TENNESSEE DEPARTMENT OF AGRICULTURE

DIVISION OF FORESTRY

Plan 2020: Harvest Plan for Sustainable State Forests

State Forest Management

November 2011

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Purpose

The state of Tennessee is rich with abundant and unique natural resources. Among these is a system of lands designated as state forests. The authority to manage Tennessee's state forests is given expressly to the Department of Agriculture Division of Forestry (TDF) in the Tennessee Code Annotated (TCA): "The Department, through the Division, is authorized to establish and manage a system of state forests to provide for the multiple use management of the various renewable and nonrenewable resources such that those resources are utilized in the combination that best meets the needs of the people of Tennessee. The system shall include those lands which the division deems suitable for public forestry purposes" (TCA §11-4-801). The commercial timber alone on the state forest system totals 1.75 billion board feet and has a present value of approximately $266 million. This valuable asset is managed on receipts from timber sales. No state appropriated funding is used in the management of the state forest system.

This document establishes a sustainable harvest level for the Tennessee state forest system that will ensure healthier state-owned forests for generations to come. The plan contains estimates of the annual allowable cut for each of the 15 forests in the system and a stand-level strategy that incorporates management of resources other than timber into the harvest decision making process.

Mature hardwood stand at Natchez Trace State Forest

Introduction

Following decades of restoration, conservation and careful management, Tennessee's state forest system now contains an abundant supply of high-quality timber and other forest products. Timber harvested from some of these forests help support local forest products industries. Money spent by consumers in the pursuit of recreational opportunities on the forests also support local merchants. As the global demand for forest products continues to trend upward, forest managers must meet the challenge of ensuring sustainable, healthy forests as they provide raw materials for the manufacturing stream. In order to maintain forest productivity, it is essential that forest products are harvested in a sustainable and renewable manner. The Division of Forestry (TDF) accomplishes this through the implementation of best management practices (BMPs) and science-based silvicultural and forest management methods.

Silviculture is defined as "the art and science of controlling the establishment, growth, composition, health and quality of forests and woodlands to meet the diverse needs and values of landowners on a sustainable basis" (SAF 1998)[1]. From this definition it is clear that silviculture is not a goal in itself, but rather, a tool for engineering the forest condition to satisfy predefined needs and/or values. For example, TDF uses sound silvicultural methods as a tool for regenerating the forest, securing a sustainable flow of timber products, conserving and perpetuating rare forest types and creating suitable wildlife habitat.

Tennessee's state forest system has undergone a careful review by an independent, internationally respected third-party, the Rainforest Alliance's SmartWood program to determine if the management practices utilized on the state forests ensure forest sustainability. This evaluation by the SmartWood program was conducted to the standards of the Forest Stewardship Council (FSC). Their conclusion was that TDF met standards required for forest management and chain-of-custody certification by FSC from 2002 to 2007.

[1] Helms, A.H. (Ed). 1998. The dictionary of forestry. Society of American Foresters. Bethesda. 210 pp.

History

By the beginning of the 20th century, Tennessee's forests and forestlands had been diminished in area, productivity and quality by poor farming and logging practices and ravenous forest fires. At that time nearly all forest land in Tennessee was held by private interests. During the depression years of the 1930's the state and federal government, through the newly established Division of Forestry and the United States Resettlement Act, began purchasing large parcels of land directly from owners and through county delinquent tax sales. In the 1950's the federal government deeded the Resettlement Act purchases in Tennessee to the State with many of them destined to be managed as state forests by the Division of Forestry.

Acquisition of the state forests has been a concerted effort by private individuals, non government organizations, and federal, state and local government agencies. The state forest system now contains 15 individual forests totaling 166,897 acres which are scattered across all seven physiographic regions of the state (Table 1). This dispersed arrangement provides convenient access to a state forest by the public and allows for demonstrations of forest practices for species and sites common to each region.

During the depression and post World War II era, restoration and conservation of natural resources became a national priority. Priorities established by the State of Tennessee included the care and conservation of natural resources. The State legislature passed wildfire laws and charged the Division of Forestry with enforcement responsibility and wildfire suppression. The new legislation coupled with the focus on natural resource conservation marked the beginning of the development of new forests in Tennessee. Beginning in 1933 with the start of the Civilian Conservation Corps (CCC) and additional funding for forestry projects, there was a readily available labor force to complete the projects. By 1936 the TDF had started developing forest tree nurseries and was soon producing millions of tree seedlings, many of which were planted on state forest lands in areas where erosion had altered the productive capacity of the soil. Native trees on these sites were growing poorly and could no longer regenerate. In addition to these poor soil conditions, wildfires had scarred the landscape and few natural seed sources were available. The TDF, aided by the CCC, planted thousands of acres to reclaim severely eroded and degraded sites. Countless acres of forest improvement treatments were conducted in young forest stands. It was also during this time that much of the state forest road system was developed that is still in use today.

Recent examinations of the state forests through a variety of surveys, inventories, remote sensing methods and use of the state forest geographical information system, revealed that a majority of state forest timber stands have become over-

Brush dam construction on Chickasaw State Forest in the late 1930's to prevent further gully erosion

Quality sawtimber on Chickasaw State Forest today

mature causing an unhealthy imbalance of tree ages. In 2006, a SmartWood auditor documented in his report a concern that too little harvesting could have a detrimental impact on future forests:

> "*Many stands on the state forests are mature and beginning to senesce. Regeneration efforts need to be increased on these areas but personnel limitations have prevented handling of the needed sales.*" - - Rainforest Alliance, SmartWood Program, 2006 Annual Audit Report for: Tennessee Department of Agriculture, Division of Forestry dated March 19, 2007, page 11.

With these findings in hand, TDF initiated a state forest system-wide inventory in 2007.

