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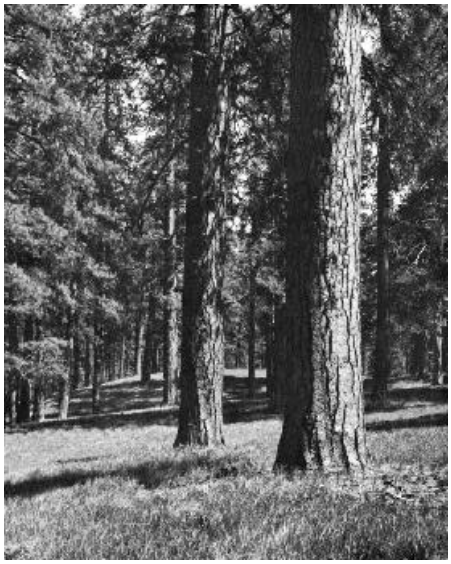

Fire and Management Problems in Ponderosa Pine

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THIS ARTICLE reflects the author's views, based upon his observations during 35 years of service as a professional forester in the Western Pine Region, including his active participation in pilot plant experiments with prescribed burning that have covered over 200,000 acres of Indian forest land during the past 21 years.

The time is fast approaching when the forest industry of the Ponderosa Pine Region will become dependent on younger, so-called second growth stands. The large, high quality pines that have been grown for us by nature have already been harvested over extensive areas, by the saw, by insect attacks, and by fire. On the rapidly dwindling areas of virgin timber and on partially cut forest areas under sustained yield management it is presently anticipated that the remaining large trees, in excess of 150 years of age, will be mostly harvested over the next 70 to 80 years.

Throughout the region there appears a general deficiency of trees in the much needed 80-150 year age classes. Future harvests, after the large trees are gone, will have to come from presently developing reproduction stands, many of which are in the 60-70 year age classes. There is evidence, over most of the region, that pines of small saw-log size can be grown in from 120 to 160 years, provided that the trees have adequate growing space and other conditions are favorable. This might indicate that it will be possible to maintain or even to increase present annual harvesting budgets.

Unfortunately, there is presently no basis for such optimism. Over extensive areas the original forest has been replaced by worthless brush fields. Reclamation of these areas will be very expensive. Over even more extensive areas, reproduction stands of ponderosa pine and of associated species are far too densely stocked for optimum growth. In addition, these dense young stands are competing for limited soil moisture with the large, high quality trees that remain. Because of resulting growth rate reduction these large trees are rendered particularly

Fig. 1- [title photograph]. Open, parklike conditions still prevail on limited portions of the ponderosa pine forest, as on this area on the Yakima Indian Reservation, in Washington. Ground cover consists principally of pinegrass (*Calamagrostis rubescens*).

* All photographs by the author.

susceptible to continuing epidemic attacks of the western pine beetle. Hazard has increased greatly and devastating fires have taken many thousands of acres out of production, probably for the next century.

Correction of the overstocking problem will also be very expensive. In spite of this there is presently in progress a vigorous corrective program. In the author's opinion, however, this program is still too expensive and too risky for general application, particularly by private owners of ponderosa pine lands.

It is also the author's opinion that unless corrective programs to solve understocking and overstocking problems can be greatly expanded and accelerated, anticipated future cutting budgets will have to be drastically reduced. Problems involved have already been discussed in considerable detail. However, the author proposes to review again, briefly some of the ecological relationships that are of primary influence in development of present conditions and to suggest measures that may aid in their correction.

THE ROLE OF FIRE

The overstocked, stagnating reproduction stands have developed over the past 60 to 70 years, since the advent of attempted total fire exclusion. The primeval ponderosa pine forest, as the first white men found it, in extreme contrast, was generally open, parklike, and free of excessive snag and windfall fuel, with a grass or low shrub covered forest floor (Figs. 1, 2).

Light surface fires, that had occurred at frequent intervals over countless centuries, were responsible for these conditions. They consumed dry grass and accumulations of dead needles, twigs, cones and exfoliated bark scales under the larger trees, thus preventing heavier fuel accumulations that might some day support much hotter fires.

Fig. 2. The open parklike appearance still persisted in 1958 in this stand on the Warm Springs Reservation in Oregon. A hot surface fire burned in July 1938. Ground cover consisted principally of balsamroot (*Balsamorhiza sagittata*), Sandgerg's bluegrass (*Poa secunda*), scattered remains of Idaho fescue (*Festuca idahoensis*), and seedlings of reinvading bitterbrush (*Purshia tridentata*). Grazing pressure has been heavy.

