

# Uses of Fire in the Management of Arizona Watersheds

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THE SPONSORS of this conference are to be congratulated for having taken an active lead over the past 30 years in overcoming obstacles to useful applications of fire in land management. As briefly summarized in the preface of last year's Proceedings, there are two parts to the problem. First, we lack professionals who are trained in the useful applications of fire, possibly, because we have concentrated our efforts on training men how to fight wildfires. Second, there is no program designed to inform the public, at least on a scale comparable to the Smokey Bear program aimed at reducing man-caused wildfires.

To these obstacles one might add a third. Much of our State and Federal legislation which is designed to prevent or suppress wildfires, makes it difficult to apply prescribed burning techniques.

In Arizona we have no official state forester, although many of my activities are in the field of forest management. Without a forester or a forestry program, Arizona, unlike other states, does not have laws or regulations that might seriously restrain the use of controlled burning. A lessee needs only to get approval from the State Land Department to burn on State land. He is warned, however, of his responsibility if fire gets out of control and inflicts damage to adjacent lands.

Almost three-fourths of Arizona is in Federal ownership and most of this is under the management of the Forest Service, Bureau of

JOSEPH F. ARNOLD

Indian Affairs and Bureau of Land Management. Useful applications of fire must therefore be made by the professionals of these agencies. But among these professionals, we find very few that are experienced in prescribed or controlled burning.

Our first need in Arizona is to get men to develop experience and confidence in the art of applying fire for useful purposes. In order to appreciate how this is being accomplished we need to review briefly demands created by our Arizona Watershed Program.

#### **DEMAND FOR CONTROLLED BURNING**

Through intensive management or manipulation of vegetation, the Arizona Watershed Program is aimed at multiple-use objectives such as: increasing yields of water, timber products and forage for livestock and game, improving conditions for recreation, reducing destructive wildfires, and reducing soil erosion. In achieving these multiple objectives, an intelligent application of fire is as important as the mechanical and chemical tools we have at our disposal. In managing vegetation, no one of these three tools can be said to be the best. Rather some combination of these methods usually gives the best results.

Up until a couple of years ago, only a very few men, mainly in the Bureau of Indian Affairs, had sufficient confidence to apply prescribed burning techniques on an operational basis. With a growing demand for a talent that was in short supply, it was deemed advisable to create an interagency committee to encourage an exchange of information and ultimately develop more men capable of using fire as a tool.

#### **SOUTHWEST INTERAGENCY FIRE COMMITTEE**

Our first organizational meeting of representatives from a half dozen State and Federal agencies convened in Flagstaff on July 12, 1961. Basic elements for a set of Bylaws were discussed and recommended at this first meeting. The Bylaws were amended and approved at the second meeting, November 17, 1961.

As stated in Article I of the Bylaws, "The Southwest Interagency Fire Committee (SWIFCO) has been organized for the following purposes:

#### FIRE IN ARIZONA WATERSHED

- a. To determine needs for research in the use of prescribed burning and for the minimizing of damage and incidence of destructive wildfires and resultant effects on all wildland resource values.
- b. To recommend research and pilot projects among the agencies best suited to investigate and test certain phases of fire problems.
- c. To disseminate information resulting from the projects being pursued through the cooperating agencies.

To assure regular attendance and representation, the Committee includes regular and alternate members from each of the following Federal, State and private organizations: Forest Service Administration, Forest Service Research, Bureau of Indian Affairs, Bureau of Land Management, Soil Conservation Service, Watershed Management Department of the University of Arizona, Forestry Department of Arizona State College, Arizona Game and Fish Department, Arizona Water Resources Committee and my Division of the State Land Department.

The Bylaws call for 2 meetings a year. Elections are held at the summer meeting, with newly elected officers assuming their duties on the following January. The fall field meeting is usually planned for November, at which time committee members have an opportunity to review results of controlled burning.

Last November, we observed Harry Kallander and his crews apply prescribed burning techniques to Ponderosa Pine forests on the Fort Apache Indian Reservation. Members were given an opportunity to throw out matches on an area that had been prescribed burned the previous year. Besides seeing prescribed burning being applied, members were given a demonstration of "Firetrol," a new fire suppressant being manufactured by the Arizona Chemical Corporation in Phoenix.