In 2010 the State Forester commissioned the development of this document that will serve as a guide to a sustainable annual harvesting level for the purpose of achieving a more balanced age-class distribution.

Table 1. State forests by district, physiographic region, county(s), and acres

Forest	District	Physiographic Region	County	Acreage
John Tully	West TN	Mississippi River Alluvial Plain	Lauderdale	2,132
Chickasaw	West TN	Upper Coastal Plain	Chester/Hardeman	12,751
Natchez Trace	West TN	Upper Coastal Plain	Henderson/Carroll/ Benton/ Decatur	36,643
Stewart	Highland Rim	Western Highland Rim	Stewart	4,228
Lewis	Highland Rim	Western Highland Rim	Lewis	1,301
Cedars of Lebanon	Highland Rim	Nashville Basin	Wilson	8,005
Franklin	Cumberland	Cumberland Plateau	Franklin/Marion	7,735
Prentice Cooper	Cumberland	Cumberland Plateau	Marion, Hamilton/ Sequatchie	24,685
Standing Stone	Cumberland	Eastern Highland Rim	Clay/Overton	8,342
Bledsoe	Cumberland	Cumberland Plateau	Bledsoe/White/ Cumberland/Van Buren	8,269
Pickett	Cumberland	Cumberland Plateau	Pickett/Fentress	20,127
Scott	East TN	Cumberland Plateau	Scott	2,827
Lone Mountain	East TN	Cumberland Mountains	Morgan	3,571
Chuck Swan	East TN	Ridge and Valley	Union/Campbell	24,280
Martha Sundquist	East TN	Appalachian Mountains	Cocke	2,001
			Total	**166,897**

Policy Statement

State forest lands are managed for multiple uses to maintain healthy and productive forests and to provide a sustained yield of high quality timber and other forest products. The successful and timely regeneration of native forest types is central to providing these benefits and managing state forest lands. The intent on all state forests is to demonstrate science-based silvicultural practices that are implemented in an environmentally sensitive manner and that are sustainable.

View of the Tennessee River Gorge at Prentice Cooper State Forest

Goals and Strategies

The TDF has adopted the following goals and corresponding strategies to achieve healthy, sustainable and well-managed forests throughout the system.

Goal 1: To promote and maintain healthy forest conditions.

Strategies:

1. Manage for a more balanced age-class distribution.
2. Manage for a mix of native forest types.
3. Create a mix of disturbance sizes and shapes to promote a variety of forest successional stages.
4. Use silvicultural methods that promote natural hardwood regeneration.
5. Address landscape-level concerns, including forest habitat diversification and connectivity when developing forest management plans.
6. Meet or exceed established BMPs to protect soil and water quality.
7. Maintain native species and genetic and structural diversity that also perpetuates desirable commercial species.
8. Maintain nutrient cycles in accordance with the best available scientific literature.
9. Design timber harvests to minimize impact of forest road construction.
10. Use existing roads where practical that meet BMP guidelines.
11. Monitor, manage and control forest pests.

Goal 2: To maintain and develop naturally reproducing forest types.

Strategies:

1. Conduct hardwood regeneration harvests when natural forest regeneration is already present or is likely to follow.
2. Ensure forest regeneration in harvested stands or critical areas.
3. Support research to identify and quantify regeneration of native forest types.
4. Develop and implement a system for predicting and evaluating regeneration success.
5. Use artificial regeneration when natural regeneration is not practical or when necessary to maintain or restore desired tree species or restore/maintain forest productivity.

A mix of disturbance sizes and shapes promoting a variety of forest successional stages at Chuck Swan State Forest.

Goal 3: To provide economic and social benefits through a sustained yield of forest products and services.

Strategies:

1. Actively manage for the growth of high quality trees of desirable commercial species.
2. Harvest the planned acreage to maintain healthy and productive forests.
3. Develop rotation age guidelines.
4. Salvage dead or damaged commercial timber when economically and ecologically appropriate.
5. Ensure silvicultural operations are compatible with the protection, use and development of the other forest resources.
6. Contact local communities concerning activities such as recreation opportunities.

Goal 4: To determine appropriate, sustainable timber harvest levels.

Strategies:

1. Monitor forest conditions by conducting regular forest inventories and analyses of timber and non-timber resources.
2. Develop criteria to establish recommended harvest levels.
3. Develop scientific feedback mechanism to evaluate desired results of harvesting.
4. Adjust timber harvest levels based on scientific feedback mechanisms.
5. Consider social values and non-timber resource needs when developing planned harvests.
6. Outreach to local communities on activities such as timber harvesting.

Goal 5: To demonstrate and promote silvicultural practices that ecologically and economically sustain forest resources.

Strategies:

1. Use state forest management activities to demonstrate sustainable practices.
2. Support scientific study of sustainable forestry within the context of forest operations on state forest land.
3. Participate, as appropriate, in assessments of sustainability.
4. Practice and demonstrate active adaptive management* as required by forest certification standards.

*__Adaptive Management__ (AM), also known as __adaptive resource management__ (ARM), is a structured, iterative process of optimal decision making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring. In this way, decision making simultaneously maximizes one or more resource objectives and, either passively or actively, accrues information needed to improve future management.

Demonstration of a regeneration harvest with variable retention at Standing Stone State Forest.

Timber Management Systems

Regeneration Harvests

Even-aged Silvicultural System

This is a system in which the resulting forest stand consists of trees of the same or nearly the same age. Arbitrarily, a forest stand is even-aged if the range of tree ages does not exceed 20% of the rotation length. Forest stand age is usually measured from the time the trees are first exposed to nearly full sunlight and thus able to grow in height without restriction.

