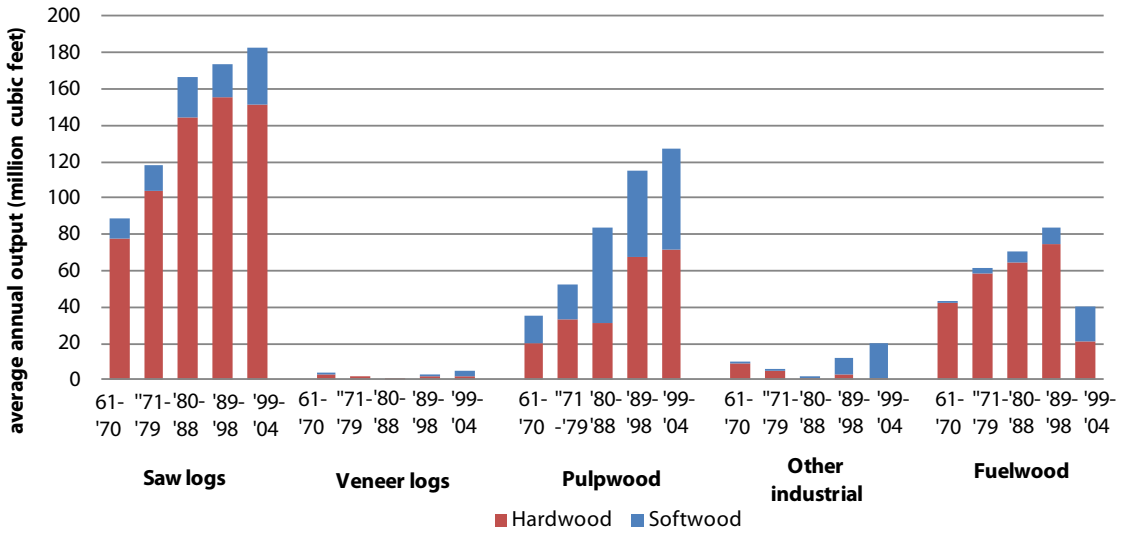
Benefits from Forest Resources

Forest-related Jobs and Economic Activity

The southeast United States produces more wood products than any other country outside the United States. Tennessee is an important component of this 'wood basket' and consistently ranks as one of the top hardwood lumber producing states in the U.S. Although a wide variety of wood products are produced in Tennessee – from pulp and paper to pencils – the production of lumber products from sawlogs is the dominant major component (Oswalt et al. 2009) (Figure 15).

Figure 15. Average annual output of roundwood timber products by product and species group, 1961-2004



While wood harvests have been increasing steadily over the past half-century, the amount of standing timber volume has been increasing also (Young et al. 2007) (Figure 16). Forest growth consistently has been greater than the combination of harvest and mortality, which suggests that even greater harvest levels could be consistent with sustainable forest management.

Tennessee is a 'hardwood state' and approximately 80 percent of the 444 million cubic feet of industrial wood produced in 2005 was hardwood (Bentley and Schnabel, 2007). Commercial hardwood species include white and red oaks, hickory, yellow-poplar, maple, ash, and sweetgum (Figure 17); softwoods in Tennessee include loblolly, shortleaf and Virginia pines, and redcedar.

Table 7 illustrates that the production of wood products is important across all the regions of the state, for both hardwoods and softwoods. County-level data on timber product output (TPO) is collected by the US Forest Service and can be obtained directly from the internet (http://srsfia2.fs.fed.us/php/tpo_2009/tpo_rpa_int1.php), or from compilations based on that resource (e.g. Bentley and Schnabel, 2007).

Figure 16. Timber growing stock in Tennessee from 1950 to 1999

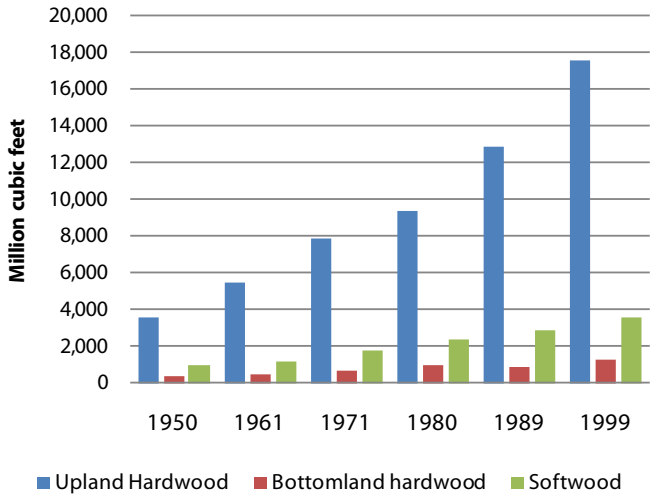


Figure 17. Hardwood roundwood by species in 2005

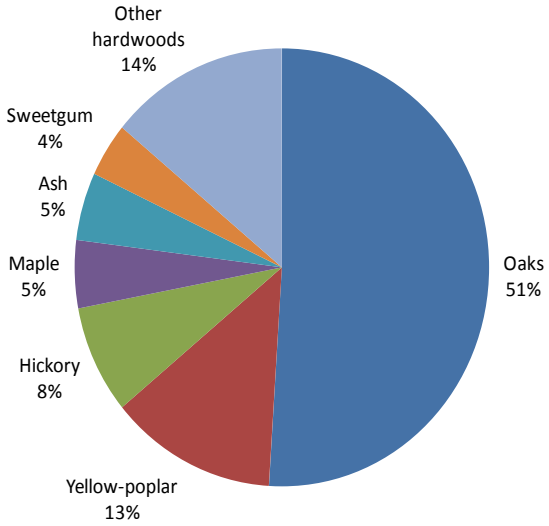


Table 7. Roundwood output by region in Tennessee for 2005

Region	Hardwood	Softwood
	thousand cubic feet	
West	50,726	11,214
West Central	77,735	32,103
Central	43,247	1,844
Plateau	64,640	12,258
East	37,410	22,460
Total	**273,758**	**79,879**

The wood industry is also widely distributed across the state and includes hundreds of primary (e.g. sawmills) (Figure 18) and secondary manufacturing operations. The most current listing of these companies, their products and size can be found on the Tennessee Department of Agriculture Division of Forestry's web site: www.state.tn.us/agriculture/publications/forestry/woodusingindustries.pdf. The number of primary mills has been decreasing steadily over the last fifty years (Table 8), while total production has risen dramatically due to the increased importance of larger and more efficient operations (Luppold and Bumgardner, 2009).

Figure 18. Primary wood-processing mills in 2007

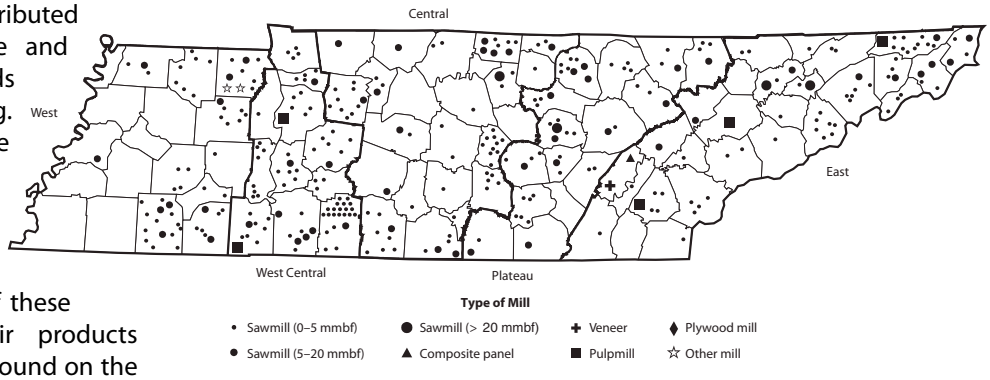


Table 8. Number of primary wood processing mills in Tennessee from 1960 to 2005

	1960	1970	1979	1989	1999	2005
	number					
Sawmills	1,135	546	694	490	440	345
Veneer	9	6	5	3	2	1
Pulp	5	7	7	6	5	5
Composite panels	0	0	0	0	1	1
Other	133	64	32	24	3	2
Total	**1,282**	**623**	**738**	**523**	**505**	**354**

Pulp and paper production is a major end use for wood coming from Tennessee's forests. Tennessee has four major pulp and paper facilities and one minor plant. Table 9 lists average daily production for these mills.

