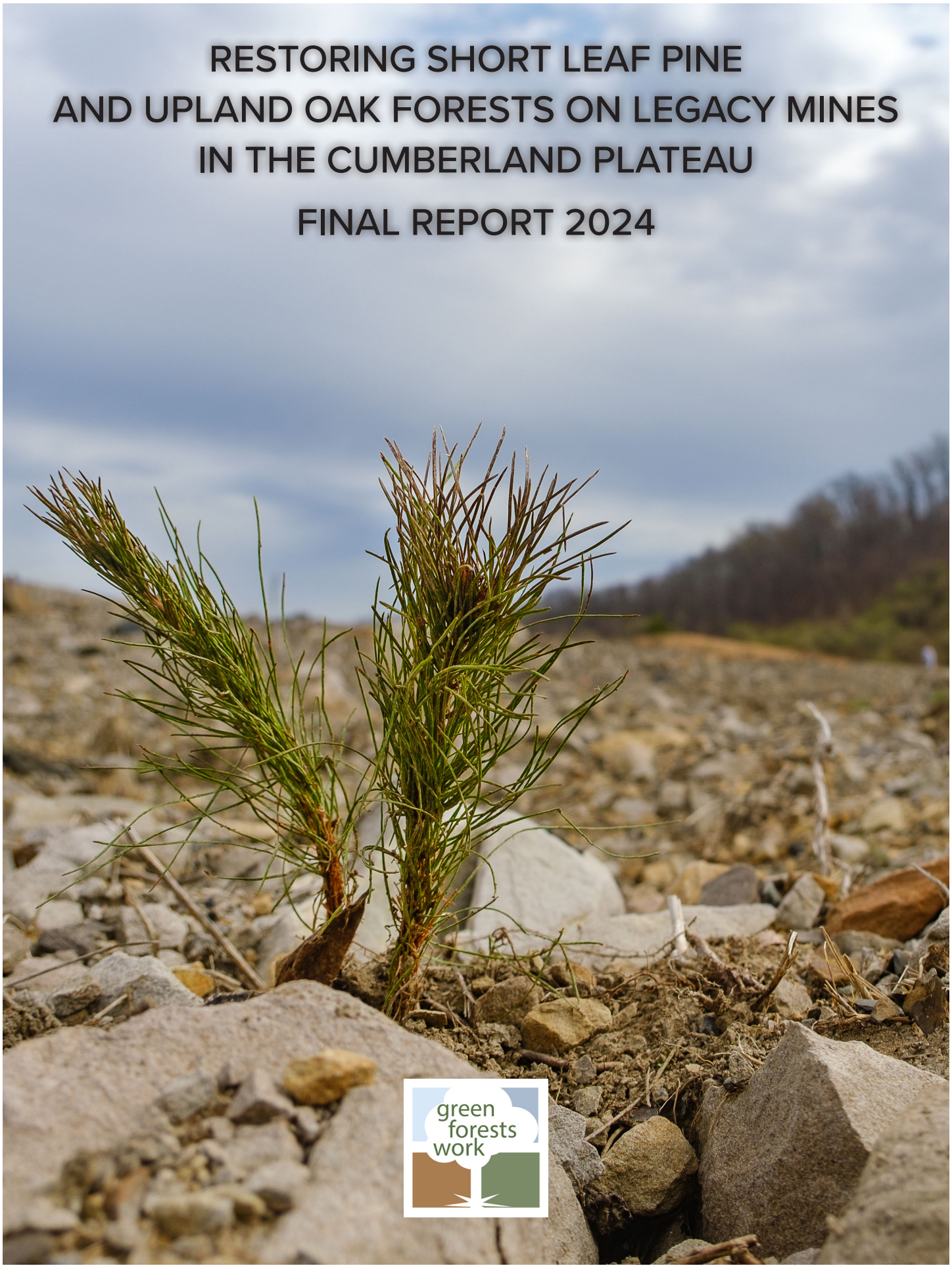
RESTORING SHORT LEAF PINE AND UPLAND OAK FORESTS ON LEGACY MINES IN THE CUMBERLAND PLATEAU

