



**United States
Department of
Agriculture**

Forest
Service

North Central
Forest Experiment
Station

General Technical
Report **NC-77**



Stereo Photos for Evaluating Jack Pine Slash Fuels

Richard W. Blank



STEREO PHOTOS FOR EVALUATING JACK PINE SLASH FUELS

Richard W. Blank, *Fire Research Technician*
East Lansing, Michigan

Jack pine (*Pinus banksiana* Lamb.) is one of the most fire-prone communities in the Northeastern and North Central States. Land managers who prescribe fire in jack pine forests must recognize the importance of various fuels in order to predict fire behavior and plan for fire control and smoke management.

Where logging has taken place in the jack pine community, the most important fuel component is slash or logging residue. The size, depth, and distribution of jack pine slash strongly influence fire behavior. The small sizes are particularly important in the Lake States because residue from pulpwood operations tends to be under 3 inches in diameter.

Managers also need to know about the other fuels in the jack pine community—litter, duff, sedges, grasses, forbs, shrubs, and trees. In Michigan, sedges¹ (*Carex* spp.) are often a major carrier of surface fire.

The purpose of the present photo series is to provide land managers with fuel amounts, size classes, heights, and vertical distributions so that they can make fuel management plans and decisions in cut-over jack pine without resorting to time-consuming and expensive sampling. The photos should also be helpful to those involved in smoke management or fire training.

Since 1976, fire managers in the western United States have used photographs (Maxwell and Ward 1976a, 1976b, 1979) and stereo photographs (Ryan and Johnson 1979) in conjunction with the planar intercept method of fuel sampling (Brown 1974) for residue management. In Pennsylvania a photo series for quantifying hardwood logging residue is being prepared.²

¹Sedges and grasses will be referred to as "grasses" in this paper.

METHODS

To represent a useful range of fuel conditions, we selected photo points on the basis of slash age, loading, continuity, and distribution. (Areas that were windrowed, roller chopped, or used as landings were avoided.) We chose seven areas of 1-year-old slash with loadings of 2, 8, 10, 16, 23, 29, and 31 tons/acre and two 3-year-old areas with loadings of 12 and 17 tons/acre. We had intended to burn all areas, document burning conditions, and remeasure to provide fuel amounts left after burning. At the time that this photo series was completed, however, only the 3-year-old, 17-tons/acre plot had been burned. Post burning appearance and data are given for the burned plot in Photo 10.

We modified Brown's planar intercept sampling method to keep all randomly selected sampling planes within the camera's field of view. To emphasize the small fuels, we established a minimum of 18 sample points in the 0- to 1-inch size class. Each of these sampling planes was 8 feet long. This method ensured that the results were within ± 15 percent of the true value.

For each plot, we laid out a triangular sampling area measuring 160 feet along the sides and approximately 75 feet along the base (fig. 1). Each sampling area enclosed about 1/8 of an acre. The triangular area was truncated at the point where it was 8 feet wide, the nearest point in the camera's view. The camera was positioned 10 feet beyond that

²Wilcox, Fred. Photo series for quantifying forest residues in the Pennsylvania hardwoods. Unpublished manuscript on file at the Pennsylvania Bureau of Forestry, Harrisburg, Pennsylvania.

