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FIRE CONTROL NOTES

A PERIODICAL DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

FOREST SERVICE • U. S. DEPARTMENT OF AGRICULTURE

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Volume 14 Number 1

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the

TECHNIQUE OF FOREST FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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Forest Service, Washington, D. C.

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Uses of Wild Land and Their General Relationship to Fire Occurrence

At the turn of the century logging and lumbering were limited mainly to the area east of the Great Plains. Mechanization of woods operations had not taken place to any marked extent. Fires in the logging woods were caused by lunch and warming fires, promiscuous slash and debris burning, and smoking. These same causes prevail today but added to them are fires resulting from the operation of tractors, power saws, high and ground lead systems, logging railroads, trucks, and other machinery common to the logging industry of today. In addition the number and size of woods operations have increased manyfold. They have moved westward into areas characterized by long periods of low relative humidities, heavy fuels, and rough terrain.

Hydroelectric power development was almost unknown in much of the United States, particularly in the far West, at the close of the nineteenth century. Today thousands of miles of transmission lines traverse millions of acres of hazardous fire areas. Thousands of miles of railroads and many more thousands of miles of highways pass through the wild land areas. Cities and villages have increased in numbers and in population and the uses of the wild land areas have expanded correspondingly.

Increased use has usually meant increased risk, or chance of fires starting.

Consumption of pulpwood has increased tremendously from 4.5 million cords in 1921 to more than 26 million cords in 1951. This increase has meant more men and machines in the woods and a greater number of families living in and near the wooded areas. Hence the wild land areas are being subjected to a higher degree of risk.

Lumber production in the United States has been steadily increasing since the low point reached in 1932 (fig. 1). A proportionately much higher increase of lumber production has occurred on national-forest lands. It follows that the risk brought about by expanded production has increased proportionately much more rapidly in recent years on national-forest lands than on privately owned lands and will continue to increase until the full sustained-yield capacity of these lands is reached.

The use of wild lands for recreation purposes has increased to a point where the numbers of people, whether picnickers, campers, hunters, or fishermen, have created a serious risk situation. This risk will increase as the population increases and the time and means available for recreation become greater. To offset the mounting impact of increased use on the number of fires that start on wild lands each year, the fire control manager must resort to fire prevention.

If a composite index of total use is plotted against the index of number of man-caused fires the two curves should be almost parallel. This would be true if no effort had been made to prevent fires. Figures for the national forests in the eleven western

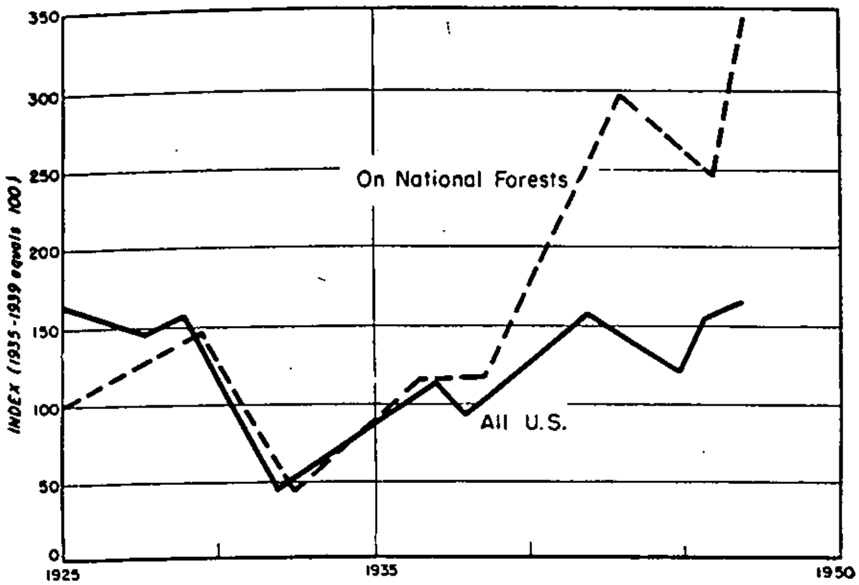

FIGURE 1.—Index of lumber cut in the United States and on national forests.

States, developed a few years ago by G. D. Fox, produced a composite index of use and an index of the number of man-caused fires. These show conclusively that in spite of large population increases and increases in industrial production, the number of man-caused fires has not paralleled increase in use (fig. 2). The fire expectance curve shows what would have been experienced after 1931 if the same relationship between numbers of fires and total use had remained at the ratio which prevailed during the period 1927-31. The large index difference between actual and expected fires indicates very strongly that increased prevention effort did result in a large reduction in man-caused fires in the face of vastly increased use of the national forests.

If the total number of fires prevented from occurring is assumed to be the result of increased prevention effort compared to the period 1927-31, and the cost for suppressing the average size fire that occurred during the 1927-31 period and the value of losses in resources that would otherwise have resulted are known, the savings resulting from this prevention effort, according to Mr. Fox, may be determined.

The annual savings in suppression costs during the period 1942-47 was calculated to be $3,000,000; stumpage value of the timber that did not burn but would have without this increased prevention effort, even with very aggressive suppression action, was estimated at $1,900,000; reforestation costs that would otherwise have been necessary and the growth increment that was saved were valued at approximately $4,400,000. The increased prevention effort that was made to offset the impact of the increased use of the national forests in the eleven western

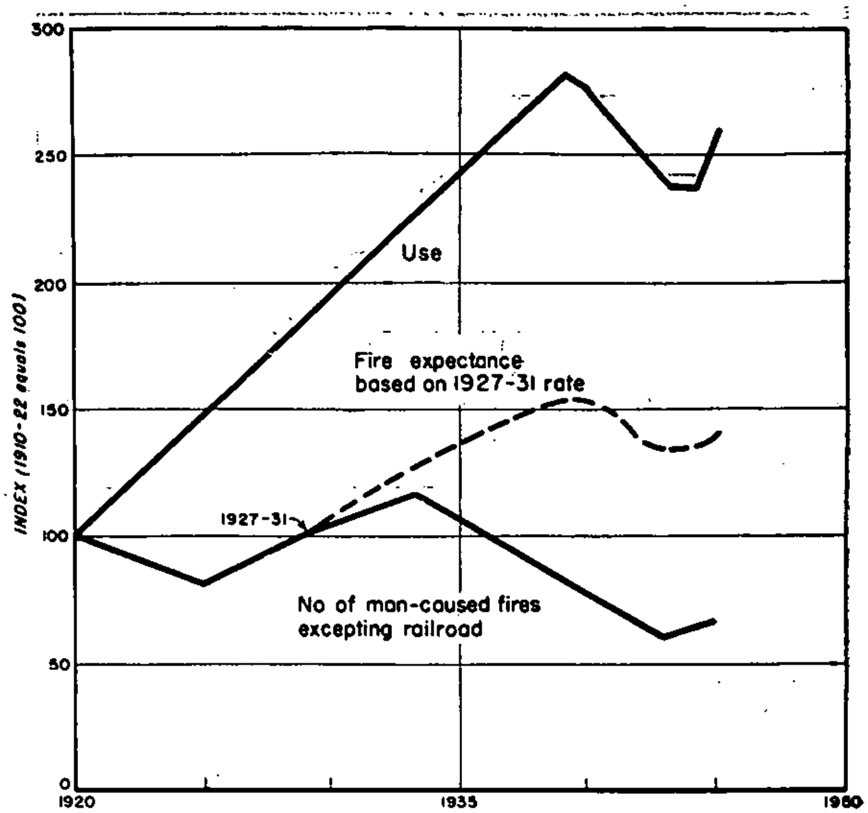

Figure 2.—Index of use and index of number of man-caused fires on the national forests of eleven western States (15-year average plotted at middle year; fire expectance based on 1927-31 rate).

States showed a grand total annual saving of about $9,300,000 during the 1942-47 period, exclusive of the value of intangibles.

The foregoing discussion emphasizes that prevention of fires does pay large dividends in suppression funds saved and damages prevented. Although the prevention of fires in the national forests of the eleven western States has more than kept pace with the increased use of those forests, a great deal remains that must be done before the prevention of fires has reached the point of diminishing returns. This is true not only on the national forests but on most all other wild land areas in the United States and Alaska.

This brings up the question of fire prevention plans. Such plans are basic to the intelligent application of effort directed at the problem of man-caused fires in the United States.

Fire Prevention Planning

Primary elements in developing a fire prevention plan for a unit are an analysis of the fire business of the unit and an understanding of the media of prevention.

Analysis of the Fire Business of the Unit

The following information must be available on general and specific causes of fires: Who starts fires; why are fires started; when do fires occur; where are fires being started; what fires are resulting in the excessive damage to resources and high suppression costs.

General and specific causes.—The general causes, other than lightning, usually recognized by most fire protection agencies are:

Railroad—fires resulting from maintenance of rights-of-way or construction or operation of common carrier railroads.

Lumbering—fires, except those caused by smokers, resulting from lumbering operations. (Lumbering operations include all activities connected with the harvesting or processing of wood for use or sale. Lumbering fires include those caused by logging railroads which are not common carriers.)

Campfire—fires resulting from fires started for the purpose of cooking, warming, or providing light by persons camping or traveling on or near wild land, except those started by railroads or lumbering employees in connection with their duties.

Debris Burning—fires resulting from any fires originally set for clearing land for any purpose, or for rubbish, garbage, range, stubble, or meadow burning without intent on the part of the burner to have such fires spread to lands not intended to be burned. (Does not include lumbering fires or hazard reduction on rights-of-way of common carrier railroads.)

Incendiary—fires that in the judgment of the reporting office are deliberately set by anyone with the intention of burning over land or damaging property not owned or controlled by him.

Smoker—fires caused by smokers' matches, or by burning tobacco in any form.

Miscellaneous—fires that cannot be properly classified under any six standard causes listed—does not include fires caused by lightning.

To provide sufficient detail on which to base fire prevention plans each general cause must be further analyzed as to specific cause. The specific causes usually recognized are:

Airplane	House or stove flue sparks	Range burning
Berry-land burning	Insect or snake control	Refuse burning
Blasting	Job fire	Repel predatory animals
Branding	Land clearing	Right-of-way clearing
Burning building	Logging line	Rubbish disposal
Burning vehicle	Meadow burning	Safety strip burn
Cooking fire	Moonshine	Slash disposal
Exhaust	Oil-gas well	Smoking
Fireworks	Playing with matches	Smoking bees or game
Fuel sparks	Power line	Spontaneous combustion
Fusee	Pyromania	Tie disposal
Glass		Warming fire
Grudge fire		
Hot ashes		

Identification of fires by general cause and appropriate specific cause provides the first inkling of what can be done to prevent fires in the area. For example, if railroad fires are a problem the area of trouble is a narrow strip on each side of the tracks. Specific causes may be fusees, fuel sparks, hot ashes, hot brakeshoes, etc. If most of the fires are started by fusees, what must be done to eliminate such fires can be definitely outlined. The fire prevention measures may involve reduction of hazards along the tracks, installation of an electric block system eliminating

in large measure, the need for fusees, education of the men in more careful use of fusees, or the development of a new kind of fusee with fewer fire starting characteristics.

Who starts fires.—The class or classes of people responsible for fires can usually be obtained from a study of reports on fires that have started in the area. Classes generally recognized in such analyses are:

Camper	Construction worker	Hunter
Fisherman	Miner	Stockman
Picnicker	Timberman	Farmer
Traveler	Rancher	Other

The fire control manager will then know the people toward whom prevention efforts must be directed. For instance, if deer hunters are starting fires during the period September 16-October 15, the manager, to minimize the chances of fires being started, may initiate such prevention measures as: Registration of all hunters; establishing special prevention patrols in areas frequented by hunters; closing high hazard areas to public use if such authority exists; closing the entire area to public use; delaying the hunting season until weather conditions become more favorable; installation of camping facilities if they are lacking and if such a lack contributes to start of hunter fires.

Why are fires started.—There are three primary reasons why fires are started: Carelessness in the use of fire; poorly designed or poorly maintained equipment, for example, a power saw may cut timber efficiently but the muffler may start fires because of faulty design, or an adequate spark arrester for tractors may be properly designed but the operator may not have replaced it when it has burned out; and intentionally for various reasons such as land clearing, ridding the country of snakes, or paying off a grudge. The more information that is available on the reasons why fires are started the easier it will be to devise methods and programs to prevent fires.

