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Slash Disposal Burns in Pine Patch-Cuttings . . . *a dialogue*

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ABSTRACT: Since 1963, there have been 17 slash disposal burns carried out successfully in pine patch-cuttings on the Challenge Experimental Forest, Yuba County, California. The burned units ranged from 2 to 46 acres. Costs per acre ranged from $8.42 to $60.97. Answers to questions most asked by foresters about broadcast burning pine slash are given in the form of a dialogue.

RETRIEVAL TERMS: Broadcast burning; burning costs; burning criteria; patch cutting; *Pinus ponderosa*; pretreatment; slash disposal; strip firing.

OXFORD: 436:332.3:662.

Broadcast slash burning, after patch-cut harvesting of young-growth ponderosa pine (*Pinus ponderosa* Laws.) is both feasible and practical. This conclusion is based on our experience with 17 slash-disposal burns on the Challenge Experimental Forest, Yuba County, California.

Here, in the form of a dialogue, are questions foresters most often ask about slash disposal burning in patch cutting, along with my answers.

How large were your burns? And how recent?

In 1963, we burned five areas totaling 29 acres on the Challenge Experimental Forest.[1] In 1964-65, we burned five more areas, adding 112 acres. In 1966, acreage burned totaled 195. The cutting areas ranged from 2 to 46 acres. On the average, we harvested 20,000 board feet per acre (Scribner rule). The dry weight of slash and litter weighed from 50 to 110 tons per acre. Sixty percent of this weight was fine fuel, less than 4 inches in diameter[2] (fig. 1).

What time of year did you burn? Was weather a problem?

Fall burns were planned each year, but were implemented only in 1963 and 1966. Weather shut us out in 1964 and 1965. Consequently, slash was burned in February and April 1965, and in March 1966. Weather data for Challenge from 1944 to 1966 suggest that there are one to four opportunities to burn each year between October and May. Fall burns can be successful in half the years; spring burns, every year.

Fall burns consume the most fuel (fig. 2) and simmer for several days. Winter and spring burns are usually dead within 30 hours.

Are any special pre-burning treatments, such as firelines, necessary?

Yes. A bulldozer pushed over all residual trees within the unit and built 16- to 30-foot firelines around each area. This work cost $20 per acre of clearcut. Snags within 200 feet of firelines were felled at an average cost (1964) of $2.30 each.

What precautions were required for the actual burning? Did you need an army of men and tractors?

An expert was used to direct the burning. He ignited the areas only

[1] McDonald, Philip M., and Schimke, Harry E. *A broadcast burn in second-growth clearcuttings in the north central Sierra Nevada.* U.S. Forest Serv. Res. Note PSW-99. Pacific SW. Forest & Range Exp. Sta., Berkeley, Calif., 6 pp., illus. 1966.

[2] Sundahl, William E. *Slash and litter weight after clearcut logging in two young-growth timber stands.* U.S. Forest Serv. Res. Note PSW-124. Pacific SW. Forest & Range Exp. Sta. Berkeley, Calif., 5 pp., illus. 1966.

Figure 1.--*A 10-acre clearcut on the Challenge Experimental Forest, California, with 55 tons of fine slash (<4-inch d.i.b.) per acre, and 88 tons of total slash.*

Figure 2.--*In this fire-safe unit, 74 percent of the original 100 tons of slash per acre have been removed.*

when fuel and burning conditions fell within his prescription (fig. 3) based on the Wildland Fire Danger Rating[3] system.

Sufficient equipment and trained manpower (table 1) were present to contain any escapes without calling for outside assistance. As we gained experience our manpower requirements went down. But, of course, the tougher the weather conditions the more men we needed.

Holding force deployment varied with the day's burning method[4,5] which in turn was predicated on weather, fuel, topography, and burning conditions. With strip firing on slopes, the fire boss deployed his crew and equipment at the fire head for ignition. As the first 30- to 50-foot strip along the head burned out--widening the effective fire break--a new strip was ignited. The holding crews worked down each side concentrating most men near the critical points while maintaining surveillance around the entire fire line. Tankers and tractors were held on standby at each end of the fire head. Portable and mobile radios provided good communication among all forces.

Did any of the fires get away in spite of your heavy manning?

No, not really. There was "spotting" across firelines in almost every burn, but the largest "escape" was less than one acre. The total area burned outside initial firelines for each year was:

1963.....0.8 acres
1964-65.....0.2 acres
1966.....0.3 acres

We have been guided by this premise: "If fire will burn inside an area there is a calculated risk of its burning outside." By burning only under the prescription, and taking fast suppression action, we have kept our "overburn" area low.

With "wet" season burning, how much slash were you really able to burn?

