The State of Penn's Woods

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Abstract

Pennsylvania has a legacy of rich forest resources. During the late 1800s, Pennsylvania supported the Nation's largest lumber industry, which led to overharvesting, uncontrolled wildfires, and heavy soil erosion. The Pennsylvania Legislature authorized a Forestry Commission and Forest Reserve System in 1897 to rehabilitate the State's decimated forest and water resources. In 1902, the agency's first forest nursery at Mont Alto produced more than 10,000 eastern white pine seedlings. This organization evolved into today's Department of Conservation and Natural Resources with a Bureau of Forestry (BOF) and Bureau of State Parks managing 2.2 million ac (890,000 ha) of State forest lands and 120 State parks. Annual seedling production peaked in 1950 with three BOF nurseries distributing more than 29 million seedlings. Additional public and private nurseries produced millions more. Today, the State has 16.6 million ac (6.7 million ha) of predominantly Appalachian oak and northern hardwood forests, making this combination the dominant land cover across the entire 28.7 million ac (11.6 million ha) of the State. Of the original four State nurseries, Penn Nursery is the only BOF nursery still operating; it provides in excess of 1 million seedlings of more than 40 different Pennsylvania native species to State forest and park lands for reforestation, diversity, water quality protection, and wildlife habitat. Penn Nursery also manages 22 tree-improvement seed orchards, which include a variety of hardwood and conifer species.

Introduction

Pennsylvania means "Penn's woods." The State's name combines the name of the colonial founder William Penn with the Latin word for woods—*silva*.

Pennsylvania's location, landforms, and climate favor the development of mixed hardwood forests statewide. Its 44,820 mi^2 (116,080 km^2) of land area rise in elevation from sea level on the Atlantic Coastal Plain near Philadelphia and climb north and westward to the Allegheny Plateau and Laurel Highlands. The highest point is 3,213 ft (980 m) on Mount Davis in Somerset County. From that point, the plateau slopes downward to the Ohio River basin to the west and Lake Erie to the northwest.

The statewide annual precipitation averages 41.2 in (105 cm). The central counties in the rain shadow east of the Allegheny Plateau are slightly drier than the eastern and western borders.

Prehistoric pollen deposits indicate that this region supported tundra and spruce woodlands as the last glaciations ended 14,000 years ago. About this time, the first people to explore Pennsylvania left stone spear points and scrapers in rock shelters and seasonal campsites across the postglacial landscape. Over the next several thousand years, the climate warmed. New tree species —oaks, chestnut, hickories, pines, and hemlocks—migrated north, providing a wealth of new forest resources. The descendants of hunter-gatherers developed village life and subsistence agriculture.

European settlers arriving in the 1600s described the land as primarily forested but broken by rivers, wetlands, natural barrens, and Native American village clearings. "Indian fields" were kept open, using fire to manage the landscape. Forests covered more than 90 percent of Pennsylvania's 28.7-million-ac (11.6-million-ha) land area.

The newcomers' consequent use of forest resources dramatically changed the land cover of Pennsylvania. European Americans cleared the southeastern counties for agriculture and urban settlements. In the 1760s, tall, straight eastern white pines (*Pinus strobus* L.) suitable for ship masts were harvested in large quantities from northeastern Pennsylvania counties and rafted down the Delaware River to Philadelphia. Harvests of lumber, fuelwood, charcoal, tannins, and wood chemicals reduced the forest area from southeast to northwest as settlement spread farther from the Coastal Plain.

Pennsylvania's location linked the waterways of the Great Lakes and Ohio River with the Atlantic seaports on the Delaware River. The State became a center of early urbanization and industrialization. For a brief period between 1870 and 1880, Pennsylvania had the Nation's largest lumber industry centered around Lock Haven, Jersey Shore, and Williamsport on the Susquehanna River. Steam sawmills turned massive quantities of mixed hardwoods, eastern white pine, and Canadian hemlock (*Tsuga canadensis* [L.] Carrière) into furniture, barrel staves, shingles, window sashes, door framing, and other construction lumber. Rough timber became

railroad ties and props for the roofs and walls of coal mines. Wood chemical factories produced methanol, acetate lime, wood alcohol, and tannic acid.

