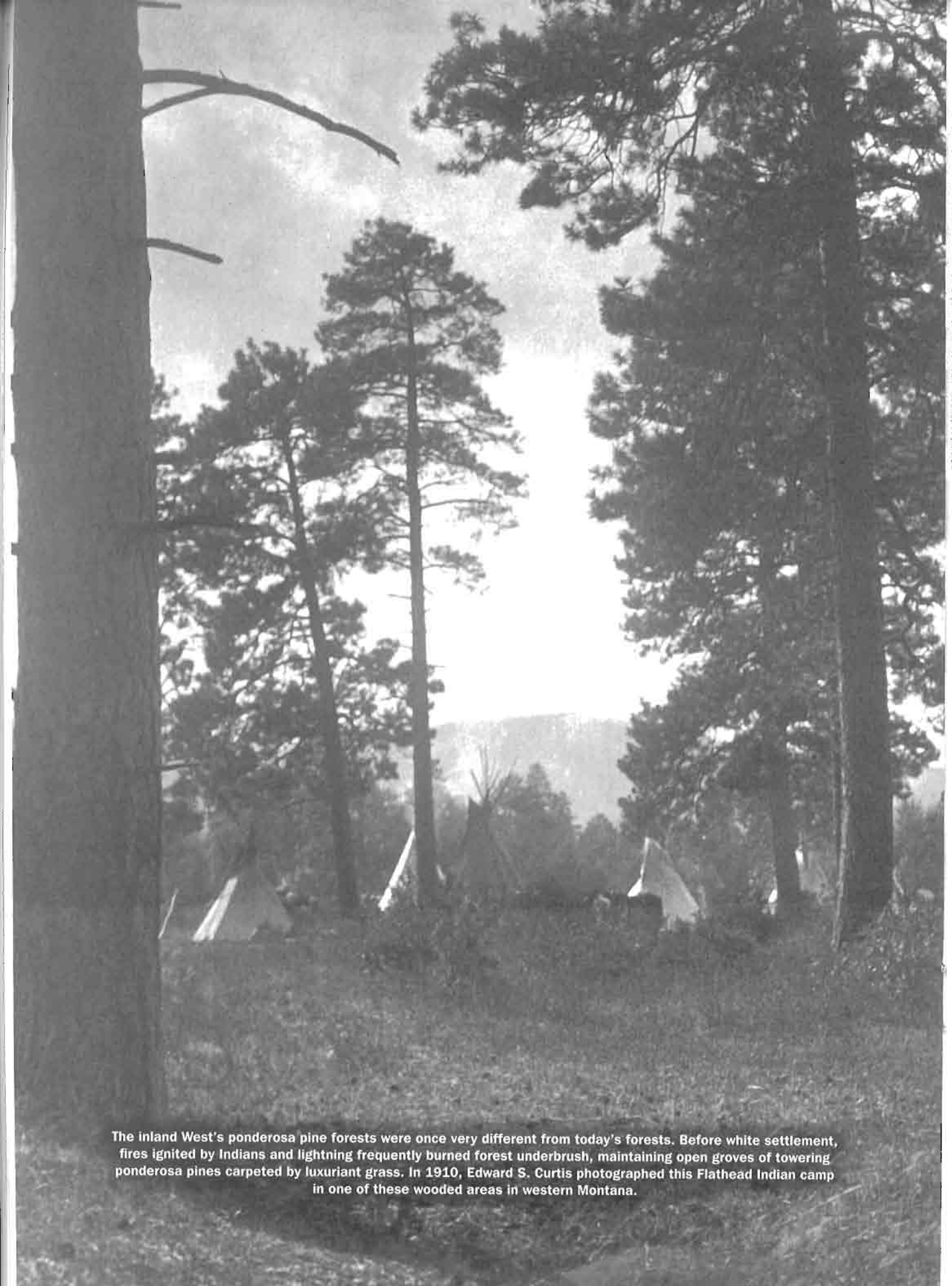
Living Artifacts

The Ancient PONDEROSA PINES of the West

BY STEPHEN F. ARNO, LARS ÖSTLUND, AND ROBERT E. KEANE

Until late in the nineteenth century, magnificent ponderosa pine forests blanketed much of the inland West. They covered perhaps 30 million acres, an area the size of New York state, spreading across the mountains of New Mexico, Arizona, and California and flourishing throughout the eastern Cascades, the intermountain Pacific Northwest, and the Rocky Mountains northward as far as British Columbia.

