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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 technique may flow to and from every worker in the field of forest fire control.

Volume 5 Number 4

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the TECHNIQUE OF FIRE CONTROL

FIRE CONTROL NOTES is issued quarterly 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. Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., 15 cents a copy, or by subscription at the rate of 50 cents per year. Postage stamps will not be accepted in payment.

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, personnel management, 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.

Address Division of Fire Control
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Contents

AN ANALYSIS OF THE HONEY FIRE

C. F. Olsen

Forester,[1] *Southern Forest Experiment Station*

Although the Honey Fire occurred almost 2 years ago the following analysis is published because of its value to other fire control personnel. The data were gathered by research personnel who were present throughout the period of the fire and who were free from any suppression duties. A "Board of Fire Review" held by the regional forester in 1938 brought out additional information and criticisms which were furnished the southern station for its study.

Employees on a south-bound freight train in north-central Louisiana carelessly disposed of a piece of burning waste from a hot box on a crisp January morning in 1938. The bit of flame landed in dead grass at the edge of the tracks inside the boundaries of the Kisatchie National Forest; 30 minutes later this small flame had grown into a forest fire with a perimeter of almost 4 miles and had spread almost 2 miles with the wind from the point of origin. A crew of four men, assigned by the Southern Forest Experiment Station to studies in fire behavior, was on the scene within 3 minutes after its start and an unusually complete record of this fire, including its rate of spread and resistance to control, was obtained.[2]

This fire record will be discussed and analyzed in detail with three objectives:

1. To indicate the rate of spread and behavior of fires burning under extremely critical conditions.
2. To describe the action that was taken to suppress the fire.
3. To use the experience gained from this fire as a guide in planning the action to be taken on other fires burning under similar circumstances.

Location

The Honey Fire,[3] known locally also as the Dyson Creek Fire occurred in the center of the Catahoula District of the Kisatchie National Forest. The fire started along the east side of a railroad right-of-way 1½ miles north of Bentley, a small settlement approximately 15 miles north of Alexandria, headquarters of the forest supervisor. The central tower of the ranger district, the Catahoula Tower, is

[1] Grateful acknowledgment is given to A. H. Antonie, R. Brooks, and C. A. Bickford for invaluable assistance not only in mapping and recording data but also in constructive criticism and review of the manuscript.

[2] In order to obtain better data, the forest supervisor had previously agreed that the members of this crew were relieved of any obligation to assist in fire suppression. Usually they were in effect dispatched with the regular suppression crew; in this instance they happened on the fire at about the time it was reported. They were criticized for not trying to control it; but with two fences and a railroad between them and the fire, there is no doubt that their truck was unusable on this fire. It was very definitely too big for them to hold with hand tools alone.

[3] This fire was briefly described by Mr. Roy Headley in *Fire Control Notes*, vol. 3, No. 4, Oct. 1939, pp. 40–41, "Lessons from Larger Fires of 1938," under the heading "Honey Fire."

located 1½ miles east of Bentley. The highways, railroad, firebreaks, and other physical improvements on the fire area are shown on the accompanying maps.

Description of the Area

The area is typical of open cut-over longleaf pine land in the Upper Coastal Plain. The topography ranges from flat to gently rolling, with occasional depressions of wet and boggy land. Several small creek bottoms occur on the area, but because they are in general very narrow, they contribute little or nothing as natural barriers to fast-spreading fires. The principal fuel in the area is grass, broomsedge (*Andropogon* sp.) being predominant. Other components of the fuel are various herbaceous plants, pine needles and cones, and hardwood leaves.

Approximately 150 acres covered by this fire were burned over on February 21, 1935. The remainder of the area, or about 950 acres, had been unburned for at least 6 years. Inasmuch as all of the area had been unburned for 3 years or longer and the site is better than average, a uniform and extremely heavy stand of grass covered the entire area and contributed markedly to the intensity of the fire. Also scattered residual seed trees and some reproduction were present in the western half of the area and the eastern half supported moderately well stocked stands of longleaf pine saplings, light to heavy stands of blackjack oak, and open grass. Following the 1935 fire, 20-foot-wide drivable firebreaks were constructed over portions of the area. An 858-acre plantation of slash pine was established by the Forest Service in the center of the burned area during the 1936–37 planting season.

All of the burned area lies with the national-forest protection boundary, but only the east half is national-forest land, the remainder being privately owned.

Weather Conditions

The weather conditions that prevailed in the region immediately before the fire started and on the 2 previous days are shown in table 1.

TABLE 1.—*Weather conditions preceding the Honey Fire (observations made at Catahoula Tower)*

Date	Temperature		Rainfall	Time of rainfall	Sky condition	Wind		Visibility
	Maximum	Minimum				Direction	Rate	
	° F.	*° F.*	*Inch.*					
Jan. 23	73	62	0.93	Noon-6 p. m.	Cloudy	South	Light	Poor.
Jan. 24	66	48	0		Cloudy and threatening.	SW-NW	Moderate	Poor (3 miles).
Jan. 25 [1]	42	----	0		Clear	NW	Moderate	Good.

[1] 10 a. m.

Since this fire was mapped for rate of spread in connection with a study of fire behavior and the recording of current weather data was an integral part of that study, weather records were made, beginning shortly after the start of the fire. The factors measured were relative humidity (by a hand-operated psychrometer), air temperature, wind movement, wind direction, and sky condition. General notes also were made. Wind movement was taken at 1-minute intervals with a portable anemometer developed by the California Forest and Range Experiment Station. This instrument consisted of a Byram-type fan anemometer resting on a universal joint and mounted on a tripod. The instrument was placed a sufficient distance from the fire to be unaffected by the drafts and currents created during rapid combustion. The anemometer was set with the spindle 3½ feet above the ground, the standard height for measuring wind velocity in all studies of rate of spread.

A record of the average and maximum wind velocity, relative humidity, air temperature, and fuel and soil moisture content (based on dry weight) is presented in table 2.

TABLE 2.—*Record of weather, fuel moisture, and soil moisture conditions during Honey fire*

Period	Wind velocity		Time	Relative humidity	Air temperature	Time	Moisture content (dry weight)	
	Average	Maximum					Fuel	Soil
	Miles per hr.	*Miles per hr.*		*Percent*	*°F.*		*Percent*	*Percent*
10:07–10:37 a. m.	6.7	9.9	10:06 a. m.	33	42	10 a. m.	15.8	34.1
11:28–11:59 a. m.	11.3	16.6	11:20 a. m.	27	50	11:55 a. m.	12.1	34.1
12:20–12:33 p. m.	12.7	14.3	12:33 p. m.	26	46	1:45 p. m.	11.6	....
			2:17 p. m.	26	46			

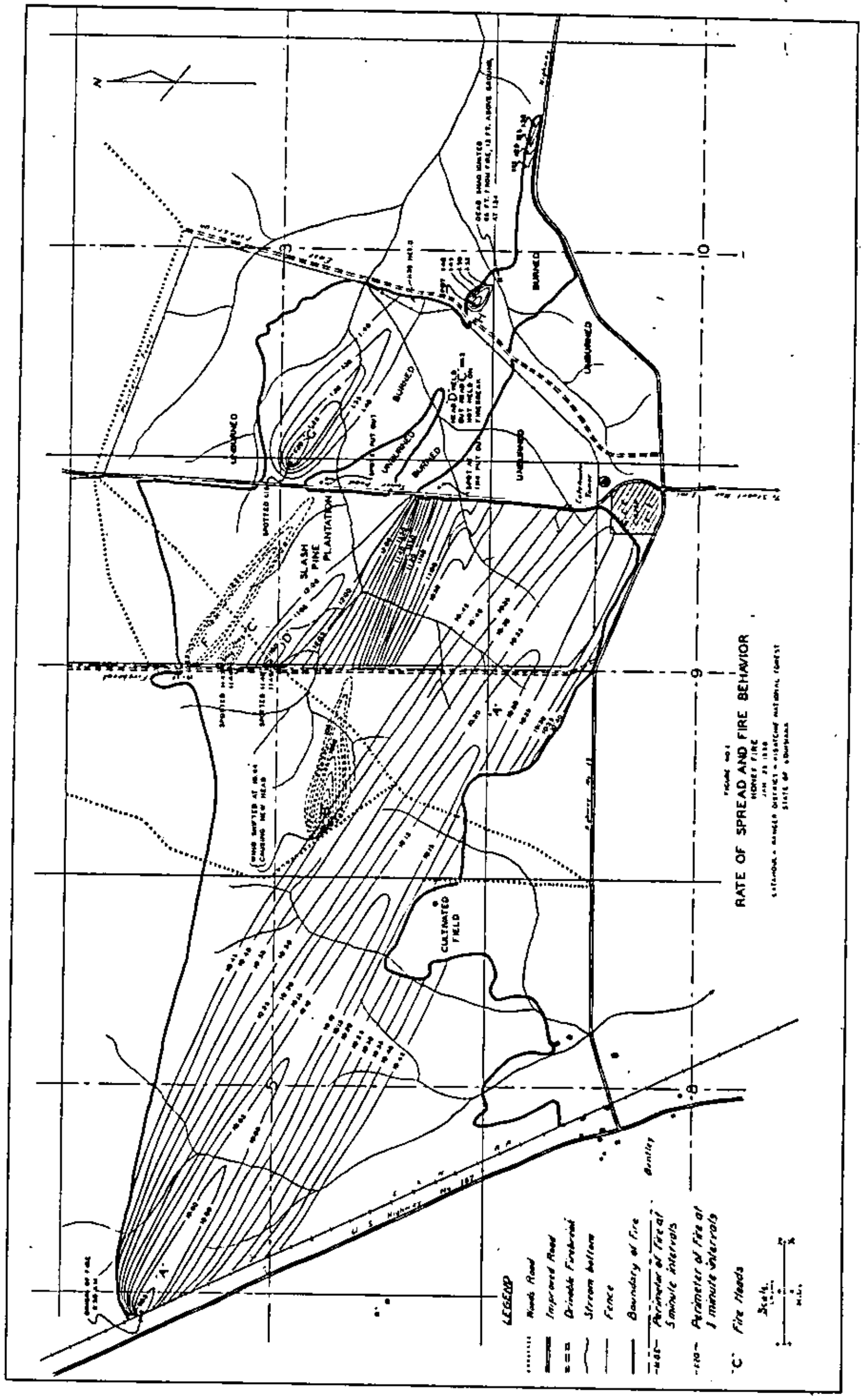
The Fire

Time of Start.

The Honey Fire started at 9:50 a. m. January 25, 1938, in the manner described. The fire-behavior crew, having been traveling south along U S 167 about 1 mile behind the train, arrived at the fire at 9:53 a. m. At the moment, the fire had advanced more than 100 feet.

Rate of Spread.

Three members of the crew started mapping the fire at 9:55 a. m., while the fourth member collected fuel and soil samples and set up instruments to obtain weather data. The main head of the fire and the north flank were mapped at that time and at each 5-minute interval thereafter. After the first 5 minutes, during which it had moved almost 6 chains forward from the point of origin, the head of the fire advanced at a rate ranging from 25 to 35 chains for each 5-minute period. This head, labeled *A* on the accompanying map showing the progress of those parts of the fire that could be reached for mapping with the limited fire-behavior crew available, stopped


RATE OF SPREAD AND FIRE BEHAVIOR
SLASH PINE PLANTATION
CULTIVATED FIELD
BURNED
UNBURNED
LEGEND
Woods Road
Improved Road
Drivable Firebreak
Stream bottom
Fence
Boundary of Fire
Perimeter of Fire at 5 minute intervals
Perimeter of Fire at 1 minute intervals
Fire Heads
Scale

of its own accord when it reached an abandoned CCC camp site on which a heavy cover of carpet grass was present. Because of distinct shifts in wind direction from northwest to southwest, however, a new head *B* developed along the north flank. A total of eight heads were mapped during the course of this fire; all of the heads labeled from *B* through *H* developed either by wind shifts along the north flank of the main head *A* and its subsequent heads or from spotting across roads or burned firebreaks. There were great differences in the rates of spread of the flames at different points on the fire. In the main, however, the fire spread forward at the rate of 5 to 6 chains (330–396 feet) per minute. The greatest rate of spread measured in a forward direction was 8 chains (528) feet in 1 minute. In the easternmost part of the area, where the fire was finally brought under control and where there were dense stands of blackjack oak in which the carrying fuel was considerably less than on the open longleaf pine areas, the forward rate of spread dropped to as low as 1 chain (66 feet) per minute.

The perimeter and area increases that accompany the forward rates of spread on fast-moving fires are also very high; the figures for the main head *A* are given in table 3.

TABLE 3.—*Rate of spread on main head (A) of Honey fire*

Time elapsed after start, minutes	Forward progress				Perimeter				Area	
	Total		Increase in last 5 minutes		Total		Increase in last 5 minutes		Total	Increase in last 5 minutes
	Chains	*Feet*	*Chains*	*Feet*	*Chains*	*Feet*	*Chains*	*Feet*	*Acres*	*Acres*
5	5.7	376	5.7	376	13.6	898	13.6	898	0.9	0.9
10	32.8	2,165	27.1	1,789	70.4	4,646	56.8	3,749	10.2	9.3
15	57.4	3,788	24.6	1,624	121.3	8,006	50.9	3,359	27.1	16.9
20	93.4	6,164	36.0	2,376	195.9	12,929	74.6	4,924	60.5	33.4
25	126.0	8,316	32.6	2,152	263.4	17,384	67.5	4,455	109.2	48.7
30	148.2	9,781	22.2	1,465	311.9	20,585	48.5	3,201	167.4	58.2
35	175.9	11,609	27.7	1,828	368.6	24,328	56.7	3,742	250.8	83.4

Fire Behavior.

Besides collecting data on the rate of spread of the fire, the mapping crew recorded observations of various items of fire behavior that influence fire-suppression action. Among these were flame height, width of the burning line, incidence and distance of spotting, and difficulties experienced by the fire fighters.

The flames at the head frequently reached out in long tongues extending 100 feet or more in advance of the actual burning of the fuel; on the flanks, a slight shift in wind direction would increase the flame height from an average of 3–4 feet to 20–25 feet, with the width of the burning line 15 feet or more.

There were numerous cases of spotting for a considerable distance ahead of the fire; in one instance, when the wind velocity was 13 miles per hour, fire spotted over 200 feet in advance of the head. An unusual case of spotting occurred when a dead snag, located 95 feet from the nearest edge of fire, ignited at a height of 12 feet above the ground. Hardwood leaves, especially those from blackjack oaks, were responsible for all spot fires noted.

The spread of the fire was stopped and the fire corralled at 2:43 p. m.; the fire was controlled and mop-up completed at 6:45 p. m.

The final total area burned in this fire was 1,092 acres, of which 493 acres were on national-forest land and the remainder, or 599 acres, on privately owned land within the national-forest boundary. Of the national-forest land burned, 396 acres were in the slash-pine plantations mentioned earlier.

Available Suppression Crews and Equipment.

On the morning of January 25, nine crews of fire fighters were available to the fire dispatcher for fire duty. The crews were made up of CCC and WPA men who worked either at the Stuart Nursery or on planting and road maintenance jobs within easy driving distance of the central tower. The crew organization is shown in table 4.

