FIRE CONTROL NOTES

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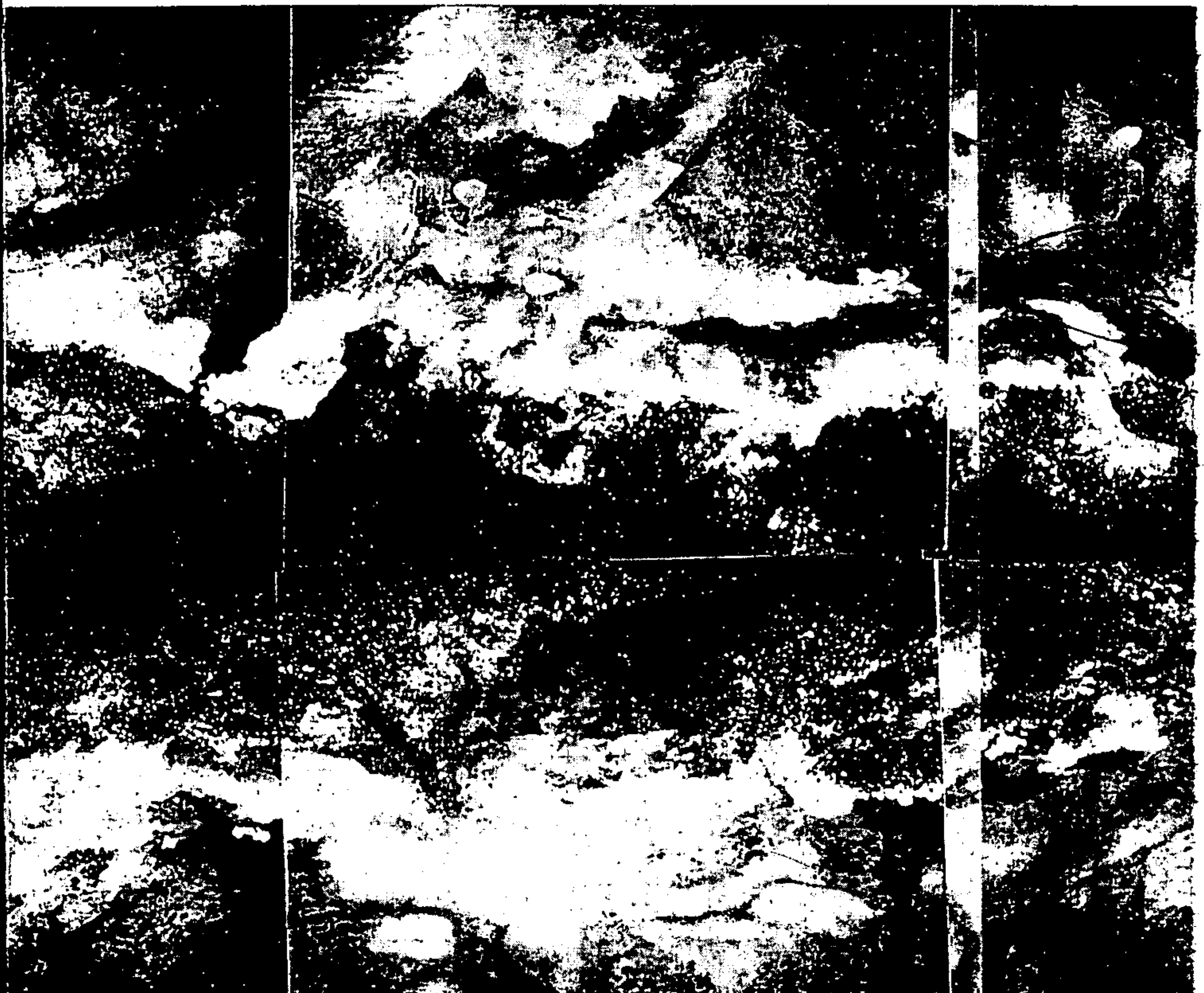

FIRE CONTROL NOTES

A quarterly periodical devoted to forest fire control

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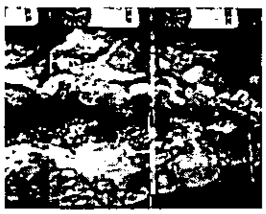

COVER.—Infrared imagery mosaic of a portion of the Sundance Fire, Kaniksu National Forest, Idaho, Sept. 2, 1967. The head of the fire is shown. The fire area is approximately 7 miles long by 3½ miles wide.

(NOTE—Use of trade names is for information purposes and does not imply endorsement by the U.S. Department of Agriculture.)

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FIRE HAZARD MANAGEMENT IN THE BITTERROOT—A FURTHER REPORT

JOHN MORRISON, *Forester*
Bitterroot National Forest

In the fall of 1962 the Bitterroot National Forest started developing a hazard management plan for 200,000 acres of high-hazard, over-mature, and insect-killed lodgepole pine stands. Objectives of the plan are to:

1. Minimize the possibility of conflagrations;
2. Salvage available merchantable timber;
3. Reduce the fire hazard; and
4. Return the area to timber production.[1]

The plan was initially implemented in 1963 when 15 helispots and 5 miles of access road were constructed. Three fuel-break areas totalling 160 acres were prepared for burning. Merchantable timber was salvaged, with 10 to 20 lodgepole pine seed trees left per acre. Unmerchantable trees and snags were felled. Burning of these areas in 1964 resulted in a good clean burn with minimum control problems. But there is now insufficient natural regeneration to stock the areas even though seed trees with serotinous cones were left.

Because of the high cost of preparing the areas, and the failure to quickly establish a satisfactory stocking of seedlings, a search was begun for other methods of establishing fuel breaks in the high-hazard, heavy-fuel areas.

THE NEW PLAN

Plans were made to develop strip fuel breaks at two of the largest and most hazardous blocks on the Forest—along the Meadow-Tolan Creeks divide and the Sleeping Child-Skalkaho Creek divide. Each of these planned fuel breaks consists of a continuous strip ¼ to ⅜ mile wide on which all the readily burnable fuels are to be consumed and a young stand of timber re-established. When the young trees reach a height sufficient to shade the ground and close their canopy, the area will become virtually fireproof.

On the merchantable timber types, all salable material will be removed by commercial sale and the residual burned. Non-merchantable areas will be lined and burned to make the break continuous.

Access roads have been built by the timber operators and the Hazard Management Project. The Meadow-Tolan fuel break will be 7 miles long and the Sleeping Child-Skalkaho break will be 8 miles long. Others are being planned.

[1] Morrison, J. Fire hazard management. Fire Control Notes 25(2) 13-15, 1964.

FOUR METHODS TRIED

In an effort to find an economical way to build the fuel breaks and reforest them naturally, four methods were tried in 1967:

1. In July, half of the standing material on two blocks was laid down using a D-8 dozer working on the contour.

2. On one block *all* standing material was laid down.

3. One block was helicopter-sprayed with one part 2-4-D (4 pounds acid equivalent) to nine parts diesel, at the rate of 10 gallons per acre.

4. Two other blocks were left in their natural state except for control lines.

Exterior firelines approximately one chain wide were constructed with a D-8 dozer. Lines between blocks were one dozer wide. The access road was used for the bottom line on all blocks. Snags that would fall across the road were cut before burning.