When settlers cut large numbers of trees, they left behind piles of unusable slash. As a result, millions of acres burned in uncontrolled fires. Fire became increasingly destructive in the remnants of cut forests and spread into standing forests. By 1895, much of Pennsylvania's woodlands had been reduced to stumps and ashes (figure 1). In that year, the State established what has become today's Department of Conservation and Natural Resources (DCNR), Bureau of Forestry (BOF) to develop a fire protection program and acquire land for reforestation and watershed protection.

Figure 1. Eroded hillside in Potter County, PA. (Photo from Pennsylvania Department of Conservation and Natural Resources, 1918)

In 1900, Pennsylvania had 224,000 farms, although 55 percent of its 6.3 million inhabitants lived in cities and towns. Industrial timber harvesting and agricultural land clearing had diminished the forest land base to only 9.2 million ac (3.7 million ha), about 32 percent of the State's land area. Because most of the population shifted from rural to urban areas, abandoned farmland reverted to forest. Forest acreage increased steadily through the 20th century as trees reclaimed old fields. Forest cover increased in every inventory conducted from the 1930s through the 1980s. Pennsylvania's current forest cover of 16.6 million ac (6.7 million ha) is the dominant land cover, at 58 percent of the total State area.

The most recent forest inventory data show large, contiguous patches of forest extending across the Allegheny Plateau in the north-central portion of the State (figure 2). In central Pennsylvania, forest land distribution follows the topographical contours of the ridges that divide agricultural valleys. Smaller, more fragmented blocks of forest land occur in more urban and agricultural regions, especially across the southern-tier counties.

