Indian Fires in the Northern Rockies
Ethnohistory and Ecology

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In Western North America, fire history information is important for implementing ecologically sound management for vast areas of publicly owned wildlands. Fire histories help elucidate the role of fire in maintaining diverse ecosystems. Many studies have shown that forests burned cyclically for thousands of years before settlement by Euro-Americans; in contrast, many areas have not burned in this century, in part because of efficient fire suppression. Ironically, by "protecting" areas from fire, we have inadvertently removed one of nature's primary rejuvenating processes.

Lightning is a major cause of forest fires, but it is relatively uncommon in lower-elevation forests and grasslands. Here, in both pre- and post-contact times, humans have been a potentially important source of ignitions. Until recent decades, however, little information existed on Indians' role in causing fires in the West. For example, were Indian-caused fires commonplace? If so, why were such fires ignited? Which forest types were affected, and to what extent? Besides being interesting anthropology, such information can help today's foresters refine their knowledge of ecosystem processes. Accordingly, the authors conducted a study of the role of Indian-caused fires in the Northern Rocky Mountains.[2]

The Salish (i.e., Flathead and Pend d'Oreille tribes) and Kootenai Indians were the principal inhabitants of western Montana for 6,000 to 10,000 years before settlement by Euro-Americans.[3] These tribes had a hunter-gatherer economy and may have numbered only a few thousand at any given time.[4] Increasing settlement after about 1860, however, greatly hampered the Indians' way of life, and the tribes eventually were moved to their present reservation north of Missoula, Montana. Before our study, evidence of Indian fire practices was sketchy. To document Indian influence in area fire history, we designed a two-phase study focusing on ethnohistory and forest fire ecology.

Ethnohistory of Indian Fires

The ethnohistorical phase of the project, conducted in 1980, consisted of a review of early written records and oral history interviews. We first searched the literature for old journals and other eyewitness accounts of Indian-caused fires. Then, with the aid of tribal culture committees and historical societies,

we sought out and interviewed knowledgeable descendants of early-day Indians and settlers. Short oral history interviews helped ascertain whether Indians had used fire and, if so, why.[5] Of our fifty-eight informants, thirty-one were Indians and twenty-seven of European descent. When asked whether earlyday Indians purposely had ignited fires, 41% answered yes, 12% answered no, and the remaining 47% did not know. Thus only about half the informants claimed knowledge on the subject, and the high proportion of "don't know" answers reflects a dwindling knowledge of early history. However, the large proportion of "yes" versus "no" responses (77% vs. 23%) verified our initial impression from journals that Indians frequently had used fire to manipulate the landscape. One researcher's subsequent review of forty-four historical accounts suggested that Indians had caused as many as 41% of 145 observed fires between 1776 and 1900 in the Inland West.[6] Seven of the ten fires witnessed by explorers Lewis and Clark between 1805 and 1806 in the Northern Rockies, for instance, were attributed to Indian ignitions.[7]

Seven informants cited specific locations where Indians regularly burned valley bottoms. One elderly man's parents told him that they always knew when the seasons were about to change because every year during late fall, Flatheads set fires in the Ninemile Valley west of Missoula. A common practice was to ignite the valley bottom upon leaving for the main winter encampment in the nearby Bitterroot Valley. The parents of an elderly resident in the Swan Valley, northwestern Montana, gave virtually the same information about Kootenai Indians in that location.[8] On August 23, 1805, in the present-day Beaverhead Valley in southwestern Montana, Captain Meriwether Lewis submerged the expeditions' canoes under water to protect them from "the fire which is frequently kindled in these plains by the natives."[9]

Written records verified that fire was an important element of Indian subsistence technology. Fire facilitated hunting, was used in game drives and surrounds, stimulated forage, and helped influence game movements in general. During missionary work in the 1840s, Father Pierre deSmet witnessed a fire surround near Lake Coeur d'Alene in northern Idaho:

> On both ends of their line they light fires, some distance apart, which they feed with old garments and worn out moccasins . . . The frightened deer rush to right and left to escape. As soon as they smell the smoke of fires, they turn and run back. Having the fires on both sides of them and the hunters in the rear, they dash toward the lake, and soon they are so closely pressed that they jump into the water, as the only refuge left for them. Then everything is easy for the hunters; they let the animals get away from the shore, then pursue them in their light bark canoes and kill them without trouble or danger.[10]

