The Role of Indigenous Burning in Land Management

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ABSTRACT

This article highlights the findings of the literature on aboriginal fire from the human- and the land-centered disciplines, and suggests that the traditional knowledge of indigenous peoples be incorporated into plans for reintroducing fire to the nation's forests. Traditional knowledge represents the outcome of long experimentation with application of fire by indigenous people, which can inform contemporary policy discussions.

Keywords: biodiversity; fire; history; policy; traditional knowledge

Every landscape reflects the history and culture of the people who inhabit it. The worldview of a society is often written more truthfully on the land than in its documents. The current American landscape represents the historical legacy of one worldview superimposed on another, the colonial overlaying the indigenous. Nowhere is this history more apparent than in the attitudes toward fire, attitudes made manifest on the landscape.

Euro-Americans arrived in North America bearing their folk knowledge that held fire in forests to be destructive and hazardous to humans (Arno 1985; Lewis 1982). This view contrasted sharply with the traditional knowledge of the indigenous inhabitants, who embraced the benefits of burning and were skilled in application of fire technology.

Fire suppression began soon after colonization, and its effects followed the expansion of the frontier westward. Anthropogenic fire all but disappeared from eastern forests by the early 1700s and from the West by 1899 (Arno 1985). The consequences of suppression are written on the landscape today, creating what former Secretary of Interior Bruce Babbitt (1997) called "a crisis in forest health." Fire suppression was a "catastrophic disturbance for those ecosystems which had been influenced by anthropogenic fire throughout their development" (Packard 1993).

The results of fire suppression have been well documented for ecosystems throughout North America (e.g., Botkin 1990; Wilson 1992; Pyne 1995; Williams 2000a). Parklands were replaced by dense forests (Biswell 1989; Lewis 1993), prairies and savannas disappeared (Lewis 1993), and re-

generation patterns were dramatically altered. Fire suppression has promoted stand homogeneity and the associated problems of insects and disease, disrupting the age-class mosaic that was historically maintained by burning (Barrett 2000).

The loss of fire in the American landscape is inextricably linked with the history of federal Indian policy that removed tribal people and, therefore, indigenous land management. In the words of Williams (2000a),

> The basis for much of our forest health crisis nationwide lies in the almost complete cessation of burning by Indians in fire-adapted ecosystems. The crisis is commonly attributed to the advent of systematic fire suppression and the Smokey Bear mentality of the 20th century. To fully come to grips with our forest health crisis today, we must go back to much earlier land management decisions that ended thousands of years of Indian interactions with the land, especially through the use of fire.

Policymakers are struggling with the outcome of that history and trying to develop new management policy to restore forest health and biodiversity. The policy pendulum has now swung back from fire suppression to recognition that fire regimes are an important part of ecosystem health. However, the role of humans in a "natural" fire regime continues to be debated (Kilgore 1985).

National forest policy now calls for managers to recreate forests of the presettlement type. Babbitt (1997) proposed that fire be reintroduced for restoration of ecosystem health and productivity. If we are to manage forests with the intent of restoration of the presettlement condition, then it is imperative that we understand the role of indigenous practices in shaping the landscape (Kimmerer 2000).

Every ecosystem in North America has been affected in some way by a fire regime (Pyne 1982; Gruell 1985; Williams 2000a) manipulated by indigenous people. Much forest science, including ecological classifications of vegetation types, arose from observation of forests that were essentially in transition from conditions of indigenous fire management to post-colonial fire suppression. Our understanding of forest processes may thus be based on an anomalous, transitional landscape (Phillips 1985). "Humans have been a part of the ecosystem over the past ten centuries of major climatic change, so that all forests have developed under some kind of human influence. This influence must be accounted for as an important part of any study of forest structure and dynamics" (Russell 1997). Further, Anderson (1997) suggests that

> a full understanding of wild plant production will be achieved only through the development of a better rapprochement between the social, historical and biological sciences. It would require the sustained and cooperative efforts of scholars using both human- and land-centered avenues of research.