FINAL REPORT 2024



GREEN FORESTS WORK'S MISSION

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

VISION

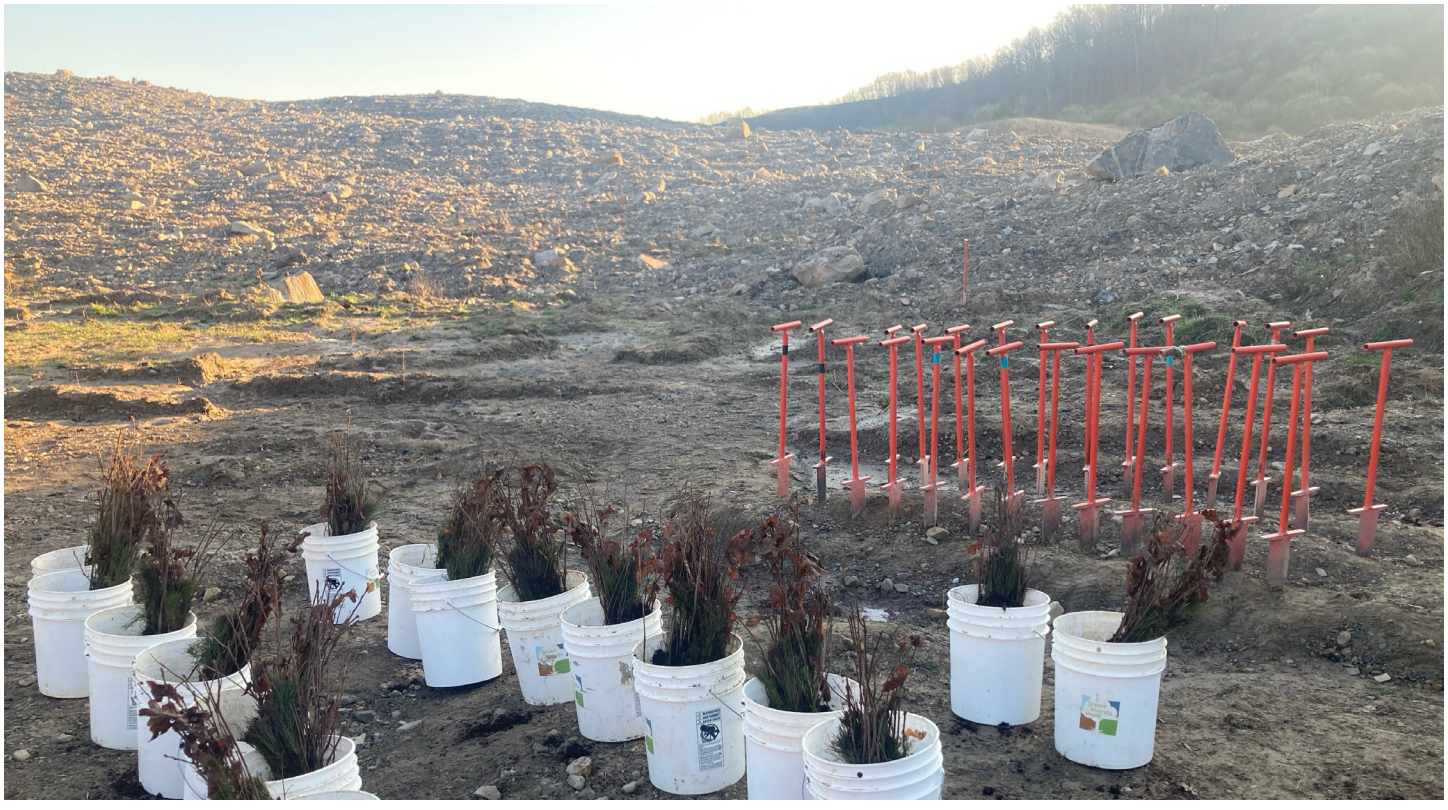
GFW's vision is to create a renewable and sustainable multi-use resource that will provide economic opportunities while enhancing the local and global environment by converting reclaimed, non-native grasslands and scrub lands into healthy, productive forestland.

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 nearly seven million trees on more than 12,000 acres.

