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## Debunking Wildfire Myths to Save Our Forests and Our Climate

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For Rachel

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# Prologue

## Detours

"Trail washed out. Take detour." That's what the sign on the tree said. My older brother and I had been hiking for about three months on the Pacific Crest Trail, starting at the Mexico-California border with the intention of hiking the entire 2,700-mile length of the trail, all the way to Canada. Over the previous couple of weeks, we had seen several similar signs posted by the US Forest Service in the national forests along the Pacific Crest Trail. Each time we had dutifully obeyed the signs, taking the hastily constructed "detour" trails, which typically added several miles to our route for the day and often took us away from essential water sources. We were getting a bit fed up. How could so many sections of the trail be washed out?

This time was different, though. As we approached this sign, located in a national forest in California's northern Sierra Nevada mountain range, we saw two men up ahead. One of them was writing on the sign. As we drew closer, the men saw us and left, hiking farther up the trail and out of sight.

When we reached the detour sign, we saw that it had an important addition—a handwritten note that read, "Clear-cuts ahead—it's a scam!" Intrigued, we ignored the detour and forged ahead on the Pacific Crest Trail. Within a short distance, the forest disappeared, and we found ourselves staring at an enormous clear-cut on public land where a wild forest had once lived. Shocked and outraged, we went back to the sign and added a couple handwritten comments of our own; then we double-timed it north on the trail, back through the clear-cut to try to catch up with the two men responsible for the revelatory note. At this point, we had already hiked more than 1,400 miles through the wilderness from the Mexican border, so we were in pretty good shape. We soon caught up with the two men and asked them about their graffiti. It turned out that they both worked for the US Forest Service. In fact, it was their job to post the misleading "detour" signs in various places along the trail, in an effort to hide the ugly truth of the Forest Service's commercial logging program. But their consciences led them to tell the public what was really happening on federal forestlands.

We ended up hiking for hours with these two Forest Service employees, and they gave us a crash course on the nature of the Forest Service's commercial logging program. Under federal laws, the Forest Service can sell trees on public lands to private logging companies and keep most of the revenue generated by those timber sales for its own budget, using the money to pay staff and buy new equipment. This creates a powerful perverse financial incentive for Forest Service staff to ignore wildlife and recreational impacts and emphasize industrial logging.

In the following days and weeks, as we hiked north on the Pacific Crest Trail, we saw more loss and devastation of our national forests due to logging activities. One day, as we took a break at the bottom of a canyon in the Willamette National Forest in Oregon, I sat on a stump six feet in diameter and looked around me: there was nothing but stumps and ruined ground as far as I could see in every direction, all the way to the ridgelines. I was overwhelmed. I thought to myself, "This has to stop," and I decided at that moment that I would dedicate myself to protecting forests and other wild places threatened by development and resource extraction.

That was 1989. I had taken a year off from college to hike the Pacific Crest Trail with my brother.[1] Although I had been hiking and backpacking in national forests and national parks since I was a kid, I did not know the difference between the two, and I had no idea that, unlike national parks, national forests are not protected from logging. I was not politically active at the time, but that soon changed.

It took us five months and four days to hike from Mexico to Canada. Soon after I returned home, I registered to vote and got involved with the

*Right:* Kirk Hanson (left) and Chad Hanson at the beginning of the Pacific Crest Trail, on the Mexico-California border. (Photo by David A. Carlson, 1989)


Trail end of the season

Kirk, left, and Chad Hanson at the beginning of the Pacific Crest Trail.

*Hikers reach goal, finish 2,700-mile trek*

*Below:* The Hanson brothers (Chad on the left) near the Canadian border on the Pacific Crest Trail. (Photo by unidentified hiker)

Sierra Club, volunteering my time to protect forests, deserts, and other wild places. At that time, I was a premed student at UCLA, but I could not forget the things I had seen on the Pacific Crest Trail. After I graduated, I decided to apply to law school and work to uphold federal environmental laws protecting national forests and other wildlands. I attended the University of Oregon School of Law, which has a strong public-interest environmental law program, and began to work with local forest protection groups in Oregon.

The early 1990s were a pivotal time for public lands. The northern spotted owl had recently been listed as an endangered species, and conservation groups were filing lawsuits in an attempt to halt the widespread loss of old-growth forests in the Pacific Northwest and elsewhere.[2] The leadership in the Forest Service was determined to continue its industrial logging approach, felling old forests and replacing them with ecologically sterile tree farms, but the political climate was shifting.

Just several years earlier, the Forest Service had unabashedly and publicly promoted its logging program, including the clear-cutting of old-growth forests. Agency managers had talked glowingly about the revenue generated for the Forest Service's budget and the profits generated for the logging industry. Politicians liked to frame the issue as one of "jobs versus owls." But public awareness was growing. More and more people were speaking out against logging on national forestlands, and the Forest Service realized that it could no longer openly promote the logging and clear-cutting of old-growth forests. In the 1970s and 1980s the Forest Service and the logging industry had dismissed old-growth forests as "decadent" and "overmature," claiming that it was best to clear-cut and replace them with "thrifty" tree plantations. But science eventually caught up with the Forest Service. Recognition of the ecological importance of old forests, and the high levels of native biodiversity they support, was becoming widespread, and the northern spotted owl was becoming a household name in the United States.

The Forest Service tried to hide its commercial logging program from the public and got more clever about the language used to describe and promote it. By the early 1990s, when conservationists confronted Forest Service staff about the latest clear-cut logging proposal on federal lands, they were told it was "ecosystem management."[3] And so the euphemisms began. The Forest Service, the logging industry, and members of Congress whose reelection campaigns were funded by the timber industry began a new marketing campaign for the commercial logging program on US forestlands. Faced with growing public support for forest protection, they all but stopped using the term "logging" and instead proposed industrial logging and clear-cutting on public lands under the guise of more benevolent-sounding terms such as "forest health," "fuel reduction," and "restoration."

When I graduated from law school in the spring of 1995, I was ready to pursue a career as a public-interest environmental lawyer focusing on national forest protection. However, at that very moment, pro-logging members of Congress proposed the most extreme attack on federal forestlands in history. The Salvage Logging Rider, as it became known, was an appropriations rider, bootstrapped to a major spending bill. The logging rider proposed an eighteen-month suspension of all environmental laws related to logging projects on federal forestlands, so long as the Forest Service claimed, with a wink and a nod, that the goal of such projects was to improve forest health or prevent forest fires, ostensibly by removing "fuels" such as dead and dying trees and "associated" trees. Moreover, under the terms of the rider, any such logging proposals signed during the eighteen-month period would be exempt from all environmental laws indefinitely, effectively instituting a period of lawless logging on public lands that would last for more than three years. This represented the earliest significant use of the "catastrophic wildfire" narrative as a political tool and weapon.

Law professor Mary Wood and I wrote a series of op-ed articles in newspapers across the nation, including the *New York Times,* urging Congress to reject the Salvage Logging Rider and recognize it as a cynical ruse to allow destructive logging on public lands.[4] Conservation groups spoke out against it too, but Congress ignored these concerns and passed the rider as part of the government spending bill, and it was signed into law by President Bill Clinton in 1995. Former vice president Al Gore later called this the Clinton-Gore administration's single biggest mistake on environmental issues.[5]

Just weeks after I received my law degree, the federal courthouse doors were closed—completely—with regard to logging on federal lands. So I decided to use my environmental law background to work on forest policy and legislation, cofounding the John Muir Project in 1996 and working to prevent the Salvage Logging Rider from being extended after its expiration. I organized a successful Sierra Club national ballot initiative, advocating an end to commercial logging on federal public lands nationwide.[6] I went to Washington, DC, where I met Congresswoman Cynthia McKinney, an environmental and social justice hero. I worked with McKinney, her staff, and environmental activist René Voss to craft and introduce landmark forest protection legislation in Congress.

For the US Forest Service, there was no going back. Congress had weaponized the catastrophic wildfire political narrative, giving the agency a powerful new tool to justify its commercial logging program. Essentially, it was pursuing the same destructive logging practices of the 1970s and 1980s, but it now had a far more effective, and deceptive, marketing strategy. Soon, nearly every timber sale proposed on federal lands was packaged as a "forest health," "fuel reduction," or "restoration" project that promised to save our forests from the supposed threats posed by natural processes like wildfires. The solution to nearly every problem could be found at the business end of a chain saw. Clear-cutting a mature forest became "meadow restoration," and logging projects that killed and removed upward of 70 percent of the trees in a given stand, including mature and old-growth trees, became forest "thinning" projects conducted because the stands were supposedly "overgrown" or "overstocked."

I spent more and more time surveying logging projects proposed by the Forest Service and trying to understand the agency's claimed reasons for carrying them out. This also meant long hours scrutinizing environmental assessments and environmental impact statements for these logging projects, locating and reading the key scientific studies cited to support the Forest Service's various assertions, and noting where these assertions had no supporting scientific evidence. Occasionally, the John Muir Project filed lawsuits in federal court against proposed logging projects in national forests, usually when the science had been misrepresented or ignored in especially egregious ways or when imperiled wildlife species were being threatened.

A few years later, a chance encounter in a remote forest solidified my personal change in direction. One day in the summer of 2002, I was bumping along a rutted logging road deep in the Sierra Nevada mountains, and I braked hard as I came around a bend. A logging crew was cutting down a patch of fire-killed trees, or “snags,” next to the road, and the workers had to stop so I could pass. I was monitoring the effects of a timber sale following the Star fire, which had occurred a year earlier. “You know, I can understand why you don’t want us to cut down that stand further down the road, where the trees are alive and green,” the foreman of the logging crew told me, pointing to a dense, lightly burned stand where I was headed to check on a pair of California spotted owls. “But this stand here,” he said, sweeping his gaze across a patch of fire-killed trees in the more intensely burned area, “has been destroyed by fire. What wildlife species are going to use this? What harm could possibly come from cutting this down?” It was an excellent question, and I didn’t have a good answer for him.

I left the logging crew behind to complete my forest monitoring work, but the question stayed with me. I became curious, and in the following days and weeks, I spent long hours in research libraries, tracking down everything I could find on the subject. What I discovered surprised me. The few early studies conducted at that time had found that “snag forest habitat,” created by patches of high-intensity fire in mature forests, was comparable to unburned old-growth forest in terms of native biodiversity and wildlife abundance. Numerous wildlife species appeared to select snag forest habitat over any other forest type.[7]

My interest grew, leading me back to graduate school at the University of California at Davis to get my PhD in ecology. As I completed my course work, it occurred to me that, in many ways, the shift in scientific and societal understanding of snag forest habitat reflected the transition in the understanding of old-growth forest in the 1980s and 1990s. Habitat types that had previously been dismissed as unimportant, or as part of the political and economic narrative to justify widespread logging, were turning out to be ecological treasures as more science came to light.[8] Previously unrecognized connections and relationships in the forests were becoming better understood.

I often think back on that day in 2002 and my conversation with the

Snag forest habitat twelve years after the high-intensity Star fire in Eldorado National Forest, characterized by an abundance of snags and downed logs and the natural regeneration of conifers, oaks, dogwoods, and native shrubs.

logging crew. As it happens, my colleagues and I were successful in stopping the Forest Service from logging the stands of live trees there, including the spotted owl nest area I was monitoring. But the adjacent snag forest was logged, removing the vital foraging habitat the owls relied on to supply their small mammal prey and turning the area into ecologically sterile stumpfields.[9] Because this misunderstood and underappreciated snag forest habitat was lost, so too was the pair of owls I had spent hundreds of hours trying to protect. As a longtime fan of John Muir's writings,[10] I should have been more mindful of his observation that all things are hitched together. It's a lesson I did not have to learn twice.

# 1

# The Fiery Myths that Undermine Climate Solutions

Here's the bad news: you are being deceived every day, misled by people you should be able to trust—elected representatives, government agency officials, and even some scientists, environmentalists, and environmental writers and journalists. Many of them don't even realize they are spreading falsehoods that threaten imperiled wildlife species and human communities and exacerbate the climate crisis. They are simply repeating notions and beliefs that have been stated over and over again, with seeming authority, in the public dialogue about large forest fires. If you care about forests, biodiversity, and climate change, as I do, there is a significant chance that, despite your best intentions, you too have trafficked in some of these falsehoods. It's nothing to be ashamed of. I did it unknowingly for years, before I started asking critical questions and delving deeper into the evidence pertaining to forest ecosystems, wildland fires, and climate change.

The challenge of solving the climate crisis is monumental but conceptually simple: we need to rapidly move beyond fossil fuel consumption and simultaneously draw down the large, human-caused excesses of greenhouse gases in our atmosphere, while helping the most vulnerable communities adapt to the climate change effects we cannot avoid. Many people in the environmental community are still laboring under the misapprehension of the late 1990s that we can effectively mitigate climate change simply by transitioning to a clean energy economy that does not rely on fossil fuels. But as the global scientific community and the United Nations have now realized, this is not nearly enough.

Due to human activities, such as fossil fuel consumption and logging, atmospheric concentrations of carbon dioxide ($CO_2$) and other greenhouse gases reached 415 parts per million in 2019,[1] and they continue to climb, hitting 417 parts per million in June 2020, even as the global coronavirus pandemic caused a substantial reduction in fossil fuel consumption.[2] These levels need to be well below 350 parts per million to avert the most severe human and ecological impacts of global climate change.[3] The problem is that atmospheric $CO_2$ has an extremely long "residence time." This means that even if the world stopped consuming all fossil fuels tomorrow, most of the excess greenhouse gases would still remain in the atmosphere by the late twenty-first century—long after the most catastrophic effects of climate change had occurred—if we do nothing else to avert the climate crisis. Even with a 93 percent reduction in fossil fuel consumption over the next few decades, we would also need to dramatically decrease logging and increase forest carbon storage to overcome the worst impacts of the climate crisis.[4]

This is why forest protection is essential. Many forests around the world are currently far below their carbon sequestration and storage capacity due to many decades or centuries of logging and the removal of carbon. We can change this if we protect existing forests, including carbon-rich forests and those that may contain lower levels of carbon but could store more, and if we facilitate the recovery of native forest ecosystems in a substantial portion of the world where vast areas of forests were cleared for livestock grazing or agriculture. If we take these steps, our forests will be able to absorb far more $CO_2$ from the atmosphere, since trees and other plants "breathe in" $CO_2$ and use it to grow and to add wood to their trunks and branches.

In combination with a swift move away from fossil fuels, these forest protection steps would allow us to limit temperature rise to less than 1.5 degrees Celsius and avoid the worst effects of climate change, including extreme heating and the direct impacts on human health, major flooding, exacerbation of drought cycles, rising sea levels and the displacement of hundreds of millions of people in coastal communities, and the contraction of numerous ecosystems. In fact, forest protection—both the protection of existing forests and the recovery of native forests that have been lost to land-use practices—could account for approximately half the necessary climate change mitigation globally, while the other half could be provided by a quick and purposeful move to clean energy that does not emit carbon.[5] These two central aspects of the way forward are essential but quite different. Ending fossil fuel consumption is about preventing things from getting worse. Increasing forest protection is about making things better.

We need to start thinking of forest protection as a coequal part of solving the climate emergency, along with a shift away from fossil fuels. Just as we understand the need to use clean energy that does not pollute the atmosphere with greenhouse gases, we must recognize the need to transition away from wood products and toward tree-free alternatives for building materials and paper, as hundreds of US climate scientists and ecologists have urged,[6] and we must enact policies to encourage more recycling and reduced consumption of wood. This also means rethinking our food consumption patterns and eating far less meat, especially from grazing animals such as cattle and sheep, given the role of livestock grazing in deforestation and forest degradation in many parts of the world, including the rainforests of Brazil. And we need to recognize that preserving forest ecosystems and preventing the exploitation of wildlife can not only protect the climate and preserve biodiversity but also prevent "zoonotic spillover" of deadly viruses into human populations.[7] In short, we need to adopt a twenty-first-century view of forests in this era of climate crisis.

However, demonizing forest fires and spreading sensational but spurious myths about them fundamentally undermine solutions to the climate crisis by keeping the focus on efforts to "stop" fires and "manage" forests ostensibly to prevent future fires. This not only fails to stop natural fires driven primarily by weather and climate but also diverts scarce resources away from creating fire-safe communities. Worse still, it results in even more logging of forests—an outcome that increases carbon emissions overall, exacerbating climate change.[8] And ironically, logging often increases fire intensity,[9] in addition to fragmenting habitat and threatening imperiled wildlife—all at a time when we need to increase forest protection to mitigate climate change and save endangered species, while directing resources toward adaptation measures such as creating fire-safe communities.

Now for the good news: you are being deceived. If everything you were told almost daily about forests, wildfires, and climate were true, there would be little hope. The truth, however, is that hope lies just beyond the falsehoods. There is still time to avert the worst impacts of the climate crisis if we act with urgency and purpose to rapidly transition beyond carbon fuel consumption, dramatically increase forest protection, and simultaneously enact adaptation measures to help the most vulnerable communities. For this three-tier path forward to work, we must be willing to question long-held myths and assumptions that are acting as impediments to meaningful progress. This is no small challenge, and the myths and misconceptions about forests, fires, and climate are deeply rooted, as we saw in three recent high-profile fire seasons.

During the summer and fall of 2018, in the hot, dry, windy conditions that have become more common due to climate change, numerous large wildfires began in California and spread quickly—several of them apparently from human-related causes near residential communities. Two of these fires, the Camp fire in the northern Sierra Nevada and the Woolsey fire in Southern California, were particularly devastating for people and received extensive media coverage. In the 153,000-acre Camp fire, more than 14,000 homes were destroyed and 85 lives were lost in the communities of Paradise, Concow, and Magalia. It was the largest loss of life in a single fire in California's history.

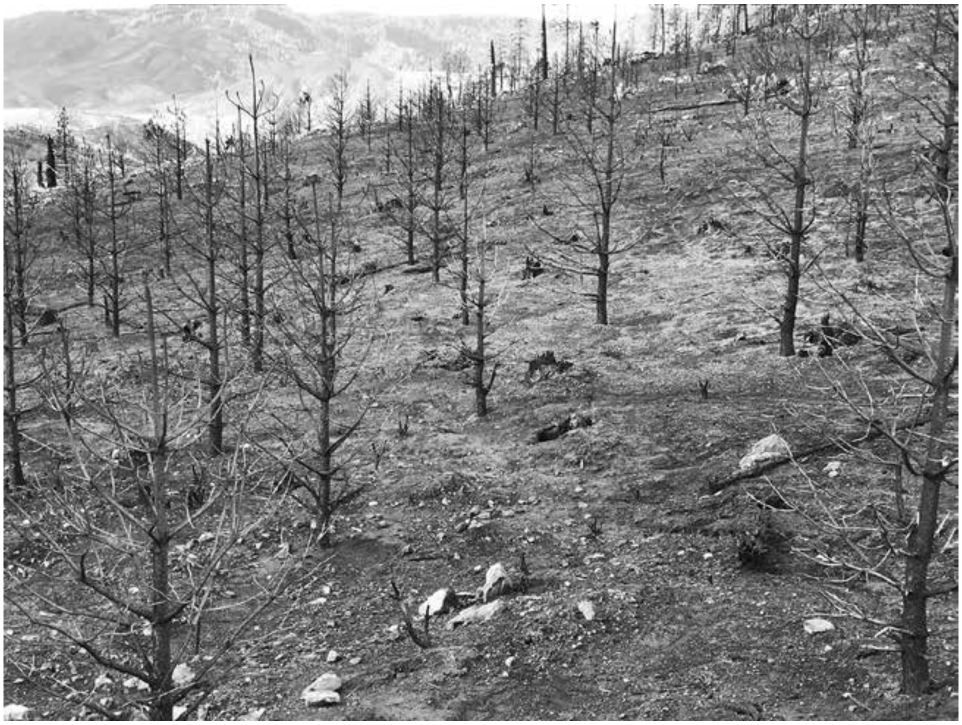
In the 97,000-acre Woolsey fire, more than 1,600 buildings were destroyed, 3 people died, and nearly 300,000 were evacuated from their homes. The media coverage was nearly constant, given that the fire burned through the Santa Monica Mountains just west of Los Angeles, including the Malibu Beach area and the canyon communities above Malibu. Many of the rich and famous lost their homes, including Miley Cyrus, Liam Hemsworth, rock legend Neil Young, rapper Lil Pump, Kim Basinger, and Robin Thicke. Numerous other celebrities, including Guillermo del Toro, Kim Kardashian, Caitlyn Jenner, and Rainn Wilson, had to evacuate as the flames approached.

Before the 2018 California fire season even reached its peak, politicians who were aligned with the logging industry were already posturing. They asserted that the human tragedies caused by these fires were the result of "overgrown" forests, too many dead trees, and environmental laws that restricted the logging industry and national land management agencies, such as the US Forest Service, from conducting logging activities, which they termed "thinning" and "fuel reduction." They claimed that logging would have curbed or stopped the fires. Using this "catastrophic wildfire" political narrative, the Trump administration demonized the environmental community, calling for a large increase in logging levels in remote forests and the rollback of environmental laws, ostensibly to protect communities.[10] Amidst the panic of the moment, three Democratic governors of liberal Pacific coast states joined the Trump administration's call for additional logging.

However, as scientists and climate activists began to examine the facts of the 2018 California fires more closely, a very different picture began to emerge. Scientists noted, for example, that the Woolsey fire burned entirely in grassland, chaparral (native shrub habitat), and oak savannas. The closest forestland was many miles away, so how could "overgrown" forests and dead trees have driven the Woolsey fire?

The Camp fire occurred mostly in a forested area, but it was soon revealed that the several thousand acres that burned so rapidly in the first few hours—before the fire reached the communities of Paradise, Concow, and Magalia—had been heavily logged in preceding years. After a lightning fire occurred in the area in 2008, thousands of acres were subjected to logging and clear-cutting on both private timberlands and US public lands, and the great majority of the fire-killed trees, and many of the live ones, were removed. Additional areas were logged under the guise of "thinning." In fact, several years before the Camp fire occurred, the US Forest Service had told the public that this logging would save communities from wildland fires. There were no lawsuits filed by environmental groups against these logging projects, and no court injunctions were issued to halt them.[11]

These revelations about logging prior to the Camp fire were consistent with recent scientific studies that had found that such logging typically results in more intense wildfires when they do occur.[12] It may seem



Camp fire area in 2019. One year earlier, the Camp fire swept through these heavily logged areas toward the towns of Paradise and Concow. The fire's high intensity and rapid spread were attributable to earlier postfire logging, under the guise of fuel reduction, and the creation of homogeneous tree plantations.

counterintuitive that forest fires often burn hotter when more trees have been removed, but it makes sense once the reasons are understood. Even in the largest forest fires, most areas burn at relatively low intensities; most of the mature trees survive, and the fire consumes the majority of the easily burned material that primarily drives the flames, such as needles and twigs on the ground and the foliage of very small trees and shrubs. Even when a fire burns an area a second time, years later, only a small portion of the standing dead trees and downed logs are consumed. The logs on the ground soak up and retain large amounts of moisture, acting like giant sponges that interrupt the spread of fire across the forest floor. Lush understory vegetation naturally grows in high-intensity fire patches; this, along with regenerating trees, creates a quasi-wetland effect in such areas. As a result, even high-intensity fire areas that later reburn experience mostly low-intensity fire effects.

Lush, moist, natural regeneration is apparent in 2018, five years after this high-intensity Rim fire patch burned in the central Sierra Nevada.

In sharp contrast, where postfire logging removes most of the snags and logs, it leaves behind a desiccated landscape prone to hot, dry conditions and the spread of highly combustible invasive grasses. This situation, in combination with the tree plantations established after postfire clear-cutting and the kindling-like "slash debris" left behind by loggers, tends to make fires burn more intensely, even though most of the woody material has been removed by postfire logging operations.

A similar situation often occurs where forests are logged under the guise of "thinning." A typical thinning project kills and removes the majority of trees in a given stand, including many mature trees and even some old-growth trees. In addition to leaving behind combustible slash debris, this reduces the cooling shade of the forest canopy, creating hotter and drier conditions on the forest floor and stimulating the growth of understory grasses, shrubs, and small trees that can readily carry flames. Further, in these thinned areas, the winds that drive wildland fires can move through the forest more rapidly, and the fires often burn more intensely because there are fewer trees to buffer and slow the winds.

The initial claims of pro-logging politicians did not stand up to scrutiny after the 2018 California fires. The Trump administration, for example, issued a press release that exaggerated the carbon emissions from these fires, while downplaying the emissions from fossil fuel consumption in the energy sector and simultaneously promoting logging.[13] But the administration failed to mention that annual carbon emissions from the US energy sector are dozens of times higher than yearly emissions from wildfires, as are the carbon emissions from logging in US forests.[14] The administration also neglected to mention that wildland fires distribute nutrients in forests and stimulate growth[15]—a process that begins just days after the flames have passed and accelerates over time, pulling increasingly large amounts of $CO_2$ out of the atmosphere. Coal mines, in contrast, do nothing of the sort.

From a community safety standpoint, the initial claims about the 2018 California fires also fell flat, especially when it was revealed that the great majority of the homes destroyed were already on fire before the flames even reached their neighborhoods. How is this possible? Most homes that do not survive wildfires are ignited by flaming embers, or firebrands, driven by the wind a mile or two in advance of the flames. These embers land by the thousands, entering houses through unprotected exterior vents, such as in attics, and starting fires inside the dwellings.[16] As discussed in detail later, there are simple cost-effective measures that can dramatically reduce the chances of a home burning in a wildfire. However, these solutions will remain largely unimplemented as long as our public dialogue is focused on the catastrophic wildfire political narrative and on management actions out in the wildlands.

A year after the California fires, on the other side of the world, hundreds of wildland fires—many of them started by lightning strikes—broke out across Australia and burned from the summer of 2019 through early 2020, resulting in the biggest fire season in decades. While the fires were still burning, news reports emerged claiming that the blazes were moving so fast that wildlife couldn't escape the flames and that more than a billion animals had been killed in the fires—a claim that was repeated daily in the international media for weeks.[17] Koalas were highlighted, with news reports stating that the animals moved too slowly to escape the advancing flames. According to other reports, so much vegetation had been incinerated, and the fires had burned so hot, that it would take more than a century for the forests and woodlands to naturally regenerate and recapture the carbon emitted by the fires.[18] Predictably, in this atmosphere of fear, the Australian logging industry and its political allies immediately began to argue for more access to forests, including those in Australian national parks. They claimed that increased logging would remove fuel, prevent large wildfires, and protect both forests and human communities. Despite abundant scientific evidence that logging increases fire intensity, pro-logging politicians in Australia immediately took steps to implement this scheme.[19]

As with the 2018 California fires, however, initial statements proved to be less sound upon closer scrutiny. By the time the weather changed and slowed much of the fire activity in late January 2020, approximately 50 million acres had burned across Australia. It was not the biggest fire season in the history of Australia—a continental nation comprised largely of fire-adapted vegetation. In the 1974 bushfire season, for example, wildland fires spanned 290 million acres across Australia. However, 2019–2020 was notable because southeastern Australia, especially New South Wales, experienced its largest burned area in memory, and about half those acres were in forests. This led to concerns about forest wildlife, given reports that the fires were moving quickly at seven to fourteen miles per hour. About 14 million acres burned in the 2019–2020 bushfire season in New South Wales through late January and early February 2020, at which time heavy rains began to fall, largely extinguishing the fires.

Let's assume that a single fire spreads at a rate of ten miles per hour. As a simple matter of geometry (radius squared multiplied by pi), that one fire would cover 181,000 square miles, or about 116 million acres, in a single day. Even if the fire were moving in only one direction, it would cover at least 50 million acres a day moving at ten miles per hour. If we assume that the fire is moving at only one mile per hour and mainly in one direction, it would still cover nearly 4 million acres in a single week, affecting more than 30 million acres if it burned for two months. But during the 2019–2020 bushfire season in New South Wales, there were many fires burning, and they burned for three months or longer. On average, these fires were spreading at rates of only a small fraction of one mile per hour—consistent with low-intensity surface fires in most cases. Of course, the wind can drive fires, causing them to spread considerably more rapidly for brief, intermittent bursts and creating patches of higher-intensity fire of varying sizes within the fire mosaic.

When fire is spreading at a rate of considerably less than one mile per hour, native wildlife simply walks, trots, or flies out of the way until the flames pass, while reptiles, small mammals, and most insects temporarily go underground. Animals have been doing this for millions of years in fire-adapted ecosystems all over the world. This is not to say that some animals aren't killed in wildland fires. Animals die in wildfires for a variety of reasons. Some may get caught in a box canyon without a path of egress; others may be less agile and unable to escape due to injury or an obstruction such as a fence. But on the whole, native animals are quite capable of surviving in ecosystems where natural fires occur, including the forests and woodlands of Australia, and many benefit from the heterogeneous habitat and food resources that fire creates.[20]

Given the slow average rate of spread in the 2019–2020 bushfire season, the assumption that most koalas in the fire areas were killed is perhaps overly pessimistic and certainly premature. Most people assume that koalas move at a glacial pace, given the way they are presented in television commercials, but the truth is that wild koalas are quite agile. They can leap six feet in the air and can run faster than most humans—much faster than the 2019–2020 fires were moving during the great majority of the time they were burning. Further, koalas can survive in the tree canopy when low-intensity surface fires pass underneath.

It turns out that the claim that more than a billion wild animals were killed in the 2019–2020 bushfires was based on zero field data and was improperly extrapolated from a 2007 study on the number of animals that would be lost in a given area of forest due to human land-clearing activities, not wildfires.[21] There is no established or credible scientific basis to assume that wildfires are comparable to habitat loss due to human development. Nor is there any scientific basis to assume that fires would kill nearly all the animals on every acre within the fire perimeter or that most or all native animals would starve shortly thereafter, particularly in fire-adapted ecosystems, and especially given the slow rate of fire spread. Such assumptions would never pass the scientific peer-review process, but in the anything-goes political atmosphere surrounding a large fire season, such claims were repeated hundreds of times in media sources and accepted as truth. News outlets that faithfully called attention to such errors were ignored. In fact, the press release that initiated this false narrative referenced the millions of animals "affected" by the fires, which included those that simply moved out of harm's way temporarily. But the title of the press release contained an error that did not match the text, using the word "killed" instead of "affected."[22] The erroneous message in the title was constantly echoed for weeks. Unfortunately, the record was never corrected by the principals involved.

Similarly, claims about the level of carbon emissions from the bushfires, and how long it would take to reabsorb the carbon emitted, were flawed. They were derived from a Trump administration model, which is applied globally and is based on theoretical modeling assumptions that exaggerate the proportion of tree biomass consumed in wildfires by more than tenfold[23] in comparison to data from actual fires in field-based studies.[24] Likewise, the frequently repeated notion that it would take many decades—perhaps a century or more—for the forests and woodlands of New South Wales to regenerate was a mischaracterization and a wild overextrapolation of a concern expressed by some scientists regarding a particular area of mountain ash forest that had burned intensely in 2013 and burned again in 2019–2020, when the regenerating stands were still young.[25] The specific concern was that, when young forests reburn in localized areas, they can potentially be changed to nonforest vegetation types or to other tree species for some decades thereafter. However, at the time this concern was expressed, no field data had been gathered to determine the natural regeneration potential of this particular mountain ash forest. Initial news reports incorrectly suggested that all forests and woodlands within the millions of acres of fire-affected areas would fail to regenerate, and this erroneous reporting was never corrected when it subsequently became clear that this was a localized concern about a single area.

The forests and woodlands of southeastern Australia naturally regenerate rapidly after fires, and they have been doing so for millennia. Even as the suspect claims about a long-term lack of regeneration were making the rounds, abundant photographic evidence was documenting the fact that, just days after the flames had passed, the forests and woodlands were already regenerating naturally.[26]

In particular, it is worth noting that mountain ash forests are highly fire adapted and, in fact, rely on periodic high-intensity fires to regenerate new stands. This is their natural fire cycle, and a mature mountain ash stand regenerates in spectacular fashion, with tens of thousands of new seedlings per acre, after intense fires.[27] In fact, the most carbon-rich forests on the planet are the mountain ash forests of southeastern Australia, and their extremely high carbon density is due to mixed-intensity fires, including high-intensity fire patches, that consume surprisingly little carbon but create nutrient-rich beds of ash that stimulate enhanced growth and carbon sequestration for decades thereafter. The combination of the snags and downed logs from the earlier stands, along with the newer, rapidly growing postfire stands, is what allows these forests to maintain such high levels of biomass and carbon storage.[28]

It is understandable that there would be concern about the potential for some localized areas of mountain ash to become dominated by other tree species and vegetation in the spatially uncommon circumstances in which high-intensity fires occur at frequencies of less than 15 or 20 years, before regenerating stands of mountain ash are able to reproduce. It is important, however, to keep the larger landscape context in mind. In the natural history of fire regimes, mountain ash forests experience high-intensity fires at intervals of 50 to 100 years.[29] This, of course, does not mean that every stand burns at high intensity within those intervals. At any point in time in a given area, there will always be a portion of the forest that burns at high intensity more frequently and a portion that burns at high intensity less frequently. In forest ecosystems in general, if high-intensity fire occurs, on average, at intervals of 100 years, approximately 17 percent of the forests will experience high-intensity fire at intervals of less than 20 years, and a similar proportion will experience high-intensity fire at intervals of more than 150 years. If the average landscape-scale frequency of high-intensity fire is 75 years instead of 100, then approximately one-quarter of forests will experience high-intensity fire at intervals of less than 20 years.[30] This is essential to understand, given that current (and historical) fires in mountain ash forests are mixed intensity, with predominantly low- and moderate-intensity fire effects. The evidence does not indicate that mountain ash forests, at the landscape scale, currently experience high-intensity fire frequencies that exceed these historical rates.[31]

The most extensive scientific analyses on this subject conducted in Australia have found that mixed-intensity fires, which include high-intensity fire patches, in forests and woodlands create important age class diversity and habitat heterogeneity, which are positively related to bird species diversity.[32] Shortly after the flames pass, native insects such as the Australian fire beetle rapidly colonize high-intensity fire patches in large numbers because these beetles require fire-killed trees to reproduce. The beetles, in turn, provide food for birds and other animals. When fire-killed trees fall and become downed logs, they provide essential habitat for dozens of species of native stag beetles, which need such logs for reproduction, as well as vital habitat for numerous rare vertebrate species. The rapidly growing postfire understory vegetation provides additional habitat and food for wildlife. Fires also help create tree "hollows"—natural cavities that are essential for a number of imperiled Australian wildlife species.[33]

The fact that mixed-intensity fires provide ecological benefits in the forests and woodlands of southeastern Australia and Tasmania does not, however, address the deeper question: is there too much fire? We know from fire history studies that before the existence of fire suppression policies, dry, open forests burned every 10 to 20 years (more frequently in some areas), while wetter forests experienced fires dominated by low- to moderate-intensity effects every 30 to 50 years and high-intensity fires every 50 to 100 years. Some of the wettest forests, which account for a very small percentage of the total, had long fire intervals on the order of three centuries.[34] Research on fire patterns in this region in the modern era has found that most forests and woodlands have experienced an increase in the average annual burned area in recent decades, linked to temperature rise and other climate change factors (although some areas have seen a decline in fire occurrence).[35]

However, fire frequencies in forested areas currently range from 40 to 200 years, depending on the area. Therefore, it is far from clear that current levels of burning are in excess of the natural range for these forests, even though the 2019–2020 bushfire season was the largest in southeastern Australia since the beginning of fire suppression. The burning of 14 million acres in the forests and woodlands of New South Wales in one bushfire season is a startling total, but it should be kept in mind that, given the overall slow rate of spread, a substantial portion of this area experienced low- to moderate-intensity fire, and there are 56 million acres of forest in New South Wales and more than 100 million acres of woodland.

Only a small portion of Australia's forests are temperate rainforests, but a significant portion of them burned in the 2019–2020 fire season, and most of these rainforests had never burned at any time in human memory. Australian rainforests do, in fact, have a natural mixed-intensity fire regime that has included high-intensity fire patches during some historical periods. Natural fire frequencies have varied widely, depending on the area. Some burned more often prior to the arrival of settlers, while others have had very long fire intervals—many times the life span of humans. Thus, it is not surprising that people alive today have no direct experience with fire occurring in these ecosystems. However, this does not mean that fire never occurs there or that it is inherently unnatural or destructive when it does occur. Australian rainforests naturally regenerate quite rapidly after wildland fires. Moreover, in some parts of Australia, fire suppression over the past century or more has led to a significant expansion of rainforests into areas previously occupied by woodlands.[36]

Near the end of the 2019–2020 bushfire season, I communicated with a number of Australian wildlife and fire ecologists. They did not stand behind the frequently reported notion that more than a billion animals had already been killed by the fires or the notion that it would take more than a century for the forests within the bushfire perimeters to regenerate. Instead, they expressed an urgent need to convince the conservative Australian government to take wildlife conservation and climate change more seriously. The bushfires presented an opportunity to do this.

Although it is laudable to pursue the goal of getting right-leaning governments to accept the climate crisis and the extinction crisis and to take action, if liberties are taken with scientific evidence in the process, can we really expect governmental actions to mitigate climate change and protect wildlife habitat? Or is it more likely that such tactics will result in actions conducted under the guise of climate resilience that tend to exacerbate both the climate crisis and the extinction crisis—actions such as the rollback of environmental laws, increased logging, downplaying the consequences of greenhouse gas emissions from fossil fuels, and diverting attention from the three-tier path to overcome the climate crisis?

Too few policy makers, conservationists, climate change activists, scientists, and environmental reporters have paused to consider the consequences of promoting these myths that demonize wildland fires or the series of events and management actions such myths set in motion. They have failed to consider how these myths affect our ability to overcome the climate crisis, protect biodiversity, and help vulnerable human communities adapt to climate change.

Once the politics of fear was employed with regard to the 2019–2020 bushfires, the Australian logging industry immediately called for increased logging, and its political allies were more than happy to promote such policies, regardless of the science. Once the myths about the 2019–2020 bushfire season in Australia made their rounds in the international press, the US logging industry and its surrogates used these myths to promote the rollback of environmental laws and to increase logging of all types to supposedly curb fires, save forests, and reduce carbon emissions. Soon, new pro-logging policies were being unveiled, and Congress was conducting hearings.

Following the large wildfires in California and Oregon in the late summer and fall of 2020, the logging industry, its political allies, and scientists funded by the Trump administration doubled down on this push to increase logging, even though, once again, the fires had typically spread fastest through the most heavily logged areas. One example was the Creek fire's fifteen-mile run north in a single afternoon as it raced through an area that had been extensively logged several years earlier after the French fire, under the guise of fuel reduction. Back then, my colleagues and I had explained to the Forest Service that its logging plans in the French fire area would likely increase future fire intensity, but the agency didn't listen, and the postfire logging proceeded. In September 2020 our predictions came true. The Creek fire spread so rapidly though this logged landscape that it trapped more than 200 recreationalists at the Mammoth Pool Reservoir in the Sierra National Forest. Fortunately, they were saved by a daring and risky helicopter rescue. In unlogged forests, including very dense, old stands with many dead trees, the Creek fire typically burned much more slowly.

That same month, the Bear fire in the northern Sierra Nevada spread more than twenty-five miles southwest in one day, burning through tens of thousands of acres that had been heavily logged and clear-cut in previous years in Plumas National Forest and through huge areas of private industrial timberlands. The same thing played out in Oregon, as large fires burned vast acreages that had been subjected to intensive logging on public and private lands, such as the Holiday Farm fire in southern Oregon in September 2020. Despite these events, the logging industry, the US Forest Service, and pro-logging politicians—some Republicans, some Democrats—renewed their efforts to promote and advance extreme logging bills, demonizing conservation groups and shamelessly claiming that more logging was needed to curb wildfires. The fact that logging doesn't stop fires and often makes them burn more intensely, and the fact that logging dramatically increases carbon emissions (discussed in greater detail in subsequent chapters), were immaterial to them. In an atmosphere driven by the politics of fear, truth is always a casualty.

It need not be so. There is still time for us to act in the right ways, and there is still hope as long as we have the courage to reject the politics of fear and question the myths about forests, fire, and climate that are standing in the way of real progress. These misconceptions and exaggerations have become a new and arguably more dangerous sort of climate change denial. Instead of denying the existence of human-caused climate change, the purveyors of these myths often vocally acknowledge climate change but then use the myths to facilitate or promote actions that would only worsen the climate and extinction crises. We are seeing examples of this on both sides of the political aisle in Congress, and similar issues are arising in nations around the world.

Some people engage in this type of misinformation innocently, while others do it cynically and knowingly, but everyone who promotes these pro-logging narratives tends to do one or more of the following: (1) deny the necessity of increased forest protection to draw down atmospheric carbon and effectively mitigate the worst effects of climate change; (2) demonize wildland fire to convey negative messages about its effect on wildlife, while ignoring or misrepresenting evidence of its beneficial effects; (3) claim or imply that "overgrown" forests and snags, not climate change, are the primary drivers of fire intensity; (4) exaggerate carbon emissions from forest fires while downplaying emissions from fossil fuel consumption; (5) make false or overstated claims about the lack of postfire forest regeneration and carbon sequestration capacity; (6) deny forests' natural ability to mitigate climate change by claiming that natural disturbance processes have turned them from net carbon sinks into net carbon sources; (7) promote more logging, ostensibly as a measure to curb fires and make forests more climate "resilient"; and (8) claim that increased logging is a solution because biomass logging—incinerating trees for kilowatts—is carbon-neutral or "renewable" energy and the carbon from logged trees will be stored long term as lumber in residential or commercial buildings. Each of these claims has major scientific faults that are discussed in greater detail in subsequent chapters.

This is the new climate change denial of the twenty-first century, and for us to move forward, we must recognize it for what it is, take steps to expose and challenge it, and find ways to go through, under, over, or around these myths to pursue true climate solutions.

# 2

# The Snag Forest

My chance encounter with a logging crew in the central Sierra Nevada in 2002 changed the course of my career. Referring to an area of snag forest habitat created by patches of high-intensity fire in the mature forest, the logging crew foreman had asked me, "What harm could possibly come from cutting this down?" I've been investigating that question as a scientist ever since.

At the time, in a sense, I was part of the problem. Prior to my 2002 encounter with that logging crew, I had written dozens of op-ed articles for newspapers across the United States, essentially accepting the premise that high-intensity fire was bad and should be prevented. My message, given what I knew at the time, was that we should not be selling and removing mature, fire-resistant trees from public lands and that we could reduce the occurrence of intense fires if we removed some small trees and shrubs and conducted more prescribed, human-set fires.[1] As I learned more about the science of forest and fire ecology, my views began to change.

Of all the myths that are impeding real progress in overcoming the climate crisis, the most persistent is the notion that wildland fire destroys forests in general and forest wildlife habitat in particular. More specifically, although there has been slow acceptance in recent decades of the ecological value of low-intensity fires, the notion that patches of high-intensity fire are unnatural and destroy wildlife habitat remains a cornerstone of the "catastrophic wildfire" political narrative. It also remains a driving force behind forest management policies that threaten imperiled wildlife

Twelve years after the 2001 Star fire, thriving snag forest habitat, or complex early seral forest, has been created by a patch of high-intensity fire.

species and worsen the climate crisis. This is so because logging is being promoted as a way to prevent high-intensity fire from destroying forest habitat.

So what is the truth? In mixed-intensity fires, do patches of high-intensity fire destroy wildlife habitat, as so many believe? Are low-intensity fires "good" and high-intensity fires "bad"? After devoting nearly two decades of research to these questions and surveying hundreds of forest fires in the United States, I can say with confidence that the answer is clear. Though it may seem counterintuitive to some, dozens of scientific studies, including my own, indicate that snag forest habitat, also known as complex early seral forest, is one of the most biodiverse forest habitat types. Many native wildlife species are positively associated with this habitat, and they often select snag forest habitat over other habitat types, including old-growth forest.[2]

Even so, every fire season in the western United States, we see on television the predictable images of 100-foot flames spreading through tree crowns, while grim-faced news anchors tell us how many acres of forest were "destroyed" by the latest "catastrophic" fire. The reaction is understandable. For decades, countless advertisements featuring Smokey the Bear told us that forest fires are bad and should be prevented. Until fairly recently, land management agencies such as the US Forest Service genuinely believed that they could essentially eliminate forest fires if they only had enough resources to suppress fires—and they sought to do just that. By the late twentieth century, however, land managers began to concede that frequent low-intensity fires were natural occurrences. After being ignited by lightning, these fires would slowly creep along the forest floor, consuming needles, leaves, and twigs and naturally reducing the number of shrubs and small trees. Though a begrudging acceptance of the benefits of low-intensity fire began to take hold, high-intensity fire, where tall flames killed most of the trees in a given area, was still assumed to be the unnatural result of fuel accumulation from decades of fire suppression. Thus began the "catastrophic wildfire" paradigm, which divides fires into two categories: good fires and bad fires, depending on whether they burn at low intensity or high intensity, respectively.

A 2004 US Forest Service public education brochure for the Sierra Nevada mountains in California captured the thinking underlying this paradigm. Entitled "Forests with a Future," the brochure portrayed high-intensity fire as an "eco-disaster" that "destroy[s] wildlife habitat." No scientific studies were cited to support this characterization. Under the heading "Good Fires, Bad Fires," the brochure opined: "Fire is natural to the forest. But not the kind of fire that burns so hot, and shoots up so high, it destroys everything." The report blamed the supposed threat of high-intensity fire on a buildup of "fuel" from "fire suppression practices over the last century," and it proposed a massive logging program in national forests, under the guise of "thinning," ostensibly to eliminate high-intensity fire from the landscape.

