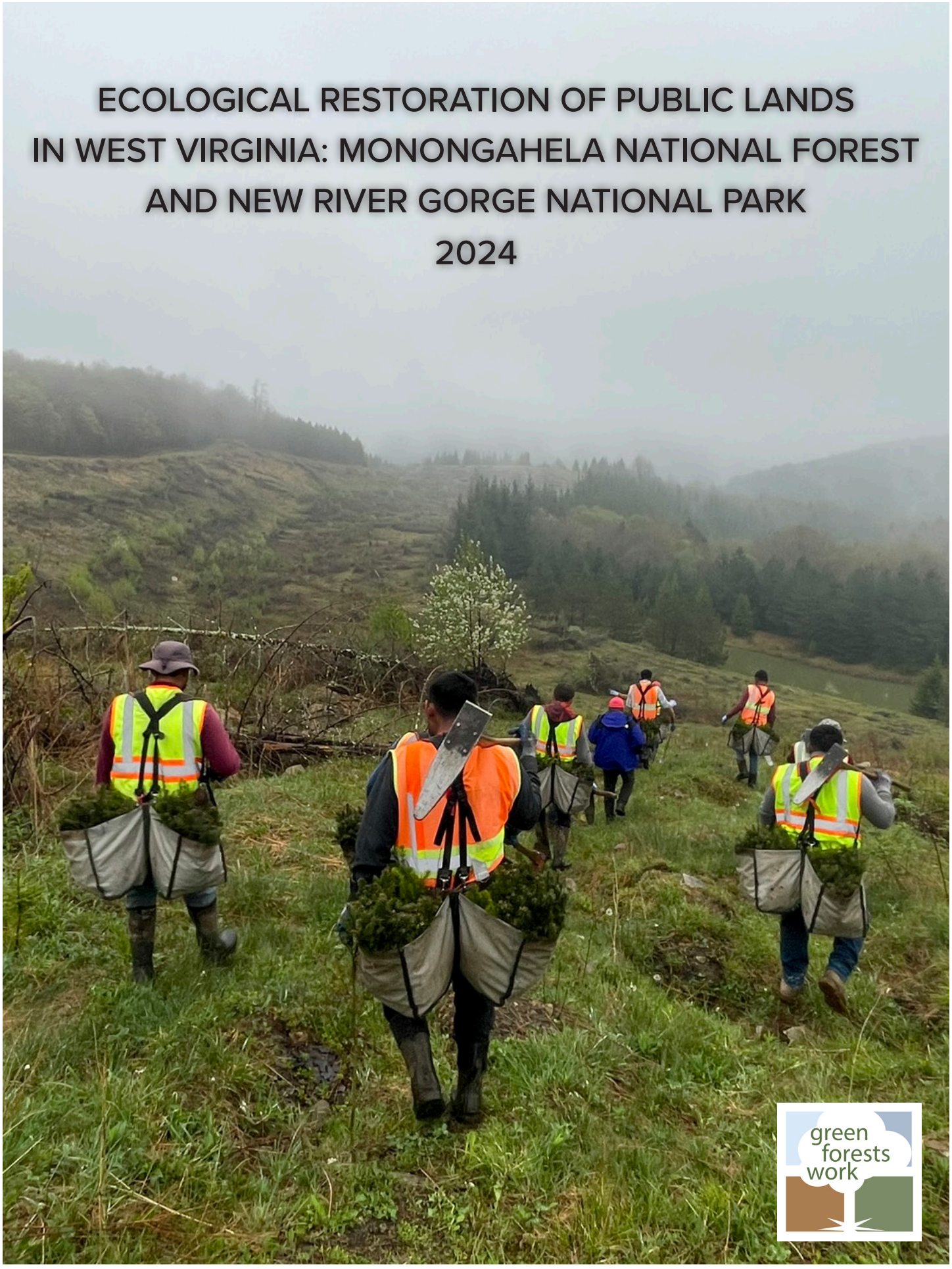
ECOLOGICAL RESTORATION OF PUBLIC LANDS IN WEST VIRGINIA: MONONGAHELA NATIONAL FOREST AND NEW RIVER GORGE NATIONAL PARK

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.