Table 9. Average daily production of pulp

Location	Pulp Mill	Tons per day
Calhoun	AbitibiBowater, Inc	1450
New Johnsonville	Temple-Inland, Inc	500
Kingsport	Domtar, Inc	850
Counce	Packaging Corp of America	1950
Knoxville	Tamko Building Products, Inc	125

The majority of sawlogs cut in Tennessee are processed in Tennessee (Table 10; however, a significant proportion are harvested or processed in neighboring states. For pulpwood, interstate movement of raw materials is more important, due to the proximity of pulp mills to state boundaries and the larger supply areas for these relatively large mills.

Table 10. Wood volume by destination in 2005

Wood harvest source and processing destination	Sawlogs	Pulpwood
	thousand cubic feet	
Harvested and processed in Tennessee	154,491	55,445
Harvested in Tennessee and exported to neighboring states for processing	34,253	65,763
Harvested in neighboring states and imported to Tennessee for processing	11,726	80,213

Secondary manufacturing of wood products in Tennessee is extremely diverse and includes products (e.g. pencils) that don't use any wood grown in Tennessee. However, local wood is an important resource for paper manufacturing. The secondary wood products manufacturing sector is led by paper, followed by furniture and related products, millwork, and manufactured homes. Unlike primary wood mills which are located close to the forest resource, secondary wood processing facilities tend to be located in population centers. The Memphis and Chattanooga regions have the largest output values for paper and paperboard mills at 75 percent collectively. Memphis led the state in paper manufacturing (as distinct from pulp production), while the Knoxville region had the largest output for furniture and manufactured homes. Both Memphis and Nashville ranked highest for millwork.

Exports have become an increasingly important role in the Tennessee forest products economy. Exports in forest products totaled $453.3 million in 2003. Paper products had the highest export value at $332.4 million, followed by wood products, $73.9 million, furniture and related products, $37.8 million, and forestry and logging at $9.1 million.

The wood industry is very efficient in the utilization of its by-products ('waste') such as sawdust, shavings and bark (Figure19). Miscellaneous uses include mulch and animal bedding. With increased demand expected for biofuels and continuous efforts to improve mill efficiency, this efficient utilization can be expected to continue.

The forest industry is very important to the economy of Tennessee. Table 11 summarizes some of the economic impact values. According to the University of Tennessee (Menard et al. 2009) the forestry sector as a whole accounts for $22.8 billion (5.9 percent) of the state's $388.2 billion economy. The primary industries account for 23.6 percent of the forestry workforce, while the secondary industries employ 76.4 percent. When these sectors are combined, employment exceeds 148,000 workers.

The great majority of Tennessee's forest are privately owned and these forest produce the bulk of the wood used by the forest industry (Figure 20). In recent years much of the large industrially-owned forest lands have been sold, so the already large proportion of wood coming from private, non-industrial lands can be expected to increase. For many landowners, timber sales represent a significant, albeit sporadic, source of revenue. Prices paid to landowners for standing timber ('stumpage') are variable over time and location; however, average, inflation-adjusted stumpage prices have increased 50-100 percent since 1980 across the state (Luppold and Bumgardner, 2009).

Figure 19. Usage of primary mill wood processing residues in 2005

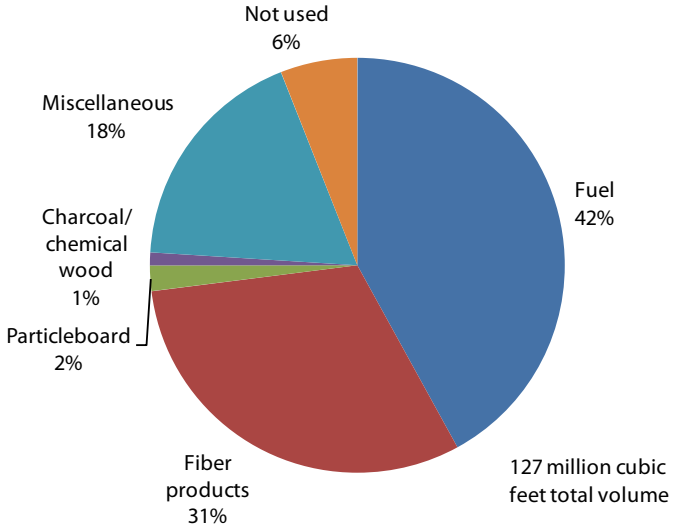
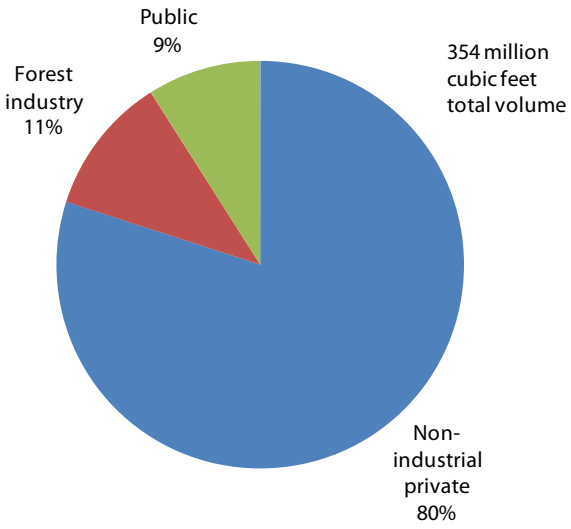


Table 11. A summary of US Census Bureau statistics for the wood products industry in Tennessee

Year	Employees	Payroll	Shipments
	number	*thousands of dollars*	
1999	37,314	1,124,588	6,848,617
2000	37,208	1,169,736	7,271,796
2001	34,794	1,101,256	6,808,651
2002	32,380	1,068,387	6,688,293
2003	31,779	1,049,181	6,902,884
2004	30,500	1,076,166	7,216,354

Figure 20. Roundwood production by forest landownership in 2005

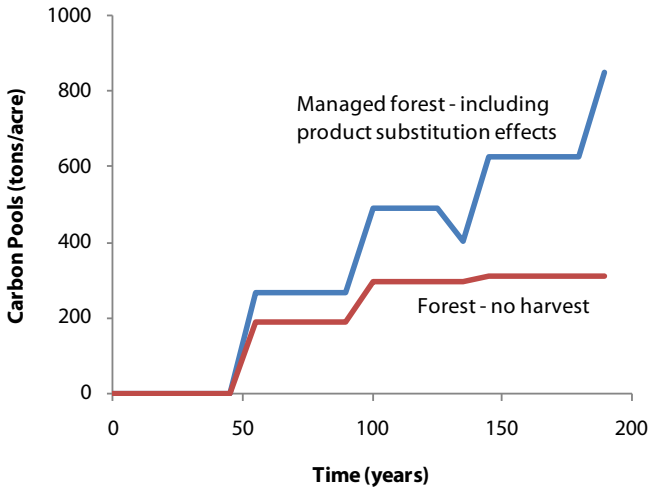


Non-timber forest products

Traditional commodity wood products such as hardwood lumber are not the only commercial products from Tennessee's forests. These products can come from trees or from the fungi, moss, lichen, herbs, vines and shrubs that are also present in the forests. These products can include edible products (e.g. Nuts and mushrooms), medicinals (e.g. ginseng), ornamental products (e.g. grapevines), landscaping plants and specialty woods (e.g. burls) that are used in herbal medicine and in the culinary, crafts, floral and landscaping industries. Oswalt et al. (2009) report that there are over 2,500 businesses involved in non-timber forest products in Tennessee.

