Mined Land Reforestation on the Rockcastle River Wildlife Managment Area

2020 Report

green forests work

Mission

Green Forests Work's (GFW) mission is to re-establish healthy and productive forests on formerly mined lands in Appalachia.

Vision

GFW's vision is to create a renewable and sustainable multi-use resource that will provide economic opportunities while enhancing the local and global environment by converting reclaimed, non-native grasslands and scrublands into healthy, productive forestland.

Our reforestation projects provide jobs for equipment operators, nursery workers, and tree planters, and improve the environment by eradicating exotic species and restoring ecosystem services. With the help of our partners and volunteers, this vision is quickly becoming a reality…

Since 2009, we have planted more than three million trees across nearly 5,000 acres.

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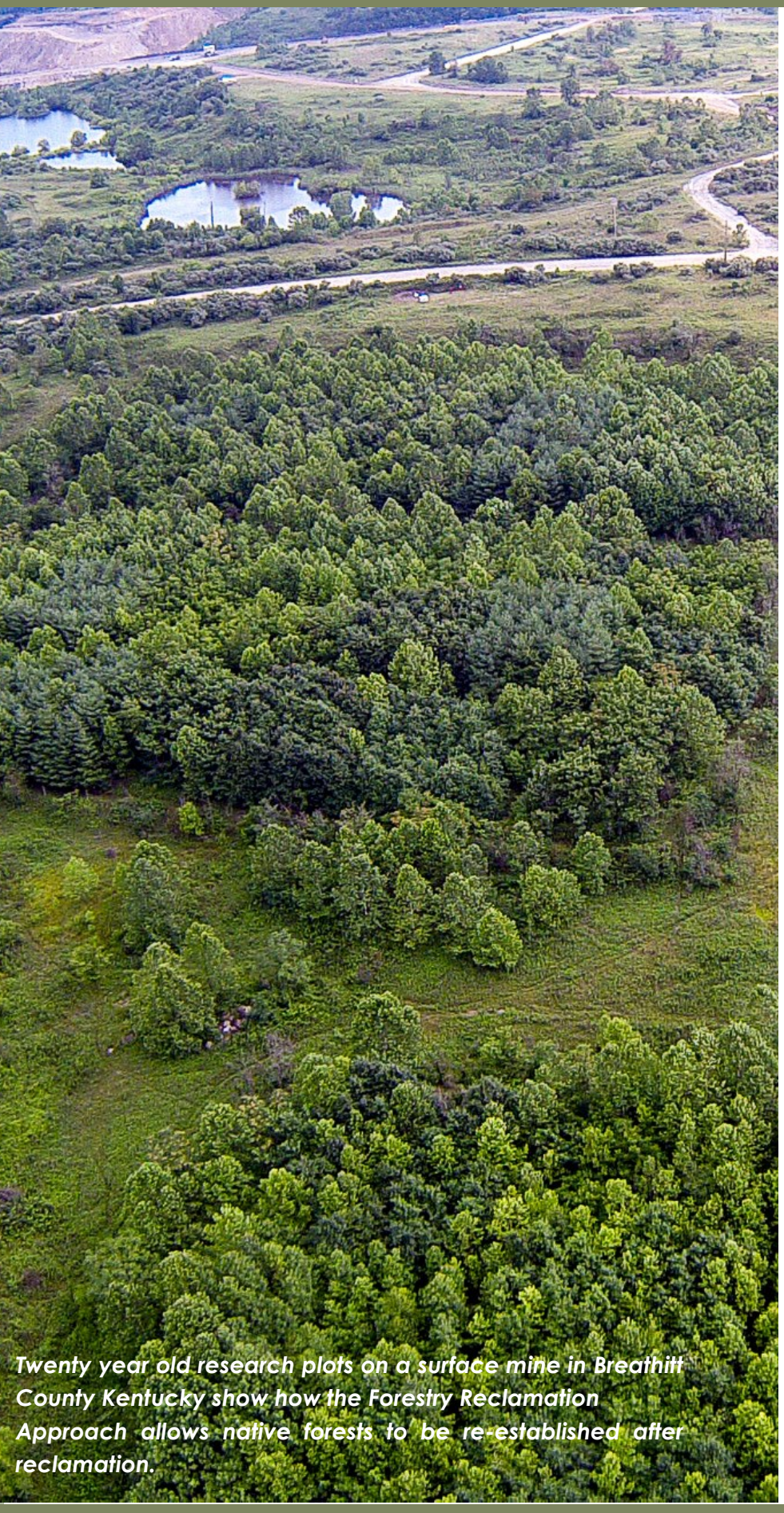

