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SMALLER PLOTS OR POINT-SAMPLES FOR THE SMALL FOREST

by

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Inventories of small forest units are expensive because given levels of precision require proportionally more field samples than on large tracts. Data from an unevenaged pine-hardwood forest in East Texas indicate that 1/10 or 1/20 acre plots, or point-sampling, each cheaper than the usual 1/5 acre plots, may afford satisfactory estimates.

PROCEDURE

One hundred and ten permanent 1/5 acre inventory plots were systematically spaced 10 by 20 chains apart in an unevenaged shortleaf and loblolly pine-hardwood forest of 2,358 acres (Baker and Hunt, 1960), a 0.933 percent sample. Four sample systems were superimposed upon this inventory as follows:

Series A – 1/20 acre plot inside north half of 1/5 acre plots, a 0.233 percent sample.

Series B – 1/20 acre plot inside south half of 1/5 acre plots, a 0.233 percent sample.

Series C – 1/10 acre sample consisting of Series A plus Series B, a 0.4665 percent sample.

Series D – two 3.03 diopter prism point-samples from the north and south edges of the 1/5 acre plot, from which data were averaged to give a single measure at each plot.

The sampling systems are shown diagrammatically in Figure 1.

RESULTS

Using standard volume tables, the net board foot volume of all sawtimber size trees[2] and the net cubic foot

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[2]All lumber quality trees 10 inches d.b.h. or larger.

volume of all trees[3] were determined for each plot and converted to a volume per acre basis. For each plot series, the mean, the standard deviation, the coefficient of variation, the standard error and the proportional limit of error (Hirsch, 1957) were computed for both sawtimber volume and cubic foot volume (Table 1).

The frequencies of stand volume by plots are shown in Table 2. Stand tables made from the data collected on the plots are compared in Figure 2.

Since the point-samples afforded estimates of basal area of all merchantable trees (Hunt and Baker, 1967), these estimates were compared only with basal area of all trees as computed from the 1/5 acre plot measurements (Tables 3 and 4). Means, standard errors, and distribution of plots by basal area classes, as estimated by the two methods, were in very close agreement.

[3]All trees 5 inches d.b.h. or larger including sawtimber but excluding culls.

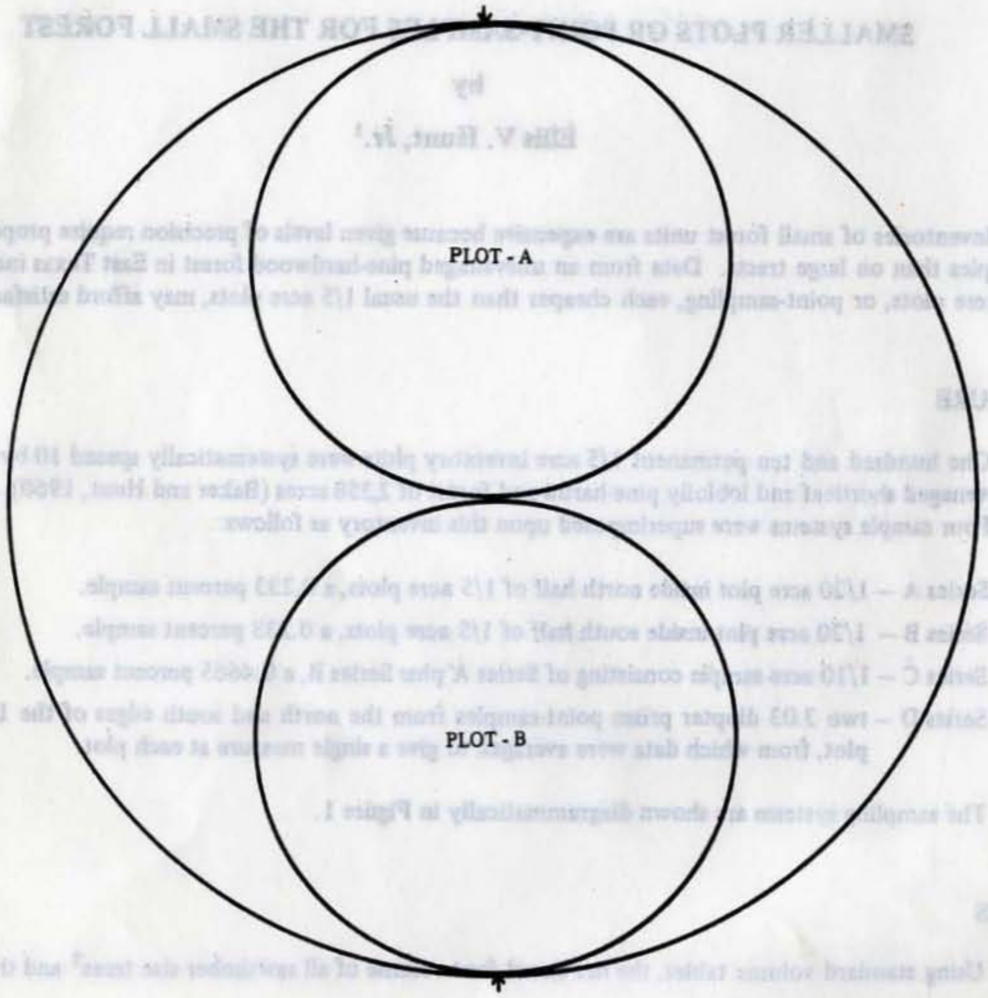

Figure 1. The sample scheme superimposed on the one-fifth acre plots; the arrows mark point-sampling positions.

