Forestry and Tree Planting in Virginia

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Abstract

Virginia (including the lower Chesapeake Bay) occupies 27.3 million acres (11 million hectares), 58 percent of which is forested (15.8 million acres or 6.4 million hectares). Most of the forest land is owned by more than 373,600 private individuals and families. The remaining 42 percent of the State is nonforest land, composed of agricultural and urban lands, as well as water. More than 75 percent of the State's forest land is stocked by hardwood forests. Regarding area of softwood forests, nearly two-thirds of stands are of planted origin. The most common plantation species by far is loblolly pine (*Pinus taeda* L.), while eastern white pine (*P. strobus* L.) makes up a distant second. Major forest types in Virginia are oak/hickory, loblolly and shortleaf pine, maple, beech, and birch. Annually, the two State nurseries plant, grow, and sell 25 million tree seedlings across 40 species. Most of the seedlings (23.5 million) are softwoods—primarily loblolly pine. Virginia has an active and vibrant tree research and improvement program that is highly appreciated by forest landowners.

Introduction

Virginia is rich in history. From its first permanent English settlement in 1607 to the present, forests have played a prominent role in the Commonwealth. Forests in early years were heavily used and exploited to make way for tobacco, corn, and cotton. Forests fueled the growth of Virginia with lumber, naval stores, and fuel for charcoal and iron furnaces. Although heavily used, Virginia's forests are resilient. Founding fathers George Washington and Thomas Jefferson both planted and cultivated trees in the State.

Efforts to restore forests began, in earnest, in 1914 with the creation of the Office of the State Forester and a mission to protect, conserve, and develop forests. The first tree nursery soon followed and was located in Charlottesville—land now occupied by the headquarters of the Virginia Department of Forestry (VDOF). Tree planting was a focus of the Civilian Conservation Corps during the Depression, and some of these tree plantations remain today. World War II called for wood and timber, and the postwar housing boom increased demand both for wood and paper. Forest industry and the then-Division of Forestry responded with the first large-scale reforestation efforts on cutover forest land in the 1950s. Heavy mechanical site preparation and later prescribed burning practices were developed and refined. Tree nurseries were developed and expanded, and by the 1960s, two State and two industry nurseries were operating.

Because of a concern over declining pine volumes in the State, the Virginia Reforestation of Timberlands program was created in 1970. This model program, funded from a self-imposed forest products tax by forest industry and matched by the General Assembly, greatly increased private lands reforestation. A third State nursery was added in the mid-1980s to meet seedling demands. Another surge in planting occurred in the late 1980s, due in part to the USDA Conservation Reserve Program, which focused on planting trees on highly erodible farm lands.

In 1988, reforestation peaked in Virginia when nearly 118,000 acres (47,750 hectares) were planted, the highest on record. In the past 20 years, planting has remained steady, with some peaks and valleys, often following the economy (figure 1). For more than 400 years, tree planting has been, and will continue to be, important for Virginia.

Virginia's Environment

Virginia's 42,774 square miles (110,780 square km) are divided into five physiographic provinces (figure 2): the Coastal Plain, Piedmont, Blue Ridge, Valley and Ridge, and Appalachian Plateau. Of this area, 58 percent (15.8 million acres/ 6.4 million hectares) is forested (figure 3) with a diversity of softwood and hardwood forests (table 1). The remaining 42 percent of the State is agricultural lands, urban areas, and water. Beginning on the Eastern Shore, where barrier islands and salt marshes are nearly at sea level, and traveling westward across rolling hills and moderate slopes, through valleys, and over rugged steep slopes, the diversity among the regions is evident.

Virginia's climate is equally diverse throughout its five climate regions (Hayden and Michaels 2000). The moisture of the Atlantic Ocean and Chesapeake Bay creates humid summer days, while the Blue Ridge and Appalachian mountain systems

