Forest Service Nurseries: 100 Years of Ecosystem Restoration

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ABSTRACT

The USDA Forest Service broke ground on its first nursery in 1902 and since then its nurseries have adapted to many changes in scope and direction: from fire restoration to conservation, to reforestation, and back to restoration. In addition to providing a reliable source of native plant material, they have also been a source of research and technology transfer in seedling production and quality. Today, Forest Service nurseries face difficult times due to sharp declines in reforestation seedling orders, but strive to respond to increased demand for a wide variety of native plants for ecosystem restoration.

Keywords: nursery, forest restoration, seedlings, reforestation

For more than 100 years, USDA Forest Service nurseries have been growing plants to restore America's forests, protect watersheds, and conserve soil. These nurseries helped America climb out of the Great Depression and advanced the science of afforestation and reforestation. As national policies shift from timber production to ecosystem restoration, Forest Service nurseries are adapting to their new mission. Here we take a brief look back at the birth of the national forest nursery system and its role during four distinct eras, the science and technology that emerged from these facilities over time, and the current role and challenges the national nurseries face in an era of ecosystem restoration.

Four Nursery Eras

Restoration Response: 1900s to 1930s. The first Forest Service nursery, Halsey Nursery in Nebraska, opened in 1902 to provide seedlings for afforestation of the Nebraska Sandhills. It was renamed in 1915 to honor Charles E. Bessey, a professor of botany and horticulture at the University of Nebraska, who along with other early environmentalists like Dr. Bernhard Fernow, Chief of the Division of Forestry in Washington, DC, and Gifford Pinchot, first Chief of the Forest Service, were driving forces in establishment of federal nurseries. The Organic Act of 1897 opened the door for nursery development, and Bessey Nursery was followed by Higgins Lake in Michigan (1903), Monument in Colorado (1907), Savenac in Montana (1908), and Wind River in Washington (1909). All these nurseries had the primary objective of growing seedlings to stabilize soils and protect watersheds after large fires and indiscriminate harvesting (Figure 1). In addition to resource protection, these nurseries had secondary goals of growing commercial timber species and testing of exotic hardwoods.

Conservation and Jobs Creation: 1930s to 1950s. Many more Forest Service nurseries, such as Vallonia in Indiana, Hayward in Wisconsin, Licking in Missouri, Stuart in Louisiana, and Oakes in North Dakota, were opened during the Great Depression (Figures 2 and 3). These nurseries were needed to meet the goals of President Franklin D. Roosevelt's Emergency Conservation Work Act of 1933. This act enlisted America's unemployed men to mitigate the effects of soil erosion and widespread decline of timber resources. Commonly known as the Civilian Conservation Corp (CCC), these 3 million men were responsible for many natural resource projects, including the planting of about 3 billion seedlings between 1933 and 1942 (Figure 4). Although many of these facilities subsequently closed during World War II, others were converted into regional nurseries to meet demand for reforestation seedlings during the postwar boom in timber harvest. A few, including Vallonia, Hayward, and Licking, were transferred to state forestry organizations and still produce seedlings for state programs.

Responding to the Public's Demand for Timber: 1950s to 1990s. The nation's postwar demand for timber caused timber harvest on National Forests to increase from 3 bbf (billion board feet) in 1950 to 12 bbf by 1965. Forest Service nurseries were instrumental in providing source-identified and locally adapted tree seedlings for reforestation of public lands. Improved nursery mechanization helped meet demand (Figure 5). Continuing timber harvest of around 10 bbf kept the need for reforestation seedlings high from 1965 into the early 1990s. In 1979, 14 Forest Service nurseries grew about 100 million seedlings annually (Burch 2005).

Return to Restoration: 1990s to Present. Around 1990, the long-term trend of timber harvest on National Forests changed drastically. Timber harvests decreased because of a shift away from use of even-aged regeneration practices (clearcutting in particular), more emphasis on intermediate treatments such as thinning, and a reduction in the landbase available for timber production for reasons such as endangered species habitat requirements and pro-

Figure 1. Nursery workers transplanting seedlings at the Wind River Nursery in Carson, WA, circa 1915. Photo credit: US National Archives 95-G-152502.