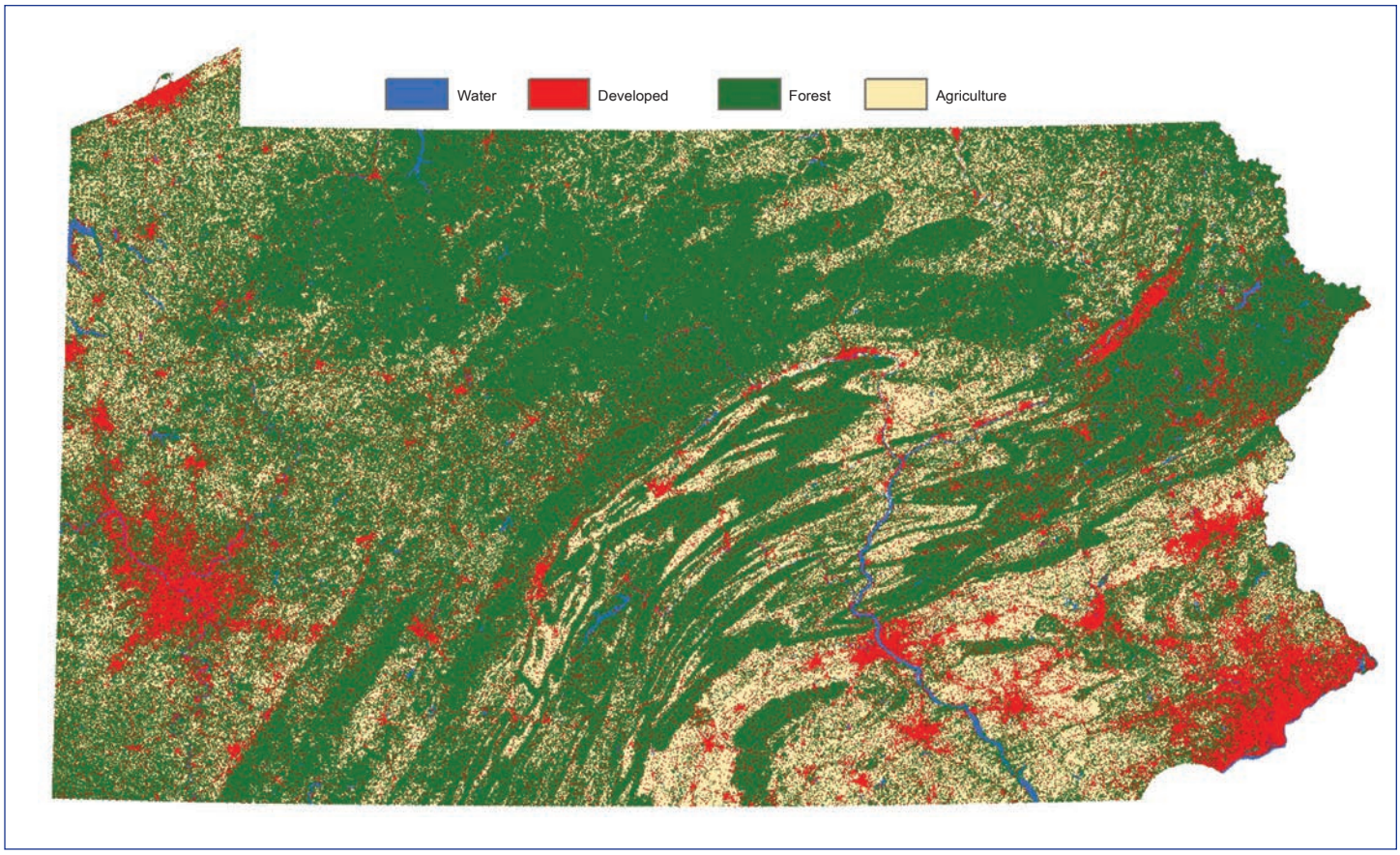

Figure 2. Forest land cover in Pennsylvania. (Data source: National Land Cover Dataset, 2006)

Statewide, Pennsylvania's net forest acreage is stable. More than 660,000 ac (267,000 ha) of forest land were lost from 1989 to 2004, mostly to residential or industrial development. Over the same period, however, a 617,500-ac (250,000-ha) gain was made, largely from reforested agricultural land (McWilliams and others 2004). More than one-half of the forest land in the State is privately owned by families and individuals (figure 3). Most of the 4.8 million ac (1.9 million ha) of public forest land is in State forests, State game lands, State parks, and municipal watersheds. Federal forests are limited to 611,100 ac (247,300 ha), mostly in the Allegheny National Forest.

Pennsylvania's 20 State forest districts comprise 2.2 million ac (890,300 ha) managed by the DCNR BOF. These forests amount to 13 percent of the State's total land area. The Pennsylvania State Forest System is one of the largest certified as "well managed" by third parties under the Forest Stewardship Council standards.

The 10 most abundant tree species by volume cataloged by the ongoing U.S. Department of Agriculture (USDA), Forest Service Forest Inventory and Analysis program are red maple (*Acer rubrum* L.), black cherry (*Prunus serotina* L. Ehrh.), northern red oak (*Quercus rubra* L.), sugar maple (*A. saccharum* Marshall), chestnut oak (*Q. montana* L.), Canada hemlock (*Tsuga canadensis* [L.] Carrière), tuliptree (yellow-poplar) (*Liriodendron tulipifera* L.), white ash (*Fraxinus Americana* L.), white oak (*Q. alba* L.), and sweet birch (*Betula lenta* L.). The most extensive forest type classifications are mixed oak, sometimes called Appalachian oak, and northern hardwoods.

