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The Wap Burn

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THE WAP BURN[1]

Prescribed Burning in Interior Wet Belt

An observation of effective use of fire-danger rating tables and fire-weather instruments in slash disposal

By S J Muraro[2]

ON SEPTEMBER 19, 1963, the B C Forest Service initiated a prescribed burn on a 400-acre portion of Salvage Timber Sale X75548, in the Interior wet belt of British Columbia. The sale is in the Enderby Ranger District, two miles north of Mabel Lake on the eastern exposure of the Wap River valley near longitude 118 degrees 40 minutes west and latitude 50 degrees 45 minutes north.

The area is generally moderately sloped (10 to 30 percent), with the exception of two steeply sloped areas (40 to 60 percent), one separating a bench from the river bottom and the other separating the bench from the moderately sloped remaining area (Figure 1). The elevation ranges from about 1,400 feet at the river bottom to about 2,700 feet at the highest point on the main haul road. A creek is the western boundary of the prescription area and the main haul road is the eastern boundary. The location of seed blocks, boundaries, topographical features and other data pertinent to this article are shown in Figure 1.

Stand Typical

The original stand was typical of Interior wet-belt forests, and consisted mainly of decadent western red cedar (*Thuja plicata* Donn) and western hemlock [*Tsuga heterophylla* (Raf.) Sarg.], with lesser volumes of Douglas fir [*Pseudotsuga menziesii* (Mirb.) Franco] and western white pine (*Pinus monticola* Dougl.).

According to B C Forest Service cruise data, gross volume on the area was 8.9 M cu. ft. per acre. After logging, in addition to the normal logging residue of tree crowns and tops, 5.94 M cu. ft. per acre of cull material remained for disposal by burning. Based on stand data (Anon. 1963) and crown-weight data by Fahnestock (1960) the estimated weight of the fuel was 131 tons per acre (Table 1). The operator was required to fell all trees eight inches dbh and larger, and the result of this salvage-logging operation can be seen in Figures 2 and 3. Prior to this burn, no slash abatement work had been done on the area.

Stations Established

Ten days prior to September 19, two weather stations were established: one in the uncut stand on seed block 3 and the other in the adjacent slash area. At each station, two sets of fuel moisture sticks were placed 12 inches above the ground and a screened hygrothermograph placed three feet above the ground. A recording rain gauge at the slash station completed the installation. Coast Fire Danger Index Tables, rather than the Interior

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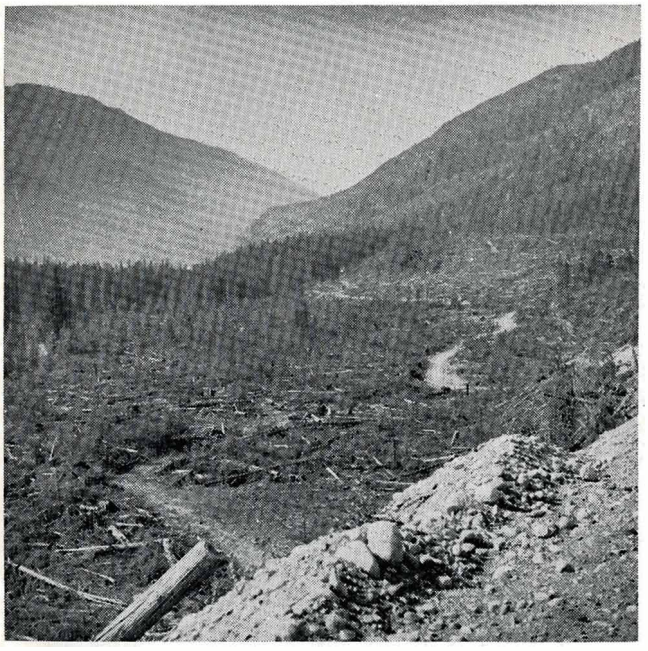

Figure 2 — View of valley bottom portion of TS X75548, looking south and showing 1961 slash area at middle right.

Figure 3 — Typical fuels along the steeper portions of Timber Sale X75548 at locations 6 and 7 on the map.

TABLE I
SUMMARY OF STAND AND FUEL COMPLEX ON TS X75548

Stand Parameters

Species	Cedar	Hemlock	W. Pine	D. Fir	
Age (yrs.)	180+	180+	200+	200+	
Height (ft)	100-120	120-140	140-170	130-150	
Av. d.b.h. (in.)	20-30	18-22	22-28	20-25	
Stems/acre	75	75	3	3	
Slash - Crowns					Total
*Crown wt. of average tree (lbs.)	607	475	399	454	—
Wt./acre (tons)	22.8	17.8	.5	.8	41.9 tons/a.

Slash - Cull Material

Volume of cull/a : 8.91 M c.f. — 2.97 M c.f. = 5.94 M c.f./a.

Weight of cull per acre at 30 lbs./c.f. tons/a.: $\frac{5940 \times 30}{2000}$ = 89 tons/a.

Total Slash Weight/Acre = 131 tons/a.

