The Seminal Importance of Fire in Ecosystem Management—Impetus for This Publication

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Fire—Agent of Change

In September 1995, the Society for Ecological Restoration (SER) held its Annual Meeting at the University of Washington in Seattle. The meeting included two dozen conferences and several symposia and field trips dealing with various aspects of applying ecological restoration on both site-specific and landscape scales. More than a thousand scientists, educators, land managers, and others interested in issues relating to ecosystem-based management attended. The keynote speaker, Professor Daniel Botkin of George Mason University, exhorted the assembly to think of the natural landscape as an everchanging "motion picture" rather than as a single idyllic frame. Botkin (1990) and other prominent ecologists have warned that environmental concerns often focus on preserving a particular successional state (single frame), such as an old growth forest, rather than maintaining a dynamically functioning ecosystem or landscape with its many successional states.

Agents of change in nature are termed "disturbances." Wildland fire is perceived by many Americans as a very "disturbing" agent of change. Although our technological society has developed the ability to delay wildland fire and to influence the frequency and severity of burning, our efforts to exclude fire are often unsuccessful in the long run and can have negative ecological effects (Agee 1993). Despite costly fire-fighting efforts, the annual area burned in wildfires has generally increased in the Western United States since the 1970's (fig. 1), an increase attributable partly to a buildup of woody fuels and partly to drought (Arno and Brown 1989; Agee 1993). Over $1 billion was spent during 1994 for fire suppression in the United States; nevertheless, 4 million acres burned in wildfires, many of which were controlled only when it rained. Unquestionably, we need an efficient fire suppression capability, but shouldn't we also be using prescribed fire and silvicultural fuels management to restore a semblance of the natural fire process (Mutch 1994; Williams 1995)?

Reading advance announcements for the SER annual meeting spawned an idea—why not propose an associated conference highlighting fire as a component of the broader goal of restoring natural landscapes. Our proposal was accepted by SER organizers and, as a result, we hosted a conference entitled "The Use of Fire in Forest Restoration." We are publishing authors' synopses of their conference presentations in this volume because we believe they represent a unique contribution to the understanding of fire as a component of ecological restoration in forests of Western North America.

Perceptions of Fire

During the last few years natural resource specialists have begun to support the concept of reintroducing fire in some form to fire-dependent ecosystems—those where fire played a vital role in determining composition, structure, and landscape patterns. But why did this sentiment take so long to develop? Interestingly, a century ago USDA Forest Service founder Gifford Pinchot and naturalist John Muir called fire "one of the great factors which govern the distribution and character of forest growth" (Pinchot 1899).

Pinchot, writing in National Geographic Magazine, explained that since time immemorial fire regulated the composition and structure of forests all across North America.

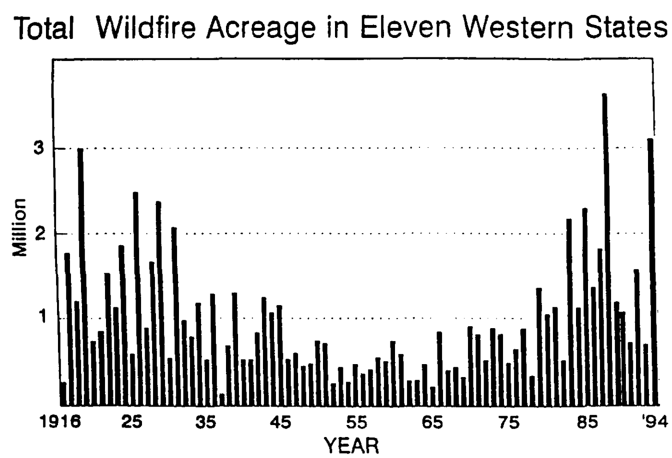

Figure 1—Total acreage burned in wildfires annually in the 11 Western States (AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY). Data prior to 1931 do not include National Park Service or Indian Reservation lands; data prior to 1926 apparently include only forested areas. (Data from USDA Forest Service Smokey Bear Reports 1916-1982 and from individual agency reports 1983-1994 compiled by Bureau of Land Management, National Interagency Fire Center, Boise, ID.)

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He recognized, for example, that the magnificent Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*) forests of western Washington and western Oregon owed their existence to fire. He referred to the "creative action of forest fires" and suggested that it would be fruitful to gain an understanding of the natural role of fire.

Over the past century, great strides have been made in learning about the ecological effects of fire in wildland forests (Agee 1993). Paradoxically, application of this knowledge has been hampered by land management policies that assumed we could exclude fire from fire-dependent forests with little adverse effect (Pyne 1982). Native Americans and a few early timberland managers recognized that fire could be used in maintaining desirable forest conditions, but after 1910—following Pinchot's departure from the agency—the Forest Service rejected this concept and developed a campaign to eliminate fire from the forest (Pyne 1982). This undoubtedly seemed like an appropriate policy and few foresaw its long-term consequences.