'Carbon' is becoming another important 'product' of forests. As is discussed in the Carbon Sequestration section, the trapping by trees of atmospheric carbon dioxide (CO_2 - a greenhouse gas) is being considered by some to be an 'offset' to the release of CO_2 to the atmosphere from, for example, burning fossil fuels. However, the carbon sequestration benefit of trees doesn't stop when wood products leave the forest. Wood product manufacturing industries supply about 50 percent of their manufacturing energy from 'carbon-neutral' biofuels (i.e. wood processing residues such as sawdust and bark). Even more importantly, wood products can substitute for more (fossil-source) energy-intensive products such as steel and concrete. The Consortium on Research on Renewable Industrial Materials (www.CORRIM.org) has quantified these effects using internationally-recognized life cycle assessment methodology. Some of these results are shown in Figure 21, which accounts for the carbon sequestration and substitution impacts of trees and the proportional amount of forest products.

Figure 21. Carbon sequestration by forests if the impacts of wood products are considered compared with a 'no harvest' option. This example is based on information compiled by CORRIM.



Tennessee has a large and productive forest products industry. Many of the fundamentals for the future of the industry are strong: The forest resource is large and growing, a well-developed and efficient harvesting, transportation and processing infrastructure is in place, and demand for wood products is expected to increase over the long term due to population growth and increasing prosperity. However, within the state and across the nation the forest products industry has been in sharp decline recently, because of the economic downturn in general and the depressed housing market in particular. Across all sectors, industry production has dropped by about 1/3 over the past few years. As the economy recovers it is likely that the Tennessee forest industry will rebound also, although it may be significantly changed.

The drivers for change are many. There has been a significant shift in wood products manufacturing to low-cost labor countries, including Mexico, China and Vietnam. This trend has impacted the more labor-intensive sectors (such as furniture) the most. Consumer preferences have shifted away from red and white oaks (species very common in Tennessee forests) to woods lighter in color or with less grain, such as maple and cherry (less common in Tennessee) and exotic species such as rubber wood and bamboo. Other circumstances that may challenge the industry in the future include

- an aging logging workforce;
- fragmentation, ownership changes, and conversion of working forest lands. Inventory data strongly suggest that there will be sufficient timber in the forest to supply even an expanded forest products industry; however, it is not clear whether this timber will be readily available;
- forest certification. The long-term demand for 'certified' wood, and its impact on the industry, is unclear but the dominance of small, private landowners as suppliers of

timber to the industry in Tennessee presents special challenges for developing the chain-of-custody required for developing certified-wood forest products.

- carbon credits. The future role of forest landowner carbon offsets within a possible carbon cap-and-trade system is uncertain; however, in principle such credits may discourage landowners from supplying wood to the industry.

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Urban and Community Forests

Urban forests provide significant benefits to cities and towns. Trees provide both quantifiable and intangible benefits. Quantifiable benefits include property values, storm water reduction, energy savings and air pollution mitigation. Intangible benefits that are more difficult to quantify include aesthetics, health and well being, wildlife habitat and soil erosion prevention. The combined value of tangible and intangible benefits is referred to as structural value of the urban forest. This value is calculated by considering individual tree species, size, condition and location within a city. For Tennessee, the structural value of all its urban forests is $80,634,000,000 (TDF 2009).

Some of the more tangible or quantifiable benefits of urban forests are discussed in this section.

Property Values

Numerous articles and studies over the past 20 years have told the story of trees increasing property values. One of the most recent studies in Portland, Oregon found that street trees (trees along the street in the right of way) increased the sale price of the home by approximately $7,000, "which is equivalent to adding 106 finished square feet to a house. Extrapolating to the entire city, the total value of Portland's street trees is $1.1 billion" (Donovan and Butry 2010).

Storm Water Runoff Prevention

Urban forests play a vital role in reducing storm water runoff in cities and towns. Generally, trees reduce and delay runoff peaks by dissipating the energy associated with storm flows.

Urban soils in all parts of the state can be impacted by unabated runoff. In Memphis and the cities of West Tennessee, the erodible loess soils can be adversely impacted by the loss of large old urban trees. Impervious surfaces increase and accelerate storm water runoff statewide. In Middle and East Tennessee, rocky soils and impervious surfaces cause similar effects.

Large trees play a significant role in the interception of rainfall. It is estimated that in urban settings large trees intercept 8 times more rainfall than small maturing trees, and a single large tree contributed $3.20 per tree per year in reduced costs of building storm water infrastructure (Xiao, 2002). In general, losses of significant numbers of large urban trees will result in cost increases for storm water infrastructure, and these costs are calculable.

Energy Conservation

Large cities are heat islands that exacerbate energy demand for cooling. A typical large city may be 10 degrees warmer than its surrounding countryside, and medium size cities may be up to 5 - 6 degrees warmer. Urban forests play a major role in mitigating heat island effects. As a result, significant energy savings can be realized.

Numerous studies over the last 35 years have shown that a single tree, strategically located, can produce significant savings in energy use. The savings are primarily generated by a reduction in summertime cooling needs. "Carefully positioned trees can save up to 25 percent of a household's energy consumption for heating and cooling. Computer models devised by the U.S. Department of Energy predict that the proper placement of only 3 trees will save an average household between $100 to $250 in energy costs annually" (National Renewal Energy Lab). A similar Sacramento study showed a 5 percent savings in annual energy costs (Donavon & Butry 2009). This energy savings benefit can be claimed by all Tennesseans, rural, suburban or urban residents.

In Tennessee, the state's urban forests provide shade that results in an estimated savings of $94,703,000 per year in cooling costs, but increase winter heating costs by $28,672,000. Hence, the net energy savings is $66,031,000 per year (Table 12). This savings is also reflected in 163,385 metric tons of carbon not emitted, which otherwise would have been released into the atmosphere. Avoided carbon emissions represents an additional annual value of $3,725,000. (TDF 2009).

Table 12. Annual Energy Conservation Provided by Tennessee's Urban Forests

	Dollar value ($)
Cooling	94,703,000
Heating	(28,672,000)
Net energy savings	**66,031,000**
Carbon Avoided	3,725,000

Air Quality

There are numerous correlations between energy savings and air quality, and several studies showing how trees can improve air quality. The Center for Urban Forest Research found that parking lots that were 50 percent shaded reduced volatile organic compounds (VOC) emitted from parked cars by approximately 10.5 percent (USDA 2002). The premise of the report was shaded parking lots would improve air quality.

Tennessee's urban FIA project estimates the value of our state's urban forests for removing pollutants from the atmosphere is over $203 million annually (Table 13). Pollutants examined include carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (P.M.), and sulfur dioxide (SO_2) (TDF 2009).

Table 13. Annual Air Quality Benefits Provided by Tennessee's Urban Forests

Pollutant removed	**Metric tons**	**Dollar value ($)**
CO	455	640,000
NO_2	1,925	19,071,000
O_3	13,920	137,895,000
P.M. 2.5	6,227	41,183,000
SO_2	2,102	5,027,000
Total	**24,629**	**$203,886,000**

Carbon Sequestration

Research also indicates that trees in cities and forests surrounding cities absorb significant amounts of CO_2. A City Green Regional Ecosystem Analysis of the Chattanooga metropolitan area shows that in 1996 the region sequestered 4,000 tons of carbon annually and stored a total of 2.4 million tons of carbon (American Forests 1996). A similar study shows that trees in the city of Knoxville in 2002 sequestered 8,425 tons of CO_2 annually and had a total of 1.08 million tons of stored CO_2 (American Forests 2002).

Urban forests play a two fold role in carbon sequestration. These forests work to cool the urban environment, thereby reducing the consumption of fossil fuels needed to produce energy. These forests are also on the front lines in absorbing and storing carbon where the carbon is being released. Tennessee's urban FIA project estimates the value of the state's urban forests for carbon stored is over $350 million. Additional carbon sequestered annually through tree growth is valued at $18.6 million. Avoided carbon, or carbon that is not produced due to less energy usage by tree shading, is valued at $3.7 million annually (TDF 2009) (Table 14).

