FIRE ECOLOGY
in Rocky Mountain Landscapes

William L. Baker

ECOLOGY

Advance praise for *Fire Ecology in Rocky Mountain Landscapes*

"This is a landmark book in disturbance ecology and a masterful synthesis reflecting William Baker's deep knowledge of fire dynamics and understanding of the historical and spatial context of fire-controlled landscapes in the Rocky Mountains. No mere compendium, this book spares few paradigms from the author's insightful scrutiny, backed by rigorous data. The book will exceed the expectations of ecologists, geographers, conservationists, and managers."

—David J. Mladenoff, Beers-Bascom Professor in Conservation,
University of Wisconsin–Madison

"*Fire Ecology in Rocky Mountain Landscapes* examines fire's role in different settings and the influence of humans and climate in shaping fire regimes, past and present. Baker offers a cautionary tale about failed management approaches, the likelihood of severe fires in the future, and the urgent need to recast our relationship with nature. Finally, it is a comprehensive reference for fire scientists and fire managers working in the interior West."

—Cathy Whitlock, professor of earth sciences, Montana State University

"Baker makes a compelling argument that extensive, high-severity fires are a natural component of Rocky Mountain ecosystems; and he questions the widespread view that our 'fire problem' and 'forest health problems' are a consequence of twentieth-century fire suppression. This book dismisses old strategies stressing costly fuels reduction and fire suppression, and instead suggests sustainable strategies that treat wildfire as a problem in land-use decision making."

—Thomas Veblen, professor, Department of Geography, University of Colorado, Boulder

"Baker presents a refreshing perspective on fire ecology, revealing multidimensional factors at work in Rocky Mountain ecosystems. His willingness to question established paradigms breaks new ground and will add immensely to our understanding of fire in these systems, ensuring that this will be a standard reference for years to come."

—Jon Keeley, research ecologist, US Geological Survey, and adjunct professor,
University of California, Los Angeles

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CHAPTER 12

Toward a Better Relationship between People and Fire

The Rocky Mountains are a favorable setting for developing a better relationship between people and fire. These mountains have a relatively sparse human population and have long contained more nature-dominated landscapes than most of the United States outside Alaska. Wildland fire in the Rockies is still strongly influenced by natural processes, at least away from human infrastructure (chap. 10). And, after a century of scientific research, we know more about natural fire in the Rockies than in many places. In chapter 11, I reviewed the tools available today for living with fire and their application across a gradient of land uses. Here, I highlight what we have learned about Rocky Mountain fire regimes and the response of plants and animals to fire from a century of scientific research. I suggest how to use some of the tools to begin immediately to create more sustainable landscapes that will allow us to have a better relationship with fire.

FIRE ECOLOGY IN ROCKY MOUNTAIN LANDSCAPES

Themes that have emerged from a century of scientific study of Rocky Mountain wildland fire include (1) the need for a multicentury landscape perspective to understand fire; (2) a large variability in fire at multiple spatial and temporal scales, including fluctuating landscapes from drought-linked episodes of extensive fire followed by long interludes of recovery; (3) the ability of native Rocky Mountain plants and animals to survive or recover well after fire; and (4) a general lack of evidence for a fire-exclusion effect, although climatic and land-use changes match fluctuations in area burned in the last century.

Historical evidence shows that we cannot understand fire in these mountains without observing a large land area over a long time period (chaps. 5–9). The landscape spatial scale and the multicentury temporal scale, well beyond the usual scales of human perception, are essential to understanding fire in the Rockies. A single person can experience only part of the spectrum of variation in fire, as fire rotations are commonly in the 100- to 500-year range in Rocky Mountain ecosystems (table 5.7). Most fires experienced in a human lifetime in a particular area are small, but fires in the Rockies have reached 100,000 hectares or more many times in the last century and a half (table 5.2). Relatively few of these large fires, patchily distributed across the region, make up most of the burned area. Only about 50 fires in excess of 15,000 hectares accounted for more than half the burned area in the Rockies over the past few decades (chap. 5). Observations in small areas or over short periods can consequently be quite misleading (table 10.9), as they can easily miss the infrequent fires that account for most of the burned area. To accurately reconstruct the historical range of variability (HRV) of fire requires a large and long view.

