Fire and Its Relationship to Ponderosa Pine

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IT APPEARS appropriate, in discussing this subject, to indicate that my relationship with ponderosa pine has been life-long. I was born in the mining town of Sumpter, in the Blue Mountains of eastern Oregon. My father was an active partner in ownership of a group of placer claims, and it was his responsibility to initiate mining, at earliest possible date in the spring, after winter snow could be cleared from about five miles of water ditch and wooden flumes along steep mountain sides. Once water flowed the men worked day and night in hydraulic mining of a gold-bearing gravel deposit of an ancient river channel, high on a mountain slope. Usually, about July 4th, the water supply became inadequate for further mining.

Some of my earliest recollections are of life at this small mining camp, near the Blue Mountain summit. Spring came late at this higher elevation and it naturally was very welcome. I can still remember the new, bright green needles of the deciduous western larch as they contrasted to the predominant darker green of Douglas-fir and the somewhat yellowish-green of pine. Western larch has been one of my favorite trees.

With cessation of the furious storm of mining, the living pace became leisurely. My parents loved the mountains and forest and I can remember picnics and camping trips, gathering mushrooms in a recent burn near the head of the mine ditch and, later in summer,

* Photographs by the author.

picking huckleberries for canning and drying. Sometimes groups of young people, with whom my parents were quite popular, would hike out from town to participate in these activities.

From about age 12, I was permitted considerable latitude in exploring and roaming with my dog and .22 rifle, with other boys if they could be persuaded to go, but frequently by myself, and occasionally with my father. The foothills around Sumpter and lower elevations of the valley had been heavily cutover for yellow (ponderosa) pine, and large scale logging by that time had migrated to Whitney and Bates, along the narrow gage Sumpter Valley Railroad. Most of this cutover was restocking to pine. Within the lower boundaries of the Whitman National Forest there still remained some areas of mature pine with open, park-like, pinegrass covered forest floors.

Later there came expeditions to the higher mountains. Most inspiring were views of the blue, seemingly endless forest covered ridges and isolated groups of higher, snow-flecked mountains.

This background provided primary motivation for selection of forestry as a career, following graduation from high school and interludes in the more civilized environments of Indiana and Southern California. Undergraduate summertime experience included timber reconnaissance on national forests in eastern Oregon and California, including west-slope Sierra and the Modoc areas. I graduated from Oregon State in 1928, thoroughly imbued, at that time, with the incompatibility of pine forestry and fire.

As a forester on the Klamath Indian Reservation in southern Oregon, I met a number of older, non-technical woodsmen, who considered the policy of attempted total fire exclusion a serious mistake. None of them, however, could explain to my satisfaction how the forest could be regenerated under a regime of frequent light burning. I do recall that a logging superintendent told me that earlier fires were usually of lighter intensity, that they crept slowly about through the needles and dry grass, and that they spared many of the young trees.

Later work on pinebeetle control projects brought me into contact with Mr. F. Paul Keen, an entomologist and forester of national renown. I was shocked to hear this scientist make similar, seemingly

heretical statements concerning the role of fire in ponderosa pine. To my stock query concerning how the forest could be regenerated he invited me to examine with him a nearby stand of pole-size reproduction. Though these trees had originated about the beginning of the century, a number, widely scattered, showed fire scars near the ground surface. Sectioning of these with a sharp axe revealed that there had been several fires, the first occurring when the trees were quite small.

My work has since taken me throughout most of the western states, into many portions of the Ponderosa Pine Region. Whenever there has been opportunity, I have examined trees cut in logging for evidence of past fires. I have also used sharp axes, saws, increment borers and hand lenses in sectioning and studying fire scars. Everywhere I have found unmistakable evidence of frequent periodic fires in earlier days, even in most of the younger stands that originated about the turn of the century. My conclusion is that fires in ponderosa pine have occurred for countless centuries, that they are a part of the natural environment, and that they have been of primary ecological influence in molding the forest as the first white man found it.

In a series of published articles, mostly in the *Journal of Forestry*, I have discussed these observations and other historical evidence concerning the role of fire, the adverse ecological changes that have developed since attempted total fire exclusion, and the results of various prescribed burning tests. (Weaver, 1943, 1951, 1964, 1967b, *et al.*). There appears no need for reviewing most of this material at this time. It does appear appropriate, however, that results of burning be discussed and described in terms of the habitat type or association concepts of Dr. R. Daubenmire (1952), Ecologist, of Washington State University. These concepts are most helpful in explaining the results of burning, in delineating the relationship of fire to ponderosa pine and in explaining vegetation changes and trends in continuance of periodic burning, or in continued exclusion of fire.

