Pillars of Carbon: National Forests and the Great Appalachian Carbon Commons

Chris Bolgiano

Dashes of red paint on occassional trees were easy to miss, and we did. We crossed the border unwittingly, my toung husband and I, lost in the woods on Cross Mountain in western Virginia. Part of the 1970's "Going Back to the Land" movement that bought thousands of young people into rural Appalachia, we stumbled cluelessly through the seeemingly endless hundred-acre woodlot we were about to buy. The back border joined the million-plus acres of the George Washington National Forest (GWNF), the largest block of public land in the East. Soon enough, I learned to reconize the line between private and public land, between mine and ours. Over time, I've also come to see it as a boundary between capitalism and community, primal and postmodern, history and hope.

Archives, books, and photos recall the history that eventually resulted in that boundary. The woods remember too. On our southernmost ridge, I trip over stumps stripped down by time to slivers but still blunt on top where saws cut. Whittle off a chip with a pocket knife and a whiff of Christmas time wafts by. In the 1870s and 1880s, Shenandoah Valley farmers sought our yellow pines in the surrounding mountains to replace the thousands of barns and mills burned by Gen. Philip Sheridan in his scorched earth campaign through the valley in 1864.

On one of our slopes, a remnant of handmade fence sags down to the creek, its slats axed from rot-resistant American chestnut wood and twined together with heavy wire. An elderly friend told us years ago it was a pig fence. By the end of the 1800s, counties were passing laws requiring farmers to fence in their livestock, and American chestnut trees hadn't.

yet died off by the billions from an imported blight. Before that, it was common practice to let livestock forage for chestnuts and acorns across mountainsides, without fences, regardless of ownership. Hunters roamed widely too, for meat and pelts, as did women foraging for plant foods, and children carefully gathering prickly chestnut burrs.

Chestnut oaks, a different species from the American chestnut but with similar leaves, are now one of the more common species in the southern Appalachians. Most are multiple-stemmed, with as many as eight mature trees ringing one enormous mother stump. Chestnut oak bark has a high level of tannic acid, which was leached out and used to tan leather. Until tree bark was replaced by synthetic chemicals in the 1940s, millions of tons of chestnut oak bark were peeled every spring just as the sap started to run and the bark became pliable. The naked logs were usually left to rot in the woods.

Unlike many other species, chestnut oaks sprout from stumps, so they proliferated instead of disappearing from the forest. Because of the dearth of deer in the decades before state wildlife agencies began regulating hunting, the sprouts were spared from grazing. Sometimes a hole rots out in the center of the stump and fills with rain, hosting whole ecosystems of tiny creatures. Or instead, some stumps grow cushions of moss, giving hunters like my husband a comfortable seat behind the cover of the sibling trees to wait for deer. Reintroduced after the panthers and wolves that kept their numbers in check were extirpated, deer have recovered beyond the capacity of the forest to feed them. Browse lines are visible on all sides of Cross Mountain, and saplings meant for the next generation are bitten off. The woods must miss panthers in particular, whose evolution was sustained by venison. Only ghost panthers haunt the woods today.

A few miles from Cross Mountain stand several massive stone furnaces, testimony to the mining and smelting of iron ore that began at least by the 1750s. Furnaces were fueled by charcoal, made by clear-cutting surrounding forest, piling the logs into a heap, and raking up soil to dump on top to keep the fire smoldering instead of burning. Some of those charcoal hearths still leave a traceable outline. A typical furnace burned about 150 acres of trees every year.

But it was a big iron boomer, or winch, in our neighbor's woods, that offered the defining clue to the dark history of the woods. Dating probably from the early to mid-1900s, it's made from separate parts ingeniously welded together to haul timbers from down in the hollows up to the ridge. Deep ruts, not quite smothered by decades of fallen leaves, reveal the old road where a horse- or oxen-pulled cart or, later, a truck carried logs to the nearest mill or railroad depot.

By 1900, railroads were creeping up almost every hollow wide enough to accommodate narrow-gauge tracks. The previous impact of individual mountaineers on the forest—pulling out a few trees with oxen, burning patches of woods to kill ticks and encourage berries, even widespread harvesting of chestnut oak bark—had been relatively light. Virgin timber still covered the higher slopes and ridges.

And what timber it was. The primeval trees of the southern Appalachians dwarfed the loggers who cut them and even the trains that carried away the logs. Timber from a single tree sometimes filled multiple cars. In a half-century frenzy of logging from 1880 to 1930, the state of West Virginia went from being almost entirely forested to almost entirely deforested. The story was much the same down the entire southern Appalachian mountain chain to Georgia. It's estimated that less than 1 percent of the original forest survived. Fortunes were made by hundreds of timber companies, mostly owned by distant businessmen. As in the coal counties, little of that prosperity trickled down to mountain people. And they lost their way of life, too, when the forest was cut, because they depended on it for so many life-sustaining products.

