WILDFIRE, PRESCRIBED FIRE, AND FUELBREAKS

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Large fires have been part of the California scene ever since we have had periodic drought, 6-month long, hot, dry summers, and brush and conifer fuels that could scarcely be more flammable by design. Scars on giant Sequoia trees cut in the Kings River Grove show severe forest fires raged as far back as the years 245, 1441, 1580, and 1797. Annual tree rings show that between 1700 and 1900, 36 severe fires burned in the California pine forest (Barrett 1935).

Records on large fires in chaparral are less clear, but we can assume that fires caused by lightning frequently started in, or burned into, chaparral and grassland (Heady 1972). Many large brush fires were reported during the late 1800's (Barrett 1935). And in 1976, there were 583 lightning-caused fire starts on the predominantly brush-covered lands protected by the California Division (now Department) of Forestry (California Division of Forestry 1976).

Wildfires

One of the most recent notable wildfires was the Marble-Cone Fire in southern Monterey County, California, that started on August 1, 1977, when lightning struck at several places. This wildfire burned over 177,800 acres, from the Hunter-Liggett Military Reservation on the southeast, 25 to 28 miles northwestward along the coastal mountains almost to Carmel Valley in a strip 10 to 12 miles wide. It was controlled only after 156 miles of control line were completed and backfired on August 18, but mopup around the boundaries continued for another week. Several reasons explain why this fire became so large:

1. The topography is among the steepest in the State. Elevation ranges from about 250 to 5,000 feet, with many deep canyons. The slope on the Monterey Ranger District of the Los Padres National Forest is, on the average, steeper than 40 percent.

2. The burn area had poor road accessibility. Much of the burn was in the Ventana Wilderness Area, where roads are not permitted, and steep topography had limited road construction elsewhere. The lightning strike which resulted in the Cone Fire could be reached only by helicopter, or by following 11 miles of foot trail.

3. Fire danger was rated extreme for 6 consecutive days before the fire. Relative humidities were as low as 8 percent, and temperatures were in the 90's. Fortunately, the windspeeds did not exceed 15 miles per hour.

4. The fuels were extremely hazardous. In fact, they were probably the most hazardous that I have ever seen because of the accumulation

of dead fuel. Within the burn area was coastal brush, chaparral, evergreen oak woodland, and occasional Knobcone pine, redwood, and Douglas-fir. No fire had occurred in some of this fuel since 1894, and within the Monterey Ranger District, 80 percent of the brush was more than 40 years old. More than one-third of the volume of this old-growth was dead. To make the situation much worse, a wet snowfall of as much as 3 feet in an area where a few inches are unusual, had fallen January 3-4, 1974. The heavy snow had broken branches from trees, and had compressed the shrubs and broken branches. The dead-to-live ratio in brushfields affected by the snow was 2:1. We consider brushfields to be highly flammable when the ratio reaches 1:2.

5. The effects of drought were reflected in the moisture contents of living fuels. During 1975-76 and 1976-77, rainfall was 38 to 48 percent of normal, and the moisture contents of live fuels reflected this proportion. As the moisture content of small green stems drops below 70 percent of dry weight, the mature brushfields burn more and more readily; 50 to 60 percent is critical. Heat from very little dead fuel is required to dry out the green fuel at these moisture contents, so that it all burns intensely. Green fuel moistures in the vicinity of the Marble-Cone Fire had varied between 40 to 70 percent during the weeks before the burn.

6. Local firefighting personnel were already involved with fighting other fires. Between July 5 to 31, there were 23 fires on California National Forests, varying in size from a few acres to 5,000. Four of these fires were burning when the Marble-Cone Fire started, and during the 20 days it burned, there were 27 other fires on National Forest lands. The result was that firefighting personnel had to be mobilized and transported in from other States, as far away as Alabama and Georgia, to help in suppressing the fire.

7. During suppression of the Marble-Cone Fire, inversion layers frequently prevented smoke dispersal. As a result, the fire was blanketed with thick dense smoke. While this condition persisted, air tankers, helicopters, and reconnaissance aircraft were grounded. Without retardant drops and firefighters able to reach their fire assignments, suppression efficiency was reduced.

