

ECOLOGICAL RESTORATION ON THE DANIEL BOONE NATIONAL FOREST

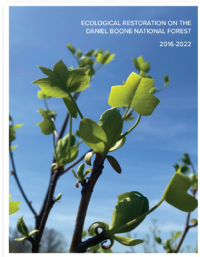
2016-2022





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ON THE COVER

A young yellow-poplar begins to leaf out at the Pine Creek Church Road reforestation site in early spring 2022.

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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 five million trees on more than 9,400 acres.

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

Surface mining in Appalachia has replaced approximately one million acres of eastern deciduous forest, one of the most diverse and valuable 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. This act 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, as there was no national standard. The loose piles of overburden could support tree growth, but they were also highly unstable. As a result, large landslides occurred and created a hazard to public safety. SMCRA addressed this issue by requiring more intense grading. 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 the Appalachian Regional Reforestation Initiative (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 we use today.

BACKGROUND/PARTNERSHIP

Since 2016, Green Forests Work (GFW) has partnered with the United States Forest Service (USFS) to perform a variety of ecological restoration projects on the Daniel Boone National Forest (DBNF). Projects have included the reforestation of nearly 75 acres of surface mined land in Laurel and Pulaski Counties, KY (Figures 1 and 2), control of invasive species on those sites and the restoration of hydrology and habitat in a wetland that supports the rare white fringeless orchid (*Platanthera integrilabia*). Over 50,000 trees have been planted and 724 volunteers have participated in these projects (Table 1).

The project was a collaborative effort between GFW and the USFS with additional support from the Arbor Day Foundation, Angel's Envy, American Forests, Sheldon and Audrey Katz Foundation, Snowy Owl Foundation, Norfolk Southern Foundation, Philadelphia Insurance, One Tree Planted, National Forest Foundation, Kentucky Division of Forestry, The American Chestnut Foundation, and the Appalachian Regional Reforestation Initiative.

