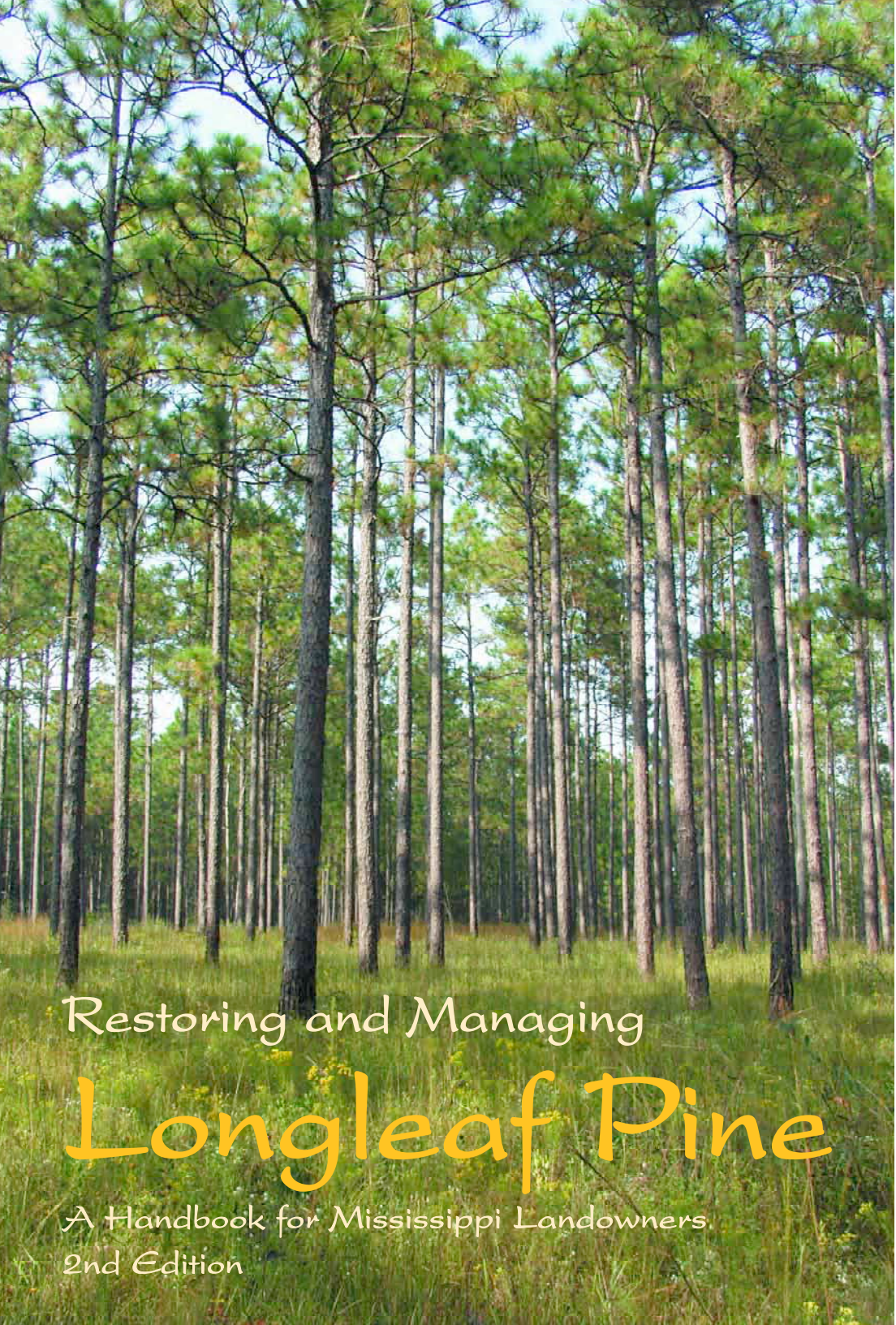

Restoring and Managing Longleaf Pine

A Handbook for Mississippi Landowners
2nd Edition

Cover photo by Randy Browning, U.S. Fish and Wildlife Service (USFWS)/Wildlife Mississippi (WM)

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Introduction

The natural range of longleaf pine *(Pinus palustris)* extends along the coastal plain from East Texas to the Piedmonts in Virginia, and in the mountains of Alabama and Northwest Georgia. Historically, longleaf was the dominant species of tree on an estimated 60 million acres. Longleaf is reported to have also occurred on another 30 million acres in mixed stands. However, natural stands of longleaf have drastically declined because of numerous factors that include land clearing for agriculture and development, regeneration failures, free-ranging hogs, replacement of harvested stands with loblolly and slash pine and the overall reduction in the use of fire as a management tool. Today, residual stands of longleaf occupy less than three million acres of its original range.

In Mississippi, longleaf historically occurred in portions of Attala and Leake Counties and within all or parts of the lower 36 counties. However, today longleaf only occupies approximately 255,000 acres with the majority of acreage occurring in Forrest, Lamar and Perry Counties.

Description of Longleaf Pine

Longleaf pine is a very distinctive, long-lived Southern yellow pine, with trees recorded in excess of 350 years of age. It is a medium to large tree that reaches heights of approximately 120 feet and diameters of 2.5 feet. Longleaf produces a clear bole and has a small, open crown. Needles cluster in fascicles of three, are 8 to 18 inches long, are densely tufted and grow on the ends of stout branches. The root system has a very deep taproot that may reach depths of 12 feet or more in mature trees. Because of this massive taproot, longleaf is very resistant to windthrow. Longleaf occurs on a variety of sites, but grows best on well-drained soils.

Longleaf cones range in size from 6 to 8 or more inches in length.

Longleaf Cone
Photo by Randy Browning, U.S. Fish and Wildlife Service (USFWS)/Wildlife Mississippi (WM)

Longleaf is a sporadic seed producer, typically producing a high seed yield about once every 5 to 7 years. Seed fall normally occurs from late October to early November and germination takes place within 2 to 5 weeks. Fall germination in other Southern pines is rare.

Longleaf is unique in that seedlings first develop into a "grass-stage" prior to height growth. A dense tuft of needles is all that shows above the ground and seedlings can remain in the grass-stage for 3 to 6 years or longer. During this time, the seedling produces a well-developed root system. However, once height growth begins, height and diameter increase rapidly. Height growth slows when the tree is approximately 50 years old. After this time, most growth that occurs is diameter growth.

Benefits of Longleaf Pine

Longleaf ecosystems have numerous positive attributes and several advantages over other pines when properly managed. Well-managed stands of longleaf are aesthetically pleasing, can provide high levels of economic return and benefit numerous species of wildlife. Longleaf is resistant to most diseases and beetle infestations that plague other pine species (see Insects and Diseases). Longleaf grows well on sandy soils and is tolerant of wildfires. Longleaf is resistant to windthrow and generally continues growth throughout its life.

Longleaf has potential economic advantages over loblolly and slash pine stands when managed on sawtimber-length rotations (see Economics of Longleaf). Wood from longleaf is denser and therefore heavier than other Southern pines. Because of this, economic returns are higher for longleaf when compared to other pines on a per volume basis. Studies have shown that longleaf will outgrow slash and loblolly in 12 to15 years on poor sites and in 25 to 30 years on average sites. However, longleaf generally takes longer to equal loblolly on highly productive sites.

Forest Classifications

Longleaf forests are classified by moisture gradients into the following categories: sandhills, flatwoods, savannas or rolling mesic hills. Longleaf ecosystems are very diverse with an estimated 1,200 endemic species of plants. As many as 40 different species of plants per square meter have been reported. Other reports indicate as many as 200 species of plants within a longleaf stand.

Sandhills

Longleaf forests in sandhills are on infertile, deep, well-drained, sandy soils. Because of droughty soils, these are poor site conditions and species diversity is low. Associated vegetation found in these communities includes turkey oak,

bluejack oak, native blueberry, false poison sumac, pixie moss, goat's rue, wiregrass and pineywoods dropseed. Species of wildlife that may inhabit these areas include white-tailed deer, fox squirrel, wild turkey, bobwhite quail, Bachman's sparrow, red-cockaded woodpecker, Eastern diamondback rattlesnake and gopher tortoise.

Flatwoods

Longleaf forests in flatwoods have moister soils and are more diverse than sandhills. Other vegetation found in these communities includes gallberry, wax myrtle, blueberry, black gum, sweet bay, wiregrass, bluestem grass, orchids and American chaffseed. Wildlife inhabiting these areas includes white-tailed deer, fox squirrel, Eastern diamondback rattlesnake, Bachman's sparrow, red-cockaded woodpecker, pine warbler, brown-headed nuthatch and pine barrens tree frogs.

Savannas

Savannas, because of a high water table, are typically the wettest of the longleaf communities. Savannas are open with little overstory. Understory plant communities are very diverse and may contain wiregrass, sedges, orchids, American chaffseed and rough-leaved loosestrife. Insectivorous plants that may be found include pitcher plants, bladderworts, venus flytrap and sundews. Rare, threatened or endangered birds that may occur in these areas include Henslow's sparrow, Bachman's sparrow, red-cockaded woodpecker and Mississippi sandhill crane.

Yellow Pitcher Plant
Photo by Randy Browning, USFWS/WM

Rolling Mesic Hills

Rolling mesic hills are among the most productive longleaf sites. Often with a sandy surface, they have fine textured soils with higher clay contents and are very diverse. Loblolly and shortleaf pine along with numerous species of hardwoods occur in association with this community. Species of hardwoods include gallberry, yaupon, wax myrtle, blueberry, huckleberry, sweetgum, blackgum, Southern red oak, post oak, live oak, white oak, chinkapin, dogwood, black cherry and hickories. Understory vegetation includes Indian grasses, three-awn grasses, bluestem grasses, meadow beauties and dropseeds. Wildlife that may be found in rolling mesic hills include white-tailed deer, black bear, wild turkey, bobwhite quail, fox squirrel, cottontail rabbits, gopher tortoise, Eastern diamondback rattlesnake, Louisiana and black pine snakes, red-cockaded woodpecker, Bachman's sparrow, great crested fly catcher, indigo bunting and summer tanager.

Meadow Beauty
Photo by Randy Browning, USFWS/WM

Planning

Goals

The level and intensity of longleaf pine management conducted on a property will depend upon site quality, topography, location, ability to use fire and overall objectives of the landowner. Objectives should be prioritized to best meet the landowner's needs. Is the primary objective forest products, wildlife management or recreation? Landowners interested only in forest products will probably establish and maintain stands at higher densities than those interested primarily in wildlife. Conversely, those interested in wildlife and recreation may wish to maintain their stands at lower densities and maintain permanent wildlife openings. Regardless of the landowner's objectives, a properly managed longleaf forest can yield a sound economic return, offer recreational opportunities, benefit numerous species of wildlife and be aesthetically pleasing.

Prescribed Burning
Photo by Randy Browning, USFWS/WM

Site Selection

Although longleaf pine will grow on a wide variety of sites (see Longleaf Forest Classifications), it grows best on well-drained soils. Longleaf generally fares better on xeric sites than other species of pine; however, it may be difficult to establish adequate stocking levels during drought years. More fertile sites may be easier to establish although control of competing vegetation may be more difficult.

Considering these challenges, and depending on the goals of the landowner, longleaf can be considered on all but the wettest sites within its normal range. Success can only be measured in terms of the landowner's objectives.

Use of Fire

Fire is a critical component of the longleaf pine ecosystem and longleaf have evolved to withstand frequent fires. Historically, frequent fires reduced competition from hardwood trees, shrubs and other pines, and is the reason that longleaf occupied such large expanses prior to colonization of America. Longleaf has often been called a "fire-dependent" or "fire-maintained" species. Older trees have thick bark that protects the cambium layer from all but the most intense fires. Clusters of long needles protect terminal buds from surface fire heat and will even protect buds from heavy scorching.

Longleaf seedlings are very intolerant of overtopping vegetation that competes for available sunlight, nutrients and water. The grass-stage is a special adaptation to fire that allows the seedling to survive periodic surface fires that reduce competing vegetation. Surface fires also control brown-spot needle blight infestations. Brown-spot is the only disease that has significant impact on longleaf by causing a reduction in growth and mortality of grass-stage seedlings (see Insects and Diseases). Grass-stage seedlings have no stem, with the bud located immediately above the surface of the ground. During this time, seedlings develop strong taproots that quickly build up root reserves. Dense needles surround the bud, protecting it from fire damage.

