



ANNUAL REPORT

2023

Restoring healthy and productive
forests on formerly mined lands
in Appalachia and beyond.

greenforestswork.org



GREEN FORESTS WORK

OUR MISSION

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

OUR 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 native 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 6 million trees across more than 11,600 acres.



An eastern hemlock (*Tsuga canadensis*) dominated riparian area in Pennsylvania that has been infested with hemlock woolly adelgid (*Adelges tsugae*), a sap-sucking insect introduced from East Asia to the United States in the 1920s. Several projects in 2023 involved underplanting other native conifers in these forests to replace the hemlock as their populations begin to decline.



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ON THE COVER

Images from across Appalachia and Australia that capture Green Forests Work activities in 2023.

LETTER FROM THE PRESIDENT



Reforestation provides global opportunities for disturbed landscapes



In the US, millions of hectares of forest have been lost or disturbed, producing significant economic, environmental, and ecological challenges. Similar land disturbances have occurred across the globe. Successful rehabilitation and revegetation of disturbed lands are vital for mitigating climate change and protecting biodiversity. In 2020, I was awarded

a Fulbright Distinguished Chair of Science, Technology and Innovation to implement a reforestation program in Australia with CSIRO (Australia's National Science Agency). After a series of delays due to the pandemic, I was finally able to travel to Australia this year and spent six months working on this global experiment.

I viewed the Fulbright scholarship as a once-in-a-lifetime experience, and I planned to use my time away from my home to the fullest. As a researcher, the thought of stepping away from my day-to-day routine for six months seemed daunting, but it was quite the opposite. I found it refreshing to explore new opportunities and learn about ecosystems that are very different from those in the US. I made a decision to accept any invitation to give a talk, have coffee or visit a field site while in the country, and that decision led to some very rewarding experiences. In an effort to stay connected, I tried to keep an on-line journal of my experiences and post something at least once a week on social media and many of those were copied to a blog on the GFW website (<https://www.greenforestswork.org/about-1>).

As a Fulbright Scholar, I promoted techniques for disturbed land rehabilitation following methods we helped develop in the US. I presented seminars to groups from university, government, and professional affiliations that outlined the global transferability of GFW's work. I also met with many NGOs, conservation groups, and private industry representatives to discuss potential projects and form collaborations. These efforts have led to a commitment for planting over 400,000 trees on disturbed landscapes at five locations in Queensland and New South Wales and these resulting forests will sequester thousands of tons of carbon dioxide. Nearly 300,000 trees have already been planted. In addition, hundreds of local school children have helped plant trees on these sites and Traditional Owners were engaged to enhance community involvement in the work.

By improving our ability to rehabilitate disturbed lands, we create new opportunities for areas that are often considered marginal, we protect biodiversity, improve environmental quality and contribute significantly to the development of a sustainable future for affected communities.

The planting of over 400,000 trees in Australia is certainly a noteworthy accomplishment, but the professional connections and experiences I have made are really the outcomes I had hoped for when I embarked on this journey. I am excited in knowing that the work will continue when I am back in the US and that the forests we have helped establish will have lasting beneficial effects on the local and global environment.

Chris Barton

2023 YEAR IN REVIEW



Over one million trees planted in 2023

The year 2023 will be remembered by many as a year of extremes, from the extremely mild winter of '22-'23 that caused the loss of 90% of Georgia's peach crop and from the 100-degree surface water temperatures around Florida to the record-breaking forest fires in Canada that blanketed the eastern US in smoke over the summer; and from extreme droughts in the central and northern US which resulted in crop losses in many states, record-setting fires in Louisiana, salt-water intrusion and transportation problems in the Lower Mississippi River, to the extreme rainfall events around the globe that unleashed devastating flooding and loss of life. Weather extremes impacted nearly everyone on Earth in some way this year. In light of these events, the need to reduce our reliance on fossil fuels and scale up ecological restoration efforts and reforestation could not be more evident.

This past year, GFW and our partners planted more than 1 million trees across Appalachia and Australia, putting more than 2,000 acres of degraded land back on track to becoming healthy, resilient, productive forestland. We also worked diligently to increase GFW's capacity and nurseries' capacities to undertake even more work in the coming years. We hired a new Reforestation Coordinator, Breezey Snyder, to assist with project development and implementation in the southern Appalachian region, and we submitted numerous grants that will hopefully allow us to bring on additional staff and undertake new, large restoration initiatives in 2024 and beyond. We also continued monitoring several of our projects to better understand our plantings' survival and growth rates, the benefits of our reforestation projects, and how wildlife species of concern are utilizing them. Lastly, we continued to work with communities and offer opportunities for experiential education, social justice, and environmental action by planting trees.