OVERVIEW

GFW, USDA Forest Service – Monongahela National Forest, USDI National Park Service – New River Gorge National Park and Preserve, National Fish and Wildlife Foundation, Arbor Day Foundation, Komatsu, Mennen Environmental Foundation, Scheidel Foundation, Proteus Foundation, The Nature Conservancy and other partners initiated a project to restore native forests on lands disturbed by surface coal mining in the Central Appalachian Region. This collaborative, science-based restoration project aims to address priority goals associated with both the Central Appalachian Spruce Restoration Initiative and the White Oak Initiative. The project includes reclaimed mine tracts in West Virginia in the Monongahela National Forest (MNF) and in the New River Gorge National Park (NRG). A holistic suite of restoration activities including invasive plant control, soil decompaction, and planting of native trees and shrubs for 50 acres in the MNF and 224 acres in the NRG were initiated in 2024. Vernal wetlands will be created and native pollinator seed will be sown at each site. This work will break the current state of "arrested succession" and restore habitat for neotropical migratory songbirds, Northern flying squirrel, native brook trout, ruffed grouse and numerous species that inhabit wetlands. In addition, restoration activities will improve watershed conditions by providing thermal protection for headwater streams, preventing erosion and subsequent stream sedimentation. This report provides an overview of accomplishments from the first year of work on the project.

Volunteer planters get instructions on proper tree planting techniques.

MONONGAHELA NATIONAL FOREST: THE MOWER TRACT

SITE HISTORY AND PROJECT GOALS

The Mower Tract (40,000 acres) of the Monongahela National Forest was purchased from the Mower Land and Lumber Company in the early 1980s. It is located on Cheat Mountain (4,848 ft elevation) in Randolph and Pocahontas Counties, West Virginia (Figure 1). The Mower Tract and the surrounding high elevation areas were historically dominated by old-growth red spruce and red spruce-northern hardwood forests; but after the industrial logging era of the late 19th and early 20th centuries, the red spruce ecosystem in the West Virginia highlands was reduced by an estimated 90%. Clear-cut slash ignited unnaturally hot wildfires, which eliminated the red spruce seed source and caused former red spruce forests to be replaced by even-aged, hardwood dominated forests. Extensive logging was linked to regional flooding and was key to the establishment of the Monongahela National Forest.

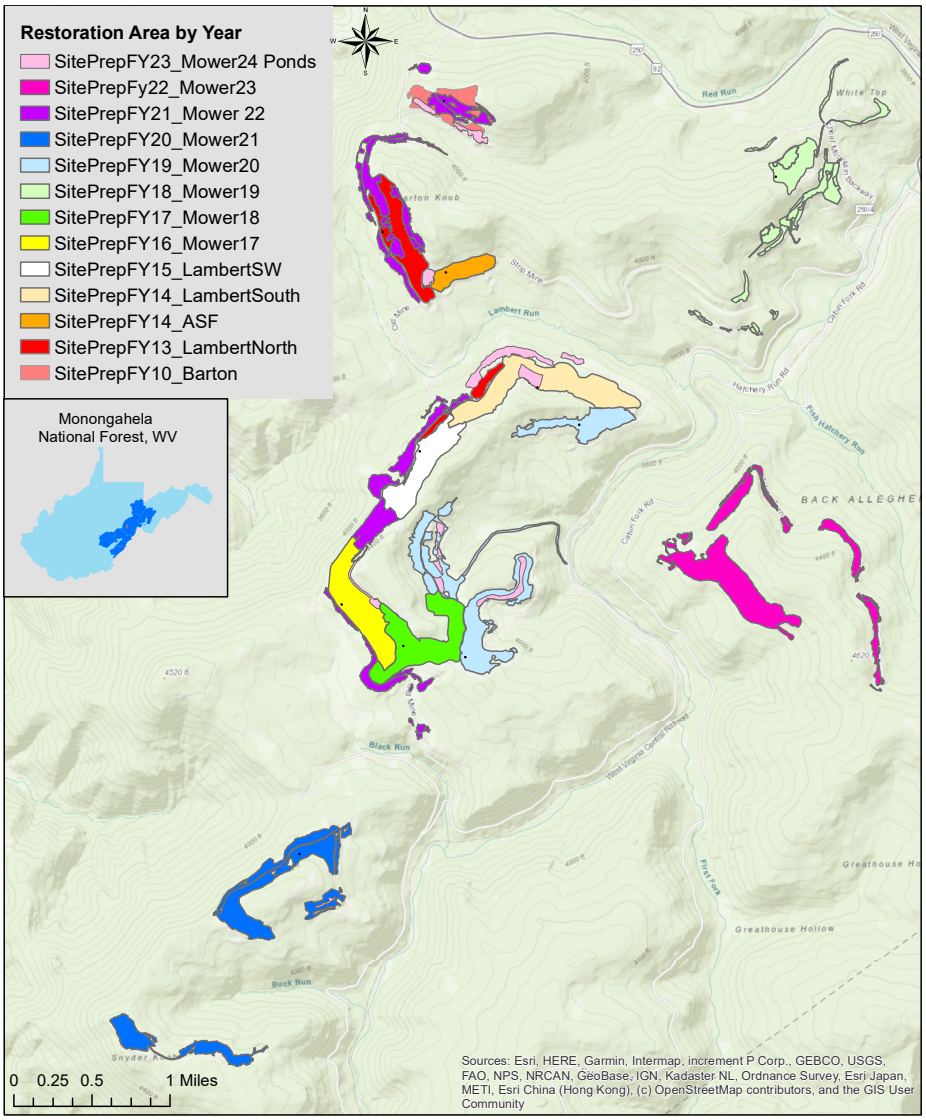


Figure 1. Mower Tract Restoration through 2024.

