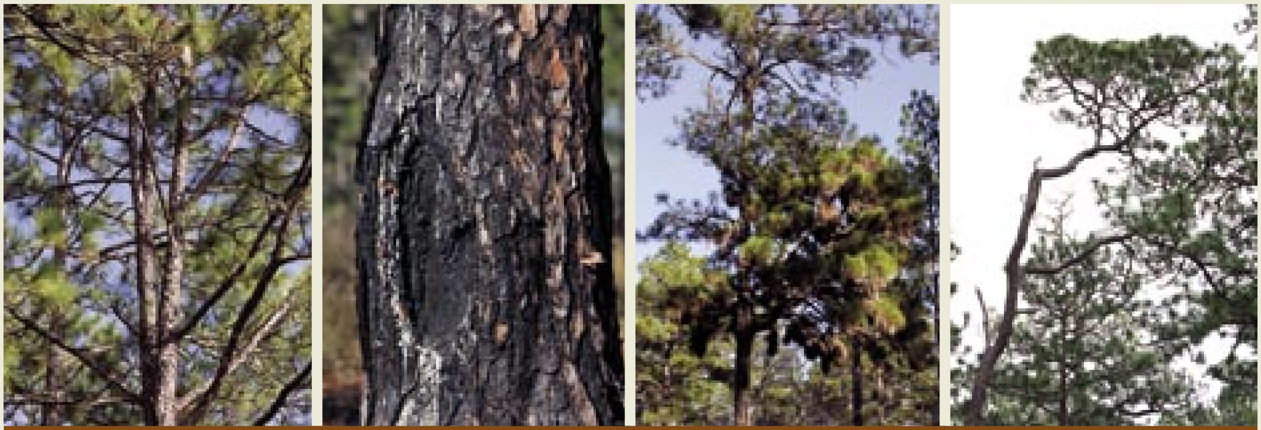
Canopy openings form incrementally through time from natural mortality of individual trees. Tree selection for harvest should encourage and take advantage of variation in overstory stocking by working with existing openings and slowly developing new ones over time. In the SNA, the enlargement of canopy openings to release regeneration is often spread over multiple entries rather than attempting to accomplish this in one harvest. This illustrates the application of one of the basic principles of the approach — the incorporation of long time scales into management decisions. Mature trees on the south side of well-established regeneration patches are preferentially marked for removal to enlarge the canopy opening and release these patches by providing more light and reducing competition for resources.

Longleaf pine seedlings can grow well in canopy openings as small as 0.25 acres.

Timber Marking

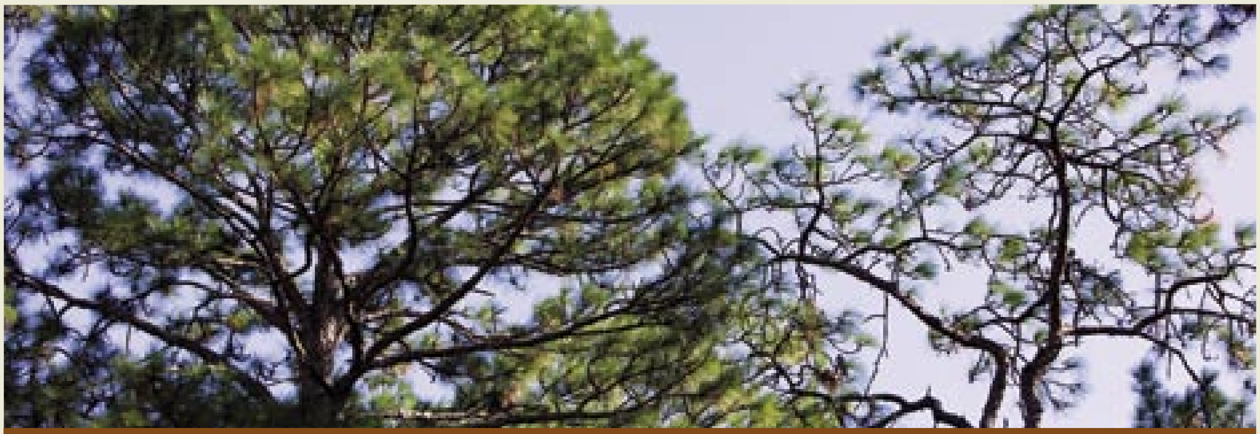
Criteria for individual tree selection may vary depending on the site and its objectives, but marking should concentrate on the following:

- Build toward, or maintain if already present, a substantial component of older trees in the stand. Older canopy dominants are a valuable source of seed for regeneration, fine fuels for prescribed fire and nesting habitat for rare species. Target age for older pines will vary by species with the goal of retaining some longleaf pines of 200+ years, and loblolly, shortleaf and slash in the 80–100 year range.
- Longleaf pine trees should be preferentially retained when harvesting in upland mixed pine stands. However, slash pine naturally occurs in wetter sites in its range and this should be considered when manipulating species composition through harvest.
- “Defective” trees should be preferentially harvested, but not totally eliminated from the forest. Such defects selected for removal include forked, crooked or diseased (e.g., fusiform cankers) trees and trees with severe basal fire scars. Within an overall goal of improving stand quality, elements of structural diversity that provide habitat for wildlife, such as “witches brooms” and “character trees” should be retained in the stand.