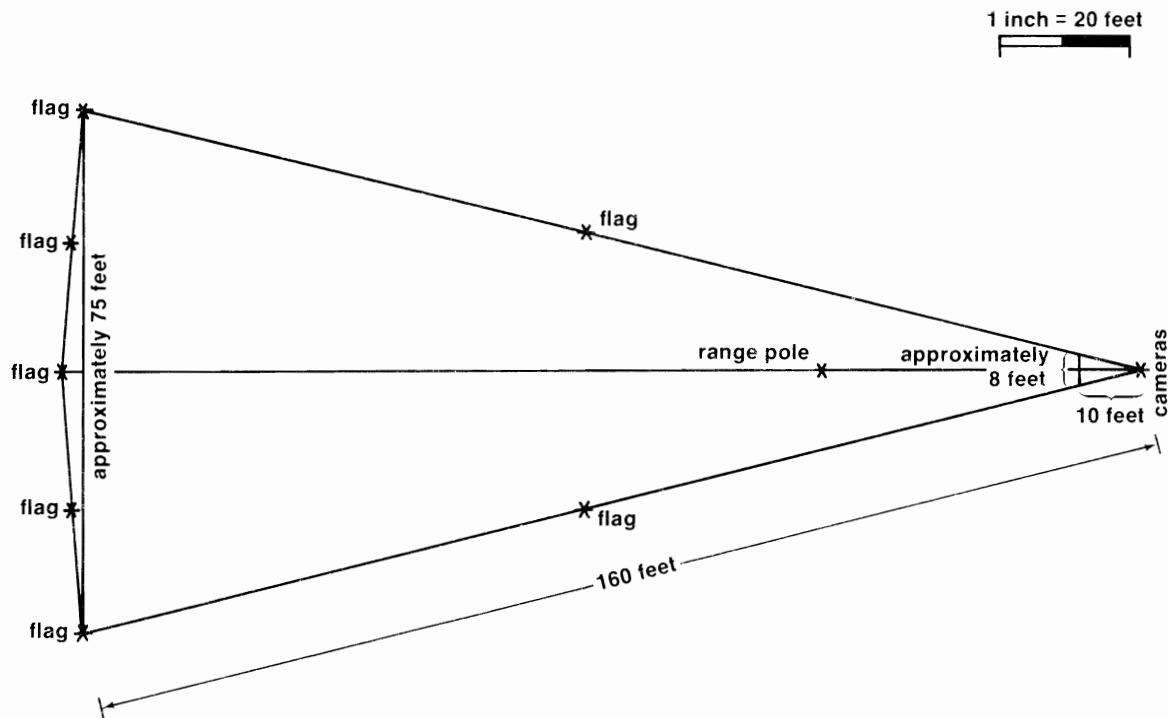


Figure 1.—Plot sampling area and camera's field of view.

point, 9 feet off the ground. (It did not view the first 10 feet.) To delineate the field of view,³ we set flags at 85 feet along the sides and on the base 160 feet from the camera. An 8-foot range pole, marked at 1-foot intervals, was centered in the field of view 50 feet from the camera lens to show perspective. To obtain the stereo pairs, we used two cameras set 12 inches apart.

We randomly selected at least five 1/4 mil-acre subsamples within the 1/8-acre sampling area and clipped, sorted, and measured grasses, forbs, and shrubs. Litter and duff depth measurements and samples were taken from the center of each 1/4 mil-acre plot. All samples were oven-dried at 105°C for 24 hours and then weighed.

³The field of view and sampling method are approximately the same as suggested by the U.S. Department of Agriculture Forest Service, 1974, *National Fuel Preliminary Draft*, 27 p., on file at U.S. Department of Agriculture Forest Service, Washington, D.C.

The prescribed burn on the plot with 3-year-old slash, 17 tons/acre was conducted by crews from the Michigan Department of Natural Resources (DNR). We sampled within 24 hours of the burn, using the same method as used for pre-burn sampling. Timber stand and logging information was obtained from the Michigan DNR and U.S. Forest Service District Offices.

HOW TO USE THIS PHOTO SERIES

This photo series can be used in the field to obtain a quick estimate of the characteristics of jack pine slash and other fuels.

1. If the pre-logging basal area is available, use the following equation (Roussopoulos and Johnson 1975) to get a rough idea of the slash loading on the area of interest:

$$\text{Pre-logging basal area (sq ft/acre)} \times 0.15 = \text{slash loading (tons/acre)}.$$

Using this slash loading figure, and the age of the slash (either 1 or 3 years), turn to the photo illustrating the same slash age and loading. This photo should show about what you see in your area.

If no pre-logging basal area is available, choose the photo that most closely illustrates what you see on the ground. Look at the depth of the slash and height of the other fuels on the photo. They should roughly approximate the heights and depths on the ground.

2. To double check, use a pair of stereo-glasses and examine the stereo photos to determine more closely the heights and depths of the slash and other fuels to see that they roughly match the area you are in.
3. Once you have matched the area in the field with the photos, you can read from the corresponding data sheet the amount per acre of the various sizes of slash and of other fuels—grasses, litter, etc. You can also find the heights and depths of slash and the other fuels. These may be usable in fire behavior equations.
4. The values, of course, are simply estimates; they are not exact. Especially variable are the fuel loadings other than slash. For greater accuracy you would have to make field measurements.
5. The stand information and method of harvest given on the data sheets may also be helpful in matching a photo with what you see on the ground.

