

Forest Research Note

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LEAF FALL, HUMUS DEPTH, AND SOIL FROST IN A NORTHERN HARDWOOD FOREST

In the mound-and-depression microtopography of the northern hardwood forest, leaves are blown off the mounds and collect in the depressions. This influence of microtopography on leaf accumulation is responsible for much of the variation in humus depth; and this, in turn, affects the formation and depth of soil frost.

These interrelationships have been studied recently at the Hubbard Brook Experimental Forest in the White Mountains of New Hampshire. The study site was a second-growth uneven-aged stand that had a basal area of 135 square feet per acre, an average tree diameter of 6 inches, and a canopy closure of more than 90 percent.

Leaf Fall

The amount and variation of leaf fall was determined in the fall of 1961. Leaves were caught in 10 boxes, each 2 x 2 feet square, scattered randomly in three 1/2-acre study plots. On a pound-per-acre basis (oven-dry weight) the catch in individual boxes ranged from 2,812 to 3,834 pounds, averaging 3,348 pounds with a standard deviation of 449 pounds, 13 percent of the mean. Most of the leaves fell during October.

Leaf Accumulation

Leaf accumulation was measured on 9 ground plots 2 x 2 feet square, which were sprayed before leaf fall with a covering of blue paint so that new accumulations could be distinguished easily. Three plots were

located on mounds (12 percent of the area), 3 in depressions (13 percent of the area), and 3 on intervening slopes (75 percent of the area). Leaf accumulations were collected for 3 years. Collections were completed each year by November 15.

Accumulations in the fall of 1961 (to compare with leaf-fall measurements) ranged from a low of 628 pounds per acre (oven-dry weight) on one of the mound plots to a high of 8,351 pounds in a depression. The mean value was 3,326 pounds, with a standard deviation of 2,253 pounds, 68 percent of the mean. Thus leaf accumulation was found to be about five times more variable than leaf fall.

The average accumulations for each year, and the averages weighted according to proportion of area occupied by each topographic position, were as follows:

<i>Average Accumulation</i>				
	<i>1959</i>	<i>1960</i>	<i>1961</i>	<i>Mean</i>
	<i>(pounds)</i>	<i>(pounds)</i>	<i>(pounds)</i>	<i>(pounds)</i>
Mounds	1,852	942	1,641	1,478
Slopes	2,566	2,658	2,522	2,582
Depressions	4,187	6,542	5,815	5,515
<i>Weighted Average Accumulation</i>				
	2,658	2,942	2,833	2,820

Analysis of variance showed that the difference between topographic position was highly significant ($F = 23.36$), with non-significant differences between years ($F = 0.43$) and year-topography interaction ($F = 1.30$). The average annual accumulation of 2,820 pounds per acre falls between the 2,425 to 3,020 pounds reported by Chandler¹ for mixed hardwoods in New York State. The weighted area average for 1961 was about 500 pounds less than the mean catch of the boxes for that year — an unaccountable difference.

Humus Accumulation

Humus type and depth were determined at 2,800 points in the experimental area in conjunction with three winters of snow and frost measurements. Mor humus occupied 67 percent of the area, mull 19, and duff

¹Chandler, R. F. The amount and mineral nutrient content of freshly fallen leaf litter in the hardwood forests of central New York. Jour. Amer. Soc. Agronomy 33: 859-869, 1941.

mull 9; the remainder, 5 percent, was bare mineral soil. The average depth of humus according to topographic position was as follows:

	<i>Mor</i> (inches)	<i>Mull</i> (inches)	<i>Duff mull</i> (inches)
Mounds	1.5	1.4	2.0
Slopes	3.0	2.9	3.5
Depressions	5.9	4.2	7.1

Roughly, humus depth on slopes was about twice that on mounds, and depths in the depressions were three to four times greater than the depths on mounds. Similar proportions were evident in leaf accumulations.

Soil Frost

The occurrence of concrete frost varied from 23 percent (after a cold period without a snow cover) to none. Throughout most of the winter snow insulates the soil and restricts frost formation. During three winters of frost observations, concrete frost was found at only 4 percent of the 2,800 sampling points. However, 78 percent of these points where frost was found were on mounds where little or no humus had accumulated; the remainder were found on slopes; and no frost was observed in depressions. The average depth of concrete frost on the mounds was 2.7 inches, and on slopes 1.6 inches. It should be noted that any overland flow from a mound having concrete frost would be absorbed by the unfrozen slopes and depressions adjacent to it.

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