Extent of Indigenous Burning

In contrast to the romanticized view of native peoples living with minimal impact on unspoiled nature (Botkin 1990; Martinez 1998), the presettlement landscape was strongly influenced by indigenous land management to enhance productivity (Botkin 1992; Wilson 1992; Blackburn and Anderson 1993; Pyne 1995). The most powerful tool for landscape manipulation was fire. Fire was used by indigenous people throughout North America (Kilgore 1985; Williams 2000a), and its presence or absence strongly shaped the presettlement vegetation. For example, evidence suggests that the dominance of oak and chestnut in Appalachian forests was enhanced by vigorous resprouting after indigenous burning (Abrams 1986, 1992; Delcourt and Delcourt 1997). The extent of tallgrass prairie of the Midwest is thought to be largely a result of Indian fires (e.g., Axelrod 1985).

Western forests, often thought to be shaped primarily by wildfire, may be more the product of indigenous burning than previously thought. For example, the distribution and historical dominance of sugar pine cannot be explained by frequency of "natural" lightning ignition alone. Cultural data provide evidence that sugar pine stands were managed by tribal groups who took "ownership" of individual stands and applied fire to reduce encroachment by competing species (Schenk and Gifford 1952). Dated fire scars on sugar pine offer the best evidence of heightened aboriginal fire frequency in the Sierra Nevada (Lewis 1993), which altered the distribution and abundance of numerous species.

So ubiquitous was Indian burning that its absence also shaped forest composition. The coastal forests of the Pacific Northwest have a very low incidence of lightning fire. Williams (2000a) notes that coastal redwood forests were little affected by burning, although small clearings were made. He argues that fire was less prominent among peoples who relied primarily on marine resources for food and materials. However, a few miles inland even the coastal redwoods contained patches of prairie "too numerous to mention" which

> if left to themselves would doubtless soon have produced forest, but the Indians were accustomed to burn them annually so as to gather seeds. These prairies were of incalculable value to the Indians, not alone for their vegetable products, but for the game found upon them (Loud [1918] quoted in Lewis 1993).

Resource-rich patches in the old-growth coastal forests were created by indigenous manipulation of the fire return interval.

Goals of Indigenous Burning

Fires were intentionally ignited to fulfill a wide variety of purposes, from clearing village sites (Brown 2000) to long-distance signaling. Lewis (1993) documents more than 70 uses of fire, including treefelling, clearing travel corridors, fireproofing settlements, and hunting. Burning also was used to reduce pest populations, including rodents and biting insects, as well as for collecting edible insects such as Pandora moths and grasshoppers. Burning

in oak woodlands reduced the population levels of acorn weevils and yielded a more abundant acorn crop, which was easier to harvest after burning (McCarthy 1993). Riparian areas commonly were burned to attract game animals to the new grass and tree sprouts (Williams 2000a). Fire still is widely used in management of basketry plants, to provide a consistent crop of straight, slender shoots and roots (Ortiz 1993). From crop management to range management, fire was a ubiquitous tool.

Indigenous people used fire to modify the environment for their own survival. The most important outcome of fire use was the intentional creation of a mosaic of habitat patches that promoted food security by ensuring a diverse and productive landscape (Lewis 1985; Williams 2000a). Producing such a mosaic promoted stability in the food supply by creating multiple resource patches. Maintaining a diversity of habitats buffers the impact of natural fluctuation in a single food species and increases overall productivity. For example, fire was used to create prairies which would attract elk, deer, and other game. Indigenous people skillfully modified the fire regime to create a range of forest openings in many different stages of postfire succession, which enhanced the diversity and yield of game, berries, root crops, edible seeds, and medicinal plants. In contrast, fire was often used by the colonists with a different intent—uniformity, such as production of pastures, cropland, and plantations (Williams 2000a).

