Origin and History of Wildland Fire Use in the U.S. National Park System

Bruce M. Kilgore

Introduction

FOR THOUSANDS OF YEARS, FIRE HAS BEEN AN ESSENTIAL PROCESS in the conifer, brush, and grassland ecosystems found in many national parks in the United States. By the 1800s, not only Native Americans, but also many frontiersmen considered fire as part of the forest—and a beneficial part at that (Rothman 2005). Pyne (1982) noted that "all classes share in this view, and all set fires: sheepmen and cattlemen on the open range, miners, lumbermen, ranchmen, sportsmen, and campers." Cattle and sheepmen firmly believed that forest fires helped rather than hurt the "Big Trees" (Landers 1894). Thus, from the earliest historic times, humans accepted and made use of fire in the forest.

Many of our present wildfire problems began when we attempted to ban all fires from the forest. Yet in the late 19th century, forest resources were being destroyed and people killed by careless logging and the catastrophic fires that followed (Kilgore 1976). These large, destructive fires started in logging slash where they gained momentum before moving into uncut forests (Davis 1959). These fires made the public aware of the potential for wildfire damage and set the stage for developing rigid fire-control policies. But neither government agencies nor the public understood the changes in natural fuel accumulation, forest structure, and wildfire potential that such an unnatural fire exclusion policy would bring about.

Yellowstone and beyond

For the first century following the 1872 establishment of Yellowstone as the world's first national park, attempts were made to suppress fire. Yet, from the beginning, many pointed out that there was a difference in how fires close at hand and those in the backcountry were handled. Starting in 1886 at Yellowstone and in 1891 in the newly created Yosemite, Sequoia, and General Grant national parks, the military fought the fires it saw. Rothman (2005) concluded that "when lightning ignited a powerful fire in a remote area, it required less reaction. Such fires simply burned until they consumed all available fuel or were extinguished by precipitation or blocked by geographic barriers." Response to fire varied from park to park, and "officials might selectively let fires burn, as much a result of the lack of funds for firefighting as for any ideological reason" (Rothman 2005).

The three Sierra Nevada parks, Yosemite, Sequoia, and General Grant, proved more difficult to manage than Yellowstone's monumental scenery and charismatic animals, because they shared the "Big Trees" (giant sequoia) and as such were

intimately connected to fire (Rothman 2007). In 1889, a year prior to the establishment of Yosemite as a national park, a fire swept through the famed Mariposa Grove of giant sequoias. This fire "played a catalytic role in the demise of the Yosemite [State] Park Commission and the arrival of federal troops to administer the park"; their administration included the suppression of fires (Rothman 2005).

The need for such early suppression efforts by the military was re-enforced by the extremely large and intense 1910 fires that burned large parts of Yellowstone and Glacier national parks as well as the rest of the inland Northwest. Even though it was lightning far from the main roads that ignited most of Yellowstone's fires and high winds that spread them, the 1910 fire season proved pivotal to the national parks as well as the country in general in accepting total fire suppression as basic policy for all public lands. After that summer, the National Park Service (NPS) followed the Forest Service (USFS) lead, and for most of the next fifty years, suppression dominated NPS fire strategy (Rothman 2007).

Despite this general fire suppression policy, a number of "light-burning" advocates supported fire use, particularly in California in the early 1900s (H.J. Ostrander, 1902; G.L. Hoxie, 1910; T.B. Walker, 1913; S.E. White, 1920). John R. White, an early superintendent of Sequoia National Park, became the Park Service's most vocal proponent of light burning (Figure 1). To reduce fuels in giant sequoia groves, White tried a number of controlled burns in Sequoia in the 1920s, at a time when suppression was the rule for both park and forest fires. He engaged in a vigorous debate with Horace Albright, an NPS founder and later its director, who was an unabashed proponent of suppression (Rothman 2007). In Yosemite, the Army and early park superintendents continued burning the meadows in Yosemite Valley until 1930, following the well-known Indian practice of light burning to maintain open forests and meadows for cultural reasons (Ernst 1943, 1949, 1961). But the NPS did not support these early attempts at fire use philosophically and continued to believe that all fires were evil. So in 1935, when the 10 a.m. suppression policy (whereby all fires were to be con-

Figure 1. John R. White (left), superintendent of Sequoia National Park in the 1920s and '30s, was the National Park Service's most vocal proponent of light burning. He used a number of controlled burns to reduce fuels in sequoia groves and engaged in a vigorous debate with early directors of the NPS. He is pictured here with George W. Stewart, an early advocate for Sequoia National Park and editor of the Visalia (California) *Delta*. NPS photo.

tained by 10 a.m. the following day) was adopted by the USFS, it was accepted by NPS as well.

During the early 1900s, a more complete ecological understanding of the impact of fire on vegetation and wildlife was being documented in the scientific literature by university and government scientists (Chapman 1912; Stoddard 1931; Weaver 1943). H.H. Chapman of Yale University carried out extensive experiments in the South with fire in longleaf and slash pine and documented the role it played in the survival of those species. As early as 1912, Chapman published an article in *American Forests* which argued that "the attempt to keep fire entirely out of southern pine lands might finally result in complete destruction of the forests" (Chapman 1912; Carle 2005). While the 10 a.m. suppression policy continued for most of the country, the work of Chapman and other "Dixie Pioneers" led to an exception to the total suppression policy in the South in 1943 (Kilgore 1976). Schiff (1962) called this USFS policy change "The switch in time that saved the pine." It authorized an exception to the total fire exclusion policy, allowing controlled burning in national forests with longleaf and slash pine.

Another important contribution from the South began when Ed Komarek started work with Herb Stoddard's Cooperative Quail Organization in 1934 (Carle 2002). This led to a broad program of support for fire research and management, culminating in establishment of the Tall Timbers Research Station in Tallahassee in 1958 (Carle 2002). In 1962, the first of a series of Tall Timbers Fire Ecology Conferences became the center of innovation in fire ecology that often directly contradicted the USFS total suppression model (Rothman 2005). These conferences provided an "open, inviting climate (that) created healthy discussions about the role of fire in the natural world" (Rothman 2005). While not obvious at the time, the gradual transition from fire control to fire management—including wildland fire use—had begun.

The early years of the National Park Service

In a recent fire history of national parks, Rothman (2005) says, "National parks and fire have an intimate and unbreakable relationship." He points out that the mission of the NPS—unique among federal agencies—helped make its fire history different from that of its peers. Its mission, stated in the 1916 National Park Service Act (commonly called the Organic Act) is "to conserve the scenery and the natural and historic objects and the wildlife therein … in such manner and by such means as will leave them unimpaired for … future generations" (NPS 1968). Sellars (1997) notes that the Organic Act required the parks to be left "unimpaired," and he interprets this as "essentially synonymous with maintaining 'natural conditions.'" That mission statement gave the NPS "a latitude to experiment with fire that other agencies did not enjoy" (Rothman 2005).

The USFS mission relates to "wise use" of resources, while the NPS is devoted to the preservation of natural environments and cultural resources. Because of these differences, the orientation to total fire suppression found in the NPS was never quite as strong as in the USFS. Before the 1964 Wilderness Act, the NPS was "the only federal bureau with a mandate specifically encouraging the preservation of natural conditions on public lands" (Sellars 1997). Yet the NPS had to be "awakened to ecolog-

ical management principles by outside critics."

Much of the history of the NPS from the 1930s on involved a conflict between two idealistic factions, each committed to different perceptions of the basic purpose of national parks. By far the stronger group emphasized recreational tourism and public enjoyment of park scenery (Sellars 1997). This group was made up of many park superintendents, rangers, landscape architects, and engineers. This group was committed to total fire suppression and was initially led by Horace Albright.

The second group was represented by a few wildlife biologists who "focused on preserving ecological integrity in the parks, while permitting development for public use in carefully selected areas" (Sellars 1997). These biologists and researchers were led by George Wright, the chief of the first NPS Wildlife Division. They were committed to maintaining natural processes. Their point of view was clearly supported by Superintendent White of Sequoia and General Grant national parks (Rothman 2005). This group defined "unimpaired" in biological and ecological terms.

The traditional fire role: Albright and Coffman

Although Grinnell and Storer (1916) warned early on that "without a scientific investigation" of national park wildlife, "no thorough understanding of the conditions or … the practical problems [of managing national parks] … is possible," the NPS under its first director, Stephen T. Mather, ignored this advice (Sellars 1997). In its early years, the NPS did not develop any servicewide fire or resource management policies, and instead let actions on resource management and fire be determined locally by park superintendents. From a national perspective, with NPS's minimal funding and few employees, encouraging public use of the parks by developing roads, trails, hotels and campgrounds took precedence (Rothman 2005).

Beginning with the leadership of Mather, the NPS protected its forests from fire, insects, and disease; it generally followed the USFS lead in its fire suppression policy and depended largely on the USFS for assistance in fire suppression. Only after the large and intense fires in Glacier in 1926 did the NPS decide it needed a forester as well as in-house fire expertise. In 1928, it hired John Coffman from the Mendocino (California) National Forest to lead its fire control program (Sellars 1997; Rothman 2007). Coffman began by introducing fire planning to the NPS, beginning at Glacier, but following another major fire in 1929 at Glacier, it seemed to many that total "fire exclusion was fantasy" (Rothman 2007).

