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Some Characteristics Of Arizona's Mixed Conifer Forest Floor

Peter F. Ffolliott, Frederic R. Larson, and Ronald E. Thill[1]

Timber basal area was the only stand or site variable tested that was significantly related to forest floor depth and weight. Frequency distributions of forest floor depths were developed for use as a management tool when depths affecting wildland products are defined.

Keywords: Forest litter, mixed conifer forest type.

The forest floor, defined as the accumulation of dead organic matter above mineral soil, has an important influence on tree regeneration, herbage production, and the hydrologic characteristics of a site. In addition, it is an important forest fuel component. Generally, three layers are distinguished: the **L** layer, unaltered organic matter; the **F** layer, partly decomposed matter; and the **H** layer, well decomposed matter.

Characteristics of the forest floor under Arizona's ponderosa pine (*Pinus ponderosa*) forests have been documented in previous studies (Ffolliott et al. 1968, 1976). The objectives of this Note were to: (1) describe the depth and weight characteristics of Arizona's uncut mixed conifer forest floor; (2) determine whether or not the amount of forest floor can be estimated from readily obtained stand and site variables; and (3) compare the characteristics of the forest floor developed under ponderosa pine and mixed conifer forests.

[1]*Ffolliott is Associate Professor, School of Renewable Natural Resources, University of Arizona, Tucson. Larson is Silviculturist, Rocky Mountain Forest and Range Experiment Station, located at the Station's Research Work Unit at Flagstaff, in cooperation with Northern Arizona University; Station's central headquarters is maintained at Fort Collins, in cooperation with Colorado State University. Thill is Research Assistant, School of Renewable Natural Resources, University of Arizona, Tucson.*

Study Area

The study area encompassed three watersheds (North and South Fork of Thomas Creek and West Fork of Willow Creek) totaling approximately 1,275 acres within the Black River Barometer watershed in east-central Arizona (Rich and Thompson 1974). Seven coniferous and one deciduous species occur in a wide variety of intermixtures on the area: Engelmann spruce (*Picea engelmanii*), blue spruce (*Picea pungens*), Douglas-fir (*Pseudotsuga menziesii* var. *glauca*), white fir (*Abies concolor*), corkbark fir (*Abies lasiocarpa* var. *arizonica*), ponderosa pine, southwestern white pine (*Pinus strobiformis*), and quaking aspen (*Populus tremuloides*).

Current gross sawtimber volume averages 21,700 bd ft per acre. Annual precipitation averages 28 in; soils are developed from basalt; elevations range from 8,400 ft to 9,300 ft.

Methods

Depth of individual forest floor layers was measured at 359 randomly located sample plots on 3 watersheds. Only coniferous needles and aspen leaves in various stages of decomposition were considered. Depth was measured without compressing the layers at four sample points within 2 ft of the plot center, one in each "quadrant". An average of the four depth measurements, recorded to the nearest 0.1 in was used.

The weight of the individual forest floor layers was obtained from 1-ft² samples taken in one quadrant at every fifth sample plot; 73 samples were obtained. These samples were brought into the laboratory to determine oven-dry weights. Corresponding depth measurements were taken at four sides of the ft² samples.

Data necessary to synthesize stand and site variables were obtained from timber inventory data taken at each sample plot. Basal area density was estimated by point sampling with an angle gage corresponding to a basal area factor of 25. Potential insolation, expressed in terms of gram-calories per cm², was determined from slope and aspect measurements (Frank and Lee 1966).

Results

Means and standard errors for depth and weight are presented in table 1. Mixed conifer forest floors generally weigh more than ponderosa pine for comparable depths. Greater **F** and **H** layer weights in the mixed conifer forest are the apparent reason for the difference.

Table 1.—Means and standard errors for depth and weight

Forest floor layers	Depth		Weight	
	Mean	$S_{\bar{x}}$	Mean	$S_{\bar{x}}$
	Inches		*Tons Per Acre*	
L	0.2	0.01	0.4	0.05
F	.7	.02	10.3	.73
H	.7	.02	10.4	1.14
Total Floor	1.6	.04	21.1	1.34

Frequency distributions of forest floor depths by individual layers are illustrated in figure 1. Forest floor accumulations tend to be deeper under mixed conifer than ponderosa pine forests (Ffolliott et al. 1968, 1976).

