VOL. 21 APRIL 1960 No. 2

FIRE CONTROL NOTES

A PERIODICAL DEVOTED
TO THE TECHNIQUE OF
FOREST FIRE CONTROL

FOREST SERVICE • U. S. DEPARTMENT OF AGRICULTURE

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.

Volume 21 Number 2

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.

FIRE CONTROL NOTES is issued by the Forest Service of the United States Department of Agriculture, Washington, D. C. The matter contained herein is published by the direction of the Secretary of Agriculture as administrative information required for the proper transaction of the public business. Use of funds for printing this publication approved by the Director of the Bureau of the Budget (October 17, 1958).

Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., 20 cents a copy, or by subscription at the rate of 75 cents per year, domestic, or $1.00, foreign. Postage stamps will not be accepted in payment.

Forest Service, Washington, D. C.

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON: 1960

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DEVELOPING A MEASURE FOR VARIOUS MAN-CAUSED FIRE RISKS

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One of the first, and toughest, jobs to be faced in fire control planning is developing a balanced fire prevention program. Funds and effort have to be apportioned between administrative units that have entirely different patterns of use, and within each unit prevention activities must be divided among all the various risks that contribute to man-caused fires. Achieving a truly balanced prevention program is not easy since the units may vary, not only in the amount of use each receives, but also in the kind of use, the severity of the fire season, the fuel hazards, and the efficiency with which present prevention funds are applied. Some method of compensating for each of these factors must be found to determine the relative risk of fire between two areas or between two unlike uses on the same area.

One way of combining all these various factors is to base prevention planning on actual fire occurrence. Since man-caused fires are the one direct measure of prevention failure, plans based on past fire occurrence automatically provide strengthened prevention effort for those areas and problems that have been shown to be either critical in importance or weak spots in the previous prevention plan.

But past fire occurrence has two serious disadvantages as the sole guide to prevention planning. First, you are planning to meet yesterday's problems. If you use a long enough period of record to eliminate weather fluctuations, then the plans will not represent current forest use and today's risks. On the other hand, if you use only statistics for the previous 1 or 2 years, then any real differences between areas or risks may be obscured by transient differences in weather.

The second objection to the sole use of past fire records is that good performance may be penalized and sloppy work rewarded. When two units are exposed to identical risks, then the one doing the best prevention job has the least number of man-caused fires. But if you take fire occurrence as the guide to prevention needs, the area with the worst record could get the major share of the funds. When carried to extremes, the use of past fire records to allocate prevention funds can lead to juggling of statistical vs. nonstatistical fires to the point where the records themselves become virtually meaningless.

Since the whole aim of forest fire prevention is to reduce the chance of man-caused fires starting, the ideal base for fire prevention planning would be direct measurements of risk (defined as the chance of a fire starting because of the presence and activity of causative agents). Unfortunately, although we can measure the presence and activity of causative agents, it is impossible to find a common denominator for such diverse agents as diesel locomotives and bird watchers without ending up back among past fire records to determine how many fires are caused by each group. Thus there would seem to be no advantage in using fire statistics to measure risk over using fire statistics directly to measure prevention needs.

Actually, though, there are several good reasons for taking the indirect approach and attempting to measure risk. Once the relative risk of fires starting from various causative agents has been established, you can plan prevention programs based on the expected future change in forest use. Planning need not be keyed to the problems of last year or the past decade. Second, you need not analyze data separately by districts or administrative units; therefore, the pooled statistics offer a broader statistical base, and any desired statistical accuracy can be achieved with fewer past years or records. Also, since risk is determined from regional averages rather than from fire occurrence on individual units, there is less pressure to manipulate fire records to show a prevention need, and greater uniformity in fire statistics should result.

How can risk be measured from data on fire occurrence? As mentioned previously, fire occurrence depends not only on the presence and activity of causative agents (risk), but also on weather and fuels (hazard) as well as the effectiveness of prevention activity. Therefore, any system of risk rating must compensate for differences in hazard and prevention effectiveness. Once this has been done, the corrected fire occurrence figures will provide an accurate index of the relative risk of different areas or different fire starting agents.

How can fire occurrence figures be corrected for weather?[1] The ideal method of measuring weather variables for use in developing a risk rating would be through an ignition index designed specifically for that purpose. However, fire danger rating systems based on rate of spread may be used as acceptable, though imperfect, substitutes. Whatever system is used, weather records must be available for the full period of fire occurrence, and not just for some arbitrary "fire season" of 2 or 3 months.

What about fuels? An index of fuels to be used in risk rating should be based on the relative ignitability of standard fuel types under specified weather conditions. Although no such fuel classifications have ever been devised, fuel maps based on rate of spread criteria such as Hornby's or on flammability zones can be used without serious error. It should be noted that a fuel index based on analysis of fire incidence by fuel types cannot validly be used in preparing a risk rating system. Forest use varies markedly by fuel types. The number of starts represents both inherent flammability differences and differences in risk, and these effects cannot be separated.

[1]The material that follows is taken from *Risk Rating For Fire Prevention Planning*, by C. C. Chandler, accepted for publication by the Journal of Forestry.

In spite of long and continued efforts, no one yet has devised a single yardstick to measure directly the effectiveness of the many and varied kinds of prevention effort practiced on a single prevention district. We can measure the miles of fireproofed roadside and the number of campers whom a patrolman has contacted, but we cannot equate the one against the other. Therefore, risk rating is only possible by removing prevention efficiency as a factor in determining fire incidence. Although this cannot be actually done, it is possible to determine fire occurrence, weather, fuels, and forest use over a short time period and to consider prevention efficiency as a constant.

In the California Region, where both the emphasis on prevention and forest use have been increasing geometrically, one year was the time period considered. In areas of greater stability, a longer time period, and hence a broader statistical base, could be used. Under these conditions, we can compare the relative risk of various types of forest use under the prevailing level of prevention effort. The comparison will be valid unless prevention efficiency is directly correlated with weather, fuels, or use. This later hypothesis can be tested statistically; in the California Region there was no such correlation.

Once all the necessary data on fire incidence, fuels, weather, and forest use have been compiled, the development of a risk rating becomes merely mechanical. For each area, fire incidence is corrected for weather and fuels, and regression equations are obtained between the resultant values and the various combinations of forest use. This work can be done most rapidly by high-speed computers, but if computer services are unavailable, rank order correlation can be used for rapid initial selection of variables. Using the regressions with the highest correlation coefficients, it is possible to compare the risk of fires from any particular type and level of forest use against any other use, or to compare the total risk between areas with unlike uses.

Two words of caution are necessary regarding procedures. First, regressions must be determined separately for each category of fire incidence. Certain kinds of forest use are highly correlated with fuels and weather. When all uses are lumped together, these intercorrelations get buried and the multiple regressions obtained have limited applicability and often certain nonsense answers. Second, testing must not be limited to linear regressions. It has become standard practice to show that the amount of forest use has increased faster than the number of fires and to attribute the difference to active fire prevention. But there is every reason to expect that the number of fires will not vary linearly with forest use regardless of fire prevention activities.

Perhaps this can be best illustrated by use of an example: If two hunters are camped within sight of each other, each tends to be more careful in his camping habits than he would be if unobserved. Further, there is a better chance that an incipient fire starting in either camp will be discovered and extinguished by one of the men themselves. Therefore, the number of fires to be expected when the number of hunters increases from 1 to 2 is something less than twice the number to be expected from a single hunter. Furthermore, there eventually comes a point where increasing the amount of use on an area actually decreases the number of fires. In a highly used area such as Yosemite Valley, potential fuels are trampled into the dirt, and it is impossible to drop a match without someone stepping on it.

One word of caution is also necessary regarding the interpretation and limitations of risk ratings. Although a risk rating gives a true picture of the relative risk between uses or between areas, it is valid only for one particular level of prevention effort. If the level of prevention effort is changed, or if emphasis is shifted from one type of risk to another, the ratings will cease to be applicable as soon as the change in emphasis becomes effective. To illustrate, if a particular forest finds that hunters represent three times the risk of loggers, but that prevention effort has been divided equally between the two, the forest may decide to increase the number of hunter patrols at the expense of logging inspections. In this event, assuming that the action is effective, the hunter fire problem will decrease while the logging fire problem gets worse. Until some sound method of predicting prevention effectiveness is devised, risk ratings will always be of transitory value.

Although data from the California Region risk rating will be published in connection with the Regional Fire Planning Synopsis, some of the results of this study may be of interest to illustrate the kind of information obtainable by a risk rating. In the analysis for the California Region we found that—

One-quarter of our man-caused fires would not have started if all roadsides had been fireproofed for a distance of 50 feet.

Hunters cause 3 to 7 times as many fires, man-for-man, as any other group of recreationists.

We average only one logging fire for every 30 million feet cut on national-forest land.

As many fires are started by powerlines as by picnickers, and that distribution lines, rather than main lines are the biggest problems.

Fishermen start more fires than either railroads or incendiarists, and that hunters start more fires than both groups combined.

On one forest with 100 miles of railroad, 43 percent of the railroad fires in the past 10 years have started along a single 5-mile stretch of track.

The threat of fires from visitors in regularly maintained, improved campgrounds is negligible. Our problem is the "boondock" camper.

FIRE FIGHTING WITH HELICOPTERS

Unit Area Control Planning and Development

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Almost $2 per minute; over $100 per hour; on a project fire, maybe $1,000 a day. That's what the small helicopter could cost a resource management unit. No wonder that many national forests and other agency units are turning to unit area control in helicopter management. It's the only way to make every one of those 2-dollar minutes count.