Much of the timbering equipment of the time was steam powered by wood or coal and threw flaming embers out into the treetops and limbs left behind on the ground. Many large, destructive fires have been recorded throughout the mountains during the logging boom. The scars remain on Cross Mountain: charcoal rubs off on my fingertips from charred husks of trees burned a century ago. West Virginia historian Roy Clarkson described the land that became the Monongahela National Forest as "smoking sticks and bare stone."

The gravest consequence was the loss of countless tons of mountain topsoil that drowned in the Chesapeake Bay and Gulf of Mexico. Already by 1911, flooding in the lowlands, from lack of trees to hold mountainside soil, was ruining farms and fields with debris and carrying away entire towns. Congress responded to public pressure with the Weeks Act. This law authorized the Forest Service, then only six years old, to begin purchasing millions of acres of burning, eroding mountainsides from willing sellers, which at that time were largely timber companies that had exploited everything of value and no longer wanted to pay local property taxes.

Today, some six million acres of recovering woodlands in eight national forests cover the highest peaks and ridges of the southern Appalachian Mountains. These nearly contiguous national forests create something rarer than a verified panther sighting: a regional ecological core of forests that make conservation possible on a landscape scale. They also represent something virtually unique in history. By purchasing and repairing exploited forests, the Forest Service reversed the millennia-long global trend of privatization of the commons, followed by environmental degradation for private profit. In an irony of historical timing, the very destruction of the original forest has resulted today in an Appalachian commons that could save the region.

Magna Carta gets all the press, but the Forest Charter that came after it in 1217 also made political history. For the first time, it defined rights that dated back to the dimmest days of the Dark Ages across all of Europe: the use of forests by common people for foraging, hunting, and grazing livestock, regardless of ownership. These were the forest commons traditions that Appalachian settlers brought with them from Europe and adapted to the uniquely bountiful forests of the southern Appalachians. Those commons traditions are now settled firmly, in modern forms, onto the national forests.

To talk about a commons, though, is to invite dissonance. In 1968 an article titled "Tragedy of the Commons" by biologist Garrett Hardin in the prestigious journal *Science* gave the idea of the commons an enduringly bad

reputation. In one of the most cited articles ever, he argued that commonly owned resources would inevitably be degraded due to rational selfishness as every herder added one more animal to take advantage of common grazing land. His admission, in his 1985 book *Filters Against Folley*, that his paper was extremely misleading and should have been titled "Tragedy of the *Unmanaged* Commons" is not nearly as well known.

Recognition of that one-word difference earned the 2009 Nobel Prize in Economics for the first woman ever to receive one, despite the fact that she wasn't even an economist. Elinor Ostrom, who died in 2012, was a professor of political science at Indiana University, given to loud clothes and, unheard of in economics, actual field work. Traipsing through shared forests in Nepal and mountain pastures in Switzerland and Japan, wading through irrigation systems in Spain and the Philippines and fisheries in Maine and Indonesia, she found that people who depend on commonly held resources could collaborate for sustainable use over centuries, even millennia.

Ostrom discovered that all successful commons have variations of several basic management principles. The way that national forests operate embody most of them. There are distinct boundaries, marked by dashes of red paint through the woods. Federal, state, and county governments provide essential services of regulating extractive uses, enforcing rules, and imposing sanctions on violators.

People who use the resources must also have a say in management decisions. In recent years, some district rangers have begun meeting with stakeholder groups, using roundtable conversations to reconcile the many, often contradictory, demands on the forest. The most formal mechanism, however, is the legal requirement that the Forest Service seek public response when it updates its land management plans every ten to fifteen years.

The GWNF plan came up for revision in 2010. A new f-word was just then entering our language that had nothing to do with sex but everything to do with exploitation. "Fracking" is short for hydraulic fracturing, a way to extract natural gas by drilling deeply down and sideways, then pumping down millions of gallons of water laced with sand, salt, and carcinogenic

chemicals. Gas is forced up, along with contaminated wastewater, which is often radioactive.

Like other parts of the Allegheny Mountains, Cross Mountain is made of shale, a type of rock associated with natural gas. There was a gas lease on our property when we bought it, which soon expired. On our back border is a sulfurous spring in which I once found a pile of belly-up salamanders, sad evidence of gas in the ground. A neighbor up the road claims he can light his kitchen faucet with a match, but I've never actually seen him do it. Gas wells were drilled nearby in the 1920s and '30s, providing some local jobs and prosperity to the grandparents of the families living there now. What's left of those old wells is generally hidden behind a few planted trees.