These ponderosa forests were very different from forests today. They had trees of many ages, but large, old trees dominated. With their spreading canopies of long-needled foliage, these stately pines towered amid luxuriant, grassy parks. As emigrant diarist Rebecca Ketcham observed in eastern Oregon's Blue Mountains in 1853: "Our road has been nearly the whole day through the woods, that is, if beautiful groves of [ponderosa] pine trees can be called woods. . . . The country all through is burnt over, so often there is not the least underbrush, but the grass grows thick and beautiful."[1]



The inland West's ponderosa pine forests were once very different from today's forests. Before white settlement, fires ignited by Indians and lightning frequently burned forest underbrush, maintaining open groves of towering ponderosa pines carpeted by luxuriant grass. In 1910, Edward S. Curtis photographed this Flathead Indian camp in one of these wooded areas in western Montana.

Edward S. Curtis, *The North American Indian*, 20 vols. (Seattle, 1907–1930), 7: pl. 231

Before white settlement, many native peoples lived in ponderosa forests for some part of the year. They used these trees for shelter, building materials, firewood, and food. When the sap ran rich with sugar in the spring, they peeled the bark and ate the thin inner layer. Harvesting the inner bark was done with sharpened poles and, later, with steel axes or chisels. The resulting oval scars on the trees are unlike those made by fires, lightning strikes, or animals. Typically, only a few ponderosas in any grove were peeled, but other trees bear small scars, indicating that their inner bark was sampled but deemed unsuitable for peeling.[2]

In the mid- and late nineteenth century, unregulated logging removed mature ponderosa forests throughout much of the West. Old pines—whose trunks often grew three to five feet thick—were the first choice of timbermen because they yielded fine-quality lumber, so valuable that today it is often salvaged for reuse. Beautiful boards up to twelve inches wide, framing timbers, and even railroad ties were cut from these trees. The establishment of federal forest reserves in the 1890s and early 1900s slowed but did not halt large-scale logging. In 1906, in one of the first large federal timber sales, loggers harvested 37 million board feet of timber, primarily of ponderosa pine, on 2,135 acres in the Bitterroot National Forest. An unusually selective harvest for the time, it nonetheless produced as much lumber as would be needed to build three thousand small houses. By the mid-twentieth century, most of the old-growth ponderosa pine forest had disappeared.[4]

During the twentieth century, another serious threat to ponderosa forests emerged—fire suppression. Historically, low-intensity fires burned most ponderosa forests at average intervals of less than thirty years.[5] In western Montana and elsewhere in the inland Northwest, scientists who study ancient deposits of pollen and charcoal in ponds and lakes have found evidence of fires extending back to the time when forests reestablished themselves after the last ice age, about eleven thousand years ago.[6] These frequent fires shaped the forests as flames less than a few feet high consumed fallen needles and bark and recycled soil nutrients, helped control insects and disease, and killed competing Douglas fir, grand fir, and white fir saplings. Fires could burn for weeks or months, until extinguished by autumn rains or snow, but they killed few of the tall trees. The result

TRADITIONAL BARK PEELING IN WESTERN MONTANA

In 1954, Thain White, an anthropologist at Montana State University (now the University of Montana at Missoula), researched the traditions of bark peeling among the Salish and Kootenai, interviewing William Gingros [Jingres], a Kootenai elder, and others about the use of bark as food and the process of bark peeling. Information and excerpts from these interviews are included here.

Bark peeling took place in the spring when the sap was flowing. After testing the sap of various trees in a grove, the women who harvested the bark selected a tree and pulled a large piece of outer bark from the trunk with a *ya'kpo sa,* a limber, ten-foot-long wooden tool with a tapered, chisel-like end. An experienced peeler then sat with the slab of bark in his or her lap and moved a scraper, often made from a tin can, away from his or her body, removing the sweet inner layer. White's informants told him that "even the smaller trees would yield peeled bark that weighed over one hundred pounds."

According to William Jingres, "When old timers used to do this peeling they did it in the spring, usually on and after the first Sunday in May. They held a celebration in which all the [Kootenais] in the old days used to participate. Now the ceremony is nearly died out. Usually a day before Sunday they held a gathering of the people. They prepared for the Sunday morning when it was necessary for them to pray to the digging sticks which were used for digging bitterroot.

"After the head woman discovered that the bitterroot was ready to dig the others in the group peeled trees for a noonday feast. Of course, if she found out that the bitterroot was not yet ready to dig then the whole affair was postponed. In the old days if any person peeled trees before the bitterroot were ready it was believed it would bring bad luck. The offender was not punished by the people, but the spirits would somehow do that. . . .

