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Photo Series for Quantifying Natural Forest Residues: Southern Cascades, Northern Sierra Nevada

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Natural fuels, by definition, are those downed and dead woody materials deposited on the forest floor entirely through natural processes, such as blowdown, self-pruning, disease, needlefall, and fire. The residue is made up of stems, branches, twigs, and needles of varying sizes in diverse amounts and arrangements, and constitutes a fuel complex.

Much of the debris has accumulated as a result of the policies of fire exclusion and suppression that dominated the thinking of resource managers in past years. These policies prevented periodic cleansing of the dead materials and contributed to a potentially greater hazard by allowing the fuels to build up. Resource managers must assess and deal with these conditions in the light of changing attitudes toward the role of fire in forest management.

This collection of photo series is designed to provide a reliable, easy-to-use tool for quantifying natural fuel complexes. Inventories made in such a way can provide base data for timber sale plans, wilderness management, fuel treatment plans, residue energy potential estimates, and other resource and protection needs. Although inventory techniques such as

the planar intersect method are very useful when a high degree of accuracy is needed, they can be time consuming and costly when applied extensively. The photo series can be used to make fast, easy, and inexpensive quantifications of residue that are adequate for most management needs.

Each photo is accompanied by a data sheet listing

- Fuel size classes with measured weights and volumes
- Other pertinent residue measurements
- Stand characteristics

The photo series is based on the work of Maxwell and Ward (1976a, 1976b) on the visual quantification of forest residues. Their publications and subsequent ones such as Koski and Fischer's (1979) were convincing arguments for the effectiveness of the photo inventory system.

The format of the natural fuels series follows that of Maxwell and Ward. Information was developed in the following manner:

- Areas to be inventoried were typical examples of undisturbed stands and were chosen from aerial photos and compartment inventory maps.

- Stands were selected to fit the classification categories of Parker and Matyas (1979).
- Inventory areas were evaluated by field personnel to determine suitability for inclusion in the photo series.
- Sample plots were established and photographed according to guidelines proposed by the Forest Service, U.S. Department of Agriculture (1975).
- Fuel inventories were accomplished following procedures described by Brown (1974).
- Tree crown weights were derived from Harrell (1978), tree volumes from MacLean and Berger (1976), and bole and bark weights from Brown and others 1977.

Using the Photo Series

To make the visual inventory of downed residue, view the field of observable fuel characteristics and compare them with the photos as follows:

1. Observe each characteristic of the residue on the ground, that is, the size, arrangement, etc.
2. Select a photo which nearly matches the observed characteristic *or* two photos that appear to bracket it.
3. Obtain the quantitative value for the characteristic being estimated from the data sheet accompanying the selected photo (or interpolate value between photos).

Repeat the three steps for each characteristic for fuels in the 0- to 3-inch diameter range. Use steps 2 and 3 for fuels 3 inches and more in diameter.

If the general area being inventoried has zones of obvious differences in residue loading, consider making separate determinations for each zone which can then be weighted and cumulated for the entire area.

Residue characteristics not distinguishable in the photos are duff and litter depth and proportions of sound and rotten residue. If you desire values for these characteristics in an inventory, you must derive them from independent sampling or observations. A table of log weights is provided for rough estimates of sound, downed fuels of 4 inches or greater d.b.h. Bole volume and weight excludes bark, 1-foot stump, and 4-inch top. If you wish more precise determinations, consult Anderson (1978) for supplemental aids.

The fine fuels ranging from up to 0.25 inch in diameter are difficult to view in the photos. Estimate the 0.25 to 1-inch fuels first, then assign the corresponding 0- to 0.25-inch value from the data sheet for the same photo (or for the interpolation between two photos). This is an assumption that downed natural fuel in the 0.25 to 1-inch range corresponds uniformly in value to that in the 0- to 0.25-inch range.

Fire behavior tables applicable to this photo series are available from Fuels Management Staff, Almanor Ranger District, Box 767, Chester, Calif. 96020.

Key to Codes

Each picture and the facing data sheet carry a code consisting of the following elements:

- Number denoting fuel loading level, ranging from lightest loading to heaviest loading, in the photo series.
- Symbol denoting vegetative series, where
 - MP = Mixed Conifer—Pine
 - MF = Mixed Conifer—Fir
 - PP = Ponderosa Pine
 - LP = Lodgepole Pine
 - WF = White Fir
 - RF = Red Fir
 - MH = Mountain Hemlock
- Number denoting forest size class of the photo series, where
 - 1 = <5 inches d.b.h.
 - 2 = 5 to 11 inches d.b.h.
 - 3 = 12 to 20 inches d.b.h.
 - 4 = >20 inches d.b.h.

Ex.: 1-LP-2 is the first photo (lightest fuel loading) in the series for lodgepole pine, in size class 2 (5 to 11 inches d.b.h.).

List of Plant Species Cited

California black oak *Quercus kelloggii* Newb.
Douglas-fir *Pseudotsuga menziesii* (Mirb.) Franco
Incense-cedar *Libocedrus decurrens* Ton.
Jeffrey pine *Pinus jeffreyi* Grev. & Balf.
Ponderosa pine *Pinus ponderosa* Laws.
California red fir *Abies magnifica* A. Murr.
Sugar pine *Pinus lambertiana* Dougl.
White fir *Abies concolor* (Gord. & Glend.) Lindl.
Lodgepole pine *Pinus contorta* var. *murrayana*
(Grev. & Balf.)
Mountain hemlock *Tsuga mertensiana* (Bong.) Carr

Metric Conversions

1 acre = 0.4047 hectare
2.471 acres = 1 hectare
1 cubic foot = 0.02832 cubic meter
35.31 cubic feet = 1 cubic meter
1 foot = 0.3048 meter
3.281 feet = 1 meter
1 inch = 2.54 centimeters
0.3937 inch = 1 centimeter
1 ton (short) = 0.907 ton (metric)
1.102 tons (short) = 1 ton (metric)

References

- Anderson, Hal E. **Graphic aids for field calculation of dead, down forest fuels.** USDA Forest Service Gen. Tech. Rep. INT-45. Ogden, UT: Intermountain Forest and Range Experiment Station; 1978. 21 p.
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- Parker, Ike; Matyas, Wendy. **CALVEG, a classification of California vegetation,** rev. San Francisco, CA: California Region, Forest Serv., U.S. Dep. Agric. 1981; 159 p.
- U.S. Department of Agriculture, Forest Service. **National fuel classification and inventory system, preliminary draft.** Washington, D.C. 1974. 61 p.

Log Weights (Tons)

	Length of log (feet)																
	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Diameter of log (inches)	4	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04
	6	.02	.02	.03	.03	.04	.04	.05	.05	.06	.06	.07	.07	.08	.08	.08	.09
	8	.04	.04	.05	.06	.07	.08	.09	.1	.1	.1	.1	.1	.2	.2	.2	.2
	10	.06	.07	.08	.1	.1	.1	.1	.2	.2	.2	.2	.2	.2	.2	.3	.3
	12	.08	.1	.1	.1	.2	.2	.2	.2	.2	.3	.3	.3	.3	.3	.4	.4
	14	.1	.1	.2	.2	.2	.2	.3	.3	.3	.4	.4	.4	.4	.5	.5	.5
	16	.1	.2	.2	.2	.3	.3	.3	.4	.4	.5	.5	.5	.6	.6	.6	.7
	18	.2	.2	.3	.3	.4	.4	.4	.5	.5	.6	.6	.6	.7	.8	.8	.8
	20	.2	.3	.3	.4	.4	.5	.5	.6	.7	.7	.8	.8	.9	.9	1.0	1.0
	22	.3	.3	.4	.5	.5	.6	.7	.7	.8	.9	.9	1.0	1.0	1.0	1.2	1.3
	24	.3	.4	.5	.6	.6	.7	.8	.9	1.0	1.0	1.2	1.3	1.3	1.4	1.5	1.6
	26	.4	.5	.6	.6	.7	.8	1.0	1.0	1.0	1.2	1.3	1.4	1.5	1.6	1.7	1.8
	28	.4	.5	.6	.7	.9	1.0	1.0	1.2	1.3	1.4	1.5	1.6	1.7	1.8	2.0	2.0
	30	.5	.6	.7	.9	1.0	1.0	1.2	1.3	1.5	1.6	1.7	1.8	2.0	2.0	2.2	2.3
	32	.6	.7	.8	1.0	1.0	1.3	1.4	1.5	1.7	1.8	2.0	2.0	2.2	2.4	2.5	2.7
	34	.6	.8	.9	1.0	1.3	1.4	1.6	1.7	2.0	2.0	2.2	2.4	2.5	2.7	2.8	3.0
	36	.7	.9	1.0	1.3	1.4	1.6	1.8	2.0	2.0	2.3	2.5	2.7	2.8	3.0	3.2	3.4
	38	.8	1.0	1.0	1.4	1.5	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.3	3.5	3.7
	40	.9	1.0	1.3	1.5	1.7	2.0	2.2	2.4	2.6	2.8	3.0	3.3	3.5	3.7	4.0	4.4

MIXED CONIFER—PINE

Size Class 4

A Series of Five Levels

CALVEG Series: **Mixed Conifer—Pine**
Code Symbol: **MP**

Dominant Species: **ponderosa pine**
Associates: **incense-cedar, white fir, douglas-fir, sugar pine**

Reminders to users:

- The marker in these photos is 1 foot square and the pole is painted in contrasting colors at 1-foot intervals to provide perspective.
- Stumps are not included in residue quantities.
- Rotted residue is that which would come apart or splinter when kicked.