Examples of intelligent applications of fire are briefly summarized for four vegetation types found on our important watersheds of the State.

#### USE OF FIRE IN MIXED CONIFER

The mixed conifer forest type (including spruce, fir, aspen and pine species), occupies around 100,000 acres at elevations generally above 8,500 feet. The forest is dense and fairly resistant to wildfires except in years of intense drought (Fig. 1). Burned-over areas are



Fig. 1. A typical mixed conifer stand.

occupied by aspen until reclaimed by the conifer species. Autumn coloration of aspen stands is the object of motorcades in both Arizona and New Mexico.

Until recently, no commercial products have been harvested from Arizona's mixed conifer forests. These forests intercept and use a lot of moisture and provide little forage and browse for livestock and game.

Preparatory to adopting patch-logging as an accepted practice, the Apache National Forest first tried it out on Burro Mountain near Springerville (Fig. 2). On the Sierra Ancha Experimental Forest, 80 acres of mixed conifer was clear-cut in 1959 on a 248 acre watershed. In the four years since treatment, this watershed has produced increased water yields ranging from 10 acre feet during a dry year to 40 acre feet during a year of above average precipitation. Since these experimental areas were clear-cut before we had our new pulp mill, only the saw-log material was used. Henceforth, trees below saw-log dimensions will be used for pulp. Having been reseeded to grass and legumes the clear-cut areas are used by deer, Elk and Wild Turkeys where they have been fenced from livestock.

In this type of management, fire is used to dispose of the slash and material not used for either saw-logs or pulp.



Fig. 2. A clear-cut patch in mixed conifer.

#### USE OF FIRE IN PONDEROSA PINE

A virgin stand of Ponderosa Pine at Malay Gap on the San Carlos Indian Reservation has been too remote to receive up-to-date fire protection. As a result, wildfires have gone through this stand on the average of once every 7 years, according to ring counts between fire scars. Because of the open nature of this stand, most of the trees have survived these fires (Fig. 3).

Virgin stands have multiple values. Besides yielding fair quantities of water, they furnish wood products, forage for livestock and game and are attractive for recreation.

By contrast, overstocked stands of sapling pines have little value (Fig. 4). They produce no saw-logs and few trees are large enough for pulp. Dense thickets intercept and use large quantities of moisture. There is no forage for livestock and game. There is no room for camping nor enough space for hunting. Worst of all, these stands suffer total destruction when swept by wildfire.

To protect pine forests against destructive June wildfires, prescribed burning is applied on the Apache Indian Reservation during the month of November, when daytime temperatures and humidity are right (Fig. 5). Burning of needles, logs and forest debris is reported to have reduced the number of wildfires by 82%;



Fig. 3. A virgin stand of Ponderosa Pine.

reduced the areas burned by 44% and reduced the size of average wildfires by 65%. Re-evaluations now being made by the University of Arizona on a much larger acreage will bring these figures up to date. Prescribed burning has been applied to some 200,000 acres of Ponderosa Pine on the Apache Indian Reservation.

Instead of using prescribed burning techniques to reduce forest fuels, the Forest Service has been concentrating its efforts on thinning operations.

The procedure being followed by the Indians may prove to be considerably more efficient than the Forest Service system. Prescribed burning followed by saw-log and pulp sales may reduce the job of thinning. In any event, the wildfire hazard will be less.

#### USE OF FIRE IN PINYON-JUNIPER

Early in the 1920's, Aldo Leopold reported the observation that most of our pinyon-juniper woodlands had been burned over by natural wildfires at some time in the past. The widespread presence of charred juniper stumps that have resisted decay provided the basis for his observations.