Although longleaf are fire resistant, they are not fireproof. Seedlings less than 3 feet tall and in the "candelabra" stage are susceptible to fire damage. During this stage, the bark is thin and the terminal bud is within flame height and exposed to normal surface fires. Once the seedling reaches a height of 6 feet, it becomes fire resistant again.

Grass-stage Seedling
Photo by Randy Browning, USFWS/WM

Fire benefits the longleaf ecosystem in numerous ways. It creates a bare seedbed for pine seedlings and other fire-dependent plants, reduces fuel loads and recycles nutrients. Periodic burning promotes early successional plants that are important to many species of wildlife indigenous to longleaf ecosystems.

Because most hardwoods have thin bark, fire is an effective means of controlling hardwood competition in pine stands. However, especially with dormant season burns, hardwoods are usually only top-killed and quickly sprout again. This keeps succulent browse at a level that can be readily utilized by deer. More effective hardwood control can be achieved when growing season burns are conducted. Also, plants such as wiregrass and toothache grass respond to growing season burns and often do not produce seed in the absence of these fires. Periodic fires also improve recreational access, enhance aesthetic value and reduce harmful populations of insects such as ticks. Longleaf stands should be prescribed burned on a regular basis to maintain a healthy ecosystem. Burn rotations will vary with the forest classification. Sandhills communities need to be burned every 3 to 10 years while flatwoods and savannas need burning every 2 to 5 years. Rolling mesic hills require prescribed fires on a 2- to 3-year rotation to maintain the integrity of the ecosystem.

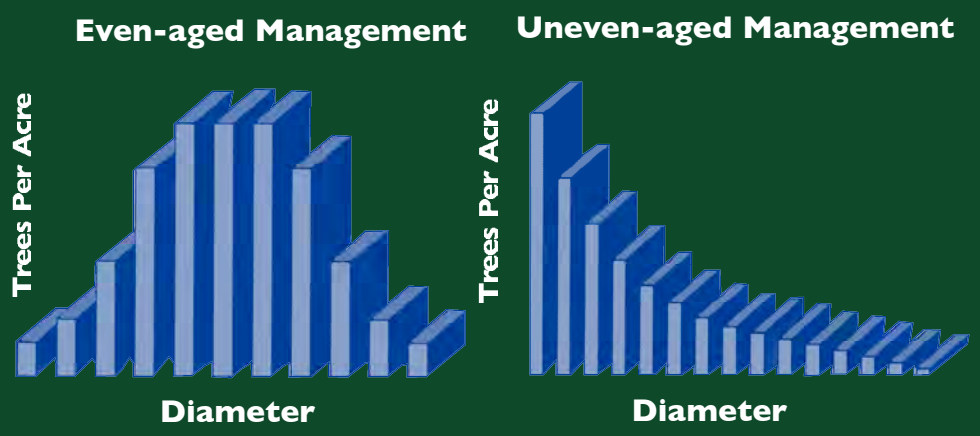
Although fire will control hardwood competition, it is important to leave some hardwoods on the landscape. Hardwood trees, shrubs and woody vines occur naturally along the draws and drainage systems within longleaf ecosystems. These areas are utilized by numerous species of wildlife for food, cover and travel corridors. Drainage systems maintained as Streamside Management Zones (SMZs) not only benefit numerous species of wildlife associated with longleaf ecosystems, but also numerous neotropical migrants. Soft-mast producing species that may occur include native blueberry, Southern crabapple, flowering dogwood, persimmon, black cherry, huckleberry and blackberry. Hard-mast or acorn-bearing trees may include white oak, water oak, Southern red oak, hickory, blackjack oak, bluejack oak, turkey oak, post oak, live oak and chinkapin. These all produce valuable foods that are utilized by wildlife at various times of the year. Many of these corridors are naturally protected from fire by the hydrology of the site. During years of drought, prescribed burns should be postponed until soil and fuel moisture levels are favorable to prevent fire from carrying across small creeks or streams. A prescribed burn manager should be consulted before conducting any prescribed burn.

Candelabra Stage
Photo by Randy Browning, USFWS/WM

Longleaf Pine Management Methods

Choosing a longleaf pine management system is a matter of personal preference. There are even-aged and uneven-aged management techniques, each with inherent advantages and disadvantages. There is no "best" method, so which route to follow will depend on what resource exists and the landowner's goals for that resource. Even-aged management consists of periodic harvest of all trees on part of the forest at one time or over several thinnings to produce a stand of trees that are all basically the same age. Uneven-aged management consists of a stand of trees with three or more distinct age classes and a range in size classes (see Figure 1). In other words, young, middle-aged and mature trees will be grown together. Uneven-aged management is popular with private landowners because it will accommodate a diversity of plants and animals and is aesthetically pleasing. Uneven-aged management can also perpetuate a forest indefinitely if harvest practices leave the best trees and promote regeneration.

Figure 1. Diameter distributions of even-aged and uneven-aged stands.



Even-aged Management

Even-aged management is defined as a forestry practice in which trees are subjected to periodic harvest in order to maintain a stand of trees that have small age differences between individual trees. Even-aged stands can be established either artificially or naturally.

Artificial Regeneration

Great strides in knowledge have been made in recent years regarding artificial regeneration of longleaf pine. Planting failures can be minimized, if not eliminated, by using proven techniques. Adequate site preparation, good quality seedlings, proper handling of seedlings and proper planting depth are all critical factors.

Artificially Regenerated Longleaf
Photo by Randy Browning, USFWS/WM

Site Preparation

Proper site preparation is essential when replanting with longleaf. Most regeneration failures can be traced to inadequate site preparation. Fortunately a variety of techniques exist to help ensure regeneration success.

Cutover Sites

Good initial and residual control of woody and herbaceous competition will promote rapid seedling development. If ground conditions are very clean, a herbicide application may be adequate. Consult with a qualified herbicide contractor to determine problem species, recommended herbicides and appropriate rates. If there is considerable logging debris or residual brush after harvest, fire and/or mechanical treatments should be used in addition to or in place of chemical treatment. The site should be clean enough for easy access by tree planters.

Old Fields

Initial and residual control of herbaceous and woody competition is essential to success. An appropriate herbicide treatment is probably the best way to assure residual control. Studies have shown that scalping strips, in addition to herbicide use, greatly improves survival and subsequent seedling

development. Scalping is the process of removing the surface root mat present in most old fields and pastures. Ripping, or sub-soiling, is also beneficial when soils have been compacted or where a hard pan is present. Ripping, as the term suggests, rips through the surface of the soil, loosening hard soil for easier root penetration. However, care should be taken to scalp and rip following the contour of the land to avoid excessive erosion. It is best to rip well in advance of planting to allow settling of the soil in the rip. Trees should be planted 4 to 6 inches to the side of the rip and not in the rip to prevent them from settling too deep.

A Rip
Photo by Randy Browning, USFWS/WM

Seedling Types and Planting

Bare-root

Bare-root seedlings should be planted as soon as possible after lifting from the nursery bed. Seedlings should have healthy green foliage, an 8 inch tap root, well-developed lateral root system and root-collar diameter over 0.4 inches. Do not prune roots. It is acceptable to have some lateral roots lying above ground, if necessary, but as many laterals as possible should be underground. Terminal buds should be at or just above the ground surface, but never beneath the surface. Special care should be taken in areas where soil movement is likely to bury the buds. If planted too shallow, the survival rate of seedlings may decline.

Containerized

Although containerized seedlings are more expensive than bare-root seedlings, survival and growth rates are generally better. Uniform seedling size makes handling and planting much easier. It is important to use healthy, freshly lifted seedlings. Planting depth is not as critical as with bare-root seedlings, as long as the containerized seedlings are not planted too deep. Recent studies conducted by the Longleaf Alliance have found that it is acceptable for an inch or so of the root plug to be above the surface of the ground.

Planting Dates and Handling

Bare-root seedlings can be planted as early as October and as late as March. The window of opportunity to plant containerized seedlings is greater than that for bare-root seedlings. Containerized seedlings can be planted from October to June. However, planting is generally most successful when either seedling type is planted in October and November. Early planting allows time for good root development prior to the following growing season.

A Containerized Seedling
Photo by Randy Browning, USFWS/WM

Care should be taken when handling longleaf seedlings. Seedlings should not be allowed to become dehydrated, frozen or overheated during the process of shipping, storing or planting. Although seedlings should be planted as soon as possible after lifting, they can be stored in a cool, shady place for several days. However, refrigerated storage (35˚F) is preferred when seedlings have to be held for more than two days. Even then, longleaf seedlings should not be stored for more than 2 or 3 weeks.

Spacing/Densities

Spacing and planting densities vary with the goals of the landowner. Seedling densities can range from 400 to 700 seedlings per acre. If low survival is anticipated, as during years of severe drought, more seedlings may be planted to offset mortality. Lower densities may be desirable where a more open condition is wanted. This might be desirable

Planting Seedlings
Photo by Randy Browning, USFWS/WM

where recreational activities, such as quail hunting or horseback riding, are important goals. Spacing is also important. If the landowner is planning to produce pine straw, for example, the rows should be far enough apart to allow access for mowing and raking.

Care of a Young Plantation

There are no substitutes for good site preparation and planting practices. Even if all goes well, further treatments may be needed in some stands. Managers should monitor young plantations and watch for encroaching herbaceous competition and brown-spot needle blight infestations. Prescribed burning will control brown-spot and will help control competition. Herbicide treatments may be needed in instances where herbaceous competition persists, as both bare-root and containerized seedlings are very intolerant to competition. Studies have shown that seedlings released from competition with two herbicide treatments were twice as tall as unreleased seedlings. Many of the seedlings reached heights of 8 feet after only three growing seasons.

Once height growth has commenced, be careful with controlled burning. Seedlings in the grass-stage and saplings over 6 feet tall are resistant to fire damage. Early height growth seedlings, however, can be killed by fire. Once the stand has achieved a safe height, regular controlled burns will prevent heavy fuel accumulations, control brush and maintain good forage for wildlife.

Natural Regeneration

Shelterwood Method

Shelterwood, or modified shelterwood systems, are effective ways to regenerate existing even-aged stands of longleaf. Instead of clearcutting and replanting, a fairly dense overstory of seed trees are retained until adequate regeneration is established. Spacing between trees is not particularly important in early thinnings of an even-aged stand. Rather, attention should be given to removing diseased, improperly formed or severely suppressed trees. Subsequent thinnings should remove trees as necessary to maintain optimal stocking for the site. Longleaf managed for timber production can be maintained at densities as high as 80 ft^2 to 90 ft^2 basal area (BA) after thinning. During intermediate thinnings, look for good cone producing trees, being careful to leave them for future seed trees. Time between thinnings can vary, usually from 5 to 10 years depending on growth rate and market conditions. Rotation age depends on site productivity and desired end products.

Longleaf Seed
Photo by Randy Browning, USFWS/WM

Table 1: Trees/acre and approximate spacing at 30ft^2 BA.

Average dbh	# trees/acre	approximate spacing @ 30 ft^2 BA
10	55	28' X 28'
12	38	34' X 34'
14	28	39' X 39'
16	21	45' X 45'
18	17	51' X 51'

When the stand approaches rotation age, it is time to prepare the site for regeneration. Frequent controlled burns during the life of the stand should keep the site in good condition. The shelterwood cut removes all except 30 ft^2 BA of well-spaced trees of good form (Table 1). Because longleaf produce heavy seeds that do not disperse far from the parent tree, the remaining trees should consist of evenly distributed, well formed parent trees. If possible, choose trees that have already proven to be good cone producers. If tree crowns are very compact and not producing many cones, the system can be modified using a preparatory thinning to 60 ft^2 BA 3 to 5 years in advance of the shelterwood cut. This will encourage crown development and may reduce future loss to windthrow and hurricane damage by enhancing root growth prior to reducing the overstory to a shelterwood.

Following the shelterwood cut, the stand should be monitored for regeneration. Once it is determined that sufficient seed will be produced, a proper seedbed needs to be prepared by conducting a prescribed burn up to 3 months prior to seed fall. This removes thick litter and grass and allows good seed-soil contact for increased germination rates. Seed fall normally occurs from late October to early November. Additional prescribed burns may be necessary to maintain a receptive seedbed if adequate regeneration is not attained within the first 2 or 3 years. To release the seedlings, seed trees are removed as soon as adequate regeneration is present. The system can be further modified by retaining several seed trees if scattered mature trees are desired in the new stand. Remember that such residual mature trees will impede the development of nearby seedlings. Additionally, residual mature trees are subject to lightening strikes and windthrow.