Conflagration Prevention

In California, heavy use of wildlands, flammable fuels, steep terrain, and extended periods of unfavorable weather combine to insure that large fires will erupt periodically. We can do little to modify weather and terrain. Only modification of fuels seems to offer hope for reducing the size of fires or preventing them from starting. Prescribed burning and fuelbreaks offer two methods of reducing fuel hazards.

The history of the use of fire in California land management is one filled with controversy. Impressive arguments have been cited for and against the use of fire. For a more detailed discussion of the pros and cons of using fire as a management tool, see the paper by Phillips (1976).

Those who favor using fire argue that ...

1. Exclusion of fire has created unnatural fuel accumulations that only fire can remedy.

2. Broadcast burning is more economical than other brush abatement methods.

3. Periodic burning is needed to maintain healthy chaparral, and certain brush and forest species such as Ceanothus and Sequoia.

4. Burning improves forage production for wildlife and domestic livestock.

5. Prescribed fire can help reduce wildfire size and intensity.

6. Prescribed fire may do less damage to the environment that other treatments.

7. Burning is natural, and therefore ecologically acceptable.

Those who oppose using fire as a management tool argue that ...

1. Chaparral is natural, and modification is difficult and expensive.

2. Fire may seriously damage the soil.

3. Severe erosion may follow burning.

4. Periodic fires are causing coniferous and oak trees to be replaced by brush, and burned sites to become drier.

5. Fires cause unacceptable air pollution.

6. Prescribed fire may not be the most economical treatment method if all costs--particularly the risk of escape--are considered.

In spite of disagreement over the merits of prescribed burning, most land managers now believe that the benefits outweigh the liabilities in the careful use of fire, and that prescribed burning is essential to long-time management of chaparral, the mixed conifer forest, and related vegetation types.

Prescribed Burning

Prescribed burning is the use of fire within predetermined boundaries under well-defined weather and fuel conditions to accomplish land management objectives. Hazardous fuel reduction is an objective of most prescribed fires. If a prescribed burn can be accomplished satisfactorily, a later wildfire will burn with less intensity and damage and be more readily extinguished. Other objectives may be accomplished while fuels are being consumed, but to have an effect on wildfires, we must reduce hazardous fuels.

The burning prescription is a statement of the weather and fuel conditions that must exist, the manpower and equipment that must be available, the preparatory work that must be accomplished, and the burning plan that must be followed to burn vegetation from a selected area. A statement of objectives is necessary if the burning prescription is to be precise.

The part that I am usually asked to help with concerns the weather and fuel elements of the prescription.

1. Prevailing wind must not exceed 10 miles per hour. When winds gust to 15 to 20 miles per hours, firebrands are carried across firelines. We need some wind, perhaps 3 to 7 miles per hour, to carry fire through most fuels, or head away from tree canopies.

2. Relative humidities should generally be above 25 percent for most fuels, but above 50 percent dry grass or pine needles does not burn well. And above 65 percent, small dead sticks take on so much moisture from the air they will not burn.

3. Air temperature should not exceed 85°F. If it does, we have more spotting problems. Also, with higher temperatures, the fuels warm up and burn more readily. This warming usually occurs during the early afternoon.

4. Several fuels characteristics must be considered. The amount of dead material that has accumulated, the moisture content of the green fuel, the chemical content, and the continuity of the fuels all affect the fire behavior.

5. Topographic features of the burn area must also be considered because they affect the burning. The prescribed burning job is easiest if the terrain is flat, but we seldom have that in California. Vegetation burns more readily on south than north exposures. Fire burns uphill, and a steep slope will be the equivalent of considerable wind. The terrain also affects the flow of wind, up or down canyon, or through passes.

If all the factors affecting fire behavior are within acceptable limits, we can light the fire.

We have the technology to burn in most of our fuel types.

Perhaps the easiest prescribed burning is in the ponderosa pine type. In early spring or late winter, a light fire through this type will clean up much of the ground litter, kill 80 percent of the coniferous growth less than 2 inches basal diameter, and kill brush topgrowth. Repeated fires at intervals of several years will clean up the plants killed in the first fire, and with a ground cover of bear clover or perennial grass, the area is stabilized for 5 to 20 years. Wildfire burning into a forest treated this way would most likely burn on the ground, and at low intensity.

