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FIRE CONTROL NOTES

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FIRE CONTROL NOTES

A quarterly periodical devoted to forest fire control

CONTENTS

COVER — This Mars flying boat converted to an air tanker is dropping a 4,500-gallon load on a slash fire in British Columbia. (See story on page 3.)

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

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MARS — NOW GOD OF RAIN

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In these days of rocket ships and the superjet it is hard to get excited about an aircraft that has been obsolete for 9 years. But these planes are truly extraordinary. They are the five Martin Mars flying boats, the largest operational flying boats the world has ever seen or probably will ever see. From 1946 to 1956, when the last one was retired, they carried a quarter of a million passengers and countless tons of freight over the Pacific for the U.S. Navy.

Fortunately the Mars story does not end on a scrap heap. It is still being written in the skies over coastal British Columbia where two of the three remaining big transports have been converted to "water bombers" to control forest fires. (One ship was lost by the Navy in a fuel-leak fire in 1950, and one was destroyed in a 1961 crash.

While the four giant boats rested on the beach of the Alameda (Calif.) Naval Air Base awaiting possible destruction from 1957 through 1959, things were getting hotter and hotter for the forest industry of British Columbia. The two bad fire years of 1956 and 1958 convinced fire protection people that better forest fire control methods had to be found, and fast. The water bomber was one technique seriously considered.

Water bombing was not new — a variety of tests between 1930 and 1950 had stirred interest in this novel use of aircraft. Here was the potential for a first-order fireline tool if only a practical carrier could be found. Early experiments were mostly with a water-filled missile dropped from the plane. On very small fires the missile was at times effective, but it was expensive and also a hazard to ground crews.

By 1958 the air tanker was accepted as a part of the fireline team. In British Columbia, five Avengers were in water bomber service, and several Beaver and Otter float planes were equipped with small float tanks.

The small tankers did wonderful work on many small fires, but they didn't carry enough water to be effective on big fires. The ideal air tanker would have to carry a large water payload, preferably several thousand gallons.

Coastal British Columbia is tough flying country, with its steep, high mountains, narrow valleys, and rough air. Traditionally, it is float-plane territory. This rugged coast has few large airfields, but it does have countless sheltered inlets and numerous large lakes. So the choice of aircraft for the ideal tanker soon narrowed down to some type of flying boat. A search for such a flying boat throughout most of 1959 ended at Alameda, where the U.S. Navy was offering the four Mars aircraft for sale as surplus.

Late in 1959 five leading forest industry firms in British Columbia formed a new company, Forest Industries Flying Tankers Ltd.[1] Its purpose was to purchase, convert, and operate the Mars aircraft as water bombers for the member companies. The four aircraft, together with a treasury of spare parts, were purchased and ferried up to Victoria International Airport on Vancouver Island. Here Fairey Aviation of Canada Ltd., with a nucleus of the new tanker crew, started work on a new dimension of water bombers.

The Mars tankers were allocated their own VHF radio frequency, and member companies equipped their logging operations with portable sets for ground-to-air communication. In addition, the Mars tankers carry the radio frequency for the B.C. Forest Service and those of several local airlines. To round out the establishment, an operational base, complete with communications centre, fueling facilities, and crew living quarters, was built at Sproat Lake on central Vancouver Island.

1960

Early in 1960 the first of the converted new tankers was airbound on a series of stiff shakedown tests. By early summer, the tanker moved up to its operational base, ready for business.

The first fire call came on July 4th. Enroute, engine failure forced her to return to base. Four days later, she made four drops on a second fire. Again engine failure forced an early return to base. The trouble was traced to excessive vibration caused by faulty propeller blading.

During the rest of the summer, the Mars made 26 drops on 6 fires, delivering a total of 127,000 gallons of water. These first-year results were inconclusive. The Mars had not controlled any fires singlehandedly. The general opinion was, however, that the results justified continuing the operation with one aircraft.

[1] The companies were MacMillan & Bloedel Ltd., Powell River Company Ltd., British Columbia Forest Products Ltd., Western Forest Industries Ltd., and Tahsis Company Ltd. In 1961 the new company of MacMillan, Bloedel and Powell River Limited was formed. In 1964 Pacific Logging Limited joined the Flying Tanker Group when a reserve aircraft became operative.

1961

The 1961 fire season started with promise: the tanker did good work on two fires, but that was all — the third fire was its last. Disaster struck. On her first run, the Mars crashed in heavy timber close to the target area, carrying her four crewmen to their deaths.

Since the exhaustive inquiry into the crash by the Department of Transport found nothing to indicate malfunction or structural failure of the aircraft, the cooperating timber companies decided to put another ship into service. The second tanker, overhauled down to the last hull rivet, was ready for fireline duty early in 1962.

1962

When this second tanker moved up to Sproat Lake early in 1962, she was accompanied by a Cessna 195 float plane. This was to be the "bird-dog" plane. Experience had indicated the need for such an aircraft; subsequent fires have proven its worth. First over the fire, the bird dog establishes ground-to-air radio contact, identifies the fireline target, and then leads the Mars in on the best drop path. The bird dog has proven indispensable. In addition to its main job of making the tanker operation safer and more accurate, it acts as handy man around the fire — warning of spot fires or flying the Fire Boss over trouble areas.

In its first year of operation the new tanker saw relatively little action. The 1962 fire season was ideal from the loggers' point of view, with little real hazard. In all, 118,000 gallons of water were dumped on five fires. On the biggest of these fires the true potential of the tanker was recognized. Called in late in the evening, the tanker could only drop two loads before being grounded by dark. Early next morning four loads were dropped along the leading edge of the fire. Unfortunately, a jammed release door forced the aircraft to return to base before the whole front could be wet down. Ground crews were unanimous in their belief that a few more loads would have pinched off the fire and prevented the subsequent spread that required several days to control.

The end of another fire season arrived, and the tanker operation was still under critical scrutiny. The plane had done a creditable job on the few fires it had fought, but mechanical defects had put it out of action more than once. In defense of the Mars it was argued that any single tanker operation is vulnerable to breakdown. Lost time from even a minor breakage requiring base repair is vital on the fireline. The case for a reserve flying tanker was slowly developing.