Uneven-aged Management

A stand with three or more distinct age (or diameter) classes is said to be uneven-aged. Maintaining a healthy forest in an uneven-aged condition requires different techniques than even-aged management systems. Uneven-aged management systems, as with other management systems, have inherent advantages and disadvantages (see Table 2).

Uneven-aged Longleaf Stand
Photo by Randy Browning, USFWS/WM

Table 2: Advantages and disadvantages of uneven-aged management systems.

ADVANTAGES	DISADVANTAGES
Forest cover maintained	Does not maximize fiber production
High value products always available to sell	Requires higher level of skill to manage effectively
High diversity of cover and forage available for wildlife	High grading possible if not managed
More flexibility in timing and intensity of harvest	
May maximize production of high value products over time	

Getting Started

To start, the condition of the stand must be considered and several questions answered. Is the stand overstocked? Are there many cull or diseased trees or other species of pine mixed with the longleaf? If so, an improvement cut may be needed. The first cut should remove diseased and improperly formed trees, hardwoods, other species of pine and enough trees necessary to facilitate logging access. If the stand is under-stocked with longleaf, other species of pine may be temporarily retained to maintain adequate stocking levels. These other pines can be removed as part of the allowable cut (see Methods of Regulating Harvest) in subsequent harvests. If the stand is severely understocked, the improvement cut may be postponed until stocking is sufficient for a merchantable thinning. Or, in some cases, stand replacement may need to be considered. Leaving several scattered hardwoods, even in the uplands, will enhance the aesthetics of the forest and provide food and cover for wildlife.

Adequate regeneration is mandatory to perpetuate an uneven-aged forest. Usually, regeneration in uneven-aged stands is achieved naturally. However, seedlings may be planted in openings where natural regeneration is not sufficient for the desired stocking levels.

If fire has been excluded for an extended period of time, it should be reintroduced with caution. Prolonged fire exclusion allows the development of fine roots in the duff layer. Burning under dry conditions will damage these fine roots and may kill mature trees. One or two winter fires within 3 days of a soaking rain will improve fuel conditions and gradually reduce fine roots in the duff layer. Subsequent burns can then be carried out more aggressively. If the brush has advanced to the point where it cannot be controlled by burning, herbicides may need to be used to regain control. Hardwoods might also be controlled mechanically or even sold if trees are of merchantable size.

Methods of Regulating Harvest

Once hardwoods are under control and culls have been removed, a system must be used to determine what trees to remove at each thinning to maintain the desired age (diameter) class distribution. The idea ultimately is to remove at each cut the amount of volume that has grown since the previous cut. If an under-stocked stand is being rehabilitated, the first several cuts may remove less than the amount grown until the desired stocking level is reached.

Diameter Limit Harvest

Removing trees above a certain diameter is one way to regulate harvest. A maximum tree diameter is chosen. All trees of larger diameter are selected for harvest. It is a simple concept and easy to administer. Unfortunately, this method often results in a high-graded stand, greatly reducing quality and productivity over time. By consistently choosing larger trees, the better performers are removed. This is the equivalent of a cattle farmer selling his best cows and keping his culls. This system could be modified, by including

smaller, poor quality trees as part of the allowable cut and retaining a few trees over the limit to prevent over cutting, high grading might be avoided. Adopting a method regulating the entire stand, not just the upper diameter component, would help eliminate many of the pitfalls of the this system.

Whole Stand Regulation

Unlike a diameter limit harvest, whole stand regulation, harvests trees from all merchantable diameter classes, not just the upper diameter classes. This results in a more balanced distribution of age (diameter) classes. If managed properly, once the target diameter distribution is reached (see Table 3), regular harvests can be made and the stand perpetuated naturally. Keep in mind that each acre will not be managed to contain all age classes, but rather all age classes will be managed across the entire tract. This management concept will create a mosaic of age classes across the tract that is aesthetically pleasing as well as beneficial to a host of species of wildlife. The canopy level will be stratified allowing the potential for a greater diversity of wildlife.

In order to understand the concept, the following example shows how a landowner may choose to manage his or her timber for various products. Table 3 lists target diameter distributions for three different timber management goals that a landowner might choose for a particular stand of timber.

Table 3: Target diameter distribution (trees per acre).

Diameter	Poles B=80, N=7	Poles/Sawtimber B=10, N=9	Sawtimber/Wildlife B=60, N=11
2	519.5	353.5	247.9
4	131.4	89.4	62.7
6	58.3	39.7	27.8
8	32.7	22.3	15.6
10	21.0	14.3	10.0
12	14.6	9.9	6.9
14	10.7	7.3	5.1
16		5.6	3.9
18		4.4	3.1
20			2.5
22			2.1

The formula used to produce this table is (B/b)/N = trees per acre. (This formula is used for each diameter class in each target distribution.)

Where: B = target residual basal area per acre
b = basal area per tree in each diameter breast height (dbh) class (see Table 4)
N = number of dbh classes retained

Explanation of "B"

Basal area retained (B) is the desired stocking after harvest. This will vary depending on site quality and management goals. For instance, the landowner may want a more open, sparsely stocked forest for quail habitat and choose to maintain the residual BA at 60 ft^2 per acre or less. On very fertile sites, a residual BA of 80 ft^2 per acre may be considered where timber production is the primary goal.

Explanation of "b"

The BA (ft^2) per tree (b) in a given diameter class measured at diameter breast height (dbh).

Explanation of "N"

The number of dbh classes retained (N) depends on the management goals of the landowner and the capabilities of the site (see Table 3). In the above examples, a landowner who wants old, mature timber will retain more dbh classes (N = 11) than one who wants to only grow poles (N = 7). Site quality should always be considered when setting management goals. For example, the landowner who wants to grow 28-inch dbh saw logs on a coarse sandy soil will probably not reach his/her goal.

Table 4: The BA per tree (b) for several dbh classes.

dbh	BA/tree (ft^2)	dbh	BA/tree (ft^2)
2	0.022	16	1.396
4	0.087	18	1.767
6	0.196	20	2.182
8	0.349	22	2.640
10	0.545	24	3.142
12	0.785	26	3.690
14	1.069	28	4.280

Managing Under the Whole Stand System

Under this system, the target distribution would rarely, if ever, exist on any one acre. Rather, it represents the per acre average over the whole stand. There would likely be dense patches of small trees well in excess of the target BA, open patches of regeneration with little or no BA and sparse patches of larger trees with regeneration developing underneath. The idea is not to regulate the diameter distribution on each acre within a stand, but to manage

the entire stand based on per acre averages.

When it is time to thin, the stand should be cruised and the current inventory compared to the target stand. Trees in excess of the target stand in each dbh class are part of the allowable cut. The following table (Table 5) is a sample of an allowable cut determination on a hypothetical 40-acre stand in which the management goal is to produce poles with a 16 inch upper diameter class and maintain an after-harvest BA of 80 ft^2.

Table 5: A hypothetical 40-acre stand managed for pole production with an after-harvest BA of 80 ft^2 (Shown as trees per acre except total allowable cut).

dbh	Current stocking	After-harvest target stocking (Table 3)	Allowable cut per acre	Total allowable cut (40 acres)
2	321.0	519.5	0.0	0.0
4	123.2	131.4	0.0	0.0
6	59.1	58.3	0.8	32.0
8	36.4	32.7	3.7	148.0
10	26.1	21.0	5.1	204.0
12	14.4	14.6	0.0	0.0
14	12.3	10.7	1.6	64.0
16	7.8	0.0	7.8	312.0
Basal Area	91.6 ft^2	80.0 ft^2	16.9 ft^2	

In this example, the allowable cut brings the BA to 74.7 ft^2, a little less than the 80 ft^2 target. This is because the stand is somewhat understocked in the 2- and 4-inch-diameter classes, and slightly understocked in the 12-inch-diameter class. Extra trees could be left in other diameter classes to retain 80 ft^2 if the lower stocking is deemed undesirable. Additional growth and thinnings will be required before this stand is balanced.

Marking the Allowable Cut

Once the allowable cut is determined, the trees to be harvested must be marked. Using this sample 40-acre tract, the allowable cut would be marked by cutting the lowest quality trees wherever they occur and opening around young trees where possible to encourage growth in smaller diameter classes.

Single Stem and Group Selection

Regardless of the harvest regulation system used, both single stem selection and group selection should be used as appropriate to mark the trees to be cut. Single stem selection should be used to remove cull trees wherever they occur and to remove individual stems when thinning dense patches of trees. Group selection should be used to create openings to encourage regeneration and to enlarge openings around existing regeneration.

Caring for an uneven-aged stand between thinnings is much the same as for even-aged management. Prescribed burning is the best way to maintain good brush control and a receptive seedbed. Timing of fires can be altered if significant amounts of regeneration are in early height growth. Otherwise, seedling losses are not as critical as with even-aged stands, since seed trees are always present to fill in openings with new regeneration.

Enhancement of Mixed Pine Stands

Although the historical longleaf forests have been severely depleted, numerous forested stands still exist that contain remnant longleaf pine. Many of these stands have resulted from the harvest of merchantable longleaf and the replanting of slash or loblolly. Other mixed stands have occurred through the exclusion of fire coupled with the natural reseeding abilities of other species of pine. These areas can be converted back to uneven-aged longleaf pine over time by removing other species of pine, by applying herbicides when needed and by reintroducing prescribed fire (See Getting Started).

Pests and Diseases Associated with Longleaf

Insects and Diseases

Both insects and pathological agents can have negative impacts on all Southern pines. However, longleaf pine is more resistant than the other species of pine. For instance, although pine tip moths cause serious damage to loblolly and slash pine, they do not generally affect longleaf. Southern pine beetles can attack longleaf, but this usually occurs only when the beetle populations are epidemic in size. Engraver beetles and black turpentine beetles will also attack longleaf, but are usually a problem only when trees are under severe stress from lightning strikes, excessive logging damage or extreme fire damage. Maintaining healthy trees by proper thinning, control of logging damage and removal of lightning struck trees are the best methods for the prevention of beetle infestations.

Pathogens that affect all Southern pines include annosus root rot, fusiform rust and pitch canker. Although longleaf can be infected with these pathogens, they are less susceptible to these diseases than loblolly or slash. However, brown-spot needle blight is a serious disease of longleaf and can suppress growth and eventually kill grass-stage seedlings. Brown-spot is a fungal infestation that causes needle loss in grass-stage seedlings, but is not a significant problem once active height growth begins. Since grass-stage seedlings are very tolerant to fire once they have reached a ground line diameter of 0.3 inches, brown-spot needle blight can be controlled with prescribed burns. Prescribed burns conducted during the dormant season kill the fungal spores and remove infected needle tissue. Prescribed burns also reduce herbaceous competition, thus promoting active height growth in longleaf seedlings. However, burns for brown-spot control should be conducted before the majority of the seedlings begin active height growth. Remember, longleaf out of the grass-stage and less than 6 feet in height are susceptible to fire damage.

Brown-spot Needle Blight
Photo by Randy Browning, USFWS/WM

Brown-spot needle blight infestations are worse when longleaf seedlings are grown in the open with minimal ground cover. However, seedlings regenerated naturally under moderately dense overstories are protected from serious infestations. Because of this, the shelterwood method is a practical way of natural regeneration for longleaf. The parent trees should be harvested by the time seedlings reach 2 years of age.

Brown-spot needle blight can be suppressed in nurseries with 4 pounds of applications of fungicide. Seedlings can be sprayed with a mixture of 4 pounds of copper sulfate, 4 pounds hydrated lime and 50 gallons of water using a rate of 60 gallons of the mixed solution per acre. Fungicide application is a viable alternative, especially in situations where fire is not practical.

When longleaf is artificially regenerated, one should make sure seedlings are free of brown-spot. The best method for long-term control of brown-spot needle blight is by planting seedlings that are resistant to the disease.

Non-native Pests

Numerous exotic pests consisting of plants, animals and insects occur within the historical range of longleaf pine. Because of their habits, many of these exotic pests have significant negative impacts on longleaf ecosystems. The feral hog is one of the most destructive species of animal that occurs within the range of longleaf, and will be discussed in more detail later.