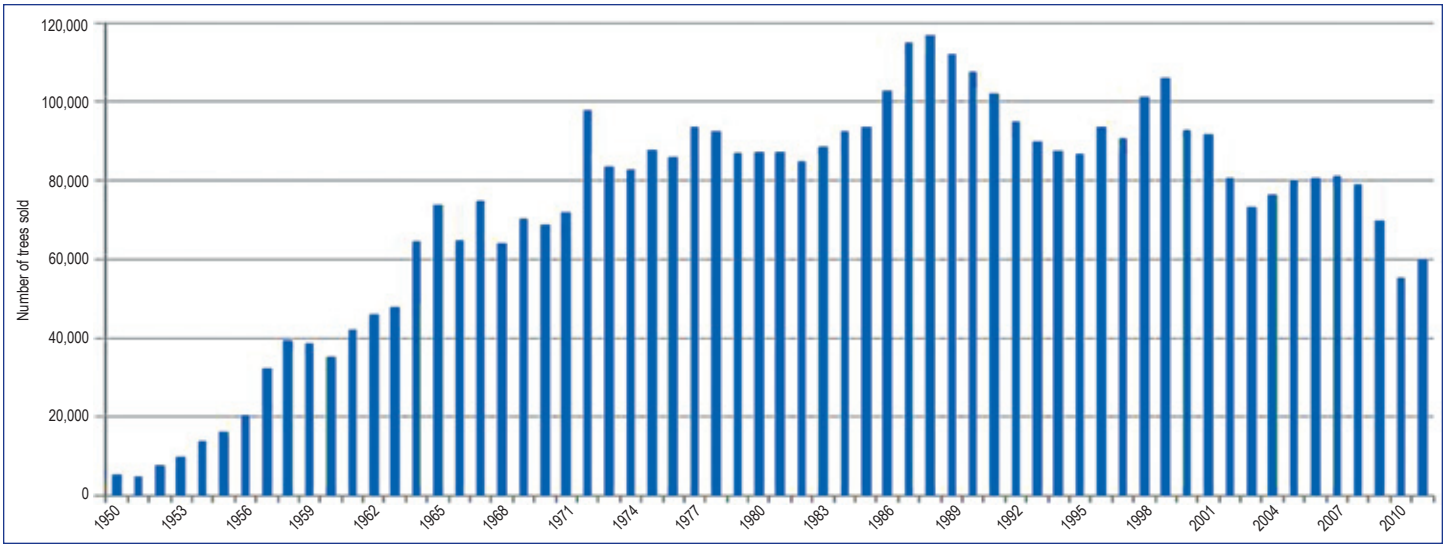

Figure 1. Virginia's historic tree-planting acres. (Data source: VDOF nurseries).

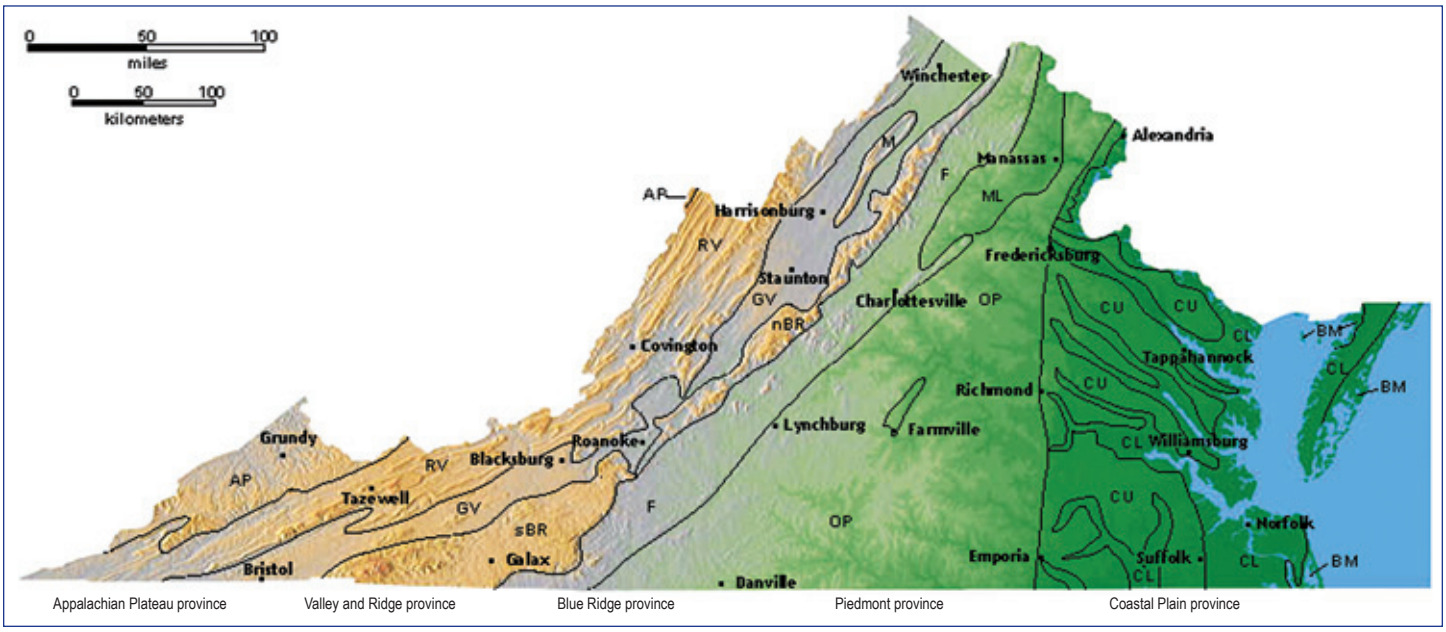

Figure 2. Virginia's five physiographic provinces: (1) Appalachian Plateau; (2) Valley and Ridge (includes Ridge and Valley subprovince [RV], Great Valley subprovince ([GV], and Massanutten Mountain [M]); (3) Blue Ridge (includes northern and southern subprovinces [nBR and sBR, respectively]); (4) Piedmont (includes Foothills subprovince [F], Mesozoic lowlands subprovince [ML], and Outer Piedmont subprovince [OP]); and (5) Coastal Plain (includes Upland subprovince [CU], Lowland subprovince [CL], and Barrier Islands and Salt Marshes [BM]). (Data source: Bailey, 1999).

provide cooler temperatures. The Northern Virginia Climate Region has the coolest average January temperatures of 19 to 42 °F (-7.2 to 5.6 °C), while the Piedmont Climate Region has the warmest average July temperatures of 68 to 88 °F (20 to 31 °C). Average annual rainfall is 42.2 in (107 cm), and snowfall amounts can vary from more than 50 in (127 cm) annually in the mountains to scattered flurries in the southeastern region. Severe weather in the form of a hurricane or tropical storm is somewhat common, averaging about one per year.