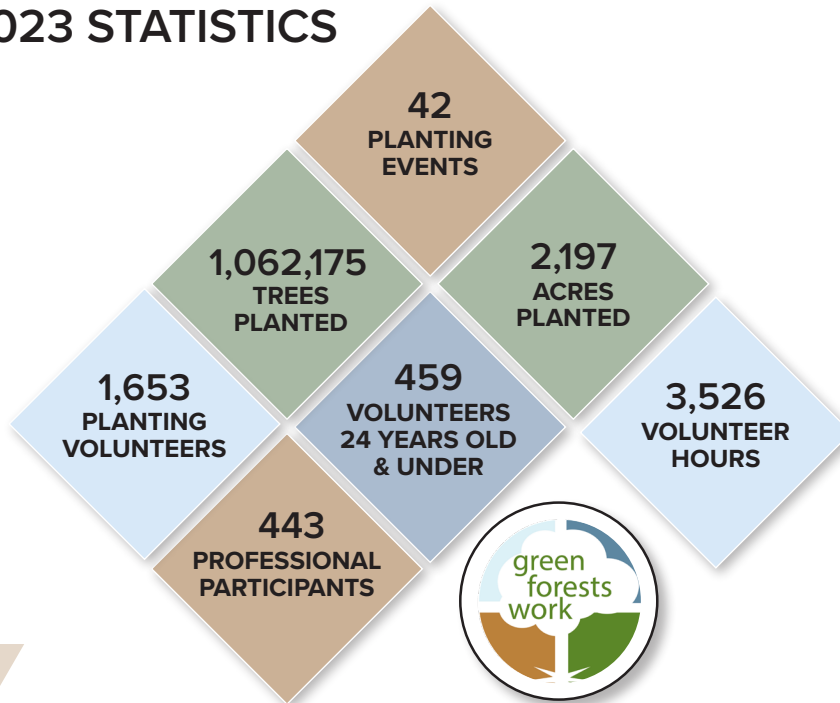


Planters work in a foggy high-elevation restoration area at Sharp Knob, WV.