In addition to logging, coal mining further reduced and prevented the re-establishment of red spruce communities in West Virginia. In the Mower Tract, approximately 2,000 acres were surface mined for coal. Reclamation laws required mining companies to return the site to approximate original contour and to control erosion, which was accomplished by compacting soils and planting non-native trees or seeding aggressive grasses and legumes. The Mower Tract was reclaimed to non-native conifer plantations and pasture and remained this way for over 30 years. Native species could not recolonize the reclaimed sites because of the compacted soils and thick grass cover.

Starting in 2010, the U.S. Forest Service began a partnership with GFW and a host of partners to conduct a suite of restoration activities, including non-native species removal, organic matter loading, soil decompaction, mined land reforestation, and wetland creation. In the short term, the goal is to create an early successional habitat, with the ultimate goal being to establish a forest that is at least 30% red spruce. Ancillary benefits include improved water quality, enhanced wildlife habitat, and improved ecosystem services, such as carbon sequestration. To date, nearly 900,000 seedling have been planted on nearly 1,500 acres at the Mower Tract in the MNF (Table 1).

Table 1. Summary of the native tree and shrub species and herbaceous species that have been planted on the Mower Tract restoration areas over the years, along with their percentages of the total.

Common Name	% of Total	Common Name	% of Total	Common Name	% of Total
Red Spruce	41.90	Ninebark	0.47	Red Chokeberry	0.01
Bigtooth/Quaking Aspen	9.17	Ironwood	0.33	Steeplebush, Pipestem	0.01
Speckled Alder	7.49	Witch hazel	1.14	Highbush Cranberry	0.01
Black Cherry	5.30	Lowbush Blueberry	0.25	Red Mulberry	0.01
American Mountain Ash	2.63	Red Elderberry	0.54	Swamp Rose	0.06
Winterberry Holly	2.23	Alternate Leaf Dogwood	0.28	Black Birch	0.00
Silky Dogwood	2.37	Hawthorn	0.26	Mountain Holly	0.00
Red Osier Dogwood	2.17	Basswood	0.18	Hemlock	0.00
Arrowood Viburnum	1.75	Beech	0.16	Catberry	0.04
Sugar Maple	1.40	Yellow Birch	0.16	Black Raspberry	0.00
Red Maple	1.49	Red Oak	0.08	Skunk Current	0.00
Black Chokeberry	3.11	Blackhaw	0.07	Wild Grape	0.00
Serviceberry	1.59	Bush Honeysuckle (Native)	0.74	Staghorn Sumac	0.24
Hazelnut	1.37	Nannyberry	0.18	Devil's Walkingstick	0.03
Chokecherry	1.62	Fraser Magnolia	0.04	Other	0.05
Wild Raisin	0.56	American Plum	0.17	Maple Leaf Viburnum	0.17
Cucumber Magnolia	0.53	Pin Cherry	0.03	Mountain Maple	0.35
Balsam Fir	4.88	Bear Oak	0.03	Hazel/Smooth Alder	0.34
Black Elderberry	1.18	Silky Willow	0.04	**TOTAL Trees**	**100.00**
American Chestnut	0.40	Red Raspberry	0.01		
Willow	0.37	Late Figwort	0.01		

RESTORATION BENEFITS

RED SPRUCE

Red spruce (*Picea rubens*) influenced forests have severely declined in West Virginia: The Red Spruce – Yellow Birch Forest (G2S2) and the Red Spruce – Southern Mountain Cranberry Forest (G2S1), which surrounds the Mower Tract, are imperiled[1] and critically imperiled[2] communities within the state, respectively. Protecting and re-establishing these communities is of conservation concern because they support 240 rare species in West Virginia alone. Red spruce have a limited range due to their specific site requirements. They grow best in cool, moist climates, which is why the high elevations of the Appalachian Mountains are one of the few places that can support their growth. Cheat Mountain, where the Mower Tract is located, has been identified by the Central Appalachian Spruce Restoration Initiative and The Nature Conservancy as a key red spruce corridor and top priority for conservation. Corridors connect large communities together, acting as roadways for all the living things within them. Having these connections between large communities allows species to move further north as the southern extent of their range becomes inhospitable due to climate change.