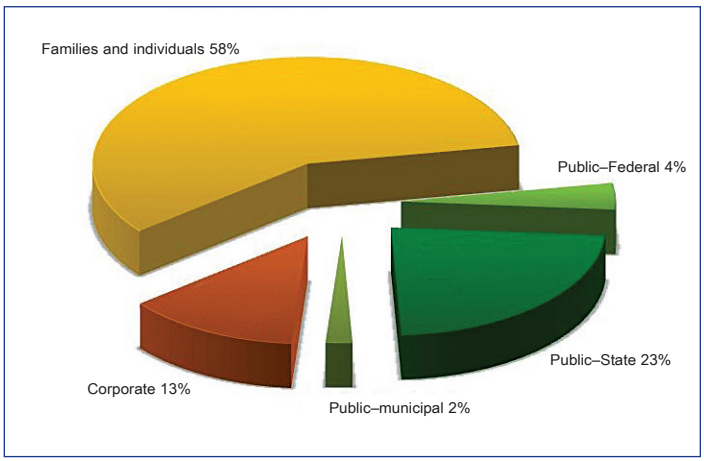

Figure 3. Pennsylvania forest land ownership. (Data source: Pennsylvania's Forest, 2004)

Replanting Penn's Woods

At the turn of the 20th century, demand boomed to acquire lands in Pennsylvania for reforestation. Political leaders recognized the necessity to restore productive conditions to land rendered unproductive by removal of the original forest cover (Rothrock 1902).

On May 25, 1897, Governor Daniel H. Hastings formed the Forestry Commission, headed by Joseph T. Rothrock (figure 4), to purchase land for Pennsylvania's new Forest Reserve System and to protect and manage those lands. As its responsibilities changed over the next century, this agency would be called the Department of Forestry, the Department of Forests and Waters, and, most recently, the DCNR BOF. In this historical narrative, we simply refer to "the agency."

Rothrock recognized the need to plant trees as part of rehabilitating the land. Before 1901, seedlings were purchased from private nurseries for planting on the forest reserves. Seedling demand outpaced availability, however. State Forester George Wirt, influenced by nurseries he had seen in Germany, established the first State-run forest tree nursery in Mont Alto, PA. Land was cleared in 1902, 6 lb of eastern white pine seed was sown, and 10,000 white pine seedlings

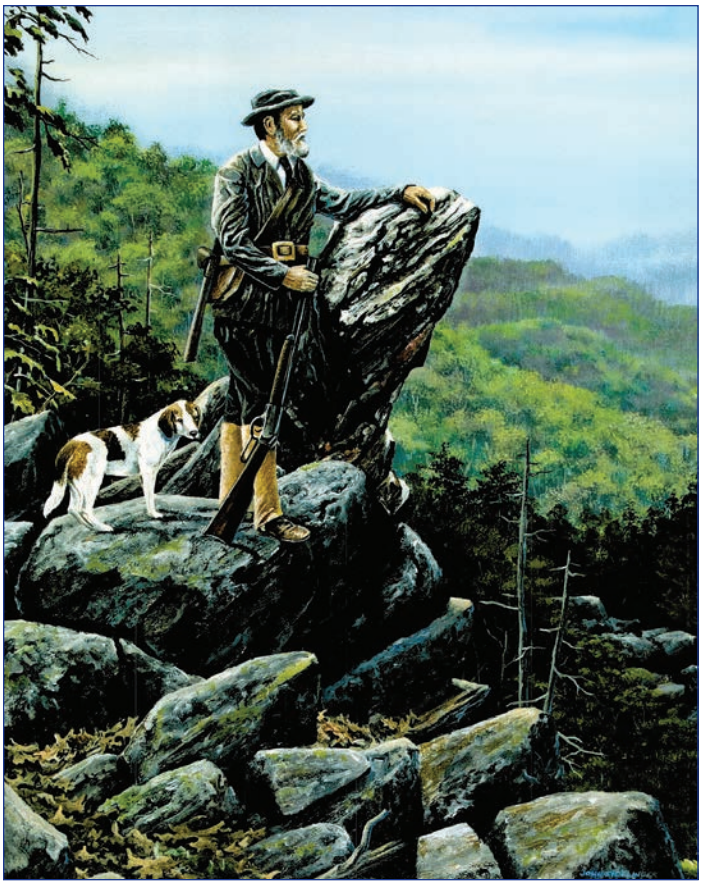

Figure 4. Joseph T. Rothrock, an early leader in Pennsylvania's reforestation efforts. (Painting by John Sidelinger, 2005)

from a private nursery were transplanted into nursery beds (Wirt 1902). The nursery size increased as demand for planting grew (figures 5 and 6).