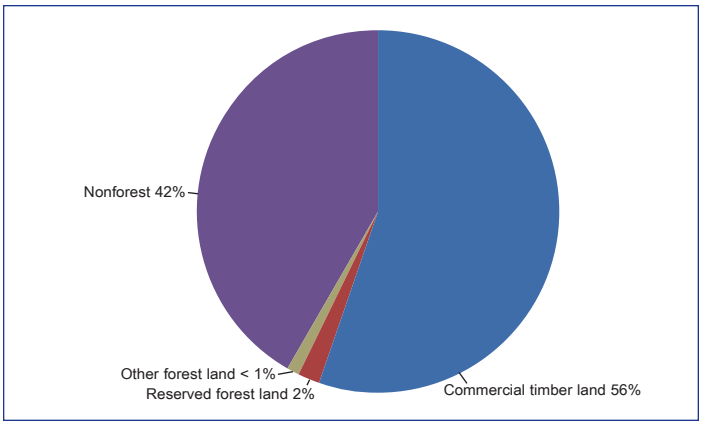

Figure 3. Land use in Virginia (total is 27.3 million acres/11 million hectares). (Data source: Miles, 2012).

Table 1. Softwood and hardwood forest types in Virginia.

Forest type	Acres *(Hectares)*			
	Coastal Plain	Piedmont	Mountains	Total
White/red/jack pine	—	16,504	156,951	173,455
	—	*(6,679)*	*(63,516)*	*(70,195)*
Spruce/fir	—	—	7,631	7,631
	—	—	*(3,088)*	*(3,088)*
Loblolly/shortleaf pine	1,378,391	1,351,327	147,760	2,877,478
	(557,815)	*(546,863)*	*(59,796)*	*(1,164,474)*
Other eastern softwoods	—	28,253	47,838	76,090
	—	*(11,434)*	*(19,359)*	*(30,793)*
Softwoods total	**1,378,391**	**1,396,084**	**360,180**	**3,134,654**
	(557,815)	*(564,975)*	*(145,760)*	*(1,268,549)*
Oak/pine	512,812	702,897	481,035	1,696,743
	(207,528)	*(284,452)*	*(194,668)*	*(686,648)*
Oak/hickory	1,309,546	3,863,035	4,553,656	9,726,237
	(529,954)	*(1,563,315)*	*(1,842,799)*	*(3,936,068)*
Oak/gum/cypress	345,066	31,377	5,326	381,769
	(139,643)	*(12,698)*	*(2,155)*	*(154,496)*
Elm/ash/cottonwood	113,685	231,003	49,731	394,419
	(46,007)	*(93,484)*	*(20,125)*	*(159,616)*
Maple/beech/birch	—	—	364,060	364,059
	—	—	*(147,330)*	*(147,329)*
Aspen/birch	—	1,638	2,634	4,272
	—	*(663)*	*(1,066)*	*(1,729)*
Other hardwoods	—	4,588	24,269	28,857
	—	*(1,857)*	*(9,821)*	*(11,678)*
Exotic hardwoods	1,673	24,338	15,161	41,173
	(677)	*(9,849)*	*(6,135)*	*(16,662)*
Hardwoods total	**2,282,782**	**4,858,876**	**5,495,872**	**12,637,529**
	(923,809)	*(1,966,317)*	*(2,224,100)*	*(5,114,227)*
Nonstocked	**22,800**	**44,653**	**28,263**	**95,716**
	(9,227)	*(18,070)*	*(11,438)*	*(38,735)*
Total	**3,683,973**	**6,299,613**	**5,884,313**	**15,867,900**
	(1,490,851)	*(2,549,363)*	*(2,381,297)*	*(6,421,511)*
Total %	**23%**	**40%**	**37%**	**100%**

Data source: USDA Forest Service Forest Inventory and Analysis, 2010.

Coastal Plain

The Coastal Plain accounts for approximately 30 percent of the State's land area and extends westward from the barrier islands and beaches along the Atlantic Ocean to the "fall line"—a geological fault that separates the Coastal Plain from the Piedmont. This region includes Virginia's section of the Chesapeake Bay—the largest estuary in the United States.

Most of the soils in this region are alluvial in origin, having been formed when the region was inundated by the ocean. Soils tend to have a high percentage of sand and can be droughty or poorly drained, depending on local topography.

In this region, 45 percent of the land is forested. Elevations range from sea level to approximately 250 ft (75 m) at the fall line. In this region, 37 percent of the area consists of softwood forest types, and the remaining 63 percent is hardwood forests (table 1). Loblolly pine (*Pinus taeda* L.) plantations make up most of the softwood area (figure 4). Diminished species in

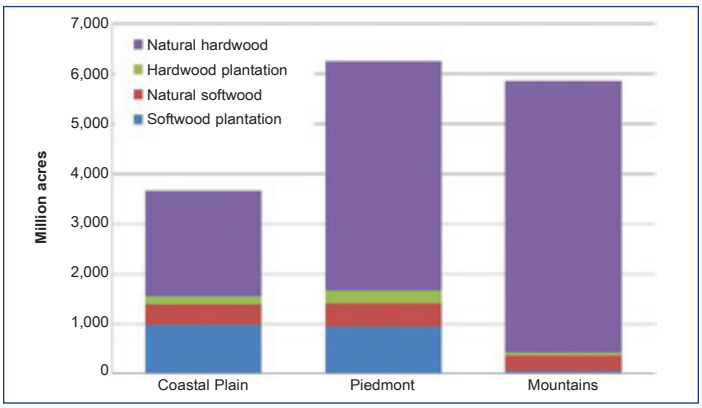

Figure 4. Stand origin for Virginia's forests. (Data source: Miles, 2012).

this area that are actively being restored include longleaf pine (*P. palustris* Mill.) and Atlantic white cedar (*Chamaecyparis thyoides* [L.] Britton, Sterns and Poggenb.).