Between 70 and 90 percent of the fine fuels went up in smoke, but less than 50 percent of the coarse fuels (over 4 inches) burned.[6] This means that the areas were essentially fire-safe and the mineral soil exposed is more than adequate for direct seeding. However, the jack-strawed tops and logs (fig. 2) do slow up foot-slogging seed-sowers or planters.

What about erosion?

Soils on the Experimental Forest are in the Aiken Series. They have good internal drainage characteristics and the erosion potential is low. On slopes less than 20 percent, erosion was rarely noticeable; on steeper slopes, erosion was slight. A swift invasion of shrubs and herbs rapidly reduces the erosion potential.

You said broadcast burning is practical. What about cost? Is it cheap enough for the private landowner?

Our broadcast burning costs (table 3) were:

	Acres	Cost Per acre	Cost Per MBF
Date of burn:		(dollars)	
October 1963	29.0	60.97	2.10
February 1965	80.4	8.42	.41
April 1965	38.0	21.60	1.16
March 1966	28.5	36.24	1.37
November 1966	166.0	9.20	.73

[3]U.S. Forest Service. *Wildland fire danger rating.* U.S. Forest Serv., Pacific SW. Forest & Range Exp. Sta., Berkeley, Calif. (var. pp.) illus. 1962. (Rev. 1966.)

[4]Davis, Kenneth P. *Forest fire, control and use.* 584 pp., illus. New York: McGraw-Hill Book Co. 1959.

[5]Beaufait, William R. *Prescribed fire planning in the intermountain west.* U.S. Forest Serv. Res. Paper INT-26. Intermountain Forest & Range Exp. Sta., Ogden, Utah. 27 pp., illus. 1966.

[6]Data on file at Challenge, Calif., office of the Pacific Southwest Forest and Range Experiment Station, U.S. Forest Service.

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FINE FUEL MOISTURE

Fuel Stick Moisture Content	Relative Humidity																	
	0 6	7 9	10 12	13 15	16 20	21 27	28 34	35 41	42 48	49 53	54 58	59 63	64 68	69 72	73 76	77 82	83 87	88 92	93 100
1-4.5	1.5	1.5	2	2.5	3	4	5	5	6	7	8	8	9	10	11	12	15	16	18+
5-10	2	2.5	3	4	4	5	6	6	7	8	9	10	10	11	12	14	16	18	18+
11-15	3	4	4	5	5	6	7	7	8	9	10	11	11	12	13	15	17	18+	18+
16-20	4	5	5	6	6	7	8	8	9	10	11	12	12	13	14	16	18	18+	18+
21-25	5	6	6	7	7	8	9	9	10	11	12	13	13	14	15	17	18+	18+	18+
26-30	6	7	7	8	8	9	10	10	11	12	13	14	14	15	16	18	18+	18+	18+
31-35	7	8	8	9	9	10	11	11	12	13	14	15	15	16	17	18+	18+	18+	18+
36-40	8	9	9	10	10	11	12	12	13	14	15	16	16	17	18	18+	18+	18+	18+
41-45	9	10	10	11	11	12	13	13	14	15	16	17	18	18	18+	18+	18+	18+	18+
46+	10	11	11	12	12	13	13	14	15	16	17	17	18	18+	18+	18+	18+	18+	18+

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SPREAD FACTOR

Fine fuel moisture	Wind speed (m.p.h.)																		
	0-2	3-5	6-7	8-9	10	11	12	13	14	15	16	17	18	19	20	21	22-23	24+
1.5	14	19	23	28	33	37	40	43	47	51	55	61	66	70	74	83	89	100
2	13	17	21	26	30	34	37	40	43	47	51	56	61	65	70	77	82	92
2.5	12	15	20	24	28	32	35	38	41	44	47	52	56	61	67	72	77	86
3	11	14	18	22	26	29	32	34	38	41	44	48	52	57	62	67	73	81
4	10	13	16	20	23	26	29	31	34	37	39	43	47	51	56	60	64	72
5	8	11	14	17	20	22	25	28	30	33	35	38	41	45	49	53	57	62
6	7	9	12	14	17	19	21	24	26	28	30	33	35	39	44	47	49	54
7	6	8	10	12	15	17	19	21	22	24	26	29	31	33	39	42	44	46
8	5	7	9	11	13	14	16	17	19	20	22	25	26	29	33	36	38	41
9	5	6	7	8	10	11	13	14	16	17	18	21	22	25	28	30	32	36
10	4	5	6	7	8	9	10	12	13	15	16	17	19	20	24	25	27	29
11	3	4	5	6	7	8	9	9	11	12	12	13	15	16	19	20	22	24
12	2	3	3	4	5	6	6	7	8	9	9	10	11	13	14	15	16	18
13	1	2	2	3	3	4	4	4	5	6	6	7	8	9	10	11	12	13
14	0	0	0	0	0	1	1	2	3	3	4	4	5	6	7	7	8	8
15	0	0	0	0	0	0	0	0	0	0	1	1	1	2	3	4	4	5
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
18+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Slope Class	Wind speed (m.p.h.)																	
II 41-60%	0-1	2-4	5-6	7	8	9	10	11	12	13	14	15	16	--	17	18	19	20+
III 61%+	0	1-2	3-4	5-6	7	8	--	9	10	11	12	--	13	14	15	16	--	17+