"The Indians did not split the *ok'nok* [inner bark], they scraped the water off after the bark was removed. This water and *ok'nok* on the White Pine is very thin with lots [of] sweet water in it, and no gummy sap. It is good. . . . The *ok'nok* that comes from yellow pine [ponderosa] after it is split is tied in knots. That is so it can be eaten easier, and it doesn't [dry] out so quickly. If it is not tied into knots you have a hard time eating it. Not much would be wasted as it sure was good. After it was tied into knots the Indians carried it to camp in their parfleches or bags. They put green leaves or grass with it to keep it from drying out so fast. . . .

"I know where my wife's aunt peeled a tree on the way to Polson in 1925. I remember seeing many trees over on the Little Bitterroot that my mother peeled. I believe that the last ones were peeled about 1914 to 1917. The [Kootenais] peeled lots of trees. They were bad for that [reservation officials banned bark peeling in the 1910s to preserve the trees for commercial use]. The Flatheads knew about eating bark, but I don't believe they did it much. I have seen many scarred trees, some of them very old, and many of them nearly completely healed over."[3]

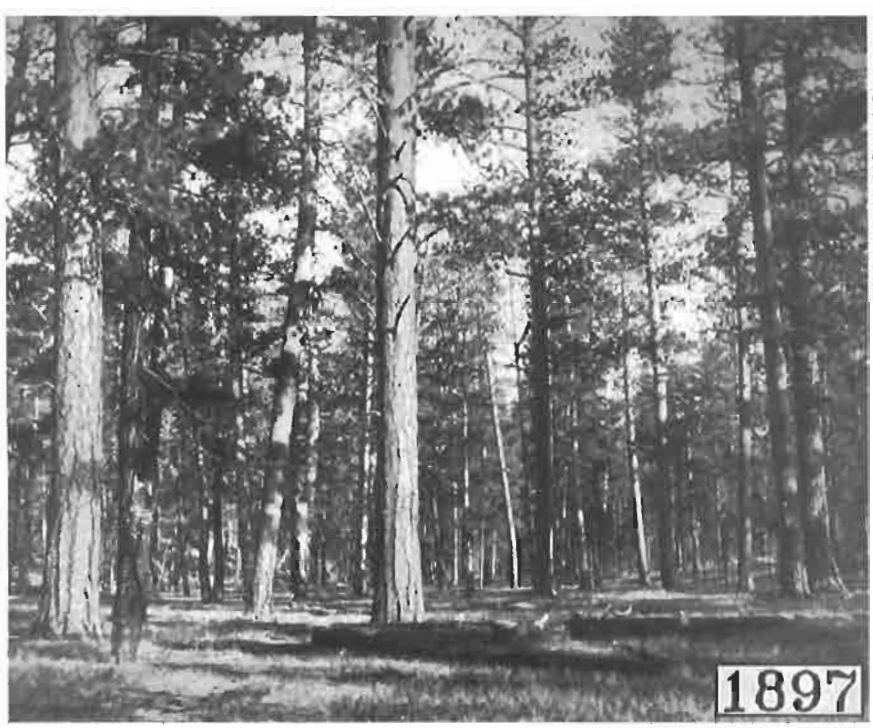
Stephen F. Arno, photographer. Quote from Alexandra Murphy, *Graced by Pines: The Ponderosa Pine in the American West* (Missoula, Mont., 1994), 43

In 1989, eighty-eight-year-old Salish elder Agnes Vanderburg described the process of bark peeling she learned as a child on the Flathead Reservation. "They peel only half the tree, you know, so they don't kill the tree. . . . [T]hey put whatever tool they've got under the bark . . . and pull the bark right off. . . . When they get the bark off, they scrape it [inner bark]. . . . It's real juicy and sweet." Here coauthor Lars Östlund examines a bark-peeling scar on a tree in a well-known peeling area in the drainage of the West Fork of the Bitterroot River.

was a forest dominated by long-lived, fire-resistant ponderosas.[7]

Early western explorers and travelers observed abundant signs of fires ignited by Indians and lightning.[8] By the early 1900s, however, the age-old pattern of frequent burning had been disrupted by the displacement of the native peoples, livestock grazing, and new U.S. Forest Service policy that called for the suppression of all fires in the forest because the agency felt that fire was an unnecessary menace to forests and people. Successful fire suppression gradually fostered dense stands of ponderosa pines and understories of small trees and brush. The stress of overcrowding increased the older trees' susceptibility to insect epidemics and disease.

As forest fuels accumulated, they fed wildfires of unprecedented severity. While large fires that killed nearly all trees (stand-replacement fires) were historically common in some forest types, they were uncommon in most ponderosa pine forests. For instance, in Arizona's and New Mexico's ponderosa forests up until about 1970, forest managers considered a



John Leiberg, photographer, U.S. Geological Survey

It was not until the early 1900s that the U.S. Forest Service instigated its "no fire in the forest" policy. In this 1897 photograph of a virgin ponderosa pine forest, the char of recent fire can be seen on the standing snag on the left and on the downed log in the foreground.

