Large swaths of the forests that once covered Appalachia have disappeared. In their place are stretches of land that look more like tundra: flat, stark, marked by short grasses, and populated with invasive species. Although healthy stands of oaks, dogwoods, and many other native species grow nearby, these incongruous-looking parcels refuse to return to their original state. So stubbornly do they resist the growth of trees, in fact, that some refer to their condition as “arrested” ecological succession.

Coal mining and, ironically, efforts to restore the land after mining ended have both played a part in the transformation. By one expert’s estimate, as many as a million acres—an area slightly less than the size of Delaware—of deciduous, temperate forest are bereft of the trees that thrived on them.

But thanks to decades of research by soil scientists and foresters, help from volunteers, and some funds from the government, forests are now returning to these bare spots. Coal mining companies are once again planting trees on mine spoil: the earth dug out from mines. And soil that was already “reclaimed” once—but ended up packed to the consistency of parking lots by heavy equipment—is being returned to productive forest land.

This hard-packed ground resulted from an important, and for the most part, beneficial 1977 law—the Surface Mining Control and Reclamation Act (SMCRA).

SMCRA was aimed at alleviating the severe damage wrought on the landscape by coal mining. Toxic metals had leached into waterways, land was severely eroded, and landslides took lives and destroyed property across the Appalachian region, which stretches from northern Alabama to Pennsylvania.

“The law solved tremendous problems. There were landslides on the steep slopes of Appalachia. There were serious erosion and sedimentation issues. I’ve worked many cases where landslides completely buried houses,” says Patrick Angel, one of the first federal inspectors hired by the U.S. Office of Surface Mining Reclamation and Enforcement.

The law, he says, led to the protection of “life and limb and property.”

But it also had unintended consequences that robbed the region of forest land—one of its most valuable environmental and economic resources.
But that timber growth came with a cost because mine spoils and mining debris could be unstable and promote landslides.

SMCRA solved many of those problems, but it also ended the reforestation program. As University of Kentucky soil scientist Christopher Barton explains, the law required that reclaimed land be made stable to minimize the probability of landslides and soil erosion. This was interpreted to mean that the land had to be flattened. Heavy equipment and repeated passes by bulldozers were used to keep the soils from moving, he says, likening the effort to creating a roadbed for a highway. “The result was that we had thousands, if not a million, acres of land that were compacted.”

The treatment “didn’t do much for creating a planting medium where the native vegetation could thrive,” he adds, and subsequent efforts at tree planting failed because roots could not develop in the tightly packed soil. Moreover, water couldn’t soak down into the soil and simply ran off, causing further damage.

Yet another problem Barton mentions is forest fragmentation. This results in the loss of habitat for the many species of wildlife that depend on large areas of uninterrupted forest to survive.

Soil scientists like Barton, James Burger of Virginia Tech University, and others have analyzed the situation since the law’s passage with an eye toward understanding how to reverse the conditions and encourage reforestation.

Among their findings, says Burger, is that mining turned the land upside down so that the soil in which trees grew best was buried, leaving a completely different type of soil substitute on top when the land was flattened.

“The inverted land profile makes a poor basis for reforestation,” says Mary Beth Adams, a research soil scientist with the USDA Forest Service. And it fostered another problem, as well. Not only did trees grow poorly, but invasive species were also able to take root and “capture the newly created landscape,” Burger says.

As a result, Burger says, “We’ve lost the productivity of the native forest, which is considered to be among the most diverse temperate, deciduous forests in the world. As many as 30 different species grow together in some areas.”

That diversity has economic value. For one thing, Burger notes that forestry and forest products in Appalachia produce $62 billion worth of goods annually. And according to researchers at the University of Tennessee, a properly managed forest can have a 6.5% return on investment. But beyond this are the “ecosystem services” provided by forests, including watershed protection, carbon sequestration, and habitat for wildlife.

“Forest services are poorly monetized, but their collective value has been estimated by experts at 3 to 10 times the value of wood products extracted,” Burger says.

Reforesting Appalachia

The question then became how to bring those benefits back. In 2004, spurred by Angel and many other reclamation practitioners, the Office of Surface Mining Reclamation and Enforcement created the Appalachian Regional Reforestation Initiative (ARRI). Comprising the efforts of federal and state regulators and academic and government scientists, it seeks to undo the unintended effects of the 1977 law. Chief among those efforts are a set of guidelines for promoting the growth of healthy forests, both on mine sites and on sites that have already been reclaimed but don’t support trees (see sidebar).

Following those guidelines, Lee Bryant is reclaiming 250 acres of compacted land owned by him and several others in Whitley County in southeast Kentucky. He has transformed land that he describes as a “moonscape” and “biological desert” into a vibrant section of forest rich in native trees and wildlife.