The GWNF lies over the Marcellus shale play. When the routine updating of the GWNF plan began, the gas industry was already fracking West Virginia and Pennsylvania. CEOs of gas companies exerted unprecedented pressure on the Forest Service to facilitate fracking, even forcing a congressional hearing, something rarely if ever done previously for a national forest plan. Industry ads in newspapers extolled the jobs and cheap energy to come.

Most people around here had never heard of fracking. Through meetings at local schools, we learned that fracking was not your grandfather's gas drilling. I joined a group on a frack-finding weekend visit to Doddridge County, West Virginia, a drilling hot spot. We saw entire hills being leveled for more well pads, compressor stations, vent stations with shimmering waves of unknown emissions, and holding tanks with obvious leaks. We heard stories of illnesses, underweight babies, creeks contaminated or desiccated, first responders overwhelmed by accidents and reporters barred from reporting on them. We noticed the out-of-state license plates on vehicles of the many workers brought in by the company. Above the host house where we camped in the yard, a new well was being drilled. Two months later, it exploded, killing two workers. Corporate profits were once again fracking the forests and the people of Appalachia.

Rising from the heights of the GWNF are the headwaters of the Potomac and the James Rivers, which ultimately supply drinking water to millions of people in Richmond and Washington, DC. Polluting these rivers at their source began to emerge as a focal point of alarm. Ordinary citizens, local governments, and municipal water managers downstream questioned whether private profits should be allowed to endanger a public resource. The industrialization of rural landscapes beloved by the people who lived in them, and many others who liked to visit, was not a popular idea. Some voices asked whether massive new development of a fossil fuel source was the best way to address the greenhouse gas problems being caused by fossil fuels.

The plan was delayed for several years as the Forest Service grappled with challenges to its authority and its mission. Finally, in 2014, the Forest Service released the final plan. It stopped oil and gas leasing altogether, for the next decade or so that the plan would be in effect.

A cloud of exhaled sighs of relief rose over the Shenandoah Valley. Several community groups joined to place a large, scenic ad in newspapers throughout western Virginia: "We thank the U.S. Forest Service . . . [and] Over 75,000 citizens . . . [and] Local, State and Federal Officials from Around the Region" who wrote against fracking. "Your Voices Were Heard!"

It was a triumph of the commons.

Two small streams seep from shallow hollows near the top of Cross Mountain and run down across my property. Each cascades in a series of rock-bottomed bowls into Reedy Run. Some of those rocks are inscribed with shells of sea creatures that lived three hundred million years ago, testaments to the indelible imprint of the past.

Reedy Run tumbles down a gap in Cross Mountain to join hundreds of other tributaries to the Shenandoah River, which empties into the Potomac River, which then empties into the watery commons of the Chesapeake Bay. And so on. The whole world is an unmanaged commons: not just fresh water, but also oceans, the atmosphere, and living space for the estimated

one hundred million distinct life forms, most of them unknown and invisible in soil, which together make the world habitable. The most basic conditions for human life are produced only by natural systems.

Large swaths of unfragmented forests covering entire landscapes are particularly adept at performing a panoply of such services. Management of the Appalachian national forests offers the continuation not only of these ecosystem benefits but also of the hundreds of millions of dollars spent annually on recreation that sustains many rural communities like mine. National forests also provide the setting where age-old Appalachian traditions survive as private lands are increasingly fragmented and posted.

I don't hike on Cross Mountain, or in any national forest, during hunting seasons. Deer and bear hunting remain strong where I live, recorded with trophy photos and bulletin board entries at our local store, and with long, detailed stories over coffee. Three generations of one family have hunted deer from a particular stand on Cross Mountain. I learned this just last year, when I disrupted doe day by tramping around noisily near a frustrated but friendly descendant (I had miscalculated the date, for which I apologized).

Fishing, too, remains popular as a way to put supper on the table. I've relished many a meal by a neighbor who has fished the GWNF's stocked lakes and native trout streams all his life. He's also an expert on mushrooms and has tried more than once to teach me the difference between edible "brownies" and the poisonous brown mushrooms that look just like them. Ginseng, ramps, running cedar for holiday wreaths, medicinal herbs, ornamental ferns, and various other plant products attract foragers, old and young, with permits required for some uncommon species.

To such primeval products of the forest must be added one that the authors of the Forest Charter couldn't have imagined in the thirteenth century, but which is emerging as critical to the twenty-first: carbon sequestration.