Table 14. Carbon benefits provided by Tennessee's urban forests

Carbon	*metric tons*	*dollar value ($)*
Stored	15,370,465	$350,447,000 total
Sequestered	818,605	$18,664,000 per yr
Avoided	163,385	$3,725,000 per yr

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Water Quality, Wetlands, & Riparian Areas

Overview of Riparian Area and Wetland natural functions and significance

Tennessee's wide variety of forest types provides a number of values, goods, and services to the public. Forested riparian areas, floodplains, and wetlands are of particular significance because of their numerous natural functions including protecting drinking water quality, serving as wildlife habitat, and providing important recreation opportunities. Tennessee's landscape contains over 60,000 miles of rivers and streams, almost 538,000 acres of lakes and reservoirs, and an estimated 787,000 wetland acres (Clarke et al. 2009, Dahl 1990). According to recent public polling, over 95 percent of Tennesseeans are concerned about water pollution, and 87 percent expressed concern about the loss of wildlife in the state. Protection and proper management of these particular types of forest habitats is critical in order to meet water quality and wildlife habitat protection goals (Price and Karesh 2002).

Riparian areas are defined as the transitional areas between aquatic and upland terrestrial habitats. These zones exist along streams, rivers, reservoirs, and are found in a variety of landscape settings including forested, agricultural, urban and suburban areas (Fischer 2001). Wetlands, including riparian zones, have more significant natural values than many upland areas because they provide both upland and aquatic ecosystem functions and can provide a broad range of habitat types within a single area due to variations in water depth and saturation (Kusler 2006a, Sherer 2009). Forested wetland and riparian habitats substantially increase the physical, chemical, and biological assimilative capacity of natural systems to manage water pollutants, and these functions are compromised when natural vegetation is removed or otherwise managed inappropriately (Sherer 2009).

Nitrogen, phosphorus, and excess sediment are major pollutants in Tennessee's waterways (TDEC 2008). Forested riparian buffers serve as water retention and infiltration areas, trapping sediment from surface flows and stabilizing stream banks which reduces soil erosion (Sherer 2009). Riparian zones are highly effective at removing and processing phosphorus and nitrogen in surface and subsurface flows (Sherer 2009, Mayer et al. 2005). The deep root structure characteristics of a forested riparian area maximize soil microbial activity, promoting de-nitrification and phosphorus uptake (Sherer 2009, Mayer et al. 2005). Shading effects from forest canopies maintain appropriate water temperatures and limit algal growth, and trees contribute small and large woody debris to aquatic systems that is critical for good habitat quality and food web dynamics (Sherer 2009, Price and Karesh 2002, Harding et al. 1998). Total riparian zone width

and length within a watershed are both significant variables in the reduction of pollutant loads, with older, wider, and longer forested buffers typically demonstrating the highest load removal, particularly of nitrogen (Mayer et al. 2005). The riparian areas and wetlands associated with small headwater streams are extremely significant with regards to providing wildlife habitat and contributing to pollutant load reductions in a watershed. The water quality downstream in larger streams and rivers is highly influenced by the cascading effects of pollutant removal and processing beginning in headwater streams (Sherer 2009, Clarke et al 2009). In addition to reducing pollutant loads to Tennessee's surface waters, forested riparian floodplains and wetlands attenuate flood conditions by reducing the energy of storm flows and storing excess flood waters (Sherer 2009).

Native species and community types of riparian areas and wetlands

Sixteen different forest community types are found in riparian areas and wetlands across the diversity of physiographic provinces in Tennessee (NatureServe 2009). The streams and rivers of Tennessee contain the greatest diversity of freshwater fish, crayfish, and mollusks in the United States (Etnier and Starnes 1993). Tennessee's wetlands provide habitat to 140 rare wetland-dependent species including 115 animals and 25 plants (TNC and NatureServe 2000, Clean Water Network 2004). Analyses of historical land types have documented that North America was largely a forested continent, therefore, most of our native fishes and other aquatic species evolved in a forested landscape (Jones et al. 1999). The overall amount and patch size of forest cover in a watershed can strongly influence the composition of aquatic species found in streams and rivers (Harding et al. 1998). A study conducted in southern Appalachian watersheds demonstrated that native sculpins, benthic minnows, and darter species cannot tolerate widespread riparian tree buffer removal, even when the majority of the watershed remains in forest cover (Jones et al. 1999). Changing the characteristics of the riparian area impacts the quality and quantity of instream habitat for native aquatic species (Arnwine and Denton 2001, TVA 2003a). The proper management of forest cover in Tennessee's watersheds, including upland catchment areas, riparian areas, and wetlands is critical to the conservation of our native species.

Economic, social, and cultural values associated with riparian areas and wetlands

Wetland and riparian areas provide significant values to society in the areas of healthy and safety, historical and cultural significance, aesthetics, and economic services (Kusler 2006a, FISRWG 1998, Fischer 2001, TDEC 1998). Many of Tennessee's most significant Native American and Pioneer settlement archaeological and historical sites are located along our rivers. Anglers spend up to $500 million annually on fishing-related activities in Tennessee. Other recreation activities including bird watching, canoeing, kayaking, and rafting generate jobs and tax revenues for Tennessee (TDEC 1998). Tourism is Tennessee's second largest industry (Clarke et al. 2009). "Ecotourism," tourism based upon natural resources attractions, is the fastest growing type of tourism in the world (Kusler 2006b). In an example from a rural area in Tennessee, between 1995 and 2000 the recreational boating revenue from four counties (Humphreys, Lewis, Perry, and Wayne) average $1.7 to $1.8 million per year with approximately 150,000-160,000 people per year recreating on the Lower Duck and Buffalo Rivers. The total economic impact of these recreational visits on an annual basis is $6 million (Wade 2001).

Riparian areas increase property values for homeowners and businesses and protect property from floods and erosion (TDEC 1998, TVA 2003a, TVA 2003b, Tennessee Parks and Greenways Association 2008). Local communities are increasingly realizing the significant benefits provided by their streams and rivers and are developing riparian protection plans, parks, and greenways (Tennessee Parks and Greenways Association 2008). Native forest cover, including forested riparian zones and wetlands, can provide hundreds of millions of dollars – and more - in reduced infrastructure costs to communities. Studies conducted in the Chattanooga region have demonstrated that loss of forest cover has resulted in $279 million increased stormwater runoff infrastructure costs, a loss of $758 million in water retention capacity, and a $6.2 million increased cost for pollutant removal (Clarke et al. 2009).

Significance of conservation and protection efforts for riparian areas and wetlands

Although Tennessee retains a large land area of wetlands and floodplains, approximately 59 percent of historic extent of these habitats has been lost since the late 1700s (Dahl 1990). During the past decade, state and federal agencies have increased their efforts to properly manage and restore wetland habitats (FISRWG 1998). The State of Tennessee has adopted "vegetative protection" and "riparian vegetative zone width" criteria as part of the assessment criteria for water quality standards (Arnwine and Denton 2001). The Tennessee Department of Agriculture has established best management practices (BMP) guidelines to protect riparian and wetland habitats during timber harvesting operations (TDF 2003). The State of Tennessee Sediment and Erosion Control Handbook calls for the preservation of natural stream buffers as part of an overall site management plan (Price and Karesh 2002). The U.S. Army Corps of Engineers has made changes to its nationwide permit systems to enhance protections of 100-year floodplains (Fischer 2001). Local communities have begun to change land development and stormwater management ordinances to better protect riparian zones and wetlands under their jurisdictions. The U.S. Fish and Wildlife Service Habitat Conservation Plan program has documented numerous examples of riparian management goals related to the maintenance and restoration of high quality aquatic habitats (Horner 2006). U.S. Department of Agriculture cost share programs have been targeting restoration and protection of wetlands and riparian zones since passage of the 1990 Farm Bill.