When do fires occur.—The timing of prevention work is important. Records of fires that have started in previous years should be studied to determine when they occurred. This time factor should be correlated with the general and specific causes, the class of people responsible, and the reasons why the fires are starting. For example, if it is known that fires occur along a certain river during May and fishermen are responsible, the fire control manager can arrive at a specific plan of action geared to that time of the year to prevent such fires.

Where are fires being started.—Knowledge of the specific location of the starting points for all fires is essential in fire prevention planning; particularly in relation to areas of special risks. The specific details are used in preparing a fire business map. A planometric map with a scale of ½ inch equals 1 mile is satisfactory as a base. Spotted on this map are the starting points of all man-caused fires that have occurred in the past 5 years. Appropriate symbols can be used to identify those started by lumbering, railroads, campers, debris burning, and the other general causes. As would be expected, fires usually occur with

a relatively high frequency in areas of concentrated use and become more widely dispersed as use becomes lighter. The areas of concentration are delineated and numbered and a detailed study of each area is made.

A simple fire business map developed for demonstration purposes is shown in figure 3. Six special risk areas or zones are indicated. The fires in each area are identified as to general and specific causes, who starts them, why they are started, when they are started, and whether damage is great and suppression costly. The analysis is assumed to reveal the following details.

Special Risk Area 1 is along the railroad. All fires are fusee fires caused by rear brakemen throwing the fusees from the rear of moving trains which are slowing down as they approach the town. The brakemen are careless in placement of fusees, and flammable fuels are along the railroad tracks. The fires occur between June 1 and September 30; they are very costly to control and damage has been great.

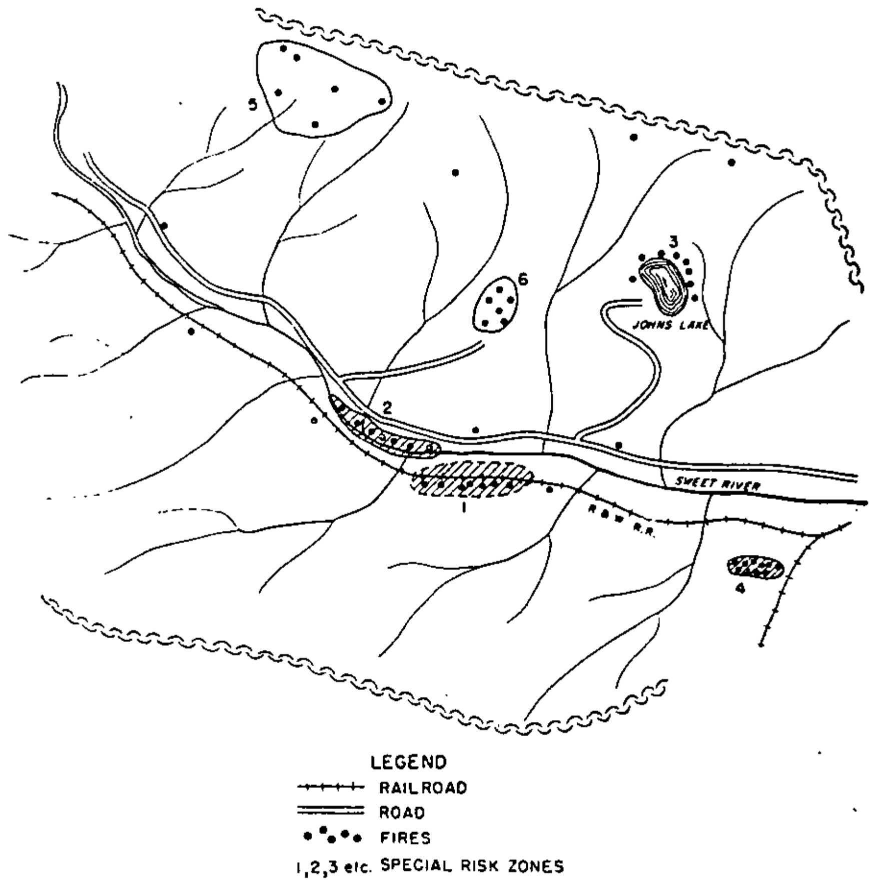

FIGURE 3.—Fire business map.

Special Risk Area 2 is along the river and the normal assumption would be that they are fishermen fires. This cannot be taken for granted; more study is required. The study would show that these fires are not caused by fishermen but by people using the swimming holes in the vicinity. The fires then are warming or cooking fires started by campers from the nearby town. No camping facilities such as stoves or tables are available, and the users are careless. The fires occur during August and up to September 15, and have not been costly to control or damaging.

Special Risk Area 3 is at Johns Lake where 50 percent of the fires are caused by smokers and the other 50 percent by campers smoking fish. No "Smoke Here" signs or other fire prevention material is posted in the area; no spots are designated or facilities provided where fish could be smoked; and the users, people from one of the valley farming areas, are careless. The fires occur from August 1 to September 15, and damage and cost of suppression are heavy.

Special Risk Area 4 is close to town. Ninety percent of the fires are from debris or rubbish burning and the remaining ten percent are miscellaneous, specifically caused by children playing with matches. Neither the town nor the county has an ordinance regulating refuse burning; the people are not watching their debris fires after starting them, and they burn during periods when winds are high and relative humidity low, and children have not been taught the danger of playing with matches. The people starting the fires live in or on the outskirts of the town. Most debris fires occur in May, the rest through the spring, summer, and fall season; the children could set fires any time of the year. Damages and suppression costs are high.

Special Risk Area 5 is high on the mountain and does not involve many fires. All fires are camp fires for cooking and keeping warm, started by careless hunters, usually during the first 10 days of the hunting season (September 16-25). Hunters may camp where they choose as there are no posted hunter camps. Since the fires are in a relatively inaccessible area where values are high and heavy fuels predominate, damage is heavy and suppression costs high.

Special Risk Area 6 is a continuing logging area. Fires are started by loggers operating power saws. Operator carelessness predominates but some fires are started by hot power-saw mufflers coming in contact with moss and other light fuels. Fires occur during July, August, and September, and suppression costs and damage are high.

The fire business map shows about 10 other widely dispersed fires. These should also be analyzed and the information recorded for consideration when final prevention plans are made.

Where are man-caused fires resulting in excessive damages to resources and high suppression costs.—It is extremely important to prevent fires in high hazard areas such as those with heavy logging slash or in other areas where fires usually become difficult and costly to control. Similarly it is very important to prevent

fires from starting in or adjacent to areas where values are high. These areas involving high suppression costs and supporting high values must be identified for special consideration in the development of prevention plans. This is usually done by delineating such areas on the maps to be used.

Media of Prevention

After completion of the analysis all the prevention devices and tools that are available and may be applied to the problem should be listed and examined. Special attention should be given to the prevention media or tools that assure the best results in reducing the number of man-caused fires in relation to the amount of energy applied. Prevention media will include the following:

Laws, ordinances, regulations.—A review of applicable laws, ordinances, regulations, or other legal means regulating use and care with fire should be made to explore the probable need for additional legal authority.

Contracts, permits, easements.—All existing contracts, permits, easements, and similar documents regulating operations should be reviewed to determine if they are adequate or additional stipulations are required.

Fire prevention signs.—The public is entitled to know where it may camp, under what conditions smoking is permitted, whether or not fireworks are permitted, and those other laws, ordinances, and regulations regarding the use of and care with fire that can be briefed on signs and posted. Also fire prevention signs are one means of conditioning the public to the dangers inherent in the use of fire. A study of available sign material and additional material required is essential.

Education.—Overcoming carelessness, and ignorance, is the most difficult problem facing control managers since it involves changing the habits of people. It involves such things as getting people to break their matches; use the ash trays of their cars; build camp fires in safe places and put them out before leaving them; burn debris at the right time and with proper preparation; shoot off fireworks away from high hazard areas; clean up flammable debris in and around buildings; etc.

Methods used to overcome carelessness are mass education, group contact, individual contact, and special letters. Mass education may be accomplished through radio programs, television, theaters, press releases, feature articles, displays, posters, and general publicity. The Cooperative Forest Fire Prevention Campaign and the Keep Green programs are excellent examples.

Group contact permits local level contact with many individuals, saves time, and is less costly. It is particularly useful in reaching schools, civic organizations, labor unions, etc.

Individual contact, friendly, planned, and skillfully directed, has proved to be much stronger than the mass education or group contact approach in reaching the miner, local settler, logger, cattleman or herder, construction foreman, resort operator, and other individuals who may be somewhat isolated.

Special letters provide another medium of planned friendly contact in educating people in the need for care in their "use of fire." By such letters the fire control manager can reach the hunter immediately before hunting season, and miners, lumbermen, stockmen, and other users of wild lands at appropriate times.

General and special prevention patrol.—This prevention tool is used extensively in many areas to check on compliance with prevention laws, rules, and regulations. It is ideally suited to fire prevention inspections of summer houses and local residences, woods operations and logging equipment, camp grounds, debris burning, hazard reduction, fishing and hunting areas, group out-of-door celebrations, power lines, construction work, etc.

Law enforcement.—All forest fire laws—Federal, State, county, municipal—must be strictly and impartially enforced. Every man-caused fire should be thoroughly investigated to determine whether or not the fire was the result of any given set of facts or circumstances constituting a trespass against the applicable laws, ordinances, and regulations. Whenever evidence that is deemed acceptable in court identifies the offender, the case should be recommended for prosecution.

Civil liability of trespasser.—The States and the Federal Government have legal rights equal to those of the citizen to recover losses occasioned by injury to its property or enforced expenditures of its funds. Prosecution to recover enforced expenditures and losses to its property where the trespasser is held responsible by the courts is one means of impressing on the public its responsibility for extreme care in the use of fire. Civil liability can be a strong prevention tool.

Closures and restrictions.—Closures and restrictions, where legally authorized, are used extensively to reduce the number of man-caused fires. Such measures involve restrictions as to entry or use. Restrictions as to entry include closure of areas to all forms of public use; closure to entry except under registration or permit; and entry conditioned on the user being equipped with fire fighting tools. Restrictions as to use may prohibit the setting of or use of fire; building a camp fire in an unsafe place; using steam boiler or internal combustion engines unless equipped with approved spark arresters or combination exhaust muffler and spark arrester; disposing of burning material in any place where it may start a fire or discharging of fireworks except in designated areas; possession or use of tracer ammunition.

Application of closures and restrictions involve certain principles. Problems must be identified, necessary measures analyzed, and the most feasible course of action selected. Public support is enlisted by providing full information and publicity—some time in advance if practicable—on why such action is necessary. Careful adjustment of closures and restrictions to both the areas and periods for which they are needed must be made and plans and personnel adequate for effective enforcement provided. Prompt removal of restrictions and closures as soon as changes in burning conditions make it possible is necessary. The public must

be notified when closures and restrictions are initiated and when they terminate.

Hazard reduction.—It is recognized that it is impossible to prevent all man-caused fires or to eliminate all the risk. To minimize risk requires the removal of critical hazards (flammable fuels) from the vicinity of the risk. Removal or reduction of fuels in which fires may start is particularly adaptable along railroad and highway rights-of-way; around sawmills and other industrial operations in the forest, towns, summer home tracts, military encampments, camp grounds and picnic areas, and isolated homes in wild land areas; on logging areas through slash disposal and snag felling; and in connection with power lines.

The Fire Prevention Plan

Analysis of the fire business of a unit and a full understanding of the media of prevention set the stage for the preparation of a Fire Prevention Plan. This plan must be specific, not general. It must use the "rifle," not the "shotgun," approach to each specific prevention problem. Specifically it must answer the questions: *What?*—the specific fire prevention job requiring action; *where?*—its location; *how?*—what fire prevention media will be used; *when?*—time prevention work will be done; *who?*—what individual has the primary responsibility for the assigned prevention task; *completion*—some means to indicate the job has been completed and when; and *inspection for compliance.*

The Fire Prevention Plan would involve two principal phases: education of the users of an area to obtain their support for the fire prevention program and to be careful in their use of fire, and specific steps certain individuals, firms, and the agency responsible for fire protection must take to prevent fires from occurring in the area.

Education of the Users of an Area

Education of the users calls for a specific action plan for general fire prevention work that requires definite answers to the seven points listed above as applied to the fire prevention sign plan, radio, television, press, and individual and group contacts.