Piedmont

The Piedmont region accounts for 37 percent of the State's land area and extends westward from the fall line and Coastal Plain to the Blue Ridge Mountains. This region consists mainly of rolling, well-drained foothills. Because of agricultural practices in the 18th and 19th centuries that caused erosion, much of the soil productivity has been lost.

The Piedmont physiographic region is 62 percent forested. Softwood forest types make up 22 percent of this area—primarily loblolly pine plantations and Virginia pine (*Pinus virginiana* Mill.) natural stands. The other 78 percent consists primarily of upland hardwoods (oak/hickory [*Quercus/Carya*] forest types). Diminished species include shortleaf pine (*P. echinata* Mill.) (table 1).

Mountains

The Mountains region accounts for 33 percent of the State's area and extends westward from the Piedmont to the West Virginia and Kentucky State boundaries. This area is composed of a number of subregions, including the Blue Ridge Mountains, Shenandoah Valley, Alleghany Highlands, Ridge and Valley, and Cumberland Plateau (Coalfields). This region has the highest point in the State, Mt. Rogers, which is at an elevation of 5,729 ft (1,746 m).

This region, which includes National Forest System lands, is 65 percent forested—94 percent of which is in hardwoods (table 1). At higher elevations, several forest types unique to Virginia occur, including spruce/fir (*Picea/Abies*) and maple/beech/birch (*Acer/Fagus/Betula*). Diminished species include eastern hemlock (*Tsuga canadensis* [L.] Carrière), Table Mountain pine (*Pinus pungens* Lamb.), and American chestnut (*Castanea dentata* [Marsh.] Borkh.).

Forest Land Ownership

Approximately 12.3 million acres (5 million hectares), or approximately 79 percent of Virginia's forest land, is owned by non-industrial private forest (NIPF) landowners (figure 5) (VDOF 2011). From 2001 to 2010, industrial landownership dropped from 6 percent (1 million acres [0.4 million hectares]) to 2 percent (0.26 million acres [0.11 million hectares]) (figure 5). This trend continues the long-term decline of the forest industry in Virginia. Much of the former industry lands have been purchased by Timberland Investment Management Organizations (TIMOs) and Real Estate Investment Trusts (REITs). This practice increased corporate non-industrial private forest lands from 12 percent (1.98 million acres [0.8 million hectares]) to 17 percent (2.68 million acres [1.08 million hectares]) of the total forest land area (figure 5).

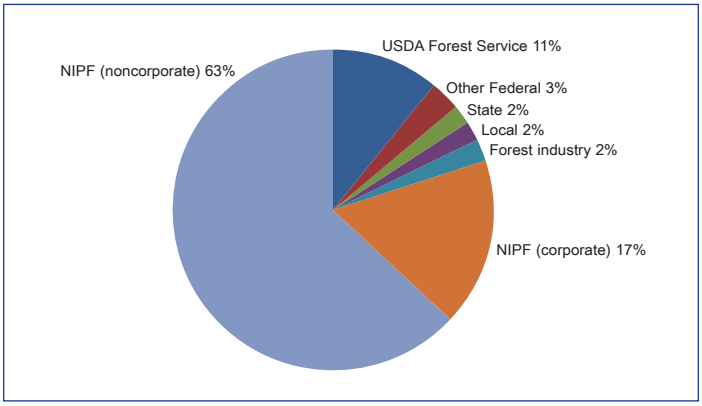

Figure 5. Forest ownership in Virginia in 2010. (Data source: Miles, 2012).

Challenges Facing Virginia's Forests

Insects and Diseases

East of the Blue Ridge Mountains, Virginia's most significant forest pest is the southern pine beetle (*Dendroctonus frontalis* Zimmerman), a native insect that primarily threatens mature plantations of loblolly, shortleaf, and Virginia pines throughout their respective ranges. Historically, outbreaks have occurred at 6- to 10-year intervals. More recently, major outbreaks have been less frequent, likely related to a multitude of factors, including improved silvicultural practices, a more fragmented landscape, and a rapid response to cutting out infested spots before they have a chance to grow and spread. Other bark beetles, such as various species of ips (*Ips* spp.) and the black turpentine beetle (*D. terebrans* Olivier), are less aggressive but can cause widespread, localized damage to pine stands under stress from drought or mechanical injury after logging.

Additional problems that periodically plague young pine plantations in the East include the pales weevil (*Hylobius pales* Herbst), Nantucket pine tip moth (*Rhyacionia frustrana* Scudder in Comstock 1880), and various species of sawflies (*Neodiprion* spp.). Root disease caused by anosum root rot (*Heterobasidion annosum* [Fr.] Bref.) is common on sandy, well-drained soils in the Coastal Plain. A more common root disease problem in the Piedmont is littleleaf disease, caused by *Phytophthora cinammomi* Rands. This pathogen is thought to be responsible for much of the decline and mortality of

shortleaf pine during the past several decades, although it can be damaging to other pines and numerous hardwood species as well.