1. *Shelterwood*

A shelterwood regeneration harvest establishes a new, essentially even-aged, forest stand from the partial removal of the overstory. Each harvest, if done in a series, is a shelterwood treatment. The essential characteristic is that the new forest stand is being established naturally or artificially before the overstory trees from the original forest stand are removed. The shelterwood method can be used to describe any of a series of harvest treatments that include:

A. A preparatory treatment designed to foster potential seed producers, with additional trees retained to meet TDF reservation/retention guidelines.

B. A seed treatment aimed at getting the new seedlings established, with additional trees retained to meet reservation/retention guidelines.

C. A final harvest in a shelterwood series or the overstory removal with residuals which will release established regeneration from competition with the existing overstory. In the case of established regeneration from natural causes, the one-time release harvest is also the final treatment and is termed the overstory removal harvest. The residual trees left to meet TDF's guidelines are the only remnants of the old forest stand not harvested.

2. *Clearcut*

A clearcut regeneration harvest establishes a new even-aged forest stand from the development of new trees after removal in a single harvest of all trees in the previous forest stand, except trees reserved in compliance with TDF's retention guidelines. Regeneration is established after the harvest from one or more of the following: natural seeding, direct seeding, planted seedlings, or coppice regeneration.

Scarlet oak at Chuck Swan State Forest

3. *Seed-Tree*

A seed-tree regeneration harvest is the application of the overstory removal method similar to a clearcut, except for an additional small number of otherwise commercial trees left singly, in small groups, or narrow strips, as an added source of seed for supplemental regeneration. Seed-trees are removed after sufficient regeneration is established. Individual seed trees may suffice to satisfy TDF's retention requirements and would not be harvested until the next rotation.

Uneven-aged Silvicultural System

Uneven-aged silvicultural systems are forest stands created or existing that include three or more distinctly different age-classes, including regeneration (forest stands with two age-classes are associated with or managed in ways that duplicate even-age methods). Attempts to convert an even-age forest stand to uneven-age are difficult. Caution must be taken to avoid treatments that effectively become "high-grades" and are not sustainable. Several entries to the forest stand are required to maintain the age-class structure and this could be functionally impossible and may create undesirable site disturbance conditions. Artificial or natural regeneration methods may be used, but the impact of competing plants may be more difficult to control in large landscapes managed under this system. Shade tolerant species are more conducive to uneven-aged management than shade intolerant species. Most of the commercial species and forest types found on Tennessee's state forest are typically western mesophytic or mixed mesophytic (Braun 1950)[2], which are intermediate to shade intolerant and do not respond well to uneven-aged management.

1. *Group Selection*

Group selection regeneration harvest is a method of regenerating uneven-aged forest stands in which trees are removed, and new age-classes are established in small groups. The maximum width of groups is approximately twice the height of the mature trees, with small openings providing micro-environments suitable for shade tolerant species and larger openings providing conditions suitable for more shade intolerant species. The forest stand in which regeneration, growth, and yield are regulated consists of a landscape containing an aggregation of groups.

2. *Single Tree Selection*

Single tree selection regeneration harvest is a method of creating new age-classes in uneven-age forest stands in which individual trees of all size classes are removed more-or-less uniformly throughout the forest stand to achieve desired forest stand structural characteristics and to regenerate shade-tolerant species such as maple, beech and birch. This method is difficult to apply correctly and is most often counterproductive for shade intolerant species in the long-term development of a forest stand.

Two-aged Silvicultural System

A two-aged silvicultural system is designed to maintain and regenerate a forest stand with two age-classes. The goal or the desired condition is for each age-class to be separated in age by more than 20% of rotation age. The desired age-class spread would be to approach 50% of rotation to lessen visual impact and extend the period of time between entries to the forest stand. A two-aged system differs from a shelterwood or seed-tree system in the purpose and number of reserve or residual trees. Most often this method is used in visually sensitive areas to feather the harvest edge, but it is also used to maintain mature seed trees to perpetuate a specific species. This is currently being used to maintain northern red oak on some forests in over-mature stands.

Intermediate Treatments

Intermediate treatments occur after establishment of the new forest stand, but prior to the final harvest. They are conducted to remove trees that will improve residual forest stand composition and improve residual tree quality. They are non-reproductive treatments and the forest stand's residual basal area following treatment should be at least the minimum level of full stocking.

1. *Improvement Treatments*

Improvement treatments in pole size forest stands may be the most beneficial for the forest stand, but are often marginally commercial with varying degrees of success. Improvement treatments in forest stands less than 15 years from rotation are usually less productive in the long run than proceeding directly to a shelterwood method aimed at creating regeneration or reducing inhibiting factors for regeneration. The term "T.S.I." or "timber stand improvement" refers to a totally non-commercial (non-revenue producing) application of this treatment.

2. *Thinning*

A thinning is a cultural treatment made to reduce forest stand density primarily to improve growth, enhance stand health, or recover potential mortality. Depending on markets, thinning can be commercial or pre-commercial.

[2] Braun, E. L. 1950. Deciduous forests of eastern North America. Blakiston, Philadelphia, 596 pp.

Resource Inventories

Conducting and maintaining accurate and current forest resource inventories is critical to implementing forest management practices and achieving forest sustainability. As part of TDF's resource planning and management strategy, the Division conducts and maintains many inventories that provide information at various levels, including system-wide, individual forest, and landscape scale. In addition to these inventories, state forest staff develop detailed forest stand analysis when writing compartment plans to aid in developing, proposing and conducting silviculture treatments.

The description and summary of the 2007 inventory results can be found in the document "State Forest Continuous Forest Inventory 2009".

Timber Volumes

Approximately 149,000 acres of the 167,000 acres of state forest are in the regulated forest land base (see definitions below for a more detailed description). Sawtimber growing stock on the regulated area is estimated at 1.7 billion board feet (bd ft) which is valued at $266,000,000 at the time of this writing. The distribution of sawtimber volumes within each of the 15 forests is provided in Table 2. These estimates are based on sample data from 720 inventory plots.

