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Front Cover: *Smoldering combustion in a trembling aspen stand immediately following passage of the active flame front associated with an experimental fire in Elk Island National Park, central Alberta, Canada, April 29, 1983. See the article by Alexander and Maffey, pages 10-13.*

Prescribed Burning of Ponderosa Pine Red Slash on the Gila National Forest

Paul Orozco and Ruben Carrillo

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Red Slash Fuel Reduction Through Prescribed Burning

Traditionally, in the Southwest, ponderosa pine (*Pinus ponderosa*) red slash has not been treated with fire to meet resource objectives until all slash has fully cured, usually a 2-to-4-year wait. Waiting for slash to cure is still the widespread practice on most forests in the Southwest. The Gila National Forest and several other forests in the Southwest Region are now burning red slash to reduce fire hazard from heavy fuel loading, although other techniques continue to occupy an important place in prescribed burning programs for the forests. Heavy fuel loads from an accelerated timber harvest 2 years earlier pressed managers to find new solutions to the old problem of fire hazard from slash. In 1990 and 1991, the Luna Ranger District on the Gila National Forest successfully burned approximately 1,700 acres (688 ha) (400 acres (162 ha) in 1990 and 1,300 acres (526 ha) in 1991) of red slash from timber sales.

The Luna Ranger District's Initial Approach to the Prescribed Burning of Red Slash

Ponderosa pine red slash, as defined in the Southwest, is slash on which the needles have turned red but are still attached to branches. The slash, usually less than 1 year old, burns at a greater intensity than cured slash because of its volatile chemical content. Burning is conducted to meet site preparation and fuel reduction targets as well as other resource

Treating red slash ponderosa pine through prescribed burning, although not a traditional fuels reduction method in the Southwest, has successfully reduced fire hazard on the Luna Ranger District.

objectives, such as improving conditions for wildlife, recreation, grazing, and certain plant species.



A typical example of red slash left after logging.

Initially, we were careful in our approach to prescribed burning of ponderosa pine red slash, using a conservative wide-burning prescription that was not much different from one that would be used to burn cured slash. We had limited experience with burning this type of red slash and were not certain any available fuel models would correctly predict fire behavior.

We started test fires on what we thought would be the very wet side of the prescription. We knew that the slash would burn on this side, but we were surprised to learn how well the fires burned while reducing 1- and 10-hour fuels. Our experiments not only supported (or did not disprove) our assumptions about burning red slash but also gave us some new ways of thinking about the prescribed burning of red slash.

The Benefits of the Prescribed Burning of Red Slash

The prescribed burning of red slash widens the window of opportunity for prescribed burning when large diameter fuels and duff are saturated. Under these conditions, the fire manager can treat the smaller more

hazardous portion of the fuelbed without serious risk of escape.

The Luna Ranger District realized the following benefits from the prescribed burning of red slash:

- **Earlier Slash Treatment.** Ponderosa pine slash can be treated within several months of the completion of a project—normally 4 to 5 months if the slash turns red during the summer months. (Burning can start any time 100-hour or heavier fuels will not burn or hold fire. This usually occurs in the Southwest after the summer monsoons are established in the Southwest and 3-plus inches (8 cm) of rainfall have occurred, normally late July or early August.)
- **Easier To Control.** In most cases, where heavy fuels and duff are saturated, red slash burns are easy to control within a specified area without control lines. (If heavier fuels are saturated, fire will not carry through an area; however, red slash 1- and 10-hour fuels burn well.)
- **Less Mopup or Patrol Required.** Where heavy fuels and duff are saturated, fine fuels will burn, but the heavier fuels will not ignite or hold fire.
- **Year-round Opportunities To Burn.** Jackpot burning (burning of red slash concentrations but with no spread, allowing a prescribed fire to burn within well-defined boundaries) extends in the Southwest from the summer months into the winter months even with snow cover.

- **Less Impact on Air Quality.** Smoke is easily managed when burning red slash since only 1- and 10-hour fuels burn. There is little or no residual burning of other fuels.
- **More Duff Retained.** Almost any amount of duff can be left for soil productivity.
- **More Nutrients Available Over Time.** After a prescribed burn of red slash, more material is left to decompose naturally, while still effectively reducing the threat of catastrophic fire, than with cured slash burning.

Disadvantages of Red Slash Prescribed Burning

These are the drawbacks of prescribed burning of red slash on the Luna Ranger District:

- **Increased Burning Costs.** Burning red slash can be labor intensive, when objectives call for jackpot burning of large areas with heavy fuel concentrations.
- **Dependent on the Day-to-Day Weather.** The burning window for a red slash fuelbed (fairly wet large fuels) is very narrow—normally 2 to 8 days after rain, depending on amount of rain, cloud cover, and relative humidity, when objectives call for 75 percent or better consumption of 1- and 10-hour fuels.
- **Increased Potential Damage.** If burning occurs during the summer when trees are late in the growing cycle and before dormancy, they are more susceptible to scorch. (Cured slash is normally burned during winter when trees are dormant.)

- **Only Fine Fuels Consumed.** Red slash burning is probably more limited in accomplishing resource objectives that call for higher intensities of burning or higher consumption than cured slash burning, because burning of red slash does not consume the large woody material that burning cured slash does.

Burning Conditions

As illustrated in table 1, burning began after there has been enough rainfall (3-plus inches (7.6 cm) usually) to saturate the heavier fuels. Normally, burning began 2 days after rain (depending on cloud cover and relative humidity) and was conducted for 5 to 7 days before the burn became too hot.

Burning was successful in light rain (lasting only a short time) and snow—especially if 4 or 5 days had passed since the last rain. If rain had occurred within a day or two, burning was also successful with little cloud cover and less than 30 percent relative humidity.

Ten-hour fuel moisture measurements taken from the field weather station were substituted for on-site measurements. The 10-hour fuel moisture burning range of 9 to 14 percent is a good guideline for meeting the prescription objectives.

Total rainfall before burning (July 1 through August 14) was 5.86 inches (14.88 cm). Total rainfall during the 46 days of burning (July 14 through September 28) was 3.68 inches (9.35 cm). The average dry temperature was 66.6°F (19.5°C), and the average relative humidity was 49 percent.

Table 1—Weather conditions at the time of the prescribed burns

Burn date	Number of days since rain*	10-hour fuel moisture	Time of record	Elevation ft (m)	Wind direction-velocity mi-h (km-h)	Temperature dry-wet °F (°C)	Relative humidity %	Cloud cover %
8-14-91	3	9	1400	7,500 (2,286)	W-06 (10)	78 61 (26 16)	41	70
8-19-91	2	14	0945	7,500 (2,286)	SW-05 (8)	68 67 (20 19)	95	30
8-19-91	2	14	1035	7,500 (2,286)	SW-05 (8)	66 55 (19 13)	53	50
8-19-91	2	14	1230	7,500 (2,286)	SW-05 (8)	71 56 (22 13)	42	50
8-20-91	3	11	1100	7,500 (2,286)	SW-03 (5)	71 54 (22 12)	36	20
8-20-91	3	11	1152	7,500 (2,286)	SW-05 (8)	72 53 (22 12)	31	30
8-20-91	3	11	1432	7,500 (2,286)	Calm	80 57 (27 14)	26	50
8-26-91	2	14	1015	8,000 (2,438)	Calm-SW	59 55 (15 13)	80	90
8-26-91	2	14	1100	7,500 (2,286)	SW-05 (8)	67 56 (19 13)	54	60
8-26-91	2	14	1500	7,500 (2,286)	NE-05 (8)	70 59 (21 15)	55	80
8-27-91	3	13	0915	8,000 (2,438)	SW-05 (8)	63 55 (17 13)	63	Clear
8-27-91	3	13	1140	8,000 (2,438)	S-SE-06 (10)	70 57 (21 14)	48	50
8-28-91	4	12	0930	8,000 (2,438)	Calm	55 53 (13 12)	89	100
8-28-91	4	12	1030	8,500 (2,591)	SW-05 (8)	64 52 (18 11)	48	100
8-28-91	4	12	1137	8,000 (2,438)	SW-05 (8)	64 51 (18 11)	44	100
8-28-91	4	12	1332	8,000 (2,438)	SW-5-10 ⁺ (8-16)	66 53 (19 12)	46	100
9-03-91	2	10	0945	8,000 (2,438)	S-0-5 (0-8)	68 55 (20 13)	47	10
9-03-91	2	10	1130	8,000 (2,438)	S-0-5 (0-8)	75 54 (24 12)	28	20
9-03-91	2	10	1330	8,000 (2,438)	S-0-5 (0-8)	71 53 (22 12)	33	80
9-03-91	2	10	1500	8,000 (2,438)	S-0-5 (0-8)	66 53 (19 12)	66	100
9-12-91	2	12	0950	8,000 (2,438)	SW-0-5 (0-8)	58 52 (14 11)	70	Light rain 60
9-12-91	2	12	1330	8,000 (2,438)	SW-0-5 (0-8)	69 54 (21 12)	41	50

Table 1— continued on next page

Fuel Conditions

Fuel loadings generally ranged from 11 to 22 tons per acre (3 to 5 kg/m²). In one case, fuel loading exceeded 30 tons per acre (7 kg/m²). The red slash was scattered jackpots and fairly heavy. It was usually over 2 tons per acre (0.4 kg/m²) in the 0- to 1-inch (0- to 2.5-cm) size class.

Fire Behavior Characteristics

Depending on fuel moisture content, flame lengths generally were 3 to 5 feet (0.9 to 1.5 m) for 5 to 12 minutes immediately after ignition. Rate of spread occurred within the red slash only and varied with the lighting technique used. Most slash was lit on the upwind side, resulting in a rate of spread of less than 1 chain (20/m) per hour.