TABLE 1. Mean per acre volumes and error statistics from 110-plot inventories, based on 3 plot sizes.

ITEM	Plot size and designation			
	1/5 acre	1/20 acre A	1/20 acre B	1/10 acre A+B
Sawtimber Stand				
Average volume, bd. ft.[1]	4,895.	4,607.	4,915.	4,761.
Standard deviation, bd. ft.	2,903.	4,447.	5,022.	3,354.
Standard error of mean, bd. ft.	276.8	424.0	478.8	319.9
Coefficient of variation, percent	59.3	92.0	102.2	70.5
Proportional limit of error, percent	11.3	18.4	19.5	13.4
Total Merchantable Stand				
Average volume, cu. ft.	1,180.	1,120.	1,137.	1,128.
Standard deviation, cu. ft.	510.	756.	886.	602.
Standard error of mean, cu. ft.	48.7	72.2	84.5	57.4
Coefficient of variation, percent	43.2	67.6	78.0	55.4
Proportional limit of error, percent	8.2	12.9	14.9	10.2

[1] Scribner log rule.

TABLE 2. Number of plots, by volume per acre classes, from inventories based on 3 plot sizes.

VOLUME CLASS	Plot size and designation			
	1/5 acre	1/20 acre A	1/20 acre B	1/10 acre A+B
Sawtimber stand, bd. ft.[1]				
0	2	19	23	7
1 - 2,500	26	26	19	28
2,501 - 5,000	38	23	26	30
5,001 - 7,500	24	16	14	25
7,501 - 10,000	14	14	9	12
10,001 - 12,500	5	3	10	6
12,501 - 15,000	1	5	5	1
15,001+	0	4	4	1
TOTAL	110	110	110	110
Total Merchantable Stand, cu. ft.				
0	0	2	3	1
1 - 250	4	9	13	8
251 - 500	6	13	9	9
501 - 750	14	14	18	11
751 - 1,000	24	20	19	22
1,001 - 1,250	21	16	9	13
1,251 - 1,500	8	10	9	15
1,501 - 1,750	14	4	7	15
1,751 - 2,000	11	8	3	6
2,001 - 2,250	2	5	4	2
2,251+	6	9	16	8
TOTAL	110	110	110	110

[1] Scribner log rule.

TABLE 3. Basal area estimated by 1/5 acre plots and point-samples.

ITEM	Basis of estimate	
	1/5 acre plots	point-sample
Number of plots or points	110.	110.
Mean basal area per acre, sq. ft.	70.72	70.18
Standard error of mean, sq. ft.	2.20	2.17

TABLE 4. Sample frequency, by basal-area classes, as estimated from 1/5 acre plots and from point-samples.

Basal area per acre sq. ft.	Number of 1/5 acre plots	Number of point-samples
0	1	1
1 - 20	1	1
21 - 40	5	7
41 - 60	32	34
61 - 80	41	33
81 - 100	16	25
101 - 120	11	8
121+	3	1
TOTAL	110	110

Similarly, average cubic foot volumes in the total merchantable stand differed little, although only 5.57 trees were measured per 1/20 acre plot as compared to 24.11 trees per 1/5 acre plot. The proportional limit of error did not reach 15 percent for any of these estimates and the number of plots with no cubic foot volume was at about the same level for all size plots. Stand tables made from the small size plots (Figure 2) did not vary appreciably from those based on conventional size plot data; they would have been equally satisfactory for planning purposes.

Since the smaller ones were superimposed upon the same locations as the 1/5 acre plots, they probably are more similar to the latter than completely independent samples; the similarity of results suggests, however, that acceptable estimates can be derived from small plots.

Since a 1/20 acre sample is only 1/4 as large as a 1/5 acre plot, with proportionally fewer trees, the on-plot measurement time is reduced by 75 percent, or perhaps more. The saving in cruising cost should offset the relatively small reduction in precision.

Point-sampling and the 1/5 acre plot estimates produced almost identical average values and standard errors, and similar distributions of basal area per acre. In point-sampling, other estimates of timber stand parameters are based directly upon basal area measurements, so if basal area is satisfactorily estimated the others should be, also. The point-sample estimates averaged 7.018 trees each and required no diameter measurements as compared to 24.11 trees measured per 1/5 acre plot; the time saving elements of point-sampling are evident. In evaluating these statistics, one should bear in mind, however, that the point-samples were the average of 2 points at each location and thus they were somewhat better than ordinary point-samples.