An informant from an earlier study described a somewhat different technique:

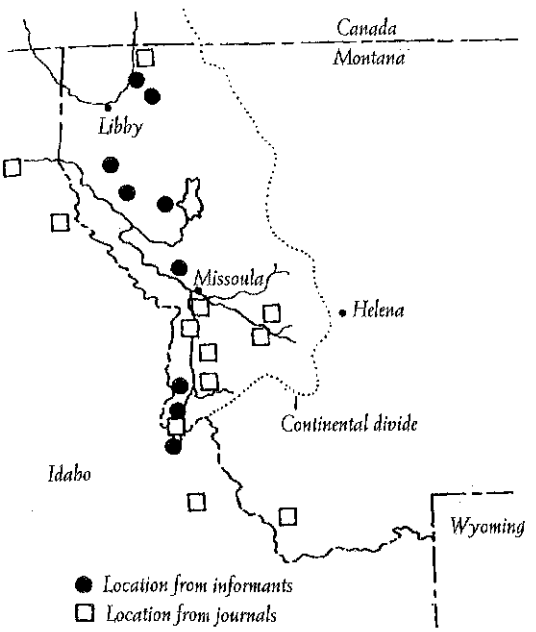
> The fire surround was held in some level region where deer were known to be abundant. The drive leader called the men of the camp together and asked them to prepare a quantity of pine-wood torches. The following morning the hunters assembled, and lighted torches were given out to a number of them. Carrying these, they then began to move out, in two directions, to form a large circle, setting fire to the brush and trees along the way. Others with bows and arrows were stationed at intervals around the fire circle, to shoot any animals that might try to escape through the flames. At the starting point a small area was left unfired. As the deer fled around the inside of the fire ring, they arrived at this opening where other bowmen were waiting for them. White tail and mule deer, as well as bears, were secured in the surround. Elk, ranging at higher altitudes during these months, were never taken in this way.[11]

Frequent burning promotes grass at the expense of shrubby forage,[12] and Indians used this knowledge to influence general game movements. By regularly burning certain areas, hunters knew that deer likely would frequent the nearby unburned stands.[13] A journal from July 1860 describes this use of fire near present-day Lookout Pass, on the Montana-Idaho border:

> In returning, the Indian set fire to the woods himself, and informed us that he did it with the view to destroy a certain kind of long moss which is a parasite to the pine trees in this region, and which the deer feed on in the winter season.[14] By burning this moss the deer are obliged to descend into the valleys for food, and thus (the Indians) have a chance to kill them.[15]

Fires also were used to improve grazing, particularly after horses were obtained in the early 1700s. Horse ownership was one measure of power and wealth, and Indians frequently kept large numbers. One informant said that 100 or more horses often accompanied small bands passing by his parents' homestead near the Ninemile Valley. To stimulate grass, Indians commonly burned ungrazed areas in early spring or fall. In 1860, U.S. Army Lt. John Mullan kept a detailed journal during a reconnaissance from Fort Benton, on the upper Missouri River, to Fort Walla Walla, Washington. Mullan noted five instances of Indians burning valley grasslands, and he repeatedly mentioned seeing many horses, as well as "luxuriant" grasses in many locales. In March 1860, near present-day Missoula, for example: "The grass had all been burnt by the Indians along the Bitter Root River . . ."[16] One recent Blackfeet Indian informant mentioned so-called "horseback lightning," or igniting the prairies using transported embers.

Several informants said that Indians used fire to maintain open campsites and trails. The small trees and brush killed by these fires simultaneously served as a future source of firewood. Open forests allowed much easier travel, a fact often noted by early settlers. Several informants and a journal said that Indian



Locations of known Salish or Kootenai ignitions in western Montana and adjacent areas between approximately 1805 and 1920. Location references are listed in Barrett (1981, fig. 3).

women were responsible for conducting such burning, using wet blankets to control small strip fires. Concerning trails, 1890s forest surveyor Horace Ayres noted:

> There is no doubt that some of the fires, especially on the higher (mountain) ranges, are due to lightning, but most of those in the valley seem to have been set by Indians and other hunting parties or by prospectors. The trails most frequented by Indians, such as the Jocko and Pend d'Oreille, are noticeably burned especially about the camping places.[17]