After 10 minutes of burning 1- and 10-hour fuels, flames were subsiding, except for the flame continuing up a green tree.

Table 1—Weather conditions at the time of the prescribed burns—continued

Burn date	Number of days since rain*	10-hour fuel moisture	Time of record	Elevation ft (m)	Wind direction-velocity mi/h (km/h)	Temperature dry-wet °F (°C)	Relative humidity %	Cloud cover %
9-16-91	3	11	1015	8,000 (2,438)	S-0-5 (0-8)	60 46 (16 8)	37	Clear
9-16-91	3	11	1330	8,000 (2,438)	S-4-8 (0-6)	70 51 (21 11)	29	Clear
9-17-91	4	10	1005	8,000 (2,438)	SW-0-5 (0-8)	60 46 (16 8)	37	Clear
9-17-91	4	10	1346	8,000 (2,438)	SW-0-5 (0-8)	70 50 (21 10)	26	30 High thin clouds
9-18-91	5	9	0950	8,000 (2,438)	E-0-3 (0-5)	57 48 (14 9)	55	90
9-18-91	5	9	1400	8,000 (2,438)	SE-0-5 (0-8)	63 50 (17 10)	43	100
9-19-91	6	9	0930	8,000 (2,438)	E-SE-5-9 (8-15)	52 47 (11 8)	72	80
9-19-91	6	9	1320	8,000 (2,438)	E-0-5 (0-8)	69 53 (21 12)	38	50
9-25-91	3	9	1115	8,000 (2,438)	W-0-5 (0-8)	68 52 (20 11)	37	Clear
9-28-91	6**							

*Data for number of days since last rain of or over a certain amount of precipitation was not collected.

**Completed burning. No weather recorded on the last day.

†Use of dash indicates measurement of range in velocity.

Since only fine fuels burned with little residual burning of heavier fuels, heat per unit area was estimated to be low (compatible to heat per unit area for grass fuel models). This output of heat is measured in Btu/ft². Fireline intensity was estimated to be in the range of a brush fuel model, since red slash burns much hotter than grass.

Little fire spread or creep occurred outside of the red slash. What spread there was could have been due to the hot intensity of the burning red slash that preheats fine fuels within 2 to 5 feet (0.6 to 1.5 m) of the burning.

Fire Effects

In most cases, we observed an estimated 90- to 100-percent consumption of the 1- to 10-hour size class fuels. (Only limited fuel loading samples were recorded.) The limited fuel loading sampling indicated as much as 50 percent overall fuel reduction in the lighter fuel loadings, ranging from 11 to 15 tons per acre (2.5 to 3.4 kg/m²). As fuel loading increases, where loading is higher in the 100-hour and larger size class fuels, overall fuel reduction decreases.

We also observed, depending on fuel moisture content (number of days since last rainfall, relative humidity, and cloud cover), a greater range in fuel consumption in red slash burning than in cured slash.

Scorch also varied depending upon burning conditions. Trees showed an increased sensitivity to scorch if burning took place during the summer months. This sensitivity, due to sap rising in the trees rather than from heat, can be observed in the scorching or waxing of the tree crown. The result is more an impairment of visual quality and setback in growth than mortality if a large part of the crown is affected. Scorch could be minimized by burning with eye-level wind speeds over 6 miles (10 km/h) per hour. Scorch ranged from 4 to 20 feet (1.2 to 6 m) high in taller trees and varied by 10 to 50 percent in the living volume of the crowns. Stand mortality was minimal, estimated to be less than 1 percent.

There was a range of removal of the duff layer. When burning at the hot end of the prescription, it is possible to remove the duff layer in places where it is less than 1/2 inch (1.3 cm). However, in most cases, the duff layer remained intact with only some light surface burning occurring.

Grasses, forbs, herbs, and even oak were observed resprouting within the burns by the spring.

Cost Analysis

For the most part, cost estimates exceeded the actual cost (table 2). The burning over the last 2 years is estimated to have been accomplished



Fuels reduction as a result of burning red slash. (Photo was taken after snowfall, which reduced height of slash. Note the sprouting of new grasses.)

Table 2—Worksheet showing estimated crew and fuel costs

Supplies, equipment, and personnel	Cost
Crew	
1 GS-9	\$ 130/day
1 GS-7	120/day
1 GS-5	110/day
2 GS-4	128/day
Total crew cost per day	\$ 488.00
Total crew cost (\$488 x 14 burn days)	\$ 6,832.00
Fuel	
40 gallons (151 L) fuel per day (\$1.50/gal or \$0.40/L)	\$ 60.00
Total for 14 burn days	\$ 840.00
Planning cost	\$ 800.00
Miscellaneous-mileage cost	\$ 1,000.00
Total estimated project costs	\$ 9,472.00
Total project cost by acre (1,300 acres)	\$ 7.30

for less than \$10 per acre (\$4/ha). This type of burning has proven to be very economical, even though it is labor intensive. The cost savings result from not having to use any type of pretreatment to control the burn.

Generally, the objective was to reduce the fire hazard in timber harvest areas by reducing fine fuels and charring heavier fuels, thus reducing fire hazard in the area. The specific fire objective was to reduce 80 percent of the 1- and 10-hour size class fuels and char 50 percent of the heavier fuels.

The site preparation objective was to remove 1/4 to 1 inch (6.4 to 2.54 cm) of the duff layer, but in most cases, this was not accomplished as expected. We recognized the need to reduce the flashy fuels first and then come back with another burn to fully reach the site preparation objectives without incurring undesirable stand mortality.

In April and May of 1992, a follow-up burn was conducted. With this burn, all site preparation objectives were fully met. These objectives were more easily attained during the second burn since duff was really the only fuel burning, and fire control and mortality were easily managed. In addition, the higher-than-usual scorch and needle waxing associated with red slash burning caused new red needles to drop on top of the fire, helping in some areas to carry the fire.

A Future for Red Slash Prescribed Burning

The successful red slash prescribed burning on the Luna Ranger District

made an immediate significant impact on reducing the fire hazard created on the district by an accelerated timber harvest 2 years ago. This type of burning can be accomplished during periods when air sheds are not usually saturated with smoke and is useful in carrying out forestry management goals that encourage less slash and duff consumption.

The capability to effectively treat red slash, reducing fire hazard, has also expedited the completion of timber sale projects. In less than 2 years, 98 percent of all remaining "sale improvement and brush disposal" work required in a timber sale contract has been completed, including the closing of roads.

Much work still needs to be completed to develop a workable prescription for a broad range of users. A good rule of thumb is to observe the 10-hour fuel moisture content (9 to 14 percent) for burning red slash to achieve a reduction of the 1- and 10-hour size class fuels without incurring intolerable stand damage. However, we need more precise information on fire intensity and heat per unit area to control the fire effects better. More experience with red slash burning can lead us to overcome the limitations that have kept us from using this method in the past. With improvements, red slash burning can be an even more valuable part of fire management. ■

Standard Fire Orders

- F**— Fight fire aggressively but provide for safety first.
 - I**— Initiate all action based on current and expected fire behavior.
 - R**— Recognize current weather conditions and obtain forecasts.
 - E**— Ensure instructions are given and understood.
 - O**— Obtain current information on fire status.
 - R**— Remain in communication with crew members, your supervisor, and adjoining forces.
 - D**— Determine safety zones and escape routes.
 - E**— Establish lookouts in potentially hazardous situations.
 - R**— Retain control at all times.
 - S**— Stay alert, keep calm, think clearly, act decisively.
-



Spotlight on Safety

Four-wheelers are becoming more and more popular for activities on prescribed burns and wildfire, and extra caution should be taken when operating them around heavy equipment. Kershaw County, South Carolina, recently was the scene of an accident involving a four-wheeler and a Caterpillar dozer. The accident happened during a site preparation burn.

An experienced forestry services contractor was patrolling firebreaks on a Honda four-wheeler when he approached his tractor operator who was on a D-3 Caterpillar dozer. The tractor operator was improving the firebreak with the blade of the tractor. There was no fire plow on the machine. As the tractor operator turned off the firebreak to push a blade of dirt into the burned area, the contractor driving the four-wheeler attempted to maneuver past the tractor. Unaware that anyone was directly behind him, the tractor operator shifted into reverse gear and backed into the four-wheeler.

The track of the D-3 struck the driver's left leg, breaking it below the knee and causing a large puncture wound near the break. The track's cleats tore into the four-wheeler, rupturing the fuel tank and drenching the driver's injured leg with gasoline. The tractor operator heard a yell, even though he was wearing hearing protection muffs, and immediately stopped the tractor.

After sizing up the driver's injuries, the tractor operator bladed a drivable trail from the accident site to the closest road so that the injured man could be picked up by a vehicle and transported to a hospital. Because of the remote location of the accident site, it was

nearly 4 hours before the injured man received hospital care. The timelag resulted in a blood clot forming and moving to his lung, requiring immediate surgery on his arrival at the emergency room. Seven days later, he underwent a second round of surgery to close the open wound and set the leg. The man was hospitalized for 11 days, 2 of which he spent in critical condition in the intensive care unit. Doctors expect him to eventually make a full recovery.

The tractor operator has run tractors in forestry work sites for over 40 years, and the four-wheeler driver has been in the forestry contracting business for over 20 years. This incident proves that, no matter how much experience someone has, accidents can still happen. Anyone who has worked around tractors on prescribed burns or wildfires has taken chances by being too close to the operating machine. Second-guessing a tractor operator's next move is only one mistake that can be costly. The injured man considers himself very lucky, especially since burning brush was only a few feet away while he was soaked in gasoline. If the tractor operator had not heard the driver yell, only the worst could have been expected.