Very briefly, Dr. Daubenmire's work indicates that climatic, edaphic and topographic factors determine the species of vegetation to be found on any particular site. Some of the species may be

FIG. 1. July 1944 appearance of one of most severely scorched pine pole patches on the south slope of Omak Lake ridge, on the Colville Indian Reservation, in the ponderosa pine-wheat-grass habitat type, where logging slash was broadcast burned the night of October 5-6, 1943.

present because of site disturbance, usually by fire, and these may be most useful to man. Almost always, however, there are present certain plants characteristic of the climatic, edaphic and topographic climax. If site disturbance does not recur, the seral or fire climax species will ultimately disappear to be replaced by climax species. By a study of the plants present on any particular site, there can be determined the approximate stage of development of sub-climax species, the climax species that may ultimately prevail, and the timber growing potentialities of the particular site. Though Dr. Daubenmire has emphasized that his studies apply solely to northeastern Washington, northern Idaho, and western Montana, it appears that his concepts should also have considerable validity in other forest areas.

It should be emphasized that these discussed prescribed burning results are based on observation and on carefully composed photographs over the years. They are not based on any sophisticated study

FIG. 2. May 2, 1967 photo from same camera point and of identical view of Figure 1. Most trees have recovered and made excellent growth. Note heavy beardless wheatgrass stand in foreground.

plans. My work has been such that I have had neither opportunity nor time to engage in painstaking statistical analysis. The discussion follows:

PRESCRIBED BURNING RESULTS

In Ponderosa Pine—Bitterbrush

In this association (*Pinus ponderosa—Purshia tridentata*) ponderosa pine is the major climax tree, while deciduous bitterbrush is the principal ground cover. Bluebunch wheatgrass (*Agropyron spicatum*), Idaho fescue (*Festuca idahoensis*) and Sandberg's bluegrass (*Poa secunda*) may also be represented in the ground cover.

In November 1939, about 100 acres of this type were treated with prescribed burning for hazard reduction in the immediate vicinity of Klamath Agency, on the Klamath Indian Reservation in Oregon. The area had been largely clearcut for a Government or Indian sawmill in the 1880's and 1890's. At time of burning the area sup-

FIG. 3. June 1955 photo of northeast slope near top of Omak Lake Ridge, in the Douglas-fir—pinegrass habitat type, where logging slash was broadcast burned in October, 1944, 11 years earlier. Logging and burning encouraged establishment of the ponderosa pine seedlings.

ported a fairly dense stand of 40-50 year old trees. Dense bitterbrush still crowded small openings and persisted under the less crowded groups of trees (Weaver, 1961).

The year following the initial burn the stand was lightly thinned and all of the reserved trees were pruned to a height of 18 feet. Thereafter the area was burned annually in the spring.

In 1960, when the area was last burned, and when I last saw it, bitterbrush persisted only as a few scattered, stunted shrubs in the larger openings. Where protected from heavy grazing there had developed a dense stand of grass, comprised principally of Idaho fescue, a needle-and-thread grass (*Stipa sp.*) and Kentucky blue grass (*Poa pratensis*). Several hundred cattle of the Klamath tribal herd were held and fed each winter on a portion of the area. Here the ground was mostly bare, or with a sparse cover of bluegrass and strawberry (*Fragaria sp.*). Hazard was very low over both the grassy and grazed areas.

FIG. 4. May 2, 1967 photo of same scene, from almost same camera point of Figure 3 taken 12 years earlier. Reproduction has reached such size that over-stocking is developing. Prescribed burning should be applied, followed by precommercial thinning. After it is cured the thinning slash should be broadcast burned.

With cessation of burning, and of heavy grazing, bitterbrush probably will again eventually predominate in the openings, and the grass under the pines will be smothered by heavy needle accumulations. In 1938 a wildfire burned about 20,000 acres of this type on the Warm Springs Reservation, further north in Oregon. When I again saw the area in 1954, it still had a generally grassy aspect (Weaver, 1959). By 1965, however, bitterbrush seedlings were appearing over considerable expanses.

This type has also been burned on limited areas on the Colville and Spokane Reservations in northeastern Washington. (Figs. 5-9).

In Ponderosa Pine—Wheatgrass

In this association (*Pinus ponderosa—Agropyron spicatum*) ponderosa pine is the climax tree, while ground cover consists princi-

FIG. 5. Summer of 1945 photo of portion of Omak Lake Ridge, in the ponderosa pine–bitterbrush type, where logging slash was tractor piled, then burned in late September, 1944. Snags, windfalls and other debris were also ignited and fire covered practically 100 percent of the ground surface. Standing larch snags were later made into wood by Indians. Note particularly that reserved pine at right is almost directly in line with another standing behind it.

pally of bluebunch or beardless wheatgrass and Idaho fescue. Heavy grazing may cause the highly flammable cheatgrass (*Bromus tectorum*) to replace the more desirable perennial grasses.

In October 1942, a test of prescribed burning for thinning and hazard reduction was conducted on about 20 acres of this type on the Colville Indian Reservation. The area included about 9 acres of open sawtimber and 11 acres of dense, 20-year old ponderosa pine reproduction which was laced with over 200 windfalls and snags of beetle-killed mature trees. The last wildfire had burned in 1920.