Additional nurseries were developed to keep pace with demand for planting stock. By 1907, the agency managed three large nurseries with a combined annual production of 2.25 million seedlings. The State legislature authorized distribution of trees to farmers and private landowners with the passage of Public Law 115 in April 1909. Eastern white pine, Scots pine (*Pinus sylvestris* L.), European larch (*Larix deciduas* Mill.), Norway spruce (*Picea abies* L.), and balsam fir (*Abies balsamea* [L.] Mill.) were produced, along with a small amount of oak and hickory. Seedling production costs of $3.11/thousand, which were considered outrageous at the time, were due to the initial startup costs of land clearing, fencing, and labor (Conklin 1907).

Figure 5. Workers covering seed at Mont Alto Nursery in the 1950s. (Photo from Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry, year unknown)

Figure 6. Workers lifting seedlings at Mont Alto Nursery in the 1950s. (Photo from Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry, year unknown)

Wirt supported the idea that each forest reserve would benefit from having a local nursery. By 1915, the agency operated as many as 50 "ranger" nurseries, so named because, in general, the ranger in charge of the reserve also served as nursery manager. Nearly all these ranger nurseries closed by 1920 when World War I resulted in a lack of available nursery personnel. Demand for seedlings was still high, however, so cooperative agreements with local State institutions and asylums were formed to establish 12 cooperative nurseries. The hope was that these nurseries would produce seedlings at low cost and provide healthful employment for inmates. Because of a lack of forester supervision, the effort was not successful, and all the nurseries were closed within a few years, except for the Western Penitentiary Nursery at Rockview, which still operates today (Meek 1936).

During the 1930s, tree planting again increased significantly when Pennsylvania became home to 113 Civilian Conservation Corp (CCC) camps. The CCC, authorized by President Franklin D. Roosevelt, brought relief to a Nation reeling from the effects of the 1929 stock market crash and subsequent depression. CCC workers in Pennsylvania made extensive improvements to the State forest and park systems—building roads, erecting facilities, and planting millions of trees—until the program ended with the start of World War II.

By 1935, the agency managed four nurseries: Mont Alto, Dague, Greenwood, and a smaller transplant nursery called Penn Nursery. This small but efficient ranger nursery had a humble beginning in a potato patch behind Ranger George L. McKinney's home on the Seven Mountains Reservation (figure 7). Penn Nursery operated as a transplant nursery, providing larger conifer and shade trees for roadside

Figure 7. George L. McKinney served as a ranger on the Seven Mountains Reservation and operated a nursery behind his home. (Photo from Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry, year unknown)

beautification of Pennsylvania's highways until 1928, when the Highway Department started its own nursery in Milton, PA (figure 8).

Penn Nursery has repeatedly adapted to changing demands and still provides high-quality planting stock for State, Federal, and private lands. Concurrently, Pennsylvania's original Forest Reserve System has grown to more than 2 million ac, forming today's Pennsylvania State Forest and Park Systems (figures 9 and 10).

Pennsylvania State Nurseries

The DCNR BOF has distributed hundreds of millions of seedlings to many organizations, agencies, and companies since 1899 (figures 11 and 12). As the agency's only forest tree nursery, Penn Nursery produces more than 1 million seedlings annually from more than 40 different Pennsylvania native species. The nursery distributes these seedlings to State forest and park lands for reforestation, diversity, water-quality protection, and wildlife habitat.