Contractors walk an excavator to the restoration area to begin pond decommissioning in fall of 2023.

[1] Imperiled (S2) is a conservation status designated by NatureServe meaning that the species has a high risk of extinction due to restricted range, relatively few populations (80 or fewer), recent or widespread declines, or other factors.

[2] Critically imperiled (S1) is a conservation status designated by NatureServe meaning that the species has a very high risk of extinction due to extreme rarity (five or fewer populations), very steep declines, or other factors.

Left: Aerial view of the ponds before work begins on their removal. Right: Post removal landscape in an area where one of the ponds was decommissioned. Bottom: The downgradient berm of the pond is eliminated and pushed into the depression where water once stood.

2024 MOWER RESTORATION

MINE POND DECOMMISSIONING

On the Mower Tract are a series of over one hundred abandoned sediment ponds that border the downgradient side of our restoration area. Under current SMCRA regulations, these would have to be removed as part of the reclamation process. However, these predated SMCRA and were allowed to remain and today serve little ecological benefit. Pre-mining, rain water was slowed by trees and vegetation, filtered into the soil, and slowly made its way underground to streams that reach the Shavers Fork of the Greenbrier River below the Mower Tract. After the mining, water was unable to infiltrate the soil due to heavy compaction by mining equipment, flowed quickly over the surface of the land and collected in the sediment ponds, where it was exposed to air temperatures and sunlight and warmed significantly before overflowing to streams and forest below the mined areas, contributing thermal pollution to the Shavers Fork. The problem is these warmer waters are increasing the temperature of this high elevation river habitat, which supports aquatic life that depend on cold waters, such as the native brook trout.

In an effort to address this problem, we initiated a project in 2023 to decommission the ponds and turn them into complexes of small wetlands with greatly reduced ponded area that can be planted with a mixture of wetland trees and shrubs that will grow and eventually shade the area. An area of approximately 60 acres will be converted to wetland complexes on the Mower Tract. Extensive earth moving and restructuring is required, so the project is being implemented in phases. Phase 1 eliminated 18 ponds on an area covering 23 acres and was planted in spring 2024.

TREE PLANTING AND SEEDING

In the fall of 2023, an excavator moved earth, decompacted edges of ponds, built porous "weep berms" that water can slowly release from, and extended soil area for planting with wetland shrubs and trees. In 2024, GFW and partners planted 100,754 trees and wetland shrubs of 18 native species on 23 acres of decommissioned mine ponds enhanced to wetland complexes as well as 36 acres of supplemental plantings in previous years' restoration areas. Before the planting, 100 lbs of native wildflower, legume, and grass seed was spread over the 23 acres of wetland complexes. Seed species included: rice cut grass, rattlesnake grass, foul managrass, beggar tick, deertongue, partridge pea, blue vervain, brown eyed Susan, boneset, arrowleaf tearthumb, great blue lobelia, mud plantain, big bluestem, and Indian grass.

Volunteers from Komatsu enjoy a day of "team-building" by planting trees with GFW and the Forest Service at the Mower Tract in spring 2024.

VOLUNTEER EVENT

This spring, a one acre section that had not been previously decompacted was "fluffed" using an excavator in preparation for a volunteer tree planting event with Komatsu in mid-May. GFW, USFS staff, and Komatsu executive staff toured the restoration areas and planted 1,500 red spruce, as well as 89 native honeysuckle and dogwood. Although the majority of the planting has been accomplished by professionals, 555 volunteers have assisted in these efforts over the years (Table 2).

Table 2. Yearly summary of restoration activities.

[1] In addition to the 192 ripped acres, 8 acres of nonripped slopes were planted.

[2] In addition to the 171 ripped acres, 18 acres of land ripped in the past project years were planted.

[3] In addition to the 28 fluffed acres where wetland complexes were built, 36 acres of land ripped in past project years were supplementally planted.

[4] Each eliminated pond retained an isolated wetland feature.

[5] There is overlap in the species planted each year. Across all years, a total of 60 different species have been planted.

Year Planted	Restoration Area (ac)	Wetlands Created	# Trees and Shrubs Planted	# Species Planted	Volunteers Engaged
2011	90	135	22,550	12	60
2013-2014	105	75	28,485	8	117
2015	116	279	46,937	11	49
2016	65	100	35,436	22	90
2017	95	318	76,782	32	90
2018	200	175	93,308	35	14
2019	58	192	51,108	23	85
2020	200[1]	84	92,318	21	0
2021	184	108	119,718	32	20
2022	189[2]	180	117,452	31	0
2023	160	60	105,215	20	0
2024	28[3]	18[4]	102,343	19	30
TOTAL	**1,490**	**1,724**	**891,652**	**60 total[5]**	**555**

OTHER PROJECTS

In addition to the mineland restoration work, GFW supports other tree planting projects in the Monongahela National Forest when the opportunity arises.

