



Helicopters serve as aerial observation posts, for spotting men on the fire line and for transporting light supplies.

# Wild Fire Damage a

**Protection costs, damage potential high, due to topography, climate, use**

**John A. Zivnuska and Keith Arnold**

**The most difficult**, important, and expensive problem of forest fire control in the United States is in California.

Of the 100 million acres of land in the state, about 46 million acres are in forest and brush, almost entirely mountainous.

In much of the area the climate is marked by a prolonged summer drought, high temperatures, low humidities, and strong winds.

Some 17 million of the 46 million acres are timber cropland, which supports a lumber industry second only to that of Oregon in volume of production and representing an investment of more than one-half billion dollars.

About 20 million acres of the forest and wild land are suitable for grazing. This part of the area includes almost all the summer range—excluding irrigated pasture—and a large part of the winter and spring range for the beef cattle and sheep industries.

Water is an important product from 96% of these forest and brush lands which include the primary watersheds.

The rapidly increasing population of the state, now totaling over 10 million, is an important force affecting the management of the forest and wild land. Recreational use is becoming increasingly heavy, and is leading to large capital investments in the wild areas of the state. Of even greater significance has been the trend toward nonurban residence. While

data are not yet available to enable exact statements, it is known that one of the significant trends in recent population changes has been the increase in number of residences in the flash-fuel types adjacent to primary watersheds and valuable timberlands.

These 46 million acres contain large roadless and wilderness areas as well as areas of concentrated use.

This combination of topography, climate, and use results in a potentially explosive situation and the most difficult forest fire control problem in the United States.

The variety of conditions and ownerships found on wild lands and the frequent intermingling of these wild lands with agricultural and urban lands add to the complexity of the protection problem.

About one half the area, primarily federal lands in national forests and national parks, is protected from fire by federal agencies such as the U. S. Forest Service and the National Park Service.

Under state law, protection of the remaining nonfederally owned timberland and primary and secondary watersheds is accepted as state responsibility. This protection job is delegated to the State Division of Forestry in the Department of Natural Resources. Six counties have chosen to protect their own wild lands by county agencies and receive grants-in-aid in lieu of direct protection. In addition, there are a number of special fire districts in some areas of the state.

The best data available as to the annual damage resulting from wild fires are the compilations prepared annually by the United States Forest Service based on

individual appraisals which are commonly arbitrary and minimal in nature. According to these estimates, damage from wild fires in California averaged more than 2½ million dollars annually during the period 1945-48.

Such damage varies greatly from year to year as a result of climatic differences, the adequacy of protection forces, and the element of chance connected with fire occurrence and discovery.

Bad fire years are usually marked by prolonged periods of climatic extremes and a number of very large fires. However, the potential danger always exists and a single blow-up can change an average year to one of high damage.

## Timber, Range, Watersheds

The most obvious damage resulting from fire is the destruction of merchantable timber. This loss has been estimated at 91 million board feet annually in California for the decade 1934-43.

Perhaps even more important than the merchantable timber loss is the destruction of reproduction and young growth.

One of the major problems of sustained yield management in many forest areas of the state lies in obtaining the reproduction necessary to perpetuate the stands. In such cases the loss of advance reproduction to fire may spell the difference between success and failure of the efforts to maintain forest production.

Damage to range lands involves a controversial and frequently misunderstood relationship.

There is considerable evidence that on certain soil and brush types in the state a program of carefully controlled fires—followed by adequate management practices—may result in range improvement. Such controlled burning, however, is very different from wild fires which sweep large areas and are not a part of the land management program.

The usual effect of wild fires is range deterioration.

In the case of watersheds the direct and readily apparent damage to the facilities on the area itself are often a minor element in the total damage. By removing the vegetative cover, fires may change the run-off and erosion characteristics of

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**Left: Destroyed young growth immediately after a burn. Right: Slow return of growth 10 years after a fire, in an area where no replanting was done.**



# and Cost Far-reaching

damage to natural resources may be permanent loss of community values

Charles Arment



Uncontrolled fires often spread with explosive speed when topography and weather conditions are favorable.

By late August, 1950, over 200,000 acres of California lands were blackened—and the lives of five men were lost—because of forest fires. The probabilities are that before the fire season is over many acres of timber, range, and watershed lands will have been destroyed or damaged—and more human lives sacrificed.

Protection from fire has long been recognized as an important factor in the management of the wild lands of California. Planning and replanning the organizations, facilities, and finances necessary to provide adequate protection at a reasonable cost is a continuous job of wild-land managers.