Although there are numerous exotic insects, one of the most notable is the imported fire ant. Although fire ants may not significantly affect longleaf, they do affect various species of wildlife. It is suspected that fire ants feed on the eggs and young of various reptiles. One of these is the endangered Southern hognose snake. Imported fire ants are also suspected to negatively affect ground-nesting birds such as bobwhite quail. Effective control of fire ants is very expensive and difficult.

A multitude of exotic, invasive plants occur across the South and negatively affect the health of Southern forests. Among the most notable species are Japanese climbing fern, Japanese honeysuckle, kudzu, Chinese tallowtree, Chinese privet and cogongrass.

The plethora of exotic pests has negative impacts on ecosystems, especially longleaf ecosystems. Two of these species, congongrass and feral

hogs, are particularly damaging to longleaf and are examined in greater detail below.

Cogongrass

Cogongrass is an invasive, perennial grass that produces dense stands reaching heights of 4 feet. Identifying characteristics include an off-set midrib on the leaves and dense, distinctive flower heads in early spring. Cogongrass has numerous attributes that contribute to its extremely invasive characteristics. Each plant can produce up to 3,000 seeds. Seeds are very light and can be dispersed by the wind for a distance of 15 miles or more. Although seed germination rates are generally high, seed viability is relatively short. Cogongrass also reproduces by producing rhizomes. Each rhizome can produce numerous shoots thereby invading a substantial area in a very short period of time. Once established, the spread of cogongrass increases at an exponential rate. Cogongrass grows in a wide range of soils from rich sandy loams to poor sands. This alien species grows best in full sun but will thrive in deep shade and will persist during severe droughts or through periodic inundations.

Although cogongrass has a relatively high rate of natural spread, mechanical spread is accelerating the problem. Landowners and contractors spread cogongrass across the landscape by moving contaminated soil and equipment while conducting normal management practices such as timber harvest and the construction and maintenance of food plots, roads and fire lanes.

Congongrass Bloom
Photo by Randy Browning, USFWS/WM

Congongrass Under Pines
Photo by Randy Browning, USFWS/WM

Congongrass Root Through Pine Cone
Photo by Randy Browning, USFWS/WM

Infestations from this alien plant can have serious implications for resource management. Dense stands of this grass can cause significant stress on forested stands by competing for available moisture and nutrients and by literally growing through the roots of native trees. Cogongrass is also allelopathic, meaning it produces its own chemical enzymes that prohibit the growth of other vegetation. Dense stands also create physical barriers that keep native plant seeds from reaching mineral soil. Cogongrass also burns at extremely high temperatures (842˚F) and dense stands can cause significant loss of forest products from either prescribed burns or from wild fires.

This noxious weed adversely affects numerous species of wildlife. Unchecked, cogongrass will not only displace the native vegetation that wildlife depend upon, but will create stands so dense that many ground dwelling animals find it difficult or impossible to penetrate. Few insects feed on cogongrass and large infestations create "biological deserts" that have no value as brood-rearing habitat for quail and turkey or as foraging grounds for numerous songbirds. Domestic goats have been reported to have starved to death on pasture land heavily infested with mature cogongrass. Implications for native species such as the white-tailed

deer could be serious if cogongrass continues to spread.

Currently, cogongrass is best controlled in forested habitat with applications of herbicide. Control has been achieved with 2 percent solutions of glyphosate, with 1 to 1.5 percent solutions of imazapyr or with a mixture of both herbicides. Best control is achieved when herbicide is applied in late summer or early fall prior to plant dormancy. However, treated areas should be closely scrutinized and retreated as needed to eradicate this noxious weed. It typically takes three treatments to achieve full control of congongrass.

Cogongrass is a serious threat to both forests and wildlife. Intensive control measures should be implemented to retard the growth and spread of this noxious pest. The potential for spread can be reduced by carefully cleaning any equipment that has become contaminated prior to transporting it to another field or location.

Feral Swine

Domestic swine were originally introduced into the United States by Spanish explorers. Hogs were also brought with other livestock by early settlers and often allowed to range freely before they were periodically rounded up for sale or for slaughter. However, many escaped and became feral. European wild hogs, or what are commonly called Russian boars, have been introduced into many Southern states for sport hunting. Many of these hogs escaped and bred with feral swine to produce European-feral crosses that roam the woods today.

Feral hogs may reach heights of 36 inches or more at the shoulder. Average weights range from 100 to 300 pounds; however, larger feral hogs have been documented. Hogs are very prolific and are capable of reproduction as early as 6 months of age. A gestation period between 112 to 115 days allows sows to produce two litters per year. Under ideal conditions, litters of 10 to 12 are not uncommon.

Feral hogs are omnivorous, opportunistic feeders and will eat whatever is available. Feral hogs feed on a wide range of plants and invertebrates and compete directly with native wildlife by consuming grasses, forbs, seeds, nuts, fruits, tubers, roots, mushrooms, earthworms, insects and snails. Feral hogs will also feed on eggs, reptiles, amphibians, birds, mammals and carrion.

Feral hogs are very destructive and cause serious damage to agricultural crops and wildlife habitat. They destroy wetlands by excessive rooting and wallowing and have been noted to severely damage pitcher plant bogs. They also destroy natural hardwood regeneration by consuming massive amounts of acorns and by rooting up seedlings. Hogs have a fondness of longleaf seedlings and many early regeneration failures have been attributed to feral hogs.

Once established, hogs are almost impossible to eradicate. However, populations can be managed through the continuous removal utilizing trapping and hunting. Consult the Mississippi Department of Wildlife, Fisheries and Parks for rules and regulations pertaining to hunting and trapping hogs in your area.

Economics of Growing Longleaf Pine

Longleaf Verses Other Southern Pines

Longleaf pine is generally more expensive to establish than other species of pine because of containerized seedling cost and intensive site preparation requirements. However, properly established and managed longleaf can have economic advantages over other species of Southern pine. Currently, low pulpwood prices are a disincentive for many landowners to invest in the timber market. Prices of solid-wood products have also been on the decline. However, most analysts feel that the sawtimber market has more potential for recovery than does the pulpwood market. Fortunately, the pole market has remained strong and poles continue to bring a premium price. According to Rhett Johnson, president of Longleaf Alliance Inc., pole prices have averaged 40 to 50 percent higher than sawtimber prices over time.

Pole prices have averaged 40 to 50 percent higher than sawtimber prices over time.

Rhett Johnson, President, Longleaf Alliance Inc.

In order to compare the economics of longleaf and loblolly pines, forest silviculturalist Fred White simulated the growth and yield of two pine plantations in the Carolina sandhills. In this analysis, White compared a longleaf plantation managed for 66 years and two successive 33-year-old loblolly plantations. The longleaf stand was managed for pine straw, pulpwood, poles and sawtimber while the two loblolly rotations were managed primarily for pulpwood with a final sawtimber harvest. The analysis showed that longleaf produced as much financial return as the loblolly, generated more frequent payments and had economic advantages not shared by loblolly pine.

In a recent study, Auburn University researchers measured 39-year-old longleaf, loblolly and slash pine trees that were planted at the same time. Test plots were subjected to several cultural treatments that included cultivation and fertilization. In this study, the researchers found little difference in height and diameter between the species. However, there was a substantial difference in the quality of the timber between the species in this study. Less than 8 percent of the loblolly and less than 12 percent of the slash could be graded as poles, while nearly 72 percent of the longleaf were graded as poles. This equates to an additional 60 percent of the stand bringing a premium price when compared to the other species. This is a strong incentive for landowners to consider the establishment and management of longleaf (see Table 6).

Table 6: Income comparison of planted longleaf and loblolly on a 35-year rotation.

	LONGLEAF			LOBLOLLY		
Year	Avg. dbh	Gross Income $	Present Value $	Avg. dbh	Gross Income $	Present Value $
15	6.0	185.20	58.38	7.5	481.12	151.67
20	8.0	505.79	108.52	10.0	865.49	185.69
25	10.0	943.94	137.83	12.5	814.74	118.97
30	12.0	1,257.05	124.92	15.0	1,097.82	109.10
35	14.0	5,585.11	377.74	17.5	3,437.46	232.49
Total/ Acre		8,477.09	807.39		6,696.63	797.92

Assumptions:

- Both stands grown on a good site and intensively managed.
- BA reduced to 80 ft^2 at each thinning and clearcut at age 35.
- Initial stocking density 600 trees/acre, no mortality.
- Longleaf growth = 5 rings per inch, loblolly growth = 4 rings per inch.
- Merchantable heights = 5 ft. every 5 years beginning with 30 ft. at age 15.
- Discount rate = 8% to determine Present Value.
- Stumpage values: $7/ton pulpwood, $15/ton small chip-n-saw , $25/ton large chip-n-saw, $30/ton small poles, $40/ton sawtimber, $60/ton class poles.
- Conversion rate = 2.6 tons/cord.

Product Distribution Assumptions:

Age	Longleaf Products	Loblolly Products
15	100% pulpwood	100% pulpwood
20	50% pulpwood, 50% small chip-n-saw	50% small chip-n-saw, 50% large chip-n-saw
25	50% large chip-n-saw, 50% small poles	100% large chip-n-saw
30	50% small poles, 50% class poles	100% sawtimber
35	100% class poles	100% sawtimber

These comparisons do not consider potential differences in establishment cost, or any potential income from pine straw.

Lessons Learned From Hurricane Katrina

Even to the casual observer, it is apparent that all trees are not created equal. Different species of trees vary in their ability to withstand hurricane force winds. This inequity can be attributed to different factors including wood strength, bole shape and root system. Other factors such as soil depth, soil texture, soil moisture and management practices can affect a tree's wind resistance.

On August 29, 2005 an estimated 1.2 million acres of Mississippi's forestland was put to the ultimate test when Hurricane Katrina roared ashore. After ravaging the Mississippi Gulf Coast, Katrina continued tracking across Mississippi. Hurricane force winds were recorded 140 miles inland. Unprecedented destruction lay in her wake.

Post-Katrina observations indicated that live oak and baldcypress trees were least affected. Of the pine species, longleaf pine fared best. Similar findings have been reported following other hurricanes. Researchers in South Carolina found that live oak, baldcypress and longleaf survived better than other species following Hurricane Hugo. A similar pattern of survival occurred in Florida after Hurricanes Erin and Opal. In Florida, sand live oak, live oak and silver maple fared the best among hardwoods, and longleaf and slash pines did better than other pines. In another study in South Carolina, researchers found that longleaf fared better than loblolly pine outside of the eyewall of Hurricane Hugo. However, little difference in wind resistance occurred between longleaf, loblolly and bottomland hardwoods within the eyewall where winds approached 150 mph.

Damaged Longleaf
Photo by Glenn Hughes, Mississippi Extension Service

Table 7: Resistance of tree species to hurricane-related damage (in descending order of resistance). Prepared by the USDA Forest Service.

Flood Tolerant	Breakage	Uprooting	Salt	Deterioration by insect and disease
baldcypress	live oak	live oak	live oak	live oak
tupelo gum	palm	palm	palm	palm
sweetgum	baldcypress	baldcypress	slash pine	sweetgum
sycamore	sweetgum	tupelo gum	longleaf pine	water oak
river birch	tupelo gum	redcedar	loblolly pine	sycamore
cottonwood	dogwood	sweetgum	redcedar	baldcypress
green ash	magnolia	sycamore	tupelo gum	Southern red oak
red maple	Southern red oak	longleaf pine	baldcypress	magnolia
pecan	water oak	Southern red oak	sweetgum	tupelo gum
mulberry	sycamore	magnolia	water oak	hickory
American elm	longleaf pine	slash pine	sycamore	pecan
persimmon	slash pine	loblolly pine	Southern red oak	redcedar
silver maple	loblolly pine	water oak	hickory	red maple
water oak	redcedar	red maple	pecan	dogwood
swamp chestnut oak	hickory	dogwood	magnolia	longleaf pine
magnolia	red maple	hickory	red maple	slash pine
hickory	pecan	pecan	dogwood	loblolly pine

Overall, longleaf is more resistant than other pine species to direct and secondary hurricane damage (see Table 7). Direct damage includes flood, exposure to salt, breakage and uprooting. Secondary damage from insects and disease often follows. Although longleaf were blown down in Hurricane Katrina, only a small percentage suffered breakage, allowing for the salvage of higher valued products. Loblolly and slash sustained more breakage, resulting in a much higher percentage of salvage as pulpwood or short logs. Regardless of the species, most stands thinned within 3 years prior to the storm suffered at least some damage from Katrina.