Several days after the accident, the contractor's burning crew was conducting another site preparation burn. After the crew leader gave firing instructions to each member, one crew member ended the briefing saying, "... and don't get behind anything that can back up!" Simple, but very sound advice. ■

Billy Bennett, *district ranger, South Carolina Forestry Commission, Spartanburg Ranger District, Spartanburg, SC.*

Call for Smokey Bear Historical Materials

Smokey Bear's golden anniversary is rapidly approaching. Yes, on August 9, 1994, this fire prevention symbol will have been reminding us to protect our wildlands for 50 years. To help kick off the anniversary celebration of Smokey Bear, there will be a special issue of *Fire Management Notes* this autumn.

If you have any high-quality transparencies (slides), glossy photos (color or black and white) or other memorabilia of Smokey Bear that you can lend to enhance the articles in this issue, we'd be most grateful. For example, we'd like transparencies of Smokey in the Rose Bowl Parade, Smokey with children in schools, Smokey at athletic events, and much more. But time is short, so send your contributions by April 6 or as soon after as is possible.

Please write a caption for each contribution, naming anyone who is in the picture. Also name the photographer and who owns the material. Finally, include a short sentence granting us authority to publish your contribution if it is selected and an address for the return of materials.

Send your contributions to Francis R. Russ, General Manager, USDA Forest Service, *Fire Management Notes*, P.O. Box 96090, Washington DC 20090-6090; telephone 202-205-0891. ■

Donna M. Paananen, *technical writer, USDA Forest Service, North Central Station, East Lansing, MI*

Predicting Fire Behavior in Canada's Aspen Forests¹



Forestry
Canada Forêts
Canada

Martin E. Alexander² and Murray E. Maffey

Respectively, fire research officer and fire research technician, Forestry Canada, Northwest Region, Northern Forestry Centre, Edmonton, AB

Quantitative System Now Available

The development of the Canadian Forest Fire Behavior Prediction (FBP) System represents the latest achievement by Forestry Canada's Fire Danger Group in practically applying fire behavior knowledge and research experience for the general improvement of forest fire management in Canada (Alexander et al. 1984; Lawson et al. 1985; Stocks et al. 1989; Forestry Canada Fire Danger Group 1992).

The technical derivation of the FBP System rests on a sound scientific basis, developed from real-world observations of numerous experimental fires conducted under field conditions and several selected wildfires documented by Forestry Canada fire researchers and others (e.g., Alexander 1982; Alexander and Sando 1989; Quintilio et al. 1991).

Fuel Type Considerations

Currently there are 16 major Canadian fuel types recognized in the FBP System. Fuel type D-1 (leafless aspen) is described in this way (fig. 1):

... characterized by pure, semi-mature trembling aspen stands prior to "green-up" in the spring or following leaf fall and curing of lesser vegetation in the autumn. A conifer understory is noticeably absent but a well-developed medium to tall shrub layer is typically present. Dead and down roundwood fuels are a minor component of the fuel complex. The principal fire-carrying surface fuel consists chiefly of deciduous leaf litter and cured herbaceous material which are directly exposed to wind and solar radiation. In the

spring, the duff mantle (F and H horizons) seldom contributes to the available fuel for combustion due to its generally high moisture content.

Four boreal mixedwood fuel types, which can contain varying amounts of aspen, are also recognized in the FBP System.

System Structure

The FBP System allows users to get a quantitative prediction of spread rate, fuel consumption, and frontal intensity for fires that are still accelerating or have in fact reached an equilibrium



Figure 1—An example of Canadian Forest Fire Behavior Prediction System Fuel Type D-1 (leafless aspen). This trembling aspen stand is located near Hondo, Alberta, Canada, and was photographed in May 1988. The perception marker shown here is composed of a 30 x 30 cm (12 x 12 in) sign and a pole with markings at 30 cm (12 in) intervals.



Figure 2—Fire spreading through a leafless aspen stand in central Alberta during the spring of the year. Free-burning fires in the trembling aspen fuel type are typically low to moderately vigorous surface fires, even under relatively severe burning conditions.

¹This brief article is based on a poster paper presented at the Aspen Management for the 21st Century Symposium sponsored by the Poplar Council of Canada, Forestry Canada, and Alberta Forestry, Lands and Wildlife, Edmonton, AB, November 20-21, 1990.

²Martin E. Alexander is currently completing a 1-year secondment as a visiting fire research scientist with the New Zealand Forest Research Institute (NZ FRI) at Rotorua, NZ, under the terms of an international agreement between Forestry Canada and NZ FRI.

Table 1—Illustration of estimating potential fire behavior using the Canadian Forest Fire Behavior Prediction (FBP) System for four contrasting situations involving a trembling aspen stand during the spring fire season (FBP System Fuel Type D-1)

Calendar date: May 1		Time of day: 1600 MDT			
Geographical location: 53 °37'N, 112 °58'W		(Elk Island National Park, Alberta, Canada)			
Item	Case A	Case B	Case C	Case D	
Inputs					
FBP System fuel type	D-1	D-1	D-1	D-1	
Slope (%)	0	0	+20	+20	
Elevation (m MSL)	717	717	717	717	
(ft MSL)	(2,352)	(2,352)	(2,352)	(2,352)	
Aspect	level	level	south	south	
Fine Fuel Moisture Code (FFMC)*	94	94	94	94	
10-m open wind speed (km/h)	10	10	20	20	
(mi/h)	(6)	(6)	(12)	(12)	
Buildup Index (BUI)*	35	35	70	70	
Elapsed time since ignition (hr)	1.0	1.0	1.0	1.0	
Type of projection (point- or line-source)	point	line	point	line	
Outputs					
Initial Spread Index (ISI)*	12.5	12.5	29.5	29.5	
Head fire rate of spread (m/min)	3.3	3.3	10.7	10.7	
(ft/min)	(10.8)	(10.8)	(35.1)	(35.1)	
Fuel consumption (t/ha)	7.1	7.1	10.8	10.8	
(T/acre)	(3.2)	(3.2)	(4.8)	(4.8)	
Head fire intensity (kW/m)	711	711	3,469	3,469	
(Btu/sec-ft)	(206)	(206)	(1,003)	(1,003)	
Type of fire	surface	surface	surface	surface	
Head fire spread distance (m)	170	200	550	640	
(ft)	(558)	(656)	(1,804)	(2,100)	
Total flank fire spread distance (m)	140	N/A**	160	N/A	
(ft)	(459)	(N/A)	(525)	(N/A)	
Backfire spread distance (m)	40	50	10	10	
(ft)	(131)	(164)	(33)	(33)	
Elliptical length-to-breadth ratio (L/B)	1.5	N/A	3.5	N/A	
Elliptical fire area (ha)	2	N/A	7	N/A	
(acre)	(5)	(N/A)	(17)	(N/A)	
Elliptical fire perimeter length (m)	560	N/A	1,220	N/A	
(ft)	(1,837)	(N/A)	(4,003)	(N/A)	
Rate of perimeter growth (m/min)	10.9	N/A	23.7	N/A	
(ft/min)	(35.8)	(N/A)	(77.8)	(N/A)	
Backfire rate of spread (m/min)	0.8	0.8	0.2	0.2	
(ft/min)	(2.6)	(2.6)	(0.7)	(0.7)	
Flank fire intensity (kW/m)	296	N/A	511	N/A	
(Btu/sec-ft)	(86)	(N/A)	(148)	(N/A)	
Backfire intensity (kW/m)	164	164	71	71	
(Btu/sec-ft)	(47)	(47)	(21)	(21)	

*Components of the Canadian Forest Fire Weather Index (FWI) System (see Van Wagner 1987).
 **N/A = not applicable because of the type of projection (i.e., line source versus point source).

steady-state with their environment (table 1). A general description of the type of fire (fig. 2) is also given (for instance, surface fire, intermittent crowning, or continuous crowning).

A simple elliptical fire growth model (fig. 3) is used in estimating the size and shape of fires originating from a single ignition source as opposed to an established "line of

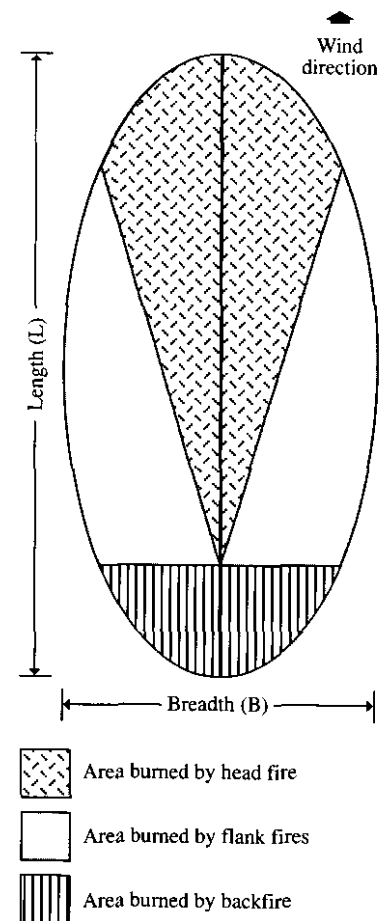


Figure 3—Schematic diagram of a simple elliptical fire growth model (after Alexander 1985). The point of ignition is judged to be at the junction of the four area growth zones, (i.e., head, left and right flanks, and back).



Figure 4—A head fire ignition pattern is used during a prescribed burning operation in Elk Island National Park, central Alberta, Canada.



Figure 5—Tree bole charring in a leafless aspen stand soon after a fire. Direct, fire-induced mortality among trembling aspen is related to stem diameter and a fire's frontal intensity. Determining the number of aspen suckers following a fire is considerably less predictable.

fire" (fig. 4). The FBP System's operation is based on a small number of readily available inputs, as table 1 shows.