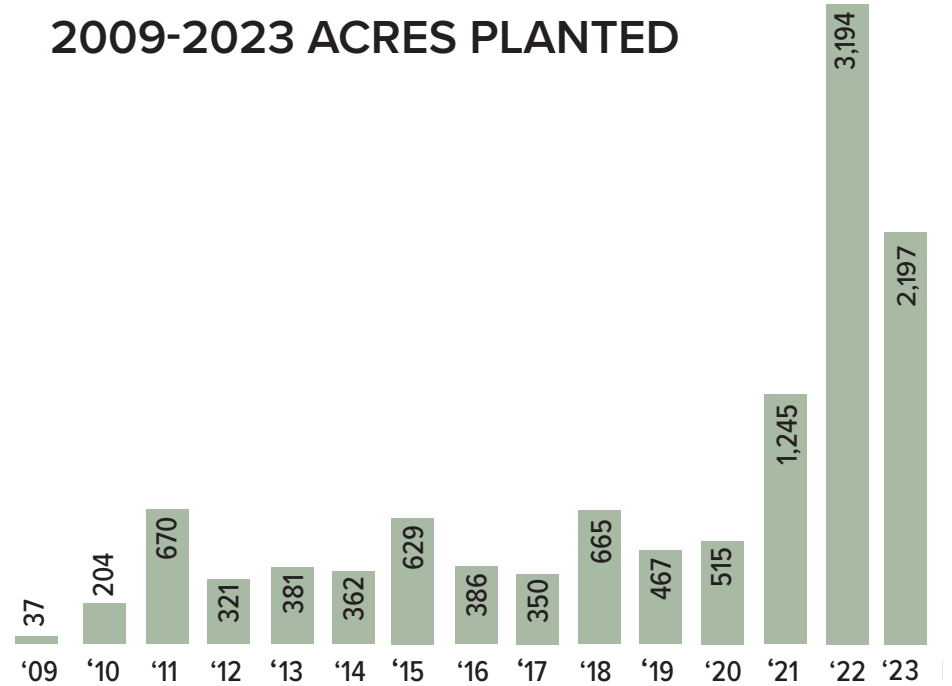
2023 BY THE NUMBERS

In 2023 we supported restoration projects in Kentucky, Pennsylvania, Virginia, West Virginia, Tennessee, and Australia. Over a million trees were planted on over 2,000 acres. New projects were funded this year through the National Fish and Wildlife Foundation's Central Appalachian Stewardship Program and the Cumberland Plateau Stewardship Fund. The new funding will support projects in the New River Gorge National Park and the Monongahela National Forest in West Virginia. New projects will also occur on private lands in Pennsylvania as well as lands in the Cumberland mountains of Kentucky.

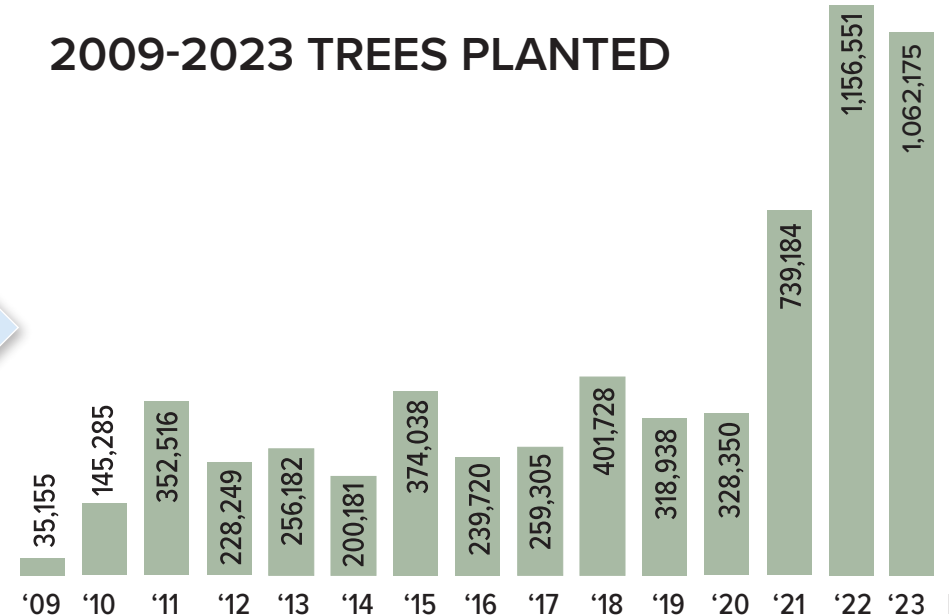
2023 STATISTICS



2009-2023 ACRES PLANTED



2009-2023 TREES PLANTED



WEST VIRGINIA TREE PLANTINGS 2023



Wild Wonderful West Virginia

MOWER TRACT AND SHARP KNOB

In 2023, GFW and partners planted 105,215 trees and shrubs and created 60 wetlands on the Mower Tract in the Monongahela National Forest (MNF). Prior to planting, non-native species were removed and the soil was decompacted. In total, 1,462 acres have been restored in the Mower Tract. This has included the creation of more than 1,700 wetlands and the planting of nearly 790,000 trees and shrubs (Table 1). Although the majority of the planting has been accomplished by professionals, more than 500 volunteers have assisted us in these efforts, as well as Appalachian Conservation Corps and AmeriCorps members annually since 2020.

Table 1. Yearly summary of restoration activities.

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
TOTAL	1,462	1,706	789,309	60 total	525

¹ In addition to the 192 ripped acres, 8 acres of non ripped slopes were planted.

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

³ There is an overlap in the species planted each year. Across all years, more than 60 species of trees and shrubs have been planted, as well as many more species of herbaceous transplants and seeds.



Contractors plant large aspen at pond area at the Mower Tract in 2023.



Since GFW began working at the MNF on Sharp Knob, restoration projects have taken place annually since 2018. Prior to planting, non-native species were removed and the soil was decompacted. So far, 241 acres have been restored. This has included the creation of 93 wetlands and the planting of over 141,000 trees and shrubs, as well as over 2,000 native herbaceous plants (Table 2). Seeds of flowering species for pollinators have been spread throughout the restoration area. Although the majority of the planting has been accomplished by professionals, 57 volunteers have assisted us in these efforts. This past fall 2022, 26 acres were decompacted, and 17,500 trees were planted in the spring of 2023. This completes the mined land restoration on Sharp Knob.