1963

The year 1963 was by far the best the Mars tanker organization had experienced. Fires were not numerous because the fire season was not particularly hazardous. But, when the tanker was called out, its performance won it full recognition as a member of the fireline team. For the first time the Mars completely extinguished a fire without ground crew support. On a fast-moving lightning fire, it wet down bulldozed fireguards so that firefighters could work in close to the fire front. In two instances the Mars soaked down fire-threatened timber edges to prevent crown fires from starting.

September of that year started out dull and cool. On southern Vancouver Island several operators started to burn slash when rain was forecast. The rain did not fall; instead the weather turned dry. The slash fires, fanned by brisk winds, were soon out of control. The Mars saw more action in 3 days than in any of the preceding 3 years. In 32 runs the tanker dropped 177,000 gallons of water over a wide fire front. Until the sea became too rough, salt water pickups were made offshore from the fire; roundtrips were made in 10 minutes.

By yearend 1963 a record 495,000 gallons had been dropped on nine operational fires. Forest Industries Flying Tankers now was confident the Mars could make a major contribution to fire control. Plans were made to bring a reserve ship into service the following year.

1964

From the point of view of the crews, anxious for action, the summer that followed in 1964 could not have been worse, although it was a blessing for the forests. The crew waited for four miserably wet summer months before they went into action. At year's end they had only bombed two fires! Base activities, however, were far from quiet. The new flying tanker LYL was nearing completion; at the same time major improvements were being built into LYK.

The story of the Mars flying tankers could not be complete without some reference to the men who fly and maintain them, for they are a rather special breed of airmen. A crew of only four men fly the ship on operational tours. Hours of practice have honed the crews into fine precision teams.

A captain, or first pilot, is responsible for the success of the mission and the safety of his aircraft. It is he who must decide whether it is safe to fly in over the fire area, considering terrain, smoke, and air turbulence. Pilots as a basic minimum must have long experience in water operations and mountain flying. Over and above an intimate knowledge of their territory, they must be at ease in smoke-filled valleys bounded by rocky hills. It is one thing to fly over this country at a comfortable altitude, but it is quite another to whistle down barely 250 feet over the treetops through bumpy air. Flying in to pick up a water load the captain takes complete control. He eases the aircraft down until it is planing through the water at precisely 70 knots. When the aircraft is planing smoothly he lowers the probes to start the water pickup (fig. 1).

The second pilot meanwhile is busy with the flaps and trim controls in preparation for takeoff. The moment loading starts the first engineer takes over control of power. In those critical 20 seconds needed to take on a full load he must maintain aircraft speed at 70 knots, then boost power for takeoff.

While flying to the fire, the second pilot listens to radio instructions from the bird dog pilot, who has already identified the first target and by now has lined up the best approach. The captain will make the water drop, but before he starts his bombing run he will probably fly over the fire to confirm the bird dog instructions. Once committed to his run, the captain concentrates entirely on the approach course and altitude. The second pilot takes over the throttles to maintain airspeed at 120 knots. Once past the target he applies climbing power to ensure a safe exit from the fire area.

Engineers double as flight and maintenance crews. Their long suit must be ingenuity in handling emergency repairs in a hurry.

The other member of the crew on the flight deck is the second engineer. When he is not busy watching the maze of instruments on the console to ensure that all systems are running green, he is making frequent inspections of the water tanks and various auxiliary power units.

Back at base the radioman takes over dispatcher duties. He must alert the base crew to any repairs or supplies the aircraft will need on return to base.

In slow years, when fire calls are few and far between, the crew keeps a tight routine of maintenance, training, and base improvement. Within the organization the two operational ships are known by their radio call letters, LYK and LYL.

Water drop studies showed a thousand gallons of water would trail off away from the main target whenever LYK released her load. To reduce this loss, sloping bottoms were fitted into the plywood tanks. The payload was reduced to 4,500 gallons, but the drop pattern was greatly improved. At 120 knots the tanker

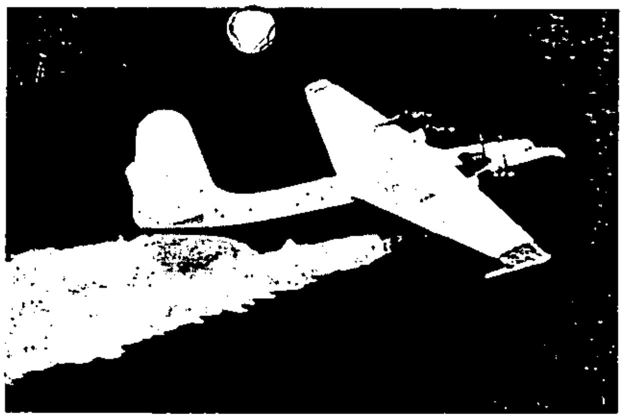

Figure 1.—This Mars flying boat picks up 4,500 gallons of water in 20 seconds while planing at 70 knots.

now can uniformly drench a target area 800 feet long by 250 feet wide. With the reduced water load, extra fuel can be carried to extend operating time.

Perhaps the most interesting modification was the addition of blending equipment. This powdered water-gelling compound effectively concentrates the water load. Drops from an elevation of 500 feet cover the same target pattern as untreated water dropped from 250 feet. This extends the tankers' reach into many a rough corner previously unsafe to approach. The powder is injected into the probes by compressed air as the tanker loads water. Enough powder is carried on board to charge 10 to 12 full loads at a rate of 1 to 1½ pounds per 100 gallons of water.

Unfortunately, these operations are restricted to fresh water, since the compound is incompatible with salt water. Test drops from 250 feet above dense timber plastered the forest floor, windfalls, and vegetation with a quarter of an inch coating of gel over an area 500 feet long and 200 feet wide.

Although now 18 years old, the two operational Mars ships are like new in their smart red and white paint, a vivid contrast to the olive drab of the last reserve ship still parked at the Victoria Airport. The hard-earned tradition of service established in their Pacific transport days is still going strong. In 5 years of flying tanker service, the Mars have dropped 903,000 gallons of water on forest fires. In addition, about 2 million gallons have been released in demonstration and training flights.

When the next bad fire season occurs, the Flying Tankers and their fine crews will be ready. For the harried Fire Boss there is nothing more welcome than his radio calling "This is Bird Dog — how do you read me?" He knows that the tankers will arrive in minutes and that his prayer for rain will be answered.