In order to facilitate this job, a field investigation of the damage caused by fires was undertaken by the California Forest and Range Experiment Station in 1944. This is a continuing program and will take several more years to complete for the state as a whole. The damage appraisal study for the National Forests in southern California has been completed, and the study is now being continued for the National Forests north of the Tehachapi Range to the Oregon line.

## Contingent Losses

Many kinds of damage are included in the total. Loss of thousands of board feet of merchantable timber is an obvious damage; destruction of young growth that would normally replace the old growth removed by logging is another. But loss of timber means loss of income to workers and industries in communities dependent upon logging and milling.

After many fires, lost timber can be restored only by planting young trees—at a cost of \$35 to \$50 an acre—within the year after the fire occurred.

Many forest fires damage telephone and power lines or put them out of commission. Getting the lines back into operation may take several days to several weeks after a large fire. Sometimes the lines must be rebuilt; at present prices this costs at least \$1000 per mile. Fences are damaged and need to be replaced; good fences cost at least \$500 per mile. Rocks, debris, and fallen trees block roads and trails, which must be reopened to travel. All this extra expense would not be necessary if fires were prevented.

The extra expense continues long after the fire is out and the improvements are repaired. For five to 10 years after a fire above normal maintenance work is required on roads and trails in the burned area. Trees that were injured die and fall across roads and trails and must be removed. Soil and rocks are more subject to movement by wind and rain as a result of loss of vegetative cover, and the flow of water over the soil surface is increased. If heavy rains fall the first few winters after a fire, culverts are plugged with debris and silt, and the final result is that the road is washed out.

Even more serious damage from erosion, siltation, and increased surface runoff may occur downstream. Flood waters may carry the debris a long way after a hard rain, onto low-lying cropland or city property and into reservoirs. Sedimentation of reservoirs reduces their water-storage capacity, and hence reduces their ability to generate power and supply water for irrigation and domestic use. The total amount of these damages may not be evident immediately after a fire, for they may accumulate over many years while the burned area heals.

In southern California, damage to reservoirs and down-stream areas may be two thirds or more of the total damage resulting from increased runoff and erosion when the forest is burned. The remaining damage is in the watershed itself.

Additional damages occur to recreational values: wildlife is lost, fish die in polluted streams, scenery is scarred, and forage for wild game burned. Travelers lose a recreational area, and resort and business establishments in the vicinity

suffer loss in two ways, from property damage and reduction of tourist travel. These effects, too, last for many years.

Beyond all this is the loss of human life that occurs nearly every year. A dollar value cannot be assigned to this loss, but all other damages do have values that can be calculated; and they are the ones with which the study of fire damage appraisal is concerned.

Where the appraisal has been completed—for the Cleveland, Angeles, San Bernardino, and Los Padres National Forests—the estimated damages due to changed runoff and erosion rates after fire were found to be especially important. They vary from about 25¢ to \$800 per acre, in addition to the loss from destruction of improvements, forage, timber, recreation, and wildlife.

As an aid to land managers, the damage estimates have been tabulated and maps prepared for each watershed on the four Forests. The tables and maps also have considerable value in fire control management. They are designed to give damage values for any portion of a watershed that may be burned from one acre to 50,000 acres and over. Damage values were determined for north or south exposures on up-stream slopes, stream bottoms, and downstream areas. They have use before a fire, while it is burning, and in determining the damage done.

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Erosion of a burned-over area following rains after a fire. Erosion, siltation and increased surface runoff may cause greater damage downstream.



## PROTECTION

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the watersheds themselves. The damage which may then occur depends upon the precipitation pattern and on the magnitude of the downstream values affected.

An outstanding example of this is the Los Angeles County Pickens Canyon fire of 1933 which burned only 4,830 acres, yet a cloud-burst two months later resulted in a flood which caused 30 deaths and an aggregate loss of \$5,000,000.

Such damage may not occur immediately. Only the experience of years can show the full damage resulting from a fire such as the 40,000-acre burn in 1948 which destroyed the cover on half of the Santiago Reservoir drainage, Orange County's major watershed.

The present level of fire damage, high though it may appear, is actually low relative to the values at stake and the degree of fire danger characteristic of California.

Maintaining the great differential between actual and potential damage is a major accomplishment of the protection agencies. The achieving of this degree of protection is an important element in the cost of wild fires in California.