Today, perhaps the most widely recognized example of negative effects of fire exclusion is the "forest health" problem on tens of millions of acres in the ponderosa pine (*Pinus ponderosa*) and related forests of the Inland West (Mutch and others 1993; American Forests 1995; Phillips 1995). Ironically, a government forester named Harold Weaver (1943) identified this problem more than 50 years ago and traced its roots to fire exclusion. Weaver (1943, 1967) and a few colleagues called for use of prescribed burning to restore fire to these forests, which historically burned in frequent low-intensity fires. Eventually their arguments were accepted by many foresters and ecologists (Pyne 1982). By the late 1970's even Congress's General Accounting Office had recognized the futility of attempting to eliminate fire in the wildlands of Western North America. As a result, Federal agencies adopted policies that broadened and revised their mission as "fire management"—not just fire control. This included prescribed burning on the landscape as well as the traditional suppression of unwanted fires (Nelson 1979).

Devising Restoration

Despite considerable knowledge and support for reintroducing fire into wildland forests, major obstacles confront land managers (Mutch 1994). Funding for prescribed burning and silviculture to reduce fuel accumulations has traditionally been subservient to funding availability for suppressing wildfires. Fuels treatment work must be paid for from the annually appropriated budget, while suppression funding is covered by an "emergency" account that is perceived by some to be unlimited. Land managers are held responsible for the smoke emissions produced by prescribed burning, and they can also suffer career setbacks when even carefully planned and executed burns escape control due to circumstances beyond their control. Conversely, management that attempts to exclude fire from an ecosystem and ultimately results in damaging wildfires is seldom questioned. Moreover, land managers are seldom blamed for high costs of fighting wildfires in built-up fuels or for severe smoke or damages such fires produce.

The severe wildfire seasons in northern California and Oregon in 1987, in Yellowstone Park, and the Northern Rocky Mountains in 1988, and throughout much of the West in 1994 have made it clear that fire cannot be excluded from fire-dependent ecosystems. On the other hand, because of altered fuels and the need to protect adjacent private lands, developed areas, and commercial forests, fire cannot be fully restored to its historic character—except perhaps in a few of the largest wilderness areas (Brown and others 1994). Nevertheless, fuels management and prescribed fire could be used to recreate an acceptable semblance of the natural fire process in many natural areas (Arno and Brown 1989). Also, the severity of wildfires could be reduced by accomplishing fuel treatments in strategically selected areas having the greatest probability of success (Williams 1995).

Role of These Proceedings

Several papers in these proceedings give suggestions and examples for restoring the fire process in various forest types representing different natural fire regimes. Three general types of fire regimes apply to North American forests (Brown 1995):

1. A "nonlethal understory fire regime" of frequent low-intensity fires was common in the ponderosa pine and Oregon oak (*Quercus garryana*) types, as discussed in some of the papers in this volume.
2. At the opposite extreme, a "stand-replacement fire regime" is characterized by lethal fires at long intervals, such as in the high-elevation lodgepole pine (*Pinus contorta* var. *latifolia*) type in the greater Yellowstone Park ecosystem.
3. Intermediate to these is the "mixed severity fire regime" that was once widespread in Western North America. Here, fire burned with variable severities in an intricate mosaic, killing many trees but allowing others to survive. Survivors were often fire-resistant species and larger trees with thicker bark and higher crowns resistant to burning.

Fire exclusion can result in conversion of a nonlethal fire regime to a mixed-severity or stand-replacement regime (fig. 2), with accompanying changes in forest composition and natural biodiversity (Agee 1993).

Presentations contained in these proceedings explain principles of fire ecology and landscape pattern in Western North American forests, especially in Session I (Assessing Needs for Fire in Restoration).

Session II (Restoration of Fire in Inland Forests) concentrates on actual examples of fire restoration in inland forests where such practices have been underway for several years.

Session III (Restoration in Pacific Westside Forests) brings out the seldom discussed subject of fire restoration in forests west of the Cascade Crest. Here millions of acres are being "preserved" as natural areas under management that excludes the essential creative process that Pinchot and Muir recognized a century ago.

Humans will have to make a leap in both ecological knowledge and philosophical understanding of our relationship to nature in order to attain the lofty goals implied by the

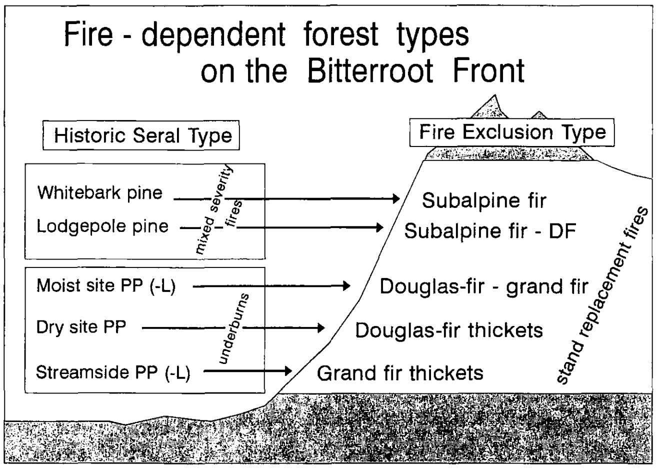

Figure 2—A schematic representation of forest zonation on the Bitterroot Range west of Stevensville, MT. The dominant tree species and corresponding fire regimes are shown for both historic (pre-1900) and modern periods. DF = interior Douglas-fir; L = western larch; PP = ponderosa pine.

terms ecological restoration and ecosystem management. In many North American ecosystems, recreating a semblance of the natural fire process will be at the heart of ecological restoration.

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