"Because the NPS could not suppress fire with the vigor it wanted, fire and the ecological benefits it brought persisted in many places in the national park system. The lack of resources to fight fire prevented an overzealous response" (Rothman 2005). Nevertheless, in terms of using fire for resource benefits, White at Sequoia and early Yosemite superintendents (in Yosemite Valley meadows) were alone in advocating controlled burning, and "suppression remained the order of the day."

Beginning in 1933, there was an infusion of Civilian Conservation Corps (CCC) personnel and funding that led to major implementation of a fire suppression strategy. By 1935, some 115 CCC camps had been established in national parks and 150,000 enrollees worked in NPS programs in the peak years. Roads, fire breaks,

fire trails, lookouts, telephone lines, and guard cabins all were part of this program. "The combination of the seemingly endless supply of federal resources, the fear of more major fires, and the dominance of the Forest Service in fire policy and planning created de facto NPS policy" (Rothman 2005).

Despite its increasing success, "the NPS's attempt to eliminate fire became a source of consternation for wildlife scientists within the Service.... Under Coffman, some charged, New Deal programs made some national park areas look more like national forests, managed landscapes rather than vestiges of a natural past" (Rothman 2007). In a meeting in 1935 in Glacier National Park, biologist Adolph Murie argued strongly against a proposal to cut and remove dead trees in a recently partially burned twelve-square-mile area on Glacier's west slope, north of McDonald Creek. Foresters argued that area was ripe for another fire that could spread to adjacent unburned forest (Sellars 1997). But Murie replied: "For what purposes do we deem it proper to destroy a natural state?... We have been asked to keep things natural; let us try to do so" (Sellars 1997).

On the other hand, the chief forester of the NPS, Larry Cook, felt that "nature goes to extremes if left alone," and that "the Service must modify conditions to retain as nearly a natural forest condition as possible for the enjoyment of future generations." Cook was very concerned that his staff had been accused of being "destroyers of the natural" (Sellars 1997). This contentious debate "reflected [the] sharp divergence between the wildlife biologists and the foresters on fire protection and overall national park policies."

Wright and his growing cadre of wildlife biologists "never agreed with Coffman's perspective; they liked his policies even less" (Figure 2). Wright "advocated preserving the forest as it was, letting natural processes drive any changes in ecology" (Rothman 2007). Coffman's forestry model, on the other hand, attempted to protect park forests not only against fire, but also insects, disease, and other threats. Wright's model suggested a dynamic forest, ever changing, while Coffman saw a forest frozen in ecological time (Rothman 2007).

Role of Wright and the biologists

A brief but significant turning point in NPS philosophy toward management of natural ecosystems—including fire—came when George Wright began his career with

Figure 2. George Wright, first chief of the NPS Wildlife Division, advocated preserving forest and letting natural processes–like fire–drive changes in ecology. A survey team, shown here, involving Wright (left), Ben Thompson, and Joseph Dixon, produced "Fauna No. 1" in 1933, a landmark report that not only recommended preservation of existing conditions, but also restoration of natural conditions in the parks. NPS photo.

the NPS as assistant park naturalist in Yosemite. Wright was a student of Joseph Grinnell, head of the Museum of Vertebrate Zoology at the University of California–Berkeley, and longtime proponent of scientifically based management of the national parks (Sellars 1997). In 1929, Wright initiated a survey of wildlife populations in the parks, funded from his personal fortune, marking the first sustained NPS "scientific research in support of natural resource management" (Sellars 2000). A wildlife survey team under Wright produced a landmark report, known as "Fauna No. 1," the first of its kind in NPS history (Wright, Dixon, and Thompson 1933). It recommended not only the preservation of existing conditions, but also "where feasible, the restoration of natural conditions in the parks." In 1934, NPS Director Arno Cammerer "declared the Fauna No. 1 recommendations to be official policy" (Sellars 2000).

Sellars (2000) pointed out that "George Wright's efforts thus began a new era in NPS history. In effect, the wildlife biologists under Wright's leadership reinterpreted the 1916 congressional mandate that the Park Service must leave the parks 'unimpaired.' In their view, the Park Service's mandate required not only preserving scenery and ensuring public enjoyment, but also applying scientific research to ensure that the parks were left as ecologically intact as possible, given public use of the areas" (Sellars 2000).

The biologists' ideas on natural resources provided new perspectives that challenged traditional assumptions and practices. In effect, they became a kind of "minority opposition party" within the NPS that raised questions about the utilitarian and recreational emphasis in park management (Sellars 2000). NPS foresters reacted with alarm to the new perspective on the role of fire in parks, because "the biologists accepted forest fire as a natural ecological element" and "even argued that, in a park maintained in a natural condition, a forest blackened by a naturally caused fire is just as valuable as a green forest" (Sellars 2000).

In terms of our interests today, George Wright was an NPS visionary, whose concepts of scientifically based resource management were far ahead of their time. "Fauna No. 1 was clearly the philosophical and policy forerunner to the 1963 reports on national park management and science by the Leopold Committee and the National Academy of Sciences" (Sellars 2000) and a forerunner to concepts of allowing lightning fires to burn in NPS areas.

But the emergence of such new ecological attitudes was short-lived. Wright was killed in an automobile accident in 1936, and the Wildlife Division staff that had grown to 27 in the Washington office dwindled to nine by the late 1930s. The NPS chose to hire foresters instead of biologists or scientists, and "wildlife biologists found themselves alone as advocates of ecological management as the foresters continued to follow USFS practices" (Rothman 2007). The few remaining biologists were transferred to another Interior agency, the Biological Survey, in 1940.

Despite the work of Wright and his colleagues in the early 1930s, fire suppression continued as the keystone of NPS policy in the '30s, '40s, and '50s. At the same time, it was clear that many wildlife biologists and other scientists, within and outside the NPS, held contrary views. A number of these scientists and academics at universities and within the agencies continued to

carry out studies on the ecological importance of fire in various ecosystems. In Everglades National Park, Bill Robertson began experimental burning in the 1950s, reminiscent of the earlier work of White in Sequoia (Robertson 1953).

In 1950, Sequoia Superintendent Eivind Scoyen supported the designation of the Kaweah Basin in the Upper Kern River drainage as a research reserve that would not be subjected to fire suppression. To that extent, the NPS "accepted the principle that (lightning) fire should not be instantly suppressed in some parts of the park system even before the controlled burn program at Everglades began" in 1953 (Rothman 2007). This was seen by Sumner (1950) as an important early step in the development of NPS policy on natural fires.

Weaver and Biswell

Two prominent western scientists who sought a better understanding of fire's natural role in the environment were Harold Weaver (Figure 3) and Harold Biswell. Weaver began with the Bureau of Indian Affairs (BIA) in 1928 and by 1943 had published a seminal paper in the *Journal of Forestry* on the role of fire in ponderosa pine that would be cited by many workers in the field (Weaver 1943; Carle 2002). In a letter to H.H. Chapman, Weaver acknowledged that Chapman's "work in longleaf pine of the south has made our path much easier," pointing out the continuity in fire ecology research from one part of the country to the other.

Biswell began work with the USFS in Berkeley, California, in 1930, transferred to the Southeast Forest Experiment Station in 1940, and transferred to the University of California–Berkeley in 1947. His early concept of fire as "the arch enemy of forests" changed with his work with controlled fire in the South (Carle 2002). Biswell had huge impacts on the fire management programs of both the NPS and USFS through his students at Berkeley and through agency personnel and academics trained or inspired by him and his work (Carle 2002). Both Biswell and Weaver supplied the long-term systematic research that had never been done during the early light-burning debates in California. Their work at last provided scientific support for the ranchers and timbermen who opposed fire exclusion policies (Carle 2002).

Figure 3. Harold Weaver of the Bureau of Indian Affairs carried out some of the earliest prescribed burning in ponderosa pine forests of the west. His breakthrough 1943 *Journal of Forestry* paper on such work was ahead of its time. Weaver at Rattlesnake Creek in the Middle Fork of the Kings River, Sequoia–Kings Canyon National Park, 1968. NPS photo by Bruce Kilgore.

The Leopold Report era

In the early 1960s, support for use of fire came from a totally different source. The NPS began feeling considerable pressure to accept sport-hunting (hunters deputized as park rangers) as one method to help reduce numbers of elk in Yellowstone's northern herd. Strong views against this policy were expressed at the time both by environmentalists and within the NPS itself (Sellars 1997). When NPS rangers killed 4,500 elk during the next winter, hunters' groups and state conservation officials reacted angrily because they were not included. This caused what the Department of Interior called a "crisis in public relations."

As a result, Secretary of the Interior Stewart Udall called for two studies to address concerns that, in effect, had been expressed 30 years earlier in Fauna No. 1 by George Wright and his biologists (Sellars 1997). In 1962, Udall asked the National Academy of Sciences (NAS) to undertake a review of the "natural history research needs and opportunities" in the national parks. He also asked A. Starker Leopold, professor of zoology at the University of California–Berkeley (and son of the ecologist Aldo Leopold), to chair a blue-ribbon panel of highly respected wildlife specialists to study the Park Service's wildlife management policies and practices (Figure 4). Never before had such prestigious committees from outside the NPS been called upon to undertake in-depth reviews of research and wildlife management policies. The earlier Fauna No. 1 lacked the political clout these panels brought to such a review (Sellars 1997).