Table 2. Timber volume (International ¼ inch log rule) on the regulated area by forest

State Forest	Volume (Board Feet)
Natchez Trace	541,140,151
Chuck Swan	255,509,652
Prentice Cooper	213,370,511
Pickett	169,544,343
Chickasaw	161,922,397
Standing Stone	84,699,507
Bledsoe	74,968,600
Franklin	74,778,856
Stewart	45,841,583
Lone Mountain	35,652,894
Martha Sundquist	28,954,454
Cedars of Lebanon	25,997,120
Lewis	13,833,997
John Tully	11,134,113
Scott	6,111,109
Average	**116,230,619**
Total	**1,743,459,287**

Regulated Vs Unregulated Forest Area

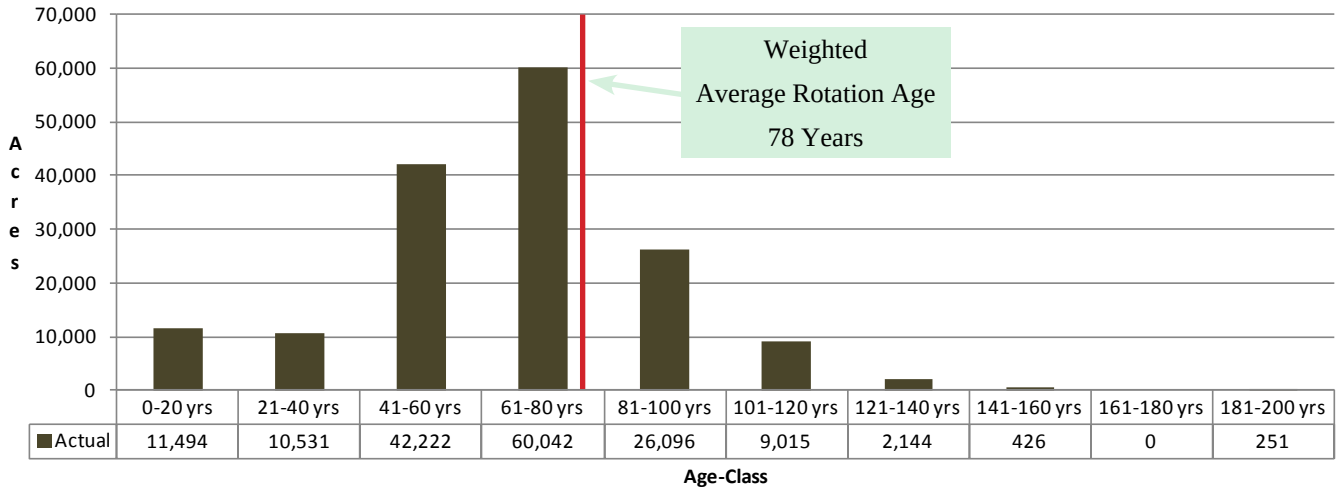
Regulated forest area is defined as those forest stands that are managed for multiple benefits including timber harvest. Unregulated forest areas are exempt from normal silviculture treatment, including timber harvesting. These unregulated areas may occur in high conservation value forests or other special areas. While these areas are grouped in the unregulated forest land base and not typically harvested, many of these areas do require some form of harvest or treatment to maintain the attributes being conserved or protected.

Forest Age Structure

1. *Estimated Age-class Distribution*

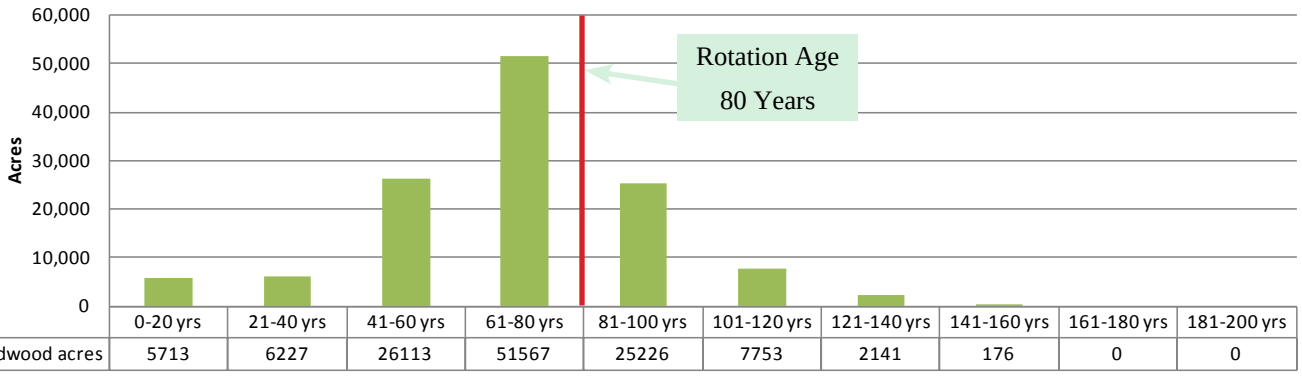
TDF has a forest management goal to better balance the age-class distribution on each individual forest as well as for the entire system. In order to do this, the current age-class distribution must be known. Estimated age-class distributions were derived from the system wide inventory, based on the distribution of ages of plots located in each forest. Figure 1 shows the age-class distribution of the entire state forest system. Figures 2-4 are the age-class distributions by hardwood, pine and mixed pine-hardwood types, respectively.