1-MP-4

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Data Sheet 1-MP-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.1	9
0.26- 1.0	1.5	98
1.1 - 3.0	.8	66
3.1 - 9.0	1.5	150
9.1 -20.0	0	0
20.1 +	0	0
Total	3.9	323

Comments:

Stand Information

Average diameter	(inches)	35
Average tree height	(ft)	90
Average crown length		40
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	2105
Bole weight per tree		5109
Bark weight per tree		1364
Total weight per tree		8578
Bole volume per tree	(ft ³)	212

Residue Measurements

Average residue depth	(ft)	0.04
Ground area covered by residue	(pct.)	44
Average duff and litter depth	(inches)	1.4
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		11
Rotten residue 3.1 inches and larger		89

2-MP-4

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Data Sheet 2-MP-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.4	30
0.26- 1.0	2.1	136
1.1 - 3.0	1.1	89
3.1 - 9.0	3.3	300
9.1 -20.0	1.9	202
20.1 +	0	0
Total	8.8	757

Comments:

Stand Information

Average diameter	(inches)	63
Average tree height	(ft)	120
Average crown length		42
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	5580
Bole weight per tree		22268
Bark weight per tree		5946
Total weight per tree		33794
Bole volume per tree	(ft')	924

Residue Measurements

Average residue depth	(ft)	0.08
Ground area covered by residue	(pct.)	61
Average duff and litter depth	(inches)	1.0
Ground area covered by duff and litter	(pct.)	80
Sound residue 3.1 inches and larger		40
Rotten residue 3.1 inches and larger		60

3-MP-4

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**Data Sheet
3-MP-4**

**Dead and Downed Fuel Loadings
(per acre)**

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.4	28
0.26- 1.0	1.6	112
1.1 - 3.0	1.2	94
3.1 - 9.0	1.6	146
9.1 -20.0	5.9	548
20.1 +	1.9	150
Total	12.6	1078

Comments:

Stand Information

Average diameter	(inches)	33
Average tree height	(ft)	90
Average crown length		45
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	1870
Bole weight per tree		4531
Bark weight per tree		1210
Total weight per tree		7611
Bole volume per tree	(ft ³)	188

Residue Measurements

Average residue depth	(ft)	0.07
Ground area covered by residue	(pct.)	53
Average duff and litter depth	(inches)	1.0
Ground area covered by duff and litter	(pct.)	84
Sound residue 3.1 inches and larger		62
Rotten residue 3.1 inches and larger		38

4-MP-4

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**Data Sheet
4-MP-4**

**Dead and Downed Fuel Loadings
(per acre)**

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.6	40
0.26- 1.0	1.4	90
1.1 - 3.0	1.2	95
3.1 - 9.0	1.7	166
9.1 -20.0	10.4	959
20.1 +	12.9	1294
Total	28.2	2644

Comments:

Stand Information

Average diameter (inches) 24
Average tree height (ft) 65
Average crown length 32

Total crown weight per tree
(includes unmerchantable top
to 4 inches) (lb) 998

Bole weight per tree 1711

Bark weight per tree 457

Total weight per tree 3166

Bole volume per tree (ft³) 71

Residue Measurements

Average residue depth (ft) 0.14

Ground area covered by residue (pct.) 72

Average duff and litter depth (inches) .8

Ground area covered by duff and litter (pct.) 78

Sound residue 3.1 inches and larger 38

Rotten residue 3.1 inches and larger 62

5-MP-4

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**Data Sheet
5-MP-4**

**Dead and Downed Fuel Loadings
(per acre)**

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	1.0	64
0.26- 1.0	2.1	137
1.1 - 3.0	4.8	385
3.1 - 9.0	5.6	545
9.1 -20.0	19.2	2019
20.1 +	13.9	1487
Total	46.6	4637

Comments:

Stand Information

Average diameter	(inches)	34
Average tree height	(ft)	138
Average crown length		77
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	1985
Bole weight per tree		7567
Bark weight per tree		2020
Total weight per tree		11572
Bole volume per tree	(ft ³)	314

Residue Measurements

Average residue depth	(ft)	0.33
Ground area covered by residue	(pct.)	99
Average duff and litter depth	(inches)	2.4
Ground area covered by duff and litter	(pct.)	50
Sound residue 3.1 inches and larger		7
Rotten residue 3.1 inches and larger		93

MIXED CONIFER—FIR

Size Class 4

A Series of Five Levels

CALVEG Series: **Mixed Conifer—Fir**
Code Symbol: **MF**

Dominant Species: **white fir**

Associates: **sugar pine, incense-cedar, ponderosa pine, red fir**

Reminders to users:

- The marker in these photos is 1 foot square and the pole is painted in contrasting colors at 1-foot intervals to provide perspective.
- Stumps are not included in residue quantities.
- Rotted residue is that which would come apart or splinter when kicked.

1-MF-4

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Data Sheet 1-MF-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	1.0	65
0.26- 1.0	2.2	144
1.1 - 3.0	3.6	292
3.1 - 9.0	2.4	247
9.1 - 20.0	.9	98
20.1 +	0	0
Total	10.1	846

Comments:

Stand Information

Average diameter	(inches)	26
Average tree height	(ft)	145
Average crown length		53
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	962
Bole weight per tree		4528
Bark weight per tree		1467
Total weight per tree		6957
Bole volume per tree	(ft ³)	196

Residue Measurements

Average residue depth	(ft)	0.25
Ground area covered by residue	(pct.)	100
Average duff and litter depth	(inches)	2.6
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		15
Rotten residue 3.1 inches and larger		85

2-MF-4

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Data Sheet 2-MF-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	1.3	90
0.26- 1.0	2.9	190
1.1 - 3.0	5.6	452
3.1 - 9.0	3.5	342
9.1 - 20.0	1.6	171
20.1 +	1.5	164
Total	16.4	1409

Comments:

Stand Information

Average diameter	(inches)	30
Average tree height	(ft)	107
Average crown length		49
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	1210
Bole weight per tree		3927
Bark weight per tree		1272
Total weight per tree		6409
Bole volume per tree	(ft ³)	170

Residue Measurements

Average residue depth	(ft)	0.38
Ground area covered by residue	(pct.)	99
Average duff and litter depth	(inches)	4.0
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		18
Rotten residue 3.1 inches and larger		82

3-MF-4

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Data Sheet 3-M F-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.8	53
0.26- 1.0	1.6	106
1.1 - 3.0	3.4	271
3.1 - 9.0	2.2	215
9.1 -20.0	8.8	857
20.1 +	6.1	651
Total	22.9	2153

Comments:

Stand Information

Average diameter	(inches)	40
Average tree height	(ft)	184
Average crown length		96
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	1920
Bole weight per tree		13098
Bark weight per tree		4244
Total weight per tree		19262
Bole volume per tree	(ft ³)	567

Residue Measurements

Average residue depth	(ft)	0.25
Ground area covered by residue	(pct.)	100
Average duff and litter depth	(inches)	2.6
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		15
Rotten residue 3.1 inches and larger		85

4-MF-4

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Data Sheet 4-MF-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.7	47
0.26- 1.0	2.1	140
1.1 - 3.0	3.3	264
3.1 - 9.0	2.3	214
9.1 -20.0	14.4	1493
20.1 +	16.4	1752
Total	39.2	3910

Comments:

Stand Information

Average diameter	(inches)	38
Average tree height	(ft)	139
Average crown length		78
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	1770
Bole weight per tree		8501
Bark weight per tree		2754
Total weight per tree		13025
Bole volume per tree	(ft ³)	368

Residue Measurements

Average residue depth	(ft)	0.4
Ground area covered by residue	(pct.)	100
Average duff and litter depth	(inches)	3.4
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		8
Rotten residue 3.1 inches and larger		92



Data Sheet 5-MF-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.7	47
0.26- 1.0	1.5	100
1.1 - 3.0	2.9	232
3.1 - 9.0	3.4	339
9.1 -20.0	23.0	2425
20.1 +	23.4	2447
Total	54.9	5590

Comments:

Stand Information

Average diameter	(inches)	37
Average tree height	(ft)	158
Average crown length		74
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	1700
Bole weight per tree		9517
Bark weight per tree		3084
Total weight per tree		14301
Bole volume per tree	(ft ³)	412

Residue Measurements

Average residue depth	(ft)	0.5
Ground area covered by residue	(pct.)	100
Average duff and litter depth	(inches)	3.3
Ground area covered by duff and litter	(pct.)	99
Sound residue 3.1 inches and larger		8
Rotten residue 3.1 inches and larger		92

PONDEROSA PINE

Size Class 2

A Series of Four Levels

CALVEG Series: **Ponderosa Pine**

Code Symbol: **PP**

Dominant Species: **ponderosa pine**

Associates: **Douglas-fir, Jeffrey pine, incense-cedar, black oak**

Reminders to users:

- The marker in these photos is 1 foot square and the pole is painted in contrasting colors at 1-foot intervals to provide perspective.
- Stumps are not included in residue quantities.
- Rotted residue is that which would come apart or splinter when kicked.