Regular underburning in ponderosa pine (*Pinus ponderosa*) also made approaching enemies more readily visible, and essentially could fireproof a campsite by eliminating cured grasses. Grass fires occasionally were ignited for warfare. In 1858, a traveler in the Tobacco Valley (northwestern Montana-southeastern British Columbia) witnessed Kootenai Indians using fire to repel an attack:

> If the Blackfeet had any idea of the Kootenais setting the grass afire they would not have selected the grove . . . for the battle ground. Indians are careful in not (accidentally) setting fire to grass in the close vicinity of their villages, and the Blackfeet had no thought of fire being set out and afterwards extinguished by the squaws and their wet blankets.[18]

Grass fires commonly were used for communication.[19] In contrast to the sophisticated smoke signals often portrayed in Hollywood movies, however, Indians simply ignited entire valley bottoms, producing dense smoke visible for miles. Large grass fires thus served many other purposes simultaneously, as described above. On August 31, 1804, near the Lemhi River in eastern Idaho, members of the Lewis and Clark Expedition witnessed the following:

> This day warm and Sultrey, Prairies or open Valies on fire in Several places. The countrey is Set on fire for the purpose of collecting the different bands (of Pend d'Oreille Indians), and a Band of the Flatheads to go to the Missouri (River drainage) where They intend passing the winter near the Buffalow.[20]

Early-day trapper Warren Ferris observed several such fires:

> On the 13th (August 1833), we continued down this (Bitterroot) river, till evening and halted on it. The (Flathead) Indians with us,

Circa 1840 painting by Father Nicolas Point depicting an Indian fire surround near Lake Coeur d'Alene, Idaho. "Chasse d'automne aux chevreuils" (fall deer hunt) from Nicolas Point, S.J., Souvenirs des Montagnes Rocheuses, Livre 3, Chasses indiennes. Courtesy of the Archives de la Compagnie de Jésus, Province du Canada-français, St-Jérôme, Québec, #1603. The painting is interesting for several reasons. First, besides portraying an actual incident, it shows a unique fire surround in which a lake was used to entrap prey. Equally interesting, however, is that the painting shows a raging crown fire surrounding the camp—undoubtedly inaccurate because the Indians clearly were more interested in hunting than fleeing from a dangerous fire. (Father DeSmet's accompanying journal verifies that small surface fires were employed.) Point's abstract painting thus implies more than just artistic license—a deep-seated fear of wildfires.

> announced our arrival in this country by firing the prairies. The flames ran over the neighboring hills with great violence, sweeping all before them, above the surface of the ground except the rocks, and filling the air with great clouds of smoke.[21]
>
> From the summit of Cota's Defile (i.e., August 1832, present-day Bannock Pass) we saw a dense cloud of smoke rising from the plains to the southeastward, which we supposed to have been raised by the Flatheads, who accompanied Fontanelle to Cache Valley, and who were now in quest of the village to which they belong. The Indians with us answered the signal by firing a quantity of fallen pines on the summit of a high mountain.[22]

Ferris also saw an accidental blaze evolve into a worrisome "communication fire" near present-day Deerlodge, Montana:

> A careless (Flathead) boy scattered a few sparks in the prairies, which, the grass almost instantly igniting, was soon wrapped in a mantle of flame. A light breeze from the south carried it with great rapidity down the valley, sweeping everything before it, and filling the air with black clouds of smoke . . . (The fire) however occasioned us no inconsiderable degree of uneasiness as we were now on the borders of the Blackfeet country, who it was reasonably inferred might be collected by the smoke, which is their accustomed rallying signal, in sufficient force to attack us . . . Clouds of smoke were observed on the following day curling up from the summit of a mountain jutting into the east side of the valley, probably raised by the Blackfeet to gather their scattered bands, though the truth was never more clearly ascertained.[23]

Interestingly, descendants of settlers often seemed to have more detailed recollections of Indian fire practices than did Indian descendants. Lack of trust by Indian informants may be one factor. Some research on Indian burning (e.g., Ross, this volume), suggests that understanding of firing techniques and ecosystemic effects was specialized knowledge, possessed by only a few individuals, and therefore may not have survived. Indians may have considered fire a rather unremarkable, albeit necessary, tool, also reducing the likelihood that much oral history would be passed down through the generations. By contrast, because settlers often viewed fire as destructive and dangerous, anti-fire biases increase the likelihood that settlers would pass along recollections of Indian ignitions. Several Indian informants stressed that their forebears were careful not to ignite severe fires. In fact, early forest surveyor John Leiberg said that typical ponderosa pine stands were never conducive to severe crown fires:

> The fires in the Bitterroot Basin were as extensive as elsewhere in the West, but have done far less damage to the merchantable timber. This is due to the resistance offered by the yellow pine and to the small

> quantity of litter and humus in the forest. The ground in this kind of growth is always covered with a thin layer of pine needles—never a proper humus—and is usually free from undergrowth, or has but a minimum. Grasses or sedges in bunches cover the ground thinly, hardly ever forming a continuous sod. In consequence fire runs through the forest rapidly.[24]

Regarding seasons of burning, the informants and journals suggested that most intentional burning occurred in fall or early spring—when old grasses were ignited easily without causing destructive forest fires.[25] Early-day Indians undoubtedly knew that summer fires could be hazardous, and only a few accounts mention Indians causing fires during that season. Nevertheless, early forest surveyors often attributed destructive forest fires to Indians and prospectors,[26] but they also rarely recognized lightning as a major cause:

> Most of the fires that can be traced to the period of Indian occupancy appear to have originated along the lines of trails (crossing the Bitterroot mountains) . . . The probability is that many fires spread from their camps and others were set purposely to destroy the forest and encourage grass growth. This latter seems to have been the case in the alpine fir type of forest along their trails, where now occur so many of the bald or grassy mountain slopes.[27]

Because of their European heritage, early foresters had a strong anti-fire bias. Fire was considered undesirable and destructive, rather than yielding any potentially beneficial effects. Leiberg wrote the prevailing sentiments of the day: "the after effects of fires in this region are various, but are always evil, without a single redeeming feature."[28] Leiberg also obtained the following misinformation from an old Indian in the late 1890s.

> An educated Nez Perce, with whom I conversed regarding the matter stated that forest fires were never started through design, but might have accidentally spread from signal fires kindled by different bands or individuals while on the hunt, that they might know the whereabouts of one another.[29]

At first glance, this statement appears to suggest Indians did not use fire to manipulate landscapes. But Leiberg had an anti-fire bias (typical of many Euro-Americans) and simply might have mistrusted the interviewer's motives. Or, he may have been referring to destructive forest fires in the Bitterroot Mountains, rather than light grass fires in the Wallowa Valley.

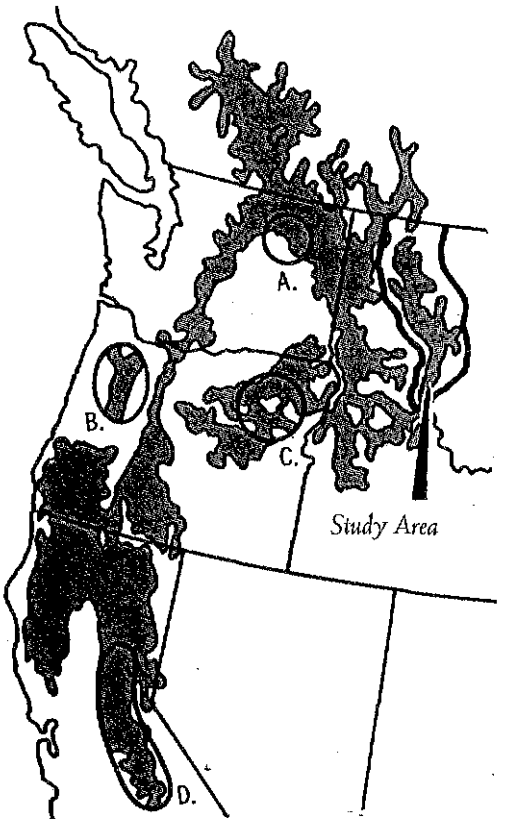
Although fall grass fires occasionally might have developed into severe burns in the adjacent steep mountains, informants and journals yielded no evidence of purposeful burning in high mountain terrain, or in moist riparian forests. We found only three references to high-altitude fires started by Indians. Warren Ferris' journal twice notes mountaintop bonfires ignited for communication. And Lewis and Clark's journals cite an instance of Indians