Preparation of a fire prevention sign plan would involve determining steps to be taken and assigning specific responsibilities for each phase of the work. Necessary steps could include mapping location of signs, selecting type of sign for each location, ordering signs, constructing and establishing sign posts and backboards, setting time standards such as dates for putting signs up and taking them down, and inspecting work.

A similar procedure is followed for radio, press, and television answering the questions what will be done, when will it be done, who will do it, where, how, etc.

Individual contacts are a very important part of any fire prevention plan. Since not all individuals, especially in areas of heavy population, can be contacted personally, careful selection

is necessary. These contacts involve: Name of each individual, his chief interest, reason for contact, what will he be contacted about, who shall do it, when should it be done, his reactions, recommendations for future contacts.

The basic principles and the methods of procedure involved in individual contacts can also be applied to group contacts.

Specific Action Plans for Special Risk Areas

The special risk areas determined from analysis of the available information and the fire business map require specific action programs covering the seven points what, where, how, when, who, completion, and inspection. For the section included in the sample fire business map work involved in the special risk areas may be: Area 1.—Hazard reduction by the railroad company along its right-of-way with particular emphasis on this area, and meeting with labor unions, brakemen, and company officials to obtain more care in placement of fusees. Area 2.—Development of camping and picnicking facilities near the swimming holes. Area 3.—Provide facilities for smoking fish, post spots where smoking may be done safely. Area 4.—Special rubbish clean-up campaigns in and around town; and meetings with civic groups to get the townspeople to impress on their children the danger coming from playing with matches. Area 5.—Arranging delay of 10 days in the hunting season to allow for the fall rains that usually occur at that time, limiting camping by hunters to specific camps, and posting areas cautioning hunters to be careful with their camp and warming fires. Area 6.—Examining the timber sale contract to determine if authority is provided to regulate conditions under which power saws may be used; preparing operating rules for power saws; working with the manufacturer toward the design of a muffler that will not start fires.

One system that may be used in briefing the planned prevention work is as follows for two of the special risk areas:

Special Risk Area 1.
- What—Elimination of fusee-caused fires.
- Where—Along railroad right-of-way with specific emphasis on risk area.
- When—By summer of 1953.
- How—Examine stipulations in right-of-way agreement to determine responsibility of railroad company in prevention of fires occurring on right-of-way.
  - When—January 1953.
  - Who—Fire control manager and legal advisor.

  Meet with railroad officials to discuss their responsibility in preventing fusee fires and formulate plans for prevention of such fires.
  - When—January 1953.
  - Who—Fire control manager and legal advisor.

  Meet with union officials and brakemen to obtain their cooperation in preventing fusee fires.
  - When—January 1953.
  - Who—Fire control manager.

  Hazard reduction along right-of-way with particular emphasis on risk area.
  - When—March and April 1953.
  - Who—By and at the expense of railroad company. Technical assistance and inspection by fire control assistant or fire control manager.

Completion—Report of progress and date of completion of hazard reduction work.
Inspection for compliance—Patrolman will check rear brakemen for fusee placement to determine if more care is being followed in the use of fusees. Time: June 10 and 20, July 10 and 20, August 10 and 20, September 10. (Inspection for compliance with stipulations in agreements, permits, etc., is essential.)

Special Risk Area 2.
What—Elimination of camping and cooking fires as causes for fires.
Where—Swimming hole on Sweet River.
How—Survey area to determine what camping facilities are needed.
When—January 1953.
Who—District ranger.
Make plans and schedule construction of facilities.
When—March 1953.
Who—Forest engineer.
Attend town meeting and inform townspeople of improvements to be constructed and why. Also impress upon them the need for their cooperation.
When—April 1953.
Who—Fire control manager.
Press and radio releases.
When—June 15, 1953, and every two weeks thereafter.
Who—Fire control manager.
Post fire prevention signs, in accordance with sign plan, along highway prohibiting camp fires at any other location along river.
When—June 1953.
Who—Patrolman.
Completion—Report on construction of camping facilities on Sweet River.
When—June 1953.
Who—Forest engineer.
Inspection for compliance—Patrolman will inspect area each weekend from July 1 to September 5.

Device for Filing a Double-Bitted Ax in the Field

A safe, simple, and efficient device for filing a double-bitted ax was designed by Harold E. White, Webb Lookout, Olympic National Forest.

This device consists of a 10-inch length of 2 by 4 and a 12-inch piece of wood ¾ by 2 inches. One edge of the 2 by 4 is cut concave to fit the bit of the ax.

The piece of 2 by 4 is nailed to a stump or other flat surface with the concave side down. The ¾-inch piece is placed under the bit to be filed and should project slightly beyond the cutting edge (fig. 1). A nail at each end, approximately 1 foot from the two pieces, will hold the ax in place.

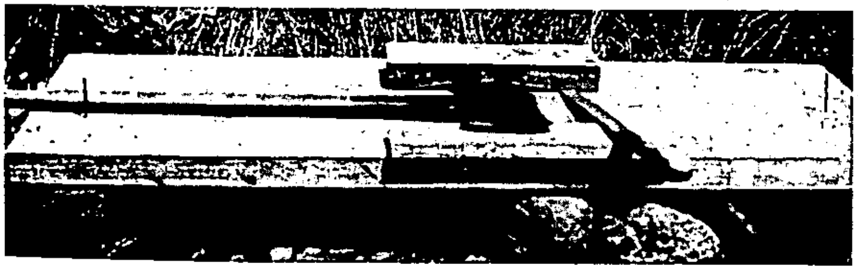

FIGURE 1.—The double-bitted ax in place and ready for filing.

The 2 by 4 prevents the file from going too far and cutting operator's hand. The ¾-inch piece prevents hand from touching ax.

This is a handy device at guard and lookout stations and for field crews where double-bitted axes are used.—W. E. WHEELER, *Fire Staff Assistant, Olympic National Forest.*

FIRE PREVENTION EFFORTS PAY OFF IN THE NORTHEAST [1]

A. W. LINDENMUTH, JR., *Forester, Division of Fire Research, Southeastern Forest Experiment Station,* and J. J. KEETCH, *Forester, Region 7*

The frequency of forest fires in the 13 northeastern States dropped about one-half from 1943 to 1950, exclusive of the effects due to weather. The analysis includes all fires, practically all man-caused, that burned on State and private lands (about 99 percent of the total number of fires in the region) on days when fire danger measurements were made.

The average downward trend and the annual observations from which the trend is determined are shown graphically in figure 1. Each dot represents the annual ratio (called fire frequency) of fire occurrence to fire expectance.

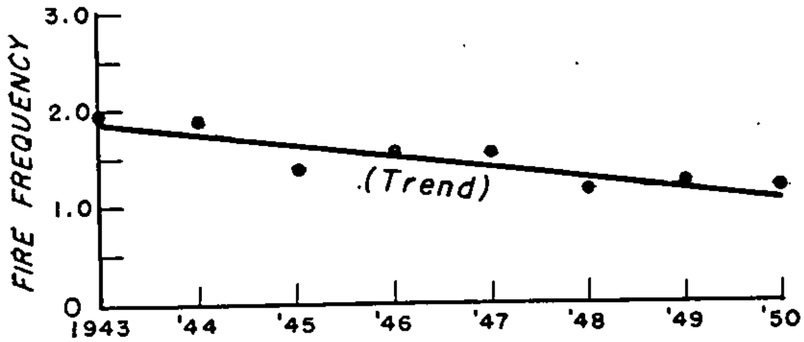

FIGURE 1.—On an average, fire frequency (the ratio of fire occurrence to fire expectance) declined in 13 northeastern States from 1.9 in 1943 to 1.1 in 1950.

Fire occurrence and fire expectance are shown in figure 2. Fire occurrence is the actual number of fires that burn. Fire expectance is a computed number proportional to measured fire danger. The computation is easy in the East where the burning indexes read from the meters are directly proportional to the average number of fires that burn. Burning index is multiplied by a constant (number of fires that burn per unit of burning index) to get fire expectance. Trial constants (number of fires divided by units of burning index) are calculated by seasons for each year during a five-year base period. The data are sorted by seasons, sometimes by months, when seasons and months are closely associated, because the number of hunters, picnickers, and

[1] Also published as Southeastern Forest Experiment Station Research Note No. 12.

other visitors to the forests varies by seasons. The three lowest trial constants out of the five calculated for each season are averaged. This average is the constant used in calculating fire expectance. By calculating the constant in this manner, fire expectance becomes a fire prevention goal. The objective is to reduce fire occurrence to or below the level of fire expectance and to hold it there; that is, to attain and hold a fire frequency of 1.0 or less.

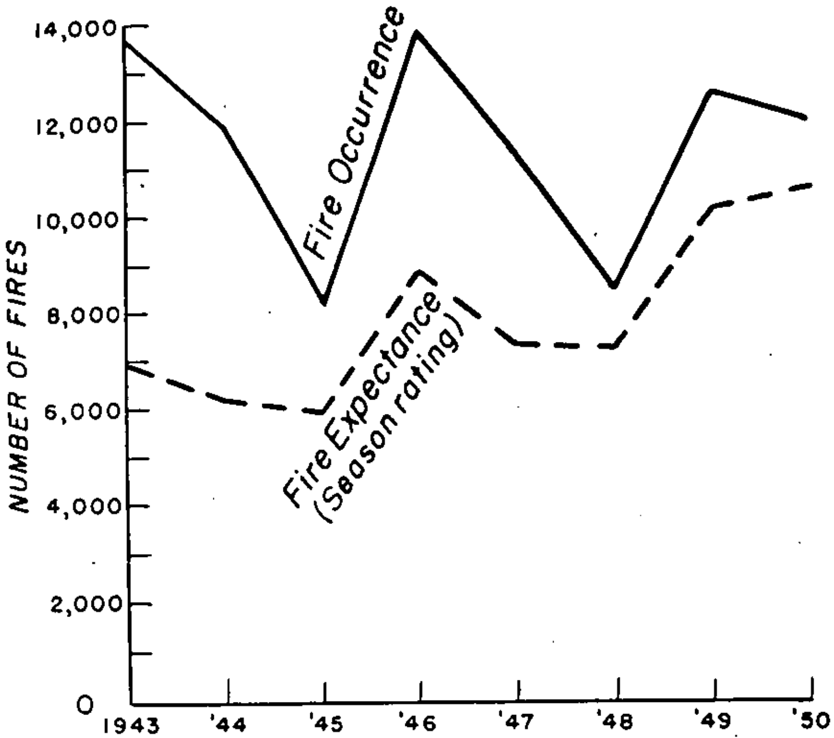

FIGURE 2.—Fire occurrence (the actual number of fires that burn) and fire expectance (a computed number proportional to measured fire danger) vary widely because of influences of weather. This variation can largely be eliminated by transforming these data to fire frequency.

By transforming fire occurrence and fire expectance to fire frequency, the effects of weather are largely eliminated from comparisons between years on the same area, and the error owing to differences in population, fuel types, land use, and other factors in comparisons between areas also is greatly reduced.

The decline in frequency of forest fires is common to most of the 13 northeastern States, particularly during the last 5 years of the period. During the postwar years there was a downward trend in 11 States, very little change in 1, and a moderate increase in another. The decline was sharpest in Kentucky, Pennsylvania, Virginia, Connecticut, and West Virginia, in the order listed.

While the degree of change varies by States, there is no indica-

tion that the location of a State affects the trend. There are differences between States because each State places a different amount of emphasis on fire prevention, employs different methods and techniques in preventing fires, and faces different fire prevention problems. However, variations are not extreme, so the data may be pooled to make up a regional picture, as has been done in the figures.

The regional observations form a relatively orderly pattern around the average trend line with small deviations predominating. Hence, it may be inferred with some confidence that the downward trend is a caused effect rather than a happenstance. The most rational explanation in view of no significant population change, particularly no decrease, is that money spent for organized and sustained fire prevention programs is buying a significant reduction in the frequency of forest fires.

What the trend in fire frequency is by causes cannot be inferred with confidence, however. The analysis was not designed to get this information; to get it, each cause would have to be analyzed separately. But some indication of what the answer may be can be obtained by tabulating the percentage of fires attributed to each cause by years and examining the tabulation for trends. From such a tabulation it appears that the frequency of fires decreased in all categories, somewhat sharper than average in the smoker and railroad categories and not so rapidly as the average in the debris burner and camper categories. This suggests that the fire prevention program is eliminating fires from all causes, but it might be profitable to fortify fire prevention efforts directed specifically toward the elimination of debris burner and camper fires.