"Appearing in 1963, the Leopold and NAS reports were threshold documents" (Sellars 1997). They pointed out facts and ecological principles at extremely high political levels, and "they compelled a new vision of NPS management" (Rothman 2007). Both reports pushed for a stronger ecological basis for park management, set a higher standard for science in the NPS, and influenced natural resource management policies. The Leopold Report panel transformed a report on the condition of wildlife in the national parks into a powerful argument for a new approach to management of park areas, including fire management.

Guided by such broad philosophical and ecological concepts, the Leopold

Figure 4. A. Starker Leopold chaired the blue ribbon panel of wildlife specialists appointed by Secretary of the Interior Udall in 1962 to study NPS wildlife management policies. The panel recommended a new vision of natural resources management, including major changes in NPS fire management policy. Photo of Leopold at Whitaker's Forest by N.H. (Dan) Cheatham.

Report (Leopold et al. 1963) (1) provided a new vision of "natural" resource management of national parks; (2) offered specific recommendations for a new NPS policy; and (3) challenged the validity of total fire suppression. Its comments on the shortcomings of past fire management actions were particularly significant to the development of wildland fire use policy in the NPS. Such comments included these often-quoted ideas:

- "…much of the west slope [of the Sierra] is a dog-hair thicket of young pines, white fir, incense-cedar, and mature brush—a direct function of overprotection from natural ground fires."
- "A reasonable illusion of primitive America could be recreated, using the utmost in skill, judgment, and ecologic sensitivity."
- "Above all other policies, the maintenance of naturalness should prevail."

And finally, both it and the NAS report urged an expanded program of research within the NPS and that every phase of resource management be under the jurisdiction of biologically trained personnel of the NPS.

These concepts had support at high levels of the NPS, and after Leopold presented his report at the North American Wildlife and Natural Resources Conference in March 1963, Secretary Udall added his support. The expertise of Biswell and the strong professional standing of each member of the five-person Leopold Report Committee were pivotal to staff members in the NPS who were developing and implementing the first wildland fire use and prescribed fire programs at Sequoia–Kings Canyon and Yosemite national parks despite entrenched anti-fire use attitudes among the professional fire control staff within the NPS and other cooperating state and federal agencies.

The close relationship between Leopold and Biswell "greatly contributed to both the ideas in the Leopold Report and the implementation of its goals" (Rothman 2007). Both men taught at the University of California–Berkeley, their labs "became crucibles for a new generation of fire scientists," and four of these "became NPS scientists who influenced fire policy during the subsequent generation." Rothman (2007) notes that Biswell's impact extended well beyond high-level discussions; it "created a generation of scholar/practitioners who carried his ideas forward."

Biswell played an instrumental role in the shift from theory to the practice of introducing fire. In 1964, he received permission to begin giant sequoia restoration studies at Whitaker's Forest, a 320-acre University of California experimental forest on the slopes of Redwood Mountain adjacent to Sequoia-Kings Canyon National Parks. From 1964 to 1975, Biswell and his students carried out fuel reduction (cut, pile, and prescribed burn) studies at Whitaker's Forest. While doing graduate work in fire ecology under Leopold from 1964–1967, I worked with Biswell and his students at Whitaker's (Kilgore 1971a, 1972). We also worked closely with Richard Hartesveldt, Tom Harvey, Howard Shellhammer, and Ron Stecker from San Jose State University as they carried out giant sequoia ecology and burn studies upslope in the Redwood Mountain portion of the park (Hartesveldt and Harvey 1967; Harvey et al. 1980).

During field days at Whitaker's Forest, Biswell would patiently explain (and demonstrate) how easily—and lightly—fire

burns in ponderosa pine needles and bear clover (Figure 5). His audience usually included skeptical fire suppression personnel from both state and federal agencies who had "done it a different way" for a lot of years. But Biswell had strong knowledge and personal experience in prescribed burning in the Southeast and in chaparral areas in northern California. His professional expertise, patience, and enthusiasm for use of prescribed fire in both the South and West was of tremendous importance to the NPS at Sequoia–Kings Canyon and Yosemite (van Wagtendonk 1995; Carle 2002; Rothman 2005).

Early wildland fire use policy for the NPS

Between 1963 and 1967, policy changes to put the recommendations of the NAS and Leopold reports into practice were slow in coming. A number of NPS Washington staff found ways to delay action and maintain the status quo despite what the Leopold Report said (Rothman 2005). When the key NPS fire staff man in Washington heard about the plans at Sequoia–Kings Canyon for allowing natural fires to burn, we understood he replied, "Over my dead body!" (Rothman 2005). But the fires of July 1967 in Glacier raised

Figure 5. Professor Harold Biswell conducts a demonstration burn in 1969 at Whitaker's Forest, a University of California experimental forest adjacent to Sequoia–Kings Canyon National Parks. Biswell played a major role in how the NPS implemented its new fire management policy in 1968. NPS photo by Bruce M. Kilgore.

the issue again. With the help of certain supportive NPS Washington staff—including Lyle McDowell and Eivind Scoyen (Rothman 2005)—by late 1967 the vision and ideas of the Leopold Report were finally incorporated into a total revision of the NPS Natural Resource Policy guidelines—including fire policy (National Park Service 1968).[1]

That first (1968) NPS policy supporting wildland fire use read as follows:

> The presence or absence of natural fire within a given habitat is recognized as one of the ecological factors contributing to the perpetuation of plants and animals native to that habitat.
>
> Fires in vegetation resulting from natural causes are recognized as natural phenomena and may be allowed to run their course when such burning can be contained within predetermined fire management units and when such burning will contribute to the accomplishment of approved vegetation and/or wildlife management objectives.
>
> Prescribed burning to achieve approved vegetation and/or wildlife management objectives may be employed as a substitute for natural fire.[2]

An interesting practical aspect was that the initial policy was only an objective; it was an "articulation of a larger ideal with little practical instruction for its execution." It included neither resources nor a support system to implement it, nor did it clearly describe parameters. So individual parks were on their own. "The use of fire as a management tool became a park-level prerogative that superintendents usually had to fund within their existing budgets … most parks continued to maintain an active suppression program even as they grappled with the implications of prescribed burning" (Rothman 2005). The parks that took the lead in implementing the new policy were Sequoia–Kings Canyon and Yosemite, parks influenced by Harold Biswell and his students.

In October 1967, while he was briefly chief scientist of the NPS, Leopold arranged a meeting in Berkeley between Sequoia Superintendent John McLaughlin and his staff and key USFS Experiment Station staff. Leopold was seeking help in developing a strategy for the first use of fire at Sequoia–Kings Canyon. (At this same time, I was personally becoming involved in the fire research program at Sequoia and Kings Canyon National Parks, and so I was able to observe firsthand the interactions involved at this and related planning meetings.)

As the meeting moved along, skepticism was expressed about whether the NPS staff at Sequoia–Kings Canyon had the facts needed to move ahead with burning. My recollections, as recorded in my notes, are that Leopold quietly interrupted the discussion and told the assembled foresters, "We came to this meeting to get ideas on where and how to go. We are *not* asking your opinion on *whether* we should go. We want to know what the best program is. In fact, we are *going to prescribe burn*."

The tone of the meeting turned around quickly. Good suggestions were made, and the NPS under Superintendent John McLaughlin moved ahead with plans for both prescribed burning and allowing lightning fires to burn the following year.

In early 1968, I officially joined Superintendent McLaughlin and his staff at

Sequoia–Kings Canyon, and that summer the park's rangers carried out the first prescribed burn (of 800 acres) just north of the Middle Fork of the Kings River. In an effort to restore fire to a more natural role, McLaughlin also allowed lightning fires to burn above 8,000 feet of elevation in the same drainage. So that summer, while we monitored impacts on burn plots and control plots on that 800-acre prescribed burn unit on the north rim (Kilgore 1971a), we were also able to look across the canyon at the Kennedy Ridge Fire—the first lightning-ignited fire purposely allowed to burn in any national park or wilderness in the country (Figure 6).

We later checked that site. It seemed to us it was behaving exactly like the ranger-ignited fire on the opposite canyon. We saw no reason to continue suppression of lightning-ignited fires in these high-elevation areas (Kilgore 1971a). Instead, we decided that such fires would just be monitored regularly.

In reviewing some historical documents, I found a 1970 paper of mine that reminded me of the NPS viewpoint at the time (Kilgore 1970). As I presented this paper to a primarily Forest Service audience in Missoula, Montana, I pointed out that I was a researcher with the National Park Service in Sequoia–Kings Canyon. I explained

Figure 6. This 1968 Kennedy Ridge fire was the first lightning-ignited fire allowed to burn in any national park in the country. NPS fire policy had been modified in 1967 to allow "fires from natural causes" to burn within predetermined fire management units. NPS photo by Bruce M. Kilgore.

that—as such—I looked at the role of fire in the forest in a different way from that of researchers working under other agency philosophies and policies. This was 37 years ago, and I said that I felt our 1970 NPS fire policy made the broad philosophical base of our program simpler than that of the USFS.