torching several dead fir trees at night along the Lolo Trail, for entertainment and spiritual reasons.[30] But, unlike people of European descent, Indians did not view forests as a source of saw timber in need of careful protection. Thus, if valley bottom fires sometimes burned high mountain forests, the post-fire communities might only benefit Indian economies. Some informants said that these fires would stimulate game browse and food plants such as blue huckleberries (*Vaccinium globulare*), which grow best in moist subalpine forests prone to infrequent severe fires. Purposeful burning in subalpine forests would be more difficult, because moist fuels can impede spreading fires during most fire seasons. And conflagrations can result on those infrequent occasions when ignitions coincide with fuels highly receptive to fire. In any case, extensive lightning fires appear to be sufficient to account for most of the fire history reported for subalpine terrain.[31]

We found little detailed information about methods of application. Evidence of highly technical burning practices was lacking in journals and oral history interviews, perhaps for several reasons. In lieu of technical knowledge possessed by the few specialized burners such as that reported for the neighboring Spokan (Ross, this volume), it appears that Salish and Kootenai burning was largely informal and opportunistic, rather than highly systematic, as has been reported for tribes in California and northern Alberta.[32] The data suggest that Indians in the Northern Rockies burned largely on an ad hoc basis. The principal exceptions might be highly localized fires: burning for game drives, clearing around campsites, and during warfare. Available evidence therefore suggests that these quasi-nomadic hunter-gatherers simply used fire informally as a tool to aid subsistence. Nonetheless, Indian fires clearly were frequent and widespread in certain environments, and benefited many elements of ecosystems besides humans.

Ecology of Indian Fires

We investigated fire history in Montana's dry lower elevation forests west of the Continental Divide.[33] Here, broad grassland and forested valleys are surrounded by steep, heavily forested mountains. During the presettlement era, most lower-elevation forests were dominated by old-growth ponderosa pine, western larch (*Larix occidentalis*), and interior Douglas-fir (*Pseudotsuga menziesii* var. *glauca*). Multiple fire scars on trees show that, although old trees are adapted to survive recurrent surface fires, pine and larch also depend on such fires to stimulate regeneration. Otherwise, stands develop understory thickets of Douglas-fir and grand fir (*Abies grandis*), reducing overall vigor. With continued fire exclusion, Douglas-fir- and grand fir-dominated stands eventually would replace native ponderosa pine-larch-Douglas-fir communities.

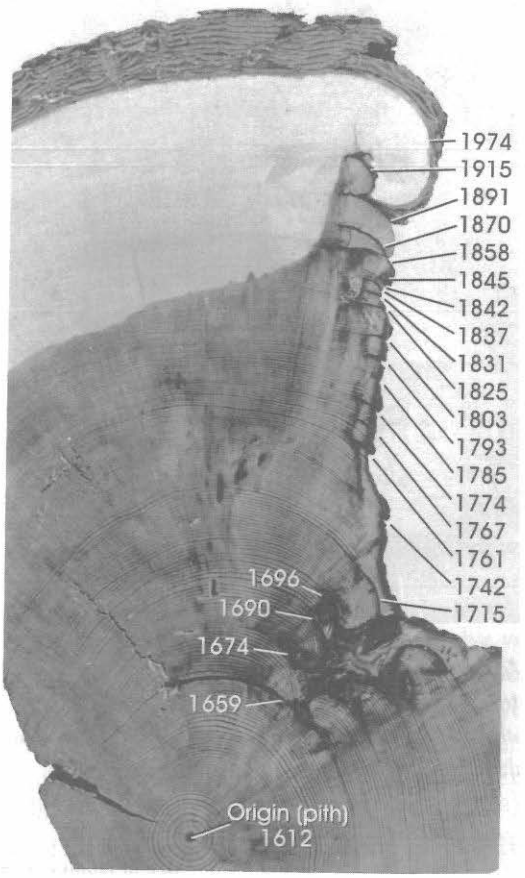


General distribution of the Pacific slope form of ponderosa pine, Pinus ponderosa var. ponderosa (after Little 1971), the map also shows the approximate distribution of mixed conifer-ponderosa pine types similar to those in western Montana. Lettered areas indicate locations where Indian burning has been implicated as an important ecological factor.