Forked tree, basal fire scar, witches broom, character tree (l–r).

- Although longleaf can grow in a suppressed state for much longer than other southern pines and still respond to release, suppressed trees in which the terminal bud has lost dominance typically do not respond and should be targeted for removal.
- Trees with low crown vigor will be preferentially removed, while retaining trees with large, dense crowns. Characteristics of low crown vigor include smaller **crown ratio**, sparse needle density and lighter foliage color.



Dense (l) vs. sparse (r) crowns. Trees with sparse crowns are preferentially removed.

Periodic inventory determines appropriate volumes for removal.

- Harvesting must balance a relatively open, multi-aged canopy structure with sufficient stocking to provide fuels for the frequent use of prescribed fire and to ensure regeneration. Trees that might otherwise be removed because of poor quality are often retained based on their location if needlecast or seedcast is needed in that area.

- Rather than trying to achieve a uniform distribution of stocking through a stand, some variation in stocking is desirable. Variation in stocking should include adequate habitat for species that require more densely stocked, closed canopy conditions.

- Salvage logging of merchantable dead trees between harvest entries is compatible with the SNA as long as the volume removed is to be applied toward the allowable cut.

- Some standing and down dead trees should be continually maintained throughout the property for their wildlife value. Some guidelines recommend maintaining two to four snags per acre for wildlife habitat (11).

- Trees are marked conservatively, erring on the side of marking too little. It is much easier to remove timber in a subsequent harvest than it is to replace it once it has been cut. As Mr. Neel says, “It takes 100 years to grow a 100-year-old tree.”

The frequent use of fire over time is the preferred management for the control of hardwoods in small size classes. Mechanical and chemical control of hardwood competition may be required in some instances but should be used only to the extent necessary to get back to a point where fire can control hardwoods. Like prescribed fire, use of chemical treatments should be driven by objective, with different chemicals and/or timing of application dependent on the objective. In choosing chemical treatments, consider not only what vegetation is controlled, but also what vegetation is desired and will remain following treatment.

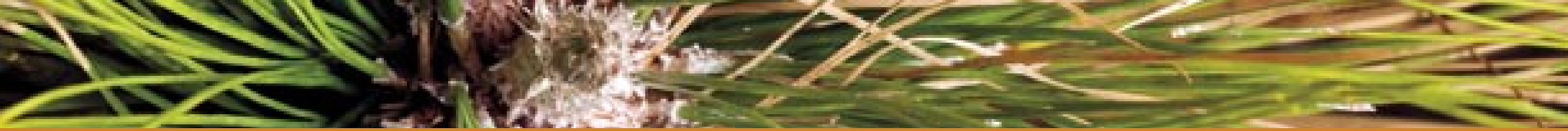
Harvesting in any given stand should be infrequent, with the goal of allowing herbaceous groundcover to recover from previous logging events. Typically, stands should be given eight to ten years to recover between harvests, although the time can vary with site quality and stand condition.

Logging

A critical component of implementing the SNA are low-impact logging practices that consider the overall goals and multiple objectives for the land. The most careful marking job is severely compromised if logging damage occurs to trees intended to remain in the stand. Minimizing damage to native high-quality groundcover and regeneration patches is another consideration that factors into logging operations that are compatible with ecological forestry. Logging crews should have an understanding of the overall land management objectives and philosophy, as well as conservation values that may require special consideration in harvest operations.

Intensive merchandizing of harvested trees is important to implementing the SNA because it helps support the conservative marking of trees. That is, maximizing the value of trees at the loading ramp by careful allocation to different product classes can greatly increase the return to the landowner and offset lower harvest volumes. The more complex nature of this type of logging also requires that sellers consider quality of logging when assessing timber bids. In the end, it may be more financially advantageous to take a lower bid from a logger who is sensitive to the management objectives and is willing to accommodate them.

Careful merchandising into different product classes maximizes returns from harvested trees.