Implications for Fire Managers

The FBP System incorporates the best available information on forest fire behavior in Canada (McAlpine et al. 1990). Canadian fire managers are therefore in a good position to predict fire behavior with reasonable assurance for a wide range of burning conditions.

In managing Canada's aspen forests, the FBP System can be applied to both fire protection concerns and fire use considerations. However, additional studies such as those conducted by Alexander and Sando (1989), Weber (1990, 1991), and Quintilio et al. (1991) are needed to strengthen the link between the physical characteristics of fire behavior and the biological or ecological effects of fire (fig. 5). This

The Canadian Forest Fire Behavior Prediction (FBP) System can be applied to both fire protection concerns and fire use considerations in managing Canada's aspen forests.

information is required in order to develop more refined prescriptions for prescribed burning than existing guides provide (Sando and Alexander 1990). ■

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"REMEMBER . . . SMOKEY HAS FOR FIFTY YEARS"— Smokey Bear's 50th Anniversary Slogan

Smokey Bear has reminded Americans for nearly 50 years to protect our Nation's forests from carelessly caused fire. To celebrate the Smokey Bear golden anniversary year, the USDA Forest Service and the National Association of State Foresters announced a 50th year anniversary slogan and logo for the famous bear. The slogan, "REMEMBER... SMOKEY HAS FOR FIFTY YEARS," will be used throughout the golden anniversary campaign.

The Ohio Division of Forestry submitted the new slogan, chosen from among 3,400 entries in a nationwide contest sponsored by the National Association of State Foresters. Working through The Advertising Council, Foote, Cone & Belding, the Smokey Bear volunteer advertising agency for 50 years, designed the anniversary logo.

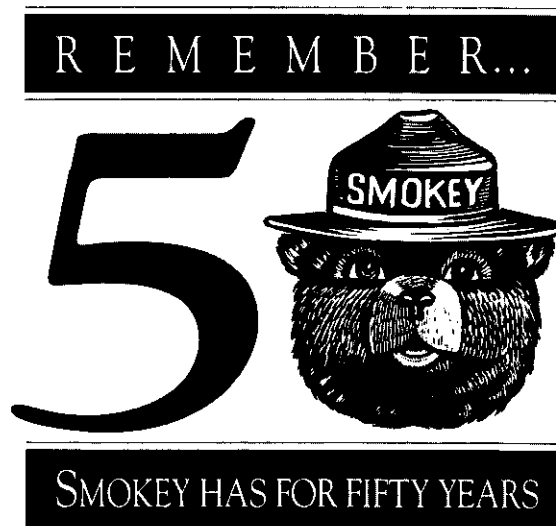
Beginning in October 1993 until August 1994, foresters and fire officials

throughout the United States will participate in local and statewide events celebrating Smokey's golden anniversary. The anniversary will wind up with a celebration in Washington, D.C., on August 9, 1994. ■

Enid Hodes, editor, USDA Forest Service, Public Affairs Office, Washington, DC

"This anniversary slogan reinforces Smokey's classic wildfire prevention message, 'Remember, only YOU can prevent forest fires.' For the past half century, generations of Americans have grown up with Smokey. Our anniversary celebration will bring back a lot of memories and drive home Smokey's message of fire prevention to a new generation."

—Chief F. Dale Robertson



16USCS80

Historic Wildfire Corridors

Jerry Meehan

Firefighter specialist, Los Angeles County Fire Department, Newhall, CA



Nearly every square mile of Los Angeles County, California (LA County), has burned at least once since the beginning of organized fire protection in the State. In fact, many of the brush-covered canyons of LA County have burned a half dozen or more times in the past 70 years. The areas that have burned at least once before (under similar conditions) are referred to as "historic wildfire corridors." Historic wildfire corridors are closely related to Santa Ana wind corridors—geographic locations where Santa Ana winds surface year after year.

According to George Boss and his staff at the LA County Mapping and Engineering Unit, there are several historic wildfire corridors in the county. Boss is very familiar with areas of frequent burns because he has been mapping fires from the air and ground for more than 20 years. (His staff is responsible for plotting every fire of 100 acres (40 ha) or more.) He notes that the mountainous area of the western San Fernando Valley near Santa Susana Pass has burned more than any other area in the county. In the past 44 years, a total of 16 fires of 300 acres (121 ha) or more have blackened these rocky slopes—the last was in 1988.

The Santa Monica Mountains between Topanga Canyon in LA County and Point Mugu in Ventura County also have prominent corridors running across them. The Malibu corridor has seen no less than 13 major wildfires since 1904. All these fires started inland at or near what is now the Ventura Freeway and were fed by Santa Ana winds, causing them to run to the coastline at Malibu

Beach. The most recent of these wildfires was in October 1985. Perhaps the best known wildfire and Santa Ana wind corridor in southern California is located in the Cajon Pass, north of the city of San Bernardino in San Bernardino County.

When topography, fuels, and weather combine to channel large and damaging fires through a geographic area time and time again, the wildfire corridors and Santa Ana wind corridors are perfectly aligned. Whether firefighters work in the wildland-urban interface of southern California or the forested lands of the Pacific Northwest, it's important for them to be aware of and recognize historic wildfire corridors for two major reasons: prevention and suppression.

Prevention

The LA County Fire Department's Vegetation Management Unit monitors wildfire corridors very closely. In planning prescribed burns, this unit identifies these troublesome areas and then plans burns across or in close proximity to the corridors. Its intent is to reduce fuel loads in and near these areas so that a fire in a lighter fuel will be contained or completely halted. Fires in young fuel beds are less flammable and generally easier to control than in old, decadent stands of mature chaparral. Radtke et al. (1982) and others have shown that once an area has burned, it will take 7 to 15 years before the dead-to-live-fuel ratio increases to a point of high flammability. In beds of *Ceanothus* spp. (which consist of about 80 shrubby species found in the semiarid West), the high flammability stage may not be reached

for as many as 25 to 30 years. An exception to this rule occurs when fires are pushed by strong Santa Ana winds or an area has been stressed by extreme drought. Under such conditions, even the youngest fuels may carry a fire that is difficult to control.

Suppression

The Vegetation Management Unit has prepared and distributed a set of fire history quad maps to each battalion chief stationed in a brush area. This set of maps identifies fuel age and past burns throughout the county. Fires are grouped into three vegetation ages:

- 1- to 10-year-old fuel
- 11- to 30-year-old fuel
- 31-plus-year-old fuel

With this map set and an understanding of fire behavior in a historic fire corridor (and perhaps personal experience), fire managers can plan suppression activities accordingly. For example, the Incident Commander (IC) can plan a strategy based, in part, on vegetation fuel age. If the IC knows that a fire is running and spotting at a quick pace and is headed for a relatively young stand of fuel, he or she knows that the fire will probably begin to slow once it enters an area burned in the past. The intensity of the fire will wane, and suppression activities can be stepped up.

Newhall Pass Corridor

Newhall Pass in the northern end of LA County is a conduit for both Santa Ana winds and large and damaging wildfires. Between 1964 and 1988, four fires originated at or near this



More than 370 structures have been damaged or destroyed in the dangerous Newhall Pass Corridor.

location, destroying 370 structures and fatally burning four civilians. The fires followed similar paths and were influenced by strong Santa Ana winds and topography such as north-south canyons. In each case, the communities of Granada Hills and Porter Ranch in the city of Los Angeles had to be defended in firestorm conditions. Note the similarities in the wind speeds of the four fires (table 1).

In the four-map set (fig. 1), I've identified three reference points. At the top of each map is Newhall Pass, in the center is Mission Point, and at the bottom, Porter Ranch.

In the 1964 Weldon Fire (map A), winds were predominantly from the northeast. The fire took a southwesterly course until it was checked in Limekiln Canyon after winds subsided. The 1969 Weldon Fire (map B)

began at the Gavin Rest Stop along Interstate 5. This fire took a more southerly course. When the fire crossed the 1964 burn, it picked up momentum and ran to the south-

Whether firefighters work in the wildland-urban interface of southern California or the forested lands of the Pacific Northwest, it's important for them to recognize historic wildfire corridors.

southwest until it was checked in Aliso Canyon. The westward spread of the fire was influenced by the earlier Weldon burn. However, the most graphic example of how young fuel can influence the direction and spread of a wildfire in peak 65-mile-per-hour (105-km/h) winds was the Clampitt Fire in September 1970 (map C).