TABLE 4.—*Crews and equipment available for suppression of Honey Fire*

Crew No.	Number of fire fighters	Supervisory personnel	Total	Equipment
1	1	1	2	Pumper truck, 350-gallon capacity.
2	12	1	13	Standard fire tools.
3	5	1	6	Do.
4	24	1	25	Do.
5	20	2	22	Do.
6	21	1	22	Do.
7	17	2	19	Do.
8	18	1	19	Do.
9	11	1	12	Do.
Miscellaneous supervisory personnel			8	
Total available manpower			148	

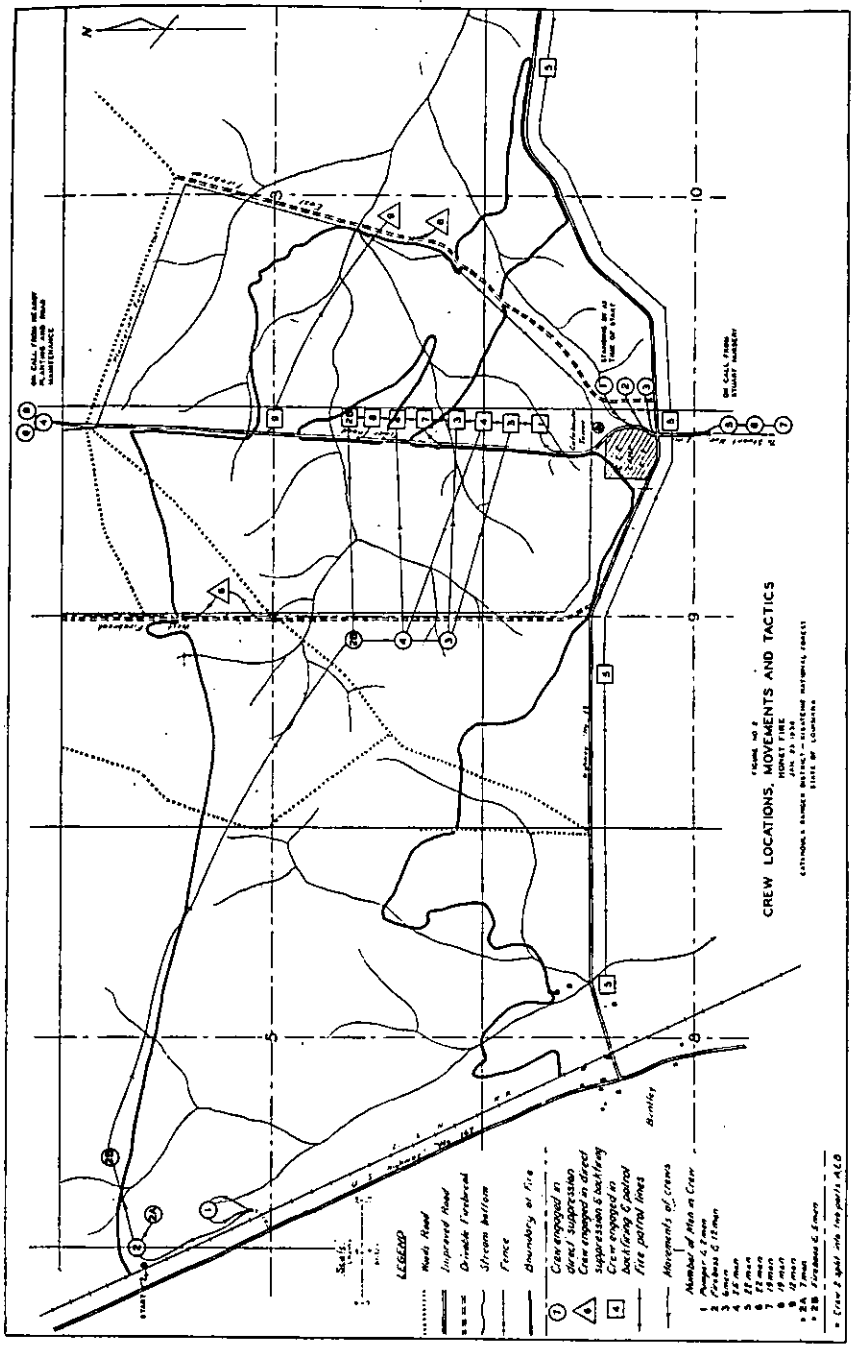
The standard fire tools, with which all except crew No. 1 were equipped, consisted of flaps (swatters), hand-operated back-pack pumps, fire rakes, water buckets, railroad "fusee" torches, axes, etc., all of which were kept in a wooden box on the trucks transporting the men. The pumper truck was equipped with dual wheels, a 350-gallon water tank, and a pressure pump unit driven from the fan-belt of the engine.

Discovery.

The fire was discovered by the lookout on the Catahoula Tower, located 2 miles to the east, at 9:52 a. m. (2 minutes after the start) and reported immedately to the fire dispatcher. A cross-shot was obtained from the Colfax Tower lookout, 4 miles to the west, at 9:53 a. m. The fire dispatcher, therefore, had a reasonably definite location of the fire within 3 minutes of its start. At that moment, however, it was impossible to determine with absolute certainty on which side of the railroad track the fire was burning. There was still a possibility that the fire was burning in the 150 feet of grassland between U S 167 and the west side of the railroad track or even west of the highway.

Crew Dispatch and Initial Attack.

The map showing the initial and subsequent crew locations, indicates the points at which the fire was attacked before control was attained.



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Crew 1, consisting of the pumper truck with a driver and hoseman, was the first crew dispatched to the fire. It left Catahoula Tower, where it was standing by for emergency use, at 9:53 a. m. and went directly to the origin of the fire near U S 167. While en route, the driver determined definitely that the fire was on the east side of the railroad track. The train momentarily delayed him by blocking the road crossing leading into the fire. He then made an attempt to reach the fire, but the pitcher-plant (*Sarracenia* spp.) land in which it was then burning was so wet and boggy that this was impossible. He returned, therefore, to Catahoula Tower and received instructions to wet down the fuel and be prepared to extinguish spots along the east side of Tower Road, starting near the Tower, while crews 3 and 4, who had meanwhile reported at Catahoula Tower for fire duty, burned a backfire along the west side of Tower Road.

Meanwhile, crew 2, the leader of which was fire boss, left Catahoula Tower for the fire at 9:55 a. m., going to the point of origin. This crew was momentarily delayed by the train at the road crossing. It is estimated that the fire had a perimeter of 40 chains (2,640 feet) upon their arrival. They started to extinguish fire along the north flank near the head for the purpose of checking the fire by cutting it into a cultivated field located about three-quarters mile southeast of the origin. These tactics failed when the head passed to the north of the field; the forward progress of the south flank, however, was checked when it reached the field. The crew leader then split his crew; he left 7 men to suppress the fire, starting from the tail and working toward the head, and led the remaining 5 men (crew 2B) on foot across country to the west firebreak. The main head of the fire, meanwhile, had reached Tower Road, where it was stopped by the abandoned CCC camp and the fireline burned by crews 3 and 4 and the pumper truck; crews 3 and 4 then went to the west firebreak to burn more backfire similar to that which they had just completed on Tower Road. There the fire boss assembled crews 3 and 4 and his own 5 men (a total of 37 men) on the west firebreak and attacked the north flank near the head and worked toward the tail. Progress by this large crew in extinguishing the fire along the north flank was encouraging; a boundary length of 33 chains (2,178 feet) was put out and being held successfully. Up to this time, the wind had blown steadily out of the northwest, with little or no evidence of shifting markedly in direction. At 10:44 a. m., the wind distinctly veered from northwest to southwest, resulting in a big sweep in the flank and the formation of a new head. The suppressed crew was forced to yield ground. The new head (*B*), which wiped out all the line that had been held up to that time, reached the west firebreak in 9 minutes (at 10:53 a. m.) and was held at that point when the head hit the backfire.

Later Attack and Tactics.

Following the initial attack described, during which two different heads on fast-moving fires were stopped by indirect attack or backfiring but on which the fire on the north flanks was not controllable, the crews resorted to further backfiring along the west firebreak, Tower Road, State Highway 19, and the east firebreak, and to patrolling the east side of these roads to prevent the formation of new heads by spotting when an oncoming head reached a backfire.

Efforts to extinguish the north flanks were made only when it was reasonably certain that the head could be held at the backfire. In all the heads mapped, the backfire effectively stopped the progress of the head of the fire. Heads *G* and *H* resulted from spotting across Tower Road before adequate backfires were completed.

In extinguishing the fire along the north flanks, the crews, with one exception, attacked the fire from a point near the head and worked toward the tail. The only fire fighting on the north flank from the tail toward the head was done by the original crew (2A) of 7 men, who were left near the tail when crew 2 was split. As a consequence, a considerable distance along the north flank (for the most part, 1 mile or more) between the tail and the west firebreak was left to burn freely, and with each shift in wind direction to the southwest new heads would develop. Examples of mapped heads that resulted from this situation are heads, *C*, *D*, and *F*; several unmapped heads developed previously in the area west of the west firebreak, causing heads *C*, *D*, and *F* by spotting across this firebreak.

Fire along the south flank was of minor concern during the run of the fire, small roving patrols were stationed at strategic points along State Highway 19 to backfire wide strips and to watch for spotting across the road when heads reached the road. The large cultivated field located three-quarters of a mile southeast of the origin did much to lessen the fire danger along the south flank. The shift in wind direction from northwest to southwest also reduced the fire danger along the south flank, since it resulted in a relatively slow-moving flank burning into the wind with only occasional minor sweeps when the wind changed back to the northwest.

Final Attack.

In the final attack on the fire, during which it was brought under control, wider firebreaks were burned along Tower Road and the east firebreak. The suppression crews also attacked the north flank of the fires from the tail toward the head by reinforcing the small crew left originally at the tail to work east. The pumper truck did very effective work along the north flank where the ground was solid enough so that it would not bog down. Throughout the final attack, effective and rapid suppression on the north flank was accomplished by working from the tail toward the head and mopping up the edges of the fire simultaneously.

Output of Held Line.

During the course of the fire, measurements were taken of the line extinguished by various crews. The amount of line held per man-hour varied greatly at different points on the fire, depending upon the behavior of the fire and the conditions under which it was being fought. In table 5 a record is given of the output of held line per man-hour for different sized crews with remarks concerning the conditions under which they worked.

Record of Stringing Backfire.

Data on the rate at which backfires or burned firebreaks were strung by different methods were obtained at several points on the fire. These data do not include the manpower required to keep the

TABLE 5.—*Rate of held line per man-hour at various points on Honey Fire*

Location of suppression action	Number men in crew	Held line per man-hour		Remarks
		Chains	*Feet*	
North flank—head *A*	19	4.7	309	No shift in wind.
North flank—head *A*	6	−11.6	−765	Line lost—shifting wind.
North flank—head *D*	14	5.8	385	Some crew members idle or resting.
North flank—head *G*	14	9.1	601	In heavy cover of oak leaves.
North flank—head *H*	18	9.15	604	In heavy oak brush—medium fuel.
North flank—heads *F* and *G*	(1)	126.6	8,356	Average difficulties with trees and soft ground.
North flank—head *A*	10	5.03	332	Average conditions—men placed too much reliance on water.
North flank—head *A*	15	4.67	308	Shifty winds, hot fire—well-organized crew.

[1] Pumper truck.

backfire under control by patrolling and mopping up spot fires. The data given in table 6 are only for stringing fire in a straight line without regard to the width of the backfire burned.

Ratio of Line Actually Extinguished to Total Needed for Control.

As pointed out above in the discussions of the initial attack and the output of held line, considerable line was lost because of the behavior of the fire at certain points. No accurate record of the total line extinguished but later lost is available. It has been conservatively estimated by Kisatchie National Forest personnel, however, that of the 864 chains (57,024 feet) of line actually built to corral

TABLE 6.—*Rate of stringing fire for backfires on Honey Fire*

Backfire location	Length burned per man-hour		Medium used	Remarks
	Chains	*Feet*		
West firebreak—near heads *C, D, F.*	52.7	3,480	Gasoline torch	Inexperienced men.
Tower Road—head *D*	26.9	1,776	Bunches of grass	Backfire only 20 feet wide, not wide enough to keep head *C* from crossing Tower Road.
Tower Road—head *F*	51.8	3,420	Rakes	
Highway 19—head *E*	26.2	1,726	Bunches of grass	In oak brush and leaves.
East firebreak—head *G*	20.9	1,378	Bunches of grass	In heavy blackjack oak.
Tower Road—head *D*	45.1	2,978	Rakes	

the fire, 240 chains (15,840 feet, or 27.9 percent) were lost during the suppression action and did not contribute toward the control of the fire. The difference, or 624 chains (41,184 feet), therefore, would have been sufficient to attain control of the fire. The ratio of line actually extinguished, but later lost, to the total needed for control is 240 chains to 624 chains; thus, 38.5 percent more line was built than actually needed. The final perimeter of the fire when controlled was 934 chains (61,644 feet). The discrepancy between the final perimeter and the length of line actually needed for control, or 310 chains (20,460 feet), is accounted for by the fact that practically none of the south flank required suppression, because the fire went out of its own accord when it reached the cultivated field, the abandoned CCC camp, Highway 19, and the backfire along Tower Road.

Difficulties Encountered by Fire Fighters.

The suppression crews were under tremendous handicaps and personal discomfort, caused by the heavy, choking smoke and the dense cloud of ashes, soot, and sparks, when patrolling an onrushing head as it hit a backfire. At such times, it was impossible for them to face toward the head; not only was the visibility extremely bad, but also the dense ashes and sparks, carried swiftly by the draft of the fire, compelled the fire fighters to turn their backs to the fire and cover their smarting eyes with their hands. The fire fighters experienced considerable difficulty in walking against and in using their equipment in the strong wind currents created near the head of the fire. Thus, the efficiency of the fire fighters stationed at these points to extinguish break-overs and spot fires was greatly reduced. Further, the roar of the fire and wind at these points made it impossible for the crews to hear verbal orders of their foremen.

The heat on the north flanks when the wind shifted was oppressive, and the danger of a crew getting trapped by the high, oncoming flames was great. The hose man on the pumper truck was particularly handicapped by the heat because he had to get very close to the fire to place the water effectively.

Because of the relatively flat terrain and the dense smoke, the fire boss was unable to get the clear and complete picture of the progress of the fire that he needed for the most effective use of his men in controlling the fire.

Critique

Recognition of Danger.

In evaluating the suppression action taken on this fire, it must be realized that no satisfactory methods and technique were then available to the fire dispatcher to rate the fire danger existing at the time of the fire. His experience in judging fire danger during several preceding fire seasons, however, made it clear to him that the weather conditions then prevailing would cause a fast rate of spread and that speedy and adequate dispatch of suppression crews was essential. Consequently, he had prepared and organized all crews for speedy dispatch. Even after dispatching all available fire fighters, he was quick to recognize the extreme conditions and to inform the supervisor's office that the fire was out of control by reporting, "I cannot hold it."

A fire-danger meter, recently developed by the Southern Forest Experiment Station,[1] should prove exceedingly useful to a fire dispatcher in recognizing fire danger, particularly under conditions similar to those prevailing at the time of the Honey Fire. The present fire-danger meter, for these conditions, would have shown the danger as class 5, or extreme. With a prompt recognition of the fire danger and with adequate plans for the fire action to be taken in the event of a fire, it is expected that fires occurring during times of great danger can be checked early and controlled while still of small size.

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[1] "A Tentative Fire-Danger Meter for the Longleaf-Slash Pine Type," by C. A. Bickford and David Bruce, Occasional Paper No. 87, Southern Forest Experiment Sta., Nov. 10, 1939.

Fire-Discovery Time.

Fire-discovery time was excellent and the towermen are to be commended for their alertness. With good visibility and with a clear view of the origin of the fire available from Catahoula Tower, conditions were very favorable for quick discovery. Furthermore, when the train made an unusual stop, it was viewed with suspicion by the Catahoula lookout.

A cross shot was quickly obtained from Colfax Tower, located 4 miles west of the origin. Because of the obtuse angle of this cross shot, which the fire dispatcher received within 3 minutes of the start of the fire, it was impossible to get a precise location. Moreover, he was under specific orders from the ranger and forest supervisor to dispatch the stand-by crew immediately upon obtaining a cross shot. Under ordinary conditions the location of the fire, as indicated by the reported conditions, would be highly satisfactory for a prompt attack. In this particular case, however, a precise location was essential, since the subsequent fire action depended upon this point. Had the fire started on the highway west of the railroad track, the logical action would have been for the fire boss to lead the first crews to the tail of the fire; but since this fire started on the east side of the track the preferred action, had the real danger been fully recognized, would have been to place the initial crews along the west firebreak to string backfire and send subsequent crews to extinguish the fire along the north flank. It can be argued that, under the circumstances, the fire dispatcher should have momentarily delayed initial dispatch of crews until he had received verification from the Catahoula towerman on this seemingly trivial point. However, to have made such verification at that time would have been contrary to the forest supervisor's instructions; under other circumstances, even the slightest delay in dispatch would have been costly insofar as size of fire was concerned.

Preparedness.

Adequate preparations and crew organization had been made for fighting fires on bad fire days. A total of 148 men, divided into 9 properly supervised, trained, and equipped crews, were ready to respond promptly to a fire call from the dispatcher. These crews were distributed at strategic points on the ranger district and had telephone connections with the fire dispatcher's office. All feasible measures of preparedness had been taken.

Dispatch of Crews.

The dispatch to the fire of all the crews available on the ranger district was effected promptly and with a minimum of confusion. Their assignments to specific points on the fire were given clearly and definitely by the fire dispatcher. The chain of communications to the individual crews previous to their initial dispatch to the fire was, for the most part, very satisfactory. Some delay was experienced in reaching the crews that were working in the Stuart Nursery quickly, because the telephone in the nursery office was unmanned for several minutes; when word finally reached the nursery, the three crews were promptly dispatched to the fire.

Supervision.

All the crews were supervised by men who had had considerable experience fighting grass fires in the cut-over longleaf pine type. Fires of the extreme intensity and rate of spread of the Honey Fire, however, are the exception rather than the rule. Consequently, it was natural to expect that some mistakes in judgment and action on the part of the supervisory personnel would be made. The writer points out what he considers as mistakes only to guide the actions of supervisory personnel in the future under similar circumstances.

Every member of the supervisory personnel, including the fire boss, used a flap, a back-pack pump, or some other fire-fighting tool. It is commendable that they were so earnest and eager to get the fire extinguished that they helped in the physical work, but it is much more important and necessary for those in charge of fire crews to expend their energies and use their superior training in analyzing ever-changing situations on a fire, in directing their men to work efficiently, in discovering and remedying weaknesses in their work, in anticipating and planning actions, and in urging the men toward their best efforts. The crew leaders should use their heads and eyes instead of their hands. Had this been done, they would have quickly realized the futility of suppressing the north flanks from the head toward the tail of the fire. Actually, the physical efforts of the supervisory personnel in suppressing the fire were of minor consequence, considering the fire as a whole.

The fire boss should make it his job to keep up with every change in the situation, know the location of all his crews, and continually plan the action to bring the fire under control at the earliest moment. His decisions should be direct, definite, and well-planned. On the Honey Fire, the fire boss, instead of placing himself at all times at a central point to gather information regarding the situation and to direct and dispatch crews, was off on the fire line with suppression crews for considerable periods of time. As a result, the desired movement of some crews to critical areas was delayed.