50-acre stand-replacement fire very large. However, increasing tree density and fuel accumulation have led to extensive severe fires, including the 460,000-acre Rodeo-Chediski fire of 2002.[9] Although data are not recorded by forest type, ponderosa pine forests have probably incurred more severe burning in the last thirty years than any other kind of forest.

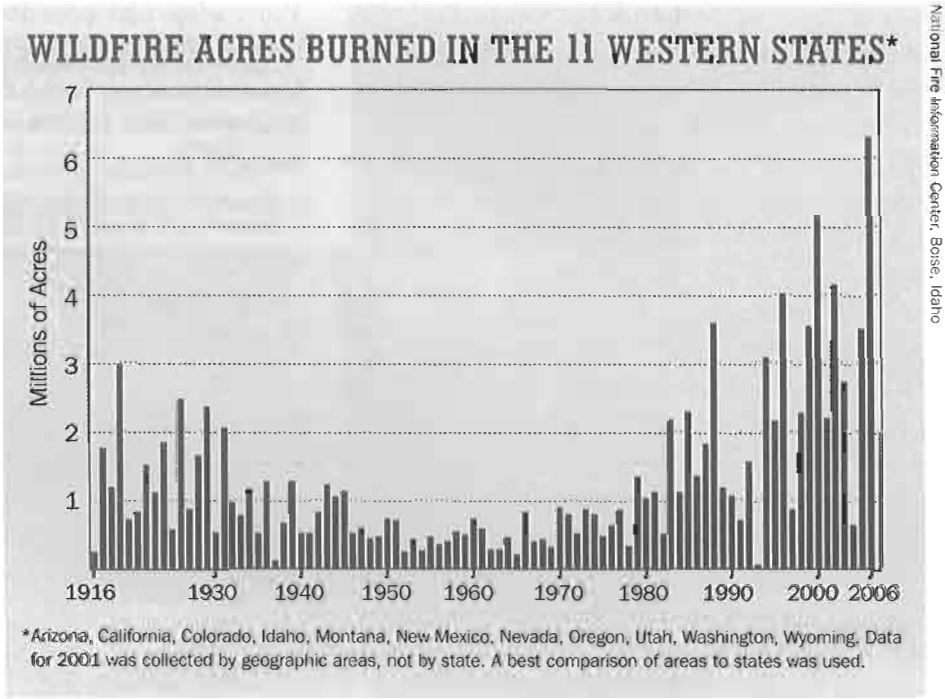
Today, surviving ancient ponderosa pines offer unique information about past environments and the cultural use of trees at specific locations. Variation in width and structure of annual growth rings can be translated by dendrochronologists to provide a continuous index of climatic variation, including precipitation, growing season warmth, and unusually severe summer frost. Most old ponderosa stands have trees with multiple fire scars that identify the years when low-intensity fires swept through. These relict trees allow researchers to better understand historical forest structure. Such information serves as a benchmark for evaluating the effects of fire suppression and logging and helps provide a basis for forest restoration.[10]

One study area of isolated ponderosa pine habitat lies within the boundaries of Montana's Bob Marshall Wilderness, scattered along a ten-mile stretch of the South Fork of the Flathead River near White River Park and Big Prairie. Historically, Indians moving between the main Flathead Valley a hundred miles downstream and the bison-hunting grounds east across the Continental Divide traveled the South Fork Valley, and many living and dead ponderosas in this area bear bark-peeling scars. About 20 percent of the mature ponderosas near old campsites have scars dating from the 1660s to the early

W. J. Lubbin, photographer, U.S. Forest Service, # 86480

W. E. Steuenwald, photographer, U.S. Forest Service, # 532640

The 1909 photograph of the ponderosa forest located in what is now the Lick Creek Experimental Area near Lake Como in the Bitterroot National Forest, above right, shows an open forest structure created by frequent fires as well as evidence of a recent selective cutting. In the photograph below, taken from the same viewpoint just thirty-nine years later, fire exclusion has resulted in a crowded ingrowth of small firs.