Based on this catastrophic wildfire paradigm, land managers have requested and received from Congress more and more money for increasingly aggressive fire suppression tactics. The Forest Service justifies this policy by arguing that, except in rare cases, wildfires simply cannot be allowed to burn in forests because high-intensity fire patches will occur.

These increasingly intensive fire suppression tactics often place firefighters in harm's way as they attempt to stop fires assumed to be destructive and unnatural—often in remote areas, and all too often with fatal consequences for firefighters.[3]

Simultaneously, land managers have requested and received increasingly more money for industrial logging operations on public and private lands under the guise of "fuel reduction," "thinning," and "resilience"—all based on the notion that high-intensity fire patches are destructive and must be stopped and that more logging will achieve this goal. Land management agencies have used these funds to plan and implement thousands of commercial thinning projects to remove mature and old trees, reasoning that they can log more acres of forest if they sell many of the larger, fire-resistant trees—which are commercially valuable—to timber companies, using the sale of these trees to offset their operating costs. In addition, large-scale postfire clear-cutting projects are being carried out on public and private lands under the banner of "restoration."

The Forest Service and other land management agencies keep the revenue from these timber sales to enhance their budgets, creating a perverse incentive for more logging of larger trees and more clear-cutting over vast expanses of public land. In this context, nearly all forest habitat is being described as "fuel" that must be removed. Live mature and old-growth trees have been cut by the thousands, and dead trees are routinely sold to logging companies and removed, resulting in large clear-cut areas on public lands, all in the name of fuel reduction. Commercial logging ostensibly to prevent catastrophic fire continues to be heavily promoted through successive versions of a Bush-era policy known as the Healthy Forests Initiative, which essentially defines a healthy forest as one in which the trees are nearly all green, there are few if any dead trees or downed logs, and fire is acceptable only if it doesn't kill mature, commercially valuable trees. This policy provides a compelling narrative to many because it underscores and capitalizes on deeply held cultural notions and perceptions about forests and fire.

Remarkably, under the catastrophic wildfire paradigm, discredited policies of the past, such as fire suppression, removal of mature fire-resistant trees, and clear-cutting, have continued and even increased in many

*Top:* Natural forest regeneration in intact (unlogged) snag forest habitat in a large high-intensity fire patch. *Bottom:* Results of postfire clear-cutting in a high-intensity fire patch within the Rim fire area, under the deceptive justifications of "restoration" and "fuel reduction."

cases. Even as land managers and policy makers lament the mistakes of the past, they essentially continue the same policies day after day, year after year. However, a new paradigm has begun to emerge as scientists and some land managers have come to recognize and appreciate the ecological importance of snag forest habitat. Over the past two decades, a surge in scientific discovery has led researchers to fundamentally rethink previous assumptions about fire and forest health. Many scientists now understand that patches of high-intensity fire have always occurred naturally in fire-adapted forests around the world, and they recognize that dead trees (snags) and downed logs are among the most ecologically valuable habitat features in the forest. However, due to fire suppression and logging conducted under the guise of fuel reduction and forest health, these habitats have become far too scarce. These lessons have emerged around the world, including in North America, Australia, Europe, and Africa.[4]

Contrary to previous assumptions, scientific evidence has revealed that most fires that occur today are predominantly low and moderate intensity, and the less widespread high-intensity areas often support the highest levels of native plant and wildlife species. Scientists now understand that, far from being destroyed, these high-intensity patches are natural ecological treasures. High-intensity fire patches do not remove or destroy habitat; rather, they create the snag forest habitat on which so many native forest species rely. Structurally, snag forest habitat is rich, with an abundance of standing dead trees of all sizes, large downed logs, pockets of natural conifer and oak regeneration, patches of native shrub habitat, clumps of large surviving trees, and a colorful array of wildflowers.

In snag forest habitat, countless species of flying insects—bees, dragonflies, butterflies, and flying beetles—are attracted to the wealth of flowering shrubs and plants that propagate after a high-intensity fire. Many colorful species of birds, such as the iridescent mountain bluebird, nest and forage in snag forest habitat, feeding on the flying insects there. Shrub-nesting birds raise their young in the native mountain chaparral that naturally grows after a high-intensity fire. These flowering shrubs, in combination with the abundant wildflowers, are especially important to dozens of native species of bees, which increase substantially in snag forest habitat.[5]

Native wood-boring beetles have receptors in their bodies that can detect forest fires by the heat or smoke. These beetles fly straight toward fire areas and lay their eggs on the charred bark of fire-killed trees soon after the fire has passed and the trees have cooled. Their larvae bore through the bark and into the wood of the snags, taking a year or more to develop into adults. Eventually, they emerge and fly away, searching for the next fire area to repeat the reproductive cycle.

Woodpeckers feed on the larvae of wood-boring beetles and bark beetles in fire-killed trees, so they tend to colonize snag forest habitat shortly after a fire, excavating their nest cavities in large snags. Woodpeckers make multiple new nest holes each year. Many rare and imperiled bat species roost in old woodpecker cavities in large snags and feed on flying insects at dusk. Dozens of bird and rodent species live in woodpecker cavities once the birds have vacated them.

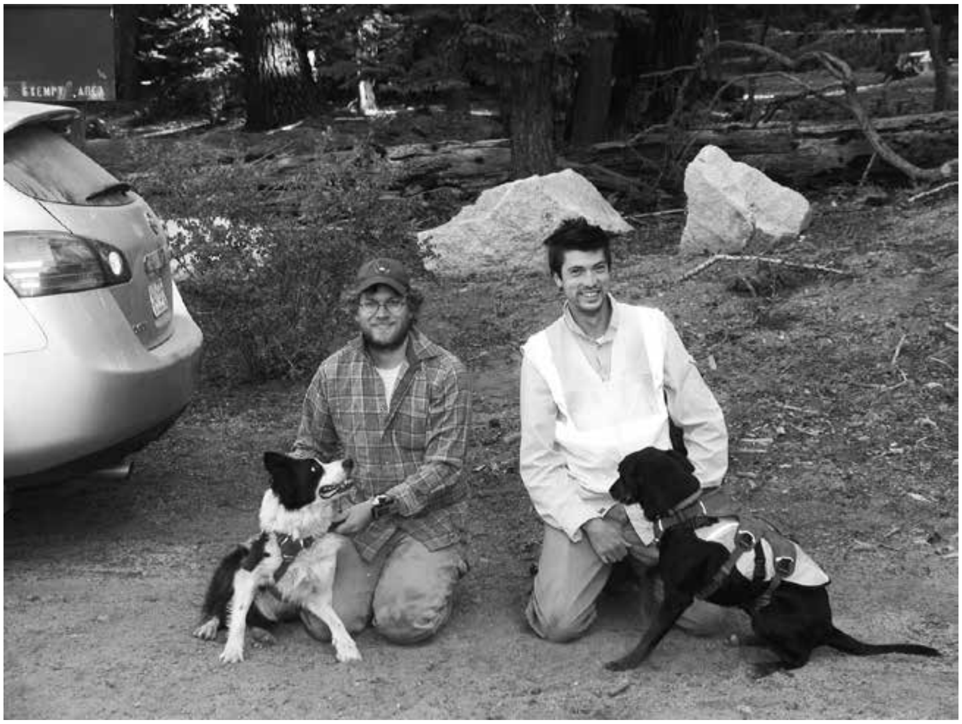
Deer and elk browse on the vigorous new plant growth that follows a high-intensity fire, and small mammals, such as snowshoe hares and wood rats, create dens in shrub patches and downed logs. Raptors benefit from an increased abundance of their prey, as do bears and wolves. Native fish populations initially decline slightly to moderately after an intense fire, but they soon rebound to levels exceeding prefire populations, as high-intensity fire facilitates an increase in the aquatic insects on which the fish prey.[6]

Many native wildlife species are primarily associated with snag forest habitat, and some are essentially restricted to it. For the latter, populations may undergo a dangerous decline unless there is a continuous supply of this habitat. One study of forests in the Pacific Northwest, for example, concluded that 61 percent of native bird species, 80 percent of mammal species, and 91 percent of butterfly and moth species are associated with this early successional forest habitat type.[7] Numerous studies have found that total bird abundance, number of bird species, or both were greatest in forests that had burned most intensely—that is, snag forest habitat. One study found that birds of the same species were larger and healthier in snag forest habitat than in adjacent unburned mature forest, likely due to a greater abundance of native insect prey in the snag forest habitat.[8]

Over the years, however, a particular concern has arisen regarding rare and imperiled wildlife species that depend on dense, old forests for nesting or denning. For years, it was assumed that high-intensity fire was harmful to such species because it can transform old forests into snag forests. This thinking, in essence, pitted the conservation of rare old forest species against the conservation of snag forest species. The result has been a twofold forest management approach that (1) disproportionately targets dense, old forests for logging activities, based on the claim that although logging will degrade the quality of this habitat, it will prevent the greater threat of high-intensity fire, and (2) emphasizes postfire clear-cutting of snag forest habitat, based on the claim that snag forests are of no use to old forest species and that clear-cutting and tree planting are necessary to restore and reforest such areas, reduce fuel to prevent future high-intensity fire and facilitate the regrowth of old forest. Yet, as more and more published research, including my own, indicated that historical fire regimes included more high-intensity fire than was previously assumed, I questioned whether this was a false dichotomy. From an evolutionary standpoint, if these old forest species evolved with patches of high-intensity fire, did it make sense to pit old forest against snag forest in ways that degraded both?

For many years, research on old forest species focused almost exclusively on habitat selection for nesting or denning; little attention was paid to what kind of habitat these species needed or preferred for foraging or hunting. Isn't where they eat just as important as where they sleep? In the forests of the Sierra Nevada mountains in California, two imperiled old forest species—the Pacific fisher and the California spotted owl—were of special interest to conservation biologists and land managers. But as the twofold forest management approach—intensive thinning of old forest and clear-cutting of snag forest—was implemented over the years, these species continued to decline.

I wondered if we were missing something. In particular, I was intrigued by the fact that fishers' and spotted owls' primary small mammal prey species are more commonly found in snag forest habitat than in old forest. So I assembled some "scat dog" teams to investigate habitat selection and avoidance by Pacific fishers in a remote forest area comprising a



Scat dog teams in the northern Kern Plateau in the 2002 McNally fire area.

mix of unburned old forest, postfire snag forest, and more lightly burned forest. Pacific fishers are endangered mink-like animals that resemble small wolverines, and it is well documented that they need dense, old forests for denning and resting habitat, but no one had investigated their use of postfire habitat. I hoped to remedy that oversight.

Each scat dog team consisted of a human handler and a dog that was highly trained to detect, by smell, the scat (excrement) of a Pacific fisher. My thinking was that, if we could determine the frequency of fisher scats in different burned and unburned habitat conditions, we could figure out what fishers preferred and what they avoided. To avert the potentially confounding effects of postfire logging and other logging activities, I chose an extremely remote area as my study site—the northern Kern Plateau in the southeastern Sierra Nevada. Topographically challenging and inaccessible (whoever named it "plateau" many decades ago had a bad sense of humor), the northern Kern Plateau consists primarily of wild, unmanaged roadless areas and wilderness areas and is home to one of three subpopulations of Pacific fishers in the southern Sierra Nevada, making it the perfect place to conduct my study. A series of significant wildfires had occurred in the area in previous years, interspersed with large areas of unburned old forest.

For two years, we gathered fisher scat in the field, often traveling to areas that were a three- or four-hour hike from the nearest four-wheel-drive trail, an hour's drive on rough dirt roads back to the nearest paved road, and then another two-hour drive to the nearest town. The results were surprising. Consistent with past research, I found clusters of activity in the dense, old forests Pacific fishers use for denning and resting, but contrary to long-standing assumptions, I also found that they actively forage in snag forest habitat and that the females positively select and prefer snag forest when foraging.[9]

This suggested a sort of "bed and breakfast" effect: fishers were denning and resting in dense, old forest that was unburned or only lightly burned (the bed) but vigorously foraging for small mammal prey in snag forest (the breakfast). This indicated that *both* old forest and snag forest are important for the conservation of Pacific fisher populations, which meant, of course, that the forest management approach of logging old forest and snag forest was likely *doubly* harmful to fishers, degrading both aspects of the animals' bed and breakfast.

Regarding California spotted owls, a team had already published some interesting radiotelemetry results in 2009, indicating that these owls go out of their way to forage in snag forest habitat, preferring it for hunting over other forest types, including unburned old forest.[10] Another study of Mexican spotted owls found that they periodically left unburned old forest to forage miles away in mixed-intensity fire areas, where small mammal prey was two to six times more abundant than in the unburned old forest.[11] This piqued my curiosity, and I began to wonder: if spotted owls actively hunt in snag forest, what happens if some of that snag forest is removed by postfire logging? In 2018 two colleagues and I published our findings that, when as little as 5 percent of spotted owl territory is subjected to postfire logging, there is a substantial decrease in the spotted owl population. Overall, about 17 percent of the area inside these California spotted owl territories had been subjected to postfire logging. That may not seem like much from a human perspective, but it was a serious blow to the owls and caused a 71 percent loss of their population. Conversely, we found that in the absence of postfire logging, high-intensity fire did not reduce spotted owl occupancy.[12]

We also discovered that previous studies reporting the decline of spotted owl populations where high-intensity fires had occurred were confounded by extensive postfire logging. In other words, postfire logging caused the population losses, not the fires. In fact, fourteen of the fifteen studies that reported negative effects of high-intensity fire on spotted owls were confounded by postfire logging, and the fifteenth was confounded by a different methodological problem (that study reported that spotted owls used high-intensity fire patches slightly less than lower-intensity fire patches but failed to account for the fact that the high-intensity fire patches were much farther from the nest site). Among the scientific studies conducted in the absence of postfire logging or other confounding factors, 100 percent found neutral or positive effects of high-intensity fire among all three subspecies—the northern spotted owl, the California spotted owl, and the Mexican spotted owl.[13]

In one Forest Service–funded study, the authors claimed that California spotted owls were avoiding high-intensity fire areas while foraging.[14] However, a closer look at the study area—the 2014 King fire in the central Sierra Nevada—revealed that the owls were avoiding high-intensity fire areas subjected to postfire clear-cutting shortly after the fire, as well as areas clear-cut before the fire, where the young tree plantations burned at high intensity. The owls were actively foraging in intact, unlogged snag forest habitat.

Other research found that high-intensity fire patches are associated with an increase in spotted owl reproduction levels simply because food for their young is more readily available when the owls have access to snag forest habitat.[15] When the 223,000-acre Horseshoe 2 fire occurred in the Chiricahua Mountains in southeastern Arizona in 2011, many were concerned about Mexican spotted owl populations. Fortunately, the forests in that area are almost entirely protected from logging, so no logging occurred after Horseshoe 2. Within three years of the fire, Mexican spotted owl populations had nearly doubled.[16] The only objective conclusion is that this very large mixed-intensity fire improved overall habitat conditions for the spotted owl.

In my neck of the woods, in the San Bernardino Mountains of Southern California east of Los Angeles, rare California spotted owls inhabit the huge San Gorgonio Wilderness Area and nearby forests. In 2015 my wife, Rachel, and I conducted nocturnal spotted owl occupancy surveys in these forests, along with some colleagues. We hiked cross-country over ridges and climbed up and down steep canyons from late at night until the early-morning hours, using headlamps to light our way. Near the end of the field season, the Lake fire occurred, spreading east across a portion of the wilderness area and burning predominantly at moderate and high intensity in many places, ultimately covering more than 30,000 acres. Numerous California spotted owl territories were entirely within the fire perimeter, and some owl biologists were worried about what they might find—or not find—the next year.

But as the 2016 field season began, it quickly became clear that spotted owl occupancy was high in the fire area, where almost all the forests are protected from logging. One particular owl territory was especially interesting. A pair of spotted owls had been nesting for years about half a mile west of where the Lake fire started. The fire had burned almost due east, moving away from their territory. However, in the first year after the fire, rather than staying in the unburned forest where they had raised their young in previous years, the owl pair flew east and set up a new nest site inside the Lake fire area, right on the edge of a large high-intensity fire patch—a perfect example of the "bed and breakfast" effect. The owls had everything they needed: dense old forest that had been moderately burned for their nest and roost site, and a large area of snag forest for optimal foraging and an abundance of small mammal prey. The owl pair successfully raised and fledged two young in the first postfire year and have continued to thrive.

The emerging science regarding spotted owls and wildland fires, however, is a threat to the old catastrophic wildfire paradigm. By demonizing large fires and promoting logging—including postfire logging—as a fire management solution, logging companies have gotten wealthy by purchasing timber from US public lands, and federal land management

California spotted owl chicks, months after the adults left the unburned old forest to colonize the Lake fire area and establish a new territory adjacent to a large high-intensity fire patch. (Photo by Rachel Fazio, 2016)

agencies such as the US Forest Service have generated billions of dollars for their budgets from these timber sales over the years. Big money is at stake. In this context, hopeful and encouraging new scientific information about the positive response of spotted owls and other wildlife to large fires is not welcomed. In fact, it is met with hostility.

After the 257,000-acre Rim fire in the Sierra Nevada in 2013, two colleagues of mine found record-high levels of California spotted owl occupancy before any postfire logging had occurred.[17] The Forest Service ignored these findings. But when we later teamed up and published our conclusions about the extremely harmful effects of postfire logging on spotted owls in many places in California, including the Rim fire area, we were not ignored. Instead, the Forest Service went on the offensive. A group of university scientists hired and funded by the Forest Service personally attacked us in a letter to the editor of a science journal (such letters are not included in the categories of submissions that undergo the scientific peer-review process).[18] They did not contest the central finding of our research—that postfire logging severely harms California spotted owl populations—because they could not debate our substantive conclusions in that regard. Instead, they engaged in character attacks, suggesting that we are "agenda driven" and urging others to ignore our research, while they predictably promoted even more logging in national forests.

Almost immediately, the US Forest Service under the Trump administration used this letter as an excuse to blacklist a larger group of independent scientists who had published research that ran counter to the assumptions of the Forest Service and the logging industry. The Trump administration proposed to use this blacklist as a way to ignore essentially all new science that contradicts its forest management policies so that it could dramatically increase logging and postfire logging in national forests in the southern Sierra Nevada.[19] That list included the authors of studies pertaining to the impact of logging and postfire logging on wildlife, forest and fire history studies documenting that historical forests were denser and included more high-intensity fire than claimed by the Forest Service, and studies of the carbon emissions related to logging and the impact on climate change.

Under existing laws created in the mid-twentieth century, the US Forest Service gets to keep 100 percent of the revenue it receives from selling snags and so-called dying trees on public lands to logging companies—revenue the agency uses to pay staff and buy equipment and machinery. The US federal courts have noted that this gives the Forest Service a "substantial financial interest" in postfire logging, which creates a "disturbing" bias that tends to undermine science.[20]

The Forest Service's personal attack claimed that I am "both a lawyer and a scientist" and that I make "legal arguments" in court, and it asserted that this is incompatible because scientists and lawyers have different and conflicting ethical obligations.[21] However, I am not a lawyer, and I never have been. Although I earned a law degree in 1995, I never took the bar examination. I changed my career path right after law school and later chose to pursue science instead. I have never practiced law and have never made any "legal arguments" in court. Clearly, this personal attack was the Forest Service's political attempt to marginalize the authors of an economically inconvenient scientific study. Troublingly, neither the authors of the letter to the editor nor the journal that published it ever contacted me to determine whether the claims were accurate.

The agency's personal attack also suggested that my coauthors and I had "harassed" Forest Service–funded scientists. Of course, it provided no evidence whatsoever to support this claim. Here's what really happened: In recent years, my coauthors and I have sent this group of Forest Service–funded researchers a series of professionally worded email messages requesting that they provide us with access to the raw data they used for studies that had already been published—data gathered on public lands with public funding. Basically, we were asking for scientific transparency. When they refused, which they consistently did, we requested the data through the Freedom of Information Act. In other cases, we brought demonstrable errors in methodology or conclusions to their attention, which they ignored.

The Forest Service further claimed that, out of the several dozen spotted owl territories analyzed in our study, we misrepresented the occupancy status of two of them. In fact, we used data sent to us by the Forest Service itself, and our analysis used those data exactly as they were represented in the Forest Service's data set.

Last, as evidence that we are "agenda driven," the letter writers claimed that we have taken a position in favor of "ecological management of our national forests" and that we believe science should not have to compete with timber commodity production imperatives and incentives on federal public lands. In response, I ask: in what universe is a position in favor of science-based decision making in conflict with science? This is just one example of the myriad challenges independent scientists face when they publish findings that run counter to economic and political programs built on the catastrophic wildfire narrative.

But this is not only about fire. Snag forest habitat is also created by cycles of drought and native beetles in forests around the world. Researchers have found that unburned snag forest habitat is just as important and ecologically rich as postfire snag forest habitat. In North America, for example, study after study has found that most bird and mammal populations increase in unburned snag forest patches, and this is espe-

Unburned snag forest habitat adjacent to a California spotted owl nest tree, San Bernardino National Forest, 2016. California spotted owls often locate their nest trees near snag forest habitat—either unburned or burned.

cially true of numerous at-risk species.[22] Similar findings have been reported in the forests of western Europe.[23] In Germany, for example, scientists found that 257 wildlife species preferred snag forest habitat created by drought and native bark beetles; 149 wildlife species preferred mature, closed-canopy forests; and 82 species preferred intermediate forests that were transitional between closed-canopy and snag forests. Overall, biodiversity increased markedly after drought and native beetles had created substantial patches of snag forest habitat, and this included numerous "red-listed" species—those that are threatened or endangered.[24]

In a study in the northern Rocky Mountains of the United States, researchers compared bird surveys conducted in standard forests with few snags to bird surveys conducted after drought and native bark beetles had created large areas of unburned snag forest habitat in the same areas. Overall, fifteen bird species showed a significant change in abundance after the creation of the snag forest habitat, and fourteen of these species *increased.* These included woodpeckers, as well as bird species that feed on insects found in shrubs, and some canopy-nesting species.[25] A similar bird study conducted in the forests of the Black Hills of South Dakota found that "almost all focal species had a strong positive relationship to percent cover of beetle killed trees."[26] In other words, populations of almost all the bird species of key conservation interest substantially increased in unburned snag forest habitat.

A study conducted in the mountain forests of Utah found that insect abundance and diversity increased with high levels of tree mortality from drought and native bark beetles, as did populations of large mammals such as deer and elk. Most bird species peaked in abundance in snag forests with 50 to 75 percent tree mortality, while some preferred snag forests with 75 to 100 percent tree mortality, as did most small and medium-sized mammals.[27] Of course, not all wildlife species increase in snag forest habitat. This is why heterogeneous patterns resulting from natural cycles, with some smaller areas of snag forest and some very large patches intermixed in forests with few snags, are so ecologically beneficial. As one group of researchers observed with regard to unburned snag forests, "a mosaic of disturbed [snag forest] conifer" forests interspersed with "intact live conifer" stands is "critical for the persistence of populations of native avifauna."[28]

Moreover, like snag forests created by fire, unburned snag forests naturally regenerate vigorously, and the smaller and medium-sized trees, many of which survive, experience a surge in growth following cycles of new snag creation by drought and beetles.[29] When unburned snag forest burns in a later wildfire, the forest rapidly regenerates, rejuvenated by the flush of new nutrients.[30] However, where logging occurs in burned or unburned snag forest, the results are ecologically disastrous. Globally, there is a growing threat to snag forest habitat from so-called salvage logging, and scientists from North America, Europe, Australia, and Asia strongly oppose salvage logging because it destroys essential snag forest wildlife habitat, compacts and damages soils, removes vital nutrients, spreads invasive and combustible weeds, and typically creates conditions that make wildfires burn more intensely, often creating feedback loops that reinforce the dominance of nonnative grasses.[31]

Where studies of various imperiled species report adverse effects in snag forest patches, it is frequently the case that these areas have been subjected to significant postdisturbance "salvage" logging. Unfortunately, as with spotted owls, a number of clumsy and misleading studies confound research in snag forests with postfire logging's effect on other imperiled species, such as the black-backed woodpecker and the northern goshawk.[32]

Snag forest habitat is like an "opposite world," where the truths emerging from science are profoundly different from our old expectations. Instead of destroying forests, the biggest and most intense fires, and the cycles of new snag forest occurrence from drought and native beetles, are creating some of the best and most biodiverse wildlife habitat. It may be politically and economically inconvenient for industries and agencies that are financially involved in promoting logging operations, but we are learning that snag forest habitat is alive and vibrant. It is colorful and rich with varied sounds, thanks to the sheer density of wildlife activity. It is often the rarest and most endangered habitat in fire-adapted forests around the world due to fire suppression and postdisturbance logging policies. The stand-transforming events that create this habitat are not harming forest ecosystems; they are creating vitally important wildlife habitat. Forests have a natural ability to regenerate quite well, even in the biggest patches of high-intensity fire and drought-created snag forest.[33] Our global obsession with demonizing and exaggerating the natural processes that create snag forest habitat is not only dangerously distracting us from pursuing solutions to climate change but also leading to actions that worsen the climate crisis.

Politicians and logging interests are telling the public that a "healthy forest" should be an unbroken sea of green. But in reality, homogeneous stands that lack snags, downed logs, and shrub patches are an ecologically impoverished landscape, full of pretty green trees but pervaded by an eerie and unsettling silence. Most of the habitat elements, complexity, and structure that define a forest ecosystem are missing, along with most of the wildlife species that depend on those habitat elements.

We need not be afraid of the effects of fire in fire-adapted forest ecosystems, nor of the periodic peaks of snag forest creation during droughts.

These processes are performing important and essential ecological work, and scientific studies by groups of competing researchers have consistently found that there is less snag forest habitat now than there was in the past, prior to fire suppression policies. In forests of the western United States, for example, an analysis of unprecedented scope was conducted to determine forest stand age and the rate of initiation of new forest stands due to high-intensity fire or high tree mortality caused by drought and native beetles. The study excluded logged areas to avoid logging's confounding effect on stand age structure. It found that the rate of occurrence of these high-intensity, stand-initiating natural events is currently one-fourth to one-third that of more than a century ago, before fire suppression.[34] In the forests of the Sierra Nevada, even after recent large fires and significant snag recruitment during the 2012–2018 drought, snag forest habitat accounts for less than 10 percent of these forests,[35] whereas historically, it was about one-third of the forests at any given point in time.[36]

If the natural processes that initiate new forest stands and create new snag forest habitat increase somewhat, that is not something to be lamented, given the current deficit of this habitat. These natural processes are keeping countless wildlife species alive and cycling essential nutrients to keep forests vigorous and enhance their ability to grow and absorb atmospheric $CO_2$. So the next time you see a mountain slope covered with fire-killed or beetle-killed trees, don't grieve, celebrate.

Our challenge in today's new and emerging paradigm is to protect forests from logging, thereby allowing them to sequester and store more carbon and help imperiled wildlife species recover, while we also protect vulnerable human communities. This approach will allow natural processes to do their vital and life-giving work in our forests. We need to accept that ecologically healthy forests have an abundance of dead trees and downed logs. And we need to stop our futile battle against wildland fire and learn to live with it, reminding ourselves that fire-adapted forest ecosystems evolved with fire and depend on it. Excluding fire from these ecosystems is like trying to keep rain out of a rainforest.

# 3

# You Can't Fight the Wind with a Chain Saw

Not long after the 2001 Star fire in the central Sierra Nevada, I started conducting field surveys in the burn area, hiking deep into the Duncan Canyon Roadless Area—a large area of primary forest that had escaped logging activities. I was amazed at the variability, the heterogeneity, of the fire's effects. In addition to nice new patches of snag forest habitat created by the Star fire, there were areas of mixed effects and large tracts where the fire had merely crept along the forest floor, burning at low intensity and killing only the smallest trees. One of the first things I noticed was that many of these low-intensity fire areas occurred within incredibly dense stands of forest with high levels of biomass. These areas had an abundance of mature and old-growth trees, as well as understories packed with small trees, shrub patches, and many downed logs and snags.

In the years since then, I have noticed the same thing in fire after fire. Dense old stands of forest sometimes burn intensely, creating high-quality snag forest, but more often they burn less intensely, and nearly all the mature and old trees survive and thrive in the rich postfire environment. Given what we hear every fire season from government officials and the logging industry—claims that "overgrown" forests and dead trees cause more intense fires—how can this be?

The answer is simple: wildland fire behavior is driven primarily by weather and, therefore, by climate. A few years ago, a team of researchers, including myself, set out to conduct an unprecedented analysis of the factors that govern forest fire intensity. Analyzing data from three de-

Dense, old forest that burned at low intensity in the 2001 Star fire, 2019.

cades, including more than 1,500 fires that covered about 24 million acres of forest in the western United States, we found that weather and climate variables were consistently the most important determinants of fire behavior in all our statistical models. A variety of other factors mattered too, to some extent, but climate-related factors were clearly dominant. Other researchers corroborated that weather and climate govern fire behavior more than anything else and that forest density, in terms of high forest biomass, is generally a "poor indicator" of fire intensity.[1]

These findings highlight an important lesson for land managers and fire suppression programs. Extreme weather—hot, dry, windy conditions—will drive wildland fires until the weather changes. Under such conditions, which are becoming more common due to climate change, no matter how many billions of dollars we spend to try to manage vegetation in remote areas, we cannot stop or curb fires. Nor can fires be stopped by fire suppression tactics during extreme weather, regardless of how much money is spent or how many firefighters and water tankers are employed.

In the era of climate change, we can no more stop weather-driven fires than we can stand on a ridge and fight the wind.

In fact, weather and climate conditions need not be extreme in order to be the driving influence of fire behavior. In 2016, in the coastal mountains and forests of central California, the Soberanes fire spread south-southeast through the Ventana Wilderness Area. Even though the fire was moving away from human communities and into increasingly remote wilderness, fire suppression forces were rapidly deployed. Soon, more than 5,000 firefighters were working to suppress and stop the fire. More than 400 miles of bulldozer scrapes were created across the landscape, based on the notion that these would serve as firebreaks. One bulldozer operator died when his machine flipped on very steep terrain. More than $260 million was spent on the fire suppression effort—the most expensive in US history for a single fire.

Initially, the Soberanes fire burned a few thousand acres per day, growing to about 45,000 acres during the first week and a half. Over the next two months, while fire suppression activities were at or near their peak, the fire crept along as it climbed into the remote mountains. During this time, its growth rate was generally a few hundred acres to a couple of thousand acres per day. Moving on average at less than one-fiftieth of one mile per hour—less than two feet per minute—the Soberanes fire spread more slowly than ants can crawl across the forest floor, with just enough wind, dryness, and heat to maintain this progress. Despite its slow advance and the massive military-like mobilization of fire suppression activity—including an army of ground crews, countless aerial drops of water and fire retardant, and fleets of bulldozers—the fire spread unimpeded and grew to about 132,000 acres, ultimately stopping when the weather cooled and the rain began to fall. The record-breaking fire suppression campaign was largely irrelevant. Weather and climate were in charge.

This message is still not being received, however. Around the world, governments continue to labor under an outdated twentieth-century approach that focuses on vegetation density, as well as increasingly ineffectual efforts to halt the advance of flames during hot, windy drought conditions. Despite the obvious futility of fighting climate-driven fires, politicians around the world are doubling down, pushing for increased expenditures and emphasizing attempts to stop fires in remote areas. As a result, resources and efforts are being expended on fire suppression approaches in wildland habitats—approaches that are ineffective at best and counterproductive at worst—while vulnerable communities are largely ignored and proven measures that could make them vastly safer go unfunded and unrealized.

In the late summer of 2016 I attended a field trip for environmental journalists led by the US Forest Service. Dozens of us piled into a bus and drove from Sacramento, California, up to the central Sierra Nevada mountains to tour the area of the 2014 King fire. Along the way, Forest Service representatives gave numerous speeches to promote logging, postfire logging, and continued fire suppression. At one stop, a Forest Service representative described a particular day when the King fire was burning rapidly and at its greatest intensity. She told the group that she and her coworkers knew there was absolutely no way to stop the fire, given the hot, dry, windy conditions that were moving it northward. One of my colleagues, Dr. Dominick DellaSala, raised his hand and politely asked an inconvenient question. If the Forest Service knew that stopping the King fire was impossible, why did the agency continue to spend millions of dollars on fire suppression activities in remote forests, when those actions were ineffective? Why not pull back personnel to the closest communities and focus on measures to ensure that the homes there didn't burn? There was an awkward pause, as dozens of environmental reporters waited for an answer. Moments passed. The Forest Service representative looked to her colleagues for help, but they had nothing to offer. Eventually, she responded, "Well, we had to fight the fire." There it was. Even though the Forest Service was certain that its efforts would be completely ineffective, it was committed to a course of action that was guaranteed to fail. The financial and political incentives perpetuating fire suppression policies simply overrode reason, experience, and the need to safeguard homes and lives a few miles away.[2]

Weather and climate are the primary influencers of wildland fire behavior. Secondarily, forest density and the abundance of dead trees are relevant to fire intensity; however, they tend to affect fires in ways that may seem counterintuitive. Most research, for example, indicates that the densest, older forests typically burn somewhat less intensely than lower-density forests. Although dense, mature forests have more biomass, that quality also gives them a cooler and more humid microclimate. For example, in a study of several large fires in eastern Oregon, mature mixed-conifer forests with the highest prefire tree densities burned at low and moderate intensities, whereas forests with half as many prefire trees per acre burned at high intensity.[3] In a study of a single large fire covering nearly 500,000 acres in southwestern Oregon and northwestern California, the forests with the highest prefire densities of small and large trees and the highest prefire levels of downed logs burned at low and moderate intensities, while forests with the fewest trees and downed logs burned at high intensity.[4]

And snags—standing dead trees—simply don't influence fire the way many assume. Shortly after trees die, their needles and twigs fall to the ground and decay, leaving little behind to carry flames in a wildland fire. It's not unlike building a campfire. You don't just place a large log in the fire ring, put a match to it, and expect it to burn. It won't. Instead, you use kindling such as dry leaves and needles and twigs—small-diameter material that readily ignites and combusts. Then, after the kindling is ignited, you can gradually add larger-diameter wood to the fire. Therefore, standing dead trees have little influence on the intensity of a wildland fire, and when they fall, they help keep the soil moist, which contributes to the more humid microclimate in dense forests. Even within the first year or two after trees die, although they retain their needles, the naturally occurring combustible oils in the needles of live trees rapidly dissipate, so recent snags can be drier than live trees, but they aren't necessarily more burnable.

It seemed so obvious that snags would increase fire intensity that scientists ignored this question for decades. My colleagues and I conducted one of the first such studies, using data on prefire densities of recently dead trees and fire intensity in two fire areas in the San Bernardino Mountains in Southern California. In the study area, significant numbers of trees had died in some places during a cycle of drought and native bark beetle occurrence. We found no difference in fire intensity between forests with many recent snags and those with few or none.[5] Many land man-

Postfire clear-cutting of snag forest habitat on public lands in the Rim fire area, 2019. The snag at the center-left was nearly four feet in diameter when it was cut.

agers scoffed and ignored our results, but other groups of scientists were curious. One group conducted a much bigger analysis of the western United States and found that neither the abundance of recent snags nor the density of older snags influenced wildland fire behavior.[6] Scientists have concluded that weather and climate are the primary drivers of wildfires in forests with high levels of snags, and dead trees are not a factor.[7] Another group of researchers found that forests with greater snag levels actually burned *less* intensely than other forests, and this effect became progressively more pronounced when fires burned ten, fifteen, or twenty-five years after the trees had died—after many had fallen and become large downed logs.[8]

Many land managers and policy makers mistakenly assume that forest density and snags are the main drivers of fire behavior because it makes sense to them. If there are more trees and more snags, they reason, then there is more "fuel" to burn, right? The truth is that forests and wildland fires are not nearly so simple. During our three-decade analysis of climate variables and forest fires across the western United States, we also investigated the effect of different levels of environmental protection within the same forest types. Contrary to the assumptions that form the basis of current forest and fire management policies, we found that forests with the fewest environmental protections and the most logging burned most intensely, while forests with the highest levels of protection from logging burned least intensely.[9] In other words, the more trees removed from the forest through logging operations, the faster and hotter fires tend to burn. By making forests hotter and drier and less able to buffer winds, and by creating conditions that favor highly combustible invasive grasses over less combustible trees and other woody plants, logging makes our forests more vulnerable to the weather conditions that are exacerbated by climate change.

But old myths die hard, and notions formed in the mid-twentieth century are deeply rooted and highly resistant to change, even in the face of overwhelming evidence of climate change. One of these notions is the long-standing belief among land managers from North America to Australia that decades of fire suppression policies have led to the widespread accumulation of "fuel" in forests and other ecosystems and that this factor—not climate change—is the primary driver of fires. Those who subscribe to this notion assume that unburned, older forests are "overgrown" and will burn almost exclusively at high intensity if fire occurs, while more recently burned forests will experience mostly low- to moderate-intensity fire. Under this forest management paradigm, they argue that we cannot allow natural lightning-ignited fires to occur in remote forests, where fires have been excluded for many decades, because fires in such areas will be too severe. Based on this series of connected assumptions, land managers have been conducting large-scale logging operations across tens of millions of acres of forests for decades. The fundamental claim underlying this approach is that such logging operations—often conducted under the rubric of "thinning"—will reduce fuel accumulations caused by generations of fire suppression and that only after such logging occurs can wildland fire be reintroduced into the landscape.

This belief was so compelling and manifestly obvious to forest and fire management agencies that for nearly a century they never bothered to test their assumptions scientifically. In the past two decades, however, researchers began to do just that, and the results were surprising. Study after study, including my own research, found the same thing: forests that were unburned for the longest time—that is, the most fire-suppressed forests, which tend to be the densest—burn mostly at low and moderate intensity when wildland fires occur. This was the finding in *every single study* that investigated this question.[10] Even in forests that had not burned in well over a century within forest types that, on average, burned once every twenty to fifty years historically, most fires are low to moderate intensity. In fact, several studies found that forests that had not burned for the longest time actually experienced somewhat *lower* levels of fire intensity when wildland fires finally occurred, in large part due to the factors discussed previously. Once again, the message emanating from the science was clear: climate factors, not forest density, are the primary determinants of how fires burn.

Heedless of the lessons emerging from science, many land managers the world over are doubling down on the fuel-reduction management paradigm. They believe they can stop and suppress large, climate-driven wildland fires by imposing an unnaturally high fire frequency on forests through prescribed burning, or "controlled burns." They apply this method to vast areas of the landscape as part of the fuel-reduction approach to forest management.

It must be noted that this management approach cannot be equated with the culturally motivated burning conducted for thousands of years by indigenous peoples around the world, in harmony and balance with nature. For millennia, indigenous people have practiced the burning of specific locations for particular reasons—including the cultivation of key food sources and materials—and it has religious significance as well.[11] Native peoples' burning of forests has always coexisted with wildland fires caused by lightning strikes. One did not preclude the other, and both were much more prevalent before colonization and fire suppression. The problem is that when prescribed fire is deployed across huge expanses of forestland as part of a management paradigm designed to suppress mixed-intensity wildland fires, it mimics neither indigenous cultural burning nor natural lightning-ignited fires.

Those who promote landscape-scale prescribed burning under the fuel-reduction management paradigm believe that if low-intensity fires are conducted on a massive scale and at extremely short intervals—just a decade or less between controlled burns within a given stand of forest—then larger mixed-intensity wildland fires will be prevented, ostensibly because there won't be enough "fuel" to carry the flames. Although this makes intuitive sense to many, there are a number of major problems with this approach.

One of the biggest issues is that forests and woodlands are capable of reburning in a weather-driven wildfire just a year or two after a prescribed fire.[12] This is true because the material that drives fires—needles, leaves, and twigs—reaccumulates very quickly.[13] Therefore, prescribed burning as a means of fire suppression entails vastly more fires than are natural. Even within forest types with the most frequent natural fires, the fire frequency ranges from fifteen to sixty years in any given stand.[14] So if prescribed burns were conducted every five years, for example, that would exceed natural levels by several times, with a massive corresponding increase in smoke and particulates. Scientists have no idea what such enormously high levels of fire conducted across such vast expanses of forest would do to ecosystems, wildlife, and forests' carbon storage levels. And in the era of climate change, even such high levels of prescribed burning would not stop large fires driven by weather and climate factors. In the 2019–2020 Australian bushfires, for example, the Currowan fire in Morton National Park burned right through one of the largest prescribed burns ever conducted in Australia's history—and it had taken place only two years earlier.

Another major problem is that, to ensure the homogeneous lower-intensity fire effects they desire, land managers often conduct prescribed fires before the natural fire season, when conditions are cool and moist. This often necessitates the use of large amounts of accelerant to get the fires started. This timing also means that prescribed fires are being conducted during the early stages of nesting season for native birds, including shrub and ground nesters, as well as cavity-nesting species whose nest holes may be just a few feet above the ground. At this stage of the nesting season, there are chicks in the nests, but they are still too

Naturally regenerating ponderosa pines killed by too-frequent prescribed burning conducted by the US Forest Service across hundreds of acres six years after the Rim Fire.

young to fly, so the prescribed burns kill the chicks. When fires occur during the natural fire season, the adult birds and their young simply fly away until the fire has passed (this is one reason forest birds nest in the spring, so their young can fly before fire season starts).

Prescribed fires conducted outside of the natural fire season can have another adverse effect on native birds. In the conifer forests of North America, many woodpecker species depend on the larvae of wood-boring beetles as their primary food source. Because the wood-boring beetles depend on recently fire-killed trees to reproduce, and because these beetles are active only during the warm, dry fire season, prescribed burns that occur before or after the normal fire season create an ecological disruption: the beetles cannot effectively colonize the burned areas, so when the woodpeckers arrive, expecting to find an ample supply of grubs, the birds have access to little or no food and can starve. Compounding this problem is the disruption of the woodpeckers' natural camouflage. Their

An adult wood-boring beetle of the "longhorn" variety in the Rim fire area in late spring 2018, on the cusp of fire season. Whenever the sun was periodically blocked by clouds, creating temporarily cool conditions, this beetle stopped moving. It started moving again only when it became sunny and warm, like fire season.

backs are mostly or entirely black, and in high-intensity fire areas, they disappear against the charred bark of fire-killed trees, effectively hiding them from raptor predators. They lose this camouflage advantage in the low-intensity fire areas resulting from prescribed burning, leading to extremely high rates of predation.

This combination of issues can lead to severe declines in woodpecker populations after prescribed burns,[15] which can have a cascading series of adverse ecological effects. The woodpeckers that depend on wood-boring beetle larvae are the strongest cavity excavators. They create multiple new nest cavities each year but only use one, and they rarely reuse a cavity. This makes them ecological "keystone" species; their importance in the ecosystem is disproportionately high because they create homes for so many other forest species. Dozens of bird and small mammal species that need tree cavities to raise their young depend on these woodpeckers' cavities. But if woodpecker populations crash because prescribed burning prevented the creation of snag forest habitat or cut the birds' food supply, populations of bluebirds, nuthatches, flying squirrels, chipmunks, and many other cavity-dependent wildlife species can also be adversely affected. This, in turn, deprives hawks and owls of food.

The "overgrown" forest myth not only leads to bad and misguided forest management but also acts as a troubling component of the new tendency to deny the reality of climate change. The narrative of overgrown forests ignores the intensive removal of carbon from forests due to logging, falsely implies that forests are already "overstocked" and therefore contain too much carbon, and promotes the removal of much of the existing carbon through increased future logging. At the same time, it denies the severe adverse impact these actions have on atmospheric carbon levels and efforts to overcome the climate crisis.

In reality, the scientific evidence is clear that the great majority of forests in the United States and around the world have much less carbon today than they did historically, due to decades or centuries of carbon removal by logging and forest-clearing activities.[16] This means that our forests hold enormous potential to mitigate the climate crisis. Policies that protect forests from logging would allow large amounts of excess $CO_2$ to be removed from the atmosphere and absorbed by the forests. This is entirely possible; it is simply a matter of engaging in the hard work of social change and mustering the political will to change policies for the better.

For this to happen, though, we as a society must stop entertaining or tolerating narratives that deny climate change and stand in the way of climate solutions. We must be able to recognize this false "overgrown forests" narrative when we see it and learn to be skeptical of scientists who are funded by agencies and entities associated with commercial logging and who aggressively promote this narrative. For example, government and university scientists funded by the US Forest Service, which sells timber from public lands to private logging companies and keeps the revenue, have recently stepped up their advocacy of the overgrown forests narrative and of increased logging on US public lands. These scientists frequently employ a wildly misleading messaging tactic, such as stating that, historically, some forests contained only a few dozen trees per acre, while current forests contain "up to" 400 or more trees per acre. This is an obviously misleading "apples to oranges" comparison; it does not mean that the *average* historical tree density was only a few dozen trees per acre, and it does not mean that the *average* current tree density is 400 or more trees per acre. Nor does it compare current forest carbon storage levels to historical levels. Nevertheless, despite the deceptive nature of this comment, it is widely repeated at public meetings and in news stories.