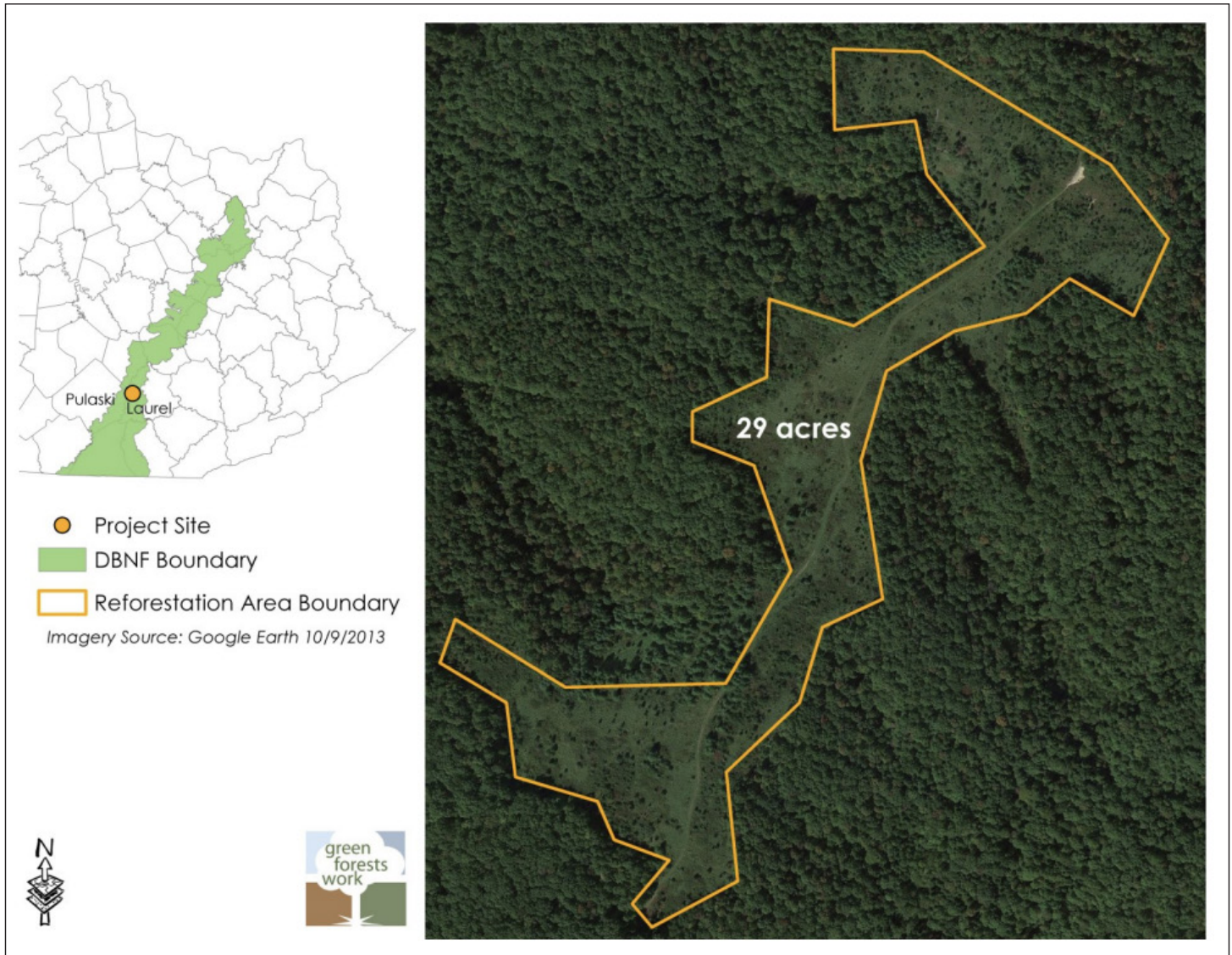


Figure 1. The 2016 Pine Creek Church Road reforestation site.

