

Forest Research Notes

N

FOREST SERVICE, U.S. DEPT. OF AGRICULTURE, 102 MOTOR 3 AVENUE, UPPER DARBY, PA.

E

No. 89
1959

SELECTION OF STAND VARIABLES IN SOUTHERN MAINE FOR MAKING VOLUME ESTIMATES FROM AERIAL PHOTOS

Aerial photographs are used widely in forest inventories. But there is a continuing need for improving the techniques of photo interpretation and making more efficient use of photographs. When the number or intensity of sample ground plots is controlled by airphoto classifications, a reliable stratification of the timber area is a *must*.

Three measurements are commonly used on photos of forest inventory plots--total tree height, tree-crown diameter, and crown-closure percent (stand density). In the Forest Survey of the Northeast, these stand variables are used to classify photo plots according to gross volume per acre. Field measurements are then made on sample plots from each volume strata.¹ The number of field plots required depends in part on the accuracy of the photo-volume stratification.

Little basic data are available in the Northeast to indicate *which* stand variables are most closely correlated with timber volume. So, a study was designed to determine the value of tree height, crown diameter, and crown-closure measurements for predicting gross cubic volume per acre. On-the-ground measurements of these variables were obtained on 28 one-fifth acre plots in Hancock County, Maine. Gross plot volumes included hardwood and softwood species, 5 inches d.b.h. and larger.

Correlation coefficients were computed and statistically tested to determine the usefulness of each variable. As indicated by table 1, the highest single correlation with

¹Bickford, C. Allen. Increasing the efficiency of airphoto forest survey by better definition of classes. Northeast. Forest Expt. Sta., Sta. Paper 58. 9 pp. 1953.

gross volume (+0.6827) was shown by crown-closure percent. The addition of average crown diameter and tree height produced a higher correlation coefficient (+0.7521), But tests showed that this increase was not significant at the 5-percent level. It was concluded that reasonable predictions of gross cubic volume could be made in stands similar to those sampled by measuring crown closure alone.

Gross cubic volumes were then plotted over corresponding measurements of crown-closure percent. A linear regression, of the form $Y = a + bx$, was fitted to the data by the method of least squares. The resulting prediction equation was: $Y = 45.0 + 4.356X$, where Y = gross cubic-foot volume of all trees 5 inches d.b.h. and larger on a 1/5-acre plot, and X = crown-closure percent of all trees in the stand at least 20 feet tall.

From this relationship, an airphoto stand-volume table was constructed for spruce-fir-hardwood forests in southeastern Maine (table 2). This table was compiled for crown-closure classes of 40 to 100 percent, the approximate range encountered on the field plots.

Table 1.--Correlations of stand variables with gross cubic volumes¹

Ground measurements of independent variables	Gross or multiple correlation coefficients
H_3 (Average height, 3 tallest trees)	+ 0.2078
H_5 (Average height, 5 tallest trees)	.2494
H_{10} (Average height, 10 tallest trees)	.4375*
CD_3 (Average crown dia., 3 tallest trees)	.2975
CD_5 (Average crown dia., 5 tallest trees)	.2862
CD_{10} (Average crown dia., 10 tallest trees)	.1723
CC% (Crown closure percent)	.6827**
$H_5 \times CD_5$.3464
$CD_5 \times CC\%$.7187**
$CC\% \times H_5$.7317**
$H_5 \times CD_5 \times CC\%$.7521**
$H_{10} \times CD_{10} \times CC\%$.7417**

¹Based on 28 one-fifth-acre plots in Hancock County, Maine.

* Significant at the 5-percent level.

** Significant at the 1-percent level.

Table 2.--Airphoto stand-volume table for
spruce-fir-hardwood forests¹

Crown closure	Volume per 1/5 acre	95-percent confidence band
<u>Percent</u>	<u>Gross cubic feet</u>	<u>Gross cubic feet</u>
40	219	153 - 286
50	263	211 - 315
60	306	265 - 348
70	350	312 - 388
80	393	350 - 437
90	437	382 - 492
100	481	411 - 550

¹Based on ground measurements from 28 one-fifth-acre plots in Hancock County, Maine. 4 plots predominately conifers (spruce, fir, hemlock); 12 plots predominately hardwoods (birch, aspen, red maple); 12 plots mixed hardwoods and conifers. Correlation coefficient: +0.6827.

It was assumed that 10-percent classes represented the most refined estimates of crown closure that could be consistently made with aerial photographs. On this basis, it seemed unrealistic to use photo-volume stratifications with ranges smaller than those given in table 2. If desired, volume entries and corresponding confidence bands shown may be converted to a per-acre basis by multiplying by 5.

--EARL J. ROGERS, GENE AVERY, and ROY A. CHAPMAN
 Division of Forest Economics Research
 Forest Service, U. S. Dept. Agriculture