They also prevented establishment of reproduction under the groups of mature trees. Paradoxically as it may appear, they also caused development of clearings wherein seedlings could become established and by means of which the ponderosa pine forest could perpetuate itself. This occurred where single trees or groups of trees had been deadened by insect attacks, disease, windthrow or by lightning strikes. The recurrent fires gradually reduced the snag and windfall remains of these deadened trees to ash beds, in the process causing a clearing in the surrounding grass and shrub cover. Tree seedlings germinated in these favorable spots, and, by the time that the grass could become reestablished, many of them were of sufficient size to survive light surface fires. Ponderosa pine seedlings were more fire resistant and were more apt to survive than were most of the associated species (Fig. 6). Thus there developed new even-aged groups of pines (Figs. 3, 5, 12).

Fig. 3. This reproduction group, in August 1949 at Malay Gap on the San Carlos Reservation in Arizona, had experienced at least one wildfire, that in 1943, which largely consumed the foreground windfall. Wildfires occurred on an average of once each seven years. Ground cover consists principally of screwleaf muhly (*Muhlenbergia virescens*).

Remnants of this primeval forest still persist in remote areas where the white man's influence has been minimized. One such is in the Malay gap area of the White Mountains, on the San Carlos Indian Reservation, in east-central Arizona (Weaver 1951). Cooper (1960), after studying this forest, concluded that, "The patchwork pattern of the ponderosa pine forest is the expression of a cyclical process of community development, governed by fire and the intolerant nature of the species."

Other recent studies have added to our knowledge. Wagener (1961), from a review of previous studies, has concluded that fires occurred at average intervals of once each 8 to 10 years in the Sierra Nevada Mountains of California. Reynolds (1959), in his Masters Thesis, Geography Department, University of California, has reported on a study of conditions resulting from burning conducted by the Indians in the Yosemite portion of the Sierra. Apparently the Indians employed fire intensively, to facilitate acorn gathering in their oak orchards, to prevent other trees from becoming established in these orchards, and to keep the forest free of thickets that might conceal enemies.

There appears irrefutable evidence of the correctness of Jepson's conclusion (1923), with reference to the Sierran forest, that "—the main silvical features, that is, density, reproductive power and dominance of types, are in great part expressions of the periodic fire status."

Fig. 4. This stand of stagnating 60-year old reproduction on the Warm Springs Reservation had never experienced fire from its inception to 1956. A few bitterbrush shrubs still persisted.

CHANGING ECOLOGICAL CONDITIONS

Changing ecological conditions have already been mentioned and have been discussed elsewhere in considerable detail (Biswell 1961, Cooper 1960, Weaver 1943, 1951, 1955). It is appropriate that they again be discussed, however, for they are continuing to manifest themselves and the future of intensive, sustained yield management in the Ponderosa Pine Region is, in a considerable part, dependent on their solution.

The white man brought many new influences to disturb the conditions above described. One of the most important of these, and in many instances the first to be applied on a large scale, was extremely heavy grazing pressure from great herds of livestock. This disturbed the density of the native forest floor grasses, in many instances entirely destroyed them, and, through trampling, exposed expansive areas of dust beds of mineral soil, admirably suited for germination of coniferous seedlings. Next, and even more important, came the attempts to exclude fire completely, on the assumption that it was a prerequisite to forest management.

Fig. 5. This was formerly a stagnated reproduction stand on the Warm Springs Reservation, of similar age and density as that illustrated in fig. 4, except for larger tree to the right of the man. It was thinned by the 1938 fire and stems of fire-killed trees still litter the ground. Surviving trees have greatly accelerated in growth. Saplings in right background and seedlings in foreground are subsequent to the fire.

Some of the most extensive stagnated thickets of ponderosa pine reproduction, on moderately poor sites, date back to the early 1900s, and it is obvious that fire has been excluded from their inception (Fig. 4). On many of the better sites considerable growth has occurred in the dense reproduction stands, but even here it is obvious that useful growth is but a fraction of what it could be were it concentrated on selected crop trees, through elimination of excessive competition. It is obvious also, in many of the more advanced of these stands, that there actually was considerable thinning caused by low intensity fires in the early 1900s, when the trees were quite small (Weaver 1961a) (Figs. 5, 7).