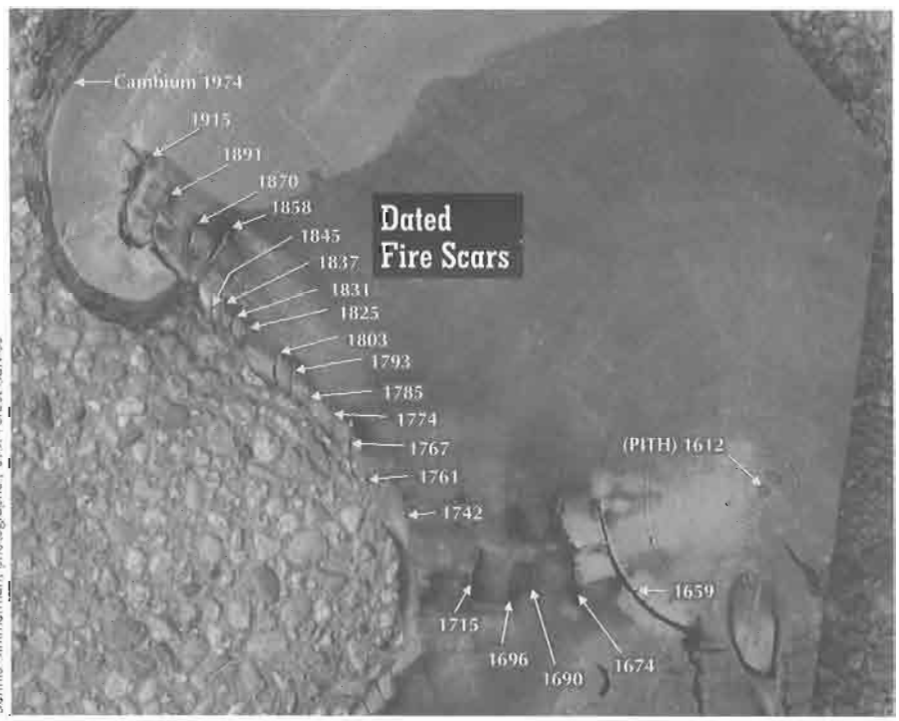
National Fire Information Center, Boise, Idaho

The number of acres annually burned by wildfires has increased dramatically since the late 1970s despite greatly increased spending on fire suppression. During this time period, ponderosa pine forests have probably incurred more severe burning than any other kind of forest because of fuel accumulation and ingrowth of brush and small trees in this warm, dry forest type.

1900s; these trees show that bark peeling increased in the mid-nineteenth century, possibly because of the influx of settlers into lower-elevation valleys.[11]

Like most of the old-growth ponderosas in the West, these pines in the Bob Marshall are endangered. In 2003, large wildfires burned through about half of the South Fork's ponderosa communities and killed a large proportion of the old pines, including nearly half of the trees bearing scars from past fires or bark peeling. Ironically, the 2003 fires were mostly underburns that only scorched the lower branches of big trees; it was the prolonged burning of the deep bark and needle litter around the trunks that killed the ancient pines.[12]

Other remnants of old-growth ponderosa forest can be found in the Bitterroot National Forest along



Dennis Simmerman, photographer, U.S. Forest Service

Forest ecologists can determine tree ages, growth rates, and fire and bark-peeling scar dates from growth-ring sequences extracted using a hollow drill called an increment borer. Fires can also be dated from sawn cross sections. This ponderosa pine cross section shows scars from twenty different fires in the 256 years between 1659 and 1915.

tributaries of the West Fork and East Fork of the Bitterroot River. This area, the homeland of the Salish people, lies along one of the routes used by the Nez Perce and other tribes traveling east to hunt bison. Studies of pre-1900 fire history show a pattern of frequent underburns, mostly at intervals of five to thirty years, going back several centuries. One study found that sites heavily used by Native Americans burned more frequently, further evidence that people ignited many of the fires. Several ponderosa groves in the area also contain bark-peeled trees. These trees (probably numbering more than a thousand) are remnants of what was no doubt a much larger population mostly removed by logging. In 2000, wildfires also killed a number of bark-peeled ponderosas in the East Fork drainage.[13]