Several years ago, I read a study published by some Forest Service–funded scientists about historical forest density in the central Sierra Nevada, based on field surveys conducted by the Forest Service a century earlier.[17] The study reported that, based on data from these early-twentieth-century forest surveys, historical mixed-conifer and ponderosa pine forests were open and parklike and had only a few dozen trees per acre, with no evidence of high-intensity fire. In contrast, the study asserted, current forests were several times denser, and high-intensity fire was a significant component of modern fires. The study recommended increased logging to remove most of the forest biomass, and therefore the carbon, to reduce fire intensity and "restore" current forests, which the authors described as overgrown. I was curious about these findings, so I asked the authors to send me the raw data from the historical forest surveys. They declined, which made me even more curious. I discovered that the original hard-copy field notes and records from the surveys were in file boxes at the US National Archives in San Bruno, California, just south of San Francisco. So I set up an appointment, traveled to San Bruno, underwent the training required to handle and inspect original historical documents at the archives, and obtained the file boxes containing the records I sought.

As I began to inspect the century-old field notes, handwritten in pencil, I could not believe my eyes. For each section of forest surveyed, there were survey cards tucked into a thin cardboard jacket, on which the surveyors had written explicit notes about where high-intensity fire patches had occurred in that particular section—key findings omitted by the Forest Service study. The note cards had a wealth of additional information written on the back of them, including data on the density of smaller trees, which had been excluded from the Forest Service study. I was even more surprised to find that the recent study had included only a small subset (about 6 percent) of the data from the historical field surveys.

There were additional omissions. For example, when the early-twentieth-century surveyors recorded the density of mature trees, they counted the number of trees in 132-foot-wide swaths, or "transects," through the forest. The problem, however, was that they estimated this distance visually. The forests were often so dense that they couldn't see 66 feet to their right or left as they walked, and many surveyors substantially underestimated the distance, so their transects were only one-half or one-third as wide as they should have been. This meant they were undercounting mature trees by twofold to threefold.

The records in the National Archives contain numerous memos back and forth between US Forest Service regional supervisors and their bosses (mainly for the years 1911–1916), explicitly discussing this problem of undercounting trees by a wide margin. Forest Service managers suggested adjusting the tree density numbers upward to account for the field surveys' gross underestimations. None of this information was presented or acknowledged in studies produced by the Forest Service in recent years, even though these memos were in plain sight, contained in the same file boxes as the field survey note cards. I found numerous other historical reports at the National Archives, including detailed descriptions of large high-intensity fire patches and postfire conifer regeneration, as well as some maps. This information was also excluded from recent Forest Service studies.

While I was still assembling data from these records at the National Archives—a process that required numerous trips to San Bruno—another Forest Service–funded study with similar data omissions was published. This one was based on another set of century-old Forest Service field surveys conducted in the same forest types but farther south, in the southern Sierra Nevada.[18] My colleagues and I decided to publish our findings soon thereafter, using all the available data for the two areas in question. In contrast to the Forest Service studies, we found that although some historical forests were certainly "open and parklike," with relatively low tree densities, they were only a minor portion of the total. Most historical forests were moderately to very dense, often with high levels of native shrubs and hundreds of trees per acre in the understory. In fact, when we considered all the historical data omitted by the other studies, we concluded that historical mixed-conifer forests were seven times denser, in terms of trees per acre, than the Forest Service studies had reported, and historical ponderosa pine forests were seventeen times denser. Moreover, high-intensity fire was a substantial component of historical fire regimes in these forests. On average, 22 to 27 percent of these forests had experienced high-intensity fire within several decades preceding the surveys.[19]

Findings similar to ours have been reported in numerous other studies using historical forest survey data from the western United States. Consistently, they have found that historical forests were considerably more variable than previously assumed and reported, with many dense areas. These studies have also reported a substantial component of high-intensity fire within frequent-fire forest types, often ranging between 18 and 39 percent high-intensity fire but exceeding 50 percent in some regions. Overall, we now know that historical forests were much denser than previously assumed. This conclusion is based in significant part on a series of studies using historical US government forest survey records from the mid and late 1800s. These studies, and research by other scientists, have been checked for accuracy and cross-validated with dozens upon dozens of other lines of evidence and historical documents, arguably making them more reliable than any other body of research in the history of forest and fire ecology science.[20]

Despite these developments, proponents of the overgrown forest myth continue to promote their narrative in the media and in public meetings. Recently, this has taken a slightly more unsettling turn, with Trump administration–funded scientists and agency representatives attempting to downplay the role of climate in wildland fires, while making exaggerated and misleading statements about overstocked forests and advocating even more logging.[21]

The reality is that there is no such thing as an "overgrown" forest. The amount of biomass that can be supported in a given stand of forest is determined by a combination of physical factors, including annual precipitation and soil conditions. If a particular stand is very dense, it is because that location is naturally capable of supporting that much biomass.

More fundamentally, the most troubling aspect of the overgrown forest narrative is that it diverts attention from the fact that today's forests have much less carbon than they naturally did before many decades of intensive logging—far less carbon than they could store if we dramatically increased forest protection to draw down the catastrophically excessive levels of $CO_2$ in our atmosphere. This type of disinformation is as dangerous as any other political narrative used to deny climate change. The good news, of course, is that this false narrative will lose its power to harm and its power to impede true progress toward climate solutions as soon as green groups, environmental reporters, and progressive policy makers stop tolerating its usage in discussions of forests, fire, and climate change. The power to change is ours.

# 4

# The "Megafire" Narrative

In the mountain communities of the western United States, old trout fishermen sometimes sit around in the evening and swap fish stories. It is a pastime that goes back generations. Once the fish stories start, everyone tries to top the last story, and with every retelling, each story gets grander and more outlandish. Over time, the fight to land a trout in some side-canyon stream becomes an epic battle, and the trout acquires a fierce aspect and magnitude vaguely reminiscent of the Great White Whale.

In recent decades, telling fire stories has become the new pastime, and competing stories of "megafires" get more imaginative and exaggerated with every retelling. In the 1998 action movie *Firestorm,* there is a scene in which a group of firefighters watches as a massive fire sweeps across a mountainside, coming toward them at the speed of a tidal wave (all computer-generated imagery, of course). Trees explode as the flames hit them, and they are tossed hundreds of feet in the air. Over the years, there have been numerous examples of extreme hyperbole in the portrayal of forest fires in Hollywood movies. But like fish stories, it's all a bit of harmless fun, and no one takes it too seriously—or at least they shouldn't.

In recent years, however, the megafire stories have become more serious, and many people in positions of authority have joined the annual frenzy of megafire storytelling every fire season. Government officials and prominent elected representatives have joined the fray, and it's hard to keep up with the eyebrow-raising headlines about so-called megafires. In this atmosphere of fear and gleeful exaggeration, new and dangerous policies are being proposed, generally based on the notion that many or most of the trees, and therefore the carbon, must be removed from our "overstocked" forests to save them from megafires. And if environmental laws stand in the way, they need to go. None of this is harmless fun.

Several years ago, I attended a meeting of US Forest Service officials, conservationists, and local logging interests regarding a proposal for a large-scale commercial logging project in an old-growth forest inhabited by numerous imperiled species, including the California spotted owl and Pacific fisher. The Forest Service, true to form, claimed that the logging would stop a megafire from occurring and save wildlife from certain doom. I challenged the scientific validity of this assumption, but instead of discussing or debating the evidence with me, one Forest Service staffer went straight to the tactic of megafire storytelling. "You don't understand," he said. "The forests are so overgrown now the fires are moving faster than a deer can run or a bird can fly." I pointed out that a deer can run about forty miles per hour, so if his statement were true, any fire that started would cover most of the western United States by the next morning. He scoffed and walked off. This is the hallmark of the megafire narrative: it's not about the facts; it's about the story.

To overcome the potential for regressive and counterproductive decision making in this context—decisions that can exacerbate the climate and extinction crises—we need to recognize megafire storytelling and understand it for what it is. Everyone around the world has repeatedly heard the megafire narrative if they live near fire-adapted ecosystems, and most likely even if they don't. It goes something like this: due to fire suppression, environmental protections, and radical conservationists who oppose logging projects and other "fuel-reduction" measures, the forests are now dangerously overgrown, causing megafires of unprecedented size and severity that are incinerating stands of old trees, sterilizing soils, and creating vast deforested moonscapes where nothing will regrow without intensive human intervention, typically in the form of postfire logging and tree planting. However, like the other related myths, the megafire narrative is factually challenged, often to a spectacular degree.

Ecologically, we don't want either too much or too little fire in our forests. Both can lead to unfavorable ecological consequences. We want fires to occur within the natural range that characterized fire regimes prior to fire suppression and logging policies—also known as the natural range of variability. If a particular ecosystem has a clearly unnatural and excessive rate of fire, such as lower-elevation chaparral habitat in Southern California, actions should be taken to reduce fire starts.[1] This can include programs to prevent and reduce unplanned, accidental human ignitions and the suppression of such ignitions—especially near communities—when they are small and the weather allows them to be extinguished.

Many may be surprised to learn that we currently have considerably less fire in our forests than we did historically, before fire suppression policies began. In forests of the western United States, for example, conservative studies estimate that there were about three times more mixed-intensity fires prior to fire suppression than there are now; other studies estimate an even larger fire deficit (my research is on the conservative end of this spectrum).[2] Independent scientists with nongovernmental organizations, university scientists, and agency scientists all agree that forests in the western United States experience much less fire now than in the past. The only thing up for debate is *how much less*. There is not an excess of fire in these forest ecosystems, as is commonly assumed; there is a deficit. This deficit is not limited to low- and moderate-intensity fire. Even in the more frequent-fire forest types of the western United States, such as ponderosa pine and dry mixed-conifer forests, groups of researchers using different methods have consistently found that there is less high-intensity fire now than there was before fire suppression.[3]

Globally, the pattern of fire deficit holds true as well.[4] In the forests of Scandinavia and central Europe, for example, the fire deficit relative to natural, historical levels is even larger.[5] In central Europe, policies of 100 percent wildland fire suppression are common, along with aggressive programs to remove snags in the event a wildland fire does occur and covers a significant area. As a consequence, numerous native wood-boring beetle species that depend on fire-killed trees have become highly imperiled, and some are now listed as critically endangered.[6] As discussed earlier, population losses of these native beetles have consequences for woodpeckers and a cascading series of related adverse ecological impacts for other cavity-nesting species and their predators.

Overall, global wildland fire activity has decreased slightly over the past two decades, including in Europe, the boreal forests of Asia, South America, and Australia.[7] In Africa, there have been slight decreases in the Northern Hemisphere portion of the continent and slight increases in the Southern Hemisphere portion, with more than 500 million acres burning in savannas, woodlands, and some forests in a typical year continent-wide. In some parts of the world where the annual acreage affected by wildland fire is inching upward, climate change is a factor. In Australia, for example, nationwide fire levels have decreased somewhat in recent decades, although southeastern Australia has experienced an increase related to climate factors.[8] However, rates of burning still appear to be less than historical rates before fire suppression.[9] In US forests and in the boreal forests of Canada, annual fire areas have increased incrementally over the past couple of decades, and the fire season has been getting somewhat longer with rising temperatures, but current fire levels remain far below natural historical levels.[10] Contrary to common assumptions, though, most studies have found that fires are not getting more intense, and there is no upward trend in the occurrence of large high-intensity fire patches over the past two decades.[11]

This complex pattern of regional increases and decreases is consistent with projections about the mixed effects of climate change on wildland fire, with various areas expected to see somewhat more or less fire activity.[12] These nuances related to recent fire activity in various parts of the world and fire deficits relative to historical fire regimes have been almost completely overlooked in discussions of wildland fires by policy makers, government officials, and government-funded scientists, as well as some conservationists, climate activists, and environmental reporters. "Megafire" has become the new global buzzword for climate disaster, and fire-as-disaster stories have proliferated.

By the time Australia's 2019–2020 bushfire season had affected more than 30 million acres nationwide, there was daily international news coverage of the fires, replete with hyperbolic terms such as "apocalyptic," "catastrophic," and even "demonic." There was no mention of the well-established scientific fact that it is normal for 100 million to 150 million acres to burn in any given year in Australia—a large country overwhelmingly made up of fire-adapted forests, woodlands, savannas, and arid "scrub" habitats. Fire seasons in which more than 200 million acres burn are occasional occurrences, and very large fires are part of these fire regimes.[13]

In the summer of 2019 approximately 7 million acres of Russian Siberia and 2 million acres of Alaska burned after a series of mostly lightning fires, leading to a frenzied global lamentation about these supposedly bizarre "Arctic" fires. Almost entirely absent from the global dialogue was any acknowledgment that these fires mostly occurred far south—often hundreds of miles south—of the Arctic Circle or that the great majority of them occurred in boreal forests, where large, intense fires are completely natural.[14] Nor was there any meaningful discussion of the fact that tree species in boreal forests reproduce abundantly after large, intense fires or that many native wildlife species have evolved to rely on the snag forest habitat created by such fires.[15] The area burned in these heavily fire-adapted forests in 2019 was unexceptional, but this too received little or no mention. In numerous years in recent decades, the boreal forests of Asia have seen more fire than occurred in the 2019 or 2020 fire seasons,[16] and boreal forests in general have less fire now than they did historically. Although there are very real concerns about the melting permafrost in the Arctic region and the resulting increase in greenhouse gas emissions, this phenomenon is fundamentally driven by rising temperatures from human-caused climate change, not wildland fires.

In Brazil and in Amazonia more broadly, the situation is more complex. Several wildland fire studies have used charcoal and pollen sediment samples to reconstruct Amazonia's fire history over several thousand years. This research reveals a highly variable pattern of wildland fire over time, likely resulting from a combination of burning by indigenous peoples, natural ignitions, and climate fluctuations. At several times over the past 7,000 years, there were large increases in wildland fire activity at numerous locations, typically associated with shifts to warmer and drier climate conditions. These elevated fire periods lasted anywhere from dozens to hundreds of years at any given location, and they sometimes included large high-intensity fire patches, as well as periods when relatively frequent, intense fires maintained natural early-successional forest in some areas. In some locations, overall rates of burning over the past twenty to thirty years clearly exceeded past rates, as loggers and ranchers used repeated fire in conjunction with ground-based machinery to deforest vast areas for livestock grazing and lumber cutting. In many other areas, however, burning rates during several periods over the past several thousand years exceeded current burning levels.[17]

The problem with the global public dialogue about wildland fire in Amazonia, which reached particularly high levels in 2019 in Brazil, is that it mistakenly implied that wildland fire is inherently unnatural and categorically destructive in this region. Media coverage of the 2019 fires in Brazil missed the main point. For months, the headlines repeatedly told us that Brazil was burning. But this put the focus primarily on the flames, rather than centering the discussion on the fundamental problem: industrial deforestation for cattle and lumber. To the credit of the global media, numerous news stories reported that the bulk of the fires had been intentionally set by the cattle and lumber industries to make it easier to clear the forests and woodlands, but this secondary message was often lost in the more sensational imagery of the fires. This led to a dominant narrative that misleadingly suggested that Brazil's forests were being lost to fire, when the deeper truth was that humans, with the encouragement of the right-wing government, were using various means, including fire, accelerants, and machinery, to deforest huge areas and violate the rights of indigenous tribes.

Wildland fires have been occurring at various rates and intensities in Amazonia for millennia, and they do not deforest these ecosystems, unlike logging and ranching. Fire history studies show that many fires have historically been lower intensity, and where higher-intensity fires have occurred, the forests have naturally regenerated.[18] But where ranching and logging interests use fire to clear understory vegetation, remove the trees for lumber or bulldoze them into piles for incineration, and then subject the land to intensive livestock grazing, deforestation can occur, along with permanent or long-term losses of large amounts of forest carbon. This is not a wildfire problem per se. It is mainly a human industrial deforestation threat.

Even among people who understand the ecological role of wildland fire and who acknowledge that most forests are not currently experiencing an excess of fire, there is often a lack of understanding about very large individual fires, or megafires. Many people who accept that forests in a given region had more fire historically than they do now still assume that very large fires are a modern anomaly. The extension of this assumption is that large fires must be destructive or even catastrophic and that the active management of forests, including the large-scale removal of carbon through logging, is needed to stop such fires. However, science does not support our worst fears.

There is abundant scientific evidence, from numerous sources, that very large fires have occurred periodically in many forest ecosystems, especially when climate conditions favored increased fire activity. For instance, the 1910 "Big Burn" in the forests of the northern Rocky Mountains of the United States spanned nearly 3 million acres over just two days. The 1849 Yaquina fire and 1853 Nestucca fire each burned about half a million acres of forest in western and southwestern Oregon. In boreal forests, huge fires have always been a periodic occurrence. The "Great Fire of 1919" burned about 5 million acres in the forests of Alberta, Canada, and the 1825 Miramichi fire stretched to approximately 3 million acres in New Brunswick, Canada. On a trip to the boreal conifer forests of eastern Siberia in 1903, John Muir described a single high-intensity fire patch approximately 100 miles in diameter, which is the equivalent of 4 million to 5 million acres, depending on the shape.[19]

Fire scar records across multiple study sites in the Sierra Nevada indicate major drought years in which enormous fires covered hundreds of thousands or even millions of acres,[20] and newspaper accounts from the late 1800s provide additional evidence of huge fires.[21] Several million acres of forest in the Sierra Nevada had fire scars in one particularly significant drought year: 1829. And in southeastern Australia, the "Black Friday" bushfires of 1939 burned nearly 5 million acres of mostly forest and woodland, more than three-quarters of which was attributable to a single large fire in eastern Victoria; in the 1851 bushfire season, about 12 million acres burned in Victoria. These are just a handful of examples among many.

In recent years, scientists have begun to study biodiversity in areas subjected to very large forest fires, with interesting results. Most of the recent research has been conducted in forests of the western United States. After the nearly 500,000-acre Biscuit fire occurred in 2002 in the remote forests of southwestern Oregon and northwestern California, researchers set out to study postfire plant species and conifer regeneration. They found the highest levels of plant species richness in high-intensity fire patches—higher, in fact, than in lower-intensity fire areas or adjacent unburned old forest.[22] They also found vigorous natural conifer regeneration in these large high-intensity fire patches, with hundreds of new seedlings and saplings per acre naturally growing after the fire. In another study of the Biscuit fire, researchers found higher levels of bird species richness in high-intensity fire patches than in lower-intensity fire areas or unburned old forest.[23] Interestingly, the findings in these studies with regard to plant and bird species richness and natural conifer regeneration were similar in the high-intensity fire patches in the Biscuit fire that reburned a second time at high intensity, indicating that these forests are highly adapted not only to large, intense fires but also to repeated intense burns.

Similarly, in the 151,000-acre McNally fire of 2002 in the southern Sierra Nevada, ecologists recorded more bird species in the fire area than in nearby unburned mature forest, and following the 57,000-acre Storrie fire of 2000 in the northern Sierra Nevada, total bird abundance was greatest in the snag forest habitat created by high-intensity fire.[24] In a study of the 65,000-acre Moonlight fire of 2007 in the northern Sierra Nevada, "more total [bird] species were detected in the Moonlight fire which covers a much smaller geographic area and had far fewer sampling locations than the [nearby] green forest."[25]

In the 257,000-acre Rim fire, which occurred in 2013 in the central Sierra Nevada, rich and heterogeneous natural forest regeneration, including abundant conifer regeneration, was occurring several years later, even in the interior of the largest high-intensity fire patches, where the US Forest Service had claimed there would be no regeneration for decades or centuries.[26] Studies found that the mycorrhizal fungi networks in the soil—which are essential for forest productivity, growth, and regrowth—were not only intact in the high-intensity fire patches in the Rim fire area

Natural conifer regeneration in 2019, in the middle of one of the largest high-intensity fire patches in the Rim fire area, more than 300 yards in any direction from the nearest live, mature tree. No distance is too great to stop natural conifer regeneration from occurring.

but were thriving, as were morel mushrooms—a key food source for many wildlife species.[27]

We are so used to the relentless pyrophobic messaging about large fires that we often miss the good news. In the forests of the southwestern United States, the little buff-breasted flycatcher had been slowly declining for decades. In fact, it had lost over 90 percent of its range in the United States due to a lack of habitat. Like so many other native wildlife species that evolved with mixed-intensity fires, the buff-breasted flycatcher is fire dependent, relying on patches of high-intensity fire in ponderosa pine and mixed-conifer forests to survive and reproduce. Generations of aggressive fire suppression, however, had taken its toll on this species, and for a while, it seemed that we might lose it entirely. Scientists warned, “Continued suppression of high-severity forest fires in the southwestern United States may eventually result in the extirpation of buff-breasted flycatchers," noting that the species needed mixed-intensity wildfires, with significant high-intensity fire patches, to recover. "Prescribed burning is unlikely to help restore flycatcher populations." Then things started to change for the better. In the past two decades, a series of large wildland fires occurred in the mountains of southeastern Arizona and southwestern New Mexico within protected forests on public lands, so no postfire logging occurred. Biologists soon began to see buff-breasted flycatchers in places they hadn't been seen in decades. In the Rincon Mountains of southeastern Arizona, buff-breasted flycatchers were found for the first time since 1911, following some large mixed-intensity forest fires. The little flycatcher is now staging a triumphant comeback.[28]

In many cases, the things society has worked hardest to "save" from forest fires are the things that need fire the most. In 2015 a lightning strike ignited a mixed-intensity fire that spread through the western portion of Kings Canyon National Park and the northern portion of the Giant Sequoia National Monument in the southern Sierra Nevada. The Rough fire grew to more than 150,000 acres before a change in the weather halted its progression. While the fire was still burning, I was getting panicked calls and emails from forest activists and reporters as the fire burned through several groves of giant sequoias—groves that in some cases had not burned in more than a century. These groves are home to some of the largest and oldest trees on the planet. They are beloved and famous worldwide. Some of the sequoias are more than 2,500 years old, well over 200 feet tall, and more than 30 feet in diameter. They are spectacular from any standpoint. So it was understandable that many people were worried. But they didn't need to be.

The truth is, we have been loving these giant sequoia groves to death, treating them like living museums rather than the dynamic, wild forests they are. Giant sequoias are serotinous, which means that, like some other conifer species, they are dependent on fire to reproduce—and not just any fire. They need moderate- and high-intensity fire in particular. The flames need to reach high enough, and the fire needs to burn hot enough, to melt resins in the cones, which releases the seeds. The fire also needs to be sufficiently intense to consume the thick duff and litter (needles, leaves, and twigs) on the forest floor, creating a nutrient-rich bed of mineral ash that allows the seeds to germinate and produce seedlings that will survive and flourish. As a US government researcher observed in 1904 with regard to giant sequoias: "Reproduction is uniformly best in burned areas, and germination has followed severest burns, which seem to best prepare the soil—baring, loosening and fertilizing it."[29]

The first spring after the Rough fire, I hiked extensively through the fire area. It was a gorgeous mix of fire effects, with high-intensity fire patches of varying sizes—including some large ones—scattered throughout a mosaic of mostly low- and moderate-intensity fire areas where most of the trees had survived. In the higher-intensity fire areas within the sequoia groves, I walked through a carpet of green, as tens of thousands of sequoia seedlings poked through the soil on every acre. Even where the fire had burned intensely, killing most of the other trees, the giant sequoias, with their thick, fire-resistant bark and their crowns towering above the rest of the forest, generally survived. In a couple of localized spots, the fire had killed a small number of mature sequoias, creating some of the best snag forest habitat I have ever seen. A giant sequoia snag is like an ecosystem unto itself. It is so large that it can serve as home to dozens of cavity-nesting birds and small mammals in a single year and can continue to do so for centuries, given that sequoias decay extremely slowly. Far from destroying the giant sequoia groves, as many had feared, the Rough fire was the best thing to happen to these forests in more than a century.

A particular concern in the past has been the potential impact of large fires and high-intensity fire patches on populations of native fish and other biota in mountain streams. Some early observers had noted declines in populations of fish and aquatic insects soon after large, intense fires, but it turns out they hadn't studied these ecosystems long enough. More recently, scientists looked deeper into this question, gathering data for years after large fires had occurred, and they found something quite unexpected. For example, more than 307,000 acres burned in 2000 in the Bitterroot National Forest in Montana—mostly one big fire with numerous large high-intensity fire patches. The year after the fire, heavy rains caused a significant flow of debris into streams in some of the high-intensity fire patches. Fish biologists were worried, especially because fish populations had briefly declined in some areas, and native fish species were already considered imperiled before the fire occurred. However, by three years after the fire, native fish populations had generally increased to prefire levels or higher, especially in high-intensity fire areas, and particularly where significant debris flows had occurred, while nonnative fish had generally declined in such areas.[30] By a decade after the fire, the effect was even more pronounced, with native fish populations increasing to well above prefire levels in most of the watersheds dominated by high-intensity fire effects. In some large high-intensity fire patches, by a decade after the 2000 fire, native fish populations were three to ten times higher than prefire populations, and invasive, nonnative fish populations had declined.[31]

Other researchers studied streams five years after the 150,000-acre Diamond Peak fire of 2000 in the remote forests of Idaho, composed mostly of ponderosa pine and Douglas fir. Interestingly, they found the highest levels of aquatic insects, on which native fish feed, in moderate- and high-intensity fire areas, with peak levels in high-intensity fire patches. They also found the highest abundance of native bat species in these areas.[32]

How can these findings be explained? Scientists discovered that large, intense forest fires create a substantial pulse of nutrients that are delivered to streams via rain, and these nutrients create conditions that allow native aquatic insects to thrive and increase, providing more food for fish.[33] Rapidly growing postfire streamside vegetation and downed logs in streams (fire-killed trees that have fallen) provide cover and shade for fish, creating good conditions for them to hunt aquatic insects and pools that facilitate reproduction. In addition, brief pulses of debris flows, which typically occur within the first postfire year, create sand and gravel beds that are good spawning grounds. Although the increase in bats was an unusual finding, it made sense once scientists discovered that the bats benefited from the increase in aquatic insects in streams in high-intensity fire areas. These insects are aquatic only in their larval phase, after which they emerge from streams as adults and fly away, providing food for bats, similar to findings in the McNally fire in the Sierra Nevada.[34]

In the 1950s and 1960s in the Pacific Northwest, land managers used bulldozers to remove logs that had fallen into streams after fires or droughts. They argued that this would be good for fish, removing impediments in the streams. Now we know that these downed logs are critically important habitat elements and that natural disturbance processes like fire are key mechanisms for creating these necessary habitat structures in streams.

To be clear, this is not to say that unburned mature and old forests have low levels of plant and animal species—quite the opposite, actually. The richness of species in old forests is quite high, but it is often even higher in large, intense fire areas. The message is simple: high-intensity fire patches are important for wildlife and biodiversity in these forests, and very large fires, which create thousands of acres of snag forest, provide outstanding habitat for a wide variety of plant and animal species. These so-called megafires are not destroying forests; they are creating highly biodiverse wildlife habitat.

Yet the megafire narrative, and the mythology surrounding it, is so compelling that dramatic stories take on a life of their own, regardless of the facts. Consider, for example, the 2011 Las Conchas fire in northern New Mexico. The fire covered 156,000 acres and included a particularly large patch of high-intensity fire about 20,000 to 30,000 acres (depending on how it was measured) in the south-central portion of the fire area. Soon, local forest scientists were being quoted in the press and in at least one book, describing a 30,000-acre "near-treeless hole" in the Las Conchas fire area.[35] These local scientists depicted it as a barren, lifeless place where little or nothing would grow. Later newspaper stories echoed this theme, and it was soon a topic of discussion in the halls of Congress. Naturally suspicious of conspicuous hyperbole, I was intrigued and traveled to the Las Conchas fire area with a colleague to survey this large high-intensity fire patch.

The reality on the ground was nothing like the reports. It was almost as if the media were covering a different Las Conchas fire, one that existed in an alternate universe. As my colleague and I entered the northern side of the largest high-intensity fire patch, we had to drive slowly because of all the birds flying back and forth across the narrow dirt road—woodpeckers, wood warblers, bluebirds, sparrows, and many others amidst the standing snags, flowering shrubs, and dense, regenerating aspen and oak groves. As we hiked deeper into the patch, we saw pockets of live, mature ponderosa pines and other conifers—hundreds of clumps of surviving trees scattered throughout the interior of the patch. Some of these live-tree pockets were small, and others were dozens of acres. Although the fire had burned just four years earlier, dense stands of young aspen and Gambel oak were growing vigorously, already ten to fifteen feet high in many places. Young ponderosa pine seedlings were naturally regenerating. A riot of wildflowers appeared around every bend in the road. Woodpeckers hunted for beetle larvae in the snags, songbirds flitted through the locust shrubs, and flycatchers caught bees in midair. Hawks soared above the snag forest, hunting for small mammals. Deer and elk tracks crisscrossed haphazardly. Small mounds of freshly dug dirt dotted the forest floor, indicating the presence of native pocket gophers—a nighttime meal for foraging Mexican spotted owls. The forest was busy and noisy, full of life and color, and there were live trees everywhere. This was not a sterile, lifeless landscape—far from it.

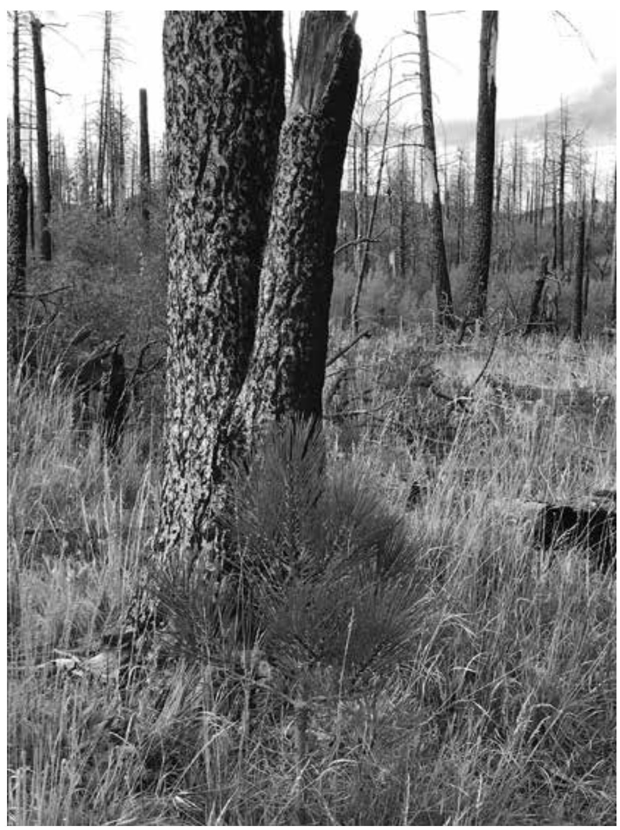
As we returned to the US Forest Service road and drove out, snaking through this large snag forest, my colleague remained cautious. He was coasting along at only twenty miles per hour, his foot poised over the brake and tapping it abruptly from time to time when birds flew too close. "I don't want to hit any of them," he said.

Reflecting on my visits to the Las Conchas fire area, it occurs to me that the motivations underlying megafire storytelling are complex and varied. In many cases, it's a simple matter of financial self-interest. Logging companies and land management agencies that profit from logging aggressively promote a "catastrophic wildfire" narrative, demonizing fire in numerous ways to justify logging and clear-cutting under the guise of "fuel reduction," "restoration," and "reforestation" as a supposed antidote to the megafire "problem." For others who engage in megafire storytelling, it's not so simple. The local scientists quoted in the press, like those who made such wildly inaccurate statements about the Las Conchas fire, are normally diligent and reliable. I know these people and their work, and they are not promoting a logging agenda. They are simply

Abundantly regenerating aspens and other trees in 2019, in the middle of the largest high-intensity fire patch in the Las Conchas fire area—falsely described as being nearly treeless.

scared. Many of these scientists have spent their careers studying old-growth pine forests and extolling the many well-established virtues of such habitats, but they have not studied the ecological role of snag forest habitat. When a large high-intensity fire patch occurs in a mature pine forest, it can be difficult for them to see the ecological value or to approach the new postfire landscape with any intellectual curiosity. They are lamenting the "loss" of big, green pine trees rather than celebrating the creation of vital new wildlife habitat, the rejuvenation of the forest, and the initiation of vibrant new stands of pines.

The truth is, there have always been very large fires in fire-adapted forests around the world, and there have always been large high-intensity fire patches. Even in the frequent-fire forest types of the western United States, such as ponderosa pine and dry mixed-conifer forests, there is abundant historical evidence that, prior to fire suppression, high-intensity fire patches covering thousands of acres—and sometimes tens of thou-



Natural conifer regeneration deep in the interior of the largest high-intensity fire patch in the Las Conchas fire, eight years postfire.

sands of acres—were a natural component of fire regimes in places where hot, dry, windy conditions occurred.[36]

Well over a century ago, prior to fire suppression, US government scientists observed that unlogged forests had "frequently severe and probably recurrent burns" that led to the "occupation of whole ridge crests and slopes by dense chaparral" and the natural regeneration of new forest stands. In these large high-intensity fire patches, "bunches of [conifer] sapling reproduction of various ages, and areas abundantly stocked with seedlings" were "of very general occurrence," and regenerating conifers were "growing up out of very dense chaparral . . . through which young saplings have pushed up and made rapid growth."[37] Contrary to the current mythology promoted by land managers and the logging industry to justify postfire logging and the creation of tree plantations, historical observations indicate that native shrubs help the growth of new forest stands: "Often the height growth [of young conifers] appears stimulated by the shading brush cover, and the chaparral in this situation must afford considerable protection."[38]

In the modern era, although there was a significant increase in large high-intensity fire patches in these forest types from the 1980s through the late 1990s, a comprehensive three-decade analysis across the western United States found that, contrary to popular assumptions, there has been no increase over the past two decades.[39] Moreover, even in the largest high-intensity fire patches, there are dozens to hundreds of clumps of live, surviving conifers scattered throughout, ranging from small groups of mature pines to pockets of live trees dozens of acres in size. Contrary to popular misconceptions, there are few places within these high-intensity fire patches that are far from live, mature trees. Even in the relatively few places that are 1,000 feet or more from surviving trees, conifer forests naturally regenerate there, too, by means of either surviving seeds in the cones of fire-killed trees or seed distribution across the landscape by seed-caching birds and squirrels.[40]

Despite this evidence, the logging industry continues to exert pressure to conduct large postfire logging operations, or so-called salvage logging, in forests around the world, especially after very large fires. The justifications for this commercial logging are strikingly similar the world over, including claims that postfire logging and tree planting are needed to reduce fuel, facilitate reforestation, and restore wildlife habitat. But there is overwhelming consensus among scientists that "salvage logging" of snag forest habitat created by fire, drought, or native beetles is one of the most destructive forest management practices and should not occur. A remarkable number of scientific studies have documented the severe adverse impacts of such logging on biodiversity around the globe, including in Australia, Europe, and North America. In the fall of 2015, more than 250 scientists sent a letter to the US Congress strongly opposing salvage logging and noting that it causes dramatic harm to wildlife, damages soils, spreads invasive plants, and usually increases future fire intensity. The scientists noted that very large fires create "quite simply some of the best wildlife habitat in forests," and these snag forest habitats "are ecological treasures" deserving of protection.[41]

Standing in the way of science, however, and in the way of our ability to protect forests and address the climate crisis, is the new and frenzied global pastime of telling fire stories. For some, hair-raising stories about megafires are both a cynical endeavor and an economically motivated imperative based on self-interest. Logging interests and their political allies aggressively use megafires as a poster child in their efforts to demonize fires and roll back environmental laws to allow more logging. For others, including some climate activists and environmental advocates, megafire storytelling has become a tool to shock the general public and policy makers into taking the climate crisis more seriously. In this context, megafires are being used as the new symbol for climate change, but many climate activists are not well versed in forest, fire, and climate science. Nor do they realize that the blatant falsehoods contained in the public dialogue about megafires tend to advance antienvironmental policies that seriously undermine conservation and climate solutions. This needs to change.

In coastal communities across the United States and in dozens of nations around the globe, hundreds of millions of people are at serious risk from rising sea levels and more intense hurricanes due to climate change. In certain areas, such as the American Midwest, temperatures driven upward by climate change are causing spikes in heat exhaustion and heatstroke, especially in low-income communities that often lack tree cover and where residents cannot afford air conditioning. Some communities are threatened by food shortages due to droughts that may be worsened by climate change, while others are inundated by severe flooding as rainstorms intensify. In grasslands, shrub habitats, woodlands, and forests, countless towns could be protected if our focus was on creating fire-safe communities. Instead, they face growing threats from wildland fires driven by weather and climate conditions—fires that cannot be suppressed no matter how much money is spent or how many water tankers and bulldozers are mobilized. In all cases, there are real things that can and should be done to help the people who are most affected by and vulnerable to climate change but have the fewest resources. Unfortunately, our attention is being diverted elsewhere.

Our unhealthy fixation on forest fires as the poster child for the negative effects of climate change, and our obsession with images of tall flames reaching treetops and the mythology of forest-destroying megafires, dominates climate-related news coverage and political dialogues. Misguided and regressive "solutions" to the perceived forest fire problem inevitably follow, leading to more bulldozers and chain saws in the forests, more carbon removed, and more carbon released into the atmosphere. The mounting problems related to climate change are not getting the attention or the resources they should, and insufficient pressure is being brought to bear on carbon-polluting industries. Are we serious about overcoming the climate crisis? Are we serious about helping the most vulnerable communities adapt to climate change? If so, what we are doing isn't working.

My suggestion? Find another poster child.

# 5

# What's the Real "Carbon Bomb"?

We've all heard it many times before, in every fire season—claims about catastrophic wildfires incinerating trees and sending their carbon into the atmosphere, sterilizing the soil, and leaving behind devastation that will take centuries to regenerate, if ever, without human intervention. In short, we are being told that, due to natural processes like wildland fires, many of our forests are no longer carbon sinks that absorb more $CO_2$ than they emit; instead, they are becoming carbon sources, with wildfires in particular acting as "carbon bombs." We are being wildly misled.

When the Rim fire occurred in the summer of 2013 in the central Sierra Nevada, all these tropes were used for months while the fire was burning and for years after the smoke had cleared. At about 257,000 acres, the fire area included a portion of the Stanislaus National Forest, several large inholdings of private timberlands, and the westernmost portion of Yosemite National Park. It was the largest fire in living memory in the forests of the Sierra Nevada at the time it occurred. Almost immediately afterward, US Forest Service staff blanketed the media with hyperbolic quotes about the Rim fire, claiming that the overstocked forests had caused the fire to burn so intensely that most of the landscape had been "nuked" and was now a "moonscape" that would not regenerate on its own—at least not for centuries. Agency officials told a colleague of mine that the Rim fire had burned so intensely that about 50 percent of the biomass in the standing forest was incinerated, immediately ending up in the atmosphere.

The Forest Service, which is in the business of logging, told the public that the only way to restore the Rim fire area and prevent similar fires was to give federal land management agencies more latitude to conduct aggressive commercial logging, including postfire logging and tree planting. Soon, pro-logging members of Congress were trying to fast-track proposed legislation that would authorize some of the most extreme and profound rollbacks of environmental laws in US history. One bill proposed to suspend federal environmental laws and mandate clear-cutting of the Rim fire area in both Stanislaus National Forest and Yosemite National Park. Another proposed to largely eliminate environmental protections on all federal public forestlands to clear the way for a huge increase in logging and clear-cutting—all of which was cleverly packaged in benign-sounding terms such as "restoration" and "fuel reduction." The logging industry and its political allies even appropriated a climate change term, arguing that massive clear-cuts across tens of millions of acres of public lands would make forests more "resilient." Conservation biologists, climate scientists, and environmental groups fought back in the media and in the halls of Congress and narrowly managed to defeat these bills.[1]

However, existing environmental laws are quite weak, allowing the Forest Service to implement many large-scale logging and postfire logging projects on public lands. About 7,000 acres of the snag forest habitat in the Rim fire area was clear-cut in Stanislaus National Forest within three years after the fire, but the majority of the snag forest remained intact—in part due to delays resulting from an environmental lawsuit. This gave scientists an opportunity to study natural forest succession and biodiversity in the unlogged areas.

I first visited the Rim fire area on May 1, 2014—the first spring after the fire, and shortly after the snow had melted. After months of relentless "catastrophic wildfire" messaging from the logging industry, the Forest Service, and many politicians, I was not sure what to expect. I spent an entire day driving and hiking through the southern and northern portions of the fire area, surveying the landscape that had almost universally been dismissed as a wasteland. Instead, I saw purple fields of native lupines and other wildflowers growing in the newly created snag forest patches. I

A field of purplish-blue lupines growing in snag forest habitat in the Rim fire area, 2016.

saw new shoots growing from the base of oak snags and tiny patches of native shrubs poking through the beds of ash. Conifer seedlings only two inches tall were already emerging from the blackened soil—pine, fir, and cedar. In some places, the conifer seedlings numbered dozens per acre; in other places, there were hundreds or more. It wasn't at all what I had been told to expect.

I kept returning to the Rim fire area year after year, often spending thirty or more field days there in a given season, taking photos and collecting data on postfire regrowth and wildlife. Each year I found the area transformed anew. Regenerating conifer and oak seedlings got taller and more numerous. The richness and diversity of birds continued to grow. Within a few years, the sheer abundance of native birds in the snag forest was astonishing. Sometimes I would stop collecting field data and just sit on a log and watch and listen as the woodpeckers hammered through charred bark and wood, feeding on meaty grubs, and the bluebirds flitted back and forth, helping themselves to the ample supply of flying insects attracted to the wildflowers and flowering shrubs. Black bears tore through downed logs to get beetle larvae and got fat on berry-producing shrubs before hibernating each winter. Pocket gophers multiplied, feeding off the roots and shoots of abundant new plant growth, and California spotted owls hunted the pocket gophers. Mule deer browsed on the patches of understory growth, and mountain lions fed their young by taking the occasional mule deer. And the wildflowers could take your breath away. It was paradise.

Contrary to the "carbon bomb" claim—that half the standing forest had been incinerated in the Rim fire—I found that the mature fire-killed trees were largely unchanged, structurally. The bark was blackened, and in some patches most or all of the needles and some small twigs had been consumed by the fire, but nearly all the carbon remained. These areas had been transformed from a mature forest into a snag forest, but none of them were barren wastelands.

I began looking into field-based scientific studies of similar fires. The most comprehensive research reported that, even in large, intense fires, only about 1 to 4 percent of the biomass (and carbon) in trees was actually consumed, on average.[2] Even in the highest-intensity fire patches, nearly all the tree carbon remained. Soon thereafter, a group of researchers published a study of moderate-intensity fire areas in the Rim fire and found that, on average, only one-tenth of 1 percent of the carbon in trees had been consumed.[3] There was, of course, a higher level of consumption of shrubs, needles, and twigs on the forest floor. Although most of this small-diameter material is consumed in fires, it accounts for only a small portion of the aboveground carbon in the forest. The great majority is in the trees.

How could the reality—proved by field research on multiple fires, including the Rim fire itself—be so different from the torrent of claims about whole trees being consumed and incinerated? It all came down to the models being used. The way science is supposed to work is that researchers gather real-world data and then create a model for some practical application that reflects those data. Sometimes researchers don't have any real data to work with, so they simply create models based on assumptions that seem to make sense or they use data from something that is similar but not the same. Sometimes these theoretical models are published in scientific journals and referenced repeatedly by others. Projections and estimates are made each year, and policies and public opinions are constructed and shaped around these models. Through repetition over time, mere assumptions acquire the aspect, but not the quality, of truth. When field-based studies are finally conducted and real data are collected, the new research is often ignored, and the old models are not fundamentally changed. In these circumstances, the scientific process doesn't work as it should.

As I looked into these questionable wildland fire models, I found that this problem is global. Around the world, government agencies use models that are built on false assumptions about the level of tree consumption in wildland fires—assumptions that often overstate carbon emissions fivefold, tenfold, or more. A model used by the Trump administration to estimate wildfire carbon emissions in the United States assumed levels of tree branch consumption eighteen times higher than actual levels from field studies, and it assumed levels of soil carbon consumption ten times higher than actual levels.[4] US government scientists have increasingly come under political pressure to inflate estimates of carbon emissions from fires so that political spokespersons can use these figures to downplay emissions from fossil fuel consumption while exaggerating those from fires to justify more logging.[5] Their position is based on the false notion that more logging will prevent fires and that removing increasing amounts of carbon from forests through logging will somehow magically result in more carbon in forests.

Another study used field plots to determine initial levels of forest carbon storage in California forests but then inexplicably failed to remeasure these plots to estimate the change in forest carbon over the ten-year study period; instead, the researchers made rough assumptions about changes based on satellite imagery.[6] Making matters worse, the study reported carbon values for only live trees, creating the false impression that the carbon in trees killed by fire or drought no longer exists in the ecosystem, and leading to the false implication that overall forest carbon levels had declined due to natural processes.

One US government modeling study claimed that, owing to recent fires and a four-year period of elevated tree mortality due to drought, California forests had changed from a carbon sink (absorbing more $CO_2$ than they emit into the atmosphere) to a carbon source (emitting more $CO_2$ than they absorb). The study assumed levels of live tree consumption more than fifteen times higher than the average values reported in field-based studies of actual wildland fires.[7] Remarkably, this theoretical modeling study was published several months after a comprehensive field study based on thousands of plots definitively proved that California's forests remain a large overall carbon sink.[8]

One particularly striking theoretical modeling study assumed that, on average, more than 50 percent of the carbon in trees was incinerated and consumed in the Rim fire. No field data were collected in the fire area, and it is unclear whether the authors even visited the Rim fire area. Based on the actual field data from the Rim fire in a subsequent study,[9] this theoretical model overstated the level of tree consumption in moderate-intensity fire areas by more than 500 times—an exaggeration of more than 50,000 percent.[10]

I found a similar problem with regard to the 2019–2020 Australian bushfires, many of which occurred in the forests and woodlands of southeastern Australia. By late January 2020, claims were being made that 900 million tons of $CO_2$ had been emitted—more than Australia's carbon emissions from energy usage in an average year, supposedly. I tracked down the source of this estimate, which assumed a level of tree consumption dramatically higher than actual consumption levels found in field studies of wildland fires—an order of magnitude higher, in fact.[11] These overestimates of tree consumption by fires are also being applied to support wildfire emissions claims in the boreal forests of Asia and North America and the woodlands and forests of Africa and South America.