Trees take in carbon dioxide, the major greenhouse gas, during photosynthesis and store, or sequester, carbon in wood, roots, and soil. Half of the heft of every tree is carbon. Trees are the single best technology yet

discovered for carbon capture and storage, a process that scientists consider essential to combat the worst impacts of global climate change. Forests of the eastern United States play an especially important role in global climate. Most of the carbon already stored in forests across America, an amount equal to sixty-seven years' worth of the country's fossil fuel emissions, lies in eastern forests.

The Appalachian national forests are the largest, most contiguous body of publicly owned forests in the East. Whether they continue sucking in carbon dioxide, helping to stabilize the climate, or release it to add heat to the world depends on forest management.

Carbon forestry is a twenty-first-century science. In recent decades, field studies have reversed the previous belief that young trees sequester more carbon than mature trees. An international team of editors analyzed hundreds of global studies in the 2009 book *Old Growth Forests: Function, Fate, and Value* and concluded that "up to an age of 600 years, old-growth forests remain carbon sinks and exhibit the same carbon sink strength as younger developmental stages . . . [and] generally lock up more carbon than any other forest stage or alternative ecosystem." So few forests older than six hundred years remain on earth that further research is impossible.

There's a chestnut oak on the cusp of a Cross Mountain cliff that I can bushwhack down to from an old tanbark road we use as a trail. This one has a single trunk, having escaped the bark skinners because back then it was a scrawny, inaccessible sapling. Like most trees in the GWNF, it's about a century old, but hardly stately; my arms overlap to the wrists when I hug it. Even on less craggy sites, few of the white, black, red, and scarlet oaks, the mockernut and pignut hickories, the maples and birches and other tree species are much bigger. The extreme erosion and fires of that earlier era drastically reduced soil fertility. Roots and soil can hold half or more of a tree's total stored carbon. Forests regrowing on severely degraded soils need centuries of leaf fall and root growth to build up as much carbon as is stored in less disturbed soils.

The longer a tree lives, the more soil it creates and the more carbon it stores. Like most species of oaks, this chestnut oak could live for hundreds

of years more. A red cedar in West Virginia has been documented at more than seven hundred years old. A forester's borer used to core a friend's sugar maple wasn't long enough to reach the center and only collected two hundred rings. In temperate, deciduous forests like these, maturing and old trees would naturally cover at least half of the landscape. Some grow slowly stouter, while others grow taller until they snag passing squalls and topple in high winds. Wind is the major natural disturbance that allows forests to renew themselves. Plant species that need sun to germinate sprout in these wind-throw gaps.

Over centuries, young forests gradually mature into the complex architecture of old growth: thick, deeply furrowed bark and large limbs; multiple layers of diverse vegetation from ground to canopy; expansive canopies that create a cooler, moister microclimate refuge against heat; large standing dead and downed trees; and, most of all, the vast underground weave of roots and the fungal threads that sheathe and nurture them, dubbed the "wood-wide web." These habitat niches are unavailable anywhere else. Hundreds of species of plants and animals are endangered, threatened, or declining in the GWNF alone, and most of them use old growth for some part of their life cycle.

For decades, I have seen history in that chestnut oak above the cliff, and resilience, and strength. Now I see a pillar of carbon, and a signpost to wisdom. The young Appalachian national forests are poised to become a reservoir of resistance to climate change, if managed to rebuild soil and stability in coming centuries. Carbon forestry means working with natural processes to avoid disruptions that cause a net loss of carbon. Trees can still be harvested, but at longer intervals, with low impact methods that avoid compacting soil, and preferably for the kind of high-quality, durable products that would show up as furniture in a twenty-second-century *Antiques Roadshow*.

Although the GWNF plan halted oil and gas leasing, it called for thousands of acres to be logged and prescribed burned every year, as do other national forest plans. Some foresters argue that the threat of drought from climate change demands even more logging and burning to reduce

the fuel that might feed future forest fires. But some climate models predict more rain in the central Appalachians, and rate the oak-pine forests that cover much of the mountains as the forest type least vulnerable to climate change. Debates are ongoing, as other national forests approach the timeline for revision of land management plans.

Maybe the chestnut oak that now crowns the cliff will plummet down the flaking sheet of shale in one of the windstorms now becoming more violent, or in a future wildfire. The shards of old pine stumps on South Ridge will certainly disappear in a few more years, taking with them their perfume from the past. The pig fence is slouching toward oblivion under the weight of winter snows. The phrase "going back to the land" has a different meaning to me now, after decades of watching forest life recycle itself. Visible clues may fade, but only when trees grow ancient and soil grows deep will the national forests recover from history. Maybe then a panther might even crouch on that cliff, waiting for deer. The great Appalachian carbon commons offers redemption from the past, as well as defense of the future.