In total, more than 930,000 seedlings have been planted on these projects since 2011, an impressive number grown from seeds collected locally on Cheat Mountain. Not only have these sites been utilized to demonstrate effective restoration practices, but many recreation opportunities have been created including an extensive network of hiking and biking trails, and dozens of campsites.

Table 2. Yearly summary of restoration activities.

Year Restored	Acres Reforested	Wetlands Created	# of Trees & Shrubs Planted	# Species	Event Type	Volunteers
2018	35	8	14,800	12	Professional	
2018			3,175		Volunteer	57
2019	22	2	11,299	17	Professional	
2020	65	5	37,082	10	Professional	
2021	47		25,799	17	Professional	
2022	46	78	34,230	19	Professional	
2023	26		14,850	16	Professional	
TOTAL	241	93	141,235	48*		57

* In addition, over 2,000 herbaceous transplants of 7 species planted, and dozens of pollinator species seeded.



Tree planters put the final touches on our work at Sharp Knob with the planting of 14,850 seedlings. Over the last six years we planted 141,235 trees on that site.

STREAM RIPARIAN AREA PLANTINGS

GFW worked with the Forest Service and The Nature Conservancy (TNC) to implement several planting projects in riparian restoration areas. Over 38,000 trees were planted on 127 acres at four sites (Table 3).

Chad Landress, Forest Fisheries Biologist for the MNF, describes these projects: “We planted four high-elevation riparian areas on the MNF in 2023. These key sites were selected based on the opportunities to restore riparian function, extend and reconnect the red spruce-balsam fir ecosystem across a broader area of the landscape, and improve coldwater stream habitat and water temperatures for brook trout.”

The Pharis Knob project site straddles the divide between the Dry Fork and Gandy Creek watersheds of the Cheat River. The project areas were impacted by agricultural conversion and over-grazing, but they were historically red spruce and balsam fir forests. The planting focused on spruce and fir plantings along riparian corridors and reconnecting neighboring spruce-fir communities.

The nearby Gandy Creek project site was a large, open riparian area near the headwaters of the mainstem of Gandy Creek, also historically grazed. Plantings consisted of larger potted red spruce and balsam fir (3’ tall), additional spruce and fir plugs, and bare-root hardwood species. Along tributaries of the upper Shavers Fork of the Cheat, balsam fir and wetland hardwood restoration was implemented in conjunction with legacy road rehabilitation at the First Fork and Beaver Creek project sites. Old roads causing watershed

impairments, such as increased groundwater temperatures, sedimentation, and stream disconnection from the floodplain, were retired or converted to trails to help remediate these issues. After roads were retired, a mix of fir and wetland-associated hardwoods were planted to expand the area’s balsam fir extent, increase species diversity in wetlands, and expedite vegetation reestablishment on the road-to-trail conversions.

Thank you to all our 2023 WV partners, including: the US Forest Service, Monongahela National Forest, Office of Surface Mining Reclamation and Enforcement, the Appalachian Regional Reforestation Initiative, The Arbor Day Foundation, WV Division of Natural Resources, Appalachian Headwaters, Mennen Environmental Foundation, American Forests, Komatsu, The Nature Conservancy, AmeriCorps, and others contributors.



Planting containerized balsam fir (*Abies balsamea*) and red spruce (*Picea rubens*) along the headwaters of Gandy Creek.

Table 3. 2023 Monongahela National Forest Riparian Restoration Areas.

TNC & MNF Planting Sites	Seedlings	Acres
Gandy Creek	18,085	60
Pharis Knob	11,610	42
First Fork	6,935	22
Beaver Creek	2,000	3
TOTAL	38,630	127

PENNSYLVANIA PROJECTS



Protecting hemlock forests

GFW and our Pennsylvania partners supported three volunteer planting events, two mined land restoration projects, and five State Game Land forest underplantings this year, with 353,200 native tree seedlings planted on 1,050 acres.

VOLUNTEER EVENT HIGHLIGHTS

Our partner Eric Oliver, formerly with the PA Department of Environmental Protection (PA DEP), hosted a volunteer tree planting in Centre County, PA. GFW staff, 55 volunteers, including Penn State University students, and Moshannon Creek Watershed Association members planted 3,850 seedlings. After the planting, students



Volunteers stuff buckets with bareroot seedling at the Shippensburg, Pennsylvania.

toured an active mine operation.