Most foresters are familiar with the concept of unit area control in timber management. It is an intensive technique applied to specific units to attain a particular objective. In this case it is an efficient and economic helicopter attack or helitack operation. This paper deals with unit area planning for helitack and the development that might be necessary to achieve the planned control.

Before any actual helitack planning is done, the use of the helicopter must be justified. Unit area managers should ask themselves these questions:

1. Is there a real problem that helitack might solve?
   a. Is fire business heavy?
   b. Are high resource values at stake?
2. Can the existing organization handle the fire problem?
   a. Is the ground coverage adequate?
   b. Is elapsed travel time to fire attack excessive?
3. Can helitack handle the fire problem?
   a. Will the cost of helitack be less than the cost of expanding the existing ground fire organization?
   b. Is an approved helicopter and pilot available?
   c. Can the helicopter operate safely and dependably under the unit's conditions of density altitude (elevations corrected for temperature), wind, topography, and cover types?

If helitack is still justified after considering these questions, then helitack planning is the next step.

PLANNING FOR HELITACK

Helitack probably will never completely replace the ground fire organization. Helicopters and helitack crews have proved to be only another tool to strengthen the existing fire organization. Most helitack planning and unit area development is based upon the existing ground crews, equipment, and facilities.

Determination of helitack priority zones.—Areas where helitack will be the quickest and most effective means of attack must be determined. Areas with presently adequate ground coverage may not be included in helitack zones. For helispot construction priorities and manning and dispatching guides, specific priority zones should be determined within the broad helitack zone. One method makes use of four map overlays:

1. Ground crew coverage adequate to keep within hour control standards.
2. Fire occurrence pattern over past 10-20 years.
3. Hazard zones based upon cover types.
4. Priority zones. Area covered by ground crews is eliminated. Hazard and fire occurrence overlays are combined into high, medium, or low priorities.

The first three overlays, on top of each other on a tracing table, determine the fourth. Special problem areas may be thrown into high priority zones, and the zone boundaries smoothed out on the basis of local experience.

Helicopter coverage.—Permanent bases of helicopter operation called base heliports must be located where the maximum amount of coverage over the unit is possible. Four time increments should be used (fig. 1):

1. Getaway time (experience on time tests).
2. Flight time from base heliport to a spot over a supposed fire (a mile per minute for most small helicopters).

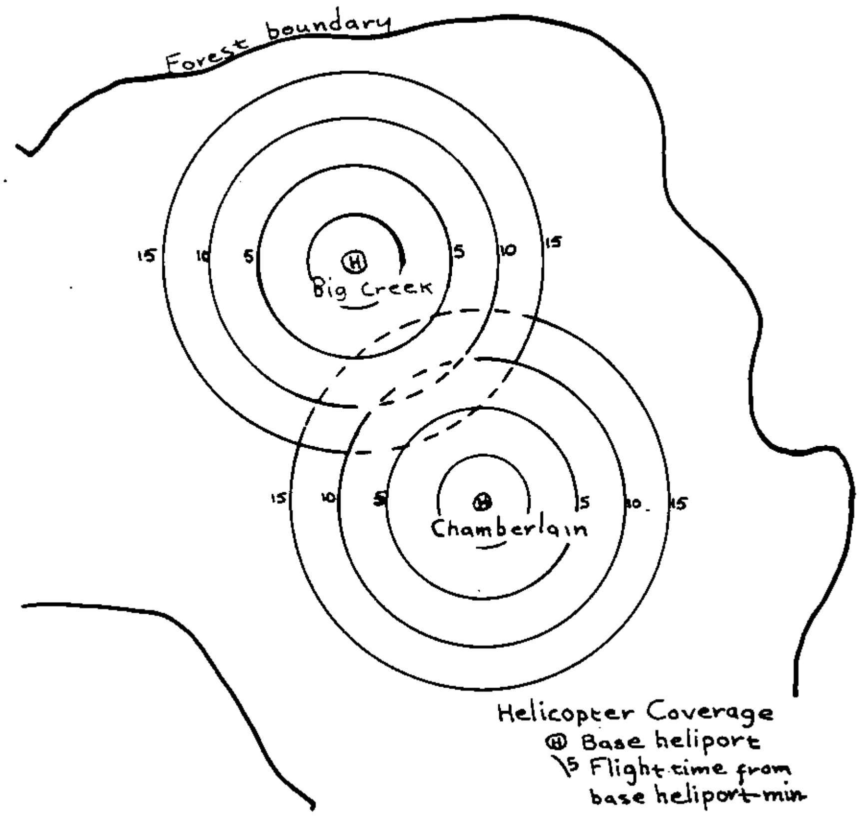

FIGURE 1.

3. Reconnaissance-to-touchdown time, or an average time to reconnoiter the fire, report its location and condition, select a landing spot, or helijump spot, and put the firemen on the ground.
4. Ground travel time from landing spot to fire.

The total of these time increments should be *less than the hour control standard set up for the unit.*

Establishing base heliports.—Important points to consider are accessibility by road, size, hazards such as powerlines and trees, prevailing winds, higher elevations so as to eliminate uphill helicopter climbs to fires, dropoff for takeoffs at elevations above 5,000 feet, dustproofing, heliport identification. Base heliports must be furnished with operational facilities such as wind socks and fire extinguishers, and safety regulations posted. Helitack crew equipment and helicopter fire accessories should be cached at base heliports.

Location of reinforcement base heliports.—Helicopter rendezvous points, or reinforcement base heliports, should be located on the edge of helitack zones for the quickest followup action. Reinforcement helitack crews and equipment are dispatched to these heliports for aerial move up action. Reinforcement base heliports may be generally located as follows (fig. 2):

1. Locate helitack zones and nearest ground crew to that zone.
2. Calculate, on the basis of time increments already described, the time for the helicopter to deliver the fireman to a spot near the fire. Add time for the helicopter to be in the air again.
3. Calculate how far along the most direct route of travel to the fire area the reinforcement crew will be by the time the helicopter is in the air again at the fire. This should mark the general area where the base heliport should be located.
4. Determine the specifc location for the heliport by observing points mentioned under establishing base heliports. *Try to get these heliports on high points, out of the canyons.*

Helitack flight and hazard map.—Flight-times-at-a-glance and flying hazards to be encountered enroute are important in planning a mission. A master flight map might include—

1. Flight time in 5-minute intervals.
2. Hazard areas, such as power and telephone lines, smokestacks, and consistently turbulent areas.
3. Landing and refueling areas.

Helispot location.—An adequate helicopter landing spot, or helispot, network is basic to the most efficient use of the helicopter. Fire initial attack will require the most intensive coverage. On the basis of this fire initial attack network, other projects, such as timber and engineering, may be planned. Suggested steps for helispot location are—

1. Locate helitack priority zones. During a reconnaissance flight locate potential helispots in high priority helitack zones first. Locate and mark natural helispots during flight.
2. Locate natural and potential helispots on map.

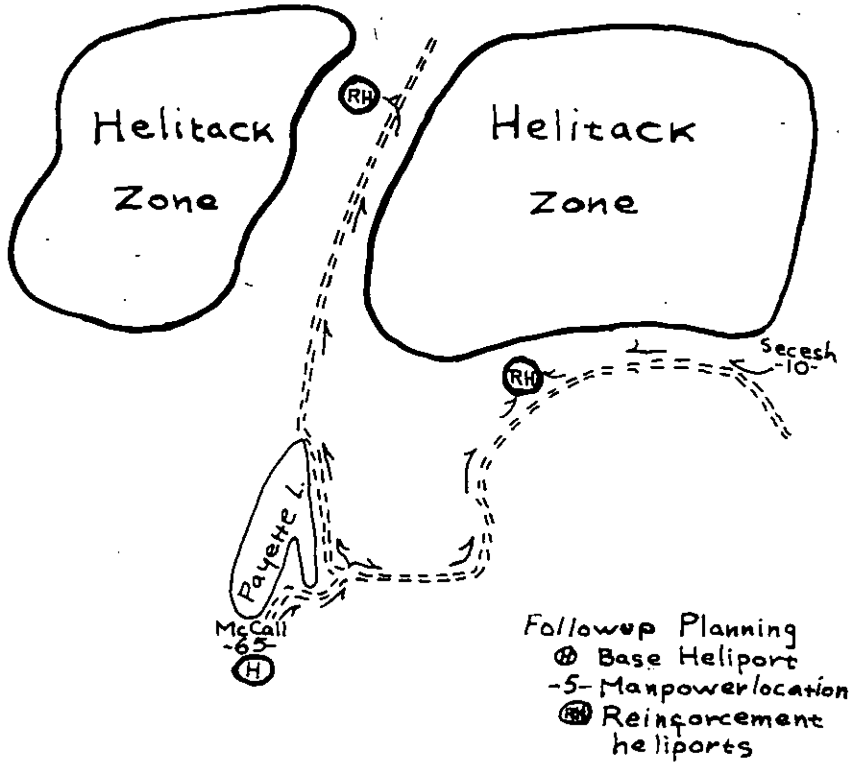

FIGURE 2.

3. Figure coverage from each helispot within the hour control standard. Use initial attack time increments from base heliport to landing.
4. Subtract total helicopter time from hour control standard. This leaves the time left for the man to hike. Plot this time in terms of his distance per time unit. Each helispot will have a rough circle of coverage around it. A large ½-inch base map used in this manner will give an extensive idea of coverage (fig. 3). For intensive planning use topographic maps and vary hiking coverage with the specific topography.
5. From above map work determine areas lacking helispot coverage and locate possible helispots in these areas.