Specifically, at that time, the NPS was trying to restore fire to its natural role in forest ecosystems. And it seemed then that the simplest way would be to let lightning fires burn. In 1970, that was exactly what we had been doing for three years in Sequoia–Kings Canyon. We even called our early efforts at wildland fire use a "let-burn" program. And when George Briggs and I published our first description of that program in the *Journal of Forestry* in 1972, we included a map of our "let-burn zone" (Kilgore and Briggs 1972). The term "let-burn" was later interpreted as adopting a casual approach—with no careful monitoring programs or follow-up concerns; so it's clear why the terminology was changed to "prescribed natural fires" (PNFs) in 1986 (NPS 1986). The newer term, "wildland fire use" (WFU), is documented in a briefing paper by the National Fire and Aviation Executive Board (2005).

In those initial years, we thought of "allowing natural fires to burn" as a clear

Figure 7. In high-elevation forests at Yosemite, lightning-ignited fires are allowed to burn so long as they pose no threat to human life or property. This 8,000-acre Hoover Fire of 2001 burned at low-to-high severity for several weeks in the same basin as the Starr King fire 27 years earlier. Most burning was of low-to-moderate severity. Some 20 similar WFU fires have burned in this basin over the past 30 years. NPS photo by Ed Duncan.

concept (Figure 7). And so I concluded my thoughts in 1970 with somewhat poetic language, adapted from the Leopold Report: "… in national parks, our guiding principle is the maintenance of naturalness. And we are finding that whenever and wherever possible, the best way to restore a semblance of native America seems to be to let natural forces run their own course" (Kilgore 1970).

By the third year of the program (1970) at Sequoia–Kings Canyon, about 70% of the two parks were included in the natural fire zone. The management unit had been enlarged to include virtually all contiguous park lands above 9,000 feet of elevation from the Kern and Kaweah drainages in the south to the South Fork of the San Joaquin River drainage on the north, except where fuels were continuous across park boundaries (Kilgore and Briggs 1972). Within that zone, lightning-ignited fires were not ignored. Fire management personnel kept close watch for any smokes, using daily fixed-wing flights. But immediate suppression action was not taken if the fire was within the natural fire zone and believed to be caused by lightning. A detailed report was sent to the park wildfire committee, which could order the fire suppressed. Similar programs began in 1972 at Yosemite National Park (Parsons and van Wagtendonk 1996).

So, it was only in the late 1960s and early 1970s that the NPS began to accept the role of lightning-ignited fires and to manage them as PNFs. This change in policy—allowing lightning fires to burn in certain areas—was partly based on scientific facts from the South and West about fire's natural role. Much research and new thinking about fire came from outside the federal government and created "the important intellectual rationale that underpinned this radical policy shift" (Rothman 2005). But it was also based on solid ecological concepts and on a vision of what ought to be found in national parks—based on strong, deep concepts about what is "natural" that were endorsed by George Wright and his biologists (Rothman 2005).

Even so, in the 1960s and early 1970s, we worked closely with Bob Mutch, Dave Aldrich, Harry Schimke, Bud Heinselman, Bud Moore, Orville Daniels, and other fire research and management leaders in the Forest Service in developing our natural fire and prescribed fire programs. Their help was instrumental in reviewing plans and proposed publications that would help explain these new programs to the public in those early years, when smoke from lightning fires in the backcountry of Sequoia–Kings Canyon and Yosemite or from prescribed fires at Redwood Mountain, the Mariposa Grove, or Yosemite Valley could cause raised eyebrows—or worse!

In practice, a PNF program will always be a limited program. Only certain very large wilderness areas can be considered for such a program, and then only certain seasons and weather conditions will permit decisions to allow lightning fires to burn. So the overall objectives of NPS wildland fire management are best met by a three-part program:

- Allowing lightning-ignited fires (PNFs) to burn when they help reach management objectives and when they do not threaten human life and developed properties;
- Using human-ignited prescribed burning as the proper tool of forest management in ecosystems changed by prolonged exclusion of fire or to reduce

fuels along boundaries of management zones;
- Continuing fire suppression in developed areas and for all fires not meeting management objectives.

In those early years, Leopold, Biswell, and McLaughlin did not have our current extensive research to support the early wildland fire use programs (Kilgore and Briggs 1972) and prescribed burning programs (Kilgore 1971b; Kilgore and Biswell 1971; Kilgore 1972). But they did have vision and insight supported by early hypotheses and evidence of the importance of fire in many southern and western forest types (Chapman 1912, 1944; Stoddard, 1931, 1935, 1936; Greene, 1931; Weaver 1943). And they were bold enough to want to try to restore fire, based on the best evidence then available, and to make changes needed in prescriptions as they went along.

In summary, in 1968, Sequoia–Kings Canyon Superintendent John McLaughlin (Figure 8) was the first federal manager to allow natural lightning fires to burn in the backcountry of a national park or wilderness (Kilgore and Briggs 1972; McLaughlin 1972; Schuft 1972). He had the Leopold Report and the newly revised NPS policy to

Figure 8. In 1968, Superintendent John McLaughlin was the first federal land manager to allow natural lightning fires to burn in the backcountry of a national park or wilderness. He did not have the current extensive research to support such a program. But he had vision and insight supported by evidence of the importance of fire in many Southern and Western forest types. And he was bold enough to try to restore fire based on the best evidence then available. NPS photo by Bruce M. Kilgore.

support him, and he had one of Leopold's former graduate students on his staff as well as strong philosophical support from Leopold, Biswell, and their students. But he was the manager who signed off on that initial wildland fire use and prescribed burn program in 1968, while key remnants of the total-suppression-oriented fire staff still served in both the NPS Washington and Western regional offices. [3]

Wildland fire use in the NPS: 1968 to 2006

Starting with the origin of WFU in the NPS in the late 1960s and early 1970s, these programs have evolved and become more sophisticated during the nearly four decades since. A number of authors have described the policy, programming, planning, monitoring, and funding phases of the evolution of the NPS fire management program (Kilgore 1976; Bancroft et al. 1985; Ewell and Nichols 1985; Parsons et al. 1986; van Wagtendonk 1991; Kilgore and Nichols 1995; Botti and Nichols 1995; Keifer 1998; Parsons and Landres 1998; Parsons, Landres, and Miller 2003.) The NPS is now managing more than 38 million acres of national park wilderness in a way that allows fires to play a more natural role. Looking beyond the program's origin at Sequoia–Kings Canyon and Yosemite, a historical overview of the WFU Program in the NPS follows.

In an early fire management program at Saguaro National Monument, Arizona, Chief Ranger Les Gunzel coined the term "natural prescribed fire" for lightning-caused fires that were allowed to burn under specific prescribed conditions (Gunzel 1974; Kilgore 1976b). The first such fire burned in 1971, and more than 900 acres burned between 1971 and 1974.

By 1974, lightning-caused fires could be allowed to burn when ignited within more than 3 million acres of designated natural fire zones in nine NPS units (Table 1). In 1974 alone, 74 lightning fires were allowed to burn on 15,000 acres of park wildlands. At the same time, five park units ignited 46 prescribed burns covering another 11,000 acres of forest and grasslands (Figures 9 and 10). Between 1968 and 1974, a total of 274 lightning fires were

Table 1. Historical summary of growth of wildland fire use in the NPS.

Date	No. of NPS units with Natural Fire Zones	Total acreage of Natural Fire Zones	No. of fires	Total acreage of fires
1968	1	300,000	2	1
1974	9	3,000,000	274*	27,000*
1982	15	7,000,000	900**	130,000**
1988	26	—	—	—
1989	0	0	0	0
1996–2005	37	38,000,000	870+	650,000

* These figures are for the period 1968–1974.

** These figures are for the period 1968–1982.

Data for 1996–2005 are from NIFC (Steve Botti, personal communication).

Figure 9. In 1969 at Sequoia–Kings Canyon, compartments roughly 1,000 feet long by 300 feet wide were ignited by drip torches and allowed to burn with the goal of reducing fuels along the Redwood Mountain Grove boundary and gradually restoring fire to its natural role in the sequoia–mixed conifer ecosystem. NPS photo by Bruce M. Kilgore.

allowed to burn more than 27,000 acres, while park staff with drip torches ignited 266 fires that burned over 37,000 acres (Kilgore 1976b).

By 1982, lightning-caused fires could be allowed to burn if ignited within nearly 7 million acres of designated natural fire zones in 15 national park units. Since the beginning of those NPS programs in 1968, more than 900 lightning-caused fires had burned over 130,000 acres. In addition, more than 840 planned prescribed burns were ignited in 26 NPS areas and covered some 180,000 acres (Kilgore 1983).

By early 1988, some 26 NPS units were under PNF. But following the extensive Greater Yellowstone fires of that year—in the park and surrounding national forests—no PNFs were allowed in 1989, and there were major cutbacks for several years (Kilgore and Nichols 1995). Although the 1989 review of federal wildland fire policy supported the continuation of PNF policy, additional planning and risk management actions were required to reinstate these programs. The negative publicity surrounding the Yellowstone fires, most of which were never managed as PNFs, led

Figure 10. Only certain large wilderness areas can consider allowing lightning fires to burn in parks and wilderness. Human-ignited prescribed burning is needed in ecosystems changed by prolonged exclusion of fire. Resource Manager Bob Barbee (standing left), Harold Biswell, and NPS Scientist Jan van Wagtendonk (standing, fourth from left) led the early fire management program at Yosemite in the late 1960s and '70s. NPS photo.

many superintendents to adopt a cautious approach to reinstating PNF programs.