BACKGROUND

GFW is a 501(c)(3) nonprofit organization housed at the University of Kentucky. In 2019, to further its mission of conserving the lands and waters on which all life depends, The Nature Conservancy (TNC) acquired 253,000 acres in Tennessee, Kentucky, and Virginia. The acquisition included the Ataya property which spans 100,000 acres at the KY-TN border and contains thousands of acres that have been impacted by surface mining. This project was created to restore shortleaf pine-upland oak forest communities on portions of the TNC Ataya property in southeast Kentucky. The short-term objectives of this project were to remove invasive species, de-compact soil, and restore native vegetation across 160 acres of formerly mined land that had been reclaimed as hay/pastureland before its acquisition by TNC. The long-term goals were to re-establish shortleaf pine-upland oak-influenced forests, improve air and water quality, improve forest resiliency, and make the sites more productive for wildlife. This report details GFW's reforestation efforts undertaken from 2022 to 2024 for the National Fish and Wildlife Foundation (NFWF) Cumberland Plateau Stewardship Fund grant on TNC's Ataya properties in Leslie, Harlan, and Knox counties of Kentucky.



The Ataya site before a day of volunteer planting.

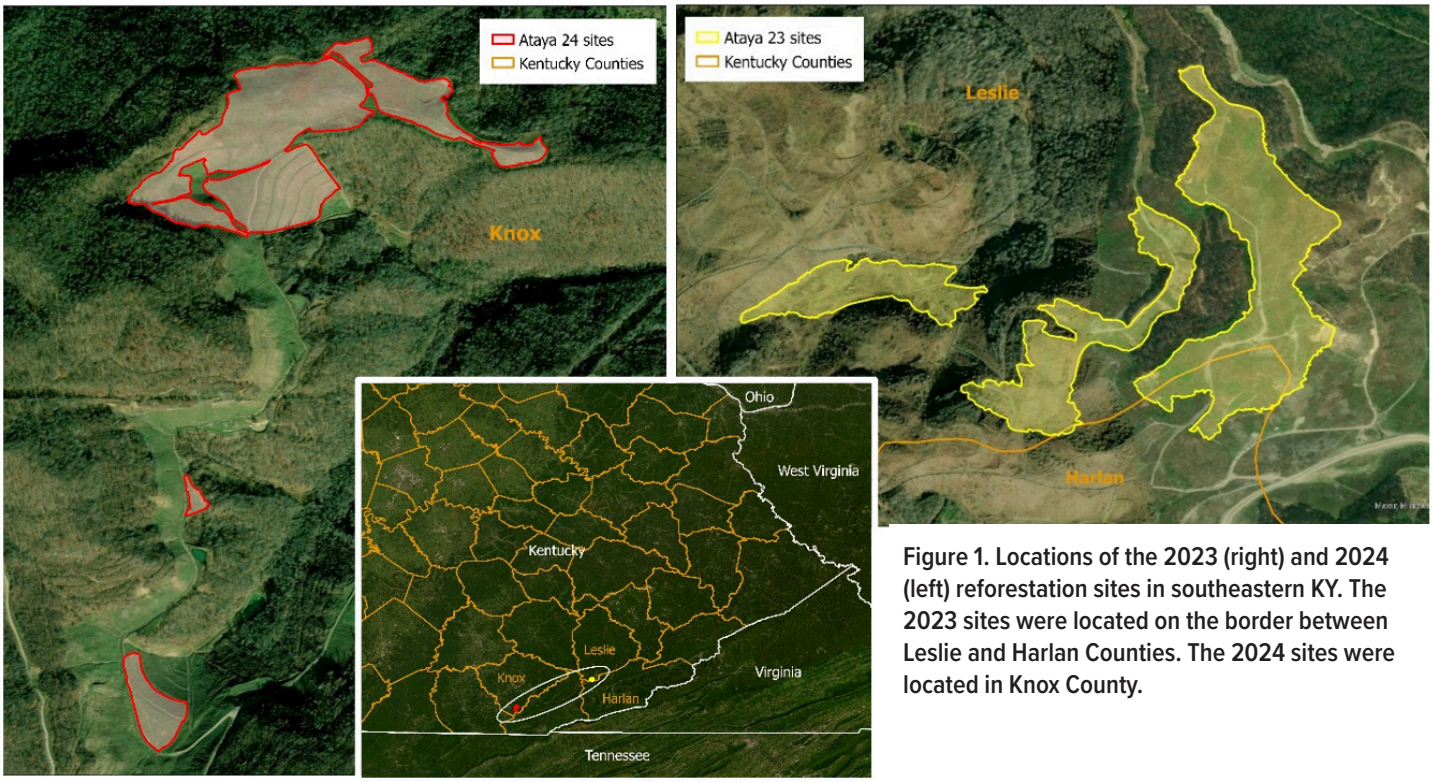


Figure 1. Locations of the 2023 (right) and 2024 (left) reforestation sites in southeastern KY. The 2023 sites were located on the border between Leslie and Harlan Counties. The 2024 sites were located in Knox County.

