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SITE INDEX OF DELAWARE-MARYLAND SWEETGUM STANDS IN RELATION TO SOIL CHARACTERISTICS

Intensive forest management requires knowledge about the differences in productivity of land areas or sites. The suitability of management systems and stand treatments often depends on the potential of the particular site in question. For example, conversion of low-value stands to another species may be economically feasible on the best sites, but not on the poor ones. To provide the guides needed for management decisions, sites must be grouped into quality classes on the basis of studies that relate site productivity to measurable site characteristics. Local studies are usually required, because factors important in one region often prove to be relatively unimportant in another.

Relationships between the site index of New Jersey sweetgum stands and soil and water-table characteristics were described in a 1963 publication[1]. That study was subsequently extended to Delaware and Maryland; this report describes results from the extended study.

Study Methods

Study methods used in the Delaware and Maryland Coastal Plain were essentially the same as those used in New Jersey[1]. Sweetgum blight, heavy cutting, and age eliminated many prospective stands from study; only 25

[1] Phillips, John J., and Marco L. Markley. SITE INDEX OF NEW JERSEY SWEETGUM STANDS RELATED TO SOIL AND WATER-TABLE CHARACTERISTICS. U. S. Forest Serv. Res. Paper NE-6, 25 pp., illus. NE. Forest Exp. Sta., Upper Darby, Pa. 1963.

suitable areas were located. Of these, only one was in Delaware; and it had a muck soil, so it too was eliminated from all subsequent analyses based on mineral-soil characteristics. Of the other 24 areas, 6 were located on Maryland's Eastern Shore and 18 on the Western Shore.

Groundwater wells were established in all of the Delaware and Maryland plots so that depth to groundwater and fluctuations in this depth could be measured.

Results

Groundwater relationships.—Because of droughts in 1963 and 1964, groundwater levels in the Delaware and Maryland plots were lower than those measured in the New Jersey study. Groundwater levels dropped below the well bottom (42 inches) early in the summers of both 1963 and 1964, eliminating any chance of relating groundwater and site index in the Delaware-Maryland plots.

Soil factors and site index.—The first step in the analysis was to test the equation developed earlier for mature soils in New Jersey[1] on the 12 Maryland plots that had similar soils. The New Jersey equation seemed adequate for 10 of these plots: the average difference between predicted and measured site index for the 10 plots was 6.7 feet, 1 foot more than the standard error of estimate found in the New Jersey study. The two Maryland plots that differed widely in site index from the value predicted by the New Jersey equation had subsoil silt contents in excess of 50 percent. This is much more silt than was found in the New Jersey or other Maryland plots, where average silt contents were 18 and 27 percent respectively. However, the inclusion of correction factors based on silt content of the subsoil did not appreciably improve the accuracy of the equation.

The second step in the analysis was to combine data from all plots (except those on muck) in the three states. In this analysis, height of the sampled trees was used as the dependent variable, rather than site index. The resulting equation was:

$$\text{Height} = 98.5 - \frac{1310}{\text{age}} - 9.7X_1 + 0.51X_2 + 0.19X_3 - 4.2X_4 - 3.5X_5$$

where:

Age = number of rings at breast height plus 3.

X_1 = 0 for alluvial soils with silt contents of less than 50 percent in the B_2 horizon; or 1 for all residual soils and for alluvial soils with silt contents of 50 percent or more in the B_2 horizon.

X_2 = percent of clay in the B_2 horizon.

X_3 = percent of fine sand in the B_2 horizon.

X_4 = 0 where silt content of the B_2 horizon is 16 percent or more; or 1 where this silt content is 15 percent or less.

X_5 = 0 where the depth to a tight B_2 horizon is 13 inches or more; or 1 where this depth is 12 inches or less.

The multiple correlation coefficient for this equation is 0.87 and the standard error of estimate is between 5 and 6 feet. While the equation accounts for 75 percent of the variation found in the average height of the sampled trees, about 45 percent of this is due to age and only 30 percent is due to the soil factors that were included in the equation.

On the basis of the study samples, this equation would predict productivity within a 10-foot class ($\pm$ 5 feet) for 60 percent of the sites. For the remainder, values would be less accurate. Height of trees on one sample plot differed from the predicted value by 17 feet, and in 10 other plots it varied by 10 or 11 feet. Nevertheless the equation may be a useful guide for estimating site productivity for sweetgum on alluvial soils in all three states. For residual soils in Delaware and Maryland, this equation is much more accurate than the earlier New Jersey equation.