Helispot construction and maintenance.—Plan helispot construction so as to use a minimum of flight time. Be sure men are oriented in safety and helispot construction principles before beginning project. Check with the pilot for ship limitations. Try to combine projects and use contributed labor where possible.

Inspect helispots each year if possible. Perform maintenance currently. Combine it with other projects so as to keep flying time to a minimum.

All helispots should be visible from the air and numbered. Records of the location of each helispot and its description and hazards should be filed at key stations.

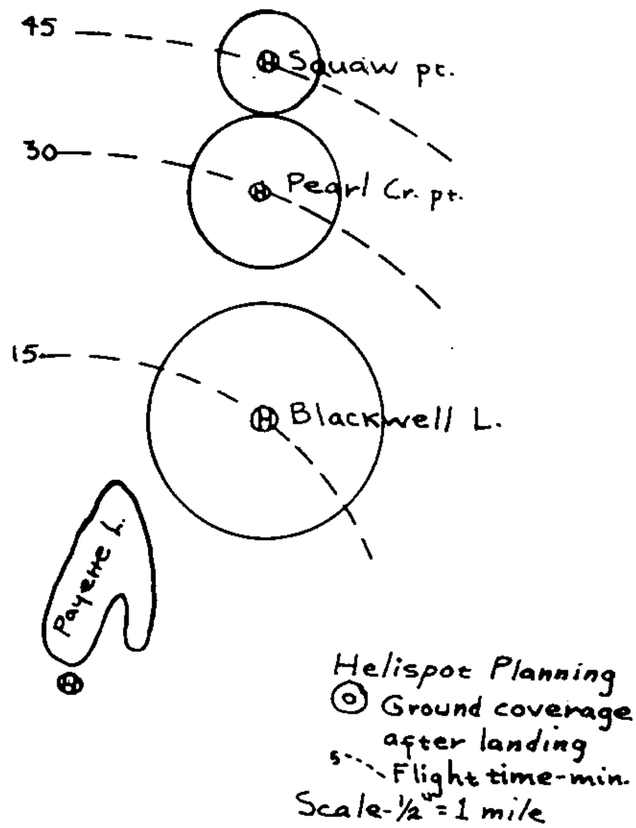

FIGURE 3.

TRAINING FOR HELITACK

Helitack crews, helitack reinforcement crews, and other personnel participating in helitack should be trained *as soon as possible* by a qualified air attack man and the pilot. Helicopter safety, helicopter operation, helitack equipment use and maintenance; helitack skills such as helispot location and construction, helijumping, etc. should be stressed. Ground crews should be trained and equipped to function as helitack reinforcement crews. These crews will respond to helicopter rendezvous points to be picked up by the helicopter and ferried in to the fire or fires.

HELICOPTER USE PLAN

The actual use of the helicopter must be managed intensively for the most effective and economic operation. A helicopter use plan is important and should include the following:

1. Use policy.
2. Permissible uses.
3. Priority of uses.

4. Guides for the use of helicopter accessories.
5. Communications plan.
6. Helitack manning plan. Helicopter and crew may be assigned to various base heliports in response to fire danger.
7. Fire dispatching plan. Helitack must be integrated with other air and ground attack.
8. Helitack fire mobilization plan. Initial attack and followup procedures on small fires. Large fire procedures.
9. Air control organization and plan.
10. Nonfire uses of the helicopter.
11. Operational forms and records.

☆ ☆ ☆

Send Them, But Safely

Safety reminders are flashed before us in many ways and in numerous places. One manufacturer reminds his employees by sounding the plant whistle in the middle of the shift. But the fire control job is unique, and many of these devices do not work for us. We cannot always lean on the boss for we may be on our own; neither can we always look to the safety officer. It remains for every person in the organization to carry a share of responsibility.

Take any fire in the early stages. There are several men on the blaze, more are enroute, and still others are being ordered by the dispatcher. This very busy man may be the key safety man until the fire boss, or someone in authority, arrives. If he will just "cue-in" the fellows he is sending with a vital word, a short phrase, or a brief snatch of information, it may mean all the difference in both safety and control of the fire.

For example, the dispatcher may know of a road hazard involving "fresh oil on 3 miles of Highway 13." A detour or bridge load limitation might alter travel instructions. Several fire vehicles may be converging on a fire over narrow, winding roads. Accidents could happen, serious delays occur. Perhaps the dispatcher should exercise his authority and establish a temporary road control.

The dispatcher may receive an "outage" report from the power company; several minutes later, the report of a fire in the same general area. His radio message to the first crews might be, "Respond to a fire at the intersection of Highway 2 and the high line. Power outage also reported." This will alert the pumper crew enroute to be cautious in the use of water on a fire perimeter that may be near a downed high-voltage line in the immediate area.

Air tankers and smokejumpers may be called from several airports. Simultaneous responses could cause complications. There must be coordination in the air to work safely. The dispatcher can ease this situation by an airnet announcement "Air tanker three nine off Red Bend at one-one and aircraft two eight off Willow Cove at one-three, both estimating the Red Mountain fire in seventeen minutes."

These cases, as every fireman knows, can be multiplied indefinitely but the need for safety is the same. Competition for the airways and ether waves is critical even in the woods. A safety signal message should not, and need not, be lengthy. The dispatcher's desk is a beehive of activity but he must be alert to see and act on some vital safety measure.—A. VIRGIL SHOEMAKER, *Fire Equipment Specialist, Arcadia Equipment Development Center.*

PLANNING THE BLACK HILLS HELITACK PROGRAM

KENNETH C. SCHOLZ, *Fire Control Officer* and
ROBERT F. KRUCKEBERG, *Forester, Black Hills National Forest*

The Black Hills National Forest, comprising one and one-half million acres in the western part of South Dakota and eastern Wyoming, was selected for the first aerial project in the Rocky Mountain Region. The terrain varies from nearly flat to steep and rocky, with gently rolling areas predominant. Elevations range from about 3,500 to 7,242 feet. The vegetative type over the entire forest is a nearly pure uneven age ponderosa pine stand with dense patches of "dog hair" reproduction interspersed throughout. A grass cover is present under all but the most dense stands (fig. 1).

Lightning is the principal cause of the large number of fires which occur annually throughout the Black Hills. Over the past 10 years there has been an average of 177 fires per year.

An excellent detection system; well-trained ground forces; numerous roads and fire trails (very few areas are inaccessible to 4-wheel-drive pumper units) were some of the conditions present when the Helitack program was set up to determine if a helicopter and a small crew of highly trained men could more effectively meet the desired attack time than additional ground manning.

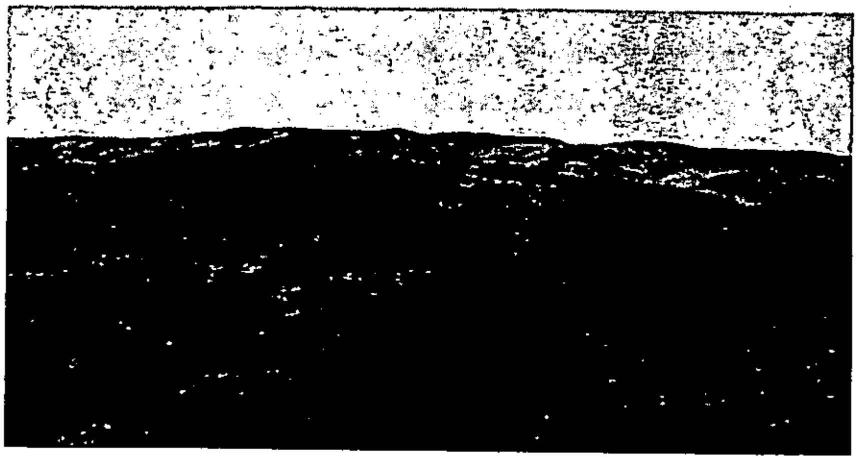

FIGURE 1.—Typical terrain in the Black Hills showing rolling hills and heavy timber type. Close inspection usually revealed small parks large enough to accommodate a small helicopter.

Many considerations must be evaluated before setting up a helicopter operation—questions that will serve to point out whether it is feasible and practical. Once it has been determined that a helitack crew is to be set up, decisions relative to base and field heliports, helispots, crew and training facilities, helitack priority zones, helicopter use plans, and many other operational decisions must be made.

Heliports.—A centrally located base heliport was selected at a high enough elevation (5,040 feet) to provide a downhill run to most areas and a safe and efficient operation for the helicopter. The site selected for the base heliport included a large building well suited for a hangar and a fenced in yard ideal for a landing pad (fig. 2). The pad was oiled to prevent dust blowing and marked for positive identification from the air (fig. 3). Alternate or secondary heliports were designated on four districts and served primarily as refueling points. No work was required on these sites except marking a touchdown pad to keep the areas clear.

Numerous parks and openings over a large part of the forest provided "built in" helispots (fig. 4). Areas that offered no natural landing spots were in zones of light fire occurrence so it was decided to go slow in helispot construction. This decision proved well founded, at least for the first year, as only three fires this year required more than a 15-minute walk from landing point to fire. Future helispot construction will be carried out in high priority areas and in other locations needing them.