During the year following the first prescribed burn it was determined that the fire had caused inadequate stocking on about 40 percent of the 11-acre reproduction area. This resulted largely from hot fires in the windfalls. These severely burned spots promptly

FIG. 6. July 1966 photo of same camera point of Figure 5 taken 21 years earlier. Near reserved tree at right has recently been windthrown and its upturned, earth-covered roots are visible. Precommercial thinning was applied in 1963 to patch of advanced reproduction appearing near center of Figure 5, and thinning slash was broadcast burned in October, 1965. Unfortunately the creeping surface fire stopped near upturned roots of windthrown tree. Foreground area should also be burned.

restocked to pine reproduction that represented a 16-year old age class when the study area was burned for the second time in September 1958. A third fire was applied in October 1964.

In 1965, after three successive prescribed burns, crop trees within the burn continued faster diameter growth, by 43%, than did crop trees on unburned control plots adjacent to the test area. Eleven acres were again adequately stocked and heavy fuel had been reduced by 86% in weight, from 21.5 tons to 3.0 tons per acre. The lower live crown level of the reproduction has been raised and ground under the trees appears open and grassy. It is obvious that fire hazard has been reduced considerably (Morris, 1958; Weaver, 1957a).

Burning on this small area has attracted usually heavy concentra-

tions of cattle, horses and deer. In spite of this, desirable grass species are still prevalent.

During World War II years, logging slash was disposed of by broadcast burning over many thousands of acres of selectively logged lands on the Colville Reservation (Weaver, 1957). In this burning all snags, windfalls and other flammable debris were also fired. The fires usually covered from 75 to 90% of the ground surface. In October 1943, this burning included another 700 acres of ponderosa pine—wheatgrass association. (Figs. 1, 2). Grass on this area is in excellent condition.

In Ponderosa Pine—Ninebark

In October 1944, the slash burning included about 1,500 acres in this habitat type or association (*Pinus ponderosa—Physocarpus malvaceus*), also on the Colville Reservation. In this association ponderosa pine is the climax tree, while the ground is dominated by head-high shrubs, including ninebark, oceanspray (*Holidiscus discolor*), chokecherry (*Prunus emarginatus*), willow (*Salix sp.*), mockorange (*Philadelphus lewisii*) and serviceberry (*Amalanchier alnifolia*). Grazing had been light and considerable grass also covered the ground. Included were bluebunch wheatgrass and pinegrass (*Calamagrostis rubescens*).

The burning killed back the shrubs, and though they sprouted vigorously the following year, the grasses appeared to improve greatly in vigor and abundance.

In 1955, when I again visited the area, shrubs had fully regained their former size and luxuriance, though grasses were still present. Most interesting to foresters were beautiful sapling stands of ponderosa pine that had developed subsequent to the fire. This appears an excellent ponderosa pine site (Weaver, 1957).

In Ponderosa Pine—Snowberry

In subsequent years the slash burning also included portions of this association (*Pinus ponderosa—Symphoricarpos rivularis*). Ponderosa pine is the climax tree, while ground cover is dominated by snow-