Alarmingly, these faulty models are the basis for reports released by government agencies every year; consequently, they become the basis for global public opinion about carbon emissions from such fires. Even the more conservative theoretical wildland fire combustion models result in a twofold or threefold overstatement of carbon emissions, while the exaggerations in others vastly exceed this. With this sort of pervasive misinformation, it is no wonder that so many people are confused about our forests' potential to mitigate the climate crisis. If the public is being told, incorrectly, that large portions of standing forests are being turned into ashes and greenhouse gases, it is understandable why many people doubt the effectiveness of natural climate solutions—that is, protecting natural habitats, especially forests, to absorb more $CO_2$ and draw down the dangerously high levels in the atmosphere.

As I thought more about this startling problem, I realized there is an even deeper issue: the models are focused on emissions from fires and generally don't take into account postfire regrowth rates. In other words, for all practical purposes, they assume that vegetation doesn't regrow after fires. But forests are not like coal mines or oil wells. Once the fossil fuels are extracted, mines and wells do not regrow coal and oil. Forests, on the other hand, respond within days or weeks after a fire passes, absorbing an accelerating amount of carbon from the atmosphere and storing it in the new, rapidly growing postfire shrubs and trees. This process is aided by the nutrient-rich bed of mineral ash, which spurs and enhances carbon sequestration long thereafter.[12]

By failing to account for postfire regrowth and carbon sequestration, emissions models create a false narrative—one that misleadingly implies that carbon is emitted in fires but is not later reabsorbed. In reality, even large, intense forest fires like the nearly 500,000-acre Biscuit fire consume only about 11 percent of the total carbon in the forest (this includes the very small amount of tree carbon consumed, portions of saplings and shrubs, and twigs, needles, and downed wood on the forest floor).[13] Because of this low rate of carbon consumption, along with the fire-caused release of nutrients that stimulates rapid and abundant forest regrowth, within a decade or less after a fire, the forest will have pulled more carbon out of the atmosphere than was emitted.

For example, researchers found that the 2002 Biscuit fire emitted an average of 7.7 tons of carbon per acre,[14] and the decay of fire-killed trees in the Biscuit fire emitted an average of 0.3 ton of carbon per acre each year over the first ten postfire years.[15] There were even lower emissions from decay in subsequent decades, and it takes many decades, sometimes a century or longer, for snags and large downed logs to fully decay. Therefore, for the first ten postfire years, total carbon emissions from the Biscuit fire (from the fire itself and from subsequent decay) were 10.7 tons per acre. Others have reported that, by only five years after a fire, regrowth pulls 1.3 tons of carbon per acre out of the atmosphere each year.[16] Therefore, by ten years post fire, approximately 13 tons of carbon have been pulled out of the atmosphere by regrowth—an overall net increase of 2.3 tons of carbon per acre relative to prefire levels. By twenty years after a new stand of forest is initiated by intense fire, natural regrowth absorbs more than 2.2 tons of carbon per acre each year.[17] This strong postfire regrowth facilitates an overall net increase in carbon storage and an overall reduction of atmospheric carbon. In fact, large mixed-intensity wildland fires are essential to maintain and increase forest carbon storage; if forests go too many centuries without experiencing such fires, nutrients become less and less available, and forests transition to woodlands and then to shrub habitats or grasslands.[18]

Many people broadly understand and accept that new forest growth naturally occurs after fires, but the "carbon bomb" narrative would have us believe that this is not the case in large high-intensity fire patches that may cover hundreds or thousands of acres. In such areas, as the narrative goes, the soils burned too hot to support new growth, and there are no surviving trees to provide seed sources within several hundred feet in any direction. The assumption is that, in these places, the forest will not naturally regenerate or it will take many decades or longer for conifer seedlings to begin to grow.

Based on this narrative, the US Forest Service hatched a plan to implement a large second wave of postfire logging of snag forest in the Rim fire area. Because of delays due to a lawsuit, about two-thirds of the snag forest the Forest Service had initially intended to cut was no longer commercially viable. Fire-killed conifers slowly decay, and by three years post fire, the standing dead trees had decayed to the point that they were no longer usable as lumber for structural purposes. Still determined to clear-cut much more of the snag forest, the Forest Service switched tactics and colluded with the State of California to seek a $28 million grant from the US Department of Housing and Urban Development (HUD). The HUD funds were supposed to help stricken communities rebuild following hurricanes or wildland fires. Instead, the Forest Service and the state intended to use the funds to subsidize additional clear-cutting of thousands of acres of intact snag forest within the largest high-intensity fire patches on public lands, spray huge amounts of the carcinogenic herbicide glyphosate, and establish dense tree plantations.[19]

In some areas, the plan was to use the funds to pay contractors to fell the snags, bulldoze them into giant piles, apply large quantities of accelerant, and incinerate the forest on-site. However, in the highest-quality snag forest habitat—areas with the most biomass and highest densities of large snags—the plan was to clear-cut the snags, grind them into wood chips, and haul thousands of truckloads to commercial biomass power facilities to incinerate for energy production. This became known as the "clear-cuts for kilowatts" plan. In 2018 the Trump administration approved the use of HUD funds for this scheme and made it clear that increased "biomass logging" in national forests and on other federal public lands was the goal.

To promote this plan in the Rim fire area, the Trump administration claimed there was "little to no" natural postfire conifer regeneration in these large high-intensity fire patches and that, unless tree plantations were established to "reforest" these areas, they would not regenerate for decades to centuries.[20] Administration officials claimed that the snag forest would reburn almost exclusively at high intensity in the next fire, so it had to be clear-cut ostensibly to reduce fuel and prevent high-intensity fire from burning the tree plantations planted after clear-cutting. The fuel-reduction aspect of the administration's argument was obviously just political messaging, given that scientific studies had already proved that if high-intensity fire areas reburn, they experience mostly low- to moderate-intensity fire effects.[21] But the claim that these large patches of snag forest habitat lacked newly regenerating pine and fir seedlings was another matter. That had to be investigated the hard way.

From the spring through fall of 2018, my colleagues and I gathered field data throughout the thousands of acres of snag forest threatened by this clear-cutting plan. We utilized the same plot locations used by the Forest Service years earlier, shortly after the Rim fire. The plots were arranged on a grid, spaced by 200 meters (656 feet). When the Forest Service conducted its surveys in 2014 and 2015, it used tiny plots—just one-fiftieth of an acre. Based on those surveys, the Forest Service claimed that the large high-intensity fire patches were almost completely devoid of natural conifer regeneration; any regeneration that was occurring was limited to smaller high-intensity fire patches or areas very close to live trees at the edges of larger high-intensity fire areas. We were concerned about the tiny plot sizes, since it is easy to miss conifer seedlings when plots are so small, so our plots were thirty-five times larger than those used by the Forest Service.

The results were shocking. About 40 percent of the Forest Service's plots were not even located in conifer forest. Many of them were in areas that had been intensively logged decades earlier, long before the Rim fire, and the earlier logging had done so much soil damage that no pine, fir, cedar, or other conifers had grown there since that time. They had been deforested by past logging. Many other Forest Service plots were in the middle of logging roads that were largely bare dirt, and some were located on paved roads. Others were on solid granite rock outcroppings or in the middle of streams or rivers; still others were located in very young tree plantations where the trees were not old enough to reproduce (and therefore could not be expected to regenerate).

In the remainder of the Forest Service's plots—in actual snag forest habitat—we found tremendous natural forest regeneration at five years post fire. Ninety-seven percent of these plots contained natural conifer regeneration, most of which had occurred after the Forest Service's 2014–2015 surveys.[22] In some cases, the young, postfire conifer forests were already more than six feet tall by 2018, and regenerating trees were more than eight feet tall in certain areas. The regrowth in these large high-intensity fire patches comprised mostly pine species (which have declined in recent decades in some areas of the Sierra Nevada), contrary to the Forest Service's predictions. There was no distance from live, surviving trees beyond which natural conifer regeneration did not occur. Even more than 1,000 feet from the nearest surviving tree, there were more than 100 new conifer seedlings and saplings per acre, on average. In closer proximity to surviving mature trees, the density of regenerating conifers was even higher.

Excited by our findings, we brought this new information to the at-

*Top:* Vigorous postfire regeneration deep in a large high-intensity fire patch in the Rim fire area in 2019, where federal and state agencies falsely claimed that little or no regeneration existed. *Bottom:* Five years after postfire logging, this area is still deforested, composed largely of bare ground and cheatgrass—a combustible, invasive grass spread by logging.

tention of the Forest Service, HUD, and the California agencies involved in the Rim fire logging project, but they ignored our data and refused to withdraw their decision to clear-cut the snag forests. Wildlife ecologists and climate scientists joined with conservation groups and filed a lawsuit in federal court against the Trump administration and the State of California, alleging that they ignored important new scientific information and that the planned clear-cutting would not only destroy the newly regenerating forest but also worsen climate change by needlessly incinerating millions of trees and pumping millions of tons of $CO_2$ into the atmosphere.[23]

While the court was considering the lawsuit in 2019, and despite opposition by hundreds of US scientists,[24] the Trump administration moved ahead with its clear-cuts–for–kilowatts project. Some large areas of the snag forest were destroyed by logging before the snow began to fall and shut down operations for the year, and postfire logging continued in 2020. But the remaining unlogged snag forest areas stand as a living testament to the inspiring resilience and beauty of nature. By its very existence, it refutes claims by the Trump administration, the Newsom administration in California, and the logging industry that these large high-intensity fire patches are barren wastelands that are incapable of regrowing.

After our field surveys in the Rim fire area in 2018, I started looking more closely into published studies of natural conifer regeneration in large high-intensity fire patches. None of them exclude areas of nonforest from their data sets, which creates a major bias. In addition, nearly all of them use field plots that are far too small to be meaningful—often 1/70th of an acre or, in one case, a mere 1/300th of an acre to determine the density of postfire conifer seedlings.[25] These studies were all funded by the Forest Service and were generally authored by Forest Service employees. Predictably, each one reported that the majority of plots in high-intensity fire areas lacked conifer seedlings or saplings, misleadingly implying that large portions of these high-intensity fire areas had been "deforested." But when plots are so small, a large portion of them are guaranteed to lack regenerating conifers, even if there are 100 to 200 new conifer seedlings and saplings per acre in that area. I have gone to the high-intensity fire areas in these studies, and that is exactly what I found: areas of abundant and vigorous natural conifer regrowth where the studies deceptively claimed that little or no regeneration existed.[26] For example, in the plots deepest in the interior of the largest high-intensity fire patches in the Rim fire area—more than 1,000 feet from the nearest surviving tree—we found that the tiny Forest Service plots overstated the proportion of the landscape that lacked natural conifer regeneration *sevenfold*.[27]

In one Forest Service–funded study of postfire conifer regeneration, the authors claimed that recent fires led to lower levels of conifer regeneration than older fires, suggesting a downward trend in forests' ability to regenerate after fires.[28] However, the older fires were field-surveyed an average of nearly two decades afterward, while the more recent fires were surveyed only eight or nine years post fire. This created a large bias in the results because postfire conifer regeneration occurs in stages over the course of two decades or more, with more regeneration occurring each year. The authors of the study acknowledged the importance of time for conifer regeneration, and they even presented data showing that only about half the natural conifer regeneration occurs by nine years post fire (most of the remaining regrowth occurs between nine and twenty years post fire). Remarkably, despite these admissions, the study's results did not take time since fire into account.

A subsequent study coauthored by Forest Service scientists and funded by the US Department of Agriculture (USDA) claimed that high-intensity fire is causing a lack of natural conifer regeneration in ponderosa pine and Douglas fir forests. The authors speculated that this could "lead to ecosystem transitions in low-elevation ponderosa pine and Douglas-fir forests across the western United States."[29] They implied that high-intensity fire patches are causing a conversion to nonforest, or deforestation. Some of the authors generated news coverage, spreading a version of this message and promoting logging under the guise of fuel reduction.[30] However, the reporters apparently did not read the study itself, which plainly states that all the field plots had naturally regenerating ponderosa pine and/or Douglas fir seedlings or saplings, and Douglas fir regeneration was actually *highest* in the high-intensity fire patches. Although the study found somewhat less ponderosa pine regeneration in high-intensity fire areas relative to lower-intensity areas, the levels of ponderosa pine regeneration were still quite high—averaging more than a dozen new seedlings per acre *each year* after high-intensity fire. The results of this study directly and strongly contradicted the political messaging being promoted by some of the authors.

In another recent development, a logging industry advocacy group posted on its website a claim that national forests have become carbon sources due to fires and bark beetles and that twice as many trees are dying than are growing, citing a USDA report as evidence. The pro-logging group used this claim to suggest that environmental protections for public forests should be weakened and logging dramatically increased, ostensibly to save forests and prevent tree and carbon losses. Pro-logging members of Congress began to take up this claim, with the climate-change deniers among them warning about carbon bombs from forest fires and bark beetles. Soon thereafter, a speaker affiliated with the logging industry was invited to a congressional hearing to give testimony on this subject. She echoed the claim of the logging industry advocacy group, but it was all based on a simple falsehood: the pro-logging group misrepresented the tree-growth figure from the USDA report. The figure actually pertained to "net growth"—that is, total tree growth minus tree mortality from logging, fire, and insects—and the net growth figure was positive and substantial, meaning that the national forests are a significant carbon sink, not a carbon source.

If forest fires and other natural events aren't the carbon bomb" that so many dishonest or misguided politicians and agency officials claim them to be, what is the real carbon bomb? Consider this: removing trees from the forest and incinerating them for energy in biomass power facilities emits even more $CO_2$ than burning coal, for equal energy produced.[31] In fact, the emissions are about 65 percent worse than those from a modern coal plant.[32] Wood, it turns out, is a particularly dirty fuel in terms of polluting the atmosphere with carbon emissions. Fossil fuels are, of course, extremely dirty and have low combustion efficiencies, but wood is considerably worse. Its low combustion efficiency is exacerbated by its higher moisture content than other fuels; even dried wood pellets contain much more moisture than coal, and attempts to create drier wood pellets consume a substantial amount of energy, making matters worse.

The biomass logging industry is always ready to spin facts and evidence, contorting them into wild configurations to deny the basic realities of climate science. In one recent propaganda report prepared by scientists at the University of Georgia's commercial logging program and the US Forest Service under the Trump administration, biomass logging advocates misleadingly claimed that incinerating trees for energy produces much less $CO_2$ than burning fossil fuels.[33] The report cited several articles published in logging industry journals to support this claim. But you have to read the fine print, so to speak. It turns out that this claim is based on the assumption that the forests cut down and incinerated for biomass energy production will grow back near the end of the twenty-first century or later, and by then, they will have reabsorbed the carbon emitted from the present-day incineration of these forests. But there are numerous serious problems with this claim.

Most notably, the climate crisis is happening now, and we have precious little time to move beyond carbon-polluting fuels and draw down the already dangerously high levels of atmospheric carbon. We cannot afford to engage in biomass logging and pump even more carbon into the atmosphere. In addition, the biomass logging industry fails to mention that, by removing vital nutrients in trees and compacting soils with heavy machinery, logging substantially reduces the carbon sequestration and storage capacity of the forest. Logging-related soil compaction alone can reduce forest carbon sequestration and storage capacity by 30 percent, and reductions of 50 to 75 percent sometimes occur.[34] Carbon sequestration and storage capacity losses of an additional 15 percent or more can result from nutrient removal from the ecosystem.[35]

With regard to logging for lumber products, the logging industry self-servingly claims that it is mitigating climate change by storing carbon in wood products within residential and commercial buildings. In particular, logging interests have tried to advance this notion with regard to engineered wood products such as "cross-laminated timber" (CLT), also known as "mass timber." The industry would like the public to believe that logging our forests to make CLT and other lumber products and constructing tall buildings from these materials are somehow "climate friendly." This is profoundly misleading. Scientific studies have found that only about one-fifth of the wood in trees removed by logging makes its way into lumber products that temporarily store carbon in buildings.[36] The branches and treetops are either incinerated in logging "slash piles" or burned in biomass power plants, and about half the carbon in a tree trunk is lost as manufacturing or milling waste and is typically incinerated for energy at lumber mills, sending even more carbon into the atmosphere.

Some reports funded by the logging industry claim that wood products, including CLT, lead to fewer carbon emissions overall, based on the assumption that logging prevents high-intensity fire and that 30 percent of the carbon in trees is consumed when fire occurs.[37] However, as discussed earlier, logging tends to increase, not decrease, fire intensity, and typically only 1 to 4 percent of tree carbon is actually consumed in forest fires, not 30 percent.

Importantly, in the forests of the United States, logging causes ten times more $CO_2$ emissions than the *combined* emissions from wildland fires and tree mortality from drought and native bark beetles.[38] And unlike logging, which reduces forest carbon sequestration and storage capacity through nutrient removal and soil compaction, fire and beetles help cycle nutrients in the ecosystem, increasing the availability of essential elements and increasing future carbon sequestration capacity.

Overall, logging in US forests causes 617 million tons of $CO_2$ emissions each year,[39] with an additional 106 million tons of indirect $CO_2$ emissions due to transportation associated with logging.[40] Moreover, while US forests sequester 1.66 billion tons of $CO_2$ each year, logging is preventing that figure from being at least 30 percent higher because of logging-related soil damage and nutrient removal and the conversion of mature forests to young tree plantations.[41] The overall impact of logging in US forests is more than 1 billion tons of $CO_2$ each year, or about the same as the overall effect of coal production. There is no question that the real carbon bomb is logging.

The notion that we must actively shift away from wood consumption in the United States and around the world may seem quite bold to some. But top climate scientists and ecologists say that this is essential to overcome the climate crisis.[42] Moreover, not so long ago the notion of moving beyond fossil fuel consumption seemed radical and unthinkable.

Now it is a widely articulated global objective among many nongovernmental organizations and prominent elected officials. The truth is that there are many good alternatives to wood for building materials, paper, and energy. We must recognize that, to avoid the worst impacts of climate change, we need to transition away from *both* fossil fuels and wood. We need to muster the political will to change.

# 6

# The Economics of Deceit

The nearly 17,000-acre Star fire occurred in the late summer of 2001 in the Eldorado and Tahoe National Forests. My wife, Rachel, and I had just bought a house not far from there on the western slope of the northern Sierra Nevada, and soon after we moved in, the Eldorado National Forest proposed a large postfire timber sale, including numerous huge clear-cutting units within two occupied California spotted owl territories. At the time, I was unaware of how harmful the postfire logging of snag forest can be for spotted owls. Instead, my focus was on conserving the dense stands of mostly live, green trees that the imperiled owls use for nesting and roosting. My nonprofit conservation organization, the John Muir Project (JMP) of Earth Island Institute, submitted comments to the Forest Service, urging the agency to refrain from logging surviving trees—those with any green needles remaining—within the spotted owl territories. The Forest Service agreed and signed a document stating that it would not remove any trees with green needles.

On the surface, we should have been satisfied, but something wasn't right. The Forest Service's main fire-intensity map showed that 35 percent of the Star fire area had experienced high-intensity fire that killed all or nearly all the trees. However, the Forest Service's final environmental impact statement claimed that 71 percent of the fire had been high intensity. It included a map of these high-intensity fire areas and claimed that no green foliage remained there—0 percent green needles. But many of these same areas had been labeled low or moderate intensity on the other map. We realized that these newly designated high-intensity fire areas included several hundred acres within two spotted owl territories: the Chipmunk territory and the Red Star territory. The discrepancy between the two maps was significant. The change in categorization from low or moderate intensity to high intensity meant that these several hundred acres in the heart of spotted owl territory would be clear-cut, and logging was expected to begin during the 2002 nesting season.

Confused and concerned, we contacted Monica Bond, a spotted owl biologist who was doing owl surveys in the area, and asked her to join us for a visit to the Star fire area. As we drove and hiked through the high-intensity fire areas mapped by the Forest Service, our confusion grew. Contrary to the Forest Service's claims of no surviving trees and no green needles, we found old-growth mixed-conifer forest stands with only light charring on the lower trunks of the mature and old trees. Most of the smallest trees had been killed, but the vast majority of the larger trees had deep green crowns full of live, healthy needles. At first, we thought we might have navigated incorrectly, and we kept checking our maps to verify that we were in the right place. We were. There was no question about it. In stand after stand, we found that most of the trees were alive. But the postfire logging project was about to clear-cut these areas based on the claim that there were zero live trees.

We spent days taking field notes and photographs, extensively documenting the large areas of live, old forest where the Forest Service and the logging industry claimed none existed. At one point, a logging crew attempted to block our access to an old-growth forest stand with a tractor, but we drove off the dirt road, bumping over slash debris and ruts and maneuvering around the tractor. Despite our irrefutable photographic evidence, the Forest Service would not budge. It was intent on proceeding with its clear-cutting project in these lightly burned old-growth forest stands within spotted owl nesting territories. The Forest Service stood to generate substantial revenue from this timber sale, since it is allowed by law to keep 100 percent of the profits from timber sales if the cut trees are categorized as "dead." Millions of dollars were at stake.

With no other options, JMP joined with the Center for Biological Diversity and filed suit against the logging project. A conservative district court judge ignored the evidence we submitted, so we went to the federal appeals court and submitted more than 200 color photos showing live, green forest stands in areas where the Forest Service claimed there were no live trees and zero green needles. The appeals court ruled in our favor and expressed concern about the wide gap between the Forest Service's claims and the actual on-the-ground evidence submitted by independent scientists. There would be no logging of live trees in the fire area.[1]

While this was happening in the southwestern part of the Star fire area in Eldorado National Forest, Tahoe National Forest was simultaneously proposing a large postfire timber sale in the northeastern part. Several additional spotted owl territories were proposed for clear-cutting within a large roadless area that was a candidate for designation as a wilderness area. The Forest Service argued that it needed to extensively clear-cut this roadless area because the forests within the large high-intensity fire patches would not regenerate within a human lifetime or longer. In addition, the Forest Service wanted to reduce "fuel" to prevent another intense fire from killing the tree plantations it intended to create in the clear-cuts.

We decided to see the area for ourselves. Deep in one of the most remote areas of Tahoe National Forest is the Duncan Canyon Roadless Area, off a backcountry route called Mosquito Ridge Road. Leaving the car behind, we began to hike, gently climbing at first and then descending into the canyon bottom. This was forest primeval. It had never been subjected to logging or road building—a rarity in the forests of the northern Sierra Nevada. We walked past sugar pines and incense cedars more than six feet in diameter and hundreds of years old. The Star fire had created a beautiful mosaic of mixed-intensity fire effects in the roadless area, and in the high-intensity fire patches conifer seedlings were already regenerating—hundreds per acre in most places. The array and abundance of birds and other wildlife were impossible to ignore.

Upon our return, we dug deeper into the documents related to the proposed logging project in Tahoe National Forest and discovered that the intention was to remove the enormous burned trees by the thousands and leave behind the kindling-like slash debris from logging—the unmerchantable branches and treetops of no economic value. In fact, records showed that, after removing the essentially noncombustible large tree trunks, the Forest Service intended leave several dozen tons of slash per acre in this so-called fuel-reduction project—levels of logging debris that its own documents classified as an "extreme" fire hazard.

JMP went back to court to stand up for science, joined by the Sierra Club, the Center for Biological Diversity, and others. The federal judge was in disbelief. At the hearing, he asked the Forest Service's lawyer if the agency really intended to stand by its story about fuel reduction. Yes, the judge was told, that was the Forest Service's story, and it was sticking to it. Not long thereafter, the judge issued his opinion, finding that the Forest Service had misrepresented the science and that there was no rational connection between its fuel-reduction claims and the proposed logging plan. Under a key federal law known as the National Environmental Policy Act (NEPA), federal agencies must candidly disclose scientific evidence of potentially adverse environmental impacts, and agencies are not supposed to misrepresent evidence or attempt to justify projects based on claims that are clearly contradicted by the science. In other words, federal agencies are supposed to tell the public the truth. Although the snag forest habitat created by the Star fire outside of the roadless area had already been logged by then, the court issued an injunction halting logging just before the chain saws and tractors reached the Duncan Canyon Roadless Area.[2]

The Duncan Canyon case became a national precedent for the protection of roadless areas from logging. Other, even larger postfire logging project proposals were withdrawn, including an enormous one that would have extensively clear-cut three roadless areas in the McNally fire area in Sequoia National Forest. This development gave me and dozens of other ecologists an opportunity to study how primary forests respond to large mixed-intensity fires in the absence of logging. The roadless areas became natural laboratories for scientific discovery, including research on natural postfire succession (natural forest regeneration), habitat selection by imperiled wildlife species, biodiversity of postfire habitat, and postfire carbon sequestration. I later published three studies based on field research in the Duncan Canyon Roadless Area that would not have been possible if the area had been logged.

In 2019 I revisited the Duncan Canyon Roadless Area with some Sierra Club staff and interns, hiking to the bottom of the canyon as I had done many dozens of times in previous years. However, it had been quite a while since I had visited this area, and I was curious to see the snag forest habitat that had been spared from clear-cutting by the court's decision. Nearly two decades after the Star fire, most of the larger snags remained standing, dotted with woodpecker nest cavities and thousands of holes drilled by the birds to get at the wood-boring beetle larvae. The naturally regenerating forests were growing beautifully, reaching far above our heads, with a mix of ponderosa pine, sugar pine, white fir, incense cedar, and black oak, interspersed with patches of native shrubs. In some places, the young forests were already more than twenty-five feet tall where, years earlier, the Forest Service and the logging industry had claimed little or no forest would grow.

It was a reminder of the importance of humility with regard to nature—something that is profoundly lacking in today's command-and-control approaches to forest fires. It has somehow slipped our minds that mixed-intensity fires have been occurring in forests around the globe for more than 300 million years. Countless cycles of intense fire and forest rejuvenation have occurred since the age of the dinosaurs. Forests do not need our "help" after fires, but logging companies the world over profit enormously from the industrial logging of both postfire forests and unburned forests under the guise of fire prevention or "forest health." This pattern is actively and often aggressively promoted in numerous nations by land management agencies that either profit directly from commercial logging operations or benefit indirectly in the form of large sums appropriated to these agencies to engage in logging. In Canada, it is the Canadian Forest Service. In Australia, it is the Australian Department of Agriculture. In the Amazon, efforts by Brazil's regulatory agency to halt illegal deforestation were severely defunded under the right-wing Bolsonaro administration. After Brazil's Forestry Commission was moved from the Environment Ministry to the pro-logging and pro-ranching Agriculture Ministry, deforestation levels skyrocketed. The list goes on and on. These twentieth-century policies must change if we are to meet the existential twenty-first-century challenges posed by the climate and extinction crises. This will require a shift in political will and new legislation and policies, since existing environmental laws are woefully inadequate.

An example of the insufficiency of existing environmental laws and

Natural forest regeneration in large high-intensity fire patches eighteen years after the Star fire, where the Forest Service claimed no regeneration would occur.

how financial incentives can influence disclosure of the truth was on display in the US Forest Service's initial logging plan after the 2013 Rim fire in the Sierra Nevada. In 2014 the Forest Service proposed to log more than 20,000 acres of snag forest habitat and, once again, pocket the revenue from the timber sales. When JMP and others raised serious concerns about the harm to California spotted owls from the planned clear-cutting, the Forest Service responded that the logging would be heavily concentrated in the more intensely burned owl territories—generally those with 35 percent or more high-intensity fire. The Forest Service claimed that in these territories, especially those with more than 50 percent high-intensity fire, the Rim fire had simply killed too many trees and the territories would no longer be occupied by spotted owls. The Forest Service downplayed the potential adverse impact on spotted owls by arguing that the bulk of the logging would occur in places the owls likely no longer existed.

JMP worked with Monica Bond and Derek Lee, two of the top scientists studying the relationship between spotted owls and wildland fire, to look into the situation more closely. We knew that the Forest Service itself conducted annual surveys of California spotted owl occupancy, and we wondered why its logging proposal made no mention of such surveys. On a hunch, we investigated and found that extensive spotted owl occupancy surveys had been conducted throughout the Rim fire area in the spring and early summer of 2014. With significant effort, we managed to obtain a copy of these 2014 owl survey results, and they bore no resemblance to statements made in the Forest Service's logging proposal.

Contrary to claims that the owls had been extirpated from the territories with substantial high-intensity fire, we found that nearly all these territories were occupied by spotted owls, and in some cases, new chicks were already in their nests. Spotted owls move around from year to year and do not always occupy the same nest territory from one season to the next. For this reason, it is common for only 60 to 70 percent of the territories to be occupied in any given year. In 2014, the year after the Rim fire and before postfire logging had started, California spotted owl occupancy was around 90 percent, including in the territories with *mostly* high-intensity fire effects. We could not recall any recent reports of higher levels of California spotted owl occupancy anywhere.

We sent our analysis and summary of these data to the Forest Service, but, as in the past, the agency was committed to its logging project, the revenue it promised to bring, and the narrative chosen to promote it. We went to court again, joined by the Center for Biological Diversity and the California Chaparral Institute. We focused on the major discrepancy between the Forest Service's statements to the public and the dramatically high levels of California spotted owl occupancy documented by the agency's own biologists. No one could dispute the fact that the Forest Service's narrative could not be squared with the scientific evidence—not the Forest Service, not the logging industry, and not the court. But it didn't matter. Even though the Forest Service had lied to the public and deliberately concealed important data that contradicted its justification for the logging project, a conservative judge ruled that courts are bound to give "deference" to federal agencies, and a conservative appeals panel deferred to the district court judge. After the temporary delay while the case made its way through the courts, logging was executed within dozens of spotted owl territories, and the owls were extirpated in the more heavily logged areas. Decay of the snags later halted further logging, at least for a while, since decayed wood cannot be used for structural lumber.

After too many right-wing ideologues being appointed to the bench by Republican administrations and too few judges willing to uphold environmental laws being appointed by Democratic administrations, the federal judiciary is now heavily populated by judges who blindly defer to any agency decision that prioritizes commerce over the environment. Environmental and climate justice organizations often know a case will be lost as soon as the judge is assigned, long before the first legal brief is filed. The story is similar in many nations around the world. Environmental laws, often created in the late twentieth century, are not equal to the task of managing the myriad threats and challenges posed by the extinction and climate crises, and pro-development judges take advantage. Voters need to take matters into their own hands to shift political realities toward bold actions and real climate and biodiversity protection solutions. They must reject lesser-of-two-evils politics and work to defeat at the ballot box politicians who lack the courage or conviction to advance real change.

In the United States, it has become increasingly difficult to uphold environmental laws and defend scientific integrity in the courts, but it remains important work. Environmental cases sometimes succeed, despite the troubling changes in the judiciary. Because the underlying problematic laws have not changed for the better, federal land management agencies like the US Forest Service are still willing to deceive the public to justify new commercial logging projects. A recent example underscores this point.

In the national forests of Southern California, there has been no commercial logging program for nearly half a century. Society changed, and values changed. Over the decades, people of all ethnicities, ages, and socioeconomic levels in the Greater Los Angeles area increasingly turned to the national forests as special places for recreation and spiritual rejuvenation. The local units of the US Forest Service in Southern California changed too—not completely, but substantially. Many mature and old-growth forests are located in the mountains of Southern California within the national forests, and the logging industry has long been waiting for an opportunity to profit from them. Early on, the Trump administration vocally signaled its intention to increase logging on public lands, and soon thereafter, two adjacent logging projects were proposed in Los Padres National Forest, just northwest of Los Angeles. The Forest Service claimed that the Cuddy and Tecuya projects were needed to prevent intense wildland fires and restore "forest health." Several hundred acres of mature and old-growth forest were slated for commercial logging. If these projects were carried out, they would lead to the first timber sales in Los Padres National Forest since the 1970s.

Alarmingly, the Forest Service claimed that it could exempt these proposals from the usual environmental analysis and public comment and participation in order to fast-track the logging. Local conservation and community groups were concerned, given that the plans included the logging of hundreds of acres in a roadless area and in dozens of roost sites of the critically endangered California condor. There was no size limit on the trees to be marked for removal, so old-growth trees—some of them eight to twelve feet in girth—were at risk of being felled and hauled to the nearest lumber mill. In the mountain communities of Frazier Park and Cuddy Valley, most residents were also concerned about the emerging science indicating that logging was likely to increase the speed and intensity of forest fires adjacent to homes—science the Forest Service ignored.

The Forest Service and the logging industry claimed that these projects were necessary because the forests were dangerously overgrown. They stated in project documents that current forests have five times more trees per acre than historical forests, pointing to recent field plot data collected. This was a compelling argument to many. Although the local community did not understand the rationale for removing large old trees, the statement that the forests were much denser than they were a century ago raised eyebrows.

Having been misled before, we decided to investigate the Forest Service's claim about tree density and found that the agency had lied again. The historical study included only native tree species that were valuable for lumber and excluded the far more common pinyon pines and oaks. It also excluded sapling-sized trees. In contrast, the Forest Service's current surveys included all tree species as well as saplings. In other words, it was a classic "apples to oranges" comparison. When we made a proper assessment—comparing tree species and sizes recorded in the historical study to the same species and sizes in the current surveys—we found that current forests are somewhat *less* dense than historical forests. We sent this information to the Forest Service, with the same predictable result. The agency never even responded. So JMP went to court again in 2019, joined by Los Padres ForestWatch, the Center for Biological Diversity, and Mountain Communities for Fire Safety, which was the lead plaintiff against the Cuddy logging project. At the time of this writing, the lawsuits against the Cuddy and Tecuya logging projects are still in progress, on appeal, with the outcomes yet to be determined.[3]

The conflict of interest in the Forest Service pervades not only management decisions on the ground but also the science produced by the agency. In one example, the Forest Service hired university scientists to conduct research on California spotted owls, but the scientists were contractually obligated to make public statements claiming that the Forest Service's forest management policies were "contributing to the viability of the California Spotted Owl." The Forest Service also retained the right to have editorial input into press announcements about the results of the scientists' research. At least one of the scientists was prohibited from producing research or making public statements that could be interpreted as critical of the Forest Service's logging program.[4]

My interactions with one Forest Service district ranger were particularly telling. We met at an event and struck up a conversation about forests, fire, and climate. He was intrigued and asked me to send him a whole series of scientific studies on various topics, which I did. After reading the research, he wanted to talk more, so we met at a local brew pub and discussed science for hours over beers. He requested additional information, and I sent along more studies. Weeks later, we met again at the pub, and he asked me why I believed the Forest Service's forest management policies were inconsistent with current science. After about five minutes, he waved his hands and said, "Okay, I've heard enough." I thought he was being dismissive, but I was wrong. He said, "I've read everything you sent me. I've heard what you have to say, and I agree with you. There are a few minor things I might quibble about, but basically, I think you're right. So here's my question to you: how do I make as many changes as I possibly can without getting fired?"

We spent the next two hours talking about just that, and he made good on his promise. For the next three years, this district ranger shifted strongly away from logging and toward a management approach that allowed more lightning strikes to burn in remote forests for the benefit of wildlife habitat. He promoted projects to remove small trees immediately adjacent to homes, rather than logging mature and old trees in remote wildlands and misleadingly characterizing such projects as fire management and community protection measures. He refrained from proposing postfire timber sales when wildland fires occurred. He and I met periodically, always over beers at the brew pub, to catch up and continue our conversation. But it did not last long. After a few years, his shift in forest management policy attracted attention. Commercial timber output was down, relative to expectations from above, and his embrace of the ecological value of mixed-intensity wildland fire and snag forest habitat was not welcomed at higher levels of the agency. He was forced to step back in line, and logging resumed.

Forest Service staff, including scientists, feel constant pressure to maintain the agency's political and economic narrative that demonizes wildland fire and promotes logging. Examples of rebellion are rare, but it occurs occasionally. In one prominent case, a small group of agency-funded scientists wrote an article recommending that more fires be allowed to burn, especially "managed wildfire"—that is, allowing lightning ignitions to develop into mixed-intensity fires to reap the ecological benefits. The scientists recommended that mechanical forest management, including thinning, should be limited in scope and implemented primarily near homes. Perhaps most unforgivably from the standpoint of the Forest Service, they noted that managed wildfire is much less expensive than mechanical thinning and provides ecological benefits that thinning does not. The Forest Service told the scientists not to publish their study and even tried to pressure the scientific journal to cancel publication of the article. In this case (unlike so many others), the scientists held firm, as did the journal, and the article was published—but the Forest Service prohibited the scientist who led the study from discussing it publicly.[5]

Despite its behavior, the truth is that the US Forest Service, like similar agencies around the world, is not a monolith. In fact, there are many good, decent people who care about forests, climate solutions, and wildlife on the agency's staff. That's not the problem. The problem is the system that governs the Forest Service and agencies like it—an outdated system of laws built on a bygone set of values, a system that financially incentivizes land managers to prioritize logging above all else and to promote and perpetuate false and deceptive public narratives to justify that logging. In short, it is a system that forces good people to behave badly, and it needs to change.

For this to happen, we must recognize that the logging industry is a major global contributor to the climate crisis, just like the fossil fuel industry is. Entities involved in logging, including agencies that profit or otherwise benefit from it, are actively misleading the public and denying climate science to continue business as usual or expand climate-harming activities that also threaten biodiversity, just as the fossil fuel industry is doing. Climate and conservation nongovernmental organizations, policy makers who care about the earth, and environmental journalists need to understand this reality for positive change to occur.

We are not there yet, however. Imagine if prominent environmental and climate justice organizations actively collaborated with scientists and representatives paid by multinational oil companies or the coal industry to perpetuate fossil fuel extraction. It is unthinkable. It is equally unthinkable that, in a story about climate change, environmental journalists would quote scientists employed by the fossil fuel industry as if they were on equal footing with independent scientists who are not funded by the industry's money. We all recognize that scientists and other representatives of the fossil fuel industry are paid to promote the industry's commodity extraction agenda and to spin or hide evidence in ways that are financially advantageous to the industry that employs them. Society as a whole, and journalists in particular, came to a similar conclusion decades ago with regard to the tobacco industry and its scientists.

The logging industry is no different, and that includes agencies around the globe that, for all practical purposes, are part of the logging industry. To this day, it is common for environmental and climate organizations to actively collaborate with agencies involved in logging and to seek their advice as if it weren't skewed toward the extraction of lumber products and forest biomass energy production. That dynamic has consequences for our ability to overcome the climate crisis and curb the unprecedented loss of native habitats and wildlife species occurring in every corner of the world, and it will need to change if we hope to move forward toward solutions.

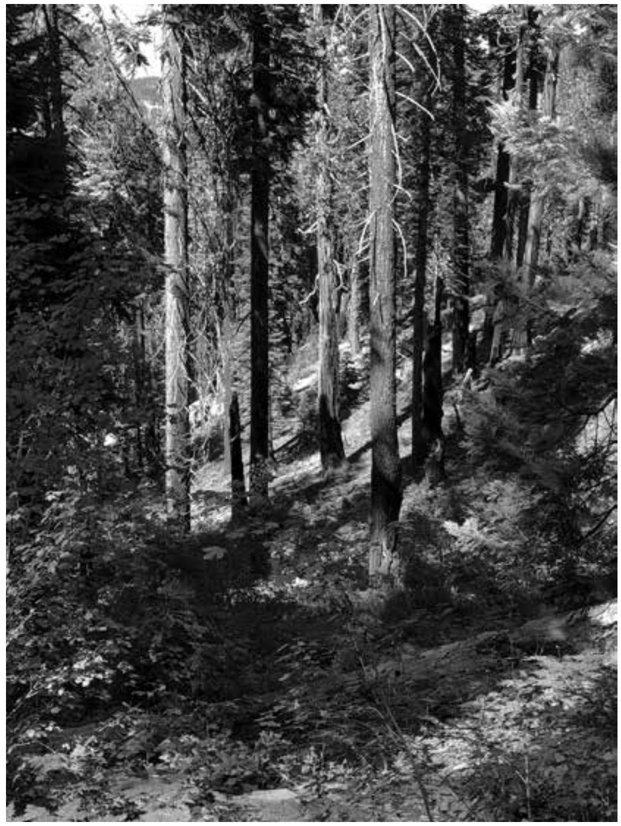
# 7

# What You Aren't Being Told about "Thinning"

All around the world, from North America to western Europe to Australia, the logging industry and its political allies—which include some nongovernmental organizations—are telling the public that forest "thinning" will prevent large wildland fires, reduce tree mortality, and make forests more resilient to climate change. This message has become so pervasive that many people accept it as truth without examining the evidence, which tells a very different story.

One of the most fundamental faults with this narrative is that current research, using field-based data, has found that logging conducted under the rubric of thinning for fire management results in a large overall reduction in the amount of carbon stored in forests and a large increase in carbon emissions into the atmosphere.[1] Stated differently, thinning kills far more trees than it saves, even if we assume, for the sake of argument, that it reduces fire intensity in a given area, which it often doesn't. A key problem is that thinning does not take into account the well-established fact that only a tiny percentage of the tree biomass (on average, 1 to 4 percent), and therefore tree carbon, is consumed in forest fires. Seedlings and small saplings less than three inches in diameter often have high levels of consumption (40 to 50 percent, or higher in high-intensity fire areas), but they account for an insignificant amount of carbon relative to larger trees.

When most people hear the term "thinning," they imagine land managers out in the forest with pruning shears, trimming some very



Mature forest in a California spotted owl nest site in Tahoe National Forest, eighteen years after the Star fire. Note the multiple layers of forest canopy, the snags and downed logs, and the shrubs—an example of ecologically beneficial habitat complexity.

small trees, low branches, and shrubs. But that is not what thinning is at all. A typical thinning project kills and removes 50 to 70 percent of the trees in a given stand and 20 to 50 percent of the tree biomass and carbon—more in some cases. This includes numerous mature and old trees that are removed and sold to increase the profits of logging companies and the budgets of land management agencies. The truth is that thinning is simply a cover-up for industrial logging in the vast majority of cases. For example, in national forests in the Sierra Nevada, standard thinning projects remove and sell trees up to thirty inches in diameter, or nearly eight feet in girth. Trees of this size are typically 100 to 200 years old.

Mature and old-growth trees may be only a small percentage of the trees cut per acre, but they account for the great majority of biomass and carbon removed. Because only about 2 percent of tree biomass is consumed even in large, intense forest fires, and most of that 2 percent comprises seedlings and saplings, this means that at least 98 percent of the biomass removed from the forest during thinning is noncombustible in a forest fire. In other words, on that basis alone, thinning conducted under the guise of fire management or carbon storage is a sham.

The logging industry claims that some mature trees must be removed to generate enough timber and revenue to make thinning projects commercially viable. But the removal of such trees makes thinning even more of a losing proposition in terms of carbon storage and climate change mitigation. And thinned forests often burn more intensely in wildland fires because thinning reduces the windbreak effect of denser forests, allowing winds to sweep through more rapidly, while also reducing the shade of the forest canopy and creating hotter and drier conditions.[2]

Another problem is that studies of thinning and forest fire behavior are funded almost entirely by the logging industry—logging companies or associations or agencies financially involved in commercial logging, such as the US Forest Service. Unsurprisingly, this funding relationship leads to serious biases. For example, the dozens of studies funded by logging interests generally do not account for the trees killed and removed by thinning itself. Rather, they focus on trees killed by fire.[3]

Imagine that there are two similar stands of trees, both with 100 trees per acre (for simplicity's sake, we'll assume all the trees are the same size). One stand is subjected to thinning, which kills and removes half the trees, leaving only 50 trees per acre. The other is not thinned. Then a wildland fire occurs and kills 20 percent of the trees in the thinned stand and 30 percent of the trees in the unthinned stand. Studies funded by logging interests consistently report such an outcome as proof of the "success" of thinning, since the percentage of trees killed in the thinned area was slightly lower. But what about the trees killed by thinning? If those are taken into account in this example, the unthinned stand would have 70 trees per acre after the fire, while the thinned stand would have only 40 trees per acre. And, as discussed earlier, the great majority of the carbon in trees killed and removed by thinning ends up in the atmosphere almost immediately; only a very small portion is stored for decades in lumber products. In addition, the nutrients removed from the ecosystem by thinning and the ground-based logging machinery significantly undermine future carbon sequestration and storage capacity.