Crew organization.—A six-man crew composed of an assistant ranger to serve as foreman and five experienced forest workers as crewmen were selected. Since no experience qualifications had been established for this type of position, the men were required to meet the standards for smokejumpers plus some others sug-

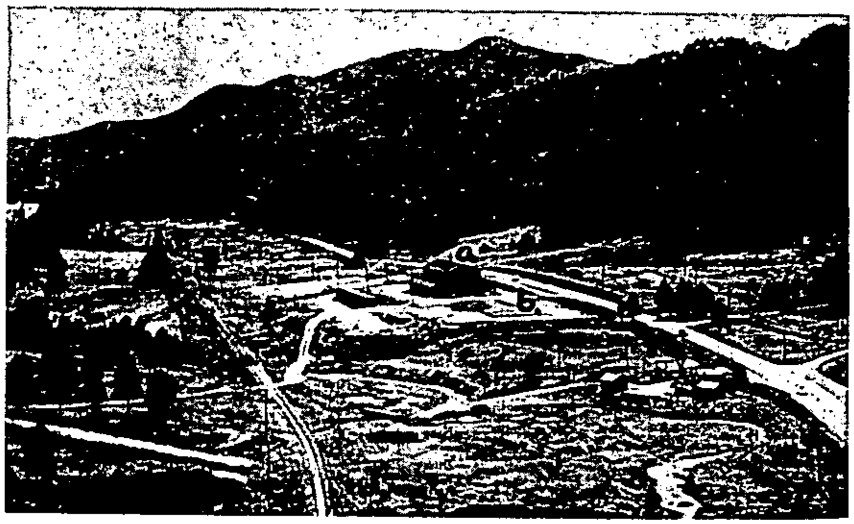

FIGURE 2.—Base Heliport at Hill City, S. Dak. Elevation 5,040 feet. *a*, Hangar; *b*, touchdown pad and safety zone, 150 by 300 feet.

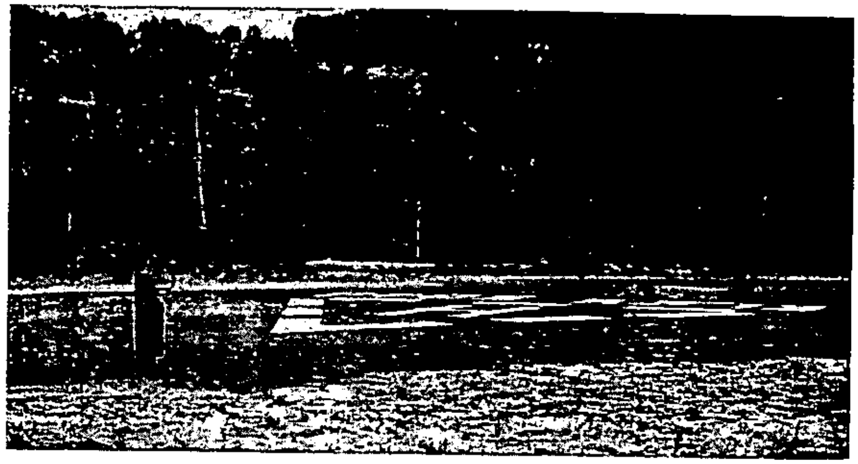

FIGURE 3.—Hill City Heliport touchdown pad marked with standard F.A.A. Heliport marker.

gested by the California Region guides. Training began 2 weeks before the helicopter arrived and was completed by the end of the fourth week, although the crew was operational when the ship arrived. Throughout the season, the crew worked a split workweek with four men on duty every day and the other two readily available if needed.

FIGURE 4.—A natural helispot typical of the many that were not visible from a distance but which showed up when the helicopter was nearly overhead.

Equipment.—The contract was awarded early in March for a Bell 47 G-2 with a 100-hour guarantee for the period June 1 through October 31. Five bids were received, varying from the low bid of $93.50 per flying hour to a high of $227 per hour for the same model. The low bid was accepted and the contract ship did an excellent job.

Many of the facilities needed at the base heliport were constructed by the helitack crew at no cost other than labor. The large building at the base site supplied many of the facilities required: hangar, work area, office space, ready room.

Helitack priority zones were not too important this first season as the helicopter was to be dispatched to all fires possible within the primary initial attack zone (a 20-mile radius from the base heliport) for the purpose of determining what it could do and what its limitations were. All dispatching was done by the forest dispatcher.

Finance.—The Forest is made up of eleven districts. The presuppression manning on each of the districts in the project area was reduced to help finance the helitack unit. This meant that in lieu of district crews having to maintain a constant standby, the helicopter crew would supply the initial action, with the district crews coming in as soon as possible for reinforcement. Other functions were invited to use the helicopter during periods of low fire danger. About 15 hours were flown to spray weeds and to observe and record insect infestations.

RESULTS—1959

During the fire season, 192 fires occurred on the forest. One hundred eighty of these occurred on the 10 districts on which the helicopter was used. The ship was dispatched on 84 calls; 67 of which were fires, 14 were false alarms, and 3 were aerial detection flights. Of the 67 fires having helicopter action, 57 had men placed on them by helicopter, 43 of which were initial attack. On 10 fires, the helicopter was used only for scouting or the fire was manned on arrival. On at least 10 of the fires that were first manned by the helitack crew, the rapid attack was the deciding factor in holding the fires to small size.

Besides being used for initial attack on small fires, the helicopter proved valuable for guiding ground crews into fires, as a communications link between crews on the fire and the dispatcher or lookout, for scouting and reconnaissance and many other functions. The ship proved to be of extreme value on the two project fires that occurred on the forest this year.

During the height of the fire season, the helicopter was out of commission for 9 days (not in one stretch), and 38 fires occurred. This was convincing evidence that it is unwise to "put all your eggs in one basket."

SUMMARY

Successful helitack programs have been in operation for several years. In setting up the Black Hills Helitack Program, our first step was to review all the literature available on helicopter operations and helitack programs. This provided us with an outline for analyzing our particular situation.

Basic analysis of the need or feasibility of using a helicopter:

1. Fire occurrence. Do enough fires occur in the initial attack area so that a helicopter can economically be used to provide transportation for initial attack crews?
2. Values protected. Are values of the resource protected high enough to justify use of helitack?
3. Hour control. Will a helicopter provide hour control more economically than additional manning?
4. Detection and rate of spread. Are fires spotted quickly enough so that two men delivered by helicopter can reasonably be expected to hold down the rate of spread until reinforcements arrive?
5. Terrain features. Are topography and vegetative cover such that the helicopter can deliver men reasonably close to the fire so that hour control requirements can be met?
6. Financing. Can existing financing absorb the minimum operational costs of a helitack program?

Setting up a helitack program:

1. Locate the base heliport as strategically as possible with emphasis on central location and logistics.
2. Determine the minimum helicopter performance requirements that will do the helitack job in the most efficient manner.
3. Determine the helicopter contract period and what minimum flying hour guarantee would make possible a profitable operation for the contractor.
4. Depending on type of ship, plan a system of alternate heliports to provide for maximum efficiency.
5. Select and start training the helitack crew prior to arrival of the helicopter.
6. Provide adequate communications, supply, and facilities.
7. Develop dispatching plan and use policy to coordinate the helitack organization into the existing administrative program.
8. Develop detailed financial plan.

After the helicopter arrives:

1. Orient and train the pilot in helitack techniques, emphasizing safe practices.
2. Orient and train the crew in helicopter procedure.
3. Integrate the helicopter into the fire control organization by giving the ground crews training and demonstration sessions.
4. Revise and adapt the planning as necessary to fully utilize the new procedures.

Records and reports:

1. Plan for complete and accurate cost and accomplishment reporting by individual fires.
2. Plan for an evaluation both by individual fires and for the full season.

PLANNING THE LOCATION OF FIRE DANGER STATIONS

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Assuming that the primary function of a fire danger station is to measure weather elements that will give an indication of fire risk and its rate of spread and intensity if started, then the location of the station must be such that the elements measured will be representative of the area. Also, the location and installation of the fire danger station should conform to certain rules in order that a basis for comparison exist between stations. With this in mind, there should be little variation in the basic standards for location of fire danger stations between areas, as well as between districts, forests, agencies, or States.

Fire danger stations should be located in the higher hazard areas in each district, but duplication of stations in the same area is unnecessary. Where no fire danger stations exist in high hazard areas, either a station should be established or a correlation should be developed between these areas and existing fire danger stations. Temporary stations can be set up with portable weather stations to collect the data necessary for the development of these correlations. Automatic weather stations can be utilized in the future to effect a saving in time and personnel.

Because current practices entail close contact with the post of duty, the distance between observer and fire danger station is of prime importance. This should be such that the observer need not be gone more than 15 minutes or over 100 yards. Careful attention should be given to local influences. Avoid swampy ground or proximity to dusty or large paved areas.

Correct exposure of the wind instruments seems to be most difficult to obtain, and optimum height excites the greatest controversy. Table 1 gives the approximate effect of obstructions on wind flow.

TABLE 1.—*Typical values of horizontal wind speed behind barriers of different densities; downwind distances measured in terms of height (h) of barrier*[1]

Type of barrier	Percent of "Free" Wind Speed When Distance of Barrier Downwind Is—								
	0h	2h	5h	10h	15h	20h	25h	30h	40h
Open (density about 30 percent)	90	80	70	75	85	90	95	100	100
Medium (density about 50 percent)	40	25	20	25	50	60	75	90	100
Dense (density about 100 percent)	0	20	40	65	80	85	95	100	100

[1]Gloyne, R. W. Some Effects of Shelter-belts and Wind Breaks. The Meteorological Magazine 84(999): 272-81. 1955.