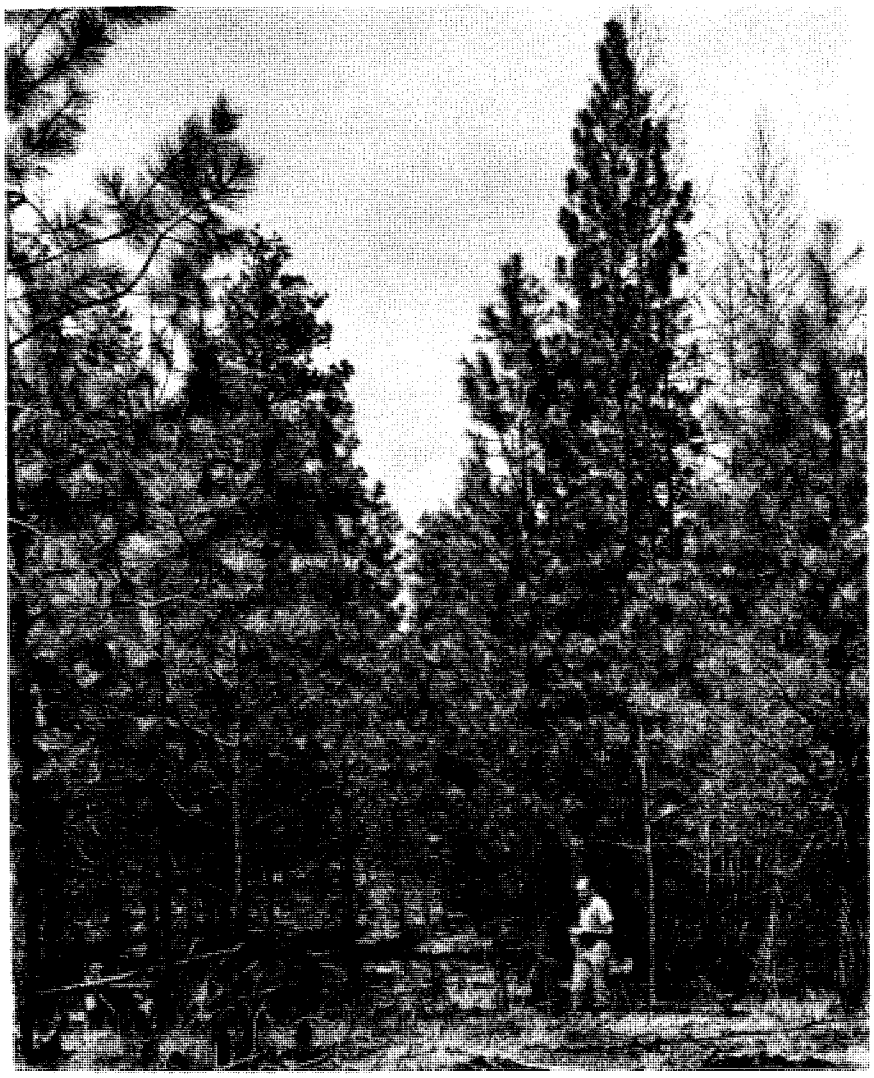

FIG. 7. Near view, taken May 2, 1967, of reproduction group, pictured in Figures 5 and 6, where thinning was conducted in 1963 and thinning slash was broadcast burned in October, 1965. Note rapid growth evidenced by dominant pine and western larch trees.

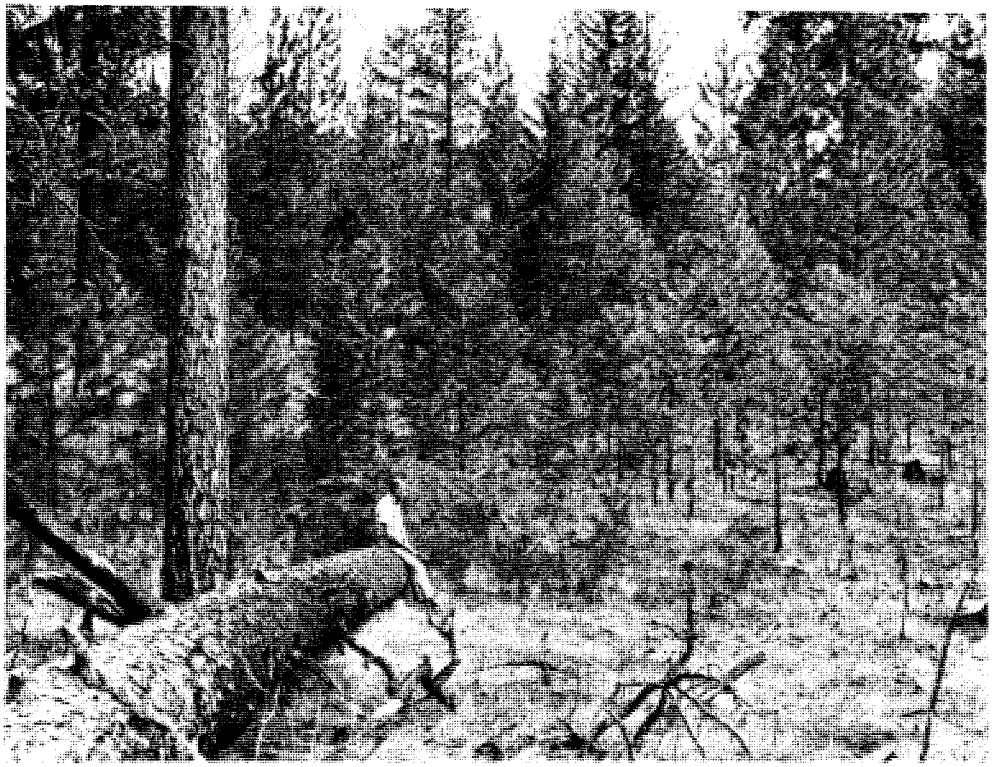

FIG. 8. May 2, 1967 photo to north along recent windfall mentioned under Figure 6. Creeping surface fire from thinning slash burning in October 1965 burned over thinned area at right and along top of windfall in foreground, but stopped about upturned roots beyond seated figure. Unthinned and unburned reproduction at left may be compared with thinned and slashburned area at right.

berry, rose (*Rosa spauldingii* and *R. ultra-montana*), spiraea (*Spiraea betulafolia*), and chokecherry (*Prunus sp.*).

Most of the burning in this type on the Colville Reservation has been conducted by Indian and non-Indian stockmen on private and trust patent land adjacent to the Franklin D. Roosevelt Lake. Many thousands of acres have been burned during late fall and early spring, at frequent periodic intervals. In spite of this frequent burning, most of the lands support beautiful reproduction stands of ponderosa pine, mostly of large pole size (Fig. 13).

