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Influence of Exposure on Woody Vegetation on the Allen Soils of the Boston Mountain Region of Northwest Arkansas

M. Dean Harper
Natural Resources Conservation Service

E. Moye Rutledge
University of Arkansas, Fayetteville

THE INFLUENCE OF EXPOSURE ON WOODY VEGETATION ON THE ALLEN SOILS OF THE BOSTON MOUNTAIN REGION OF NORTHWEST ARKANSAS

M. Dean Harper
U.S.D.A. Soil Conservation Service
E. Moye Rutledge
University of Arkansas

INTRODUCTION

Purpose

According to previous observations and studies, northern exposures are more desirable for tree growth than southern exposures(1,3,4,5). The purpose of this study was to determine if the above statement was true and, if so, to what extent. It was also desirable to learn if species varied in their adaptation between northern and southern exposures.

Location

This study was carried out in the Boston Mountains in the southern part of Washington County, Arkansas. Three sets of opposing northern-southern exposures were sampled. The sample plots were located in similar conditions and as far as could be determined had received similar forestry treatment. They were located at R28W T13N Sections 8 and 17 and R31W T13N Section 31.

FIELD STUDY AND SAMPLING METHOD

The arm length transect method was used in sampling this area. These transects are made by walking in a straight line for 60 feet with arms outstretched. This makes a sample area 60' x 6' or 360 sq ft. Each tree that is within arms' reach is recorded according to species and size class. The following size classes were used: 1 to 3", 3

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to 9", 9 to 15", 15 to 20" and 20" plus. The size was determined by diameter at breast height, or four and one-half feet above the ground.

Treatment of data was similar to the methods employed by Curtis and McIntosh(2).

The following data were calculated for each species of tree found: per acre and relative percent frequency, per acre and relative percent density, per acre and relative percent basal area, and density-frequency-dominance (D.F.D.) index. Frequency refers to the number of sample plots in which a species is found. Density refers to the actual number of trees per unit area. Basal area indicates the number of square feet covered by each species and is calculated at four and one-half feet above the ground. The sum of the relative frequency, density, and basal area is the D.F.D. index. Each D.F.D. index has a possible value of three hundred (300).

In order to reduce the number of variables in this study, all the exposures sampled had the same soil type, Allen stony sandy loam. All slopes ranged between 30 and 45 percent in gradient and had between 300 and 500 feet of altitude change from mountain top to valley.

The Allen stony sandy loam is deep, medium textured, moderately permeable and well drained. It is derived from colluvium. The parent material is sandstone. This soil occurs on mountain sides and mountain benches on gentle to steep slopes. It is in the Red-Yellow Podzolic great soil group. Allen is considered to be a good site class for trees.

Sampling was started at the top of the slope and continued to the bottom. Fifty samples were taken, twenty-five on southern exposures and twenty-five on northern exposures. The sample plots ran lengthwise east and west.

Samples of all species are on file at the University of Arkansas Herbarium.

RESULTS AND CONCLUSIONS

On the northern exposure four species were shown to have a D.F.D. index greater than twenty-five (25). This is shown in Table I.

Hickory (Carya texana (Sarg.) Little) and northern red oak (Quercus borealis (Michx.f.) seemed to be the dominant species or the ones exerting the most influence over this community. As shown in

Table I, there were more hickory than northern red oak, but the northern red oak were much larger than the hickory. Sugar maple (Acer saccharum Marsh.) and blackgum (Nyssa sylvatica Marsh.) were of secondary importance in this community. There were more sugar maples than blackgums, but the blackgums were larger on the average.

White oak, (Q. alba L.), dogwood (Cornus florida L.), American elm (Ulmus americana L.), black walnut (Juglans nigra L.), and black locust (Robinia pseudoacacia L.) were present on the northern exposures with a D.F.D. index between 20.0 and 10.0. They could, therefore, be considered as commonly occurring but not as exerting much influence on the community.

Redbud (Cercis canadensis L.), ash (Fraxinus pennsylvanica var. lanceolata (Borkh.) Sarg.), and winged elm (U. alata (Michx.) were found on the northern exposures with a D.F.D. index between 6.0 and 2.0

Northern red oak seemed to be exerting the major controlling influence on the southern exposure community as is shown in Table II. White oak (Q. alba L.), black hickory, and sugar maple seemed to be of secondary importance. The white oaks had a larger average size than the black hickorys or sugar maples, but black hickorys and sugar maples occurred more frequently. American elm, post oak (Q. Stellata Wang.), black locust, winged elm, and blackgum occurred on the southern exposure with a D.F.D. index ranging from 16.2 to 6.3.