For firefighters, the worst possible weather conditions existed for the Clampitt wildfire, which erupted at the Newhall Refinery in Newhall Pass (see table 1). The fire moved 2 miles (3 km) from its origin in less than 10 minutes. The flames spotted across the eight-lane Interstate 5 and then ran directly into the 1969 Weldon burn. The entire east flank of the Clampitt

Table 1—Comparison of four destructive fires in Newhall Pass Corridor, a historic wildfire-Santa Ana corridor in California

Fire name	Date	Temperature (°F (°C))	Humidity (%)	Wind speed (mi/h (km/h))	Fuel age (year)	Acres (ha)	Peak wind (mi/h (km/h))
Weldon	3-16-64	70 (21)	4	NE 47 (76)	45+	3,050 (1,234)	73 (117)
Weldon	10-29-69	83 (28)	10	NE35 (56)	5-50+	4,010 (1,623)	55 (89)
Clampitt	9-25-70	97 (36)	7	NE 45 (72)	1-51+	107,163 (43,369)	65 (105)
Sesnon	12-09-88	77 (25)	11	NE 45 (72)	18-19	2,670 (1,081)	92 (148)

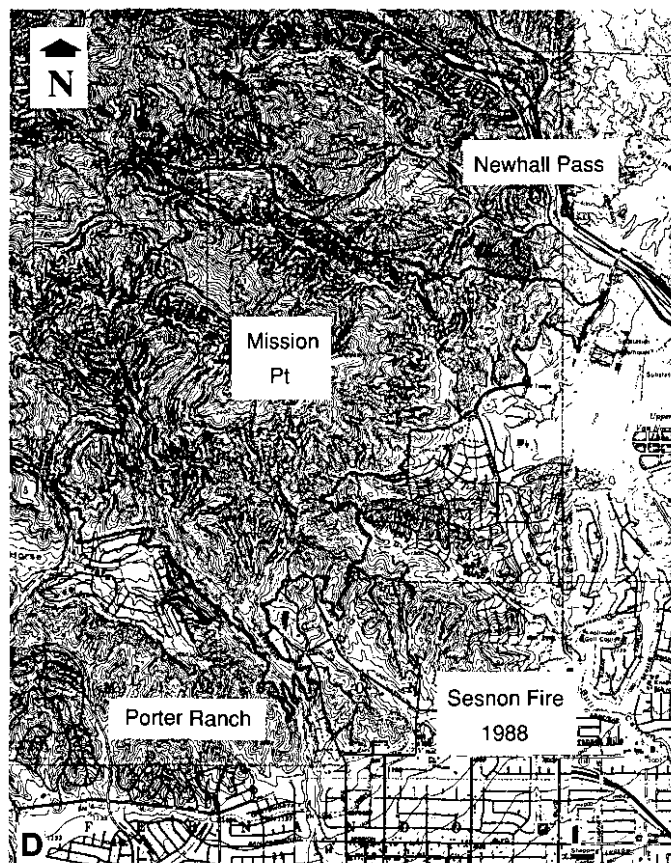
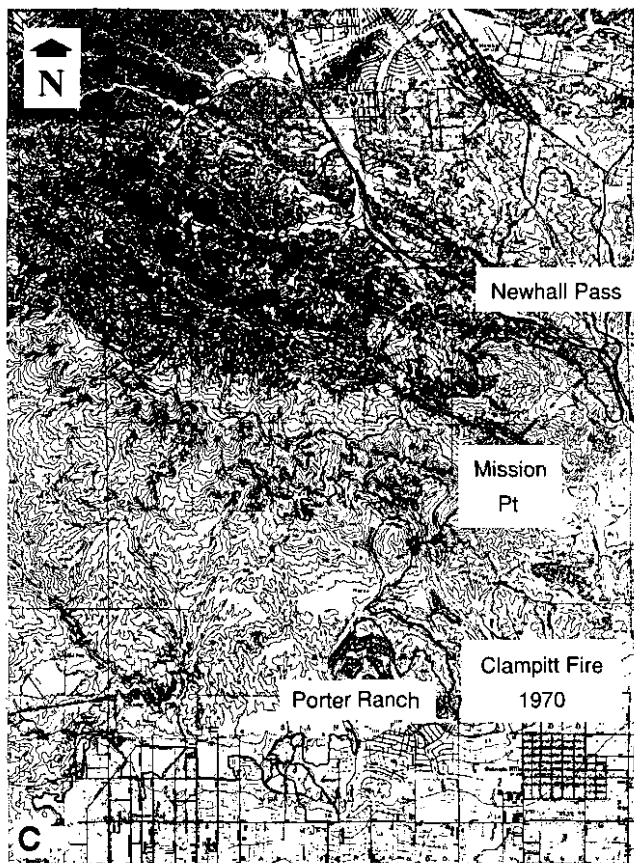
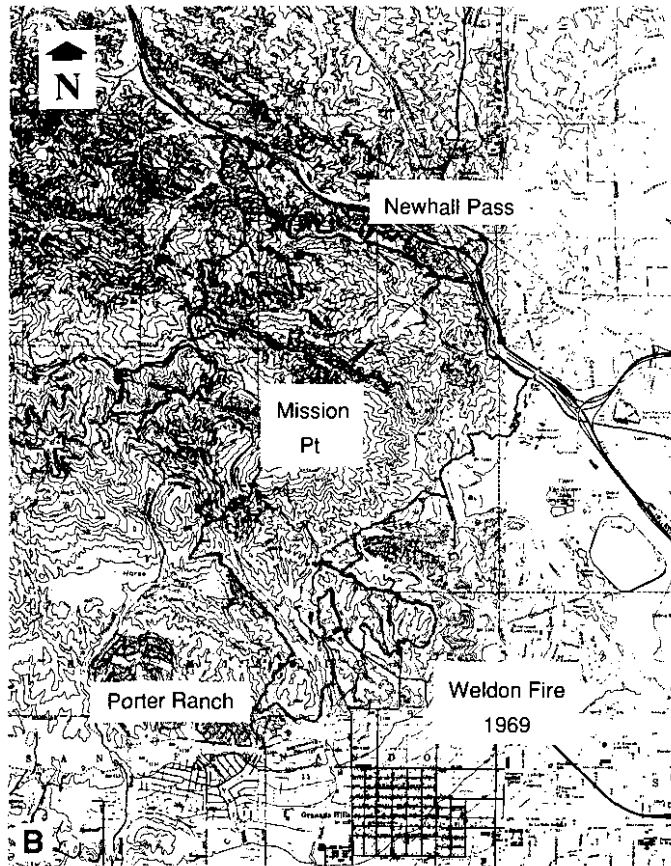
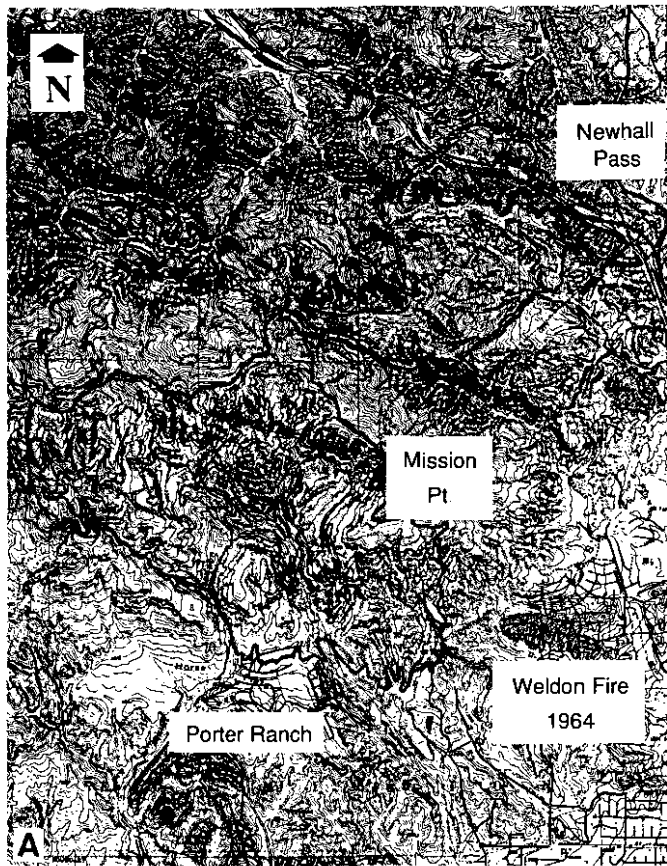


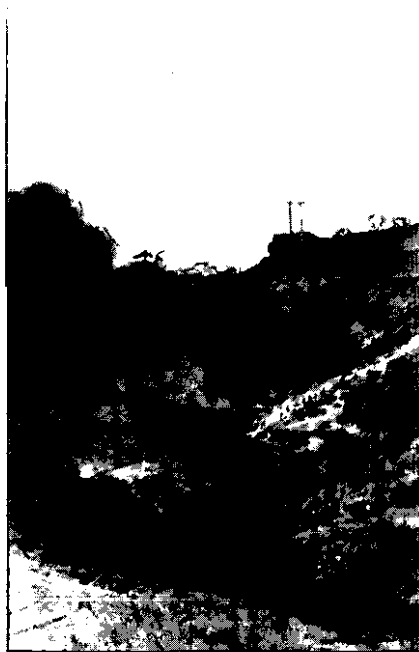
Figure 1—Maps of four Newhall Pass Corridor fires: Map A—1964 Weldon Fire, map B—1969 Weldon Fire, map C—1970 Clampitt Fire, and map D—1988 Sesnon Fire (U.S. Geological Survey).



In 1988, the Sesnon Fire raced up the slope in 80 mile-per-hour (129 km/h) winds, damaging or destroying some 40 homes in this Porter Ranch neighborhood. Porter Ranch has been defended in each of these Newhall Pass Corridor fires.

Fire was checked by the 1-year-old burn. Finally, the 1988 Sesnon Fire (map D) burned much the same area as the Weldon Fire did 19 years earlier.

In LA County, we preplan our prevention-suppression response in chaparral-covered canyons much the same way as high-rise buildings or commercial occupancies are preplanned in our cities. We identify where the problems are going to occur before they happen. We know where the wildfire corridors are located, where the wind corridors are most troublesome, and how old our chaparral is. Such preplanning pays off. For example, the last time a fire ran down Malibu Canyon, we were able to stop it along Rambla-Pacifico Road with backfires because we knew how the fire was going to behave. From



Santa Ana-fed flames consume 18-year-old fuel on Mission Point during the 1988 Sesnon Fire.

patrolman to battalion chief, it's important that wildland fire personnel become familiar with the historic wildfire corridors in their jurisdictions. They've all burned at one time or another; the only question is—when will they burn again? ■

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Property Accountability: What Do You Know?