The burning temporarily kills back the shrubs and encourages the grass. Though the shrubs sprout vigorously under the pines, it appears to take two or three years for them to become of sufficient luxuriance to impel the stockmen to again burn. This burning is for purpose of "reducing the rough."

Burning such as this has also been conducted by Indian stockmen

FIG. 9. May 2, 1967 photo of another nearby patch of unthinned and unburned reproduction. In October, 1944, this was a bare ash bed, following burning of large logging slash pile. Reproduction of ponderosa pine and Douglas-fir, developing over the years, is now over-stocked. It should be treated by prescribed burning now, while the trees are still small enough to be susceptible to thinning by fire, as illustrated in Figures 10 and 11, following. Vegetation of areas depicted in Figures 5–9 inclusive appears characteristic of an ecotone, or area of transition between the pine–bitterbrush and Douglas-fir–pinegrass habitat types.

on the nearby Spokane Reservation, mostly in the pine-wheatgrass and pine-bitterbrush associations. These areas, also, are mostly characterized by excellent pine reproduction, though it appears inadequate on some of the south slopes above the Spokane River. These stands and the Colville stands described above have probably been burned by Indians at frequent periodic intervals for hundreds of years (Weaver, 1964).

In Douglas-fir—Pinegrass

Most of the slash burning on the Colville Reservation was in this association (*Pseudotsuga menziesii—Calamagrostis rubescens*) (Weaver, 1957). Douglas-fir is the climax tree, but mature pon-

derosa pine, a fire climax or seral tree, presently is predominant in this habitat type. Western larch (*Larix occidentalis*) is an associated seral tree. At higher elevations, where severe fires burned during the 1920's it should be noted that this tree, together with lodgepole pine (*Pinus contorta*), has restocked in even-aged stands over many thousands of acres. Returning again to the habitat association under discussion, pinegrass is the predominant ground cover.

In long continued absence of fire or other site disturbance, Douglas-fir will inevitably take over. Where fire has been excluded for many years it is almost exclusively predominant in reproduction and on areas treated, this reproduction was abundant before the burning.

Besides reducing hazard the slash fires have encouraged excellent ponderosa pine reproduction (Figs. 3, 4 & 12). These stands are now from 20 to 24 years old and, though hazard is still low, prescribed burning should again be applied. Reproduction covering about one section (640 acres) was thinned during 1963 and 1964, under the Accelerated Public Works program. Thinning slash was broadcast burned during October 1965, without excessive damage to the reserved trees (Figs. 7, 10, 11 & 12). It should be noted that an additional 2,000 acres of older and larger pole stands in this habitat type were thinned during 1963 and 1964, and that the slash was broadcast burned while it was still green.

It is interesting to note that during the summer immediately following these burns, pinegrass seedheads appeared by the millions.

I surmise that the Douglas-fir—pinegrass habitat type is probably very extensive in the previously mentioned Blue Mountains of eastern Oregon.

In Ponderosa Pine—Muhley

Most extensive prescribed burning in ponderosa pine has been on the Fort Apache Indian Reservation in east-central Arizona, mostly in what may possibly be termed the pine-muhley association (*Pinus ponderosa—Muhlenburgia montana* and *M. virescens*). During the years 1948-1966 inclusive, about 205,000 acres had been covered by burning, which included approximately 85,000 acres that had been