Anyone on the Catahoula Tower could have obtained an excellent grasp of much of the situation. When the fire passed close to the tower the smoke was heavy and visibility was bad; later, however, the view from the tower would have given the fire boss a comprehensive picture of the fire and helped him tremendously in planning crew locations and actions. In similar situations, the fire boss should always size up the fire either from a high point such as a ridge or tree top, or by cruising the area by car, sending scouts out for information, or by referring to aerial photographs. It is strongly recommended that on a large fire the fire boss have at his disposal two or three men to reconnoiter and to serve as messengers to carry his orders to the leaders of the individual suppression crews.

Morale of Fire Fighters.

The morale and determination of all men were excellent, and in many cases remarkable. Virtually all of them used their flaps and back-pack pumps effectively, showing that the training they had received was very much worth while. During the hot flank attacks, however, the flapmen relied heavily upon the pumpmen spraying water to knock down the flames. The men should be trained to rely less upon water in fighting the flanks by having the crew leaders temporarily stop suppression and rest the crews when the wind shifts on a flank, resulting in a very hot fire to fight. More line on the flanks will be extinguished and held by resting a crew while the fire is burning intensely and then efficiently directing them when the heat and flames have diminished.

Crew leaders should strive to keep their crews working in units of five or six men. A crew of this size is very flexible and mobile and, when trained for perfect coordination and teamwork, it can hold a long line. Large crews working as a unit are generally inefficient either because they stumble over one another or because the work is unbalanced, the first men bearing the brunt of the attack and the stragglers expending their energies chiefly by running to keep up with them and doing relatively little productive work. The morale of a crew weakens when the work load is not evenly divided among all its members.

Equipment.

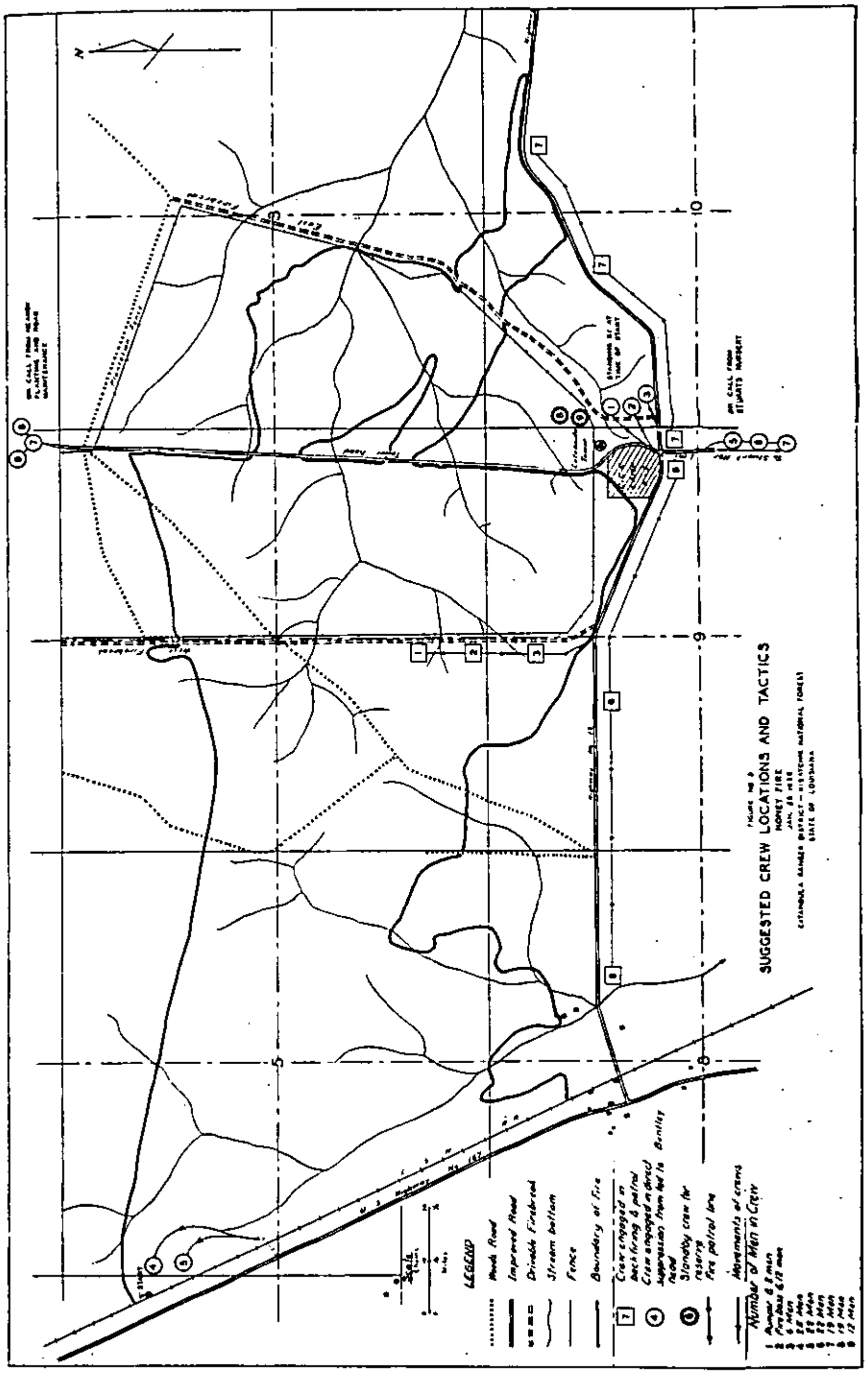
On the whole, the fire-fighting equipment was in excellent condition. In only one instance was failure of equipment noted, namely, the railroad fusees intended for stringing backfire, which would not ignite, undoubtedly because they had become damp from atmospheric moisture. The crew attempting to extend the backfire along the west firebreak one-half mile north of Highway 19 was delayed while trying to make the fusees ignite. The result was that heads, *C*, *D*, and later *F* crossed the graded firebreak, and eventually led to heads *G* and *H*. The need for having *all* equipment in perfect order was strongly exemplified by this one small but important failure.

The supply of tools for all fire fighters was automatic in that each crew had an adequate amount of standard fire-fighting equipment in the truck on which they traveled to the fire. No delays were noted on this account.

The urgent need for accessory equipment on fires of this type was brought out by the handicaps and difficulties encountered by the fire fighters. Emphatically, the crews assigned to backfiring and patrolling backfires should be supplied with smokeproof goggles so that they can work efficiently in the smoke and flying ashes. The value of such goggles was indicated by the fact that one fire fighter, normally working as a welder in the shop, wore his dark welding glasses while patrolling, and later commented that he experienced no great discomfort from ashes, soot, or sparks when the head reached the backfire. Respirators should also be investigated to determine whether or not the patrol crews could perform more effectively with such equipment. Since the hose man on a pumper truck is subject to intense heat and smoke over a prolonged period, he also should be provided with special equipment to enable him to do his job better. Asbestos hoods and suits have already been developed for such use and might upon trial prove ideal for this specific purpose.

Technique of Attack.

The logical point of initial attack on the Honey Fire, as already discussed, depended on a very accurate location of its origin. As soon as the fire boss saw that the fire was definitely on the east side of



SUGGESTED CREW LOCATIONS AND TACTICS

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the railroad track with a large area of dense grass before it for its run, he should have directed his crew (No. 2) together with crew 3 to start backfiring immediately and liberally along the west side of the west firebreak. The pumper truck should also have been available at this point to support the fire fighters. Crews 4 and 5, comprising 47 men, should then have been dispatched to the tail to extinguish the north flank from the tail toward the head. Crew 6 of 22 men and, if needed, crew 7 of 19 men, should then have been dispatched to patrol Highway 19 and the south flank. The 2 remaining crews, comprising 31 men, if called at all by the fire dispatcher and fire boss, should have been held at the Catahoula Tower as stand-by crews. These positions are shown on the locations and tactics.

Initial backfiring should have been started promptly along the west firebreak instead of along Tower Road. The woods road, located one-half mile to the west, could not have been used for the initial backfiring because (1) insufficient time would have been available to string an adequate backfire along the woods road before the main head reached it, and (2) there could be legal complications and violation of policy had a backfire been strung on privately owned land not bordering a Government-owned land, even though national-forest land was seriously threatened. Prompt backfiring along the west firebreak would have overcome both of these difficulties. At least 20 minutes would have been available to the crews for stringing backfire along the west firebreak, since the main head did not reach this point until 10:20 a. m. This would have been ample time for the three crews available to have strung at least one-half mile of backfire 100 or more feet wide. It was impossible to burn such a protection strip around the plantation earlier in the season because the land involved was privately owned. The 20-foot-wide graded firebreak surrounding the plantation was scraped clean of all vegetation and was an excellent line from which to backfire safely.

Had the initial attack of stringing backfire along the west firebreak failed so that the fire spread into the plantation, the next attack should have been to string backfield along the Tower Road, using the stand-by crews available at Catahoula Tower.

At all places where an adequate firebreak had been burned, the onrushing head was checked and the few spots that started in the unburned grass across the firebreak were quickly extinguished by the patrol crew. The checking of heads *B*, *D*, and *F* are good examples of control with backfiring. When the backfiring is delayed or the patrol crew inadequate, as for example on heads *C*, *G*, and *H*, break-overs occur almost invariably, greatly delaying control of the fire.

Backfiring.

Backfire can be safely strung at a fast rate even with the crudest equipment, as shown in table 6. The greatest precautions must be taken, however, to keep the backfire always under control and to avoid the misfortune of letting it get away. At the same time, a backfire, to be effective, must be of sufficient width and length to hold the main head being fought as well as any additional heads that may subsequently develop before the flanks are controlled. On the Honey Fire, the backfiring crews strung fire too timidly, particularly insofar as the length of the backfire was concerned. It was most fortunate that the backfires were so successful, since they were seldom more than 50 feet wide. Furthermore, had the crews not been so reluctant to string long backfires, control of the fire could undoubtedly have been gained much earlier. This reluctance can in part be accounted for by the fact that backfiring along the Tower Road and the east firebreak would necessarily mean deliberately burning part of the plantation. The acreage consumed in a backfire, however, is negligible; each mile of backfire 100 feet wide requires only 12 acres. This would have been a trivial loss for the great protection it offered.

The following technique for stringing backfire has been effectively and safely used and is recommended for use whenever backfiring must be resorted to in order to obtain control: Organize the crew into fire stringers and patrolmen. The latter should take their positions across the line from which the backfire is being burned. Their only job is to keep alert for possible spotting along the entire backfire line and to extinguish spots quickly as they occur. The stringers, three or four selected men in each crew, should be given special training in the methods of stringing fire, using bunches of grass, a fire rake, a torch, or other available equipment. The first man should string his line of fire parallel to and approximately 10 feet from the line from which the backfire is being made. The width will, of course, depend upon numerous factors, among which are the type and density of the fuel, the wind velocity, and the width and condition of the line (road, etc.) from which it is being made. The greatest precautions should be taken to put the initial backfire line in safely. Waiting until the first man has safely burned approximately 100 feet of his line of fire, the second man should start his line of fire parallel to but 20 feet from the first line. The third stringer, in turn, should wait until 100 feet of the second line has been safely burned and then string his line parallel to but 30 or 40 feet from the second line. If four stringers are used with intervals between lines of 10, 20, 30, and 50 feet, a backfire 110 feet wide can be burned with great rapidity. There should be an interval of at least 100 feet between stringers at all times.

The crew foreman must be very alert when backfires are being burned so that they do not get out of control. If two crews are available, the backfire should be started at a point where the main head is expected to hit and the crews string backfire in opposite directions along the line from which it is being burned. The crews should continue to string fire for at least seven hundred or even 1,000 feet beyond the points where the danger is critical; a crew will not be criticized for stringing too much backfire if it has done so safely.

Stand-by Crews and Reinforcements.

As previously brought out, all of the fire fighters available on the ranger district were dispatched to this fire before it was finally brought under control. Two other fires occurred on the Catahoula Ranger District during the Honey Fire; they were extinguished by crews dispatched from the Honey Fire without undue loss of time or acreage, indicating that the fire organization was prepared to cope with serious fire conditions. The local force was strengthened by the fine cooperation and judgment of the ranger on the adjoining district, who, upon passing the scene of the fire while en route to his office after attending a court trial in Alexandria, on his own initiative phoned ahead to his dispatcher to call in all work crews for the emergency and to send two of them to stand by at a CCC side camp located about 10 miles north of Bentley. The ranger is to be commended because he took definite action when he saw the need.

Summary

A detailed analysis of the Honey Fire is presented in order (1) to show the rapid rate of spread and the behavior of a fire burning under critical weather conditions in the southern pine type of a coastal plain, (2) to describe the suppression action taken, and (3) to offer constructive criticism and suggestions as a guide in planning suppression action for future fires burning under similar conditions.

The combination of high, shifting winds and low fuel-moisture content prevailing at the time of the fire created critical burning conditions. The rate of spread was extremely high, the maximum forward increase measured being 8 chains (528 feet) in 1 minute or at a rate of a mile in 10 minutes.

In order to control such a fire it is necessary to have an adequately equipped suppression force available at a moment's notice. The difficulties experienced by fire fighters at various parts of the Honey Fire are stated and suggestions are made for the use of accessory equipment in overcoming such handicaps. There is a distinct need also for efficient supervision of each crew, as well as able leadership, including well-planned tactics, by the fire boss.

The futility of attempting to control the flanks by suppressing a rapidly spreading fire from a point near the head toward the tail of the fire is brought out. Such tactics lead to a great loss in what would otherwise be held line and make it possible for new uncontrollable heads to form with each relatively slight change in wind direction.

The heads of rapidly spreading fires cannot be stopped by direct attack with the equipment now available; one must resort to an indirect attack involving the use of backfiring. Fighting fire with fire can be very dangerous, however, and the greatest care must be exercised in its use if an adequate backfire is to be attained and if break-overs are to be prevented. A method of backfiring, in which fire is simultaneously strung by three or four men separated by definite distance and width intervals, is outlined. It is very important that backfires be sufficiently long to stop the onrushing head even in case its direction of burning has been changed by a shift in the wind, and sufficiently wide to prevent spotting across the backfire, which may start new heads.

THE WILLAMETTE FLYING 20

Roy Elliott

Staff Assistant, Willamette National Forest

The use of fire guards selected from all parts of a forest represents an interesting adaptation of the 40-man-crew idea. It is understood that these crew members performed regular guard duties at their own stations when not needed for suppression or stand-by work; when needed, they assembled at some point agreed upon where their equipment had been delivered from the central cache.

A crew of 20 experienced forest guards was organized, trained, and put into practical use on the Willamette National Forest during 1940.

The guards themselves named it "The Willamette Flying 20." It proved to be a "20-mule team" for strength and in pulling our fire-fighting record out of possible disaster on three occasions.

The idea for the Flying 20 grew out of the experimental special Siskiyou 40-man crew of 1939 with alterations here and there to improve organization and to meet conditions peculiar to the Willamette Forest. Indeed, the forest was fortunate in having the help and experience of one of the original Siskiyou crew to lead in organizing and training the men and to act as foreman of the local crew.

The Willamette Forest embraces an area within its protective boundary of nearly 2,000,000 acres consisting of five ranger districts which stretch north and south along the crest of the Cascade Mountain Range for nearly 125 miles. Crew members were selected from the guard organizations of each of the five ranger districts. Essential qualifications were industry, good health, native ability, and an agreeable temperament.

The organization and use of forest guards for such duty was a radical departure from former practice, notwithstanding selection, training, and ability of the guards for fire-line work. As a matter of fact, in the past the guards of have been left pretty much to themselves and to routine guard duties while forest officers have been content to use of the fire lines the physically unfit, inexperienced, ill equipped, and inefficient pick-up labor from nearby cities and towns. Care in selection, training, and equipping the guards and finally rounding them into expert fire fighters is commendable. The trouble is that as a general rule the full possibilities of their use have not been explored and most certainly full advantage has not been taken of this source of expert fire fighters in building up a fire-fighting organization. The 20-man crew was organized in an effort to harness the available manpower on the forest to get the best out of it where needed the most.

The size of the crew would make little difference in organization. It should, however, be made to fit the particular ranger district or forest conditions, depending on number of personnel available to draw upon, trained replacements available, transportation facilities, equipment, and effect on the regular protective force. Cooperators, R and T crews, organized industrial crews, and other competent woodsmen, when available, are all good sources from which members of such a crew may be obtained. An 8- or 10-man crew may be all a given administrative unit will support. The main idea is to make better use of available experienced guards in whom the Government has a training investment both in money and labor.

The organization within the crew consists of one foreman and two straw bosses, one of the latter having charge of the clearing and line-location work and the other having charge of the digging crew. Specific duties of members other than foreman and straw bosses should be worked out to fit conditions on ranger districts or forest concerned, such as fuel types, topography, forest types, etc.

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The Flying 20 at work.