Table III shows a comparison between the northern and southern exposures. It can be seen that northern red oak was of much more importance on the southern exposure. This is contrary to the usual situation as described by Moore(4). Black hickory and blackgum had approximately four times the density and basal area on the northern exposure as they did on the southern. Sugar maple, American elm, white oak, and black locust did not seem to be significantly different in their adaptation to the two exposures. Dogwood, black walnut, redbud, and ash were important in that they were found on the northern exposure and were absent on the southern. Post oak was the only species found on the southern exposure that was not found on the northern. Winged elm seemed to be of twice the importance on the southern exposure as on the northern.

The fact that, in general, the species that re-

TABLE I

NORTHERN EXPOSURE

Species	Relative % Frequency	Relative % Density	Relative % Basal Area	Density-Frequency-Dominance Index
Black Hickory	21.8	39.6	24.17	85.57
Northern Red Oak	14.6	11.1	42.30	68.60
Sugar Maple	14.6	16.0	3.35	33.95
Blackgum	8.3	5.3	13.62	27.23
White Oak	7.3	5.8	5.10	18.20
Dogwood	9.4	7.1	1.21	17.71
American Elm	8.3	7.5	1.28	17.08
Black Walnut	4.2	2.2	4.92	13.33
Black Locust	5.2	2.2	2.64	10.04
Redbud	3.1	1.3	0.87	5.27
Ash	2.1	0.9	0.16	3.16
Winged Elm	1.0	0.9	0.16	2.06

TABLE II

SOUTHERN EXPOSURE

Species	Relative % Frequency	Relative % Density	Relative % Basal Area	Density-Frequency-Dominance Index
Northern Red Oak	31.9	55.6	50.45	142.00
White Oak	16.7	8.7	20.29	45.69
Black Hickory	12.5	11.0	10.05	33.55
Sugar Maple	15.3	11.0	3.01	29.31
American Elm	6.9	7.7	1.63	16.23
Post Oak	4.2	1.7	9.57	15.47
Black Locust	4.2	1.7	4.19	10.09
Winged Elm	4.2	2.7	0.74	7.64
Blackgum	4.2	1.7	0.47	6.37

TABLE III

COMPARISON OF NORTHERN AND SOUTHERN EXPOSURES

Species	Northern Exposure		Southern Exposure	
	Density-Per Acre	Basal Area sq ft	Density-Per Acre	Basal Area sq ft
Northern Red Oak	121.0	60.2	488.8	33.4
Black Hickory	430.8	34.0	96.8	7.1
Sugar Maple	174.2	4.7	96.8	2.1
White Oak	62.9	7.2	77.4	14.2
Black Walnut	24.2	6.9	---	---
Black Locust	24.2	3.7	14.5	2.9
American Elm	82.3	1.8	53.2	1.1
Winged Elm	9.7	.2	24.2	.5
Dogwood	77.4	1.7	---	---
Redbud	14.5	1.2	---	---
Blackgum	58.1	19.1	14.5	.3
Ash	9.7	.2	---	---
Post Oak	---	---	14.5	6.7
Total	1089	140	880	70

quire more mesic conditions(4) were of more importance or found only on the northern exposure and that the northern exposure had a basal area per acre of 140.83 sq ft while the southern exposure had only 70.14 sq ft per acre indicates that the northern exposure is a more mesic(5) site for tree growth.

SUMMARY

Field studies were made to determine the effect of northern and southern exposure on stands of woody vegetation on Allen stony sandy loam in the Boston Mountain Region of Northwest Arkansas. Three sets of opposing northern-southern exposures were sampled.

Northern red oak, black hickory, sugar maple, white oak, black locust, American elm, and blackgum were common to both northern and southern exposures. Dogwood, ash, redbud, and walnut trees were found on northern exposures and were not found on southern exposures. Post oak trees were found on southern exposures but were not found on northern exposures. There were more trees per acre on northern exposures and the individual trees were larger on northern than on southern exposures. The total basal area at breast height was 70.14 sq ft per acre for southern exposures and 140.83 sq ft per acre for northern exposures.

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