Young pine stands typically suffered less damage than thinned stands. Although the initial damage may not have appeared catastrophic, research (unpublished) by The Longleaf Alliance indicates that the long-term negative impact to these stands may be significant. In study plots impacted by previous hurricanes, they found that many trees less than 10 years old

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Table 8: Hurricane Katrina damage to loblolly, longleaf and slash pine plantations in Forrest County, Mississippi. Prepared by Mississippi State University Extension Service.

				Pre-Katrina (standing trees)			Post-Katrina (standing + leaning)			Percent Loss (%)		
Tract	Species	Product	Mean dbh	BA per acre	Trees per acre	Tons per acre	BA per acre	Trees per acre	Tons per acre	BA	Trees	Volume
Black Creek	Loblolly	Pulpwood	7.9	29	86	26.8	12	36	11.4	59	58	57
		Chip-n-saw	9.6	70	138	47.8	12	24	8.0	83	83	83
		Sawtimber	12.7	21	24	17.0	7	8	5.7	67	67	66
		Sum	9.4	120	248	91.6	31	68	25.1	74	73	73
	Longleaf	Pulpwood	7.6	28	88	19.5	20	64	14.0	29	27	28
		Chip-n-saw	10.1	55	98	33.0	38	68	24.4	31	31	26
		Sum	9.0	83	186	52.5	58	132	38.4	30	29	27
	Slash	Pulpwood	8.0	25	72	20.5	13	38	11.2	48	47	45
		Chip-n-saw	9.7	76	148	52.0	34	66	24.2	55	55	53
		Sawtimber	13.5	6	6	4.7	6	6	4.7	0	0	0
		Sum	9.3	107	226	77.2	53	110	40.1	50	51	48
Slade	Loblolly	Pulpwood	8.0	24	68	16.9	12	30	10.4	50	56	38
		Chip-n-saw	10.1	91	164	62.7	5	10	3.1	95	94	95
		Sawtimber	12.5	17	20	12.5	0	0	0	100	100	100
		Sum	9.8	132	252	92.1	17	40	13.5	87	84	85
	Longleaf	Pulpwood	7.2	53	186	41.0	48	172	38.0	9	8	7
		Chip-n-saw	9.7	51	100	33.8	39	78	27.3	24	22	19
		Sum	8.2	104	286	74.8	87	250	65.3	16	13	13
	Slash	Pulpwood	7.5	39	128	35.1	37	112	31.7	5	13	10
		Chip-n-saw	9.6	68	134	43.4	42	82	23.7	38	39	45
		Sawtimber	12.1	8	10	5.8	0	0	0	100	100	100
		Sum	8.8	115	272	84.3	79	194	55.4	31	29	34
Average	Loblolly	All		126	250	91.8	24	54	19.3	81	78	79
	Longleaf	All		94	236	63.6	73	191	51.8	22	19	18
	Slash	All		111	249	80.7	66	152	47.7	41	39	41

Observations:
1. Loblolly suffered the heaviest losses in terms of BA, trees and volume. Longleaf suffered the least.
2. Overall the chip-n-saw and sawtimber size trees were impacted the greatest because of larger crown size.

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at the time of the storm did not grade out as poles a decade later because of sweep (curved bole). They found that sweep was most pronounced in slash, loblolly and longleaf respectively.

After Hurricane Katrina, two pine plantations in Forrest County, Mississippi, were measured to determine to what extent hurricane force winds damaged different species of pine. These pine plantations, located about 3 miles apart, were subjected to sustained winds in excess of 90 mph. Individual stands of loblolly, slash and longleaf were established on each tract in 1985. Each of the stands had been thinned to a BA of approximately 70ft^2/acre 4 years prior to the storm. After Katrina, plots were established within each stand type on each of the plantations. Data collected included site information, species, tree diameter, basal area, trees per acre, percent loss and products pre- and post-Katrina (Table 8).

Loblolly Pine

The average stocking density (250 trees / acre) and BA (126 ft^2 / acre) at the time of the storm was higher in the loblolly stands than those of other species of pine. Product classes in the loblolly stand consisted primarily of chip-n-saw with pulpwood and small sawtimber making up the remainder. Of the pine species surveyed on these sites, loblolly pine suffered the most damage (Table 9). Across both sites, only 16.3 percent of the loblolly trees were undamaged after the storm. Almost 76 percent of the damaged trees were snapped while leaning and blown over trees accounted for a little less than 8 percent.

Slash Pine

The pre-Katrina stocking density (249 trees / acre) and BA(111ft^2 / acre) of the slash stands averaged only slightly less than that of the loblolly stands. Product classes consisted primarily of chip-n-saw, pulpwood and a minor amount of sawtimber. Slash fared far better than loblolly across both sites (Table 9). A little more than 52 percent of the slash surveyed was undamaged. However, as with loblolly the majority of the damage consisted of snapped trees. With more than 38 percent of the damage consisting of snapped trees, there was a significant loss in value. Leaning and blown over trees accounted for 9.5 percent of the total damage.

Table 9: Wind damage from Hurricane Katrina

	Hurricane Damage (%)			
Species	**None**	**Snapped**	**Leaning**	**Blown over**
Loblolly	16.3	75.9	5.7	2.0
Slash	52.4	38.1	7.8	1.7
Longleaf	64.0	8.9	16.9	10.2

Damaged Loblolly Stand
Photo by Glenn Hughes, Mississippi Extension Service

Longleaf Pine

Both pre-Katrina stocking density (236 trees / acre) and BA (94 ft^2 / acre) of the longleaf plantations were less than those of the other species. Product classes in these stands consisted of pulpwood and chip-n-saw. Smaller product classes in the longleaf stands are due in part to the fact that bare-root seedlings were used to establish these stands. Bare-root seedlings typically stay in the "grass stage" longer than containerized seedlings currently on the market. Therefore, these trees did not start height growth until they were 3 to 5 years of age and consequently put them behind loblolly and slash both in terms of height and diameter. However, longleaf fared better in the storm than the other two species. Across both sites, 64 percent of the longleaf suffered no damage (Table 9). Also, the type of damage was opposite of that found in the other species. The majority of the damage (27.1 percent) occurred as leaning or blown over trees while only 8.9 percent of the trees were snapped.

Economic Impacts

The excessive damage to the loblolly resulted in an unmanageable stand. Snapped trees suffered an immediate reduction in quality and therefore a significant reduction in value. In some cases, the loss amounted to as much as a 90 percent reduction in value. Snapped chip-n-saw sold as pulpwood while snapped sawtimber was salvaged for short saw logs and pulpwood. Furthermore, snapped trees rapidly lost weight. The value loss was further compounded since most timber is sold on a per ton basis.

Although there was significant damage to the slash plantations, enough volume was retained to constitute a somewhat manageable stand. In this case, the landowner has the option to postpone final harvest until stumpage prices recover from the glut of salvaged timber on the market.

Damaged Slash Stand (left), Damaged Longleaf Stand (right).
Photo by Glenn Hughes, Mississippi Extension Service

Enough volume was retained in the longleaf areas to constitute a manageable stand. This is economically significant as there has already been 20 years invested in these stands. The storm created a few openings in the longleaf stands. However, because of the nature of longleaf, these openings can be inter-planted and the overall stand converted to a multi-aged stand and still maintained with fire. Longleaf suffered significantly less damage in the snapped category. The highest percentage of damage to longleaf was in the blown over and leaning categories. Economically, this is significant since blown over trees can still be sold as a quality product as compared to snapped trees being primarily sold as pulpwood. Because leaning trees still have a somewhat intact root system, they generally remain alive for several months or years. This allows for a wider window of opportunity for salvage and subsequently a potential revival of stumpage prices. Environmentally, this is important because in most instances, once the down and leaning timber is removed, the integrity of the longleaf stand remains.

This data clearly indicates that longleaf was less affected by hurricane force winds than loblolly and slash. Landowners along the Southern Coastal Plain are at risk of future hurricanes. Replanting with longleaf is a way to reduce the risk associated with such catastrophic events.

Wildlife Management

Longleaf pine ecosystems are extremely diverse. However, because of the overall reduction in total longleaf acreage, many of the plants and animals that are associated with this ecosystem have been adversely impacted. Numerous plant and animal species are endemic to longleaf ecosystems and a total of 170 different species of amphibians and reptiles are found within the historic range. Because of the drastic decline of longleaf ecosystems, close to 30 species of plants and animals have become threatened or endangered. Approximately 100 more plants and animals that are associated with longleaf ecosystems are listed as species of concern by various state and federal agencies.

In order for a particular species of wildlife to prosper, it is imperative that adequate food, water, cover and space be available. However, since different species of wildlife have varying habitat requirements, longleaf forests often require manipulation and maintenance to produce quality habitat for the species of interest. Sound forest management practices that include periodic timber harvest and prescribed burns are beneficial for most species of wildlife associated with longleaf ecosystems. However, when managing for a particular species of wildlife, the magnitude of timber harvest and the frequency of fire will be dependent upon the habitat requirements of that species. Because of the extent of species of wildlife associated with these ecosystems; only a few will be discussed.

White-tailed Deer
Photo by Randy Browning, USFWS/WM

White-tailed Deer

Odocoileus virginianus

White-tailed deer are plentiful and are considered the most popular big game species in the United States. However, white-tailed deer have not always been abundant. During the early 1900s, deer populations were limited in many of the Southeastern states because of habitat loss and the over exploitation from subsistence and market hunting. However, through the efforts of many State wildlife agencies, conservation organizations, dedicated sportsmen and private landowners, white-tailed deer have made a remarkable recovery.

White-tailed deer are adaptable and occur on a wide range of habitats. White-tailed deer consume a variety of forage including the fruits, nuts, leaves and twigs of woody plants. Deer also forage on numerous forbaceous plants (weeds), mushrooms and some grasses. Many hard- and soft-mast-producing trees and shrubs occurring within longleaf pine ecosystems are important to deer, such as various oaks, American beech, crabapple, persimmon, huckleberry and dogwood. Other woody plants found within longleaf ecosystems that deer feed upon include blackberry, dewberry, muscadine, fringetree, hawthorn, blueberry, yaupon, gallberry, American beautyberry, honeysuckle and greenbriar.

Prescribed fire is an important management tool for maintaining forage and cover for white-tailed deer. Dormant season burns primarily top kill woody plants, therefore promoting regrowth of succulent browse. Dormant season burns should be conducted on a 3- to 5-year rotation to maintain forage within the reach of deer. Prescribed burning also stimulates the growth of numerous forbs that are important to deer. Forbs are generally highly digestible, palatable and nutritious. This allows white-tailed deer to prosper in stands of longleaf that have a relatively open understory.

Wild Turkey

Meleagris gallopavo

The range of the Eastern and Osceola wild turkeys overlaps the historic range of longleaf pine. Turkey populations were considered to be high in pre-colonial times. However, turkey populations declined drastically around the turn-of-the-century from the loss of forested habitat and by unrestricted harvest by subsistence and market hunters. However, since that time, turkey populations have significantly increased through the protection and restoration efforts by numerous state wildlife agencies, sportsmen, private landowners and conservation organizations.

Turkeys are omnivorous and opportunistic feeders with adult diets consisting primarily of vegetative matter. Being opportunistic, turkeys also feed on a variety of insects, spiders, small snakes and lizards. Turkeys feed heavily on the seeds, fruits and leaves from of a variety of plants common to longleaf ecosystems. Hard seeds these birds consume include acorns, beechnuts, pecans, pine seeds and sweetgum seeds. Soft-mast includes dogwood, black gum, huckleberry, dewberry, blackberry, gallberry and yaupon. Turkeys also feed on the seeds and leaves of numerous grasses, sedges and forbs. Turkeys will feed heavily on cultivated crops such as soybean, corn, sorghum, wheat, oats, rye, ryegrass and clover when available.

Turkeys prosper in well-managed longleaf ecosystems that have adequate

nesting, roosting and brood-rearing habitat. Prescribed burning is an important management tool for maintaining quality turkey habitat. Prescribed fire promotes succulent regrowth of grasses and forbs utilized by wild turkey. However, the type of habitat to be developed and maintained will determine the frequency of the burn rotation. Turkeys prefer to nest in dense understory vegetation. Therefore, prescribed fires should be conducted on a 3- to 5-year rotation to maintain adequate nesting habitat.