Burning in the chaparral is more complicated. Frequently, there is insufficient ground surface fuel to carry the fire, which must be carried by wind through the crowns. When this occurs, dead wood and green twigs to about 1/4 to 1/2 inch diameter are consumed. To achieve greater, and safer, fuel removal, brush is frequently prepared by crushing or spraying. The partially dry brush resulting will usually be consumed by fire under safe burning conditions.

Fuelbreaks

Firefighters have always needed openings or breaks in the fuel type if they were to stop fire under hazardous burning conditions. If these were man-made, they were almost always narrow--no more than 15 to 30 feet wide--until the availability of phenoxy herbicides in 1946 made the maintenance of wider, cleared strips feasible. During the 1950's and 1960's, about 2,000 miles of fuelbreak were constructed in California.

A fuelbreak can be described as a wide block or strip of land, strategically located for fire control, on which a cover of dense, heavy, or flammable vegetation has been changed to one of lower fuel volume or reduced flammability. The fuelbreak is usually located on a ridgetop. Firefighters like to have them 300 feet wide, although many are narrower. Fuelbreaks usually include a road or other bare strip that serves as a place to start backfiring.

Fuelbreaks are constructed in three stages. First, we get rid of the existing undesirable chaparral or coniferous fuel through the use of mechanical equipment, hand labor, herbicides, prescribed fire, wildfire, or, most likely, a combination of treatments. One good method is to spray or crush the mature brush. It can then be readily burned during the winter or spring when untreated brush will not burn.

Whenever brush or trees are removed by any means, regrowth from crown sprouts and seedlings is immediate, and if countermeasures are not taken, the regrowth will reoccupy the site within a few years. Herbicides have been our principal tool in controlling woody regrowth, but we are currently taking a look at goats to see how they might do the job. The third step in fuelbreak construction is to establish some sort of low-growing ground cover.

Fuelbreaks can provide safe access for quick manning of fire control lines. Low volume fuel, usually grass, can be readily fired out, whereas backfiring a narrow line in heavy fuel with high heat output would be impossible. Dropping chemical retardants from aircraft may be much more effective on fuelbreaks than in heavy surrounding fuels. Finally, fuelbreaks can break up brushfields, so that fires can be confined to preplanned blocks.

The usefulness of fuelbreaks during wildfire depends on their location, on how they are used, and on wind and fuel conditions. We have never attempted to itemize instances of fuelbreak usefulness, but many examples come to our attention (Green 1977). One of the most recent was the Mine Fire of July 28, 1977, near Corona, California. This fire was in a steep area overlooking citrus, and new and old residential construction. Fuels were chamise and other brush that had not burned for 70 years. The Mine Fire burned 5,000 acres, but a fuelbreak had been constructed along the ridgetop separating the Corona and Santa Ana basins, and the fire was stopped along 4 to 5 miles of this fuelbreak.

A recent trend in fuelbreak development is the use of prescribed fire to help maintain and widen the fuelbreak. Grass or other fuelbreak cover can be burned off. Then brush or coniferous fuels below can be ignited under prescribed conditions, and allowed to burn up to the fuelbreak. This approach effectively lessens the chances of fire jumping the fuelbreak. We think this combination of prescribed fires and fuelbreaks will help in stopping the big fires.

Although fuelbreaks have been used effectively, they have also been criticized as an approach to fire control. A frequent criticism is that high velocity winds can carry fire across a wide break, manned or not. Firebrands carried downwinds by winds of 30 to 70 miles per hour can cause spot fires 1/4 to 1/2 mile or more ahead of the main fire front. Attempts at backfiring in such situations are seldom successful. Unmanned fuelbreaks will seldom stop fires, and grassy fuels on steep slopes may at times aid in the spread of fire.

Summary

Large wildfires have been part of the California wildland scene for thousands of years. The 1977 Marble-Cone fire, which burned over 177,800 acres, is a recent example of a large wildfire. It became large because of abundant dead and dry fuels, rough topography, poor accessibility for firefighters, and ongoing fires that required the attention of local firefighters.

Prescribed burning is controversial, but most land managers now generally believe prescribed fire to be essential for long-time management of most California woody vegetation types. Considerable education of management personnel and the general public is needed.

Fuelbreaks are wide strips through the brushfields or forests on which hazardous fuels have been replaced with ground covers more acceptable to firefighters. They are useful in the control of all fires except those being spread by firebrands from very strong winds. The 1977 Mine Fire near Corona, California, again demonstrated the usefulness of fuelbreaks.

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