Forest Research Notes

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THREE SCALES OF AERIAL PHOTOGRAPHY COMPARED FOR MAKING STAND MEASUREMENTS

Three scales of aerial photography were tested in an attempt to determine the best scale to use in forest surveying. This was done by comparing photo measurements of average tree height, average crown diameter, and crown-closure percent. These stand variables were selected for testing because of their applicability in making aerial estimates of timber volume.[1]

During the winter of 1956, a small test area in Hancock County, Maine, was photographed on infrared film at scales of 1:1,000, 1:5,000, and 1:15,840.[2] As hardwoods were leafless at that time, photo interpretation was concentrated on predominantly coniferous stands (spruce, fir, hemlock, and northern whitecedar). On each of twelve 1/5-acre plots, three photo-interpreters determined (1) average total height of the three tallest softwoods, (2) average crown diameter of the three tallest softwoods, and (3) crown closure percent of the softwood stand.

Analyses of variance were employed to compare photo measurements by interpreters and photo scales; "t" tests were used to evaluate differences between photo and field measurements of the three variables. Results of these tests are summarized in tables 1 to 4.

Tree height.--Table 1 shows a significant difference among scales and among interpreters for photo estimates of average total height, but the interaction of scales and interpreters was not significant. The analysis also reveal-

[1]Smith, J. Harry G. Problems and potential uses of photo-mensurational techniques for estimating volume of some immature stands of Douglas-fir and western hemlock. Photogram. Engin. 23: 595-599. 1957.

[2]Appreciation is expressed to the Maine Forest Service, the James W. Sewall Company, Old Town, Me., and the U.S. Dept. Agriculture Forest Insect Laboratory, Beltsville, Md., for supplying aerial photographs used in this study.

ed a significant difference between mean photo heights and corresponding field heights. This difference was negative for all scales and interpreters, that is, all photo heights were lower than the field average of 53 feet.

The "t" test summary (table 2) indicated that there is no statistical choice of photo scales for measuring tree heights. The mean estimate of 48 feet on 1:5,000 photos was closest to the true field value, but it is doubtful that the slight gain in accuracy over 1:15,840 photos would justify the increased cost of using the larger scale.

Crown diameter.--As in the case of tree heights, there was a significant difference between scales for photo estimates of average crown diameter (table 1). However, the significant interaction of scales and interpreters indicates that no single scale was consistently best for all interpreters.

Table 1 also shows a significant difference between photo and field measurements of crown diameter. Photo esti-

Table 1.--Summary of analyses of variance for photo measurements (x = significant at 1-percent level)

Source of variation	Total height	Crown diameter	Crown closure
Between field and photo estimates	x	x	--
Among photo scales	x	x	x
Among interpreters	x	--	--
Interaction: scales x interpreters	--	x	--

Table 2.--Summary of "t" tests for photo versus field measurements of mean total height, in feet[1]

Scale	Interpreter			Means
	A	B	C	
1:1,000	43.92**	44.17**	45.58**	44.56**
1:5,000	46.67*	45.58**	52.17	48.14*
1:15,840	41.08**	40.75**	49.00	43.61**
Means	43.89**	43.50**	48.92*	45.44**

[1] Mean field height: 53.33 feet.
* Difference significant at the 5-percent level.
** Difference significant at the 1-percent level.

Table 3.--Summary of "t" tests for photo versus field measurements of mean crown diameter, in feet[1]

Scale	Interpreter			Means
	A	B	C	
1:1,000	12.92**	11.25**	14.00	12.72**
1:5,000	12.75**	14.50	12.00**	13.08**
1:15,840	17.75	15.08	13.83*	15.56
Means	14.47	13.61**	13.28**	13.79**

[1]Mean field crown diameter: 16.08 feet.
*Difference significant at the 5-percent level.
**Difference significant at the 1-percent level.

Table 4.--Summary of "t" tests for photo versus field measurements of crown closure percent[1]

Scale	Interpreter			Means
	A	B	C	
1:1,000	47.42	52.00	52.67	50.69
1:5,000	55.83	61.25	58.75	58.61
1:15,840	66.67*	70.83**	57.92	65.14*
Means	56.64	61.36	56.44	58.15

[1]Field crown closure: 55.00 percent.
*Difference significant at the 5-percent level.
**Difference significant at the 1-percent level.

mates, with one exception, were consistently lower than the field average of 16 feet (table 3). Interpreters "A" and "B" obtained their best estimates on 1:15,840 photos, while interpreter "C" did best on the 1:1,000 scale. Although the interaction prohibits a generalization for scale averages, it appears that average crown diameters can be determined as accurately on 1:15,840 photos as on larger print scales.

Crown closure percent.--Photo measurements of this variable differed significantly by scales (table 1). Crown-closure estimates on 1:1,000 photos were about 4 percent lower than the field average of 55 percent. On 1:5,000 photos, estimates averaged about 4 percent higher than the field value. Neither differed significantly from the field value (table 4). On 1:15,840 photos, the average crown-closure estimate was 65 percent. This figure was signifi-

cantly different from the 55-percent field average, but was still within generally acceptable limits.

Conclusions.--None of the three aerial-photo scales tested showed a marked superiority for evaluation of average total heights, crown diameters, or crown-closure percent. Though the 1:5,000 scale provided the most accurate results for two of the three variables tested, measurements on 1:15,840 prints were within a range acceptable to many interpreters. Until the advantages of larger photo scales can be more clearly substantiated, the 1:15,840 scale is therefore recommended to northeastern foresters as the best buy for their photo dollar.

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