Twenty year old research plots on a surface mine in Breathitt County Kentucky show how the Forestry Reclamation Approach allows native forests to be re-established after reclamation.

Table of Contents

Front Cover: Doug Potter, GFW's Reforestation Coordinator demonstrates planting techniques to volunteers.

BACKGROUND

In 2018, Green Forests Work (GFW) partnered with the Kentucky Department of Fish and Wildlife Resources (KDFWR), United States Forest Service—Daniel Boone National Forest (USFS-DBNF), and others to reforest approximately 22.1 acres of surface mined land in the Rockcastle River Wildlife Management Area (RR-WMA) as a part of our efforts to restore forestland to surface mined areas within the Cumberland River Watershed and proclamation boundary of the Daniel Boone National Forest (Fig. 2). This partnership led to a second, approximately 61-acre reforestation project on the RR-WMA in 2020 (Figs. 1 & 2). After mining, the sites had been compacted by heavy equipment and revegetation consisted of seeding the areas with aggressive, non-native grasses, legumes, and other weedy species. The compacted ground and thick cover of non-native vegetation was preventing the colonization and establishment of native trees. Autumn olive, a highly invasive, non-native shrub, had formed thickets across some areas, further hindering the establishment of native trees. The few native trees that had established on the site were stunted due to the compacted soil conditions. Project partners aimed to restore ecosystem services to the site by restoring a shortleaf pine-upland oak forest cover that would resemble the forest composition that was present prior to the surface mining.

The 2020 project was a collaborative effort between GFW, KDFWR, USFS-DBNF, the Arbor Day Foundation, the Sheldon and Audrey Katz Foundation, Art for Trees, the Snowy Owl Foundation, Angels Envy, A Living Tribute, The American Chestnut Foundation (TACF), and the Appalachian Regional Reforestation Initiative (ARRI).

Figure 1. Project partners examine the thick cover of sericea lespedeza, tall fescue, and other non-native plants that were seeded on the site after mining. Thickets of autumn olive can be seen in the background.