Chaos by Choice?

"Some of the principles which we are about to discuss call for action which seems to be contrary to human nature. As a whole these principles call for conscious, continuous, and well-organized management and supervisory processes. It is not human nature to be orderly and well organized. Human instincts have to be curbed, human attitudes changed, and human beings inspired in order to bring about orderly and systematic activities on the part of human beings. Furthermore, it is not particularly dramatic to live in a well-organized and orderly fashion. It seems that human beings by nature would rather find themselves in emergencies and then rise to the challenge of those emergencies than carry on their activities in such a way that the possibility of emergencies is reduced. There is much more drama in becoming the hero of an emergency than there is in carrying on our activities in such an orderly fashion that there is no emergency." Excerpt from a talk on Basic Administrative Practice, by Lawrence A. Appley, now president of the American Management Association.

FIRE TOOL BOX MOUNTED ON EQUIPMENT TRAILER

R. N. McCULLOUGH
District Ranger, Snoqualmie National Forest

The White River Branch of the Weyerhaeuser Timber Company has developed a heavy trailor unit to carry the necessary fuel and equipment for each tractor side. On top of the tank of this trailer are brackets to which a fire tool box can be bolted during the fire season and where it is not apt to be damaged. In this way

the fire tools are always near at hand and never forgotten at the last landing.

This has proved to be a much more satisfactory way of maintaining good fire tools than handling the box as a separate unit.

FIRE WEATHER FORECASTS

FRED M. FITE

Regional Fire Dispatcher, Region 1, U. S. Forest Service

Special fire weather forecasts can be of great help to the fire boss, and also a money saver, if the fire weather forecaster has the proper information on which to base a forecast, and the officer in charge of the fire will have enough confidence in the forecast to take advantage of that information.

On at least two occasions, to my personal knowledge, while Ralph S. Space was assistant chief in the Region 1 Division of Fire Control, he prepared to backfire in the face of apparently adverse weather conditions. He did this on the strength of special forecasts received, and was very successful. Had he waited until the weather actually changed, it would have been too late to take advantage of the temporary change.

The following is quoted from his report: "Most of the manpower (some 900 men) was concentrated in preparing a close-up flanking attack . . . special weather forecast indicated . . . a southeast wind. Forces were shifted and tactics changed to backfire preparations . . . the wind changes, lines held, thousands of dollars saved . . ."

All of the fire weather men are just as anxious to give a helping hand with special forecasts as the fire control men should be to receive them. That these two desires do not always dovetail to result in maximum use of the aid meteorologists can give is due to a number of things. Some of these can and should be remedied.

The fire control man should not hesitate to get in touch with the fire weather meteorologist whenever he needs help with respect to weather information. In some areas communications are still very poor, but the forecasts can certainly be worth the price of a few phone calls.

Forecasts are based on a tremendous amount of observational material (radio soundings, pilot balloon observations, and many surface observations) which the meteorologist has at all times. While it is true that sharp localization cannot be made without knowing the exact location of the fire, still there is much information the meteorologist can give to aid fire control management in estimating needs even before the complete details are known. I believe that special forecasts should be asked for as soon as there is knowledge that a fire exists, with the understanding that the meteorologist will give what information he can and that more exact forecasts will be forthcoming as soon as other information can be forwarded to the weather office.

In order for the forecaster to make an accurate special forecast for a given fire, he should have certain information from the area of the fire. Following are some suggestions:

The forecaster should have a thorough understanding of the location, elevation, aspect and steepness of the area. He should

also know the approximate size of the fire or area to be burned. If possible, the forecaster should visit the area for any large operation such as broadcast burning, helicopter spraying, etc., before operations begin.

When it is possible to supply the information, weather factors should be measured at a station representative of the area to be covered by special forecast. Use an established fire danger station as a sampling station, if one is available. Otherwise, set up a temporary station and be sure the forecaster is informed of its exact location.

Here in Region 1, whenever it is available, our forecaster would like to receive at 1 p. m. on the day preceding that covered by the forecast, the maximum and minimum temperatures and relative humidity during the preceding 24 hours; the current wet and dry bulb temperatures; wind velocity and direction recorded at noon; plus the current observations of wind directions in the canyon bottoms and across ridges.

The field man should not gain the impression that if weather information is not taken at a specific time that it is of no value to the meteorologist. On the other hand, when an observation is taken, then it is of the utmost importance that the forecaster know when and where it was taken.

Many times a forest officer will go to a fire with only a pocket sling psychometer. If he can take a careful reading of the wet and dry bulb values, and estimate the wind velocity and observe the direction, that information, together with the time and place of observation, should be forwarded to the forecaster, along with the initial request for a fire weather forecast.

If the fire remains uncontrolled and becomes a large project operation, it would be well to set up a weather station on the fire, if there is none nearby located representatively, and proceed to report weather as follows:

At 8 a.m., maximum and minimum temperature preceding 24 hours.

Current dry and wet bulb temperatures.

Sky conditions, together with any change in sky conditions during past 12 hours.

Wind direction and velocity, and location of station. Wind direction and velocity over ridges if that is available, either from a nearby lookout or by estimation.

Maximum humidity during night and minimum humidity yesterday afternoon, if a hygrothermograph is available.

At 4 p.m., current wet and dry bulb temperatures, sky conditions (indicate change, if any, since 8 a.m.), wind direction and velocity at station and across ridges.

For well-defined, small areas, forecasts should hit temperatures with an accuracy of plus or minus 5 degrees, and relative humidities with a plus or minus 5 percent.

Wind is the hardest factor to forecast since it is affected by local conditions. However, the forecaster should be able to pre-

dict winds definitely favorable or unfavorable to the planned activity.

Finally, but of great importance, keep the fire weather forecaster informed of how the burn or going fire is progressing and also how his forecasts are meeting the above accuracies. This may seem of little importance to the fire control man, who is working on the fire, but it is of great importance from the forecaster's point of view.

When it is not possible to have the Weather Bureau mobile unit on the fire or project, then it is best to arrange direct communications between the project and the forecaster. Make communications a part of the operation plan to avoid confusion and encourage systematic exchange of information.

Handy Woodpacker

This simple yet convenient device for carrying wood was designed by Harold E. White, Webb Lookout, Olympic National Forest.

To construct the woodpacker mortise a piece of wood 1 by 4 by 23 inches into the middle of the edge of a piece 2 by 6 by 12 inches. A length of chain with about 56 inches of ¼-inch rope is stapled to the 2 by 6 on the edge opposite the mortise. Place the 1 by 4 piece between the front and back canvas of an Alaska type packboard so that the 2 by 6 forms a shelf at the base of the pack board. To prevent the device from coming out between the canvas, a ¼- or ⅜-inch bolt 14 inches long is placed on the under side of the 2 by 6 and through the rings at the bottom of the packboard.

FIGURE 1.—Alaska type packboard showing 14-inch bolt in place; mortised piece with chain and rope; and woodpacker in use.

To load the woodpacker, place it on a stump or log and pile wood on the 2 by 6 shelf with the chain in the clear. When wood reaches the top of the packer, pull chain and rope up over the wood and hold tight while you slip your arms into the packboard straps.

A heavy load of wood can be conveniently packed in this manner. Release the rope to unload and the wood will fall off in the clear.—W. E. WHEELER, *Fire Staff Assistant, Olympic National Forest.*

CHOOSING SUITABLE TIMES FOR PRESCRIBED BURNING IN SOUTHERN NEW JERSEY [1]

S. LITTLE and H. A. SOMES,[2] *Northeastern Forest Experiment Station, U. S. Forest Service,* and J. P. ALLEN, *New Jersey Department of Conservation and Economic Development*

INTRODUCTION

Prescribed burning is useful in managing pine-oak forests in the Pine Region of southern New Jersey. It favors reproduction of pine by preparing suitable seedbeds; it checks the development of hardwood reproduction; and it protects against wild fires by reducing the amount of fuel on the forest floor (*3, 5, 6*).[3]

Prescribed burns are now being used on both State and private lands in southern New Jersey. Foresters select the areas to be treated, map the operations, and suggest other silvicultural practices and improvements (such as roads and firebreaks) to be used in conjunction with the burning treatments. The actual burning is done by trained crews whose wages are paid by the owner. The State Department of Conservation recommends qualified crews, and all burning is done under permits issued by this Department.

The ideal fires for these periodic burning treatments are light (*3*). Usually the flames are so low on upland sites that a man can readily walk through them; the flames generally rise not more than a foot or two above the ground. Such fires do not consume all the fuel, but they lessen the depth of it greatly.

This type of fire should be obtained, if possible, when burning with the wind. Although fires set against the wind have given satisfactory results, they spread more slowly, and are much more costly, than fires set with the wind (*4*). And since upwind fires require drier fuel, they may cause excessive damage if the wind shifts.

Using fire this way as a silvicultural tool is still more an art than a science. Experience and skill are necessary to obtain fires of the desired intensity. The biggest problem of all in using prescribed fires is to choose the suitable time for burning.

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[1] Also published as Station Paper 51 by the Northeastern Forest Experiment Station.

[2] Stationed at the Lebanon Experimental Forest, New Lisbon, N. J., which is maintained by the Northeastern Forest Experiment Station in cooperation with the New Jersey Department of Conservation and Economic Development, Bureau of Forestry, Parks, and Historic Sites.

[3] Italic numbers in parentheses refer to Literature Cited.

Choosing the Proper Time

Choosing the proper time is highly important in getting a satisfactory fire. When fuels are too dry or the wind is too strong, the fire may cause excessive damage. At the other extreme, when fuels are too wet, much time may be wasted. Attempts to burn on unsuitable days have increased the cost of treating certain tracts by as much as 400 percent.

Winter Months are Best

The winter months have been found the best for prescribed burning in southern New Jersey. Suitable conditions are usually found between Christmas and March 1—although in some years they have been found as early as December 1 and as late as March 20.

During this period changes in fuel moisture are relatively slow; so there is less chance that fires will increase greatly in intensity during the burning of a tract. There is also less danger of heat injury to trees during this period. The chance of killing the foliage of young pines is much less when air temperatures are below 50° F. than on warmer days.

However, the number of days suitable for prescribed burning during a winter is limited. During the winter of 1946-47 there were 38 suitable days; the winters of 1947-48 and 1949-50 offered only 20 days each.

Choosing the Right Day

In choosing the right day for making a prescribed-burning treatment, the fire-danger-rating system developed by the U. S. Forest Service for use in the eastern United States (*1*) can be used as a guide.

A word of caution is needed here. One must bear in mind that the fire-danger-rating system was not designed for this purpose. It was designed primarily to help forest-protection workers predict when accidental forest fires are likely to occur during fire seasons.

In prescribed burning, the fire-danger ratings can serve only as rough guides to fire behavior and intensity. They cannot be expected to provide exact measures of burning conditions. Their main usefulness in prescribed burning is in setting the upper and lower limits of probable burning conditions.

In 4 years' experience with prescribed burning in southern New Jersey, successful burns have been made when the danger rating was as low as 3; and safe burns have been made when the danger rating was as high as 30.[4] However, when ratings approach 30, conditions are likely to be too dangerous for burning. The greatest proportion of satisfactory burning days (75 percent) occurred when the danger ratings were between 10 and

[4] Fuel moisture, wind velocity, condition of the vegetation, and season of the year are the factors used in predicting fire danger. These are integrated on a fire-danger meter, which indicates the danger rating on a 100-point scale.

15. Of all the days that had ratings between 5 and 25, 63 percent were favorable for burning.

Within this range of fire-danger ratings, however, one must rely on judgment and experience to determine local burning conditions. Flammability varies greatly according to many factors, including topography, kind of stand, fuel type, amount of fuel, and past and present weather conditions.

For example, in winters of below-normal precipitation most of the burning has been done at low (5-10) danger ratings, and in winters of above-normal precipitation at higher (10-25) danger ratings.

Effect of weather conditions.—Suitable times for burning when the fire-danger rating is relatively high (20-30) are usually in periods when past precipitation has had a greater effect on natural fuels than the fire-danger measurement indicates. For example, cool moist weather between storms has sometimes caused a difference between fire-danger rating and actual flammability.