In partnership with the Chesapeake Bay Foundation and South Hampton Parks and Recreation Department, Oliver organized a 2-day volunteer event at Furnace Run in Shippensburg. An estimated 185 volunteers of all ages and backgrounds planted 7,500 seedlings of various species on 20 acres of recently decompacted sand quarries through rain and shine.

Volunteers also spread 160 lbs. of native pollinator seed. Our planting contractors returned several days later to plant an additional 7,000 seedlings. The Chesapeake Bay Foundation provided all seedlings. Many partners were involved in preparations, bucket stuffing, and leading volunteer groups.

MINED LANDS

Owners of a 27.5 acre legacy mine in Summerville, PA, wanted to bring back native forest to a portion of their property. The Susquehanna River Basin Commission and PA DEP met with the landowners and formulated a plan to meet their goal of reforesting their land. The Pennsylvania Environmental Council funded the site preparation/ripping, and GFW brought the seedlings and planters.

In collaboration with the PA DEP, Western PA Conservancy (WPC), and Armstrong Conservation District (ACD), two small projects were also implemented near East Brady, PA, in Armstrong and Clarion Counties.

Both projects were on abandoned mine lands (AML), that were mined in 1940. GFW planted 7,575 conifer and hardwood seedlings

at the site. WPC hosted a volunteer planting event there and planted 500 American chestnut seedlings.

GAME LANDS

Hemlock woolly adelgid was recently discovered on State Game Lands 74. This invasive insect could be devastating, as hemlock is one of the dominant tree species across the site and, in some areas, makes up 60-70% of forest stands.

Once infested, it is just a matter of time before the hemlock begins to show signs of decline - thinning needles, reduced canopy coverage, and those that die will no longer be able to cool the streams with their spreading, flattened branches.

In anticipation of the situation that will result when the hemlocks die, underplantings of native conifers were implemented. The project planted 139,525 seedlings of red spruce, white spruce, white pine, and balsam fir on 465 acres.

Within the Allegheny River watershed, our crew underplanted 68,875 seedlings in a 214-acre project in State Game Land 47 in Venango County. Conifers, hardwoods, and shrubs of 20 native species, including 500 American chestnuts, were planted. This conifer underplanting aims to promote and expand conifer cover to sustain and increase this important habitat component, enhance wildlife habitat and species diversity, and diversify forest structure.

On PA State Game Land 283, we planted 44,900 seedlings of four native conifer species on 140 acres. The forested riparian areas dominated by hemlock had few, if any, seedlings growing in the understory, even in canopy gaps. The areas needed underplanting to boost the understory and enhance the structure, diversify the conifer component, and lessen the impacts of hemlock woolly adelgid.

On PA State Game Land 24, we planted 32,850 conifer seedlings across 105 acres at the Skidmark underplanting project. Stand degradation over the years due to Beech leaf and beech bark disease decimating the beech population and wind events has left many of the largest trees standing dead.



Pennsylvania native and GFW Intern, Emma Hill, spent the summer helping with projects in PA, WV and KY. Above. Bundles of different conifers that were utilized for the underplanting projects.

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FROM PAGE 11

"I started working in this stand roughly 15 years ago and have watched the beech dying out, the birch blowing up, the stand degrading... and then to see the birch mulching work and now the tree plantings, it feels good."

-Scott L. Wolbert, Regional Forester, Pennsylvania Game Commission, Northwest Region

Thanks to our contract planting crew with Napieralski Forestry Enterprise and to all our partners: One Tree Planted for supporting all our PA projects, The Nature Conservancy for help with SGL 283, Eric Oliver (formerly PA DEP), and Tom Clark (formerly Susquehanna River Basin Commission) for facilitating this year's PA mine land restoration projects, Pennsylvania Environmental Council for site preparation of mined lands, Chesapeake Bay Foundation for seedling donations, PGC Howard Nursery for 100,000 seedlings, all the PGC employees that helped us so much this year, Dave Saville of Appalachian Forest Restoration LLC for growing all the red spruce, The American Chestnut Foundation and Arbor Day Foundation for 500 American chestnut seedlings, and private donors.



Volunteers and professionals plant trees on the various project sites in Pennsylvania.

MARTIN COUNTY, KENTUCKY



Bringing back the forest to our old Kentucky home



Clockwise from top left: Project area after site preparation was completed. Tree planters prepare for a day of work. University of Kentucky forestry technicians, Louise Hosburgh (left) and Jill Newman, set up monitoring plots at the Martin Co. site.