In the decade from 1996 to 2005, the trend turned around, with 37 NPS areas allowing PNFs (or WFU fires) to burn on 38 million acres of natural fire zones. There were 870 fires in this decade, burning 650,000 acres (Steve Botti, personal communication). Not unexpectedly, two-thirds of that acreage was found in four units in Alaska. And much of the Lower 48 acreage was found in six large national parks: Glacier, Grand Canyon, Yosemite, Yellowstone, Sequoia–Kings Canyon, and Everglades (see Table 1).

Major learning experiences

Between 1968 and 2006, there have been a number of major learning experiences that have benefited the WFU program of the NPS.

Waterfall Canyon and Starr King fires. During the first two decades of NPS PNF programs, four fires in particular provided learning opportunities for the agency. In 1974, both the Waterfall Canyon Fire in Grand Teton National Park, Wyoming, and the Starr King Fire in Yosemite attracted much attention to the concept of allowing such fires to burn in NPS areas. Both tested the program's validity, because they stimulated controversy about impacts of smoke on both NPS visitors and nearby communities.

Ignited in July, the Waterfall Canyon Fire covered about 3,700 acres before it was put out by late autumn snows. It was a slow-burning fire and highly visible across Jackson Lake; smoke at times obscured the view of the Grand Tetons. As a result, some permanent residents of Jackson, visitors, and parts of the tourist industry complained of air pollution and accused the NPS of a "scorched earth" policy (Kilgore 1975). Superintendent Gary Everhardt felt such public reaction was understandable, but he maintained strong support for the program.

A few years later, when he became NPS director, Everhardt sent out the first comprehensive press release describing in some detail the three-part NPS program of PNF (now WFU), prescribed burning, and suppression. "Everhardt's public support spoke volumes about the importance of the burn program and the backing it now enjoyed from the highest levels of the NPS" (Rothman 2005).

Ouzel Fire. In 1978, the Ouzel Fire at

Rocky Mountain National Park in Colorado presented the first serious problem for the NPS PNF program. It was the first PNF that threatened an adjacent community, and, as such, was a significant public relations and constituency problem for the NPS. It also highlighted the gap between intellectual concepts about fire management and realities on the ground (Rothman 2007).

Lightning had ignited the fire on August 9 above 10,000 feet of elevation in spruce–fir forest. For more than a month, NPS staff managed it as a PNF in accordance with their wildland fire management plan. The fire initially smoldered and crept along the surface, but by August 23, it began flaring up and intermittently crowning (Figure 11). This pattern continued until September 1 when high winds caused persistent crowning and spotting. After a brief suppression effort, the fire was considered stable and on September 11, rain and snow fell. But on September 15, winds again increased considerably and the fire made a substantial run outside the high-elevation fire management zone in the direction of the small community of Allenspark, just outside the park's boundary. A Type I Incident Management Team was called in, and with the help of natural topography, confined the fire within the park (NPS 1978; Laven 1980; Kilgore 1983).

Several learning points were stressed in the Ouzel Fire's evaluation report:

- Fire history, vegetation patterns, fuel loadings, aspect, and drainages where unusual fire behavior may be expected should be emphasized in a natural fire program plan. Fires similar to the

Figure 11. In 1978, the Ouzel Fire at Rocky Mountain National Park, Colorado, was the first PNF to threaten an adjacent community. At first, it crept along the surface, then intermittently crowned. After suppression and a brief stable period, it made a run toward the town of Allenspark. The fire review urged greater emphasis on fire history, adequate prescription criteria, and more consideration of human-ignited prescribed burns. Rocky Mountain National Park archive photo.

Ouzel Fire had burned through the basin in the past, and patterns of such fires did not conform to the 10,000-foot contour used in the plan (Laven 1980).

- The plan must provide enough prescription criteria to adequately guide the decision-maker in managing natural fires. These include burning indices, fire weather forecasts, prolonged periods of drought, season of the year, 1,000-hour time-lag fuel moistures, number of fires going in the central Rockies, and availability of suppression forces. The plan needs to be more specific about actions to be taken when the fire exceeds prescription parameters and about who is responsible for taking such actions. Then the plan needs to be followed.
- Human-ignited prescribed burns should be considered an additional management tool—particularly where a park borders private development.
- Finally, expecting to suppress a fire during a run, after allowing it to burn to a large size, seemed to be poor planning. At Ouzel, the NPS learned that "letting fire burn was not necessarily an ecological and political solution to fire management issues" (Rothman 2005).

Wildland fire use in Alaska. As the NPS was dealing with the Ouzel fire at Rocky Mountain, a whole new situation presented itself with the addition of 15 new national monuments in Alaska. The new Alaskan parks "presented an enormous challenge for fire managers" (Rothman 2007). Although the NPS remained focused on what it considered the crown jewels of the system—Yellowstone, Yosemite, and similar well-known parks—the burned areas in Alaska (as well as in Everglades National Park and Big Cypress National Preserve in Florida) "dwarfed the burned area in those premier parks.... Alaska reprised an earlier kind of fire landscape, one in which the nature of fire overwhelmed the human ability to respond" (Rothman 2007).

Complete suppression was a tactical impossibility. "This reality ... encouraged the practice of allowing prescribed natural fire" in a big way (Rothman 2007). With little funding of its own, the NPS had to rely on peer agencies—largely the Bureau of Land Management (BLM)—for protection of the new NPS lands, including fire suppression (BLM and NPS 1979). Before long, however, differences in agency missions relating to emphasis on fire suppression versus total fire management led to the determination that the NPS would need to pursue its own Alaska fire management program; the handling of PNFs on NPS land was a primary concern. Under a new interagency agreement worked out in 1982, BLM retained primary leadership in fire suppression, while the NPS provided leadership for the monitoring of PNFs on NPS lands. "Fire management in Alaska evolved into the most integrated and comprehensive interagency cooperation in federal land management" (Rothman 2007).

Greater Yellowstone fires of 1988. By the late 1980s, much progress had been made with fire management programs in the NPS, but there was a growing gap between the concepts of fire management and the ability of NPS to implement them. Some managers still felt that, "with enough resources and an ideal political climate, fire managers could remove the threat of conflagration from national park lands" (Rothman 2005). But state-of-the-art science and

sophisticated management planning concepts could not guarantee implementation of such plans nor assure the ability to control fire when strong winds and unfavorable geographic, climatic, and vegetation conditions came into play. So the third major learning experience came with the Greater Yellowstone fires of 1988. This was the first major test of the PNF concept (called "let-burn" by the press) and of both agency and interagency resolve to continue the commitment to the broad philosophy and concept of restoring fire to its natural role in parks and wilderness.

In 1972, Yellowstone National Park had prepared a relatively simple fire plan that reflected the broad goal and philosophy-driven concepts of that time. But it did not "take into account the unusual instance—the once-in-a-generation event that could not be planned for" (Rothman 2005). In 1988, after heavy rainfall in both April and May, practically no rain fell in June, July, and August—the driest summer on record. Lightning strikes early that summer yielded a number of natural fires in Yellowstone and its adjacent USFS units that were allowed to burn following the policy of their 1972 plan (Carle 2002). On July 15, the decision was made that no new natural fires would be allowed to burn. But, by then, the fires inside the park exceeded 8,600 acres in size. On July 21, the fires covered 17,000 acres and suppression became the single objective in Yellowstone. An extensive interagency suppression response began.

High winds caused widespread spotting, and "conventional firefighting techniques such as burning to create fuel breaks and backfiring proved ineffective" (Rothman 2007). For the next two months, "everything about the [Yellowstone] fires seemed designed to demonstrate that fire could exceed human control" (Figure 12).

Figure 12. The 1988 fires in Yellowstone provided the first major test of the PNF (WFU) concept and of agency and interagency resolve to support the philosophy of restoring fire to its natural role in parks. High winds caused widespread spotting. Conventional firefighting techniques proved ineffective. There was little public understanding at the time of such a massive fire event. NPS photo by Jim Peaco.

At that point a freeze was declared on all PNFs in the NPS. High winds brought the North Fork Fire to Old Faithful on September 7 and the fire was declared out only after rain and snow fell in late September. In total, the fires burned across 1.4 million acres in the Greater Yellowstone Area. Almost one-third of the acreage was inside adjacent national forests. The nearly one million acres that burned inside Yellowstone—out of its total of 2.2 million acres—represented "the most visible evidence of the fires' power and the fundamental ineffectiveness of all human countermeasures" (Rothman 2007).