Data Sheet 1-PP-2

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.2	11
0.26- 1.0	.5	31
1.1 - 3.0	1.4	109
3.1 - 9.0	.8	63
9.1 -20.0	0	0
20.1 +	0	214
Total	2.9	214

Comments:

Stand Information

Average diameter	(inches)	8
Average tree height	(ft)	39
Average crown length		13
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	98
Bole weight per tree		85
Bark weight per tree		18
Total weight per tree		201
Bole volume per tree	(ft ³)	3

Residue Measurements

Average residue depth	(ft)	0.3
Ground area covered by residue	(pct.)	44
Average duff and litter depth	(inches)	1.8
Ground area covered by duff and litter	(pct.)	96
Sound residue 3.1 inches and larger		89
Rotten residue 3.1 inches and larger		11



Data Sheet 2-PP-2

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.1	4
0.26- 1.0	.3	24
1.1 - 3.0	.3	20
3.1 - 9.0	.5	41
9.1 -20.0	3.2	325
20.1 +	0	0
Total	4.4	414

Comments:

Stand Information

Average diameter	(inches)	7
Average tree height	(ft)	25
Average crown length		14
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	73
Bole weight per tree		41
Bark weight per tree		9
Total weight per tree		123
Bole volume per tree	(ft ³)	2

Residue Measurements

Average residue depth	(ft)	0.83
Ground area covered by residue	(pct.)	17
Average duff and litter depth	(inches)	1.3
Ground area covered by duff and litter	(pct.)	78
Sound residue 3.1 inches and larger		20
Rotten residue 3.1 inches and larger		80

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Data Sheet 3-PP-2

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.1	3
0.26- 1.0	.5	33
1.1 - 3.0	.7	52
3.1 - 9.0	.9	68
9.1 -20.0	4.0	382
20.1 +	0	0
Total	6.2	538

Comments: Because an abundance of size class 1 trees was encountered in the sampling plots, the average diameter works out to be less than size class 2. There are a substantial number of size class 2 trees in the plot.

Stand Information

Average diameter	(inches)	5
Average tree height	(ft)	17
Average crown length		14
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	32
Bole weight per tree		18
Bark weight per tree		4
Total weight per tree		54
Bole volume per tree	(ft ³)	1

Residue Measurements

Average residue depth	(ft)	0.19
Ground area covered by residue	(pct.)	12
Average duff and litter depth	(inches)	.75
Ground area covered by duff and litter	(pct.)	46
Sound residue 3.1 inches and larger		52
Rotten residue 3.1 inches and larger		48



Data Sheet 4-PP-2

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.5	34
0.26- 1.0	1.1	76
1.1 - 3.0	2.1	171
3.1 - 9.0	5.5	543
9.1 -20.0	.7	73
20.1 +	0	0
Total	9.9	897

Comments:

Stand Information

Average diameter	(inches)	9
Average tree height	(ft)	35
Average crown length		11
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	125
Bole weight per tree		105
Bark weight per tree		22
Total weight per tree		252
Bole volume per tree	(ft ³)	4

Residue Measurements

Average residue depth	(ft)	0.64
Ground area covered by residue	(pct.)	77
Average duff and litter depth	(inches)	3.0
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		29
Rotten residue 3.1 inches and larger		71

PONDEROSA PINE

Size Class 3

A Series of Four Levels

CALVEG Series: Ponderosa Pine

Code Symbol: PP

Dominant Species: ponderosa pine

Associates: Douglas-fir, Jeffrey pine, incense-cedar, black oak

Reminders to users:

- The marker in these photos is 1 foot square and the pole is painted in contrasting colors at 1-foot intervals to provide perspective.
- Stumps are not included in residue quantities.
- Rotted residue is that which would come apart or splinter when kicked.



**Data Sheet
1-PP-3**

**Dead and Downed Fuel Loadings
(per acre)**

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.1	4
0.26- 1.0	.2	12
1.1 - 3.0	.4	28
3.1 - 9.0	1.1	110
9.1 -20.0	0	0
20.1 +	0	0
Total	1.8	155

Comments:

Stand Information

Average diameter	(inches)	19
Average tree height	(ft)	55
Average crown length		22
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	688
Bole weight per tree		963
Bark weight per tree		201
Total weight per tree		1852
Bole volume per tree	(ft ³)	39

Residue Measurements

Average residue depth	(ft)	0.08
Ground area covered by residue	(pct.)	17
Average duff and litter depth	(inches)	2.2
Ground area covered by duff and litter	(pct.)	90
Sound residue 3.1 inches and larger		17
Rotten residue 3.1 inches and larger		83



**Data Sheet
2-PP-3**

**Dead and Downed Fuel Loadings
(per acre)**

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.2	13
0.26- 1.0	.6	42
1.1 - 3.0	.8	66
3.1 - 9.0	.1	10
9.1 -20.0	1.3	134
20.1 +	0	0
Total	3.0	265

Comments:

Stand Information

Average diameter	(inches)	18
Average tree height	(ft)	49
Average crown length		31
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	611
Bole weight per tree		775
Bark weight per tree		162
Total weight per tree		1548
Bole volume per tree	(ft ³)	31

Residue Measurements

Average residue depth	(ft)	0.12
Ground area covered by residue	(pct.)	33
Average duff and litter depth	(inches)	2.0
Ground area covered by duff and litter	(pct.)	86
Sound residue 3.1 inches and larger		9
Rotten residue 3.1 inches and larger		91



Data Sheet 3-PP-3

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.2	12
0.26- 1.0	.5	33
1.1 - 3.0	1.1	90
3.1 - 9.0	1.5	155
9.1 -20.0	1.7	185
20.1 +	0	0
Total	5.0	475

Comments:

Stand Information

Average diameter	(inches)	16
Average tree height	(ft)	59
Average crown length		36
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	473
Bole weight per tree		725
Bark weight per tree		152
Total weight per tree		1350
Bole volume per tree	(ft ³)	29

Residue Measurements

Average residue depth	(ft)	0.16
Ground area covered by residue	(pct.)	37
Average duff and litter depth	(inches)	2.0
Ground area covered by duff and litter	(pct.)	98
Sound residue 3.1 inches and larger		11
Rotten residue 3.1 inches and larger		89



**Data Sheet
4-PP-3**

**Dead and Downed Fuel Loadings
(per acre)**

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.1	5
0.26- 1.0	.9	63
1.1 - 3.0	1.5	119
3.1 - 9.0	2.5	241
9.1 -20.0	1.1	88
20.1 +	2.3	186
Total	8.4	702

Comments:

Stand Information

Average diameter	(inches)	17
Average tree height	(ft)	70
Average crown length		45
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	540
Bole weight per tree		1000
Bark weight per tree		209
Total weight per tree		1749
Bole volume per tree	(ft ³)	40

Residue Measurements

Average residue depth	(ft)	0.07
Ground area covered by residue	(pct.)	23
Average duff and litter depth	(inches)	1.9
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		76
Rotten residue 3.1 inches and larger		24

PONDEROSA PINE

Size Class 4

A Series of Three Levels

CALVEG Series: Ponderosa Pine

Code Symbol: PP

Dominant Species: ponderosa pine

Associates: Douglas-fir, Jeffrey pine, incense-cedar, black oak

Reminders to users:

- The marker in these photos is 1 foot square and the pole is painted in contrasting colors at 1-foot intervals to provide perspective.
- Stumps are not included in residue quantities.
- Rotted residue is that which would come apart or splinter when kicked.