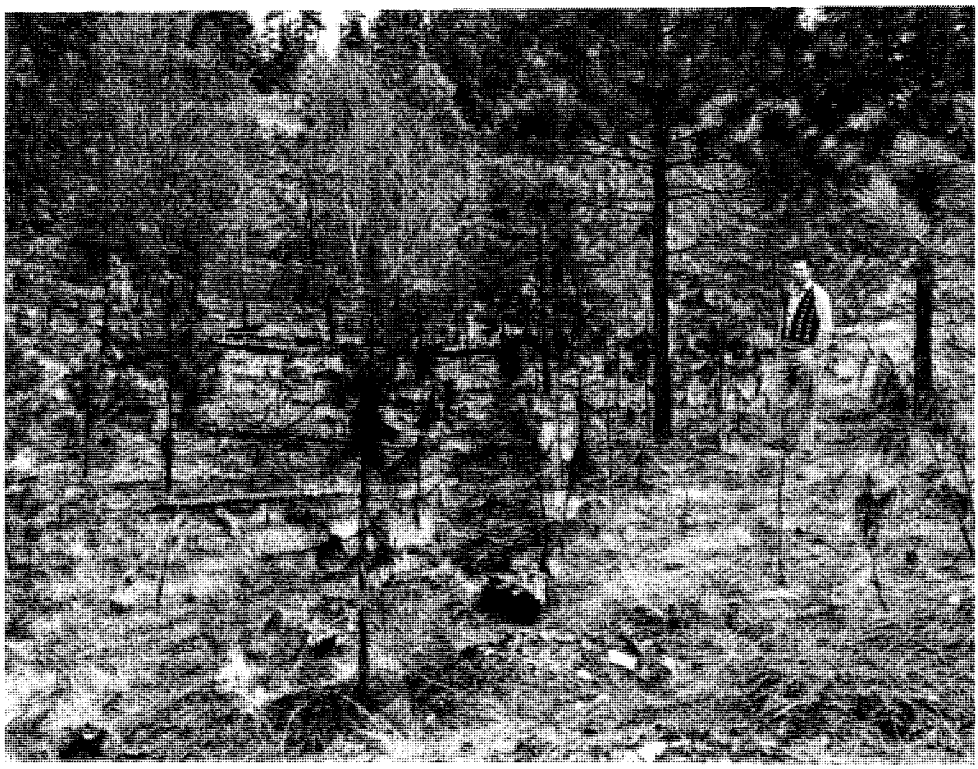

FIG. 10. May 2, 1967 photo of area an Omak Lake Ridge where creeping surface fire from thinning slash burning of October, 1965 did an excellent job of thinning ponderosa pine reproduction. Note, through center of photo, where the fire almost completely consumed a windfall. This is an area of transition between the pine–wheatgrass and Douglas-fir–pinegrass habitat types.

treated twice and about 15,000 acres that had been burned three or more times.

The burning has also been conducted on lower fringe areas, where alligator juniper (*Juniperus pachyphloea*) appears to be the climax tree and where it has invaded under the pines. The burning has checked this trend.

This Fort Apache burning has been generally beneficial (Wilm, 1966). It has resulted in signifiicant reduction in fire hazard and in moderate thinning (Knorr, 1963; Kallander, 1966).

Effectiveness of the treatment in reducing damage from wildfires was dramatically demonstrated by the Penrod Mountain fire of June 1964. This fire, which covered about 2,000 acres before being controlled, started near a logging railroad on one of the worst fire days of the year, and was driven northward by a 30 to 40 mile per hour wind, spreading along both sides of an auto road. On the left of the

FIG. 11. May 3, 1967 photo of area atop Omak Lake Ridge that was completely covered by creeping surface fire from October 1965 thinning slash burning. This is an excellent visual example of the manner in which prescribed fire thins reproduction patches in the openings, while at same time it eliminates unwanted reproduction under the larger trees. Three different age groups are visible, including the sapling groups that followed 1944 logging slash burning. This also is an area of transition between the ponderosa pine-wheatgrass and the Douglas-fir–pinegrass habitat types.

road the 40-year old pole stand had been treated by prescribed burning in 1956 and again in 1962. Except for a few minor hot spots, the fire stayed on the ground through this area and at least 90% of the dominant and co-dominant trees survived. East of the road there had been no previous prescribed burning treatment. There the fire crowned almost continuously and caused almost complete destruction.

In 1950 the Rocky Mountain Forest and Range Experiment Station cooperated in establishing twelve 2½ acre prescribed burning plots at Blue Mountain, east of the sawmill town of McNary, for the purpose of testing thinning and hazard reduction possibilities. Six of these plots, selected at random, were burned; three under damp conditions when it was difficult to make the fire burn, and three under much drier and hotter conditions. In 1958 it was re-