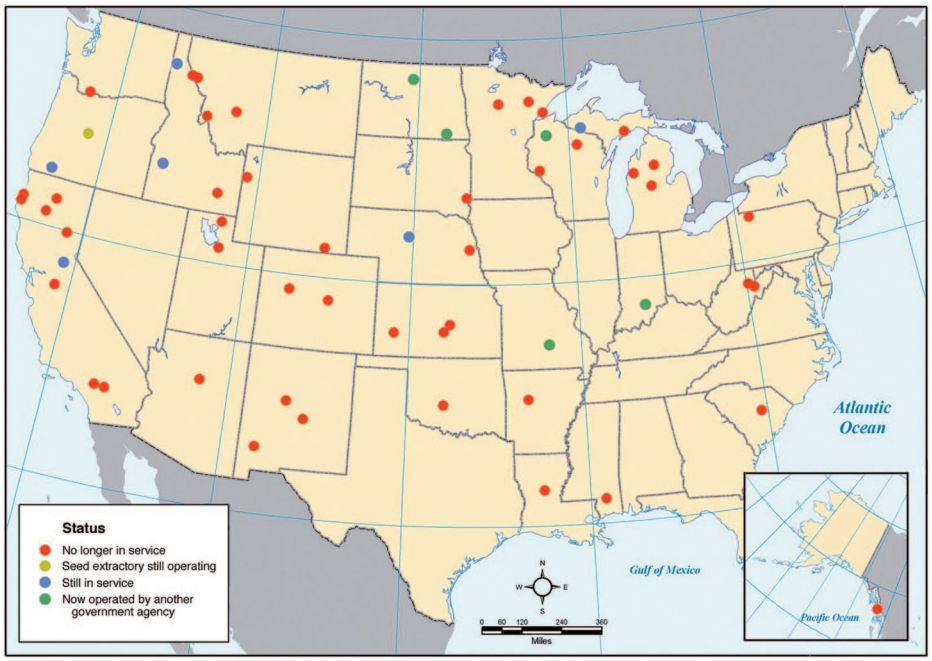

Figure 2. Distribution and current status of Forest Service nurseries. Map created by Jeffrey S. Evans, USDA Forest Service, RMRS.

Stuart Forest Nursery.

Established in 1933 near Pollock, LA, as Catahoula Nursery, the nursery name was soon changed to the Stuart Nursery to honor Forest Service Chief Robert Y. Stuart, who was responsible for establishment of the nationwide forest nursery system. Stuart Nursery was one of a few federal nurseries established in the South in response to the tremendous need for reforestation capability. Millions of acres of forestland, from Virginia to eastern Texas, were harvested in the late 1800s and early 1900s, converted to agriculture, and much was either abandoned or left decimated and subject to erosion (Figure 4). Establishing the nursery and seed extractory was primarily a CCC project. The first crop of nearly 9 million seedlings was planted throughout Louisiana and Mississippi. Researcher Philip Wakeley of the Southern Forest Experiment Station collaborated with nursery personnel M.A. Huberman and A.D. McKellar—together they grew and outplanted nearly 750,000 seedlings between 1933 and 1950. Results of their work set the standard for pine seedling quality in the South that is still used today (Barnett 2004). Although the nursery closed in 1964, the extractory continued to provide seeds until 1991.

Stuart Nursery personnel spraying Bordeaux mixture in 1935 to control disease in bareroot longleaf pine. Photo credit: USDA Forest Service 293414.

tection of roadless areas (Burch 2005). In a decade, the number of active Forest Service nurseries dropped from 14 to six as annual seedling demand plummeted from 100 million to 30 million seedlings.