LOOKOUT TOWER SAFETY IMPROVED

A. B. CURTIS, *Chief Fire Warden,*
Clearwater and Potlatch Timber Protective Associations,
Orofino, Idaho

Because more visitors climb lookout towers on the Clearwater and Potlatch Timber Protective Associations' areas each year, improved safety is needed.

Bertha Hill Lookout, on the Clearwater Timber Protective Association area, is one of the oldest (1902) lookout sites in the United States. Many thousands of acres of valuable forest land, publicly and privately owned, can be seen from the lookout. The fifth lookout tower at this location is shown in figure 1.

In 1965 the directors of the Clearwater Timber Protective Association decided that the increasing number of officials and visitors climbing the tower needed more protection. Therefore, a safety net (fig. 2) was installed.

A woven chain link fence material welded to 1-inch iron pipe framework was used. It is similar to the wire mesh behind home plate on a baseball field or the wire netting around a golf course.

The galvanized wire netting was cut in sections, 5 by 20 feet, and four sections, one for each side of the tower, were framed. The 5- by 20-foot wire nets are anchored to the steel walk around sills with hinges at walk level so that the net can be raised or lowered during the winter to prevent snow buildup and the accompanying added weight. Built-in corner sections were also made to protect the four corners. The framework is strong enough to hold several hundred pounds, and the iron piping is adequately braced at about 7-foot intervals to provide a little more rigidity. The wire is number 11 gage, galvanized.

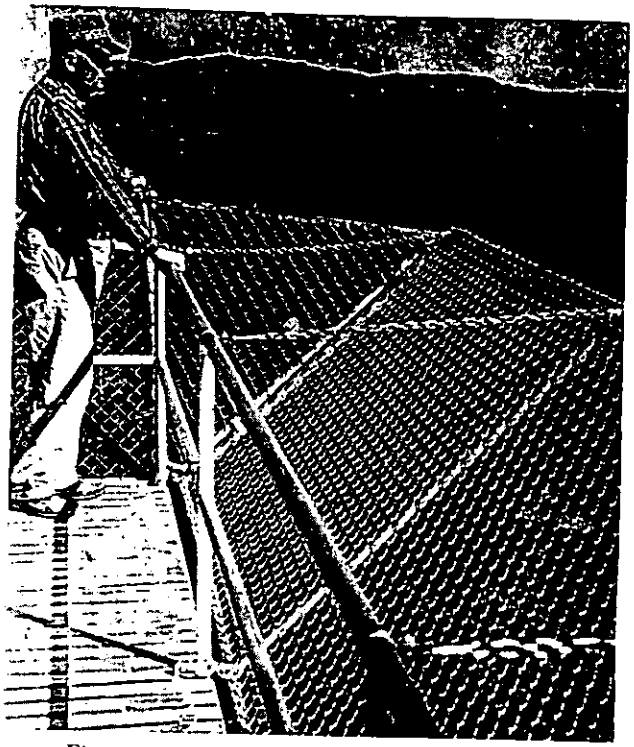

Figure 2.—Safety net on Bertha Hill tower.

Figure 1.—Bertha Hill lookout tower.

A 100-foot roll of wire fencing costs $40; piping and chains cost 21 and 16 cents per foot, respectively. The total cost of the material was about $88. In addition, laborers were paid $200 to fabricate the material, install it, paint, etc.

The safety net does not seriously impair the lookout man's vision. When smoke is spotted, the mapboard can be moved for satisfactory azimuth readings.

THE HARROGATE FIRE — 15th MARCH 1964

B. J. GRAHAM, *Bushfire Protection Adviser*

Note: This article is adapted from the South Australian Emergency Fire Services Manual, 1964.

General: The fire started at about 2.30 p.m. in Section 1938, Hundred Kanmantoo, on Mr. Brice's property (fig. 1). The fire travelled mostly east through valuable grazing land and burnt approximately 1,600 acres.

The exact cause of the fire is not known, but after investigations it is thought to have started from a spark from the exhaust of a chain saw.

Fuel type: Most of the area consisted largely of annual grassland; there was a scattering of Eucalypt trees.

Preceding seasonal conditions: The winter and spring preceding the current summer were very *wet*, and the current summer was mild. Therefore, pasture fuels in this area were abundant and completely cured.

Weather of the day: The temperature reached 92° in the afternoon of 15th March, 1964, with a light wind blowing west to northwest. The winds were consistent; the approximate mean velocity was 10 m.p.h.

Fire behaviour: Commencing at Sect. 1938, Hd. Kanmantoo, the fire swept generally east at 2½ m.p.h.

The rate of spread of the head fire was affected by such topographical features as creeks and ridges. These features and the country's rocky nature restricted access. Where possible, the flanks were worked by fire crews, and the head fire was confined largely to a front of 90 chains.

By 3:05 p.m. the fire had spread for approximately 70 chains east.

By 3:12 p.m. it had spread for another 60 chains, but the flanks were being controlled and the head fire continued east.

At 3:20 p.m. a pincer movement by units working on both flanks was becoming effective, and the head fire, still moving east, was narrowed to a 70-chain front. The fire had then travelled approximately 2 miles. At about this time the Brukunga Unit was destroyed, and one man (the driver) was badly burned. The farm buildings at White Hut, which were in the fire's path, were saved.