Data Sheet 1-PP-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.1	3
0.26- 1.0	.7	47
1.1 - 3.0	.4	30
3.1 - 9.0	.9	85
9.1 -20.0	1.4	131
20.1 +	0	0
Total	3.5	296

Comments:

Stand Information

Average diameter	(inches)	27
Average tree height	(ft)	52
Average crown length		23
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	1490
Bole weight per tree		1825
Bark weight per tree		381
Total weight per tree		3696
Bole volume per tree	(ft ³)	73

Residue Measurements

Average residue depth	(ft)	0.01
Ground area covered by residue	(pct.)	15
Average duff and litter depth	(inches)	1.0
Ground area covered by duff and litter	(pct.)	78
Sound residue 3.1 inches and larger		51
Rotten residue 3.1 inches and larger		49



Data Sheet 2-PP-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.002	.1
0.26- 1.0	1.0	67
1.1 - 3.0	2.0	156
3.1 - 9.0	1.8	152
9.1 -20.0	.9	72
20.1 +	0	0
Total	5.7	447.1

Comments:

Stand Information

Average diameter	(inches)	25
Average tree height	(ft)	88
Average crown length		36
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	1260
Bole weight per tree		2800
Bark weight per tree		585
Total weight per tree		4645
Bole volume per tree	(ft ³)	112

Residue Measurements

Average residue depth	(ft)	0.03
Ground area covered by residue	(pct.)	23
Average duff and litter depth	(inches)	1.6
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		92
Rotten residue 3.1 inches and larger		8



Data Sheet 3-PP-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.3	20
0.26- 1.0	1.4	96
1.1 - 3.0	1.8	142
3.1 - 9.0	1.5	148
9.1 -20.0	5.0	457
20.1 +	0	0
Total	10.0	863

Comments:

Stand Information

Average diameter	(inches)	37
Average tree height	(ft)	116
Average crown length		68
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	3010
Bole weight per tree		8425
Bark weight per tree		1761
Total weight per tree		13196
Bole volume per tree	(ft ³)	337

Residue Measurements

Average residue depth	(ft)	0.18
Ground area covered by residue	(pct.)	43
Average duff and litter depth	(inches)	2.0
Ground area covered by duff and litter	(pct.)	88
Sound residue 3.1 inches and larger		49
Rotten residue 3.1 inches and larger		51

LODGEPOLE PINE

Size Class 2

A Series of Five Levels

CALVEG Series: **Lodgepole Pine**
Code Symbol: **LP**

Dominant Species: **lodgepole pine**
Associates: **(pure stand)**

Reminders to users:

- The marker in these photos is 1 foot square and the pole is painted in contrasting colors at 1-foot intervals to provide perspective.
- Stumps are not included in residue quantities.
- Rotted residue is that which would come apart or splinter when kicked.

1-LP-2

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1-LP-2

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.3	19
0.26- 1.0	.6	42
1.1 - 3.0	.8	62
3.1 - 9.0	.5	51
9.1 -20.0	.3	29
20.1 +	0	0
Total	2.5	203

Comments: Because an abundance of size class 1 trees was encountered in the sampling plots, the average diameter works out to be less than size class 2. There are a substantial number of size class 2 trees in the plot.

Stand Information

Average diameter	(inches)	4
Average tree height	(ft)	28
Average crown length		14
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	21
Bole weight per tree		31
Bark weight per tree		4
Total weight per tree		56
Bole volume per tree	(ft ³)	1

Residue Measurements

Average residue depth	(ft)	0.28
Ground area covered by residue	(pct.)	49
Average duff and litter depth	(inches)	.8
Ground area covered by duff and litter	(pct.)	80
Sound residue 3.1 inches and larger		16
Rotten residue 3.1 inches and larger		84

2-LP-2

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Data Sheet 2-LP-2

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.1	6
0.26- 1.0	.7	48
1.1 - 3.0	1.2	98
3.1 - 9.0	.4	43
9.1 -20.0	1.8	197
20.1 -+	0	0
Total	4.2	392

Comments:

Stand Information

Average diameter	(inches)	6
Average tree height	(ft)	21
Average crown length		13
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	34
Bole weight per tree		41
Bark weight per tree		5
Total weight per tree		80
Bole volume per tree	(ft ³)	2

Residue Measurements

Average residue depth	(ft)	0.01
Ground area covered by residue	(pct.)	15
Average duff and litter depth	(inches)	.5
Ground area covered by duff and litter	(pct.)	64
Sound residue 3.1 inches and larger		2
Rotten residue 3.1 inches and larger		98

3-LP-2

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Data Sheet 3-LP-2

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.4	27
0.26- 1.0	.4	26
1.1 - 3.0	1.0	79
3.1 - 9.0	4.1	346
9.1 -20.0	1.3	140
20.1 +	5.8	619
Total	13.0	1237

Comments:

Stand Information

Average diameter	(inches)	5
Average tree height	(ft)	30
Average crown length		16
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	26
Bole weight per tree		44
Bark weight per tree		5
Total weight per tree		75
Bole volume per tree	(ft ³)	2

Residue Measurements

Average residue depth	(ft)	0.56
Ground area covered by residue	(pct.)	73
Average duff and litter depth	(inches)	2.0
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		31
Rotten residue 3.1 inches and larger		69

4-LP-2

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Data Sheet 4-LP-2

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.2	13
0.26- 1.0	2.5	164
1.1 - 3.0	2.5	196
3.1 - 9.0	8.3	675
9.1 -20.0	3.2	276
20.1 +	0	0
Total	16.7	1324

Comments:

Stand Information

Average diameter	(inches)	10
Average tree height	(ft)	46
Average crown length		27
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	106
Bole weight per tree		256
Bark weight per tree		29
Total weight per tree		391
Bole volume per tree	(ft ³)	10

Residue Measurements

Average residue depth	(ft)	0.12
Ground area covered by residue	(pct.)	53
Average duff and litter depth	(inches)	.84
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		91
Rotten residue 3.1 inches and larger		9



Data Sheet 5-LP-2

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.9	61
0.26- 1.0	2.9	191
1.1 - 3.0	10.5	844
3.1 - 9.0	15.4	1296
9.1 -20.0	2.7	254
20.1 +	0	0
Total	32.4	2646

Comments:

Stand Information

Average diameter	(inches)	6
Average tree height	(ft)	48
Average crown length		15
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	41
Bole weight per tree		106
Bark weight per tree		22
Total weight per tree		169
Bole volume per tree	(ft ³)	4

Residue Measurements

Average residue depth	(ft)	1.14
Ground area covered by residue	(pct.)	93
Average duff and litter depth	(inches)	2.4
Ground area covered by duff and litter	(pct.)	94
Sound residue 3.1 inches and larger		79
Rotten residue 3.1 inches and larger		21

LODGEPOLE PINE

Size Class 3

A Series of Four Levels

CALVEG Series: **Lodgepole Pine**
Code Symbol: **LP**

Dominant Species: **lodgepole pine**
Associates: **(pure stand)**

Reminders to users:

- The marker in these photos is 1 foot square and the pole is painted in contrasting colors at 1-foot intervals to provide perspective.
- Stumps are not included in residue quantities.
- Rotted residue is that which would come apart or splinter when kicked.

1-LP-3

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**Data Sheet
1-LP-3**

**Dead and Downed Fuel Loadings
(per acre)**

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.3	21
0.26- 1.0	.4	25
1.1 - 3.0	.2	20
3.1 - 9.0	1.5	142
9.1 -20.0	0	0
20.1 +	0	0
Total	2.4	208

Comments:

Stand Information

Average diameter	(inches)	17
Average tree height	(ft)	90
Average crown length		35
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	289
Bole weight per tree		1792
Bark weight per tree		204
Total weight per tree		2285
Bole volume per tree	(ft ³)	70

Residue Measurements

Average residue depth	(ft)	0.11
Ground area covered by residue	(pct.)	29
Average duff and litter depth	(inches)	.4
Ground area covered by duff and litter	(pct.)	98
Sound residue 3.1 inches and larger		40
Rotten residue 3.1 inches and larger		60

2-LP-3

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**Data Sheet
2-LP-3**

**Dead and Downed Fuel Loadings
(per acre)**

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.1	5
0.26- 1.0	.4	25
1.1 - 3.0	.7	55
3.1 - 9.0	1.7	134
9.1 -20.0	4.4	373
20.1 +	0	0
Total	7.3	592

Comments:

Stand Information

Average diameter	(inches)	11
Average tree height	(ft)	49
Average crown length		21
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	122
Bole weight per tree		322
Bark weight per tree		37
Total weight per tree		481
Bole volume per tree	(ft ³)	13

Residue Measurements

Average residue depth	(ft)	0.07
Ground area covered by residue	(pct.)	17
Average duff and litter depth	(inches)	.3
Ground area covered by duff and litter	(pct.)	62
Sound residue 3.1 inches and larger		84
Rotten residue 3.1 inches and larger		16

3-LP-3

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Data Sheet 3-LP-3

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.2	15
0.26- 1.0	1.8	122
1.1 - 3.0	1.6	126
3.1 - 9.0	6.3	519
9.1 -20.0	1.9	153
20.1 +	0	0
Total	11.8	935

Comments:

Stand Information

Average diameter	(inches)	12
Average tree height	(ft)	57
Average crown length		20
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	150
Bole weight per tree		463
Bark weight per tree		53
Total weight per tree		666
Bole volume per tree	(ft ³)	18

Residue Measurements

Average residue depth	(ft)	0.06
Ground area covered by residue	(pct.)	54
Average duff and litter depth	(inches)	.7
Ground area covered by duff and litter	(pct.)	70
Sound residue 3.1 inches and larger		96
Rotten residue 3.1 inches and larger		4