Significance of forests to healthy public drinking water supplies

A recent study of land use and water supply in the Northeast and Midwestern United States demonstrates that forests are extremely vital to providing clean public drinking water supplies (Barnes et al. 2009). Forests provide multiple services with regards to filtering pollutants and moderating water availability (Indiana Department of Transportation 2009). The concept of "source water protection," including forestland protection, will increase in importance in future decades as a more cost effective method of ensuring healthy public supplies. For example, several large metropolitan areas in the Northeastern U.S. chose to purchase land in the forested source watersheds of their drinking water supplies and remain able to provide water to millions of citizens at lower overall treatment costs (Barnes et al. 2009).

The U.S. Forest Service study of the Northeastern and Midwestern states examined the ability of 540 watersheds to produce clean water, the dependence of clean public water supplies on privately-owned forests, and the degree of development pressure on these private forests. The study found that the following challenges face public water supplies not protected by proper forest cover and other land use management techniques:

- Emergence of new contaminants that suppliers may not be prepared to test for or treat, or that may be in the water long before they are identified as a threat to public health,
- Spikes in pollutant loads after storms that make treatment more difficult, and
- Increased treatment and capital costs due to higher loads and changing regulations.

Allowing continued land use cover change that degrades water quality will threaten both the public health and increase water treatment costs (Barnes et al. 2009). This type of analysis is being developed for the State of Tennessee to examine the importance of Tennessee's forestlands to public drinking water supplies across the state.

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Wildlife Habitat

Game species and Hunting Recreation

Tennessee has a rich tradition of outdoor recreational activities associated with the state's forest resources. Virtually all hunting and fishing activities can be directly and/or indirectly linked to species that depend on various forest cover types during some portion of their life cycle. Without healthy forests the fish and wildlife populations in Tennessee would likely decline along with the forests. Ultimately the recreational opportunities would similarly diminish.

The National Survey of Fishing, Hunting, and Wildlife-Associated Activities has been conducted about every 5 years since 1955 and is the most comprehensive survey of wildlife related outdoor activities available. The most recent survey was conducted in 2006 (hereafter the 2006 Survey) as a cooperative effort between the U.S. Department of the Interior and the U.S. Department of Commerce (USDI 2006). This survey provides each state with information on the number of outdoor recreation participants, days of participation, and how much they spend on their activities.

The 2006 survey does not break out activities based on habitat types. However, treeless habitats (e.g., prairies) are so rare, isolated and/or small that the argument can easily be made that virtually all outdoor activity is directly or indirectly related to forested habitats. Making this assumption will overinflate the estimates but the bias should not be extraordinarily high.

The 2006 survey placed sportspersons (i.e., those that hunt and/or fish) and wildlife watchers (e.g., non-consumptive users that view, photograph, and feed wildlife) into separate groups. The wildlife watcher group is made of "near home" and "away from home" categories, but both categories should be influenced by forest resources either through activities conducted in rural and/or urban forests. The estimates also include non-resident visitors to the states so their use of Tennessee's resources can be included too. The total participation is not the simple sum of sportspersons and wildlife watchers because many persons participate in both activities.

Approximately 2.8 million people participate in wildlife oriented activities annually in Tennessee. About 969,000 individuals are classified as sportspersons and 2.4 million are classified as wildlife watchers. Sportspersons average about 20.8 millions days of activity annually. Wildlife watchers dedicate an average of about 198.4 millions days to wildlife related activity. A large portion of the wildlife watcher days are spent at or near the watchers home. These activities are largely related to forest resources, and primarily urban forests.

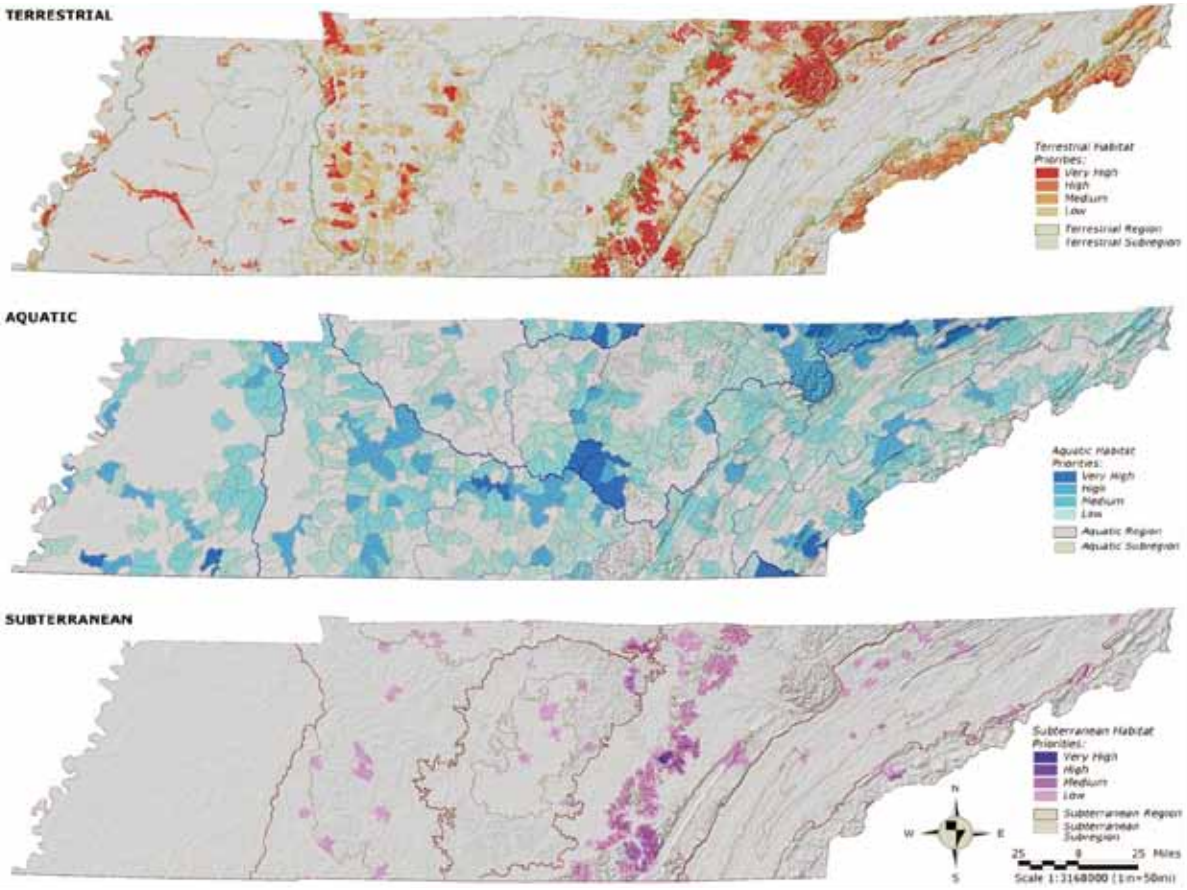
The economic impact of wildlife related activities is estimated to be $2.08 billion annually. Sportspersons annually spend about $1.08 billion and wildlife watchers spend about $992 million. These spending estimates include the purchase of equipment and the daily travel expenses incurred while participating in wildlife related activities.

Wildlife related activities in Tennessee are primarily associated with forested habitats or with habitats that are directly impacted by adjacent forested habitats (e.g., lakes and streams). Just under 3 million people enjoy wildlife related activities annually by dedicating about 220 million user days and spending over $2 billion in pursuit of these activities. The forest resources are the core of these endeavors. Healthy productive forests in the future will help ensure these people continue to enjoy and use Tennessee's forest resources.