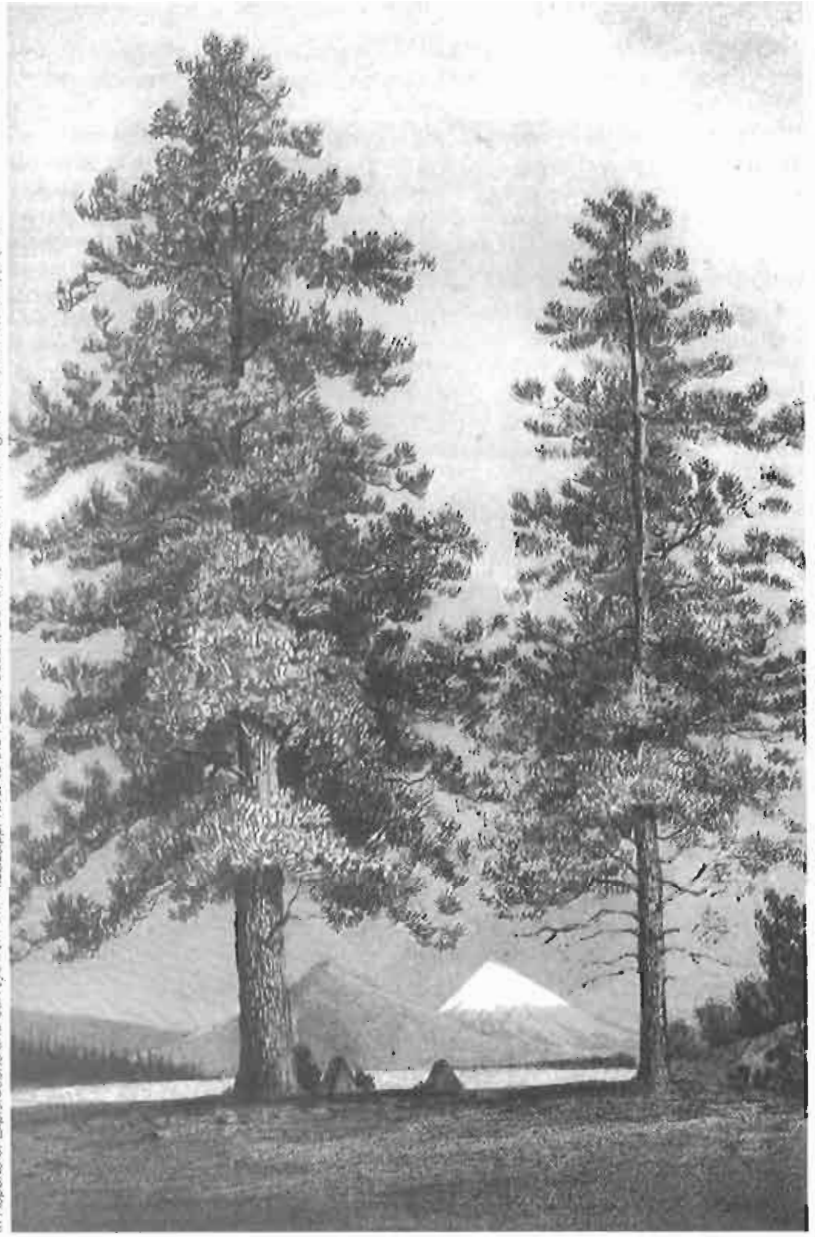
As these examples show, old-growth ponderosa pines and open-grown younger stands that could eventually develop large old pines are fast disappearing. Today, throughout the West, scattered individuals and remote, isolated stands--probably less than 3 percent of the original ponderosa forest—are all that is left. These small remnants are scattered throughout

Robert E. Keane, photographer

One relict ponderosa pine forest in western Montana lies along the South Fork of the Flathead River in the Bob Marshall Wilderness. In 2003, wildfires killed a large portion of the area's old pines, including nearly half of those that bore scars from past fires or bark peeling. Here coauthor Stephen Arno poses with one of the bark-peeled survivors.

WHERE TO SEE MONTANA'S OLD BARK-PEELED PINES

1. East Fork of the Bitterroot River: Indian Trees Campground, Sula Ranger Station, Lost Trail Resort, and along Warm Springs Creek
2. West Fork of the Bitterroot River: Fales Flat Campground and Hughes Creek
3. Lolo Creek: along the Lolo Trail. Captain William Clark observed in 1805 that "particularly on this Creek the Indians have pealed a number of Pine for the under bark which they eate at certain Seasons of the year, I am told in the Spring they make use of this bark."[14]
4. Clark Fork River: Council Groves State Park
5. Blackfoot River Drainage: Primm Meadow Reserve. A magnificent grove of old ponderosas also populates part of the town of Lincoln, though these trees are not bark-peeled.
6. Flathead Lake: Near the shore in the state parks and on Wild Horse Island
7. Kootenai River: widespread, including east of Libby and Fisher River below Wolf Creek
8. Bob Marshall Wilderness: White River Park, Murphy Flat, and Big Prairie
9. Glacier National Park: Big Prairie and Lone Pine Prairie
10. Swan Valley: Condon Work Center



John S. Newberry, "Report on the Botany of the Route," part 3, n. 1, in *Reports of Explorations and Surveys from the Mississippi River to the Pacific Ocean*, 1845–5, 12 vols. (Washington, D.C., 1857), 6: opp. p. 36

Each ancient ponderosa pine is a living artifact. By studying these pines, historians and scientists can better understand past climates and forest use and the conditions that will sustain ponderosa forests into the future. This drawing of prime old ponderosas appeared in John S. Newberry's report on the botany of the area surveyed for the Pacific railroad route in 1855.

more than half of the ninety-two national forests in the eleven western states. To date, few if any inventories have been made to determine the structure, extent, and exact location of stands containing these magnificent old trees.

