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R. L. Ponto (1973)

A SURVEY OF METHODS USED IN MARKING AND RELOCATING SMALL FOREST FIRES.

Northern Forest Research Centre
Environment Canada
Edmonton

A SURVEY OF METHODS USED IN MARKING AND RELOCATING SMALL FOREST FIRES

by R. L. Ponto*

ABSTRACT

Methods to assist initial-attack crews in locating confirmed fires, particularly those with intermittent smoke emission, are reviewed.

Visual markers seldom benefit both air and ground crews. Noise signalling devices are of no help to air crews and little help to ground crews. Most electronic systems and systems involving specialized mounted equipment were deemed too costly.

INTRODUCTION

Lightning caused fires frequently produce small quantities of smoke or smoke on an intermittent basis. These fires are detected by patrol aircraft but often cannot be relocated by initial attack crews travelling either on the ground or by helicopter, even with estimated co-ordinates. Relocation is time consuming and if the fire is not found until it flares up, initial attack resources are ineffective.

Although several visual systems for marking small fires from patrol aircraft are being used operationally, a significant number of fires reach greater acreage than necessary as a result of delayed re-location. Methods for marking small fires from aircraft are being assessed at the Northern Forest Research Centre for: (a) effectiveness in various cover

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types from both the ground and air, (b) simplicity, (c) cost and (d) suitability to a variety of aircraft.

REVIEW OF EXISTING AND POTENTIAL METHODS

Crepe Paper

The Flight Research Station in Ottawa developed a crepe paper marker for relocating mineral deposits.

Rolls of orange crepe paper 100 feet long by 6 inches wide were used to make these markers. A pocket across the outer end of the roll was made by folding about three-quarters of an inch back and stapling it securely. A five inch length of one-eighth inch-diameter lead wire was stapled into this pocket. After unrolling the entire 100 foot length, a small six inch grocery bag was stapled to the other end to act as a parachute. The parachute was made by stapling back the edges about one-half inch around the bag opening. The roll was then rolled up starting with the parachute.

For marking the rolls are unwound a few inches and thrown from the aircraft, flying about 200 feet above the tree tops. The lead wire mass helps to unwind the crepe streamer quickly. The streamers may drift downwind, settling on the windward side of the trees instead of in a line following the direction of flight. This should be noted by the spotter and relayed to the attack crew, as best visibility is achieved when searching in the downwind direction.

The only advantage of this system is its low cost. Some disadvantages are that the crepe streamer may fall or be blown below the tree

tops. It seldom falls so that it is a good marker from both the air and ground.

Tissue Paper

The B.C. Forest Service began using toilet tissue for marking fire locations in 1947. In 1968, they decided that improvements to standard toilet tissue was desirable since it was wider than necessary and separated easily at the perforation marks.

Following field tests a marking paper was recommended. It was white unperforated tissue paper, .0015 inches thick, 3 inches wide, 375 feet long glued to a 0.75 inch cardboard core. It is available from Crown Zellerbach Paper Co. in Victoria at a cost of approximately 25 dollars per case of 100 rolls.

There are two techniques for dropping rolls of this tissue paper from the aircraft - in level flight and by modified dive-bombing. In level flight the best dropping height is 200 to 250 feet above the trees. Cross winds or calm air can cause poor trail configuration and the dive-bombing technique must be used. This is accomplished by entering into a shallow dive from 500 feet and dropping the paper just before pull-out at 200 feet. The paper will trail in the direction of the flight line and be on the target aimed at during the dive.

Fire Location - All fires discovered by patrol aircraft are marked with 4 crosses, one at each quarter surrounding the fire and as close to the fire as possible. Two paper rolls per cross are normally used.

Laying the Paper Trail - After determining the best access route to the fire a paper trail should be laid in a straight line from the fire to the nearest helispot or road. Single-roll drops should be spaced approximately 300 feet apart with the last roll crossing the road or helispot. If a change of direction is necessary, a cross should be laid to warn the ground crew.