Pinyon-juniper stands are not commonly subject to wildfires. Only the more dense stands having a high percentage of pinyon, a species

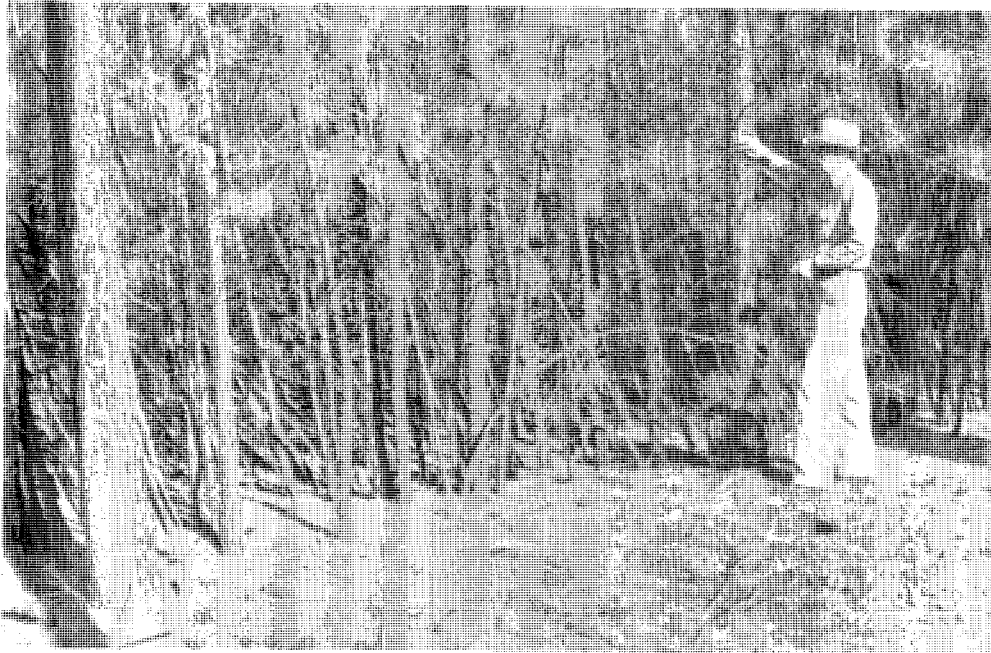


Fig. 4. An overstocked thicket of sapling pines.

with a high pitch content are subject to wildfires during years of extreme drought.

Mature stands of pinyon-juniper have very little value (Fig. 6). The amount of wood material is too small to pay for harvesting costs. Overstory trees crowd out forage plants valuable for grazing. Also, valuable browse plants like Cliffrose cannot compete with the overstory trees. And without an adequate herbaceous cover, soils between the trees are subject to erosion.

Mass burning of standing trees has been applied on about 30,000 acres of the Hualapai Indian Reservation during the past ten years (Fig. 7). To get fire to carry even in the dry month of June, trees are cleared from a fire line and pushed into the living stand forming a continuous windrow on the windward side of the stand to be burned. When sufficiently dry, fire is applied to the windrow and is carried into the stand. Once started, fire can be moved over a mile front as fast as crews can fire the ignition line.

Reseeding operations begin within a day or two after burning has been completed. A mixture of grass seeds with some species of legumes is spread over the area either by planes or Indian crews. After two summer growing seasons, the new forage crop is ready for grazing (Fig. 8).



Fig. 5. Prescribed burning of pine forests with fire moving slowly against the wind.

Fig. 6. A typical stand of pinyon-juniper.