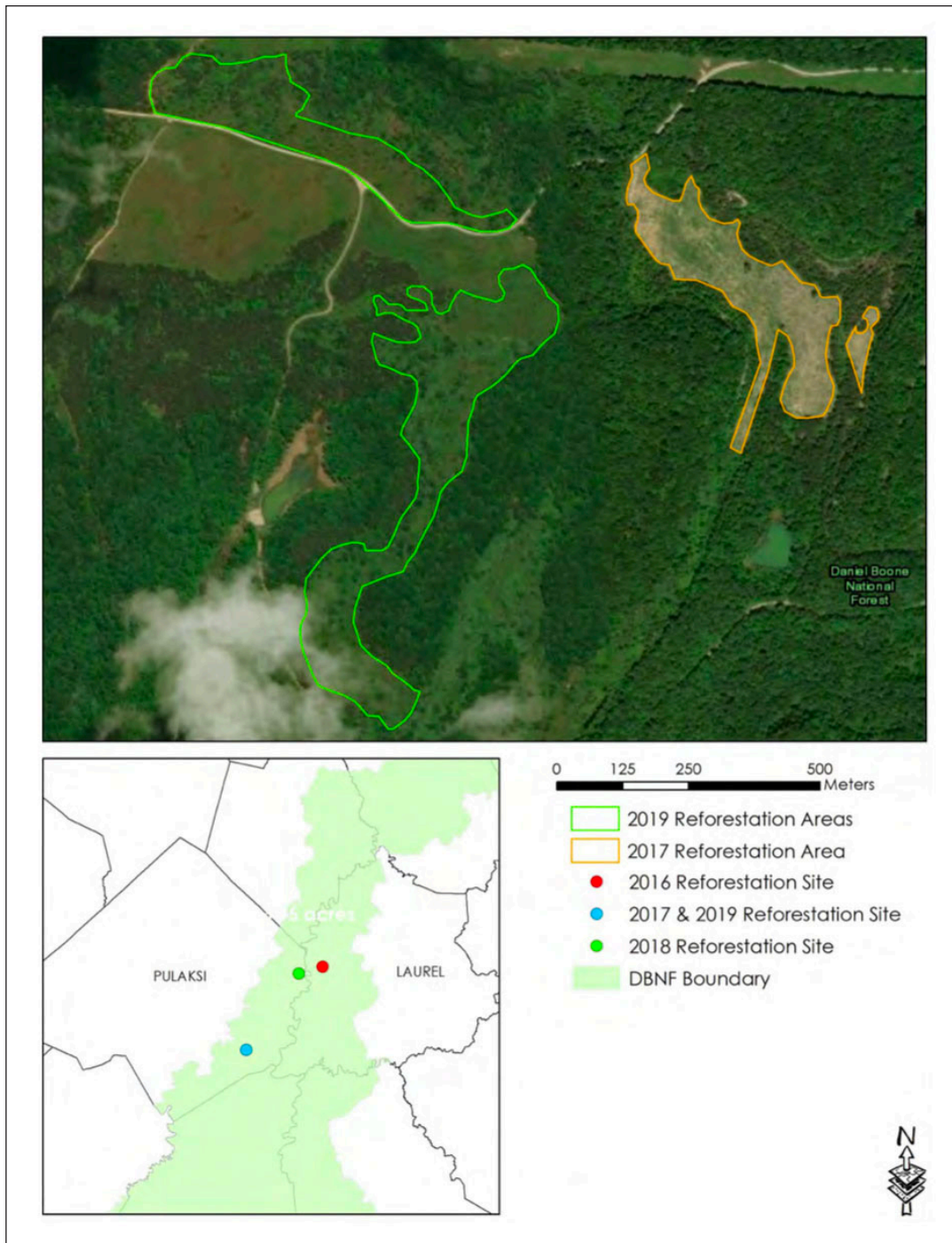


Figure 2. The Wildcat reforestation areas.

Table 1. Summary of reforestation activities in the Daniel Boone National Forest.

Year	Site	Trees Planted	Volunteers
2016	Pine Creek Church Rd	20,047	120
2017	Wildcat I	6,570	174
2019	Wildcat II	18,740	320
2021	Wildcat II	1,200	23
2022	Pine Creek Church Rd/Wildcat II	3,761	87
TOTAL		50,318	724

MINE REFORESTATION

GFW uses a modified version of the Appalachian Regional Reforestation Initiative's Forestry Reclamation Approach to re-establish forests on formerly mined lands where the site has already been reclaimed and the bond has been released. At the DBNF sites, site preparation activities included scalping the ground with a small bulldozer to remove unwanted vegetation and deep ripping of the land to reduce soil compaction and provide a planting medium that will support tree growth, allow gas exchange and promote water infiltration. Ripping is performed in a crossed-ripped fashion where ripped lines are eight feet apart, creating an 8-foot by 8-foot planting grid that supports 680 trees per acre.

Seedlings that represented twenty-five species were hand planted by professional tree planters and volunteers (Table 2). Planting performed in 2020-2022 by volunteers was done to infill areas where seedling stocking levels were low.



Heavy equipment is used to remove unwanted vegetation and decompact soil.

Table 2. Species planted on the reforestation sites from 2016-2022 and the percent of total.

Species	Number Planted	Percent of Total
White Oak	16,300	32.4
Shortleaf Pine	6,550	13.0
Northern Red Oak	4,248	8.5
Black Oak	4,300	8.5
Black Cherry	2,350	4.6
Shagbark Hickory	1,200	2.4
Yellow-Poplar	1,200	2.4
Black Locust	1,000	2.0
Sweetgum	950	1.9
Grey Dogwood	900	1.8
Hazelnut	900	1.8
American Chestnut	850	1.7
Wild Plum	650	1.3
Silky Dogwood	600	1.2
Roughleaf Dogwood	600	1.2
Black Walnut	600	1.2
Sycamore	600	1.2
Persimmon	500	1.0
River Birch	480	0.9
Mockernut Hickory	300	0.6
Sassafras	200	0.4
American Elm	140	0.3
Virginia Pine	100	0.2
Witch Hazel	100	0.2
Total	50,318	100



“The great French Marshall Lyautey once asked his gardener to plant a tree. The gardener objected that the tree was slow growing and would not reach maturity for 100 years. The Marshall replied, ‘In that case, there is no time to lose; plant it this afternoon!’” - John F. Kennedy

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 unifying experience.