The equipment and supplies are important and must be given considerable attention in planning. Again so many factors must be considered and there is so much variation in the tools needed in different localities that a standard list is impractical. A 2-pound double-bit woodsman's ax was found preferable over the conventional 3-pound ax commonly used in fire fighting. The lightweight 5-pound sleeping bag is highly recommended. Dehydrated foods are preferable, but it was found advisable to allow each guard to add particular articles of food desired. The crew will be more contented if individuals are allowed to select certain kinds of food to their liking; each man has a number and his pack has a corresponding number so that this favor can be easily granted with little inconvenience.

Each outfit for the Willamette crew contained a complete and independent complement of food supplies, tools, and equipment. The equipment in one pack consisted of a radio outfit, and the man carrying this pack acted as radio operator and also as a first-aid man.

All 20 outfits were kept centrally located and were dispatched by truck when the crew was called out. All outfits were promptly returned to the central location at the termination of the fire, where contents were checked and replenished, equipment repaired, and the packs otherwise made ready immediately for the next call. A trapper-Nelson type packboard was used for packing. Average weight of the packs was 35 pounds. Tools, equipment, and supplies recommended for such a crew are now stocked by the Forest Service in the North Pacific region, Portland, Oreg.

The primary function of the Flying 20 crew has been to cut off the head of the fire and control it within the first work period, or as soon thereafter as possible. They expect to be called on and to reach the head of the fire usually far in advance of untrained and unconditioned crews which are often used on a fire. Upon reaching the fire they must be physically able to carry on the job of control at a high rate of efficiency, know how to proceed with control work without loss of effort, and be always mindful of their own safety. They are the spearhead of the attack. The ideal situation is for them to proceed from one hot spot to another, turning the constructed line over to the less expert crews to hold and mop up.

On more than one occasion on the Willamette it was found that hot spots or spot fires in advance would just about be lined by the time the other crews arrived, making it convenient to turn over patrol and mop-up to them. The 20-man crew was thus released for other more important assignments.

Two days, preceding the annual group guard-training camp, were used in training the crew. The first day was spent in review and discussion of improved fire-fighting techniques to be used by the crew, and the second by putting into practice the theories and techniques discussed. The efficiency of the crew was evident from the start when they constructed three-fourths mile of line at the approximate rate of 1.4 chains per man-hour.

It was fortunate that the crew was trained and made ready at that time for an emergency. Less than 2 weeks later they were called on one of the potentially worst class E fires experienced on the forest. Two class D fires, following at regular intervals, provided ample opportunities for training.

Following is a report of action by the Flying 20 crew:

Gates Creek fire, 165 acres:

July 18.—7 p. m. Hiked 8 miles to Cougar springs where bedded down for night—carried packs.

July 19.—

- 3 a. m.: Prepared and ate breakfast.
- 4 a. m.: Left with packs for fire.
- 5:45 a. m.: Started work on fire line.
- 7:20 a. m.: Completed first sector, 21 chains.
- 8:45 a. m.: Follow-up crew took over and Flying 20 started on the second sector, built 50 chains of line—burned out and held this line for the remainder of the day; fire very hot on this sector. Snag fellers were kept very busy.
- 3 p. m.: Called for assistance on another sector where fire was escaping; reorganized crew on that sector and helped rebuild and hold that piece of line.

The Gates Creek fire was located 11 miles from a road and 2½ miles from the nearest horse trail. It was a day's work to get to the fire and return to camp. A trail was later constructed and the camp was moved nearer the fire line. Civilian crews were until 7 o'clock reaching the fire for the initial attack the first morning. Several found the going too rough and walked off the job. Without that, 71 chains of held line constructed by the crew in the first work period where they were needed most, this fire might have been disastrous. The aid given the organized crew, on whose sector the fire escaped, also indicates the effectiveness of the Flying 20 compared with the less experienced organized crews and the totally inexperienced pick-up crews sometimes relied upon in fire suppression. Other emergencies also occurred during the season on which the crew as a whole or members individually gave valuable fire-fighting service.

Summarized briefly the following points should be given careful consideration for success in organizing a forest-guard special fire-fighting crew.

1. Select crew members who possess good health, industry, experience or native ability, good temperament for such assignment, and agreeableness.

2. Assign members of crew to guard stations as accessible to automobile transportation as possible. The crew should be used primarily as a second line of defense, however, and get-away time is not so important as with the first-line personnel of the protective force.

3. Provide well-trained and available replacements.

4. Make advance arrangements for transporting and assembling the crew with the least possible delay.

5. Work out in advance a list of food supplies, tools, and equipment with consideration for reducing weight of the packs to the lowest minimum practical. It will take time to obtain and assemble the material since some of the articles are difficult to purchase and may have to be obtained by special order.

6. Work out a schedule of wage rates between members of the crew as equitable as administrative procedure and funds will permit.

7. Set up a project for training the crew as early as possible. They should be instructed in all phases of improved fire-fighting technique and also be given the opportunity of applying their knowledge by actual doing. Training on actual fires on or off the forest is recommended when available and it can be arranged.

8. Keep members of the crew physically fit for the job by assignments of hard work or a 5- or 6-mile hike daily. The Willamette crew was required to walk 6 miles daily when not engaged in an equally good physique-building occupation.

9. Make the organization of the crew subject of discussion in a ranger meeting well in advance of the fire season and work out at that time by conference procedure the details of what is going to be done, how it is going to be done, and by whom.

The Willamette Forest is well pleased with the performance of the Flying 20 crew during 1940. Improvements can and will be made and the forest expects to have an even better outfit with which to go into 1941.

WARDEN AND COOPERATOR TRAINING

U. J. Post

Forest Ranger, Bighorn National Forest, Region 2, United States Forest Service

In transmitting the following article to Fire Control Notes, Acting Regional Forester Stahl said: "The training of wardens and cooperators is perhaps the most difficult training job attempted by the region, particularly where these men are ranchers whose homes are distributed over a considerable area."

Post's method of controlling the progress of line-construction crews is somewhat different from most other previous approaches to the problem.

During the last few years, the use of CCC labor on fires on the Bighorn Forest has led to less dependence upon wardens and cooperators except in cases of large fires when the "all-out" call is given and then the local men compete with trained crews.

On fires that have been handled all or in part by local cooperators there has been a rather bad showing in line construction, entirely because of lack of training and practice. Willingness and spirit have been evident but results have been lacking. The situation was discussed with individual cooperators and all favored preseason training and demonstration of new methods.

Since the birth of the one-lick method, a lot of effort has been expended in trying to apply it to use with local fire cooperators. The method is the best that has been developed if a large enough crew is available and ground cover and soil conditions are favorable. Such conditions are not always found on fires in the Rocky Mountain region, however. And on the Bighorn most fires are small, the soil is usually so rocky that mattock work is not effective, and there are heavy windfall and reproduction to contend with. To overcome these difficulties, it was decided to remodel the method to apply to local conditions, yet use the conveyor-belt idea if possible because it definitely eliminates confusion and lost time of men hunting for work to do. The next step was to get the proper balance of tools that would meet most types of work found locally and fit a 10-man crew. This done, notices were sent out for an outdoor feed for the coming Sunday.

Sunday morning men, women, and children began to arrive at one of the best improved campgrounds on the forest. The ladies, with the help of a round-up cook, prepared the dinner and the men were introduced to a lot of tools. Two fire lines were marked out where timber and ground conditions were average, including rock, windfall, reproduction, and mature open timber.

The first line was attacked by the entire crew, using the local haphazard method, each man selecting his own job and with no one in command. Trench was dug in uncleared line, under logs, and around trees, and at times there were two men chopping the same tree. The whole gang tried, of course, to see how fast that line could be put through, but if it had been a real fire it would have gone over the hill. Finally the line was finished and someone yelled, "Well, we got 'er, let's eat."

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The second line was still to be built, and this time the crew was divided into clearing and trenching gangs, one group to work while the other watched. A crew boss was designated and men in the clearing gang were spaced about 8 feet apart and given a demonstration of how to do the job. Each man was to work in one spot until the man behind moved up and not move around or leave the position unless ordered to do so. The boss was a busy man at first, but it required only a few minutes for the crew to get the idea and soon the line was being opened up at the rate of a slow walk with no overexertion on the part of the men. Once the clearing was out of the way, the trenching gang went into action with the clearing crew observing.

The trenching was handled in the same manner as the clearing, each man digging out about 2 feet and moving up, the rate of speed being controlled by the boss. Shovels were used for this job, with a few mattock men to work up and down the line as needed. Upon completion of the trench the whole crew was talking about the work and had forgotten about dinner. One warden said, "You got something there."

The men built more line, all working together, and then sat down to talk it over. They agreed to use the method on fires during the coming season and expressed a desire to get together each spring to practice and discuss new methods and developments. All were in favor of any new method that would do the job faster and thereby enable them to return sooner to their own work at the ranches.

Two weeks later about half of the men at the demonstration were at work on the forest branding calves. A fire broke out in the afternoon about 20 miles away. They proceeded to the fire and found men from a road-construction crew and several others who had not had training already there. The fire was burning in mature tie timber and reproduction and some windfall. Soil conditions were average. The fire was traveling with a light wind. Two of the wardens were placed in charge, one for the clearing crew and one for trench construction. The wardens took complete charge of the work, including the instruction of the untrained men who were placed in the line alternately with the trained men. Each trained man elected himself an instructor and the dirt began to fly. They handled the job well and left a finished and completed line behind them, with no lost time.

The results: The fire was controlled in 1 hour; length of line 45 chains, size of crew 30 men. The cooperators were convinced that they had found a way to get the fire-control job done quickly. The owner of the road outfit wanted his men trained as soon as possible and was sold on the method.

GROUP TRAINING FOR FIRE ORGANIZATIONS

R. I. Boone

Assistant Supervisor, Gila National Forest, Region 3, U. S. Forest Service

Systematic group training has been given to guards and other field men for many years. Thoughtful readers will wonder how the author has solved problems arising out of training "beginners" and experienced guards at the same time. Have selected experienced guards been used as instructors, or perhaps "demonstrators" in training beginners?

During the last 2 years group training camps for fireguards have been held on the Gila National Forest. The result of the training given is reflected in more effective fire-suppression action over a rough, isolated, forested area which is accessible mainly by pack trails.

Fire crews usually have to walk in to fires, and supplies are transported by pack outfits. The greater part of the fire-occurrence zone on the Gila falls in a wilderness area, so it cannot be opened up with truck trails. In the future airplanes will be tried out for delivering supplies and equipment.

During the 1940 fire season 276 fires were handled, 220 of which were held to class A size, 52 to class B, and 4 to class C, with a total of 259 acres burned over during the entire season. The size of the job can therefore be appreciated.

The group training camps are planned and conducted as follows:

If possible, a central location is selected for the camp site in order to reduce travel costs. Consideration has also been given to accessibility of the camp site by truck so that supplies and equipment could be transported at minimum cost. Another consideration is presence of the more hazardous fuel types in the immediate vicinity, so that fire-suppression problems can be given that will fit the guards to handle fires in the most hazardous areas on the forest with due regard for the safety of the crews.

The guard personnel is divided into groups, according to the duties that they will be called on to perform. For example, lookout men are placed in one group, fireguards in another group, and trail and construction foremen are assigned to a separate group.

Experience with the organization during the past season determines subjects covered in the training course. For instance, the record may indicate that the fireguards showed lack of judgment in line location and mop-up work; lookouts failed to keep the dispatcher informed on the condition of going fires and the necessity for prompt follow-up action; or that trail and construction foremen lacked training in handling small one-crew fire camps, timekeeping, and property records, in the use of first-aid kits, and in providing for the safety of their crews in dangerous locations.

District rangers are used as instructors. Training subjects are assigned to the men who are best fitted by experience and their general knowledge to handle them. After these teaching assignments are made a conference of the instructors is held, and an agreement is reached concerning the best method of teaching the different subjects. Each instructor is then required to prepare a written training outline covering the subject he is responsible for, the method decided on for teaching, and the amount of time needed to train the particular groups.

The traing-camp program is prepared from the data supplied by the instructors. Classes are held down to a maximum of 12 men, as it has been found that training in small groups is much more effective than in larger classes. Following is an example of a program for one day:

Date—Tuesday, April 8

Subject	*Time*	*Instructor*
Telephone line construction	8 to 10 a. m.	Jones.
Care and use of tools	10 to 12 noon.	Reed.
Fire packs	1 to 2 p. m.	White.
Fireguards' reports	2 to 4 p. m.	Brown.
1- and 2-man fires	4 to 5 p. m.	Smith.
Law enforcement	7 to 9 p. m.	Bell.

The law-enforcement training period is devoted to a prearranged mock trial to bring out important points.

The instructors rate each man who is assigned to their classes, indicating his ability in different lines of work and specifying just what additional training is needed when he is placed on duty and in the inspection contacts that are made during his period of employment. The rating records are then given to the district ranger for the district on which the guard will be employed during the coming fire season.

The self-inspection forms used by the guards furnish an excellent guide for training purposes, as they naturally rate themselves low on the subjects which they do not fully understand.

The last day at the training camp is spent in the suppression of an actual fire set for that purpose. An administrative guard, or one of the older fireguards, acts as fire boss and directs the suppression work. The rangers closely observe this action and make notes of good and bad points for discussion when the fire has been handled. Guards and foremen take a keen interest in such discussions, and from the pooling of ideas obtained, many interesting points in fire-suppression technique are brought out.

AVIATION AND WISCONSIN FOREST PROTECTION

LAURENCE F. MOTL

Communications Engineer, Wisconsin Conservation Department

Forest-protection agencies, although beginning only comparatively recently to use the airplane, are finding it offers many advantages in their work. Generally speaking, in forest-protection work airplanes are used for transportation of materials, scouting and reporting progress on fires, aerial control of fires including location of spot fires, reconnaissance work, mapping generally and of burned-over areas in particular, locating tower sites, impressing the public with the need of fire-prevention measures, and rapid transportation of personnel. The uses of a plane by any given agency will be determined by the nature of the country under protection, the facilities already available for its protection, and the organization of the unit responsible.

Utility of the airplane in forest-protection work has been increased manyfold by developments in the field of radio, which have been rapid in the past year. It is now possible for a plane to stay over a fire and maintain continuous communication not only with fire crews on the fire but also with dispatching stations many miles away. In an airplane ultrahigh frequency radio communication is possible with stations five or six times farther from the fire than is possible from the ground stations on the fire. In many cases in addition to its other functions an airplane may thus be used as a radio relay station to supply or dispatching stations many miles away.

In view of Wisconsin's highly developed tower system, it is questionable whether under normal conditions an airplane should be used for locating fires. Also, the road and fire-lane system should, except on rare occasions, preclude the necessity for using an airplane to transport fire-fighting equipment to fires. However, all of the other uses of a plane in forest-protection work which have been named should be applicable in Wisconsin.

Because of the airport and hanger facilities at Tomahawk, the fire-protection forces have been able to make a trading arrangement with a local airplane owner whereby in exchange for storage space a plane for use on forest-fire work is available a certain number of hours each year. Experience both interesting and valuable has resulted.

The plane concerned is an Aeronca K, 40-horsepower monoplane. Experience has shown that it has several disadvantages for efficient application to fire-suppression work in that its cruising speed is too slow, its rate of climb is too low, and its cruising range is rather limited. Nonetheless its use has been greatly beneficial. With a field SV radio set installed in the plane it was found possible to communicate remarkably well with various tower stations over ranges as great as 65 miles. One concrete example of its use will illustrate its practicability:

Late in the afternoon of October 20, 1939, D. W. Waggoner, cooperative ranger for the northern cooperative area, telephoned to ask if an airplane could be put at his disposal the following day in the vicinity of Medford. He explained that there were four fires burning in that vicinity and all of them were potentially bad. The weather had been dry for several weeks, the humidity was low, the wind high, and the crews working on the fires were inexperienced. Consequently and because the fires were several miles apart, he was having great difficulty supervising the crews. Provided the weather continued unchanged, it was agreed that the plane would be furnished.

The following morning gave every prospect of the beginning of another 24 hours of bad fire weather. The air was dry, visibility poor, and there was about a 25-mile wind blowing from the west. The towerman on the Corning fire tower, which is located about 15 miles west of Merrill, was notified to turn his radio to "stand-by receive" for 3 minutes every quarter hour to pick up messages from the plane. Because the plane was slow in air speed and there was a strong head wind, a rather large amount of time was consumed in reaching Medford. An interesting fact might be pointed out here. Given an airplane with a speed of 75 miles per hour flying into a 35-mile-per-hour headwind, in 1 hour the plane will cover only 40 miles. If the speed of the plane is increased by 35 percent, making it cruise at 100 miles per hour when flying into the same wind, it will cover 65 miles. In other words, the range of the plane will be increased by 62.5 percent. Thus when flying into a very strong wind, a comparatively small increase in speed will increase the ground speed by a much greater percentage.

After landing at Medford and taking on additional gasoline, the plane was headed west to where the fires could be observed. Radio tests on schedule back to Corning tower revealed that contact to Tomahawk via telephone relay could be maintained if desirable. Contact was then made with Waggoner, who was equipped with a portable radio set. He had heard the plane motor, anticipated the call, and answered immediately. For the next 2½ hours while the plane was over the fires continuous contact was maintained with Waggoner. He was given information about the fires which he was in no position to obtain quickly on the ground. Waggoner stayed on the fire considered most serious while the plane periodically flew over the other three fires, informing him of progress and developments. Waggoner later pointed out that from his point of view, this information which enabled him to stay on the most serious fire but at the same time almost continuously keep up with activities on all four fires was one of the most valuable features of the plane service. After the fires were definitely under control the plane returned to Tomahawk, arriving about 6 p. m.