Figure 8. Workers line up seedlings in transplant boards for planting at Penn Nursery. (Photo from Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry, year unknown)

Since the establishment of DCNR nurseries, staff members have collected seed and distributed seedlings within the same genetic conservation zone whenever possible (figure 13). Each seed lot is assigned a number, which includes information

Figure 9. Workers lifting seedlings at Penn Nursery. (Photo by Tina Alban, Penn Nursery, May 2007)

Figure 10. Workers sowing acorns at Penn Nursery. (Photo by Tina Alban, Penn Nursery, April 2008)

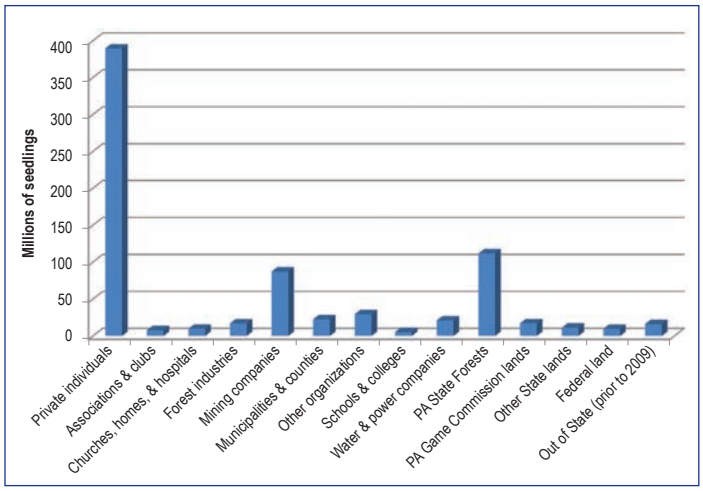

Figure 11. DCNR BOF seedling distribution by classification of planter, 1899–2012. (Data source: Penn Nursery, 2012)

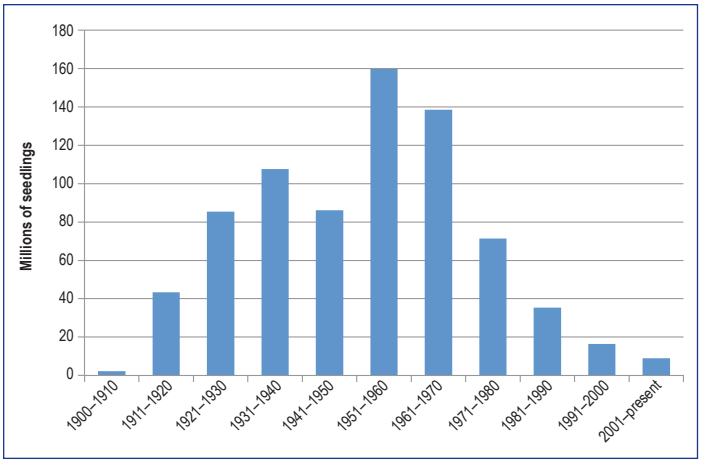

Figure 12. Seedlings distributed by DCNR BOF nurseries. No seedling production figures for other nurseries in Pennsylvania were available. (Data source: Penn Nursery, 2012)

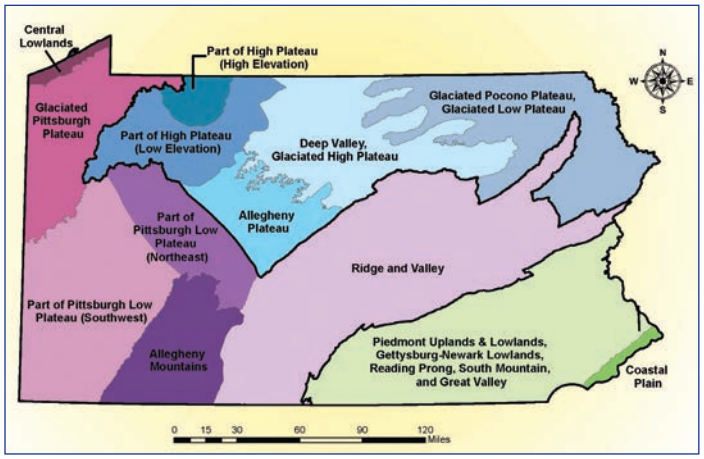

Figure 13. Plant genetic conservation zones of Pennsylvania. (Data source: Pennsylvania Department of Conservation and Natural Resources, 2007)

about its genetic zone of origin. The seed lot number remains with that seed until it is permanently established on public lands as a seedling. In addition to managing local seed collection, Penn Nursery maintains 22 tree-improvement seed orchards established by BOF forest geneticists and through cooperative projects with the USDA Forest Service and universities.