Scientific research and land management at these more extensive scales of thinking and understanding have expanded greatly but remain incomplete, in part because a lingering scientific tradition of small-plot studies and frequency-based measures of fire has held back understanding. Fast computers, remote sensing, geographic information systems, and the emergence of landscape ecology have facilitated scientific inquiry over large spatial extents in the last two decades, but fire history research at landscape scales is still limited (chaps. 5–9). Variation in fire across landscapes has been missed by past methods, which focused on counting and dating fires in small plots in intentionally chosen locations, often in old forests with long fire-scar records.

Frequency-based measures of fire, used in these small-plot studies, have also fostered extensive misunderstanding of the role of fire, including the idea of frequent fire (chap. 5). This idea derives from counting fires, which makes little sense, as it fails to take into account the enormous variation in fire size (fig. 5.3). Simply counting fires tells us that there are indeed many of them (e.g., 56,350 fires between 1980 and 2003 in the Rockies), but 55,228 of those 56,350 fires (98 percent) together accounted for only about 4 percent of the total area burned over the period. This is a fire rotation, and average mean fire interval across all points in the landscape, of about 6,900 years (equation 5.1 and data in chap. 5). Summing the areas of the 55,228 small fires shows that this apparently large number really means only 1 fire per 6,900 years on average at any particular point in the Rocky Mountains, not at all a frequent-fire regime. This example illustrates that counting fires, or using frequency-based measures (e.g., composite fire intervals), provides a misleading perspective on the importance of fire. Unfortunately, the idea that fires were frequent and of low severity across points in dry forests under the HRV is common, and much effort and funding have gone into efforts to restore and maintain frequent fires (chap. 7). However, fires were not actually frequent, on average, at points in any Rocky Mountain ecosystem under the HRV, based on population mean fire intervals and fire rotations (table 5.7). It is time for small-plot studies and frequency-based measures, along with the idea of frequent fire, to be replaced by area-based measures and methods (chap. 5).

A primary finding of the limited landscape-scale studies in the Rockies is the extensive variability of fire in space and time. Variation in fire size, fire severity, fire intervals, and nearly every other attribute of fire is manifest when large land areas and long time periods have been studied (chaps. 6–9). Variability occurs at several scales in the Rockies. The location of large fires varies regionally from year to year (fig. 5.4), shaped by patterns of drought, lightning, and vegetation. Within a landscape, patchy fire location and fire-size variation can lead to large short-term variation in time since fire and fire interval (fig. 5.10c). Individual fires may be of high severity over large areas, but they also can vary greatly in severity and leave surviving trees or tree groups, as well as a zone of scorched trees or scattered spot fires (figs. 3.15, 6.8), potentially creating thousands of discrete patches from a single fire (fig. 7.2). Fires occur every year, but most of the total burned area is from a small percentage of the fires that are large (box 3.1) and that tend to occur in drought years. Decadal episodes and individual years of severe drought (e.g., 2000, 2002), linked to oceanic and atmospheric conditions, historically and recently promoted large fires that are responsible for most of the total burned area in the Rockies (chaps. 2, 5).

Variation in fire sizes and intervals leads to fluctuating landscapes characterized by episodes of extensive fire followed by long interludes of small fires and general recovery (box 3.1). Rocky Mountain ecosystems that recover quickly relative to their fire rotation (e.g., prairies—table 5.7) spend long interludes in a mature condition, but slow-recovery ecosystems (e.g., many forests) may be recovering during large parts of the interludes. Episodes of extensive fire are often synchronized during regional droughts, leading to postfire forests recovering in unison across large land areas. Large areas of Rocky Mountain forests are still recovering from severe mid- to late-nineteenth-century fires. Recovery is natural, but the pattern of change expected from fire exclusion is similar, creating confusion. Fluctuating landscapes are normal in fire regimes (box 3.1) and mean that wildlife habitat, clean water, old-growth forests, and other ecosystem services desired by people quite normally change rapidly after long interludes of relative stability.