The treated blocks were burned on Sept. 18, 1967, and the untreated blocks on Sept. 20 (figs. 1, 2, and 3). All blocks ignited readily and burned well. The sprayed block burned somewhat violently, possibly because flash fuels were supplied by the low shrubs killed by spraying.

SEED FALL IS ADEQUATE

The day after firing, seed traps were placed in all blocks except the 100% laydown block. The traps

(Continued on page 16)

Figure 1.—Untreated area ready to burn.

TRAIL BIKES EFFECTIVE IN FOREST FIRE CONTROL

EARLE S. WILLIAMS, *Forest Ranger*

Maine Forestry Department

A major problem of forest fire control in the "back country" of Maine is making simultaneous and rapid attack on numerous lightning fires resulting from a single storm. Men walking in with hand tools from the nearest road or lakeside have been used in past years.

The increasingly popular use of rough-country motor bikes by recreationists along many abandoned skid roads led to their trial use for firefighters in 1965. After reviewing available equipment, two Trail Breaker bikes were selected which have the following features suitable for forest fire control agencies:

1. Two-wheel drive
2. Good flotation (670x15, 2-ply tires)
3. Ground clearance—15 in.
4. Fording depth—24 in.
5. Transmission ratio 70 to 1 (maneuvers 90% slopes)
6. Adaptability to a variety of ground conditions (swampy areas, rocky and rough areas)
7. High load-carrying capacity (back pumps, power saws, hand tools, personal gear)

The weight of this bike, 180 pounds without load, is greater than most. Although this may be considered a disadvantage, it is offset by the desirable flotation, transmission ratio, and load-carrying capacity features of this equipment. All-around performance has been very good in comparison with other units. Some current uses offering the greatest potential are:

1. *Initial Attack.*—Up to now, ground crews with packs on their backs have been guided into lightning fires from float-equipped aircraft overhead. It may take several hours for a crew to walk to a remote fire, tying up a plane that could be urgently needed in other areas. The speed of the bike over abandoned hauling roads and skid trails puts a man on the fire earlier and in better working condition with more equipment and supplies.

2. *Line Supervision on Larger Fires.*—Good supervisory personnel are probably needed more with today's crews than ever before. Once lines are constructed, the bike could be helpful in making better use of sector or crew bosses for more rapid coverage of the line. In later mopup stages, a firefighter may be used to patrol a large amount of line from the bike, and report by radio on line conditions. Other uses, such as deliveries of supplies and small tools, are evident.

3. *Prevention.*—Inspections of occupied recreation areas, woods operations, and similar situations—which may be reached now only by walking—will be speeded up. Rangers will be able to keep up with visitors and others using trail bikes.

4. *Service.*—Servicing of remote lookout towers with supplies, communications, and maintenance gear can be done more efficiently.

5. *Other Uses.*—General administration activities on State lands not serviced by roads are facilitated by use of trail bikes. As with any machine, safety hazards are present and training must be provided to avoid personal injuries through careless use.

Operating cost figures are not yet available. A tankful of gas gives 8 hours of running time, and though the original cost of $800 appears high, time savings translated into dollars can be impressive. Large savings should result from the bike's ability to get that first man to the fire fast while there is still a chance of economical control. The possibilities for reducing damage and suppression costs are great.

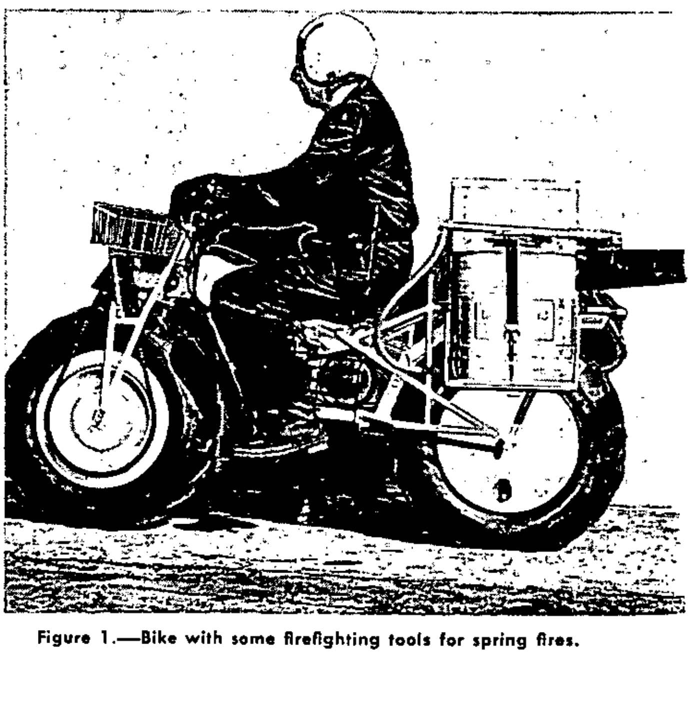

Figure 1.—Bike with some firefighting tools for spring fires.

A FIELD TRIAL FOR REGULATING PRESCRIBED FIRE INTENSITIES

STEPHEN S. SACKETT, *Research Forester*
Southern Forest Fire Laboratory
Southeastern Forest Experiment Station

Certain firing techniques can be used to control the intensities of prescription burns. When lines of fire are set to permit spread with the wind, fire intensities are generally greater than those produced by lines of fire moving against the wind. Flank fires generally create intensities somewhere between those generated by head fires and backfires. Spot fires often generate the entire range of intensities—the leading edge behaving as a head fire, the sides as flank fires, and the rear as a backfire.

Multiple lines or spots of fire are often necessary when a large area has to be burned in a specified time. The lines or spots of fire have a "drawing" effect on each other where they converge, and their individual intensities become magnified in the junction zones. Since most fire damage occurs within these junction zones, the interval between fire sets is vital in regulating overall intensities.

PROCEDURE AND OBSERVATIONS

A workshop on prescribed burning was held recently on the Francis Marion National Forest, South Carolina. All burns took place in an open, mature stand of loblolly and longleaf pine averaging about 80 feet in height. Litter fuel consisted mainly of a 2- to 3-year accumulation of needles, and the vegetative undergrowth was composed of wiregrass (*Aristida stricta* Michx.), gallberry (*Ilex glabra* (L.) Gray), titi (*Cyrilla racemiflora* L.), and other minor shrub species.

Mild February weather prevailed: air temperature was 68°F. and the average relative humidity 34 percent; wind was light and from the southeast in the stand, with gusts up to 19 m.p.h. in the open. The spread index was calculated at 33, and the buildup index totaled 16. Three days had elapsed since the last rain (0.34 inch). Although the surface fuel was moderately dry, the soil was still damp.

Four 4-acre blocks were allotted for spot fires, and five for strip head fires. In order to evaluate the effect of distance between fire sets on behavior and intensities of the resulting fires, particularly in junction zones, the number of sets per block in the four spot fire blocks was varied as follows: 2, 4, 30, and 60 spots.