Another successful State government nursery is Howard Nursery, managed by the Pennsylvania Game Commission (PGC). In 1939, this nursery was established in Howard, PA, by the USDA and managed by the Soil Conservation Service. By 1947, the USDA had leased the nursery to Pennsylvania's BOF to produce planting stock for distribution to landowners for reforestation and farm woodlots. The PGC took over the lease in 1954 and, a few years later, the land was permanently transferred to the PGC. The Howard Nursery currently produces 2.3 million seedlings of more than 50 different species, including those that produce the most desirable food and cover for wildlife, with an emphasis on native species.

The nursery distributes PGC seedlings for planting on State game lands and private lands enrolled in Farm-Game, Forest-Game, and Safety Zone cooperator programs. It also distributes seedlings to other State agencies, schools, Boy Scouts, Girl Scouts, and other private-property owners.

A third State-owned nursery, operated by the Department of Corrections at Rockview, provides meaningful vocational training opportunities for inmates. Inmates can develop vocational skills in planting, transplanting, pruning, irrigating, fertilizing, and integrated pest management for the production of trees and shrubs. Rockview favors production of species native to Pennsylvania, although not exclusively. The nursery also has a greenhouse component in which inmates can sow a variety of annual flowers for bedding plants, hanging baskets, planters, and window boxes. Rockview propagates poinsettias, Easter lilies, chrysanthemums, and other seasonal flowers. Nursery products are used by the State Correctional Institution and other State agencies.

Current Tree Planting Programs and Challenges in Pennsylvania

Pennsylvania is rich in forest and park lands, and it is also rich in mineral resources, including coal, both bituminous and anthracite. Mining's destructive impacts on the land were widespread long before the Pennsylvania Legislature acted to regulate mining activity in the mid-1940s. Legislation passed in the early 1960s and 1970s provided further environmental protections and encouraged tree planting as a long-term, permanent cover to reclaim surface mine sites. In 1986 alone, the DCNR BOF shipped more than 2.5 million seedlings for surface mine reforestation. This figure is only a fraction of the seedlings produced for mineland reforestation by other State and private nurseries. In addition, the Department of Environmental Protection, Bureau of Abandoned Mine Reclamation provided funding between 1984 and 1995 to the DCNR BOF to plant trees on orphaned mine sites, resulting in more than 3 million seedlings being established on reclaimed areas (figure 14). During the past decade, use of seedlings has declined in favor of direct sowing of tree, shrub, and herbaceous seed directly onto orphaned mine sites. Direct sowing may be more cost effective, but the extent of successful reclamation has yet to be fully evaluated.

Other programs, such as the Appalachian Regional Reforestation Initiative and the creation of habitat for the endangered Indiana bat (*Myotis sodalis* Miller & Allen), encourage hardwood tree planting in addition to traditional regulatory plantings (figure 15).

Figure 14. Planting on strip mine near Dubois, PA. (Photo by Tina Alban, Penn Nursery, April 1994)

Figure 15. Northern red oak (*Quercus rubra*). (Photo by Tina Alban, Penn Nursery, October 2012)

The DCNR BOF cooperates with the USDA Natural Resources Conservation Service (NRCS) to assist private forest landowners with tree planting for a variety of purposes, including agroforestry, wildlife habitat, riparian buffer establishment, and native forest restoration. Planting projects are accomplished through technical assistance and Federal incentive program funding via the BOF's foresters and NRCS field staff.