4-LP-3

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**Data Sheet
4-LP-3**

**Dead and Downed Fuel Loadings
(per acre)**

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.4	29
0.26- 1.0	1.0	69
1.1 - 3.0	3.4	275
3.1 - 9.0	11.2	940
9.1 -20.0	7.4	673
20.1 +	0	0
Total	23.4	1986

Comments:

Stand Information

Average diameter	(inches)	12
Average tree height	(ft)	50
Average crown length		18
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	264
Bole weight per tree		422
Bark weight per tree		48
Total weight per tree		734
Bole volume per tree	(ft ³)	17

Residue Measurements

Average residue depth	(ft)	0.79
Ground area covered by residue	(pct.)	83
Average duff and litter depth	(inches)	1.1
Ground area covered by duff and litter	(pct.)	98
Sound residue 3.1 inches and larger		75
Rotten residue 3.1 inches and larger		25

LODGEPOLE PINE

Size Class 4

One Level

CALVEG Series: **Lodgepole Pine**
Code Symbol: **LP**

Dominant Species: **lodgepole pine**
Associates: **(pure stand)**

Reminders to users:

- The marker in these photos is 1 foot square and the pole is painted in contrasting colors at 1-foot intervals to provide perspective.
- Stumps are not included in residue quantities.
- Rotted residue is that which would come apart or splinter when kicked.



Data Sheet 1-LP-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.1	9
0.26- 1.0	.4	23
1.1 - 3.0	.2	12
3.1 - 9.0	1.6	131
9.1 -20.0	.6	66
20.1 +	4.7	502
Total	7.6	743

Comments:

Stand Information

Average diameter	(inches)	24
Average tree height	(ft)	90
Average crown length		53
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	553
Bole weight per tree		2893
Bark weight per tree		330
Total weight per tree		3776
Bole volume per tree	(ft ³)	113

Residue Measurements

Average residue depth	(ft)	0.05
Ground area covered by residue	(pct.)	16
Average duff and litter depth	(inches)	.3
Ground area covered by duff and litter	(pct.)	72
Sound residue 3.1 inches and larger		20
Rotten residue 3.1 inches and larger		80

WHITE FIR

Size Class 2

A Series of Four Levels

CALVEG Series: **White Fir**
Code Symbol: **WF**

Dominant Species: **white fir**
Associates: **(pure stand)**

Reminders to users:

- The marker in these photos is 1 foot square and the pole is painted in contrasting colors at 1-foot intervals to provide perspective.
- Stumps are not included in residue quantities.
- Rotted residue is that which would come apart or splinter when kicked.

1-WF-2

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**Data Sheet
1-WF-2**

**Dead and Downed Fuel Loadings
(per acre)**

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.3	22
0.26- 1.0	.7	47
1.1 - 3.0	2.4	192
3.1 - 9.0	4.6	436
9.1 -20.0	.3	30
20.1 +	0	0
Total	8.3	727

Comments:

Stand Information

Average diameter	(inches)	8
Average tree height	(ft)	38
Average crown length		14
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	113
Bole weight per tree		114
Bark weight per tree		37
Total weight per tree		264
Bole volume per tree	(ft ³)	5

Residue Measurements

Average residue depth	(ft)	0.79
Ground area covered by residue	(pct.)	100
Average duff and litter depth	(inches)	3.0
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		39
Rotten residue 3.1 inches and larger		61



Data Sheet 2-WF-2

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.7	43
0.26- 1.0	2.1	142
1.1 - 3.0	5.2	416
3.1 - 9.0	2.2	180
9.1 -20.0	0	0
20.1 +	0	0
Total	10.2	781

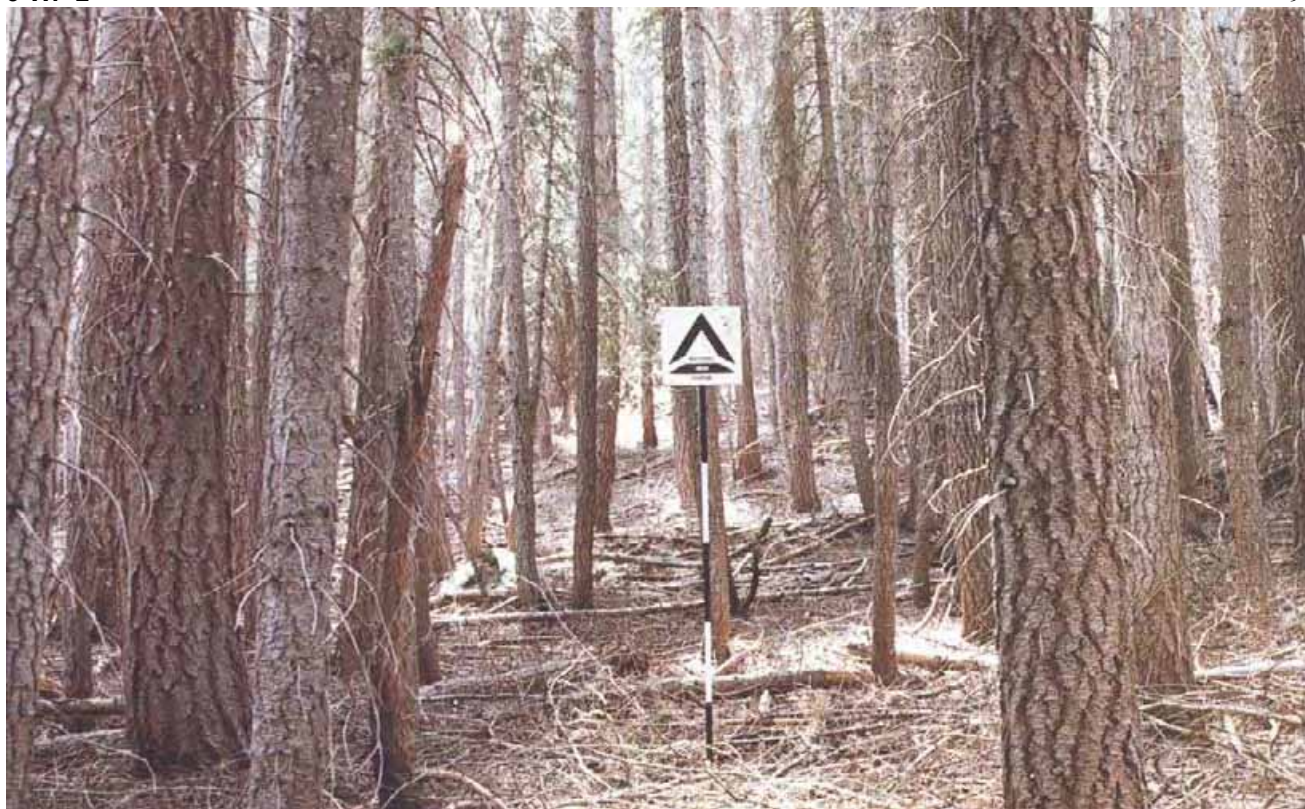
Comments: Because an abundance of size class 1 trees was encountered in the sampling plot, the average diameter works out to be less than size class 2. There are a substantial number of size class 2 trees in the plot.

Stand Information

Average diameter	(inches)	5
Average tree height	(ft)	26
Average crown length		12
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	48
Bole weight per tree		29
Bark weight per tree		9
Total weight per tree		86
Bole volume per tree	(ft ³)	1

Residue Measurements

Average residue depth	(ft)	0.23
Ground area covered by residue	(pct.)	79
Average duff and litter depth	(inches)	1.2
Ground area covered by duff and litter	(pct.)	96
Sound residue 3.1 inches and larger		95
Rotten residue 3.1 inches and larger		5



Data Sheet 3-WF-2

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.9	59
0.26- 1.0	2.2	149
1.1 - 3.0	5.1	405
3.1 - 9.0	6.4	566
9.1 -20.0	0	0
20.1 +	0	0
Total	14.6	1179

Comments: Because an abundance of size class 1 trees was encountered in the sampling plots, the average diameter works out to be less than size class 2. There are a substantial number of size class 2 trees in the plot.