PRICELESS PLANET COALITION

In 2022, we initiated a new partnership with the Priceless Planet Coalition (PPC) and Conservation International to plant 100,000 trees on a former coal mine in Martin County, KY. The PPC has a goal of planting 100 million trees on the planet by 2025 and we are one of eighteen global projects helping them reach that goal. From water and food shortages to extreme weather devastations, the PPC is striving to engage citizens to help with change, impact environmental policies and make a tangible difference.

Site preparation began in early 2023 and 140,215 trees were planted on 150 acres in the spring, exceeding our goal of 100,000 trees. The site was planted with tree species from a declining forest type (i.e., shortleaf pine-upland oak woodland) that will help to improve air and water quality, enhance forest resiliency, mitigate climate change through increased carbon accumulation, provide multi-seasonal pollen and nectar sources for pollinators and make the sites more productive for wildlife.

During the summer we went back to the site and established monitoring plots to evaluate biodiversity, natural regeneration, and survival rates of planted trees. The tree density in sampled plots was high, indicating good survival. Interestingly, natural colonization of the plots by native trees that we didn't plant was also high suggesting that site preparation activities had effectively broken the arrested succession at the site. We will continue monitoring at the site for the foreseeable future.

PIKEDALE, AUSTRALIA



Green Forests Work Down Under

In March 2023, Dr. Barton returned to the Pike Creek reforestation site to finish planting and do some clean-up on the project that was started in 2021. The weather was perfect for planting and an inch of rain fell the day after planting was completed. Barton and his partners were able to plant 32,750 trees in a little over three days (Table 4). Afterward, a “browse study” was established at the site to examine the influence of herbivores on reforestation success. This was done by erecting 900 m² exclusion fences in replicated plots in the reforestation area and compared to similar sized plots where tree shelters were utilized (no fence) and control plots where no protection was provided. These plots will be measured annually.

With help from partners like the Arbor Day Foundation, Unearthed Environmental Services and Corporate Carbon, we were able to plant 232,750 trees at this site over two years and begin the transformation from pasture to forest. The nearly 2,500 acre site will be protected for 100-years under the Australian Emissions Reduction Act. Approximately 16,000 tonnes of CO₂e will be sequestered by new forest and over 100,000 Australian Carbon Credits Units have been attained.

Table 4. 2023 Pike Creek

Trees and Shrubs	# Planted
White gum (<i>Eucalyptus scoparia</i>)	9,829
Narrow-leaved ironbark (<i>Eucalyptus crebra</i>)	7,144
Red gum (<i>Eucalyptus dealbata</i>)	8,621
Grey box (<i>Eucalyptus moluccana</i>)	7,156
TOTAL	32,750



Top: Tree planters prepare for a day of work at the Pike Creek site in March 2023. Above: Aerial view of browse study established in 2023 showing a plot with trees protected with both fence and tree shelters and another with just tree shelters.

URBAN AND COMMUNITY PLANTINGS



Let justice and peace flow



Top: Students from Lexington Catholic High School and Bishop Stowe plant trees to celebrate the Season of Creation. Above: GFW Director of Operations, Michael French, provided and helped plant trees at his sons' (Luke, rear, and Wyatt, front) school.

Over the years, GFW has supported educational planting projects and seedling giveaways for schools, Arbor Day events, and other projects. This fall, GFW worked with the Lexington-Fayette Urban County Government to reforest a portion of Hisle Farm Park. On September 23, nearly 50 volunteers from the local Catholic Community planted 300 seedlings donated by GFW on 1 acre of the park.

The planting event was held to celebrate the Season of Creation and its 2023 theme of “Let Justice and Peace Flow.” During the Season of Creation, many Christian groups come together in prayer and action for a common home. Inspired by the words of the Prophet Amos: “*But let justice roll on like a river, righteousness like a never-failing stream!*” (Amos 5: 24), the group was called to action to join the river of justice and peace, to take up climate and ecological justice, and to speak out with and for communities most impacted by climate injustice and the loss of biodiversity. Along with the tree planting, volunteers participated in a mass presided over by Bishop John Stowe and enjoyed lunch on a beautiful fall day in Kentucky.