Several commercial reforestation contractors working in Pennsylvania agree that large-scale, bareroot reforestation plantings have declined in the past decade. Although area plantings still occur, the number of acres being reforested has decreased. This decline may be due to the fact that many goals of the Conservation Reserve Enhancement Program (CREP) have been met and enrollment of new land has declined. Riparian buffer plantings have dominated planting contracts. Some report that changes in Federal laws regarding prevailing wages and securing laborers also present a challenge by increasing business costs.

In addition to CREP, the Wildlife Habitat Incentive Program and Environmental Quality Incentive Programs through NRCS, along with the Chesapeake Bay Foundation promotion of riparian buffer plantings, create demand for seedlings. Riparian buffers are also encouraged by the TreeVitalize Program, a broad-based, public-private partnership to encourage tree planting in communities across the State. To date, the program has established more than 340,000 trees since 2004. These plantings consist of seedlings for riparian buffers and large caliper trees for city streets, parks, and other public properties. The program also includes a rebate incentive for homeowners to purchase large caliper trees for planting on private property. Shrinking Federal and State grant monies are also affecting nonprofit groups.

Large-scale, bareroot tree planting may have declined, but tree planting overall during these economically challenged times remains strong across the State. Increases in educational programs to promote awareness of the importance of trees and technical assistance to private landowners continue to sustain demand for seedlings. Interest in planting trees for biomass fuels is also increasing. Willow (*Salix* spp.), poplar (*Populus* spp.), and alder (*Alnus* spp.) are a few of the species for which demand may increase for use as fuels (figure 16).

Forest tree mortality from exotic pests, such as gypsy moth (*Lymantria dispar* L.), emerald ash borer (*Agrilus planipennis* Fairmaire), and hemlock wooly adelgid (*Adelges tsugae* Annand), continue to threaten the health of Penn's woods. White-tailed deer (*Odocoileus virginianus* Zimmermann) and invasive exotic plants, including oriental bittersweet

Figure 16. Planting by Williams Forestry & Associates, Canton, PA. (Photo by Justin Ulanoski, Williams Forestry & Associates, spring 2011)

(*Celastrus orbiculatus* Thunb.), Japanese barberry (*Berberis thunbergii* DC.), Japanese honeysuckle (*Lonicera japonica* Thunb.), and Japanese stiltgrass (*Microstegium vimineum* [Trin.] A. Camus), make successful seedling establishment a challenge.

In recent years, many industrial forest products companies in Pennsylvania divested their timber- and pulp-producing lands. Although many acres were purchased by the State and other conservation organizations, most lands were bought by timber investment management organizations to be managed as commercial timber land.

Future impacts, such as climate change and invasive exotics, are uncertain, but Pennsylvania nurseries will be ready to shift seedling species and quantities to accommodate new changes.

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Acknowledgments

The authors thank the following people for taking time to answer our many questions and to provide maps and photos.

- James Finley, Ph.D., Ibberson Chair in Forest Resources Management, The Pennsylvania State University.
- Jim McKenzie, President, Octoraro Native Plant Nursery and Board Chair of the Pennsylvania Landscape and Nursery Association.
- Mark Odenthal, Mining Permit and Compliance Specialist, Pennsylvania Department of Environmental Protection (DEP), Bureau of District Mining Operations.
- Brian Bradley, Environmental Program Manager, Pennsylvania DEP, Bureau of Abandoned Mine Reclamation.
- Justin M. Ulanoski, Manager, Northeast Operation, Williams Forestry, Millville, PA.
- Shawn Lehman, Forest Biometrician, Pennsylvania Department of Conservation and Natural Resources (DCNR), Bureau of Forestry.
- Annetta Ayers, Nursery Manager, Pennsylvania Game Commission, Howard, PA.
- Geoff Ellison, President, Drennen Forestry, Cullman, AL.
- Joe Petroski, Chief, Geospatial Applications, Pennsylvania DCNR, Bureau of Forestry.
- Tammy Marks, Administrative Assistant, Penn Nursery and Wood Shop, Spring Mills, PA.
- Alex Day, Retired, Forest Nursery Operations Manager, Penn Nursery and Wood Shop, Spring Mills, PA.

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