Another point worthy of note in connection with the fires discussed was the effect of the airplane on the morale of the fire fighters. These were local residents, since the fires were in cooperative territory. It was noted that immediately upon arrival of the plane not only did the men on the fires put forth greater effort but that additional men also volunteered for service. One of the men who worked on the fire was later heard to remark to a friend, "Doggone! There I was sitting by a fence post when that airplane came along. I'll bet my hat those suckers were looking right at me and told Waggoner about it. You know he looked at me sort of funny when he came around afterward."

The presence of the plane over the fires not only served to emphasize to the public the seriousness of the fires in a way no other means could, but it also brought home to everyone in a conspicuous way the State's interest in suppression of the fires.

Aviation has made a substantial contribution to almost every form of public service that has given it a fair trial. The Federal Forest Service and some State forestry services have already clearly demonstrated that airplanes can also be of great service in forest-protection work. Forest-protection personnel at Tomahawk firmly believe as a result of both experience and observations that the airplane must of necessity eventually be recognized as a tool for the suppression of forest fires which will be considered as essential as tractors, plows, pumpers, and even the back-pack can.

Grasshoppers and Forest Fires.—Burning of debris along fence rows, roadsides, and marshes by farmers often results in disastrous forest fires. Such burning is often done without full knowledge or without full consideration of the disadvantages as compared to the benefits. Farmers will always have to do some burning, but if they can be encouraged to burn only when real benefits result and only when conditions are favorable, the job of forest protection will be easier.

Often farmers applying for burning permits indicate that they want to kill grasshoppers or their eggs. Usually they want to do the burning during the dryest part of April or early May. In many cases the burning includes not only roadsides and along the fence lines but also the borders of fields adjacent to woods or grass marshes where the fire cannot easily be confined to a limited area.

Consider now these facts about grasshoppers as given in Farmers' Bulletin 1691. The grasshoppers over-winter in the egg stage. Egg laying takes place in late July, September, and October, and until the first good frost. Most of the grasshopper eggs are laid in the top 2 inches of soil.

Wouldn't fewer "wild" fires result if farmers could be persuaded to do their burning for grasshopper control during the winter when the danger of fires in the woods is perhaps not so great as during the dry parts of April and May?

The Bureau of Biological Survey has found that birds play an important part in the natural control of grasshoppers. Yet the burning of fence rows, roadsides, and marshes destroys the nesting places of the birds.

Obviously unless the fires are very hot many of the eggs deposited 2 inches deep in the soil will not be affected. Why, therefore, burn at all? Why not give the birds a better break?

In the light of these facts it appears that fire-control men can profit occasionally by browsing far afield in the literature of other sciences, even in entomology. It also appears that on districts where there is a "grasshopper burning" problem, presuppression technique may include some educational work among farmers on grasshopper control.—Arnold Buettner, forest ranger, Wisconsin Conservation Department.

RADIO IN STATE FIRE-CONTROL WORK

H. R. Dahl

District Forest Ranger, Forest Protection Division, Wisconsin Conservation Department

The use of portable radio sets in forest-fire control work is not limited to any one group or unit. In contrast to other articles in this issue of Fire Control Notes, the author of the following article describes the use of radio in more populous areas of greater motor accessibility.

The value of radio in forest protection has been the subject of extended discussion the last few years. Experiments conducted by the Wisconsin Forest Protection Division during the fall of 1939 and the spring of 1940 have definitely proved the worth of radio for fire protection in this State to those who have used the equipment.

The United States Fire Service type SV portable radiophone has been found to be the most practical type for field work. The working range of this set varies with topographical and atmospheric conditions, with a maximum range of 80 miles between advantageously located stations. Independent transmitting and receiving stations are mounted on the same chassis. All batteries are contained in the set cabinet, and the same antenna is used for receiving and transmitting. The weight of the set, complete with batteries, is 18½ pounds, and its compact construction makes it easily portable over rough terrain.

In Wisconsin the most extensive tests have been made in Forest Protection District No. 5, in Marinette and Florence Counties. Although only four sets have been available in an area of more than a million acres, the equipment has been of invaluable assistance on many fires where radiophones were used to supplement existing telephone lines. Two of the radio sets were permanently installed in lookout towers, one set in the Thunder Mountain Tower in Marinette County and the other in the Buckeye tower in Florence County. The field sets worked out of the district headquarter's hanger station at Wausaukee in Marinette County and the Florence Ranger Station in Florence County. Communication was possible directly from the fire line to the towers, from which the information regarding conditions at the fire line was relayed to the dispatcher at the district headquarters, where the messages were translated into orders for the quick movement of fire crews or essential equipment. Communication by radio proved a decided improvement over the old method, where the dispatcher had to depend upon his own judgment of conditions as determined by information received from the towermen, who were usually several miles from the fire.

The investment for radio equipment in District No. 5 was amply repaid by its service in the 940-acre fire in the vicinity of Athelstane on May 10, 1940. It served as the chief means of communication in the desperate battle waged by 150 fire fighters on the most stubborn blaze in the district in several years. The fire occurred in a high-hazard area of unbroken jack pine and scrub oak plains, at a time when forest fuels were tinder dry as a result of extended drought and low humidity. Fanned by a 20-mile wind, the fire threatened to result in a major catastrophe.

Upon the arrival of the initial crew from the ranger station at Wausakee, a radio station was installed, and the district dispatcher was furnished with an up-to-the-minute picture of progress. Fire-suppression crews and equipment moved with clocklike precision to meet the growing demands as the fire progressed. The burned area was confined to a relatively narrow strip and the fire was brought under control in about 4 hours. It is the conviction of the district personnel that only by the use of radio, which afforded prompt action in dispatching crews and equipment, was the Athelstane fire prevented from becoming one of the most disastrous conflagrations that have occurred in this part of the State.

Because of the successful results with the skeleton equipment now in use, the Forest Protection Division plans an intensification of its radio coverage. Radio schools for its personnel have been established, and practically every member now holds a radiotelephone operator's license which permits him to operate such equipment. Thirty additional sets have been ordered which, together with those now in use, will make a total of 68 sets on the forest-protection areas of the State.

Many possibilities are envisioned for the use of radio communication in fire-control work. Radio communication is being considered for service to emergency lookout points where the cost of radio would be more economical than the construction and maintenance of telephone lines. Radio may also be used to advantage for contact with stand-by crews to be located at strategic points during periods of high fire hazard. It can be used to contact CCC crews on work projects in the forest areas and thus make them instantly available without interfering with their regular conservation activities. Also, on large fires, scouts may be stationed at various points along the fire line to report the requirements on the entire front. It appears that the use of radio in fire-control work is about to write a new page in the forest-fire history of this State.

ACCENT ON YOUTH

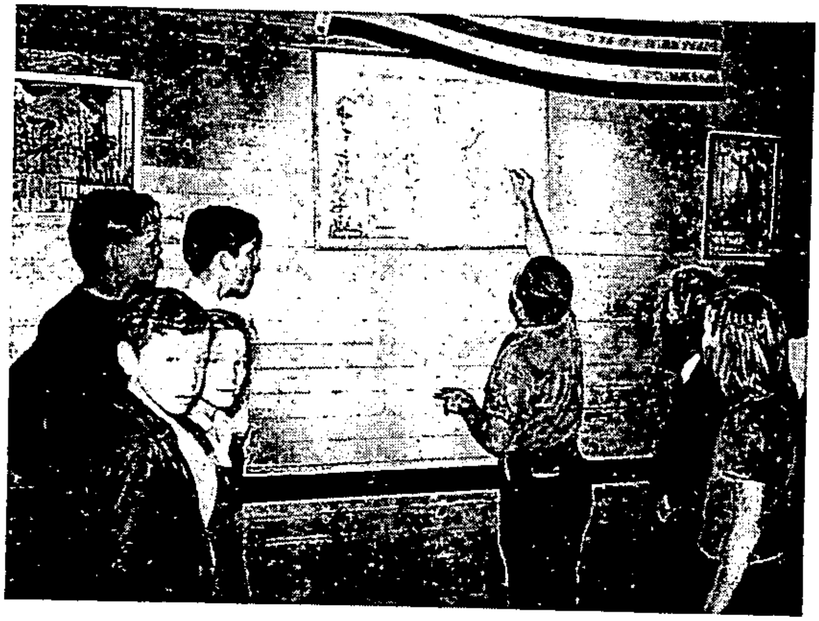
V. B. McNaughton

Fire Assistant, Mississippi National Forest, and

R. M. Conarro

Regional Fire Assistant, Region 8

The problem of forest-fire prevention will not be solved by any one program but by cumulative effect of many direct and indirect programs. One such program which is "paying off" today and will continue to do so for many years to come has to do with competitive fire prevention in rural schools in the national forests of Mississippi.



Bringing the record up to date. F-405305

Each school competing is allotted an area to keep free from fire. An attractive colored map showing all competing schools and their respective protective areas is hung in each school. Once a month this map is brought up to date by a forest officer. At the end of a 6-month period (which coincides with the fire season and school term) a climatic "forestry day" is held at which the winners are presented with their prizes. In some cases a rather elaborate forestry-day program under direction of a master of ceremonies, and consisting of a declamation contest, music by a local band, talks by prominent speakers, and various contests is arranged. Sometimes even a special edition of the local paper is issued and a radio hook-up is used for the program.

The purpose and thought behind such relatively intensive school programs seem to justify their existence. Reduction in the number of fires occurring is only one of the results—only a means to the final goal.

Officers on the national forests are concerned with trees and men, and in the past few years have become somewhat more acutely aware of their obligations to the forest residents than heretofore. However, the man in the forest has not in most cases become aware of his obligation and responsibility to the trees.

The school programs help both the men and the trees. If administration of the national forests is successful, work will become more pletniful and stabilized. The per capita income of the forest residents will be increased. Higher standards of living will follow.

And as for the boy of today, who will be the man of tomorrow, he will be a better, more responsible citizen of his community; for fire prevention is nothing more than respect for the property rights of others. And small though it may seem to some, the principle of property rights is highly important in maintaining law and order in a forest society.

Finally, the fire prevention programs offer to even the smallest of the children an opportunity to contribute directly to national security. It gives the children a concrete, definite "something" to do. It is their part in making America strong and self-sufficient. Far-fetched? Well, perhaps, but don't forget the intense juvenile educational programs in the totalitarian countries, programs aimed at inoculating the youth with doctrines of hate and prejudice.

Do not expect the youth of America, especially the rural youth, to grow up to be good citizens with no training or guidance. Every opportunity must be used to teach intelligent and responsible patriotism to those who tomorrow must carry the torch of democratic ideals in a world where ours may be the only existing light for free men.

The contest rules may vary with local problems or conditions. In some places only grammar schools compete; in others high schools are included. Following is a typical set of rules:

(1) Each school is allowed 1,000 points to start the contest.
(2) For each man-caused fire 50 points is deducted.
(3) For each acre burned 1 point is deducted.
(4) For each false alarm 5 points is deducted.
(5) Fires suppressed by local people before the arrival of crews will not be counted against the schools' records.
(6) The contest will run from October 1 to March 31. The school having the highest number of points remaining from its orginal 1,000 will be the winner.
(7) In case of ties duplicate prizes will be awarded.

Adequate prizes must be secured to get the best results. It is usually not difficult to "sell" the program to local business firms who willingly contribute merchandise or cash for the winners. Try not to have any absolute losers; give all contestants something in recognition of their participation. Be sure to give the prize donors their share of publicity; the next year's prizes will be that much easier to solicit.

Back up the program with plenty of publicity. Don't overlook the forest personnel and cooperators in "talking up" the program throughout and adjacent to the forest.

Get the public approval of the State and county superintendents of education for the program. Generally the teachers are very enthusiastic over the idea, but once in a while a "preceding letter" is necessary to avoid a lukewarm reception.

As for the children—well, don't worry about them. Their bubbling, contagious enthusiasm will thrive on surprisingly little attention. The big job will be to keep them within bounds. After all, it is one thing to go home and ask Pa to be careful with his debris burning, etc., and it is something else to climb a neighbor's fence and tear apart his burning brush piles when he has not cooperated with either the school or the national forests by notifying the forest supervisor of his intention to burn.

School fire-prevention programs will not solve the fire problems entirely. Aggresive law enforcement, personal contacts, notification systems, publicity, good detection and suppression action, and all the other many tangible and intangible things that affect fire control will still be needed.

Forest Fires.—The power-pump unit of the Lebanon crew was detailed to hold a section of the woods on the edge of Marlow Village. The forest fire, backed by a stiff breeze, roared about 600 feet away but, suddenly, with a shift in the wind, headed toward the village. Thick, dense smoke settled over the town and the pump crew put out many spot fires from flying sparks and coals. The crew stationed at the village water hole, stayed at its post in the face of the surmounting difficulties. Suddenly the power pump began to sputter and operator Raymond W. Langley discovered that the water-feed pipe to the cylinder which cools the motor had become disconnected. Disregarding burned fingers he eased the motor and repaired the damage. Almost at the same moment the flames jumped into patch of Christmas-tree size spruce and fir less than 100 feet away and the grove became a mass of flames. To add to the excitement, snakes driven ahead of the fire began sliding into the water hole. It was estimated that at least 50 of them were swimming around, and they became so numerous that they clogged the intake hose of the pump. A man was even detailed to keep the intake open with a stick. In spite of everything the crew stayed with the pump, the buildings were all saved, and the fire roared on its way in another direction where there was less opposition.—Netsa NEFE News.

THE BEAR VALLEY HIGH-HAZARD PLAN

H. Robert Mansfield

District Ranger, Malheur National Forest, Region 6, U. S. Forest Service

The development of a simple, workable high-hazard area plan which will insure fast action on fires has been one of the major concerns of the Bear Valley district of the Malheur National Forest for the past year. A brief statement covering the need of such a plan, the problems encountered in its development, and the form which it is assuming may prove of general interest.

The Hines Co. has been operating on the Bear Valley district for a number of years. In 1936 their cutting system was changed from 80 percent to the light-selection system. At that time the slash-disposal system was changed from a complete pile and burn to no disposal whatsoever except piling and burning about a 100-foot strip along roads which were to be maintained. From 1936 to the spring of 1940 about 70,000 acres of slash had accumulated and the area was increasing at the rate of approximately 20,000 acres per year.

The Hines Co. is, of course, responsible for fire protection of the area under sale contract. In the spring of 1940, however, the original sale contract covering in the neighborhood of 60,000 acres was closed. This released Hines from responsibility on that area and turned full responsibility back to the Malheur Forest.

In the Malheur area the progress toward normal of hazard created by slash is extremely slow, and the slash on Hines' operation presented burning conditions somewhat comparable to those in a powder factory. If this area were to be protected from fire, plans had to be perfected which would reduce elapsed time to as near the zero point as possible. The size of the hazard area and limited funds made it necessary to develop a plan which would make the fullest possible use of existing control features, rather than to superimpose on the ground a theoretically complete and perfect plan drawn up in the office.

Quick action appeared to be the key to the situation and quick action depended upon a complete road system and complete information concerning fire-fighting conditions in the area. The information needed to be in visual form for fast use, hence the necessity for a map.

Because of the importance of topography in planning fire action, the timber-survey topographic map was chosen as a base. Prepared on a 2-inch scale this map gives a good picture of the topography and allows room to show needed information in detail without being too large to handle. To further simplify use, the completed map is being made on a township basis with the township sheets bound in a reduced-size atlas binder.

The timber-survey maps do not show a great amount of detail other than that necessary to timber management. It is therefore necessary to ink in names of streams, mountains, lookouts, springs, etc., so that points on the map may be quickly correlated with the ground. It is also necessary to place the road system on the map.

The Hines Co. does truck logging and endeavors to keep skidding distances to a minimum. As a result, the country is left with a maze of roads, all of which need only be freed from logs in order to be usable for fire control. Taking the map to the field and sketching the roads in by use of section lines and topography proved to be the most satisfactory way of getting the roads accurately located on the map. Such a complicated road system is developed by the company that a simple, foolproof naming plan was needed so that even a guard familiar with the country could easily find his way to a given point. The most simple plan seemed to be to give the main roads names according to the drainage which they followed and to number the spurs from these named roads. On the ground the naming was done by use of informational signs of a temporary nature and on the map the naming was shown in detail. For example, a person traveling up the "30–30" Springs Forest Truck Trail will come to an informational sign indicating the Flagtail Creek Road. Following up the Flagtail Creek Road he will find signs indicating Spur 1, Spur 2, etc. Following Spur 2 he will find Spur 2A and 2B.

Pump chances, water storage, company tool caches, Forest Service tools, firebreaks, fuel types, etc., are being shown on the map by appropriate symbols as rapidly as they are developed or accurately located.

The final maps will be blueprints which are relatively cheap and are easy to correct to show changes in or additions to the plan. The legend used provides for the protective positions, water storage, pump chances, live springs, running creek water, available camp spots, and section-line crossing markers to be shown in blueprint form, while features, such as roads piled and burned, areas of extreme hazard, large scabs or meadows, and boundaries of slash, are to be shown by color.