"Riparian areas in the headwaters of the West Fork Greenbrier River were improved through efforts of GFW in 2024. Elklick Run and Fox Run were planted with 12,536 red spruce on 46 acres. These areas were heavily impacted by past land use such as industrial logging and have continued to remain in an open canopy condition with relatively low plant diversity dominated by Canada goldenrod. Despite these streams occurring in high elevation landscapes where they should be strongholds for brook trout, the open canopy conditions result in temperature stress for coldwater species and brook trout occurrence is limited."

According to the MNF fisheries biologist, "The restoration of red spruce in these riparian areas will increase stream shade and directly improve conditions for coldwater dependent species like the brook trout. Further, red spruce prevalence in these areas will increase plant diversity indirectly by shading out some of the goldenrod and creating microclimates conducive to other species. The cooling effects of red spruce along these streams as well as the ability of spruce to increase riparian soil moisture holding capacity by deepening organic soils will provide improved aquatic ecosystem function downstream in the West Fork Greenbrier where the endangered candy darter and proposed threatened green floater mussel occur. The effects of red spruce in riparian areas builds resiliency for climate change extremes such as drought and flood stress."

- Chad Landress,
Forest Fisheries Biologist, Monongahela National Forest

RESEARCH HIGHLIGHTS

Over the years we have engaged a number of graduate students and undergraduate interns to perform research on various aspects of the ecological restoration project at the Mower Tract. With projects that have evaluated the success of spruce plantings to those that examine wildlife use of created wetlands and reforested areas to those that examine restoration techniques, seven graduate students have defended their theses and dozens of undergraduate students have gained valuable work and research experience. Recently, several of the projects listed below were published in scientific journals. We are committed to not only restoring these degraded lands in Appalachia, but to also providing the scientific evidence that our approach is working and anticipated results are being realized.

Students measure a red spotted newt found in a wetland at Mower.

Sherman, Lauren; Christopher D. Barton; Jacquelyn C. Guzy; Rebecca N. Davenport; John J. Cox; Jeffery L. Larkin; Todd Fearer; Jillian C. Newman; Steven J. Price. 2024. Wetland Creation and Reforestation of Legacy Surface Mines in the Central Appalachian Region (USA): A Potential Climate-Adaptation Approach for Pond-Breeding Amphibians? Water, DOI: 10.3390/w16091202

Price, Steven, Rebecca Davenport, Lauren Sherman, Jeffery Larkin, John Cox, Jillian Newman, Christopher Barton. 2024. Response of Red-backed Salamander (Plethodon cinereus) to the Forestry Reclamation Approach on Legacy Surface Mines in the Monongahela National Forest (West Virginia). Ecological Restoration, Volume 42, Number 2, June 2024, pp. 105-107. DOI: 10.3368/er.42.2.105

Rhodes, Benjamin and Christopher Barton. 2024. Comparing the response of red spruce plantings on legacy coal mines and old-field restorations sites in the WV highlands. Natural Areas Journal. 44(2) : 65-75. https://doi.org/10.3375/2162-4399-44.2.65

Snyder, Briana, Christopher Barton, Steven Price, Michael Lacki and Zach Hackworth. 2024. Bat activity on high elevation reforested coal mines in the Monongahela National Forest, WV. Ecological Restoration, Volume 42, Number 2, June 2024, pp. 108-122. DOI: 10.3368/er.42.2.108

A Komatsu PC 210 excavator scatters woody debris across the decompacted mine spoil. The woody material provides wildlife habitat, protects planted seedlings from deer browse, and provides environmental benefits such as the prevention of soil erosion, retention of soil moisture and soil organic matter input.

NEW RIVER GORGE: WAR RIDGE

SITE HISTORY AND PROJECT GOALS

The War Ridge site is located on Backus Mountain in Fayette County, WV. The NPS acquired the property in 2003. The site consists of four small areas that were surface mined for coal in the late 1980s to early 1990s and were connected by haul roads. Vegetation mainly consisted of native shrubs, herbaceous species, and moss. Non-native, invasive species were present but very minimal. Because of the excessive soil compaction from mine reclamation processes, very few native trees had successfully established, and those that did manage to survive had stunted growth and mostly included tulip poplar (*Liriodendron tulipifera*) and red maple (*Acer rubrum*). White pine (*Pinus strobus*), which had been planted during reclamation, was also present in one of the areas. Since reclamation, several wetlands have formed naturally.