In addition, the drop in timber harvest from 12 bbf in the late 1980s to 4 bbf in 1994 severely disrupted traditional funding to nurseries. When timber harvest levels were at their zenith, roughly two-thirds of reforestation work on National Forests was financed with Knutson–Vandenberg Act deposits derived from timber sales. The Knutson–Vandenberg Act was signed into law in 1930 and requires purchasers of National Forest timber to deposit funds necessary to reforest the timber sale area. These funds are also used to operate Forest Service nurseries. Today, less than one-half of the reforestation program is financed this way, placing increased pressure on scarce, annual appropriations (Burch 2005). Forest Service nurseries have reduced their workforce and used other measures to improve cost efficiency, and more recently have been growing other nontraditional plant materials to help support traditional nursery programs. Concurrently,

Figure 3. Many Forest Service nurseries, like Licking Nursery on the Mark Twain National Forest in Missouri, opened during the Great Depression. Here, left to right, this crew is forming beds, pressing seed rows, and sowing seeds. Photo credit: USDA Forest Service 290709 provided by Gregory Hoss, George O. White State Nursery, Licking, MO.

Figure 4. Civilian Conservation Corp crews, similar to this team planting loblolly pine seedlings from Stuart Nursery into a gully near Moscow, TN, in 1954, worked to mitigate soil erosion and enhance timber resources. Photo credit: USDA Forest Service 502031.

Savenac/Coeur d'Alene Nursery.

Savenac Nursery was established on one acre of ground near Haugan, MT, in 1908 by Elers Koch, the Assistant Regional Forester in the Northern Region. Perhaps fortuitously, the nursery burned to the ground in the 1910 fire in which 3 million acres in northern Idaho and western Montana were charred. Rebuilt quickly, the need to reforest the burned area was immense and by 1912 the facility was the largest Forest Service nursery. About 3 million seedlings were shipped annually with another 10 million in the ground on 35 acres (Olson 1930). The nursery's location on the Yellowstone Trail, the first engineered road in the Northwest, was essential for shipping seedlings throughout the region for restoration activities. During the Great Depression, Savenac expanded to about 60 acres and provided employment for some of the CCC men in nearby Camp Taft. In 1960, the Coeur d'Alene Nursery was developed in northern Idaho to replace Savenac, which closed in 1966. Savenac Nursery was added to the National Register of Historic Places in 1984, and the site still serves as an education center. The Coeur d'Alene Nursery's 130 acres of bareroot seedbeds can yield 20 million seedlings annually, and its 90,000 square feet of indoor growing space produce an additional 4 million container seedlings.

A shipment of seedlings from Savenac Nursery pulls out onto the Yellowstone Trail in 1916. Photo credit: US National Archives 95-G-031136A.

demand for a variety of noncommercial forest plants is increasing. New stock types (Figure 6) and new species are needed to restore areas affected by fire, recreation, and grazing; restore riparian zones, sensitive habitats, wetlands, endangered species, and wilderness areas; enhance wildlife value; and to continue introducing plants resistant to foreign pests like white pine blister rust (Landis et al. 1992). These opportunities present new challenges to nursery managers because little is known about propagating these new species.

Table 1. Current Forest Service nurseries and their production of native plants for ecosystem restoration

	Location	Year established	Regions served	Production (millions)	Number of species
Charles E. Bessey[a]	Halsey, NE	1902	E Wyoming, Colorado, South Dakota, Nebraska, Kansas	3.5	49
Coeur d'Alene	Coeur d'Alene, ID	1960	Idaho Panhandle east to North Dakota	9.0	45
J. Herbert Stone	Central Point, OR	1978	Washington, Oregon	6.5[b]	169
James W. Toumey[c]	Watersmeet, MI	1935	Minnesota to Missouri and east to the Atlantic Ocean	14.5	25
Lucky Peak	Boise, ID	1960	S Idaho, Utah, Nevada, W Wyoming	2.0	20
Placerville	Camino, CA	1957	California	3.0	15

[a]Halsey Nursery renamed Charles E. Bessey Nursery in 1915.
[b]Also produces 15 tons of native grass and forb seeds annually.
[c]Watersmeet Nursery renamed James W. Toumey Nursery in 1937.