Among hardwoods, the most common native defoliator is the fall cankerworm (*Alsophila pometaria* [Harris]) followed by the spring cankerworm (*Peleacrita vernata* [Peck]), both of which can reach outbreak levels periodically throughout Virginia. Because defoliation occurs very early in the season, most trees typically recover from even severe defoliation. Cankerworms have a wide host range, but prefer oaks and maples. Other native insects can occasionally cause localized damage to hardwood forests, including the eastern tent caterpillar (*Malacasoma americanum* [F.]), fall webworm (*Hyphantrea cunea* [Drury]), locust leafminer (*Odontata dorsalis* [Thunb.]), tulip tree scale (*Toumeyella liriodendri* [Gmelin]), and variable oakleaf caterpillar (*Heterocampa manteo* [Doubleday]).

Over the past several decades, Virginia's forests have been plagued by the numerous nonnative invasive species, especially the gypsy moth (*Lymantria dispar* [L.]). Gypsy moths entered Virginia from the northeast in the late 1970s and have gradually spread south. Gypsy moths have had a profound effect on many parts of the landscape, especially in the oak-hickory forests in the mountain region. Oak decline is also widespread, in large part, due to aging forests that are exposed to a variety of abiotic stress factors as well as native insect and disease problems.

Other invasive insects include the hemlock woolly adelgid (*Adelges tsugae* Annand), a tiny sap-sucking insect, which kills eastern and Carolina hemlock (*Tsuga caroliniana* Engelm.). Although hemlock mortality is variable depending on tree age, site, elevation, and length of time since infestation, hemlock stands have declined significantly and the future remains uncertain.

A more recent exotic insect to Virginia's forests is the emerald ash borer (*Agrilus planipennis* Fairmaire), which was found in northern Virginia in 2008 and is killing every ash (*Fraxinus* spp.) tree in its path. Although insect biological controls have been released, it is unclear whether they will be able to slow or stop the EAB from decimating Virginia's ash resource. Nonnative diseases are also on the increase, including dogwood anthracnose (*Discula destructive* Redlin), butternut canker (*Sirococcus clavigignenti-julglandacearum* Nair, Kostichka, and Kuntz), beech bark disease (*Nectria coccinea* var. *faginata* Lohman, Watson, and Ayers) and, since 2011, thousand cankers disease (*Geosmithia morbida* Kolařík) of black walnut (*Juglans nigra* L.).

Urbanization

Urbanization is a major factor in forest land conversion as the rate of people moving from central cities to surrounding suburbs increases. Land for homes, businesses, shopping venues, schools, recreational areas, and other needs will continue to reduce our forest land acreage. During the past 10 years, Forest Inventory and Analysis (FIA) data indicated a 16,000-acre (6,475-hectare) average annual net loss of forest land in Virginia (Miles 2012).

Wildfire

The protection of lives, property and resources from wildfire is paramount and continues to be a foundational issue for VDOF. Virginia's leading cause of wildfire continues to be careless debris burning, accounting for nearly 40 percent of all wildfire causes. In a typical year, approximately 1,200 wildfires burn more than 10,000 acres (4,047 hectares). The human effect of these wildfires is increasing each year as the Wildland-Urban Interface increases at an alarming rate.

Each topographic region has unique fuel types and firefighting challenges.

Mountains: Fuels are mostly hardwoods with scattered areas of pine (pitch [*Pinus rigida* Mill.], Table Mountain, white, and Virginia). Hemlock and mountain laurel (*Kalmia latifolia* L.) contribute to the fuel loading.

Piedmont: The topography ranges from gently rolling hillsides to steep slopes. Gypsy moth and southern pine bark beetle outbreaks along with tornadoes, hurricanes, and ice storms during the past several years have added to the heavy fuel loading and significant snag hazard in some areas.

Coastal Plain: This area has one of the biggest challenges with communities being built in, or adjacent to, what was originally the main source of fiber for local pulp and saw mills. The loblolly pine plantations belonging to forest industry that originally covered thousands of acres are rapidly being developed and are now building homes and businesses along with growing trees.

Before the 20th century, fire occurred regularly in some parts of Virginia. Both Native Americans and settlers used fire to clear land and improve habitat for game. Consequently, many of Virginia's original native plants and animals were adapted to, or were even dependent on, fire. Early policies that required wildfires to be extinguished as rapidly as possible have contributed to declines in many of the State's fire-adapted species and natural communities.

Although the use of prescribed fire in resource management is regarded as an indispensable tool for land managers, Smokey Bear's message of preventing unwanted wildfire is still very important. In fact, Smokey understands the need for fire in the management and health of our forest ecosystems.

Conservation of Working Forest Land

In response to declining forest land in the State, the VDOF forest land conservation program was created to protect working forests from development by providing landowners with options for voluntary conservation. Because larger blocks of working forest provide the greatest range of benefits, the conservation program focuses on keeping the forest land intact and unfragmented, protecting the ability of landowners to manage their forest land for timber products and environmental benefits. The agency used geographic information systems analysis to rank all forest land in Virginia based on its contribution to water quality, wildlife habitat, production of forest products, and relative threat of conversion.

VDOF conservation easement deeds contain several elements that are specific to protecting working forests. These include specifying how and when stewardship plans are prepared and updated, location of homes to reduce effects on forest management, and restrictions on converting forests to cropland or pasture.