In the five strip head fire blocks, the strips were placed about a chain apart. All plots were burned the same day. Estimates of the resulting crown scorch served as gages of fire intensities. Scorch was classified as follows:

Class	Percent Crown Scorch
A	None
B	1-33
C	34-66
D	67-100

From observations of rate of spread, flame height, and vegetative fuel consumption, fire intensities appeared to increase directly with the number of ignition points, and were inversely related to the spacing between fire sets.

When examined for scorch 2 months after burning, the condition of the crowns supported preliminary observations. The strip head fire blocks had a greater percentage of Class C and D tree crowns than did any of the other treatment blocks. Scorch was negligible in those blocks that had been burned with 2 or 4 spots. In those with 30 and 60 spots, the percentage of scorch approached that in blocks burned with strip head fires (fig. 1). As the number of spots increased (spacing between decreased), the chances for convergence and greater intensities also increased.

Not all crown scorching results in damage to those species studied, but excessive amounts may be harmful. Scorching does, however, indicate the level of fire intensity. Because of the relatively large bole sizes and tree heights involved, observations made during this demonstration probably resulted in conservative interpretations. A younger stand would likely have suffered greater crown scorch and thus more potential damage.

CONCLUSIONS

The interval between fire sets appears to strongly influence the fire intensities created by prescription burning. Data from this demonstration indicate that, with many sets placed close together, it should be possible to produce a high-intensity burn. Conversely, a low-intensity fire should result from fewer sets and wider spacing.

In the South, most fire prescriptions in pine stands call for low-intensity fires that do not damage the crowns of crop trees. Sometimes, however, higher intensities are necessary; for instance, in clearcut areas where fire is used for slash disposal, or in mixed stands where hardwoods are undesirable and need to be controlled.

If further study shows that interpretations made in this demonstration are applicable for a normal range of fuel and weather conditions, another useful means will be available to regulate prescribed fire intensities.

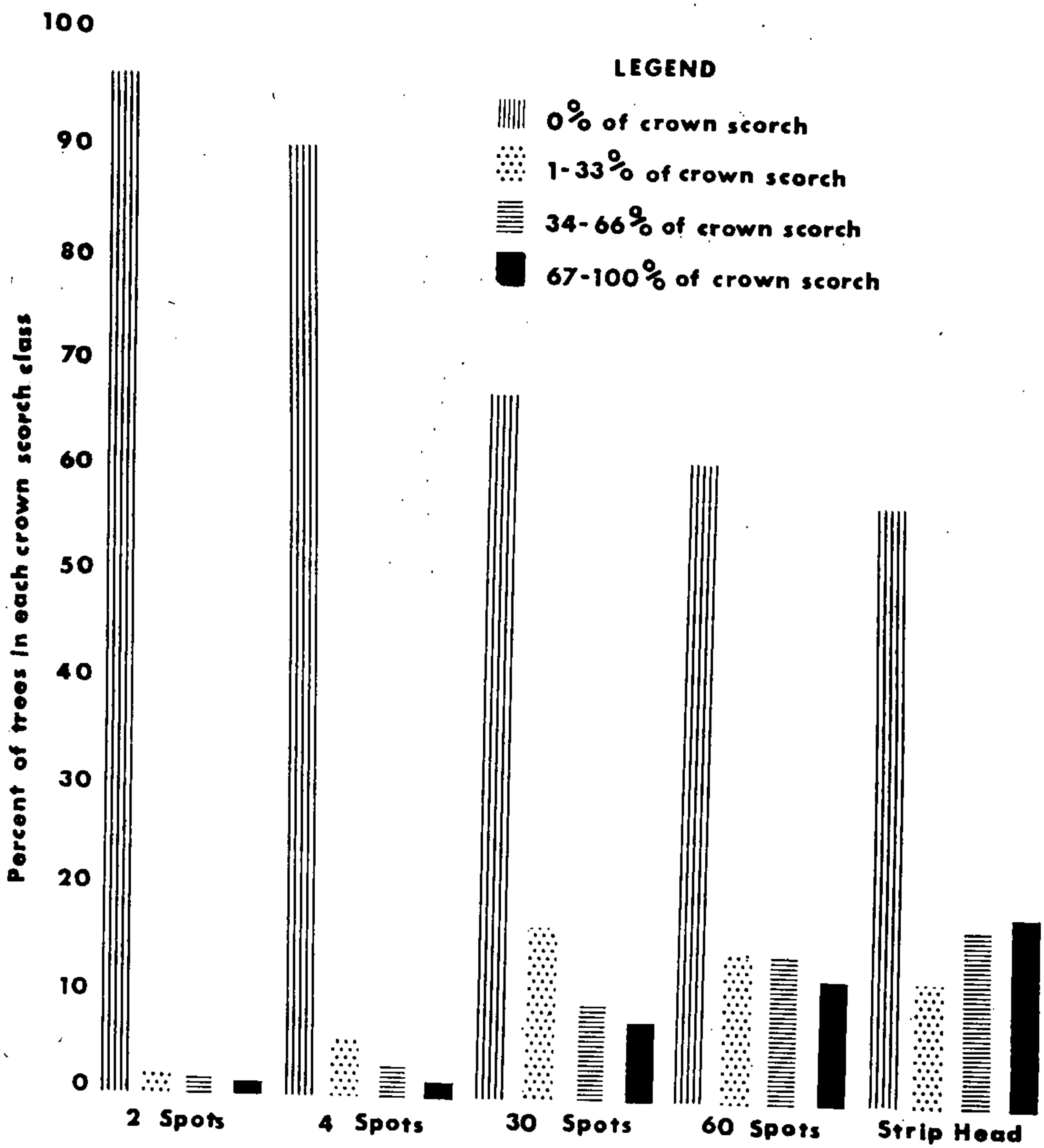

Figure 1. Crown scorch associated with a variety of firing techniques.

INFRARED MAPPING IMPROVES EFFICIENCY, CUTS COSTS OF FIRE SUPPRESSION

ROBERT A. COOK and RICHARD A. CHASE[1]

"Intense smoke prevented effective scouting, either by ground or air. By use of infrared imagery in early stages, spot fires were picked up that were unknown to ground forces . . . perimeter imagery showed 720 chains of fireline to build rather than the 400 chains previously estimated. As a result, crews and equipment were reassigned to "beef-up" the north and south side . . . additional manpower and retardant drops were ordered. Use of infrared mapping saved 1 to 1½ sections of virgin timber . . . suppression costs were reduced at least $100,000."

This report from a Northwest fire indicates the value of the Infrared Mapping Unit.[2] Using it, the Fire Boss can readily obtain current intelligence on fire behavior at night, or in spite of dense smoke cover, and direct his forces more efficiently.

The prototype mapping unit, resulting from 5 years of joint research by the Forest Service and the Office of Civil Defense, was released from the Fire Research Laboratory at Missoula as an operational tool in July, 1966, and has mapped many fires since.

Previously, Fire Bosses had to depend mainly upon daytime observations. While helicopters or reconnaissance planes greatly aid observers in gathering needed information quickly, they can be used only until it becomes too smoky, windy, or dark to fly. When these conditions prevail, it has been necessary to rely solely on ground scouting, which can be slow, and may provide sketchy and inaccurate information, since scouts must avoid the hazards of fire, smoke, and precipitous terrain in walking the fire perimeter. The data also may be obsolete when it reaches fire headquarters. By supplementing such methods with infrared mapping (fig. 1), Fire Bosses may now quickly acquire current information under almost all conditions.