Suitable times for burning when the danger rating is very low usually follow periods of higher danger. Then the duff may be dry enough for satisfactory burns, although the measured danger rating is very low because of (1) little wind and (2) the effect of a heavy frost, dew, or light rain or snow.

Effect of fuel type.—Burning conditions in southern New Jersey vary appreciably with the local fuel or forest type. On upland sites, the actual flammability may be lower in pure pine stands than in pure oak stands during the dormant season. This is partly because the pines provide more shade, partly because the pine needles form a more compact and slower-drying litter than oak leaves. Consequently, prescribed fires in several upland tracts have died out, or lessened greatly in intensity, under clumps of pine. Also, on some days when actual flammability was too high for burning oak-pine stands, stands of nearly pure pine could be treated.

Although the open canopies in pine-scrub oak stands permit higher wind velocities and more rapid drying of fuels (*2*), the actual flammability may sometimes be lower than in oak-pine stands. This is because scrub oak leaves are smaller, form a more compact litter, and provide less duff than black, white, and chestnut oaks. (In these respects scrub oaks are more like southern red and pin oaks.) As a result, some prescribed fires have not burned in spots where 20-year-old scrub oaks formed dense thickets, even though they spread through the arborescent oak areas. And stands of pitch pine and scrub oaks have been successfully treated at times when the flammability was too high for burning oak-pine stands.

Pine swamps have moister soils, usually more open overstories, and more fuel in shrubs and duff. Thus, pine swamps have sometimes been too wet to prescribe-burn, or at other times would burn too hard, when at the same time oak-pine stands have been treated successfully.

Effect of amount of fuel.—In all fuel types, suitable times for prescribed burning vary with the amount of fuel. In areas being treated for the first time the fuel is usually more abundant and more continuous than in previously prescribe-burned areas. Consequently, if the first prescribed fire is to be light, a time must be chosen when much of the lower fuel is too wet to ignite. In contrast, the more frequently and more recently the area has been treated, the less fuel is usually available; then a burn can be made at the higher fire-danger ratings and still produce a light fire.

However, there are some days that provide suitable conditions for both initial burns and reburns. On these days the litter may be dry, underlying duff wet, air temperatures relatively low, and the wind light.

Time of Day

Time of day is important too. Usually burning conditions build up to a peak of severity in the early afternoon. Hence more care has to be taken in firing tracts in the morning than in afternoon or evening, because there is a much greater chance that morning fires may later increase in intensity.

Recommendations

Use of Fire-Danger Ratings

Subject to the cautions that have been pointed out, fire-danger ratings can be used as a rough guide in determining suitable times for prescribed burning as follows:

In oak-pine stands.—Satisfactory burns can probably be made at fire-danger ratings of 10 to 15, sometimes at ratings of 5 to 10 or 15 to 20.

In upland pine stands.—The range of danger ratings on days suitable for burning upland pine stands is similar to the range for oak-pine stands—but more flexible. Sometimes upland pine stands have been burned when fuels in oak-pine stands were too dry for safe burning. Sometimes they have been burned at low danger ratings. Usually these times—as in oak-pine stands—were during or just after a light precipitation that followed a dry period.

In pine-swamp stands.—Danger ratings have been less useful in predicting burning conditions for pine swamps. Satisfactory burns of pine swamps have been made at ratings of 5 to 20. Unsuccessful attempts have been made, because of too-dry fuels, at ratings of 3 and up; and, because of too-wet fuels, at ratings of 25 and less. Only 35 percent of the attempts to burn pine swamps with light prescribed fires have been successful.

Use of Test Fires

A test fire may be used to check actual burning conditions against the fire-danger rating and local fuel conditions.

Usually a small patch of litter in the woods is used. If a carefully placed lighted match will start a fire of slightly less than the desired intensity, then an attempt to burn tracts having similar fuel can be made.

If there is any question about how a fire will behave, the usual procedure is to try first a "backing" fire, changing to a "quartering" fire, and then to a headfire if the behavior of the fire indicates that the change will be satisfactory. Because all of the perimeter of a tract is usually fired anyway, that procedure does not greatly increase the cost of burning. Under proper conditions, the use of both headfire and backfire in a tract does not cause a damaging flare-up when they meet.

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METHODS OF REINFORCING STANDARD 5-GALLON GASOLINE CANS FOR DROPPING

AERIAL EQUIPMENT DEVELOPMENT CENTER

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The Aerial Equipment Development Center at Missoula has completed tests of various methods of reinforcing the standard 5-gallon gasoline can to withstand greater impact without rupture. These cans are used to a large extent for delivery of water to fire fighters by parachute because of their light weight, availability, and reasonable cost. Re-use or return from the fire is not contemplated and therefore any method of reinforcement must be inexpensive and at the same time reduce materially the percentage of loss.

Five-gallon gasoline cans were filled with water and dropped from various heights onto a plank platform to establish the height of the "gallows" from which succeeding drops would be made. This was established at 10 feet, which we believe will provide a sufficient safety margin for free-fall drops from helicopters (requested by the California Region) and reduce materially the failure of cans dropped by parachute. At this height the standard cans suffered almost 100 percent loss when dropped in an upright position. The release mechanism used a quick-release safety-belt buckle with release line attached in order to give uniformity of drop position.

Test drops were conducted in series. Cans were full except in two series of five cans each in which a 1½-inch airspace was left. One can out of five in each of the first six series of tests was dropped on gravel and turf for comparison, but the results showed no significant difference. For information, two drops were made with cans landing on the side, and one drop with friction and adhesive tape to determine if tape with less tensile strength than the filament tape would be satisfactory.

Results of the drops were as follows (figs. 1-3) :

Type of protection or reinforcement	*Cans in test (number)*	*Landing position*	*Results*
None	5	Flat	Four cans split at seam 4 to 12 inches; fifth can developed slight leak.
None	5	Corner	Corner crushed in 4 to 6 inches; no leaks.
None [1]	5	Flat	Both seams of four cans and 1 seam of the fifth split 6 inches.
None [1]	5	Corner	Corner crushed in 4 inches; no leaks in three, pinhole leaks in two.
Board pallet (¾-inch) on bottom.	4	Flat	One or both seams ripped 3 to 10 inches; board broken on one can.
Board pallet (¾-inch) on bottom.	1	Corner	Board not broken; no leaks.

Type of protection or reinforcement	*Cans in test (number)*	*Landing position*	*Results*
Boards banded on 4 sides and projecting 3 inches below can bottom.	2	Flat	2 boards broken on each; 1-inch hole in top of one, 4-inch split in seam of other.
Boards banded on 4 sides and projecting 3 inches below can bottom.	3	Corner	1 or 2 boards broken; no leaks except small rock puncture in bottom of can dropped on turf.
C-8 (2,900-pound) webbing.	2	Corner	No leaks.
C-8 (2,900-pound) webbing.	3	Flat	No leaks in two, hairline leak in seam between webbing in third.
Corded or filament scotch tape, 4 strips 2 inches apart.	3	Flat	No leaks in two; pinhole leak in bottom seam of third.
Corded or filament scotch tape, 6-inch strips ½ inch apart.	3	Flat	No leaks in two; pinhole leak in seam between strips on third.
Corded or filament scotch tape, seams taped solid.	4	Flat	No leaks in three; pinhole leak in bottom seam of fourth.
Seams heavily taped with adhesive.	1	Flat	Both seams split 6 inches.
None	2	Side	1-inch tear, top and bottom corners.
Boarded on 4 sides.	2	Corner	Small rock punctures in bottoms, landing on turf.

[1] Cans had 1½-inch airspace, all other cans were full.

From these tests it is apparent that the cans reinforced with the corded scotch tape are the most durable. This method of reinforcement is also the most economical of the various methods tried. Using the ¾-inch tape available the cost per can is approximately 20 cents. No doubt the tape can be secured in 6- or 8-inch widths, and a single square patch with the reinforcing cords placed across the seam of the can will provide still greater protection. The cost of the tape should be materially reduced with purchase of several rolls.

Another factor which affects the distribution of impact forces is the attitude or angle of the can at the instant of impact. Nearly all of the cans which were dropped on one corner withstood the impact without rupturing the seams. Occasionally the crimp in the bottom of the can would develop pinhole leaks. A couple of the cans with smashed corners had microscopic leaks which were not apparent until some time later when the cans were again inspected for loss of water. These pinhole leaks are not considered serious because of the time required for any appreciable amount of water to escape. However, any can dropped should be inspected immediately and placed in position to retain the water, should any leaks have developed.

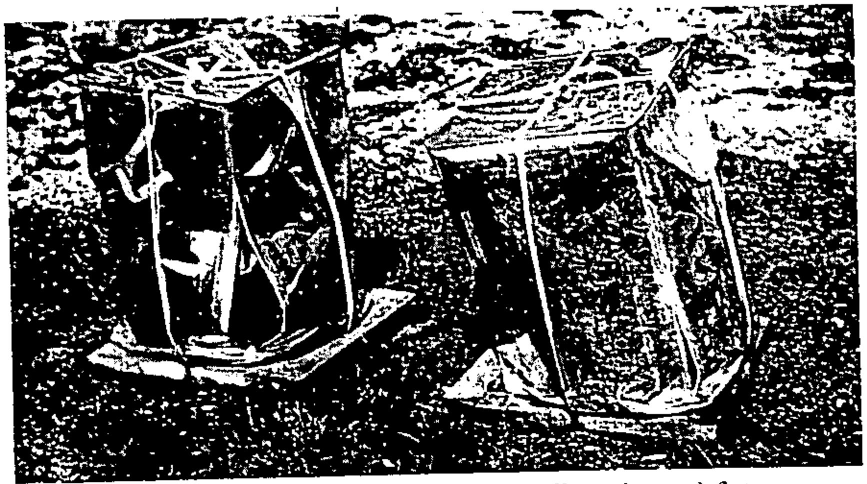

FIGURE 1.—Cans protected by ¾-inch board pallets, dropped flat.

It was reported earlier in the tests that full cans withstood impact better than those with an airspace left at the top. Completed tests do not bear this out since there apparently is little or no difference.

Field tests using four small cargo chutes (rated at 25 pounds maximum load) loaded with full cans, total weight 42 pounds, proved the effectiveness of corded tape reinforcement. The two unprotected cans were a total loss; the two protected cans had no loss of water. However, the use of light parachutes (25-pound capacity) should be given further study under actual operational conditions before final recommendations.

In another test a tape-reinforced can was dropped in a winged cargo box. Water cans dropped previously in this type of container suffered 100 percent loss. On this drop the winged cargo

FIGURE 2.—Left, Can protected by ¾-inch boards banded on 4 sides and projecting 3 inches below. Right, Can reinforced with C-8 webbing.

FIGURE 3.—Both cans dropped under identical conditions. Results illustrate strength of filament or corded tape reinforcement.

container functioned well but hit the ground with considerable impact. The water can in the winged container was bulged almost round and a hairline crack was discovered in the seam under the tape. A very slow leak developed, but it is believed a solid sheet of tape would have prevented any loss of water and might even have prevented the hairline crack.

We believe the use of tape for reinforcing the standard 5-gallon gasoline can is sound and economical. The reinforced cans should also serve for free-fall low-elevation (up to 10 feet) dropping from helicopters.

PLANES VS. MULES

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Airplanes over forest fires are becoming a common sight, especially over large fires or fires in inaccessible places. The airplane is, in many instances, replacing the horse for scouting fires and transporting smokechasers, and the mule for supplying isolated fire camps. The question of whether or not cargo dropping can replace the mule in supplying isolated fires is one of the most controversial in fire control circles.

Experience on the Gila Forest in 1951 proved that the airplane is capable of delivering supplies for fire fighters in remote areas and can do the job better than mules. This article will attempt to point out some of the problems involved and will give comparative cost data on one Class D fire. Each method of supply has its advantages—and naturally, disadvantages.

A string of mules can travel day or night, during all kinds of weather, in smoke or clear areas. They can deliver supplies on ridges or in the bottoms of steep winding canyons. However, they must be rested, fed, and watered; their rate of travel is relatively so slow that the camp may be without supplies and suppression action delayed. Also, the pay load per mule is limited.