Malheur personnel believe that the plan will help a guard to find a fire more quickly, aid the protective assistant to dispatch men and materials more effectively, and enable a fire boss to size up promptly the situation confronting him without overlooking any good bets. Each guard will be furnished a map for each township in which he will work. The protective assistant, ranger, and supervisor's office will have complete sets of the maps of all townships covered and reserve sets will be kept on the ranger district for use on project fires.

The plan is being developed for the new sale area as well as for the old area of which Hines' fire responsibility has ceased. This is being done because the Forest Service has (without in any way releasing the company from its contractual responsibility for fire protection of the area) taken over the direction of the extra patrolmen and lookouts which the slash area requires and because it will be only a matter of a few years before the entire responsibility will revert to the Forest Service as a result of the time-limit clause in the sale contract.

As extra guards, the company is financing two patrolmen provided with pick-ups fitted with Panama pumps, 100-gallon water tanks, hose, tools, and radio; one added lookout with stand-by radio; and

(Continued on p. 213)

REDUCING MAN-CAUSED FIRES

HENRY A. HARRISON

District Ranger, Whitman National Forest
Region 6, U. S. Forest Service

Fire-prevention guards have been used successfully throughout the country, but this is one of the few reports of their activities that has appeared in FIRE CONTROL NOTES.

In the spring of 1940, data compiled by the Pacific Northwest Forest Experiment Station showed that the Sumpter district of the Whitman National Forest was very close to the worst of the 100 districts in region 6 for man-caused fires. A careful analysis of causes was made, and a comprehensive fire-prevention plan for the district was formulated.

The Sumpter district has a large protective area of private lands adjacent to and intermingled with Government lands. The district is all in a mineralized area, and use by miners and prospectors is heavy. From three to five major logging operations are active each year on the private lands. The combined use of the entire area by loggers, woodcutters, miners, prospectors, stockmen, settlers, hunters, and others makes the fire risk from human activities great. The analysis indicated that one of the weak points in fire prevention on the district was the inability of the ranger, because of limitations in time, to maintain enough contacts with local residents and users.

During the 1940 season, for the first time, a special guard, whose duties were primarily fire prevention, was used on the Sumpter district. The guard was a man of varied experience chosen for his ability to meet and talk to people. He was carefully trained and instructed in his duties, which included:

1. Making scheduled trips over the entire district to contact users and forest residents to the fullest extent possible.
2. Leaving auto tags at parked cars where no contact was made.
3. Visiting logging operations at regular intervals to contact loggers and check fire equipment.
4. Making a record of smaller slash and other fire hazards. A plan for removal of hazards was made and put into effect by the ranger and prevention guard.
5. Going to all man-caused fires, usually in addition to the regular suppression crew. Unless urgently needed to help suppress the fire, the prevention guard's job was to make a complete investigation and effect law enforcement if possible.
6. Maintain fire-prevention signs on the district in accordance with the posting plan.

The guard traveled in his personally owned car and carried a type SV radiophone equipped with a fishpole antenna. Communication with radio-equipped lookouts was possible over most of the district, so the guard was in almost constant touch with the protective assistant. On several occasions he chanced to be the closest man to a fire and was dispatched for initial action.

The use of a fire-prevention guard is only one of a number of fire-prevention activities being carried out on the Sumpter district;

(Continued on p. 213)

A PLAN IN CHART FORM FOR THE PLACEMENT OF THE PRESUPPRESSION ORGANIZATION

H. G. Hopkins

*Assistant Forest Supervisor, Monongahela National Forest, Region 7
U. S. Forest Service*

The fire-danger meter is casting off its swaddling clothes and management is directing the baby's growth. The Monongahela is another of the organizations that is putting this youngster to work in its everyday activities.

Burning Conditions

Burning conditions change rapidly in the section of the Appalachian Mountains where the Monongahela National Forest is located. It is not unusual, during the spring and fall fire seasons, for fires to be reported in the afternoon of a day that started off with the forest floor dripping wet or even covered with a light snow. The loose top layer of hardwood leaves, and the dead grass, ferns, and weeds dry quickly before sun and wind and will carry fire at a surprising rate while the lower, tighter packed layer of leaves is still wet.

Burning conditions may be developing rapidly on the south slopes all unsuspected by a ranger or guard working on a damp or snow-covered north slope. Or, fire danger may creep up on a man while he is working on a past-due report in the shelter of his office. To further complicate the picture, there is nothing dependable or regular about fire weather. The Monongahela fire season is usually defined as March 15 to May 30 and October 1 to December 15, but burning conditions may develop at any time of year. Further, there may be stretches of a week or more, during the so-called burning season, when the clouds hang low and fire conditions do not develop.

Under such circumstances, a mechanical method of determining fire weather is of great benefit, and so forest personnel have grown to lean heavily upon fire-danger station reports, and the fire-danger class as recorded by the Appalachian Station fire-danger meter.

On day early last spring I was inspecting the fire-danger station set up at Camp Woodbine on the Gauley district. A reading was taken and the data applied to the meter, resulting in a class 3 day reading, indicating moderate burning conditions. The observer, a local enrolled man with many years in the woods behind him, looked across at a snow-covered north hillside and with evident scorn for those "danged Jemison" sticks, remarked, "Now you know fire wouldn't burn today." That very afternoon, right under our noses, a little brush fire spread over 3 acres in 10 minutes, and we became convinced that those "danged Jemison" sticks would bear watching.

Such rapid charges in conditions indicate a need for great flexibility in the fire-control organization. Guards are paid by the day when actually employed, and may be called up for duty at almost

F
PLANS
Presuppression
White Sulphur

Elkins, W. Va., *January 1, 1941.*

SAMPLE PLAN FOR PRESUPPRESSION ORGANIZATION
WHITE SULPHUR RANGER DISTRICT

Danger class—Fire season	2					3			4				5				Expected number man-days	Average wage	Fund
Visibility (— = Normal; L = Low)	—	L	—	L	—	L	—	L	—	L	—	L	—	L	—	L			
Risk (— = Normal; H = High)	—	—	H	H	—	—	H	H	—	—	H	H	—	—	—	H			
Expected number days—Fire season	22	2	5	1	34	5	10	1	16	1	5	1	1			1	105		
Ranger					°	0	°	°	°	P	P	S	S	S	S	S	3		
Dispatcher	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	105	4.16	P&M
Smoke chaser	P	P	M	M	M	M	M	M	M	M	M	M	M	M	M	M	81	4.16	P&M
Lookouts:																			
Hopkins Mountain	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	105	3.66	P&M
Paddy Knob	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	105	3.66	P&M
Sharp Knob (Gauley)	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m			
Beaver Lick (W. Va.-F. S.)	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	10	3.33	FF
Meadow Creek Mountain										M		M	M	M	M	M	4	3.33	FF
Elk Mountain										M		M	M	M	M	M	4	3.33	FF
Patrolmen:																			
Auto										M		M	M	M	M	M	4	3.33	FF
Slaty Fork											M	M	M	M	M	M	8	3.33	FF
Wardens:																			
Browns Creek—H. Dilley									°	°	M	M	2	2	3	3	28	1.60	FF
Cloverlick Run—J. H. Higgins					°	°	°	°	M	M	M	M	M	M	M	M	8	1.60	FF
Slab Camp—A. Bowen									°	°	°	°	M	M	M	M	2	1.60	FF
Crooked Fork—G. Gay									°	°	°	°	M	M	M	M	2	1.60	FF
Cummins Creek—J. S. Lee							°	°	°	°	M	M	2	2	3	3	11	1.60	FF
Blue Springs—R. Hannah											°	°	M	M	M	M			
Auto—A. Perry					°	°	°	°	M	M	M	M	2	2	3	3	28	1.60	FF
Frost—K. Chestnut					°	°	°	°	M	M	M	M	M	M	M	M	25	1.60	FF

(Only selected positions shown.)

Legend:
L—Low visibility; averaging less than 5 miles.
H—High risk as defined in instructions for use of plan.
P—Man working on project funds near phone in vicinity of fire-control duty station, and to report in hourly or as required by dispatcher.
°—Man or crews contacted, location and availability determined, but no stand-by order given.
S—Man to stand by at phone on project funds.
M—Manned or stand-by on fire-control funds (P&M or FF).
2—Number of men to stand by including warden.
m—Man needed but expected to be paid by State or other cooperator.

any time of the day or night. Most of the guards are local residents, living within an hour's drive of their presuppression station. Roads to many lookout points aid in quickly and economically adjusting the detection organization to the needs.

The Plan

A plan for placement of the presuppression organization has been prepared for each ranger district in concise chart form. Placement varies with the three variables of fire danger—weather, visibility, and risk—and, of course, is based on consideration of the static factors of fuel type, topography, and values.

Five classes of fire danger are recognized, as classified by the Appalachian Forest fire-danger meter. This is designed to take into account all of the factors, as fuel moisture, wind velocity, length of burning period, condition of vegetation, etc., which determine, for a fire in a given fuel type and topographic situation, the rate at which it will spread and the degree to which it will resist control.

Two classes of visibility are recognized: (*a*) Normal or regular visibility. Studies have indicated that lookouts on the Monongahela can see 7 miles 70 percent of the time, and 5 miles 90 percent of the time. The same studies have indicated that seasonal variations in visibility are insufficient to form a basis for planning changes in the detection organization. (*b*) Low visibility. Visibility is low when a ⅛-acre fire could not be detected over 5 miles away, save for rare intervals or minor fractions of the day. This condition may be expected less than 10 percent of the time during fire weather. Short periods of low visibility, lasting less than one-half day, must, of necessity, be disregarded as a basis of increasing detection personnel, except during class 5 weather, when any reduction of visibility below normal will be the basis for organizing as indicated for periods of low visibility.

Two classes of risk are recognized: (*a*) *Normal risk* refers to the usual risk for any particular area. It is recognized that the normal risk in some areas, as along a logging railroad right-of-way, may be much greater than in others, as in an area closed to all entry. However, the normal risk for each particular area has been considered in arriving at the plan for placement of the organization during periods of normal risks. (*b*) *High risk* refers to unusual conditions of risk such as exist weekends during fishing seasons.

The chart constitutes a basis for both financing and inspection of the districts. It is revised annually as indicated necessary by new or additional experience.

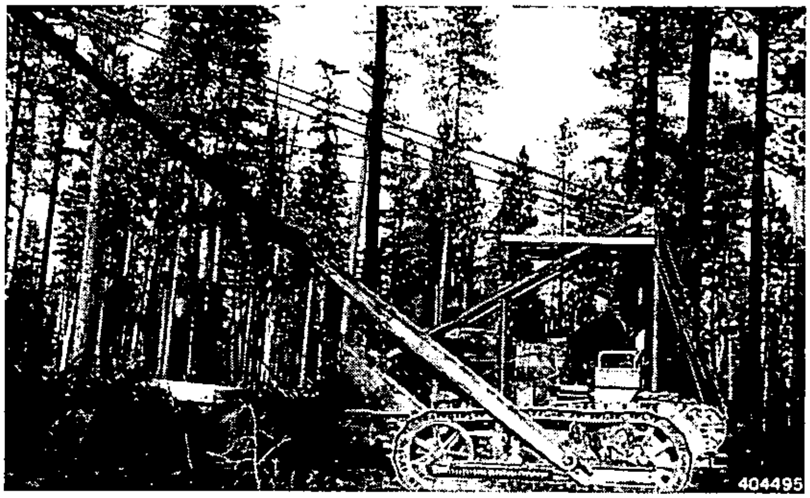
A "PUSHER" FOR SNAGS

MERLE S. LOWDEN

Deschutes National Forest, Region 6, U. S. Forest Service

A large saving in snag-felling costs has been effected on the Deschutes National Forest during the last 2 years through use of a snag-felling machine. This "pusher" has reduced the average cost of felling ponderosa pine snags in hazard-reduction work on fire lanes to approximately one-half of what it was when the work was done by hand with crosscut saws.

The Deschutes machine consists of a 40-foot boom mounted on a "60" caterpillar tractor equipped with Hyster. The lower one-half of the boom is built of 8-inch channel iron and the upper one-half of 6-inch material. The entire length is reinforced with heavy channel-iron cross bracing.

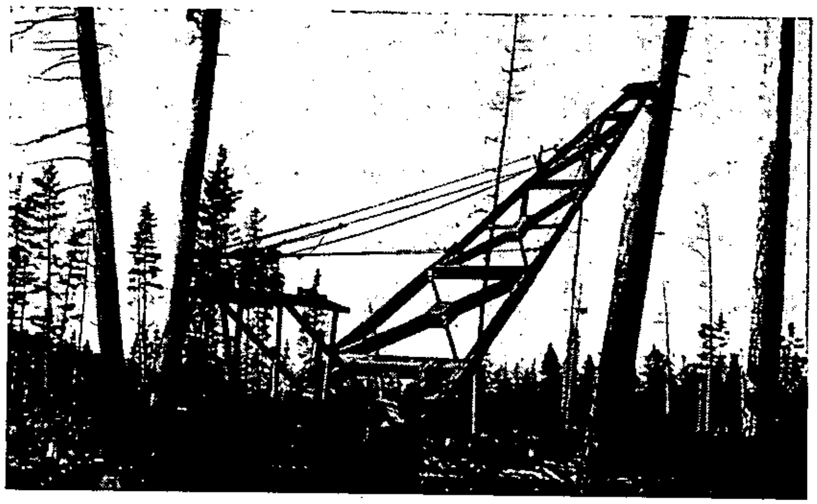


Side view of pusher snag-felling machine used on the Deschutes National Forest.

The boom is fastened on the lower end to the caterpillar frame and is held in place by five ¾-inch guy cables and a ⅞-inch lift cable. The four guy cables from the top of the boom are attached to the protective frame over the driver's seat and the guy from the lower side is attached to the front of the caterpillar frame. The lift cable is attached near the upper end of the boom and to the Hyster. It is used to raise and lower the boom when repairs or adjustments are made. It is not used when the machine is in operation because the guy cables would need to be detached. The guy cables keep the boom in a relatively fixed position and help prevent it from slipping up the snag. The end of the boom is fitted with three large triangular teeth cut from ¾-inch boiler plate which catch on and assist in preventing the boom from slipping from the snag.

The driver is protected from falling limbs or pieces of the top by a heavily braced frame of 3-inch iron pipe welded together, on which is attached a roof of ½-inch boiler plate. The canopy has large holes in it to enable the driver to see up along the snag.

The beetle-killed snags in the area being worked rot in the roots within the first year and are comparatively easy to push. Snags up to 36 inches in diameter and 150 feet in height are pushed without difficulty. With a 2-man crew of operator and helper, the machine pushes 200 snags per day in clearing fire lanes 300 feet wide. It has traveled as far as 9 miles per day doing this in areas where the snags average less than 2 per acre. Where the snags are farther apart the costs per snag increase because of travel time between snags. Just when the snags become so thinly scattered that it pays to fell them by hand has not yet been determined, but studies are now being carried on to determine this point.



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The Deschutes snag-felling pusher in action.

For a number of years a local logging operator has used a snag pusher consisting of a boom mounted backwards on a high arch, which is pulled by a crawler tractor in the usual manner. Snags and live trees on railroad rights-of-way are pushed over with this machine by backing the arch-mounted boom against the tree or snag. The machine appears to work satisfactorily, but there are more hazards in using a machine that is backed up than in using one that works forward. The present "pusher" mounted directly on the tractor was designed to overcome some of the risks.

During the first year the pusher was used, a number of "bugs" were eliminated. Getting teeth for the boom that did not break or bend was a problem, but the present short, heavy, triangular buzz-saw teeth are doing the job.

While it is questionable whether the machine could be used on heavy Douglas-fir snags or on similar species, modifications could probably be made and a similar machine worked out to do the job. On pine snags the machine has worked well and its use has resulted in savings that can be used in doing more slash piling and burning. So far no snags have been felled with the machine in suppression of a fire, but a try will be made on the first available fire.

OIL CURE FOR LOOSE HANDLES

Idaho National Forest

On all forests, despite the greatest care, how to keep handles of fire tools from becoming loose is no doubt the cause of a constant "headache." Handles inspected regularly and found to be well fitted and perfectly tight will often show up badly on the job.

Humidity apparently has nearly as much effect on handles as it does on forest fires and loose handles and fires made a bad combination. It is hard to realize that changing weather and use play such havoc with them.

Some forests or agencies may be interested in an experiment carried out in region 4 by the Idaho National Forest. The idea is not new, but we have never heard of it being used on a large scale or any notes being made on the results of such an experiment.

A well-dressed handle, perfectly fitted and properly wedged, is about the ultimate in loose-handle prevention, but it is not enough to stand extremes of hot and cold and wet and dry weather conditions. With this in mind experiments were made with the use of oil.

The oil is applied after the handle is properly fitted and wedged with wooden wedges. A small hole 11/32 of an inch in diameter is bored in the center of the end of the handle which is within the eye of the tool. The hole is, in most cases, about 2 inches deep, depending on the depth of the eye of the tool involved, but not deep enough to weaken the handle. The tools are placed in racks with the tool end up and the hole is then filled with No. 10 S. A. E. motor oil and allowed to stand overnight or an equivalent length of time. It is then filled again and plugged tightly with a 3/8-inch plug 3/4 of an inch long. The most suitable plug is made from ordinary 3/8-inch birch doweling. The handle should be tight and thoroughly dry at the time of treating.