Overstocking is continuing on many of the more recently cutover areas, because cheap methods of controlling this tendency have not been developed. Planting with trees at desired spacing and thinning with hand or power tools are expensive. Illustrative of the magnitude of the overstocking problem is the situation in the Northern Region of the Forest Service, where 7.6 million acres of dense pole and sapling stands now occupy 47 percent of the total commercial forest area (Morris, D., 1962). It is considered that some of these dense stands are too advanced in age to stand the ecological shock of thinning, yet they have not thus far produced anything of commercial value. It is concluded that solutions will have to be worked out, or foresters will have to be satisfied with yields far below capacity. Of course, only portions of these stands are of ponderosa pine.

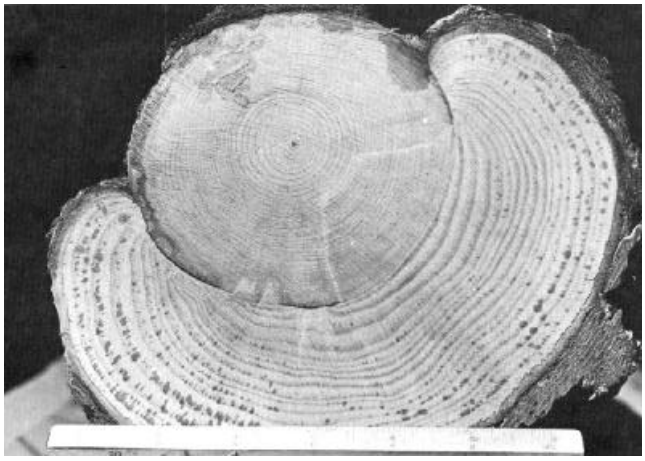

Fig. 6. This stump section, cut from a tree that survived the 1938 fire on the Warm Springs Reservation, further illustrates the resistance to fire of the ponderosa pine and its ability to respond to release from competition by greatly accelerated growth. This tree was 61 years old when it was cut in 1957.

The Leopold Committee (1963), in discussing the adverse effect of dense, over-stocked reproduction on other plant associations, on wildlife, on protection and on recreation in the national parks of the California Sierra has reported that,

> *Today much of the west slope is a dog-hair thicket of young pines, white fir, incense cedar, and mature brush—a direct function of overprotection from natural ground fires.*

Also a function of protection from earlier ground or surface fires, is the development of dense understory stands of Douglas-fir, white fir and incense cedar reproduction over many hundreds of thousands of acres of ponderosa pine in the Pacific Northwest (Fig. 8). This is viewed with complacency by some foresters because they sincerely believe it to be a process of natural succession, or because they believe that species content of these stands will not be of major concern under future management.

The western pine beetle is continuing to harvest mature and over- mature trees of the overstory (Fig. 8, 9). Light selection cuts designed to harvest the more decadent of these trees, the ones that are most apt to succumb to the beetles, have accomplished much in reducing intensity of epidemics and in saving timber that would otherwise be a complete waste. These cuts are of but temporary benefit, however, for they are treatments of symptoms, not basic causes. As long as competition continues from the understory, the beetles will continue to harvest the larger trees.

Inevitably, with harvesting continuing from beetle attacks, then light selection cuts, then from beetles

Fig. 7. This is typical of 60-70 year old stands on the Yakima Reservation, where most of the overstory pines were killed over many thousands of acres by the pine butterfly (*Neophasia menapia*) and the western pine beetle (*Dendroctomus brevicomis*) in the mid-1890s. These stands were tinned by low intensity fires set by stockmen in the early 1900s.

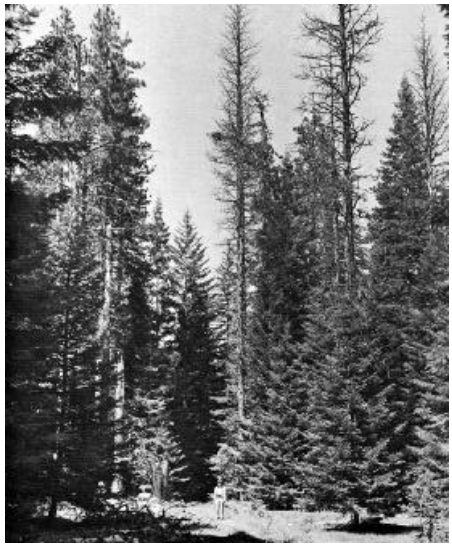

Fig. 8. This understory of white fir (*Abies grandis*) on the Yakima Reservation, has developed since attempted total fire exclusion. Overstory pines cannot endure this competition and are dying from pine beetle attacks.