Stand Information

Average diameter	(inches)	5
Average tree height	(ft)	31
Average crown length		9
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	49
Bole weight per tree		34
Bark weight per tree		11
Total weight per tree		94
Bole volume per tree	(ft ³)	1

Residue Measurements

Average residue depth	(ft)	0.27
Ground area covered by residue	(pct.)	92
Average duff and litter depth	(inches)	1.7
Ground area covered by duff and litter	(pct.)	98
Sound residue 3.1 inches and larger		70
Rotten residue 3.1 inches and larger		30



**Data Sheet
4-WF-2**

**Dead and Downed Fuel Loadings
(per acre)**

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.9	61
0.26- 1.0	2.5	169
1.1 - 3.0	3.2	259
3.1 - 9.0	13.1	1117
9.1 -20.0	1.4	123
20.1 +	0	0
Total	21.1	1729

Comments:

Stand Information

Average diameter	(inches)	6
Average tree height	(ft)	27
Average crown length		10
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	60
Bole weight per tree		46
Bark weight per tree		15
Total weight per tree		121
Bole volume per tree	(ft ³)	2

Residue Measurements

Average residue depth	(ft)	0.2
Ground area covered by residue	(pct.)	73
Average duff and litter depth	(inches)	2.2
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		81
Rotten residue 3.1 inches and larger		19

WHITE FIR

Size Class 3

A Series of Five Levels

CALVEG Series: **White Fir**
Code Symbol: **WF**

Dominant Species: **white fir**
Associates: **(pure stand)**

Reminders to users:

- The marker in these photos is 1 foot square and the pole is painted in contrasting colors at 1-foot intervals to provide perspective.
- Stumps are not included in residue quantities.
- Rotted residue is that which would come apart or splinter when kicked.

1-WF-3

96



Data Sheet 1-WF-3

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.6	38
0.26- 1.0	3.2	216
1.1 - 3.0	2.1	168
3.1 - 9.0	2.2	181
9.1 -20.0	2.6	214
20.1 +	0	0
Total	10.7	817

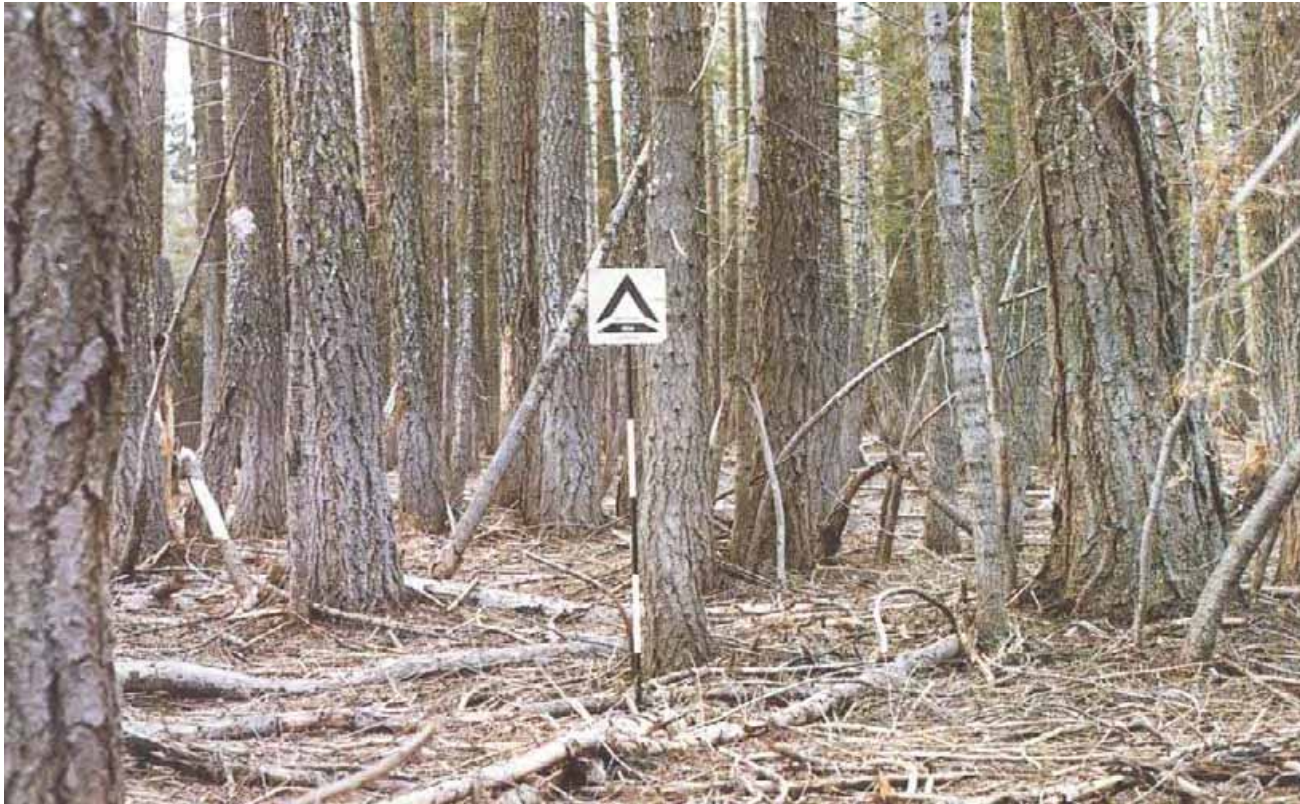
Comments:

Stand Information

Average diameter	(inches)	13
Average tree height	(ft)	52
Average crown length		23
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	256
Bole weight per tree		114
Bark weight per tree		352
Total weight per tree		722
Bole volume per tree	(ft ³)	16

Residue Measurements

Average residue depth	(ft)	0.14
Ground area covered by residue	(pct.)	69
Average duff and litter depth	(inches)	1.7
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		91
Rotten residue 3.1 inches and larger		9



Data Sheet 2-WF-3

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	1.0	66
0.26- 1.0	4.5	299
1.1 - 3.0	2.6	212
3.1 - 9.0	6.3	562
9.1 -20.0	.4	30
20.1 +	0	0
Total	14.8	1169

Comments:

Stand Information

Average diameter	(inches)	13
Average tree height	(ft)	56
Average crown length		27
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	292
Bole weight per tree		457
Bark weight per tree		148
Total weight per tree		897
Bole volume per tree	(ft ³)	19

Residue Measurements

Average residue depth	(ft)	0.18
Ground area covered by residue	(pct.)	88
Average duff and litter depth	(inches)	1.8
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		71
Rotten residue 3.1 inches and larger		29

3-WF-3

100



Data Sheet 3-WF-3

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.9	59
0.26- 1.0	1.8	118
1.1 - 3.0	2.2	172
3.1 - 9.0	10.3	920
9.1 -20.0	1.1	96
20.1 +	1.6	131
Total	17.9	1496

Comments:

Stand Information

Average diameter	(inches)	12
Average tree height	(ft)	85
Average crown length		27
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	236
Bole weight per tree		559
Bark weight per tree		181
Total weight per tree		976
Bole volume per tree	(ft ³)	23

Residue Measurements

Average residue depth	(ft)	1.29
Ground area covered by residue	(pct.)	97
Average duff and litter depth	(inches)	3.8
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		71
Rotten residue 3.1 inches and larger		29

4-WF-3

102



Data Sheet 4-WF-3

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.7	44
0.26- 1.0	1.4	94
1.1 - 3.0	2.2	176
3.1 - 9.0	6.8	677
9.1 -20.0	13.5	1279
20.1 +	5.0	530
Total	29.6	2800

Comments:

Stand Information

Average diameter	(inches)	22
Average tree height	(ft)	103
Average crown length		41
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	736
Bole weight per tree		2211
Bark weight per tree		716
Total weight per tree		3663
Bole volume per tree	(ft ³)	91

Residue Measurements

Average residue depth	(ft)	0.43
Ground area covered by residue	(pct.)	95
Average duff and litter depth	(inches)	2.7
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		31
Rotten residue 3.1 inches and larger		69



Data Sheet 5-WF-3

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.8	51
0.26- 1.0	3.5	232
1.1 - 3.0	3.0	267
3.1 - 9.0	13.0	1088
9.1 -20.0	10.8	911
20.1 +	4.6	365
Total	35.7	2914

Comments:

Stand Information

Average diameter	(inches)	16
Average tree height	(ft)	63
Average crown length		33
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	400
Bole weight per tree		693
Bark weight per tree		225
Total weight per tree		1318
Bole volume per tree	(ft ³)	29

Residue Measurements

Average residue depth	(ft)	0.12
Ground area covered by residue	(pct.)	79
Average duff and litter depth	(inches)	1.5
Ground area covered by duff and litter	(pct.)	98
Sound residue 3.1 inches and larger		87
Rotten residue 3.1 inches and larger		13

WHITE FIR

Size Class 4

A Series of Five Levels

CALVEG Series: **White Fir**
Code Symbol: **WF**

Dominant Species: **white fir**
Associates: **(pure stand)**

Reminders to users:

- The marker in these photos is 1 foot square and the pole is painted in contrasting colors at 1-foot intervals to provide perspective.
- Stumps are not included in residue quantities.
- Rotted residue is that which would come apart or splinter when kicked.