An airplane can make cargo drop flights only during daylight hours. Strong winds, low clouds or heavy smoke often hamper the drops. The location of the drop area is very important. The ideal drop area is an open space located on a ridge or in a saddle with an approach and take-off course free from surrounding mountains. The plane needs only to be serviced with gas and oil and it is ready for the next trip. The pay load of the plane is governed by its capacity, the altitude and weather conditions, but in nearly all cases is much larger than that for the mule.

The time element, so vital in fire suppression work, is definitely in favor of the airplane. Rush emergency items can be delivered within minutes by plane but by mules delivery would be "too late." The problem of assembling enough pack stock and packers to supply large fires is becoming more difficult each year. This problem increases rapidly with the increase in size of the fire to be supplied. By contrast, cargo planes are available almost overnight for any size fire.

Data from an actual 1952 Class D fire are used here to show relative delivery costs of supplies. The fire started May 31 in a rough, inaccessible area within the Gila Wilderness Area. The route of supply from the supervisor's headquarters (also the

source of supply) is 45 miles by road and 12 miles by trail. By plane, it is 80 air miles from the airbase (also a source of supply) to the fire. The first reinforcement of fire fighters arrived at the fire early June 1; the second crew arrived during the day, making a total of 57 men on the fire.

This fire was supplied entirely by air. Food, tools, beds and camp equipment were dropped at the camp the first morning. The plane made three flights to deliver 3,300 pounds of cargo. Total flight time was 6 hours and plane rental was $240 plus pilot and cargo dropper's salaries of $28.08. Disposable mess outfits and one-way cargo chutes were used. Blankets and tools were the only items packed out from the fire. This cost is the same by either method.

If the supplies had been packed in to the fire with mules, the estimated cost is as follows:

Truck mileage (base to end of road) 90 miles @ 25¢ per mile	$ 22.50
Forage cost, 28 head pack and saddle stock:	
Grain, 7 lbs. per animal per day—392 lbs. @ $6/100	23.52
Hay, 20 lbs. per animal per day—1,120 lbs @ $50/ton	28.00
Stock hire, 28 head @ $2.50 per day, 2 days	140.00
Hire of 4 packers, 18 hrs. each @ $1.35 per hr.	97.20
Total[1]	$311.22

[1] Based on four 6-mule strings carrying an average mule load of 168 lbs., 2 days per round trip, and packing forage for two feedings.

The above costs for packing are representative of costs in the Southwest. No estimate is made for either the packers' helpers or the airplane cargo packager, since these costs would be about the same. A comparison of the two costs—by air drop $268.08 and by mule $311.22—shows a definite advantage for the plane. The time of delivery by plane is of course much shorter than by mule, but this time element was not calculated in dollar values.

Experience on the Gila Forest during 1950, 1951, and 1952 has proved that in the future the airplane will in a large measure replace pack mules in suppression of forest fires.

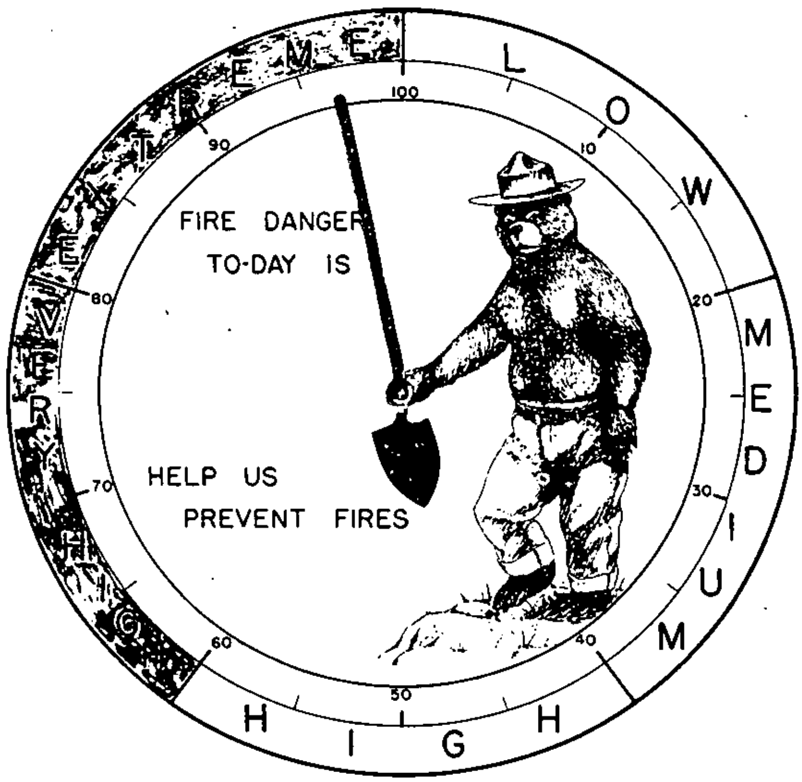
Keeping Ax Handles Tight

The July 1952 issue of Fire Control Notes contains an article on how to keep ax handles tight (Keep Your Ax Handle Tight, by H. H. Smith and S. P. Burke). When Fire Control Notes was first published, there were two short articles on the same subject (The Loose Axe-Handle Bogey, by F. W. Funke, p. 290, August 1937, and No More Loose Handles, by D. J. Kirkpatrick, p. 24, October 1938). It is recommended that after the handle has been fitted, the head end be dipped in paint, the thicker the better, and the handle then be driven in and wedged. I have used this method in Arizona's hot, dry climate and handles will stay tight in caches. For that matter, so will the woodpile ax, which is subject to all climatic conditions.—H. J. TURNEY, *District Ranger, Tonto National Forest.*

SMOKEY BEAR FIRE DANGER RATING METER

T. A. Pettigrew
Central Dispatcher, Trinity National Forest

The Region 5 fire danger rating system is based on rating areas with values running from 0 to 100. The fire danger rating is given in five brackets: low, medium, high, very high, and extreme. In most cases each ranger district is in a different rating area from its neighbor and in some instances there are two rating areas within a ranger district. For example, on the Big Bar Ranger District the extreme fire danger starts at the numeral rating of 65, while the adjoining Hayfork District enters the extreme bracket at 33. This system has always been confusing to our own personnel, especially those going to another district or forest where they had no idea what bracket the fire danger was in when given the numeral rating.



In order to overcome this situation the Trinity National Forest has made a fire danger meter with five brackets each representing 20 points on the numeral rating. On this meter the area average is 40, the division point between medium and high fire dangers; the area base index is 70, the center of very high fire danger. A conversion table was made to convert the standard Region 5 numeral fire danger rating to this new scale. The meter was made twice as large as the regular Region 5 meter for use in public places like post offices, lumber camps, and sawmills. This is a means of keeping the public in general and the lumbering industry in particular informed of the current fire danger.

In order to make the meter attract attention and give it more eye appeal, Billy Lunsford, one of our junior foresters, drew Smokey for us. Smokey's right hand is in the center of the meter so it appears that he is holding the pointer. The shovel pointers are made of acetate or plastic of a suitable thickness. These were cut out on a jigsaw; however, it would be better to have a hobby shop stamp them out. The shovel is 7½ inches in length over-all, the blade and ferrule are covered with copper colored lacquer and the handle is painted red with fingernail polish. It is necessary to buff the clear acetate or plastic before painting it.

An India ink tracing of the poster was drawn; then black and white prints were made. Smokey's pants are colored blue, the hat brown, and the rocks grey or tan. The five brackets of fire danger are also colored. The poster is secured to a piece of ¼-inch plywood. The shovel pointer is fastened in place with a screw through the ferrule and into the plywood back. This screw, when tightened correctly, holds the pointer in any position.

DISPATCHER'S RECORD ON CONCENTRATION OF LIGHTNING FIRES

T. A. PETTIGREW
Central Dispatcher, Trinity National Forest

During widespread thunderstorms, dispatchers have a problem in spotting fires on a map and recording information in some form so all information for any fire can be quickly found. In dispatching for lightning concentrations, especially when the storm causes more than a dozen fires, the standard dispatcher's log book is impractical for recording reported fires and action taken. When it is used, the dispatcher wastes much valuable time trying to determine locations of fires and checking to see what, if any, action has been taken on a given fire. Several years ago the form illustrated here was put in use on the Trinity Forest and it has proved to be satisfactory for recording information for as many as 90 fires from one storm. Brief but complete information is recorded for each fire and can be referred back to in a few seconds.

DATE	NO	NAME	DIST	DIST NO	TIME	REPORTING STA. AND BEARING	SECOND REPORT	THIRD REPORT	LOCATION	ACTION TAKEN	MEN FROM	FOLLOW-UP	LUNCHES OR FOOD SENT	EQUIPMENT NEEDED	TIME CONT.	TIME OUT	REMARKS, RADIO NO., ETC.

When the first lightning fire is reported, the dispatcher at once completes the first seven columns on this form, plus the column headed "Location." This is entered by legal subdivision. As other reports are made on the fire, they are recorded in the proper column, as is the action taken. A pin map is started using push pins with numbers in their tops corresponding with the numbers in the second column of the form. If a fire proves to be a false alarm, the pin is removed and that line on the form crossed out. By a look at the form it can be determined what fires have not been acted on, the ones which are controlled or out, and those which need supplies and follow-up.

The Trinity Forest personnel do not contend that this is the best method of recording action on a concentration of fires, but it is a workable one. It is merely offered with the thought that it might be better than some being used at present.

THE NORTHEASTERN FOREST FIRE PROTECTION COMMISSION

ARTHUR S. HOPKINS, *Executive Secretary*

Notwithstanding the fact that the Northeastern Forest Fire Protection Commission has been operating somewhat less than 3 years, it has already made substantial contributions to forest fire prevention in the seven northeastern States from New York to Maine.

This body was organized under an Interstate Forest Fire Protection Compact approved by Congress on June 25th, 1949, and confirmed by the legislatures of the several States in the region. The present officers are Chairman A. D. Nutting, Forest Commissioner of Maine, and Vice-Chairman W. F. Schreeder, State Forester of Connecticut. The Commission is made up of three members from each State; the State Forester, a member of the Joint Legislative Committee on Interstate Cooperation, and a personal representative of the Governor. The full Commission meets once each year. The planning and training phases are carried on by the Technical Committee which consists of all of the State Foresters. Its purpose, as defined in the Compact, is to promote effective prevention and control of forest fires in the northeastern region of the United States and adjacent areas in Canada by the development of integrated forest fire plans, by the maintenance of adequate forest fire fighting services by the member States, by providing for mutual aid in fighting forest fires, and for procedures that will facilitate such aid, and by the establishment of a central egency to coordinate the services of member States and perform such common services as may seem desirable.

The Compact also specifically mandates each member State to formulate a forest fire protection plan and to integrate such plan with a regional plan to be prepared by the Commission. These State plans are now substantially completed and work is actively in progress in connection with the preparation of the regional plan.

Inasmuch as the forest fire compact idea had its inception shortly after the disastrous Bar Harbor fire of 1947, the mutual aid provisions of the Compact received the greatest emphasis in the beginning. It was most obvious that if the interchange of any personnel was to be made with the most efficiency, a standard overhead organization for use in connection with large or "campaign" fires would be necessary. Such an organization has been set up and a number of training sessions have been held. The training material is worked up by a selected team of personnel from four or five States who act as instructors at an annual

training meeting in the winter. At these meetings, key personnel from the several States are given instruction which fits them to act as trainers in their own States. From two to ten men from each State have attended the several training meetings which have been called to date. It is the considered opinion of all the States concerned that this standard training alone has justified the Compact because of its effect on the morale and efficiency of the rank and file of the various forest fire fighting services.

The Commission, in its office, maintains inventories of the trained personnel in the various States as well as the kind and amount of forest fire equipment available for use in a foreign State at times of emergency.

The critical drought of last July and August furnished an example of how the Commission can act in an emergency. For the first time, the mutual aid provisions of the Compact were called into action. On the basis of information received from Maine that several large fires were burning and that no rain had fallen subsequent to the first of July, on the 26th of that month all of the Compact States were alerted and informed that very possibly Maine might require some assistance. Weekly reports were requested from each State as to the accumulated burning index and the number of fires. Contact was maintained with Maine. On August 3rd, Maine reported that there was a possiblity that, because of a high northeasterly wind, several of their large fires might be out of control within 24 hours.