Demand for donated conservation easements is strong in Virginia because of a generous State tax credit program. The State provides tax credits that are equal to 40 percent of the value of the donated easement and can be sold to other taxpayers. This enables landowners to generate cash for their donations. These credits are also available to landowners who donate land for conservation.

Other than the State tax credit, Virginia has no dedicated funding source for land conservation. As a result, additions to Virginia's State forest system have resulted from private land donations, grant funds, or special allocations of State funds. The VDOF protects about 68,000 acres (27,519 hectares) on 22 State forests.

Tree Production in Virginia

Virginia State Nurseries

VDOF manages two State nurseries within Virginia. The hardwood nursery, known as the Augusta Forestry Center, is located in Crimora, VA, about 20 miles (32 km) west of Charlottesville. Each year the Augusta nursery grows 1.2 million hardwood seedlings across 25 native Virginia species and 1.5 million conifer seedlings (figure 6). The center is also actively involved in helping to restore the American chestnut in Virginia. Seed collected by the American Chestnut Foundation is planted on the nursery for research purposes. The Augusta nursery is also the location of the shipping and packing operation. Each year, seedlings are shipped all over the State via United Parcel Service to Virginia landowners.

Garland Gray Forestry Center is located in Courtland, VA, approximately 25 miles (40 km) southeast of Petersburg. This nursery was built in 1984 specifically for growing loblolly pine (figure 7). The nursery's soil and environmental conditions are perfect for the species, and 20 million loblolly pine seedlings are grown there each year. Since Virginia's forest land base is shrinking, high-quality seedlings are needed to ensure superior performance and adaptability across Virginia's landscape. Virginia seedlings have been tested in the State for

Figure 6. Workers lift red osier dogwood seedlings at the Augusta Forestry Center. (Photo from VDOF, 2007).

Figure 7. Loblolly pine seedling beds at the Garland Gray Forestry Center. (Photo from VDOF, 2010).

performance and, most importantly, cold hardiness. Since Virginia is in the northernmost range of loblolly pine, any seedling planted here has to be adapted to cold weather. The Garland Gray Nursery ensures seedlings meet the cold hardiness criteria needed for specific outplanting sites. Through the use of cultural practices such as root pruning, seedling survival is also enhanced, especially in years where drought is an issue.

Most recently, the Virginia nurseries have contracted to have new inventory management software developed. The new software will use cutting-edge technology so that the business can adapt to the changing environment. Online ordering has now become a normal aspect of any operation that has to sustain itself. Although an online store is currently being used, the new online store will be more enhanced, will allow for more detail, and will be able to accept online orders from tax-exempt customers. This will allow for more transactions by credit, which is another must have for any current business. Nearly two-thirds of the nursery inventory is sold to contractors planting on behalf of the landowners. With this shift in sales, new technology must be in place to track credit accounts and bulk customer activity. This new software will help enhance our service to our customers and Virginia landowners.

Tree Improvement Program

VDOF has supported an active tree improvement research program for more than 50 years. In that time, we have achieved substantial gains in the health and productivity of Virginia's loblolly pine forests and in the potential growth and form of the loblolly pine seedlings we produce. We estimate that every 1-percent gain in productivity as a result of tree improvement and selection has a $14.5 million effect on Virginia's economy each year. Since we are now providing seedlings with as much as a 62-percent gain in productivity, the financial effect on our State is clearly substantial.

Tree improvement research is based on a simple premise: select individual trees with the most desirable traits (such as growth rate, straightness, wood quality, branching characteristics, or disease resistance) and then use their flowers, pollen, and seed for breeding future generations of nursery stock (figure 8). Before tree improvement, loblolly seeds were collected from unimproved, natural stands—mostly from trees felled during logging operations.

Because Virginia lies at the northern limit of loblolly pine's natural range, Virginia's selections are especially valuable to our forest landowners. Numerous selections from farther south showed good early growth in tests only to suffer high damage or mortality when exposed to their first cold temperatures, snow, or ice events. In addition, the graders who have made selections in Virginia have rigorously focused on tree form, so our selections have a unique combination of rapid growth and excellent straightness and branching characteristics.

Diminished Species Restoration

VDOF monitors the status of numerous currently or potentially diminished tree species, such as Atlantic white cedar, eastern hemlock, butternut (*Juglans cinerea* L.), ash, walnut, and others. Depending on the ecological or economic (or both) importance of the species and the opportunities for successful action, we then develop strategies and programs, such as grafting (figure 9), for restoration. Our three current programs relate to American chestnut, longleaf pine, and shortleaf pine.

Figure 8. Controlled pollination of loblolly pine at the New Kent Forestry Center. (Photo from VDOF, 2009).

Figure 9. Pine-grafting by hand is one strategy for restoring diminished species. (Photo from VDOF, 2006).

American Chestnut

In 1969, Dr. and Mrs. Arthur Valk of Wilmington, DE, deeded 420 acres (170 hectares) of land in Nelson County, VA, to the VDOF to be used for American chestnut research. The tract was named the Lesesne State Forest after Mrs. Valk's father, Archibald Marian Lesesne DuPont. Research there focuses on hybridization with other blight-resistant chestnut species (in cooperation with the American Chestnut Foundation) and breeding of survivors and hypovirulence (both in cooperation with Dr. Gary Griffin with the American Chestnut Cooperators' Foundation).