To facilitate use of this new equation, table 1 has been computed for predicted values of site index (base age of 50 years).

Site index by soil groups.—Site-index values are listed by soil groups, drainage classes, and types in table 2. Although there was considerable variation in site index within classes, the values presented here may be useful as a guide for estimating site index.

Alluvial soils were often very good sites for sweetgum, with site index generally between 85 and 95. Coarse-textured nonglauconitic deposits in New Jersey ran lower (77-82), as did some of the Bibb soils in Maryland.

Mature residual soils were moderate to good sites for sweetgum. Values on the very poorly drained Portsmouth loam varied little from the average of 85 feet. Greater variation occurred on the moderately well-drained Woodstown loam (78 to 93); and the sole value for Rutledge (78) was 18 feet higher than the single New Jersey plot that fell in that soil series. The only Fallsington plot also had a much higher value in Maryland than in New Jersey; its value was 88 compared to 58 and 64 for the two New Jersey plots.

Muck soils were normally low in productivity. But where drainage has been improved, sweetgum may have a relatively high site index—85 on one study plot.

Table 1.—Predicting sweetgum site index on soils of the Delaware-Maryland-New Jersey Coastal Plain[1]
(In feet at 50 years of age)

A

Clay in B_2 horizon (percent)	Alluvial soils with silt contents in B_2 horizon of— 50 percent or more	Alluvial soils with silt contents in B_2 horizon of— 16-49 percent	Alluvial soils with silt contents in B_2 horizon of— 15 percent or less	Residual soils with silt contents in B_2 horizon of— 16 percent or more	Residual soils with silt contents in B_2 horizon of— 15 percent or less
5	65	75	71	65	61
10	68	77	73	68	64
20	73	82	78	73	69
30	78	88	83	78	74
40	83	93	88	83	79
50	88	98	94	88	84
55	—	100	96	91	86

B

Fine sand in B_2 horizon (percent)	Depth to tight B_2 horizon: 13 inches or more	Depth to tight B_2 horizon: 12 inches or less
5	+ 1	− 2
10	+ 2	− 2
20	+ 4	0
30	+ 6	+ 2
40	+ 8	+ 4
50	+10	+ 6
60	+11	+ 8
70	+13	+10
75	+14	+11

[1] First obtain base value in A; then correct as indicated in B. Estimated site index is the result of adding these two values.

Conclusions

In this study, neither individual soil characteristics used in regression equations nor soil types recognized in the National Cooperative Soil Survey proved to be precise indicators of site productivity for sweetgum stands in New Jersey, Delaware, and Maryland. However, estimates of site productivity made from information in this report should still be useful to practicing foresters. Best estimates can be made on the following basis:

- All soils: the site index values given here by soil type may be used as a guide in estimating site index.

Table 2.—Site index for Maryland and Delaware sweetgum stands by soil groups, drainage classes, and soil types

Soil groups, drainage classes, and soil types	Site-index values *Feet*
MATURE RESIDUAL SOILS	
Moderately well drained:	
Adelphia-Donlonton loam or fine sandy loam[1]	74, 90
Donlonton-Keyport loam	76
Donlonton silt loam	78
Keyport fine sandy loam	80
Woodstown loam	78, 84, 93
Poorly drained:	
Fallsington fine sandy loam	88
Very poorly drained:	
Portsmouth loam	83, 85, 87
Rutlege sandy loam	78
ALLUVIAL SOILS	
Bibb silt loams	74, 75, 81, 82, 90, 94
Johnston loamy fine sand	96
RECENT ALLUVIAL DEPOSITS	
Well drained (Fluctuating water table)	87
Poorly drained[2]	84, 90
MUCKS	
Mucks	68, 85

[1] Where two type names are used, the soil is an intergrade between the two.
[2] The value 90 is on a deposit showing greensand influence.

- Alluvial soils and recent alluvial deposits: the prediction equation presented here should be useful for estimating site index in all three states, although it predicts within a 10-foot site-index class ($\pm$ 5 feet) on only about 75 percent of the sites.

- Mature residual soils: for mature soils in New Jersey, the equation previously reported[1] will give slightly more accurate predictions than the one offered in this paper. For mature residual soils in Delaware and Maryland, the equation presented in this paper gives more reliable results.

— JOHN J. PHILLIPS[2]

[2] When this study was made, the author was associate soil scientist on the staff of the Northeastern Forest Experiment Station's research unit at New Lisbon, N. J. At present he is on the staff of the Wisconsin Public Service Commission, Madison, Wis.