The reports which had been received up to that date indicated that the woods were closed in Maine, the eight eastern counties of Massachusetts, Rhode Island, and the northerly part of New Hampshire, leaving only New York, Vermont, and Connecticut available for assistance. In addition, New Hampshire had a stubborn fire in the northerly part of the State which also presented a possibility of the need for help. The contacts with Maine indicated that, if aid was necessary, it would require only portable pumps and hose. Upon receipt of this information, Connecticut and New York were contacted to determine the quantities of such equipment available for immediate dispatch to Maine.

Early on the morning of August 4th, New Hampshire requested aid, asking for pump operators. This request was referred to Vermont which contacted New Hampshire and made arrangements to furnish such personnel, when necessary, and to stand by New Hampshire. At noon of the same day, Maine formally requested aid. Previous contacts with Connecticut had indicated that it would take them 24 hours to assemble any substantial number of pumps or quantities of hose. New York, however, had a supply available at its Saranac Inn Depot. At 1:15 P. M., Maine was notified that the New York plane was loading five portable pumps and 16,000 feet of hose and would take off from Saranac Inn about 2:30 P. M., arriving at the Old Town Airport in Maine about 4:30 P. M. This schedule was carried out and the equipment requested delivered in approximately 4½ hours. As has been previously stated, this was the first call for assistance made to

the Commission. It involved equipment only but had there been the need, trained teams of overhead personnel or individuals could also have been dispatched to Maine's assistance.

The Commission has already prepared and distributed a pocket manual covering the use of radio in the field. It is also at work on the preparation of a forest fire protection manual.

Although the Compact provides that each State shall render aid to the United States Forest Service or to other agencies of the Federal Government in combating, controlling, or preventing forest fires in areas under their jurisdiction located within the boundaries of a signatory State, the Forest Service itself is not a member of the Commission. The Compact does provide, however, that the Commission may request the Forest Service to act as primary research and coordinating agency and that the Service may accept the initial responsibilities in preparing its recommendations for a regional fire plan and also that representatives of the Forest Service may attend meetings of the Commission.

All of the States feel that the provisions, providing for the cooperation of the U. S. Forest Service, are most fortunate. They have already resulted in a much closer working relationship between the several States and the regional Forest Service officers who have given most unstintingly of their time and knowledge. Much of the progress which the Commission has made up to this point is the result of the direct contributions made by the staff of Region 7, particularly Roy W. Olson and Robert F. Collins.

Press-Radio Men Given Fire Coverage Cards

At the suggestion of newspaper and radio men who have become powerful backers of Keep Green, an identification card was evolved this year by Keep Oregon Green to help the newsmen "cover" fire emergencies. The card, signed by state forester and regional forester, asks district wardens and district forest rangers to "see that the bearer is given every courtesy when visiting your fire lines for news coverage."

The card was issued to solve what had been somewhat of a problem, according to the newsmen. They said they had often found it difficult to report fire news because of access restrictions and difficulty in locating someone able to speak with authority on what was going on. The card gets authorized press and radio men through the lines to the men in command.

TEAMWORK ON A FIRE [1]

Horace B. Rowland, *Chief, Division of Protection*
Pennsylvania Department of Forests and Waters

I believe that all of us here will agree that teamwork as we understand it is one of the most indispensable ingredients of good fire control work. We all know what it is. Details may vary a little, but the fundamental idea is that each person involved plays his part for the benefit of the over-all group or job. Personal prominence is set aside.

Perhaps we who are involved in forest fire control have more need for teamwork because so few of us have at our command an organization of our own people who can be directed at our will. Our fire control forces are usually made up of many diverse but cooperating groups. In our State, as in most, we have Federal agencies, the Forest Service and the Park Service. We also have State agencies which in turn depend upon individual fire wardens, fire companies, fire fighters, landowners, and industries.

It is the job of many of us in the supervising agencies to plan for teamwork throughout the year so that when the emergency of a fire does arise we can depend upon the many groups to work together. This teamwork is hard to get on the spur of the moment if we are unfortunate enough to find it lacking on a fire operation.

Teamwork is essential if we are to have any sort of worth while organizational planning. This is especially important on any large fire. To staff such a fire we call in those in our organization who might most nearly fill the position in question. This might result in crossing administrative unit lines. We may call in help from adjoining ranger or forest units or cross district lines. We even discuss the possibility of calling help from other States or from the U. S. Forest Service to help State agencies. These things are within the realm of possible action for all of us and might involve the use of men not known to us personally. To make such arrangements work we must all keep teamwork high in our minds whether we are on the receiving end or the giving end.

Back home we plan for teamwork with our fire wardens. These are all independent individuals, who often do not know each other personally. We have training meetings, fire warden schools, winter and preseasonal meetings, picnics for fire wardens and crew members. Regardless of the actual training material one of the primary objectives of all such sessions is that these men get to know one another so that they may work better together if called upon.

We have had occasions where lack of teamwork has resulted in one fire warden undoing the work of another simply because he wanted to go it alone; he was loath to work with another. This man felt he was just as good as the other fellow, and had as much experience. Why should he step aside, and why should he turn over his equipment?

[1] Taken from a paper presented at the Interagency Fire School, Douthat State Park, Clifton Forge, Va., Sept. 17-18, 1952.

We have cases where landowners or industrial operators have set backfires to protect their own interests rather than to team up with the State agencies in an over-all plan to control a fire. These incidents indicate a lack of teamwork. It has been the job of most fire control agencies to meet these situations and to promote the required teamwork. Fortunately most of this sort of thing is past but it still crops up once in a while much to our embarrassment.

You and I have all seen the evidence of poor teamwork in our own groups, such as reluctance to accept help from other than our organization on its own working territory. We have instances where the hardest decision a warden, inspector, ranger, or even a forester has to make is that he needs help. Many still think that a call for help, even when it is desperately needed, is an admission of weakness or inadequacy on their part. It seems to me the opposite is true. The strong man is not the one who tries to carry through alone because he hates to ask for help but rather the one who sizes up his situation, plans his needs, and asks for the equipment, transportation, or additional manpower that he doesn't possess.

I believe that with all our training in the technique of handling fire, in the strategy of fire control, in the organization of supervisory overhead, we have to continually train our people in the willingness and ability to give and to accept teamwork on the fire line or in the organization. We have to plan our training sessions and conferences and other activities to bring about as much mutual acquaintance and understanding as is possible. This meeting itself is helping prepare the ground for future wholehearted teamwork.

It is true that very few of us have to deal with any wide open cases of failure but I think we all see or have experienced those incidents that represent lack of wholehearted teamwork: The occasional dragging of feet when it comes to helping the other fellow or when called upon to do something out of routine. The hesitancy in leaving our own work to go help with the other job. The quickness with which we take refuge in the urgency of our own work when the suggestion may be in the offing that we go into action for the other fellow. The lack of enthusiasm in taking over part of the other fellow's job. The reluctance in asking for help when such a request might be considered a failure on our part or when the help may come from our neighbor or associate. The alarm at seeing some of our pet equipment being sent to the other fellow. The sudden need to have all our own resources available only for our own possible emergency. The ungracious way in which we accept help sent to us. The attitude that such help is a token of inadequacy. The impression given that we would have gotten along just as well without the help.

These are all samples of the lack of teamwork. Webster says, "Work done by a number of associates, all subordinating personal prominence to the efficiency of the whole,"—is teamwork. We all need it; we can all give it; we all need to cultivate and foster it—it makes for good fire control.

FIRE CONTROL TRAINING IN EASY YEARS

A. R. COCHRAN

Chief, Fire Control, Region 7, U. S. Forest Service

Severe fuel moisture conditions, high temperature, heavy south wind pressure of turbulent air set the stage for the fire of the decade. Some time during the noon hour while the sawmill crew was off to lunch, the Iron Mountain fire started, presumably caused by undetected fuel sparks from the steam rig. Starting on the south side of Iron Mountain, several miles south of the Holston District of the Jefferson National Forest this fire ripped through State protected territory, and before it was controlled some twenty hours later had burned a swath several miles in length completely killing everything in its path and in many places consuming whole areas of timber. The never-to-be-forgotten date was May 6, 1941. A county survey party working about a half mile above the sawmill site escaped being burned by crawling into the bed of a creek, on which fortunately they were working, until the fire had passed over. An axeman said of Wylie, another axeman in this party, "Wylie were a prayin' and he weren't foolin' either."

The subsequent board of review showed that the ranger and his organization assisted by the State had done an outstanding job in controlling this fire and holding the burned area at a minimum under the conditions which prevailed. This included dispatching manpower, overhead, and equipment to the fire and the organization and servicing on the fire.

The size of the fire, its behavior, and the suppression action by the ranger furnished a good training subject in the annual group training school held the winter following. While a large amount of manpower was used and the cost relatively high, there was little evidence of waste and no one was willing to concede that the job could be done with less manpower unless there was to be a heavy sacrifice in burned area.

Ten years have passed bringing great changes in the availability of manpower and overhead. Gone are the days when trained and experience seasoned CCC and "relief" work crews were to be had for the calling. The decade's end was characterized by excessive costs of labor and supplies for fire fighting—another serious problem for the fire control head. Eight of the ten years have been easy, or relatively easy fire years. Naturally many changes have come in the fire control organization. How would the Iron Mountain fire problem be met today?

This is a practical question to ask, but how could it be made a training opportunity? In the past few years much advance has been made in the field of organizing overhead for fire suppression. Modern radio communication has come into use since 1941—a subject in which training is badly needed. Even the oldtimers need

to reflect on tough fire behavior, for the easy years have a lulling effect. The easy years make it difficult to produce real training experience, especially for the younger members of the organization.

The Forest turned once more to the Iron Mountain fire as the most realistic training subject available for the 1952 season.

The Iron Mountain fire offered a good training situation in fire behavior for here is a case of severe fire weather combining with conditions of atmospheric turbulence; the latter being recognized as almost certain to occur each season and in some seasons several times to produce difficult fire suppression problems.

This fire offered a realistic problem in manning, organizing, and servicing. For what has happened will certainly happen again. The training problem was to present this excellent training situation in a realistic manner. One of the obstacles to adequate training is the cost of preparation, for competition with other urgent work is keen. This is a price that must be paid for there are no worth-while bargains or short cuts to adequate preparation. Ranger Ockers of the Holston District provided for the use of three basic training methods in conducting this school; namely, demonstration, dramatization, and group discussion.

For the demonstration he built a relief model of the area of the Iron Mountain fire on a scale of approximately 2 feet to the mile. The model was given a plaster Paris surface treatment so that the successive stages of the fire could be painted on and the progress of line construction shown by appropriate painted lines. Time control was maintained by the use of a large dial clock. The relief model was of sufficient size to lend reality to the problem.

A script was prepared for the dramatization of the action that would be taken by the district to suppress the Iron Mountain fire, assuming conditions and situations of manpower and overhead that prevail as of today. The pitfall in script writing is to fail to connect it with reality. The best technical thought and skill must go into this as a dispatching and organization problem, otherwise it becomes a stumbling block to training and may do actual harm. The various stages in the fire's progress are subject to analysis and group discussion, and it is possible to inject problem solving at any desired stage for the purpose of elaborating on or emphasizing any aspect of the over-all suppression problem. This is subject to a reality check because the log and review of the original fire is available for a reference base any time it is needed.

The ranger having completed adequate and technically competent advance plans for training had laid a good foundation for the next step, that is, to stage the program. For this the use of a furniture mart display room was secured which furnished ample well-lighted space for the trainees and the training props. The relief model was placed in the front center of room space. Seats were placed in front of the relief model for the fire boss and his staff. Back of the staff seats was placed a large blackboard and easel board facing the trainees. Seats for the trainees were placed

in a semicircle facing the ranger and his staff, with the relief model between.

The day preceding the opening of the training session the ranger and his staff ran a rehearsal of the proposed action. It was also necessary to rehearse the time control and the showing of the progress of the fire and suppression action on the relief model so that the training props would have maximum value.

The final stage found the ranger and his staff consisting of a line boss, a plans chief, and a service chief in their seats with the district dispatcher at a desk some distance removed to simulate action in the ranger's office. The trainees occupied their semicircular seating arrangement. The overhead organization found its decisions subject to challenge from the trainees, for a technical committee had been appointed from this group with the responsibility and authority to question decisions made by the overhead organization.

The arrangements had enough connection with reality to command the respect and interest of the trainees. The overhead staff was placed in a defensive position and thus was forced to make the soundest, best-considered decisions possible. At each stage the trainees had an opportunity to enter into a discussion concerning organization, service, and fire control strategy.