There was great misunderstanding among the public about the Yellowstone fires. American citizens watching television or reading their local papers felt that "half of their beloved park had been devastated. And … that a perverse 'let it burn' policy was responsible" (Carle 2002). Very few understood that fires that had started outside the park and moved into the park "produced half of the burn totals in the Greater Yellowstone area" (Carle 2002). For example, the Storm Creek Fire began as a lightning strike in the Custer National Forest northeast of the park. When it threatened the Cooke City–Silver Gate area adjacent to Yellowstone, television coverage often reported it as resulting from "Yellowstone Park's natural fire program" (Carle 2002). The North Fork Fire, which burned more area inside Yellowstone than any other, was ignited by a woodcutter's chain saw on adjacent Targhee National Forest land and was managed under a suppression strategy from the beginning. There was little understanding of the long-term perspective—that such massive fire events "are impossible to control, but since they only come along every few centuries, the risk for people and their property is akin to the long-term risks of living near volcanoes or earthquake faults" (Carle 2002).

A few fire scholars took the opportunity following the 1988 fires to inject their particular critique of NPS fire policy into forestry journals or the press. Bonnicksen (1989) accused the NPS of relying on "Mother Nature and God" instead of science and scientific models to manage its lands. Appropriate responses were prepared by Yellowstone Superintendent Bob Barbee and fire scientists in the NPS (Barbee et al. 1990). Some people felt that public response to the Yellowstone fire events of 1988 represented a breakdown in public understanding of the natural role of fire in wildlands, and particularly a breakdown in our ability to communicate through television, radio, and the press about that role in Yellowstone and elsewhere (Kilgore 1991; Smith 1992).

By the end of 1988, a report by the ten-person Interagency Fire Management Policy Review Team concluded that the philosophy behind the current PNF policy in national parks and wilderness areas was fundamentally sound (USDA and USDI 1989). But it also called for 14 specific ways to strengthen and reaffirm existing fire management policies in parks and wilderness, including a number of changes in implementation of policy.

A second review panel was assembled by the Greater Yellowstone Coordinating Committee to assess the short- and long-term consequences of the fire and make recommendations on possible follow-up actions by the NPS. Chaired by Norman Christensen of Duke University, it was made up of ecologists with expertise in natural disturbances. This panel confirmed the historic basis for high-intensity crown fires

in Yellowstone, agreed on the central importance of maintaining such natural fire processes, and recommended against any short-term feeding of wildlife or seeding to avoid erosion. They concluded that "the only way to eliminate wildland fire is to eliminate wildlands." And they warned that "to extirpate fire completely from a wildland ecosystem is to remove an essential component of that wilderness" (Christensen et al. 1989; Christensen 2005). One lesson to be learned is that of "humility in the face of natural forces over which we often exert little control" (Kilgore in Carle 2002).

Changes since the 1988 fires

Summarizing the past 18 years since the 1988 Yellowstone fires, several positive changes seem to have occurred (Tom Nichols, personal communication):

- Better predictive service support has improved the decision-making abilities of fire managers, especially in smaller land-management units.
- There is better interagency communications and more agencies and units using WFU.
- With the assistance of fire use management teams, more WFUs are being allowed to start and grow, even under planning level 5, with review and approval of the appropriate fire director at the National Interagency Fire Center (NIFC).

On the other hand, many potential WFU fires are still being suppressed due to factors such as:

- Air quality regulations;
- Competition for fire resources and personnel, especially during higher planning levels;
- Risk aversion by land and fire managers; and
- Public concern about "letting fire burn."

As each lightning-ignited fire is suppressed because of one of these considerations, the vegetative ecosystems of the park continue to change—with natural increases in fuels, changes in structure, and increases in wildfire potential. Although more acres are being burned by more WFU fires in more parks than ever before, there is reason to doubt that many of these programs have yet reached a level of ecological significance in restoring a more natural role for fire within ecosystems. Both agency policy and its planning documents require us to "manage" WFU fires. Such management is affected by risk tolerance, with some units able to tolerate long-duration WFUs, while others may wish to limit them in size and duration.

Miller (2005) pointed out that there are several factors that work against WFU and in favor of suppression:

- **Incentives/disincentives.** The main reason that some managers choose to implement the current policy on WFU is "his/her personally held belief that 'it's the right thing to do.'" Instead, they need to have confidence "that they and their careers will be protected when they make a well-reasoned, but risky decision" to allow WFU.
- **Organizational culture.** A few regions and units are oriented toward fire use, rather than suppression (usually places with a history of successful WFU programs). We need to better understand this organizational culture and use that information "to foster cultures that are more accepting of fire use."

- **Language.** Our vocabulary reinforces the idea that fire is bad. We talk of "risks" from fire, but not "opportunities" and "benefits." We are concerned about "severity" and talk of "catastrophic fire." (We should think of fire as a "disturbance.")
- **Internal education.** There is a disconnect between resources planning and fire management planning: resource managers need to know more about fire behavior and operations, and fire managers need to know about fire effects on resource values.

Given the controversy surrounding the WFU policy at Yellowstone, it's amazing that the policy survived. With that perspective, the 1989 Interagency Team Report (USDA and USDI 1989) was actually a vote of confidence for the policy (Kilgore and Nichols 1995).

Since then, serious fire incidents led to additional policy reviews in 1995 and 2001 (USDI and USDA 1995; USDI et al. 2001). The revised 1995 federal fire policy recognized, for the first time, "the essential role of fire in maintaining natural ecosystems" (USDI et al. 2001). The 2001 review, in turn, said that:

- "The 1995 policy is generally sound and appropriate.... Wildland fire will be used to protect, maintain, and enhance resources and, as nearly as possible, be allowed to function in its natural role. Use of fire will be based on approved Fire Management Plans and will follow specific prescriptions contained in operational plans."
- "As a result of fire exclusion, the condition of fire-adapted ecosystems continues to deteriorate; the fire hazard situation in these areas is worse than previously understood."
- "The fire hazard situation in the Wildland Urban Interface is more complex and extensive than understood in 1995."
- "Changes and additions to the 1995 Federal Fire Policy are needed to address important issues of ecosystem sustainability, science, education, communication, and to provide for adequate program evaluation."
- "Implementation of the 1995 Federal Fire Policy has been incomplete, particularly in the quality of planning and in interagency and interdisciplinary matters."
- "Emphasis on program management, implementation, oversight, leadership, and evaluation at senior levels of all federal agencies is critical for successful implementation of the 2001 Federal Wildland Fire Management Policy."

In summary, the 2001 review recommended that "federal fire management activities and programs provide for firefighters and public safety, protect and enhance land management objectives and human welfare, integrate programs and disciplines, require interagency collaboration, emphasize the natural ecological role of fire, and contribute to ecosystem sustainability."

Based on these reviews, it is clear that NPS commitment to allowing fires to assume their natural role, wherever possible, is still there, but with a name change to WFU—"wildland fire use." The name change raises a point about the future of fire management in the NPS. Both "let-burn" and "prescribed natural fires" make some intuitive sense, while "wildland fire use" does not. This being the case, perhaps

WFU should be dropped in favor of a simpler concept: namely, that "fire is fire." In this case, each fire would be evaluated on its merits for (1) ecological values; (2) economic impacts; and—of top importance—(3) the safety of human life. Such an approach is explicit in the 1995 and 2001 federal wildland fire policy, but the bureaus have been slow to implement this concept.

Conclusions

Looking back on the origin and history of wildland fire use in the NPS, the agency has made considerable progress between 1968 and 2006 in allowing lightning-caused fires to burn as well as using prescribed burns and suppression as part of their management plans and actions. However, those managers willing to allow lightning fires to burn have also been severely criticized when high-intensity fires don't give the results expected.

One of the main lessons from the 1988 Yellowstone fires seems to be that "extensive, high-intensity fires are an infrequent, but ultimately unavoidable element in whatever fire management option we choose" for the lodgepole pine forest of the Greater Yellowstone Ecosystem (Despain and Romme 1989). A central lesson of the 1988 fire season was that stand-replacing, natural crown fire—when mixed with politics, the media, and public opinion—is a volatile issue. Those fires provided the most severe test for wildland fire use policy (Kilgore and Nichols 1995).

Fire is an important natural process in forests and other vegetation of the national park system. Its restoration is important, but doing so is not easy. We need continuing research, trial implementation of new concepts based on better understanding of national park ecosystems, and thoughtful evaluation of results. In our efforts to be cautious and reasonable in the aftermath of fires such as the 1988 fires at Yellowstone, we need to be careful not to suppress all ecologically significant fires in parks and wilderness (Kilgore 1991).

A wildland fire use program needs management commitment to make it work. To achieve the objective of restoring fire to its natural role in each park or wilderness, our nation's managers must take reasonable, calculated risks. As a society, we, in turn, must find ways to accept and support—and not just penalize—reasonable risk-taking by NPS superintendents and USFS supervisors and managers, while still giving priority to human life and property.

Acknowledgments

This paper started with an invitation from Carol Miller and Tom Zimmerman of the U.S. Forest Service to participate in a special session on "Wildland Fire Use in the United States: Building the Future from 35 Years of Learning" at the November 2006 Third International Congress on Fire Ecology and Management in San Diego, California. Lyle McDowell and Bob Barbee provided long-term managerial perspective on the development of the NPS fire management program, while papers by David Parsons and Jan van Wagtendonk summarized the long-term research perspective for fire management, particularly in the Sierra Nevada. Books and other articles by historians Richard Sellars, David Carle, and Hal Rothman were of major importance in this paper. Steve Botti and Tom Nichols provided valuable ideas on the current WFU program of the NPS, including data included in Table 1 and insights on program changes since 1988. In addition, Steve Botti, Tom Nichols, David

Parsons, Jan van Wagtendonk, David Graber, Lyle McDowell, and Richard Sellars offered valuable review comments and suggestions. Dan Cheatham provided the photograph of A. Starker Leopold.