Since 2000, he and others, under a cost-sharing arrangement with government agencies, have planted more than 40,000 trees that are producing nuts and fruit. He is also working with The American Chestnut Foundation to plant blight-resistant, hybrid chestnuts and has planted various oak species, silky dogwoods, and hawthorns, as well. The trees have encouraged wildlife, including songbirds, turkey, quail, and grouse, to re-inhabit the area.
According to Barton and other researchers, the reclaimed mine land may be a good match for the American chestnut, which used to grow widely in Appalachia until it was leveled by devastating fungal diseases. The soil and light characteristics of the region suit the tree, and researchers hypothesize that the mine spoils have fewer root-rot pathogens that can reduce the trees’ survival.

Bryant regards what he is doing as a legacy for his children and their children. To be sure, he does expect to earn money by harvesting timber, but overwhelmingly the restoration work is a “labor of love.”

“When do you get a chance to do something that actually heals the earth? Very few times do we get an opportunity to put something back as good as or even better than Mother Nature would do,” he says.

Bryant’s work is being done in conjunction with Green Forests Work (GFW), a non-profit organization devoted to reforesting mined lands in Appalachia.

Started with funding from the Appalachian Regional Commission, a federal-state partnership aimed at promoting sustainable development, GFW with the aid of more than 9,000 volunteers has planted more than one million trees on nearly 2,000 acres of former mined land since 2009.

GFW also worked with other area organizations to obtain an $8 million grant from the USDA to enhance 12,500 acres of forest as habitat for the cerulean warbler, whose original habitat has been sharply reduced. And under the grant, GFW will also reforest 1,000 acres of reclaimed mine land with the American chestnut.

GFW is further working to reforest the tops of mountains, which have been

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**Five-Step Approach to Reclaim Drastically Disturbed Land for Forests**

As a result of extensive research by government and university scientists, the Appalachian Regional Reforestation Initiative (ARRI) has developed a strategy to reclaim drastically disturbed land for forests. Their Forestry Reclamation Approach (FRA) consists of five basic steps:

1. Create a suitable rooting medium for good tree growth that is no less than 4 ft deep and comprised of topsoil, weathered sandstone, and/or the best available material. Where the mine soil has been severely compacted, loosening of this layer can be accomplished by using a type of deep plowing, called ripping.

2. Loosely grade the topsoil or the topsoil substitutes established in step one to create a non-compacted growth medium. If the reforested area is on a steep slope, the top 4 ft should not be compacted, but the spoil below that level should be.

3. Plant herbaceous ground covers that are compatible with the growth of trees.

4. Plant two types of trees: early successional species for wildlife and soil stability, such as dogwood and black locust, and commercially valuable crop trees, like black cherry, hickory, and oak.

5. Plant the trees properly, using professional tree planters if possible.

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Cerulean warbler. Photo courtesy of Wikimedia Commons/mdf.
blasted off for coal mining. Without trees on those mountaintops, heavy rainfalls, which are not unusual, send torrents of water to the valleys (“hollers”) below, causing damaging floods.

“By reforesting the mountains, we are attempting to address the peak flow and flash flood type of situation,” says David Cooper, a volunteer with GFW.

ARRI has also been working with the coal industry, Angel notes. He says that since 2004, the industry has planted 95 million trees on 140,000 acres.

The planting of so many trees is only the beginning, however. “We know how to get tree stands established,” Adams says. The question now is how to ensure that they turn into mature, productive forests and healthy ecosystems.

And she is also exploring the possibility of adding species to the region.

On experimental plots in former mine sites from Alabama to Pennsylvania, Adams and her colleagues have planted elms that tolerate Dutch elm disease to see if they can successfully grow. “These are probably good reforestation tools, and eventually, we may be able to add them to the planting mix. American elms don’t mind compacted soils, and have flexible root systems,” she says.

American elm. Photo courtesy of USDA.

More Work Ahead

As important as such developments are, much more remains to be done. “Sufficient incentives and regulations for the coal miner, either by “carrot or stick,” are not in place to eliminate all the poor practices and ensure that new, science-based procedures are applied,” Burger says. “Coal companies are still producing hundreds of acres of poorly reclaimed land that will not support native forest productivity and diversity.”

But, he adds, turning things around isn’t just up to the mining companies. “The public must ensure that SMCRA is properly interpreted in mining regulations, and state and federal regulators must enforce all the provisions,” he says. Landowners also need to clearly voice their expectations for productive, reclaimed land, and coal operators have to follow through using the best practices.

As these groups continue coming together to tackle the issue, however, they’ve got one critical piece of knowledge in their pockets that they didn’t before. Bringing back the region’s forests, they’ve learned—along with their wealth of aesthetic, environmental, and economic benefits—means first restoring the soil. “Healthy forests,” Adams says, “require healthy soils.”