*From Fahnestock 1960.

TABLE III—BURN RATING

Ignition Location	Hazard Abatement	Seedbed Preparation
1	Poor	Poor
2	Poor	Poor
3	Fair	Poor
4	Poor	Poor
5	Poor	Fair (Spotty)
6	Good	Good
7	Good	Good
8	Good	Fair
9	Fair	Fair (Spotty)
10	Poor	Poor

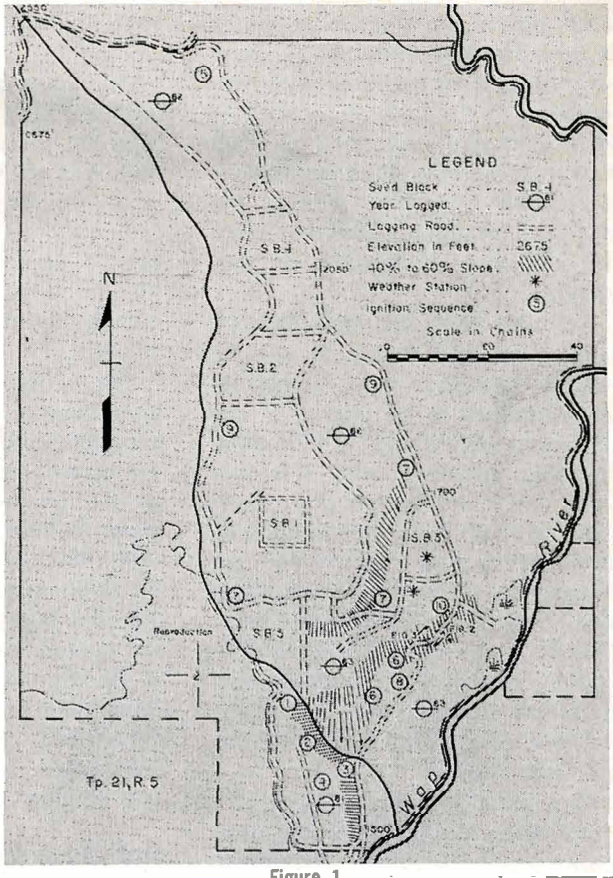

Figure 1

tables, were used to compute the danger index on the premise that Interior wet-belt conditions are similar to Coast conditions. Because slash hazard tables are not available for the Interior, Coast hazard tables for Douglas fir logging slash were used.

Difficulty was experienced in calibrating the indicator stick balance and fuel-content records may have an error of plus or minus three percent. Consequently, minor differences in the moisture content between the two sets of sticks at each of the stations are meaningless and are not discussed. Temperatures and relative humidities at the stated locations on the area were measured with a psychrometer and may vary slightly from those measured at the established weather stations (Table II).

The differences in temperature and relative humidity recorded at the two stations is of particular interest. The large amount of rain during the previous week and the occurrence of morning fog probably were mainly responsible for accentuating the expected temperature and humidity differences between open and uncut areas (Table II). The differences are maximal and can be expected to decrease as the drying regime continues. Afternoon fuel moisture content was also about five percent lower in the slash than in the uncut areas, although early morning moisture content was about 20 percent at both stations. Even in late afternoon (1600 PST) water droplets were evident on moss in the uncut stands.

Weather Not Ideal

September 19 dawned cool and clear, with fog patches lying in the valley. A decision was made to first burn the area of 1961 slash fronting reproduction in the southwest corner

TABLE II—SUMMARY OF WEATHER DATA FROM STATIONS

Date 1963	RAIN		RELATIVE HUMIDITY PERCENT*				TEMPERATURE DEGREES F.				Drought Index	Danger Index	SLASH HAZARD INDEX	
	Time	Amount	Noon		Minimum		Maximum							
	PST	Inches	Slash	Uncut	Slash	Uncut	Slash	Uncut	Slash	Uncut			Brown	Leafless
Sept. 10 to Sept. 14	2200 to 1430	Total 1.08	100	100	75	100	62	55	51	51	—	—	—	—
Sept. 15	—	—	63	80	50	73	67	58	40	44	1	0	2	1
Sept. 16	0200 to 2300	.21	95	100	77	100	53	54	47	49	0	—	—	—
Sept. 17	—	—	46	67	35	60	65	59	46	50	0	0	4	1
Sept. 18	—	—	33	60	28	53	69	63	42	48	1	2	11	7
Sept. 19	—	—	30	52	25	47	75	65	36	42	2	3	14	12
Sept. 20	—	—	33	65	32	50	72	67	39	45	3	5	15	14

* Complete recovery of relative humidity occurred each night.

of the timber sale (Figures 1 and 2). At approximately 0900 PST, a crew commenced firing southward along the perimeter of the slash at location 1, while a second crew fired a small draw at location 2. Instructions were to continue firing both sides of the road in a southward direction, after the perimeter at location 1 was secured.