PROJECT IMPLEMENTATION

TNC staff surveyed sites that lie along the Leslie County and Harlan County border in the early summer of 2022 (Figure 1). TNC and GFW staff developed a plan to restore native forest habitat on the surface mined areas. The groundcover consisted primarily of sericea lespedeza (*Lespedeza cuneata*), an invasive, exotic species, which was outcompeting the other native forbs and grasses. Because the land was not managed for hay production or grazed, some trees and shrubs had established. However, the shrubs primarily consisted of invasive, exotic species including autumn olive (*Elaeagnus umbellata*) and multiflora rose (*Rosa multiflora*) (Figure 2). Few native trees other than American sycamore (*Platanus occidentalis*) were established on the site, and these were stunted due to the excessively compacted soil that resulted from mining reclamation. Since the desired outcome was the restoration of shortleaf pine-upland oak forest on the site, GFW recommended removing the non-native vegetation and mitigating the compacted ground prior to planting a diverse mix of native trees and shrubs that would closely resemble the vegetative community that would have been present on the site, prior the surface mining.

In July of 2022, GFW contracted a local company to use small bulldozers to remove the thick groundcovers and unwanted woody vegetation by pushing it into piles and "weep berms" within the reforestation areas and at the project perimeters (Figure 3). The objective was to remove the unwanted vegetation, as well as the top few inches of soil that contains the seedbank, which is composed primarily of seeds of non-native, undesirable species. However, the sod and soil that was removed is not topsoil in the conventional sense. The soil that was removed is largely composed of rock overburden that was used as a growth medium during mining reclamation. The

Figure 2. The Ataya property before site preparation in 2022. The site was inundated with an invasive grass species, sericea lespedeza, and the woody vegetation is predominately autumn olive, an invasive shrub species.

berms that were created at the project perimeter are composed of the sod, soil, and woody vegetation, and they serve as habitat for insects, birds, amphibians, reptiles, and mammals as they settle and the vegetation decomposes. The weep berms also help prevent or slow surface runoff of water from the areas and prevent offsite erosion and sedimentation of downstream watersheds.

After the vegetation removal was completed, a large bulldozer equipped with two, three foot ripping shanks mounted directly behind each track was used to loosen the ground, which had been excessively compacted during mining reclamation. Soil decompaction was accomplished by pulling the ripping shanks, fully immersed into the soil, behind each track of the bulldozer (Figure 4). The project area was cross-ripped by first ripping back and forth across the site on 8' spacing between rips. Wherever possible, the bulldozer operator then oriented the bulldozer perpendicularly to the first rows of rips and ripped the entire site a second time on 8' spacing to create a cross-hatch pattern. Vegetation removal and cross-ripping was conducted on a total of approximately 94 acres.

Cross-ripping loosens soils to create a better rooting medium for trees, allowing tree roots to extend in multiple directions and improving sites' hydrologic characteristics. The loosened soil increases infiltration rates, so that precipitation is absorbed and more slowly released from the area. Ripping the compacted land immediately creates a rough ground surface and exposes large rocks, creating microsites that will provide cover for insects, small mammals, reptiles, and amphibians. Some exposed soil results temporarily after vegetative clearing and cross ripping, which

Figure 3. Unwanted vegetation and the top three inches of soil are pushed into berms within the project area and at the perimeters. They serve as habitat for insects, birds, amphibians, reptiles, and mammals as well as helping preventing offsite erosion and sedimentation of downstream watersheds.

reduces herbaceous competition and allows planted seedlings to establish. However, the bare soil is quickly colonized by native plant species, increasing species richness and initiating the natural succession process. The exposed soil allows additional woody colonizers to take hold, including many native trees and shrubs that are not included in the species prescription. Many of our projects show a flush of native flowering herbaceous species after ripping which benefits pollinators, including butterflies, moths, and bees.