LITERATURE CITED

- Brown, James K. Handbook for inventorying downed woody material. Gen. Tech. Rep. INT-16. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1974. 24 p.
- Maxwell, Wayne G.; Ward, Franklin R. Photo series for quantifying forest residues in the: coastal Douglas-fir—hemlock type, coastal Douglas-fir—hardwood type. Gen. Tech. Rep. PNW-51. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1976a. 103 p.
- Maxwell, Wayne G.; Ward, Franklin R. Photo series for quantifying forest residues in the: ponderosa pine type, ponderosa pine and associated species type, lodgepole pine type. Gen. Tech. Rep. PNW-52. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1976b. 73 p.
- Maxwell, Wayne G.; Ward, Franklin R. Photo series for quantifying forest residues in the: Sierra mixed conifer type, Sierra true fir type. Gen. Tech. Rep. PNW-95. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1979. 79 p.
- Roussopoulos, Peter J.; Johnson, Von J. Help in making fuel management decisions. Res. Pap. NC-112. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1975. 16 p.
- Ryan, Kevin C.; Johnson, R. E. Stereo photographs aid residue management. U.S. Department of Agriculture Forest Service, Fire Management Notes 40:7-9; 1979.

Data sheet 1.—Approximate fuel amounts in areas similar to Photo 1.

Fuels	Tons/acre	Height or depth
		<i>Inches</i>
Slash		
Branches		
0.0 -0.25	0.5	
0.26-1.0	1.0	
1.01-3.0	0.2	
3.0 +	—	
Needles	0.3	
Subtotal	2.0	(Total weight lies within 1 foot of ground)
Grasses	0.4	7.0
Forbs	<0.05	4.0
Shrubs	0.4	7.0
Litter	2.8	0.4
Duff	6.8	0.4
Subtotal	10.4	
Grand Total Fuel Loading	12.4	

Location and Date: Sec 22, T25N,R1W, Mio District, Huron-Manistee National Forest; June 1979.

Stand Information: 50-year-old jack pine with scattered red oaks. Site index for jack pine was 45; basal area 30 square feet/acre; average volume 1.6 cords/acre. Photo was taken from same point as Photo No. 2 (1-year-old, 8 tons/acre) after almost all 1-inch diameter or larger slash had been removed.

Method of Harvest: Feller-buncher.



Photo 1.—*One-year-old slash, 2 tons/acre.*

Data sheet 2.— Approximate fuel amounts in areas similar to Photo 2.

Fuels	Tons/acre	Height or depth
		<i>Inches</i>
Slash		
Branches		
0.0 -0.25	1.3	
0.26-1.0	1.0	
1.01-3.0	2.1	
3.0+	2.9	
Needles	0.6	
Subtotal	7.9 ¹	
Grasses	0.4	7.0
Forbs	<0.05	4.0
Shrubs	0.4	7.0
Litter	2.8	0.4
Duff	6.8	0.4
Subtotal	10.4	
Grand Total Fuel Loading	18.3	
Vertical distribution of slash:	Height (feet)	Tons/acre
	0-1	7.5
	1-2	0.4

Location and Date: Sec 22, T25N,R1W, Mio District, Huron-Manistee National Forest; June 1979.

Stand Information: 50-year-old jack pine with scattered red oaks. Site index for jack pine was 45; basal area 30 square feet/acre; average volume 1.6 cords/acre.

Method of Harvest: Feller-buncher.

Time of Harvest: Winter, 1978-1979.



Photo 2.—*One-year-old slash, 8 tons/acre.*

Data sheet 3.— Approximate fuel amounts in areas similar to Photo 3.

Fuels	Tons/acre	Height or depth
		<i>Inches</i>
Slash		
Branches		
0.0 -0.25	1.4	
0.26-1.0	1.6	
1.01-3.0	2.5	
3.0 +	4.2	
Needles	0.7	
Subtotal	10.4 ¹	
Grasses	0.2	7.0
Forbs	—	—
Shrubs	0.8	6.0
Litter	6.3	0.7
Duff	4.2	0.3
Subtotal	11.5	
Grand Total Fuel Loading	21.9	

¹Vertical distribution of slash:

Height (feet)
0-1

Tons/acre
10.4

Location and Date: Sec 22, T25N,R1W, Mio District, Huron-Manistee National Forest; July 1979.

Stand Information: 50-year-old jack pine with scattered red oaks. Site index for jack pine was 45; basal area 30 square feet/acre; average volume 1.6 cords/acre.

Method of Harvest: Feller-buncher.

Time of Harvest: Winter, 1978-1979.