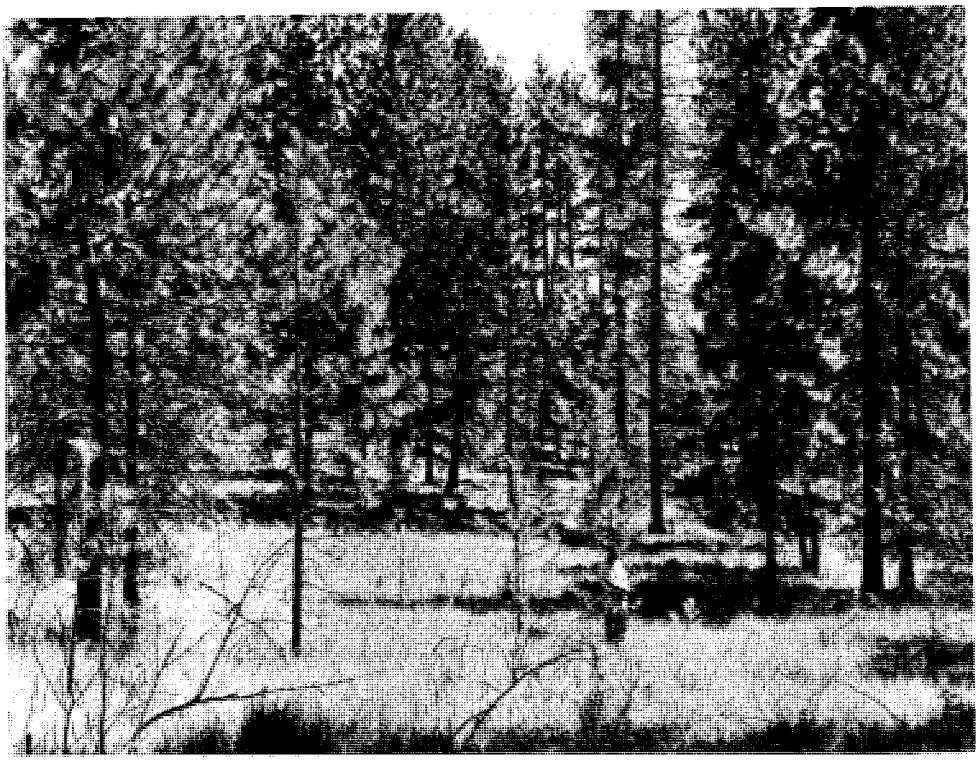

FIG. 12. July 1966 photo of area atop Omak Lake Ridge, in Douglas-fir—pinegrass type, where logging slash was broadcast burned in October, 1944, and where creeping fire completely covered ground surface in October, 1965. Note that most recent fire has killed smaller reproduction under larger trees, but has spared dominant saplings in openings. It has also killed back various hardwood shrubs. Fire scar evidence indicates that wildfires burned at intervals of once each 7 to 8 years over Omak Lake Ridge. The last extensive wildfire burned in 1920.

ported that this test had failed to produce acceptable results, for on the "cool" plots, insufficient numbers of trees had been deadened, while on the so-called "hot" plots, thinning had been too severe. Here the fire caused a number of small openings in the reproduction stand (Gaines, 1958).

In my opinion these conclusions are premature. Over the years obvious accelerated growth has occurred on trees bordering the openings. It is also of interest to note that the openings are restocking to reproduction. In contrast, growth on the unburned plots and on the "cool" burn plots appears considerably retarded. The project needs further study.

Also, in the White Mountains of eastern Arizona is the remote Malay Gap area on the adjacent San Carlos Indian Reservation.

FIG. 13. May 4, 1967 photo of frequently burned 70-year old ponderosa pine stand in the ponderosa pine–snowberry habitat type, about one mile south of Nez Perce Creek, in the eastern portion of the Colville Indian Reservation. The last fire burned in October, 1964.

Here is a beautiful stand of ponderosa pine, with a heavy grass forest floor. Openings are occupied by vigorous even-aged groups of ponderosa pine reproduction, of a variety of age classes. It was found that fires had occurred at frequent periodic intervals in this stand. One fire-scarred stump section, analyzed with assistance of the Tree-Ring Research Laboratory of the University of Arizona, indicated an average frequency of one fire each 6.9 years. The last extensive wild-fires burned in 1943 and 1946 (Weaver, 1951).

This beautiful forest is one of the few, if not the last, relict examples of the primeval ponderosa pine forests as they were before the white man arrived with all of his disturbing influences (Cooper, 1960). This area should be preserved in its primeval condition. I am pleased with recent information that several thousand acres of this area have been treated with a prescribed burn.

SUMMARY

My summarization is based principally on results on the Colville and Fort Apache Indian Reservations, since it is on these areas where I have had most of my prescribed burning experience. Extensive observations and experience elsewhere, however, have convinced me that it has considerable validity throughout the Ponderosa Pine Region. The summary follows:

1. Periodic prescribed burns reduce fire hazard and maintain it at a low level.
2. Periodic burns improve forage and range, by reducing heavy needle and debris mats that inhibit grass and other desirable plants, by releasing nitrogen that encourages growth of these plants, and by encouraging growth of nitrogen fixing plants. Large, woody shrubs are deadened back to the ground line. Subsequent sprouts are more tender and more available for browse (Fig. 12).
3. Over most of the habitat types, particularly on the Douglas-fir—pinegrass type, the burning assures continued dominance of ponderosa pine (Fig. 3, 4 & 12).
4. Periodic fires greatly improve the forest aesthetically. Anyone who has seen the beautiful stands herein described can appreciate this. What beauty is there in monotonous, dense, stagnating, debris littered jungles?
5. Periodic burning causes development of uneven-aged stands, comprised of even-aged groups of trees of various age classes. The fires do prevent establishment of reproduction under the larger, more valuable trees, where it definitely proves deleterious if it is permitted to continue growing. Paradoxically as it may appear, the fires also cause clearings wherein seedlings become established and by means of which the ponderosa pine forest perpetuates itself. This occurs where single mature trees or groups of trees have been deadened by insect attacks, disease, windthrow, or by lightning strikes. The recurrent fires gradually reduce the snag and windfelled remains of these deadened trees to ash beds, in the process causing a clearing in the surrounding grass and shrub cover. Tree seedlings germinate in these favorable spots, and by the time that grass and a mat of fallen needles can become reestablished, many of them are of sufficient size to survive light surface fires. Ponderosa pine seedlings are more fire resistant and are more apt to survive than are most of the as-

sociated species. Thus there develop new even-aged groups of pines (Figs. 10, 11) (Cooper, 1960) (Weaver, 1951, 1967a & b).