Although adult turkeys forage primarily on vegetative matter, poults' diets consist primarily of insects. Turkey poults require a high protein diet during the first 3 to 4 weeks of their life in order to obtain sufficient growth rates. Therefore, it is important to manage and maintain quality brood-rearing habitat when managing for wild turkeys. Brood-rearing habitat can be established through cultivation and management of various legumes or through the use of fire. Fire stimulates succulent growth of many native plants therefore promoting insect production. Good brood-rearing habitat consists of fairly sparse ground vegetation that allows easy movement while still offering concealment. Prescribed burning on a 2-year rotation will generally yield these conditions.

Although turkeys will roost in a variety of habitats in both coniferous and deciduous trees, they depend heavily on the availability of mature trees within Streamside Management Zones (SMZs). Turkeys also use SMZs for travel and foraging corridors. As previously mentioned, it is important to exclude fire from these areas to avoid damage to important hardwood trees and shrubs.

Bobwhite Quail
Photo by Randy Browning, USFWS/WM

Bobwhite Quail

Colinus virginianus

Bobwhite quail populations have been on an overall decline for several decades. The decline has been attributed to the loss of quality habitat and an overall degradation of the remaining habitat. For instance, quail are weak scratchers and are inhibited by dense stands of introduced pasture grasses such as bahia and Bermuda grass. An overall decrease in small farms, an increase in clean-row farming practices, intensified timber management practices and a reduction in the use of fire have all contributed to the decline in habitat.

High quail populations are often associated with agricultural land. However, good quail populations can be obtained in properly managed pine stands. Quail prefer open to moderately open pine stands such as those managed for sawtimber and pole production. High quail production can occur in longleaf stands when BA is maintained at 80 ft^2 per acre or less and periodically burned.

Prescribed burning is a critical component of quail management. Fire reduces vegetative density, releases nutrients back to the soil and creates bare ground. Fire also promotes the establishment and maintenance of native bunch-grasses important for nesting and brood-rearing habitat. Good nesting habitat consists of 2- to 3-year-old stands of native bunch-grasses and approximately 25 percent of an area should be maintained for nesting.

Good brood-rearing and foraging habitat consist of native bunch-grasses and native legumes that are burned on an annual or biannual basis. Native legumes such as partridge pea, beggarweed and lespedeza are heavily utilized by quail. Fire helps germination rates of these native legumes by scarifying hard seed. Fire also promotes insect abundance by maintaining succulent forage on the forest floor. This is important because the diets of quail consist almost exclusively of insects during the first 2 to 3 weeks of their life. Insects continue to make up a substantial part of the diet of quail throughout adulthood. Therefore, 1/3 to 1/2 of the property being managed for quail should be burned each year on a rotational basis.

Another critical component of quail habitat is loafing cover. Quail need areas in which to rest and to avoid avian predation. Brushy fence rows make excellent loafing areas. Additional loafing areas can be created by establishing fire lanes around existing thickets or by planting low growing trees and shrubs such as the Chickasaw plum.

Red-cockaded Woodpecker

Picoides borealis

The endangered red-cockaded woodpecker is well known for its dependency on longleaf ecosystems. Its historical range extended throughout most of the Southeast to as far west as Texas, Oklahoma and Missouri. However, the red-cockaded woodpecker has disappeared along with the stands of mature pine and has been extirpated from New Jersey, Maryland, Tennessee and Missouri.

The red-cockaded woodpecker is a small, black and white bird with a black cap and large white cheek patches. Rarely visible, except perhaps during the breeding season and periods of territorial defense, the male has a small red streak on each side of its black cap called a cockade, hence its name. These

woodpeckers are unique in the fact that they excavate nesting and roosting cavities in mature, living pine trees. The minimum age of Southern pine trees used for cavity trees is approximately 70 years old. Cavities are normally excavated in trees that have been infected with red heart fungus. Red heart fungus decays heart wood, thus making excavation easier for the woodpecker. The woodpecker chips out small resin wells around the entrance of the cavity. Pine sap seeps from the open resin wells giving the trunk a waxy, white coating. This sticky coating helps repel nest predators such as the rat snake.

Red-cockaded woodpeckers are social birds and establish colonies. Offspring, especially males, remain at the colony site and assist the breeding pair with care of the young. The red-cockaded woodpecker prefers foraging in semi-open pine stands that primarily consist of diameter classes of 10 inches dbh or more. Hardwoods are not a significant component of these foraging grounds. Red-cockaded woodpeckers feed primarily on beetles, ants, roaches, caterpillars, wood-boring insects, spiders and occasionally fruits and berries.

Given the opportunity, bluebirds, chickadees, titmice, other woodpeckers, flying squirrels, bees, wasps and several species of reptiles and amphibians will utilize cavities excavated by the red-cockaded woodpecker.

Mississippi Sandhill Crane

Grus canadensis pulla

The Mississippi sandhill crane is an endangered bird that stands about 4 feet tall. Sandhills have long legs and necks and are gray to brownish-gray in coloration. This species of sandhill crane can be identified by a red forehead. In flight, sandhill cranes extend both their neck and legs as compared to great blue herons which fly with their neck crooked.

The Mississippi sandhill crane is a non-migratory species found only in Jackson and Harrison Counties. They use wet pine savannas with low basal areas for feeding and nesting habitat. Cranes prefer a basal area of 5 ft^2 per acre or less. Nests are constructed on the ground and usually located within shallow pools of standing water. Average clutch size is two, but fledgling survival is typically very low. Cranes eat a variety of native foods that include plant tubers and roots, berries, insects, crayfish, worms, frogs and rodents. However, cranes will also feed on agricultural crops such as corn.

Gopher Tortoise

Gopherus polyphemus

Populations of gopher tortoise are scattered throughout the Gulf Coastal Plain with most being found in North-central Florida and Southern Georgia. Limited numbers of tortoises are found in Southeastern Louisiana, the southern third of Mississippi and Alabama.

Gopher Tortoise
Photo by Randy Browning, USFWS/WM

Gopher tortoises, or "gophers" as they are commonly called, live in dry, sandy habitats such as longleaf pine-oak sandhills and sand pine scrub. Gophers are strong diggers and excavate crescent-shaped burrows that are often 10 feet deep and over 30 feet in length. These burrows protect the gopher from extreme temperatures during the summer and winter as well as from fires. Gopher burrows are also important to numerous vertebrates and invertebrates. Over 360 species are known to use gopher tortoise burrows. Some of the animals that use these burrows include the Eastern diamondback rattlesnake, black pine snake, armadillo, rabbit, opossum, indigo snake and gopher frogs.

Gopher tortoises feed on a wide variety of plants with bunch-grasses and broad-leaf grasses comprising the majority of the diet. However, various legumes as well as blackberries, saw palmetto berries, pawpaws and other fruits are readily consumed.

Conditions needed for healthy tortoise populations include well-drained soils for burrows, sufficient low-growing food plants with open canopies for sunning and nesting. Fire is critical for maintaining open habitat and nesting and for the promotion of low-growing forage plants utilized by the gopher tortoise. In the absence of fire, canopies would quickly close and render the habitat unsuitable.

Habitat loss and fragmentation pose serious threats to the continued survival of the tortoise. Gopher habitat has been plowed for agricultural crops, converted to loblolly and slash pine plantations and further fragmented by the many facets of urban sprawl. Gopher tortoise numbers have declined in Louisiana and Mississippi to the extent that the species is listed as a federally threatened species in both states.

Dusky Gopher Frog

Rana capito sevosa

The dusky gopher frog is an endangered species that was historically found in Louisiana eastward to the Mobile River delta in Alabama. In Mississippi, gopher frogs have been recorded in Forrest, Harrison, Jackson and Pearl River Counties. However, breeding populations are known to occur only in Harrison and Jackson Counties.

Gopher frogs are unique in the fact that they require two distinct habitat types to survive. Dusky gopher frogs require isolated, temporary pools for breeding and upland foraging sites with subterranean refuges. These refuges must be cool and moist. Gopher tortoise burrows, stump holes and crawfish burrows are ideal. The most productive breeding pools become dry at certain times of the year and therefore are not populated with predacious fish and insects that feed on tadpoles. However, sufficient winter rains are needed to fill these ephemeral wetland pools. Water must remain in the pools for a period of 4 or 5 months to allow time for tadpoles to transform into juvenile frogs.

Because there is such a small population of dusky gopher frogs, natural events such as droughts or even flooding could threaten the survival of this species. Upland-pine-forest habitat and temporal ponds need to be protected from direct and indirect negative changes such as increased sedimentation or fire suppression. Even rural development could alter hydrology and further fragment habitat.

Eastern Diamondback Rattlesnake

Crotalus adamanteus

Rattlesnakes are classified as pit vipers and are found only in the Northern Hemisphere. Pit vipers have a pair of hollow fangs for injecting venom into their prey. These fangs are retractable and fold against the roof of the mouth when not in use.

The Eastern diamondback is a heavy-bodied snake and is the largest of the rattlesnakes. Adult Eastern diamondback rattlesnakes are usually between 4 to 5 feet in length. However, larger snakes have been recorded with the world record measuring 8 feet.

The Eastern diamondback is an ambush predator and coils patiently awaiting prey to approach within striking distance. Cotton rats and rabbits are principle prey of diamondbacks but other small mammals and birds are also consumed. Eastern diamondbacks utilize gopher tortoise burrows as retreats as well as winter den sites.

The Eastern diamondback rattlesnake ranges along the Gulf Coastal Plain from North Carolina to Louisiana. Although the Eastern diamondback is not listed as endangered or threatened, it is a species in decline. The reduction in diamondbacks has been attributed to loss of habitat and extensive harvest by snake hunters.

Gopher Tortoise Burrow

Photo by Randy Browning, USFWS/WM

Black Pine Snake

Pituophis melanoleucus lodingi

Black pine snakes are generally dark brown to black. They have stout bodies and grow up to 6.5 feet in length. This subspecies of pine snakes range from Southwestern Alabama to Southeastern Louisiana and typically inhabit well-drained longleaf pine uplands. In Mississippi, the black pine snake has been recorded in nine Southeastern Counties. They are: Forrest, Perry, Greene, Pearl River, Stone, George, Hancock, Harrison and Jackson Counties.

Little is known about this snake, but it is believed that it preys primarily on rodents. Like the diamondback, these snakes are believed to also utilize gopher tortoise burrows as retreats and winter den sites. Black pine snake populations have been on the decline for the past 70 years and are currently candidates for federal listing.

Eastern Indigo Snake

Drymarchon corais couperi

The Eastern indigo snake is the longest native snake in North America and can reach lengths of 8.5 feet. These snakes are large bodied and iridescent blue-black in color. However the head may be partially cream, orange or red.

Eastern indigo snakes primarily inhabit sandy longleaf pine-oak uplands and originally ranged from Southwestern South Carolina, through Florida and into Southern Mississippi. However, sightings have been limited across much of its range for the past 50 years.

Indigo snakes are active during daylight hours and feed on a variety of animals that include frogs, lizards, snakes, turtles and small mammals. Indigo snakes also utilize gopher burrows for retreats and as winter den sites.

The Eastern indigo snake is federally listed as threatened because of the overall decline in the species. This decline has been attributed to the destruction of suitable habitat, which is primarily the longleaf ecosystem.

Financial Assistance for Enhancement, Restoration and Protection of Longleaf Pine

Conservation Easements

A conservation easement is a legal agreement that ensures a property will be managed in perpetuity according to the landowner's desires. It may also qualify the landowner for tax benefits.

Conservation easements are one of the most landowner-friendly conservation tools available for those wishing to preserve a particular conservation ethic on a specific piece of land. Easements enable a landowner to protect natural habitats on their property while at the same time taking advantage of potentially substantial federal tax benefits.

Mississippi is one of several states that have adopted a Uniform Conservation Easement Act. Under the act, a landowner can place restrictions on the present and future uses of their property with the intent of preserving conservation practices.

Furthermore, the federal government, specifically the Internal Revenue Service, recognizes the conveyance of a real property interest to a qualified conservation organization to accomplish a specific purpose has public benefits and as such could qualify the owner for a substantial tax deduction.