Low-impact Logging

General guidelines for low-impact logging include:

- Timber harvesting should be planned in detail. A conference should be held between the buyer and landowner (or representatives) in advance to discuss the roads used, type of equipment and protection of natural features. Understory damage should be minimized by restricting harvesting to drier times so that logging will not cause excessive rutting. The owner or manager should reserve the right to cease operation if conditions are deemed unsuitable.
- Loading ramps should be located in previously disturbed areas, preferably old fields or food plots. Drag trails should be concentrated on roads, firebreaks or other previously disturbed areas. These areas can be easily restored to their traditional role in the management infrastructure after harvest operations.
- Logs should be skidded with the large end elevated. If possible, knots and limbs should be trimmed flush with the trunk prior to skidding to reduce disturbance of the understory, especially in areas of native groundcover. Limbing gates should not be used.
- Care should be taken to avoid skinning standing trees during felling and dragging, and seedlings and saplings should be protected during the operation. Snags not marked for removal should be protected.
- Any lodged tree should be freed or removed immediately.
- Tops should be removed in place and flat lopped to encourage burning and decomposition. Tops and slash should be removed from around the base of trees and from patches of regeneration.
- Loggers must avoid areas specially flagged for protection.
- The season of logging may be affected by considerations for certain wildlife species, such as nesting bobwhite quail. Logging operations may be required to take special precautions for rare species, such as gopher tortoise burrows or populations of rare plants (12).

Wiregrass directly seeded in recently thinned pine plantation.

Restoration of pine plantations

Although often thought of as relevant only to established, mature longleaf stands, the SNA can be applied to restore any land that has had longleaf pine and native groundcover at some time in the past. Indeed, this is the situation that many landowners and managers face as they contemplate restoring densely stocked young plantations of slash or loblolly pine back to multi-aged longleaf forests. One solution for this scenario is to liquidate the offsite pine species and replant with longleaf. However, this sacrifices a considerable investment in time and progress toward mature forest structure. An alternative approach is to phase in conversion to longleaf over time by harvesting a portion of the stand, creating small gaps and then replanting them with longleaf (13). This technique has been used successfully in trials but requires patience as some sites respond more favorably than others. This approach to conversion illustrates, again, a long-term perspective on forest management.

Conversion to longleaf over time using this method begins with a traditional row thinning with individual trees marked for removal in remaining rows. No effort should be made to achieve uniform density across the stand; some degree of variation is desirable and is to be expected based on the condition of trees within the stand. Just as with mature stands, thinning should be oriented toward stand improvement, removing trees of low vigor and those with defect. However, adequate canopy should be left so that there is a supply of needles for fine fuels for prescribed fire. This will dictate leaving some trees within the stand that would otherwise be removed based on their quality. An active fire management program with a goal of burning no less than every two years should be established if it is not already in place.

This first thinning is also an opportune time to begin the restoration of native groundcover by planting native warm season grasses (NWSG). After the thinning, the open canopy conditions and light soil disturbance in takeout rows provide good conditions for direct seeding of NWSG. Several southeastern ecotypes are becoming available from commercial suppliers; these should be used rather than seed from outside the region.

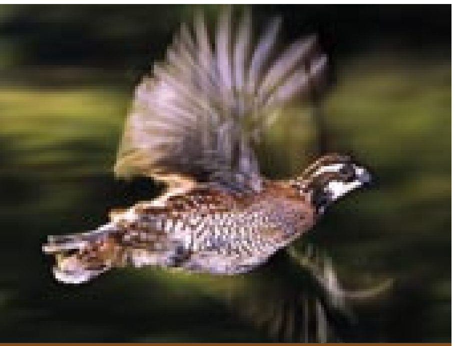
At the second thinning, small gaps (~0.25 to 0.5 acres) should be created in a portion (for example, 20 percent) of the stand that are then planted in longleaf. These gaps should be based on patterns of structural variation naturally developing in the stand (i.e., utilize and build upon existing and developing gaps). They should vary in size, shape and distribution, avoiding cookie cutter geometric shapes or regimented distribution of gaps within the forest. Again, it is vital to strike a balance in stocking to ensure enough trees to provide adequate fuels for prescribed fire while allowing sufficient light for growth of planted longleaf seedlings. Gaps do not necessarily need to be "clean"; natural disturbances often leave trees in gaps. These residual trees provide structural variation and fine fuels for continuity of fire across the gaps. However, incorporation of residual trees in gaps may represent a tradeoff that should be considered in terms of their impact on the growth rate of underplanted seedings (14).

A potential liability of this conversion process is the release of hardwoods present in the understory when gaps are created. By limiting the size of openings, adequate fuels in the form of pine needles from the surrounding pine overstory can be maintained for frequent prescribed fire. While hardwoods should be controlled primarily by frequent prescribed fire, sometimes burning alone is not able to achieve the desired results. In some instances, mowing in combination with frequent burning can increase fine fuels in the form of grasses. For this reason, seedlings should be planted at spacings that allow access for tractors and other equipment. Depending on site conditions and the amount of hardwoods present, herbicide treatments in gaps prior to planting longleaf seedlings may be necessary to reduce competition and facilitate longleaf establishment.