OPERATION OF THE UNIT

The infrared mapping unit consists of a scanner, detector, printer, and associated electronic circuitry and controls; all units are mounted in a light twin-engine aircraft, with a crew consisting of pilot and operator.

As the aircraft flies over the fire area, infrared energy emissions from the ground are picked up by the detector and converted to an electrical signal, which is amplified and converted to a visual signal displayed on a cathode ray tube. This thermal picture is recorded on Polaroid film. The prints appear similar to aerial

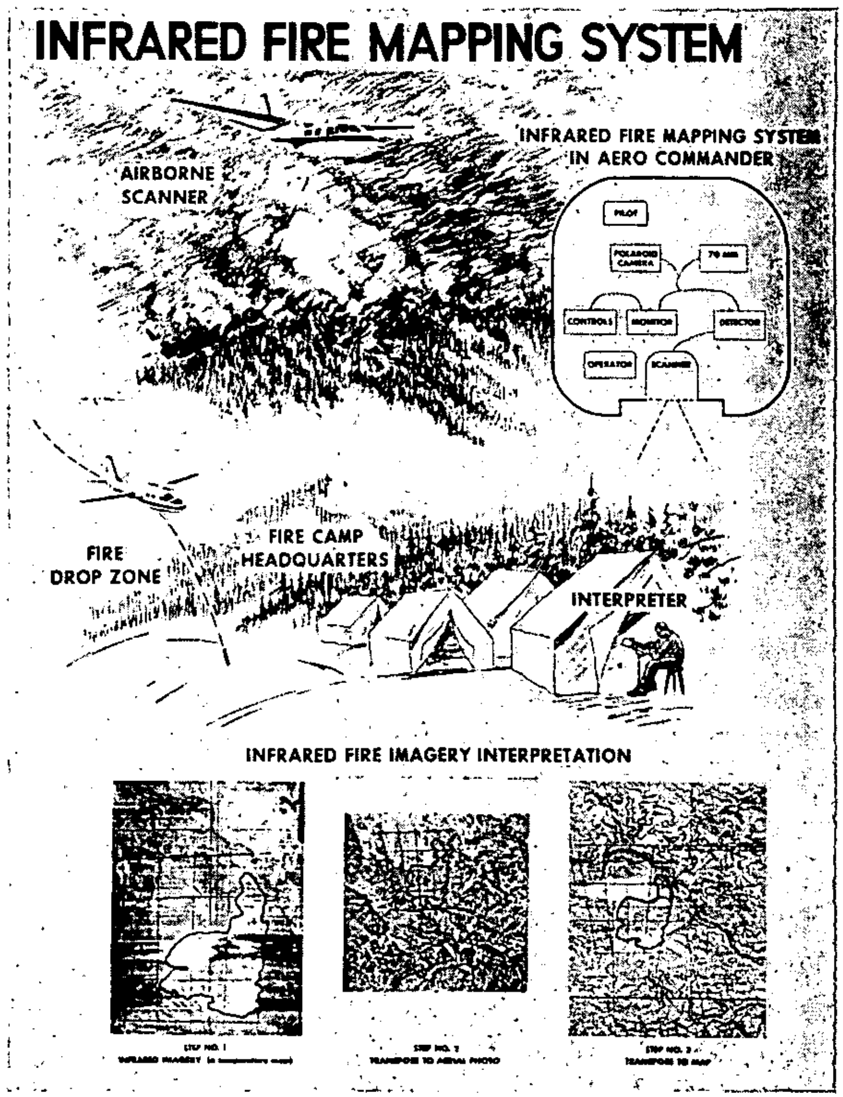

Figure 1.—Illustration of steps involved in infrared fire mapping.

[1] Respectively, Fire Control Technician, Western Zone Air Unit, Region 4, and Staff Specialist, Division of Fire Control, Washington, D.C.

[2] Bjornsen, Robert L. Infrared—a new approach to wildfire mapping. Fire Control Notes 26(3), pp. 3-4. 1965.

photos, with shades from black to white. The burning areas are white; brightness varies with fire intensity. Roads, buildings, open areas, timber types, and many topographic features are in various tones of gray because they emit infrared energy of lower signal strengths.

A mapping mission for the Forest Service begins with a request to the Regional dispatcher for the unit. This request, including details on fire location, fire headquarters, nearest airport, etc., is relayed to the crew. Usually the initial flight is made before the plane lands at the local airport. The imagery is delivered to the fire headquarters, where a trained interpreter transfers the fire perimeter and other data to aerial photos and maps. Subsequent mapping missions over the fire are coordinated by radio, and imagery prints may be dropped to the interpreter at the fire headquarters in a special plastic tube minutes after being made.

The best imagery is usually obtained at night, but satisfactory imagery can be made during daylight. Dawn and dusk are the poorest time for mapping. Though unaffected by smoke, imagery cannot be made through fog or cloud cover.

USED ON 21 FIRES IN 1966

The base of operations for the infrared mapper was established at Boise, Idaho, under supervision of the Division of Fire Control, Intermountain Region of the Forest Service, Ogden, Utah. The first operational use of the unit took place on July 29 on the Cottonwood Fire, Lewis and Clark National Forest, Montana. Before the summer was over, 21 fires in five States were mapped for the Forest Service, the Bureau of Land Management, and the California Department of Forestry.

An excellent example of the mapping unit's value was on the Indian Ridge Fire, Klamath National Forest. This fire was completely smoked-in for several days; helicopters and other reconnaissance planes were unable to operate. However, infrared imagery was obtained regularly at noon and midnight, furnishing vital information to fire personnel.

The largest fire mapped was the 20,000-acre Round Fire in August on the Mendocino National Forest, Calif. Here also, the smoke pall was extremely bad, and imagery was important in providing needed fire intelligence.

Redding, Calif., was the base of operations from Oct. 10 to Nov. 8. Some imagery was obtained for Civil Defense purposes, and an electronic technician was trained to operate the scanning equipment. Two California fires were mapped near Oroville during this period.

1967 OPERATIONS: 47 FIRES

During the busy 1967 fire season, the infrared plane flew nearly 400 hours serving Federal and State fire control agencies throughout the western United States, including Alaska, where it proved effective in detecting hot spots in tundra fires. A total of 47 different fires was mapped, many of them several times. Once during the August fire emergency in the Northwest, 14 fires were mapped in one night. The total area mapped each day varied, but reached nearly 100,000 acres several times. An example of the imagery obtained is shown in figure 2.

In addition to these fire missions, the unit participated in a Civil Defense exercise in Los Angeles and was used to obtain imagery of insect-killed timber in South Dakota for research purposes.