At 3:30 p.m. the head fire hit the Nairne-Harrogate road. It jumped over, but it was controlled after burning 50 acres. The rest of the front was controlled along

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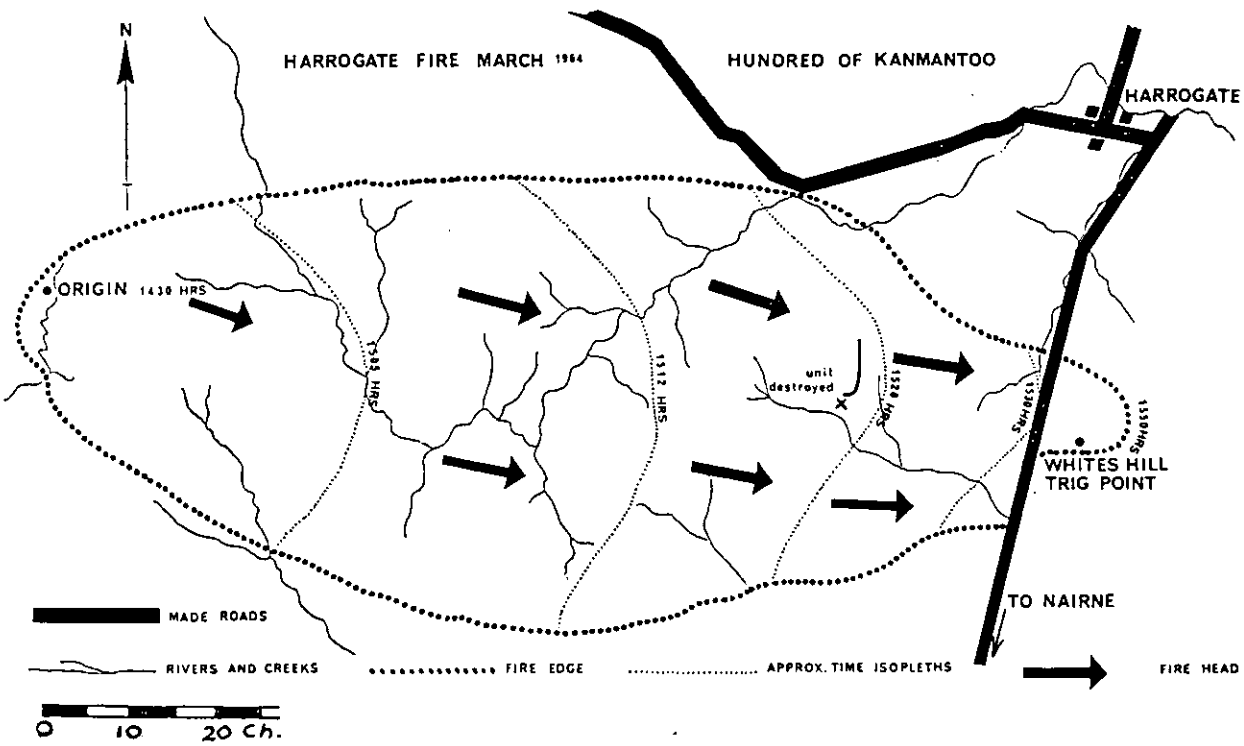

Figure 1.—Progress map of Harrogate Fire.

THE FIRE-BEHAVIOR TEAM IN ACTION—THE COYOTE FIRE, 1964

JOHN D. DELL, *Fire Research Technician*
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Experiment Station
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On a large wildfire, the fire boss bases much of his strategy on information provided by his staff and other assistants. In 1964, fire-behavior teams furnished advice at several forest fires in southern California. Each team, directed by a fire-behavior officer, gathered and analyzed vital information on weather, fuels, and topography. The team concept, originally described by Countryman and Chandler,[1] proved an effective method for evaluating the behavior of fast-moving fires. This note briefly describes how a fire-behavior team operated on the 67,000-acre Coyote Fire that burned on the Los Padres National Forest in September 1964.

ROLE OF THE FIRE-BEHAVIOR TEAM

Team observations and the fire-behavior officer's interpretation combined with reports of scouts and line overhead were extensively used in fire control planning.

An important function of the fire-behavior team is fire-weather observation. By working closely with the U.S. Weather Bureau's fire-weather forecaster, the team saves much time and avoids duplication of effort. Information provided by the fire-weather forecaster includes maps of the latest synoptic weather transmitted by radio by facsimile recorder (FAX) from the U.S. Weather Bureau.

Team members may also make upper air soundings of humidity and temperature or measure the winds aloft (fig. 1).

Figure 1.—Fire-behavior team takes a pibal (pilot balloon observation) with theodolite to determine patterns of local winds aloft.

THE COYOTE FIRE

At 11 p.m., on September 22, 1964, a fire-behavior team was dispatched from the Riverside Forest Fire Laboratory to the Coyote Fire at the request of the Los Padres National Forest. Santa Ana winds, surfacing at night, had swept an almost-controlled brush fire across firelines into heavily populated residential areas. By early morning, the fire, then out of control, had burned more than 600 acres. One of the most devastating conflagrations in recent local history was imminent. However, during the day shift the fire ceased to threaten the residential areas as the Santa Ana winds returned aloft. The sea breeze and upslope wind caused the fire to spread into the mountains (fig. 2).

At the Coyote Fire camp, the fire-behavior officer was briefed by the Weather Bureau's fire-weather forecaster on existing and anticipated weather. The fire-behavior officer made a behavior forecast ready for the Plans Chief before each shift so fireline overhead could be thoroughly briefed. Also, any sudden deviations were explained immediately to the Fire Boss, and a revised forecast was made.

Team members, meanwhile, began taking pilot balloon observations (pibals) of winds aloft, making ground observations, studying preattack maps, and talking with fireline overhead in order to better understand fire conditions. Equipped with its own transportation, radio net, and instruments, the team was able to disperse to various locations on the fire. A communications net linked the team with the fire-behavior officer, and pertinent information was sent regularly. Ground observations were made of temperature, humidity, windspeed, and wind direction; type, density, and condition of fuels in the path of the fire; topography and aspect; current fire behavior; and trouble areas. The fire-behavior team made a thorough surveillance of the area above and to the flanks of the

[1] Countryman, Clive M., and Chandler, Craig C. The fire behavior team approach in fire control. Fire Control Notes 24(3): 56-60. 1963.

Figure 2.—The huge Coyote Fire near Santa Barbara, Calif., (Sept. 22-Oct. 1, 1964) required the use of three fire-behavior teams. The fire burned more than 67,000 acres of brush-covered watershed.

main front. It noted that strong northeasterly winds were still aloft, although the layer had been rising since morning. The odds were against these winds surfacing as they had the night before, but the forecast indicated this might happen.