After eight to ten years, more gaps are created (based to the degree possible on those that are already forming naturally in the stand) and another cohort of young longleaf is planted. This process is repeated as needed until the stand is dominated by multiple age classes of longleaf and sufficient numbers and distribution of mature longleaf trees are present to contribute seedfall for natural regeneration.

Integration of wildlife management

Wildlife management is often a primary component of an overall mix of objectives for many landowners. While it is beyond the scope of this publication to review detailed wildlife management practices for game species of the South, it is important to examine the way common practices interact with the forest ecosystem. Under the SNA, wildlife benefits, just like timber, are a result of managing for the ecosystem as a whole. Similarly, if management seeks to maximize populations of a given game species, there are other aspects of the ecosystem that will suffer. The SNA has demonstrated its ability to maintain huntable populations of wildlife in the overall context of ecosystem management. Lands managed under this system also provide habitat for a wide range of non-game species, including many of the rare and endangered species associated with the longleaf system.



Bobwhite quail.

Frequent prescribed fire is the most important wildlife management tool available to managers and it is also the most cost-effective. The open, park-like structure of frequently burned woodlands provides habitat for a unique faunal community associated with longleaf pine grasslands. A diverse and abundant community of understory legumes, which are an important food source for a variety of wildlife, is also linked to this frequent fire regime.

Another common wildlife management practice in the Southeast is soil disturbance and establishment of food and cover crops in fields and food plots. A component of early successional habitat in the landscape can enhance populations of many game species. Because of land-use history, many properties already contain an existing mosaic of habitats that range in their degree of disturbance. Existing fields and food plots should be incorporated into the system of wildlife plantings as much as possible. If additional food plots are desired, they should be located in previously disturbed areas rather than disking up high quality groundcover. These features should be permanently sited. Avoid the use of aggressive exotic plants, such as Lespedeza bicolor, as alternatives are available that serve similar functions. For quail, many managers rely more on supplemental feeding than small food plots embedded in the woods.

In recent years, extremely low rates of pine timber stocking have been advocated as a means of boosting quail populations. An open woodland structure that allows sufficient sunlight to reach the forest floor to support a species-rich grass-dominated understory is an important component of quail management. However, reducing stocking to some of the suggested levels can, in some cases, reduce the supply of pine needles to a point that prescribed fire alone is not sufficient to maintain understory vegetation, ultimately leading to hardwood control problems. Lower densities may not be appropriate for other species of interest, such as whitetail deer or red-cockaded woodpecker. Very low stocking levels can also limit future options for timber management, thereby reducing timber income and cash flow from the property over the long term.

Economics

Regardless of the value placed on the non-timber amenities that come from ecological forestry, the economic feasibility of a chosen management style is a reality check that most landowners and managers must face. While many may be comfortable with the concept of not attempting to maximize timber revenue, the ability of the land base to support its basic operating expenses, such as property taxes and management costs, is often essential.

Ecological forestry is generally assumed to involve significantly poorer economic performance than more intensive approaches to forest management. This may be true when common business analysis tools are used, such as Net Present Value (NPV), and when timber returns are analyzed in isolation, but more holistic analyses are perhaps more appropriate. The SNA captures a wider range of non-timber values, some of which can be priced in the market place. It emphasizes lower costs of management, such as utilizing natural regeneration rather than incurring replanting costs. There are more frequent, evenly spaced cash flows from harvesting operations. Because there is greater liquidity (i.e., mature timber is always available for harvest), there is greater flexibility in market timing, allowing the landowner to take advantage of favorable market trends. Longleaf forests managed under this system can also produce more value-added timber products, such as poles and heart pine lumber, as well as offering non-timber values such as hunting leases.

Permanently sited fields and food plots minimize understory disturbance in forests.

Structurally diverse multiple-age-class longleaf forests also reduce risk in several ways. Obviously, their tolerance of fire is a distinct advantage compared to intensively managed loblolly and slash pine, practically eliminating the risk of loss from wildfire. Longleaf is also more resistant to insect damage and disease. They also tend to be less impacted by ice storms and wind damage. While no forest can withstand the maximum winds of a major hurricane, mixed-age longleaf stands have been demonstrated to be more resilient to the broader impacts of these storms. For many landowners, these factors, along with moderate economic returns from timber revenues, add up to an attractive alternative to more intensive forms of management.