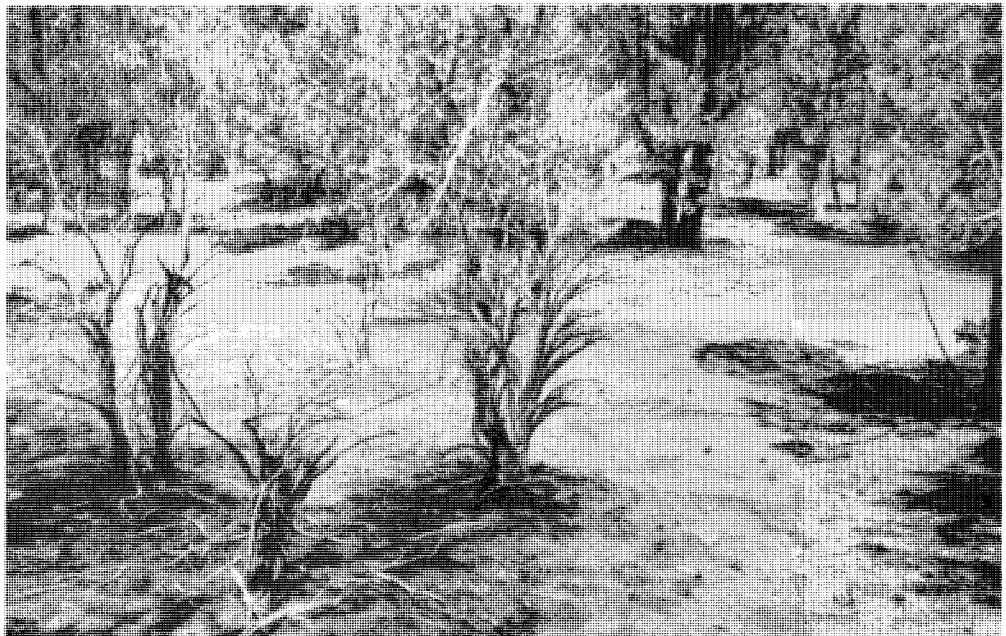






Fig. 7. Mass burning of pinyon-juniper.

Fig. 8. An excellent stand of grass, produced by the end of the second summer following burning and reseeding.



JOSEPH F. ARNOLD

As a result of this conversion, the Hualapai Indian Reservation reports that steers sold from the burned and reseeded areas brought \$15.33 more per head in 1959, \$27.65 more in 1960, \$24.00 more in 1961, and \$20.00 more in 1962, than animals from the untreated pinyon-juniper rangelands. On 10,000 acres converted from pinyon-juniper to grass, the stocking rate was increased from 93 head of steers to about 1500 head for a 5 month grazing season. This represents a 16-fold increase in livestock production.

In another method of conversion, fire is used to dispose of material left by chaining or cabling. In this operation, trees are first uprooted by pulling a 300 foot ship's anchor chain or cable between two crawler tractors. After sufficient drying, the debris is burned. Cleared areas are then reseeded by plane and to assure successful establishment of plants, the seeds are worked into the soil by dragging a ship's anchor chain over the area for a second time.

In open stands, fire is applied to the base of individual trees. Using long-handled gas burners, a hot flame is applied to the base of each tree to girdle it.

We have one species of juniper, the Alligator Juniper, which because of resprouting is not easily killed by fire. This species is either uprooted by bulldozers or treated with chemicals.

#### USE OF FIRE IN CHAPARRAL

Chaparral is a cover of shrubby species that has a history of being periodically swept by wildfire. In California, the Bel Aire-Brentwood wildfire in 1961 resulted in insured property losses totalling \$24,000,000. This is only one of many fires that have occurred annually over the years.

Away from population centers, considerable acreages of chaparral in California have been intentionally burned under State supervision to improve range values. By comparison, we in Arizona are only now beginning to burn chaparral—mainly on an experimental basis.

Intentional burning of chaparral can be expected to increase in Arizona on the basis of preliminary results now being reported. In the experimental Three-Bar Wildlife Area west of Roosevelt Lake, water yields have been measured since 1956 in a cooperative project involving the Forest Service, Arizona Game and Fish Department,



Fig. 9. Three-Bar watershed, where resprouting of shrubs has been checked with herbicides following the wildfire of 1959.

and Salt River Project. The experimental watersheds were burned in June of 1959 by a wildfire that swept over 21,700 acres of brushlands involving suppression costs and damages totalling \$598,000. Before the fire, there were less than 3 inches of water that flowed from a 76 acre watershed out of 67 inches of precipitation for a 35 month period. For the three years following the fire, there has been a seven-fold increase in streamflow for each inch of precipitation. Of course, the regrowth of shrub species on this watershed has been checked through annual applications of herbicides (Fig. 9).