No claim of uniqueness is made for this training setup. It is one answer to one year's fire control training problem. The results were such that it is felt that the problem could be repeated after an interval of 2 or 3 years if no difficult fire suppression job had come up in the meanwhile.

Fire Sirens

Here is a suggestion that may be helpful to fire truck driver-operators who must take their trucks over busy highways or other roads where it's necessary to use their sirens extensively. On most fire trucks the siren switch is floor-board mounted, and consists of an ordinary push-to-operate starter switch. Trucks so equipped cause the driver to do a left-footed dance between the clutch pedal and the siren switch at times when the siren is needed most. Some trucks have a dashboard-mounted switch, or a horn-button switch. This, however, leaves the driver with only one hand holding the wheel, which isn't good.

There is a simple, inexpensive solution to this problem. It is a common headlight dimmer switch mounted in the truck's floor board simply by using the old starter-type switch mounting holes. No additional wiring is required. The switch will easily carry 6-volt loads up to and including 30 amperes. If the siren draws more than that, it's a good idea to install a relay.

The wiring for one of these units is simple. There are three binding posts on the switch, the center one is usually for the "hot" wire. The other two are ordinarily for high- and low-beam circuits, and the wire from the switch to siren can be attached to either one of these.

The beauty of this unit is that you can push the switch once, take away your foot, and the siren will sound off until you touch the switch again. Also, you can keep both hands on the wheel, and you can use the clutch when shifting gears without letting the siren die. This is advantageous, of course, rounding corners, going through intersections, and up and down hills. It is especially valuable if the truck isn't equipped with a long-roll or coaster-type siren.—CORP. ED PARK, *Dispatcher, Rycom Fire Department, APO* 331, *San Francisco, Calif.*

POWER-SAW OPERATION FIRES

DAN D. ROBINSON

Associate Professor, School of Forestry, Oregon State College

Forest protection personnel have been concerned over the increasing incidence of fires from power chain saw operations.[1] The logging industry in western United States has also recognized the problem but information has been lacking on the specific conditions which cause such fires to start.

Early in 1952 Booth-Kelly Lumber Company of Springfield, Oregon, made a grant to the School of Forestry at Oregon State College to study the problem in the Pacific Coast States and develop recommendations for reducing fire losses from power-saw operations. Results of the study appear in the 1952 issue of The Logger's Handbook published by The Pacific Logging Congress and are summarized here.

Data on fires occurring from operation of power saws during 1950-52 were compiled from all available sources in British Columbia, Washington, Oregon, and California. The specific causes of power-saw fires during felling and bucking operations were as follows:

	Felling fires (number)	*Bucking fires (number)*	*Total*	
			Number	*Percent*
Specific cause:				
Spark or carbon discharge	12	15	27	16
Leaking fuel	6	10	16	10
Spilled fuel	6	10	16	10
Forest fuel contacting hot muffler	35	22	57	33
Hot exhaust	3	16	19	11
Backfiring of motor	1	15	16	10
Loose wiring	0	2	2	1
Miscellaneous	3	11	14	9
Total	66	101	167	100

Total number of fires occurring during the felling operation is disproportionately high because 25 of the 35 fires starting from forest fuel contacting the hot muffler were due to one hazard on one particular make of saw. Where additional information was available the kind of fuel in which fire started can be broken down as follows:

	Fires	
	Number	*Percent*
Kind of fuel:		
Moss	13	11
Sawdust	24	21
Rotten wood	8	7
Duff	27	24
Needles and fine slash	11	9
Pitch	4	3
Bark	7	6
Confined to saw	22	19
Total	116	100

[1] L. L. Colvill and A. B. Everts, Region 6, U. S. Forest Service, studied the problem on national-forest timber sales and reported their findings in An Informal Study of Power-Saw Fires, Fire Control Notes, January 1952.

On the basis of the case histories of the reported fires and extensive field observations on numerous logging operations the following precautions are suggested as means of reducing the number of fires from power-saw operations:

1. Use proper mixture of gas and oil as recommended by manufacturer.
2. Permit hot saw to cool 2 to 3 minutes before refueling.
3. Refuel saw on a spot cleared to bare ground.
4. Use funnel, or a gas can with flexible metal hose or small screw-on hand pump when refueling saw. Inexpensive hand pumps with flexible neoprene hose are available for this purpose. The pump screws onto the top of a standard 2½-gallon gas can and need not be detached until the can is refilled.
5. If gas is accidentally spilled on saw, wipe it off with a cloth or allow spilled fuel to evaporate before starting motor.
6. Move saw at least 10 feet from spot of refueling before starting motor.
7. Keep outside surfaces of saw clean of oil and fine sawdust. A small, fine wire brush helps to clean cylinder head cooling fins and other inaccessible surfaces.
8. Clean the carbon from muffler and cylinder ports at least once each week.
9. Keep muffler on the saw and check frequently for cracks. Vibration tends to loosen muffler bolts and this causes muffler to crack or break off.
10. Check insulation on spark plug wire and keep connections tight.
11. Check fuel lines and connections frequently for gas leaks. Vibration tends to loosen fuel line connections and gas tank caps.
12. Avoid running the carburetor on a lean mix. A lean adjustment causes the motor to overheat rapidly.
13. Do not attempt to operate a saw that is backfiring, missing, or otherwise not running properly.
14. Clear flammable material away from saw cut insofar as practicable.
15. Set hot saw on log, stump, or bare ground rather than in dry litter or slash.
16. Check sawdust pile for smouldering embers before moving to next cut.
17. Use chisel bit or planer type chain where possible.
18. Keep a filled fire extinguished and a shovel with the power saw. The extinguisher should be carried on the operator's belt or in his hip pocket. *It should not be strapped on the saw.*
19. Check carbon spark discharge by running saw under full load after dark or in a dark, well-ventilated room. Carbon spark discharge may be checked on the operation during daylight hours by holding a piece of white blotting paper in the exhaust stream near the muffler port. Hot carbon will burn small black spots on the surface of the blotting paper.

All models and makes of power saws used on western United States logging operations were studied and tested in an effort to determine what features were a fire hazard. Tests were conducted under conditions simulating actual woods operation while saws were operating under full load.

The most dangerous fire hazards on the machines are hot mufflers, hot exhaust streams and, to a lesser degree, hot carbon particles discharged in the exhaust stream. Direction of exhaust discharge, location of muffler, and baffling inside the muffler are factors which may cause accidental fires.

Muffler and exhaust temperatures at muffler port were measured on all models of saws while the machines were operating in bucking and felling position. With one exception muffler temperatures were above 550° F., the approximate ignition point of forest fuel. Maximum muffler surface temperatures on some models reached 1,100° F. Exhaust temperatures at muffler port generally approximated muffler temperatures or were somewhat lower.

A number of starts were obtained by holding dry moss, duff, and fine branches against mufflers while the saws were operating. Several starts were also obtained by setting the machine in dry forest debris after completing a cut. There is a momentary increase in muffler surface temperature immediately after the motor is shut off which increases danger of ignition if the hot saw contacts dry forest fuels.

The field tests definitely established the fact that all makes and models of saws can be a fire hazard. On the basis of these observations a saw should contain the following features to be reasonably safe during summer operation.

1. The muffler should be located at the highest practical position towards the rear end of the saw.
2. The exhaust should discharge to the side and outward parallel with the ground or at a slight upturned angle.
3. The exhaust stream should be broken up by baffle plates or by bouncing the exhaust off the inner walls of the muffler.
4. Mufflers should be double-walled with an air space between walls or should consist of a perforated pipe enclosed by a protective metal shell.
5. An air stream should be forced across the muffler to aid in cooling the surface.
6. Muffler ports should be screened or contain a series of small outlets to break up carbon particles.
7. Surface temperature of mufflers should not be greater than 500° F. under full load.

None of the present models of power saws meet all of these features. Certain engineering problems may prohibit the incorporation of all suggestions on some saws. In the final analysis, certain combinations of the foregoing features on the machines usually determine the degree of hazard.

Carbon sparks are reported as the cause of 16 percent of the reported fires listed in the tabulation. Sixteen of the 27 fires reported from this cause involved mufflers without adequate interior baffling. Three models of saws tested discharged carbon sparks which remained alive after hitting the ground. In each instance the saw had a muffler without baffle plate or screen. Carbon sparks are sometimes blamed for fires which actually start from a hot exhaust stream.

The feasibility of spark arresters was considered. However, weight and space are limiting factors in a practical spark arrester for power saws. The outside surface of the arrester overheats thereby creating a hazard comparable to that of a hot muffler. Carbon spark discharge is negligible from an adequately baffled muffler if the engine is clean and the correct gas and oil mixture is used. It appears to be more practical to use a muffler with adequate baffling and keep the engine clean than to employ spark arresters to reduce carbon discharge.

Fuel leaks and loose wiring in the ignition system have been responsible for some fires. Vibration tends to loosen fuel line connections and spark plug wires. Heavier fuel lines and additional packing material at the connections should reduce leakage. Fuel tanks should be vented to permit control of fuel leaks when saws are operating in vertical or inverted positions. Rubber hoods

over spark plugs would reduce danger of sparks from shorts at this point.

The survey and tests conducted on power-saw operation fire hazards indicate that careless operation practices and certain features of the saws are responsible for fires. An intensive education program by public agencies and responsible industry officials is warranted, and modification of certain hazards on the saws should be undertaken.

Keep Oregon Green Pays Off

In 1941 Governor Sprague called public and industrial leaders of Oregon together and declared that if the heavy mantle of smoke which hung over much of western Oregon each summer, caused by destructive forest fires, was to be stopped a public education program to Keep Oregon Green was necessary. This necessity, he said, stemmed from the fact that more and more persons were using our great outdoors for work and play, and that they were more or less ignorant of the cautions that should be observed in the use of fire. As a result of this meeting, the Keep Oregon Green Association was formed for the purpose of making Oregon's citizens aware of their vital stake in their forests and range lands and hence of their responsibility.

Keep Oregon Green is supported entirely by contributions from the logging, lumbering, pulp and paper industries, county courts, associations, business firms, civic clubs, banks, railroads, the State Board of Forestry, and individuals who are interested in helping to reduce the number of man-caused fires in Oregon. Activities are carried on by an executive secretary, a board of trustees of whom Governor Douglas McKay is president, and voluntary workers who make up the 36 county committees.

Headquarters of the association is in Salem, on State Street, in one of the State Forestry Buildings, which is contributed by the Oregon State Board of Forestry. From here material is furnished to county committees, district wardens, forest rangers, civic organizations, schools, and to many others who can make good use of it. This material consists of forest fire prevention posters; decals; place cards; exhibit material for use at fairs, parades, and in window displays; cuts for newspaper advertising; spot radio announcements; calendars; colored slides and films; ash trays; and forest fire prevention plates for use on automobiles and trucks.

The generosity of Oregon's 122 daily and weekly newspapers and 46 radio stations in contributing space to news and editorials on forest fire prevention and thousands of radio spot fire prevention announcements is doing much to reduce the number of man-caused fires. During the season of 1951 there were 1,168 forest fires from the following causes: smokers, 339; logging, 205; slash and debris burning, 164; campers, 127; incendiary, 55; railroads, 33; miscellaneous, 245. If during the month of September no major fires take place and fall rains set in, Oregon will show an amazing reduction of man-caused fires this year despite the relatively dry summer throughout the State. There must be something to account for this. The experts say it is public education with much credit going to the Keep Oregon Green campaign.

One of the most effective jobs done by the association has been the organization of the youth of our State into the Oregon Green Guard. More than 40,000 boys and girls, ages 8 to 16, are members and have taken a pledge to do their utmost to help Keep Oregon Green.

The thinking of the people of Oregon has changed since 1941 and they have acquired a consciousness of fire danger and fire costs. Now a precaution has become something of a crusade, with a crusader spirit that has spread to other timber-growing States.

THINK PROTECTION, TALK PROTECTION, PRACTICE PROTECTION, should be the creed of every citizen.—ALBERT WIESENDANGER, *Executive Secretary, Keep Oregon Green Association, Inc.*

FORESTRY cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and techniques may be communicated to and from every worker in the field of forest fire control.


Please...
help people be more careful!
Remember-Only you can
PREVENT FOREST FIRES!