Philosophy

The policy of fire suppression in Western society arises from the myth that nature can be controlled. Ironically, trying to control nature through fire suppression has led to greater unpredictability. The indigenous worldview emphasizes the dual nature, creative and destructive, of all forces. Fire can be a force for good as it warms homes and stimulates grasses, but it can also be immensely destructive. The role of humans is not to control nature, but to maintain a balance between these opposing forces.

This balance is based on recognition of reciprocal relationships between human and nonhuman members of the ecological community. As coequals, humans are dependent on nonhumans, and the reverse is also true (Pierotti and Wildcat 2000). Human application of fire is part of that interdependence. The ethic of reciprocal responsibility underlies the indigenous use of fire, an adaptive symbiosis in which humans and nonhumans both benefit from burning. For example, indigenous people of the Northwest routinely burned grasslands and savannas to increase the yield of root crops, such as camas and other geophytes. The people realized a direct benefit from burning, and so did the plants, as the fire frequency and extent produced expansion in the patch size and population density of the geophyte species (Anderson 1997).

Meeting the responsibility for reciprocity among members of the ecosystem is understood to be simultaneously pragmatic and spiritual. Application of fire is viewed by many indigenous groups as a spiritual responsibility to the land, a tool that was given to people to fulfill the caregiving responsibilities for the land (Martinez 1998) and to promote world renewal (Krober and Gifford 1949). The Karuk people of northern California burn ritually in New Year ceremonies. Silas Whitman of the Nez Perce tribe states, "We burn because it is good for the land; fire brings more life." For example, the prairies of Walpole Island First Nation have been ritually burned since time immemorial by the Potawatomi, Ojibwe, and Ottawa peoples who accept this as their responsibility and name themselves the "keepers of the fire." The prairies of Walpole Island are renowned among ecologists for their species richness, which far exceeds the diversity where the indigenous fire regime has been interrupted.

Evidence

Sophisticated application of fire technology has been a major component of indigenous land management for millennia. The landscape encountered by colonists was largely shaped by indigenous burning, yet until recently, few people acknowledged that Indian fire use had an impact on the land (Pyne 1995; Williams 2000a). A forestry textbook published as recently as 1973 portrayed the view that "no habitual or systematic burning was carried out by the Indians" (Williams 2000a). This marginalization of traditional knowledge arose partly out of ignorance and prejudice, but also because of the fragmentary nature of the evidence (Williams 2000a). Accounts of aboriginal burning are found in notes, journals, and the oral tradition. These are qualitative, anecdotal sources that are not readily accepted by Western scientists whose training is usually limited to interpretation of quantitative data. Much traditional knowledge has been lost to time and forced assimilation, but much persists in the oral tradition and practices of contemporary native communities, who are only rarely consulted as equal partners in land management.

The correspondence between traditional ecological knowledge of fire response and later scientific evidence is very strong. Examination of traditional knowledge offers an opportunity for crosscultural verification of scientific hypotheses concerning fire management. There is an increasing body of evidence noted by Brown (2000) that validates the oral tradition, through data collected from historical documents, dendrochronology, charcoal profiles, archeological evidence, and statistical analysis of land survey records. Paleoecological data also support interpretation of widespread Indian burning and its effects on vegetation composition (e.g., Clark and Royall 1996; Delcourt and Delcourt 1997). However, it must be acknowledged that there are many pitfalls in the interpretation of such indirect evidence (Williams 2000a). The widespread significance of indigenous burning is by no means universally accepted. Kilgore (1985) summarizes the arguments critical of the importance of aboriginal burning, which focus primarily on issues of scale.

The main impediment to scientific acceptance of the wide impact of aboriginal burning arises from a lack of understanding of the cultural context in which it took place. For many peoples, manipulation of the landscape through

skillful application of fire was critical to cultural survival, and enhanced food productivity made agriculture unnecessary (Biswell 1989).The material culture of many tribal peoples simply could not have been sustained without extensive use of fire (Blackburn and Anderson 1993). In terms of energy efficiency, fire was the most potent land management tool available to indigenous people. Millennia of experimentation and detailed empirical observations led to a sophisticated application of fire technology. Coupled with a worldview that emphasizes the role of humans as active participants in nature, fire was integral to many cultures.