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INTENSITY FACTOR--Timber Fuels

Fuel Stick Moisture Content	Buildup										Fuel Stick Moisture Content
	0-1.9	2-3.9	4-6.9	7-10.9	11-16.9	17-25.9	26-39.9	40-51.9	52-99.9	100+	
1.0	57	62	67	71	76	81	86	90	95	100	1.0
1.5	54	60	64	68	73	78	83	87	92	97	1.5
2.0	51	56	61	65	70	75	80	86	89	94	2.0
2.5	49	53	58	63	67	72	77	82	87	91	2.5
3.0	45	51	56	60	65	70	75	79	84	89	3.0
3.5-4.0	44	49	53	58	62	67	72	77	82	86	3.5-4.0
4.5-5.0	40	44	49	54	58	63	68	73	78	82	4.5-5.0
5.5-6.0	36	40	45	50	54	59	64	69	74	78	5.5-6.0
6.5-7.0	32	37	42	46	51	56	61	65	70	75	6.5-7.0
7.5-8.0	30	34	39	44	48	53	58	63	68	72	7.5-8.0
8.5-9.5	26	31	35	40	45	49	54	59	64	69	8.5-9.5
10-12	23	27	32	37	41	46	51	56	61	65	10-12
13-16	19	24	28	33	38	42	47	52	57	62	13-16
17-20	16	20	25	30	34	39	44	49	54	58	17-20
21+	13	17	22	27	31	36	41	46	51	55	21+

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TIMBER BURNING INDEX

Intensity Factor	Spread Factor																							
	0 2	3 4	5 6	7 8	9 10	11 12	13 14	15 16	17 19	20 22	23 25	26 28	29 31	32 34	35 39	40 44	45 49	50 54	55 60	61 67	68 74	75 81	82 90	91 100
0-12	0	0	1	1	1	2	2	2	2	3	3	4	4	5	5	6	6	7	8	9	9	10	11	
13-19	0	1	1	2	2	2	3	3	4	4	5	5	6	7	7	8	9	10	12	13	14	15	17	19
20-26	0	1	1	2	3	3	4	4	5	6	6	7	8	9	10	11	13	14	16	17	19	21	23	26
27-32	1	1	2	3	3	4	5	5	6	7	8	9	10	12	13	14	16	18	20	22	24	27	30	33
33-36	1	1	2	3	4	5	6	6	7	8	10	11	12	14	15	17	19	21	24	26	29	32	35	39
37-39	1	2	3	4	5	6	7	8	9	10	12	13	15	16	18	21	23	25	28	31	35	38	42	47
40-42	1	2	3	4	5	6	7	8	9	10	11	13	14	16	18	20	22	25	28	31	34	37	41	45
43-46	1	2	3	4	5	6	7	8	10	11	13	14	16	18	20	22	25	28	31	34	37	41	45	50
47-49	1	2	3	4	5	6	8	9	10	12	14	15	17	19	21	24	27	30	33	36	40	44	49	54
50-52	1	2	3	5	6	7	8	9	11	13	15	16	18	20	23	26	29	32	35	39	43	48	52	58
53-56	1	2	4	5	6	7	9	10	12	14	16	18	20	22	24	27	31	34	38	42	46	51	56	62
57-59	1	2	4	5	7	8	9	11	12	14	17	19	21	23	26	29	32	35	40	44	49	54	59	66
60-62	1	3	4	5	7	8	10	11	13	15	18	20	22	24	27	31	34	38	42	47	52	57	63	69
63-66	1	3	4	6	7	9	10	12	14	16	18	21	23	25	28	32	36	40	44	49	55	60	66	73
67-69	1	3	4	6	8	9	11	13	15	17	19	22	24	27	30	34	38	42	47	52	58	63	70	77
70-72	1	3	5	6	8	10	11	13	15	18	20	23	26	28	32	35	40	44	49	54	60	66	73	81
73-76	1	3	5	7	8	10	12	14	16	18	21	24	27	29	33	37	41	46	51	56	62	69	76	84
77-79	1	3	5	7	9	11	12	14	17	19	22	25	28	31	34	38	43	48	53	59	65	72	79	87
80-82	1	3	5	7	9	11	13	15	17	20	23	26	29	32	36	40	45	50	55	61	68	75	83	91
83-86	2	3	5	7	9	11	13	15	18	21	24	27	30	33	37	42	47	52	58	64	71	78	86	95
87-89	2	4	6	8	10	12	14	16	19	22	25	28	31	34	38	43	49	54	60	67	74	81	89	99
90-92	2	4	6	8	10	12	15	17	20	23	26	29	32	36	40	45	51	56	62	69	76	84	93	100
93-96	2	4	6	8	11	13	15	17	20	24	27	30	33	37	42	47	53	58	64	72	79	87	96	100
97-100	2	4	6	9	11	13	16	18	21	24	28	31	35	38	43	49	55	60	67	74	82	90	100	100