Several national forests and national parks, including the Coconino National Forest and Grand Canyon National Park in Arizona and the Lolo and Bitterroot National Forests and Glacier National Park in Montana, have used prescribed burning along with careful removal of young trees and some of the accumulated forest-floor litter to restore a few small areas of ponderosa forests. Nevertheless, such efforts are hampered by lack of funds to finance treatments that commonly cost one thousand to three thousand dollars an acre and by difficulties involved in applying prescribed fire, including concerns about effects of smoke on nearby communities and the possibility that a fire might escape and burn private land.[15]

Active management could invigorate the ancient bark-peeled and fire-scarred trees, making them less vulnerable to wildfire and bark beetle epidemics. These restoration practices need to be greatly expanded, and they can be with the support of people interested in western history. Local conservationists can identify locations with old-growth ponderosas, and public land managers often welcome interest in forest restoration. However, so far only a few forest specialists have become involved in saving the ancient ponderosa forests. More voices are needed. Historians, archaeologists, anthropologists, fire scientists, ecologists, and those who want to better understand history have a stake in prolonging the life of these unique living artifacts and in re-creating conditions that will sustain open-grown ponderosa forests in the future.[16]

We can only hope to some day view again a ponderosa forest like the one geologist Clarence Dutton described in northern Arizona in 1882: "The trees are large and noble in aspect and stand widely apart. . . . Instead of dense thickets where we are shut in by impenetrable foliage, we can look far beyond and see the tree trunks vanishing away like an infinite colonnade."[17]

Stephen F. Arno retired as a research forester from the USDA Forest Service Rocky Mountain Research Station at Missoula, Montana. **Lars Östlund** is an associate professor of forest ecology at the Swedish University of Agricultural Sciences, Umeå, Sweden. **Robert E. Keane** is a fire ecologist for the Rocky Mountain Research Station who specializes in ecosystem modeling and restoration ecology.

Lars Östlund, photographer

Ponderosa pine scarred by fire on left and bark peeling on right, in the drainage of the West Fork of the Bitterroot River

Living Artifacts

1. John W. Evans, *"Powerful Rockey": The Blue Mountains and the Oregon Trail* (Enterprise, Oreg., 1990), 238.

2. Daniel E. Moerman, *Native American Ethnobotany* (Portland, Ore., 1998), 410–12. Most bark peelings are found in ponderosa pines, but some are also found in lodgepole pines, whitebark pines, Sitka spruce, and occasionally other species, including aspens. Today, we know that inner bark contains carbohydrates, fiber, and vitamin C as well as substances that may bolster immunity and reduce the risk of cardiovascular diseases and cancers. The eating of pine bark across the northern hemisphere seems related to long winters and limited access to vegetables during most of the year. Indigenous people in northern Scandinavia and northern Russia made remarkably similar bark peelings among the ancient Scots pines. See Lars Östlund, I. Bergman, and O. Zackrisson, "Trees for Food—A 3,000 Year Record of Subarctic Plant Use," *Antiquity,* 78 (June 2004), 278–86; Ingela Bergman, L. Östlund, and O. Zackrisson, "The Use of Plants as Regular Food Sources in Ancient Boreal and Subarctic Economies—A Case Study Based on the Sami Use of Scots Pine Inner Bark in Northern Fennoscandia," *Arctic Anthropology,* 41, no. 1 (2004), 1–13; Lars Östlund, O. Zackrisson, and G. Hörnberg, "Trees on the Border between Nature and Culture—Culturally Modified Trees in Boreal Scandinavia," *Environmental History,* 7 (January 2002), 48–68; Thomas W. Swetnam, "Peeled Ponderosa Pine Trees: A Record of Inner Bark Utilization by Native Americans," *Journal of Ethnobiology,* 4 (December 1994), 177–90; A. H. Stryd, *Culturally Modified Trees of British Columbia: A Handbook for the Identification and Recording of Culturally Modified Trees* (Victoria, B.C., 1997); C. M. Mobley and M. Eldridge, "Culturally Modified Trees in the Pacific Northwest," *Arctic Anthropology,* 29, no. 2 (1994), 91–110.

3. Thain White, *Scarred Trees in Western Montana*, Montana State University Anthropology and Sociology Papers, no. 17 (Missoula, Mont., 1954). Used courtesy of Salish Kootenai Community College, Pablo, Montana.

4. Helen Y. Smith and Stephen F. Arno, eds., *Eighty-eight Years of Change in a Managed Ponderosa Pine Forest,* USDA Forest Service General Technical Report RMRS-GTR-23 (Ogden, Utah, 1999).