Numerous studies concerned with wind profiles reveal that wind speed increases rapidly for the first 20 feet above the top of the ground cover, whether trees, brush, or grass, then levels off. It would appear, therefore, that the best height is 20 feet above the general ground cover. However, if this means that the anemometer must be at a height of say 100 feet, then it seems that elevation has become a factor. Is the wind speed obtained at this height representative of the wind which will be involved in the spread of a fire in that area? The Washington State Department of Natural Resources has, we believe, taken a realistic approach to the problem, by setting the height of the wind instruments at 20 feet above the ground and as far away as possible from all obstructions. In any case, the minimum horizontal distance should be no closer than twice the height of the obstruction. Locations on roofs and lookout towers are not advisable.

It is desirable to locate the other instruments with the anemometer and wind vane, but this is not necessary. Regardless, the fuel sticks should be exposed to full sunshine throughout the day, and both the fuel sticks and instrument shelter should be located where they will receive an unobstructed flow of wind. Instruments should be installed according to U. S. Weather Bureau standards or as prescribed in fire control manuals. These manuals vary slightly in detail for various sections of the country.

MACHINES VERSUS MANPOWER IN INITIAL ATTACK

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Fire planners have the responsibility of determining the most effective, economical combination of equipment and manpower required to meet initial attack objectives.

In the beginning, any planning must consider the optimum initial attack system desired. Such a system should satisfy the following basic principles: (1) Have strength, energy, and sufficient flexibility to handle changing fuel (fig. 1), risk, hazard, and weather conditions; (2) require a minimum of servicing during a mission; (3) have maximum coverage for the area and task involved; (4) be economically justifiable; and (5) perform all tasks within elapsed time requirements.

The Southern Region of the U. S. Forest Service has developed an initial attack and suppression system based on the use of machines. This system operates in more than 70 percent of the regional area. On the basis of a 10-year fire fighting record that has averaged 1,800 fires per year, we have made certain observations on the applicability of machines to the basic principles outlined above.

FIGURE 1.—Typical forest fuel in the Coastal Plains, southern United States. Fires in this fuel spread at the average rate of 80 chains perimeter per hour.

(1) The advantages of machines lie in their strength, which can be made proportionate to the job at hand; their continuous energy and service; and their diversity of types and uses. Manpower strength, on the other hand, is fixed by that of the individual whose energy is unpredictable and periodic; its capacity is limited to the number of tools and the severity of the fire situation. A bulldozer may fell and mop up a burning snag in 15 minutes, whereas manpower would be unable to even attack the job within the burning period. Furthermore, the machine has the endurance to repeatedly and continuously perform such tasks. One tractor-plow unit crew suppressed 10 fires per day; a larger handtool crew could handle only 2 similar fires. In an average worst-fire-danger day, machine-fought fires averaged 27 acres per fire, while the manpower-fought fires reached 94 acres per fire in the same area. Also, 4 percent of the manpower-suppressed fires reached class E size compared with 0.3 percent for machine-suppressed fires.

(2) The comparatively small amount of servicing required by most mechanical equipment gives it a tremendous advantage over manpower with handtools. Properly selected machines can move to a fire, put it out, and return to base with a minimum of servicing from auxiliary facilities. A tractor-plow with a 3-man crew forms a complete initial attack unit. Either alone or in combination with other like units it handles 90 percent of the fires occurring in the Coastal Plains and Piedmont areas. Auxiliary equipment for these machines are the slipon and small tractor-tanker units. This contrasts with an initial attack system that is all or part manpower and requires warehousing, transportation, field camp, food, and sleeping equipment just to service human energy only.

(3) Machines offer more extensive coverage in two ways. From an economic standpoint, stronger initial attack can be launched on more acres per mechanical unit. From the standpoint of energy, machines can handle initial attack on more fires and perform a greater variety of tasks than manpower. Our records show that one tractor-plow unit with a 3-man crew accomplished initial attack objectives on an average of 75,000 acres with a better record than was obtained during the Civilian Conservation Corps days with 50 men for 10,000 acres. Mechanized attack minimizes a difficulty which manpower finds serious; that is, line building through widely varying cover and fuel types. The tractor-plow can construct an average of 120 chains of line per hour through all varieties of fuel types in the Southern Region with the exception of swamp areas (fig. 2). Handtools in a like situation would require one or all of seven specific tools, and manpower would cover less than one chain per man-hour.

(4) Machines give us more protection per dollar expended, as is evident in the three preceding observations. They require less management, have other uses in forest work, and can be stored during periods of nonuse. In addition, the time required of fire officers for training fire crews is much less; thus, machines contribute to higher morale.

F-465053
FIGURE 2.—Mathis plow unit constructing 4-foot wide line to mineral soil at the rate of 150 chains per hour.

(5) We have learned that initial attack is much faster with machines than with trained handtool crews. Elapsed time studies on 600 fires using similar danger class days showed that the average fire, when reached by machine attack, covered 13 acres; when reached by handtool crews, 46 acres. Factors that favored machines were faster getaway time because fewer men were involved; generally faster travel; more flexibility because they were radio equipped; faster cross-country travel; and greater finesse in attacking the fire.

PLANNING FOR PUBLIC DETECTION

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Today, the American public plays an integral role in forest fire detection. Statistics show that over 50 percent of all smokes are reported by an informed, fire-conscious public.

Such was not always the case in Michigan. Until some 30 years ago citizens displayed little concern over wildfires unless lives, communities, or valuable property were endangered. Lumbermen, after removing vast tracts of pine and hardwood, left the areas ripe for fires that swept through slash and second growth. Early settlers cleared the land for farming; many viewed the uncontrolled fires of the day as a useful tool for that purpose, disregarding or not thinking of the ultimate results. Pioneers in the field of forest fire prevention waged an uphill battle for many years. Michigan's first legislation regarding forest fire was enacted in 1817, but more than one hundred years passed before any serious effort was made to enforce the laws. Not until 1925 did Michigan have a burning permit law.

Gradually the public, not only in Michigan but throughout the Nation, began to realize the terrible price it was paying for uncontrolled forest and grass fires. Today, through the tireless efforts of the press, radio, TV, government agencies, and many civic groups, the people have better understanding of the principles of conservation. The vast majority now realizes and accepts its responsibility to future generations. Most citizens consider it their duty to report all fires immediately. This is borne out by the fact that over one-half of all fires in recent years were discovered and reported by local residents and travelers. The development of this sense of duty is largely a matter of education.

Never again can we afford to become complacent. All career conservationists have the unending task of keeping the public well informed and aware of existing forest fire danger. Experience has shown that an informed public will respond to an emergency.

Michigan forest fire officers continuously carry on certain practices which promote public responsibility in the detection of forest fires. Several of these practices are listed below:

1. Smokey Bear posters and other fire prevention materials are distributed systematically. Maps are maintained of poster locations and frequently reviewed to be sure that all key points, particularly entrances to hazardous areas, are covered. Posters are displayed in such places as gas stations, grocery stores, and sporting goods shops. On occasion, Boy Scout troops and other youth organizations have assisted by placing fire prevention displays in windows of business establishments.

2. A very important part of a forest fire officer's job involves working with the public in his assigned area. At meetings with various groups and individuals the officer constantly plans for better fire detection. Every effort is made to acquaint the public with the forest fire suppression system in effect in its locality. Persons are advised where to telephone in case of fire, and are impressed with the importance of acting fast when fires are small. Most telephone companies give emergency directory listings for forest fire equipment stations and telephone operators are trained to handle reports of forest fires.

3. The forest fire officer makes periodic checks with local keymen, business establishments, resort owners, and other cooperators to make sure that they have proper telephone listings. If a remote area lacks a communication system, he sets up a messenger plan with the inhabitants.

4. When the forest fire officer assists in formulating news articles or radio and television programs, he always stresses the importance of prompt reporting of forest fires by the public.

The average Michigan citizen is beginning to fully realize the huge stake he has in the out-of-doors. He is ready to do his part to "Keep America Green." It behooves us, in the field of conservation, to guide him accordingly.

PUBLIC FIRE DETECTION IN WISCONSIN

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In the spring of 1954, the Forest Protection Division of the Wisconsin Conservation Department launched a new, five-county forest protection district in central Wisconsin. The way had been cleared by petitions and hearings, changes in legislation authorizing an extensive[1] district or districts, and necessary surveys and investigations.

Extensive district #11 was added to the ten original intensive[1] districts and embodied a modified and more economical form of protection than was previously known in the State. Later, extensive district #12 was organized. Economy was to be gained through the use of fewer personnel, less detection and suppression equipment for a given area, some dependence on the local rural fire departments, and public assistance in detecting and reporting forest fires. Public detection was to be supplemented during high fire danger by contract airplane patrol and ground patrol. This contrasted with the lookout tower and State-owned telephone and radio systems of the intensive districts. The burning permit law was modified to require permits only during high danger periods, which were announced by posted signs and in local papers.

Because forest and wild land areas then averaged only 41 percent of the total land area in the five counties, expenditures for a lookout tower system were unwarranted, at least as a beginning. (This percentage is rapidly changing each year with the increase of forest plantings on marginal farmlands.) Then too, the airplane and television were being experimented with in some quarters as possible superior detection tools.

These considerations, coupled with a uniform dispersal of population and the desire for better protection, as evidenced by numerous petitions in preceding years, pointed up the possibilities for good public cooperation in detection of forest fires.