The long-term goal for the four small areas, as well as the haul roads, was restoration of an upland oak-hickory forest type. Because of the lack of invasive species and existence of a unique vegetative community, GFW and NRG natural resource staff desired to keep as much of the soil in place as possible. Deep plowing the site was still necessary for soil decompaction, since it is necessary for tree growth and survival. This process will disturb the site, but if the soil containing the seed bank is still present, the vegetative community will start to return in the spring following the disturbance.

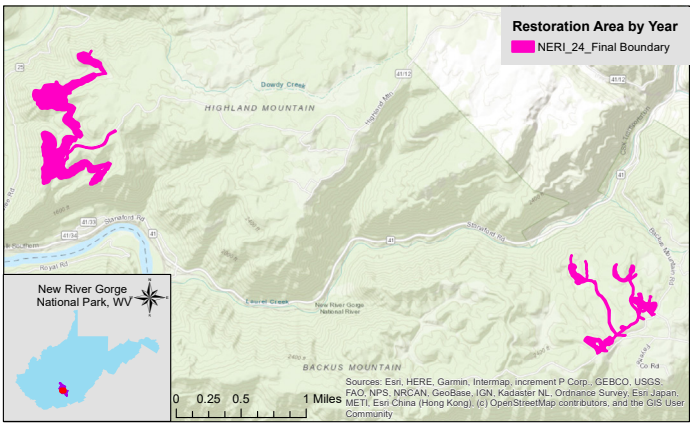


Figure 2. New River Gorge National Park mined land restoration 2024.The eastern polygon is War Ridge, and the western polygon is Hylton Strip.

A small bulldozer fells unwanted trees on the haul road.

Tree planters reforest a surface mine area which had been decompacted and partially covered with woody debris.

RESTORATION ACTIVITIES

Because NRG is known to host federally endangered bat species, felling timber is prohibited from April to November, when bats are utilizing trees for rest. In winter, bats are either hibernating in caves or have flown south. Subsequently, site preparation did not begin until mid-February. An NPS wetland specialist delineated and flagged the wetlands so that the contractors could work around their boundaries. A small bulldozer was used to fell the undesired and stunted trees. This woody debris was pushed to the project perimeters. When the dozer was not acting in this capacity, the blade was lifted off the ground to prevent soil removal as much as possible. Then a larger bulldozer equipped with two, three foot ripping shanks mounted directly behind each track was used to loosen the ground. Soil decompaction was accomplished by pulling the ripping shanks, fully immersed into the soil, behind each track of the bulldozer. 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.

On portions of the site that had large accumulations of woody debris, the contractors used an excavator to scatter the woody debris more evenly across the site. On the haul roads, the excavator was used to break down berms along the sides. Smaller trees were felled and scattered during this process. As the woody debris and logs decompose, they will provide valuable functions on the site. The dead wood provides a suitable growth medium for mosses, lichens, and fungi, which support a variety of wildlife. The woody debris also provides habitat for a variety of insects, birds, and mammals. As the wood decays, nutrients and organic matter are provided to the soil, increasing the soil's fertility and water-holding capacity. The downed trees also increase the rate of natural regeneration by acting as perches for songbirds such as Dark-eyed Juncos (*Junco hyemalis*), which spread native seed in their droppings.

The final activity of the heavy machinery was the opportunistic creation of wetlands. Four vernal pools and a series of step pools were created throughout the site. The step pools were created from a drainage from a nearby campground. The water will flow downslope, gathering and slowing at each pool, until it enters one of the previously designated wetlands. Restoration activities were conducted on a total of 30 acres.

Site preparation was completed the first week of March and the site was planted on March 26th. A professional planting crew from Williams Forestry and Associates (WFA) planted 26 acres with 18,650 tree and shrub seedlings purchased from Kentucky Division of Forestry (KDF) and Native Forest Nursery (NFN). The diverse mix of seedlings, consisting of 21 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. NRG natural resource staff also spread approximately 15 lbs of wetland seeds around the various wetland areas.

The remaining 4 acres were saved for a volunteer tree planting event. After acquiring the War Ridge property, NRG converted one of the areas into a campground with eight designated drive-in camping spots. Restoration activities occurred in the immediate vicinity of the campground, offering the public direct access to a restoration area. On April 20th, GFW and NGR staff were joined by 24 local community members, campers, and West Virginia University National Park Trust members at the campground to assist with the planting of 2,400 trees.

Table 3. Species, number of species, and percentage of planting mix of each species for New River Gorge.