Early on the evening of the 23d, a team member was sent to the ridgetop above the fire to observe its behavior and to look for any signs of unusual changes. At 7 p.m., he noted that the humidity had dropped to 14 percent. Light and variable winds gradually developed into a strong northeasterly blast that gusted up to 35 m.p.h. The fire began to intensify on the upper slopes. These factors indicated the fire would probably resume the same pattern as on the previous night — but on a wider front. The fire-behavior team immediately reported these observations to the fire-behavior officer at fire camp. He, in turn, notified the Fire Boss so crews on the line could be warned. By 7:40 p.m., these winds were felt in Santa Barbara.

These winds continued most of the night. At 2 a.m. (September 24), temperatures as high as 92° F. and humidities as low as 10 percent were reported at the Weather Bureau's fire weather mobile unit at the fire camp. Fire again swept through residential areas in the foothills.

By morning the fire had burned along the entire Santa Barbara front, over the ridge, and down into the Santa Ynez River drainage. Personnel were added to the fire-behavior team to increase coverage of the growing conflagration. The fire-behavior officer and part of the team were requested to observe and advise on a critical backfiring operation on the west side of the fire. Another team member made an upper air sounding by helicopter, in order to determine moisture in the lower atmosphere and atmospheric stability over the fire.

In the fire-behavior forecast for the 24th, prepared early that morning, it was predicted that strong Santa Ana conditions would continue at high levels, but would weaken at low levels during the day. It was reported that fuels were very dry and hot runs could be expected where favored by wind or topography. Atmospheric instability would favor the development of large convection columns, spotting, and firewhirls. Santa Ana winds were again likely to surface.

During the next few shifts the Coyote Fire nearly doubled in size. More than 3,000 firefighters from all parts of the Western United States joined in the battle. Zone fire camps were set up at several points around the fire in order to place the manpower where it could be shifted most efficiently. This, of course, created a difficult communications problem for the fire-behavior team. Sending fire-behavior forecasts to all these zone camps over already overloaded communications systems was difficult, yet very essential. Every effort was made to bridge the communications gap and to relay forecasts to all camps, since many of the line personnel from distant forests were unfamiliar with some of the conditions that affect the behavior of southern California fires.

Another fire-behavior team flew from the Northern Forest Fire Laboratory at Missoula. Two more radio-equipped vehicles and extra backpack radios were brought in from Riverside. The fire-behavior officer reorganized and divided his enlarged team and located the shifts at four points around the fire (fig. 3).

Potrero Seco Camp. — The fire-behavior officer and fire-weather forecaster were headquartered here with the mobile weather unit. Team 1 was assigned to take pibals and upper air soundings, and to make ground observations and reconnaissance ahead of fire.

Los Prietos Camp. — Team 2 was assigned ground observations and reconnaissance on the west and northwest sides of fire.

Pendola Camp. — Team 3 was assigned ground observations, pibals, and reconnaissance in the upper drainage area of the Santa Ynez River.

Polo Camp. — One meteorologist was stationed here to take helicopter upper air soundings, ground observations, and reconnaissance on the south side.

Relay. — Here a pickup truck equipped with radio

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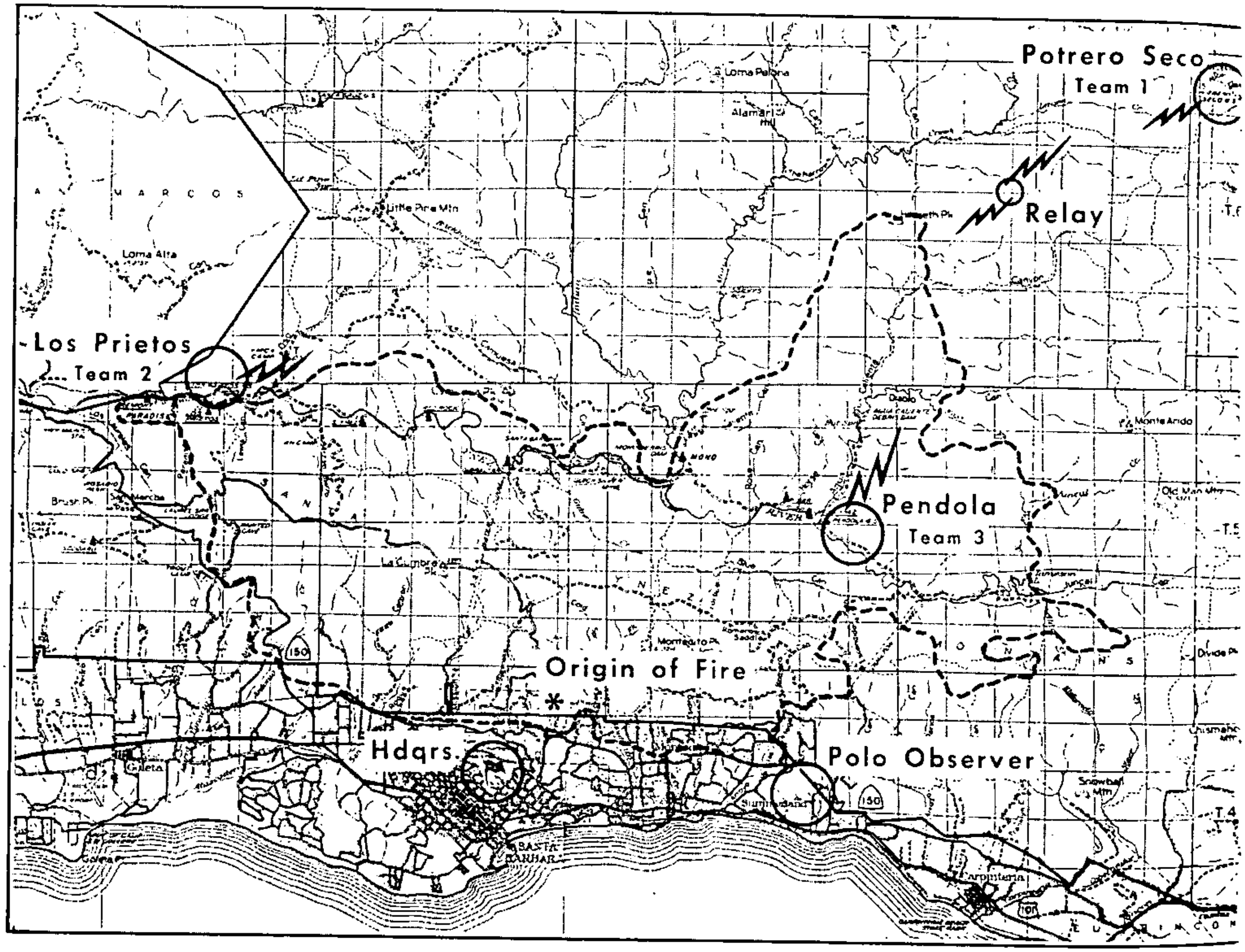

Figure 3.—As the fire spread north, the fire-behavior officer divided and relocated his team for better coverage.