That western pine beetle attacks are not always confined to mature and overmature trees is indicated by a recent severe epidemic in young, second-growth ponderosa pines in the "Mother Lode" region of California. Within a period of one year this epidemic is reported to have deadened over one billion board feet. Drought conditions have not helped matters, but, it appears that other factors have also been of influence. The author suspects that excessive competition resulting from overstocking may possibly be one of the most important of these.

Dense, even-aged stands of ponderosa pine of pole-size, from about 8 to 12 inches in d.b.h. and about 70 years of age, are sometimes decimated by epidemic attacks of the mountain pine beetle. Forest entomologists fear for extensive stands in this critical classification. There is urgent need of thinning (Fig. 7).

The great increase in fire hazard is the most ominous change since earlier days, in the author's opinion. As has been explained, frequent surface fires kept the primeval forest open and comparatively free of fuel accumulations. In the fall of 1875, the naturalist John Muir (1901), observed a great forest fire burning between the Middle and East forks of the Kaweah River, in the Sierra Range in California. He described how

> *It came racing up the steep chaparral-covered slopes of the East Fork canyon - in a broad cataract of flames, now bending down low to feed on the green bushes, devouring acres of them at a breath— the lurid flapping surges and the smoke and terrible rushing and roaring hiding all that is gentle and orderly in the work. But as soon as the deep*

Fig. 9. Understory competition, which robs the larger trees of limited soil moisture, causes lessened vigor and encourages pine beetle attacks. This deteriorating overstory is on the Yakima Reservation.

> *forest was reached the ungovernable flood became calm like a torrent entering a lake, creeping and spreading beneath the trees where the ground was level or sloped gently, slowly nibbling the cake of compressed needles and scales with flames an inch high, rising here and there to a foot or two on dry twigs and clumps of small bushes and brome grass.*

Muir felt safe in closely observing this fire, for,

> *There is no danger of being chased and hemmed in, for in the main forest belt of the Sierra, even when swift winds are blowing, fires seldom or never sweep over the trees in broad all-embracing sheets as they do in the dense Rocky Mountain woods and in those in the Cascade Mountains of Oregon and Washington. Here they creep from tree to tree with tranquil deliberation allowing close observation—.*

Our very success in suppressing fires has radically changed the conditions described by Muir. Great advances have been made in fire prevention and in fire suppression, and fewer fires escape from control than in earlier days of organized protection. When fires do escape control, however, and they still do, they are apt to be devastating. Uninterrupted fuel accumulations of the past 50 to 60 years, together with development of the reproduction and brush thickets, have made it extremely difficult to control such fires, and costs of control appear almost fantastic.

In the 22 year period from 1940-1961, in California, for instance, it is reported that fires have burned over approximately 700,000 acres of commercial forest, principally ponderosa pine type and in mixed types in which ponderosa pine and sugar pine are important components. It appears that most of these fires were not in the category of the light surface fire described by Muir. Devastating fires have recently burned in other portions of the Ponderosa Pine Region (Weaver 1961b) (Fig. 10).

Fig. 10. Wildfire destroyed this mixed stand of ponderosa pine and Douglas-fir on the Yakima Reservation during the summer of 1961. Fires had previously been excluded from this stand for over 40 years.

CORRECTIVE MEASURES

Precommercial thinning is being vigorously conducted on national forest lands, with funds set aside from timber sales receipts under the Knudsen-Vandenberg Act, of June 9, 1930, and, more recently in certain counties, with funds provided from the Accelerated Public Works Program. In the North Pacific Region, for instance, it is reported that about 100,000 acres of poles and saplings in the ponderosa pine forests have already been thinned and that the work will progress in the future at the approximate rate of 28,000 acres per year. Even at this rate it appears that from 20 to 30 years will pass before all of the area presently considered available for thinning can be treated. In the meantime, as has been suggested, overstocking may continue to develop on other more recently cutover lands.

The work has also been initiated on Indian forest lands. In the Pacific Northwest, it is considered that about 100,000 acres are presently available for this treatment.