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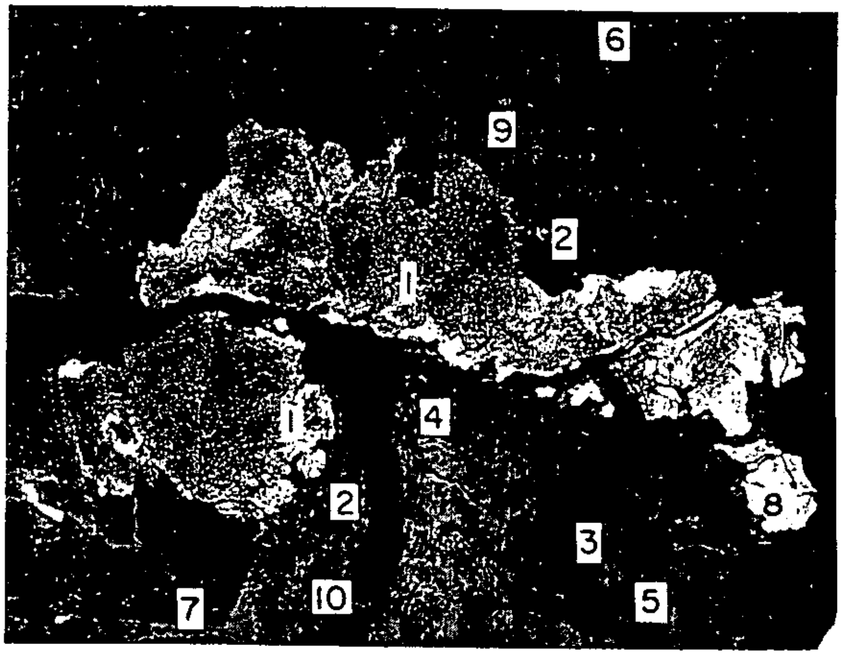

Figure 2.—Imagery—Shoepack Fire, St. Joe National Forest, Idaho, 9/26/67, at 2215, 5,000 feet over terrain. 1-burned area; 2-spot fires; 3-stream; 4-roads; 5-timber; 6-scan lines; 7-timber removed; 8-extreme heat; 9-fire camp; 10-flaw.

NATIONAL FIRE TRAINING CENTER

by Edward G. Heilman, *Forester*
Fire Control Training Field Support Unit
Marana, Arizona

As forest fire control becomes more complex, through the use of tools such as aircraft, fire retardant chemicals, electronic and other equipment, fire training needs become correspondingly more involved. Sink-or-swim training methods will no longer serve fire control goals.

Although for years the Forest Service has endeavored to improve fire training, having introduced such breakthroughs as fire simulators, programed instruction (including teaching machines), vastly improved films, and other means, it has recognized the need to keep fire training on a par with ever-expanding educational technology.

FACILITIES

In February 1967, the Forest Service's Division of Fire Control established a Field Support Unit at Marana Air Park, Marana, Ariz. (fig. 1). Because of the Service-wide scope of its activities, the training unit receives program direction from the Chief's Office, Division of Fire Control. Individual regions have access to the Marana unit through this division.

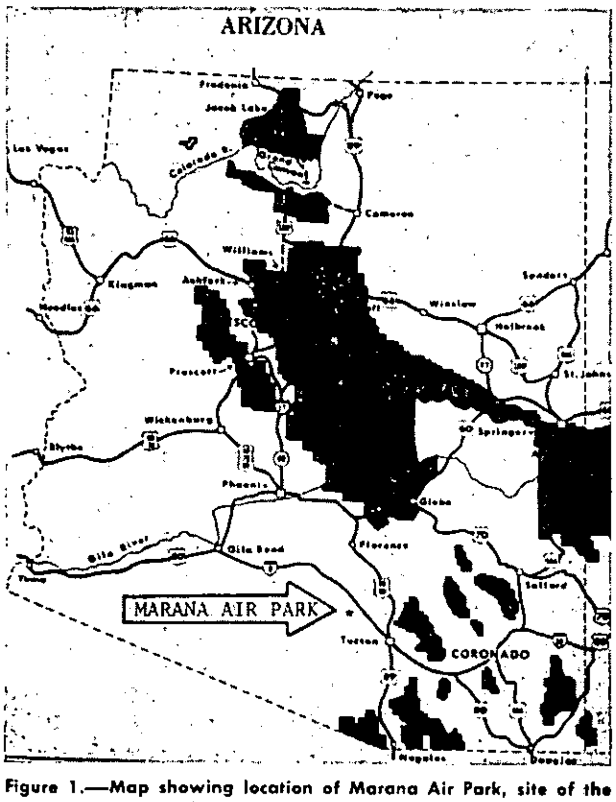

Figure 1.—Map showing location of Marana Air Park, site of the National Fire Training Unit.

Located 30 miles northwest of Tucson, the unit leases offices and classroom space to accommodate 100 trainees (fig. 2). Availability of housing and meals provides a live-in environment conducive to better learning.

The runways and other flight facilities at Marana offer on-the-spot opportunities for air operations training. The Air Park also serves as an air tanker base during the local Region's fire season from May through July.

MISSION

The Marana Unit serves fire control training needs by using modern learning techniques. Its main goal is to provide support to regional fire control training programs through:

Development and Use of Instructional Tools.

In contracting with instructional technologists, the Unit's position would be, "Here's what we want to teach," expecting the technologist to reply, "Here's how to teach it and the training aids needed." While most instructional tool development will probably be contracted, there will be in-house efforts involving regions and the Marana Unit. Examples of some instructional tools developed elsewhere are the programed texts: *Fundamentals of Fire Behavior, Ten Standard Firefighting Orders, Fire General Policy Review,* and various slide-tape programs.

Figure 2.—Classroom facilites at the Marana Fire Control Training Center.

Development of Service-wide Courses.

The unit will provide assistance in preparing and conducting such Service-wide training courses as Advanced Fire Behavior, Fire Generalship, Advanced Command Air Operations, Fire Prevention, Law Enforcement, and others. A large teaching staff is not envisioned. Instructors will be drawn from the field for temporary assignment as the course requires.

Distribution of Fire Training Aids.

During field trips and other contacts, the unit will evaluate locally developed fire training aids for Service-wide use.

Establishment of a Fire Training Library.

A technical fire control library has been established to provide field units, contractors, researchers, and trainees with a comprehensive reference library for assisting the fire training effort.

Assistance at Regional Schools.

With coordination by the Division of Fire Control, the unit will furnish on-site assistance at some regional schools, including qualification of fire simulator instructor teams. The Marana facilities are also available for regional courses. Training officers are encouraged to visit the unit.

Pilot-Testing New Training Methods.

The program includes evaluation of new "hardware" such as television systems (fig. 3), new teaching machines, and cartridge-loaded movie projectors; and it includes appraisal of "software" such as written or filmed programs. The unit maintains contact with the latest developments in both educational ideas and equipment.

The newest command system fire simulator has been installed at the Marana Center to furnish regular and advanced fire simulator training on both national and regional levels (fig. 4). It will also be used to develop and test new simulation procedures and equipment.

One example of this is a recently prepared air-oriented fire simulator exercise. In this exercise, observer-trainees are actively involved with the trainee fire team in decision-making through a parallel teaching system using Edex student-response equipment. The system uses programed audiovisual instruction and individual responder units where trainees indicate their answers to questions by pushing one of four buttons. By monitoring indicator dials, the instructor can immediately determine both individual and group responses. Using this information, he can furnish additional instruction as needed by the individual or group.

Figure 3.—Using television equipment to supplement classroom instruction.

Forest fire control today offers new challenges to the wildland manager. To meet them, improved fire training is necessary. The Marana Fire Control Center will help furnish this training to the field fireman.