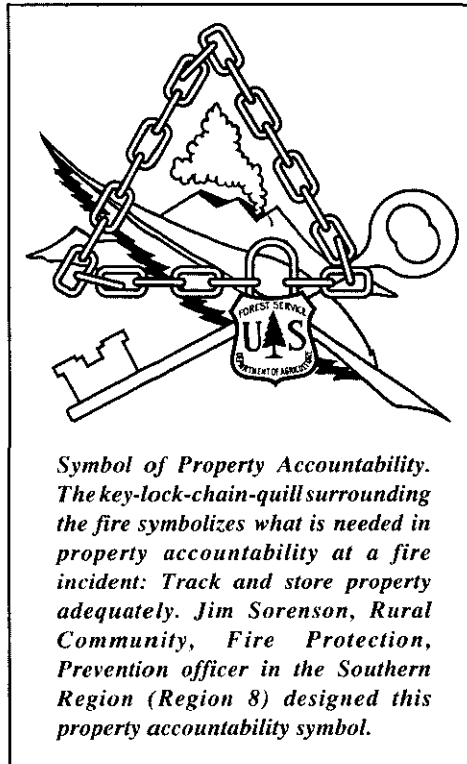
Getting the Word Out: Creating Awareness

The Property Accountability Awareness Group formed in late 1991 to help firefighters from the bottom to the top focus on keeping track of property used in fighting fire and to discuss how to improve getting the word out on property accountability. The group sends this message to each firefighter: Be aware of your responsibilities in accounting for property and carry them out.

Obstacles Perceived

When the group first met, members identified important perceptions about property accountability. Some of these touched on weaknesses they saw in the system, and others, on attitudes that stood in the way of a first-class performance in accounting for property:

- Position for tracking property not clearly identified in the Interagency Command System.
- Law enforcement personnel not involved at the time loss is discovered.
- A fire-will-pay-for-it mentality.
- New systems created to cover performance problems.
- Property, such as radios, cameras, and calculators, indiscriminately assigned.
- Demobilization process does not ensure return of property.
- Inadequate emphasis on property accountability in training sessions or workshops.
- Property accountability not an element for rating performance.
- Lack of onsite involvement by the comptroller or property management officer reduces property accountability.



Symbol of Property Accountability. The key-lock-chain-quill surrounding the fire symbolizes what is needed in property accountability at a fire incident: Track and store property adequately. Jim Sorenson, Rural Community, Fire Protection, Prevention officer in the Southern Region (Region 8) designed this property accountability symbol.

Recognizing what the perceived obstacles are to top-notch accountability performance and talking about them is a necessary step in making a change in behavior.

Sharing Information and Experience

The Property Accountability Awareness Group is interested in your perceptions, experiences, and most of all your successes in accounting for property used on fires. If you have information to share, contact Beverly Deem by DG: B. Deem: W02A or by telephone. FTS or commercial 208-389-2608. ■

Beverly Deem, administrative officer.
USDA Forest Service, National
Interagency Fire Center, Boise, ID

What Do We Mean by Accountable Property?

Accountable Property. Any property received from agency support systems as well as property received directly from the General Services Administration or commercial sources for use on fires.

Categories of Property. The Interagency Fire Business Management Handbook, Chapter 30, lists two categories of property:

- **Nonexpendable.** Property that is complete in itself, retains its identity when placed in use, and has an expected service life of over 2 years. Examples of nonexpendable property are computers, copiers, radios, and chainsaws. Sensitive property, nonexpendable accountable property valued at less than \$300, is highly susceptible to loss or theft as determined by the Forest Property Management Officer. Examples of sensitive property are cameras, calculators, tape recorders, firearms, binoculars, and typewriters.
- **Expendable.** An article of property that is consumed or loses its identity when placed in use or has an expected service life of less than 2 years. Examples of expendable property are canteens, waterbags, blankets, sleeping bags, tools, forest fire shelters, badges, keys, and protective clothing.

Who's Responsible for Property on a Fire?

- Employee (every employee) —for the care, use, and custody of property, for the return of property, and for the reporting of lost or damaged property
- Supervisor—for ensuring property procedures are followed by employees supervised and for informing employees of their responsibilities
- Incident Commander—for making sure a sound overall property management system is in place

Property Managers: The Checkout-Checkoff Checklist

I have—

- Established an area to store and protect property.
- Selected an employee to issue property and put in place a property tracking system.
- Selected an employee to receive property and accurately and clearly record the return of property.
- Set up a system or made sure a system has been set up, under the direction of the supply unit leader, for identifying or marking property.
- Set up a system for property clearance during demobilization.

Forest and Rural Fire Research in New Zealand Resumed

In April 1992, the New Zealand Forest Research Institute (NZ FRI) reestablished a wildland fire research program at its Rotorua campus. Although a number of factors contributed to the need for such a program, most notable was the demise of the New Zealand Forest Service in 1987, which had acted as a national fire protection organization. NZ FRI has not undertaken any wildland fire research since the late 1970's.

Initially, a position for a permanent fire researcher was created, an advisory committee on forest and rural fire research established, and, under the terms of an international assignment

agreement between Canada and New Zealand, Martin E. Alexander from Edmonton, AB, a fire research officer with Forestry Canada since 1976, began a 1-year appointment with NZ FRI in Rotorua.

Visiting scientist Alexander and the NZ FRI fire researcher H. Grant Pearce are initially focusing on the following:

- Technology and information transfer activities pertaining to fire danger rating and fire behavior prediction.
- A revision of the fire danger classification criteria currently used in New Zealand.
- Demonstrations of the experimental fire technique designed to furnish fire behavior data in selected fuel types.
- A problem analysis on fire research needs.

Alexander also is serving as a "mentor" to Pearce.

The funding for the fire research program at NZ FRI is being provided by the National Rural Fire Authority, the Foundation for Research, Science and Technology, the New Zealand Forest Owners' Association, the Department of Conservation, and the Ministry of Forestry.

Further information about New Zealand's wildland fire research program is available from J.R. Tustin, Manager, Forest Technology Division, New Zealand Forest Research Institute, Private Bag 3020, Rotorua, New Zealand. ■

Martin E. Alexander, *visiting fire research scientist, New Zealand Forest Research Institute, Rotorua, NZ*

Custer National Forest Incident Command System Used in Urgent Nonfire Programs

Curtis W. Bates and Sherry L. Milburn

Respectively, forest supervisor and public affairs officer, Custer National Forest, Billings, MT



The Incident Command System (ICS), most often associated with suppressing wildfires, has been used in other disasters like floods, earthquakes, volcanos, and oil spills. In all of these short-term catastrophic emergencies, the ICS has proven to be a highly successful tool for systematically managing logistics, labor, and resources. Custer National Forest managers, impressed by ICS' track record in meeting natural catastrophies, decided to adopt the system to fight their own emergency—meeting hot new nonfire priorities while maintaining a “minimum program” workload in all their normal resource areas. The challenge was to do it all with no increase in budget.

Custer National Forest—Balancing on the Edge

On the Custer, as on many other national forests, the normal, modern-day workload has often grown faster than its budget. For years, the Custer tried to meet all its program demands and maintain a balance between resource uses. Under these less-than-desirable conditions, the Custer kept its head above water most of the time by *furiously treading water*. It did just enough in each resource area to keep all the programs barely functioning. This precarious position was possible to maintain as long as the various resource capabilities and the public demands for those resource uses stayed in balance.

New forces brought change in 1990. Two emerging issues—one focusing on public rangeland management and the other on increasing

demands for oil and gas leasing—achieved national attention and tipped the delicate balance on the Custer.

Oil and Gas Leasing, Public Rangeland Management Issues—Top Priorities

All national forests deal with rangeland and mineral resources, but the Custer National Forest has, by far, the largest range management program and the largest workload in oil and gas leasing of any forest in the Nation. Much of the workload in these two resources is concentrated on the 1.5 million acres (607,050 ha) of the Little Missouri National Grassland in North Dakota. However, the remainder of the lands administered by the Custer National Forest in North and South Dakota and Montana are nearly as significant in terms of workload dealing with grazing and mineral deposits.

Rangeland management and oil and gas leasing emerged as priority issues as a result of a change in the public's perception of what is acceptable on public lands. Numerous magazine and newspaper articles, television and radio programs, and political and special-interest group campaigns have focused interest on the environment in general, and, specifically, on the issues of public land grazing and oil and gas exploration.

Opposition to public land grazing has been building during the last 2 to 3 years, and slogans like “No moo in '92” and “Cow free in '93” are nationally recognized expressions of this opposition. Public concern has arisen from the opinion that rangeland is being damaged by livestock

grazing. That opinion has been exacerbated by a recently completed General Accounting Office (GAO) audit, which reported that a significant amount of the Nation's public rangeland was overstocked, in declining condition, or had resource conflicts.

On a forest like the Custer where 101,747 cows graze nearly 900,000 animal unit months each year, outspoken public opposition to public land grazing elicited significant concern. This concern was elevated to a need for action when the recent GAO audit pointed out that 568 of the Custer's 703 grazing allotment plans needed to be revised or completely rewritten.

Based on the audit's findings, Custer National Forest managers estimated, under normal circumstances, the workload generated by an effort to bring that many allotment plans into proper compliance would take at least 20 years. This would never be acceptable to the “Cow-free” community. Thus, the Custer's management was faced with a need to take swift, significant action to respond to this issue.

At the same time the Nation's awareness of the public land rangeland management issues was being elevated, oil and gas leasing on public lands surfaced as a second issue. The sudden increase in oil and gas leasing demands came as no surprise, particularly considering the country was experiencing rising gasoline prices, the Nation was threatened with oil shortages and foreign oil dependency, and war was looming in the Persian Gulf. Prompted by these factors and by increasing demands by the oil

industry for more oil and gas leases on public lands, the Forest Service was directed, as part of its mission, to get on with evaluation of the public lands for oil and gas leasing. The Forest Service responded by developing a list of areas to be evaluated, prioritizing those areas, and scheduling for the completion of evaluations.