The historical journals suggested that most Indian fires occurred in valley grasslands and adjacent dry forests.[34] By contrast, early travelers rarely noted Indian burning in less well-traveled mountain canyons. Therefore, we used a paired-stand approach to investigate whether measurable differences in fire frequency existed between such areas. We sampled 10 "heavy-use" stands at the edges of the broad intermountain valleys, and 10 comparable but "remote" ponderosa pine stands several miles up nearby canyons. Without frequent Indian-caused fires, both locales presumably would have similar fire frequencies (i.e., caused by lightning).

To estimate fire history, we sawed fire scar samples from old-growth trees, using the annual growth rings to identify specific fire years (see figure on facing page).[35] We used these samples to estimate fire frequency, first, for the presettlement era (pre-1860), then for the settlement (1861–1910) and fire exclusion (post-1910) periods. In the latter period, land management agencies tried, with considerable success, to exclude all fires.[36]

Between ca. 1500 and 1860, fire frequency was substantially shorter in nine of ten heavy-use stands than in their remote counterparts. Three heavy-use stands were in areas identified by informants as having been repeatedly



Cross-section of a ponderosa pine from the Bitterroot Valley, Montana, with scars from recurrent low-intensity fires. The tree recorded twenty-one fires between 1659 and 1915. Fire suppression interrupted the pattern of frequent fires after 1915. USDA Forest Service photo.

burned by Indians, and these stands had some of the shortest fire intervals, averaging about seven years each. In fact, pre-1860 fire intervals averaged less than ten years in most of the heavy-use stands. By comparison, fires averaged fifteen to twenty years on most remote sites. Statistically, the fire intervals for three heavy-use stands were significantly shorter (0.05 probability).[37] Also, the nine-year-long mean fire interval for all ten heavy-use stands combined was significantly shorter than the eighteen-year-long mean interval for all remote stands. The one "remote" stand not following the above pattern occurs in a canyon near hot springs well used by Indians. Therefore, poor sample site selection may have produced this result. Remote-stand fire intervals were more variable than in heavy-use stands, consistent with a regime of random lightning fires. By contrast, the heavy-use stands had comparatively uniform fire intervals, highly suggestive of a human-dominated (controlled) fire history.

We hypothesized that burning likely increased after the tribes acquired horses in the early 1700s. Horses greatly improved Indian mobility, and the tribes maintained very large herds, perhaps requiring more frequent or

Repeat photography near Sula, Montana. This area of the upper Bitterroot Valley, with many ancient Indian campsites, was visited by Lewis and Clark in 1805–06, Nez Perce Chief Joseph in 1877, and other early travelers. Circa 1895 photograph shows an open stand of ponderosa pines resulting from frequent fires. By 1980, in the absence of fires, the stand soon became dense (see facing page). The first photograph is courtesy of the Darby Historical Society; the second is by George Gruell of the USDA Forest Service. Photos no. 85-0031 & 0032, K. Ross Toole Archives, University of Montana.

widespread burning to rejuvenate grass and clear trail underbrush. We therefore compared pre-and post-1730 fire frequency, using data from nineteen of the oldest trees in the database. Post-1730 fire intervals were somewhat shorter than before 1730, but differences were not significant statistically, suggesting relatively uniform fire frequency from at least 1500 to 1860. The analysis yields several potential interpretations. First, Indian burning may not have changed substantially after acquisition of the horse. Or, Indians may have rotated grazing areas in such a way that burning occurred irregularly in some locales. Any chronic over-grazing would have reduced the ability and need for deliberate burning, by depleting grassy fuels.[38] Conversely, if increased burning had destroyed some fire scar evidence, we would have been unable to detect subtle changes in already high fire frequencies.

Fire patterns during the settlement period (1861–1910) were similar to those before 1860, but differences between heavy-use and remote stands were less pronounced. Nonetheless, overall fire frequency still was significantly

shorter in the heavy-use stands (i.e., twelve vs. fifteen years). Interestingly, mean fire intervals grew shorter in some remote stands, while increasing in some heavy-use stands. Given the short fifty-year period, such results simply might be due to chance. However, Indian burning was in decline by 1860, and prospectors, settlers, and others may have caused fires in both heavy use- and remote areas.[39]

During the fire exclusion period (post-1910), fire occurrence diminished markedly in most stands. Moreover, differences between heavy-use and remote stands were no longer significant. Fire intervals longer than 35 years were common in both types of locations, and several stands did not burn at all between 1910 and 1980. So consider the abrupt change in humankind's role in fire history: Euro-Americans reversed untold centuries of frequent Indian- and lightning-caused fires in grasslands and dry ponderosa pine forests.