Figure 3.--*Burning prescription limits, for slash burning, Challenge Experimental Forest, 1963-1966.*

Table 1.--*Manpower requirements and hourly pay, broadcast burning, Challenge Experimental Forest, 1963-66*

Personnel	Hourly rate[1]	Oct. 22 1963[2]	Feb. 24-25, 1965	Apr. 29, 1965	Mar. 30, 1966	Nov. 9-10, 1966
	Dollars	*Number*				
Fire boss[3]:	5.60	1	1	1	1	1
Weather and fire behavior specialists[4]	4.40	2	0	0	1	0
Inter-unit liaison and safety officers[3]	4.40	2	1	1	2	1
Ignition boss[3]:	4.70	1	1	1	1	1
Ignition team	3.30	6	4	5	4	4
Line boss[3]:	4.70	1	0	1	1	0
Holding crew boss[3]	3.80	2	1	3	3	2
Holding crewmen	3.10	15	2	3	6	7
Tank truck operators	3.30	4	1	4	5	3
Tanker crewmen	3.10	4	1	4	5	4
Equipment boss[3]:	4.40	2	0	1	1	1
Tractor operators	4.40	2	0	1	1	1
Water wagon operators	3.30	1	0	0	0	0
Fallers	3.60	2	0	0	0	0
Totals	--	45	12	25	31	25

[1]Hourly rate adopted for comparing costs in different years. Based on 1966 rates with annual leave included.

[2]McDonald and Schimke. Op. cit.

[3]Overhead personnel.

[4]Support personnel.

Table 2.--*Manpower and equipment needs and direct costs of slash-disposal burns, Challenge Experimental Forest, California, 1963-66*[1]

Items	October 22, 1963		February 24-25, 1965		April 29, 1965		March 30, 1966		November 9-10, 1966	
	Number[2]	*Dollars*	*Number*	*Dollars*	*Number*	*Dollars*	*Number*	*Dollars*	*Number*	*Dollars*
Manpower:										
Overhead	9	357	4	250	8	232	9	362	6	508
Support	2	70	0	0	0	0	1	31	0	0
Crew	34	891	8	311	17	412	21	465	19	1,102
Total	45	3/1,318	12	561	25	644	31	858	25	1,610
Equipment:										
Pickups	8	(4/)	4	15	4	7	3	8	8	26
Tankers (300-500 gal.)	4	(4/)	1	81	4	80	5	82	3	49
Tractors (110-120 d.b.-h.p.)	2	(4/)	0	0	1	65	1	65	1	106
Water wagon (4,000 gal.)	1	(4/)	0	0	0	0	0	0	0	0
Total	--	2/353	--	96	--	152	--	155	--	181
Supplies:										
Torch fuel, fusees, misc.	--	2/97	--	20	--	25	--	20	--	20
Total cost	--	3/1,768	--	677	--	821	--	1,033	--	1,811

[1]Includes cost of patrol and mopup. A 'standard' was used to compare costs between years. Preparation costs for planning, preburn operations and 'dry-runs' could add 10 to 50 percent to a single burn. Preparation costs for these operations averaged less than 15 percent.

[2]McDonald and Schimke. Op. cit. [3]Differs from published values because 'standard' wage rates are used. [4]Detailed breakdown of cost not available.

The variability in cost stems mainly from the size of burn units and crew size, as dictated by burning conditions. We used U.S. Forest Service equipment use rates and "standard" manpower pay-rates commensurate with job assignments.

Did you have any help in your burns?

We've had impressive cooperation on our burns: Plumas National Forest, California Division of Forestry, and the Soper-Wheeler Company--to list only a few.

Any final words?

On steeper slopes fire may be the only means of slash disposal. Elsewhere machine piling costs $30 to $50 per acre. Compare these costs with our slash burning costs. If you do decide to use broadcast burning, start slowly, and hire an expert!

The Author

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