SOME FINDINGS IN FOREST TYPING¹

By YAM (JIM) LEE²

INTRODUCTION

The accuracy of forest typing vitally depends on photo interpreters, who determine status and conditions of forest land from aerial photographs. It involves the estimation of forest area, volume, stand size, species composition, tree height, and stand density on which our forest maps are based. However, photo interpreters, though using the very same kind of materials in the estimation of these items, may and often differ with one another in the results obtained. Consequently, test and analysis of these results should be carried out occasionally to detect possible variations and to insure accuracy and similarity. The purpose of this study was to assess the accuracy of forest typing, that is, crown closure, stand height class and species composition determination in the Alberta Forest Service, Forest Surveys Branch.

COLLECTION OF DATA

In the summer of 1960, 120 permanent sample plots were established to commence a program to provide growth and yield data, stereograms and photo volume tables. These plots were located in the Whitecourt Forest Division, Alberta. Every 4 plots form one individual group, yielding a total of 30 groups in various forest types. The stands studied ranged from 17 to 119 years of age, including 3 groups of all-aged stands. The average height of dominant and codominant trees was calculated, total volume per acre in cubic feet determined, and crown closure ocularly estimated. Subsequently, 30 stereograms were made from aerial photographs with R.F. 1:15,840 and focal length 6 inches.

Table 1 shows the summary of ground data for the 30 stereograms.

OPERATORS

Operator A, the author of this article, visited all these groups in the field, and is familiar with aerial photographs.

Operators B, C, and D are good interpreters but have not been typing for some time.

Operators E and F set up some of the groups and have been interpreting aerial photographs for more than 10 years.

Operators G, H, and I have 4 to 8 years' experience in interpretation of aerial photographs. J has been working on the job for approximately a year.

ESTIMATION OF PHOTO DATA

All operators worked with the aid of direct lighting. The University of Michigan Photo Interpreter's scale was used in the estimation of crown closure to the nearest 5 percent under the stereoscope. Both species composition and tree height to the nearest 5 feet were estimated without any aid under the stereoscope by all operators.

¹ Thanks are due to Mr. E. S. Huestis, Director of Forestry, and Mr. R. G. Steele, Senior Superintendent, for their permission to publish this article.

² Forester I/C Growth and Yield Studies, Forest Surveys Branch, Dept. of Lands & Forests, Edmonton, Alberta.

TABLE 1
SUMMARY OF GROUND DATA FOR THE 30 STEREOGRAMS

Stereogram Number	Age Years	Mean d.b.h. Inches	Average D+ CoD. Ht. in Feet	Crown closure ¹ Estimated Ocularity in %	Species ² Composition	Number of trees per acre 4" +	Basal area/ac. 4" + in sq. ft.	Total Volume per acre 4" + in sq. ft.
1	81	8.4	75	68	SwA	485	186.4	4,831
2	81	9.2	75	70	SwA	442	202.6	5,597
3	60	7.5	69	76	A	461	140.4	3,211
4	86	9.0	82	70	ASw	470	208.4	5,769
5	110	10.4	89	68	SwA	364	213.9	6,359
6	82	10.0	87	75	Pl	349	189.4	6,560
7	85	9.4	79	58	PlA	364	175.4	5,182
8	84	8.5	76	85	Pl	450	178.1	5,313
9	89	8.1	70	70	Pl	465	164.6	4,573
10	81	12.4	81	49	A	139	115.7	3,401
11	84	10.6	76	65	PlA	238	146.1	4,144
12	82	11.7	80	54	SwPl	203	150.8	4,258
13	83	9.6	76	62	ASw	268	135.9	3,497
14	17	4.7	26	72	Pl	325	38.6	253
15	116	9.7	74	69	Pl	371	188.7	5,147
16	47	5.7	34	71	Pl	502	88.2	950
17	All-aged	7.0	54	54	FbSw	492	130.6	2,136
18	114	6.9	48	51	Pl	442	115.4	1,859
19	All-aged	7.6	58	58	Fb	489	153.7	2,841
20	117	5.1	46	85	Pl	1152	162.8	2,158
21	All-aged	8.2	65	54	Fb	327	119.9	2,551
22	31	4.4	31	78	Pl	650	69.6	568
23	65	6.0	61	82	Pl	857	166.6	3,437
24	116	5.3	51	62	PlSb	1225	190.2	2,738
25	116	8.5	77	78	Pl	601	234.1	7,179
26	119	7.2	71	70	Pl	783	222.5	5,833
27	118	7.3	68	70	Pl	728	214.3	5,614
28	61	6.1	60	75	Pl	749	153.5	3,090
29	66	6.5	65	74	Pl	818	185.8	4,332
30	117	12.1	91	66	ASw	211	176.2	5,647