Across the South, approximately 70 percent of the forestland is owned by non-industrial private landowners. Social scientists have surveyed thousands of these individuals to learn their motivations for land ownership. These surveys indicate that the primary objectives for their forestland are to pass on to heirs, aesthetic enjoyment, investment and recreational use, including hunting and fishing. Timber production is more often seen as a secondary objective for many of these landowners (15). Considering this, and the fact that most landowners have multiple objectives, the SNA would seem like a better fit for many of these landowners than more intensive approaches to forest management. Although the SNA has as its primary objective the overall health of the ecosystem, there are substantial economic benefits that result from this approach to management.

The economic performance for a given style of management on a particular property or forest is unique to that situation and depends on many variables such as stocking levels, site quality and past management, among others. While broad generalizations about the economics of the SNA are difficult because of these factors, the two case studies presented below provide examples of the financial aspects of this approach to forest management.

Case study 1: Greenwood Plantation

Greenwood Plantation, an 18,000-acre property located outside Thomasville, GA, provides an example of forests managed using the SNA for decades and serves as a valuable case study of the long-term nature of the approach. Timber harvest records span the period from 1945 to 1995 and cover four separate tracts that collectively formed the plantation. Beginning in 1945, a standard 10 percent inventory was conducted by a third-party consultant every decade. Although the details of these records are insufficient to reconstruct stand tables and diameter distributions, they provide an overall summary of harvested and standing timber volumes across the property over this 50-year period. These data are summarized in Figure 2 and succinctly illustrate the conservative but economically viable nature of the SNA. Over the 50-year period, more than 56 million board feet of timber were harvested from the property while the standing volume increased in the same period by approximately 48 million board feet (from 39 to 87 million board feet) even with the substantial harvest removals (Figure 2 and Figure 3).

The pulpwood volumes also provide some information about regeneration under the SNA. Many foresters who visit forests managed using the SNA remark that there appears to be inadequate regeneration to eventually replace the overstory. Figure 3, however, indicates that adequate regeneration is present in the forest. That is, the pulpwood size class is not showing a precipitous decline in standing volume over five decades, even though pulpwood is continually harvested. This implies that regeneration is recruited over the years and is providing the ingrowth to the pulpwood size class to keep the system going.

Finally, it is important to note that even while the Greenwood property was intensively managed for quail hunting and timber production over the years, and in fact produced excellent quail populations and high timber volumes, this management did not come at the expense of other resources or the ecosystem health. The Home Place tract has one of the few remaining examples of old-growth longleaf forest, with cohorts of trees more than 300 years old. Groundcovers are in good shape over most of the property, with

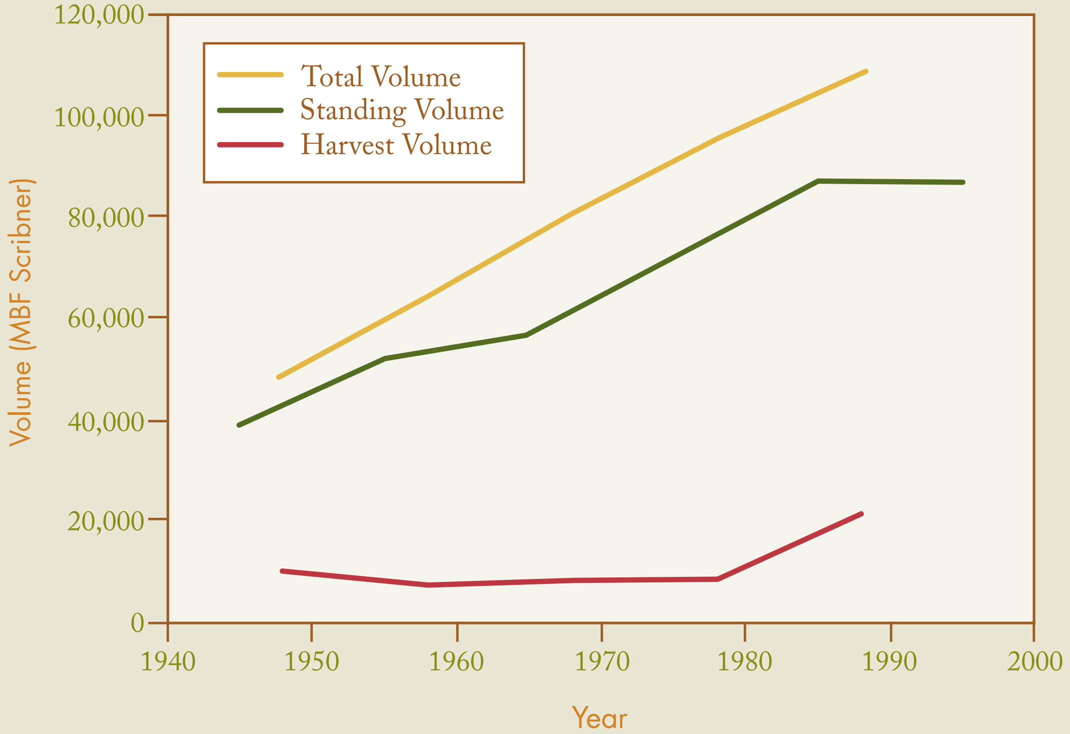


Figure 2: Standing volume, harvested volume and total (standing + harvested) volume over time for Greenwood Plantation. Volumes include all product classes for pine and hardwood and were calculated from periodic inventories and harvest records. The volume of standing timber increases over time even with significant removals through harvest.