Figure 5. Transplanting was an important practice during the timber years. Self-propelled transplanters like this one in the Lake States improved efficiency. Circa 1955. Photo credit: US National Archives 95-G-450868.

Supporting Reforestation Science and Sharing Technology

Besides growing seedlings, Forest Service nurseries have always been leaders in developing new techniques for seedling production, reforestation, and ecological restoration. Most early research that became the foundation for the nursery industry was done at Forest Service facilities (for example, Pettis 1909, Tillotson 1917, Olson 1930). Pettis (1909) was instrumental in developing quality seedlings in the eastern United States, while Tillotson (1917) helped shape artificial regeneration nationwide. For decades, James Toumey's work in Forest Service nurseries was the source for nursery production techniques (Toumey 1916)—in recognition, Toumey Nursery in Michigan was named for him in 1937. Researcher Philip Wakeley of the Southern Forest Experiment Station collaborated with nursery personnel at the Stuart Nursery in Louisiana. The resulting publication (Wakeley 1954) still sets the standard for seed, seedling, and tree-planting technology in the South, and it stimulated research in seedling quality worldwide. In 1979, Richard Tinus combined his pioneering research with Stephen McDonald's nursery experience and their *How to Grow Tree Seedlings in Greenhouses* became the standard reference for the rapidly expanding container nursery industry (Tinus and McDonald 1979). These authors teamed with James Barnett and Thomas Landis to produce the seven-volume *Container Tree Nursery Manual*, which has become the primary nursery reference throughout the world (for example, Landis et al. 1999). And, as the ability to produce seedlings with superior morphological characteristics became more routine, Forest Service nurseries and researchers collaborated to understand seedling physiological parameters important to reforestation success, and to pass that information on to other nursery managers (for example, Tinus 1996).

Perhaps the most significant contribution of Forest Service nurseries was the quality and variety of their stock. In the early 1900s, nurseries produced only bareroot seedlings and transplants that took from 3 to 5 years to grow (Figure 7). Modern nurseries offer a variety of stock types from container seedlings that can be grown in less than 1 year to container transplants that can survive and grow on the most challenging reforestation or restoration site. Information on how to produce these species and stock types has been shared with other nurseries through technology transfer publications and workshops. Modern forest and conservation nursery equipment, such as the Wind River seed drill, can trace its lineage back to Forest Service innovations and modifications.

Besides producing billions of seedlings for restoration, the real legacy of Forest Service nurseries lies in their research and development and sharing those techniques. Their efforts enabled other state and private nurseries, and nurseries worldwide, to develop successful methods for producing reforestation and conservation seedlings during this past century.

The Future of Forest Service Nurseries

Two recent national reviews validate the importance of the nurseries to the Forest Service and nation; however, a long-

Figure 6. New stock types and technologies are developing for unique restoration projects. The outplanting of stock grown in tall pots (A) on difficult sites can be automated with large equipment (B). Photos by Kas Dumroese.

Charles E. Bessey Nursery.

In 1890, Dr. Bessey of the University of Nebraska and Dr. Fernow established test plantings of seedlings on the prairies of the central Nebraska Sandhills. Based on their success, President Theodore Roosevelt created the Dismal River and Niobrara River forest reserves, and Halsey Nursery was established in 1902 to produce seedlings. The original purpose of these "planted forests" was to provide timber to homesteaders under the Kinkaid Act of 1904 and to expand the transcontinental railroad. The first seeds sown were ponderosa pine—seed collection costs were $1.36 per pound. Success of the outplantings in 1904 was marginal because of poor seedling size and quality. After new cultural techniques (transplanting and root pruning) were adopted, outplanting survival jumped to 85 to 90%. An ice pond was created on the nursery to provide large blocks of ice during winter months to keep seedlings dormant until spring. In 1915 the name was changed to honor Dr. Bessey. During the Prairie State Forest Program of the 1930s, Bessey Nursery was one of two nurseries supplying seedlings for windbreak plantings throughout the Great Plains. Men in the CCC camped at Bessey Nursery and worked either in the nursery or forest. Currently, Bessey Nursery is the bareroot and container seedling production facility for the Rocky Mountain Region of the Forest Service and the Nebraska Forest Service (Fleege 1995).