Data Sheet 1-WF-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.7	49
0.26- 1.0	1.6	109
1.1 - 3.0	1.7	137
3.1 - 9.0	.7	62
9.1 -20.0	3.1	322
20.1 +	1.6	172
Total	9.4	851

Comments:

Stand Information

Average diameter	(inches)	33
Average tree height	(ft)	76
Average crown length		48
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	1410
Bole weight per tree		3511
Bark weight per tree		1138
Total weight per tree		6059
Bole volume per tree	(ft ³)	152

Residue Measurements

Average residue depth	(ft)	1.40
Ground area covered by residue	(pct.)	83
Average duff and litter depth	(inches)	2.0
Ground area covered by duff and litter	(pct.)	86
Sound residue 3.1 inches and larger		21
Rotten residue 3.1 inches and larger		79

2-WF-4

110



Data Sheet 2-WF-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	1.0	65
0.26- 1.0	3.7	250
1.1 - 3.0	2.4	196
3.1 - 9.0	6.1	553
9.1 -20.0	1.7	185
20.1 +	0	0
Total	14.9	1249

Comments:

Stand Information

Average diameter	(inches)	21
Average tree height	(ft)	82
Average crown length		24
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	683
Bole weight per tree		1525
Bark weight per tree		494
Total weight per tree		2702
Bole volume per tree	(ft ³)	66

Residue Measurements

Average residue depth	(ft)	0.2
Ground area covered by residue	(pct.)	96
Average duff and litter depth	(inches)	.8
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		45
Rotten residue 3.1 inches and larger		55

3-WF-4

112



Data Sheet 3-WF-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.5	35
0.26- 1.0	1.2	80
1.1 - 3.0	4.5	357
3.1 - 9.0	7.1	629
9.1 -20.0	4.9	446
20.1 +	3.3	349
Total	21.5	1896

Comments:

Stand Information

Average diameter	(inches)	27
Average tree height	(ft)	113
Average crown length		33
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	1020
Bole weight per tree		3419
Bark weight per tree		1108
Total weight per tree		5547
Bole volume per tree	(ft ³)	148

Residue Measurements

Average residue depth	(ft)	1.1
Ground area covered by residue	(pct.)	97
Average duff and litter depth	(inches)	2.5
Ground area covered by duff and litter	(pct.)	98
Sound residue 3.1 inches and larger		49
Rotten residue 3.1 inches and larger		51



Data Sheet 4-WF-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.6	40
0.26- 1.0	2.0	134
1.1 - 3.0	1.8	144
3.1 - 9.0	.3	24
9.1 -20.0	17.3	1515
20.1 +	5.4	433
Total	27.4	2290

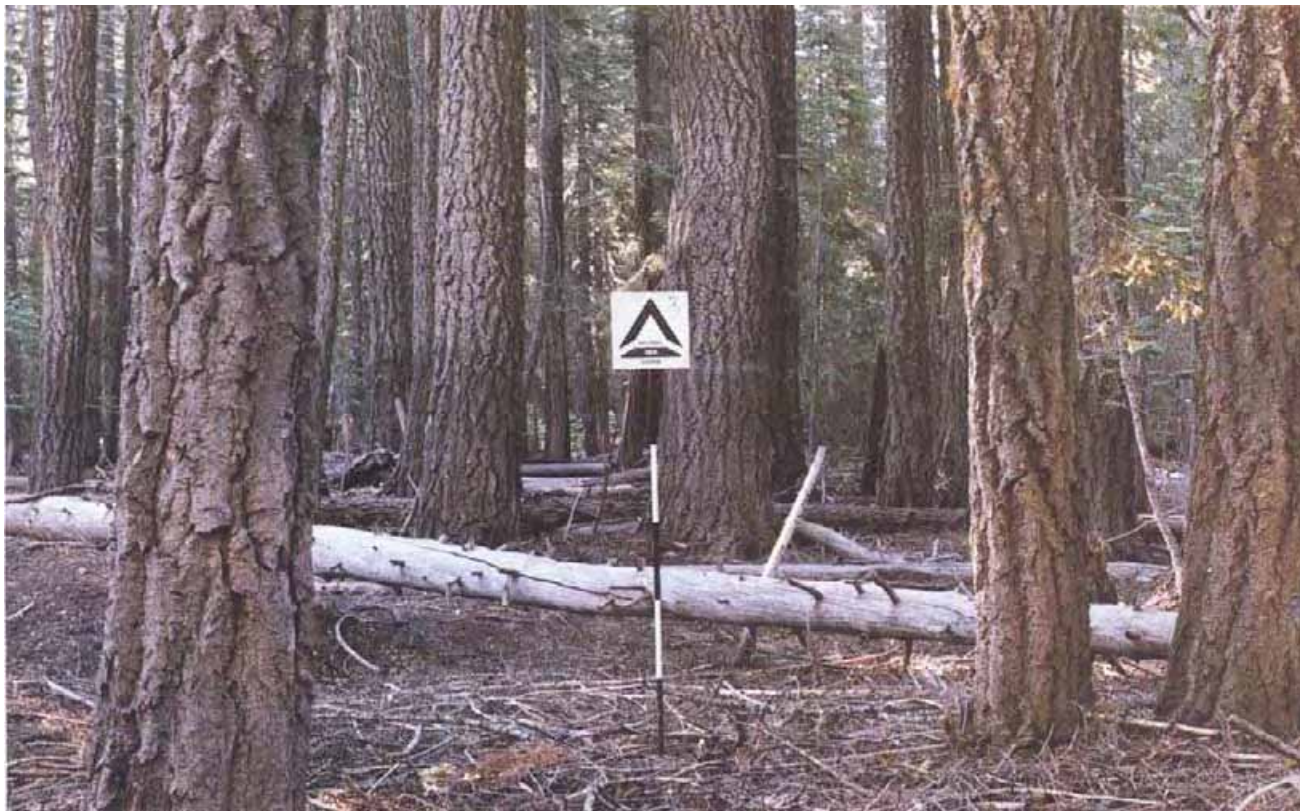
Comments:

Stand Information

Average diameter	(inches)	38
Average tree height	(ft)	88
Average crown length		43
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	1770
Bole weight per tree		5567
Bark weight per tree		1804
Total weight per tree		9141
Bole volume per tree	(ft ³)	241

Residue Measurements

Average residue depth	(ft)	0.09
Ground area covered by residue	(pct.)	68
Average duff and litter depth	(inches)	10.2
Ground area covered by duff and litter	(pct.)	92
Sound residue 3.1 inches and larger		79
Rotten residue 3.1 inches and larger		21



Data Sheet 5-WF-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	1.0	63
0.26- 1.0	3.8	251
1.1 - 3.0	3.6	291
3.1 - 9.0	4.9	440
9.1 -20.0	22.5	2038
20.1 +	8.6	681
Total	44.4	3764

Comments:

Stand Information

Average diameter	(inches)	28
Average tree height	(ft)	102
Average crown length		17
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	1080
Bole weight per tree		3350
Bark weight per tree		1085
Total weight per tree		5515
Bole volume per tree	(ft ³)	145

Residue Measurements

Average residue depth	(ft)	0.19
Ground area covered by residue	(pct.)	87
Average duff and litter depth	(inches)	2.0
Ground area covered by duff and litter	(pct.)	98
Sound residue 3.1 inches and larger		70
Rotten residue 3.1 inches and larger		30

RED FIR

Size Class 3

A Series of Five Levels

CALVEG Series: **Red Fir**
Code Symbol: **RF**

Dominant Species: **red fir**
Associates: **lodgepole pine**

Reminders to users:

- The marker in these photos is 1 foot square and the pole is painted in contrasting colors at 1-foot intervals to provide perspective.
- Stumps are not included in residue quantities.
- Rotted residue is that which would come apart or splinter when kicked.



Data Sheet 1-RF-3

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.4	28
0.26- 1.0	1.8	120
1.1 - 3.0	1.1	90
3.1 - 9.0	.7	59
9.1 -20.0	1.1	88
20.1 +	0	0
Total	5.1	385

Comments:

Stand Information

Average diameter	(inches)	16
Average tree height	(ft)	88
Average crown length		50
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	416
Bole weight per tree		1128
Bark weight per tree		365
Total weight per tree		1909
Bole volume per tree	(ft ³)	48

Residue Measurements

Average residue depth	(ft)	0.07
Ground area covered by residue	(pct.)	44
Average duff and litter depth	(inches)	.7
Ground area covered by duff and litter	(pct.)	72
Sound residue 3.1 inches and larger		86
Rotten residue 3.1 inches and larger		14



Data Sheet 2-RF-3

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	1.1	70
0.26- 1.0	2.8	184
1.1 - 3.0	.8	67
3.1 - 9.0	2.9	271
9.1 -20.0	1.8	179
20.1 +	0	0
Total	9.4	771

Comments:

Stand Information

Average diameter	(inches)	12
Average tree height	(ft)	57
Average crown length		33
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	244
Bole weight per tree		400
Bark weight per tree		130
Total weight per tree		774
Bole volume per tree	(ft ³)	17

Residue Measurements

Average residue depth	(ft)	0.59
Ground area covered by residue	(pct.)	88
Average duff and litter depth	(inches)	3.0
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		41
Rotten residue 3.1 inches and larger		59



Data Sheet 3-RF-3

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.5	35
0.26- 1.0	1.8	122
1.1 - 3.0	2.3	184
3.1 - 9.0	5.3	512
9.1 -20.0	7.5	638
20.1 +	0	0
Total	17.4	1491