IMPROVED SYSTEM FOR USING FIRE-WEATHER FORECASTS

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Portland, Oreg.

Introduction

Recently, a fire control agency determined that fire-weather forecasts to protect wild lands from lightning fires were not used often enough. This agency had used presuppression protection against possible lightning fires only when the fire-weather forecast called for thunderstorms.

The fire control personnel were insufficiently informed concerning the probability of fire occurrence. When a fire-weather meteorologist was consulted, he said that, to satisfy the public, forecasts had once contained predictions that an event would or would not occur. However, he indicated that much more weather information could now be furnished to fire control officials if forecasts could contain events that had only a certain probability of occurring. He indicated that, for three reasons, uncertainty always exists regardless of how weather forecasts are stated. First, only rather crude measurements can be made of the atmosphere; second, the prediction problem exceeds our ability for exact solution; third, there are unknown and changeable influences on the atmosphere from outer space. The meteorologist was convincing: the fire control agency decided that resources would be more efficiently conserved through systematic use of probability forecasts.

The fire control agency, the meteorologist, and the incident above are fictitious. However, they illustrate a point. The information that follows describes how probability forecasts can be used in fire control. We will specifically refer to thunderstorm forecasts and their use, but probability forecasts can also be used for other weather elements.

Definition of Probability

The most useful measure of the meteorological certainty of any weather event is a statement of mathematical expectancy or probability. We will define probability of thunderstorms, or of any other weather event, as being equivalent to the percentage of frequency of occurrence. For example, if 1,000 forecasts calling for 70-percent probability of thunderstorms have been issued, there should also have been about 700 days with thunderstorms.

Making the Best Decision

Protective measures against expected lightning fires should be taken when the predicted probability of thunderstorms exceeds the ratio of cost to loss. That is, the probability of occurrence of adverse weather should be compared with the ratio of the cost of protective measures to the loss resulting if no protective measures were taken and adverse weather occurred. No proof is given here, but a general derivation has been developed.[1]

The above may be expressed as follows: For the greatest economic benefit,

when $P > C/L$, agency should use extra protection,

$P = C/L$, agency may either protect or not protect,

$P < C/L$, agency should not add extra protection;

where P is the probability of occurrence,

C is the cost of extra presuppression protection, and

L is the loss that would occur if no extra protection were added and the adverse weather occurred.

Illustrating Use of Probability Forecasts

Use of probability forecasts is illustrated in the following example:

A Forest Supervisor decided to obtain the greatest economic utility from probability forecasts of thunderstorms, which were being routinely issued by the fire-weather forecaster.

His first problem was to determine the cost of extra presuppression manning and action for anticipated lightning fires. He found that costs of extra protection varied according to the general level of burning conditions. Average costs per day for extra presuppression manning for expected thunderstorms under given burning conditions were as follows:

Low	Moderate	High	Very High	Extreme
$25	$60	$100	$200	$400

Second, it was necessary to determine the average loss that would occur if no extra protection were provided. This required consideration of three factors:

1. Suppression costs that would have resulted either with or without extra presuppression.

(Continued on page 15)

[1] Thompson, J. C., and Brier, G. W. The economic utility of weather forecasts. Monthly Weather Rev., v. 83, No. 11, November 1955.

AIR TANKER RETARDANT DROP WARNING DEVICE

I. T. Kittell, *Dispatcher*
Shasta-Trinity National Forest

Firefighters have been injured severely and even killed by the impact of retardants dropped from low-flying air tankers. To warn ground firefighters of the approach of an air tanker on the final drop run, Joe Noble, safety officer of the Shasta-Trinity National Forest, suggested that an electronic siren be installed in the lead plane directing the air operation or in the air tanker. Because air tankers often operate on initial attack without lead planes, it was decided to install the siren in an air tanker.

The electronic unit provides three functions:

1. The traditional siren sound, a rising and falling wailing sound.
2. A sharp, short series of tones best described as "yelp."
3. A public address system.

After considerable research concerning available equipment, the Region 5 electronics engineer decided that a 24-volt model of a regular transistorized electronic siren/PA system as used for ground fire vehicles would be suitable for an experiment.

Aero Union, an air tanker contractor for both the California Division of Forestry and the U.S. Forest Service at the Redding, Calif., base, allowed installation of this warning system on one of their B-17 air tankers in September 1964. It was mounted on a flat metal plate in the nose of the B-17, aimed forward and down at about a 45° angle from the longitudinal axis of the fuselage (figs. 1, 2).

On aircraft other than B-17's, an adapter may have to be built to allow the forward and downward positioning of the speaker. The system control head is mounted in the cockpit to provide easy access for the pilot or copilot.

The warning system was first used on the Bear Gulch Fire (in rough country) on the Shasta-Trinity National Forest on October 15, 1964. Both the siren and yelp were clearly audible above both aircraft and fire noise. They were audible more than a mile from the fire, depending on elevation of the air tanker, position of the ground firefighters, etc. All on the fire agreed that the device gave ample warning to take cover before the retardant impacted.

The warning system was later tried on several fires on California Division of Forestry and other protection areas. Audibility of the signals was consistently good to excellent. The public address function was not tried while the aircraft was in flight, but it was successful in taxiing and in retardant-loading operations. The PA function, if proven successful in test flights, will be useful in warning firefighters of spot fires or other hazards.

Editor's Note: An air tanker warning device is being developed and tested by the Missoula Equipment Development Center. Permanent installation of such a device is not recommended for U. S. Forest Service use until development and tests are completed and a Forest Service standard is adopted.