Figure 1. All forest acres by age-class



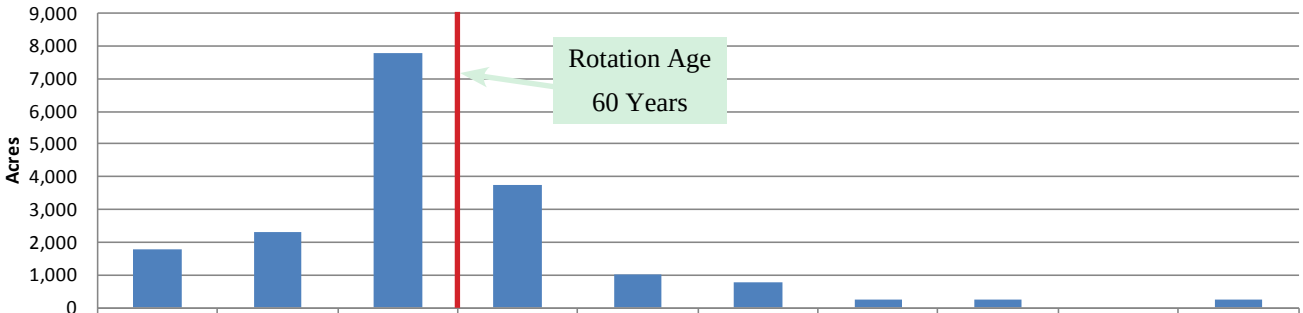
Hardwood growth following clearcut regeneration harvests at ages 1, 5, 10, 15 and 20 years old at Chickasaw State Forest

Figure 2. Hardwood forested acres by age-class



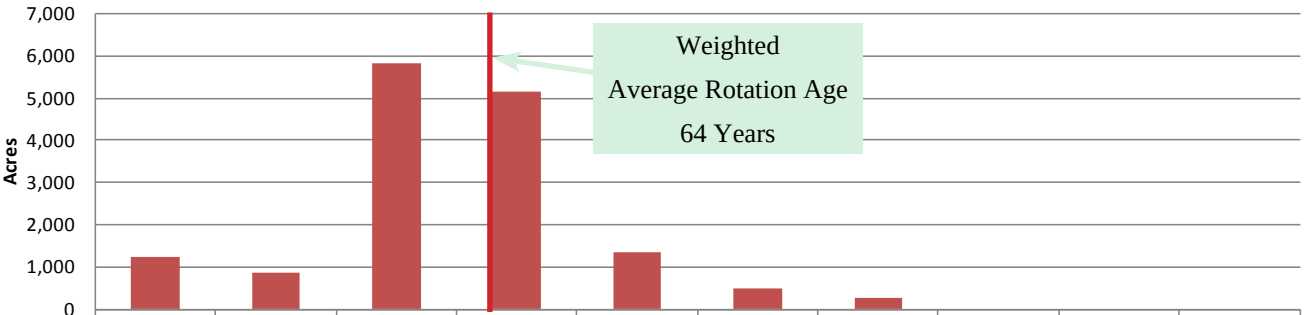
	0-20 yrs	21-40 yrs	41-60 yrs	61-80 yrs	81-100 yrs	101-120 yrs	121-140 yrs	141-160 yrs	161-180 yrs	181-200 yrs
Hardwood acres	5713	6227	26113	51567	25226	7753	2141	176	0	0

Figure 3. Pine forested acres by age-class



	0-20 yrs	21-40 yrs	41-60 yrs	61-80 yrs	81-100 yrs	101-120 yrs	121-140 yrs	141-160 yrs	161-180 yrs	181-200 yrs
Pine acres	1776	2296	7789	3726	1000	753	251	251	0	251

Figure 4. Mixed pine-hardwood forested acres by age-class



	0-20 yrs	21-40 yrs	41-60 yrs	61-80 yrs	81-100 yrs	101-120 yrs	121-140 yrs	141-160 yrs	161-180 yrs	181-200 yrs
Mixed acres	1233	854	5809	5137	1356	502	251	0	0	0

One of the primary goals of state forest management is to provide a variety of forest conditions and wildlife habitats across the landscape. The current stand age distribution is skewed to older age-classes. Only about 22,000 acres or 13.5% of the entire state forest system is in early forest succession age-classes (less than age 40). Individual stands will be skewed somewhat to older ages for many decades, by design and circumstance. More harvesting is needed to create conditions and habitats that will continue to support a diversity of native plant and animal species.

Some tree species are short lived. Northern red oak, for example, has an expected forest life of 120-150 years with substantial mortality starting at about age 100. It is a major species component of the state forest, a valuable timber species and a very important mast producer for wildlife. When stands are allowed to remain undisturbed for over 100 years, they experience appreciable northern red oak mortality. Prior to onset of mortality, the reproductive capacity of red oak trees is greatly reduced after the age of 80 and often fail to regenerate at desired levels. Most red oaks have died out of stands that are 120 years old. The remedy, earlier and more harvesting, is critical in order to maintain such a valuable species in the forest landscape.

High quality hardwood trees at Standing Stone State Forest

2. *Forest Types*

There were 36 forest types identified in the recent state forest inventory. Table 3 lists these types along with the acres and average age for each. Oak and oak-hickory types are the dominate forest types found on the state forests. However, not all forest types may be represented. Forest types that are too small to have been sampled are not included.