Comments:

Stand Information

Average diameter	(inches)	19
Average tree height	(ft)	83
Average crown length		30
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	581
Bole weight per tree		1360
Bark weight per tree		441
Total weight per tree		2382
Bole volume per tree	(ft ³)	57

Residue Measurements

Average residue depth	(ft)	0.57
Ground area covered by residue	(pct.)	99
Average duff and litter depth	(inches)	2.0
Ground area covered by duff and litter	(pct.)	98
Sound residue 3.1 inches and larger		64
Rotten residue 3.1 inches and larger		36



Data Sheet 4-RF-3

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.9	62
0.26- 1.0	4.0	267
1.1 - 3.0	7.6	611
3.1 - 9.0	4.7	430
9.1 -20.0	9.0	778
20.1 +	0	0
Total	26.2	2148

Comments:

Stand Information

Average diameter	(inches)	19
Average tree height	(ft)	80
Average crown length		15
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	581
Bole weight per tree		1349
Bark weight per tree		437
Total weight per tree		2367
Bole volume per tree	(ft ³)	57

Residue Measurements

Average residue depth	(ft)	0.57
Ground area covered by residue	(pct.)	96
Average duff and litter depth	(inches)	2.6
Ground area covered by duff and litter	(pct.)	96
Sound residue 3.1 inches and larger		69
Rotten residue 3.1 inches and larger		31



Data Sheet 5-RF-3

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.7	46
0.26- 1.0	2.6	171
1.1 - 3.0	5.4	432
3.1 - 9.0	15.8	1412
9.1 -20.0	7.0	587
20.1 +	0	0
Total	31.5	2648

Comments:

Stand Information

Average diameter	(inches)	16
Average tree height	(ft)	78
Average crown length		25
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	416
Bole weight per tree		962
Bark weight per tree		312
Total weight per tree		1690
Bole volume per tree	(ft ³)	41

Residue Measurements

Average residue depth	(ft)	1.16
Ground area covered by residue	(pct.)	99
Average duff and litter depth	(inches)	1.7
Ground area covered by duff and litter	(pct.)	86
Sound residue 3.1 inches and larger		72
Rotten residue 3.1 inches and larger		28

RED FIR

Size Class 4

A Series of Five Levels

CALVEG Series: **Red Fir**
Code Symbol: **RF**

Dominant Species: **red fir**
Associates: **(pure stand)**

Reminders to users:

- The marker in these photos is 1 foot square and the pole is painted in contrasting colors at 1-foot intervals to provide perspective.
- Stumps are not included in residue quantities.
- Rotted residue is that which would come apart or splinter when kicked.



Data Sheet 1-RF-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.9	58
0.26- 1.0	3.1	206
1.1 - 3.0	3.0	243
3.1 - 9.01	1.0	105
9.1 -20.0	.8	86
20.1 +	0	0
Total	8.8	698

Comments:

Stand Information

Average diameter	(inches)	31
Average tree height	(ft)	80
Average crown length		58
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	1280
Bole weight per tree		3303
Bark weight per tree		1070
Total weight per tree		5653
Bole volume per tree	(ft ³)	143

Residue Measurements

Average residue depth	(ft)	0.34
Ground area covered by residue	(pct.)	89
Average duff and litter depth	(inches)	1.3
Ground area covered by duff and litter	(pct.)	86
Sound residue 3.1 inches and larger		0
Rotten residue 3.1 inches and larger		100

2-RF-4

134



Data Sheet 2-RF-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	1.2	77
0.26- 1.0	3.2	214
1.1 - 3.0	4.2	336
3.1 - 9.0	5.1	462
9.1 -20.0	2.1	203
20.1 +	0	0
Total	15.8	1292

Comments:

Stand Information

Average diameter	(inches)	26
Average tree height	(ft)	109
Average crown length		41
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	962
Bole weight per tree		3165
Bark weight per tree		1025
Total weight per tree		5152
Bole volume per tree	(ft ³)	137

Residue Measurements

Average residue depth	(ft)	0.83
Ground area covered by residue	(pct.)	100
Average duff and litter depth	(inches)	4.5
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		54
Rotten residue 3.1 inches and larger		46



Data Sheet 3-RF-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.7	45
0.26- 1.0	2.8	186
1.1 - 3.0	5.6	445
3.1 - 9.0	4.7	454
9.1 -20.0	7.4	662
20.1 +	0	0
Total	21.2	1792

Comments:

Stand Information

Average diameter	(inches)	28
Average tree height	(ft)	115
Average crown length		32
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	1080
Bole weight per tree		3835
Bark weight per tree		1243
Total weight per tree		6158
Bole volume per tree	(ft ³)	166

Residue Measurements

Average residue depth	(ft)	0.72
Ground area covered by residue	(pct.)	93
Average duff and litter depth	(inches)	2.0
Ground area covered by duff and litter	(pct.)	100
Sound residue 3.1 inches and larger		55
Rotten residue 3.1 inches and larger		45



Data Sheet 4-RF-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.2	16
0.26- 1.0	1.5	97
1.1 - 3.0	3.5	279
3.1 - 9.0	2.2	187
9.1 -20.0	23.8	2057
20.1 +	0	0
Total	31.2	2636

Comments:

Stand Information

Average diameter	(inches)	39
Average tree height	(ft)	101
Average crown length		62
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	1850
Bole weight per tree		6491
Bark weight per tree		2103
Total weight per tree		10444
Bole volume per tree	(ft ³)	281

Residue Measurements

Average residue depth	(ft)	0.09
Ground area covered by residue	(pct.)	65
Average duff and litter depth	(inches)	.6
Ground area covered by duff and litter	(pct.)	70
Sound residue 3.1 inches and larger		76
Rotten residue 3.1 inches and larger		24

5-RF-4

140



Data Sheet 5-RF-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.3	19
0.26- 1.0	2.2	150
1.1 - 3.0	3.2	255
3.1 - 9.0	3.3	291
9.1 -20.0	21.7	1980
20.1 +	10.8	990
Total	41.5	3685

Comments:

Stand Information

Average diameter	(inches)	34
Average tree height	(ft)	100
Average crown length		50
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	1480
Bole weight per tree		4943
Bark weight per tree		1602
Total weight per tree		8025
Bole volume per tree	(ft ³)	214

Residue Measurements

Average residue depth	(ft)	0.1
Ground area covered by residue	(pct.)	76
Average duff and litter depth	(inches)	1.4
Ground area covered by duff and litter	(pct.)	96
Sound residue 3.1 inches and larger		58
Rotten residue 3.1 inches and larger		42

MOUNTAIN HEMLOCK

Size Class 4

One Level

CALVEG Series: **Mountain Hemlock**
Code Symbol: **MH**

Dominant Species: **mountain hemlock**
Associates: **(pure stand)**

Reminders to users:

- The marker in these photos is 1 foot square and the pole is painted in contrasting colors at 1-foot intervals to provide perspective.
- Stumps are not included in residue quantities.
- Rotted residue is that which would come apart or splinter when kicked.



Data Sheet 1-MH-4

Dead and Downed Fuel Loadings (per acre)

Size class (inches)	Weight (tons)	Volume (ft ³)
0.0 - 0.25	0.3	21
0.26- 1.0	.6	42
1.1 - 3.0	1.1	87
3.1 - 9.0	1.1	109
9.1 -20.0	8.1	719
20.1 +	3.0	316
Total	14.2	1294

Comments:

Stand Information

Average diameter	(inches)	28
Average tree height	(ft)	79
Average crown length		58
Total crown weight per tree (includes unmerchantable top to 4 inches)	(lb)	873
Bole weight per tree		2929
Bark weight per tree		586
Total weight per tree		4388
Bole volume per tree	(ft ³)	97

Residue Measurements

Average residue depth	(ft)	0.13
Ground area covered by residue	(pct.)	63
Average duff and litter depth	(inches)	.9
Ground area covered by duff and litter	(pct.)	96
Sound residue 3.1 inches and larger		55
Rotten residue 3.1 inches and larger		45



The Forest Service of the U.S. Department of Agriculture

- . . . Conducts forest and range research at more than 75 locations from Puerto Rico to Alaska and Hawaii.
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Blonski, Kenneth S.; Schramel, John L. **Photo series for quantifying natural forest residues: southern Cascades, northern Sierra Nevada.** Gen. Tech. Rep. PSW-56. Berkeley, CA: Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture; 1981. 145 p.

A total of 56 photographs shows different levels of natural fuel loadings for selected size classes in seven forest types of the southern Cascade and northern Sierra-Nevada ranges. Data provided with each photo include size, weight, volumes, residue depths, and percent of ground coverage. Stand information includes sizes, weights, and volumes of the trees sampled for the inventory. Instructions for using the photos to describe natural fuel accumulations are provided.

Retrieval Terms: forest residues, fuel loading, ground fuels, measurement, photointerpretation, Sierra Nevada (northern), Cascade Range (southern)