Nursery workers tending 1+0 seedlings growing beneath "Pettis frames" at the Charles E. Bessey Nursery, circa 1915. Photo credit: USDA Forest Service 39206.

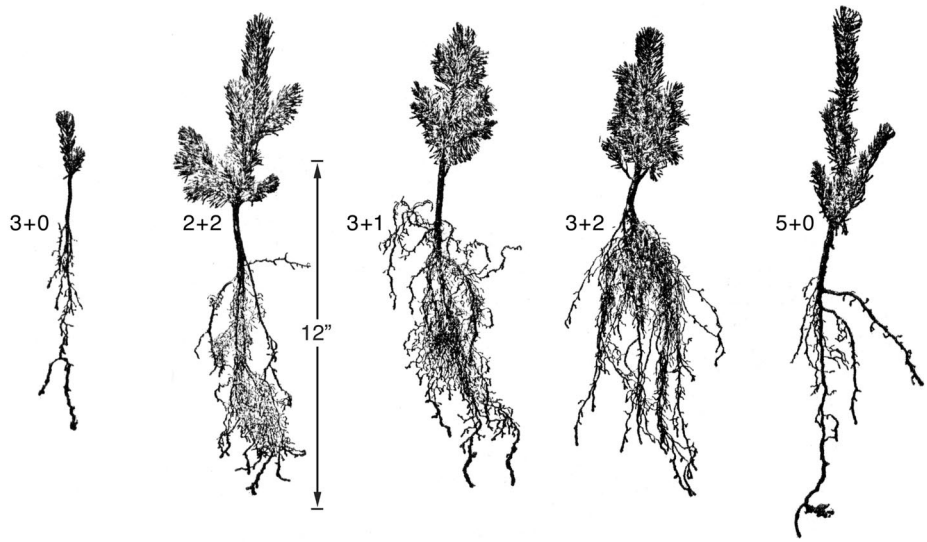

Figure 7. In the first half of the 20th century, transplant stock types (2+2, second from left; 3+1, center; 3+2, second from right) were preferred over seedlings (3+0, left; 5+0, right) because transplants had more fibrous root systems and better shoot-to-root ratios. From Korstian and Baker (1925).

Figure 8. A crop of 2+0 ponderosa pine seedlings for reforestation growing at the Placerville Nursery near Camino, CA. Photo by Kas Dumroese.

term solution to the current financial crisis brought on by reductions in timber harvests has yet to be found. Clearly, the traditional role of Forest Service nurseries has expanded from growing native trees for afforestation and reforestation to the production of a wide variety of other native plants for the expanding needs of ecosystem restoration. Currently, these nurseries are producing even more species and stock types to meet the demands of public land managers (Table 1).

As a nation, we should value Forest Service nurseries as they continue to fulfill key roles that initially led to their establishment—reliable sources of locally adapted, high-quality, native plant materials for ecosystem restoration (Figure 8). The surge in demand for native species for restoration, and techniques for propagating them, completes the circle—Forest Service nurseries were at a similar point 100 years ago with important timber species. Then, as now, their "can do" attitude and broad national support played a pivotal role in the Forest Service becoming the world's leading conservation organization. That positive attitude can still be found at nurseries, but the challenge for the next century is to leverage the capabilities of these facilities with the growing need for restoration on public lands, and to ensure we preserve the skills and science needed to respond to emerging issues.

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