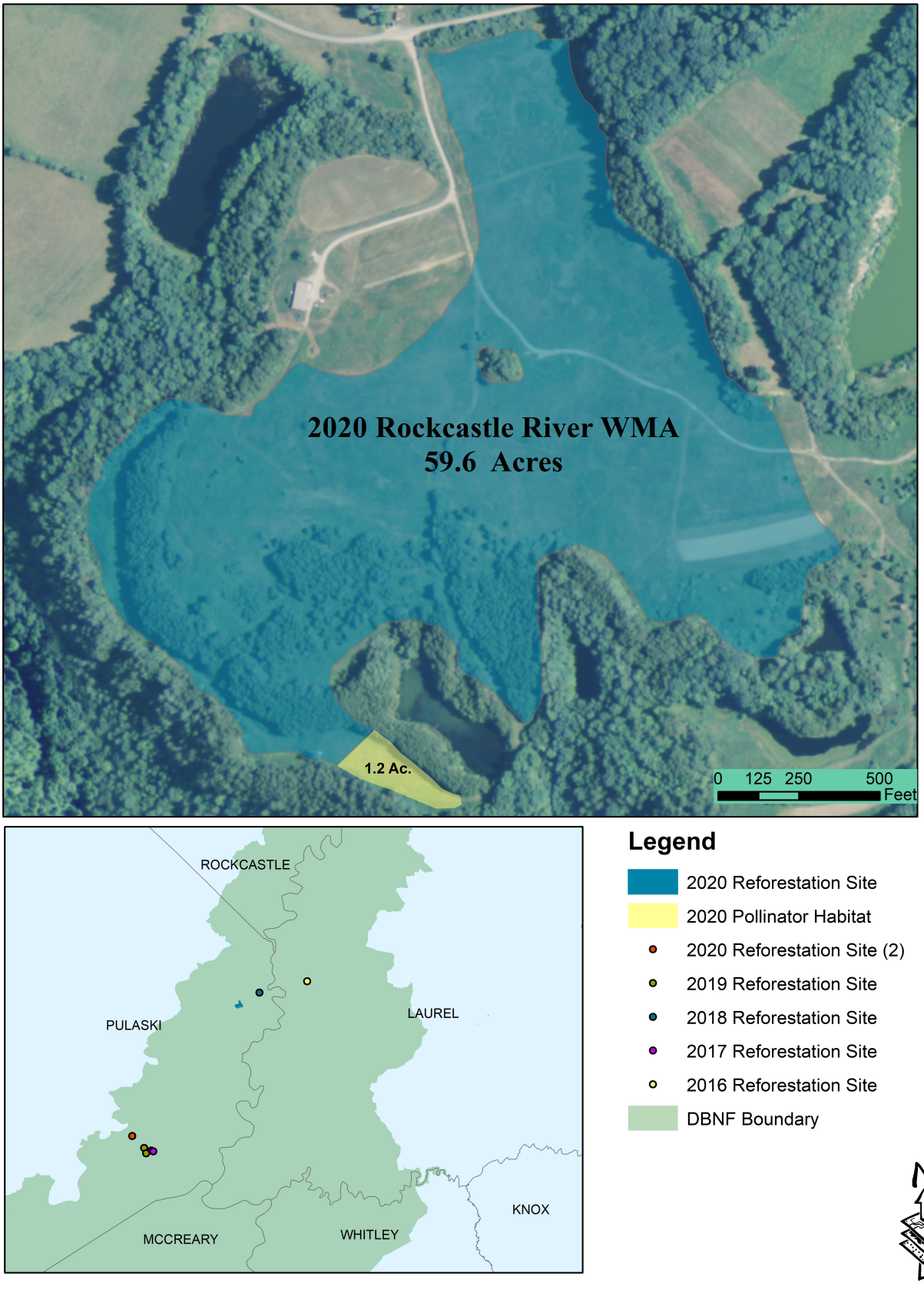

Figure 2. Locations of previous reforestation sites and boundary of 2020 site.

SITE PREPARATION

GFW uses a modified version of ARRI's Forestry Reclamation Approach to re-establish forests on formerly mined lands where the site has been reclaimed and the bond has been released. Further details on each step of this process are provided below.

Unwanted Vegetation Removal

The project site was primarily dominated by non-natives such as autumn olive (*Elaeagnus umbellata),* sericea lespedeza *(Lespedeza cuneata)*, and tall fescue (*Festuca arundinacea*). Most of the native vegetation consisted of brambles and small shrubs. The native trees, primarily pines and black locust, were severely stunted. Since the limiting factor to natural tree regeneration on many formerly mined sites is soil compaction, the existing vegetation must be removed and controlled so deep ripping can occur.

Because of the thick blanket of non-native groundcovers and the presence of their seeds in the soil, two Komatsu bulldozers scraped off the top 2-3 inches of soil, along with the vegetation, and pushed it to the project perimeter in the spring of 2020 (Fig. 3). Preliminary observations of several other projects, where the same methods were applied, appear promising. Much of the vegetation that colonizes the sites after clearing is native and less competitive. Although removing the "topsoil" seems counterintuitive, the material is not the prime soil that this term traditionally refers to—it is mine spoil, a mix of rock overburden that has experienced little soil development due to the lack of regeneration and water infiltration.

The piles of soil and vegetation along the project perimeter quickly decompose and provide a suitable medium for natural regeneration. In the meantime, the "soil"/brush piles also provide food and shelter for wildlife.