Road Marking - If there is a complicated road network leading to the fire the roads should be marked. This is accomplished by laying a cross directly on the road at the first main junction and a single roll laid on the fork about 100 feet past the junction. Each subsequent junction should be marked by a single roll laid on the road to be travelled about 100 feet beyond the junction. The final point travelled by vehicle will be marked by one or two rolls laid at right angles across the road and leading directly to the fire.

Helispot Marking - If a helicopter will be used to carry crews the closed landing point should be marked by a cross with the paper trail leading from that point to the fire.

The tissue paper method had been the most widely accepted method used operationally to date. The main advantage of using tissue paper is its low costs and non-slippery surface which enables it to stay in the tree crowns better than some of the other trail marking methods. However, even unperforated tissue often tears upon release from the aircraft or by strong winds while in the tree tops. Light rains will wash the tissue from the trees.

Calculator Paper Refill Rolls

Rolls of calculator tape, dropped in the same manner as other trailing methods, was field tested by the Alberta Forest Service. Results appear similar to the tissue trailing method tested in B.C.

Plastic Flagging

Plastic flagging has been used by the Alberta Forest Service in the same manner as tissue, but with little success. Standard widths are too narrow to be easily detected from the air. Its surface is smooth and slippery, and does not stay in the tree crowns well. It seldom falls so that it can be easily detected by both air and ground crews. Favourable points include: low costs, resistance to tear and variety of colors obtainable.

To be easily seen from the air, plastic flagging would have to be dropped as a net to overcome the problem of falling below the tree canopies. Weight could be added to avoid drift during descent and undesirable movement once in the tree tops. Usefulness of this marker could be enhanced by attaching some noise signalling device for directing ground crews.

Aluminum Foil

Aluminum foil has never been field tested, however, observers agree that a reflecting surface is easier to spot from the air than non-reflecting surfaces. This method should be fairly effective as a visual marker and reflection may be intense enough to trigger infrared detectors.

String

Rolls of string laid from aircraft have been used to direct ground crews from a location on a road or from a helispot to the fire. This method is effective for guiding ground crews only. The length of line, approximately 800 feet, that can be laid is the only advantage of using this method.

Parachutes

Paranetics Inc. has recently designed a tree marker parachute for the U.S. Forest Service. It can be dropped from an aircraft or shot into the crowns from the ground. It is made of nylon, bright yellow, eight feet wide in a cross shape, and weighs two ounces.

Prices per	1	$34.00 each
	15	15.00 each
	100	9.60 each
	1,000	7.50 each
	5,000	7.00 each
	10,000	6.50 each

Use of other materials is being considered to reduce costs. Parachute markers should be dropped with a noise signalling device or transmitter to guide ground crews and to help recover parachute for future use.

Smoke Bombs

Several agencies have considered use of smoke bombs for marking fires. Most types tested produced a good quantity of smoke that can be seen for several miles but only lasted for a few minutes making it impractical for operational application.

Use of smoke bombs incorporating several timing devices has been suggested. Smoke could be released for short intervals every five or ten minutes. This method seems to be highly impractical, because much flying time would be wasted waiting for smoke emission, not to mention inherent fire hazard associated with smoke bombs.

Automatic Flagmen

This electronically controlled device can be mounted on either helicopter or fixed-wing aircraft. The pilot simply pushes a button that in turn ejects a 15 foot flag, weighted on one end, from the dispenser. The fixed-wing aircraft model, usually mounted under the wing, measures 6 inches wide by 67 inches long, weight $14\frac{1}{2}$ pounds and holds 160 flags. The helicopter model, usually mounted near the front of the tail, measures 6 inches by 31 inches, weight 8 pounds and holds 100 flags. Both models cost approximately 400 dollars.

Tests are being carried out by the manufacturer Air Ag. Inc., to adapt the device for use in forested areas. It cannot be transferred from one aircraft to another easily.

Helium Filled Balloons

Helium filled balloons dropped with an anchor were tested by the U.S. Forest Service with little success. Wind tangled the balloons around the tree tops, dropped them below the visible range, quite often causing them to burst prior to relocation. Helium molecules are very small and penetrate the balloon surface, causing the balloon to deflate.