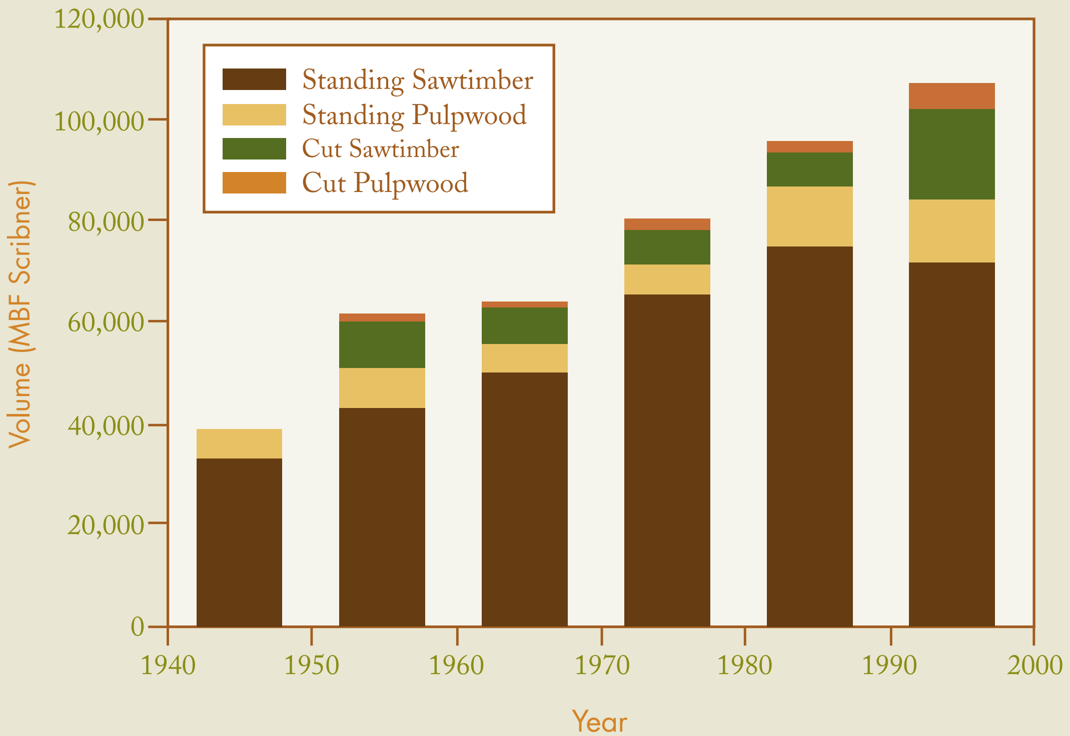
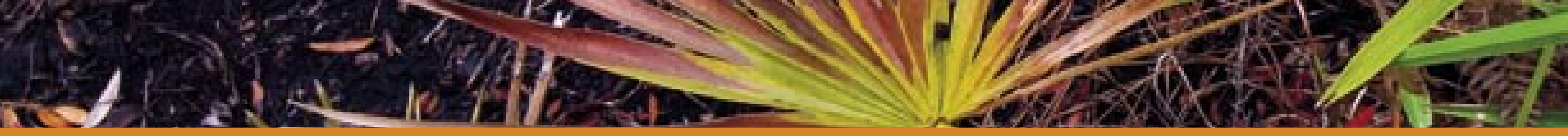


Figure 3: Standing and cut volume by decade and product class for Greenwood Plantation. Volumes include both pine and hardwood.



high species diversity and many uncommon and rare species. A stable population of the endangered red-cockaded woodpecker is present on the property, as are many other wildlife species commonly associated with a healthy, functioning longleaf pine ecosystem. These factors, along with the timber volumes that have been harvested over the years and the amount of timber still standing, provide some of the strongest evidence that the SNA is able to maintain and perpetuate a healthy forest without sacrificing any component, while still providing economic return and preserving options for the future.

Case study 2: Ichauway Demonstration Forest

In 2005, a 941-acre demonstration forest was set up at the Joseph W. Jones Ecological Research Center at Ichauway. The demonstration forest was delineated to reflect a size and range of conditions commonly found on recreational properties in the region. The overall goal of the project is to demonstrate conservation-based management practices that balance multiple objectives including timber, wildlife habitat, aesthetics, asset appreciation and conservation values. Another goal is to collect quantitative information on the economics of this approach to management.