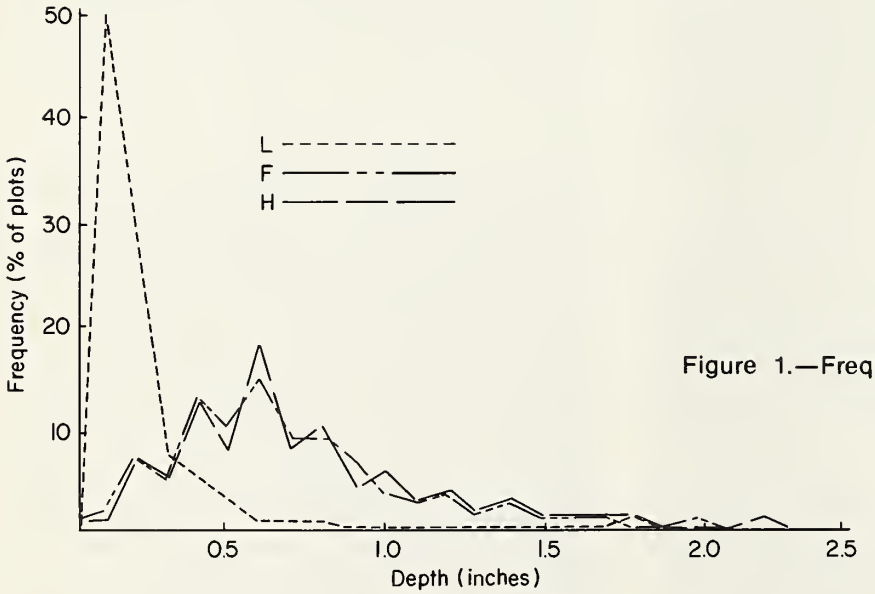

Figure 1.—Frequency distribution of forest floor depths by layers.

If specific depths of forest floor can be defined as affecting tree regeneration, herbage production, site hydrology, or forest fuels, these frequency distributions can be used to estimate the portion of Arizona's uncut mixed conifer forests that is characterized by these amounts.

Theoretically, crown closure and temperature can affect the depth of forest floor (Kittredge 1948, Lutz and Chandler 1951). We therefore attempted to relate the individual layer and total floor depths and weights to crown closure and temperature by empirical regression analysis. Crown closure can be estimated by basal area[2], and temperature is indexed by potential insolation.

Basal area was the only independent variable that showed significant regressions for forest floor depth and weight, excluding the **L** layer. The prediction equations, when basal area (X) is expressed in ft² per acre, are:

Forest floor depth *Inches*	Forest floor weight *Tons per acre*
$Y_T = 1.20 + 0.0023X$ $r = 0.28$	$Y_T = 9.20 + 0.065X$ $r = 0.46$
$Y_H = 0.52 + 0.00091X$ $r = 0.23$	$Y_H = 2.30 + 0.044X$ $r = 0.36$
$Y_F = 0.48 + 0.0015X$ $r = 0.25$	$Y_F = 6.40 + 0.022X$ $r = 0.28$
Y_L (Not significant)	Y_L (Not significant)

With the exception of the **L** layer, the equations for predicting forest floor depth and weight from timber basal area were similar to those reported for ponderosa pine forests (Ffolliott et al. 1968, 1976).

While they may have some significance, the forest floor-basal area relationships did not have high correlation. According to Brown (1966), predictions of the amount of forest floor from stand site variables are most dependable in stands with uniform structure. Unfortunately, uniformity is not the norm in Arizona's mixed conifer forests.

The relation of weights of forest floor layers to depths is given in figure 2. The relationship $Y = bX$, as determined from the average of the ratios of weight and depth (Natrella 1965), was used to develop these functions. As under ponderosa pine forests, the **H** layer is denser than the **L** and **F** layers.

[2]An unpublished study, untitled, on file at the School of Renewable Natural Resources, University of Arizona, Tucson, has shown percent of overhead crown closure in a mixed conifer forest stand in east-central Arizona to be correlated with basal area density estimated by point sampling with a basal area factor of 25.

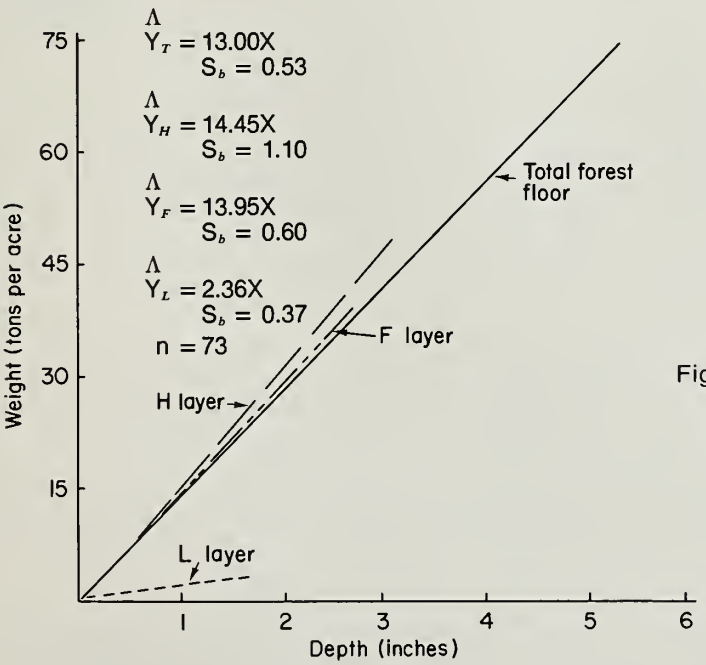

Figure 2.—Relationship between forest floor weight and depth. Lengths of regression lines indicate range of data.

Summary

1. The mean depth and weight of the forest floor in Arizona's uncut mixed conifer forests were 1.6 in and 13.0 tons per acre, respectively, with the greatest accumulations in the F and H layers.

2. Frequency distributions of forest floor depths were developed for use when depths affecting wildland products are defined.

3. Timber basal area was the only tested stand or site variable significantly related to individual layer (with the exception of the L layer) or total forest floor amounts. Although the correlations were low, the regressions may prove helpful in describing forest floor characteristics under Arizona's mixed conifer forests.

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