Photo 3.—*One-year-old slash, 10 tons/acre.*

Data sheet 4.—Approximate fuel amounts in areas similar to Photo 4.

Fuels	Tons/acre	Height or depth Inches
Slash		
Branches		
0.0 -0.25	2.8	
0.26-1.0	3.7	
1.01-3.0	6.3	
3.0 +	0.6	
Needles	2.4	
Subtotal	15.8 ¹	
Grasses	0.1	9.0
Forbs	—	—
Shrubs	<0.05	6.0
Litter	6.0	0.7
Duff	9.0	0.4
Subtotal	15.1	
Grand Total Fuel Loading	30.9	

¹Vertical distribution of slash:

Height (feet)	Tons/acre
0-1	14.5
1-2	1.1
2-3	0.2

Location and Date: Sec 30, T25N,R4W. Roscommon Forest area, Michigan Department of Natural Resources; September 1980.

Stand Information: 50-year-old jack pine. Site index for jack pine was 50; basal area 180 square feet/acre; average volume 14 cords/acre.

Method of Harvest: Feller-buncher.

Time of Harvest: Winter and Spring, 1979.



Photo 4.—*One-year-old slash, 16 tons/acre.*

Data sheet 5.— Approximate fuel amounts in areas similar to Photo 5.

Fuels	Tons/acre	Height or depth
		<i>Inches</i>
Slash		
Branches		
0.0 -0.25	2.8	
0.26-1.0	6.6	
1.01-3.0	6.0	
3.0 +	5.7	
Needles	1.7	
Subtotal	22.8 ¹	
Grasses	<0.05	5.0
Forbs	—	—
Shrubs	—	—
Litter	3.7	0.3
Duff	12.0	0.5
Subtotal	15.7	
Grand Total Fuel Loading	38.5	

¹Vertical distribution of slash:

Height (feet)	Tons/acre
0-1	22.0
1-2	0.7
2-3	0.1

Location and Date: Sec 22, T22N,R1W, Cadillac District, Huron-Manistee National Forest; September 1979.

Stand Information: 40-year-old jack pine plantation. Site index for jack pine was 50; basal area 170 square feet/acre; average volume 23 cords/acre. This was part of a 168-acre plantation that was ice-damaged.

Method of Harvest: Feller-buncher and chain saw.

Time of Harvest: Winter and Spring, 1978-1979.



Photo 5.—*One-year-old slash, 23 tons/acre.*

Data sheet 6.— Approximate fuel amounts in areas similar to Photo 6.

Fuels	Tons/acre	Height or depth
		<i>inches</i>
Slash		
Branches		
0.0 -0.25	4.7	
0.26-1.0	8.8	
1.01-3.0	7.0	
3.0 +	5.5	
Needles	2.8	
Subtotal	28.8 ¹	
Grasses	—	—
Forbs	—	—
Shrubs	—	—
Litter	3.1	0.3
Duff	14.6	0.9
Subtotal	17.7	
Grand Total Fuel Loading	46.5	

¹Vertical distribution of slash:

Height (feet)	Tons/acre
0-1	26.6
1-2	2.2
2-3	<0.05
3-4	<0.05

Location and Date: Sec 22, T22N,R1W, Cadillac District, Huron-Manistee National Forest; September 1979.

Stand Information: 40-year-old jack pine plantation. Site index for jack pine was 50; basal area 170 square feet/acre; average volume 23 cords/acre. This was part of a 168-acre plantation that was ice-damaged.

Method of Harvest: Feller-buncher and chain saw.

Time of Harvest: Winter and Spring, 1978-1979.



Photo 6.—*One-year-old slash, 29 tons/acre.*

Data sheet 7.—Approximate fuel amounts in areas similar to Photo 7.

Fuels	Tons/acre	Height or depth <i>Inches</i>
Slash		
Branches		
0.0 -0.25	3.2	
0.26-1.0	9.9	
1.01-3.0	6.2	
3.0 +	9.8	
Needles	2.0	
Subtotal	31.1 ¹	
Grasses	0.1	5.0
Forbs	—	—
Shrubs	—	—
Litter	2.1	0.3
Duff	9.8	0.5
Subtotal	12.0	
Grand Total Fuel Loading	43.1	

¹Vertical distribution for slash:

Height (feet)	Tons/acre
0-1	26.8
1-2	3.4
2-3	0.7
3-4	0.1

Location and Date: Sec 22, T22N,R1W, Cadillac District, Huron-Manistee National Forest; August 1979.