The easiest way to understand conservation easements is to look at the basic rights that come with owning land. When a conservation easement is placed on a property, the owner may give up certain rights (e.g., developing the property, etc.). Restrictions on the property are specified in the easement document, the conveyance of which must be made in perpetuity in order to receive federal tax benefits. The easement document itself is a legal instrument that is signed and recorded in the county in which the property is located.

There are three important aspects of any conservation easement that must be met. First, the easement must meet a definite conservation purpose. The primary purpose, in most cases, would be the protection and/or restoration of primarily hardwood habitats. Second, in order to qualify as a conservation easement under the Uniform Act, the easement must be granted to or be held by a "qualified conservation organization," such as the Mississippi Land Trust (www.misslandtrust.org).

It is important to note that the conservation organization, which holds the easement, does not actually acquire the rights donated by the easement. Rather, the easement gives the organization the right and responsibility to monitor and enforce the restrictions placed on the property and ensure adherence to the easement document.

A third, but equally important aspect of the easement process, is the development of a baseline ecological assessment. It is an ecological "snapshot" of the property. The baseline ecological assessment establishes and records the condition of the property, as well as the land uses that exist when the conservation easement is established. The baseline document is then utilized by a conservation organization serving as the easement holder to monitor the property and the conditions that exist on the property through time.

Except for the restrictions described by the easement, the property owner retains all other rights that were conveyed when the property was purchased. Hunting, fishing, wildlife viewing and timber management can still be conducted. Conservation easements do not allow public access to the property.

The Uniform Conservation Easement Act prohibits use of the property where more than a minimum use of the property for a commercial recreational activity is allowed. When the owner of such property is not the owner of the surface estate and mineral interests, the tax benefits associated with the conservation easement shall occur if the probability of such surface mining occurring on such property is so remote as to be negligible.

The tax benefits associated with conservation easements apply to a landowner's federal income tax. These benefits are as follows:

1) allow a deduction a donor can take for donating a voluntary conservation easement in any year in the amount of 50 percent;
2) allow farmers and ranchers to deduct up to 100 percent of their income; and
3) allow 16 years over which a donor can take deductions.

As in any conservation program, it is best to seek the advice of fish and wildlife and tax professionals with experience in the development of conservation easements.

The Mississippi Land Trust has a handbook to fully describe the

conservation easement, its benefits and the process needed to place one on property. For a free copy of the conservation easement handbook, please call the Land Trust at (662) 686-3375 or visit their web site at www.misslandtrust.org.

Conservation Reserve Program

The Conservation Reserve Program (CRP) has been hailed as one of the most successful conservation programs in the United States.

The CRP protects highly erodible and environmentally sensitive lands with grass, trees and other cover. It was extended through 2012 and allows up to 32 million acres to be enrolled. New enrollments can replace expired or terminated contracts. However, only lands with acres that qualify under the continuous sign-up guidelines are eligible to be re-offered. Lands with high environmental values, including filter strips, waterways, windbreaks, riparian areas, wetlands and lands planted to hardwoods and longleaf pine are given priority.

A longleaf pine conservation priority area has been established within the CRP as part of the program's eighteenth sign-up. Within this conservation priority area, all cropland to be devoted to longleaf habitat may be eligible for enrollment in the CRP providing it meets cropping history requirements and is physically and legally capable of being cropped. Establishment of this national priority area is an important step in the effort to re-establish the longleaf ecosystem. It also provides an additional opportunity for landowners to participate in our nation's largest land conservation program.

Land enrolled in this priority area will receive an annual rental payment. This payment is based on the relative productivity of the soil type being offered and the average dry land cash rental rate for comparable land in the county. Cost-sharing, at a rate of 50 percent, is available to re-establish longleaf pine habitat. Practices eligible for cost-sharing include, but are not limited to, site preparation and longleaf pine seedlings. Contracts under the sign-up are 10 to 15 years in length. Annual rental payments are made after October 1 of each year. Cost-share payments are made after the approved practices are completed.

To apply, contact your local USDA Service Center or Farm Service Agency office. You do not have to make a competitive offer as required of other programs. Your offer will be automatically accepted if all eligibility requirements are met.

Environmental Quality Incentives Program

The Environmental Quality Incentives Program (EQIP) provides financial and technical assistance to farmers and ranchers who have soil, water, air or related natural resource threats on their land. Lands eligible for the EQIP contracts can be cropland, pasture land or non-industrial private forest land.

One-year minimum and 10-year maximum contracts will provide technical assistance and pay up to 75 percent of the costs of conservation practices such as invasive species control, site preparation, seedlings and planting. Beginning and limited resource producers as well as socially disadvantaged farmers may be eligible to receive up to 90 percent cost share. Activities under the contract are required to be carried out according to a conservation plan. The total cost-share and incentive payments to any person or entity is limited to $300,000 over a 6-year period. However, the Secretary of Agriculture may raise the limitation to $450,000 for projects of special environmental significance.

The EQIP is funded at the following levels: FY 2008 - $1.20 billion: FY 2009 - $1.34 billion; FY 2010 - $1.45 billion; FY 2011 - $1.59 billion; and FY 2012 - $1.75 billion.

To learn more about the EQIP, contact your local office of the Natural Resources Conservation Service or your local U.S. Department of Agriculture Service Center.

Healthy Forests Reserve Program

The purpose of the Healthy Forests Reserve Program (HFRP) is to restore and enhance forest ecosystems that promote the recovery of threatened and endangered species, improve biodiversity and enhance carbon sequestration.

In Mississippi, species targeted for habitat restoration activities and for population recovery include the gopher tortoise, gopher frog and the black pine snake. Currently, the program is offered in 14 counties that include Covington, Forrest, George, Greene, Hancock, Harrison, Jackson, Jones, Lamar, Marion, Pearl River, Perry, Stone and Wayne.

Only private lands or Tribal lands are eligible for enrollment into the program. These lands must demonstrate the ability to restore, enhance or increase the likelihood of recovery of one or more of the above mentioned species.

To participate in the program, landowners can enter into a 10-year cost-share agreement, a 30-year easement or a permanent easement. The percentage of cost-share that participating landowners may receive for approved conservation practices are 50 percent, 75 percent and 100 percent respectively. Landowners choosing to enroll their land into an easement option may receive 75 percent of the easement value for enrolled land with the 30-year easement or 100 percent of the easement value for land enrolled permanently.

Landowner protections are available to landowners who are enrolled in the HFRP and agree to restore or improve their land for threatened and endangered species for a specified time. In return, landowners avoid future

regulatory restrictions on the use of that land under the Endangered Species Act.

For more information about the HFRP, contact your local office of the Natural Resources Conservation Service or your local U.S. Department of Agriculture Service Center.

Mississippi Reforestation Tax Credit

The Reforestation Income Tax Credit encourages reforestation practices on Mississippi lands by non-industrial, private, timberland owners. Most landowners, including trusts, are eligible for this tax credit except private corporations that manufacture products or provide public utility services. Eligible lands for credit must be owned by the person or entity claiming the credit and can include agricultural, pasture, cutover and idle land.

The tax credit available is usually equal to 50 percent of the actual costs of the approved reforestation practices, but may be limited to 50 percent of the average cost of approved practices as established by the Mississippi Forestry Commission.

Annually, the credit earned cannot exceed $10,000. If a taxpayer owes less tax than the credit earned, then any unused portion of the credit may be carried forward for succeeding tax years. The maximum dollar amount of credit that an eligible owner may utilize during his or her lifetime is $75,000. These limits apply at the individual and the partnership levels. For example, if a husband and wife reforest jointly-owned land then their "partnership" tax credit is limited to $10,000 annually. But if each owned separate properties their credit limit is $10,000 each.

Pine and hardwood tree planting practices, including the cost of seedlings, planting by hand or machine and site preparation, are eligible practices. Mixed-stand regeneration practices to establish a mixed crop of pine and hardwood trees by planting or direct seeding, or both, including the cost of seedlings, acorns, planting, seeding and site preparation, are also eligible. Direct seeding practices to establish a crop of pine or oak trees by directly applying seed/acorns to the site, including the cost of acorns, seeding and site preparation are eligible. In addition, post-planting practices to reduce or control undesirable competition within the first growing season of an established crop of trees are eligible. Approved reforestation practices shall not include the establishment of orchards, Christmas trees or ornamental trees.

To be eligible for the tax credit, a reforestation prescription or plan must be prepared by a graduate forester of a college, school or university accredited by the Society of American Foresters or by a registered forester. Next, the forester signs the Mississippi Tax Credit Form (MS 80-315) to verify that the reforestation practices were completed and that the reforestation prescription or plan was followed.

A reforestation prescription or plan is a written description of the approved reforestation practices that the eligible owner plans to use and includes a legal description and map of the area to be reforested, a list of the tree seedlings or species of seeds to be used in the reforestation and the site-preparation practices that will be utilized.

To learn more about the Mississippi Reforestation Tax Credit, contact the Mississippi Forestry Commission under Forest Management www.mfc.state.ms.us.

Partners for Fish and Wildlife

Congress passed the Fish and Wildlife Act of 1956, which gave the U.S. Fish and Wildlife Service (Service) authority to enter into voluntary agreements with non-federal government entities, including private landowners, to restore and enhance habitat for fish and wildlife resources. In 1987, the Service began a voluntary partnership program with landowners and other partners interested in restoring wetlands and other important fish and wildlife habitats. More recently, the Partners for Fish and Wildlife Act of 2006 authorized the Service to provide financial and technical assistance to private landowners to restore, enhance and manage private land to improve fish and wildlife habitats through the Partners for Fish and Wildlife Program.

The restoration, enhancement, management or reestablishment (i.e., habitat improvement) of degraded wetlands, native grasslands, streams, riparian areas and other habitats to conditions as close to natural as practical is emphasized. The program's philosophy is to work proactively with private landowners and other partners for the mutual benefit of declining federal trust species and the interests of the landowners involved.

Usually, a dollar-for-dollar cost-share is achieved by working with landowners and a host of nationally based and local entities (e.g., federal, state and local agencies and private conservation organizations). Landowners sign an agreement to restore the habitat for the life of the agreement (at least 10 years) and otherwise retain full control of the land.

The Partners Program has had many accomplishments since it was started in 1987. From 1987 through 2008, the program worked with private landowners to restore more than 2,000,000 acres of upland habitat, including native prairie and grasslands, longleaf pine and other uplands; over 800,000 acres of wetlands; and 7,000 miles of riparian and in-stream habitat. This involved over 30,000 landowner agreements. Mississippi has been a leader in this program, with approximately 6 percent of the nationwide acreage being in the state.

In 2007, the Partners Program in the Southeast Region, in collaboration with its many partners, completed a strategic plan – Strategic Habitat Conservation and the Power of Partnerships (2007-2011). This Plan addresses five program goals (i.e., Conserve Habitat, Broaden and Strengthen Partnerships, Improve Information Sharing and Communication, Enhance the

Workforce and Increase Accountability), and steps down the implementation of these goals to each state within the Southeast Region. The Plan can be viewed and downloaded from the Internet at: http://www.fws.gov/southeast/partners/StrategicPlan.html.

Wildlife Habitat Incentives Program

The Wildlife Habitat Incentives Program (WHIP) helps landowners improve wildlife habitat on private lands. Cost-sharing to landowners is provided for developing habitat for upland wildlife, wetland wildlife, endangered species, fisheries and other wildlife.

This program is different than most programs because it indicates an underlying shift from only providing incentives for land retirement to placing an emphasis on land management practices. It makes cost-share payments, not rental or easement payments, to landowners.

The participant and the Natural Resources Conservation Service (NRCS), the agency within the U.S. Department of Agriculture responsible for implementing the program, must enter into an agreement to implement the fish and/or wildlife practices desired by the participant and the NRCS. Participants in this program must own or control land and agree to prepare and implement a management plan that contains certain conservation practices to be installed on the land. The plan describes the landowner's goals for conservation, including the practices necessary to achieve such goals.

The NRCS agrees to provide the necessary technical assistance and pay 75 percent of the cost of installing the practices. However, limited resource producers, socially disadvantaged and beginning farmers and ranchers may be eligible for cost-share up to 90 percent. Approval may be granted for cost-share assistance for not more than $10,000. Under the WHIP, applications are ranked and point values are assigned to the land that is submitted for financial assistance. Applications with the most points are funded.