A few trees were leftover from the Hisle Farm Park planting, so GFW’s Director of

Operations, Michael French, took some to plant at his boys’ school in south-central Indiana. French had been discussing making the school grounds more attractive with the school administration and teachers by restoring native trees, shrubs, and wildflowers and their associated ecosystem services in appropriate areas. There were already some native trees and wildflowers, and this would be an effort to complement those while providing shade to spectators and players during sporting events and to attract wildlife.

The long-term vision of some of the school staff is to eventually create a diverse outdoor classroom/mini-arboretum on the school grounds, and this was the first planting toward making that vision a reality. Melissa Newcomb, the high school biology teacher, and her husband, French, and his two sons planted, sheltered, and mulched twelve chinquapin oaks.

Additional seedlings will be planted later this fall, and other improvements will occur this winter. Permission was granted to remove and replace some of the Bradford pears on the property with native tree and shrub species, and more seedlings will be planted in the spring of 2024. The school’s students will likely be involved with the future plantings.

RESEARCH HIGHLIGHTS



Learning from nature



Breezey Snyder examined bat foraging at the Mower Tract for her MS degree from the University of Kentucky.

WILDLIFE RESEARCH

The Forestry Reclamation Approach (FRA) is a practical guide to reforesting surface-mined lands. Bats, a group of mammals with declining populations, could benefit from mine reforestation. To determine if the FRA can provide a suitable bat foraging habitat, we surveyed bat activity at created depressional wetlands on 1-year-old and 8-year-old FRA reforested lands (FRA1; FRA8), wetlands in naturally regenerating forest on traditionally reclaimed mined land (~40 years old; REGEN), and wetlands in mature forest not previously mined (MAT). I passively recorded echolocation calls for 12 nights across 16 sites between June and August 2021. I analyzed bat activity using the number of recordings, pulses, and feeding buzzes in conjunction with nocturnal insect abundance and biomass, microhabitat characteristics, and landscape characteristics via generalized linear mixed-effects modeling. Both FRA1 and FRA8 had activity levels similar to MAT. REGEN had significantly greater foraging activity than the other three land classes possibly due to its distance from roads and proximity to forest edges. Insect abundance and biomass were comparable across sites, indicating FRA practices do not hinder the establishment of a prey base for bats. Overall, bats are utilizing the restored mined land for foraging (Table 5). Reforestation of mined lands, complemented with wetland creation, provides habitat that could benefit bat species conservation in Appalachia.

Table 5: Bat species identified by echolocation calls at Cheat Mountain

Species	FRA1	FRA8	REGEN	MAT	Total
Big brown bat	1,388	37	153	91	1,669
Eastern red bat	820	318	1,184	522	2,844
Hoary bat	311	232	600	187	1,330
Silver-haired bat	0	66	0	73	139
Myotis spp.	5	5	34	0	44
Tricolored bat	0	65	146	45	256
TOTAL	2,524	723	2,117	918	6,282



Students from Leestown Middle School in Lexington, KY identify macroinvertebrates that had colonized leaf packs which had been submerged in a local stream for several weeks.



EXPERIENTIAL EDUCATION

Long-time GFW partner, Dr. Kenton Sena, recently published a study that GFW helped implement. As well documented, urbanization reduces human-nature experiences and removes humans from interaction with non-human living things and their ecosystems. In urban spaces, outdoor experiential educational activities can help students increase their familiarity with the outdoors and get their hands dirty. The case study reports on an environmental field day for middle school students from an urban Kentucky middle school. Students rotated through three activities (picking insects out of leaf packs, testing water quality, and planting trees), then completed a brief survey designed and administered by their faculty. Students rated



Kenton Sena

the tree planting activity more highly than the other two activities, suggesting that this activity was more accessible, interesting, and engaging to a broader range of students. However, student qualitative responses to the water quality and leaf pack activities demonstrated an ability to make connections between those activities and the broader world, such as the importance of their stream-water quality for the Gulf of Mexico, or the implications of finding pollution-tolerant insects for understanding stream health. Overall, the study recommended that environmental field days can help students develop a sense of awe or wonder in nature.

For more information see:

“So That We Can Save the Earth from Dying”: Highlights from a Middle School Environmental Field Day, by Kenton Sena, Jill Abney, Hannah Ruehl, Chris Barton. In: *Journal of Contemporary Water Research & Education*, 178 (1): 17-30. 25 September 2023 <https://doi.org/10.1111/j.1936-704X.2023.3389.x>

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