Figure 3. The unwanted vegetation is cleared and controlled using bulldozers equipped with blade attachments.

Soil Decompaction

To mitigate soil compaction, the ground was cross-ripped using a D-9 bulldozer equipped with two, 4-foot long ripping shanks mounted behind each track in the spring of 2020 (Fig. 4). The rips were spaced approximately eight feet apart, creating an 8-foot by 8-foot grid after cross-ripping.

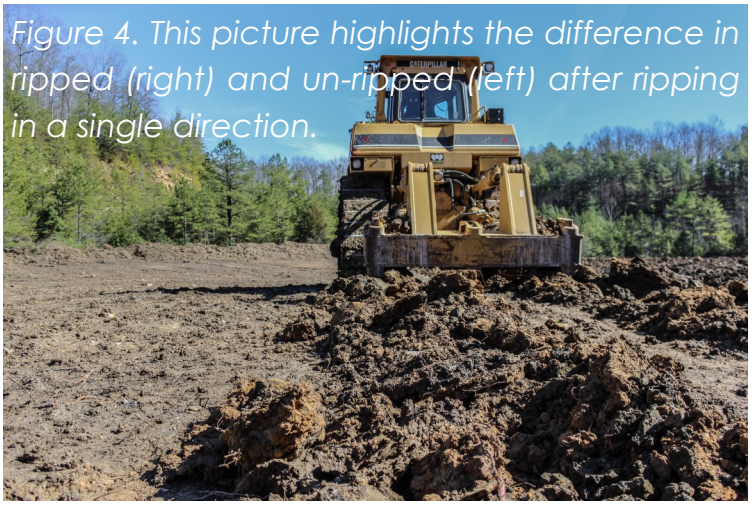

Figure 4. This picture highlights the difference in ripped (right) and un-ripped (left) after ripping in a single direction.

THE APPALACHIAN REGIONAL REFORESTATION INITIATIVE: THE BEGINNING OF GREEN FORESTS WORK

Surface mining in Appalachia has replaced approximately one million acres of deciduous forest, some of the most diverse and valuable temperate forests in the world, with primarily non -native grasses and shrubs. Understanding the reasons behind this requires a brief history of mine reclamation, starting with the Surface Mining Control and Reclamation Act (SMCRA) of 1977. SMCRA created the U. S. Office of Surface Mining Reclamation and Enforcement (OSMRE), whose mission was to enforce a new set of reclamation guidelines that would standardize reclamation practices for the mining industry. Prior to SMCRA, some mining operations practiced "shoot 'n shove" mining, where overburden was "shot" off the coal seam and "shoved" downhill. Revegetation requirements were minimal and varied from state to state. The loose piles of overburden could support tree growth, but they were also highly unstable. After SMRCA was implemented, mining companies began intensely grading sites to prevent landslides and water quality problems. The overburden was used to backfill the mined area to achieve the approximate original contour, but the grading led to severe soil compaction. Native hardwood trees could not tolerate the compaction and competition from aggressive groundcovers, so mining operations moved away from forestry reclamation (i.e. planting trees) to establishing hayland/pasture to meet revegetation requirements. Without management, the pastures were quickly (within 10 years) overcome with invasive, exotic species and resided in a state of arrested succession. Researchers foresaw the unintended consequences of SMCRA and began developing a method of reclamation in the 1980s that would allow both stability and tree growth. By 2004, there were numerous scientific studies supporting what became known as the Forestry Reclamation Approach (FRA).

OSMRE created ARRI in 2004 to coordinate the implementation of the FRA. After making progress with the active mining industry, ARRI members began to look back at the sites reclaimed under SMCRA that led to their establishment, so called "legacy" mines. Experimental re-reclamation of legacy mines by ARRI members revealed the need for increased scale to stimulate the economic development and environmental improvement Appalachia needed, thus the idea of Green Forests Work was born. Further research laid the groundwork for the modified version of the FRA that GFW implements on formerly mined lands.