Native animals and plants survive or recover well after fire and appear generally adjusted to fluctuating landscapes. Some clearly are stimulated by fire, but fire dependence is rare; most plants and animals simply have functional traits that allow individuals or populations to persist or recolonize after fire. Animals, particularly those that are less mobile are sometimes killed by fast-moving fires, but most survive by moving away or taking refuge (chap. 4). Fires, no matter how severe, are not catastrophes for most animals, and postfire habitat after even severe fires may favor a flush of insects and birds. However, not just any fire or mosaic of burned patches is beneficial to animals, as they may have specific landscape requirements. Plants cannot escape approaching fires, of course. Most Rocky Mountain trees are killed and must recolonize by dispersing seed from nearby unburned areas. Resprouting and seed banks are rare among Rocky Mountain trees, but many common shrubs, graminoids, and forbs resprout readily after fire, and forbs and some shrubs may have seed banks (chap. 3). Rapid resprouting of surviving plants dominates after fires in most Rocky Mountain ecosystems; seed is a rarer source of postfire plants. Rocky Mountain plants generally have traits that allow survival and recovery within a few years after fires of any size or severity. However, many trees and some dominant shrubs that rely on postfire dispersal may recolonize more slowly, at times leading to multidecadal lags in regeneration that allow openings to persist for decades. These semipersistent, fire-created openings add diversity to Rocky Mountain landscapes.

People have altered fire regimes, but the best available data suggest that fire may not have declined in the Rockies relative to the pre-EuroAmerican era, either overall or in most individual vegetation types (chap. 10). Fire rotation has been estimated as about 275 years in the Rockies as a whole since 1980 and about 247 years in the northern Rockies over the last century, and both figures are near the middle between the low (140 years) and high (328 years) estimates of fire rotation for the Rockies under the HRV (chap. 10). These estimates suggest that since EuroAmerican settlement, fire control and other activities may have reduced fire somewhat in particular places, but a general syndrome of fire exclusion is lacking. Fire exclusion also does not accurately characterize the effects of land uses on fire or match the pattern of change in area burned at the state level over the last century (fig. 10.9). In contrast, fluctuation in drought linked to oceanic and atmospheric conditions appears to match many state-level patterns in burned area over the last century. Land uses that also match fluctuations include logging, livestock grazing, roads, and development, which have generally increased flammability and ignition at a time when the climate is warming and more fire is coming.

GOOD INTERFACES FOR PEOPLE AND NATURE

Faced with global warming and more flammable landscapes, at least three dreams and a nightmare are before us. Pyne's (2004) "tending fire" story is the dream of people preventing large, severe fire through continual management. The story had Indians managing, and thus taming, fire everywhere through ongoing use, which we are advised to emulate today with expansive prescribed burning. However, this story and dream fail in the Rockies, where Indians were generally few and impacts of their burning likely minor except in a few places (chap. 10). The second dream is the fire control dream, which promises comfortable living in fire-prone settings, backed by expansive, taxpayer-funded, fuel-reduction programs in the surrounding forests and a cadre of well-trained firefighters with tankers, foams, and other suppressants. This dream is challenged by the lack of any clearly detectable decline in burned area in the Rockies (chap. 10) and the enormous fires (table 5.2) that at times still burn into communities. The third is a John Muir dream of nature unleashed, of wildly spreading fires with enormous, beautiful, and powerful flames watched safely from beneath old-growth trees on a wilderness mountaintop. Unfortunately, the realities of expanding human-caused fires, cheatgrass, and diminished wild landscapes constrain this dream today. All three dreams have pleasing overtones but fail in some way. What is more realistically before us is a potential nightmare: large-scale insect outbreaks, drought-killed vegetation, expanding invasive plant populations, arson and accidental ignitions, and wildland-urban interface fire ramped up by global warming, with houses in flames, fleeing residents, exploding propane tanks, sirens, hoses, foam everywhere—all live on the nightly news.

Something better is needed soon. A mosaic of people and nature at landscape and regional scales could be created, a mosaic better designed for fire than current landscapes, which have been shaped willy-nilly by individual property sales and disparate land-use decisions. We have limited time, as an increase of burned area by two to five times could enable fire to sweep across much of the Rockies in as little as the next half century. Individual communities, of course, could burn sooner, which provides incentive for action. Although action can also be taken to improve conditions in managed and wild landscapes (chap. 11), the most important immediate place for action is in interfaces between people and nature. The adage "Good fences make good neighbors" could be changed to "Good interfaces make good neighbors of people and nature."