To become operative, a program involving public participation in detection requires communication facilities and a cooperating agency to relay calls.

The problem of communications was a weighty one. People must have inexpensive, fast, convenient, and familiar means of reporting fires locally or cooperation is ineffective. The local ranger was usually in the field on patrol, checking burning risks and hazards, fighting fires, or tending his many other duties, and thus unavailable at his office for a direct telephone call much of the time. Word of a fire would have to come to him over his mobile truck radio.

[1]Described in Wisconsin Statutes 26.12.

Message relay agents for telephoned fire calls from individuals were found in the five county sheriff's offices. Through the intercounty radio net, manned 24 hours a day, the various sheriffs' offices relay calls to the Wautoma sheriff who, in turn, telephones them to the district ranger station. The district dispatcher contacts the local ranger on the forest protection radio which is on a separate channel.

This is the principal means of collecting and receiving fire calls from the public, but there are other methods. The signboard at the house of each State emergency fire warden, of which district #11 has 170, says "Report fires here" and, of course, people do just that. Many fire wardens are town chairmen who were the legally constituted town fire wardens before the forest protection district was organized. Calls reporting forest fires are also received through rural fire departments and relayed to the ranger. Certain groups of workers or professional men such as county traffic officers, highway patrolmen, and veterinarians cooperate with the local ranger. School children are advised by the ranger where and how to report fires. As he becomes better known in the community, more and more calls come directly to him at his home or office.

After the method of channeling fire calls was devised, the next job was to publicize it to gain the public's acceptance. At first, it was mandatory that the details of the plan be spread immediately to as many people in the new district as possible in the hope that some at least would start to function as fire detection cooperators. Later a more thorough and convincing job could be done through several media and personal contacts.

News was spread through the usual channels to the countryside. The State Conservation Commission rule setting up the new district and describing the boundaries was published in the official State newspapers. This rule, which has the effect of law, emphasizes that the Conservation Department is responsible for the recording and suppression of all forest, field, and marsh fires outside the limits of incorporated cities and villages. Newspapers, radio, TV, signboards, and posters outlined the details of the new laws and organization, including where and how to report forest fires. For example, special paperboard signs were printed and used on over 300 signpost locations throughout the district advising people to report fires to the sheriff's office. When burning permit requirements were in effect, these same signboards, which are located in various places, such as road intersections, town halls, and stores, carried notice of that fact. Some brief meetings were held where requested or required, as with fire departments, to explain details of operation.

However, the biggest, most difficult, and most time-consuming job still lay ahead; namely, selling acceptance of a forest fire protection program which prompts people to report wildfires and cooperate in prevention, suppression, and law enforcement. This requires grassroots education; its effectiveness is the test of final success. Among certain groups or individuals who, for various reasons, do not see eye to eye with the ranger on the business of forest fires, this education goes forward slowly—imperceptibly at times—but lasts indefinitely.

A person can be told that he should report forest fires, but if he believes that the land must be burned to kill grasshoppers or to produce blueberries or that grass fires do no damage or that woodland pastures must be burned each spring, his definition of a reportable fire needs some alteration. On the other hand, some may feel that another public agency is not needed, that the money is wasted, that the ranger is encroaching on the authority of the local fire department, or that the local people can handle any and all fires without outside help. Such people will not be very cooperative.

These and other examples were challenges to the ranger in district #11 in selling his program. However, he has been successful in making friends and furthering fire prevention and prompt reporting of fires.

This has been accomplished in such ways as showing movies and speaking to schools and adult groups, personal contacts, cooperating with rural fire departments and other public agencies, displaying efficient know-how in fire fighting, and having an adequate law enforcement program.

District #11 rangers have attended meetings ranging from the Ladies Aid Society to Feeder Pig Associations. They have made calls at school forests, summer camps, fairs, firemen's meetings, fire fighting demonstrations, parades, and conventions. With a movie projector, a Smokey Bear suit, or just an informal talk, they have managed to get their message across.

The annual fire reports indicate that public detection and reporting of forest fires in Wisconsin's district #11 is a success with gains each year:

Year:	Total Fires	*Fires reported by the public*	
		Number	*Percent*
1955	234	137	58
1956	248	158	63
1957	227	144	63
1958	377	254	67

FIRE PREVENTION POSTER PLANNING

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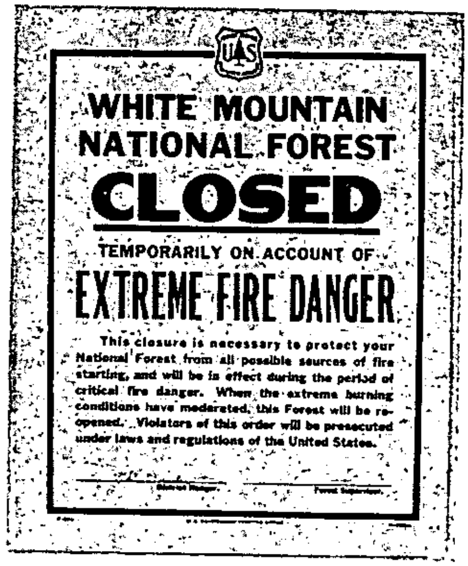
Fire prevention is necessarily a long-range program since the habits of people are slow to change. Repetition of the prevention message is, therefore, a basic policy of this program. Once the causes of fires have been determined, there are several effective media that may be used to spread the message of fire prevention to large numbers of people. One of these media is the poster. Some posters motivate people by appealing to civic responsibility; others appeal to sentiment (fig. 1), or to self-interest. Some are of the regulatory type, such as the closure poster (fig. 2), that is intended to restrict the movement of forest users and calls attention to the penalties for violation.

An effective poster appeals to different people in different ways. A poster emphasizing financial losses due to forest fires may appeal to self-interest or to civic responsibility. One depicting the plight of wildlife will appeal to sentiment; to hunters, the appeal may be to self-interest. Such posters as "Keep America Green" appeal to both sentiment and civic responsibility.

F-493434

FIGURE 1.—Posters appealing primarily to sentiment often carry a symbol of fire prevention such as Smokey Bear.



F-493435

FIGURE 2.—Closure poster prohibits entry.

Posters must be attention getters. They should carry a timely message with enough variation to keep them interesting, and be designed for seasonal and functional use to reach the individuals for whom they are intended. A well-developed prevention poster plan will obtain adequate coverage and avoid overposting. Many factors must be considered in developing the plan; these vary with the risk involved.

Types of posters.—Generally, the many types of posters now in use are attractive, eye-catching, and brief. The sizes vary with the particular needs. Large posters should be displayed on high-speed roads (fig. 3), with smaller sizes used on trails and back-country roads. Other types of posters and signs may carry an "injected" fire prevention message. An information sign implying the fire prevention message is shown in figure 4.

Intensity of posting.—The frequency of posting will vary with the scope of the program, type of use, and rate and pattern of travel. Using too few rather than too many is a good general rule, since the least number that will do the job will be the most effective. One frequently used guide is to display large posters at 5-mile intervals on highways, and smaller posters at 2-mile intervals on horse and foot trails. Functional posters (fig. 5) are displayed, as needed, at hunting and fishing campsites, logging areas, and organization camps.

Location of posters.—Public reaction should be kept in mind when selecting poster locations. Create pleasing displays by using attractive backgrounds. Make sure that posters do not interfere with scenery, recreation areas, or information signs. Limit highway posting to the use of permanent posters at points where traffic normally slows down. Avoid posting that interferes with the motorist's vision and thereby creates traffic hazards.

F-493436

FIGURE 3.—A prominent poster with a brief message and large lettering suitable for high-speed roads.

F-487777

FIGURE 4.—A plantation sign with an implied fire prevention message.

F-493437

FIGURE 5.—A functional poster at an undeveloped campsite.

Maintenance.—Maintenance is a most important item. Poorly installed or poorly maintained poster displays may be detrimental to the entire prevention program. Unsightly posters are a liability and must be replaced at once. Also, change posters as seasons and risks change and remove them when the risk no longer exists.

A poster worth displaying is worth putting on a backboard unless the poster is for temporary use. Wherever placed, it should carry the prevention message to the public.

SUMMARY

Posters can be effective fire prevention tools. To be effective, however, their use must be carefully planned and controlled. The plan should:

1. Show poster locations.
2. State uses of posters.
3. Note type of message to be used at different times of the year.
4. Show number of posters currently installed.
5. Show tentative maintenance schedule.
6. Include placing and destroying of temporary posters.
7. Control poster installations by others; e. g., cooperating agencies and private organizations.
8. Provide for periodic plan revisions.

SLASH DISPOSAL IN FIRE PLANNING

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One of the important responsibilities of a forest resource manager is the formulation and execution of fire protection plans for his unit. In making these plans he must analyze the fire hazards existing on the unit and the risks to which the forest is exposed. One basic decision that must be made is the amount of burned acreage that can be tolerated in any period without jeopardizing management objectives. A fire control organization must then be planned which is adequate to hold fire losses within prescribed limits during worst probable fire weather and risk at the least possible cost.

On a national forest the basic fire planning unit is the ranger district. All district plans on a national forest are coordinated in a forestwide plan.

In planning an adequate fire control organization the resource manager should utilize all facilities at his disposal, integrating them into a coordinated plan for the unit. This plan will include a basic fire control organization concerned with prevention, detection, and initial attack. It should also include provision for use of other personnel and facilities as fire danger rises and as high risks occur. Additional manning will include all facilities available to the local unit; other district crews of all types—road, improvement, survey, timber management; logging and sawmill operators; construction contractors; and other industrial operators and forest users.