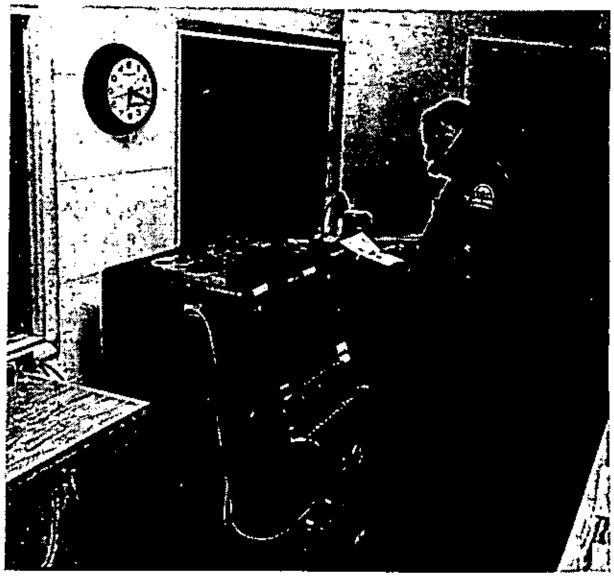

Figure 4.—Umpire-Director booth, Marana command system simulator.

FOREST FIRE PREVENTION—THE VITAL ROLE OF COMMUNITY LEADERS

M. L. Doolittle, *Research Forester*
Southern Forest Experiment Station

Key men in rural communities are often enlisted in forest fire prevention programs. They include elected officials, successful businessmen, farmers, and others influential in education, religion, economics, and government. A recent study by the Southern Forest Experiment Station's Forest Fire Prevention Research and Development Project at State College, Miss. indicates that the success of fire prevention programs may be related to the pattern of leadership in the community.

In the study, a rural community with a relatively low fire-occurrence rate was found to have general leaders who had the positions, records for action, and reputations associated with leadership. In a second community with a much higher fire-occurrence rate, there were many in high positions, but none whose influence was widespread, or who were regarded as leaders by most other residents.

STUDY COMMUNITIES

The two study communities were chosen for comparison because, while similar in such characteristics as land-ownership and use, and economic composition, their rates of forest fire occurrence differed sharply. The approximate boundaries of each were determined by asking residents to which community they belonged. As finally delineated, the study communities contained about 200 families each. The *High Rate* community was having over 10 times as many forest fires as the *Low Rate*. In both communities, incendiarism accounted for well over 50 percent of the fires. In *Low Rate*, fire occurrence had decreased sharply in the 10 years preceding the study. In *High Rate* it had been excessive for longer than local foresters could remember.

An investigation into the reasons for the contrast in occurrence rate disclosed that, in the *Low Rate* area, the forest protection agency had done nothing revolutionary to prevent fires, but, partially as a result of key-man contacts, residents spoke of fire prevention as a first-person activity. "We just showed people that fire setting wasn't the thing to do," said one prominent citizen. "We had regular forestry programs three or four times a year. We showed films to the school kids too, and that seemed to really help. Then we did a lot of just sitting and talking to people. We got a few people convinced, and the rest followed."

In contrast, people in the *High Rate* area discussed the Government and fire protection in the third person. For example, a successful dairyman said, "The Government has me surrounded on three sides. I don't know how they ever got hold of all this land, but a fellow can't buy any for love nor money. People around here don't get anything out of the Government land but a big headache. Why, it's got to where you can't even let a fire get out without the Government coming and trying to put you in the pen!"

LEADERSHIP PATTERNS

Leaders in the two communities were identified through their positions, community activities, and reputations. Positions normally associated with leadership included appointive and elective offices. Community activities included participation in public programs of importance to the whole community. Reputation, perhaps the most significant of the criteria of leadership considered, involved recognition as a leader by community residents. Names of those in important positions and those active in public programs were noted. People with a reputation for leadership were identified through interviews with community residents. In singling out leaders, emphasis was on area of influence.

In the *Low Rate* community, a few leaders with wide general influence emerged, regardless of identification criteria. Two of the four people most often named as leaders were elected officials, and a third had just completed a term in an elective office. One had demonstrated community action by encouraging voter turnout in a special county election to approve the building of a pine plywood mill. As an advocate of the building plans, he was almost certain to support forest protection programs. In this community, foresters had little difficulty in finding the right people to aid in a prevention program which proved very successful.

In the *High Rate* community, on the other hand, a large number of people emerged as leaders, but none was named often enough to be regarded as such in the whole community. One individual was influential among his immediate neighbors; another, the respected elder among a large, close-knit kin group; still another was recognized because of his vast land and cattle holdings. Such people were named as leaders by fellow residents more often than elected officials and others in positions normally associated with leadership, the effect being that the *High Rate* area had no general leadership at the community level.

Those regarded as key contacts by county forestry and agricultural officials attended State and regional agricultural conferences, participated in the county forestry association, and represented the local political unit on the county soil and water conservation board. They were not, however, considered leaders by the other residents of the community. It is not surprising, therefore, that they had little influence over those who were causing forest fires, and prevention programs directed by them may even have been resented.

CONCLUSIONS

Where people of high position have little influence, and there are no general community leaders, local fire protection agencies face difficulty. When diffuse leadership is the only kind available (as is often true in the South), forest protection contactors must recognize and work with it, if he is ever to get effective fire prevention action.

The real question, of course, is, "How do you obtain assistance and support from such leaders once you find them?" To answer this question, scientists at State College, Miss., are making two studies. The first is of such things as leadership qualities, information sources, dissemination patterns, and areas and levels of influence. The other, prevention activities—ranging from personal contact to community organization and development—will be made under carefully controlled conditions. Scientists hope to determine how effective such activities are, both singly and in various combinations. Their findings certainly will not replace the effectiveness of personal contacts, but they may help those involved to increase their efficiency.

FLUORESCENT SIGNAL STREAMERS WORK WELL

ALBERT E. BOUCHER, *Smokejumper Foreman*

Redmond Air Center

Good communications is the key to smooth aerial operations. During busy fire periods, radios are at a premium, and ground personnel must communicate with support aircraft by visual signals. This is usually accomplished by laying 1-ft. by 8-ft. strips of colored material ("streamers") on the ground in signal patterns.

Those now in common use are made of crepe paper, cambric cloth, or thin plastic. Certain features of these materials can reduce their effectiveness. Coloring fades rapidly, wind makes it difficult to keep the streamers in position, and reflective qualities are inadequate under poor light conditions.

A vinyl-coated pennant cloth in bright fluorescent colors has proven very effective for this use. Available commercially at reasonable cost, it eliminates or greatly reduces the inadequacies of present products. Being colorfast, it will not fade. The material is stiff enough to remain flat in moderate winds, yet it is easy to roll or fold. The cloth is available in 38-inch-wide rolls and can be cut to size and shape with scissors.

The 40-man smokejumper unit at the Redmond Air Center, Oregon, was issued the new streamers on a trial basis for the 1967 fire season. They were used to signal aircraft for tools, food, water, etc. All comments were favorable. Pilots and observers reported being able to see and "read" the fluorescent streamers much more quickly and easily than the ordinary ones. Slight breezes didn't disturb them nor were they confused with small red cargo parachutes.