Table 3. Forest types, acres and average forest type age listed in descending order by acres

Forest Type	Acres	Avg. Age
White Oak/ Red Oak/ Hickory	37,191	63
Chestnut Oak/ Black Oak/ Scarlet Oak	23,048	68
Yellow Poplar/ White Oak/ Red Oak	10,624	64
White Oak	8,942	67
Loblolly Pine	8,145	41
Mixed Upland Hardwoods	7,981	52
Chestnut Oak	7,373	65
Loblolly Pine/ Hardwood	5,680	66
Sweetgum/ Yellow Poplar	5,075	65
Virginia Pine/ Southern Red Oak	4,294	66
Post Oak/ Blackjack Oak	4,041	61
Nonstocked	4,024	17
Red Maple/ Oak	3,757	51
Eastern Redcedar	3,746	63
Eastern Redcedar/ Hardwood	3,244	61
Sassafras/ Persimmon	3,192	38
Sugar Maple/ Beech/ Yellow Birch	2,974	62
Yellow Poplar	2,937	56
Virginia Pine	2,822	56
Scarlet Oak	1,637	68
Shortleaf Pine	1,540	69
Other Hardwoods	1,489	19
Eastern White Pine	1,277	35
Shortleaf Pine/ Oak	1,240	55
Sugarberry(Hackberry)/ Elm/ Green Ash	1,077	40
Swamp Chestnut/ Cherrybark Oak	760	43
Sycamore/ Pecan/ American Elm	702	52
Eastern White Pine/ Red Oak/ White Ash	687	58
Northern Red Oak	508	53
Cherry/ Ash/ Yellow Poplar	497	38
Eastern Hemlock	467	47
Sweetgum- Nutall-Willow Oak	350	40
River Birch/ Sycamore	348	52
Hard Maple/ Basswood	277	0
Red Maple/ Upland Hardwoods	176	103
Eastern White Pine/ Eastern Hemlock	97	50
Total | Average	**162,221**	**53**

Timber Harvest Scheduling

Timber harvest goals are established for regulated areas only and are based on rotation lengths of 80 years for hardwood and 60 years for pine. The current regulated forest area has a large inventory of mature and over-mature trees. This current forest structure is not sustainable for the long term. The focus of this plan is to begin balancing the age-class distribution of the forest by regenerating forested stands leading to a sustainable forest structure. Specific considerations include the need:

1. To promote and maintain healthy forest conditions including balancing the age-class distribution of trees in the regulated portion of the forests.
2. To ensure the presence of older forest stands.
3. To provide economic and social benefits through a sustained yield of forest products and services.
4. To determine sustainable long-term timber harvest levels.
5. To promote silvicultural practices that ecologically and economically sustains forest resources.
6. To provide demonstrations of silviculture methods and forest management practices for landowners and forest managers.

Logging operation at Natchez Trace State Forest

Harvest Planning

Compartment Plans

Compartment plans are the basis for developing the objectives for each compartment and the prescriptions for silviculture treatments for any given stand within the 10-year plan term. This includes stands that are to receive intermediate, harvest and regeneration treatments. This plan also determines the short-term allowable harvest levels for the compartment for pine and hardwood stands.

Annual Operating Plan

The Annual Operating Plan is a schedule for all planned silvicultural, forest management and timber harvesting activities. It is a work plan for the coming year.

Timber Sale Guidelines

The timber sale program within TDF is administered through guidelines described in the Timber Sale Manual and the Division of General Services Rules for Disposal of Forestry Products. The Timber Sale Manual provides the guidelines for preparing sales of timber based on the compartment plan prescriptions. General Services' rules govern the process of disposing of State property, which includes timber.

Retention Guidelines

Variable retention are the trees left standing, by design, following an even-aged system harvest for the purpose of providing habitat or overstory forest conditions for some wildlife species or to provide visual quality attributes to the stand.

Coordination of Timber Management with Other Uses

It is the responsibility of the district forester to see that timber management activities are coordinated with other forest uses and consistent with the policies and goals outlined in the State Forest Management Plan. If federal or state listed fauna or flora, or habitat critical to their survival, occur within or adjacent to a proposed timber management project area, TWRA and/or TDEC are notified prior to commencement of work on the project. Wildlife biologists or botanists are consulted to determine what, if any, changes to the project are necessary to protect the species or habitat. When archaeologically significant sites are found to occur within a proposed timber management project area, the State Archaeologist and/or Historical Commission are notified prior to commencement of any additional work on the site. The state forest forester coordinates assessment of the site and implementation of protection measures with the appropriate agency or organization.

Harvest Level Management

Sustainability

Sustainability is often thought about from a timber production point of view. However, forests must not only provide a sustainable timber base, but also must be economically and biologically sustainable and socially accepted. This means that economic, environmental and social dimensions must be considered by forest managers. The biological diversity and social implications of state forest management are found in the State Forest System Plan, Forest Plans and forest management certification standards. The discussions of the factors impacting sustainability are important and relevant, but are not within the scope of this report.

In forest management, and particularly in forest certification, indicator metrics are used to compare management action to management plans and policies. TDF has developed the following set of six indicators to evaluate the sustainability of current and future harvest levels:

1. Total growing stock volume of both merchantable and non-merchantable tree species on forest land available for timber production
2. Annual removal of wood products compared to the removals allowed determined to be sustainable
3. Area of forest land relative to total land and area of reserved forest land
4. Extent of area by forest type, size class, and age class
5. Value of forest products produced
6. Forest ownership and land use (including acres of specially designated land – regulated versus non-regulated)

Umbrella magnolia blooming at Franklin State Forest

Harvest Criteria

Long-term sustained yield is “the highest uniform wood yield that may be sustained under specific management intensity consistent with multiple-use objectives on lands being managed for timber production.” (Dictionary of Forestry) The sustainable level of harvesting in a year is the volume for stands to be harvested when added together does not exceed the calculated annual allowable cut (AAC) amount. One way to look at sustained yield is to equate the harvest level to the annual growth. The annual allowable cut therefore can be determined by calculating the average annual growth of the forest over time [referred to as the mean annual increment (MAI)] as a means to guide the planning of annual harvest levels. In a fully regulated forest this is the maximum level of harvest that can be sustained in perpetuity.

If the harvest level is determined based on acres, then it is under *area regulation*. If it is determined by volume, it is under *volume regulation*. However, in practice, harvesting regulation is usually some combination of area and volume.