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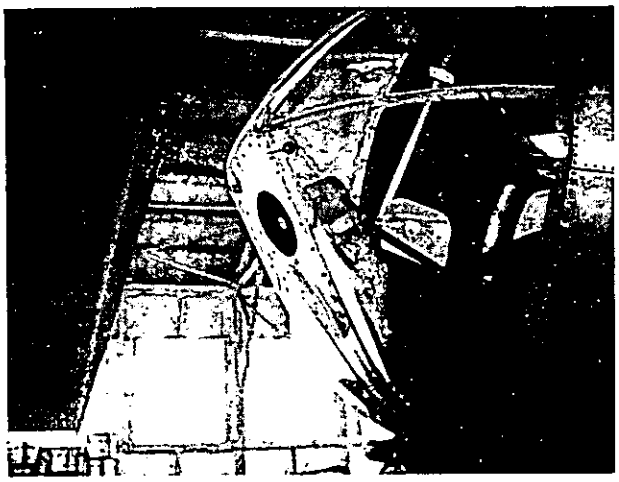

Figure 1.—Exterior view of speaker mounting plate in nose of B-17 air tanker. (Courtesy of Aero Union, Chico, Calif.)

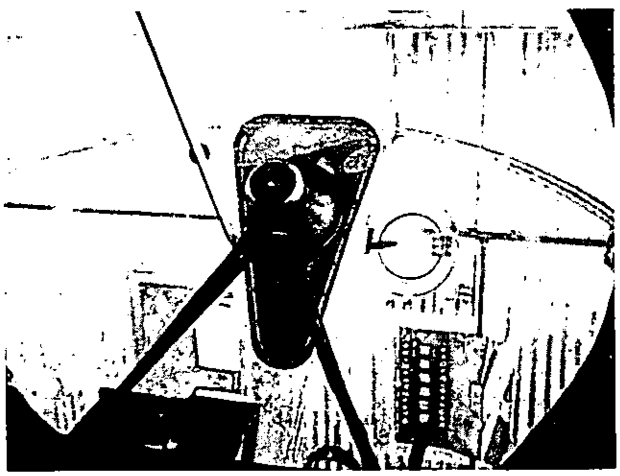

Figure 2.—Interior view of speaker mounting in nose of B-17 air tanker. Interior bracing is shown. (Courtesy of Aero Union, Chico, Calif.)

SMOKEJUMPER AND ADVANCED FIRE CONTROL TRAINING IN THE CALIFORNIA REGION

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Most smokejumper candidates selected from 1957 to 1961 in the California Region were college students. Few were foresters or interested in a forestry career. They jumped a few seasons, then took jobs in their chosen fields. By the end of the 1961 fire season it was obvious that much training and experience was being lost by the rapid turnover in jumpers.

A new approach to recruiting and training smokejumpers has been tried for three consecutive seasons since 1961 with outstanding results. The objective of the new program is to train career fire people in smokejumping and in other fire control skills, thereby increasing their adaptability and broadening their background.

At present men with at least two seasons of fire experience are selected from the Forests. The Forest recommends the man and must be willing to release him for one season for smokejumping and other intensive fire control training. Most of the men selected are already qualified as tank truck operators, crew bosses, or sector bosses.

The training program lasts for 8 weeks. A typical schedule starts with a 5-day field trip. The trainees carry an 80-lb. pack that includes rations, sleeping bags, tools, water, and personal items. They hike 20 miles cross country and have a different camp each night. During the week many subjects are taught that are of importance to the trainees. The week ends with a 6-hour small fire exercise. Two-man crews are required to find a simulated fire in an isolated location, fall a snag, complete a fireline, and then hike to waiting trucks. The exercise requires the use of map, compass, and pacing to find the fire and return to the truck.

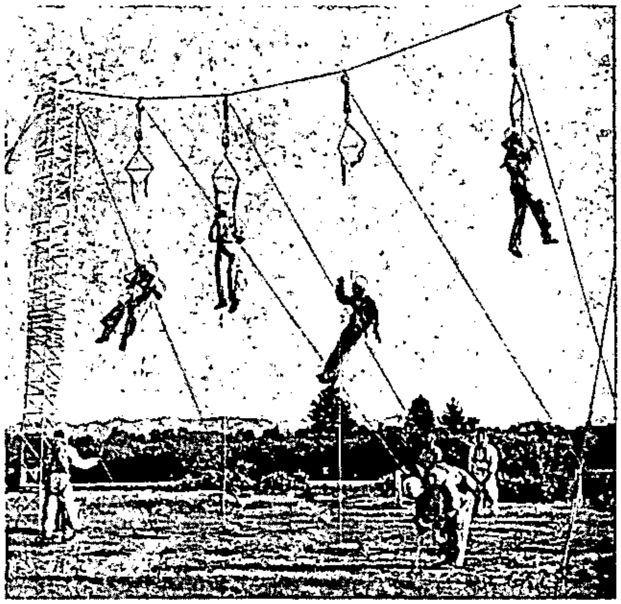

Figure 1—Letdown practice.

Jump training starts the second week (fig. 1). The trainees learn how to exit from an aircraft, steer a parachute, and land. They also learn how to roll, let down in timber, and care for jumper equipment. Several hours are spent on the obstacle course to toughen muscles used in jumping, and also in the classroom on a variety of fire control subjects.

Figure 2.—Practice jumps.

The men make their first practice jumps in the third week (fig. 2). Critiques of the jumps are held in the field, and classroom work continues on such subjects as radio use and procedure, parachute and cargo retrieving, and fire behavior.

One week is devoted to helicopter and fixed wing aircraft operations. Subjects such as helicopter accessory use, retardant mixing, airport management, air attack procedures, traffic control, and record keeping are taught in the classroom. Field application follows.

The remainder of the course is devoted to leadership and instructor training. There are opportunities for additional self-training to fit individual needs and desires.

During the fire season the men are used either as jumpers or ground fire crews. Because of their fire experience, the top man on the jump list is Fire Boss for that fire. This gives each man a chance to exercise his leadership abilities and practice newly learned skills.

The program has been supported enthusiastically by the Forests. The men jump only one season, then return to their Forests better prepared to advance to more responsible positions. Old jumpers can return each June for refresher jumps. In this way, a reserve of trained men for emergency jumps is maintained.