During the last two fiscal years the cost of protection for the 31.1 million acres of timber, watershed, and range considered as state responsibility lands has been close to 8½ million dollars annually. The cost per acre of protection for the 13.7 million acres of state and private timber and primary watershed lands directly protected by the California Division of Forestry is estimated at 41.4¢, ranging from 20.2¢ in the North Coast District to 75¢ in southern California. Los Angeles County spends more than \$10 per acre per year to protect some of its high value watershed lands. Cost estimates on federal lands are unavailable.

In addition to the realized costs of wild fires in California there is a potential cost which plays a major role in the economics of fire protection in the state. This is conflagration potential—the ever-present danger that a wild fire will become temporarily uncontrollable and sweep through occupied areas in a manner that will cause great destruction of property values and human life.

Under the extreme fire conditions in this state blow-up situations frequently occur. During such times wild fires must be controlled while still small. If not, they can attain a speed of travel and rate of combustion such that they appear practically to explode over large areas.

Such conflagration potential is also an important factor in the management of controlled fires. Confinement within the prescribed boundaries becomes absolutely essential. In some cases it may be

necessary to defer control burns so that their smoke will not delay detection of wild fires.

In the face of these conditions of maximum fire danger, settlement in California is expanding rapidly into critical fuel areas. Housing developments are found in narrow, brush-filled canyons. Recreational development is heavy in areas of limited access where emergency exits might be cut off.

Almost every year several communities in the state narrowly escape being swept by a wild fire from the surrounding forest and brush lands. Moreover, the rapidly increasing capital investment and human use in highly exposed areas has greatly increased the magnitude of the protection problem. It is this danger of fire disaster which perhaps overshadows all other costs of fire in California.

Since the combination of wild land cover, climate, and topography result in California's high fire danger as well as its high productivity and desirability as a place to live, the cost of protecting the wild land from fire must be considered a part of the cost of living in the state.

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## LOSSES

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Use of the tables and maps before a fire—presuppression—is in planning the distribution of manpower and equipment within a protection unit to give the maximum protection available to the areas of highest value. This may mean concentrating fire fighting forces in areas where damages are high in order to provide fast attack on all fires in the high-value areas. The ability to get men and equipment on a fire within 15 minutes to a half hour after the fire is discovered may save a whole watershed from burning over.

Keeping fires small is especially important in areas of high potential damage. In southern California the vegetative cover is of primary importance for watershed protection with recreation values also of major importance in some areas. If these watersheds are burned, the usual result is accelerated erosion and runoff, and loss of water in flood flows. Damage to recreation values may also be high. In northern California timber and rangeland values, as well as recreation use and watershed protection, are important. Here, again, the areas with the highest value are being determined so that most men and equipment can be stationed in areas of high values.

On going fires the damage appraisal figures can be used to guide firefighting

strategy. Probably the most important part of this task is deciding where to locate control lines to stop the spread of fire. When the potential damage on any portion of a watershed is known, the fire strategy can be planned to control a fire with the least amount of damage and suppression costs. Then the men and equipment needed to do the job within a given length of time are ordered.

It may be advantageous, for example, to allow a fire to burn a larger area in a low-damage watershed as in the case of a 500-acre fire, burning in steep, rugged country of low value. Putting a control line around this area would require considerable manpower and equipment at high cost, and there may be danger that the control line would not hold. By dropping back to terrain more favorable for construction of control lines, the fire may burn an additional 200 acres but be controlled with reasonable assurance; and less manpower and equipment can complete the job in shorter time under much safer conditions. The damage is still low, and fire fighting costs much less.

If the fire were in a watershed important to adjacent community values, the plan would be to hold it to the lowest acreage possible. Here the higher cost of suppression is justified by the greater values saved.

The use of fire damage appraisals in managing fire protection organizations is not the final goal of land managers. The ultimate goal is the reduction of all man-caused fires.

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## GRASSES

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Commercial strains of orchard grass cannot be grown in California without irrigation except in the moister areas. A new strain imported from Palestine has proved highly successful under dry conditions on a ranch near Sacramento. The imported strain is a low producer but hybrids between it and a commercial strain are more vigorous than either parent, when grown in Berkeley, and have survived one long dry summer near Sacramento.

At present, drought resistant strains of orchard grass are being obtained from various parts of Southern Europe, North Africa, and Southwestern Asia, and these will be hybridized extensively in order to build up new drought resistant strains adapted to California conditions.

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