Important components of Forest Service fire protection strength in the West are the crews and individuals whose primary duty is disposal and protection of logging slash created as the result of national-forest timber sales.

Timber harvesting operations, because of hazard involved, have a tremendous impact on the fire planning job. When planning, it is imperative that consideration be given to the effect of slash hazard on the entire protection picture.

Essential steps in planning and carrying out an adequate slash disposal and protection program are as follows: (1) Determine the size of the job; (2) decide what facilities are needed to do the job; (3) estimate the cost of the program; (4) provide for necessary finances, personnel, equipment, facilities, and training; (5) dispose of slash or provide additional protection for a specific period.

The size of the job will be determined by the area of slash created each year, the density of slash per acre, the fire weather that can be expected, the risk to which the area will be subjected, topographic considerations, accessibility, the degree of disposal needed, forecasted increase or decrease in rate of cutting, and amount of slash to be given protection in lieu of disposal.

The next logical step in planning the slash disposal job is to determine the facilities needed, such as manpower, supervision, housing, lookout structures, transportation, and equipment (tankers, pumps, hose, torches, radios, handtools). It is essential that adequate inventory be made of facilities already on hand which would be available for the job. From this inventory plans can then be made for additional facilities required.

Cost estimates for disposal by burning will vary among areas. The timber sale area itself will be the planning unit. For additional protection the planning unit may be a watershed, a ranger district, or a larger area. The remaining part of the job is to recruit, organize, equip, and train needed manpower to accomplish the actual slash disposal or extra protection work.

The slash disposal and slash protection organization is an important part of fire protection. Although its primary purpose is for work on timber sale areas, it furnishes a supply of immediately available manpower trained and equipped for fire control. When properly coordinated in ranger district and national-forest manning plans, this organization greatly strengthens the regular fire protection force.

Another way in which slash disposal can be coordinated with regular fire planning is in the execution of the slash burning job. Where this job is heavy and the number of days throughout the year when effective burning can be safely done is limited, it becomes imperative to utilize all possible facilities and manpower during the burning season. Regular fire protection personnel are trained and experienced in fire behavior and fire suppression work and lend efficient assistance in the slash burning job. Burning is usually done when these men can be spared from their regular fire protection duties. They form a logical and effective supplement to the regular slash disposal crews.

So important to the entire fire protection job is the current disposal of slash that plans should be made to utilize all available sources of manpower, supervision, and equipment. In addition to the regular fire force already mentioned this should include all available personnel, regardless of regular assignment.

It is often necessary during the actual burning period to man one or more regular protection stations, including lookouts. This is important for several reasons: To furnish minimum fire control coverage for the rest of the district; serve as a communication hub; record fire weather observations on areas that have been burned and not yet mopped up; warn of sudden change in fire weather.

There is another important reason for including all personnel in plans for slash burning. On many districts, several years may elapse before a large fire occurs. Where slash disposal is an annual job, it furnishes a good opportunity for actual experience and training in fire behavior and suppression.

Where timber being harvested creates slash hazard, adequate plans must be made for current abatement and protection of slash. An important responsibility of the land manager is planning, financing, and carrying out this program. The most effective use of money and manpower is made when the entire slash disposal and protection program is integrated in the overall fire plans for the basic planning unit. This results in the best possible total fire protection organization at the least possible cost.

FIRE PLANNING FOR THE WASATCH FRONT IN UTAH

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The critical watersheds of the Wasatch Front are in ever-increasing jeopardy from the loss of vegetative cover due to fires. Historical records and recent disastrous floods and mud flows into adjacent Utah communities attest to the damage potential inherent in any fire on these watersheds.

The Wasatch Front area, located in northern Utah, is approximately 100 miles long and 30 miles wide (fig. 1). It extends from a point north of Brigham City south along the precipitous range behind Ogden, Salt Lake City, and Provo (fig. 2) to a point near Spanish Fork. Three-fourths of the population of Utah live adjacent to this mountain front. They depend on it for water, and much of their outdoor recreation; and their homes and even their lives depend on its slope stability.

The job of the fire planner for the Front area is complicated by two factors. First, there is a population and suburban expansion onto the lower slopes of the mountain range with attendant risks and increased man-caused fire incidence. Second, there is the extreme hazard and rapid rate of spread characteristic of the flashy cheatgrass and oak brush fuels that clothe the slopes, extending from valley floor to mountain top in many places. The elevation ranges from 4,000 to 10,000 feet.

Added to the problem of planning for adequate suppression is the fact that fire-weather conditions are typically critical during July and August. The precipitous west slopes are directly exposed to drying desert winds that often have velocities of 40 m.p.h. during this period.

The land ownership pattern, especially on the lower slopes, involves several agencies in the fire protection effort. National forest, State, county, city-owned watershed, and private lands intermingle in many places and are interdependent for fire prevention and suppression. Close cooperative working relationships have been developed to meet recognized fire responsibilities. The effectiveness of this team approach affords an outstanding example of the cooperation that is possible among different levels of government in the protection of critical watersheds.

In current planning several criteria and objectives have been established:

1. The Wasatch Range has been placed in the highest wild land value classification in recognition of watershed values and direct valley-mountain relationships.
2. Analysis of fire damage on these watersheds has provided a sound basis for establishing maximum fire limits. These

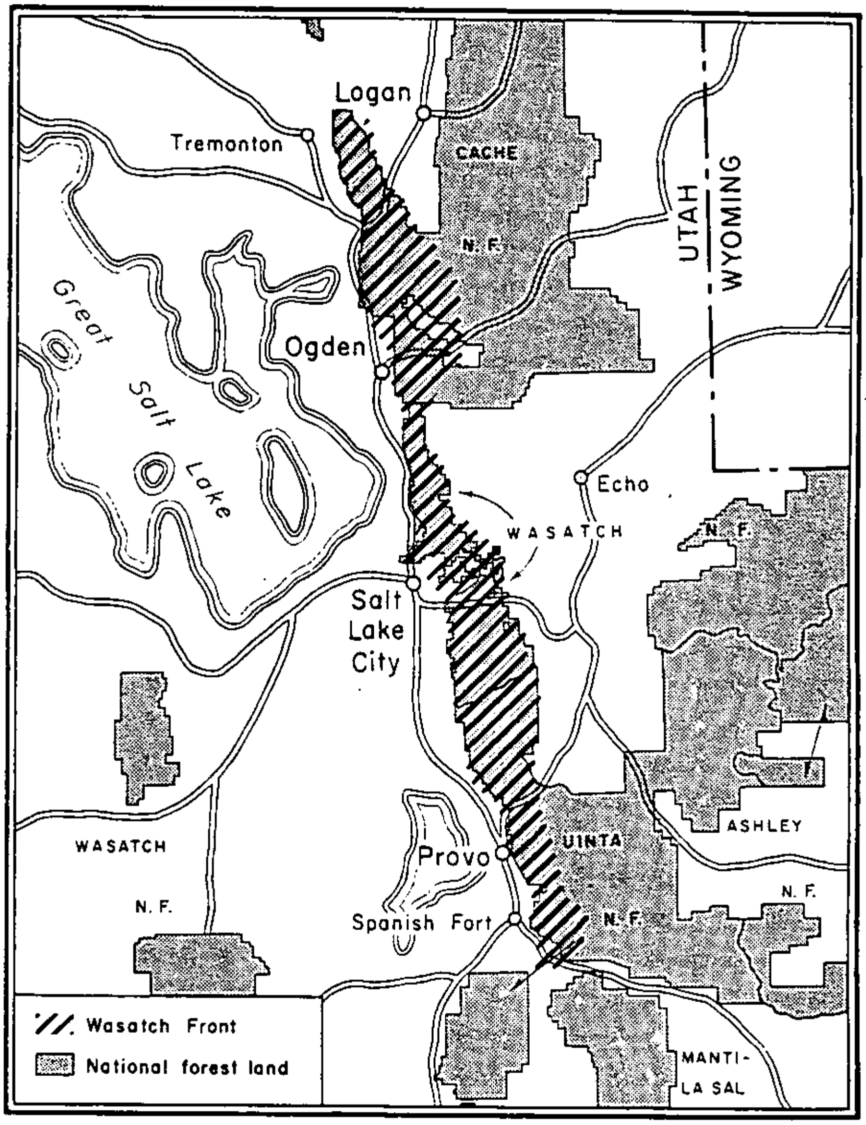

FIGURE 1.—The Wasatch Front in northern Utah.

are in line with national Forest Service standards. For this area, a 10-acre limit for any fire has been established (with provision for a 20-acre limit in flash fuels, except for drainages immediately tributary to municipalities).

3. Data covering fire's rate of spread, resistance to control in fuel types, and weather conditions (represented by a fire danger rating of 70 on the Intermountain Forest and Range Experiment Station meter) were used to set hour control standards needed to meet size-of-fire objectives.

FIGURE 2.—The Wasatch Front at Provo, Utah.

Planning must be directed to two major necessities if fire control objectives are to be met. The first of these is to strengthen prevention to reduce man-caused fire incidence. To do this, a prevention analysis is underway to develop an action program for specific situations. With the sorting out of problems will come agreement among responsible agencies for assigned segments and the provision of adequate manpower to meet the calculated need. Public support, already strong, can be depended upon to further this effort.