Paint and Dyes

The B.C. Forest Service tested various combinations of glass containers filled with brightly colored paints and powders. Christmas tree balls and various other glass containers have been used in these drops both singly and in clusters. Seldom did a container break from the impact with the tree crown, it usually fell below the tree top level and was not visible from the air. Similar results were reported from other agencies who dropped plastic bags filled with paints, dyes or powders.

Audio Generators

Noise generating devices are of little value for marking fire location unless dropped in combination with a visible marker for eventual relocation from the air. One innovation consists of an inexpensive bicycle horn. The horn is modified to make a continuous noise when activated. One alkaline D cell battery will supply power for about six hours. The horns cost approximately 50 cents each and can be modified in about five minutes. The sound is audible for approximately 900 feet, depending on cover and terrain.

This device is of more value for paracargo signalling than fire relocation as both audible distance and duration of signal are very limited.

Heliography Method

This system works only for directing ground crews on fires visible to a lookout and on days when there is sufficient sunshine to generate a visible flash. Equipment required consists of a mirror four inches

by six (vehicle side mirror), a hand compass, a fire location map with lookout azimuth circles, and a portaphone to contact the tower.

The fire is plotted on the field map using the bearing and distance from the initial tower report. After arriving at the closest point to the fire, a compass shot is taken on the lookout. From this point, the locator travels to the point where he is on the azimuth bearing from the lookout to the fire. He continually confirms his position using the portaphone and mirror flashes directed at the lookout - until reaching the fire.

Strobe Light

A strobe light dropped with a parachute has been considered for use as a marker. The model designed for the Northern Forest Research Centre weighs 4 pounds and would operate continuously for 24 hours. Although it could be used several times, its initial cost is relatively high: $150 per unit. Problems such as falling through the trees, parachute warapping over the strobe light and difficulty in relocating from the ground would likely be experienced with this system.

Distant Measuring Equipment

Aircraft location is very accurately determined using triangulation from two or more stations. Station range is about 200 miles and are accurate to within a few hundred feet per 100 miles. This system could help direct aircraft to a fire, but would be of no benefit for directing ground crews. It is doubtful if the expense of this equipment could be justified.

Direction Locating Equipment

Field tests involving the use of crash position indicators were conducted in 1972. The transmitter, measuring eight inches in diameter and two inches thick operated on a frequency of 242 MZ. The receiver was a small hand held type equipped with two directional antennas. The signal, heard through the ear plug, increases as the receiver is pointed toward the transmitter. Cost of receiver and transmitter was 200 dollars and 170 dollars respectively.

Results showed that the signal from the transmitter does not follow terrain but is line of sight. Maximum range in flat timbered terrain is approximately one quarter mile. Signal reflection from surfaces such as rocks and stumps, proved to be the major problems. At times equally strong signals were received from several directions. Each signal had to be followed until the correct direction was established making relocation a very time consuming procedure.

Although no experiments were conducted to locate the transmitters from helicopter, relocation would probably have been more successful than the ground search. Cost of equipment, use of a frequency near the distress frequency and the reflection problem makes this method impractical for operational application.

SUMMARY

The most widely accepted methods to date have been the so called trail markers; tissue paper, plastic flagging, crepe paper and calculator tape. Under ideal conditions these markers can be spotted from both air and ground, however conditions are rarely ideal. Quite often trail markers

as well as other visual markers, can be easily relocated by the person who marked the fire initially but is much more difficult for anyone else to locate.

Paint and dye methods have been used with practically no success. Audio generators have also been unsuccessful except when accompanying a good visual marker. Because of short duration in smoke emission and inherent fire hazard the use of smoke bombs is considered quite impractical. Helium filled balloons have been tested with little success. Application of the heliography method is limited to very few fires. Parachutes have been used with some success by the U.S. Forest Service, but mostly where fire co-ordinates can be very accurately estimated. The automatic flagmen is considered unpractical for marking fires. Both crash position indicators and distant measuring equipment are considered too costly for this specific use.