The majority of the demonstration forest is dominated by second-growth longleaf pine and mixed pine-hardwood forests. As with the larger Ichauway property, the overall goal is maintenance of high-quality longleaf pine and associated groundcover where already established, and restoration of longleaf on appropriate sites where needed.

An interactive economic model was developed for the tract using computer spreadsheets. Timber growth, revenues and expenses were projected for a 50-year time horizon. Initial stocking data were obtained from a standard 10 percent timber inventory conducted by a third party contractor. Components included in the model are various management activities and assumptions regarding forest growth, revenue and expenses.

Growth was forecast using classic stand table projections based on growth rates from other research projects on Ichauway. Revenues were based on periodic timber harvests of 80 percent of the cumulative growth and an annual lease of all hunting rights. Expenses were based on common management practices for a property of this type and used contract market rates in the region. The primary economic metrics considered in this analysis were Internal Rate of Return (IRR), cumulative cash flow and overall asset value. The results of this study are summarized in Figure 4 (real figures after inflation).

IRR was calculated both with and without the initial cost of bare land. For some people, forestland acquisition and management represents a new endeavor, while others are longtime landowners who are more interested in comparisons of alternative management strategies. While the IRR (without initial land cost) of 5.42 percent is less than a recent average of 9.5 percent reported for intensively managed pine plantations, this is a reasonable return in light of the broader amenities afforded by this style of management. Perhaps more important, long-term cash flow is substantial and the overall asset value grows consistently through time.

Because of the long time horizon in this model, NPV is disappointing. However, many landowners do not rely on classic economic analyses such as NPV to evaluate their land management decisions. They balance economic returns from timber management with other objectives such as wildlife, recreation, aesthetics and overall asset appreciation. These types of landowners may not consider money spent on land purchase or management as they would other more typical investments, nor do they track such expenses using standard discounting methods. Of more interest to the owner of a moderate-sized recreational tract are the ongoing costs and benefits of management alternatives. Cash flow analysis and overall value of the asset are more relevant metrics for this class of landowner. This analysis demonstrates that landowners can expect reasonable, though moderate, economic returns in the form of cash flow and IRR from this approach to management, as well as long-term asset appreciation.

Harvest Scenario	80% growth
Starting Value	$1,297,255
Standing Volume @ Year 1	4,671 MBF
Average Present Value	$1,489,351
20-year IRR w/ land value	3.21%
20-year IRR w/o land value	5.42%
Total Accumulated Net Cash Flow	$1,796,027
Standing Volume @ Year 50	6,009 MBF
Ending Value	$4,907,850

Figure 4: 50-year projection of economics for application of SNA to Ichauway demonstration forest.

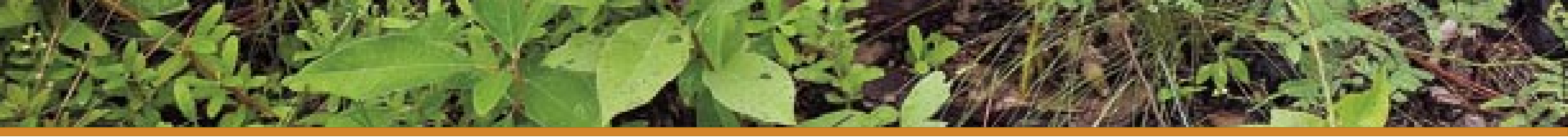
Conservative harvests build volume through time and maintain a wider range of options for the future.

Maximizing economic returns is not an objective of an ecological forestry management approach, but revenue from an ecologically sustainable timber harvest program is typically an important component of the overall property management budget. Critics of forest management that more fully balances multiple objectives often cite economic practicality as a barrier to wider implementation. This model-based case study demonstrates that if an ecological forestry approach such as the SNA meets the landowner's objectives, then revenues are sufficient to support operations and realize a reasonable cash flow over the long-term. While the model was intended to address private land ownerships, the results are equally applicable to any forestland ownership in which multiple management objectives have equal or greater importance than timber production.

Summary

More intensive production-oriented systems of forest management will continue to fill vital needs for society as well as meeting the objectives of many landowners. As the goals of society and individual landowners for forests have evolved, however, ecologically-based approaches to forest management such as the SNA gain greater relevance. For some landowners, management strategies such as the SNA that balance timber production goals with concerns for biodiversity conservation, wildlife habitat, water supply, aesthetics and recreation may better meet their objectives, yet are under-utilized relative to the size of that land base. This is a diverse constituency that includes private landowners, state and federal resource management agencies and nongovernmental conservation organizations.