Site preparation was completed in September 2022. On January 29th and February 5th, 2023, a planting crew from Williams Forestry and Associates (WFA) planted 52,000 tree and shrub seedlings

Figure 4. After the vegetation and the top three inches of soil is removed (left), a large bulldozer equipped with two, three foot ripping shanks decompacts the soil (right).

purchased from Kentucky Division of Forestry (KDF) and Native Forest Nursery (NFN). The diverse mix of seedlings, consisting of 18 species, was planted on an approximate 8' x 8' spacing in the ripped ground, with trees planted at the intersections of the cross-rips, when those areas could be identified. The professional planters planted approximately 74 acres. To assist with the establishment of native herbaceous species, the planters also broadcast a mix of 470 lbs. of native warm season grasses and wildflower seeds purchased from Roundstone Native Seed.

The remaining 20 acres was reserved for several volunteer planting events in the Spring of 2023. On March 6th, a group from Radford University consisting of 18 faculty and students planted 1,200 seedlings. On March 7th, a group of 46 students and staff from the University of Kentucky's Lewis Honors College and College of Food, Agriculture, and Environment planted 1,400 seedlings. Twenty-eight members from Berea College and Kentucky Writers and Artists for Reforestation planted 1,300 seedlings. The final volunteer planting at these sites was a 2-day event with 50 employees from Beam Suntory, the spirits company noted for their Jim Beam and Maker's Mark bourbon. They planted 8,085 seedlings. In total, 142 volunteers planted 11,985 trees.

In September of 2023, another site for this project was identified and surveyed in Knox County (Figure 1). Like the sites in Leslie and Harlan County, it was heavily invaded by sericea lespedeza and autumn olive and also had compacted soils that prevented tree growth. GFW prescribed the same restoration treatment with the goal of restoring an upland oak-shortleaf pine forest type. Site prep occurred in January 2024. Three vernal wetlands existed on the property. GFW flagged their perimeters and instructed the contractors to leave the wetlands untouched. Over two days in February, a WFA planting crew hand-planted 50,000 tree and shrub seedlings purchased from KDF and NFN. Of the 50,000 seedlings, 46,000 were bare-root and 4,000 were plugs. The professional planters planted 76 acres. During the tree planting, the Williams Forestry crew also broadcast 350 lbs of native warm season grasses and wildflower seeds. Because of the difficulty in accessing the site, volunteer planting events were not held at this site.

Top 2 photos: A group of faculty and students from Radford University helped us to reforest a former surface mine on TNC's Cumberland Forest Ataya property in Leslie and Harlan Counties in eastern Kentucky on Monday, March 6, 2023. Bottom 2 photos: Participants from Beam Suntory planted 8,085 trees on approximately 10 acres on the Cumberland Forest Ataya property.

Table 1. Species, number planted, and percent of the mix for each species over both years combined.

Species	Species Scientific Name	Total Planted	% of Total
White Oak	*Quercus alba*	34,356	30.14
Chestnut Oak	*Quercus montana*	8,871	7.78
Northern Red Oak	*Quercus rubra*	9,845	8.64
Black Oak	*Quercus velutina*	5,435	4.77
Shortleaf Pine (plugs)	*Pinus echinata*	4,038	3.54
Shortleaf Pine (bare root)	*Pinus echinata*	16,640	14.60
Black Cherry	*Prunus serotina*	7,897	6.93
Scarlet Oak	*Quercus coccinea*	3,150	2.76
Shagbark Hickory	*Carya ovata*	5,585	4.9
American Chestnut	*Castanea dentata*	3,250	2.85
Yellow Poplar	*Liriodendron tulipifera*	3,561	3.12
Persimmon	*Diospyros virginiana*	1,974	1.73
Sweet Birch	*Betula lenta*	1,974	1.73
Sycamore	*Planatus occidentalis*	987	0.87
Black Locust	*Robinia pseudoacacia*	987	0.87
Red Maple	*Acer rubrum*	987	0.87
Wild Plum	*Prunus americana*	987	0.87
Red Mulberry	*Morus rubra*	987	0.87
American Hazelnut	*Corylus americana*	987	0.87
Silky Dogwood	*Cornus amomum*	987	0.87
Eastern Redbud	*Cercis canadensis*	500	0.44
TOTAL		**113,985**	**100**

OUTCOMES AND FUTURE WORK

In total, 170 acres of surface mined land were prepared and planted with 113,985 seedlings and 820 lbs of native warm season grasses and wildflower seed to restore upland oak-shortleaf pine forest on Ataya properties in Leslie, Harlan, and Knox counties of Kentucky (Table 1, 2, and 3). In 2023, 94 acres were planted with 63,985 seedlings and sown with 470 lbs of seed in Leslie and Harlan County. In 2024, 76 acres were planted with 50,000 seedlings and sown with 350 lbs of seed in Knox County. Even though we originally planned for the reforestation of 160 acres, we were able to restore and plant an additional 10 acres due to the procurement of additional funding. As the site matures, site maintenance may be necessary to achieve the desired stand composition. TNC has plans to maintain these areas through management activities such as prescribed burning and herbicide applications.