Practices in these programs will help provide cover for wildlife, including the planting of trees, as well as nesting and brood-rearing habitat for species like turkey and bobwhite quail. Aquatic habitats and water quality can be improved by establishing habitat adjacent to streams. Wildlife habitat can also be improved within forest stands through this program. Another priority is to establish woody and/or grassy corridors.

To learn more about the WHIP, contact your local office of the Natural Resources Conservation Service or your local U.S. Department of Agriculture Service Center.

About Wildlife Mississippi

Who Are We?

In 1997 Mississippians had the vision and dedication to create Wildlife Mississippi. Wildlife Mississippi, is a low-overhead, no frills organization which was founded to conserve, restore and enhance our fisheries and wildlife resources for the enjoyment and enrichment of all residents of Mississippi, their progeny and visitors to our state.

Wildlife Mississippi has an effective conservation philosophy. It is based on three basic principles: 1) a strong economy provides incentives; 2) encourage conservation stewardship while recognizing private property rights; and 3) polluters should be liable for harm they cause others. Now is the time to establish an effective conservation philosophy that contains effective and cost-efficient programs to improve Mississippi's fish and wildlife resources for years to come.

Wildlife Mississippi's success will not be measured by numbers of members, nor size of staff, nor budget, nor an impressive office building which will never be built. Mississippi's wealth of leadership and overwhelming support and participation of sportsmen, industry, business, farmers, landowners and wildlife enthusiasts will ensure that Wildlife Mississippi will succeed. All funds raised by Wildlife Mississippi will stay at home, in Mississippi. Wildlife Mississippi has already become a model for America. The future of Wildlife Mississippi is unlimited.

Conservation Initiatives

To support its focused conservation goals, Wildlife Mississippi is concentrating its staff and fiscal resources on four major initiatives.

• Conservation Education: Wildlife Mississippi educates citizens about conserving natural resources. Each year throughout the state, Wildlife Mississippi conducts countless presentations, classes and programs as well as annual seminars and workshops. We publish landowner guides, widely-read newspaper columns, educational brochures and technical handbooks.

• Fish and Wildlife Habitat: Wildlife Mississippi has restored thousands of acres of hardwood and longleaf pine forests and native prairie, all beneficial for wild turkey, white-tail deer, bobwhite quail and many other species of wildlife. We've protected, restored and enhanced fisheries habitat in lakes, ponds, rivers and streams, plus the nesting, migration and wintering habitats of waterfowl. Wildlife Mississippi believes in protecting Mississippi's rare and declining species of fish, wildlife and plants before they are declared threatened or endangered and work to recover species already declared.

• Outdoor Recreation and Parks: Wildlife Mississippi believes safe, family-oriented outdoor recreational opportunities enrich our lives and promote tourism. From kid's camps to our conservation education center, we work to cultivate an appreciation for outdoor activities and areas. We encourage new boat ramps, wildlife management areas, refuges and improved parks and national forests. We are involved in creating outdoor recreation areas and parks accessible for all Mississippians. In addition, we have worked to make shooting houses available for the physically challenged.

• Conservation Policy: We work with conservation agencies, the Mississippi Legislature and the United States Congress to identify strategies to help protect, restore and enhance our natural resources. We help shape public policy with on-the-ground action to conserve Mississippi's natural resources. The Wildlife Habitat Incentives Programs and the Healthy Forests Reserve Program were concepts of Wildlife Mississippi. We conceptualized the Theodore Roosevelt and the Holt Collier National Wildlife Refuges, as well as the Sky Lake Wildlife Management Area, the largest stand of ancient cypress in the world.

For more information on Wildlife Mississippi, write them at P.O. Box 10, Stoneville, MS 38776, call them at (662) 686-3375 or visit their website at www.wildlifemiss.org.

References

Boyer, William D. and John B. White. 1989. Natural regeneration of longleaf pine. In: Proceedings of the Symposium on the Management of Longleaf Pine. USDA, Southern Forest Experiment Station, General Technical Report SO-75.

Boyer, William D. 1996. Anticipating good longleaf pine cone crops. Alabama's TREASURED Forests (15:24-26).

Boyer, William D. 1999. Longleaf Pine: Natural Regeneration and Management. Alabama's TREASURED Forests (Vol. XVIII, No. 4: 7-9).

Byrd, J. D., and C.T. Bryson. Biology, Ecology, and Control of Cogongrass [*Imperata cylindrica* (L.) Beauv.]. Mississippi Department of Agriculture and Commerce-Bureau of Plant Industry. Fact Sheet No. 1999-01.

Colie, N. C., and D. G. Shilling. 1993. Cogongrass [*Imperata cylindrica* (L.) Beauv.].: a good grass gone bad! Florida Department of Agriculture & Consumer Services, Division of Plant Industry Botany Circular No. 28.

Cooper, M. B. Endangered Species of Mississippi. 1994. Mississippi Department of Wildlife, Fisheries and Parks, Museum of Natural Science.

Cotton, Dan, and D. Brennan. Bobwhite Quail. A Management Handbook. Mississippi Department of Wildlife Fisheries and Parks.

Dennington, R.W., and R.M. Farrar. 1983. Longleaf pine management. USDA Forest Service Forestry Report R8-FR 3 (17pp.).

Earley, L. S. 1997. A Working Forest. Sandhills Area Land Trust of Southern Pines, North Carolina.

Franklin, Robert M. 1997. Stewardship of longleaf forests: a guide for landowners. Longleaf Alliance Report No. 2.

Frost, C. C., J. Walker and R. K. Peet. 1986. Fire-dependent savannas and prairies of the southeast: original extent, preservation status and man agement problems. In D. L. Kulhavy and R. N. Conner (eds.), Wilderness and Natural Areas in the Eastern United States: A Management Challenge. Nacogdoches, TX: Center for Applied Studies, School of Forestry, Stephen F. Austin State University. pp. 348-357.

Gober, Jim R. 1999. Products of the Longleaf Pine. Alabama's TREASURED Forests (Vol. XVIII, No. 4: 20-21).

Hainds, Mark. 1999. Herbicides and Longleaf Pine Establishment. Alabama's TREASURED Forests (Vol. XVIII, No. 4: 14-15).

Hilton, Jarel. 1999. Biological Diversity in the Longleaf Pine Ecosystem. Alabama's TREASURED Forests (Vol. XVIII, No. 4: 28-29).

Hughes, Glenn. 1999. Longleaf Pine in Mississippi. Mississippi State University Extension Service. Publication 2201.

Johnson, E. R. R. L. and D. G. Shilling. 1998. Cogongrass [*Imperata cylindrical* (L.) Palisot]. Weed Science. University of Florida.

Johnson, Rhett. 1999. Does Longleaf Make Dollars and Sense? Alabama's TREASURED Forests (Vol. XVIII, No. 4: 26-27).

Jose, Shibu, J. Cox, D. L. Miller, D. G. Shilling, and S. Merritt. 2002. Alien Plant Invasions. The Story of Cogongrass in Southeastern Forests. Journal of Forestry. Vol. 100, No. 1: 41-44.

Landers, J. L., D. H. Van Lear, and W. D. Boyer. 1995. The longleaf pine forests of the Southeast: requiem or renaissance? Journal of Forestry. Vol. 93, No. 11: 38-44.

Moore, Julie H. 2001. Managing the Forest and the Trees. A Private Landowner's Guide to Conservation Management of Longleaf Pine. The Nature Conservancy, The Longleaf Alliance and Southern Group of State Foresters.

Patterson, D.T., E. E. Terrell, and R. Dickens. 1979. Cogongrass in Mississippi. Mississippi Agriculture and Forestry Experiment Station Research Report 46(6):1-3.

Stout, I. J. and W. R. Marrion. 1993. Pine flatwoods and xeric pine forests of the southern (lower) coastal plain. In W. H. Martin, S. G. Boyce, and A. C. Echternacht (eds.), Biodiversity of Southeastern United States - Lowland Terrestrial Communities. New York: John Wiley & Sons, Inc. pp. 337-446.

Wahlenberg, W. G. 1946. Longleaf pine: its use, ecology, regeneration protection, growth, and management. Charles Lathrop Pack Forestry Foundation and USDA Forest Service. 429 p. Washington, DC.

Walker, L. C. and H.V. Wiant. 1973. Silviculture of Longleaf Pine. Bulletin11. School of Forestry, Stephen F. Austin State Univiversity., Nacogdoches, TX. 105 pp.

Ware, S., C. Frost, and P. D. Doerr. 1993. Southern mixed hardwood forest: the former longleaf pine forest. In W. H. Martin, S. G. Boyce, and A. C. Echternacht (eds.), Biodiversity of Southeastern United States - Lowland Terrestrial Communities. New York: John Wiley & Sons, Inc. pp. 447- 493.

Yarrow G. K. and D.T. Yarrow. 1999. Managing Wildlife. Alabama Wildlife Federation. 588 pp.

Young, R. A. and R. L. Giese. 1990. Introduction to Forest Science. Second Edition. John Wiley and Sons Inc. 586 pp.

Glossary of Terms

Allelopathic - Ability of a plant to produce chemical inhibitors to suppress the germination of competing vegetation.
Allowable cut - The timber volume that can be harvested without depleting target growth.
Bare-root seedlings - Commercial seedlings that are harvested by undercutting the roots.
Basal area (BA) - The area of the cross section of a tree stem, in square feet, measured at breast height (4.5 feet). Used as a measure of timber stocking in a given stand.
Bole - Main trunk of a tree.
Browse - Leaves, shoots, buds and twigs of trees, shrubs and vines that are consumed by wildlife.
Cambium - The living portion of the tree between the outer bark and the wood where cell division and growth occur.
Candelabra stage - Longleaf seedlings that have initiated height growth but can not be considered sapling sized.
Canopy - The collective leaves and branches of trees that intercept sunlight and shade the forest floor.
Carrion - Decaying flesh of a dead animal
Clear-cutting - Timber-harvesting method in which all trees are removed from the stand.
Conifer - Trees that are usually evergreen and cone bearing. Commercially considered soft woods.
Containerized seedlings - Seedlings that are grown in a specialized container in a potting median.
dbh - Diameter at breast height. The diameter of a tree outside the bark at 4.5 feet from the ground.
Deciduous - Tree that loses its leaves for some time during the year.
Diameter limit harvest - The practice of regulating harvest of timber by removing trees above a specified diameter. This method is discouraged as it removes better trees and over time reduces tree quality.
Duff - A layer of decomposing organic matter on the forest floor.
Ecosystem - Complex of living organisms interacting with their physical environment.
Even-aged management - Forest management in which trees are subjected to periodic harvest in order to maintain a stand of trees that has small age differences between individual trees.

Fire lane - Natural or artificial barrier utilized to check the spread of fire.
Forb - Herbaceous plant that is not a grass, sedge or legume.
Grass-stage - The initial development in longleaf in which the seedling looks like a clump of grass. This is a special adaptation to fire that allows the seedling to survive surface fires.
Habitat - Environment in which an organism lives and grows.
Heartrot - Decay of the center or heart wood of a tree, usually caused by a fungus.
High grading - Type of timber harvest in which the best trees in a stand are removed while leaving lesser quality trees to perpetuate the stand. (See Diameter limit harvest)
Improvement cut - Intermediate timber harvest which removes diseased or improperly formed trees as well as undesirable species in order to improve the growth and quality of the remaining trees.
Mast - Nuts, seeds or fruit of trees or shrubs utilized as food by wildlife.
Mesic - Moderately moist site.
pH - measure of acidity. pH of seven is neutral while those below are acid and those above are alkaline.
Prescribed burning (Controlled burning) - Planned fire used to meet certain management objectives.
Regeneration - Establishment or renewal of a tree crop by artificial or natural means.
Sapling - Young tree with a dbh of less than 4 inches and a height of at least 3 feet.
Shelterwood method - Timber-harvesting practice in which mature trees are removed in two or more cuts. A sufficient number of parent trees are left in order to naturally regenerate an even-aged stand of trees. Parent trees are generally removed once regeneration is sufficient.
Site index - Measure of the productivity of a site based on the height of dominant trees in a stand at a base age.
Streamside management zones (SMZs) - Vegetated areas adjacent to streams in water courses that help protect them from pollutants.
Subxeric - Moderately dry site with some moisture holding capacity.
Uneven-aged management - Forest management in which the make up of trees in a stand consists of three or more distinct age classes.
Xeric - Dry, well-drained site with low moisture-holding capacity.

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