The oil is absorbed by the handle in the eye of the tool, but not enough to soften the wood or make it spongy. The treatment makes the handle more resistant to weather and much less likely to shrink or expand because of varying moisture content.

Last season more than 2,000 fire tools (axes, pulaskis, and hammers) were so treated and our loose handles decreased more than 75 percent. A loose handle is now more rare than common. The treatment is not expensive and can be given at the time of reconditioning with very little more time or trouble than rewedging.

A GUARD FOR DOUBLE-BIT AXES

SAMUEL W. ORR

Forest Ranger, Routt National Forest, Region 2, United States Forest Service

During the last few years a number of different types of ax guards have been devised and experimented with, none of which has proved entirely satisfactory. Either they have been too expensive to manufacture or have been impracticable in one way or another.

About 3 years ago experiments were commenced with the idea of improving upon previous efforts. Several types of guards were devised, none of which seemed to fill the bill. In the spring of 1940, however, a guard was completed which brought favorable comment from those who examined it. This guard had the advantages of durability, cheapness of manufacture, efficiency, and lightness. The material used in making it was condemned 1½-inch unlined linen fire hose such as that used with power pumps on suppression work. Rubber lined hose was rejected because of weight and bulkiness, and the tendency of the rubber to deteriorate.

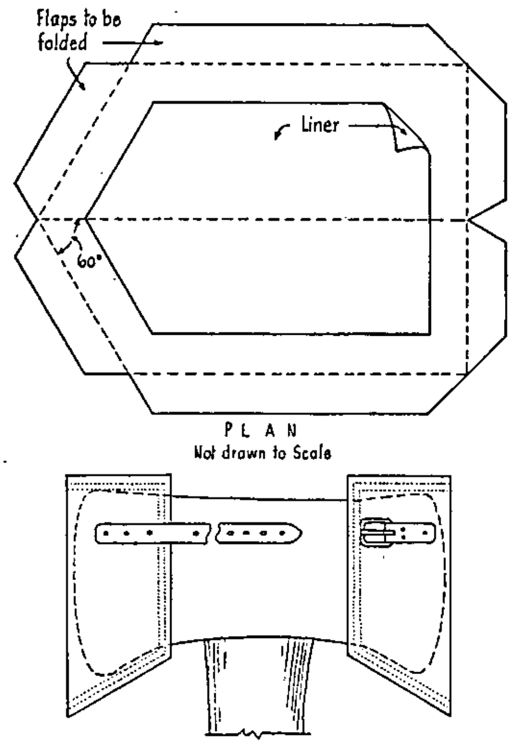
In making the first satisfactory model of this guard, a section approximately 10½ to 11 inches long was cut from a length of unlined 1½-inch linen fire hose. From one end of this section a 4-inch length was measured and cut off. The part remaining was cut once lengthwise so as to give a flat piece of material approximately 5 inches wide and 6 inches long.

A template, or pattern, was made of paper (metal would be much better). Using the template as a guide the 5- by 6-inch section of hose material was marked with a pencil and cut to shape. Tinner's snips or sharp heavy shears seem best for this operation. Or a safety razor blade in a holder may be used, dispensing with the marking of the material by following the outline of the template with the razor blade.

Having cut the 5- by 6-inch section to shape, the uncut 4-inch section removed from the original piece was cut twice along its length, thus securing 2 pieces, measuring approximately 2½ by 4 inches, which were cut as shown in the illustration. These 2 pieces, which were named "liners,' were then sewn to the exact center of the piece previously cut. Linen harness thread seems to be the best material for this purpose. The two liner pieces were used in order to avoid an undesirable bulge in the completed guard. After attaching the liners as indicated, the flaps of the larger piece were folded inward, so that their inside edges butted against the outside edges of the liners and were sewed down into position with linen harness thread.

The ends of the guard were folded, butted, and sewed in the same manner as the sides except that instead of linen harness thread, wire was used for sewing, in order to prevent the edge of the ax from cutting through, should it by chance come in contact with seam. One end of the guard was folded and sewed on an angle of about 60°. By folding and sewing in this manner a pocket was made which when slipped over the heel of the ax took advantage of the slight curvature at this point of the implement, and prevented the guard from slipping off the blade.

Upon completion of two separate guards as described, a buckle was riveted to one guard and a strap to engage the buckle was riveted to the other. Both buckle and strap should be placed about one-half to three-fourths inch below the center of the guard, to prevent any possible slippage of the guard off the toe of the ax.



THE FINISHED GUARD

Showing method followed in folding and sewing, and the guard as it looks when completed.

The speed of production and production costs probably can be shaved by the use of a die to cut the guards to shape and size and by the use of wire staples similar to those used in Bostich stapling machines in place of the wire used on the end seams. It is understood that heavy staples of this type are available for uses similar to that proposed.

Exact dimensions for the guard are not given, since there are slight differences in dimensions of double-bit axes of different makes and weights. However, length of the template and the liner can be varied, or as a last resort, guards can be made sufficiently large to fit all axes. The last-named alternative is not desirable, however, since a snug fit which gives the guard the advantage of holding itself on by use of the curve at the heel of the tool is highly desirable.

FIRE-DANGER RATING IN WISCONSIN

WILMER S. CAROW

Forest Ranger, Wisconsin Conservation Department

The number of State and private agencies engaged in forest-fire control activities developing and using fire-danger ratings is constantly growing. The author presents a picture of some of the thinking and action which is taking place in Wisconsin in an effort to avoid a repetition of catastrophies of earlier years.

Just as military forces have to be organized and equipped for easy expansion or contraction as necessity dictates, so too must fire-control forces be organized and equipped. In Wisconsin a permanent skeletonized force is always in readiness at forest-protection headquarters to handle small emergencies, but this small force must be quickly augmented as fire danger increases. Heavy equipment and large quantities of hand tools and supplies must always be available and in condition for easy distribution as great emergencies arise.

When may such emergencies be expected? How often? And for how long a time will they last? How much equipment and manpower will be necessary?

Great forest fires and such holocausts as the Peshtigo, Hinckley, Phillips, and Cloquet fires do not just happen. Weeks in advance of the climactic events a dangerous fire situation begins developing. Hot dry winds, brassy skies, and anemic-looking forest cover herald the arrival of innumerable fires in woodland areas. Through espionage and reconnaisance the strength and nature of the enemy—fire—must be determined. Opposing forces must be prepared to meet the situation that is presented. A fire-suppression army must be recruited and instructed, and its various units must be placed in strategic locations with easy communications and efficient detection services.

Down through the years practical woodsmen have noted many useful signs of rising fire danger. The common enemy, fire, has betrayed itself so often that many of its traits are now well known. It is easily possible to detect the enemy's approach, but in what numbers will it attack? How fast will the enemy travel? And how difficult will it be to stem the advance?

Fortunately, in recent years through the efforts of many investigators, good answers to many of such questions are becoming available. The study of these problems is known as "fire-danger mensuration." It could be termed more simply "fire-danger rating." The objective is to measure the danger of each fire day as one would scale a board.

If an army travels on its stomach, a fire travels on its fuel; and just as an army needs air to breathe, so a fire needs oxygen to burn. Any investigation of fire danger will then naturally be directed to a study of the fuels—referred to as the *hazard*; and of the atmosphere—*weather*. Only one more factor need be considered—the probability of fires starting; that is the kindling agencies. It is called *risk*. Now if the hazard contributed by the fuels and by the atmosphere can be successfully rated, and, in addition, the approximate risk of fires starting can be determined, the result is a practical solution to the problem of accurately estimating the total fire danger.

The forest-fire problem is divided into three primary factors: (1) The kindling agencies which cause fires to start, (2) the weather which allows them to burn, and (3) the fuels which they burn. Now let us scrutinize the fuels, or hazard, more closely.

Since the fuel—both type and amount—prevalent in any given locality changes slowly, it can be regarded as an almost constant factor. Fuels are quite easily classified as to speed and intensity of burning under given conditions. A grass marsh, for instance, burns rapidly but with relatively little heat and the actual flames cover only a narrow band along the edge of the fire. On the other hand, an area of heavy pine slashings burns more slowly but is very much hotter and its control is much more difficult and slower because the actual burning area extends in much deeper from the fire line. The fuels on the various areas comprising a forest-protection district may thus be typed and classified. Just as cars are assigned horsepowers, fuels are classified both as to the rate at which a fire will travel through them, termed "rate of spread," and the difficulty of control, called "resistance to control.'

Rating numbers for various fuels are now being determined under various weather conditions and charted for future practical use. Much progress has already been made in determining ratings not only in Wisconsin, but also in many other forest areas. The different fuels have generally been roughly classified, both as to rate of spread and resistance to control, under the following headings: (1) Extreme, (2) High, (3) Moderate, and (4) Low.

However, while discussing the problem of fuel-type classification, it must not be forgotten that the condition of the fuels is most important. When the annual vegetation, such as grass, brush, ferns, etc., is green, it absorbs the heat of the fire and slows down its spread which speeds up control. The condition of the fuels as to relative dryness is, of course, most important—which leads directly to the problem of weather in its daily and seasonal fluctuations and abnormal variations.

Weather observation stations are maintained at the 10 district ranger headquarters and at some of the subdistrict stations, and all cooperate with the United States Weather Bureau. Readings are taken on Weather Bureau instruments three times daily and telegraphed to Chicago. Each morning during the fire season a specialized forecast is received from the Chicago office and relayed over State telephone lines to the various district forest rangers. This enables them to rate the probable fire danger in advance on the basis of the forecast of the weather elements which will be in effect.

The most important of these elements is rainfall. How long has it been since a certain amount of rain fell? On the average, evaporation will take place at a specified rate during certain seasons of the year. All forest fuels are hygroscopic, which means that they have the power of holding water within themselves in proportion to the percentage of saturation of the atmosphere. When the relative humidity (percentage of saturation) of the air goes up, the fuels take on moisture; when it goes down, they give off moisture. This power is called "hygroscopic regain" and depends to a certain extent on the temperature. The higher the temperature, the less power the fuels have to retain moisture and vice versa.

Now, it has been found that the rate at which fires burn depends upon the moisture content of the fuels, other factors being equal. When the relative humidity of the atmosphere approaches 100 percent, the moisture content of the fuels approaches 25 percent of their oven-dry weight and they do not burn readily. When the relative humidity approaches 20 percent, the fuel-moisture content approaches 5 percent and fuels are extremely inflammable. By combining relative humidity readings, obtained by a simple operation, with the length of time since a certain amount of rain has fallen, it is possible to approximate closely the moisture content of the fuels and thus gage their inflammability.

In addition to determining the amount of moisture which fuels contain, the relative humidity has other important influences on fire behavior. The smaller the amount of moisture in the air, the more oxygen there will be in a given volume. Slight as this difference may be, it has its effect, especially when a good wind is blowing. Furthermore, the lower the humidity, the faster is the heat generated by the fire enabled to drive off the remaining moisture in the fuels. More heat is thus available to be carried to adjoining fuels.

Wind is even more important than relative humidity, and its effects have been well worked out so that they can be stated in numbers. Given the fuel type, the length of time since a certain amount of rain, the condition of annual vegetation, the relative humidity, and the wind velocity at any certain time, it is possible to obtain a fair approximation of the rate at which fires will spread and the resistance they will exert to control. The device which is used to compound these factors to give a measure of the total fire danger, is called a fire-danger meter. Unfortunately, winds are often variable and extreme topography influences drafts so that such estimates can never be exact in a specific area when wind-velocity readings are taken some distance away. However, in general, such calculations can be highly useful in estimating the number of men and amount of equipment necessary to control the fires in a large area.

As a final figure, if the probable number of fires each day is multiplied by the rate at which they will spread, it is necessary only to divide by the rate at which one man can control fire to know the number of men necessary to have available. It is not quite so simple, of course, because of equipment and other factors, but in general that is the method. On that basis the fire-control army is expanded and on the same basis it is demobilized as the danger subsides.

THE "BLOCK DATA" FIRE PLAN

M. C. Howard

Forest Supervisor, George Washington National Forest, Region 8, United States Forest Service

Use is being made of a rectangular system of fire-control units in mountainous terrain on several eastern forests. The author from the forest adjoining the Monongahela, about which Hopkins writes in this issue of Fire Control Notes, deals with private cooperators in the "blocks." It is a system of dividing a forest—or any area—into rectangular blocks, each of which is considered as a unit for purposes of listing or tabulating the organization, tools, food, and other fire-control equipment available in that unit.

Fire plans take many forms and shapes, some suitable for field use and others of atlas or office size. The so-called *Block-data system* is not original with the George Washington, but it has been adapted with admirable results. It is a system of dividing a forest or any area into rectangular blocks, each of which is a unit for the purpose of listing the organization, tools, food, and other fire-control equipment available in that unit.

The block-data system provides a field record that can be aded to and revised currently, piecemeal, or periodically. It is a digest of the information a ranger, dispatcher, or detailed forest officer must have at his fingertips if he is too handle a fire situation with assurance and dispatch. Carried always by the ranger it becomes a directory of the district personnel and a check list of fire-preparedness jobs.

The following sample records indicate the data maintained for a given block which, on the George Washington, is 5 minutes of latitude and an equal distance in longitude, approximately 25 square miles. If need be, the block is further subdivided and each division is identified by a letter:

Detection

Block 0-14

A and B--Elliott Knob Tower, Staunton 186-F-13, or radio.

A----------For scouting and/or observation from home:

D. F. Shinaberry, Deerfield, Staunton 186-F-23. Has good view.

J. H. Rivercomb, Staunton 186-F-6. Fair view.

B----------J. L. Robertson, Fordwick, Craigsville 4932. Has fire finder.

See numerous stations listed in "Supplemental Telephone Directory." (By way of explanation, a card has been posted at many telephone stations along the main highways. Each telephone is assigned a number which is carried on the card and on the map. Where visibility is good and cooperation can be arranged a small fire finder is also erected.

Suppression

Area	Name	Telephone	Number of Men	Tools for—	Transportation	Food supplies
		FIRST LINE OF DEFENSE				
A	F. B. Rowe	Staunton 186-F-12	6	6	Sedan	Hoy's store.
	D. F. Shinaberry	Staunton 186-F-23	6	6	½-ton	Do.
	Edd Graham	Staunton 186-F-3	10	6	1½-ton	Hamilton's store.
	F. S. Crew	Call Tower	10	24	Fire truck	Do.
B	H. L. Lockridge	Through Elliott Knob.	6	6	½-ton	Craigsville grocery.
	E. N. Via	Messenger from W. L. Staples, Craigsville 3841.	6	6	½-ton	Do.
	A. D. Graham	Through Mill Mountain.	6	6	1½-ton	Do.
		SECOND LINE OF DEFENSE				
A and B.	CCC NF-25	Hot Springs 8-L-1	100	100	CCC	Army.
	Lehigh Portland Cement Co.				Craigsville Motor Co.	
	Mr. R. Forbes	Craigsville 3511	30	6		Craigsville grocery.
	Craigsville High School.	Craigsville 3216	20		C. Motor Co	Do.
	Mr. A. C. Small					
		THIRD LINE OF DEFENSE				
A and B.	CCC NF-2	Bwtr. 39-F-12	100	100	CCC	Army.
	Clear through ranger.	Bwtr. 100				
	Churchville High School.	Messenger through Staunton 61-F-11 or 20-W-1.	20		R. G. Stone, Staunton 34-F-10.	Monger's store.
	Mr. C. R. Hale	H. C. Stark, Staunton 34-F-22.				
	Goshen High School.	Messenger from Craigsville 3642.	20		C. C. Brown, Craigsville 4392.	Corner store.
	Mr. C. P. Short				R. Field, Craigsville 3643.	

Cover and Hazard Conditions

Area B has bad fire history. Numerous small brush burning and hunters' fires.

Areas predominanely hardwood and southern pine reproduction.

Remarks

Ration list posted in following stores:

Name	*Place*	*Telephone No.*
Hoy's Store	Deerfield	Staunton 186-F-5.
Hamilton's Store	Deerfield	Staunton 27-F-4.
Craigsville Grocery	Craigsville	Craigsville 2411.
Monger's Store	Churchville	Staunton 34-F-5.
Corner Store	Goshen	Craigsville 1642.
Staunton Wholesale Grocery.	Staunton	Staunton 407.
Mr. R. C. Payne		Staunton 1704 after hours.

FIRE AND INSECTS IN THE DOUGLAS-FIR REGION

R. L. Furniss

Bureau of Entomology and Plant Quarantine

It has been observed that burned areas in some forest types create favorable conditions for encouraging insect attacks to the point where more damage is caused by the insects than by the fire itself. The relationship between fire and insects in the Douglas-fir type is here vividly portrayed.

Many persons who have seen groups of fine Douglas-firs suddenly turn red and die as a result of insect attacks have pondered upon the cause and cure. Some, considering the understory trees and other vegetation that have developed since concerted efforts have been made to keep fire out of the woods, have concluded that in such cover is a likely place for pests of all kinds to thrive. It is evident to anyone who will observe that there are all kinds of leaping and crawling insects everywhere upon the forest floor. What then would be more logical than that this multitude of insects should periodically come forth and find the forest trees to their liking? If that is what takes place, the solution seems simple and direct. Burn the brush!