Designing better interfaces requires taking steps on both the nature and the community sides. On the nature side, some previous actions no longer make sense. Fuel reduction is not ecologically needed in most Rocky Mountain ecosystems (chap. 10), and it is also rather futile, given the magnitude of the projected increase in fire and the inability of fuel reduction to prevent large fires under extreme weather (table 5.2; chap. 11). Fuel reduction outside of community fire-planning zones (chap. 11) is a waste of funding that would be better directed at interfaces. Also, since fire may not have declined relative to the HRV and may increase several times in coming decades, there is no need to conduct prescribed burns to offset a perceived fire deficit or to regenerate shrubs or trees. A focus on restoring tree populations (e.g., tree density) may also be misdirected, as restored trees may burn anyway. Postfire logging and seeding are generally inadvisable; as global warming continues, recovering vegetation may face a drier, more stressful postfire environment; logging, seeding, and other treatments may further hamper natural recovery (table 11.2). In addition, postfire recovery of graminoids, forbs, and shrubs in many Rocky Mountain ecosystems is generally from resprouting, with seed playing a minor role (chap. 3).

Since fire is increasing, and postfire seeding often slows natural recovery, ecological restoration is needed well before fire occurs, to increase the ability of ecosystems to recover after fire (chap. 11). An immediate need is to control invasive weeds that might expand with increased fire. Many other restoration actions and land-use reforms also can increase the ability of vegetation to recover after fire, and the most effective actions, such as closing and rehabilitating roads or reducing livestock grazing, are underused (box 11.1). It may also be worthwhile to use fuel breaks to directly protect particular high-value sites (e.g., old-growth remnants, vulnerable populations of sensitive species) that could be damaged by increased fire.

On the community side, reducing risk is most needed in and around private and community property right away. Most of the need is inside and on the periphery of communities and developments. Open spaces with low fire risk (future parks, recreational fields, golf courses, low-stature greenspace) could soon be created on peripheries and linked into fuel breaks or moist, green forests where possible (chap. 11). Dedicated open spaces, with low-risk features, could provide initial and enduring protection. A linked system of low-risk open space and natural or constructed fuel breaks or other fire-resistant features (e.g., wide cleared trails, clearings) also serves as a logical community growth boundary, which can prevent an expanding WUI. Reducing the expansion of its WUI is one of the most powerful steps a community can take to allow its members to coexist with wildland fire. Fuel reduction outside the community fire-planning zone is not needed. Fuel reduction on public land inside the zone is worthwhile, but adjoining property owners should have to adopt fire-wise construction methods (chap. 11). Communities in general would be wise to adopt fire-wise methods, particularly if they are near forests or where it is difficult to obtain or construct suggested defensive open spaces or breaks.

Intermix cannot be saved. It was foolish to build homes in the midst of natural vegetation in the Rockies, where nearly all the vegetation is subject to high-severity fire. Like smoking, it may be a right, but it is now recognized to have negative public consequences. Intermix is a large potential source of human-caused fires that may burn public or other private lands. When fires approach housing in intermix, firefighters will likely continue to practice triage, as unprotectable housing is common, access often poor, and danger for firefighters high. A total ban on intermix is warranted. Preventing or reducing intermix serves both people and nature.

It is sensible to reduce human-caused fires in the WUI and in wildlands, as such fires already account for almost 40 percent of burned area in the Rockies (chap. 11). Ideas for reducing fire risk along roads, in campgrounds, and near other infrastructure (chap. 11) could be implemented quickly, providing immediate and long-term benefits. Increased warning signs, phased reductions in fire use, smoking bans, and intentional closures of public lands will likely be needed. The public could be educated about the potential magnitude of increased fire that may be coming, to gain support for closures and other inconveniences needed to reduce risk.

The current fire control workforce could be redirected to help create and maintain sustainable landscapes. Firefighters will be needed during the decades of global warming, even if communities are well protected, to set backfires and extinguish spot fires in the WUI. Perhaps they can eventually become wildland-fire-use teams, who will always be needed to monitor fires and to control some of them, particularly until we have people-nature mosaics that allow more wildland fire use.

The historical evidence is compelling that wildland fire in the Rockies has nearly always been too powerful to be controlled during severe fire weather, when most of the burning occurs. Industrial-scale, brute-force control of fire is very costly, requires large-scale alteration of nature, and is unlikely to generally succeed in creating sustainable landscapes. The alternative I propose is immediate action and enduring changes that seek instead to keep people and their infrastructure some distance from nature and wildland fire, minimize alterations of nature, and create landscapes that require relatively little ongoing, costly maintenance. The needed actions that can help us live sustainably with fire are generally beneficial for both people and nature, as they can help us to contain growth, include open space in our communities, and protect nature. Communities can quickly and often relatively cheaply redesign and limit their interfaces with wildlands. If we begin now to create landscapes that keep us some distance away, protected by good fences, then nature, fire, and people can become good neighbors.