Besides increased yields in water, partial conversion of brush to herbaceous species is proving beneficial to game species like deer and quail. There are encouraging indications that the use of fire in September may be used to kill or at least set back species like scrub oak and at the same time favor valuable browse species like Mountain Mahogany and Cliffrose. Partial effects like this are being obtained from a test now underway where alternate strips on the contour are being burned over a period of three years. The use of dessicants shows promise of drying out strips to be burned in a fairly low hazard month like September. And the use of chemical fire suppres-

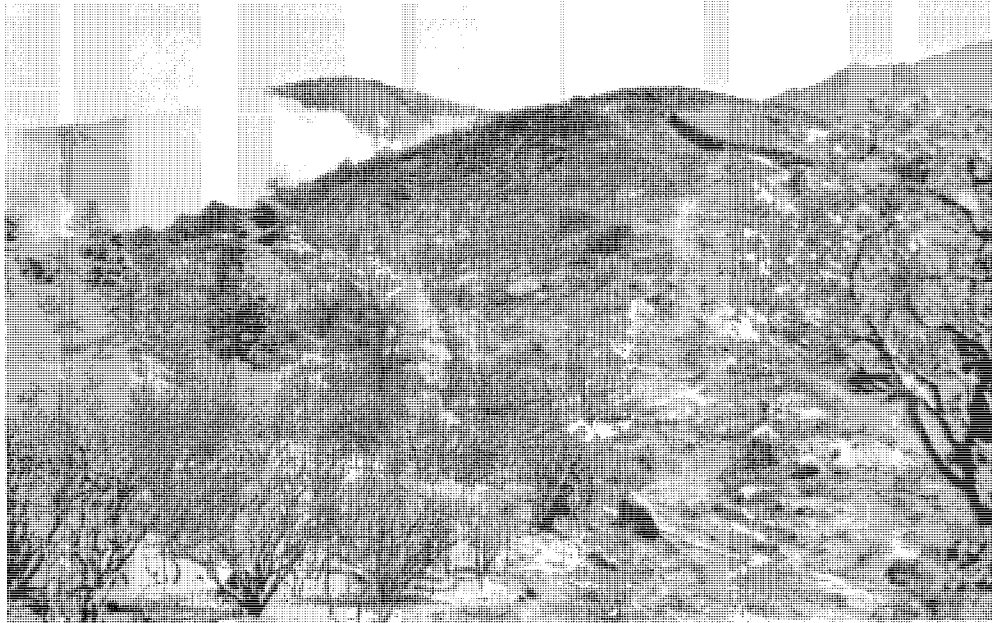


Fig. 10. A test burn in chaparral.

sants shows considerable promise in helping keep fire confined to desired limits.

Encouraged by results being obtained at the Three-Bar Experimental Area, the Forest Service and Bureau of Indian Affairs are making test burns on operational-sized areas. In a test burn on the Tonto National Forest last fall, brush was first crushed in a fire lane around the area to be burned. Only after the fire lane was burned clean, was fire applied to the chaparral stand (Fig. 10). Although clean burning occurred only in spots, the experience gained will undoubtedly help develop the confidence men need to develop a method for burning chaparral safely and with desired results.

#### SUMMARY

In the mixed spruce-fir-aspen-pine forests, the use of fire will largely be confined to cleaning up slash and debris after logging and pulp wood harvests.

In the management of Ponderosa Pine forests, the usual practice of piling slash after logging and burning will continue. It is hoped the successful prescribed burning techniques as presently being applied by the Bureau of Indian Affairs will be adopted by other agencies.

Mass burning of pinyon-juniper stands dense enough to carry fire, can be expected to increase in areas where rough terrain provides

natural fire breaks. But where there is a chance of fire getting out of control and endangering pine forests, fire will most likely be used as a follow-up treatment to chaining and bulldozing.

With further research and experience, we can learn to use fire safely in the management of chaparral. By using chemical dessicants to dry out brush to be burned and by using chemical fire suppressants to help keep fire confined to desired limits, we can develop safe methods for burning chaparral.

Fire has its place in achieving the desired goals of managing vegetation, but only in combination with mechanical and chemical methods of treatment. Success will depend on applying these methods in the right combinations tailored to a particular site.