Two orchards have been established: one is a pure American chestnut orchard grafted from surviving trees throughout Virginia and the other is a hybrid orchard of American chestnut and Chinese chestnut (*Castanea mollissima* Blume) established in cooperation with, and using seedlings from, the Connecticut Agricultural Experiment Station.

Today, we have a number of 15/16th (93.75 percent American chestnut; 6.25 percent Chinese chestnut) American chestnut seedlings from this work, and we continue to develop more. The 15/16th trees will be crossed with other 15/16th trees. A small percentage of their offspring should be chestnut blight resistant with the phenotype of the pure American chestnut tree. This cross could be 10 to 20 years away at the current rate the VDOF program is progressing. VDOF does not currently sell any hybrid or native American chestnut seeds or seedlings; all progeny from these efforts are used for further research and demonstration. If the American chestnut research is ultimately successful, VDOF could begin selling these seedlings and restore this tree to its native habitat.

Longleaf Pine

Native longleaf pine has almost completely disappeared from the Virginia landscape. When Virginia was first settled by Europeans, the lands mainly south of the James River were covered by 1.0 to 1.5 million acres (between 405,000 and 607,000 hectares) of longleaf pine forests at the limit of the species' northern range. Those forest ecosystems were very diverse biologically and served as valuable sources of naval stores (tar and pitch) for use in ship building, open range for livestock, and high-quality timber. But changing land-use practices such as fire exclusion, land clearing, feral pig grazing, and replacement by other pine species in reforestation programs, caused the longleaf forests of Virginia to decline and virtually disappear.

Although viable numbers of the species remain in portions of its native range to the south, only a few hundred mature longleaf trees currently remain in Virginia. We are actively involved in the identification, protection, and production of seed from that remaining genotype—activities that have become top priorities for our restoration effort.

Shortleaf Pine

Shortleaf pine has the widest range of any pine in the Southeastern United States, and occurs statewide in Virginia except on the Eastern Shore. It has long been a major forest component for much of Virginia. Before European settlement, Virginia's forests were significantly affected by the use of fire by Native Americans. Shortleaf pine's moderately thick bark and ability to resprout after top-kill allowed it to survive in this landscape. The land clearing, disturbance, and land abandonment regime associated with settlement was also favorable for shortleaf pine establishment.

In the decades before 1940, subsistence and tobacco-based agriculture in Virginia were still common. In the decades after 1940, however, Virginia saw increases in industrial development, movement away from subsistence farms, population shifts to urban/suburban areas, development of industrial forestry based on loblolly pine, and great reduction in acres burned by wildfire. Because of these factors, natural shortleaf pine regeneration declined.

In many areas across Virginia, shortleaf pine now occurs only as an occasional remnant tree in older stands or along property lines and has little regeneration. A real danger exists that the species will be lost from the landscape in these areas. We grow, sell, and encourage the planting of shortleaf pine. Our intent is to maintain or re-establish this species in the landscape in its natural range as a viable silvicultural option to offer to landowners.

Tree Planting Programs

Loblolly pine is by far the most widely planted tree species within the Commonwealth of Virginia. Although the species is only planted east of the Blue Ridge Mountains, it still accounts for approximately 90 percent of the total acres reforested within the State annually. The species is highly adaptable to a variety of soil types—from highly infertile Piedmont clay to well-drained sandy loams in the Coastal Plain. With the eastern and south central parts of the State being located within the "wood basket" of the Southeast, many opportunities are available for forest landowners to profit from growing timber. Education has been the key to success regarding increased tree planting in Virginia. Programs developed by VDOF and workshops held by Virginia Cooperative

Extension have raised landowner awareness about the issues surrounding forestry and the need for sound forest management. Private landowners control approximately 80 percent of the State's forest land, making this an important focus area.

Several cost-share programs within the State offer open field planting for landowners who have lost production in their agricultural fields and wish to convert to forest land. Although we are losing 16,000 acres (6,475 hectares) of forest land per year to urbanization, as foresters we are still able to replace a fraction of this loss by using these opportunities. In 2011, approximately 2,000 acres (810 hectares) were planted in trees and converted from agriculture to forestry land use (IFRIS data). In addition, nearly 750 acres (305 hectares) of pasture land bordering streams were planted in various hardwood species. Most landowners converting land to forest use have chosen to plant loblolly pine. Although it is impossible to revert from development, anytime we can change a land use to forestry, we are improving our State as a whole by adding the much-needed benefits that forests provide.

Over the past 5 years, eastern white pine (figure 10) and hardwood planting has been in decline. White pine planting has been affected mostly by a decrease in demand for use as Christmas trees and for interior trim. The most highly prized Christmas tree is Fraser fir (*Abies fraseri* [Pursh] Poir.). These trees are grown in southwestern Virginia and transported all over the State for reasonable costs. Hardwood planting decline results from high planting costs and the nature of the species. The cost of planting hardwoods in Virginia can exceed $500 per acre, while the average cost of planting loblolly pine is around $75 per acre. Furthermore, rotation age of hardwood species is at least double that of an average loblolly pine stand. Of the Virginia landowners planting hardwoods, most are doing so for streamside buffers, field borders, and for wildlife habitat enhancement.

Figure 10. Collecting cones from white pine trees. (Photo from VDOF).

Growing trees is, by its very nature, a long-term investment for forest landowners, with its economic returns not being realized for many years. For this reason, cost-share assistance for reforestation is critically important to many landowners. These programs are summarized in the following sections.