TREE ESTABLISHMENT

Species Selection

As mentioned above, the goal of this project was to restore a shortleaf pine-upland oak forest type that would resemble the forest that was present on the site prior to mining. GFW typically plants a diverse mix of early successional trees and shrubs, with a minor amount of black locust to serve as a nurse plant and nitrogen fixer that improves soil fertility. However, later successional species (e.g. oaks and hickories) comprise a large percentage of the mixes, because species with wind-dispersed seeds typically colonize on their own in the exposed soil. 41,400 one- and two- year-old bare root seedlings were planted in the intersections of the rips, resulting in a density of 680 trees/acre (Table 1). By allowing many additional species to establish through wind and animal dispersal, biodiversity and the initial stocking rate are increased.

Common name	Scientific name	Number	%
White oak	*Quercus alba*	15,700	37.9
Northern red oak	*Quercus rubra*	4,700	11.4
Chestnut oak	*Quercus prinus*	4,000	9.7
Black oak	*Quercus nigra*	2,000	4.8
Shortleaf pine	*Pinus echinata*	2,900	7.0
American chestnut	*Castanea dentata**	500	1.2
Black cherry	*Prunus serotina*	1,500	3.6
Shagbark hickory	*Carya ovata*	2,000	4.9
Mockernut hickory	*Carya tomentosa*	1,000	2.4
Pignut hickory	*Carya glabra*	1,000	2.4
Black locust	*Robinia pseudoacacia*	2,100	5.1
Sycamore	*Planatus occidentalis*	1,000	2.4
Silky dogwood	*Cornus amomum*	500	1.2
Blackgum	*Nyssa sylvatica*	500	1.2
Persimmon	*Disopyros virginiana*	500	1.2
Yellow poplar	*Liriodendron tulipifera*	1,000	2.4
American hazelnut	*Corylus Americana*	500	1.2
Total:		41,400	100

Table 1. Species, numbers of each species, and percentages of species planted at the 2020 RR-WMA site.

**American chestnuts were backcrosses provided by The American Chestnut Foundation.*

Descriptions of the benefits of some of the species that were planted on the site are described below.

White Oak

White oak (*Quercus alba*) is a dominant species of many eastern forests, but it is especially prevalent in the central, northern, and Appalachian hardwood regions of the mid-south and mid-west. Its acorns provide food to more than 180 different types of wildlife, including deer, turkeys, racoons, and red-headed woodpeckers to name a few. White oaks are one of the most sought-after lumber trees, and it plays a critical role in the distilling industry, as white oaks are the preferred species for barrels used to age spirits. Thus, maintaining enough white oak stock is critical for the health of our forest ecosystems and the people who depend on the economies they support. While there is currently enough stock to meet demand, research and long-term growth projections show that there will likely be a shortage of large, high-quality white oaks in the future. Some of the suspected reasons for this future shortage include fire suppression, lack of forest management, and unsustainable timber harvesting.

The White Oak Initiative is attempting to address this concern by uniting industries, agencies, universities, and non-profits to develop a strategic plan for monitoring, research, restoration, and education. This reforestation project supports the Initiative by planting 15,700 white oaks, which was the most significant component of the planting mix (37.9%).

TREE ESTABLISHMENT (cont.)

Shortleaf Pine

Shortleaf Pine (*Pinus echinata*) was included in the planting mix as part of a regional initiative to restore a declining ecosystem, which has lost 50 percent of its former range over the last 30 years due to pine beetle outbreaks, altered fire regimes, timber harvesting, and land use changes. Including shortleaf pine helps improve the diversity of the forest and will make it more resilient to climate change.

Pollinator-friendly species

Some of the species that were planted were selected not only for their timber or fruit or nut production, but also for their benefits to pollinators. Blackgum, locust, poplar, cherry, dogwoods, and other species will provide a diversity of pollen sources for honeybees and native pollinators. Additionally, KDFWR staff expressed their intent to leave a wildlife opening near one of the ponds. Because the vegetation in that area was mostly composed of non-native and sometimes invasive species, we decided to clear the 1.2 acre wildlife opening and seed it with a mix of native grasses and wildflowers to improve the habitat for native wildlife.