Harvest Target

To avoid any compromise of the sustainability guiding principle, the Division has established a target of cutting no more than 70% of average annual growth on any individual forest per year. Many aspects of the state forest resources are considered as criteria when plans for harvesting on state forest are developed. Because of possible errors in estimating standing timber volume and other forest attributes and the conservation or preservation concerns involving non-timber resources, the Division determined that harvesting some amount less than the average annual growth would be prudent. MAI is considered the maximum sustainable annual growth estimate. Until sufficient inventory, and empirical growth and yield data is available to better model future growth, a conservative approach is being used for the target harvest level. Although the goal is to bring the forest into a more balanced age-class distribution, it must be done systemically to avoid excessive harvesting in the short-term on any one forest. This will allow forest managers to maintain mature to over-mature stands in certain places even on regulated acres.

Implement on All State Forests

Sustainability requires active management to perpetuate the forest conditions that meets the multiple use mission of the state forests. Silviculture treatments are needed on all state forests to create and maintain favorable conditions for all resources. At the heart of this objective is TDF’s desire to have a wide variety of species and age-classes on each forest. Age-classes skewed too far toward the old or to the young inhibit the maintenance of conditions conducive to healthy forests.

Annual Harvest Level

Since the 1980's, TDF has utilized the compartment planning approach to identify stands for harvesting (Figure 5). However, compartment planning takes considerable time and human resources. To date, a little over half of the compartments have a written plan. As a result, annual harvesting has been conducted at a level that is below the allowable cut. Over the past 22 years, the annual system wide harvest level has averaged 531 acres or about 1/3 of the annual allowable cut.

Based on the recent continuous forest inventory (CFI) results, the annual allowable cut level (70% of MAI) is estimated to be 1,668 acres or 19.3 million board feet (Tables 4 and 5). This is about 1.1% of the regulated forest as measured by area or by volume.

Figure 5. Historic and planned annual harvest levels by acres

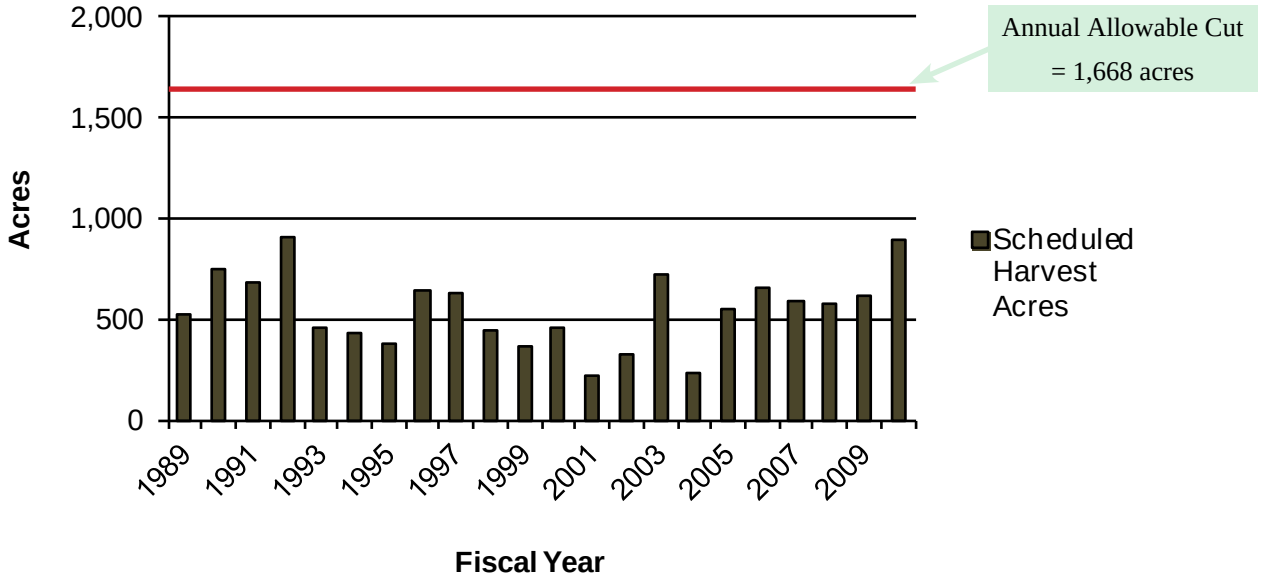


Table 4. Annual allowable cut in acres for the regulated area by forest

	Regulated Area (acres)			Annual Allowable Cut (acres)		
State Forest	**Pine**	**Hardwood**	**Total**	**Pine**	**Hardwood**	**Total**
Bledsoe	2,711	5,135	7,846	35	67	102
Cedars of Lebanon	2,336	2,882	5,218	19	24	43
Chickasaw	2,186	10,027	12,213	23	105	127
Chuck Swan	2,745	20,386	23,131	32	237	269
Franklin	400	5,524	5,924	5	70	75
Martha Sundquist	521	1,389	1,910	7	19	26
Lewis	266	920	1,186	4	12	16
Lone Mountain	106	3,376	3,482	1	26	26
Natchez Trace	8,957	25,808	34,765	96	275	371
Pickett	2,040	17,008	19,048	24	199	223
Prentice Cooper	1,727	17,949	18,974	17	169	186
Scott	230	1,146	1,376	3	13	16
Standing Stone	0	6,799	6,799	2	82	84
Stewart	231	3,816	4,047	2	39	42
John Tully	0	2,018	2,018	0	61	61
Average	**1,630**	**8,279**	**9,862**	**18**	**93**	**111**
Total	**24,456**	**124,182**	**147,937**	**270**	**1,399**	**1,668**

Table 5. Annual allowable cut in board feet (International 1/4 log rule) for the regulated area by forest