The Redmond Air Center smokejumpers have now adopted the new streamers and have also constructed message droppers using the fluorescent cloth.

The color used at the Air Center was called "Blaze Orange," but material is also available in "Arc Yellow," "Blue," "Signal Green," "Rocket Red," and "Saturn Yellow." The cost varies from 63 cents per yard for 500 yards or more, to 88 cents for less than 100 yards. The streamers tried by the Redmond smokejumpers were 9½ inches wide (to fully utilize the roll) by 12 feet long—equal to about one square yard. This material may be purchased from United Tent and Supply Co., 759-61 N. Spring St., Los Angeles, Calif. 90012.[1]

[1] Trade names and commercial products or enterprises are mentioned solely for information. No endorsement by U.S. Department of Agriculture is implied.

LARGE HELICOPTER USE IN FIRE SUPPRESSION

DIVISION OF FIRE CONTROL
Washington, D.C.

The value of helicopters for various fire control tasks has been established for 20 years. These versatile and efficient aircraft are now employed almost routinely on most large fires, and many smaller ones as well.

Most helicopter use has been with the light utility 2- or 3-place models with a load-carrying capacity of approximately 1,000 pounds. Large helicopters have been used only infrequently due to lack of availability. The high investment and operating costs of the larger models have discouraged commercial operators from purchasing them until opportunities for expanded use were more certain. Thus, they have generally been available to fire control agencies only in emergencies from military sources, necessarily limiting investigations into their potential for fire suppression work.

This situation is changing. In recent years, several western commercial helicopter operators have made large models available for fire use. Experience with these aircraft during the 1966 and 1967 fire seasons has clearly indicated that they offer an opportunity to significantly improve the efficiency of fire control forces in certain situations. Although the cost per hour for these larger models may run as much as 3 to 4 times that for lighter helicopters, this is more than offset by their larger capacities and improved performance (table 1).

TABLE 1.—General characteristics of some large helicopters now in use. Actual capacities will vary with local conditions and fuel weight.

Model	Passenger capacity	Payload (pounds)	Retardant Capacity (gals.)
Bell 204-B	8	4,130	3-400
Sikorsky S-58	13	5,040	3-400
Sikorsky S-61	(a)	7,400	7-900
Kaman H-43-A	(a)	2,400	2-250

(a) Not approved by U.S.F.S. for personnel transportation.

OPPORTUNITIES FOR USE

Evaluation of the performance of large helicopters during the past two fire seasons has pinpointed situations where they have definite advantages over other types of equipment. On personnel transport and cargo hauling missions, the performance characteristics and load capacities of these aircraft permit large volumes of men and equipment to be moved rapidly into a remote fire. With the Sikorsky S-58, for example, no more than three trips would be required to deliver a complete 25-man organized crew and its equipment. For a 5-mile ferry, the entire operation could be completed by one copter in approximately 20 minutes (fig. 1).

During the 1967 fire "bust" in Northern Idaho, three U.S. Army HUEY helicopters, the military version of the Bell 204-B, flying a total of 34 hours, moved 174 men and more than 12,000 pounds of equipment and supplies to four large fires in roadless areas. More than a dozen light helicopters would have been required to accomplish this task in the same time.

HELITANKER OPERATIONS

While fixed-wing airtankers offer advantages of high speed and large load capacity, necessary in many circumstances, the large helitanker has also proven an important tactical tool. With its great maneuverability, the helicopter can accurately pinpoint drops, and has achieved excellent results in close support of line workers. Also helicopter drops can often continue after fixed-wing operations have been curtailed by smoke and reduced visibility.

The relatively small load capacity of even the large helitankers, as compared to fixed-wing airtankers, is often offset by their ability to operate from water or retardant-mixing sources close to the fire. The "dip buckets" developed for these aircraft make it possible for them to load easily from

Figure 1.—The large capacity of the Sikorsky S-58 enables it to quickly move fire suppression forces to remote areas.

small ponds or portable retardant mixing plants in the fire vicinity without landing (fig. 2). Thus, little time is wasted in ferrying, and the helitankers can actually drop greater quantities than fixed-wing aircraft operating from distant bases.

In 3 days on the Airstrip Fire, Willamette National Forest, Oregon, one S-61 helitanker applied 147,000 gallons of water and 26,000 gallons of retardants. At the peak of operations it was delivering water at a rate of 9,000 gallons per hour! An additional 34,000 gallons of water and 10,000 gallons of retardant were dropped on this fire by a Bell 204-B and a Kaman helitanker (fig. 3).

LIMITATIONS

In contemplating use of large helicopters, their limitations must be considered and fire control personnel should consult closely with Air Officers. Much care must be taken to select suitable landing sites, since these larger craft have different requirements than the light helicopters familiar to most fire people. Also, the large models cannot hover at altitudes as high as those of some frequently-used small helicopters.

Figure 2.—A Bell 204-B helitanker loads its drop bucket with retardant mixed by a portable mixer near the firelines.

FUTURE POTENTIAL

Use to date confirms the large helicopter has a definite place in the fire suppression force. The high operating cost per hour is offset by the aircraft's ability to transport larger loads at faster speeds than lower-cost, smaller models; and in appropriate circumstances it can be much more efficient. Conversion from personnel transport to cargo carrier to helitanker can be rapidly effected, giving fire managers a versatile, increased-capacity piece of equipment.

Further improvements in the helicopters or related equipment, such as the lightweight helitanker buckets pioneered by the Pacific Northwest Region, will further increase their adaptability to many fire jobs. Because of present military requirements, the number of large helicopters available for purchase by commercial operators is limited. Some operators may still be reluctant to make the large investment required. It appears certain, however, that the availability of large helicopters for fire work is increasing. Fire control personnel should become acquainted with the potential benefits—and limitations—of large helicopters so they may consider their use in appropriate situations.

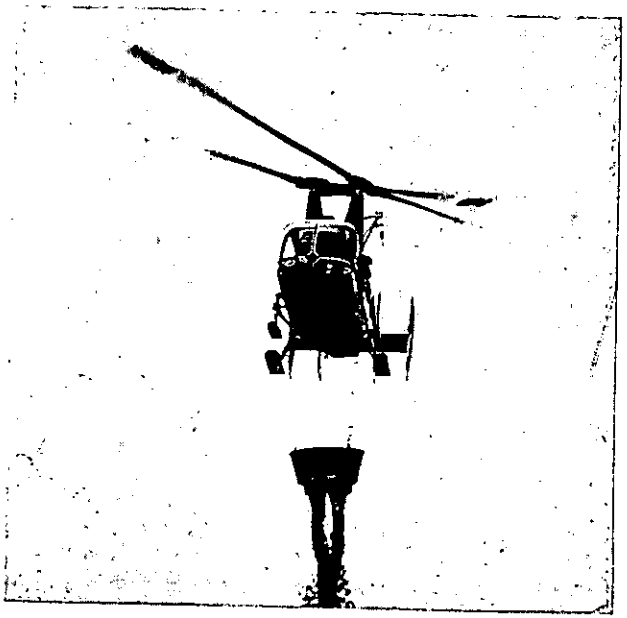

Figure 3.—The Kaman helitanker, with 250-gallon bucket.