CORPORATE RESPONSIBILITY

Green Forests Work is often asked to help private industries meet corporate responsibility and sustainability goals through tree planting. The bourbon distiller, Angel’s Envy, hopes to offset their use of white oak in bourbon barrels by planting back this important species in Appalachian forests. Angel’s Envy has supported GFW reforestation projects since 2016 through their Toast the Trees campaign (#ae4thetrees). They have provided 187,700 white oaks in total, 14,255 of which were planted on the DBNF reforestation sites. Not only has Angel’s Envy helped provide the white oaks for the projects, but they have also helped plant them during annual volunteer events including 4,000 trees on the DBNF.

Philadelphia Insurance has also supported our projects, a connection made possible through the Arbor Day Foundation. Philadelphia Insurance provided 80,000 trees to reforestation projects. Employees from Philadelphia Insurance also joined us for two days of tree planting on the DBNF and planted 4,450 trees.



BEREA COLLEGE

Berea College, a liberal arts college located in Berea, Kentucky, was one of the first college groups that participated in tree plantings with GFW. Involvement has included students from multiple departments (Education Studies, Agriculture and Natural Resources, Appalachian Studies, Sustainability and Environmental Studies) as well as a number of extracurricular groups. Dr. Sarah Hall brought students from the college to participate in the DBNF plantings in 2016, 2017, 2019 and 2022. While many Berea College students are from the mountains of Appalachia, many are not, and involvement in a project like this allows those who are not from the region to learn about the environmental consequences of coal mining and connect with the land as well as their classmates from the region.



BOY SCOUTS

GFW has a long history of engaging Boy Scouts in our reforestation projects. Since 2010, GFW has provided opportunities for Scouts to get community service hours through tree planting and earn a Forestry Merit Badge. Several Boy Scout Troops participated in the DBNF planting projects in 2016, 2017, 2019 and 2022. They are always enthusiastic about the work and enjoy the camping opportunities at the planting sites.



KENTUCKY ARTISTS AND WRITERS

Author, environmental advocate and University of Kentucky writing professor Erik Reece along with Eric Scott Sutherland, a consulting arborist with Town Branch Tree Experts, and activist Chuck Clenney started Kentucky Writers and Artists for Reforestation in April 2017. Partnering with GFW, the group planted 3,000 trees on a legacy mine in Breathitt County, KY. During its second event, in October 2017, the group planted 800 acorns on the DBNF Pine Creek Church Road mine in honor of the 800th anniversary of The Charter of the Forests, signed in 1217 by King Henry III as a companion document to the Magna Carta. The document was among the first in history to recognize access to public lands as a basic human right. A kiosk and meditation trail were erected at the site to memorialize the event. They returned to the site in 2022 to backfill 1,040 more trees in areas where they were needed.





UNIVERSITY OF KENTUCKY HONORS COLLEGE

Dr. Kenton Sena's HON 301 "Ecology of the Middle Earth" class joined us for Middle Earth Day at the Wildcat site on March 27, 2021. His students braved the rain to plant 1,200 shortleaf pine seedlings to increase the stocking rate and diversity at GFW's 2019 reforestation site on the DBNF. After the planting was complete, students read passages from J.R.R. Tolkien's "The Lord of the Rings" that pertained to trees and the environment. They used the text to explore what it means to be "fully human" in our ecosystems. Dr. Sena brought another class to the site for planting in 2022. No rain this time, but plenty of snow!



APPALACHIAN CONSERVATION CORPS

The Appalachian Conservation Corps (ACC) is a non-profit, AmeriCorps-affiliated organization that works on public lands throughout the central Appalachian region. Members are generally 18-25 years old and are placed on work crews that vary in size. Work crews are tasked with completing various conservation projects which helps them to gain knowledge, acquire experience, and learn new skills. Through a grant from the National Forest Foundation and in cooperation with the US Forest Service, GFW trained and employed two crews of eight individuals to work on the reforested coal mines in the DBNF during the Fall of 2020 and 2021.