The Practice

A careful examination of the philosophy and practice of Indian burning reveals that it differs from a nonanthropogenic fire regime (i.e., wildfire) in five important respects: seasonality, frequency, extent, site, and outcome (Williams 2000a).

Seasonality of burning varied with the tribe and the ecosystem in question, but in general fire was applied at a carefully considered time that would minimize its destructive nature while harnessing its creative power. Numerous studies confirm that the timing of indigenous burns differs significantly from the seasonality of natural lightning ignitions (Barrett 1980; Barrett and Arno 1982; Lewis 1982; Arno 1985; Brown 2000; Williams 2000a). Lightning fires are most abundant in the late summer, but indigenous fires were set in seasons less conducive to wildfire. For example, in the boreal forests of northern Alberta, fire was applied in the early spring when the grass was dry but the soil was still moist and the surrounding forests were too wet to carry a fire. The small-scale, low-intensity burns created openings in the forest where regrowth was accelerated on the newly blackened earth, extending the growing season in this harsh environment by several weeks and attracting abundant game (Lewis 1982).

The season of burning also depended on the desired outcome. For example, people in the Southwest would burn the chaparral in the fall to increase forage for deer. The lower temperatures and increased soil moisture favored vigorous resprouting, which was beneficial in attracting deer in the winter. In contrast, if the intent was to clear land for tobacco cultivation, the chaparral was ignited in the spring, when a hotter burn would discourage resprouting and prepare a suitable seedbed. In the Great Plains, Indians rotated the seasonality of burning as a tool to influence seasonal movement of bison, in synchrony with their own semi-nomadic movements. In the mosaic of tallgrass prairie and aspen parkland, the prairie was burned in the fall, forcing bison into the parklands that the people inhabited during the winter. In spring, the parklands were burned, which stimulated movement of the bison out onto the open prairies (Lewis 1982). This sophisticated application of fire required extensive knowledge of the vegetation response, the life history of herbivores, and their interactions with predators.

Williams (2000a) reports an exception to the general pattern of burning in the spring or fall, when fire intensity would be reduced. In northern California and in the Willamette Valley of Oregon, Kalapuya people burned the grasslands in the summer, when fire might be expected to be more intense and potentially destructive. This unusual midsummer burn created a second flush of growth in the fall when the rains returned, a dual cropping system that maintained local herbivore populations. However, the intensity of the summer burns was quite low because of their high frequency, which reduced fuel accumulation. Appropriate season of burn was thus understood in interaction with fire frequency.

Frequency. Most wildfires are started by lightning strikes; however, scholars of aboriginal fire agree that anthropogenic fire far exceeded the frequency of natural lightning strikes. "Lightning in fire-adapted ecosystems does not usually cause fires. Lightning tends to strike . . . high rocky points, individual trees, or other places where no ignition occurs. Most snag fires are soon extinguished by the rain that usually accompanies lightning" (Williams 2000b). Indigenous people enhanced fire frequency not only with more ignitions but in creating fuel piles so that areas would burn that ordinarily might not carry a fire. Several studies of fire return intervals (Barrett 1980; Blackburn and Anderson 1993; Brown 2000; Williams 2000b) indicate that fire scars are much more abundant in areas of Indian habitation than in comparable regions not managed by indigenous people.

> Ironically, trying to control nature through fire suppression has led to greater unpredictability.

The frequency of fire application generally was based on the management goal. Land was burned annually if the intent was to increase game by providing new grass forage. Berry patches were maintained by burning on a cycle of three to five years, depending on the ecology of the target species. A 10- to 12-year fire interval was typically observed around beaver ponds to maximize regeneration of aspen and willows to feed beaver (Lewis 1982; Williams 2000a). The result of altered fire frequency was to create a mosaic of successional patches, varying in species composition and age structure, which ensured a diversity of plant foods, medicines, game, and materials for the subsistence of the people.