The second major need is to plan for speed and dependability of detection and initial attack in meeting the rapid rate of fire spread in flash fuels. Strength of forces available, however, do not compare with those found on some other watersheds; southern California, for example.

In past years dependence has been placed on public detection. The effectiveness of this indicates the deep local interest in the protection of mountain watersheds. However, the values at stake make it necessary to establish more positive and prompt detection. Analysis has shown that we must have detection within 3 minutes to meet control objectives. Specific locations for detection points are still in the planning stage.

Along with rapid detection must come speed of report and initial attack. This will be provided by FM radio communication, part of which is already established.

Studies of techniques, equipment, and manpower that will most effectively and economically provide initial attack to meet hour control objectives will include air tankers, helicopter delivery of personnel, and direct attack. These new methods will be coordinated with the more common ground attack methods, although in many cases the latter will constitute reinforcement strength. The plan for coordinated attack provides for a driveable firebreak along the lower slope above suburban developments (in addition to the sections already constructed), a system of helispots at selected points to provide hour control coverage for 85 percent of the area, other key secondary firebreaks, and water supply points. A primary air tanker base and heliport are planned at Salt Lake City. Secondary heliports will be provided near Provo, Ogden, and Brigham City. Secondary air tanker bases planned at Provo and Ogden will be primarily reinforcement bases since initial attack, standby air tankers are not planned at these locations.

Conventional ground attack forces will be equipped with tankers and FM radio communications and will be stationed near fire concentrations. An air-ground radio net is also planned to insure coordination of initial attack between air and ground forces.

Planning the Location, Size, and Type of Fire Caches

"Fire planning" is a term long associated with fire control activities. To most people, it means planning the number and location of fire control personnel. In actual practice, however, it must go much further than this. True, manpower is the means for obtaining adequate fire protection. But that, however, requires that men be provided with the necessary firefighting equipment. It is therefore essential that fire caches be included as an integral part of fire planning.

The objective in fire cache planning should be to provide the equipment necessary to meet maximum fire control needs. This involves location and size of caches and type of tools and equipment in them.

Fire caches must be planned to meet the needs of three different forces involved in fire suppression: first, the initial attack crews; second, local reinforcements; and third, reinforcements other than local. Each force presents separate and distinct problems.

Initial attack.—Location and size of fire caches for this type of action should be based on the number of personnel and attack locations established in the local unit fire plan. Each of the initial attack personnel must be equipped with suitable firefighting equipment. Normally, the equipment is composed principally of handtools. However, fuels and topography occasionally dictate the need for mechanized equipment such as power saws and trenchers. The size, location, and type of fire cache equipment needed by such crews cannot be planned until the final organization is determined.

Reinforcement action.—History shows that some fires go beyond the initial attack stage. This is where reinforcement action enters the picture. In some cases, reinforcement action may be only a dozen or so men. In others, it may be several hundred. Some of this personnel is located on the ranger district and forest. Often, however, a portion of the reinforcement action must come from some distance. To supply these reinforcements, it is essential that fire caches be properly located and that they contain the proper amount and type of firefighting equipment.

One method of determining fire cache requirements for this type of action is to analyze fire records. The analysis should be based on equipment and supply requirements over a period of years, expressed in terms of number of men to be supplied. A 20-year period is normally an adequate base for determining equipment needs. The volume of use in this study will establish standard firefighting equipment needs and also serve as an indicator for miscellaneous equipment (except certain special items) and for initial, prepackaged food supplies. Such items, for example, as extra sleeping bags, hard hats, torches, and boxed rations are normally maintained in quantities based on the amount of standard firefighting equipment needed.

Fire caches planned for reinforcement use must be so distributed that they will provide maximum efficiency and speed of supply. The objective should be to stock enough equipment on local units to supply manpower locally available. The balance should be located in central fire caches. Fire planning will determine the amount of local manpower available for fire suppression.—MERRILL E. TESTER, *Forester, Division of Fire Control, Northern Region, U. S. Forest Service.*

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Fire Control Planning in the Alaska Region

Contrary to the common belief, there is an important fire control planning job in Alaska's national forests. Although annual rainfall varies from 26 to 186 inches, with most of the area getting well over 75 inches, we do have periods of high fire danger. The very nature of the timber types and topography in Coastal Alaska lends itself to high fire danger whenever there is a lack of rainfall.

For many years the Alaska region was in a custodial status. There was some timber cutting and other uses of the national forests; however, this use was limited and as a result only a few fires occurred. Harvesting of the timber resource during the past 10 years has materially increased and many thousands of acres of slash are created each year. Also more people are using the national forests and as a result, more fires are started. Then too, there are examples throughout Southeast Alaska of fires having occurred in undisturbed stands.

Because of the vast, relatively unpopulated nature of the national-forest areas and the lack of a systematic detection system, it is often several hours before a crew can be placed on a fire. There is a real job of planning in order to detect fires in their early stages and get someone on them before they are out of hand. Two large fires in the past 2 years show that given the right conditions, we can have serious fires with much damage.

There are an average of 39 days during the summer season when fires will burn. These days occur over a 3-month period beginning in June. If as many as 8 or 10 of these fire-weather days are consecutive, we have potentially dangerous conditions. The 20 to 22 hours of daylight speed up the fuel drying process. As soon as rain stops falling, the moss begins to dry out; then the fine litter. Slash areas soon reach an explosive condition and because of the rugged topography a fire starting at the bottom of a draw in a cutover area quickly sweeps to the top. Much of the soil is shallow, of organic origin, and underlaid by bedrock. Fires burning over this type of soil during dry periods destroy much of the soil itself, leaving scars that will show for many years to come.

Because of this increasingly important fire problem, we must develop a fire danger rating system that will warn of an impending hazardous fire situation. The development of a fire danger meter or rating system indicating such a buildup will enable us to take the necessary precautionary action with loggers and the general public and thus prevent the occurrence of large fires. We are only in the early stages of a comprehensive fire control planning program.

Fire occurrence is relatively low and practically all fires are man-caused, lightning having caused only three fires during the past 10 years. The Alaska Region lacks many of the facilities found in other Forest Service regions. All forests are practically roadless and trails are few and far between. Airplane landing strips are nonexistent. With the present pattern of fire occurrence and high hazard and risk areas so widely scattered, a detection system as commonly used is not practical. Communication is mostly by radio and does not adequately meet the demands of general administration and fire control needs. Because of these conditions planning for prevention, detection and suppression poses problems not found elsewhere.—WAYNE SWORD, *Chief, Section of Operation and Fire Control, Alaska Region, U. S. Forest Service.*

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Planning Initial Attack With Water

On the Quinault Ranger District of the Olympic National Forest, three 1-ton trucks with standard Forest Service 160-gallon slipon tanks were used in planning initial attack on small fires with water. Each unit maintained the following equipment:

1. Portable pumper.
2. Live reel.
3. Nozzle kit.
4. 500 feet of 1-inch C.J.R.L. hose.
5. Fire tools for five men.
6. A 30-watt two-way mobile radio.

Each tanker was manned by a leader and two men well trained in the use of the equipment.

During periods of fire danger, each of the three crews worked within hearing of its radio which was kept on continuous standby. Work was planned so that the crews were more or less evenly spaced over the district and any fire occurring would be within easy reach of one crew.

To have everything in readiness, each morning the crews started the pumps, ran them up to regular operating pressure, checked for adequate gas and oil, and made sure the slipon tank was fully loaded with water. No crew was allowed to leave the station unless the equipment operated perfectly. The crew leader immediately reported any mechanical trouble to the fire dispatcher and arrangements were made to make repairs or replacements.

A spare pump was always ready at district headquarters to replace one that failed. Spare nozzles, hose, and other equipment that might be needed were also kept on hand.

Crews attended preseason guard-training camp and in addition were given at least 24 hours' training in the use of water for initial attack. During the summer, crew leaders were encouraged to hold frequent practice sessions in the use of their equipment.

At the first report of a fire, the closest crew was dispatched and the other two crews instructed to move to the fire. The first crew to reach the fire was instructed to use water on the hot spots and attempt to stop the spread. If help was needed, the plan called for the second unit to move in at about the time the first unit ran out of water. The third unit, if needed, would arrive in time to relieve the second unit. When a unit expended its water, it was to go to the nearest source for another load, leaving one crew member to fight the fire with handtools. If one man could load the tank from the nearest source, two men would stay with the fire.

As one of their regular jobs, crews developed and maintained all available water sources along roads in their work area. This gave them firsthand knowledge of each source. Water tanks were set up on ridgetop roads when other sources of water were not available.

This system was used successfully on several fires. On those fires where hose lays longer than 500 feet were required, initial attack with water became ineffective; the crew then resorted to handtools and reinforcements were ordered.

With ranger headquarters located geographically close to the center of the district, two work centers were established—one in the south portion and one in the north. It takes about 1 hour to travel from one end of the district to the other. The work centers spaced the crews so that first followup could arrive at a fire within approximately 30 minutes maximum elapsed time. By carefully conserving water, a crew could carry on the attack until the next crew arrived.—CLARENCE E. EDGINGTON, *Regional Fire Dispatcher, Pacific Northwest Region, U. S. Forest Service.*

INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and with no paragraphs breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and unit.

Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints are acceptable. Legends for illustrations should be typed in the manuscript immediately following the paragraph in which the illustration is first mentioned, the legend being separated from the text by lines both above and below. Illustrations should be labeled "figures" and numbered consecutively. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

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