INFORMATION FOR CONTRIBUTORS

Please submit contributions through appropriate channels to Director, Division of Fire Control, Forest Service, U.S. Department of Agriculture, Washington, D.C. 20250. Articles should be typed in duplicate, double spaced. The author's name, position, and organization should appear directly below the title.

Articles covering any phase of forest, brush, or range fire control work are desired. Authors are encouraged to include illustrations with their copy. These should have clear detail and tell a story. Only glossy prints or India ink line drawings can be used. Diagrams should be drawn with the page proportions in mind, and lettered so as to permit any necessary reduction. Typed captions should be attached to the illustrations, or included in the text following the paragraph in which they are first mentioned.

NEW TRAILER-MOUNTED FIRE RETARDANT MIXER SUCCESSFULLY FIELD-TESTED

FRANKLIN R. WARD, JOHN D. DELL and WILLIAM C. WOOD[1]

A new trailer-mounted chemical fire retardant mixer (fig. 1) was successfully field-tested in the Pacific Northwest Region during the 1966 slash burning season. The test was done on seven high-lead or tractor-logged units on the Umpqua National Forest in Oregon. We used the unit to apply a fire retardant to perimeters of clearcut blocks for extra protection during broadcast burns; the retardant was also used to slow down rate of fire spread at critical points within blocks.

A 1½ ton stake-side truck towed the trailer and carried bags of retardant and water. On firelines inaccessible to trucks, a tractor did the pulling. Manipulation of the live-reel hose over slash was difficult and slow. The unit performed best on roadside application above slash units and on treating accessible draws and chimneys below the road level. The optimum crew size was three to five men, depending on amount of slash, topography, and distance hose had to be laid. When towed by a tractor or 4-wheel drive vehicle over firelines on moderately steep terrain, the unit handled satisfactorily.

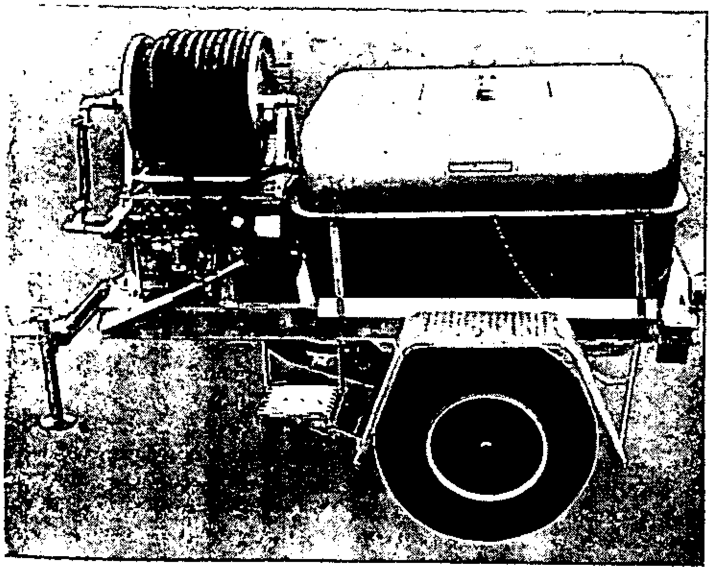

Figure 1.—The trailer-mounted chemical fire retardant mixer can hold 300 gallons.

The mixer unit consists of a 300-gallon fiberglas tank equipped with an impeller for mixing, a 12½ horsepower (at 3200 rpm) engine, a 250-foot capacity live reel, and a Seeger-Wanner Model A20F positive displacement piston pump rated by the manufacturer at 22 gpm, at 578 rpm, and up to 500 psi. These components are mounted on a heavy-duty single-axle trailer. The equipment was assembled for the Forest Service by Mitchell, Lewis, and Staver Company[2] of Portland, Oregon, at a development cost of $2,127.

Engineers from the San Dimas Equipment Development Center made laboratory tests to determine if this unit could adequately mix the fire retardant Phos-Chek 259. They also tested Phos-Chek 202 and Gelgard M.[3]

The tests showed that the unit *could* mix Phos-Chek 259. It was the only retardant used in the field tests. Although no difficulty was experienced with the pump in the laboratory trials, even when pumping Phos-Chek 202 at 800 plus centipoise, both Phos-Chek 202 and Gelgard M were more difficult to mix than Phos-Chek 259. Changes have been made in the mixer to correct this.

The unit generally performed well in its first field trial, although a need for certain equipment modifications became evident. The live reel was not large enough to handle the amount of hose used, nor did it have a handle for rewind; a larger live reel with handle has been installed. The trailer did not have ample protection for belt and flywheel on the mixer shaft. A metal plate attached to the undercarriage corrected this problem. A maintenance kit and spare tire have been added and other minor repairs and modifications made. Further field use of the mixer is planned.

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[1] Ward and Dell are associated with the Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.; Wood with the Pacific Northwest Region, U.S.F.S.

[2] Trade names and commercial products or enterprises are mentionel solely for information. No endorsement by the U.S. Department of Agriculture is implied.

[3] U.S. Forest Service, Mitchell retardant mixer. 1966 (Unpublished report on file at San Dimas Equipment Development Center, San Dimas, Calif.)

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Fire Hazard Management—*Continued from page 3*

Figure 2.—Same area as figure 1. Firing completed 2200—Sept. 20, 1967.

Figure 3.—Same area as figures 1 and 2. 2200—Sept. 21, 1967.

were checked on Nov. 13 with the following results:

50% laydown blocks . . .	58M seeds per acre
Spray block	50M seeds per acre
Natural area	132M seeds per acre

The traps were left in position for checking in the spring to determine later seed fall. The seed fall to date appears sufficient to establish a new, fully stocked stand.

Because the untreated areas cleaned up as well as the treated ones, we believe that *no treatment other than control lines is necessary to establish satisfactory fuel breaks in our high-hazard fuels.*

In merchantable stands, the salable material will be removed and the residual burned. The slash from the cut material will make ignition easier here. Standing stems will be killed by the fire and will furnish shade for the new seedlings.

Strategically located fuel breaks for controlling potential conflagrations are being given first priority as roads are developed through high-hazard units. They will be rehabilitated to develop full timber production potential as well as to fireproof them.

Infrared Mapping—*from p. 8*

Despite heavy use during the summer, the mapper functioned well. Minor electronic repairs were required only once, and the detector failed on one mission due to ice accumulation.

SUMMARY

Infrared imagery can reduce firefighting costs in many ways. In addition to accurately locating fire perimeters and spot fires, it reveals the relative intensity of the fire on the different sectors. Rate of fire spread can be accurately calculated from successive imagery made at timed intervals. Topographic and cultural features can be identified. All this information can assist the Fire Boss in establishing priorities for suppression on various parts of the fire and in selecting suitable control line locations. Manpower and equipment needs can be better estimated. In the mopup stage of the fire, new imagery pinpoints hot spots, permitting better scheduling and use of manpower.

Accurate interpretation of the imagery, and the subsequent transfer of information to aerial photographs and maps, is very important to its successful use. To facilitate broader application of infrared mapping, the Forest Service has trained 58 interpreters from Federal, State, and County protection agencies in Western States. More will be required.