6. Coincidental with development of the new, even-aged groups of reproduction, the fires act as an effective thinning agent while the trees are still in the seedling or small sapling size classes (Figs. 10, 11). Once the trees develop to larger sizes, effective precommercial thinning by fire becomes more difficult (Figs. 7–9).

Consideration of the above briefly summarized silvical requirements of ponderosa pine leads to a practical suggestion for uneven-aged management.

The saw can be substituted for nature's harvesting agents in the felling of groups of mature trees, taking care to keep the tops away from reserved trees. Once the logs are skidded and loaded, piling tractors can be used, where necessary, to shove tops and limbs towards the center of the opening. If the forest has previously been treated by periodic prescribed burns, the logging slash can be burned under comparatively dry conditions, and damage will not be caused to reserved trees. New reproduction groups will then develop in the openings. In stands similar to those on the Colville, burning should be applied once each 7 to 10 years (Weaver, 1957).

Prescribed burning can also be used in even-aged management. Under this system, however, it usually is necessary to resort to expensive planting. It does offer opportunities to control disease, such as dwarf mistletoe, and to introduce genetically superior trees. Under both even-aged and uneven-aged management populations of domestic and game animals must be rigidly controlled. In my opinion, uneven-aged management is preferable over most of the region.

Can mechanical or chemical methods be substituted for prescribed burning? Mechanical methods, for instance use of chain saws for precommericial thinning, and of bulldozers for slash piling, or for uprooting or mashing of competing brush, can be very effective, but also expensive. Chemical methods show improving possibilities, for instance in fertilization, in control of competing vegetation, and possibly, in thinning of dense pole stands.

In answer to the above question, however, it is my opinion that these methods can only supplement prescribed burning in ponderosa

pine. Even if they could effectively reduce fire hazard, which I don't believe is possible, there would surely develop serious ecological problems and problems in multiple use of the forest.

To what extent is prescribed burning actually being used in management and protection of ponderosa pine? To my knowledge, it is presently being used on an adequate scale only on the Fort Apache and Hualapai Indian Reservations in Arizona. Administrators are fearful of departure from approved and accepted methods, and some of the older foresters have behind them a lifetime of training and conditioning in the proposition that fire is evil in the forest and its use in any constructive way is impossible. The plea is always for "more research." Aside from that described herein, there has been very little research in the Pacific Northwest, and little in Arizona.

Surely more research is needed. I believe, however, that we have already conducted research adequate for initiation of practical prescribed burning programs in stands similar to those characteristic of the Colville and Fort Apache Reservations. As has been suggested, this research lacks in sophistication and in detailed statistical analysis. In spite of this, it has produced the results described, and I shall be happy to arrange a "show-me" trip for any interested people.

Recently there has been an encouraging increase in interest in possible uses of prescribed burning, and several parties of research and administrative foresters have toured the Colville and Spokane stands, and the precommercially thinned areas where slash has been broadcast burned on the Yakima Reservation in Southern Washington.

It may be unfortunate that this interest is developing after so much emphasis has been placed on abatement of air pollution, for people not conversant with forestry problems will surely object to smoke from prescribed burning. It is my guess that it will be found that smoke from an adequate prescribed burning program in ponderosa pine will cause but an infinitesimal fraction of pollution resulting from use of the internal combustion engine, and from certain industries. Besides, the smoke entirely disappears with the next good rain.

Commercial grass seed growers of the Willamette Valley, in Oregon, have apparently convinced legislators that field burning is neces-

sary to the continuance of their industry. Have foresters attempted to present a similar case for prescribed burning and for slash burning? It should be positively and aggressively asserted that professional opinion is that proper use of fire as a tool is necessary for the forest.

For over 30 years I have heard suggestions that conditions really aren't so bad in the Ponderosa Pine Region, that something besides fire will surely be found for reduction of hazard, thinning, and reversal of the trend towards more shade tolerant vegetation. I can't see much progress in this direction. The reproduction jungles and increasing accumulation of beetle killed snags look worse to me than ever, and despite the marvelous improvements in fire fighting equipment and techniques, fierce, devastating fires still burn through these jungles. The problems discussed herein must be solved if commercial forestry is to continue, and the solutions will not come by continuing to ignore them or waiting for a "better way." The valuable tool we have at hand should be utilized.

CONCLUSIONS

The foregoing briefly describes how prescribed burning operations reduced incidence of wildfires; and the areas burned, damage and the costs of these fires. They have resulted in moderate thinning. At least on the Colville Reservation they have interrupted the trend towards development of climax tree reproduction and have encouraged ponderosa pine. They also have benefited wildlife and have improved range for domestic livestock.

Contrary to recent intensive and widely disseminated propaganda to the effect that "Only you can prevent forest fires!", fire in ponderosa pine is a part of the natural scene; part of an environment that we are being urged to perpetuate. I believe it will be found that prescribed burning is the key to intensive ponderosa pine silviculture. It should be continued for it is based on sound ecological concepts.

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