Recently, Arno and others studied fire history in a cool, moist forest at Seeley Lake, northeast of Missoula, Montana.[40] Unlike in the drier valleys to the west, moist western larch forests often experienced comparatively long fire intervals (e.g., 35–200 years).[41] Yet the 600-year-old larch at Seeley Lake had many fire scars, leading the researchers to suspect Indian burning. In fact, artifacts revealed a major campsite for at least 3,500 years[42], and an earlier-cited quote about burning near trails and camps refers to this very locale.[43] Underburns averaging every twenty-four years maintained a park-like stand—highly unusual for such productive forests. Unfortunately, the thinning fires virtually ceased after the late 1800s and the old-growth trees now are heavily crowded by understory thickets.

Fire History: Lessons from the Past

Primeval fires throughout the Northern Rockies contributed to the high level of landscape diversity encountered by early-day settlers. Frequent surface fires in semi-arid valleys prevented heavy accumulations of forest fuels, tree crowding, and subsequent stand deterioration. The recurring underburns thus precluded highly destructive fires by promoting open stands of large fire-resistant trees. Conversely, lightning caused most fires higher in the mountains, and fire intervals and severities were more variable. This fire pattern produced a mosaic of different-aged stands, in contrast with the old, park-like pines in the lower valleys. The net result of thousands of years of that fire history was a complex of diverse and dynamic ecosystems that evolved with repeated disturbance.

After millennia of subsistence in the Northern Rockies, Indians were well accustomed to interacting with fire in the environment. But Euro-American civilization, challenged by this uncontrollable force of nature, had a cultural aversion to fire. Since 1900 we have tried to eliminate most forest fires, with varying success. But in just one century, settlement has changed the landscape, altering biodiversity, forest growth, wildlife habitat, and a host of other factors. In recent years, land managers have begun to move away from simple custodial management and total fire suppression. Instead, managers now are considering the aboriginal model of what has been termed "adapting to nature."[44] In the 1990s, foresters increasingly use prescribed fires and stand thinnings to return Western forests to a semblance of their historical condition and enhance long-term forest health.

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Notes

1. Authors are, respectively, Consulting Research Forester (995 Ranch Ln, Kalispell MT 59901) and Research Forester (USDA Forest Service Intermountain Fire Sciences Laboratory, Box 8089, Missoula MT 59807).
2. Stephen Barrett, "Relationship of Indian-caused fires to the ecology of Western Montana forests" (M.S. thesis, University of Montana, Missoula, 1980).
3. Carling Malouf, "The coniferous forests and their use through 9,000 years of prehistory" (pp. 271–90 *in Coniferous Forests of the Northern Rocky Mountains, Proceedings of the 1968 Symposium* (Missoula, 1969); Wayne Choquette, "Cultural resource overview of the Bonneville Power Administration proposed transmission line from Libby Dam, Montana, to Rathdrum, Idaho" (*Washington Archaeological Research Center Project Report* 100, Pullman, 1980).
4. James Teit, "The Salishan tribes of the western plateaus" (*Bureau of American Ethnology* 45th *Annual Report*, pp. 23–396, 1928).
5. Willa Baum, *Oral History for the local historical society* (Nashville, 1974).
6. George Gruell, "Fire on the early Western landscape: An annotated record of wildland fires, 1776–1900" (*Northwest Science* 59(2): 97–107, 1985). (The author reviewed journals of travelers in Montana, Idaho, Wyoming, Nevada, Utah, and eastern Oregon).
7. *Ibid.*
8. Personal communication with Gary McLean, Archaeologist, Flathead National Forest, Kalispell, MT.
9. Gary Moulton (ed.), *The Journals of the Lewis & Clark Expedition* Vol. 8, June 10–September 26, 1806. (Lincoln, NE, 1988), 148.
10. Hiram Chittenden and Alfred Richardson (eds.), *Life, letters, and travels of Father Pierre-Jean DeSmet, 1801–1873.* (New York, 1969), 1021–22.
11. Claude Schaeffer, "The subsistence quest of the Kootenai" (Ph.D.dissertation, University of Pennsylvania, 1940), 13. Northwest Plateau peoples used several varieties of deer drives. For a second example of a circle drive with fire from Coeur d'Alene, see deSmet in Boyd (this volume). Coeur d'Alene also drove deer in winter snow without benefit of fire.
12. Gruell, "Fire on the early Western landscape."
13. John Lieberg, 1899. "Bitterroot Forest Reserve." In *19th Annual Report of the U.S. Geological Survey* (1897–1898), Part V., Forest Reserves. pp. 253–82.
14. Members of the genus *Alectoria* are not mosses or parasites, but epiphytic lichens.
15. John Mullan, "Report of a reconnaissance from the Bitterroot Valley to Fort Hall." In *Explorations and surveys for a railroad route from the Mississippi River to the Pacific Ocean,* (U.S. War Dept., vol 12, Book I, 1853–1855. 36th Cong., 1st Sess., House Ex. Doc. 56, 1861), 151–52.
16. Mullan, *ibid.*, 37.
17. Horace Ayres, "Lewis and Clark Forest Reserve, Montana." (pp. 27–80 In *21st Annual Report of the U.S. Geological Survey* [1899–1900], Part V, Forest Reserves, pp. 72–103, 1900.)
18. William Hamilton, "A trading expedition among the Indians in 1858 from Fort Walla Walla to the Blackfoot country and return." (*Contributions to the Historical Society of Montana . . .* III, Helena, 1900), 110–11.