One Forest Service–funded study in the Rim fire area reported some-

Dinkey logging project, Sierra National Forest, 2012. Typical of commercial "thinning" operations in national forests, most of the trees, including many large, old ones, have been cut down, and nearly all the understory habitat has been eliminated, leaving the area homogenized, simplified, and diminished. In a very real sense, the forest ecosystem has been removed from this area.

what lower levels of fire intensity in thinned versus unthinned areas.[4] However, this was an uneven comparison. The unthinned areas included large expanses of mainly shrub habitat, which naturally burns at high intensity. In addition, in the thinned areas, the study combined stands in which only very small, young trees had been removed with commercially thinned areas in which many mature trees had been removed—the latter areas tended to burn more intensely. If a fair comparison were made between commercially thinned and unthinned mature conifer forests, the difference in fire intensity would disappear. The main difference was that, in the commercially thinned areas, many trees—including mature trees—had been killed and removed prior to the Rim fire, but the study did not account for this. Another Forest Service–funded study not only failed to account for trees killed and removed by thinning, but also claimed that logging, conducted under the guise of thinning, is effective in reducing fire intensity, despite the fact that the study's own results showed that most of the "thinned" forests burned at *higher* intensities.[5]

A second bias is the use of false and self-serving modeling assumptions. Many studies do not involve field-based measurements in actual forest fires; instead, they report the outcomes of models. But these models, and the assumptions on which they are based, are created by the authors of these studies, which are funded by logging interests. One of the most common assumptions is that stands with fewer trees will burn at lower intensities, especially during hot, dry, windy conditions. When this assumption is built into theoretical models, as it typically is, the outcome is predetermined, setting up a confirmation-bias situation in which authors create models that are essentially guaranteed to report that thinning reduces fire intensity. Researchers who analyzed a broader and more realistic range of conditions and included the impact of thinning on wind speed found that commercial thinning increased fire intensity in 57 percent of the scenarios.[6]

Similarly, some theoretical modeling studies funded by logging interests create models that make biologically implausible assumptions about the proportion of biomass and carbon in live, mature trees consumed in wildland fires. Such modeling studies commonly assume that 30 to 80 percent of tree biomass will be consumed in high-intensity fires, and they typically assume that unrealistically high proportions of high-intensity fire will occur in unthinned forests. Therefore, they are often assuming tree-consumption levels several dozen times higher than actual levels based on field studies, leading to exaggerated claims about carbon emissions from wildland fires.[7] If the deck is stacked in this way, so to speak, studies can misleadingly and falsely claim that thinning results in more carbon retention in forests than wildland fire in the absence of thinning.

A third bias involves the "opportunistic selection" of study site locations. This is just a technical way of saying "cherry-picking." For instance, a few thinned areas might have burned at somewhat lower intensities in a particular area, but just over the ridge, there may be several thinned areas that burned at higher intensities. Thinning studies that cherry-pick locations analyze only those areas that burned somewhat less intensely and omit the others from the analysis. A key red flag is when a study does not mention the explicit methodology used to determine which locations would be included in the study.[8]

One such study subjectively selected a particular high-intensity fire location in northern Arizona and claimed that a nearby thinned forest retained relatively more carbon than the fire area. It attributed this finding to a lack of natural postfire regeneration in the high-intensity fire patch.[9] But when I visited the study's high-intensity fire site, I found that it was not even remotely representative of other high-intensity fire patches in the surrounding area, which were regenerating nicely with a mix of conifers, oaks, aspens, and native shrubs. If you search long and hard enough, you will likely find a small site here or there that has little natural regeneration after a high-intensity fire, just as you can find small locations in unburned, mature forest with little or no regeneration of conifer seedlings or saplings. But it is highly misleading to imply that such areas are representative of how dry southwestern ponderosa pine and mixed-conifer forests respond to high-intensity fire patches. In reality, natural forest regeneration in such areas is characterized by a rich and abundant mix of tree and shrub species.[10] Interestingly, when I visited this small, uncharacteristic area of high-intensity fire in northern Arizona, I found that the adjacent low-intensity fire area also had little or no regeneration of young conifers.

One of the most interesting biases is the assumption that thinning, as opposed to prior burning, temporarily reduces the intensity of a subsequent wildland fire. One study analyzed stands that had been commercially thinned, followed by prescribed fire. The authors assessed how later wildfires affected these thinned and burned areas compared with similar stands that had experienced prior burning but no thinning. They found similar mortality levels among the remaining trees after wildland fires.[11] The difference was that 78 to 94 percent of the trees in all but one of the thinned areas had already been killed by thinning before the wildland fires occurred (in the one remaining area, about 57 percent had been killed before the wildfires). It is obvious that previous fire, not thinning, temporarily modified subsequent wildland fire behavior. The thinning simply killed and removed most of the trees. Yet the authors of the study, which was funded by the US Forest Service, promoted the highly misleading conclusion that thinning was "most effective" at reducing tree mortality, when in fact, their own data showed the opposite: thinning resulted in the highest overall tree mortality when mortality from thinning itself was included.

Perhaps the most hazardous misconception is that thinning can stop forest fires and therefore protect human communities. Entire forest management policies, spanning decades and affecting millions of acres of forest, have been built on this notion, leading to countless large logging projects conducted within a couple of miles of homes or recreational cabins. As discussed previously, areas that have been logged through thinning projects sometimes burn at somewhat lower intensities and sometimes (more often) burn at higher intensities, but studies do *not* say that thinning will *stop* wildland fires, which are driven by weather and climate. Nevertheless, every year, communities in mountain areas are told that the latest proposed logging project out in the forest, somewhere over a far ridge, will reduce fuel, stop a forest fire, and save the community.

In one of my many conversations over the years with representatives of state and federal agencies, I asked an official of the US Forest Service why it keeps proposing logging projects in remote forests and calling it community protection, instead of helping home owners conduct annual pruning of vegetation immediately adjacent to their homes. In response, he said, "When there is a dragon out there, you don't wait for it to come to you. You go out and slay the dragon." No doubt he thought this sounded very cool and dramatic. But this unsettling combination of hubris and ignorance is destroying communities and getting people killed.

Just several years before the Camp fire occurred in northern California in November 2018, the Forest Service planned and implemented a thinning project ranging from a few hundred yards to a couple of miles from homes. The Forest Service told the communities of Paradise and Concow that this logging project, which removed many thousands of live trees and many dead ones too (for biomass energy production), would save them from a forest fire.[12] This gave people in these communities a false sense of security, leading them to believe that they need not take any action themselves to make their homes safe from fire. After all, a federal agency had told them that the logging project would protect them. When the Camp fire began a few years later, it spread toward Concow and Paradise, driven by fierce weather and climate conditions. The thinning project did not stop the fire, which raced through the logged areas faster than any forest fire in recent memory, ultimately destroying many thousands of homes and costing eighty-five people their lives.

This is not an isolated example. In the years leading up to 2007, the Forest Service conducted thinning operations across hundreds of acres of public forestlands within about a mile and a half of the community of South Lake Tahoe in the northern Sierra Nevada for the stated purpose of protecting homes from wildland fire. In the summer of 2007 the Angora fire occurred, burning north-northeast toward the community. It quickly burned through all the thinned forests in its path and destroyed 254 homes. That same year, in the mountains of Southern California, the Grass Valley fire burned rapidly through previously thinned forests in San Bernardino National Forest, where both live and dead trees had been removed, and destroyed 199 homes. In all these cases and numerous others, the Forest Service and the logging industry had claimed that thinning was "highly effective."[13]

While this serves as a stunning example of political spin, it raises a troubling question: if the outcomes of these fires—a huge loss of homes and lives—are a success according to the Forest Service, what is its notion of failure? By focusing on managing forests hundreds of yards or farther from homes, as opposed to helping residents living adjacent to national forests protect their homes from fire, the Forest Service and the logging industry have tragically ignored and denied the fact that weather and climate overwhelmingly control fires. Regardless of whether relatively more or fewer trees are killed when fire passes through a thinned area, thinning does not stop fires, and it often allows fire to sweep more quickly through the forest and toward a community.

In addition to failing to consider tree mortality due to thinning and cherry-picking field sampling locations, Forest Service studies tend to ignore the effects of combustible slash debris from logging—another serious source of bias.[14] If this debris has not been piled and burned by the time a wildland fire occurs, these areas burn extremely intensely, and it is common for logging slash piles to remain for several years—sometimes much longer—after thinning. After the merchantable timber has been cut from the forest, there is little incentive to reduce the kindling-like debris created by logging. Burning slash piles requires coordination with federal and state agencies and air quality regulators. It is expensive, and sometimes nearby communities object. So it frequently does not happen.

This problem came close to home recently. A large thinning project conducted by the San Bernardino National Forest in the mountains adjacent to where my wife and I live was promoted as a measure to protect communities east of Big Bear Lake from wildland fire. The plan envisioned intensive tree cutting starting about a mile and a half out in the wildlands and coming right up to the edge of the community. Assumptions with regard to future fire outcomes were based on the promise that the slash debris created by the thinning project would be promptly piled and burned and that the thinned areas would be maintained to keep combustible grasses to a minimum. However, three years after the cutting was completed, thousands of slash piles remained, dotting the landscape—like bonfires waiting to happen. Many of these slash piles were right next to residential property boundaries and adjacent to homes, including ours. To avoid what happened in the Angora fire near Lake Tahoe, where slash piles remained for years and intensified the fire as it spread toward the community, the Forest Service finally began to burn some of the piles left after the project, but the area is still more combustible than it was before the thinning project began.

The ground-based equipment employed in the thinning project acted as a vector for the spread of combustible, invasive grasses and weeds, as is so often the case. Exacerbating this, the removal of so many trees substantially reduced the forest canopy's shade and increased sun exposure, favoring the growth of these weeds. Now, the areas right next to homes are hotter, drier, and windier and are filled with highly ignitable invasive plants like cheatgrass and tumbleweeds. In some locations, the dry tumbleweeds have accumulated in clumps six feet deep. If a wildland fire occurs in the area, it will burn more intensely and rapidly toward our community thanks to the Forest Service's thinning project.

But the Forest Service measures success by the amount of acreage thinned and clear-cut—all conducted under the guise of fuel reduction. National forests that complete such projects are deemed successful and receive funding for more and more logging projects. The fact that these projects often increase the fire threat to communities is not taken into account in this system of performance evaluation and rewards—even if a fire occurs and homes burn, or worse.

Thinning projects are often justified by logging interests and land managers as a way to reduce competition between trees and prevent tree mortality from bark beetles during droughts. The argument is that thinning makes forests more "resilient" to climate change. However, in this context too, the data indicate that thinning kills far more trees than it saves and actually makes forests less resilient. One study, for example, expected to find that drought- and beetle-induced tree mortality would be highest at low-elevation sites that are already warmer and drier; instead, it found that tree mortality in the forests of the southwestern United States was not strongly related to either elevation or stand density.[15] The authors acknowledged that it was unclear whether reducing tree density would reduce tree mortality in periods of severe drought. Another study investigated ponderosa pine stands and found that, even at high density levels, "there was no apparent correlation between stand density and mortality."[16] Researchers have concluded that efforts to reduce overall tree mortality through logging typically ends up killing more trees than it prevents from dying.[17]

Another investigation found that as young pine forests grew to very dense levels, they experienced only about 17 percent tree mortality; the author noted that mortality rates "declined over the years" as the forests grew older and denser.[18] Similarly, other researchers found that pine stands go through a modest pulse of new snag creation owing to competition and native beetles when they are of an intermediate age, but after about eighty-five years of age, annual tree mortality drops to very low levels, even as the stands continue to grow denser.[19]

The reality is that forests naturally experience brief periods of significant "snag recruitment," especially during major droughts, but this is not caused by dense forest conditions. Even when such snag recruitment

Even in the largest patches of snag recruitment caused by drought, many trees survive. The new habitat heterogeneity in these areas is generally consistent with moderate-intensity fire effects.

occurs, many live trees are mixed in with the new snags, creating excellent habitat heterogeneity. For example, about fifteen years ago, there was a significant snag recruitment event across 1.5 million acres of lodgepole pine forests in Colorado, leading to much speculation that large swaths of forest were being "lost." However, when scientists surveyed these areas, the largest patch of forest they could find with no live trees was only about 1 acre.[20] The same is true in the ponderosa pine and mixed-conifer forests of the Sierra Nevada, which recently experienced a significant pulse of snag recruitment in some areas of the western slope in the southern part of the range. Even in the areas with the highest levels of snag recruitment, many live trees were interspersed among the new snags. Contrary to false messaging from pro-logging agencies claiming that 80 to 90 percent of the trees had been killed across a vast landscape, in reality, it ranged from 10 to 20 percent in most areas.[21]

Recent work in genetics has revealed that native bark beetles long ago evolved the ability to detect and select the weakest trees during droughts, which they do, leaving the strongest and best-adapted trees to reproduce and making forests more resilient.[22] Bark beetles and patches of snags resulting from their activity during dry periods are not negative indicators of forest health and climate resilience; they are positive indicators. Logging crews and chain saws, in contrast, have no such sophisticated ability to distinguish strong trees from weak ones.

Among the primary arguments for thinning projects is the notion that forests of the past were open and parklike, with very low tree densities. In this context, thinning is promoted as "restoration." This is an extremely common political message with regard to forests in the western United States. However, as discussed previously, although some historical forests in the West were open, with relatively low tree densities (often after moderate-intensity fires), most were moderately to very dense. This has now been extraordinarily well established by a series of studies using nineteenth-century US government land survey data, backed by an unprecedented level of cross-validation with other data sources.

One illuminating example is provided by John C. Fremont's epic expedition through the Blue Mountains of northeastern Oregon in 1845. Fremont kept a detailed journal of his observations as he and his crew traversed the entire mountain range years before settlers made war on the native peoples of the region and later began logging and fire suppression policies.[23] Importantly, he made frequent specific notes about forest conditions, including density, which the following samples from his journal illustrate:

> You will remark that we are now entering a region where all the elevated parts are covered with dense and heavy forests (542).
>
> Resuming our journey, we commenced the ascent of the mountain through an open pine forest of large and stately trees (546).
>
> After travelling occasionally through open places in the forest, we were obliged to cut a way through a dense body of timber, from which we emerged on an open mountain side (547–48).
>
> We continued to travel through the forest, in which the road was rendered difficult by fallen trunks, and obstructed by many small trees, which it was necessary to cut down. . . . A laborious day, which had advanced us only six miles. . . . [The following

> day] the trail passed sometimes through very thick young timber, in which there was much cutting to be done; but, after travelling a few miles, the mountains became more bald (548).
>
> Descending a bad ravine, into which we drove our animals, and had much trouble with them, in a very close growth of small pines (549).
>
> After cutting through two thick bodies of timber . . . the forest became more open. . . . The pines here were 11 or 12 feet in circumference (549).

Overall, Fremont made eighteen specific references to forest density, and more than two-thirds of them described dense forest conditions—often so dense that the travelers could not weave their narrow wagons, crew, and animals through the forest without taking many hours to cut through the thick understory of smaller trees.

An additional concern is thinning's impact on many rare, imperiled, and declining wildlife species. There are several significant problems. First, logging operations conducted under the rubric of thinning generally begin in mid or late spring, at the peak of bird nesting season, when chicks are in their nests but are not old enough to fly. Nearly all commercial thinning is conducted with heavy, ground-based logging machinery, including tractors. Requirements to conduct prelogging surveys to determine the locations of bird nests are rare or nonexistent in many forested regions, which means that logging machinery routinely rolls over and kills the young of shrub- and ground-nesting species. Felling live, mature trees routinely kills chicks of canopy-nesting species, which build small nests of twigs and grasses high on tree branches. Snags are also removed in the typical commercial thinning project, which kills chicks of cavity-nesting bird species. In theory, laws such as the US Migratory Bird Treaty Act should prevent this, but they do not, for the simple reason that the death toll occurs out of sight and out of mind. If there are no surveys to determine the existence and location of nests, logging companies, land management agencies, and pro-logging politicians can conveniently pretend that the deaths are not happening.

Beyond the direct killing of chicks, there are other serious ecological problems associated with thinning. One article authored by Forest Service–funded scientists cavalierly suggested that if thinning suppresses the occurrence of high-intensity fire patches in some circumstances, the only bird species harmed are the ones associated with snag forest habitat.[24] Apparently, these authors have very little scientific background or expertise in biodiversity—especially with regard to postfire habitat. If they did, it would have occurred to them that most of the bird species in the forest are positively associated with snag forest habitat.[25]

Some of the rarest and most at-risk bird species are most severely harmed by thinning. For example, the olive-sided flycatcher is strongly associated with snag forest habitat due to the abundance of native flying insects on which it feeds. This species' population has been slowly declining for decades, as fire suppression and logging policies have become more aggressive. For years, land managers dismissed concerns about these birds because they often saw them in recently thinned areas. The problem is that thinning creates what is known as an "ecological trap" for this species. Olive-sided flycatchers search for forests that look very open, such as recent higher-intensity fire patches. They are tricked by the reduced tree cover in thinned areas and colonize these recently logged stands, but the habitat features and complexity associated with snag forest habitat are absent, as are the flying insect food sources normally found in a fire area. As a result, the birds suffer much higher nest failure rates than they do in fire areas, leading to severe population declines.[26] In essence, commercial thinning attracts olive-sided flycatchers and kills them.

Imperiled old forest species are also impacted by thinning. One study found that California spotted owl populations declined by 43 percent within a few years after a commercial thinning operation.[27] The endangered mink-like Pacific fishers avoid thinned areas, which restricts and narrows the amount of habitat they can use.[28] This is a serious concern, given that very few Pacific fishers remain after decades of logging. Likewise, a smaller relative of the fisher, the imperiled Pacific marten, avoids thinned areas, leaving them with less and less habitat.[29]

But land managers and logging companies continue to dismiss and downplay concerns about harm to imperiled wildlife species, claiming that thinning and associated snag removal in wildlands are needed to protect distant communities from fire and that the effects on rare and threatened species will simply have to be accepted. Shockingly, even after the tragedy of the 2018 Camp fire, the Forest Service and the logging industry continue to push for more logging projects in the region surrounding the devastated communities of Paradise and Concow, despite the rapid spread of fire through the areas previously subjected to thinning and snag removal.

Similarly, even though the Grass Valley fire of 2007 raced through areas that had undergone extensive thinning and snag removal, the Forest Service is doing it all over again. Instead of focusing resources on proven, effective approaches to make homes adjacent to the national forest safer, including advising home owners on essential improvements such as ember-proof vents and helping them create defensible space by pruning within 100 feet of their houses,[30] the Forest Service is proposing yet another large thinning and snag removal project in the same area where fire destroyed 199 homes after the last thinning and snag removal project.

From North America to Australia to western Europe, we repeatedly hear from land managers and timber companies that logging, conducted under the guise of thinning, will stop or largely curb wildland fires, reduce tree mortality from fire and other natural processes, and increase forest resilience in a changing climate. This public messaging is ubiquitous, fervent, and well financed. But people who are interested in biodiversity conservation and real climate solutions must beware of the fine print under those empty and self-serving promises. There is a lot we aren't being told.

# 8

# An Inconvenient Woodpecker

The little black-backed woodpecker just can't seem to catch a break. It is a rare species that depends primarily on areas that have recently been burned in forest fires and, more specifically, on large areas of very dense, mature forest that has burned at high intensity.[1] Its habitat needs have been the same for many millennia. But in the modern world, the woodpecker has found itself in the crosshairs of an odd mix of antagonists.

Logging corporations and their political allies are in the habit of demonizing fire because the "catastrophic wildfire" narrative is the cornerstone of their campaign to roll back environmental protections and dramatically increase logging and clear-cutting under the guise of fire management. Meanwhile, some well-meaning but misguided environmentalists, scientists, and climate change activists have begun to echo this message in an apparent attempt to use the public's fear and misunderstanding of wildland fire to get people to take climate change more seriously. They bemoan the "worst" fire seasons, use the same "catastrophic wildfire" terminology as antienvironment politicians, and suggest the "thinning" of forests to address the perceived problem.

Neither side is being fully honest with the public, and both are doing a disservice to the very real and serious threats related to rising temperatures from climate change caused by human activities. Both camps fail to acknowledge that current levels of fire in the forests of the western United States and the boreal forests of Canada, where the black-backed woodpecker lives, are not unnaturally high—even in recent years. More

Male black-backed woodpecker feeding a chick a wood-boring beetle grub in the 2007 Angora fire area near South Lake Tahoe. (Photo by Rachel Fazio, 2012)

than a century ago, natural forest fires were considerably more prevalent than they are now, causing a fire deficit in most forests today.[2] Due to fire suppression and postfire logging policies, most wildlife species that depend on postfire habitat, like the black-backed woodpecker, have become rare.[3]

As black-backed woodpeckers suffer, so do many other species. These woodpeckers depend on the larvae of native wood-boring beetles that are attracted to recently fire-killed trees. The woodpeckers keep the beetle populations in check and the forest in ecological balance. In addition, these monogamous birds create multiple nest cavities each year—each spring, the male creates two or three cavities, and the female picks the one she likes best. In doing so, they make homes for many other wildlife species, such as bluebirds, nuthatches, and flying squirrels, that need cavities but cannot create their own. Due to its strong dependence on snag forest habitat and its key role in creating nest cavities that help other species raise their young, the black-backed woodpecker is the primary management indicator species, or bellwether, for dozens of other snag forest species.

Evolving during the Pliocene, the black-backed woodpecker has been a native inhabitant of North American conifer forests in colder climates for approximately 3 million years—more than ten times longer than human beings have walked the earth.[4] For thousands of millennia, it has been dependent on large, dense patches of snag forest habitat in conifer forests, just as related species, such as the northern three-toed woodpecker, have been dependent on snags in the conifer forests of other continents.

In its natural snag forest habitat, the black-backed woodpecker is a thing of perfection. Its jet-black back offers remarkable natural camouflage against the charred bark of fire-killed trees, protecting it from predators—protection it sorely needs, as the bird is admittedly a clunky flier. I have stood less than twenty feet from black-backed woodpeckers in a snag forest, and if they don't move or vocalize, they are practically invisible. Less than nine inches long from its beak to the tip of its tail, the black-backed woodpecker is small but mighty, with numerous evolutionary adaptations that enable it to strike harder and deeper into the wood of snags than other woodpeckers, keeping itself well fed on beetle grubs. For example, the black-backed woodpecker has a much broader rib cage and shorter legs than other woodpeckers—a combination that allows it to accelerate its body mass over a greater distance toward the trunk of a tree and drill deeper for grubs. Its brain is titled forward in its head, which spreads out the impact force, and unlike humans, it lacks a liquid layer between the brain and the skull, which prevents concussion. Most notably, the black-backed woodpecker is one of only two North American woodpecker species with only three toes. This evolutionary adaptation allows greater heel mobility on impact and greater strike force (think of a baseball player taking a swing at a fast ball—if the player's heels were fixed to the ground, the swing would be far less powerful, resulting in very few home runs). These traits make the black-backed woodpecker highly specialized and dependent on the larvae of wood-boring beetles.[5] One black-backed woodpecker needs about 13,500 beetle larvae a year to survive, and that requires a lot of snags. Black-backed woodpeckers *belong* in snag forests, just as snag forests belong in forest ecosystems.

Importantly, although black-backed woodpeckers in the United States are primarily associated with snag forest habitat created by wildland fires, they sometimes nest in unburned snag forest created by cycles of drought and native bark beetles.[6] Both types of snag forest are severely threatened by current "salvage" logging policies on both public and private lands.[7]

I have been studying black-backed woodpeckers for more than eighteen years and have spent thousands of hours in the middle- and upper-elevation forests of the Sierra Nevada, hiking through large patches of snag forest in search of these rare and elusive birds. But they are clever, and they don't make it easy. During one field season, my colleagues and I were searching for black-backed woodpecker nests in the Rim fire area, west of Yosemite National Park. We used "playback" machines to broadcast thirty-second recordings of black-backed woodpecker calls. This drew in curious individuals, who wondered why some new bird was intruding on their territory. That's when the hard work started, because once we saw a black-backed woodpecker or heard its telltale "pik-pik" call nearby, we had to follow it, hoping to track it back to its nest. This was easier said than done, as the birds were not inclined to wait for us to catch up as they dodged and weaved through the snags. As we chased through the snag forest, jumping over downed logs and pushing through patches of naturally regenerating conifers and shrubs, we tried to keep an eye on the sky ahead to make sure we didn't lose the bird, but we often did.

Eventually, after many fits and starts, we would get close to a nest and hear the otherworldly trilling sounds—sort of like giant crickets—the chicks make just before the parents feed them grubs. But on numerous occasions, the male parent would lead us to a nest cavity, go inside for two minutes or so, and then emerge and fly away. We would be left standing there, watching the cavity and expecting him to come back and feed the chicks again, but he never did. When we looked more closely, we realized that the exposed wood around the cavity looked a bit weathered, and there were no signs of recent excavation. Then it dawned on us that we had been outsmarted more than once by the woodpeckers: they were leading us to old nest cavities to draw us away from the chicks in the current cavity, which was often hundreds of yards away.

If you spend a lot of time in snag forests looking for black-backed woodpeckers, as my colleagues and I do, it's hard not to love them. But for many, there is a strong cultural bias against these birds and their habitat. Fire suppression forces are trained to see wildland fire as the enemy and to hate it. By extension, they often hate the species associated with it. Logging interests hate black-backed woodpeckers with a passion, since efforts to protect the snag forests on which the birds depend have led to less postdisturbance logging in certain places and thus reduced profits.

Some older forest activists and forest scientists spent years studying the many ecological wonders and benefits of old, green forest. Some of them have trouble adapting to our evolving and growing understanding of forest and fire ecology, especially with regard to the naturalness of high-intensity fire patches and the high ecological value of snag forest habitat created by either fire or drought cycles. They have difficulty accepting or understanding that dense, old forests are ecologically essential both as green forests and as high-quality snag forests. Some are so focused on their affection for big, green pine trees that little else matters, and science and biodiversity become largely irrelevant.

These biases and prejudices are deeply ingrained. In the United States, millions of taxpayer dollars have been spent on propaganda to demonize wildland fires and promote fire suppression and logging. Americans have been taught to fear and hate the life-giving force on which black-backed woodpeckers and many other species depend for their survival. In one particularly gratuitous advertisement from the Forest Service many decades ago, a terrifying illustration depicts the Grim Reaper riding a wraithlike white horse as the Reaper sets fire to an old-growth stand, accompanied by the message: "Death Rides the Forest."[8]

Decades later, publicly funded propaganda continues in an effort to convince people that wildland fires are "catastrophes" that "destroy" forests. For financial reasons, this messaging is extremely important to the Forest Service, and it always has been. For many years, when large forest fires occurred in remote areas, the Forest Service didn't have time to build new logging roads into these inaccessible areas before the fire-killed trees decayed to the point that they were unusable for lumber. Such fires deprived the Forest Service of its ability to sell the trees to logging companies and generate revenue from logging and clear-cutting on its own terms and timeline; thus, wildland fires have long been viewed as a budgetary threat. In the 1990s I was able to obtain an internal Forest Service report from the agency's accounting office in the Washington, DC, area. The cover was telling: it depicted a scale with a large bag of money on one side and trees on fire on the other.

The publicly financed demonization of wildland fire serves another economic purpose for the logging industry, including the Forest Service: it facilitates the false political and economic narrative that increased logging and reduced environmental protections are needed to "fight" and "stop" forest fires, while simultaneously clearing the way, politically, for extensive postfire logging and revenue generation when fires do occur. After all, when the public is constantly barraged with messages from the government and government-funded scientists that fire destroys forests and that the only thing of value left after forest fires is the fleeting economic worth of the burned timber, it is no wonder that so many people do not understand that there is much more to the story.

When climate change activists around the world echo these same messages, demonizing wildland fire and snags in general, it furthers, advances, and facilitates the agenda of the logging industry and right-wing, antienvironment governments that push the "catastrophic wildfire" message to justify policies that increase logging and clear-cutting of both unburned and postfire forests. Ironically, the result is far more carbon being pulled out of forests, reduced carbon sequestration and storage capacity in forests, and greater carbon emissions into the atmosphere. This is something that environmental and climate change activists should keep in mind the next time they are tempted to send out yet another tweet telling the world that "Australia is burning," "California is burning," or "the Arctic is burning." Of course they are burning. Fire is natural in the eucalypt forests and woodlands of Australia, in the conifer forests and oak woodlands of California, in the boreal forests of Asia's northern latitudes, and in other forest ecosystems around the globe, even in Amazonia.

As a landmark review of the scientific literature objectively concluded, the "global area burned appears to have overall declined over past decades, and there is increasing evidence that there is less fire in the global landscape today than centuries ago," contrary to "widely held perceptions both in the media and scientific papers of increasing fire occurrence, severity and resulting losses."[9] Fire is not destroying forest ecosystems in Australia, California, or the boreal subarctic, but logging is. In Brazil, the deforestation of millions of acres is not caused by wildland fire; it is caused by the ranching and logging industries, which are deliberately clearing the forests for profit.

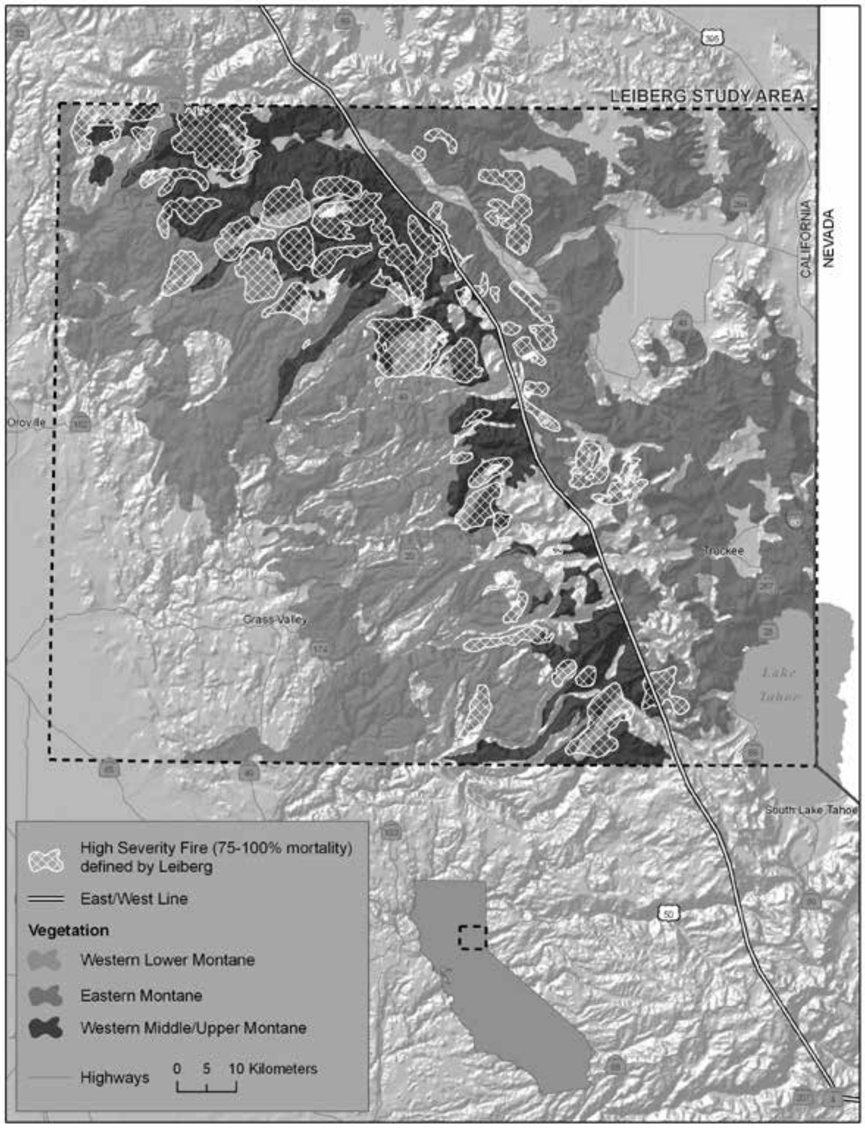
I share, on the deepest level, a desire to help the global community and policy makers understand the reality and urgency of the climate crisis, and I understand the impulse use forest fires as dramatic punctuation for this message. After all, governments around the world have already primed the public to believe, falsely, that forest fires are destructive and "demonic," so it is easy to use imagery—both literal and figurative—of forests engulfed in flames as a symbol of the climate crisis. But we must change course. People of conscience who are seeking in good faith to solve the climate and extinction crises must take a different approach because the current one is exacerbating both of these existential threats to humanity and the biosphere.

In 2002, when I first began to study the black-backed woodpecker, the Forest Service assumed that the species was a reasonably common habitat generalist, worthy of no particular attention. But I kept finding anecdotal accounts of black-backed woodpeckers using recently burned forests. Unfortunately, at the time there was insufficient field data to conduct a robust statistical analysis of black-backed woodpecker habitat selection. As I spent more and more time in the fire areas of the Sierra Nevada in 2002 and 2003 and observed black-backed woodpeckers in the field, I wondered whether the story the public had been told for generations might need some updating.

The narrative at the time was that, prior to fire suppression, wildland fires had been almost exclusively low-intensity events that occurred quite often and kept understory vegetation and needles and twigs on the forest floor to a minimum, thus preventing high-intensity fires from occurring. High-intensity fire patches, especially large ones, were viewed as a modern anomaly caused by "fuel accumulation" due to fire suppression. If the story was so simple, I wondered why there were so many accounts of black-backed woodpeckers being found in mature forest that had burned at high intensity. To satisfy my curiosity, I consulted historical texts in the archives of research libraries. I discovered that, prior to fire suppression and postfire logging, historical journals generally described black-backed woodpeckers as "quite numerous," such as the 1870 account by famed ornithologist James Cooper in the Sierra Nevada. By the late twentieth century, ornithologists began describing this species as "rare."[10]

I also found an extensive report by John Leiberg, a researcher for the US Geological Survey. He conducted a massive forest survey and mapping effort in the late 1800s across the entire northern Sierra Nevada. For several years, Leiberg and his crew of surveyors trekked through these forests, mapping logged and unlogged forests and the extent of wildland fire effects occurring in the nineteenth century. Leiberg's mapping effort showed dozens and dozens of large high-intensity fire patches in forests that had never been logged—many of them covering several hundred to several thousand acres, and some of them between 10,000 and 35,000 acres. Leiberg specifically noted that most of these large high-intensity fire patches predated the influx of settlers and miners that accompanied the 1849 California gold rush. He finalized his report in 1902 and submitted it to Congress, noting that the large areas of high-intensity fire largely dated back to the early 1800s. In stark contrast to the common notion that historical forests had been homogeneously open and parklike, with only lower-intensity fire, Leiberg consistently described a complex mix of dense and open forests, with many large areas of what we now call snag forest habitat.[11]

When I got to Leiberg's description of Duncan Canyon—the very place where I had started to find and study black-backed woodpeckers—my eyes widened. He wrote: "All the slopes of Duncan Canyon from its head down show the same marks of fire—dead timber, dense undergrowth, stretches of chaparral, thin lines of trees or small groups rising




John Leiberg's map, showing large patches of snag forest habitat (white cross-hatching) created by big forest fires in the 1800s in the northern Sierra Nevada, prior to logging and fire suppression.

out of the brush, and heavy blocks of forest surrounded by chaparral."[12] The high-intensity fire areas mapped by Leiberg in Duncan Canyon had all naturally regenerated, becoming mature and old conifer forest by the time of the Star fire in 2001, which transformed several areas back into snag forest habitat, adjacent to other areas of dense, old forest that were more lightly burned.

As I began my graduate work in ecology and prepared to write my doctoral dissertation on fire history and black-backed woodpeckers, I gathered most of my field data in the Star fire area, especially in Duncan Canyon. I collected more than enough data to conduct the first statistical analysis of black-backed woodpecker habitat requirements in the Sierra Nevada and published a study. My findings indicated that black-backed woodpeckers were heavily selecting not just fire areas or even high-intensity fire areas in general; rather, they were selecting large areas of dense, old forest that had burned at high intensity.[13] The picture was becoming clearer, and it made perfect sense. If historical forests were so sparsely treed and lacked high-intensity fire patches, how can one explain the habitat needs of the black-backed woodpecker from the standpoint of evolutionary biology? My research on black-backed woodpecker habitat selection was lining up quite well with Leiberg's historical descriptions and his mapping of these forests.

Even so, many still believed in the myth of historical forests with relatively few trees and only creeping surface fires. As I tried to better understand the dramatic gap between scientific evidence and popular myths, I realized that the economically self-serving messages from the logging industry and the Forest Service did not explain all the disparity. There were numerous honest conservationists and some scientists who strongly believed these misconceptions and had difficulty accepting clear and mounting evidence to the contrary. Why? A simple mathematical mistake was a significant part of the problem. For decades, scientists had been analyzing fire scars in large old trees to determine the frequency of historical fires. Conifers, such as pines and firs, create one new growth ring each year, so it is not difficult to determine the age of a tree; nor is it difficult to remove sections from tree trunks and see the years in which fire scars occurred and the number of years between fire scars, a span of time called the "fire return interval."

It all seems fairly straightforward. However, fire scar studies are conducted in large areas, often covering thousands of acres, and researchers select numerous large old trees to analyze. If fire scars are found in individual trees in the study area in, say, 1850, 1855, 1860, and 1865, the area would be considered to have a five-year fire return interval.

However, truly big fire years, when large fires span a substantial portion of the forested landscape—often during droughts—are infrequent, generally occurring fewer than a dozen times in a given century.[14] In typical years, most fires are quite small, and only a minor fraction of the trees are affected in a given area. This can lead to large overstatements of historical fire frequencies in a given fire scar study area.

To illustrate the problem, imagine a 3,000-acre study site. If a fire occurred every five years somewhere in the study area, and the average fire burned only 10 percent of the study area (300 acres), the fire return interval would be five years, but the average frequency of fire on any given acre, or in any particular forest stand, would be much longer: fifty years. In the forest types that naturally experience relatively frequent fires, such as the ponderosa pine and mixed-conifer forests of the western United States, it was common for early fire scar studies to report historical fire return intervals of only about four to twelve years. If low-intensity fires were truly occurring so often in historical forests, it is easy to understand the origins of the assumption that these frequent, low-intensity fires maintained open, low-density forests with few understory trees.

More recently, numerous fire scar studies have started to report not only the fire return interval but also the fire *rotation* interval, which is essentially the actual frequency of fire in any particular location. In study after study, the fire rotation interval, reflecting the true historical rate of burning, was twenty to sixty years in "frequent fire" forest types—generally three to ten times longer than the misleading fire return interval.[15] But many people simply never caught up with the current science, and the discredited fire return interval is still commonly referenced by land managers and conservationists, often leading to damaging forest management policies.

Black-backed woodpeckers are unaware of this arcane human debate, but they are painfully aware of their overall lack of habitat. Current forests in the western United States have much less snag forest habitat—from both high-intensity fire and cycles of drought—than they did before fire suppression and logging began. There is only about one-third as much snag forest habitat in today's forests compared with the historical forests inhabited by black-backed woodpeckers,[16] and much of the suit-

Black-backed woodpecker foraging for grubs in snag forest habitat in the Sierra Nevada.

able snag forest habitat currently created by high-intensity fire or drought cycles is subjected to postdisturbance clear-cutting. Black-backed woodpeckers are in trouble. In the Sierra Nevada, for example, only several hundred pairs remain in the entire mountain range.[17]

Despite this evidence, some environmentalists, climate change activists, and land managers dismiss conservation concerns about the black-backed woodpecker, based on the assumption that habitat for this species will increase in the future due to climate change. Ironically, the opposite is true. In fact, the black-backed woodpecker is highly vulnerable to climate change. These birds need a cold climate; they are rarely if ever found in lower-elevation forests that get hot in the spring and summer. In the conifer forests on which black-backed woodpeckers depend, the majority of the annual precipitation falls as snow, not rain. However, due to rising temperatures from climate change, the colder-climate forest types are being forced to move upslope in elevation and northward, and the warmer-climate forest types are expanding.

Current predictions are that, as the warmer forests where black-backed woodpeckers cannot survive cover increasingly greater expanses, the colder forest types inhabited by black-backed woodpeckers will substantially decline by the end of the century. For this reason, the black-backed woodpecker is classified as being highly vulnerable to climate change if we continue on our current path and do not take major steps to overcome the climate crisis.[18] In my field surveys in the Rim fire area, I have spent many hours watching black-backed parents struggle to feed their chicks and themselves on unseasonably hot spring days in the relatively lower-elevation territories on the margins of what this species can withstand. Sometimes they stop on a snag, open their beaks, and appear to "pant" for minutes on end as they try to endure the heat.

Because of this expected climate-induced contraction of their range, even if there are more forest fires in the future, the net effect for black-backed woodpeckers will be a large overall loss of habitat. What's more, contrary to the popular belief that there will be significantly more forest fires in the future and that fire intensity is increasing due to climate change, climate science is not that simple. Although many earlier studies predicted moderate increases in fire—increases that would still result in *lower* fire levels than naturally occurred prior to fire suppression—more recent studies are presenting a more complex picture. Current research uses not only climate variables such as temperature and precipitation but also vegetation variables that predict how ecosystems will respond to changing climate conditions. A sense is emerging that future forests will see a mix of regional increases and decreases in fire activity in the western United States and globally, as some areas experience hotter and drier conditions and others become warmer and wetter. Even in areas projected to become hotter and drier, some climate research indicates that these areas may soon experience *less* high-intensity fire as drought conditions reduce the understory vegetation needed to carry flames.[19] One of the most comprehensive recent studies found the following with regard to fires in the western United States: "While some studies have shown increasing fire season length, we saw no significant increase in high severity fire occurrence by month, May through October. . . . We found no correlation between fraction of high severity fire and total fire size, meaning increasing large fires does not necessarily increase fractional high severity fire area."[20]

Heedless of the mounting scientific evidence about the growing threat to black-backed woodpecker populations, land managers continue to push for more and more thinning operations in woodpecker habitat, based on the false assumption that this will stop large forest fires and reduce tree mortality. Alarmingly, research shows that not only postfire logging but also logging conducted under the guise of thinning can harm black-backed woodpeckers. Even when thinned stands burn at high intensity, the result is poor-quality habitat for black-backed woodpeckers. Because so many medium-sized and larger trees were removed by logging prior to the fire, there are too few snags. And fewer snags mean fewer wood-boring beetle larvae for the woodpeckers to eat.[21]

Black-backed woodpeckers are so vulnerable because they depend on the convergence of several factors to provide suitable habitat where they can live, eat, and raise their young. In the 257,000-acre Rim fire area, for example, only about 6 percent of the area was black-backed woodpecker habitat—even before postfire logging occurred.[22] Although one-fifth to one-third of the Rim fire area burned at high intensity (depending on the estimates and definitions used), much of the high-intensity fire occurred in nonforest areas such as grassland, chaparral, and oak woodland or in low-elevation conifer forests where black-backed woodpeckers don't live. A relatively small portion of the total area of high-intensity fire occurred in middle- and upper-elevation conifer forest, but much of that forest was too sparse and open to provide good black-backed woodpecker habitat, or it consisted of young tree plantations from past clear-cutting. Dense, mature to old conifer forests that burn at high intensity at the right elevations, creating suitable black-backed woodpecker habitat, are quite rare.

When all these factors do converge, those locations are heavily targeted for postfire logging by the Forest Service and private logging companies. That is where the highest concentration of economically valuable postfire timber is located and where the most money can be made. The Forest Service and the logging industry often attempt to dismiss concerns about the impact on black-backed woodpeckers by stating that only 10 to 25 percent of a given fire area is slated for postfire logging. However, this is wildly misleading because that 10 to 25 percent often corresponds to *most* of the suitable black-backed woodpecker habitat. For example, after the 98,000-acre King fire in the central Sierra Nevada in 2014, the Forest Service logged only 23 percent of the fire area in Eldorado National Forest, but that resulted in the clear-cutting of 80 percent of black-backed woodpecker nest sites.[23]

Making life even more challenging for black-backed woodpeckers is a recent Forest Service–funded study that misleadingly claimed that black-backed woodpeckers are avoiding the most intensely burned interior areas of large forest fires.[24] The Forest Service's public relations department under the Trump administration pushed this message heavily in the media, generating numerous national news stories claiming that even the iconic black-backed woodpecker thinks fires are too big and too severe. This message was accompanied, of course, by calls for more postfire logging in large patches of snag forest in big fire areas. However, the Forest Service's public relations machine failed to tell journalists that the interior areas selected for this Forest Service study had been heavily logged after the fires. Black-backed woodpeckers do not avoid large high-intensity fire patches deep within big fires; rather, they avoid postfire clear-cuts.[25]

A subsequent study published data gathered in the large Rim and King fire areas shortly after the fires occurred and before any postfire logging operations. Without the confounding influence of postfire logging, the authors found that black-backed woodpeckers *preferred and selected* interior areas of these large fires in the most intensely burned locations farthest away from unburned forest or lower-intensity fire areas.[26] Notably, this study was coauthored by a few courageous Forest Service–funded scientists who stuck to the evidence and risked straying from the agency's political messaging.

Unaware of the political and economic forces lined up against it on the right and the left of the political spectrum, the little black-backed woodpecker fights to survive. Even in a good year, when significant amounts of habitat are created by fire or drought, much of this habitat is destroyed by postdisturbance "salvage" logging operations that disproportionately target the best black-backed woodpecker habitat—places with the highest density of medium-sized and large snags—on both private and public lands.

But the fate of this rare and reclusive bird, and that of the many other wildlife species that indirectly depend on it, seems to be of little concern to the clamoring political forces that promote the myth of catastrophic wildfire and demonize patches of snag forest. Perhaps we should listen more to the little black woodpecker and what it has to teach us. We might learn something.

# 9

# Climate Change Enablers

The climate change enablers probably aren't who you think they are. After all, they frequently and vocally proclaim that climate change is a major threat to the biosphere and human communities, and they often promote or propose policies they claim will mitigate the climate crisis. But, whether they do it cynically or innocently and unknowingly, climate change enablers engage in a new and insidious type of climate change denial. Specifically, by denying the necessity of protecting the forests, by denying forests' ability to absorb far more $CO_2$ from the atmosphere, and by denying logging's contribution to large increases in $CO_2$ emissions, climate change enablers threaten our ability to move toward true climate solutions and pose a substantial risk of making things worse.