Ed. note: Brief summaries of this paper were presented at the Third International Congress on Fire Ecology and Management in San Diego, California, November 14, 2006, and at the National Park Service Wildland Fire Management Workshop in Chandler, Arizona, December 5, 2006.

Endnotes

1. Bob Barbee, the former NPS regional director and superintendent of Yellowstone National Park, and an early resource manager at Yosemite National Park, notes the important and little-acknowledged role that Lyle McDowell, chief of the Branch of Natural Resource Management in the Washington office of the NPS, played in Washington in embracing the new vision of fire's role in resource management (Rothman 2005). "He bought the Leopold Report philosophically and he was trying to translate it into practical action … his resource management plan was the first to conceptualize fire as a useful tool for management." Barbee himself played important roles in NPS acceptance of fire's natural role in Yosemite and later in Yellowstone as well. Eivind Scoyen, who served as superintendent of Sequoia and Glacier and later as deputy director in Washington, served as a counter to older views of fire in the Park Service's highest echelons. "He helped soften resistance to the new ideas" and helped counter skepticism at the top (Rothman 2005).
2. Lyle McDowell was the sole author of these three paragraphs, which constituted the NPS fire management policy in 1968. In late 1967, he and his supervisor attended a regional directors' meeting aimed at approving new NPS policy statements. As the several-day meeting ended, "Director Hartzog asked if anyone had any further policy to be considered. McDowell and his supervisor "popped up and said [they] had a statement for consideration." They passed out copies to the director, regional directors, and various staffers present. "Quiet filled the room for several minutes while the statement was read. One staffer suggested a one-word … change followed by unanimous approval. The policy statement which appeared in the 1968 Green Book was exactly as I had written it.… I consider this … the most significant accomplishment of my thirty years with the NPS" (McDowell, personal communication).
3. There were many people who played a key role in the origin and history of wildland fire use in the NPS. Those involved at Sequoia–Kings Canyon and Yosemite include A. Starker Leopold and Harold Biswell of the University of California–Berkeley; John McLaughlin, superintendent of Sequoia–Kings Canyon from 1967 through the early 1970s; several students of Biswell and Leopold, including Jim Agee, Jan van Wagtendonk, and David Graber; key NPS researchers, such as David Parsons; NPS resource managers, such as Dick Riegelhuth, George Briggs, Larry Bancroft, and Tom Nichols; superintendents, including Jack Davis, Stan Albright, Boyd Evison, Jack Morehead, Les Arnberger, Bob Binnewies, Mike Finley, and Bob Barbee at Sequoia–Kings Canyon,

Yosemite, and Yellowstone during the 1960s, '70s, and '80s; several NPS support staff in the Washington and regional offices during that same period, including Lyle McDowell and Merle Stitt; several key fire researchers, forest supervisors, and regional office support staff of the USFS at that time; and fire professionals stationed at the Boise (later National) Interagency Fire Center, such as Dave Butts, Steve Botti, and others.

References

Bancroft, L., T. Nichols, D. Parsons, D. Graber, B. Evison, and J. van Wagtendonk. 1985. Evolution of the natural fire management program at Sequoia and Kings Canyon National Parks. In *Proceedings: Symposium and Workshop on Wilderness Fire.* 15–18 November 1983, Missoula, Montana. J.E. Lotan et al., technical coordinators. General Technical Report INT-182. Ogden, Utah: U.S. Department of Agriculture–Forest Service, Intermountain Forest and Range Experiment Station, 174–180.

Barbee, R.D., N.L. Stephenson, D.J. Parsons, and H.T. Nichols. 1990. Replies from the fire gods. *American Forests* 96:3/4, 34–35, 70.

BLM and NPS [Bureau of Land Management and National Park Service]. 1979. Cooperative fire control agreement between BLM/Alaska and NPS/Alaska, April 10, 1979, National Archives, Pacific Alaska Region, Record Group 79, Box 1, 79-01-A1103 File: A40 ACGP Fire Management Committee, 1–2.

Bonnicksen, T.M. 1989. Fire gods and federal policy. *American Forests* 95:7/8, 14–16, 66–68.

Botti, Steve. 2006. Personal communication, October 19.

Botti, S.J., and H.T. Nichols. 1995. Availability of fire resources and funding for prescribed natural fire programs in the National Park Service. In *Proceedings: Symposium on Fire in Wilderness and Park Management.* March 30–April 1 1993, Missoula, Montana. J.K. Brown et al., technical coordinators. General Technical Report INT-GTR-320. Ogden, Utah: U.S. Department of Agriculture–Forest Service, Intermountain Forest and Range Experiment Station, 94–103.

Carle, D. 2002. *Burning Questions: America's Fight with Nature's Fire.* Westport, Conn.: Praeger.

Chapman, H.H. 1912. Forest fires and forestry in the southern states. *American Forests* 18, 510–517.

———. 1944. Fire and pines—A realistic appraisal of the role of fire in reproducing and growing southern pines. *American Forests* 50, 62–64, 91–93.

Christensen, N.L. 2005. Fire in the parks: A case study for change management. *The George Wright Forum* 22:4, 12–31.

Christensen, N.L., L. Cotton, T. Harvey, R. Martin, J. McBride, P. Rundel, and R. Wakimoto. 1987. Review of fire management program for sequoia–mixed conifer forests of Yosemite, Sequoia and Kings Canyon National Parks. Final Report to the National Park Service, Washington, D. C.

Christensen, N.L., J.K. Agee, P.F. Brussard, J. Hughes, D.H. Knight, G.W. Minshall, J.M. Peek, S.J. Pyne, F.J. Swanson, J.W. Thomas, S. Wells, S.E. Williams, and H.A. Wright. 1989. Interpreting the Yellowstone Fires of 1988. *BioScience* 39, 678–685.

Davis, K.P. 1959. *Forest Fire Control and Use.* New York: McGraw-Hill.

Despain, D.G., and W.H. Romme. 1991. Ecology and management of high-intensity fires in Yellowstone National Park. In *Proceedings: Tall Timbers Fire Ecology Conference, May 18–21, 1989, High Intensity Fire in Wildlands, Management Challenges and Options.* Tallahassee, Fla.: Tall Timbers Research Station, 17:43–57.

Ernst, Emil F. 1943. Preliminary report on the study of the meadows of Yosemite Valley. Unpublished report. Yosemite National Park, Calif.: National Park Service.

———. 1949. Vanishing meadows in Yosemite Valley. *Yosemite Nature Notes* 28:5, 34–41.

———. 1961. Forest encroachment on the meadows of Yosemite Valley. *Sierra Club Bulletin* 46:8, 21–32.

Ewell, D.M., and H.T. Nichols. 1985. Prescribed fire monitoring in Sequoia and Kings Canyon National Parks. In *Proceedings: Symposium and Workshop on Wilderness Fire.* 15–18 November 1983, Missoula, Montana. J.E. Lotan et al., technical coordinators. General Technical Report INT-182. Ogden, Utah: U.S. Department of Agriculture–Forest Service, Intermountain Forest and Range Experiment Station, 327–330.

Greene, S.W. 1931. The forest that fire made. *American Forests* 37:10, 583–584, 618.

Grinnell, J., and T.I. Storer. 1916. Animal life as an asset of national parks. *Science* 44 (September 15), 377.

Hartesveldt, R.J., and H.T. Harvey. 1967. The fire ecology of sequoia regeneration. *Proceedings: Tall Timbers Fire Ecology Conference* 7, 65–77.

Harvey, H.T., H.S. Shellhammer, and R.E. Stecker. 1980. *Giant Sequoia Ecology: Fire and Reproduction.* Scientific Monograph Series no. 12. Washington, D.C.: National Park Service.

Hoxie, G.L. 1910. How fire helps forestry: The practical vs. the federal government's theoretical ideas. *Sunset* 34 (August), 145–151.

Keifer, M. 1998. Fuel load and tree density changes following prescribed fire in the giant sequoia–mixed conifer forest: The first 14 years of fire effects monitoring. In *Proceedings: Tall Timbers Fire Ecology Conference.* L.A. Brennan and T.L. Pruden, eds. Tallahassee, Fla.: Tall Timbers Research Station, 20:306–309.

Kilgore, B.M. 1970. Research needed for an action program of restoring fire to giant sequoias. In *Intermountain Fire Research Council Symposium on "The Role of Fire in the Intermountain West."* Missoula, Mont.: Intermountain Fire Research Council, 172–180.

———. 1971a. Response of breeding bird populations to habitat changes in a giant sequoia forest. *American Midland Naturalist* 85:1, 135–152.

———. 1971b. The role of fire in managing red fir forests. *Transactions, North American Wildlife and Natural Resources Conference* 36, 405–416.

———. 1972. Fire's role in a sequoia forest. *Naturalist* 23:1, 26–37.