19. Gruell, "Fire on the early Western landscape."
20. Moulton *ibid.*, 179.
21. Warren Ferris, *Life in the Rocky Mountains: A diary of wanderings on the sources of the rivers Missouri . . .*, Paul Phillips, ed. (Denver, 1940), 215.
22. *Ibid.*, 103.
23. *Ibid.*, 106–7.
24. Leiberg, "Bitterroot Forest Reserve," 275.
25. Such statements might simply reflect bias if modern-day Indians were worried about inadvertently protraying their ancestors as arsonists, or conversely, as highly responsible "land stewards."
26. Leiberg 1899 *ibid.*, Ayres, "Lewis and Clark Forest Reserve," and Ayres, "Flathead Forest Reserve, Montana" (pp. 245–316 In *20th Annual Report of the U.S. Geological Survey* (1898–1899), Part V, Forest Reserves, 1900).
27. Leiberg 1899, 387.
28. Lieberg 1899, 388.
29. Lieberg 1899, 387.
30. Moulton, *The Journals of the Lewis and Clark Expedition*, 50.
31. Peter Mehringer, Stephen Arno, and Kenneth Peterson, "Postglacial History of Lost Trail Pass Bog, Bitterroot Mountains, Montana" (*Arctic and Alpine Research* 9: 345–68, 1977).
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34. Gruell, "Fire on the early Western landscape."
35. Stephen Arno and Kathy Sneck, "A method for determining fire history in coniferous forests of the Mountain West" (USDA Forest Service General Technical Report INT-42, 1977).
36. Arno, "Forest Fire History in the Northern Rockies" (*Journal of Forestry* 78(8): 460-65, 1980); James K. Agee, *Fire ecology of Pacific Northwest forests* (Washington, 1993).
37. George Snedecor, *Statistical Methods* (Ames IA, 1967).
38. Agee, *Fire ecology of Pacific Northwest forests.*
39. Ayres, "Lewis and Clark Forest Reserve," "Flathead Forest Reserve"; Leiberg, "Bitterroot Forest Reserve."
40. Stephen Arno, Helen Smith, and Michael Krebs, "Old growth ponderosa pine and western larch stand structures: Influences of pre-1900 fires and fire exclusion" (USDA Forest Service Research Paper INT-495, 1997).
41. Stephen Barrett, Stephen Arno, and Carl Key, "Fire regimes of western larch-lodgepole pine forests in Glacier National Park, Montana" (*Canadian Journal of Forest Research* 21: 1711–20, 1991).
42. Personal communication with Milo McLeod, Archaeologist, Lolo National Forest, Missoula MT.
43. Ayres, "Lewis and Clark Forest Reserve," 257.
44. Colin Hardy and Stephen Arno, "The use of fire in forest restoration" (USDA Forest Service General Technical Report INT-341, 1996).