American Chestnut

American chestnut used to be a major component of Appalachian forests and was also the most valuable nut-producing tree. A fungal disease that was brought to North America on Asian chestnut trees in the early 1900s eradicated American chestnut from the eastern United States by the 1950s. Asian chestnuts evolved with the fungus and developed a resistance to the disease. Over the last three decades, TACF has been backcrossing the Chinese chestnut (*Castanea mollissima*) with the American chestnut to produce trees that are approximately 15/16 American Chestnut in character but retain resistance to the blight fungus from Chinese chestnut ancestors.

The former range of the American chestnut directly overlaps with the Appalachian coal region, making mined lands a great place for reintroduction. Furthermore, chestnuts were once a dominant component of upper slopes and ridge top positions, where it is economically feasible to surface mine for coal. By including chestnuts in the species mix, we are restoring them to their preferred position on the landscape.

Figure 5. Planting buckets with the appropriate mix of species are prepared for the volunteers prior to every event. The trees' roots are kept moist by saturated peat moss.

TREE ESTABLISHMENT (cont.)

Volunteerism

Although the majority of GFW's planting labor is performed by professionals, volunteer tree planting events provide a great opportunity for education and outreach. Volunteers are taught tree planting techniques, the history of reclamation, methods used to implement the reforestation project, as well as the benefits of reforestation. These events help raise awareness of environmental issues and empower people to take action. The diversity of volunteer groups exemplifies the many motives people have to plant trees; it is truly a uniting experience (Figs. 6 & 7).

Unfortunately, GFW was only able to host a few volunteer events this year due to the coronavirus outbreak. However, we are grateful to our volunteers who helped plant more than 3,400 seedlings across 5 acres of this site. Their efforts will allow us to plant more trees in future years by reducing labor costs.

Since 2009, GFW has engaged more than 21,000 volunteers in our tree planting events, approximately half of whom were adolescents.

Figure 6. Professional foresters teach volunteers about the importance of forests to society, the benefits of individual species, and how to plant trees.

DISCUSSION

This project is part of GFW's larger effort to restore shortleaf pine-oak forests in the Cumberland River Watershed. Since 2015, we have reforested more than 235 acres on formerly mined lands in southern Kentucky and northern Tennessee in the Cumberland River Watershed. We have identified other areas in need of restoration within the watershed. As funding becomes available, we intend to continue restoring healthy, productive native forests in the region to have a greater impact on water quality, wildlife habitat, and forest connectivity and health.

Figure 7. Students and staff from Radford, Penn State, Xavier, Eastern Kentucky, and Appalachian State Universities assisted us this year by participating in the planting.

Conducting reforestation projects on public lands could arguably be one of the best locations for these efforts, as large, contiguous forests provide more and better quality ecosystem services. Replacing invasive species with native trees and shrubs will protect the surrounding forest's health. The early successional habitat that is created will provide numerous wildlife benefits in the short term and decrease forest fragmentation in the long term. This will provide additional habitat for forest interior dependent species such as the Cerulean Warbler. Public land reforestation projects also provide great opportunities for research, education, and outreach. Several of our projects in the area have been utilized by KDFWR, the University of Kentucky, the University of Tennessee, and the USFS-DBNF for such purposes.

This project would not have been possible without the contributions of many partnering agencies, NGOs, and donors. GFW is thankful to all of our partners (see next page) for their support of these projects and we look forward to continuing this work into the future.

PARTNERS

Green Forests Work

Art for Trees

Sheldon and Audrey Katz Foundation

Angel's Envy

Arbor Day Foundation

Kentucky Department of Fish and Wildlife Resources

US Forest Service - Daniel Boone National Forest

A Living Tribute

Office of Surface Mining Reclamation and Enforcement

Kentucky Division of Forestry

University of Kentucky

Snowy Owl Foundation

The American Chestnut Foundation

Appalachian Regional Reforestation Initiative