Extent. Aboriginal burning also differs from wildfire in its extent. Most burns were of a modest scale, designed to maintain small successional patches. Large-scale burns could be viewed as maladaptive, disrupting the diverse mosaic, disrupting ecotones, and decreasing productivity and stability of the food supply (Lewis 1993). Extent of fires was controlled by careful timing, increased fire frequency and reduced fuel load, and the use of natural fire breaks. The mosaic of patches differing in successional age and flammability would itself limit the extent of fires.

Without doubt, fire control was not uniformly effective, just as we experience today, and some fires escaped, with unintended consequences. One notable exception to the general pattern of small-scale burning is the huge conflagrations traditionally set by peoples of the northern Great Plains. Prairie fires would extend for miles and were used to influence the distribution of buffalo. This large scale of burning reflects the very different ways of Plains peoples, whose food security arose not from a mosaic of diverse patches in a local area, but from maximizing productivity of a single species, the buffalo. A broad range of effects is seen, depending on the resource needs of the people and the flammability of their landscape.

Site. Indian fires also differ from lightning-ignited wildfires in the sites at which they occur. For example, riparian areas that might not burn without assistance were regularly ignited to improve waterfowl habitat and encourage growth of basketry materials and certain medicines. Locations of fires might reflect annual migrations along the elevational gradient, which enabled people to take advantage of seasonally available foods. By understanding differential burning conditions, Indians were able to restrict fires to certain areas, matching the fire regime to the ecological conditions and life history of the target species and thus enhancing productivity.

Application to Current Goals

Aboriginal use of fire to create and maintain a landscape mosaic is an ancient practice that can be a key to meeting contemporary land-use goals. Fire was used as a pragmatic tool to meet the goals of indigenous practitioners, to increase the yield and diversity of subsistence foods. These practical goals were also coupled to a spiritual responsibility to carefully use fire to multiply life. The "natural" fire regime was manipulated to produce a richly diverse mosaic of vegetation types differing in successional age and species composition.

The intent of contemporary forest management is no longer to support the subsistence economy of human beings but to enhance ecosystem health, productivity, and biodiversity. It is in this capacity that indigenous knowledge of fire is an invaluable resource for forest managers. The same indigenous strategy that was used to increase biodiversity and productivity for subsistence can also be used to enhance and maintain biodiversity for goals of ecosystem health.

For example, indigenous Kalapuya people of Oregon's Willamette Valley routinely burned savannas and meadows to increase the yield of food plants such as camas and tarweed (Williams 2000b). Other postfire species increased as well, among them the Kincaids Lupine, a legume that is vital to the life cycle of the Fenders blue butterfly (Schulz and Crone 1998). At least 24 species of butterflies once inhabited these meadows; since cessation of indigenous burning, seven have become extinct and six, including the Fenders blue, are listed as endangered species (Schulz and Crone 1998). Restoration of the indigenous fire regime and the mosaic it created can have significant impacts on biodiversity.

Restoration of indigenous-style burning is not a panacea for problems of fuel accumulation and structural changes that have accompanied a century of fire suppression, but it should be part of the strategy for restoration of forest health. Pyne (1995) states that

> to restore natural conditions without the Indians and the things they did, including burning, is to construct an artificial landscape that is historically and ecologically incomplete. The reason for reinstating fire is not to try and restore pre-Columbian vistas, but because we cannot sustain the landscape we value without it.

The suppression of traditional caregiving practices has contributed to the current state of forest health; resumption of human responsibility for fire can be part of the solution. Indigenous practice and philosophy offer us an alternative view of the "natural" fire regime, in which humans regain their role as "keepers of the fire" and the symbiotic relationship between humans, forests, and fire is reestablished for mutual benefit.

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