Before proceeding with this wholesale control project, it is well to stop and consider what may logically be expected from such a course. No doubt many insects of one kind or another would perish in the flames, but would they be the right ones? Only a very few of the thousands of different kinds of beetles, bugs, flies, and slugs found in our fields and forests ever do man any measurable harm. Still fewer kill forest trees. Of these, only one is of any considerable importance in killing Douglas-fir in western Oregon. It is a small, reddish-brown, hard-shelled beetle about 1/4 inch long. It is known as the Douglas-fir beetle (*Dendroctonus pseudotsugae* Hopk.). It is the insect to be destroyed, if possible.

The habits of the Douglas-fir beetle are well known as a result of detailed studies carried on over a number of years by the United States Department of Agriculture, Bureau of Entomology and Plant Quarantine. The studies reveal that the beetle spends practically all its life beneath the bark of the host tree. The life cycle requires one year. Each spring a new brood emerges from trees attacked the preceding spring. The beetles immediately fly to other trees and, working in pairs, begin a concentrated attack upon the chosen trees. Each pair bores through the bark to the surface of the wood, where a vertical egg gallery several inches long is constructed. Along the sides of the egg gallery the female deposits a number of eggs. The eggs soon hatch into small white grubs, or larvae, which bore out at right angles to the egg gallery, forming on the inner bark and on the wood surface a characteristic double fan-shaped design that can be seen by removing a section of bark from an infested tree. The larvae increase in size until they are about one-fourth inch long. The fully grown larvae construct small cells in the bark, in which they transform first into a transition or pupal stage and then into new adults. After spending the winter in the bark, the adults emerge to complete the life cycle. The attacked trees are killed by the girdling effect of the numerous egg galleries and larval mines.

The Douglas-fir beetle is a native insect associated with Douglas-fir throughout its natural range. There is every reason to believe that this beetle was killing trees long before the first logger laid ax to the tall timber in the Pacific Northwest. East of the Cascade-Sierra Nevada Range it is an aggressive tree killer. In the Douglas-fir region of western Oregon and Washington it normally attacks and breeds in injured, weakened, or fire-killed trees, although it also readily attacks trees felled in logging operations. At times, even in this region, it attacks and kills numerous healthy trees. Such killing can usually be traced to a build-up of beetle population in logging slash, in extensive windthrows, and in drought-weakened or fire-killed trees.

An outstanding example of the damage that the Douglas-fir beetle will occasionally cause as a result of fire is furnished by events following the great Tillamook fire of 1933. The countless dead and scorched trees resulting from that fire provided a vast rearing ground for the Douglas-fir beetle. These burned trees, being dead or nearly so, offered no resistance to the beetle attacks and yet provided a superabundance of nutritious food. Responding to these ideal conditions, the beetles multiplied prodigiously. Within a year after the first trees were attacked a vast population had developed. When these beetles emerged, the burned trees were no longer attractive to them. Consequently they attacked healthy green trees that normally would have resisted attack, and killed many large groups of trees near the burn. In the years 1935 and 1936 a total of approximately 200,000,000 board feet of green timber was killed in this manner. The epidemic soon subsided, however, because of the natural resistance of green trees to Douglas-fir beetle attack, but by then much damage had been done.

With the habits of the Douglas-fir beetle and the type of damage that it causes in mind, it is possible to evaluate the probable effects of burning the brush as a control measure on this, the most important insect enemy of Douglas-fir in western Oregon. First, it is evident that the time spent outside the host tree is so brief that timing the fire to catch the beetles on the wing or at rest in the woods would be a most difficult undertaking. Furthermore, not all the beetles emerge at one time, making it necessary to burn and reburn many times to kill them all. Destruction of the brush would not of itself be an effective control measure because the beetles are not attracted to and do not breed in reproduction or any species other than Douglas-fir.

In other words, the breeding-ground theory as applied to the undergrowth is a fallacy. In order to kill the beetles beneath the bark of standing infested trees it would be necessary to scorch them so heavily and so far into the tops that many of the unattacked green trees nearby would be killed by the fire. Aside from the loss of the trees, this would be very undesirable, for, as already pointed out, fire-killed and fire-scorched trees provide one of the best breeding grounds for the Douglas-fir beetle. From all this it is obvious that allowing fire to run through the woods, far from being an effective insect-control measure, would actually result in an increase in numbers of the primary culprit.

In conclusion, it can be stated that Douglas-fir in western Oregon is normally resistant to insect attacks. Occasionally as a result of unusual circumstances, an outbreak of the Douglas-fir beetle may develop and for a year or two cause extensive damage. The best way to prevent a large part of these outbreaks is to prevent the large forest fires that provide much of the breeding material necessary for the beetles to attain sufficient numbers to attack and kill green trees.

Slash Disposal and Forest Management After Clear Cutting in the Douglas-Fir Region.—A recent bulletin by Munger and Matthews reports upon studies of this important subject in a manner that should make this circular useful beyond the region treated. Particularly noteworthy are methods used in appraising hazard on burned and unburned cutover areas as the basis for comparison of conditions 1, 5, 10, 15, and more years after logging and the emphasis that is placed upon prompt reforestation as the most effective means of obtaining a normal hazard after timber harvest. It also discusses slash disposal laws and practices, effects of slash disposal, principles of slash burning, essential steps in protecting logged-off lands from fire, and incidental commercial uses of cut-over land. This publication can be obtained from the Superintendent of Documents, Washington, D. C., by asking for U. S. Department of Agriculture Circular 586; price 10 cents.—Pacific Northwest Forest and Range Experiment Station.

THE BEAR VALLEY HIGH-HAZARD PLAN

(Continued from p. 196)

a campfire foreman, who takes charge of handling company manpower and heavy equipment on fires. The Forest Service is supplying one patrolman equipped similarly to the Hines-financed patrols. Radio equipment for these patrols is of the SX, SV, and TH types with SX and SV radios mounted in the pick-up cabs for constant communication when necessary.

REDUCING MAN-CAUSED FIRES

(Continued from p. 197)

however, it seems to be one of the most beneficial. Although the 1940 fire season was the first in which such a guard was used, it is interesting to note that the number of man-caused fires was less than for any of the 9 preceding years. While one season's results do not give a reliable indication of progress it seems likely that use of a fire-prevention guard over a period of years will lower the average number of man-caused fires.

UNCONTROLLED BLUEBERRY BURNING IS UNJUSTIFIED

SCOTT PAULEY

Forest Ranger, Wisconsin Conservation Department

Adequate fire protection in an area must take into consideration the necessity of educating the local people in the proper use of fire in connection with berrying activities.

Since the time of the first white settlement in Wisconsin it has been the general assumption that fire is a necessary method of quick, cheap land clearing. In the early days there was little attempt at control of these land-clearing fires and they often spread for miles beyond the limits of the cleared area.

Gradually the attitude developed that such fires should be controlled, and with the establishment of the forest-protection districts it was necessary to obtain permits to burn within their boundaries. People were encouraged to burn during the periods of the year when the hazard was lowest and the danger of damage least—during the winter and early spring when brush is damp and peat soils wet or frozen. The increased effort at control has resulted in a reduction of 50 percent in the number of forest fires caused by land clearing in the last 12 years. Still it remains an unsolved problem, for more than 25 percent of Wisconsin's forest fires were caused by land clearing in 1939 and 28 percent in 1940. It must be conceded, for the present at least, that fire is still the chief method of land clearing in Wisconsin and, if practiced with common sense, its merits probably entitle its continued use in certain areas.

Along with the concept that fire is the cheapest and most effective land-clearing agent, has developed the idea that its use increases the yield of certain berry-producing plants and some wild forage crops. This assumption has developed to a point where fire is used, in some instances, primarily for this purpose and not incidentally for a land-clearing undertaking.

The Michigan Forest Fire Experiment Station, located at Roscommon, has experimented with controlled fire treatment of blueberry areas since 1930. Until 1936 the experiments were confined to relatively small areas, but in 1938 the project was extended to large areas in the Upper Peninsula.

No official report has been made as yet on any of the experiments but certain conclusions of practical interest in forest-fire control may be safely predicted at this time. Mr. Gilbert Stewart, director of the station at Roscommon, said in a letter to the author:

"Fire itself simply acts as a pruning agent, removing all woody growth and competing vegetation and puts each individual blueberry plant in the proper pruned condition to yield large quantities of fruit. Fruit usually is borne the second year following fire. It is imperative, however, that injury to plant roots be avoided. Many of the best blueberry areas are lowlands where the roots are contained in organic soil. If fires are permitted to run across such areas, and ground fires develop which consume the plant roots, large areas of blueberry land are ruined and may revert to sedges and grass and heavy growth of sprout aspen. Injury to root systems on high land is less likely, but must be avoided at all times. Even after an area is properly burned over and the effects from the standpoint of pruning are benficial, it does not follow that large quantities of fruit will be borne.

"Adverse weather conditions may completely offset the beneficial effects of controlled burning. Entire crops will be destroyed if frost occurs after the plants have blossomed. Too little mositure during the spring and summer will not permit full-bodied berries to develop, and dry-weather conditions during the season when berries are ripening cause the crop to dry up and fall. It follows then that, in addition to a beneficial burning program, weather conditions must be favorable to guarantee the crop. Fire itself cannot guarantee a crop but when properly done simply places plants in proper condition to bear heavily, provided these other factors are favorable."

It is thus apparent that controlled burning can be beneficial in the production of blueberries if the number of factors listed are sympathetic following the burning. This conclusion in itself is of some significance since it lends credence to the generally accepted theory that fire will increase the yield of blueberries. It does not, however, mean that burning, whether controlled or not, is the economical method of treating any area where blueberries grow. It is obvious that an area must be devoted to the growing of blueberries, to the exclusion of everything else, if fire is to be used to any advantage.

The fact that, aside from the beneficial pruning action, fire removes the competing vegetation means that the seedlings and saplings of the future forest or woodlot are removed and that eventually the area treated with fire will be completely denuded of all forest growth.

It should also not be overlooked that deleterious effects to the soil must naturally follow. The periodic removal of living and dead associates of the blueberry bushes in the form of smoke removes forever the source of organic material so essential to the maintenance of soil fertility. It might be assumed that eventually soil fertility on the area might be so reduced that blueberry production itself might suffer from lack of essential soil nutrients. If that point were reached, the blueberry bushes themselves might not survive, and the last living source of vegetative protection to the soil would be removed. In most areas, especially in hilly blueberry country, such treatment of the soil normally results in an erosion problem.

Perhaps the chief objection to the use of fire as a means of increasing blueberry production is that in most instances such fires are of incendiary origin and no effort whatever is made to control them. It would appear that if the beneficial effect of fire in the treatment of blueberry areas is to be realized it must be controlled with the greatest of caution and be limited to areas where blueberry production only has proved to be the most economical method of land use.

COOPERATIVE PROTECTION AREAS IN WISCONSIN

L. E. Brackett

Cooperative Forest Ranger, Wisconsin Conservation Department

While 13,000,000 acres of Wisconsin forests are protected by organized fire-control forces in 10 districts, many agricultural areas containing large acreages of forests are not so protected.

In a forest-protection district organization the detection and suppression of forest fires is the business of first importance to the forest rangers. In the cooperative areas the control of fires, as well as their prevention and detection, is the responsibility of the chairman of the town board. (See Sec. 26.13 (1) Wisconsin Statutes.) Generally this man is a farmer to whom personal farming duties and other interests are of primary importance. During days of fire hazard he is busy in his fields or perhaps with other duties of his town office. Prompt action, comparable to that in the forest-protection districts, cannot be expected under the present set-up. Good cooperation and action can be expected, however, as soon as the town chairman knows that a fire is burning in his town.

Section 26.13 (3) Wisconsin Statutes provides that the town chairmen post their towns against burning during hazardous periods. Many have been reluctant to do so until they actually have had a fire, and many have not been posting at all. In some cases, the feeling has been that the citizens of the town would oppose such action and would retaliate at the polls.

The forest-protection division, realizing the importance of prevention and diligence during a severe hazard such as existed in 1936, delegated cooperators to go into outside areas to remind the town chairmen of their responsibilities and to suggest that they post their towns. As a result of such personal contacts and the educational work of the rangers the attitude of the chairmen is changing and the feeling against posting is gradually being overcome.

Through a slight increase in the 1937–38 budget, it was possible for the conservation department to extend a form of cooperative protection to all or parts of 35 counties. The towns within these counties were grouped into four large areas outside the forest-protection districts, and a full-time forest ranger was assigned to each area. This program was started in the fall of 1937. The rangers are carrying on a program of fire prevention and education in the cooperative areas and are responsible to the supervisor of the forest-protection area designated. The men contact the town chairmen at least once a year and work with the local responsible officer in an advisory capacity in fire suppression and are helpful in all matters relating to the fire-control program. They also attend as many county board meetings as possible.

Reports received from the cooperative areas give the following information on fires that have occurred:

Year	Number of fires	Acres burned	Damage in dollars
1939	118	7,310	$15,867
1940	143	10,897	23,078

In many cases the forest ranger has had to sell the town fire wardens on the idea of forest protection. Through their efforts also the majority of towns within the cooperative areas have been encouraged to declare a closed season on burning before the fire hazard becomes acute. Many insurance companies, banks, and Government agencies that have taken over farms and have found out about the cooperative protection are now demanding that the town declare a closed season on burning during hazardous times. People living in the cooperative areas who wish to do some burning also are learning to get in touch with their town chairmen before setting fires.

The educational and prevention program was enchanced through the purchase, by the department, of four moving-picture projectors and a complement of visual education material. Movies have been shown to and educational talks given before 25,858 school children and 5,050 miscellaneous club members, and conservation films have been shown to 10,250 4–H Club members. Such contacts are destined to influence the coming generation.

Many of the counties in the cooperative areas have bought fire-fighting equipment. Some towns have bought pack cans. Some counties are considering building fire towers to tie in with the tower system in the forest-protection districts. This would be a great advantage to the towns as it would aid detection and speed up action. On the other hand, counties in which severe fire hazards will exist in a dry year do not appear much concerned about equipment. Undoubtedly, they will be should serious fires break out in these counties, as they have in the past, and the poor towns submit large suppression bills to the county boards for payment.

Forest-area supervisors apparently had much the same conditions to contend with in the early development of the forest-protection districts as are now being met in the cooperative protection areas. Town chairmen at that time were the town fire wardens. Burning had been done without restriction for many years. When one forest-area supervisor tried to convince the community that continuous burning of the land was injurious to agriculture, he was told by a farmer that lands in Iowa were selling for $200 per acre because they were burned every spring and if he burned his land the soil would be the same as that in Iowa. If the ranger discovered a fire, he would contact the town chairman, as is now done in the cooperative area, and ask him to have the fire suppressed. Invariably the reply was that it was not doing any harm. Later when the fire got away, the "organized" remark was that it was out of control and nothing could be done.

Protection in the cooperative areas is a big undertaking, and demands much work in public relations and education. So far only the surface has been scratched.

IS THE HUNTER A SPECIAL FIRE RISK?

J. E. Hanson

Forest Ranger, Wisconsin Conservation Department

Following several years' experience as a forest ranger, it has been my observation that whenever a fire hazard exists hunters are a special risk.

During the past several fall seasons hunters have been directly responsible for many fires, principally smoker fires and campfires. Probably 50 percent of the hunters smoke, and some of them are careless and throw burning cigarette and cigar butts, pipe heels, or matches into forest fuels. It is usually cold during hunting seasons, especially in the early morning and the late afternoon, and hunters often build campfires to keep warm. Some hunters are careless and build their fires in dry, dense growths of vegetation and other hazardous materials; others leave camp without extinguishing their fires. Such practices cause forest fires, and oftentimes in inaccessible areas, because hunters roam far from roads and places of habitation.

A few years ago, while on patrol duty in a hazardous section during duck season, I saw a hunter leave a blind near a small lake, pick up his decoys, and start for home. In checking over the recently occupied blind I found a lighted cigar burning in dry grass. After extinguishing the burning material and returning to my office I looked up the automobile license number, located the owner, and discussed with him the possible results of his carelessness.

During the 1939 deer season the forest-fire hazard was high, but conditions would not have been serious had not the presence of hunters in the woods raised the fire risk. It was necessary for the protection organization to be ready to answer fire calls at all times, and fighting fires in the forest was dangerous because of the high-caliber rifles used by the hunters.

Each spring and fall, when the fire hazard is usually high, sportsmen hold field trials for hunting dogs at the bird sanctuary grounds near Solon Springs in the heart of the sand belt and jack pine area of Douglas County. Most of the sportsmen are from other States and therefore may not be as forest-fire conscious as people who live in Wisconsin. Several small patrol crews, equipped with fire-fighting tools, follow the crowds during the field trials. All persons are warned of the fire danger and all smokers cautioned to be careful with smoking materials. They are also instructed to suppress any fire which may start. Undoubtedly these precautionary measures have prevented the starting of many fires.

Hunters are not responsible, of course, for all forest fires caused by carelessly discarded "smokes" or neglected campfires, but all hunters should be careful with fire.

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