It must be emphasized that precommercial thinning is only a partial solution to the overstocking problem. It is considered that it must be confined principally to reproduction stands having a very light or

Fig. 11. A controlled burn of October 1948 almost entirely consumed the large foreground windfall in this partially logged stand on the Fort Apache Reservation in Arizona. It also caused conservative thinning in the reproduction thickets, which had originated about 1919. This should facilitate subsequent precommercial thinning treatment.

nonexistent overstory of larger trees, otherwise the subsequent logging of the overstory trees will partially destroy the expensive thinning work. On Indian lands in the Pacific Northwest, for instance, it is estimated that at least 400,000 acres of dense reproduction have over- story stands of merchantable trees.

Also the work is very expensive, even though the Forest Service has managed to reduce average thinning costs to about $30 per acre under force account projects and to $20 per acre under contracts.

Not much is accomplished towards hazard reduction, because of the prohibitive cost of disposal of thinning slash through piling and burning. Instead, this work is confined to narrow strips along roads and fire breaks. It has been suggested by some foresters, that hazard is already so high that little good can be accomplished by piling and burning the thinning slash, that fires out of control will probably destroy the stands anyway. This may be questioned. If thinned stands without slash disposal are burned by wildfire, the expensive investment in stand improvement is usually completely lost.

Because of the cost of thinning, and, more particularly, because of the high risk from fires, it does not appear that the work will be accomplished on an adequate scale on privately owned forest lands.

Aside from comparatively small farm woodlot thinnings, subsidized under the Agricultural Conservation Program, the author knows of no large scale precommercial thinning projects being conducted on industrial ponderosa pine lands in the Pacific Northwest. These privately owned pine lands are probably more extensive than similar lands in government ownership and most of them can benefit greatly from thinning.

RECOMMENDATIONS AND CONCLUSIONS

More effort should be made to reduce fire hazard in thinned stands as well as on other ponderosa pine lands. In making this recommendation the author is not proposing expensive thinning slash disposal by piling and burning. In many areas the work can be accomplished at a minimum cost by application of controlled or prescribed burning, before the thinning work is started. Tests already conducted have

Fig. 12. This reproduction stand consisted of 18, 40 and 60-year age classes when photographed on the Colville Reservation in Washington in October 1961. It has been treated with two controlled burns, the first in October 1942, and the second in September 1958. Heavy fuels have been largely consumed, there has been considerable thinning and released trees have greatly accelerated in growth. Idaho fescue, pinegrass, snowberry (*Symphoricarpos albus*), and spiraea (*Spiraea spp)* are typical ground plants.

Fig. 13. This 40-year old stand on the Colville has been treated by the controlled burns of 1942 and 1958. This was formerly a thicket of dense reproduction, laced with numerous large windfalls. Left foreground tree has been scarred, but most of these wounds heal over quickly.

indicated that under favorable conditions this burning can very effectively reduce fire hazard without excessive damage to pine reproduction stands of pole and even sapling size (Biswell 1956, Weaver 1961a, 1961b) (Figs. 11, 12, 13).

Where reproduction stands are particularly dense, with excessive fuel accumulations, any burning must be approached with great caution. Even in such situations it should be possible to reduce hazard greatly by burning the snags and windfalls in late fall, before they become soaked from winter rains and snow, but when ground cover fuels have become sufficiently damp to prevent the fires from running to any appreciable extent.

There is evidence, in areas where hazard is already low, that thinning slash can be broadcast burned without excessively damaging the reserved trees (Fig. 14). It should subsequently be possible to maintain low hazard by periodic application of prescribed burning and, under such conditions, there should be available a much wider range of weather conditions under which it can be applied.

More attention should be devoted to relieving valuable mature and overmature trees from competition from the dense understory (Fig. 15). It is possible that this, too, can be most readily accomplished through burning. This may cause a temporary increase in western pine beetle activity, but after one or two years the insects will subside to the low endemic status (Keen 1960). Where such burning is attempted, provisions should be made to salvage log any severely fire scorched or beetle attacked trees.

On areas where conditions are such that establishment of subsequent reproduction may prove difficult, or where the large trees are decadent, the overstory should be logged. If we don't log it, the beetles will inevitably do it for us. Of course, an attempt should be made in all situations to log all overstory trees before they die from any causes.