5. Stephen F. Arno and Steven Allison-Bunnell, *Flames in Our Forest: Disaster or Renewal?* (Washington, D.C., 2002), 68–70, 114–15.

6. Peter J. Mehringer, *Late Quaternary Precursors: The Last 20,000 Years —An Overview,* USDA Forest Service General Technical Report PNW-GTR-322 (Portland, Oreg., 1994), 1–21; Stephen F. Arno, *The Historical Role of Fire on the Bitterroot National Forest,* USDA Forest Service Research Paper INT-187 (Ogden, Utah, 1976). Growth rings on living ponderosas reveal sequences of frequent low-intensity fires dating back as far as the fifteenth century. In

California's Sierra Nevada, a continuous record of frequent fires has been traced back more than two thousand years by examining scars on stumps of giant sequoias. Sequoias grow immediately upslope from ponderosa pine forests. See Thomas W. Swetnam, "Fire History and Climate Change in Giant Sequoia Groves," *Science,* 262 (1993), 885–89.

7. Stephen F. Arno, Joe H. Scott, and Michael G. Hartwell, *Age-Class Structure of Old Growth Ponderosa Pine/Douglas-Fir Stands and Its Relationship to Fire History,* USDA Forest Service Research Paper INT-481 (Ogden, Utah, 1995). Ponderosa pines resist low-intensity fire better than competing species even when young, due in part to the pine's thicker bark, open canopy, deep roots, and large buds protected by long needles. Needle litter cast by ponderosas—a ton or more per acre every year—encourages frequent fires.

8. Tribes used fires for signaling, driving game animals, attracting game to new grass, clearing camp areas and travel routes, attacking enemies, and stimulating the growth of useful plants. These burning practices contributed to development of open forests dominated by ponderosa pine. George E. Gruell, "Fire on the Early Western Landscape: An Annotated Record of Wildland Fires 1776–1900," *Northwest Science,* 59 (May, 1985), 97–107; Henry T. Lewis, *Why Indians Burned: Specific versus General Reasons,* USDA Forest Service General Technical Report INT-182 (Ogden, Utah, 1985), 75–80.

9. Stephen F. Arno and Carl E. Fiedler, *Mimicking Nature's Fire: Restoring Fire-Prone Forests in the West* (Washington, D.C., 2005), 81–87, 209–10.

10. Arno and Allison-Bunnell, *Flames in Our Forest: Disaster or Renewal?,* 103–17.

11. Stephen F. Arno, D. J. Parsons, and R. E. Keane, *Mixed-Severity Fire Regimes in the Northern Rocky Mountains: Consequences of Fire Exclusion and Options for the Future,* USDA Forest Service Proceedings RMRS-P-15-Volume 5 (Ogden, Utah, 2000), 225–32; Lars Östlund, Bob Keane, Steve Arno, and Rikard Andersson, "Culturally Scarred Trees in the Bob Marshall Wilderness, Montana, USA—Interpreting Native American Historical Forest Use in a Wilderness Area," *Natural Areas Journal,* 25 (October 2005), 315–25; Darris Flanagan, *Indian Trails of the Northern Rockies* (Stevensville, Mont., 2001). Bark peeling in ponderosas likely occurred for hundreds or thousands of years, but the limited life spans of trees make confirmation difficult. Stephen F. Arno, Helen Y. Smith, and Michael A. 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 (Ogden, Utah, 1997), 14–19.

12. Robert E. Keane, Stephen Arno, and Laura J. Dickinson, "The Complexity of Managing Fire-dependent Ecosystems in Wilderness: Relict Ponderosa Pine in the Bob Marshall Wilderness," *Ecological Restoration,* 24 (June 2006), 71–78.

13. Bitter Root Valley Historical Society, *Bitterroot Trails, Volume I* (Hamilton, Mont., 1982), 192–95; Arno, *The Historical Role of Fire*; Stephen W. Barrett and Stephen F. Arno, "Indian Fires as an Ecological Influence in the Northern Rockies," *Journal of Forestry,* 80 (October 1982), 647–51.

14. Gary E. Moulton, ed., *The Journals of the Lewis and Clark Expedition,* vol. 5 (Lincoln, Neb., 1988), 201.

15. Arno and Fiedler, *Mimicking Nature's Fire,* 65–73, 81–87, 143–48, 203–10.

16. Ibid., 147–48.

17. Clarence E. Dutton, "Physical Geology of the Grand Cañon District," in *Second Annual Report, U.S. Department of the Interior, Geological Survey* (Washington, D.C., 1882), 136 .