Stand Information: 40-year-old jack pine plantation. Site index for jack pine was 50; basal area 170 square feet/acre; average volume 23 cords/acre. This was part of a 168-acre plantation that was ice-damaged.

Method of Harvest: Feller-buncher and chain saw.

Time of Harvest: Winter and Spring, 1978-1979.



Photo 7.—*One-year-old slash, 31 tons/acre.*

Data sheet 8.— Approximate fuel amounts in areas similar to Photo 8.

Fuels	Tons/acre	Height or depth
		Inches
Slash		
Branches		
0.0 -0.25	0.9	
0.26-1.0	3.2	
1.01-3.0	5.5	
3.0 +	2.1	
Needles	0.1	
Subtotal	11.8 ¹	
Grasses	0.5	8.0
Forbs	—	—
Shrubs	0.1	5.0
Litter	4.5	0.4
Duff	9.3	0.5
Subtotal	14.4	
Grand Total Fuel Loading	26.2	
¹ Vertical distribution of slash:		
	Height (feet)	Tons/acre
	0-1	11.5
	1-2	0.3

Location and Date: Sec 8, T24N,R2W, Roscommon Forest area, Michigan Department of Natural Resources; August 1979.

Stand Information: 46-year-old jack pine with scattered red oaks. Site index for jack pine was 50; basal area 180 square feet/acre. After logging, firewood was taken from tops resulting in a low loading for slash greater than 3 inches in diameter.

Method of Harvest: Feller-buncher and chain saw.

Time of Harvest: 1976.



Photo 8.—*Three-year-old slash, 12 tons/acre.*

Data sheet 9.— **Approximate fuel amounts in areas similar to Photo 9.**

Fuels	Tons/acre	Height or depth
		<i>Inches</i>
Slash		
Branches		
0.0 -0.25	1.7	
0.26-1.0	4.6	
1.01-3.0	5.8	
3.0 +	4.7	
Needles	0.2	
Subtotal	17.0 ¹	
Grasses	0.5	9.0
Forbs	—	—
Shrubs	0.6	7.0
Litter	6.8	0.5
Duff	10.5	0.9
Subtotal	18.4	
Grand Total Fuel Loading	35.4	

¹Vertical distribution of slash:

Height (feet)	Tons/acre
0-1	15.7
1-2	1.2
2-3	0.1

Location and Date: Sec 8, T24N,R2W, Roscommon Forest area, Michigan Department of Natural Resources; August 1979.

Stand Information: 46-year-old jack pine. Site index was 50; basal area 180 square feet/acre.

Most of the larger material is hidden in the grass.

Method of Harvest: Feller-buncher and chain saw.

Time of Harvest: 1976.



Photo 9.—*Three-year-old slash, 17 tons/acre.*

Data sheet 10.—Approximate fuel amounts in areas similar to Photo 10.

Fuels	Tons/acre	Height or depth <i>Inches</i>
Slash		
Branches		
0.0 -0.25	0.1	
0.26-1.0	0.3	
1.01-3.0	0.5	
3.0 +	1.7	
Needles	—	
Subtotal	2.6	(Total weight lies within 1 foot of ground)
Grasses	—	—
Forbs	—	—
Shrubs	—	—
Litter	{ 1.7	{ 0.1
Duff		
Subtotal	1.7	
Grand Total Fuel Loading	4.3	

Location and Date: Same as photo 9, only after burning; October 1979.

Prescribed Burn Information: The prescribed burn was on 9/19/79 after 28 days since the last rain of 0.56 inch. Perimeter ignition was used for lighting the fire at 13:35; ignition was complete at 14:05. At 12:30 the temperature was 58°, wind 6 MPH, relative humidity 38 percent, and cloud cover 0 percent. Using NFDRS Model C, the spread component was 1, energy release component was 16, ignition component was 28, and burning index was 5. All material 2.75 inches in diameter and smaller was consumed in the burn.



Photo 10.—*Three-year-old slash, 3 tons/acre (post-burn).*

Blank, Richard W.

Stereo photos for evaluating jack pine slash fuels. Gen. Tech. Rep. NC-77. St Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1982. 23 p.

Describes a quick, visual method for estimating jack pine logging residue and other fuels. The method uses a series of large color photographs and stereo pairs as well as data sheets that detail size classes and loadings of the logging slash and other fuels.

KEY WORDS: Residue management, stereo photos, slash loadings, fuel loadings, planar intersect sampling method, prescribed burn.