In late May 2019 I attended a field trip to the Rim fire area with representatives from the US Forest Service, California state agencies, the California governor's office, forest scientists, and forest conservation groups. My colleagues and I had worked to organize this field trip for months, pressuring state and federal agencies to agree to the trip by showing up and commenting at public hearings, generating media coverage, and using social media. By the fall of 2018, dozens of grassroots environmental groups and some national groups had become involved in the campaign. The state and federal agencies knew they couldn't keep brushing us off, so they finally yielded, and the trip was on. Our goal was simple: show agency representatives firsthand that the assumptions they were making to justify additional postfire logging in snag forest habitat were incorrect.

As discussed earlier, the agencies were improperly using a $28 million HUD grant to subsidize a huge postfire clear-cutting project in remote public forests in the Rim fire area. The funds were supposed to be used to rebuild communities impacted by recent climate-related calamities, including hurricanes, and make them better climate adapted. Instead, large areas of snag forest were targeted for a "clear-cuts for kilowatts" project—where the snags would be felled, hauled to biomass power plants, and incinerated for energy production. The agencies claimed the forests were not naturally regenerating in these large high-intensity fire patches, and they argued that "active management" (clear-cutting, spraying herbicides, and creating commercial tree plantations) was needed to restore tree cover to these areas, which had supposedly been "deforested" by the Rim fire. Our extensive field data collected in 2018 had proved this claim false, but the agencies had ignored the data we sent to them. We figured it would be harder for them to ignore the rapidly regenerating pine and fir forests if they saw them with their own eyes.

Initially, the agencies agreed to visit numerous snag forest locations. We believed this was essential. If we visited only a couple of locations, we knew that some of the pro-logging entities would later imply that these sites were not representative of the majority of large high-intensity fire areas. As the date neared, however, the agencies began to balk, offering one hollow excuse after another to drop locations. In the end, they agreed to briefly visit only one snag forest. But the event was on, and we resolved to make the best of it.

Representatives from more than fifteen conservation and climate change groups, including the John Muir Project, the Sierra Club, Greenpeace USA, and Geos Institute, participated in the field trip. It turned out that the Forest Service and the state agencies had invited two elderly, well-known forest policy specialists from local groups that described themselves as forest conservation organizations but actually spent much of their time working with the logging industry and promoting commercial logging of old forests and postfire clear-cutting. We also learned that a representative from The Nature Conservancy (TNC), a large national organization, had been invited by the pro-logging agencies and would be in attendance.

The day before the official field trip, some of us, including a representative of California governor Gavin Newsom, visited many of the snag forest areas the agencies had refused to visit. As we hiked through one large snag forest patch after another, the governor's representative had difficulty concealing her surprise at the abundance of natural regeneration in these places where supposedly none existed. Even locations more than 200 or 300 yards in any direction from the nearest surviving tree were full of young pine, fir, and cedar saplings—often hundreds per acre—along with black oaks and patches of native shrubs. The tops of many of the pine saplings were over our heads as we hiked past them. It was lush and vibrant, not at all what the governor's representative had been told she would see.

The sun began to set while we were in the last patch of snag forest, and the activity of the native woodpeckers, warblers, bluebirds, and others dramatically increased as the heat of the day quickly waned. "Oh my God, that's amazing," the governor's representative said. We agreed, but we reminded her that all the rich, wonderful snag forest areas we had visited were scheduled to be clear-cut for biomass energy production, based on the claim that they were devoid of natural forest regrowth.

The following day, the main field trip began. The agencies promoting the clear-cutting plan had arranged for a bus to drive participants to several stops along the route. The final schedule, released by the agencies just days earlier, indicated that several stops and discussions would occur before we visited the single snag forest patch at the end of the day. The itinerary called for representatives of the Forest Service to give presentations, along with the two older Forest Service–affiliated "environmentalists" and a TNC representative. The three latter speakers repeatedly stressed how concerned they were about fires in the era of climate change. They expressed the standard "catastrophic wildfire" view that large wildfires like the Rim fire are destroying forests and that we should intervene with active forest management to make forests more "resilient." They raised the specter of a "reburn," suggesting that all the "fuel" in the snag forest areas would make the next fire burn much more intensely. One of them claimed that huge areas burned in the Rim fire had been deforested, but he could not identify or describe a single such location when asked. It didn't matter that my colleagues and I had conducted exhaustive scientific surveys across all these snag forest areas just months earlier and could not find a single acre that lacked natural postfire conifer regeneration. Nor did it matter that the overwhelming weight of scientific evidence has determined that snag forest burns mostly at lower intensities if another fire occurs, while postfire logging and the creation of tree plantations result in *higher* fire intensity.[1] Their presentations weren't about the facts or the evidence. The speakers had a narrative that played well to people's fears.

At the last stop of the day—the snag forest site—the attendees saw for themselves the ample natural regrowth. They heard from representatives of many conservation and climate change organizations who had personally visited numerous such snag forest sites in the Rim fire area the day before and who strongly opposed the clear-cutting project. Many of them noted that the planned postfire logging would kill most of the naturally regenerating conifer saplings, which would be rolled over and pulverized by the ground-based logging machinery.

A courageous representative of one of the state agencies spoke up and said she was very concerned about the postfire logging plan, in light of the natural regeneration occurring in the snag forest. She suggested that the agencies pause and take a closer look at the level of forest regrowth and the likely adverse impacts of postfire logging. Another state representative quickly agreed with her and began to tell the group why he thought the logging project should be paused, but he never got a chance to finish. The primary administrator of the HUD clear-cutting grant ran into the middle of the group and interrupted, saying that the decision to proceed with the clear-cutting had been made, the $28 million in federal funds had been allocated, and there was no going back and nothing to discuss. Dissent had been suppressed.

Another agency representative informed the group that the pro-logging forces had the "consensus [they] needed" to proceed with the Rim fire clear-cuts–for–kilowatts scheme. It was not lost on her, of course, that dozens of conservation and climate change groups—including those in attendance—were strongly opposed to the logging plan. What she meant was clear. The two self-described environmentalists and TNC rep-

*Top:* Rich, naturally regenerating snag forest habitat with ponderosa pine saplings, in proposed biomass clear-cutting Unit BB010 in the Rim fire area, prior to logging, 2018. *Bottom:* Unit BB010 after the clear-cuts–for–kilowatts logging was completed under the guise of "restoration," 2019. This area was a black-backed woodpecker nesting site when it was logged.

resentative invited along for the ride had given the agencies the political cover they needed to proceed with the massive clear-cutting project, even though it would send an estimated 3 million metric tons of $CO_2$ into the atmosphere and worsen the climate crisis.[2] What's more, in this new and deceptive type of climate change denial, proponents of the Rim fire clear-cuts–for–kilowatts scheme, including three Forest Service scientists in attendance, promoted it as a necessary measure that would make the forest landscape more "resilient" to climate change, ignoring the evidence before them regarding natural postfire conifer regeneration and the enormous carbon emissions that would occur if the logging proposal proceeded.

Another recent example of climate change enablers greenwashing the climate crisis involves a report written by the Trump administration's Department of Energy (DOE) through the DOE-funded Lawrence Livermore Laboratories, in coordination with TNC and the biomass logging industry. The report focused on California, acknowledging that moving beyond fossil fuels is not enough and that we must take steps to draw down atmospheric carbon. So far, so good. However, instead of advocating increased forest protection, the report promoted a nightmarish scheme that would entail a more than *tenfold* increase in commercial logging and the incineration of trees and chaparral, under the guise of natural climate solutions and "waste" utilization. What's more, it specifically promoted the logging of mature trees for lumber (sawtimber) to increase logging companies' profits.[3]

But the report committed a profoundly misleading bait-and-switch tactic to promote this massive increase in logging. As support for the logging increase, it cited the 2018 California Forest Carbon Plan, which recommended annual forest "health and resiliency treatments" heavily dominated (at least 80 percent) by fire, not by logging.[4] The studies on which the California plan relied recommended more managed wildland fires—allowing lightning ignitions to occur, without fire suppression, in remote areas to restore forests with mixed-intensity fire.[5] Even though the other 20 percent of "treatments" would entail "thinning," the studies emphasized noncommercial thinning of very small trees (also known as "hand thinning") adjacent to homes for community protection, rather

*Top:* Beautiful natural forest regrowth and wildlife habitat in proposed biomass clear-cutting Unit BB036 in the Rim fire area, prior to logging, 2018. *Bottom:* Unit BB036 after execution of the clear-cuts–for–kilowatts plan, 2019. This was a black-backed woodpecker nesting site at the time it was logged.

than commercial thinning of mature trees in remote wildlands. Yet the report by DOE, TNC, and the biomass logging industry failed to mention this context, severely misrepresenting the cited sources and proposing that the entire project consist of commercial logging, which it falsely claimed was the "least cost-intensive" approach. This claim was directly contradicted by one of the key studies on which the California plan relied, as the authors noted that "letting a natural ignition burn as 'managed wildfire' [is] more efficient, cost-effective, and ecologically beneficial than mechanical treatments."[6] And unlike logging, wildland fire creates key wildlife habitat elements, such as snags, and it cycles nutrients, which enhances forest productivity and carbon sequestration capacity.

The DOE-TNC report also claimed that its proposal would "maximize in-stand carbon." For this assertion, the report relied on an unpublished 2019 document that had not gone through the scientific peer-review process and was not even available online. The DOE-TNC report incorrectly assumed that increased logging would reduce fire intensity and result in "avoided emissions" and that removal of "suppressed" and dead trees would result in a net increase in forest carbon storage. It did not mention that the most comprehensive research has found that logging tends to increase fire intensity and causes a large overall net loss of forest carbon storage and a substantial increase in carbon emissions.[7] Nor did the report take into account the significant reduction in forest carbon and storage capacity caused by logging due to nutrient removal and soil compaction. Moreover, there was no meaningful assessment of the serious effects on biodiversity resulting from such an unprecedented increase in commercial logging and no mention of the environmental laws that would certainly have to be weakened or eliminated to facilitate the increase. The DOE-TNC report alluded to other, hidden assumptions about wildland fire, but the authors refused to justify these assumptions to the public, and they denied my request to provide me with the sources of these assumptions; they also denied my request for a copy of the unpublished 2019 document.

Bizarrely, the DOE-TNC report proposed the construction of a massive series of $CO_2$ pipelines across California to transport the $CO_2$ that would supposedly be captured at biomass power facilities after incinerating forests and chaparral for energy production. It made the cavalier suggestion that the $CO_2$ could be pumped underground in the Central Valley of California, focusing on areas with abundant oil and natural gas in the region (notably, this practice of $CO_2$ injection is used as a form of fracking to increase the extraction of natural gas and oil). The report blithely mentioned "geologic" issues but did not include any candid assessment of the risk that enormous vaults of underground $CO_2$ would be released during earthquakes or that pumping $CO_2$ underground would likely cause an increase in quakes.[8] Nor did the report include any candid assessment of key environmental justice issues, such as the huge increase in toxic and particulate emissions into lower-income communities of color resulting from the massive proposed increase in forest biomass incineration (the largest biomass incineration facilities in California have been constructed in such communities). The DOE-TNC report is just another series of false solutions offered by those seeking to continue or increase the destructive practices that caused the climate crisis—using carbon fuels for energy and cutting down forests—rather than promoting positive changes.

TNC's involvement in yet another scheme to increase logging is part of an emerging pattern of climate change denial. TNC now owns commercial timberlands and engages in industrial logging there, selling timber as a commodity and profiting like any other logging corporation—except that, as a nonprofit corporation, TNC gets a tax break. Recently, TNC and Bain & Company proposed increased logging in forests, arguing that this would enable more carbon storage in wood products such as cross-laminated timber, also called mass timber, for tall buildings. TNC and Bain & Company explicitly promoted this as a climate change solution but did not address the fact that about 80 percent of the wood in logged trees rapidly ends up in the atmosphere as carbon emissions or the fact that logging significantly reduces forests' carbon sequestration potential.[9] TNC recently opposed biomass logging, but only in the very narrow context in which clear-cut areas are turned into housing developments; otherwise, it has endorsed biomass logging as a supposedly climate-friendly alternative to fossil fuels.[10] TNC failed to mention that incinerating trees for energy is even more polluting than burning coal.[11] Moreover, TNC is profoundly out of step with the hundreds of top climate scientists and ecologists who have noted that logging for biomass energy or wood products is a major source of carbon emissions in the United States and that we need to shift away from wood consumption and protect our forests from logging to overcome the climate crisis.[12]

Regardless of whether they call themselves environmentalists, individuals and organizations that promote activities that pull carbon from underground or out of the forest in the name of climate solutions are greenwashing the climate crisis.

Climate change enabling has become common among liberal US lawmakers who, under the banner of climate change solutions, are proposing misguided measures that are at best insufficiently ambitious to address the climate crisis or at worst likely to exacerbate it. For example, the CLEAN Future Act, released in draft form in January 2020 by Democratic leaders, was promoted as a "clean energy" bill. But alarmingly, it included polluting carbon fuels such as natural gas, coal, and forest biomass incineration as "clean energy," and it proposed subsidies and credits to facilitate increased logging of forests for biomass energy production.[13] Nowhere did the bill acknowledge the fact that incinerating trees for energy is even worse than burning coal. Nor did it consider the fact that biomass incineration power plants and wood pellet factories are commonly located in the poorest communities, where they emit harmful particulates and pollutants every day and increase flooding in communities that are already at risk due to climate change.[14] Moreover, the draft bill stated a goal of achieving "net zero" carbon emissions by 2050. But we need to do much more than reach carbon neutrality (net zero) by 2050. Carbon neutrality only ensures that atmospheric carbon levels won't rise even higher. They are already far too high, and the goal of reaching net zero three decades from now does not address the magnitude of the climate crisis. We need to rapidly decarbonize our economy and draw down the dangerously high levels of greenhouse gases in our atmosphere by protecting forests and reducing wood consumption.

It may surprise many to learn that more logging occurs in the United States than in any other nation in the world.[15] This means that the United States is the biggest culprit in terms of carbon emissions from logging, and it has a global responsibility to dramatically reduce logging and wood consumption—just as it has a responsibility to transition away from fossil fuels. However, this goal is being undermined by climate change denial from leaders who propose actions that superficially sound like solutions to the climate crisis but in reality are woefully inadequate or even harmful.

At a recent hearing of two subcommittees of the Democrat-led House Energy Committee, speakers associated with the logging industry and funded by the Trump administration were invited to promote the logging of forests, consistently misrepresenting forest and climate science and denying logging's role in making climate change worse. Not to be outdone, House Republicans introduced their own climate greenwashing bill in 2020. Representative Bruce Westerman, who typically receives more campaign contributions from the logging industry than any other member of the House, introduced the Trillion Trees Act, with the support and encouragement of the Trump administration. A more appropriate name would be the "Trillion Stumps Act," as the bill explicitly encourages ever-increasing levels of logging on public and private lands in the United States and promotes increased logging in tropical rainforests around the world. The bill's enhanced funding for "reforestation" is highly misleading, as it entails subsidizing the creation of tree plantations after clear-cutting—a proposal that, in practical terms, promotes clear-cutting by reducing costs through these subsidies. (The Forest Service is required to plant trees after clear-cutting, but funds for such activities are often limited; by funding tree plantations, the Trillion Stumps Act would, in essence, finance clear-cutting.) The bill would also override environmental laws to allow land managers to use old environmental analyses from prior logging projects to justify new logging projects, regardless of how outdated the science might be in the old documents.

A more subtle type of climate change enabling has become common among US government–funded scientists over the past two years: they acknowledge the climate crisis but downplay its significance while misrepresenting the science pertaining to forest fires and promoting logging in remote forests. In one case, carbon emissions from forest fires were inflated to demonize fire, while emissions from fossil fuel consumption were presented as relatively less consequential.[16] The false message communicated to the public was that perhaps we should worry less about fossil fuel consumption and more about forest fires, and that increased logging is a viable solution to climate change.

In another example, a Forest Service–funded scientist claimed, without any scientific support, that climate-related factors are responsible for only 25 percent of forest fires, citing the logging industry myths of overgrown forests and fuel accumulation to explain the other 75 percent. The comment was quickly celebrated by right-wing, antienvironment commentators.[17] It was also used as vindication for Donald Trump's denial of the role of climate change in wildfires and to support his policies promoting the rollback of environmental protections and increased logging in public forests.[18]

Similarly, an article in *Forbes* quoted US Forest Service and US Geological Survey scientists who downplayed climate factors in wildland fires and claimed that forests are burning more intensely because they are too dense, implying that lack of logging is to blame.[19] These scientists, funded by the Trump administration, were actively communicating the administration's climate change–denying message to environmental journalists. Completely absent from their comments is an acknowledgment of scientific research that has found that the densest forests experience mostly lower-intensity effects when fires occur.[20] Nor do they acknowledge that the most comprehensive scientific analyses have found that increased logging is generally associated with higher fire intensities in wildland fires.[21] And tellingly, none of these government-funded scientists mention the increased carbon emissions into the atmosphere caused by logging.[22]

Many politicians, agencies, organizations, and industries have various political and economic motives to greenwash the climate crisis and act as enablers for actions that may worsen the crisis. However, many other climate change enablers have no such motivations. Many are honest, concerned people who have been influenced by disinformation about forests, natural disturbance processes, and climate, including some environmental and climate movement leaders. For these green advocates, their chief vulnerability is fear. Concern motivates, but fear undermines critical thinking, clouds judgment, saps hope, and leads to problematic views and bad decisions that can worsen the climate crisis.

A case in point is the 2019 film *Wilder than Wild,* which depicts the Rim fire as the bogeyman of the climate crisis. The film's thesis is, essentially, that fuel accumulation from decades of fire suppression, in combination with climate change, has created conditions conducive to catastrophic megafires like the Rim fire. Using commentary from numerous people associated with the Forest Service and logging industry advocacy groups, the film promotes the notion that the Rim fire deforested a vast landscape that will never naturally regenerate. The audience is told that our forests are becoming carbon sources because of large fires. Active management—that is, logging—is promoted as the solution, and the film includes scenes that depict postfire logging in a favorable light.

The filmmakers had clearly been misinformed by the Forest Service and logging interests, and my sense is that the film's false and misleading claims are more innocent and fear based than cynical. My colleague and I spent time in the Rim fire area with one of the filmmakers, and I found him to be thoughtful and genuinely concerned about forest ecosystems and climate solutions. We spent one spring day hiking through large patches of snag forest habitat and saw a tremendous amount of natural conifer regeneration occurring, even hundreds of yards from any live mature tree. We found that an extremely small proportion of tree biomass had actually been consumed in the fire, and a remarkable number of native birds had taken up residence in the snag forest habitat.

Given what the filmmaker saw with his own eyes, he clearly understood that many of the assertions and claims in *Wilder than Wild* were false or misleading. Yet I think it is far too simplistic to suggest that the film's content is the result of deliberate dishonesty. The problem is subtler than that. The politics of fear can skew one's thinking and perceptions to such a degree that normal modes of critical thinking and adherence to evidence no longer apply. In this case, the Forest Service and logging advocacy groups turned the filmmakers' good-faith concerns into a sort of mindless fear. As a result, decent people who care about forests and climate change produced a film that endorses a point of view that, if put into action, would result in fewer environmental protections for forests, increased logging, greater loss and fragmentation of wildlife habitat, higher carbon emissions, and a worsening of the climate crisis.

I later sent the filmmaker numerous peer-reviewed scientific studies and a letter from more than 250 scientists concluding that the big patches of snag forest habitat created by large fires are "ecological treasures" and represent "some of the best wildlife habitat in forests." I sent him an email and asked why his film conveyed the opposite notion—that big fires destroy forests and wildlife habitat—and I wondered why his film implied that forests don't naturally regenerate when he saw with his own eyes that they do. His response was polite, but he dodged my question by saying that not all content could be included in the film. Perhaps, but that doesn't explain why the film contained so much inaccurate and scientifically discredited information. My sense is that fear prevented him from acknowledging the science proving the ecological value and importance of snag forest habitat created by so-called megafires.

My recent conversations with a couple of environmental leaders underscore the problem. One of them said to me, "We can't rely on our forests to help with climate change because they're all burning up." When I pointed out the broad consensus among scientists that there is less mixed-intensity fire now than a century ago, that only a tiny percentage of tree carbon is consumed in even the largest fires, and that even high-intensity fire patches are experiencing vigorous natural regeneration, he was clearly skeptical. He smiled in a way that suggested he was unconvinced, shook his head, and said, "I don't know," ending the conversation.

Perhaps it was something he had read. For instance, one recent article in a prominent magazine falsely claimed that old-growth trees are "incinerated" in "megafires," and thousands of acres of forest are "consumed."[23] Though dishonest and factually inaccurate, this kind of conceptual imagery can be powerful; it creates vivid impressions among people who may not spend much time in the forest. Sensationalized or fictionalized reporting is a stubborn problem, and highly dramatized accounts of forest fires are apparently very popular among readers. This type of story is viewed as "good copy," and editors may be reluctant to admit mistakes or rein in hyperbole, which in turn exacerbates the misinformation being disseminated to concerned citizens, as well as the fear they may be feeling. A large group of scientists sent a letter to the magazine in question, politely pointing out some of the numerous inaccurate statements in the story, but the magazine never replied (which does not inspire confidence).

Another environmental leader who considers himself a climate change policy wonk informed me that trees are dying at twice the rate they are growing in national forests. I conveyed to him the good news that this statistic was an example of misinformation contained on the website of a right-wing logging industry advocacy group. The group cited a US Department of Agriculture report as its source, but it falsified data from the report to promote a political narrative that advanced its logging agenda.

My acquaintance then told me that nearly all the conifer trees had died across nearly 100 million acres of US forests due to native bark beetles. I again conveyed the good news that nothing of the kind had occurred. The Trump administration had produced a series of maps showing about 100 million acres of forest representing "areas with tree mortality from bark beetles." The images were arresting and were intended to elicit fear and convey the impression that the highlighted forests had been killed—the message being that forests cannot be counted on as carbon sinks to mitigate climate change, so why protect them from logging? I reassured my environmentalist friend that the Trump administration's maps and figures were wildly misleading; in fact, the great majority of the areas had only one or two new snags per acre, and only a tiny percentage had sufficient tree mortality to be classified as snag forest habitat. To my surprise, he was not relieved. Instead, he dug in and cited his own anecdotal experiences in the Rocky Mountains, where he had seen some large patches of snags from recent tree mortality. The fact that these snag patches represented only a very small percentage of the overall forested region did not matter to him. He was unaware of the ecological importance of snag forest habitat, and what he had seen on his drive through the mountains had scared him. He gave himself over to fear and the self-reinforcing hopelessness it breeds. In doing so, he became susceptible to misinformation designed to facilitate business-as-usual logging. His intentions were pure, but he did not realize he had become part of the problem.

This has been an issue for a long time in the environmental community. In 1989, as my brother and I were hiking the Pacific Crest Trail, shocked by the extent of the clear-cutting we saw, some Democrats in Congress were attaching a logging rider to an appropriations bill. The "Section 318 Rider from Hell" suspended environmental laws and mandated the logging of 8 billion board feet of timber in northern spotted owl habitat on public lands in the Pacific Northwest. It doomed tens of thousands of acres of old-growth forest and pumped more than 25 million tons of $CO_2$ into the atmosphere (my estimate). The rider was the product of a political deal between establishment Democrats and powerful Republicans in the Senate and leaders of a prominent environmental organization. A few years later, I invited one of these environmental leaders to go on a hike with me, hoping to gain some insight into why he would make such a destructive deal. I assumed, at the time, that he had simply been operating from a cynical realpolitik standpoint, but I was wrong. As we hiked, I asked him about the logging rider. He wanted to change the subject, but I persisted. "Why did you do it?" I asked. "Because it could have been 11 billion board feet!" he erupted. I had completely misjudged him. He wasn't cynical; he was terrified. He was so afraid of losing that instead of fighting for what he truly believed in, he decided to guarantee a loss and manage its terms. But what would have happened if he and his colleagues had chosen to stand on principle and fight? For far too long, the environmental community has built its strategies around the fear of losing. But fear is the currency of political weakness. All positive social change has ultimately been driven by hope and inspiration.

Climate change deniers will accept the reality of the climate crisis on their own timelines, or they won't. As time passes, their numbers dwindle. Climate change exploiters and greenwashers will increasingly be seen for what they are. They have already chosen to place political expedience and the carbon economy ahead of the truth. My message is for those who may be enabling climate change unknowingly but are people of good faith who seek the truth and a real resolution of the climate crisis. I ask you to set aside fear and panic, which can only undermine progress toward overcoming the climate crisis. Let deep and genuine concern be your guide; have faith in the natural world and the courage to stand up and fight for what you believe in. The bad news accelerates when we avoid genuine change and pump more and more greenhouse gases into the atmosphere, but the good news will accelerate when we move beyond the carbon economy, protect our forest ecosystems, embrace biodiversity, and turn the corner on the climate crisis.

# 10

# The Logging Collaboratives

It was a five-hour drive for me and my colleagues. For the heads of the local logging company, it was just over an hour. No driving at all was involved for the Forest Service staffers—they just walked to the other side of the building. At first, I thought this was simply a matter of logistics—a time management challenge to overcome—but I later came to understand the deeper significance underlying these mundane details.

A decade ago, some colleagues and I decided to participate in a forest collaborative group in the south-central Sierra Nevada. The Collaborative Forest Landscape Restoration Program had been included in an appropriations bill passed by Congress in 2009, setting up a system of collaboratives in various forested regions near national forests. The premise of the program was that environmentalists, scientists, and concerned community members would get together with Forest Service staffers and representatives from the logging industry to discuss forest and fire issues, search for common ground, and try to come to some agreement regarding the management of public forestlands. On the surface, this sounded appealing to many people. My colleagues and I wanted to see whether this new program might lead to more ecologically defensible and less destructive forest management practices on public lands, so we joined the Dinkey Collaborative, named after Dinkey Creek in Sierra National Forest.

The meetings were held several times a year at the Forest Service's local headquarters in Clovis, California, at the edge of the western foothills of the Sierra Nevada. This was the first red flag. The second was that the facilitator who ran the meetings had been hired and paid by the Forest Service. Over time, a whole series of significant red flags was raised. For example, after consulting with the local logging industry, the Forest Service prepared each of the new "projects" the collaborative was asked to consider and potentially support. The proposals came complete with maps, management prescriptions, and background information that sought to justify the project. In every single case, the proposals were for new commercial logging projects in old forest habitat. Each proposal sought to remove thousands of mature and old-growth trees up to nearly eight feet in girth.

Because the collaborative was geographically located near the Sierra National Forest and met at the Forest Service's headquarters, the group was generally dominated by the local logging industry, off-road vehicle proponents, and Forest Service staff. Representatives of forest protection organizations lived much farther away and could not attend every meeting. This is typical. Invariably, these collaborative groups are dominated by local resource extraction and off-road vehicle interests, with minor or token representation from forest protection organizations. A majority of attendees at our meetings often supported the Forest Service's latest logging proposal, including the local logging company that stood to benefit financially from the timber sales. In fact, representatives from that company actually voted in favor of these timber sales as participants in the collaborative. In any other context, this would be considered a self-dealing transaction, which is a classic form of corruption. In logging collaboratives, it is considered standard operating procedure.

But there was another, more subtle problem. Although many of the representatives from environmental groups consistently opposed the logging projects proposed by the Forest Service, a small group of representatives from two national environmental groups and one regional group often brokered deals with the Forest Service, agreeing to support the latest logging proposal in exchange for minor environmental concessions. The pressure to fit in, to get along, and to reach agreement was obviously at work, especially in this context; pro-logging interests outnumbered forest protection advocates, and the agenda and path forward were being determined by the Forest Service and the logging industry. It was a star-

Typical "thinning" project supported by the logging collaborative in Sierra National Forest, 2012. This logging occurred near a California spotted owl nest site.

tling example of the psychology of conformity—a common phenomenon in collaboratives across the United States.

Soon, one of the representatives of a regional forest policy group—a self-described environmentalist—was promoting the local logging industry in the media and advocating more logging of mature and old-growth trees within the habitats of imperiled species such as the Pacific fisher and California spotted owl. To the heads of the local logging company, this "environmentalist" was a useful stooge. They knew how to take advantage of his insecurities and make him feel important in order to get what they wanted.

Although representatives of the two national environmental groups would not participate in such overt advocacy for the logging industry, they failed to strongly object when the Forest Service unveiled more and more new logging proposals. The Forest Service treated silence or tepid opposition as assent. In fact, the agency noted in the documents for each logging project that the Dinkey Collaborative supported the proposed timber sale. The collaborative was being used to greenwash the destructive logging of old forest in sensitive wildlife habitats—logging that was pulling huge amounts of carbon out of the forest and sending most of it into the atmosphere.

Representatives of most of the environmental groups that attended the collaborative's meetings consistently opposed the Forest Service's logging proposals, but this dissent was quickly managed and suppressed. Initially, the collaborative's process for making recommendations or decisions was described as "consensus," but given the concerns expressed by environmental representatives and the scientific studies submitted to and discussed with the collaborative, there was no real consensus. These studies indicated that the proposed logging projects would severely harm imperiled wildlife species; would likely increase, not decrease, fire intensity; and would make the forests less, not more, resilient to climate change.[1] One report on the Sierra Nevada commissioned by Congress concluded: "Timber harvest, through its effects on forest structure, local microclimate, and fuel accumulation, has increased fire severity more than any other recent human activity."[2] Soon, the collaborative changed the rules to require "modified consensus," which was a sanitized way of saying that dissenters would be ignored—especially those who kept bringing up inconvenient scientific findings.

Forest protection advocates in the collaborative proposed several nonlogging forest management practices, such as the active creation of new snags in snag-deficient areas or increased "wildland fire use" (allowing fires caused by lightning strikes to burn in remote forests, without trying to suppress them). Tellingly, even when members of the collaborative agreed to these recommendations, the Forest Service simply ignored them. The agency implemented only those collaborative-approved proposals that had been conceived and initiated by the Forest Service itself—and these were consistently commercial logging projects.

Dissent within the collaborative was suppressed by an endless series of pro-logging speakers who attended nearly every meeting. Almost all of them were invited and paid by the Forest Service, and somehow, their answer to every conceivable forest management question was more logging. But environmental representatives kept asking questions and raising concerns. Why was the Forest Service proposing a steady stream of logging projects? Was it trying to meet some sort of timber target goal being directed from above to satisfy political and economic objectives? The Forest Service maintained there was no internal pressure to "get the cut out" (i.e., generate a certain level of commercial timber output), and it claimed that every logging project was being conducted to achieve "forest health" and "fuel reduction." But that answer seemed disingenuous, and it didn't match the behavior of the Forest Service and was inconsistent with the weight of scientific evidence. So we kept raising the question, and the Forest Service kept flatly denying the existence of any timber targets.

One day, after a meeting of the collaborative and another series of denials from the Forest Service, I was in my car, ready to begin the five-hour drive home. Just as I was pulling out of the parking lot, a Forest Service employee rushed out the front door and flagged me down. I stopped and rolled down the passenger-side window, and he leaned in to talk to me. He told me that the Forest Service was lying to us: there were, in fact, specific timber targets for each national forest imposed by higher-ups in the agency.

After this conversation, I obtained the Forest Service document clearly listing the volume of commercial timber that each national forest was expected to produce annually, including Sierra National Forest. My colleagues and I submitted this document to the collaborative and confronted the Forest Service with the facts, which contradicted its previous statements. Its representatives were uncomfortable and embarrassed, but the political operatives running the Forest Service were not going to let a little shame change their course. So the Forest Service changed the subject and resumed the business of proposing new logging projects. Most of the environmental representatives objected or expressed concern, but what could they do? The collaborative was dominated and operated primarily by the Forest Service and the logging industry, and it was clear that dissent would be ignored. Shortly thereafter, the courageous Forest Service staffer who had alerted me to the reality of timber targets was reassigned to another region and quietly disappeared. The Forest Service

“Thinning” promoted by the logging collaborative in Sierra National Forest, 2012. This logging occurred near a Pacific fisher den site.

does not appreciate external dissent, but internal dissent from one of its own is simply not tolerated.

A recurring problem in the Dinkey Collaborative pertained to the treatment of scientific evidence, especially studies by independent scientists who were not funded by the Forest Service. During the collaborative’s meetings and field trips to the sites of proposed logging projects, Forest Service officials and logging industry representatives often made statements that were demonstrably false as they tried to justify and promote the latest logging project. I’m not referring to issues about which reasonable minds might disagree. These were true whoppers—misrepresentations of facts and evidence that were beyond the pale, such as the claim that fires spread faster than deer can run or birds can fly. As noted earlier, even the largest and most intense forest fires move at just a fraction of one mile per hour on average—if they moved as fast as a deer can run, a fire could cover tens of millions of acres in a single day.

When we objected to these myths and misrepresentations and attempted to correct the record, the Forest Service–paid facilitator often said, “Every opinion here has equal value.” That sort of platitude sounded nice in the abstract, but when decisions were based on outright falsehoods—decisions that threatened already imperiled wildlife species and exacerbated climate change—we felt there should be a better process for upholding the truth and the scientific evidence. Do two opinions really have equal value if one is consistent with current science and the other is flatly contradicted by the evidence? Of course not. Nevertheless, our concerns fell on deaf ears.

Another troubling issue was the collaborative’s so-called charter, which was written mainly by the Forest Service and the local logging industry, with some input from the few environmental representatives willing to make deals with the Forest Service. In essence, the charter was a blueprint for more commercial logging operations in the national forest. The document was replete with deceptive and misleading logging industry talking points, including numerous references to the removal of trees ostensibly to “restore” historical forest conditions, which it erroneously claimed were characterized by low-density stands. In this vein, it promoted more logging “contracts” to make the forests more “resilient” to climate change. My colleagues and I managed to insert some minor text about allowing some lightning fires to burn without suppressing them and the ecological importance of snags, but none of this language was binding, and for the reasons already discussed, it was ignored by the Forest Service.

The federal law that created the Collaborative Forest Landscape Restoration Program contained no requirement for the creation of or adherence to any such charter for a given collaborative. Regardless, the Forest Service and its paid facilitator continually pressured attendees to sign the charter, using it as a sort of loyalty oath to impose conformity and marginalize views that did not comport with the Forest Service’s pro-logging orientation. I declined to sign it, as did some others. I was not compelled by law to sign such a document, and given that I had well-considered scientific objections to many of the statements and assumptions it contained, I thought my refusal was reasonable. Moreover, I felt that the relentless pressure on participants to sign their names to the charter gave the collaborative a somewhat creepy, vaguely cult-like aspect.

The Forest Service, however, continued to insist that I sign the collaborative's charter, so I emailed my signature, along with a memo explaining why I was signing and identifying the elements of the charter that I considered scientifically problematic. Among other things, I noted that the charter explicitly incorporated two Forest Service reports that promoted the logging of mature and old trees. These reports had never been vetted through the scientific peer-review process, and they contained numerous scientifically inaccurate statements and assumptions. The collaborative had never carefully considered the scientific integrity, or lack thereof, of these Forest Service reports or taken a position in support of them, so I objected to their reference in the charter as some sort of foundational documents or guidance. I also noted that the federal law that created the Collaborative Forest Landscape Restoration Program mentioned "small" trees but never said anything about removing and selling mature and old-growth trees from public lands. In my view, the collaborative's behavior and the charter's language were not consistent with the underlying federal policy. Then I briefly conveyed my experiences as a scientist participating in the collaborative and my concern about a prevailing "environment that is often fairly unreceptive, even hostile on occasion, to scientific information that runs counter to the Forest Service's timber management objectives."

The facilitator paid by the Forest Service responded, telling me that the "charter is a stand-alone document for you to either entirely accept or not accept as it is currently written." My signature would be rejected if it was accompanied by any criticism of the charter or any questioning of the basis for the Forest Service's logging program. In response to my comment about the collaborative's resistance to science that questions the Forest Service's assumptions, the facilitator added that "maybe the Dinkey Collaborative is not the right group for you to be a part of." In a similar vein, in response to my comment that federal law did not envision the commercial logging of mature and old-growth trees, the facilitator doubled down on his previous statement and wrote, "perhaps this is not the right collaborative effort for you." The Forest Service stated in no un-certain terms that I would "become a member of the Dinkey Collaborative" only if I withdrew my scientific concerns. I stood by my assessment and critiques, which meant that I was out of the collaborative and could play no meaningful participatory role, even though this was a federally funded program pertaining to public lands that held its meetings in a public, federally owned facility. Several other environmental leaders left in the aftermath.

I have spoken to dozens of US forest protection advocates from the Sierra Nevada to the Rockies, from the southwestern forests east to the Appalachians. Their stories are very similar. In case after case, collaboratives tend to be dominated by Forest Service and logging interests, as well as by off-road vehicle and ranching or mining interests in some places. Ecological science takes a backseat to resource extraction—usually logging.

In the Ochoco Collaborative in eastern Oregon, local logging companies, The Nature Conservancy (TNC), and the Forest Service are pushing for increased logging of large, old-growth trees in dry pine forests on public lands, according to Paula Hood, codirector of the Blue Mountains Biodiversity Project based in Fossil, Oregon. Hood notes that the collaborative recently submitted a letter objecting to a proposed logging project because it did not remove *enough* big trees. The collaborative requested that *additional* large, old trees be logged in the Black Mountain timber sale in Ochoco National Forest to make the project more profitable for logging companies. As Hood put it, "The implications of the collaborative group's objection, with TNC as a lead objector and supported by timber interests, are huge and threaten to put many thousands of large and old trees at risk of being logged." During one meeting of the collaborative, Hood discovered that TNC's representative was being funded by the US Forest Service (USFS). "The TNC representative being paid for work by the USFS is one of two examples I know of in which a person who is very USFS and logging-friendly on a collaborative group is also being paid, at least in part, by the USFS," she told me. "Neither of these examples were put forth in a particularly transparent manner—in both cases, it just happened to come up one day while I was present at a collaborative meeting."

Stories from the northern Rocky Mountains convey a similar tale. Mike Garrity, executive director of the Alliance for the Wild Rockies, described his experiences in a collaborative pertaining to Helena National Forest in Montana. At issue was a huge proposed timber sale known as "Ten Mile," and a collaborative group was formed. Garrity recalled the atmosphere of participation and apparent goodwill at the formation of the collaborative. "The Forest Service, the City of Helena and Lewis and Clark County, local hunting and fishing groups, local residents, and environmentalists all participated," he told me. Among other things, the collaborative agreed that no new permanent roads would be built in the watershed at issue, and importantly, no roads would be built into roadless areas. Conservationists were particularly concerned about the integrity of two beautiful roadless areas in the watershed—both of which were proposed for wilderness designation by the Northern Rockies Ecosystem Protection Act. This was truly wild country—home to wolverines, grizzly bears, lynx, and elk—but it was still very accessible from downtown Helena, Montana. As part of this collaborative agreement, the Forest Service stated in writing that it would not log the roadless areas. "In the end, we looked each other in the eye and signed an agreement we could all live with that protected Helena's watershed. Since we were all Montanans, we trusted each other to keep our word," Garrity reflected. But because the Forest Service didn't get what it really wanted, it just ignored the agreement. Not long afterward, it signed a decision to log 11,650 acres, clearcut 2,239 acres, and bulldoze 15 miles of new roads into the roadless areas to facilitate extensive logging within them. Garrity's outrage over the betrayal persists. "We met for nine months and reached an agreement that the Forest Service promptly violated when they signed their decision," he recalled.

Veteran biologist, conservationist, and author George Wuerthner participated in several collaboratives in the eastern Cascades of Oregon, always with the good-faith hope that participants would heed the findings of new and emerging ecological science, but these ventures always led to disappointment. Wuerthner recounted, "First, they all started out with some unchallenged assumptions. For instance, logging was going to be the cure for 'forest health,' and of course another assumption was that the forests were unhealthy. There was no room to discuss these assumptions. In other words, if you didn't agree with these basic starting points, you were not welcome to participate. Science is always used in these meetings, but selective use of science. Alternative views are not welcomed." In Wuerthner's view, one of the primary and pervasive failings of these collaboratives was "the problem of disproportionate representation" by individuals who were either directly employed by the logging industry or local or county politicians aligned with timber companies and funded by the logging industry. "So, you might have twenty people attending a meeting, and typically sixteen to eighteen people in that meeting were pro-logging," Wuerthner told me. That skewed representation was made worse by the fact that meetings were always held on weekdays, when most people were at their regular jobs. But for representatives affiliated with the logging industry and the Forest Service, attendance at these meetings was part of their job description. Wuerthner summed up the problem: "The only people who can attend are paid to be there, so this tends to disproportionately represent those with a vested financial interest in the outcome." And according to Wuerthner, the few conservationists who could attend these meetings had no ecological training and "simply did not have the ecological context to understand the issues." This made it easy for representatives of the Forest Service and the logging industry, who were more numerous anyway, to push proposals forward based on questionable assumptions. In this context, any objections tended to be weak and ineffective. However, the token participation of a few self-described environmentalists was marketing gold to the Forest Service and the logging industry, and they frequently promoted logging projects as being approved or endorsed by local "environmentalists." In this sense, the collaboratives served mainly to greenwash the latest logging and clear-cutting plans on public lands.

Sometimes these collaboratives take on a darker and even more troubling aspect. In such cases, forest protection advocates are not merely marginalized or ignored but personally attacked simply for questioning the activities and assumptions of the collaboratives. Sarah Hyden of WildEarth Guardians told me about a collaborative in New Mexico, the Greater Santa Fe Fireshed Coalition, that recently targeted her. "The Fireshed Coalition has seemingly been given primary responsibility for carrying out the Forest Service's public outreach concerning projects," she said. "They do not allow any perspectives but their own to be presented at public meetings and sometimes employ tactics to obstruct or discredit those who they consider to be opposition." Similar to other collaboratives, the Fireshed Coalition has financial conflicts of interest, in that some of the "partner agencies and organizations have various interests in fuel treatment projects, including obtaining contracts and funding for project work," according to Hyden. These projects, which the Forest Service euphemistically promotes as "fuel reduction," often involve the cutting and killing of up to 90 percent of the trees in stand after stand across large portions of entire watersheds, causing severe ecological damage. Hyden and others have asked the Forest Service to prepare an environmental impact statement before going ahead with any more such projects, but the agency has refused, and the Fireshed Coalition provides it with political cover.

Luke Ruediger, Siskiyou conservation director for Klamath Forest Alliance and executive director of Applegate Neighborhood Network, shared his experiences with one collaborative and described an eye-opening series of conflicts of interest:

> Despite supporting the concept and practice of collaboration, many in the conservation community in southwest Oregon have strategic, scientific, ecological, and ethical concerns about local forest collaboratives. There are concerns about how they influence public land management, use selective interpretations of regional ecology, and operate in exclusivity. There are also concerns about the projects they support and implement.
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> The local "forest collaborative," known as the Southern Oregon Forest Restoration Collaborative (SOFRC), lacks any truly collaborative decision-making structure and is instead governed by a seven-member board of directors. Currently, the board of directors includes the vice president of the Southern Oregon Timber Industry Association, former BLM [Bureau of Land Management] silviculturalists, former Oregon Department of Forestry officials, and representatives of local "forest restoration" groups involved in commercial logging projects on federal land. In some cases, "collaborative partners" are actually funding federal planning efforts, funding and implementing on-the-ground treatments, designing timber sale units and layout, marking the trees, log-

> ging the trees, and selling those trees to industrial mills, creating a significant conflict of interest.
>
> Currently, SOFRC is promoting the Rogue Basin Cohesive Forest Restoration Strategy (RBS), a landscape-scale “restoration” plan focused on manual thinning and vegetation management across the entire Rogue River Basin. The RBS was developed with virtually no input from conservation interests and proposes a massive increase in public land logging, including commercial logging in inventoried roadless areas, botanical areas, research natural areas, national monuments, and late successional reserves. The proposal focuses on “balancing” seral stages by logging late successional, closed canopy forests and converting them to open forest habitats through commercial logging that includes significant canopy reduction and absolutely no diameter limit. In response, federal land managers have begun incorporating the RBS into federal land management projects, leading to extremely controversial logging projects and “restoration thinning” prescriptions that would have targeted stands between 180 and 240 years old, removed northern spotted owl habitat, logged large fire-resistant trees, and reduced canopy cover to below 30 percent. Other recent projects have included a “Modified Rogue Basin Strategy Alternative” that would eliminate important requirements for site-specific scientific analysis and public comment on individual timber sales, while allowing up to 25,000 acres of commercial logging and 90 miles of new road construction to be implemented over a ten-year period.
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> In southwest Oregon, forest collaboratives have become de facto members of the timber lobby by encouraging “active management,” undermining environmental regulations and protections, sidestepping the public involvement process, and pressing for commercial logging activities in currently protected landscapes.