Each crew has its own crew leader so the crew can operate without supervision, and by camping on site, the crew does not waste time traveling each day, particularly where work sites are remote. The crews completed a nine-consecutive-day period of work, or “hitch” each year. Using chainsaws and herbicide, the 2020 crew eradicated Autumn olive (*Elaeagnus umbellata*), an invasive deciduous shrub native to Asia, across the 29-acre Pine Creek Church Road site. Likewise, the 2021 crew removed 17.9 acres of the non-native invasive species at the Wildcat site.

All project goals were accomplished by both crews, and additional work was completed beyond what was originally planned.

The young adults sharpened their skills and acquired many new ones. Hard work by the teams helped to build character and enhanced their sense of leadership. GFW and USFS staff educated the crews on the reasons for the greater ecological restoration work on the mined lands and their role in it, which elevated their sense of environmental responsibility and stewardship. Crew members had positive and memorable experiences, while enhancing the impact of the mined land restoration work and fulfilling project needs.



WHITE FRINGELESS ORCHID RESTORATION

At Green Forests Work, we take pride in the fact that we plant millions of trees. However, dense closed-canopy forests are not always the endpoint we hope to achieve. Many forests of the eastern US were historically maintained as woodlands through fire and foraging of megafauna (elk and bison). These woodlands contained canopy openings that allowed grasses, wildflowers and other herbaceous and shrubby vegetation to thrive. With fire suppression and loss of key wildlife foragers (although the elk are making a comeback), many woodlands have succeeded to closed-canopy forests at the expense of the herbaceous understory community.

On a rainy spring day in 2017, we visited a small wetland in southeastern KY that had once been the home to an orchid species that is listed on the Endangered Species Act, the white fringeless orchid (*Platanthera integrilabia*). From previous research, it was determined that the orchid population had likely disappeared due to a combination of shade from a dense canopy and drying of the wetland. With chainsaws in hand we created canopy gaps in the wetland that day to allow sunlight to penetrate the forest floor and to decrease the evapotranspiration demand of the forest. We also used some of the downed woody debris to clog up ditches in the wetland and slow the release of water. It was a long and wet day, but fulfilling in the hopes that our efforts could potentially help an imperiled species.

Fast-forward two years.....SUCCESS! Quite a site to see not just a few, but HUNDREDS of orchids in full bloom. Not only were the orchids able to come back, but they were spread throughout the wetland. These results provide optimism that the species can be restored and have sparked interest in doing similar work in other wetlands that were once home to this beautiful flower.

Following the success of this restoration effort, we have embarked on a five-year effort to restore several additional wetlands in the DBNF that previously contained the white fringeless orchid. Restoration activities began in spring 2022 on a site in the Sterns Ranger District. Approximately half of the wetland interior trees, primarily red maple, were felled to increase light and decrease evapotranspiration demand. Subsequently, with assistance from the Kentucky Nature Preserves, we transplanted 13 vegetative *Platanthera integrilabia* plants (single leaves), 4 cleistes (2 were in bud), and 5 *Platanthera clavellata* to an area of the wetland that would be safe from heavy equipment use.

Using an excavator, we utilized the felled logs to create seven debris dams in a channelized area of the wetland where water was seeping away from the site. The debris dams were lined with geotextile to help slow the water and create saturated conditions at the soil surface. A groundwater dam that extended the entire valley of the small watershed was also constructed just below the wetland to help raise the water level. Vegetation monitoring plots were installed prior to construction and will be revisited in summer 2022 to evaluate orchid, and other vegetation, response.





CONCLUSION

Ecological restoration on the DBNF has provided many opportunities and benefits. These efforts have helped to reduce forest fragmentation and restore ecosystem services. Replacing invasive species with native trees and shrubs will protect the surrounding forest's health while creating an early successional habitat that will provide numerous wildlife benefits in the short term and ultimately benefit forest interior species as the trees mature. Similarly, wetland restoration activities will hopefully bring back a rare vegetation community that was nearly lost in Kentucky forests. This work has contributed to the development of a regenerative economy in an economically distressed region of the United States and created jobs. These public land restoration projects also provide great opportunities for research, education, and outreach. GFW is thankful for the opportunity to partner with the USFS-DBNF and others on these projects and looks forward to continued partnership in the future.