¹ Average of 4 plots estimated ocularly

² With volume over 25 percent of total volume.

Sw—white spruce, Sb—black spruce, Fb—Balsam fir, A—aspens, Pl—Lodgepole pine

ANALYSIS OF DATA

Table 2 shows the results of the photo estimates of the 30 stereograms from the 10 operators (mentioned) as compared with ground data.

TABLE 2
RESULT OF PHOTO ESTIMATIONS OF THE STEREOGRAMS FROM 10 OPERATORS
AS COMPARED WITH GROUND DATA¹

Operator	ERRORS IN ESTIMATION									
	Species Composition		Total Height		Height Class ²		Crown Closure		Crown Closure Class ³	
	Number of	in %	More than ± 5 feet	in %	Number of	in %	More than ± 5 feet	in %	Number of	in %
A	8	27	10	33	8	27	11	37	10	33
B	11	37	18	60	17	57	7	23	5	17
C	17	57	25	83	23	77	21	70	4	13
D	11	37	12	40	10	33	10	33	4	13
E	14	47	10	33	6	20	13	43	7	23
F	14	47	13	43	7	23	9	30	4	13
G	8	27	15	50	11	37	11	37	9	30
H	14	47	21	70	14	47	6	20	3	10
I	10	33	12	40	8	27	7	23	2	7
J	14	47	17	57	11	37	11	37	3	10

¹ Crown closure compared with the average photo estimate.

² Height class: 11-30' (1), 31-45' (2x), 46-60' (2y), 61-80' (3), and 81' + (4)

³ Crown closure class: 11-40% (A), 31-70% (B), 71% + (C) and Overstocked (D)

Both the average crown closure of all 10 operators for the 30 stereograms and what was estimated ocularly on the ground were correlated with basal area, number of trees, and total volume. Table 3 shows the regressions between basal area, number of trees and total volume, with crown closure on aerial photographs and crown closure on the ground.

TABLE 3
REGRESSIONS AND CORRELATION COEFFICIENTS BETWEEN
BA, NT, V. AND CCA, CCg

Dependent Variable	Constant (a)	Regression Coefficient (b)	Independent Variable	Correlation Coefficient (r)
BA	— 3.352	2.080	CCa	0.306 N.S.
BA	— 1.782	2.337	CCg	0.302 N.S.
NT	— 24.344	6.752	CCa	0.925 **
NT	— 5.760	7.558	CCg	0.907 **
V	— 74.042	51.270	CCa	0.948 **
V	40.440	57.788	CCg	0.911 **

Where BA = Basal area per acre in square feet for trees 4" +.

NT = Number of trees 4" + per acre.

V = Total volume per acre in cubic feet for trees 4" +.

CCa = Average crown closure of the 10 operators' estimations in percent.

CCg = Average crown closure of each group estimated ocularly in percent.

N.S. = Not significant.

** = Significant at 1 percent level: 0.463, degrees of freedom, $n_1 = 2$, $n_2 = 28$.

The Forestry Chronicle Downloaded from pubs.cif-ifc.org by 44.207.124.84 on 04/25/23
For personal use only.

The Forestry Chronicle Downloaded from pubs.cif-ifc.org by 44.207.124.84 on 04/25/23
For personal use only.

The Forestry Chronicle Downloaded from pubs.cif-ifc.org by 44.207.124.84 on 04/25/23
For personal use only.