Similar concerns and issues have arisen in my conversations with representatives of Native American tribes. Marissa Fierro, currently with the California Indian Environmental Alliance, represented tribal interests in a collaborative in the Sierra Nevada in California. She described a consistent pattern of orientation toward the wishes of local logging companies, often at the expense of Native American cultural values, traditional ecological knowledge, and biodiversity. She said:

> Given the historical context of western colonization and land management practices within northwest California, there exists an unspoken precedence in some rural communities to disregard precolonization (indigenous) land management practices. Rural forest collaborative groups are often dominated by families tied to the local logging industry for generations. Large timber interests and local contractors have found a synergy that feeds off federal funds allocated for "forest management." Forest policy and forest practice terminology are often misused within proposal language, inflating project needs and benefits. Other collaborative members and tribal governments with a priority focus on conservation, biodiversity, and ecological cultural values become marginalized. Group dynamics remain biased as federal land management entities remain as the ultimate decision-making authority in term of which projects are prioritized for funding.

I have traveled all over the country and spoken with many different people who have participated in collaboratives in an effort to stand up for ecological science—some of them volunteer forest activists, some of them scientists, and some of them environmental attorneys. The details change from area to area, but the basic elements of the story are always the same: the rules and realities of participation strongly favor logging and other extractive interests, including the Forest Service; there is an unmistakable hostility toward biodiversity interests or forest and fire ecology produced by researchers who are not funded by the Forest Service; and the Forest Service tends to ignore a collaborative's recommendations or agreements if they do not prioritize commercial logging. Logging collaboratives are like casinos: the system is rigged, and the house always wins.

As someone who participated in a collaborative for four years, I know of what I speak. Based on my experiences and my interviews with others, I have to conclude that the collaborative system, including the Collaborative Forest Landscape Restoration Program, is a failure to the extent that its goal was to foster participation by a representative cross section of the American public to achieve better and more scientifically informed forest management decisions. If, however, this program's true goal was to shift power over forest management decisions to local logging interests and give pro-logging politicians a means to greenwash logging and clear-cutting on public lands, then it has certainly achieved its purpose.

Given all this, my conclusion is that participation in collaboratives by forest protection advocates, scientists, and environmental lawyers is a well-intentioned but misguided endeavor. Their time and energy would be far better spent either publicly exposing these collaboratives for what they really are or ignoring them and organizing to put grassroots pressure on policy makers to protect federal public lands from logging. Perhaps we should reach out to old friends and colleagues who became involved in collaboratives for the right reasons but who, after years of alienation in a hostile group setting and constant bombardment by Forest Service propaganda, have developed the glassy-eyed demeanor of the true believer. We should strive to be kind and patient, even if they are not, and recognize that many of these collaboratives have developed the key characteristics of a cult.

Across the United States, collaboratives have been steered mainly by logging interests, including logging companies, agencies that profit from commercial logging such as the Forest Service and BLM, and nongovernmental organizations such as TNC, which has acquired large areas of forest that it logs for timber revenue. This leads to a narrow perspective on forest management that sees forests as sources of timber and biomass energy rather than as ecosystems, recreational landscapes, or carbon reserves. Because collaboratives are invariably located in rural areas near national forests, the people who can attend meetings most easily and in the greatest numbers reflect the demographics and political views of those same rural areas, where the logging industry is dominant. For this reason, these collaboratives do not reflect the political, ideological, or ethnic diversity of the United States. Instead, they tend to be skewed toward white, older, corporate, or right-wing individuals who prioritize commodity production and are uncomfortable when presented with independent scientific evidence.

The system created by the Collaborative Forest Landscape Restoration Program places disproportionate power and influence over the management of federal forestlands in the hands of a small and unrepresentative cross section of society. It disempowers or effectively excludes from participation the more diverse populations in cities and suburbs located several hours away from the nearest national forests. This is a fatal flaw in the system, given that every US citizen should have a voice in deciding how public lands are managed or protected, and given that most of the recreationalists who visit public lands are from cities and suburbs some distance away. This is especially true in the era of climate change, when logging projects in national forests send large amounts of carbon into the atmosphere, exacerbating the rise in temperature and sea level that threatens communities hundreds of miles away, once again proving John Muir's point that all things are hitched together.

# 11

# Fire in the East

Many people in the United States think of wildland fire as a “western” issue—one that is relevant only to the arid western states, where significant wildland fire activity is accepted as an annual occurrence. Over the years, I have spoken with many people in the eastern part of the country who seem to believe that wildland fire simply doesn’t occur in the hardwood and pine forests east of the Rocky Mountains, and perhaps it never has.

Then the Bastrop County Complex fire occurred in 2011 in east-central Texas, east of Austin. Driven by bone-dry conditions, high temperatures, and strong winds, the fire quickly spread northward, ultimately spanning more than 34,000 acres. At least 1,673 homes were destroyed, and four people lost their lives. Five years later, the Chimney Tops 2 fire occurred in similar conditions, burning across nearly 18,000 acres as it spread westward toward Gatlinburg, Tennessee, in the southern Appalachians, destroying or damaging more than 2,000 buildings and causing fourteen fatalities. That same fall, a combination of lightning strikes and illegal campfires sparked thirty-three wildland fires in the southern Appalachians, cumulatively burning 90,000 acres—about half of which occurred in the Nantahala National Forest in North Carolina. Most of the remainder was a 28,000-acre lightning fire in the Cohutta Wilderness Area of Chattahoochee National Forest in Georgia. Many people who previously had no direct experience with wildland fires began to wonder: do we live in fire country?

I first visited the Bastrop fire area in east Texas in the fall of 2014.

Natural loblolly pine regeneration in a large high-intensity fire patch three-and-a-half years after the Bastrop fire in eastern Texas.

The prevailing scientific wisdom at the time was that loblolly pine and other pine forests of the southeastern United States had a historical fire regime characterized by very frequent low-intensity fires. Such forests, it was believed, were not resilient to larger, more intense fires that produced high-intensity fire patches of significant size, as occurred in many western forests. I had no experience with wildland fires in southern pine forests, so I had no reason to question these assumptions. But within the first five minutes of hiking through a large high-intensity fire patch in a loblolly pine and post oak forest in the Bastrop fire area, I knew the situation was more complex than previously believed. Even though it had been only three years since the fire, I saw several dozen to several hundred loblolly pine seedlings and saplings per acre, some of them far from the nearest surviving tree. Post oaks sprouted from their bases. In some places—where no postfire logging or tree planting had occurred—the naturally regenerating loblollies and post oaks were already over the top of my head. The abundance and diversity of birds were breathtaking—pileated woodpeckers, red-headed woodpeckers, great crested flycatchers, cardinals, and eastern bluebirds, among many others. Clearly, loblolly pine forests had a long evolutionary history with mixed-intensity burns, and these forests were highly resilient to such fire effects.

Intrigued, I began to dig into the scientific evidence related to forest and fire ecology in southeastern forests, and I was surprised to find that many of the same ecological lessons emerging from studies of forests in the western and upper midwestern United States were broadly applicable to southern forests. Part of the problem was that, as in the western forests, the concept of "fire return intervals" was misunderstood. Many people mistakenly thought these figures pertain to how often fires burned on any given acre historically. This led to false assumptions about hyperfrequent, extremely low-intensity historical fires and the absence of moderate- or high-intensity fire patches. For example, in a study conducted in the Bastrop fire area, researchers used fire scar data in a 250-acre area to determine historical loblolly pine fire frequencies and reported that the average fire return interval prior to the arrival of non–Native Americans was 10.9 years, but only 11.4 percent of trees were scarred in any given year.[1] Once again, this indicates that, on any given acre or in any given stand of forest (as opposed to the entire study area), the real historical frequency was considerably longer, since fires generally do not span the entire study area in any given year.

Studies designed to determine the actual historical fire frequency on any given acre or in any given stand of forest have clarified things considerably. For instance, before the arrival of nonindigenous settlers, loblolly pine forests burned, on average, once every thirty-five years from a combination of Native American cultural burning and lightning strikes.[2] This is generally consistent with historical fire frequencies in western forest types with mixed-intensity fire regimes, such as ponderosa pine and mixed-conifer forests.[3] Similarly, in loblolly pine forests of coastal North Carolina, historical fire frequencies for any given stand averaged twenty-five to ninety years.[4]

Other scientists used charcoal sediments to estimate changes in fire frequency over time. One study found that wildland fires, caused by a combination of Native American burning and lightning, became more

*Top:* Vigorous regeneration in a large high-intensity fire patch in the Bastrop fire area, 2015. *Bottom:* An adjacent area subjected to postfire logging more than two years before this photo was taken. All the habitat created by the fire, and nearly all the forest carbon, was removed, and the area was converted to invasive, nonnative grasses. Most of the artificially planted trees died.

frequent in the southern Appalachians after the Native Mississippian people moved into the area around 1,000 years ago, but fire activity declined following the arrival of nonindigenous settlers about 250 years ago.[5] The researchers found that wildland fires were not limited to pine-oak forests on ridges and upper slopes but extended into the wetter, lower-elevation hardwood forests too. The authors also noted that, between 1,000 and 4,000 years ago, wildland fires in these forests were less frequent and more severe, providing additional evidence for a long evolutionary history of mixed-intensity fire in southern Appalachian forests.

Similar findings have been reported in the historical forests of West Virginia,[6] as well as in the forests of eastern Kentucky, where fire was common for thousands of years until fire activity declined with the arrival of settlers.[7] In the southern Appalachians, numerous historical accounts from the 1700s through 1901 document areas of early-successional vegetation, including significant patches of shrub species and young regenerating trees, resulting from earlier higher-intensity fires.[8] Higher-elevation spruce-fir forests of the southern Appalachians were historically characterized by large higher-intensity fires—one such fire in 1925 spanned about 25,000 acres.[9]

Wildland fire's influence on biodiversity seems to have significant broad similarities from west to east as well. Mixed-intensity forest fires that create patches of snags, downed logs, and areas of understory shrubs appear to be important for numerous wildlife species in southeastern forests; removal of these habitat elements by logging causes significant harm, just as it does in western forests. One group of researchers found that the removal of snags and downed logs significantly reduced overall bird abundance, diversity, and total number of species in loblolly pine forests.[10] Among the adversely affected species were the great crested flycatcher (*Myiarchus crinitus*), which is a secondary cavity nester; woodpeckers, including the red-headed woodpecker (*Melanerpes erythrocephalus*); and the eastern towhee (*Pipilo erythrophthalmus*)—the latter two are species of conservation concern due to persistent population declines.[11] Eastern bluebirds (*Sialia sialis*) were found only in areas with no snag removal.

Similarly, other scientists found that the removal of snags and downed logs in the loblolly pine forests of coastal South Carolina significantly reduced populations of native insects that birds, small mammals, and other wildlife rely on for food.[12] The message from science is clear: the habitat elements created by fires and other natural events are highly important for biodiversity, and management actions that reduce such habitats harm numerous wildlife species. In the Georgia piedmont region, twenty-one species of birds increased after fire, while only six decreased, and postfire forests were strongly preferred for nesting.[13] As one group of scientists stated with respect to wildland fires in southeastern forests: “Media coverage often concludes that forests have been destroyed by these wildfires and imply that wildlife habitat has been destroyed as well. But has wildlife habitat really been destroyed? Does fire so damage ecosystems that they are gone forever? Of course not, especially in the eastern United States where vegetative recovery is relatively rapid following disturbance. From an ecological perspective, ecosystems and their associated wildlife habitats are not destroyed, only changed to an earlier stage of succession.”[14]

The historical and scientific literature documenting the naturalness and ecological necessity of fire in southeastern forests is, in fact, deep and extensive.[15] It is therefore surprising that so many Americans think of wildland fire as being only a western issue. This needs to change to facilitate the restoration of natural fires, and the important habitat they create, to southeastern forests. However, as in the West, the command-and-control “fuel reduction” management paradigm is standing in the way of ecological progress. Like many western national forests, southeastern national forests are increasingly threatened by large, intensive commercial logging projects based on the scientifically unsound premise that dense stands of forests will burn too intensely in a wildland fire and that industrial logging will somehow curb such fires or “restore” forests. But as already stated, research the world over indicates the opposite: more logging leads not only to more habitat degradation but also to more intense fires.

Similar to forest mismanagement in the West, state and federal land managers in the Southeast are forcing unnatural, hyperfrequent prescribed burns on the landscape as a misguided fire suppression tactic.

For example, the longleaf pine forests of the southeastern United States, including the coastal plain, are considered one of the most frequent-fire forest types in North America. But here again, misunderstandings about the research related to fire return intervals have arisen. For instance, one analysis reported an average historical fire return interval (based on fire scar data) of 2.1 years in longleaf pine forests of Louisiana prior to 1905, but it is important to understand what this means.[16] The study area was approximately 300 acres, and in most years in which a fire occurred, only 9 to 16 percent of the trees actually had any fire scars. This is common because fires are very small in most years and would have covered only a small portion of the overall study area. Therefore, fires were not actually burning every two years on any given acre of forest; rather, they were burning every sixteen years or so—*on average*.

This is a key point. More extensive fire history research in longleaf pine forests along the southeastern coastal plain found that, about 13 percent of the time, historical fire intervals were two to three decades, and maximum fire-free intervals were fifty-eight to seventy-four years.[17] These intervals are consistent with mixed-intensity fire effects, which include some high-intensity fire patches.[18] Therefore, even in longleaf pine forests in the coastal savanna ecosystems of the Southeast, a portion of the forest in any given area has always been experiencing higher-intensity fire effects, particularly given the numerous lightning ignitions each year.[19] However, for decades, land managers at state and federal public lands throughout the southeastern coastal plain have failed to understand the nuances of fire return intervals, leading them to impose prescribed burns at an unnaturally high frequency—sometimes every two years.

In recent decades, a rich body of research has uncovered the complex history of wildland fire in the forests of the Ozark Mountains of southwestern Missouri, northwestern Arkansas, and eastern Oklahoma. The most current research describes heterogeneous conditions prior to the arrival of nonindigenous settlers, with lightning fires and Native American cultural burning resulting in a mix of dense or moderately dense forests comprising hardwood species and shortleaf pine, interspersed with open savannas and grassy glades created by patches of higher-intensity fire and maintained by more frequent grass fires.[20] This highly varied combination of vegetation types provided habitat for many different plant and animal species, each of which has different needs. But fire suppression is now threatening this biodiverse ecosystem. For example, the imperiled collared lizard depends on the glades created by fire sufficiently intense to kill most or all of the trees, but these glades have become rarer over the past century due to fire suppression policies.[21]

As in other forested regions, a misunderstanding of the concept of fire return intervals has led to confusion in the Ozarks. Some scientists reported fire return intervals of about eight years in the forests of the Ozarks prior to the arrival of nonindigenous settlers, and they also reported that only about 17 percent of the trees experienced fire scars in any given fire year, similar to findings in other eastern forests.[22] This indicates that the average frequency of fire on any given acre or in any given stand of forest was actually more than forty years. Historical fire frequencies varied widely, however. For example, prior to 1810, fire frequencies in the Arkansas Ozarks ranged from five to twenty-two years in some locations and up to more than sixty years in others.[23]

Throughout the Ozarks and forests across the Southeast, land managers often miss this critical nuance in scientific studies and mistakenly believe that historical fire frequencies were much higher than they really were. This leads to forest mismanagement, including the imposition of prescribed burns at rates that far exceed natural, historical fire frequencies, based on the notion that these hyperfrequent human-set fires will reduce fuel, with the goal of maintaining homogeneous, low-intensity fire regimes. This management approach is based on a fundamental misunderstanding of fire return intervals, and it fails to grasp that, historically, these forests often had moderately frequent and relatively infrequent fires, consistent with mixed-intensity fire effects—the very fire effects that created the highly biodiverse, heterogeneous mix of habitats that have supported and nurtured various wildlife species for millennia. In other cases, land managers, including the US Forest Service, are misusing and mischaracterizing the concept of fire return intervals to carry out large, destructive commercial logging projects, falsely suggesting that historical forests were homogeneously "open" and that industrial logging operations—which have no evolutionary precedent—are needed to "restore" forests.

But the forces of nature that have shaped these ecosystems are wilder and more dynamic than many modern humans realize. Although mild to moderate weather conditions may prevail in most fire years, natural periods of drier, hotter, and windier conditions have always resulted in much bigger fire years occurring on longer cycles. For example, severe drought conditions in 1780 resulted in mixed-intensity wildland fires that burned nearly 70 percent of the eastern Ozarks—an area covering millions of acres. Despite these historical lessons, land managers have attempted to suppress and control the natural processes on which the Ozarks depend, calling for the continued "suppression of wildfires."[24] This mind-set predominates to this day. But these forests do not need unnaturally frequent prescribed fires or logging; they need more managed wildland fires, allowing lightning-caused fires to burn without suppression to restore a mix of fire intensities and natural habitats to these forests, while making communities more fire safe and fire adapted.

Farther north, in the New Jersey Pine Barrens, historical accounts report that wildland fires burned an average of 54,000 acres each year in the early twentieth century, while just a small fraction of this acreage burns each year today.[25] When wildland fires occur, they burn with a mix of fire intensities,[26] and the pitch pines and other native trees naturally regenerate vigorously, including in high-intensity fire patches.[27] Land managers often apply prescribed fire in the Pine Barrens, yet research indicates a much greater abundance of natural pine and oak regeneration following mixed-intensity wildfires in these forests relative to forests undergoing prescribed burning or those that are unburned.[28]

In the upper mideastern United States, the Laurentian forests of the Great Lakes area form a wide band between the eastern US deciduous forests to the south and the boreal forests to the north. They comprise predominantly conifer species such as black spruce, jack pine, and eastern white pine, mixed with maple, birch, beech, alder, and aspen. These forests, which have far less wildland fire now than prior to the institution of fire suppression policies, naturally tend toward the upper end of the fire intensity spectrum. Mixed-intensity fires in this region are generally dominated by high-intensity fire effects; fires burned at higher intensities every 50 to 100 years before fire suppression, although they burned intensely at intervals of 150 to 300 years in some areas. After such fires, which naturally tend to be large (and sometimes *very* large), these forests naturally regenerate rapidly and abundantly. The postfire habitat created by intense fire provides rich food sources for large mammals such as moose, numerous woodpecker species such as the black-backed woodpecker, and many dozens of other native wildlife species.[29]

Though much remains to be discovered about the fire ecology of forests in the eastern United States, it is clear from existing research that wildland fires, including large mixed-intensity fires, are no stranger to these forests and that such fires play a vital role in creating and maintaining a variety of important wildlife habitats. It is also clear that eastern forests are quite well adapted to mixed-intensity fires and naturally regenerate very effectively after the flames have passed.

In 2020 I returned to the Bastrop County Complex fire area in eastern Texas and spent some time hiking through the largest high-intensity fire patches. At less than nine years post fire, the areas that had been allowed to naturally regenerate—without postfire logging and artificial planting—were developing into a beautiful combination of open pine-oak savanna and areas of dense, rapidly growing loblolly pine stands. In these latter areas, some trees were already thirty feet tall and had more than 70 percent forest canopy cover, which created a cool, shady microclimate. These naturally regenerated pine trees were already seven to eight inches in diameter in many areas, and they were adding three to four feet in height every year, reaching for the sun through the standing snags. A colorful array of birds, from woodpeckers to warblers, darted around overhead and called out as I hiked.

As I moved from one rich snag forest patch to another, I thought about the evidence emerging from fire ecology in the forests of the eastern United States, which is actually quite positive, as is much of the evidence regarding western forests. Rather than seeing death, destruction, or loss, I see hope, life, and renewal in the smoke and flames. Our challenge is to embrace the good news that science has to offer about fire in these forests, while redirecting our attention to ensuring that human communities in naturally fire-prone landscapes—in the western and eastern United States and around the world—are climate adapted and protected from wildland fire to the greatest extent possible, so that fire can continue to do its important and ecologically beneficial work out in the forest wildlands.

# 12

# Fire-Safe Communities

As Californians, my wife and I have had many personal experiences with wildland fire. While trying to study for midterm exams in 1991, she sat on an apartment rooftop as the Oakland Hills fire burned toward the historic Claremont Hotel in Berkeley. Together, we experienced the effects of smoke-filled weeks while living in the Sierra Nevada. We wondered whether the wind would change direction and shift our evacuation status from voluntary to mandatory during the 2015 Lake Fire, and again in the 2020 El Dorado fire, in the San Bernardino Mountains of Southern California. We understand the importance of keeping people safe when they live near fire-adapted ecosystems.

We have also witnessed the failure of infrastructure and evacuation protocols. We experienced firsthand the difficulty of trying to get to a store to buy bottled water when fire knocked out our power for a week, along with the ability to draw water from our well. We read the frantic social media posts from my cousin and her boyfriend, who decided to stay at his family's ranch during the Sand Fire in the foothills of the San Gabriel Mountains near Los Angeles because they had no way to evacuate their horses. Dozens of people were staged at a nearby supermarket with horse trailers, ready to assist, but they were refused entry into the neighborhood by fire suppression staff.

In the spring of 1991 I did an internship on a nature preserve in Southern California. My job description entailed everything from poacher patrol to trail maintenance (while carefully stepping around rattlesnakes) to fence repair. I spent a lot of time in remote areas of the nature preserve. One day I was doing some trail work up on a mesa when I saw smoke rising at the far end of the plateau. I jogged over to the edge of the mesa and discovered a small wildland fire from a recent lightning strike. It was only about one-twentieth of an acre at most, and it was creeping through the trees at a rate that was hardly detectable, with flames just inches high. It was a cool day with no wind, and it had rained recently—weather conditions that just barely allowed a wildland fire to ignite and spread. I spent a couple of hours stomping out the edges of the fire with my boots. Once I was satisfied that it was out, I hiked off the mesa and returned to the preserve's headquarters. Dirty and exhausted, I proudly told the preserve manager what I had done. In my youthful naïveté, I expected him to be impressed and to thank me for "saving" the habitat up on the mesa. Instead, he just shrugged and said, "I guess it's okay that you put it out, but we were going to do a burn up there in a few weeks anyway, since a bunch of the native plants need fire and the area hasn't burned in a long time." It was an important moment in my thinking about wildland fire, and it was the beginning of my understanding that wildland fire does not destroy fire-adapted ecosystems. It was also the start of my realization that wildland fire behavior is mostly about climate and weather. If it had been a dry, hot, windy day in August, there is no chance I could have put out that little fire with my boots; under such conditions, neither could thousands of firefighters with water tankers and bulldozers.

My firsthand experience with a small forest fire in extremely mild weather conditions, and seeing how easily it was put out, helped me understand how misguided fire suppression policies began and how they are perpetuated. After all, when 97 percent of all wildland fires can be easily suppressed during cool, moist conditions, it is not surprising that state and federal agencies think that, with increased effort, they can suppress the other 3 percent of fires. And so, even though these remaining fires occur when climate and weather are solidly in control, with high temperatures, strong winds, and bone-dry air, they keep trying, futilely, year after year, spending billions of dollars and risking the lives of firefighters to fight the weather. As a consequence, every year, those 3 percent of fires account for nearly all the acreage that burns.

Historically, before fire suppression policies, the 97 percent of lightning ignitions that are currently extinguished would have inched along during mild fire weather in the spring, until conditions in the summer allowed many of them to become large mixed-intensity forest fires, spreading faster and burning larger portions of the landscape, while creating a mosaic pattern of fire intensity and habitat heterogeneity, until the fall weather set in and put them out. With climate change, weather is increasingly in charge of how fires spread.[1] Nevertheless, societies around the world remain reluctant to accept that wildfires are fundamentally weather and climate events. No one tries to fight or stop a hurricane or a tornado. That would be insane and pointless. Instead, we build homes that can better withstand these weather events, and when they occur, we do our best to warn communities and help people and their animals evacuate. Why are we not doing the same thing with respect to weather-driven wildland fires?

There are two diametrically opposed approaches to wildland fires and community protection: the "from the wildlands in" approach, and the "from the home out" approach. The former, which has dominated the response to wildland fires for decades and continues to do so, is characterized by a primary emphasis on fire suppression and vegetation management, including logging and destruction of native chaparral (shrub habitats), in wildlands that are distant from communities. The basic assumption is that these tactics will limit or stop fires before they reach towns. This "from the wildlands in" paradigm, which prioritizes logging and addresses community safety indirectly, as an afterthought, is degrading wildlife habitats, removing large amounts of carbon from forest ecosystems, worsening climate change, and largely ignoring glaring risks to communities. In short, it is leading to massive losses of homes, and it is getting people killed.

The "from the home out" approach, based on current science, emphasizes making the homes themselves more fire safe; secondarily, it focuses on pruning vegetation annually immediately adjacent to homes—within a 100-foot radius of structures. Management of wildlands vegetation, such as chaparral removal and logging, is not part of this paradigm, and direct fire management is oriented toward preventing unplanned human ignitions near communities and suppressing ignitions, when possible, if they are very close to homes. This approach accepts that wildland fires are natural in fire-adapted ecosystems; it recognizes that it is not a question of "if" a given community will face a wildfire but "when," much like coastal communities accept the likelihood of hurricanes. In this context, the community itself is paramount, and attention and resources are devoted to minimizing the loss of homes and lives when fires happen.

In the early fall of 1961, during dry, hot conditions, a fire ignited on the eastern end of the Santa Monica Mountains in Southern California, adjacent to the ultrawealthy communities of Bel Air and Brentwood. Hollywood celebrities and other notables among the rich and famous, including then–former vice president Richard Nixon, were forced to evacuate, and many lost their homes. Until then, communities in the Los Angeles area had simply put their faith in wildland fire suppression. People assumed that fires would be stopped before they reached their communities. Based on this view, there was little thought about the ignitability of homes on ridges or in canyons surrounded by grassland, chaparral, or forest. Wood shingle roofs and siding were common. Exterior vents, such as those for attic spaces, were unprotected from flying embers. Dense grasses and shrubs grew right up to the sides of houses. No one considered this a problem because there was so much confidence in the twentieth-century "from the wildlands in" approach to fires. As a result, more than 500 homes were destroyed in the Bel Air fire, owned by some of the most recognizable names in America at the time.

This caused a tectonic shift in thinking about wildland fire and community protection in the city and county of Los Angeles.[2] It started slowly at first, but over the next two decades, local governments increasingly focused on community protection, transitioning to a "from the home out" approach. Wood shingle roofs and siding were banned and replaced. Home owners were required to prune vegetation around their houses each year, in recognition of numerous scientific studies indicating that vegetation management beyond 100 feet from houses provides no additional protection from wildland fires.[3] Reducing the ignitability of houses themselves, and their immediate surroundings, became the primary focus. Losses of homes in wildfires began to decline, and a number of success stories have emerged.

One example was the La Tuna fire in the Verdugo Mountains, where I grew up, northwest of downtown Los Angeles. Driven by extreme fire weather, including high temperatures and howling winds, the fire scorched 7,194 acres of shrubland and forest in the La Tuna Canyon area of Los Angeles, Glendale, and Burbank in the fall of 2018, making it the largest fire within Los Angeles city limits in half a century. What made the La Tuna fire remarkable was not its size, however, but the lessons it provided about protecting homes. By the time the fire was over, nearly 1,400 homes had been either within the fire perimeter or within 200 feet of its path, yet only five homes were destroyed.[4] How was that possible?

After the lessons learned from the 1961 Bel Air fire, Los Angeles has become a national leader in encouraging and enforcing fire-safe principles for homes. For many years, a normal part of life in Los Angeles has been annual inspections and notices about the creation of "defensible space"—the practice of reducing combustible grasses, shrubs, twigs, and saplings within 100 feet of homes each spring. If people fail to do it themselves, city or county workers do it for them, and the home owners pay the expenses later. Moreover, building codes are constantly updated as new information about fireproofing homes becomes available. Home owners who remodel are expected to bring their homes into compliance with the latest fire safety measures. This is an accepted way of life, a minor cost associated with living adjacent to habitats that naturally experience wildland fire and always will. Of course, there is always room for improvement. Although more than 99 percent of the homes survived the La Tuna fire, a few in remote areas of the Verdugo Mountains had escaped annual monitoring for defensible space or had not been updated with fire-resistant roofing or exterior vents. But the success story represented by the La Tuna fire highlights the vital role of protecting homes long before a fire begins.

Many policy makers still mistakenly believe that the effects of wildland fires are random, which leads to inaction. More troubling, some politicians who receive campaign support from the logging industry are now attempting to use the loss of homes and lives in recent California wildfires as an excuse to attack environmental laws and increase destructive commercial logging in national forests under the guise of "thinning" and "fuel reduction"—attempting to further engrain the failed "from the wildlands in" approach. Los Angeles is not swayed, however, and appears to be committed to its "from the home out" approach.

A fire safety official from Los Angeles County told me about the county's checklist of factors that determine whether a home will burn in a wildland fire. The list is used to ensure that building codes are updated as new data emerge. He told me the story of one wildland fire that burned through a newer community, where all the homes had the most recent fire safety features. The cluster of homes survived the fire, except for one, and he and his colleagues couldn't figure out why this one house burned when neighboring homes didn't. Finally, they realized that it was the dog door. The high winds blew open the dog door, which had been left unsecured after the family evacuated. This sent flaming embers into the interior of the house, where they ignited something combustible. So, the newest item for inclusion on the list? Dog doors.

Although Los Angeles is a notable and important example, it is by no means the only one. A story in the *Idaho Statesman* about a fire in the northern Rockies underscores this point compellingly:

> We spend billions attacking almost every wildfire, but scientists say that's bad for the forest, can put firefighters in unnecessary danger and doesn't protect communities as well—or as cheaply—as we now know how to do. A wall of fire barreled through the forest with a jet-engine roar near Secesh Meadows last August, and local fire chief Chris Bent knew his work was about to be tested. Flames danced atop lodgepole pines, smoke darkened the sky, and residents of the tiny mountain hamlet north of McCall prepared for the worst. Just a month earlier, a forest fire had burned 254 homes near Lake Tahoe and the 2007 fire season appeared ready to claim its next community. But as the raging East Zone Complex fire reached the cluster of loosely-spaced homes, the flames dropped to the ground, crackling and smoldering. The fire crept right up to doorsteps. But without the intense flames that spurred the fire just moments before, no homes burned—a feat fire managers attributed largely to Bent's push to clear flammable brush from around houses in the community. "It just blew through the area," Bent said. "We were well prepared." The town's ability to withstand a frontal assault by a major wildfire

> demonstrates what fire behavior experts have been saying for more than a decade. Clearing brush and other flammables and requiring fireproof roofs will protect houses even in an intense wildfire—without risking firefighters' lives. More provocatively, the research suggests that fighting fires on public lands to protect homes is ineffective and, in the long run, counter-productive. It is also far more expensive.[5]

Despite the evidence, land management agencies like the US Forest Service remain heavily focused on logging projects hundreds of yards to miles away from houses, claiming that this will reduce fire intensity and protect homes. Aside from the fact that logging typically increases fire intensity, this strategy has been proved a failure by the Forest Service's own scientists. For example, after 199 homes were destroyed by the Grass Valley fire in the San Bernardino Mountains in 2007, two Forest Service scientists found that high-intensity fire was not a significant factor in igniting them. Of the 199 houses destroyed or badly damaged, 193 had been ignited by one of the following: low-intensity surface fires that crept up to houses without defensible space and burned them down, flaming embers that floated into attics without ember-proof exterior vents or into dry leaves and pine needles in unprotected rain gutters, or structure-to-structure ignition due to the burning of adjacent homes.[6] The message is clear: this is not a fire and vegetation management problem; it is a community protection problem.

Eventually, California passed a statewide requirement to maintain defensible space within 100 feet of homes, setting an important national precedent. However, a law is only as good as its enforcement, and California's defensible space provision is simply not meaningfully enforced in most of the state's fire-prone regions. When I lived in Los Angeles, where defensible space was enforced for years before the state law was enacted, every spring I would get a notice from the city about the deadline for clearing grasses, saplings, and other combustible vegetation, and I would spend a day doing the work. My neighbors would do the same, every year. But when my wife and I moved to the northern Sierra Nevada, we got only one visit pertaining to defensible space in the eleven years we lived there. We pruned the vegetation next to our house every year anyway, but most people in our community did not, and many were unaware of the importance of applying some simple fire-safe principles.

In most parts of California, annual inspections and enforcement of defensible space maintenance around homes are nonexistent. Local governments rely on the state forest and fire agency, Cal Fire, for that. But Cal Fire is a prime example of an agency that, like the US Forest Service, is still stubbornly rooted in the outdated "from the wildlands in" paradigm. The agency engages in fire suppression activities mostly in remote areas far from homes, and it approves permits for logging operations on private and state forestlands across California. Its relationship with the logging industry can fairly be described as incestuous. An investigation by the *San Diego Union-Tribune* found that Cal Fire inspects only a small percentage of the homes in or adjacent to California wildlands each year. And when Cal Fire inspectors find violations, enforcement is extremely rare—just a fraction of 1 percent of the home owners found to be in noncompliance are issued citations.[7] For all practical purposes, the state law essentially does not exist.

Outside of Los Angeles County, few California home owners pay attention to defensible space, and building requirements are lax and outdated. From the home owners' perspective, why should they bother? State and federal agencies, the logging industry, and politicians funded by the logging industry are constantly telling them that the answer is to spend billions of dollars on fire suppression, chaparral removal, and logging in wildlands far from the 100-foot defensible space zone around homes. Rural towns and counties are bombarded with this messaging, which means that little or no attention is being paid, and few resources are being devoted, to helping communities survive a wildland fire when it occurs.

We saw the tragic consequences of this neglect when the Camp fire ignited in the fall of 2018 in the northern Sierra Nevada. For years, logging companies and the US Forest Service had been extensively logging several thousand acres of private and public forestlands adjacent to the communities of Paradise and Concow—engaging in widespread cutting and clear-cutting of earlier fire areas and conducting commercial "thinning" operations. In fact, the US Forest Service issued a decision in 2011 to log

Before the Camp fire occurred in 2018, this area had been heavily logged. The Camp fire swept through very rapidly and burned extremely intensely.

more than 1,500 acres of public land adjacent to Paradise and Concow, explicitly telling the communities that this would protect them from a future fire.[8] The Concow logging project removed 2 million board feet of commercial timber—in the form of live, mature trees—and carried out biomass logging across a large expanse within an earlier (2008) fire area, intensively logging and clear-cutting snag forests and removing thousands of tons of dead trees as commodities for incineration and energy production in commercial biomass markets.

When the Camp fire started a few years after this logging project, it burned through the thinned and logged areas at about three miles per hour during the first few hours, racing toward Concow and Paradise. In comparison, two of the largest and most intense forest fires in the Sierra Nevada—the 2013 Rim fire and the 2014 King fire—occurred during similarly extreme fire weather and moved at 0.7 and 1.5 miles per hour, respectively, on their fastest days; on most days, they moved at just a small fraction of 1 mile per hour. Although significant logging had occurred in

A large stump from previous postfire logging and snag removal. The flames from the Camp fire raced through this logged area with extraordinary intensity just before reaching the community of Concow, only a few hundred yards away.

various locations within the Rim and King fire areas (especially where these fires moved fastest), the several thousand acres that burned in the first few hours of the Camp fire were among the most heavily and extensively logged areas in the entire Sierra Nevada. The rate at which the Camp fire burned through these logged areas—where thousands upon thousands of snags and live trees had been removed far from homes under the guise of fuel reduction and community protection—was unprecedented for forest fires in the region.

The communities of Paradise and Concow had been told, by federal agencies and logging industries that they trusted, that the logging projects would keep them safe from wildland fire. This, along with Cal Fire's unwillingness to meaningfully enforce California's defensible space law and inadequate and outdated building codes, represented a dangerous combination of circumstances. People believed that the fire threat was "out there" somewhere, over the ridge. They trusted that the combination of intensive landscape-scale logging and fire suppression in the wildlands would stop a fire. Many houses had combustible wood shingle roofs and siding. Many old attic vents remained unprotected, when spending just a few hundred dollars at the hardware store could have upgraded them to ember-proof vents. Pruning guidelines had been ignored. In the end, the Camp fire destroyed more than 14,000 homes, and eighty-five people lost their lives.

One of the most immediate realizations was that most of the homes lost had already been in flaming ruins *before* the Camp fire reached the towns of Paradise and Concow. Embers landed like a hailstorm, thrown by winds for miles in advance of the flames. The firebrands landed on wood roofs, which quickly ignited. Where they landed on fire-resistant composition or steel roofs, they rolled down into rain gutters thick with dry leaves and pine needles. They floated into exterior vents, and they landed in dense, dry grasses and thickets of saplings immediately adjacent to the houses' wood siding, rapidly erupting into flames.

An extensive investigation by the *Los Angeles Times* exposed the shocking ineffectiveness of wildland logging and chaparral removal conducted under the guise of creating "fuel breaks" by state and federal agencies.[9] During the hot, dry, gusty conditions that typically prevail during climate- and weather-driven fires, winds toss the firebrands for miles, right over these so-called fuel breaks and into surrounding towns. When the flames themselves reach the fuel breaks, they simply burn through them—often driven more intensely by logging slash debris, tree plantations, or invasive grasses spread by logging and chaparral-clearing activities. The investigation also revealed that the devastating loss of homes in the Camp fire could have been prevented if state and federal agencies had focused their efforts on the homes themselves—if they had helped home owners fix the obvious vulnerabilities in their houses and on their properties instead of pursuing a failed strategy that primarily benefits logging and biomass energy interests.[10]

The biggest tragedy of the Camp fire, of course, was the loss of eighty-five lives. Here too, the current emphasis on logging and fire suppression led to tragedy. The Camp fire burned through the thinned, logged areas much faster than other recent fires, reaching the towns of Paradise

An entire neighborhood in the town of Paradise was destroyed by embers before the Camp fire even reached the area. Note the live green trees surrounding the remains of the burned homes. Once the Camp fire reached Paradise and Concow, it did not burn nearly as intensely as it did when it was spreading through the heavily logged areas surrounding the towns. This is why most of the trees in these towns were still green and only lightly scorched, which I witnessed firsthand. (DigitalGlobe, 2018)

and Concow hours sooner than expected and robbing the people there of the critically important time they needed to evacuate. Compounding this problem is a pervasive lack of infrastructure to provide effective and early warning when a wildland fire is nearby and to help people and their animals evacuate safely and quickly before the fire reaches them. These types of community-oriented measures are largely ignored, and that is costing lives.

We could do so much better, and we could save so many more homes and lives, if we fundamentally shifted direction and embraced the "from the home out" approach. We could help home owners in fire-prone areas make their homes safer, conduct comprehensive defensible space monitoring each year, and enforce legal requirements. We could implement far better systems to warn people when fires are approaching and fund the creation of dedicated rapid mobilization forces to help people and their animals evacuate, especially elderly or disabled individuals who may need assistance. We could create fire-safe community shelters out of noncombustible materials such as recycled steel, fitting them with air filters to keep thick smoke from entering. We could update building codes to require all new construction to incorporate the best fire-safety measures, and we could provide financial assistance to low-income home owners to help them bring older houses up to current standards and cover the costs of annual pruning.

We could also revise and update land-use and zoning laws, prohibiting new developments in inherently risky locations, such as windswept canyons and ridges or places with only one or two good evacuation routes. It is important to recognize that even the best building codes cannot guarantee that a home won't burn, and people's lives may still be at risk, even if all the homes survive. Moving forward, this sort of planning needs to be part of the conversation about wildland fires and community safety.

Several of the most important fire-safe community measures were incorporated into the Wildfire Defense Act, recently introduced by Senator Kamala Harris (D-CA). However, agencies and industries that benefit financially from the current approach are highly resistant to change, which hinders the potential to generate political momentum.

Another key component of a "from the home out" approach is to create and fund a workforce devoted to preventing human-caused ignitions during fire season. A couple of years ago, during a hot, dry summer day in the San Bernardino Mountains where my wife and I live, a man drove for two hours up and down Highway 38, stopping periodically to throw flaming objects out his window. Fire suppression forces were nearby, waiting for a fire to occur, but they did nothing. Understaffed local law enforcement agencies were unable to respond in a timely manner, as was the US Forest Service (in the entire mountain range, spanning hundreds of thousands of acres, there are only two US Forest Service law enforcement agents). Reports of the arsonist were broadcast on the local radio station, and he soon fled. Fortunately, locals were able to extinguish the small ignitions resulting from his actions. Nearby communities were spared the threat of a fire because the high winds predicted never materialized in that part of the mountains. We got lucky that day, but the event exposed a serious vulnerability in society's current approach.

In some circumstances, the financial and political incentives that drive and perpetuate the regressive "from the wildlands in" approach take on an uglier and more sinister aspect. A few years ago, an arsonist started a fire in a national forest in the northern Sierra Nevada. It turned out that the perpetrator worked for the local logging mill. Unfortunately, this has become a common event in many parts of the western United States, as those in the logging industry realize that postfire logging is a quick way to generate revenue and many board feet of timber for mills. Whatever (inadequate) environmental protections may apply to forests, they are mostly waived after fires, including any restrictions on the size of trees removed or the size of clear-cuts. This makes postfire logging an economic bonanza for the timber and biomass logging industries. In fact, the situation has created such a perverse financial incentive for arson and postfire logging that an expression was developed years ago to describe the phenomenon: light it and log it. To make matters worse, and heedless of the unconscionable precedent it would set, the US Forest Service rewarded this criminal behavior in the northern Sierra Nevada by planning and executing a postfire logging project in a dense snag forest created by the arson fire—the Minerva 5 timber sale in Plumas National Forest.[11] The logging industry's mill profited from arson, as did the Forest Service, which kept the revenue from the timber sale. And because postfire logging tends to increase fire intensity, the nearby community is now even more vulnerable to a wildland fire.

Another major concern is the fact that utility companies are largely unregulated when it comes to fire safety. Occasionally, they voluntarily shut down local grids during extreme fire weather to prevent ignitions caused by aboveground power lines, but often they do not. This has resulted in numerous large and devastating fires near communities, including the Camp fire. Regulators could be given the authority to shut down utilities in certain areas during extreme fire conditions. In addition, many power lines could be buried underground, and rooftop solar panels could be subsidized to lower greenhouse gas emissions and reduce reliance on power lines.

Many things could and should be done to reverse the disastrous course of the past approach to wildlands fire management, but entrenched economic and political interests are aggressively fighting against change. In the wake of the Camp fire, politicians in California realized that they needed to prioritize community protection, but most are just trying to create the appearance of changing direction without actually doing so. For example, Democratic governor Gavin Newsom unveiled a "new" policy in 2019, identifying several dozen projects ostensibly designed to protect communities from wildland fire. Newsom relied heavily on Cal Fire for recommendations, and unsurprisingly, nearly all the projects involved chaparral removal and logging far from homes.[12] I spoke at length with two representatives of Governor Newsom, and they both assured me that they would focus on creating fire-safe homes and defensible space at a later time. "When?" I asked. They would not answer my question. Similarly, the Forest Service and the Newsom administration were executing an even larger-scale biomass logging project on remote public lands in the Rim fire area in 2019 and 2020. Like the Concow project, they claimed that this remote clear-cuts–for–kilowatts project, conducted far from rural towns and recreational camps, will somehow protect nearby communities from fire.

The lessons learned from recent fires in California are broad, and their importance is not limited to western North America. That point was driven home when the town of Gatlinburg, Tennessee, in the Appalachian Mountains, was devastated by a wind-driven wildland fire sweeping westward into the community. We saw severe and preventable losses of homes and human lives in the 2019–2020 Australian bushfires, which spurred a conversation about focusing on fire-safe communities there. We also saw the devastation of communities around Attica, Greece, in the summer of 2018, where wildfires took 102 lives and firefighters were unable to stop the fires during an extreme heat wave exacerbated by climate change.

Changing our approach to wildland fire will cost money, of course, but the political will is shifting. More and more people are questioning why we are spending billions of dollars each year on ineffective and counterproductive wildlands management practices when we could be spending those funds on proven community-focused methods to create climate-adapted towns, save homes and lives, protect wildlife habitats, and keep more carbon in our forests to mitigate climate change.

# 13

# Keep It in the Forest, Keep It in the Ground

What is a forest? Is it merely a group of live green trees, or is there more to it than that? The logging industry and its political allies would certainly like the public to believe the former. This is not simply a matter of semantics. Misunderstandings and mischaracterizations about the defining nature of a forest ecosystem have profound implications for climate change.

Demonizing natural processes that create snags, and presenting a political narrative in which the solution to every problem is found at the end of a chain saw, has confused, scared, and distracted countless people, including policy makers and reporters. As a politics-of-fear tactic, it has facilitated the rollback of environmental laws and enabled the removal of large amounts of carbon from forest ecosystems, reaping huge financial rewards for the logging industry as it released hundreds of millions of tons of $CO_2$ into the atmosphere every year. If the logging industry and its political allies succeed in convincing the public and the press that forests are nothing more than live green trees, then clear-cutting carbon-rich snag forests or mature and old-growth forests and replacing them with tree plantations can be greenwashed as “forest management” and “reforestation,” instead of calling it what it really is: deforestation.

A brief discussion of what defines a forest ecosystem is in order. Mature live trees are, of course, a key component of a forest, but they are by no means the only one. Everywhere in the world—from Canada to South America, from Asia to Africa, and from the Mediterranean to the

These forests in San Bernardino National Forest in Southern California are structurally complex. They have different ages, species, and sizes of trees; varying canopy layers; snags and patches of snags; downed logs; and shrubs. They are shaped by natural processes and cycles.

This snag forest habitat in the Rim fire area is complex and ecologically rich. It includes abundant snags, downed logs, and regenerating trees and shrubs.

boreal forests of Scandinavia—forest ecosystems include small live trees in the understory. Dozens of species of trees make up each ecosystem, not just one or a few species, as in tree plantations. And the trees in a forest are native species, which is often not the case in plantations. In addition to live trees, forest ecosystems have other intrinsic features that are just as important. Chief among them are standing dead trees—snags—and downed logs. Snags and logs store a large portion of the carbon in forest ecosystems, and they cycle vital nutrients to maintain the productivity and the carbon sequestration and storage capacity of forests. They also provide essential habitat for many native wildlife species, as well as insects.[1] Finally, forest ecosystems around the world have hundreds of species of native nontree plants, including shrubs, wildflowers, and grasses.