One might conclude, therefore, that if one hundred or more samples are needed to ensure representativeness in inventory of ordinary unevenaged southern pine-hardwood forests, small plots, 1/10 or even 1/20 acre in size, would be more economical and for many purposes perhaps as satisfactory as the larger conventional size plots. The time saving will be particularly noticed when systematic spacing is used, for the total length of line chained or paced between plots could be the same for small plots as for the larger ones. When small plots are used, sample intensities of 0.25 to 0.5 percent may be satisfactory on areas as small as 2,358 acres, thus solving some of the problems involved in the inventory of the small forest. Point-sampling could be used with similar time savings.

LITERATURE CITED

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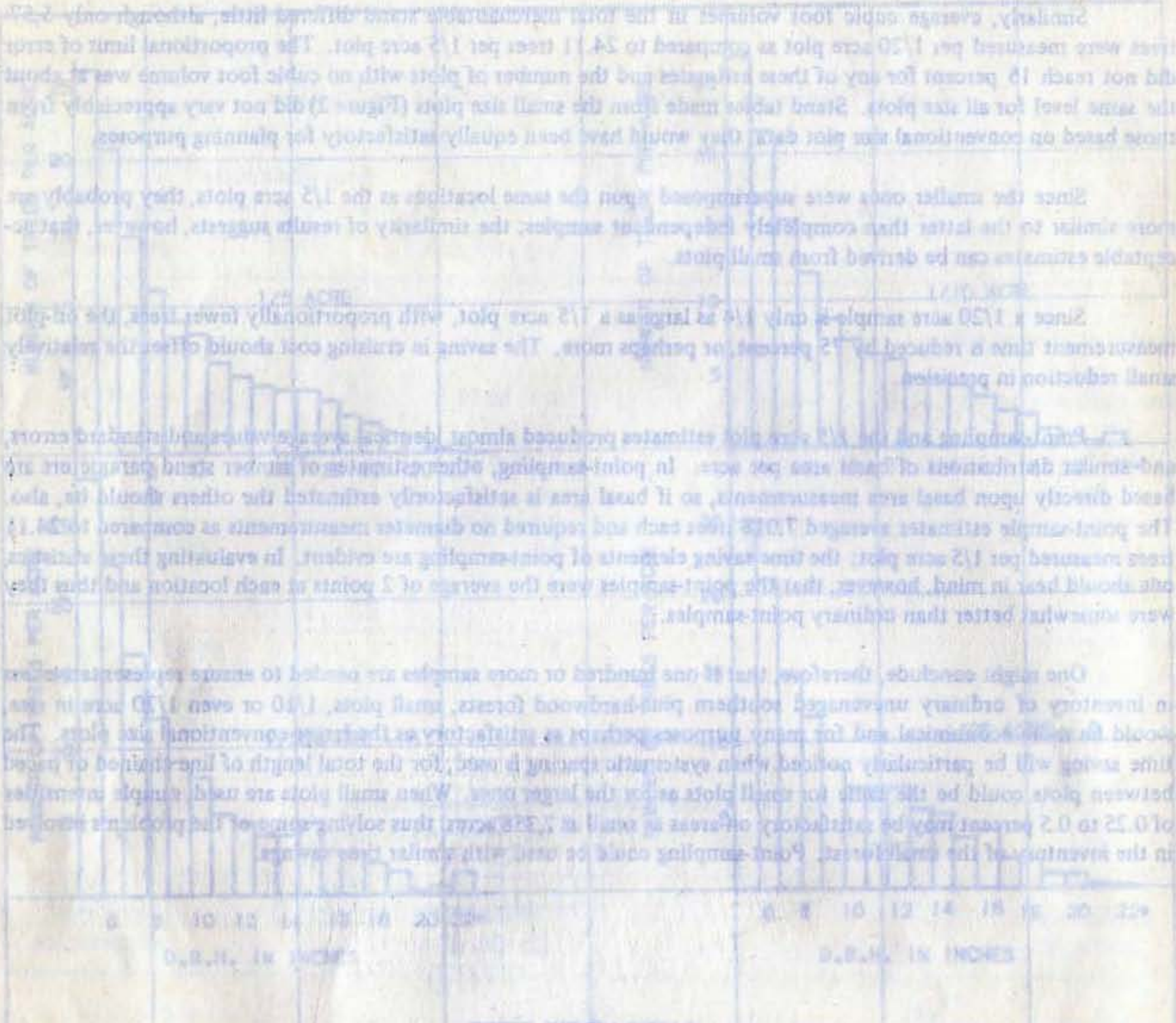

Figure 2. Stand distribution derived from 110 samples in each series.

DISCUSSION

The frequency distribution of plots by board foot volume per acre was remarkably similar for all plot sizes, but the number of plots having no volume (no sawtimber trees) was markedly larger for the 1/20 acre plot size, nearly 20 percent of the plots. Despite the small number of trees measured on the smaller plots (1.66 per 1/20 acre plot vs 6.64 per 1/5 acre plot) there was little difference between computed average volumes per acre, and the proportional limit of error did not exceed 20 percent for the 1/20 acre plot size and was only 13.5 percent for the 1/10 acre size samples.