It is presently considered that expensive precommercial thinning should be applied to the better site

Fig. 14. Two year old precommercial thinning slash was broadcast burned on this area in March 1963 on the spokane Reservation in Washington. Scorching was minor and it appears that all of the reserved trees will survive.

Fig. 15. This dense stunted reproduction on the Yakima Reservation is almost 50 years of age, and the valuable overstory pines are evidencing widespread signs of deterioration. Unless this condition can be corrected the overstory may soon have the depleted appearance of that illustrated in Fig. 9.

areas, where response in accelerated growth will be more favorable. What should we do with extensive dry, poor site areas? It is obvious that any management treatments on such areas should be cheap and be susceptible of uniform application over extensive areas.

Prescribed burning, again, may be a valuable management tool on such areas. Limited tests have demonstrated that prescribed burning is a rough and still largely unpredictable thinning tool (Gaines 1958, Morris, W. 1958, Woolridge 1963) (Fig. 11, 12, 13). This, in the Author's opinion, is because we, as foresters, are still inexperienced in its application, and because we have attempted to apply it in abnormally dense stands where fuel has accumulated for many years. There is abundant evidence, as mentioned, that most of our best pole stands, in the 60-70 year age classes, were effectively thinned by low intensity fires when the trees were still of seedling and small sapling size. Rough and patchy thinning of poor site areas may be preferable to no thinning.

Despite many marvelous developments in forest research, it is the author's opinion that we still have not adequately investigated the basic ecological relationships and the management methods that will enable us to practice more intensive sustained yield management over extensive portions of the Ponderosa Pine Region. If these problems are not soon solved, it will be necessary to reduce future cutting budgets drastically in ponderosa pine. More intensive research should be pursued towards solution of these problems, and vigorous corrective action should be taken promptly, after research has demonstrated just what action will lead to the desired results.

LITERATURE CITED

Biswell, H. H., and A. M. Schultz. 1956. Reduction of wildfire hazard. Calif. Agr. 10 (11): 4-5.

___. 1961. The Big Trees and Fire. National Parks Magazine. April 1961.

Cooper, Charles F. 1960. Changes in vegetation, structure and growth of southwestern pine forests since white settlement. Ecol. Monographs 30(2):129-164.

Gaines, Edward M., Harry R. Kallander, and Joe A. Wagner. 1958. Controlled burning in southwestern ponderosa pine: results from the Blue Mountain Plots, Fort Apache Indian Reservation. J. Forestry 56:323-327.

Jepson, Willis Linn. 1923. The trees of California. Univ. Calif. Press.

Keen, F. P. 1960. Biology and control of the western pine beetle. Misc. Publ. 800. U. S. D. A. Forest Service:235-6.

Leopold, A. S., S. A. Cain, C. H. Cottam, Ira N. Gabrielson, and T. L. Kimball. 1963. Wildlife management in the national parks. American Forests 69(4):32-35; 61-63.

Morris, Donald J. 1962. Trends in timber management planning on the national forests. J. Forestry 60:301-305.

Morris, William G., and Edwin L. Mowat. 1958. Some effects of thinning a ponderosa pine thicket with a prescribed fire. J. Forestry 56:203-209.

Muir, John. 1901. Our national parks. Houghton MiRin Co., Boston and New York.

Reynolds, Richard. 1959. Effect upon the forest of natural fire and aboriginal burning in the Sierra Nevada (Master's Thesis, Geography Department) Univ. Calif., Berkeley, California.

Wagener, Willis W. 1961. Past fire incidence in the Sierra Nevada forests. J. Forestry 59: 734-747.

Weaver, Harold. 1943. Fire as an ecological and silvicultural factor in the ponderosa pine region of the pacific slope. J. Forestry 41:7-15.

___. 1951. Fire as an ecological factor in the southwestern ponderosa pine forests. J. Forestry 49:93-98.

___. 1955. Fire as an enemy, friend and tool in forest management. J. Forestry *5 3:* 499-504.

___. 1957. Effects of prescribed burning in ponderosa pine. J. Forestry 55:133-138.

___. 1961a. Ecological changes in the ponderosa pine forest of Cedar Valley in southern Washington. Ecology

42:416-420.

___. 1961b. Implications of the Klamath fires of September 1959. J. Forestry 59:569-572.

Woolridge, David D., and Harold Weavcr. 1963. Some effects of thinning a ponderosa pine thicket with a prescribed fire. II In preparation