Nongame and Rare Wildlife Species

In 2005 the Tennessee Wildlife Action Plan (WAP) was accepted by the U.S. Fish and Wildlife Service. This plan identified 664 species as in greatest conservation need (GCN) (TWRA, 2005). These species inhabit terrestrial, aquatic and subterranean habitats across the state (Figure 22). Additionally, Tennessee's WAP identified potential threats or problems associated with management of these species or their habitats. Strategies were also offered to address these potential threats. For example, increasing the quantity and quality of forest management directed toward benefiting nongame and rare wildlife would substantially increase the quantity and quality of forest habitat slowing the rate of forest habitat degradation and loss for many species of wildlife.

Figure 22. Priority areas for wildlife of Greatest Conservation Need in Tennessee



Tennessee's WAP identified 56 ecological systems based on forest community composition and abundance. Fifty-three of these ecological systems were identified as hardwood communities and three as naturally occurring pine-oak or mountain pine communities. The WAP also identifies 572 species that are dependent, directly for habitat or indirectly because of water quality protection, on the forests of Tennessee. Most of Tennessee's terrestrial GCN species are found within the predominant hardwood forests of the state. Management of these forests is paramount to the conservation of these species as well as providing benefits to all wildlife.

Forest management decisions are based on the objectives of the landowner, whether private or public. When wildlife management is not the primary objective, or objectives do not include or consider wildlife, habitat for wildlife may be impacted proportionately. Further, when wildlife habitat is considered, depending on the target species and the management employed, specific management actions could be beneficial to the target wildlife species and not to others. The following narrative should be considered where wildlife management is the landowner's primary objective and management options are selected to increase benefits to nongame and rare wildlife.

In that context and within the Tennessee WAP, incompatible forestry practices were defined as "Modification of the forest composition or type of an area related to silvicultural activities (or inactivity) not compatible with target species or habitat." Examples of incompatible forestry practices that may limit or reduce nongame and endangered species use include high grading, clearcutting, pine monoculture, use of exotic plants and others. The degree of incompatibility or level of impact linked to these practices and associated activities is dependent upon the wildlife species or group of wildlife species being considered, level of efficiency in implementation of the practice and the resulting stand structure and composition (i.e. open stands vs. closed stands and/or hardwood vs. mixed pine-hardwood vs. pine monoculture).

To clarify incompatibility, it must be noted that the inappropriate implementation of an activity or practice may lead to the negative impacts. An obvious example would be incorrect implementation of forestry best management practices (BMPs) that caused excessive stream sedimentation. The use of some harvest methods can also prove incompatible with target species or habitat. High grading of hardwood stands can reduce hard mast production and in removing the healthier trees, the stand quality and the habitat quality provided can be degraded. Any harvesting practice, whether it is implemented for regeneration or an intermediate treatment, that does not develop and maintain stand level mid-story conditions could prove incompatible with many of the GCN species in Tennessee. In the end, some wildlife species will be benefited at the expense of others. To be most effective in managing for non-game wildlife, silvicultural treatments should be designed to create the conditions favored by targeted species.

Some regeneration practices have greater potential to negatively impact habitat for Tennessee's GCN species. Negative impacts, such as habitat fragmentation and nest predation, of large clearcut areas may be mitigated by using smaller, irregularly shaped, soft-edged interspersed clearcuts. Smaller cuts could also provide benefits of cover and feeding areas for post-fledgling young birds in an appropriate landscape level context.

When landowner objectives are based solely on fiber production and wildlife implications are not considered, high density, even aged, short rotation pine stands provide few wildlife benefits. However, with limited economic concessions, there are practices that can be employed to reduce negative impacts and provide some benefits to wildlife (Allen et al., 1996). Habitat fragmentation can be reduced when stand placement is considered in the context of the surrounding forests. Maintaining connectivity of hardwood stands around pine plantations provides travel corridors for wildlife, and greater interspersion of food and cover resources. Additional habitat connectivity can be realized through maintaining riparian zones in native species of shrubs and hardwoods. Widening streamside management zones beyond widths designed for water quality protection can also provide additional habitat.

Pine plantation stand characteristics can be managed to provide improved habitat. Native pine species planted at wider spacings decreases stem density which allows some level of understory development to take place. Intermediate practices, like thinnings (pre-commercial or commercial) or regenerating by harvesting patches (group selection or patch clearcutting), can also develop needed stand structure. Preserving hardwood inclusions and corridors in larger acreage plantations will provide tree species diversity. Longer rotations

to promote saw timber dominated stands will provide additional structural elements not found in younger stands.

Lack of forest management is considered relevant as well. Across the state, and especially in the mountainous east, examples can be found of 60-80 year old closed canopy oak/hickory forests with little vertical structure (i.e. understory, mid-story and canopy development). Vertical structure is critical for increasing wildlife diversity. This lack of structure is a result of closed stands that have experienced little or no disturbance. Structure can be provided by applying intermediate treatments, such as burning or thinning, and by regeneration harvesting in groups or patches.

Relative to non-game and rare wildlife species, other situations occurring in Tennessee's forest warrant highlighting. In west Tennessee (Mississippi flood plain), loss of bottomland hardwoods has had an immense impact on all faunal groups but specifically forest interior birds, riparian birds, migratory birds, wading birds, amphibians and reptiles. This loss has contributed to a lack of hydrologic function (i.e. flood water retention and release), as well. Forests of middle Tennessee have little vertical structure and are heavily fragmented. Loss of forest connectivity or forested corridors significantly impacts wildlife. For example, interior forest birds need large patches of contiguous forest. In middle and east Tennessee, with the loss of industrial forest lands and subsequent fragmentation, large contiguous tracts of forests are essentially restricted to public lands.

Statewide, the threat of non-native pests impacting the health of forest habitat is growing as more of these pests are introduced to the state or are becoming more widespread. Some non-native plants are disrupting forest habitat communities by displacing native vegetation through competition for nutrients, water and sunlight. Tree of Heaven, privet, bush and Japanese honeysuckle, and Japanese stiltgrass are just a few examples of non-native plant pests disrupting many of Tennessee's forest communities (USDA 2009). Other non-native pests are directly impacting the native species which serve as hosts to these invading organisms. Gypsy moth and hemlock woolly adelgid are two major insect pests affecting a vast amount of forest land in east Tennessee by impairing oak and hemlock dominated forests, respectively. Monitoring and control of these pest problems is critical to ensuring that Tennessee's forest habitats, which support so many wildlife and non-game species, stay healthy.

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Natural Heritage

Rare and Endangered Plant Species

The rare plant species found in our state's forests have multiple benefits and values many of which are immeasurable. We do know that American ginseng contributes on average $2.6 million of economic impact each year from the harvest of an average of 8,725 pounds of wild ginseng each year between 1998 to 2008 (Tennessee Ginseng Harvest Data 1998-2008 2009). We also know that plants support fish and wildlife by providing food and habitat. According to the U.S. Forest Service for every plant species that goes extinct up to 30 other species of plants, insects and other animals may also decline. Plants are a cornerstone of biological diversity. Plants support a healthy environment by providing clean air, clean water, preventing soil erosion, moderating climate and ecosystem stability. Plants play an integral role in the hydrologic cycle and the regulation of greenhouse gases through the uptake of carbon dioxide and release of oxygen. Plants support people in numerous ways. Plants provide us with food, fiber, flavors, fragrances, repellents, flowers, fuel, medicines, ornamentals, and inspiration. Plants are a potential genetic mine full of genetic traits such disease resistance or drought tolerance which could benefit our agricultural crops. It is believed that 40-50 percent of our medicinal drugs originated from wild plants. Plants are often a major contributor to our sense of place being an essential element in the natural beauty of our surroundings. Plants are important in terms of aesthetics when it comes to places people choose to live, recreate, relax, and observe or photograph nature. Plants have numerous economic and intrinsic values, yet for most imperiled plants we know little about them. Unfortunately, we are destroying plants and their habitat at a much faster rate than we are protecting and studying them. If we lose these species we lose all that they may offer to us (Center for Plant Conservation 2009a and 2009b).