Common Name	Species	Total Planted	% of Total
White Oak	*Quercus alba*	20,323	20.8
N. Red Oak	*Quercus rubra*	11,404	11.6
Scarlet Oak	*Quercus coccinea*	6,244	6.4
Chestnut Oak	*Quercus montana*	7,136	7.3
Black Oak	*Quercus velutina*	5,352	5.5
Black Cherry	*Prunus serotina*	5,902	6.0
Yellow Poplar	*Liriodendron tulipifera*	5,602	5.7
Black locust	*Robinia pseudoacacia*	4,535	4.6
Red Maple	*Acer rubrum*	4,710	4.8
Virginia Pine	*Pinus virginiana*	3,568	3.6
American Chestnut	*Castanea dentata*	2,800	2.9
Black Gum	*Nyssa sylvatica*	1,784	1.8
White Pine	*Pinus strobus*	3,568	3.6
Shagbark Hickory	*Carya ovata*	3,568	3.6
Sweet Birch	*Betula lenta*	5,352	5.5
Sugar Maple	*Acer saccharum*	3,568	3.6
Red Mulberry	*Morus rubra*	2,109	2.2
Redbud	*Cercis canadensis*	75	0.1
Flowering Dogwood	*Cornus florida*	75	0.1
Persimmon	*Diospyros virginiana*	150	0.2
River birch	*Betula nigra*	75	0.1
TOTAL		**97,900**	**100.0**

Left: Volunteers plant trees on a beautiful spring day. Above: An American Woodcock (*Scolopax minor*) finds refuge within the scattered woody debris.

Tree planters reforest the Hylton Strip within the New River Gorge National Park.

NEW RIVER GORGE: HYLTON STRIP

SITE HISTORY AND PROJECT GOALS

Hylton Strip is a tract of land on Highland Mountain in Fayette County, WV. The NPS acquired the property in 1988. Mature hardwood forests surround the site, and a steep slope on the western edge leads down to the New River. The land could be accessed via a 0.5 mile haul road overgrown with invasive species such as multiflora rose (*Rosa multiflora*) and autumn olive (*Elaeagnus umbellata*). The site was surface mined for coal prior to the adoption of the Surface Mining Control and Reclamation Act of 1977. As such, the land was not returned to its original contour. Instead, the area consists of two large, flat sections and tiered benches that were regraded to fill highwalls. A ditch line was also created on the downslope border of the site to help catch runoff and sediment. Two streams cross through the site. One of these streams went underground through a culvert. The other stream floods a portion of the site, creating a wetland habitat. Though the site was revegetated with non-native grasses and shrubs, some slopes between the benches had natural regeneration of trees. The majority of the species were tulip poplar, black locust (*Robinia pseudoacacia*), and red maple. However, the benches and the understory of the slopes had a dense cover of invasive species including multiflora rose, autumn olive, sericea lespedeza (*Lespedeza cuneata*), wineberry (*Rubus phoenicolasius*), and Paulownia tree (*Paulownia tomentosa*).

NRG natural resource staff desired the restoration of an upland oak-hickory forest type as well as the erasure of man-made structures. Due to the heavily invaded nature of the site, GFW staff recommended removing all the unwanted, invasive vegetation and the top three inches of soil on the benches as well as the slopes in order to inhibit re-establishment of those invasive species. Despite the natural tree regeneration, the slopes did not contain any oak or hickory trees or seedlings. By including the slopes in the restoration plan, invasive species could more easily be controlled and oak and hickory species could be planted. While it was not possible to re-contour the site, other man-made structures could be removed from the landscape. GFW staff in coordination with NRG natural resource staff created a restoration plan that included taking out the culvert, filling the ditch, and ripping and planting the haul road.

RESTORATION ACTIVITIES

Restoration activities moved to Hylton Strip after the dozers completed their work at War Ridge. The contractors used 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. 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. The berms serve as habitat for insects, birds, amphibians, reptiles, and mammals as they settle and the vegetation decomposes. The material was also used to fill the ditches on the downslope border, and more was piled on top. These berms, as well as the others throughout the site, help prevent or slow surface runoff of water from the areas and prevent offsite erosion and sedimentation of downstream watersheds.

The ditch line contained rock barriers every 25-100 ft, creating more than 200 segments. During summer surveys of the site, NRG staff noted five of these segments contained ponded water. GFW staff located the segments and confirmed they had water at the time of site preparation. Because February and March is the breeding season for many amphibians, including wood frog (*Lithobates sylvaticus*), red spotted newt (*Notophthalmus viridescens*), and spotted salamander (*Ambystoma maculatum*), which was actually confirmed in two segments, the ponded ditch segments were not filled with spoil and debris.