Advantages of the Program:

1. Better fire control action; jumpers have more fire experience than under previous recruiting procedures.
2. Trained firefighters learn additional skills and receive training not available at the District or Forest level.
3. Additional training to potential supervisory fire personnel.
4. Saves screening over 1,000 applications and establishing register for recruitment of a small number of jobs.

Disadvantages of the Program:

1. Except for four or five cadres, a completely new crew must be trained each year since there are no returnees.
2. Forests may want their men to return before the end of the fire season to fill key fire positions left vacant by students returning to school.

ONE CELL FIRELINE LIGHT

JOHN B. RICHARDS, *District Warden, Douglas Forest Protective Association,*[1] *Roseburg, Oreg.*

Much of the Douglas Forest Protective Association's firefighting is done at night. Therefore, the Safety Committee developed the one cell fireline light (fig. 1). The light, which is primarily used during the laying out of firelines at night, eases the workload of scouts and bulldozer operators and reduces the accident hazard confronting scouts.

The light is made from 16-gage wire with enough tensile strength to retain shape and hold one flashlight battery. The coil on top is two complete wraps and is shaped to permit the insertion of a No. 14 bulb. The bottom is hooked to hold the knob on the positive end of the battery. The battery is inserted with the positive end down. One end is left long so the light can be hung from limbs, brush, and other objects. To aid the insertion and removal of the bulb, the thumb and index finger should be placed at points A and B and squeezing should be done gently.

The scout places the lights where

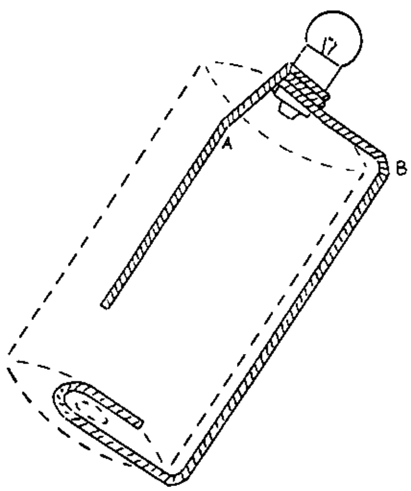

Figure 1.—The one cell fireline light is shown.

the fireline should be constructed. He hangs them on tree branches, in the bark of old-growth trees, on top of stumps, and from brush. He works far in front of the bulldozer operator in order to reduce the possibility of logs, trees, rolling chunks, and rocks being loosened by the bulldozer and then striking him.

The lights are readily seen by the bulldozer operator. They enable him to know exactly where the line should be constructed, and they provide him with some visibility of the terrain.

Following fireline construction, the swamper, who is behind the bulldozer, can sometimes retrieve the lights. If he cannot, there is no great loss, for the lights are very inexpensive and easy to make.

[1] The Association is located in Douglas County, Oreg.

(*Harrogate Fire*—Continued from page 7)

the road, and the fire was considered under control. The time was 3:50 p.m. The fire units then attacked the southern boundary and quickly obtained control.

Fencing losses: Several miles of fencing were damaged, and approximately 1 mile of it must be replaced. Some fences of sawn hardwood and iron droppers withstood the fire, but the wire components will last for a much shorter period because of the deterioration of the galvanising content.

Firefighting strategy: The organisation and method of attack employed by fire controllers was extremely efficient and resulted in the saving of large areas of heavily grassed land. Seventeen E.F.S. units, capably supported by private units, attacked the fire on the first day, and a lesser number conducted patrolling and mopping-up operations on Monday, 16th March.

The confining of this fire to approximately 1,600 acres is even more praiseworthy when one considers the rocky nature of this inaccessible country and the fact that except for the Nairne-Harrogate road no natural or artificial barrier was near the fire.

(*Coyote Fire*—Continued from page 10)

relayed fire-behavior observations from the roving teams to the fire-behavior officer. The relay system, though makeshift, provided fairly good coverage of the fire, supplied more information on which to base forecasts, and made it easier for the teams to circulate forecasts to the various camps.

About 270 ground weather observations, 40 pilot balloon observations, and 7 upper air soundings were taken during the 6-day period the fire-behavior teams were assigned to the Coyote Fire. From helicopter, truck, jeep, and by walking the fireline, team members observed and reported conditions on the fire almost continually.

CONCLUSIONS

The Coyote Fire provided a good example of the effectiveness of the team approach in fire-behavior coverage of conflagrations. With information flowing in from various locations, the fire-behavior officer has more time to appraise the situation, consult with the weather forecaster, and furnish a more complete and accurate fire behavior forecast. With team members in constant communication, he can be alerted to areas requiring his special attention. The fire-weather forecaster, supplied with frequent weather observations taken by the team, benefits by having more detailed local information on which to base his forecasts.

The fire-behavior team, as employed in southern California during 1964, is certainly not the final answer to fire control problems. It is, however, the best approach yet developed for keeping abreast of the behavior of a forest fire. Equipped with the instruments, tools, and trained personnel to do the job, fire-behavior teams offer a service that — if properly used — can contribute to more effective fire control operations.

(*Fire - Weather Forecasts* — Continued from page 11)

2. Resource loss from fire.

3. The various levels of burning conditions.

Loss estimates were difficult to obtain. However, the average loss per day from lightning fires when there was no extra presuppression protection under given burning conditions was as follows:

Low	Moderate	High	Very High	Extreme
$10	$80	$200	$670	$2,000

Third, each category of cost is divided by the same category of loss. Thus, the ratio of cost to loss for each category of burning conditions is as follows:

Low	Moderate	High	Very High	Extreme
1.00	.75	.50	.30	.20

Therefore, the Forest Supervisor should never use extra protection for predicted thunderstorms when the burning condition is Low. It is Moderate when a 75-percent or greater probability of thunderstorms was predicted. Extra protection would also be used when the burning condition is High with a forecast of 50 percent or greater probability; when Very High with a forecast of 30 percent or greater probability; and with an Extreme burning condition and a forecast of 20 percent or greater probability.

Conclusions

Use of judgment or use of the principles discussed above may result in the same decision. However, the complexity of the problem is usually too great to be handled efficiently through judgment. Utilization of forecasts based on probability of occurrence generally provides better results. However, more research is needed in order to more systematically apply the results of fire-weather forecasting to the problems of fire control.

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