Some of the most sensitive areas within forests that include rare plants are seeps and other wet areas. These areas contain rare orchids and other species that are adapted to them. Numerous rare species on the Cumberland Plateau and the Southern Blue Ridge can be found in such places. The high elevation forests of the Southern Blue Ridge also contain a large number of listed species. On the Eastern Highland Rim portion of the Interior Low Plateau there are flatwoods that contain a number of rare species that would normally be found far to the south in the coastal plain states. In the Southern Blue Ridge, Ridge and Valley and the Cumberland Plateau many rare species can be found in rock outcrop areas within the forests. The Interior Low Plateau and Ridge and Valley forests have small glades and barrens within them that harbor many of the listed species in those physiographic

provinces.

According to the Tennessee Natural Heritage Inventory Program (2009) the vascular flora of Tennessee includes 93 pteridophytes (ferns and ferns and fern allies), 14 gymnosperms, 751 monocots and 1,581 dicots. Also within the state are 435 non-native plant species. Of these 2,874 species (Chester et al. 2009) 486 are considered rare enough to include on the state's official rare plant list. 52 species of nonvascular plants (mosses and liverworts) are also on the state rare plant list. 248 of the listed species are known from only one physiographic province. Of those that are restricted to one province the Southern Blue Ridge province has the greatest number of rare species at 117. The Interior Low Plateau has 68, Cumberland Plateau 30, the Ridge and Valley 19, the Upper Gulf Coastal Plain 7, and the Mississippi Alluvial Valley 2.

The entire list of rare plants includes 163 which occur in woods or forests specifically. Others may occur in openings within the forest. 52 of those that occur in forests are listed as state-endangered and 45 are listed as state-threatened (Tennessee Natural Heritage Inventory Program 2009).

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Recreation

Millions of visitors come to Tennessee each year to see the wildflowers and fall colors of the extensive forestlands of the state. In 2007, 9.4 million visitors spent over $718 million dollars in an area within 50 miles of Great Smoky Mountains National Park. It is estimated that more than 13,000 local jobs are a direct result of the presence of the park. Even in a time of economic slowdown the park continues to benefit the area economically (National Park Service, 2009 and Stynes, 2008). The value to the local economy of this one park is known because of numerous studies, but the value of those forest lands that have not been studied can only be estimated. State Parks, State Forests, National Forests and private forestlands all have an inestimable value for people who hike, bike and picnic. The importance of scenic areas like forests increases dramatically as cities continue to spread outwards into the landscape. A much needed relief from the stress of the city can be found in the forest.

Outdoor recreation pursuits are continually changing. Our social structure, mobility, technology, leisure time, increased affluence and a multitude of new recreation equipment influence these changes. As opposed to basic human needs for food, safety and shelter, recreation deals more with attitudes, values and emotions.

Today there are many forest users who have views and activities that sometimes conflict. Some people seek the peace and solitude that forests provide in order to promote mental and physical fitness. Others enjoy more physical activities to achieve the same outcome. There are those who prefer traditional forms of recreation such as sight-seeing, hiking, hunting, fishing, wildlife watching, camping, and even plant and fauna identification. However, others find forests ideal places for non-traditional forms of recreation such as riding All Terrain Vehicles (ATV's) or Off-Highway Vehicles (OHV's), mountain bikes, hang gliders, rock climbing, kayak/canoeing and orienteering or geo-caching. Potential new forms of recreation not yet thought of, mixed with increasingly strict environmental controls, could lead to unexpected confrontations down the road.

Increased recreation use (traditional and/or non-traditional) will have a greater impact on other resources and the forest ecosystems. With the influx of more individuals and groups in pursuit of their recreational activities, it becomes increasingly important to develop management strategies to provide a quality outdoor experience, minimize conflicts and maintain ecological processes. In addition, active recreation planning and coordination must take place to protect all resources and to integrate the management of these resources with the values of a working forest.

Outdoor Recreation Opportunities

Outdoor recreation opportunities can be found in a myriad of ownerships, from private to public, from local to federal. The state of Tennessee provides outdoor recreation through the management of the state parks, state forests, natural areas, wildlife management areas and other lands. Similarly, there is ample opportunity for quality recreation in the outdoors on lands managed by the Federal system, City and County Parks, as well as private business' and individuals. As mentioned above, it is necessary to realize that one piece of forest cannot satisfy the need of all users and planning for the use is essential. The following are an overview of what is typically considered as traditional recreation uses on forest lands and the prevalence and type of activity provided. It would be difficult to mention all outdoor recreation opportunities.

Camping

Camping remains a popular activity for millions of Tennesseans and Americans alike. Primitive backpack-camping, motorized camping and group camping, play a strong role in many of our parks and forests and to a limited extent in State Forests. Primitive backpack campers are those who camp at undeveloped sites and for not usually more than one-night.

Motorized camping is done in close association with a motorized vehicle, as the name implies and most campsites are accessed via well-established roads. The vehicle (whether car, truck, SUV, along with camper trailer or single-use RV) continues to be used for storage or transportation during the camping experience. This is unlike backpack camping where the camper carries all their gear for a day or more away from their vehicle. Motorized camping normally requires a fee payment and a permit.

The third type of camping is group camping (i.e. Boy Scouts, Girls Scouts, Church or other organizations). It is defined as camping with ten or more people. Forest managers typically restrict these activities to sites where there will be little or no environmental impact. Public lands managers do a good job when working with groups to meet their camping needs.

Picnicking

Picnicking is a common recreational activity in designated areas on most public lands. In addition, there are accessible picnic areas with pavilions, tables, small parking areas in most Tennessee State Parks and some State Forests.

Hunting and Trapping

Hunting has been a traditional recreation use of the forest. It is arguably the most commonly enjoyed recreation use of privately owned forests, and of some publicly owned forests.

Although hunting is considered a recreation activity, in many cases it is a tool used to sustainably manage the forest. This is particularly true for herbivores, such as deer. Controlling wildlife damage through hunting is a key role in sustainable forest management. Likewise trapping can help keep other wildlife/small game in balance with their habitat. Thus hunters and trappers provide a valuable service to the forest owners, while enjoying their sport.

Fishing

Tennessee's streams, rivers or lakes supply opportunities for cold-water and warm-water fishing. Healthy forests play a crucial role in yielding quality water to support Tennessee's excellent fishery resource. For this reason, loss of forest lands may result in impaired fishing waters and an impaired fishery resource.

Hiking

Most managed public forest lands maintain many trails, providing different uses ranging from primitive to paved greenways.

Horseback Riding

With Tennessee being second in the nation in horse ownership, it is no surprise that horseback riding is a rapidly growing activity. Horseback riding enthusiasts are continually looking for new and unexplored areas to ride. Horseback riding opportunities can be found on many of Tennessee's public lands.

Birding/Nature Observation

Bird watching and nature observation are uses that occur throughout the state's forest land. The best locations for observing any particular species will be where the specie's desired habitat is found. The forests of some areas of the state have unique habitat that support relatively rare bird species. These forested areas are particularly large with little to no fragmentation. Most of Tennessee's forest lands

have diverse habitats and support great numbers of bird species.

Canoeing/Kayaking/Boating/Rafting

Tennessee's streams, rivers or lakes supply opportunities for various types of paddling.

Miscellaneous

Miscellaneous recreational activities fall into the category of non-traditional as well. These include astronomy, geo-caching, gold panning, jogging, hang gliding, orienteering, photography, rock climbing, rappelling, some ice-skating and/or snow skiing, sledding, snowboarding, snowshoeing, spelunking, swimming, snorkeling and tubing. All of these activities are permitted unless they are in conflict with the rules and regulations of the management.

Recreation on State Forests

State Forests, typically because of the size of the land base, provide a unique opportunity for dispersed, low-density outdoor recreation that cannot be obtained from small forest areas or from private ownership. However, state forests based state law, acquisition terms and their basic mission are finite and cannot provide everything to everyone, nor should they. Recreation opportunities on state forest land are aimed at dispersed forms of recreation.