Unlike tree plantations, which are crops, forests are not homogeneous. Some areas are very dense, some are open, and some are in between; they contain trees of different sizes, ages, and species. Forests are dynamic, shaped for millions of years by numerous natural disturbance processes—fire, wind, flood, drought, and wood-boring insects. These processes ensure the survival and perpetuation of the strongest and fittest trees. They change some live trees into snags and downed logs, or they transform entire patches of mature and old stands into snag forests, just as time turns snag forests into mature and old forests once again. These processes and cycles have been occurring for millennia, and entire groups of plant and animal species have evolved to depend on the habitat created by these processes. In contrast, there is no evolutionary history of logging in forest ecosystems. Logging is an anomaly of the industrial world—one that degrades and eliminates most of the things that define a forest ecosystem, while systematically removing carbon from forests and releasing it into the atmosphere.

Clear-cutting is not the only type of logging that removes the very essence of forests. To a lesser but nevertheless substantial degree, commercial thinning does so too, eliminating most of the forest understory and often most of the midcanopy, pulverizing downed logs into tiny bits of wood, crushing and killing wildflowers and compacting soils with heavy machinery, rolling over and destroying shrubs that are home to nesting birds, felling and removing snags at a time when woodpecker and bluebird chicks cannot escape, and spreading invasive grasses. What is left are some widely spaced mature trees and little else—not a forest ecosystem.

Understanding forests is important. After all, we can't protect them if we don't understand what they are. And we need to protect them because, if we don't, we won't be able to overcome the climate crisis or the extinction crisis. Many people still have difficulty understanding how the logging of forests—whether it happens in Siberia, Australia, Amazonia, Scandinavia, Canada, the United States, or elsewhere—can be related to rising sea levels, the intensification of hurricanes that threaten coastal communities, or greater extremes in precipitation that lead to increased flooding. Many have difficulty making the connection between logging of the world's forests and the extreme temperature spikes that disproportionately affect communities of color in cities, increasing cases of heatstroke during the summer.

Why do so many have difficulty making this connection? People

*Top:* This is not a forest. The snag forest created by the Rim fire was destroyed and removed by postfire logging. This was followed by the spraying of toxic herbicides and the planting of this tree plantation. There is no complexity, no habitat, and almost no biomass. *Bottom:* Though it may be less obvious than a clear-cut, the forest ecosystem here has been almost entirely eliminated by commercial thinning. The understory habitat, the snags, and the downed logs have been removed, leaving a sterile area consisting of evenly spaced green trees.

now understand that carbon emissions from coal or natural gas power plants and carbon emissions from the tailpipes of cars are driving atmospheric carbon levels higher and higher and affecting ecosystems and communities around the globe. Logging does the same thing, as the great majority of the carbon in logged trees ends up in the atmosphere almost immediately. This is a global issue, and everywhere that logging occurs, or where trees and mill residues are incinerated, is a source of carbon emissions, just like the smokestack of a coal plant. The latest logging project in a national forest in Northern California, Michigan, or Tennessee increases atmospheric carbon levels and temperatures and worsens the threat from rising sea levels in Southern California, New York City, Bangladesh, and other coastal areas.[2]

Far too much of the public dialogue about mitigating climate change has completely missed the point. Some argue that we cannot realistically keep global temperatures from reaching catastrophic levels *only* by protecting forests or *only* by planting trees. Others suggest that the way to overcome the climate crisis is to concentrate on rapidly moving beyond fossil fuels, implying that protecting forests is much less relevant. But the science is clear. Any strategy that focuses almost exclusively on the transition away from fossil fuels is guaranteed to fail. It is equally true that any strategy that focuses almost exclusively on protecting forests and other ecosystems is guaranteed to fail. We must pursue bold actions on *both* fronts, immediately and simultaneously, if we hope to succeed.[3]

Although planting native tree species in certain parts of the world where large expanses of forest were long ago converted to agriculture could contribute to this goal in certain circumstances, the best chance of mitigating climate change involves "proforestation"—the protection of *existing* forests[4]—and, secondarily, the passive recovery of forests (as opposed to artificial planting) by allowing them to regrow naturally where they were previously cleared for agriculture or livestock grazing.[5] Protection of existing forests pertains not only to carbon-rich old forests and primary forests that have never been logged but also to forests that have been degraded by past logging or converted to tree plantations. Getting these areas out of short-rotation industrial logging and facilitating their return to native mature forests will contribute significantly to the goal of mitigating climate change, especially because the natural carbon storage potential in such areas is far higher than current levels of carbon storage.

As discussed earlier, the current atmospheric concentrations of $CO_2$ equivalents ($CO_{2e}$) are significantly in excess of 400 parts per million (reaching 417 parts per million in 2020)—far too high to avoid the most catastrophic effects of climate change. And because it takes many decades, even centuries, for excess greenhouse gases in the atmosphere to dissipate, we need to take specific actions to *reduce* atmospheric $CO_{2e}$ levels to less than 350 parts per million. Protecting forests from logging—that is, from carbon removal—and promoting the natural recovery of forests that were cleared for agriculture are the quickest, most effective, and most ecologically sound ways to do that. Even moderate steps to protect forests and increase carbon storage could account for 37 percent of the actions needed to mitigate climate change globally; bolder steps could constitute about *half* the actions needed to avert the most extreme and destructive effects of climate change, while also preventing most species from going extinct.[6]

We need strong international leadership to protect forests from degradation, fragmentation, and deforestation all over the world, but one of the biggest impediments to real progress is the United States. The United States has a disproportionately large role in the United Nations, which is based in New York City. It is a member of the UN Security Council, but how effective can it be in advocating for international policies to secure greater protections for forests in South America, Asia, or Africa when the US government continues to weaken environmental laws and to subsidize commercial logging operations on federal public lands? This not only undermines the potential to demonstrate proactive international leadership on forest protection and climate change but also creates global resentment, as forested nations on every continent see the United States as a hypocrite.

Exacerbating this problem is the fact that, although many US citizens now understand the linkage between deforestation and climate change, most of them see it as an international problem—one that exists in South America and Indonesia and Siberia, far from US shores. Americans fail to grasp that more logging and clear-cutting occur in the United

States than in any other nation on earth, including Brazil.[7] In fact, the United States is the world's worst culprit in terms of carbon emissions from logging. This means that the United States has a deep responsibility to do better, to protect more forest habitat, to reduce wood consumption, and to demonstrate international leadership in forest protection efforts. What would this look like?

It would start with ending both logging and fossil fuel extraction on public lands to keep the carbon in the forest and in the ground. We know that public forests in the United States are significant carbon sinks—absorbing substantially more carbon from the atmosphere than they emit—and we also know that they could be much larger carbon sinks if we stopped pulling huge amounts of carbon out of them through logging.[8] The more forests are protected from logging, the greater their carbon storage capacity and their climate change mitigation potential.[9] Ending the logging program on US public lands and getting federal land management agencies out of the commercial logging business would be like removing 24 million cars from US highways.[10] The direct benefits would be *much* bigger if funds were dedicated to acquiring, from willing sellers, large tracts of additional forestlands and taking them into protected public ownership, as well as protecting large areas of forest through conservation easements, especially in regions with relatively little public land, such as the Southeast.[11]

Taking this step at the federal level, and taking similar steps at the state level, would not only help us overcome the climate crisis but also help us connect forest habitats fragmented by decades of logging, benefiting imperiled wildlife species. Moreover, the billions of dollars currently spent each year subsidizing and promoting logging in US forests could be redirected into a green jobs program to help fire-vulnerable communities become safer. Current subsidies for the biomass logging and wood pellet industry could be redirected to services and jobs that improve the health of local communities of color that are disproportionately impacted by this industry and the air pollution it causes.[12] Newly acquired public forestlands would need people to staff them, leading to the creation of jobs, and additional public lands would increase access to nature for lower-income communities in regions that currently have too few public forests.

As part of this approach, we can adopt policies that foster a transition away from wood consumption for paper products, construction materials, and energy—similar to the transition away from fossil fuels. Substantial federal resources could be allocated to research and development of nonwood alternatives; to support and subsidize advances that greatly reduce the carbon footprint of other materials such as concrete and steel; and to encourage less overall consumption, maximize recycled content, and discourage unnecessary new construction. We could also explore methods to grow more food crops indoors, within or adjacent to population centers—not only to reduce energy usage from transportation but also to return some farmlands back to carbon-rich native forest ecosystems.

Logging interests are actively promoting industry-funded misinformation in an attempt to increase wood consumption. They have been especially aggressive in pushing for subsidies and environmental policies that would promote engineered wood products such as cross-laminated timber (CLT), or mass timber. The wood products industry would like to see a huge increase in the construction of tall buildings using CLT instead of steel and concrete, and it would like to see the demolition of perfectly good older buildings to facilitate the unnecessary construction of new ones. The industry spends large sums on lobbying to promote increased logging as a climate solution, despite the clear scientific evidence that CLT and other wood products substantially exacerbate the climate crisis and undermine climate solutions.[13] This is a new and dangerous form of climate change denial—and most people are unequipped to recognize it for what it is.

The logging industry's claims have been discredited by scientific analyses revealing that the industry has been using unrealistic and false assumptions in its models, leading to false claims that substituting wood for steel and concrete will reduce the overall carbon footprint of construction.[14] One study found that the carbon footprint of wood is 6 percent higher than that of concrete,[15] and this assessment did not include the reduced carbon sequestration and storage capacity caused by nutrient loss and soil compaction from logging.[16] Importantly, a recent breakthrough in solar energy production will soon make it possible to dramatically reduce the carbon footprint of concrete and steel even further.[17]

The recycled content of steel is already quite high, since steel is one of the most recyclable materials on the planet; however, it could be even higher if policies encouraged a maximum recycled content. Concrete is currently undergoing a sort of renaissance; more and more new companies are reimagining this basic building material, and many are employing technologies that can capture $CO_2$ directly from the air and use it to make concrete products.[18] Other companies are making structural lumber out of hemp and recycled plastic or hemp fibers and soy-based glue.[19] Such products account for only a small percentage of the current market, but that could change with a shift in policy direction regarding subsidies, tax incentives, and funding for research and development. Although reduced consumption of wood and paper products should be the top priority, the use of nonwood alternatives is a key aspect of climate change mitigation.

Fear and panic are understandable emotions in the face of the climate crisis, and unfortunately, there is a tendency for environmental and climate activists to focus only on how to theoretically reduce atmospheric carbon, rather than asking what sort of world we want when we manage to overcome the climate crisis. Will it be a world that we recognize and cherish, or a world devoid of its natural wonders because we squandered and destroyed them in the pursuit of false solutions promoted by climate change enablers? Some of these false solutions have already been noted, such as the Department of Energy's proposal to massively increase commercial logging levels and incinerate trees for biomass energy production. Then there's the deceptive Trillion Trees Act, which doesn't require the planting of a single tree but demands more logging based on the discredited notion that the carbon in trees can be stored in lumber products. Yet another is the CLEAN Future Act, which encourages continued reliance on fossil fuels and promotes biomass logging, misleadingly spinning these fuel sources as "renewable energy."

If our thinking and our approaches are too carboncentric and not sufficiently ecocentric, we will lose our way as we search for the right path forward. Approaches that promote ongoing fossil fuel consumption, the logging of forests, the further development and degradation of ecosystems, or wildly dangerous and risky climate-engineering notions that involve pumping various chemicals into the atmosphere with unknown consequences, are not climate solutions. Real climate solutions do not promote pulling carbon out of the ground or out of the forest.

The timber and biomass logging industries and their political allies, who include right-wing politicians and some self-described liberals who accept campaign contributions from these industries, are assiduously attempting to greenwash logging as a climate-friendly and "renewable" alternative to fossil fuels, as does a recent report from the biomass logging industry and the US Forest Service.[20] This is the new face of climate change denial: logging interests and the politicians they pay consistently deny the true impact of such policies. They deny the fact that incinerating trees for energy produces much more $CO_2$ than burning coal does,[21] and they deny that most of the carbon in logged trees is emitted into the atmosphere almost immediately from the incineration of slash debris and mill residue (100 percent is emitted in the case of biomass logging).[22] They try to sidestep the reality that we must reduce atmospheric carbon levels now and that we cannot afford to *increase* carbon emissions by treating trees as if they were giant sticks of coal. They claim that we need not be concerned about greenhouse gas emissions from using forests as a carbon fuel because those carbon emissions will be "captured," transported through thousands of miles of newly constructed pipelines, and pumped underground—just like the "clean coal" ruse perpetrated by the fossil fuel industry for many years—and they ignore the science indicating that $CO_2$ stored underground is released during earthquakes and can actually trigger earthquakes.[23] They traffic in the climate change–denying myth that biomass logging is "carbon neutral," ignoring the massive rise in atmospheric carbon emissions over the next several decades if biomass logging were increased.[24] They claim that the logged forests may eventually grow back, but they fail to mention that this would happen long after the worst effects of climate change had already occurred. And they ignore and deny the substantial reduction in forest carbon sequestration and storage capacity that results from logging and the adverse impacts associated with that.[25]

In essence, by promoting wood products, including mass timber (engineered wood beams), and biomass logging as green climate solutions, the timber and biomass industries want us to ignore the fact that

A naturally regenerating patch of snag forest was subjected to postfire clear-cutting more than four years before this photo was taken. The slash debris was bulldozed into giant piles, accelerant was applied, and the piles were incinerated like enormous bonfires. Years later, the area still supports no tree growth.

most of the wood removed from forests is used as dirty, climate-polluting fuel.[26] They also want us to assume that logging has no consequences for forest regrowth. My colleagues and I recently completed research into postfire regeneration in the 2013 Rim fire area, and we have been shocked at the extent to which prefire logging operations have reduced the forest's ability to sequester and store carbon. In areas where commercial thinning took place before the Rim fire occurred, more than one-third of the logged areas were converted to nonforest, where no conifer trees had grown for decades due to soil damage and nutrient loss. The areas deforested by logging typically comprised old logging roads, skid trails, and landings. In three other fire areas, the Forest Service and the logging industry had conducted postfire logging operations followed by tree planting in the 1990s. But the tractors did so much harm to the fragile postfire soils, and so many of the artificially planted trees ultimately died, that about three-quarters of these areas had been converted to invasive grasses, shrub habitat, or bare ground and remained deforested fourteen to seventeen years later, when the Rim fire occurred.

To move beyond fossil fuel consumption while simultaneously protecting forests from logging and decreasing wood consumption, a substantial political shift needs to occur. Such a shift will require a new theory of political change. For decades, the environmental movement has relied on political "access" to promote green policies. In the United States, the theory behind this approach is that we should view liberal politicians in general, and the Democratic Party in particular, as allies and expend considerable resources and efforts to ensure that these politicians maintain or enhance their power. The underlying assumption is that liberal politicians will reward the environmental community by standing firm against legislative attacks on environmental laws and by actively promoting important new policies that will advance and increase environmental protections. But for decades, this approach has proved woefully inadequate, especially as it pertains to forests. This reality has become particularly problematic because protecting forests from logging is now essential, not optional, if we hope to overcome the climate crisis.

In the late 1970s President Jimmy Carter betrayed the environmental community when he proposed that most of the wild, unlogged forests in roadless areas on public lands be relegated to road building, logging, clear-cutting, and other industrial development. This set off a long and ugly series of betrayals by Democrats in Congress and the White House—a pattern that continues to this day. In the late 1980s congressional Democrats who were funded by the logging industry pushed through the Section 318 appropriations rider, which suspended environmental laws and mandated the logging and clear-cutting of tens of thousands of acres of mature and old-growth forest on public lands in the Pacific Northwest. During the Clinton-Gore administration, it was the Salvage Logging Rider of 1995—another appropriations measure that overrode all federal environmental statutes to allow unfettered logging in national forests and on other federal lands for years. The Clinton-Gore administration also instituted a series of regulatory policies that badly weakened the Endangered Species Act. Congressional Democrats worked with Republican George

W. Bush to pass the deceptively named Healthy Forests Restoration Act of 2003, which weakened long-standing environmental analysis requirements for logging projects on federal public lands. The Obama administration actively pushed for the largest rollback of environmental protections in national forests in years, attaching a measure to the 2014 farm bill reauthorization that exempted many commercial logging projects on federal public lands from any meaningful environmental impact analysis with regard to climate or biodiversity. After that, logging levels began to increase in national forests. Most recently, establishment Democrats in Congress have proposed the CLEAN Future Act, which promotes biomass logging and a continuation of the fossil fuel economy, as well as the so-called Emergency Wildfire and Public Safety Act of 2020, which would eliminate many of the remaining environmental protections for national forests and other federal public lands to facilitate a large increase in logging and biomass logging under the guise of fuel reduction, including the removal of mature and old-growth trees, clear-cutting, and postfire clear-cutting.

In each of these cases, the largest and most prominent environmental organizations complained mildly and briefly, but there were no significant political consequences for the Democrats responsible for these attacks on environmental protections for public forestlands. The environmental community actively campaigned for the election and re-election of these same Democrats—many of whom had questionable or abhorrent positions and voting records on environmental issues but were always a step or two to the left of their Republican opponents. Over the years, green groups kept choosing to support the "lesser of two evils," even as the Republicans marched further and further to the right on environmental issues and the Democrats marched right along with them, just a step or two behind. Whenever the Democrats sold out the environmental community, green groups were in an awkward position and were unsure how to respond.

Over time, it has become clear that our "friends" in the Democratic establishment are taking the environmental community for granted and are not really friends or allies at all, with some notable exceptions. Dozens of progressive Democrats—many of them younger and more diverse than their establishment counterparts—began to push for a much bolder vision in response to the climate and extinction crises, but the Democratic establishment did everything in its power to marginalize the progressives, whom they characterized as overly idealistic upstarts.

How can this toxic, disempowering, and self-defeating context be changed? First and foremost, environmental, climate change, and climate justice organizations should reject the outdated and failed political "access" approach. This does not mean that we should refuse to engage in direct conversations with legislators and their staffs—quite the opposite. The dedicated work of environmental lobbyists is more important than ever, but it is not enough. We must also work to reinvigorate and reenergize our grassroots organizing capacity and visibility in order to shift political realities and hold elected officials accountable. Entrenched political leaders who are far more interested in making deals and expedience than in doing the right thing should be actively targeted for removal from office during primaries. The successful campaign of Alexandria Ocasio-Cortez in the 2018 congressional primary in New York is an important example. However, such efforts should be greatly expanded, not only to oust problematic Democrats and replace them with greener progressives but also to remove antienvironment Republicans—replacing them with pro-environment Republican challengers in the primaries and progressive challengers in the general elections.

Green groups have been pursuing the access-oriented "inside strategy" far too long, failing to recognize that a liberal politician who is held half as accountable can be just as dangerous as a conservative who is held twice as accountable. By accepting the lesser of two evils, we are often left with the evil of two lessers. We can and must do better. We need to come to a new understanding of political realities and recognize that tepid or conspicuously compromised policy proposals are not realistic in the current political and ecological environment. The public has become increasingly unwilling to get involved and turn out in support of such approaches, but strong and visionary initiatives can inspire people to action. Time is short, and the stakes are high. If this is not the time for boldness, what is?

# 14

# A New Wildfire Vocabulary

Some years ago, a colleague of mine walked into a US Forest Service office in California and told the receptionist he would like to talk to someone about forests and the impacts of logging. Soon, a woman came out to speak with him. He told her that while hiking in the national forest (which the Forest Service was entrusted to manage for the public), he had seen some large, recent clear-cuts and was concerned about the effects on imperiled species such as the spotted owl. She flashed him a strained smile and informed him, "Sir, we don't practice clear-cutting on this national forest." Confused, he persisted. "But what about the clear-cuts I just saw?" She cheerfully responded, "That isn't clear-cutting; that's ecosystem management," as if my friend was a bit slow on the uptake but might be capable of catching on.

Whether one is contemplating social issues, geopolitics, or environmental matters, it has been broadly true throughout history that oppressive systems have always used and twisted language to advance regressive and destructive policies and regimes. Language matters, and its weaponization by logging interests, land management agencies involved in logging, and politicians funded by the logging industry warrants careful attention. And it needs to change. A kind of ecological hate speech has developed around the issue of wildland fire and forests, and it is perpetuating the removal of massive amounts of carbon from forests worldwide under the banner of benign or benevolent-sounding terms, exacerbating climate change, and pushing at-risk wildlife species and ecosystems closer to the brink. To overcome the existential threats and challenges of our time—the extinction and climate crises—we need to change the way we talk about these issues and confront the use of regressive language in others when we hear it.

The purpose here is to deconstruct the language on which the "catastrophic wildfire" paradigm is built. In this context, I identify a series of problematic euphemisms and decipher what they really mean so that readers will be able to recognize them for what they truly are. And I propose a new, alternative vocabulary to facilitate positive change.

The first term that comes to mind is "fuel." Under the catastrophic wildfire paradigm, nearly every tree in the forest—live trees, snags, and downed logs—is now called "fuel" or "hazardous fuel." These terms not only devalue trees and deny their importance in the forest ecosystem and for climate change mitigation; they also portray trees as something dangerous—something to be feared. This arborophobic and pyrophobic language conveniently facilitates industrial logging, including postfire clear-cutting. However, as discussed earlier, only a tiny fraction of tree biomass is consumed in forest fires; even for snags and downed logs, the great majority of the biomass typically remains intact and unconsumed.[1] Given the ecological importance of trees, snags, and downed logs to native wildlife and to carbon storage, I suggest using the word "habitat" instead of "fuel." Depending on the context, it also makes sense to refer to live trees, snags, downed logs, and other forest vegetation as "stored carbon" rather than "fuel."

The second problematic use of language that comes to mind is actually a whole list of euphemisms used to promote commercial logging and clear-cutting operations in fire-adapted forests around the world. The most common ones include "fuels treatment," "forest health treatment," "active management," "mechanical thinning," "salvage," "ecological restoration," "ecosystem management," and "reforestation" (a euphemism for postfire clear-cutting and the planting of tree farms). These phrases are a type of code used to put a positive political spin on these actions. I recommend calling them what they really are: logging. Moreover, when land managers or politicians—whether conservative or liberal—talk about "increasing the pace and scale of restoration," they are promoting an increase in industrial logging to accelerate the removal of carbon and wildlife habitat from forests, and they should be held accountable. Similarly, if someone issues a policy proposal under the banner of "working forests," this is code for prioritizing commercial logging over all else.

The phrases "forest health" and "healthy forests" deserve special attention. The prevailing use of the word "health" with regard to forests has nothing to do with ecology or biodiversity. Instead, it describes the goal of controlling and suppressing natural processes such as fire, cycles of drought, and fluctuations of native beetle populations in order to facilitate the orderly and planned extraction of timber commodities from forests. For example, a 1993 US Forest Service report defined forest health as the suppression and control of natural processes for the purposes of ensuring that such processes "do not threaten management objectives now or in the future."[2] If forest ecologists use the word "health" at all, they use it in the phrase "ecologically healthy forests" to emphasize biodiversity and ecological processes. More often, ecologists (except those funded by the logging industry or land management agencies that profit from logging) simply refer to "natural processes," "biodiversity," and "ecological heterogeneity."

A particularly subtle and misleading term is "resilience." This word is commonly used in forest management circles, and it almost always refers to logging of some type, including clear-cutting. In my experience, virtually no one understands what this word means, and nearly everyone uses it incorrectly. According to the United Nations Convention on Biological Diversity, there are two kinds of resilience, and they are diametrically opposed.[3] The first is "ecological resilience," which refers to natural processes of varying intensities and scales that create habitat heterogeneity and maintain the full range of native biodiversity across the landscape, including species that depend on natural events such as high-intensity fire. Forests are not ecologically resilient in spite of mixed-intensity fires; they are resilient *because of* forest fires and other natural events and cycles.

The opposite of ecological resilience is "engineering resilience." This term is essentially synonymous with "forest health," in that it pertains to policies that seek to command and control nature and minimize or suppress natural processes to further an agenda of commodity production and resource extraction. Engineering resilience is the antithesis of biodiversity conservation, yet nearly every time the word "resilience" is used in relation to forests, it means engineering resilience—that is, logging. Much like "restoration" and "forest health," the word "resilience" has become so poisoned that many scientists and forest protection advocates simply don't use it. I recommend that the term always be modified by specifying "ecological resilience"—preferably accompanied by a brief description of what that means.

A case in point is the Resilient Federal Forests Act, introduced in the House of Representatives in 2015 by Bruce Westerman, a Republican from Arkansas who has a logging background and is the recipient of large amounts of logging industry campaign cash. The act envisioned one of the largest permanent rollbacks of environmental laws on public lands in US history. Under the deceptive banner of "resilience," it proposed to exempt nearly all logging projects from environmental review and meaningful public comment and participation through "categorical exclusions." The goal was to facilitate increased commercial logging on federal public forestlands following "catastrophic events," which were defined as "any" natural event, including "any fire," "drought," "rain storm," "windstorm," or "snow or ice storm." In other words, whenever a fire occurred, the wind blew, or rain or snow fell in the forest, an unlimited number of commercial logging or clear-cutting projects—each covering thousands of acres—could be planned and executed in national forests without any environmental impact analysis with regard to wildlife, soils, or climate change. Hundreds of scientists wrote to Congress, calling the act an ecologically destructive Trojan horse, and they urged legislators to oppose it.[4] Although the act later passed in the House of Representatives on a heavily party-line vote, it subsequently stalled in the Senate as public concern mounted over its cynical and Orwellian language.

My next criticism involves the value-laden, hyperbolic words and phrases used to describe forest fires. Here, I am speaking in particular to environmental journalists and their editors at news outlets around the globe. This is really more of a plea than an admonishment because the work they do is profoundly important to our understanding of forest, fire, and climate issues and to the public dialogue that develops and ultimately shapes policies. Because of this, it is especially important for environmental reporters to avoid pejorative language that demonizes wildland fire.

Every week (and sometimes every day) during fire season, I read stories asserting that forest fires "destroyed," "devastated," "annihilated," "incinerated," "consumed," "damaged," "razed," "eliminated," "deforested," or "nuked" forest ecosystems. Some stories describe forest fires as "demonic" or claim that fires have created a "moonscape" or a "wasteland" that is "lifeless" and devoid of wildlife habitat. Other stories quote politicians or government-funded spokespersons spreading the myth that trees "explode" in wildfires—with no rebuttal from independent experts. These descriptions are misleading and inaccurate, but many reporters and editors find them hard to resist, despite the availability of numerous good alternatives. For instance, a reporter could simply state that a forest fire "spanned," "spread across," or "grew to" 50,000 or 150,000 acres, instead of claiming that the fire "destroyed," "incinerated," or "consumed" that same acreage. Other stories describe a specific acreage as being "charred," "blackened," or "scorched" by fire, and although these words are not as extreme, they do not meaningfully describe the habitat-creating and nutrient-cycling effects of fires, including large ones, in fire-adapted forest ecosystems. "Rejuvenated" would be a far more accurate term in light of current scientific knowledge on forest fire ecology and biodiversity.[5] The most neutral word in this context would likely be "affected."

The ultimate pejorative term, and the one that is most pervasive whenever a big fire event occurs anywhere in the world, is "catastrophic wildfire" (also be on the lookout for its somewhat less noxious but still problematic cousins "uncharacteristic wildfire" and "megafire"). This term has no ecological or scientific meaning, but it has become deeply embedded in the public vernacular about wildland fires. Often, it is used in conjunction with descriptions of "good fire" versus "bad fire," which passes moral judgment on forest fires for being mixed intensity, as they have been for millions of years. Based on this narrative, only low-intensity fire patches are "good," and high-intensity patches that create snag forest are "bad." By extension, wildlife species that have evolved over millennia to depend on the unique habitat created by high-intensity fire must also be "bad" and therefore undeserving of protection from logging and other development (as if the black-backed woodpecker should be blamed for liking trees of the wrong color).

I strongly recommend simply not using the terms "catastrophic wildfire," "uncharacteristic wildfire," and "megafire" and not characterizing forest fires as "good" or "bad." "Uncharacteristic wildfire" inaccurately implies that an individual fire that may be somewhat more intense than *average* is somehow unnatural and harmful. This ignores everything we know about ecology and fire history, including the fact that there have always been fires of different sizes and intensities in all forest ecosystems. Averages are, by definition, calculated from lower and higher values. Some wildlife species prefer conditions created by cooler burns, but many others like it hot. Mixed-intensity fire provides the heterogeneous habitat conditions that support the diversity of native wildlife in the forest.[6]

To the great credit of a few large news outlets in the United States, significant progress has been made toward the use of a more ecologically informed and more value-neutral vocabulary for forest fires. However, most news outlets in the United States and elsewhere still employ language that demonizes forest fires and promotes fear and even hatred toward this natural process and toward snag forests. It is in this atmosphere that regressive, climate-harming logging policies thrive.

In some cases, the problematic language is so subtle and so widely used that it is almost imperceptible. For example, I strongly prefer the value-neutral term "fire intensity" to "fire severity." "Severe" refers to "something bad or undesirable"[7]—clearly not a value-neutral word. But the terms "fire severity" and "high-severity fire" have become ingrained as terms of art in my field. As a forest and fire ecologist, whenever I publish studies in peer-reviewed scientific journals, I am required to use the term "severity," as are others in my field. The explanation given by some scientists is that, technically, "severity" refers to a fire's effect on vegetation (such as the percentage of trees changed into snags), whereas "intensity" refers to the energy output of a fire. To me, this is an unsatisfying

A bluebird perches on a branch in snag forest habitat. What if the images used to depict forest fires focused on the colorful and beautiful wildlife species that depend on snag forest habitat? (Photo by Maya Khosla, 2017)

explanation because, aside from the fact that it ignores the negative connotations of the words "severe" and "severity," the truth is that a highly *intense* forest fire almost invariably has tall flames that turn a high percentage of trees into snags. Moreover, if we are being *technical,* a given forest fire cannot be "severe" because "severity" is a measure of the effects on vegetation long *after* the fire is over—months or even a year later, in fact. The truth is that many in the scientific community who steadfastly insist on using the term "severity" do so because they lack a deep understanding of the ecological role and benefits of high-intensity fire or because they are affiliated with agencies or entities that, for political and economic reasons, are hostile to anything that kills a tree unless it is a chain saw.

The demonization of forest fires is not always verbal. Sometimes it is visual. For instance, for many decades, fire intensity maps created by land management agencies have used the color red to define high-intensity fire patches, yellow for moderate-intensity fire, and green for low-intensity fire. What are the cultural connotations of these colors? Red is typically used to warn of harm or danger in signs on roadways, in hospitals, and in factories in many nations. "Red ink" in accounting terms means a negative balance sheet, where expenses exceed revenue. Green, in contrast, means "go" or stands for positive approval, such as when a project or proposal gets the "green light" to proceed. Green is considered the color of growing, living things, but in reality, the snag forest habitat created by high-intensity fire patches is greener and more colorful than forests that have burned at low intensity. Snag forest habitat has a richer understory of deep green shrubs and young conifers, bright green oak leaves, and wildflowers in a rainbow of colors.

In addition to its intrinsically negative connotations, red tends to draw the eye in ways that green or yellow do not. When I give presentations on forest and fire ecology, I often show a US Forest Service "fire severity" map of the Rim fire, which shows "high-severity" fire in bright red. When I ask people to visually estimate the percentage of the Rim fire area in the "high" category, they generally perceive it as being somewhere between 30 and 50 percent. In reality, on the map only 19.9 percent of the Rim fire is depicted in "high-severity" red—less than one-fifth of the total fire area. The purposeful use of red to define high-intensity fire not only creates a subconscious negative impression but also misleads people into overestimating the intensity of fires. What if we switched things and used green for high-intensity fire and other colors (not red) for other intensities? How would such a change in color scheme alter our perceptions and, in subtle ways, change how we respond to mixed-intensity fire events?

Nonverbal bias is also present in the visual media coverage of forest fires. Even if the majority of a given forest fire was low intensity (which is common)—that is, the fire crept along the forest floor and killed only smaller trees—most of the media coverage would consist of dramatic images of high-intensity fire patches with tall flames at the treetops. Another common type of visual bias involves showing fire areas just after the flames have passed, where the trees are blackened and the ground is covered in ash. To the general public, these places look desolate, so it is no wonder that so many people mistakenly think that wildland fires are destroying forest ecosystems. What if the press returned to fire areas a year or more later and showed the regenerating trees, the flowering shrubs, and the colorful wildflowers on full display? What if the media reported

The author standing among naturally regenerating aspens along Fish Creek in San Bernardino National Forest, just three years after the Lake fire. This aspen stand had been slowly dying for decades until it was saved and rejuvenated by a large high-intensity fire patch. (Photo by Rachel Fazio, 2018)

that native mammals and birds and insects had colonized the fire area and increased their populations, nourished by the abundant food and supported by the plentiful nesting or denning habitat in the snag forest? Would public perceptions begin to change? Would public policies shift in a better direction? Probably. To their credit, some reporters have done this very thing, but most have not.

So, what is the upshot here? What is the message for environmental and climate change activists, policy makers, and environmental journalists? It's simple: just stop. No more "the world is on fire" or "the earth is burning" tweets or sound bites, please. The fear-based language, the hyperbole, and the demonization of forest fires are contributing to horrible, destructive policies that are making things worse, and we can't afford to make things worse. We simply don't have the time. Given the decades of disinformation from logging interests and the "catastrophic wildfire" propaganda from corrupt government agencies, it is easy to understand how people can so profoundly misunderstand and mischaracterize forest fires. As I admitted earlier, I misunderstood for years. It is also easy to understand the temptation to demonize fire to push content or to shock people into taking action. Fear sells, and it can spur people to act—but it almost always results in the wrong sort of action. Fear exacerbates problems, gets us deeper into trouble, and diverts our attention from the real threats of rising temperatures and sea levels.

We can do much better, and we must. We can embrace a new vocabulary for wildland fire—one that promotes real climate solutions and transcends the politics of fear.

# 15

# Moving beyond the Politics of Fear

When I was a kid, a friend invited me to join the local Boy Scouts troop in Glendale, California, where my family lived. Our troop was basically a serious backpacking club. We did little else. I waited for an end-of-season sale at the local camping store and got myself a cheap backpack, a secondhand sleeping bag, and a few other basic items. In a typical year, we did twelve trips—about one every month. Even in the middle of winter, we would head up to the mountains, hike for miles in the snow, and set up camp.

Our scoutmaster, a local physician, had a simple philosophy. He wanted everyone in the troop to acquire basic wilderness survival skills and to learn how to read a topographical map and navigate with a compass. At the beginning of each day on a backpacking trip, he would point to his map, showing us where we were, and then point out our destination for the end of the day. Then he would say, “See you all there.” Without fail, he always hiked at the back of the pack to make sure no stragglers got left behind.

And so, by the time I was twelve years old, I was backpacking in deep wilderness on troop outings, often hiking and navigating by myself with a map and a compass. Most of the trips were weekend excursions, but we did one weeklong trip to the High Sierra every year, hiking for fifty miles or so through backcountry valleys and over 12,000-foot passes. These soon became my favorite outings. By the time I was fourteen, I was planning my own fifty-milers in the High Sierra. Some of my older brother's friends had cars, so I would plan the route, ensure that everyone had the proper equipment and food, and act as the guide and the cook—as long as they agreed to drive. It worked out just fine. When I was old enough to drive myself, I went on more and more outings, exploring new backcountry routes and finding remote alpine valleys tucked away under 14,000-foot ridges. The wild mountain forests and peaks became home to me.

As an undergraduate at the University of California at Los Angeles, I covered expenses for tuition, books, food, rent, and gas by working as a night patrolman for a neon and fluorescent sign repair company. While other college students were going to parties, on most nights I was heading off to work, driving along the main commercial routes all over the city to find illuminated signs in need of repair. I would pass on this information to my employer, which would follow up with the business in question and arrange to do the repair work. I also worked as a car courier, racing all over Los Angeles in my tiny, beat-up 1978 Honda delivering packages. I arranged my academic schedule so that all my classes were on particular days of the week so that I could work the other days and earn enough to pay the bills. I picked up as many shifts as I could, working about thirty hours per week. My courier job took me to every part of the city, from East LA to South LA to the San Fernando Valley. Many of these communities were being torn apart by gang violence at that time, and I saw the victims of that violence on an almost weekly basis. The intensity and pace of the courier job were extremely stressful, and the turnover rate was high. Back then, the average LA car courier lasted only about six weeks. I did it for more than six years.

Every chance I got, I grabbed my old ripped-up backpack and headed to the mountains for the weekend or even just for the night. Sometimes a friend or two joined me, but if not, I went by myself, no matter the season. This had become far more than recreation to me. I found that I needed to be in these wild places. It kept me together. But many people struggled to understand why I chose to spend time in such places. They asked, "Aren't you scared?"

Years later, my work as a field ecologist has me spending dozens of days each year doing research in mountain forests, far from the nearest road, and I still get the questions: What if you see a bear or a mountain lion? Do you bring a gun? What if there's a fire? What if a dead tree falls on you? I'm never quite sure how to answer these questions, because I don't see wild places as frightening, alien, or dangerous. I know some remote forests nearly as well as most people know their living rooms. How do I explain that, if I happen to see a bear or a mountain lion, I consider it a good day, a lucky day? I see the fires that periodically sweep the landscape as a life-giving and rejuvenating force, and I see the dead trees as an essential source of food and homes to dozens of wildlife species I have come to know and love. In all the decades I have been hiking through snag forests, I have seen only one snag fall, and it wasn't very close.

The truth is that an excursion into these wild mountain forests is safer than a trip to the grocery store, but not in the minds of many people around the world. For many, wild places represent the "foreign" and the "unknown," and they seem somewhat surreal. People imagine that strange and perhaps terrifying things happen in these places. We have become disconnected from the natural world—an unfortunate alienation that feeds and inspires myths and misconceptions and fear. Nowhere in the natural world is this truer than the misperceptions surrounding large natural events, such as forest fires, that create patches of snag forest.

It is in this context that the politics of fear can do its insidious work, giving impetus to regressive policies and actions, sapping hope and intellectual curiosity, undermining reason and faith in the natural world. Every attack on environmental laws in the past three decades, and every rollback of these laws that has actually occurred—in 1995, 2003, 2014, and 2018, for example—has been driven by the politics of fear and the demonization of natural processes. And the same politics of fear has led to some of the worst and most ill-advised decisions by land managers.

In the fall of 2003, the Old fire spread up the City Creek drainage on the western side of the San Bernardino Mountains in Southern California. The creek, located in San Bernardino National Forest, was home to one of the main subpopulations of the endangered mountain yellow-legged frog, and a group of US government biologists began to panic. Anticipating a pulse of sedimentation into City Creek during the first rainfall after the fire, they feared the frogs would be wiped out by the silt and mud flowing into the creek. There was no scientific evidence that postfire sediments would cause significant population losses among the frogs, and the government biologists had no background in fire history or ecology. What they did know was that the Old fire had been more intense than the average fire and was therefore bad and catastrophic, in their view. They decided to take immediate action to "save" this subpopulation of mountain yellow-legged frogs from the effects of the villainous Old fire.

Not long after the fire, the scientists swept in and scooped up every single mountain yellow-legged frog they could find in City Creek and transported them to a laboratory for safekeeping until the fall and winter rain and snow had passed. There was a problem, however. A fungus called chytrid is spread to frogs through contact with humans. It is typically 100 percent fatal, and it moves through frog populations quickly once they are infected. This risk was well known to the government biologists and the Forest Service, as was the general inadequacy of frog handling procedures and safeguards to prevent infection. But the biologists and land managers were far more afraid of the Old fire, despite the lack of scientific evidence to justify their actions. Soon, the captive frogs were infected with chytrid, and every one of them died.

A few years later, a biologist with a local natural history museum was scrambling up City Creek and could not believe his eyes. He was seeing mountain yellow-legged frogs—a lot of them—where they had supposedly been extirpated. The government's frog "rescue" team had obviously missed some when it removed the frogs from City Creek years earlier. And the frogs had proliferated and thrived in the postfire stream channel. Local environmentalists were elated.[1] The government biologists and land managers were pleased with the news too. They swooped in and removed the remaining frogs from City Creek, assuming—without any evidence—that the creek could not provide suitable habitat for the frogs, simply because a wildland fire had occurred there, just as hundreds of others had occurred in the same canyon over previous millennia. These frogs were also infected by chytrid and died. Now, there are no yellow-legged frogs in the creek.

Over the years, similar stories played out in other fire areas in the mountains of Southern California. Each time the land managers moved in to "save" the frogs from the effects of fires, they infected the frogs, killing nearly all of them.[2] To this day, the Forest Service and the government biologists tell the public that forest fires extirpated yellow-legged frogs from City Creek and a couple of other locations, but the fires did nothing of the sort. The frogs were casualties of arrogance and the politics of fear.

The victims of this fear are numerous. They include spotted owls, killed not by large fires but by the logging that so often follows. They include black-backed woodpeckers and dozens of little shrub-nesting birds that are quietly slipping toward extinction under the combined pressures of fire suppression, "thinning," and postfire habitat removal.[3] And they include human communities, ignored by policy makers and land managers bent on slaying dragons out in the forest wildlands and extracting commodities in the process, rather than saving homes and lives in at-risk rural towns.

When people around the world are taught, through a steady barrage of government-funded disinformation, to fear and hate wildland fires and dead trees, and when access and connection to nature are restricted, it is no wonder that the intrinsic values and wonders of forest ecosystems and the native species that inhabit them are so often ignored and devalued. In such a context, forests are seen as valuable and important only to the extent that they can do something for us, fulfill some utilitarian purpose in terms of providing goods or services. Natural events like forest fires are seen as inherently bad—something that must be attacked and later exploited economically by so-called salvage logging.

This societal paradigm is built on the politics of fear. But it simply could not exist, and could not continue, if people accepted the intrinsic value of native ecosystems like forests and the natural events and processes that shape and sustain them—natural processes that are quite literally as old as the hills. Positive change would be inevitable if we accepted and embraced the good news emerging from independent science—that the natural events that create snags and snag forests are not destroying forests, and there is not an unnatural excess of these processes or this habitat in forest ecosystems.[4] In fact, these events are as essential as sun and rain in fire-adapted forests, creating some of the best and richest wildlife habitat. And forests have the capacity to naturally regenerate after these events. This sort of beneficial change can be facilitated and accelerated if societies take purposeful steps to expand protected public forestlands, increase urban residents' access to nature, restore lost connections with wild places, create broader constituencies for forest protection, and increase the well-being of human communities.

These days, I spend as much time taking people into snag forest habitat to experience its beauty and wonders as I do conducting field research. I consider it equally important. If a person spends a single day in a snag forest in the spring, accompanied by someone who can describe the intricate, complex, and beautiful relationships in this ecosystem, that person will never view forests in the same way and will never simply accept at face value the propaganda that demonizes natural events and natural landscapes.

Though they are much maligned, the truth is that the natural cycles that occasionally create patches of snags are in many ways the cornerstones of forest ecosystems. Without these cycles and the snag habitat they create, native wood-boring and bark beetles could not exist or reproduce. Without the beetles, woodpeckers would have no food and would disappear. Without woodpeckers, there would be no homes for bluebirds, nuthatches, flying squirrels, chipmunks, and countless other birds and small mammals that need tree cavities. If snag forests did not exist, patches of native shrubs would largely vanish, along with the dozens of bird and mammal species that depend on these shrubs for their food and homes. And if cavity-nesting and shrub-nesting species disappeared, so too would numerous species of hawks and owls, deprived of the prey they need to survive.

Moving beyond the politics of fear is not optional. It is essential if we are going to make the policy changes needed to protect our forests, undo decades of habitat degradation and fragmentation from logging, and absorb more $CO_2$ from the atmosphere, as well as shift away from fossil fuels. This will require us to change our thinking about natural events in forests and to have some faith in nature, recognizing that these processes and cycles were occurring in forests for tens of millions of years before human beings ever walked the earth.[5] It will also require a change in how these issues are presented and explored in the public dialogue and in the language we use.

To environmental journalists, my request is this: please dig deeper. Obtain genuine alternative views when government-funded studies or reports come out—especially if they promote more logging. Go on site visits with independent forest and fire ecologists, and recognize the bias of spokespersons and scientists employed or funded by the logging industry or pro-logging agencies, just as you do for the fossil fuel industry or chemical manufacturers. Strive to embrace hope and intellectual curiosity over fear and panic. Help move us beyond the tired and outdated twentieth-century journalistic paradigm of wildland fires as ecodisasters, and work to create a new twenty-first-century vocabulary for natural events in our forests.

To anyone who cares about the natural world and about overcoming the climate crisis, here is my plea to you: if you are not already doing so, get involved, get active. Don't rely on existing green groups to create the necessary change. Nongovernmental organizations do not have the situation covered or handled. We need help, and lots of it. Consider the work an honor and a privilege, not an obligation.

John Muir's words are just as relevant now as they were in 1895, if not more so: "The battle we have fought, and are still fighting, for the forests is a part of the eternal conflict between right and wrong, and we cannot expect to see the end of it. . . . So we must count on watching and striving for these trees, and should always be glad to find anything so surely good and noble to strive for."[6]

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