After the vegetation removal was completed, a large bulldozer cross-ripped the site. Unlike War Ridge, the woody debris contained too many invasive species to be scattered. While scattering available woody debris can be helpful for a site, it can be more helpful to control the invasive species population with the constructed berms. However, this site contained some larger trees throughout its extent. When possible, the contractors left the larger trees standing. The ripping shanks cut through the root systems of those trees during the cross-ripping, which will cause the trees to die over the next few years. The trees will become snags, an important habitat feature for many wildlife species. As the trees die, they will drop portions of their upper branches, creating woody debris on the site.

The two streams running through the site created additional small projects. The wetland that formed adjacent to one of the streams was delineated and flagged by an NPS wetland specialist before site preparation began. When the contactors reached the stream, they avoided the wetland. They also placed tree logs and woody debris over the stream so the bulldozers could access the northern portion of the site without disturbing the stream. The "bridge" was removed when the ripping in that northern section was completed. The second stream had a culvert 10 ft below the ground. The metal pipe was dug up and moved off-site. The initial idea was to return the stream to the surface. However, upon removing the culvert, we discovered the water had been flowing under the culvert instead of through it. The water was too deep to access, but a channel with rocks and woody debris was still created should water once again flow on the surface in the future.

The haul road was the last section to be decompacted. While a bulldozer was initially used to clear most of the road for access to the site and the road was ripped in one direction, an excavator was needed for finer detail work. The excavator ripped out the invasive shrub species at the edges of the road while avoiding the large, desirable tree species. It also

Before (left) and after (right) site preparation at the Hylton Strip restoration area in the NRG.

scattered the woody debris and felled trees across the road after using the excavator bucket to scoop and dump soil from, or "fluff", the compacted areas in which the bulldozer could not maneuver or reach. Vegetation removal and cross-ripping was conducted on a total of 107 acres.

Site preparation was completed on March 27th and planting began the same day. The WFA crew planted 76,850 tree and shrub seedlings over the course of three days. Of these, 73,350 were purchased from KDF and NFN, and 3,500 tree seedlings were provided from the Cumberland River Compact project, another mined land reforestation project that had an excess amount of seedlings. Like Hylton Strip, seedlings were planted in the rips on a 8' by 8' spacing. To assist with the establishment of native herbaceous species, the planters also broadcast a mix of 350 lbs. of native warm season grasses and wildflower seeds (dryland mix) from Ernst Seed. The seed was spread over 75 acres which included the two large central areas and the narrow strip of land in-between them. NRG staff spread approximately 5 lbs of wetland seeds around the two streams and wetland area.

FUTURE WORK

The oak-hickory forest type has severely declined throughout NRG. Restoration activities from the past year have set these sites on a trajectory to grow into mature oak-hickory forest. Monitoring of the sites by NRG natural resource staff will ensure that the restoration area continue to progress toward that end goal. Maintenance of these sites, also directed by NRG staff, may be required and could include invasive species control, replanting in areas experiencing damage due to wildlife browse, and prescribed burning. This year's work is part of a larger endeavor to reestablish oak-hickory as the dominant forest type within the Park. Two more mine impacted sites are already slated for reforestation next year. NRG natural resource staff are also surveying the forest surrounding Hylton Strip to determine which areas would benefit from oak under-plantings.

Table 4. Species and amounts of seed mixes that were broadcast across 75 acres of ripped dryland and 4 acres of wetland.

Common Name	lb
Dryland Mix	
Bottlebrush Grass	113
Browneyed Susan	12
Common Milkweed	13
Deertongue	83.3
Indiangrass	33.1
Oxeye Sunflower	10
Partridge Pea	20
Staghorn sumac	33
Wild Senna	20
Indianhemp	2.5
White Goldenrod	1.3
Butterfly Milkweed	4
Calico Aster	1
New England Aster	1
Heath Aster	1.7
Flat Topped White Aster	1.5
Total	**350.4**
Wetland Mix	
Arrowleaf Tearthumb	1
Blue Vervain	1.5
Fox Sedge	1.5
Lurid Sedge	1.2
Deertongue	7.5
Wild Senna	4.5
Boneset	0.4
Sensitive Fern	0.25
Square Stemmed Monkeyflower	0.4
Swamp Milkweed	0.75
Great Blue Lobelia	0.1
Marsh Blazing Star	0.2
Purple Node Joe Pye Weed	0.4
Flat Topped White Aster	0.2
Mistflower	0.1
Total	**20**

A rough greensnake (*Opheodrys aestivus*) slithers through the project area.

A handful of native seed that was sown in the tilled area.

PARTNERS

National Fish and Wildlife Foundation
Arbor Day Foundation
Komatsu
Mennen Environmental Foundation
National Park Service
Proteus Foundation
Scheidel Foundation
Pisgah Banjo Company
The Nature Conservancy
The American Chestnut Foundation
University of Kentucky
US Forest Service

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