Some types of hiking trails have been developed in all 15 Tennessee State Forests. Most are primitive and vary in length from a couple of miles to 20 or more. While primitive, these trails are usually maintained by the forest staff with varying amounts of assistance from volunteer hiking groups. Many of these trails do not have their own maps and/or guidebooks.

Five of the 15 State Forests have designated trails for mountain bicycling. Other TSF offer limited mountain bicycling on undeveloped roads or timber paths.

State forest land with its many unimproved roads, trails and generally quiet environment is ideal for nature observation. A public use map of the roads and trails is limited but available from each district to aid nature observers. The entire state forest system is maintained in a largely natural system. Nature photographers and artists also find an abundance of natural settings on state forest land. Natural areas and many local parks provide enough land mass to provide habitat while making it easy for the public to access due to their proximity.

Scenic/pleasure driving is perhaps the largest recreational use of Tennessee state forest and park lands. Most recreation users participate in this activity coming to and from the state forest, but for many this is the sole purpose of their visit to state forest land. The beauty of the forest, the solitude, tumbling mountain streams, scenic vistas, and ever changing colors, attract great numbers of visitors.

Other than walking, all forms of transportation, including horseback riding and bicycling, are regulated on state forest land by State Forest Rules and Regulations in TCA 0080-7-1-.06. Riding on state forest land is restricted to designated areas only, which are mostly unimproved roads. In addition, vehicles must have properly functioning spark arresters and properly functioning mufflers. No person shall operate a motorized vehicle on any roadway unless such motorized vehicle is equipped with a muffler in good working order and in constant operation to prevent excessive or unusual noise. The district forester also can designate certain roadways and areas for the use by motorcycles, trail bikes, all-terrain vehicles, bicycles and other off-road vehicles and these areas are posted for such use and in some cases may only be used during daylight hours. These designations of use are attempts to minimize conflicts between motorized and non-motorized forms of transportation.

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Carbon Sequestration

Many businesses large and small, across disciplines, spanning the globe, are reconfiguring their mode of operation to meet the prospect of emerging green (ecosystem) markets. Carbon credit trading is an emerging ecosystem market from which some forest landowners may profit. This market could become sizeable if federal or state governments intervene to set mandatory targets for carbon dioxide (CO_2) reduction. It could also become less significant as industries change to be more successful in lowering their carbon emissions.

Forests are the most efficient natural land-based carbon sink, with forests of all ages and types having a great capacity to sequester and store carbon, both in the trees themselves through photosynthesis and in the soil, forest floor, and down, dead wood. Forest management, using traditional silvicultural treatments, can enhance the forest's capacity to sequester carbon by ensuring full stocking, maintaining health, and reducing tree mortality due to wildfires, insects, and diseases (Malmsheimer et al. 2008). Managed stands have been shown to store carbon at a faster rate than slower-growing natural stands of the same species (Birdsey 1992).

Landowners who choose to participate in a carbon credit trading program can earn and sell carbon credits as their trees grow. Trees and forests sequester (or seize) CO_2 in the atmosphere through photosynthesis. Some of the carbon is used by the tree to sustain growth, while excess is stored. This stored carbon can be quantified and sold as carbon credits.

Carbon credits have value to business entities who are seeking to offset their CO_2 emissions. Such entities may include power companies or other manufacturers that burn fossil fuels such as coal, natural gas or oil. In a cap and trade system that includes "offsets," when an entity falls short of lowering their CO_2 emissions to their goal, entities must purchase carbon credits either from another manufacturer that has succeeded in reducing emissions beyond their goal or from carbon sequestration projects that sequester atmospheric carbon (such as forests). Businesses in the carbon aggregation and trading sector are emerging to represent landowners in selling their sequestered carbon.

Currently it is challenging and potentially expensive for Tennessee forest landowners to participate in carbon trading. Some states have developed a state registry, often in concert with a property tax abatement program, but Tennessee does not have such a program. Instead, landowners must enroll as individuals or become part of a certified group (such as with a participating consulting forester). The property must first be certified as being

sustainably managed by an approved certification system. Certification requires an approved forest management plan and an on-site inspection confirming that the landowner is in compliance with sustainability principles.

If landowner revenues for forest products continue to be flat or even decline, emerging ecosystem markets such as carbon credit trading may provide some off-setting revenue.

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Open Space

Open space is valuable to all Tennesseans, and has been for over 100 years. Following are a few examples of early efforts to secure and sustain open space in and around current urban centers.

In the mid 1970's, Shelby County commissioned a study to develop a plan for the land use of Shelby Farms, since the area was no longer being used as a prison farm. The Eckbo Plan was adopted, recommending the Farms be kept as open space, since it was projected that in 30 years the Farms would be entirely surrounded by development. The plan proved prophetic, because indeed, the Farms are now surrounded by developments and the cities of Germantown and Memphis.

Well before that, in the early 1900's, a landscape architect, with encouragement and support from the Olmstead Brothers (of New York Central Park fame), encouraged Memphis to buy Lea's Woods, which, after being acquired, became known as Overton Park Forest. This Forest again came into the news in the 1970's and 80's as a lawsuit was filed to protect it from being cleared for Interstate 40. This lawsuit was ultimately decided by the U.S. Supreme Court in favor of protecting the forest.

In the early part of the 20th century, Percy and Edwin Warner donated approximately 2200 acres to the city of Nashville to conserve this land as open space. This action resulted in Nashville having one of the largest urban parks in the country. Recently an additiona1,326 acres of forest adjacent to Warner Parks was purchased from H.G. Hill Properties and added to the Warner Park system.

Another example of early support for open space was the proposal in 1921 to develop the Appalachian Trail.

Continuing the trend of increasing open space in urban areas, the Beamans of Nashville donated 1500 acres to Nashville in the Northwest part of the county for another large open space park.

Tennessee, along with other states in the country, is following the trend of developing greenways, both intra-city and intercity. Murfreesboro has developed an extensive system of greenways along the Stones River. Knoxville, in conjunction with Sevierville, Pigeon Forge, and Gatlinburg, and Maryville and Alcoa, have developed long range plans to develop intercity greenways connecting their cities to the Great Smokey Mountains National Park.

Numerous other examples exist across the state of cities and towns, subdivisions, counties, and other entities who have acquired, through donation, purchase or set aside, land to meet the open space needs of Tennessee. Unfortunately, a complete inventory of these lands in cities and towns is not easily obtainable. However, it should be noted that

even though land is held in public ownership does not mean that these lands are protected from development, as the I-40 threat to Overton Park Forest demonstrated.

As areas between the city and the country are being developed, there have been many opportunities to retain open space. Some opportunities were lost as the land was completely developed. Many times, especially where counties had planning services, areas within subdivisions are not completely developed and open space is being retained. These lands are often held privately by homeowner's associations, but numbers and acreages have not been inventoried. This may be a future assessment that the state would undertake to meet future opportunities for strategic planning.

At the state-wide level, both state agencies and non-profit organizations hold thousands of acres of land as open space. One organization, the Land Trust for Tennessee, notes that their efforts have provided open space protection to approximately 51,454 acres in 45 Tennessee counties (Land Trust for Tennessee 2010). These open spaces include farms, forests, river corridors, historic areas, scenic landscapes and other open spaces.

The State also has significant acreages of open space (Figure 23). Lands of the Forest Legacy program, State Forests, State Parks, and Wildlife Management Areas contribute to the state's open space inventory and are easily identifiable. These open spaces across the state include:

- 15 State Forests (166,679 acres)
- 53 State Parks (164,554 acres)
- 117 Wildlife Management Areas and Refuges (1,483,391 acres)
- 19 Forest Legacy tracts (38,240 acres)
- 60 State Natural Areas (111,570 acres)

Federal agencies also own land that is dedicated to various uses, but is classified as open space. These lands include those managed by the National Parks, USDA Forest Service, US Fish and Wildlife Service, US Corps of Engineers, Tennessee Valley Authority, and others.

References:

Land Trust for Tennessee. http://www.landtrusttn.org (accessed June 10, 2010)

Figure 23. Map of public land in Tennessee (2009)