	70% of Average Annual Growth/acre (MAI)			Annual Allowable Cut (AAC) (Regulated acres x 70% MAI Total/acre)	
State Forest	**Pine**	**Hardwood**	**Total**	**Regulated Acres**	**AAC 70% MAI**
Bledsoe	42	82	124	7,846	972,904
Cedars of Lebanon	15	26	41	5,218	213,938
Chickasaw	29	110	138	12,213	1,685,394
Chuck Swan	13	115	129	23,131	2,983,899
Franklin	6	155	161	5,924	953,764
Martha Sundquist	78	130	208	1,910	397,280
Lewis	36	118	154	1,186	182,644
Lone Mountain	3	75	78	3,482	271,596
Natchez Trace	56	110	166	34,765	5,770,990
Pickett	13	91	104	19,048	1,980,992
Prentice Cooper	11	90	102	18,974	1,935,348
Scott	13	38	51	1,376	70,176
Standing Stone	3	147	150	6,799	1,019,850
Stewart	9	108	117	4,047	473,499
John Tully	0	168	168	2,018	339,024
Average	**22**	**104**	**126**	**9,862**	**1,283,420**
Total				**147,937**	**19,251,298**

Harvest Plan

The annual state forest harvest level is regulated on both an area and volume basis. Many of the non-timber resources that are managed are more associated with the area treated and not so much the volume of timber involved. The rotation ages of 80 years for hardwoods and 60 years for pines, which were established in the early 1970s, are still in effect today for regulated acres. In any given compartment 1/8th of the hardwood acres and 1/6th of the pine acres are harvested during a ten-year planning period. This theoretically results in rotation lengths of 80 years for hardwoods and 60 years for pine on the regulated areas. The volume regulation estimate limits the harvest level to insure the annual cut does not exceed 70% of average annual growth (MAI).

Some forest areas are designated as unregulated and managed independently of the regulated areas. Many of the unregulated areas do require silvicultural treatments including harvesting. These designated areas are being managed to protect certain conservation attributes such as caves, view sheds and endangered plant or animal species and their habitats. Harvesting, or other manipulations on these sites are designed to maintain or protect these attributes that define the sensitive status of the area. TDF designated conservation areas, special places and state natural areas are examples of these unregulated areas. Rotation ages may be lengthened or shortened depending on the specific attributes that are being managed. Unregulated areas that are managed to include harvesting are included in the allowable harvest calculations at 50 % of the volume or acres for the affected area.

Upon implementation, silvicultural activity, including harvesting, will increase on some forests, and will be initiated on some forests, while activity on the balance of the forests will remain at near current levels. The simplicity of the plan should in no way overshadow the depth of consideration given to the determination of when, where, how and how much harvesting will be done.

No planned harvesting will take place before a ten-year Compartment Plan has been written and approved by the designated professional foresters. Compartment Plans are written by either the state forest forester or an area forester. Plans are then reviewed sequentially by a District Forester, the State Forest System Unit Leader and Assistant State Forester and then approved by the State Forester. The compartment planning process also includes review and input from other natural resource agencies (TWRA and TDEC) and by other organizations where appropriate.

With approximately 167,000 acres and over 6,500 stands in the state forest system, it can be a daunting task to determine the priority of stands to harvest. The recommendation of individual stands to be harvested is made by the forester with management responsibilities on the subject forest. Stands are selected from those in the compartment plans that are available for harvest. When selecting stands for harvest, the following questions are among those considered:

- Is the harvest within the allowable cut for the forest?
- Are there forest health issues (insects, disease, weather-related damage, etc.) within the stand?
- When were the adjacent stands harvested?
- What are the market conditions for the products that will be harvested?
- How will the harvest impact wildlife habitat?
- What is the age of the stand?
- What is the condition of the stand relative to the quantity and quality of the timber?
- What species will be harvested?
- Are there staff and resources available to do a quality job of planning and overseeing the harvest at a given forest?

The recommendations are then discussed with the District Forester and the State Forest Unit Leader before the final decision is made.

Summary

The age class distribution of the forest system is skewed toward the mature to over-mature age categories, which is an indication that the forests are not as healthy as they can be. Additional harvesting (disturbance) and regeneration is needed to maintain productive, healthy and sustainable forests. Recommendations are made in this document to increase the combined harvest level from approximately 550 acres per year to over 1,650 acres per year. Recent inventories revealed that approximately 19 million board feet of timber is being added to the forest every year. Obviously, if the forest system is growing at this rate, it is sustainable as long as the total of all removals and mortality do not exceed this volume of annual growth. The TDF has established a harvest target of 70% of this annual growth. The new total harvest goal of 1,668 acres is based upon this "allowable cut". Annual growth will be recalculated every five years based upon data from subsequent forest inventories. Future annual cutting plans will be increased or decreased based upon any significant change in annual growth.

One of the key factors in achieving the goals and objectives described in this plan is the continuity of trained personnel. Successful implementation of this plan is also dependent on the availability of the right equipment to maintain the forest infrastructure to BMP and forest certification standards. The addition of personnel and equipment are critical to success; the earlier these additions are made the sooner we will be able to meet expected outcomes.

Tennessee's state forests are now comprised of large volumes of high-quality timber products resulting from decades of restoration, conservation and careful management. It is now time to put in place a management scheme that will ensure a sustainable supply of these products while, at the same time, ensuring that all management activities are carried out in an environmentally sensitive and scientifically defensible manner for the benefit of future generations of Tennesseans.

Conclusions

The Tennessee Department of Agriculture Division of Forestry is committed to the proper and sustainable management of the land and forest resources entrusted to it. Sound forest management is predicated on the professional manager's ability to manipulate stands through harvesting and other silvicultural practices to create and maintain vibrant and healthy forests. The agency's leadership, professional foresters and technicians are uniquely prepared, equipped and committed to carry out this plan. Tennesseans are fortunate to have these incredible state forests as natural treasures, and implementation of this plan will only improve their health for the benefit of future generations.

Sweden Cove at Franklin State Forest