Table 4 shows the difference between the crown closure for the 30 stereograms of the average of the 10 operators' estimations and ground data estimated ocularly. It is apparent that the hypothesis is correct. Thus, it can be safely assumed that there is a great difference between CCa and CCg.

DISCUSSION

Species Composition

Species composition is one of the most difficult tasks in photo interpretation. The results of this study showed that most of the operators identified successfully the main species in the stand but failed to recognize the second major species. It became evident that the best results were obtained from the operators who spent more time in the field, namely operators A and G.

Height Estimation

It was found that an intermittent period of inactivity, even in the veteran operator, can reduce accuracy in the estimation of tree height and height class of a stand, as seen in two out of three cases (Operators B and C).

Crown Closure Estimation

Both crown closures of the 10 operators' estimates and the ground data estimated ocularly in the woods were not significant when they were correlated with basal area but were highly significant with both number of trees and total volume (Table 3).

With reference to crown closure, both in old and young stands, a great difference was found between CCa and CCg (Table 4). Two factors are believed to contribute to this phenomenon;

- (1) For stereograms 14 and 22, smaller trees (young stand) show up denser on the aerial photographs than on the ground and vice versa in an old growth stand as shown by stereograms 20, 24, 28, and 29.
- (2) For stereograms 26, 27, 28, and 29, where the forest floor (understory trees) in these test areas is comparatively clean, (especially true in a pine stand) the estimate of crown closure in percent resulted in an under-estimate as compared with the photo-estimate.

Thus, it is apparent that tree size and species composition of a stand affect the interpreters in the estimation of crown closure.

Looking at the variation in forest typing from interpreter to interpreter, importance of standardizing photo interpretation is immediately evident (Pope 1957). Judging from the results of this study, continuous work on aerial photographs is an important asset in forest typing. For example, B, C, and D were once good and accurate interpreters but failed to get satisfactory estimates of crown closure, tree height and species composition of the 30 stereograms, because of the recent lack of contact with aerial photographs. It is obvious that a higher percentage of accuracy in forest typing was obtained from each of the interpreters who are now interpreting in the Alberta Forest Service. This kind of test carried out occasionally will not only measure the degree of accuracy in forest typing but also give the interpreters an opportunity to check their estimates against actual data on the ground.

CONCLUSION

The results of the current study indicate that:

1. Forest typing in the Alberta Forest Service has been accurate and satisfactory.
2. An occasional test, given to the photo interpreters, will measure the degree of accuracy and improve efforts in forest typing.
3. Interpreters should go out to the field to check their typing as much as possible.
4. Estimation of crown closure in percent in a young stand is generally higher on the ground than using aerial photographs under the stereoscope but vice versa in an old growth stand. Tree size and species composition of a stand do affect greatly the estimation of crown closure.
5. Both estimates of crown closure on the ground and from aerial photographs are highly significant when associated with number of trees and total volume, but not significant when associated with basal area.

REFERENCES

- JOHNSON, E. W. 1958. A training program for men measuring tree heights with parallax instruments. *Photogram. Eng.* 24: 50-55.
- LEE, YAM. 1959. A comparison of some 12-inch and 6-inch focal length photographs for photo mensuration and forest typing. University of British Columbia, Vancouver 8, B.C. M.F. Thesis 124 pp.
- MOESSNER, K. E. 1953. Photo interpretation in forest inventories. *Photogram. Eng.* 19: 496-507.
- POPE, R. B. 1957. The effect of photo scale on the accuracy of forest measurements. *Photogram. Eng.* 23: 869-873.
- SMITH, J. H. G. 1957. Problems and potential uses of mensurational techniques from estimation of volume of some immature stands of Douglas fir and Western hemlock. *Photogram. Eng.* 23: 595-599.
- _____, YAM LEE and J. DOBIE 1960. Intensive assessment of factors influencing photo-cruising shows that local expressions of photo volume are best. *Photogram. Eng.* 26: 463-469.
- SNEDECOR, G. W. 1956. *Statistical Methods*. Fifth edition. The Iowa State College Press, Ames, Iowa. 534 pp.