———. 1975. Restoring fire to national park wilderness. *American Forests* 81:3, 16–19, 57–59.

———. 1976a. From fire control to fire management: An ecological basis for policies. *Transactions, North American Wildlife and Natural Resources Conference* 41, 477–493.

———. 1976b. Fire management in the national parks: An overview. In *Proceedings: Tall*

Timbers Fire Ecology Conference and Intermountain Fire Research Council Fire and Land Management Symposium 14, 45–57.

———. 1983. Fire management programs in national parks and wilderness. In *Proceedings: Intermountain Fire Council and Rocky Mountain Fire Council "Symposium on Fire: Its Field Effects."* October 20-22, 1982. J.E. Lotan, ed. Missoula, Mont.: Intermountain Fire Council, 61–91.

———. 1991. Management options and policy directions concerning high-intensity fire: A fire policy panel discussion. In *Proceedings: Tall Timbers Fire Ecology Conference, May 18–21, 1989.* Tallahassee, Fla.: Tall Timbers Research Station, 385–392.

Kilgore, B.M., and H.H. Biswell 1971. Seedling germination following fire in a giant sequoia forest. *California Agriculture* 25:2, 8–10.

Kilgore, B.M., and G.S. Briggs. 1972. Restoring fire to high elevation forests in California. *Journal of Forestry* 70:5, 266–271.

Kilgore, B.M., and H.T. Nichols. 1995. National Park Service fire policies and programs. In *Proceedings: Symposium on Fire in Wilderness and Park Management.* March 30–April 1 1993, Missoula, Montana. J.K. Brown et al., technical coordinators. General Technical Report INT-GTR-320. Ogden, Utah: U.S. Department of Agriculture–Forest Service, Intermountain Forest and Range Experiment Station, 24–29.

Landers, W.F. 1894. Report on the investigation of causes and effects of forest fires in California. September 1894, NARA, Record Group 79.2.1, Letters received by the Office of the Secretary of the Interior relating to national parks, Sequoia and General Grant, 1890–1907, Box 49.

Laven, R.D. 1980. Natural fire management in Rocky Mountain National Park: A case study of the Ouzel Fire. In *Proceedings, Second Conference on Scientific Research in the National Parks.* Washington, D.C.: National Park Service, 10:37–45.

Leopold, A.S., S.A. Cain, C.M. Cottam, J.M. Gabrielson, and T.L. Kimball. 1963. Study of wildlife problems in national parks: Wildlife management in the national parks. *Transactions of the North American Wildlife and Natural Resources Conference* 28, 28–45.

McDowell, Lyle. 2007. Personal communication, February 15.

McLaughlin, J.S. 1973. Restoring fire to the environment in Sequoia and Kings Canyon National Parks. In *Proceedings, Tall Timbers Fire Ecology Conference.* Tallahassee, Fla.: Tall Timbers Research Station 12, 391–394.

Miller, C. 2005. Workshop comments on forest health and fire in the national parks. In N.L. Christensen, Forest health and fire in the national parks: Workshop summary. *The George Wright Forum* 22:4, 47–48.

National Fire and Aviation Executive Board. 2005. Three kinds of wildland fire. Briefing Paper no. 03. Boise, Id.: National Interagency Fire Center.

Nichols, Tom. 2006–2007. Personal communications, October 20, 2006; February 20, 2007.

NPS [National Park Service]. 1968. *Compilation of the Administrative Policies for the National Parks and National Monuments of Scientific Significance (Natural Area Category).* Washington, D.C.: U.S. Government Printing Office.

———. 1978. *Board of Review Report for the Ouzel Fire, Rocky Mountain National Park.*

Rocky Mountain National Park, Colo.: National Park Service.
———. 1986. *Wildland Fire Management Guideline: NPS-18.* Washington, D.C.: National Park Service.
Ostrander, H. J. 1902. How to save the forests by use of fire. Letter to editor, *San Francisco Call,* September 23, p. 6.
Parsons, D.J., D.M. Graber, J.K. Agee, and J.W. van Wagtendonk. 1986. Natural fire management in national parks. *Environmental Management* 10:1, 21–24.
Parsons, D.J., and J.W. van Wagtendonk. 1996. Fire research and management in the Sierra Nevada national parks. In *Science and Ecosystem Management in the National Parks.* W.L. Halvorson and G.E. Davis, eds. Tucson: University of Arizona Press, 25–48.
Parsons, D.J., and P.B. Landres. 1998. Restoring natural fire to wilderness: How are we doing? In *Proceedings: Tall Timbers Fire Ecology Conference.* L.A. Brennan and T.L. Pruden, eds. Tallahassee, Fla.: Tall Timbers Research Station, 20:366–373.
Parsons, D.J., P.B. Landres, and C. Miller. 2003. Wildland fire use: The dilemma of managing and restoring natural fire and fuels in United States wilderness. In *Proceedings of Fire Conference 2000: The First National Congress on Fire Ecology, Prevention, and Management.* K.E.M. Galley, R.C. Klinger, and N.G. Sugihara, eds. Miscellaneous Publication no. 13. Tallahassee, Fla..: Tall Timbers Research Station. 19–26.
Pyne, S.J. 1982. *Fire in America: A Cultural History of Wildland and Rural Fire.* Princeton, N.J.: Princeton University Press.
Robertson, W.B., Jr. 1953. A survey of the effects of fire in Everglades National Park. Unpublished report. Everglades National Park, Fla.: National Park Service.
Rothman, H.K. 2005. *A Test of Adversity and Strength: Wildland Fire in the National Park System.* Washington, D.C.: National Park Service.
———. 2007. *Blazing Heritage: A History of Wildland Fire in the National Parks.* New York: Oxford University Press.
Schiff, A.L. 1962. *Fire and Water: Scientific Heresy in the Forest Service.* Cambridge, Mass.: Harvard University Press.
Schuft, P.H. 1973. A prescribed burning program for Sequoia and Kings Canyon National Parks. In *Proceedings, Tall Timbers Fire Ecology Conference.* Tallahassee, Fla.: Tall Timbers Research Station, 12:377–389.
Sellars, R.W. 1997. *Preserving Nature in the National Parks: A History.* New Haven, Conn.: Yale University Press.
———. 2000. The significance of George Wright. *The George Wright Forum* 17:4, 46–50.
Smith, C. 1992. *Media and Apocalypse: News Coverage of the Yellowstone Forest Fires, Exxon Valdez Oil Spill, and Loma Prieta Earthquake.* Westport, Conn.: Greenwood Press.
Stoddard, H.L. 1931. *The Bobwhite Quail: Its Habits, Preservation and Increase.* New York: Charles Scribner's Sons.
———. 1935. Use of controlled fire in southeastern upland game management. *Journal of Forestry 33*:3, 346–351.
———. 1936. Relation of burning to timber and wildlife. *North American Wildlife Conference* 1, 399–403.
Sumner, E.L. 1950. The Kaweah Basin Research Reserve: an untouched area for the future.

Regional Director to Director, February 6, 1950, Sequoia National Park, FR 1950, 1970–1976, Ma-U, Box 327, F317, Sequoia National Park Archives.

USDA and USDI [U.S. Department of Agriculture and U.S. Department of the Interior]. 1989. *Final Report of the Fire Management Policy Review Team.* Washington, D.C.: USDA and USDI.

USDI and USDA. 1995. Final report: Federal wildland fire management policy and program review, December 18.

———. 2005. *Wildland Fire Use: Implementation Procedures Reference Guide.* Washington, D.C.: USDI and USDA.

USDI, USDA, Department of Energy, Department of Defense, Department of Commerce, Environmental Protection Agency, Federal Emergency Management Agency, and National Association of State Foresters. 2001. *Review and Update of the 1995 Federal Wildland Fire Management Policy.* Washington, D.C: USDI et al.

van Wagtendonk, J. W. 1991. The evolution of National Park Service fire policy. *Fire Management Notes* 52:4, 10–15.

———. 1995. Dr. Biswell's influence on the development of prescribed burning in California. In *The Biswell Symposium: Fire Issues and Solutions in Urban Interface and Wildland Ecosystems.* February 15–17, 1994; Walnut Creek, California. D.R. Weise and R.E. Martin, technical coordinators. General Technical Report PSW-GTR-158. Albany, Calif.: U.S. Department of Agriculture–Forest Service, Pacific Southwest Research Station, 11–15.

Walker, T.B. 1913. T.B. Walker expresses his views on conservation. *San Francisco Chronicle,* January 5, 56.

Weaver, H. 1943. Fire as an ecological and silvicultural factor in the ponderosa pine region of the Pacific slope. *Journal of Forestry* 41, 7–15.

White, S.E. 1920. Getting at the truth: is the Forest Service really trying to lay bare the facts of the light-burning theory? *Sunset, the Pacific Monthly* (May) 62, 80–82.

Wright, G.M., J.S. Dixon, and B.H. Thompson. 1933. *Fauna of the National Parks of the United States: A Preliminary Survey of Faunal Relations in National Parks.* Fauna Series no. 1. Washington, D.C.: U.S. Government Printing Office.

Bruce M. Kilgore, 342 Fenway Drive, Walnut Creek, California 94598; or 1502 South Mink Creek Road, Pocatello, Idaho 83204; bekilgore@aol.com