State-Funded Programs

Virginia's Reforestation of Timberlands Program is the flagship cost-assistance program. Created in 1970 by the General Assembly, the program's purpose is pine reforestation. It is funded by a forest products tax of primary wood processors and State general funds. Site preparation, tree planting, and followup competition control are practices available through the program. Landowner reimbursement is based on a flat rate, averaging about one-third of the cost. To date, the program has assisted with planting or stand improvement for more than 41,000 projects on 1.5 million acres (607,402 hectares).

The Southern Pine Bark Beetle Prevention Program assists landowners with focused practices designed to foster healthy pine forests. Although administered by the VDOF, source funding comes from the U.S. Department of Agriculture (USDA), Forest Service, State and Private Forestry. The program assists private landowners with reforestation practices for beetle-resistant longleaf pine in southeastern Virginia as well as precommercial pine thinning and commercial pine thinning of smaller (less than 25 acres [10 hectares]) pine stands.

Federally Funded Programs

Virginia landowners benefit from numerous USDA programs, including the Environmental Quality Incentive Program (EQIP), administered by the Natural Resources Conservation Service, and the Conservation Reserve Program and Conservation Reserve Enhancement Program (CRP and CREP), offered through the Farm Service Agency.

Private and Regionally Specific Programs

Several private companies (Vaughan-Bassett Furniture, Plow and Hearth, Glatfelter Pulp Wood, and Belfort Furniture) recognize the benefit of trees in Virginia and have funded seedling programs. These companies partnered with VDOF to distribute pine or hardwood seedlings to landowners to improve the sustainability of Virginia's forests. In recent years, new opportunities for assistance have emerged. These have specific scope, purpose, and funding streams and provide assistance to landowners for traditional and new

forestry practices. The Tomorrow Woods program, Forests for Southwest Virginia, and Forests to Faucets are examples of these partnerships.

The Future of Tree Planting in Virginia

Virginia nurseries have increased inventory and have experienced an increased demand for seedlings over the past 2 years (figure 11). If the past 5 years of economic conditions are an effective indicator of future sales, however, it appears we could be headed back down again because the future of planting is mostly correlated with the number of acres harvested annually. As long as timber is being removed from the landscape, tree planting will occur in rural Virginia. It appears that the state of the economy has had the opposite effect on forestry than most of us would have predicted.

Virginia Dominion Power has introduced several waste-wood-powered plants across Virginia. Because most of the fuel used at these plants is waste wood that would normally be left on the logging site, this additional revenue stream presents opportunities for forest landowners to increase their returns. The more options landowners have to make money, the more likely they are to continue with good forestry practices, such as tree planting.

USDA Forest Service programs have helped subsidize expensive wildlife management planting projects for Virginia landowners. Hardwood planting has the potential to increase

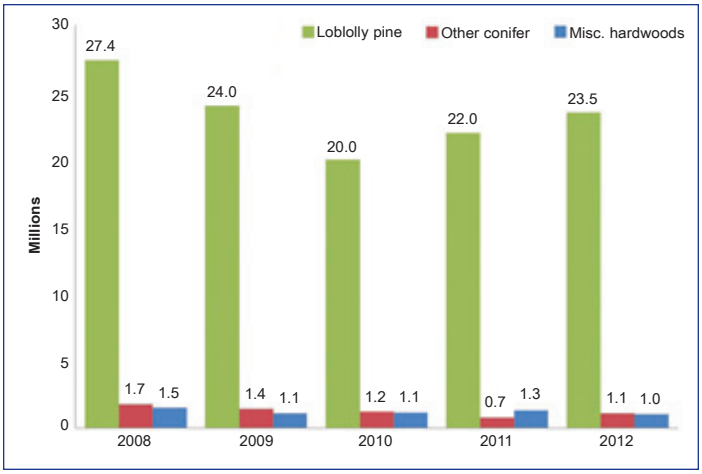

Figure 11. Virginia nursery seedling sales during the past 5 years. (Data source: VDOF, 2012).

over the next few years if these programs stay intact and are provided to the right audience. As with all forestry professionals, we must stay positive and react appropriately and aggressively to the changes around us.

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References

Bailey, C.M. 1999. Physiographic map of Virginia. College of William & Mary, Department of Geology. http://web.wm.edu/geology/virginia/provinces/phys_regions.html. (23 July 2012).

Hayden, B.P.; Michaels, P.J. 2000. Virginia's climate. Charlottesville, VA. University of Virginia Climatology Office. http://climate.virginia.edu/description.htm. (23 July 2012).

Miles, P.D. 2012. Forest Inventory EVALIDator Web-application version 1.5.00. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station. http://apps.fs.fed.us/Evalidator/tmattribute.jsp. (23 July 2012).

U.S. Department of Agriculture (USDA), Forest Service, Forest Inventory and Analysis (FIA). 2010. Forest Inventory Data Online (FIDO). http://apps.fs.fed.us.fido/. (26 July 2012).

Virginia Department of Forestry (VDOF). 2011. 2011 State of the forest report. Charlottesville, VA. 22 p. http://www.dof.virginia.gov/resources/pub-2011-State-Of-Forest.pdf. (23 July 2012).

Additional Reading

Becker, C.W. III. 2006. Virginia's forests—our common wealth. Charlottesville, VA: Virginia Department of Forestry. 24 p.