At 0912 PST, the dry-bulb temperature was 57 degrees F and the relative humidity was 72 percent which changed to 64 degrees F and 50 percent respectively by 1025 PST. The wind remained calm with only slight advection currents due to the warming of the easterly exposure. The fuel-moisture stick content was approximately 15 percent. Smith flame guns, fusees, and back-pump flame throwers were used, but ignition difficulties were experienced at both areas, fire spread occurring only in extremely heavy concentrations of both fine and large fuels.

Fire spread was promoted by the forced draft of a helicopter, but upon movement of the aircraft the spread ceased. This suggests that winds of 15 to 20 mph, steep slopes, or extremely heavy concentrations of continuous fine fuels are necessary to maintain fire spread, when the moisture content of these fuels is in the range of 12 to 15 percent.

At about 1330 PST, firing was started along the road at location 3. The dry-bulb temperature was 77 degrees, relative humidity 29 percent and the wind calm. The effect of slope at this location resulted in a better burn than on the level ground at locations 1 and 2. However, due to relatively old (1961) discontinuous slash and the marginal fuel-moisture content, results were still not satisfactory.

Humidity Rising

Late in the afternoon, crews continued attempts to ignite the upper, more level area of late 1962 slash at location 4 and to burn out along the haul road at location 5, in preparation for the next day's burning. By this time (1630 PST), the humidity was rising and a gentle downslope wind prevailed. At location 5, ignition was commenced simultaneously along the main haul road and about 200 feet into the slash parallel to the road. Fire spread was sporadic and only isolated pockets were burned satisfactorily.

On September 20, after another foggy morning accentuated by smoke from the previous day's burning, the slash was allowed to dry until noon before ignition was attempted. At 1150 PST, the dry-bulb temperature was 74 degrees F, relative humidity 33 percent, fuel-moisture content approximately 12 percent and there was no wind.

The smoke pall from the previous day's burning tended to lower afternoon temperatures from those of the day before. As burning conditions improved, fires ignited the previous day began to burn with more vigour. At 1200 PST, firing commenced along the slope at locations 6 and 7, along the road edge at locations 8 and 9, and ignition was attempted at the top of the slope at location 10. The slash from 1963 logging at ignition positions 6 and 7 was typical of fuels on the eastern, steeper portions of the area (Figure 3).

Hot Slash Fire

The freshly logged, steep slopes at locations 6 and 7 ignited readily with fusees and, within several minutes, a solid line of fire was advancing rapidly up the slope. Flames extended up to 100 feet ahead of the main front and a moderately dense convection column formed at the upper edge of the slope. Radiational heat on the road (location 8), 150 yards from the burning slope, was intolerable to unprotected skin surfaces.

According to Fahnestock (1960), fire intensities in fresh slash are about 25 percent greater than in one-year-old slash. This combination of slope and fuel resulted in an extremely hot, fast-moving fire in spite of the lower, but still marginal, fuel moistures.

Air movement into the convection column above the slope and radiational heating caused the flat, relatively wet area at location 8 to burn vigorously. These factors caused the same type of burn at the west edge of seed block 3.

The flat area between locations 8 and 7, beyond the radiational heat range of the fires at location 7, supported local combustion but not fire spread. Ignition was slightly more difficult than on the slopes.

Similar results were obtained along the edge of the road at location 9 and the remaining gently sloped area, although fire spread did occur in localized areas of extremely heavy and continuous fuels.

Results

The burn on each of the ignition areas was rated for hazard abatement and seedbed preparation. The ratings are as in Table III.

Conclusions

Burning conditions were not entirely suitable on either of the days for satisfactory hazard abatement or seedbed preparation. On the 19th, failure to obtain wholly satisfactory results is attributed to reduced fuel surface area due to the nearly complete needle cast of the 1961 slash, lack of a sloping land surface, the absence of wind and the high moisture content of the larger fuels indicated by a drought index of 2.

On the 20th all of these negative factors were present, but to a lesser degree; there was less needle cast, more area was advantageously sloped and there was a lower, large-fuel moisture content (drought index 3).

On both days, slope was an important factor influencing the effectiveness of the burn. On the first day, hazard abatement on the sloped area was rated as fair and the remaining areas were poor; on the second day, hazard abatement and seedbed preparation on only the sloped areas were rated as good except for the area at location 8 where convection winds substituted for slope.

The extreme slash-hazard index and the generally sluggish fire behaviour indicates that the Coast Hazard Tables for Douglas-fir logging slash are not a good criterion of fire behaviour in the less hazardous cedar-hemlock type.

The ease of ignition using fusees seems a fairly good indicator of burning conditions. If ignition is troublesome, it is likely that free burning will not occur and delaying the burn would be advisable.

Observations on this and other prescribed burns emphasize the need for research to accurately delineate previous and current weather regimes necessary for successful prescriptions.

REFERENCES

Anon. 1936. Timber Sale File X75548, B C Forest Service Management Division, Victoria, B C.

Fahnestock, R. 1960. Logging Slash Flammability. Intermountain Forest and Range Experiment Station, Res. Paper No. 58.