Hidden beneath the Little Missouri National Grassland in North Dakota and the Beartooth Plateau of Montana may be large oil resources. The Custer National Forest, with its major oil resources, appeared high on the priority list developed by the Forest Service, and its managers were expected *immediately to get on with the analyses* required to complete these evaluations.

These rearranged priorities translated into something beyond "business as usual" for the Custer. In fact, they translated into an urgent, major undertaking—preparing at least three environmental impact statements that dealt with huge expanses of land, a wide variety of environmental conditions, and a myriad of resources and resource interactions.

ICS—A Way to Deal With "Burning" Issues and a Change in Operations

The substantial increases in public focus on public rangeland management and demands for oil and gas leasing forecast a drastically increased workload for the Custer National Forest. The forecast of a surge in workload was especially evident because the two resources being targeted occur in such large proportions on this forest's lands. Moreover,

Firefighters' Incident Command System enabled the Custer National Forest staff to deal with the "burning" issues of public rangeland management and oil and gas leasing without extra staff or budget.

managers were faced with the reality that there would be no corresponding increase in budget or staffing to respond to these issues.

Custer National Forest managers quickly recognized their ability to respond to these issues would be hindered considerably if they attempted to take on the added workload *without making significant reductions* in other areas. What the forest needed was a complete change of focus, a change from ordinary ways of doing business, and a change in the ordinary chain of command.

Where does ICS enter the picture and why? It was obvious, faced with the dilemma of having huge additional workloads imposed with no increases in funding or personnel to respond to these workloads, that "business as usual" would not handle the Custer's situation. Because Custer National Forest employees collectively had a great deal of tenure and lengthy experience in fire suppression and because the forest supervisor had 10 years of experience in ICS as a Type I Incident Commander, it seemed only natural to turn to using ICS as a method of dealing with the two "burning" issues.

Forest managers proposed to treat the issues, and the actions necessary to respond to them, as incidents. They decided to develop an ICS organization to manage them much in the way

firefighters mobilize to handle large fires. At the end of 1990, the Custer National Forest did just that. Managers superimposed an ICS organization over the existing line-staff organization and placed an Incident Commander in charge of each incident. They protected the integrity of line authorities by placing the forest supervisor, along with the Forest Management Team, in the area command function and assigned district rangers as operation section chiefs. Figure 1 shows this organizational structure.

Each Incident Commander was given a letter which delegated authority to that Incident Commander for a particular "incident," outlined the job to be done, and established the boundaries or constraints that went with the job. These letters are the equivalent of the delegation of authority given an incoming team on a large fire. The real "doing" part of the effort was delegated to the strike team leaders, who report to the Incident Commanders through the operation section chief (district ranger) just as they would on a real fire.

Getting the Job Done with ICS

Organizing in the ICS accomplished several things for the Custer National Forest. It established a priority for attaining two urgent objectives—evaluating the Custer National Forest and Grasslands for oil- and gas-leasing potential and making strides in completing a significant number of allotment management plans within a 2-year timeframe. Using ICS also provided the authority for a task-oriented organization to

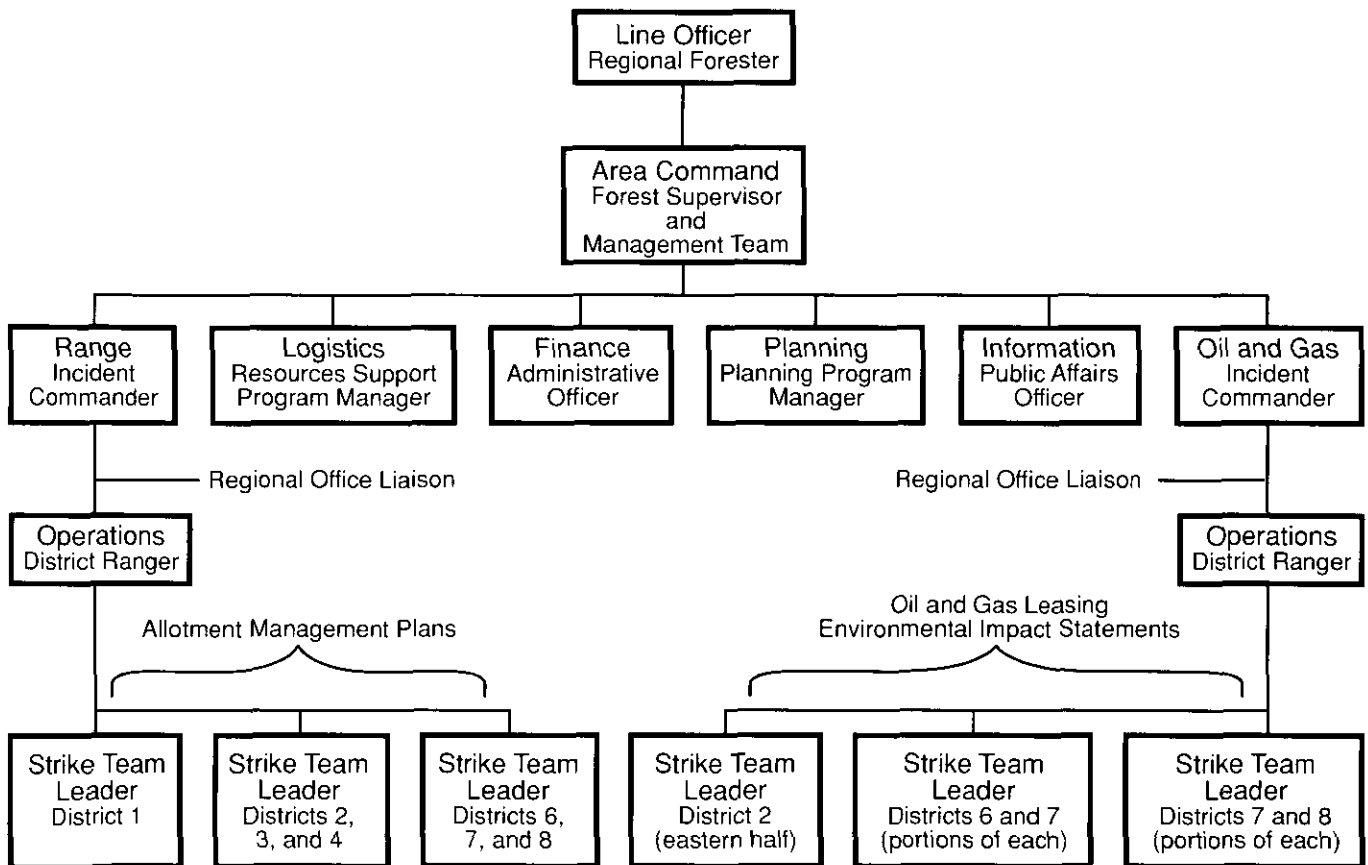


Figure 1—Custer National Forest Incident Command System (ICS) Organization. Key: District 1 = Sheyenne Ranger District, District 2 = Beartooth Ranger District, District 3 = Sioux Ranger District, District 4 = Ashland Ranger District, District 6 = Grand River and Cedar River National Grasslands, District 7 = Little Missouri National Grassland (Medora), District 8 = Little Missouri National Grassland (McKenzie). There is no District 5.

concentrate on accomplishing those priority objectives. While operating under ICS, each employee in the ICS structure has no other duties, just as though he or she were on fire assignment. When they were not needed by the ICS, employees stepped out of the ICS structure to accomplish normal forest business.

ICS also allowed functional and district boundary barriers to be removed. While in the ICS mode, the

Incident Commander and strike team leaders operate without regard for normal chain of command, functional roles, or duty assignment. The Incident Commander has authority to direct any resource assigned to him or her for any purpose needed to accomplish the task. When there is competition between the two priority efforts for the same forest resources, such as people, vehicles, or computer time, the area command resolves the conflicts.

When faced with the task of developing three environmental impact statements for the oil- and gas-leasing program and doubling or tripling the numbers of allotment management plans and their subsequent National Environmental Policy Act documents in 2 years, there were tradeoffs, even using ICS. The forest managers anticipated tradeoffs, particularly since there was to be no additional funding or staff for the ICS

effort. All programs except those needed to accomplish the priority programs in minerals and range were reduced or eliminated.

To accomplish the shift of priorities, a minimum-level program for each of the functions normally performed at the district and forest level was established. This minimum level represented the level below which the organization was not willing or able to go without literally closing the doors. Some targets would be missed, some customer services would be slighted, and many routine jobs would be dropped, it was recognized, but these were the tradeoffs the Custer National Forest was willing to accept for a 2-year period in order to cope with the two priority programs. These tradeoffs were identified up front with a "will do" and "won't do" list.

It is doubtful much progress could have been made toward evaluating public lands for oil and gas leasing or there would have been a dent in the backlog of allotment plans without the total change in program emphasis and the use of ICS. Through ICS, the Custer National Forest management was able to focus on the proper tasks and give authority to accomplish those tasks, regardless of district boundaries, former priorities, or traditional methods. ICS gave the staff the organization and procedures for managing an urgent situation that otherwise would have been impossible.