In the 2024 planting, the Native Forest Nursery did not have enough shortleaf pine as bareroot seedlings in their inventory to complete our order. Since shortleaf pine is an integral species for the forest type we desired, we supplemented the order with shortleaf pine plugs. Bareroot seedlings are lifted out of the ground and the roots are clean of soil material. Plugs are grown in thin, long containers or trays, so their roots are bound up with soil material (Figure 4). Because we had both types of seedlings as shortleaf pine, we set up research blocks to compare their growth and survival rates. Initial plot monitoring will occur in July 2024.

Seedlings can be purchased as either plugs (left) or bareroot (right). Volunteers use dibble bars to plant seedlings.

Table 2. Species, number planted, and percent of the mix for each species for 2023 and 2024.

Species	Number Planted 2023	Percent of 2023 Mix	Number Planted 2024	Percent of 2024 Mix
White Oak	24,356	38.06	10,000	20
Chestnut Oak	4,871	7.61	4,000	8
Northern Red Oak	5,845	9.13	4,000	8
Black Oak	2,435	3.81	3,000	6
Shortleaf Pine (plugs)	--	--	4,038	8.1
Shortleaf Pine (bare root)	12,178	19.03	4,462	8.9
Black Cherry	3,897	6.09	4,000	8
Scarlet Oak	--	--	3,150	6.3
Shagbark Hickory	2,435	3.81	3,150	6.3
American Chestnut	1,150	1.80	2,100	4.2
Yellow Poplar	1,461	2.28	2,100	4.2
Persimmon	974	1.52	1,000	2
Sweet Birch	974	1.52	1,000	2
Sycamore	487	0.76	500	1
Black Locust	487	0.76	500	1
Red Maple	487	0.76	500	1
Wild Plum	487	0.76	500	1
Red Mulberry	487	0.76	500	1
Hazelnut	487	0.76	500	1
Silky Dogwood	487	0.76	500	1
Eastern Redbud	--	--	500	1
TOTAL	**63,985**	**100**	**50,000**	**100**

Table 3. Species and rates of native grasses and forbs that were broadcast across the ripped areas in 2023 and 2024.

Species	2023 lb/acre	2023 lbs	2024 lb/acre	2024 lbs
Grasses				
Little Bluestem	1.0	94	0.92	70
Big Bluestem	1.0	94	0.92	70
Swtichgrass	1.0	94	0.92	70
Indian Grass	0.5	47	0.46	35
Side Oats Grama	0.5	47	0.46	35
Subtotal Grasses	**4.0**	**376**	**3.68**	**280**
Forbs				
Purple Coneflower	0.150	14.10	0.14	10.50
Maximilian Sunflower	0.150	14.10	0.14	10.50
Partridge Pea	0.100	9.40	0.09	7.00
Wild Senna	0.100	9.40	0.09	7.00
Showy Tickseed	0.100	9.40	0.09	7.00
Common Milkweed	0.050	4.70	0.05	3.50
Illinois Bundle Flower	0.050	4.70	0.05	3.50
Lance-Leaved Coreopsis	0.050	4.70	0.05	3.50
False Sunflower	0.050	4.70	0.05	3.50
Blackeyed Susan	0.050	4.70	0.05	3.50
Greyheaded Coneflower	0.050	4.70	0.05	3.50
Indian Blanket	0.050	4.70	0.05	3.50
Browneyed Susan	0.025	2.35	0.02	1.75
Bergamot	0.025	2.35	0.02	1.75
Subtotal Forbs	**1.000**	**94.00**	**0.94**	**70.00**
Total	**5**	**470**	**4.62**	**350**

PARTNERS

National Fish and Wildlife Foundation
Beam Suntory
The Nature Conservancy
Sheldon and Audrey Katz Foundation
American Chestnut Foundation
Arbor Day Foundation
Great Lakes Cheese
Arctic Express

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