The SNA has demonstrated its ability to maintain the multiple values of longleaf pine grasslands through time, with revenues from an ecologically sustainable timber program helping to support the broader land management goals while maintaining conservation values. We believe that the SNA and other ecologically-based approaches to forest management deserve wider consideration and application as appropriate tools to meet the diverse range of management objectives for forests today and into the future.



Glossary

Biological legacies – Organisms, organically derived structures, and organically produced patterns that persist from the predisturbance ecosystem.

Canopy gap–An opening in the continuous cover formed by tree crowns in a forest.

Coastal Plain–An area of flat, low-lying land adjacent to a seacoast and separated from the interior by other features. Generally defined as the maximum extent of the seas in mid-Cretaceous times (~100 million ago), the Coastal Plain constitutes the largest land mass of the southeastern U. S., extending from eastern Virginia to east Texas. The Coastal Plain is bordered on the west and north by the Piedmont and Interior Highlands physiographic regions. The southeastern Coastal Plain generally defines the historic range of longleaf pine, with the exception of the montane longleaf extension in northeastern Alabama and northwestern Georgia.

Crown ratio–The ratio of crown length to total tree height.

Fine fuels–Fast-drying dead combustible material, generally characterized by relatively high surface area-to-volume ratio and diameters less than .25 inches that is consumed rapidly by fire when dry.

Intermediate stand treatment–A stand management treatment conducted between the regeneration phase and the final rotation-age harvest in even-aged silvicultural systems, or treatment conducted between harvest entries in uneven-aged systems. These treatments can include stand improvement activities (e.g., release, cleaning, weeding), manipulation of stand structure (e.g., thinning) or application of prescribed fire.

Native groundcover–An association of plant species adapted to frequent fire that is found in undisturbed understory strata of longleaf pine forests. Typically dominated by grasses, native groundcover is noted for its high species richness and importance as fuel for prescribed fire. Native groundcover has a low tolerance to soil and root disturbance and is negatively impacted by activities such as plowing or disking, which can ultimately eliminate many species that play important functional roles in the longleaf ecosystem.

Natural disturbance–Discrete events that are not primarily of human origin and which alter ecosystem structure and resource availability.

Masting event–A year in which there is abundant production of mast, or seed-bearing fruit from trees.

Prescribed fire–Fire set under specified environmental conditions, which allows the fire to be confined to a predetermined area and produces the fireline intensity and rate of spread required to achieve planned resource management objectives.

Regeneration–The process by which a forest is reseeded and renewed. Advanced regeneration refers to regeneration that is established before the existing forest stand is removed.

Silviculture–The art and science of controlling the establishment, growth, composition, health and quality of forests.

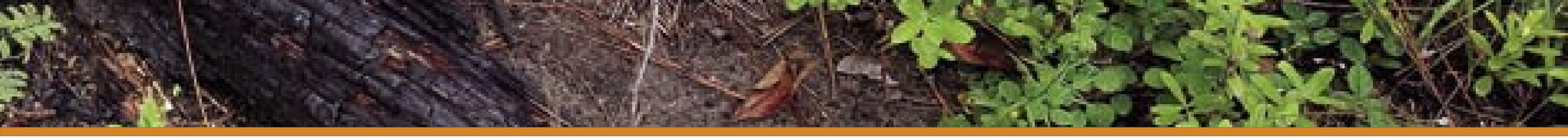
Single tree selection–An uneven-aged silvicultural approach in which trees are removed singly and periodically, with harvest and regeneration distributed throughout the stand rather than confined to a specific area, resulting in the mixture of trees of many ages and sizes. In application, each tree in a stand is judged individually in light of management objectives and is either selected for harvest or left as a residual in the stand. In general, relatively few trees are harvested on a per acre basis at any given harvest entry. This approach maintains a continuous forest canopy over time, and harvest removals of one or a few trees are representative of small-scale natural disturbance events.

Snag–A dead tree that is still standing. Snags provide important food and cover for a wide variety of wildlife species.

Stand–A group of forest trees of sufficiently uniform species composition, age and condition to be considered a homogeneous unit for management purposes.

Thinning–A cutting made to reduce stand density of trees primarily to improve growth, enhance forest health or to recover potential mortality (SAF).

Uneven-aged–Three or more age classes of trees represented.



Footnotes

Footnotes were used to reference original Jones Center research and publications cited in this document as well as recent or less well-known research by others. We did not feel it necessary to use extensive footnotes to reference well-established facts concerning longleaf pine natural history and ecology.

Recommended readings are intended for readers that are interested in more extensive treatments of longleaf natural and cultural history, as well as those interested in more in-depth technical material. Some readings offer alternative perspectives on silviculture and management of longleaf pine.

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