ICS 1 Year Later

After 1 year of operating with the ICS concept superimposed on the traditional line-staff organization,

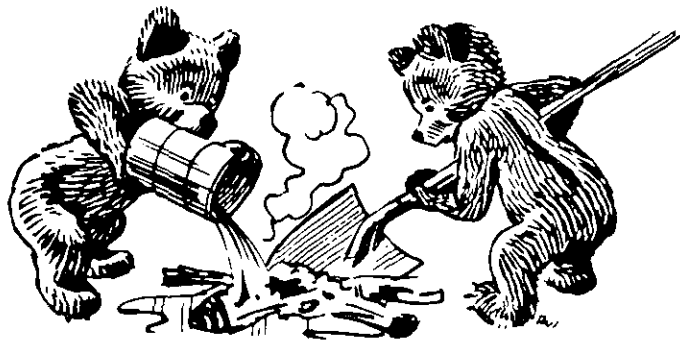
forest staff have achieved excellent results in both of the priority programs. Accomplishments have been realized that would not otherwise have been possible within a constrained budget.

The Custer National Forest did not progress without some "growing pains." Early in the process, it became clear that there were going to be ongoing challenges because many of the people on the forest were filling dual roles, one in the "regular" everyday forest programs and a second in the ICS structure. This invariably led to a delicate balancing of priorities and, in some cases, to some temporary shifting of duties to others so that both programs could accomplish what was needed to be done.

At times, there were difficulties in establishing the proper lines of communication between employees and supervisors in the traditional roles, and, at the same time, within the ICS structure. For example, district rangers in the traditional organization

report directly to the forest supervisor. Under the ICS structure, the district rangers serve as operation section chiefs and report to the Incident Commanders who, in both emphasis programs, are the forest supervisor's office staff. It required some adjustments in thinking to cope with the communication problems. But, once people were reminded to treat the incidents as though they were large fires on the unit being managed by overhead teams, the communication problems tended to resolve themselves.

Despite some early rough spots, there were many successes. District as well as functional barriers were broken, and direct lines of communication were established between the Incident Commanders and all levels of the organization. ICS allowed the forest staff to refocus their energy, time, and dollars. Carrying over a fire management strategy to nonfire missions will be an excellent choice of strategy to cope with future "burning" issues at the Custer. ■



Class A Foam Videos and Publications

The National Wildfire Coordinating Group (NWCG) Fire Equipment Working Team is producing a series of videotapes on the use of class A foam for wildland fire management. The series introduces the basic principles of foam chemicals, explains the function of mixing and foam generating equipment, and demonstrates suppressive and protective applications. Four videotapes in the series have been completed. The team is also producing a "Foam vs Fire" series of three publications (two were completed in 1992) describing class A foam, its uses, and equipment and systems needed for its application.

In 1992, San Dimas Technology & Development Center (SDTDC) published two reports on compressed air foam systems and proportioners.

Videotapes

Tapes now available through the Publications Management System are as follows:

- "Introduction to Class A Foam"—Briefly introduces class A foam technology, discussing chemistry, generating equipment, and examples of application. 1989, 13:00, VHS only, NFES No. 2073.
- "The Properties of Foam"—Explains how class A foam enhances the abilities of water to extinguish fire and to prevent fuel ignition and presents basic foam concepts including drain time, expansion, and foam type. 1992, 15:00, VHS only, NFES No. 2219.
- "Class A Foam Proportioners"—Explains how common mixing systems, including eductors and direct injection devices, add a measured amount of foam concen-

trate into a known volume of water; discusses advantages and disadvantages of the systems. 1992, 23:10, VHS only, NFES No. 2245.

- "Aspirating Nozzles"—Explains how aspirating nozzles work and introduces the variety of nozzles available. 1992, 10:13, VHS only, NFES. No. 2272.
Tapes that will be available in 1993 include:
 - "Compressed Air Foam Systems"—Explains the basics of compressed air foam systems; discusses options for water pumps, air compressors, and power sources; and demonstrates safe operation. Available Spring 1993.
 - "Tactics I: Indirect Attack"—Discusses primary objective of raising fuel moisture and demonstrates applications for protection of vegetation and structures and for constructing line from which to burn. Available Fall 1993.
 - "Tactics II: Direct Attack"—Discusses primary objective of achieving the critical flow rate and demonstrates applications of suppression including flame knockdown, extinguishment, and mopup. Available Fall 1993.

Publications

NWCG Publications. The three publications on "Foam vs Fire" are as follows:

- "Foam vs Fire: Primer"—Introduces for the firefighter the basics on class A foam and its application. October 1992, NFES 2270.
- "Foam vs Fire: Class A Foam for Wildland Fires"—Covers in depth the theory, equipment, terminology, and guidelines for use of class A foam and discusses its adaptability to present application equipment. June 1992, NFES 2246.

- "Foam vs Fire: Aerial Applications"—Explains the application of class A foam by aircraft. Scheduled publication 1994.

SDTDC Reports. The two reports on proportioners and compressed air foam systems, written by Dan W. McKenzie, mechanical engineer at SDTDC, are as follows:

- "Compressed Air Foam Systems for Use in Wildland Fire Applications"—Covers equipment arrangements for compressed air foam systems (CAFS) for use in wildland fires, guidelines to be used when acquiring CAFS units, and rules of thumb for sizing, driving, and controlling the CAFS unit. September 1992, 5100—Fire Management 9251 1203, SDTDC.
- "Proportioners for Use in Wildland Fire Applications"—Covers methods of proportioning foam concentrate into water to make a foam solution that can be used with standard nozzles, aspirating nozzles, or in a compressed air foam system for use in fighting wildland fires. September 1992, 5100—Fire Management, 9251 1204, SDTDC.

Serial Publication. "Foam Applications for Wildland & Urban Fire Management" is a serial publication of articles on foam application and technology. NWCG Fire Equipment Working Team's Task Group for International/Interagency Foams and Applications Systems, SDTDC.

Ordering Videotapes and Publications

NWCG videotapes and publications, except "Foam Applications for Wildland & Urban Fire Management," may be ordered from the Boise Interagency Fire Center. The estimated price for each tape is \$3.00 and the "Foam vs Fire" publications, \$.50. To

order, mail or fax a purchase order or requisition (no checks, money orders, or cash) to—

Boise Interagency Fire Center,
ATTN: Supply, 3905 Vista Avenue,
Boise, ID 83705; FAX 208-389-2542

For the SDTDC publications and the "Foam Applications for Wildland & Urban Fire Management," write to—
Publications, USDA Forest Service,

San Dimas Technology and
Development Center, 444 East Bonita
Avenue, San Dimas, CA 91773;
Telephone 714-599-1267 ■

Paul Schlobohm, forester, U.S.
*Department of the Interior, Bureau of
Land Management, Boise Interagency
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"Class A Foams, Generating Systems, and Tactics": A Bureau of Land Management Workshop

The Bureau of Land Management's workshop entitled "Class A Foam, Generating Systems, and Tactics" demonstrates the properties of water and foam for fire suppression, examines proportioning and foam generating devices, and describes applications and tactics. Case studies from actual fires are used to suggest tactics for direct and indirect attack, mopup and overhaul, and structure and resource protection. Instruction is a combination of lecture, hands-on demonstration, and live fire exercises.

The course is scheduled as follows:

- April 20-22, 1993
- October 19-21, 1993

The sessions will be held at the Boise Interagency Fire Center, Boise, ID. To place nominations, please contact Ron Rochna, course coordinator, at 208-389-2432 or write to Boise Interagency Fire Center, 3905 Vista Avenue, Boise, ID 83705.

A 16-hour class A foam S-course is also under development for training. The course is expected to combine material from the videos, publications, and workshop exercises to enable students to successfully use foam for fire management. ■

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Missoula Symposium: Fire's Natural Role in Parks and Wildlands

Can fire play a natural role in our parks and wildlands without causing undesirable results? "Fire in Wilderness and Park Management: Past Lessons and Future Opportunities," a symposium, held at the University of Montana, Missoula, MT, from March 30-April 1, 1993, explored many aspects of this controversial issue. Occurring 10 years after Missoula's first major wilderness fire conference and nearly 5 years after the extensive wildfires of 1988, it reexamined past fire management programs and proposed new ones.

Each day, participants considered a different aspect of the topic:

- "Are Goals and Policies Being Met?"
- "Understanding and Managing Constraints"
- "Implementing Programs and Future Opportunities (East and West)"

"Over 50 men and women were on the program as individual speakers, panel members, discussion leaders, and

session moderators," reports Jim Brown from the USDA Forest Service, who was chair of the steering committee for the conference. "They included not only wilderness and park managers from U.S. and Canadian agencies, but also environmentalists, economists, educators, ecologists, futurists, historians, journalists, politicians, preservationists, and scientists."

In addition, there were poster presentations from researchers and managers on topics as varied as "fire behavior in western fuels" and "fire-related visitor safety." Commercial vendors also displayed products to help wilderness and park professionals manage their prescribed fire and wildfire programs. According to Dick Mangan, USDA Forest Service, who was chair of the commercial exhibits, "The displays included remote-site systems to monitor weather, Geographical Information Systems and Geographical Position Systems, and portable satellite transmission technologies." ■

Donna M. Paananen, technical
writer, USDA Forest Service, North
Central Station, East Lansing, MI

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"Watch Out!" Situations

1. Fire not scouted and sized up.
2. In country not seen in daylight.
3. Safety zones and escape routes not identified.
4. Unfamiliar with weather and local factors influencing fire behavior.
5. Uninformed on strategy, tactics, and hazards.
6. Instructions and assignments not clear.
7. No communication link with crew members/supervisors.
8. Constructing lines without safe anchor point.
9. Building fireline downhill with fire below.
10. Attempting frontal assault on fire.
11. Unburned fuel between you and the fire.
12. Cannot see main fire—not in contact with anyone who can.
13. On a hillside where rolling material can ignite fuel below.
14. Weather is getting hotter and drier.
15. Wind increases and/or changes direction.
16. Getting frequent spot fires across line.
17. Terrain and fuels make escape to safety zones difficult.
18. Taking a nap near the fireline.

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