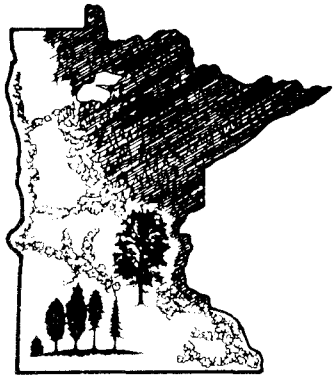

Minnesota Forestry Research Notes

No. 206
July 15, 1969

EFFECTS OF SCALE, PRINTING METHOD AND PRINT SURFACE VARIATIONS UPON AIR PHOTO IMAGE QUALITY[1]

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In the summer of 1965, high quality panchromatic-Wratten 12 (minus-blue) filter aerial photography at scales of 1/15,840 and 1/20,000 was flown over a 15-mile east-west test strip across Big Falls, Minnesota. Similar flights using infrared film were made in the summer of 1966. A total of six different kinds of prints were made from each negative involving combinations of two different printing methods (conventional hand-dodged, electronic "Log-E") and three different print material-surfaces (double weight semi-matte, double weight matte-dried glossy, and cronapaque).

The following three types of items, on each of the 24 sets of prints (2 seasons x 2 scales x 6 print types), were measured, counted and estimated, respectively, by four trained interpreters: (a) 30 stand height points; (b) 15 1/2-acre crown count plots; (c) 35 1-acre and 35 1/7-acre crown density plots. Only the stand height points were measured on the ground. These photo measurements, counts and estimates were compiled and analyzed on the basis of a split plot analysis of variance using an IBM 360/30 computer. The data from 1965 and 1966 were analyzed in the same manner, but separately, due to the fact that the time lapse between coverages and problems of point location made comparisons questionable. The photo interpretation results are graphically displayed in the figure on the following page.

The split plot design involved many interactions which cannot be interpreted directly from the graph of the means. The following evaluation is based mainly upon the analysis of variance.

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[1] Project financed in part by a Boise Cascade-Mando Division Forestry Graduate Fellowship.

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Published by the School of Forestry, University of Minnesota, St. Paul, Minnesota 55101, cooperating with the Division of Forestry, Minnesota Conservation Department, and Forest Industries of Minnesota

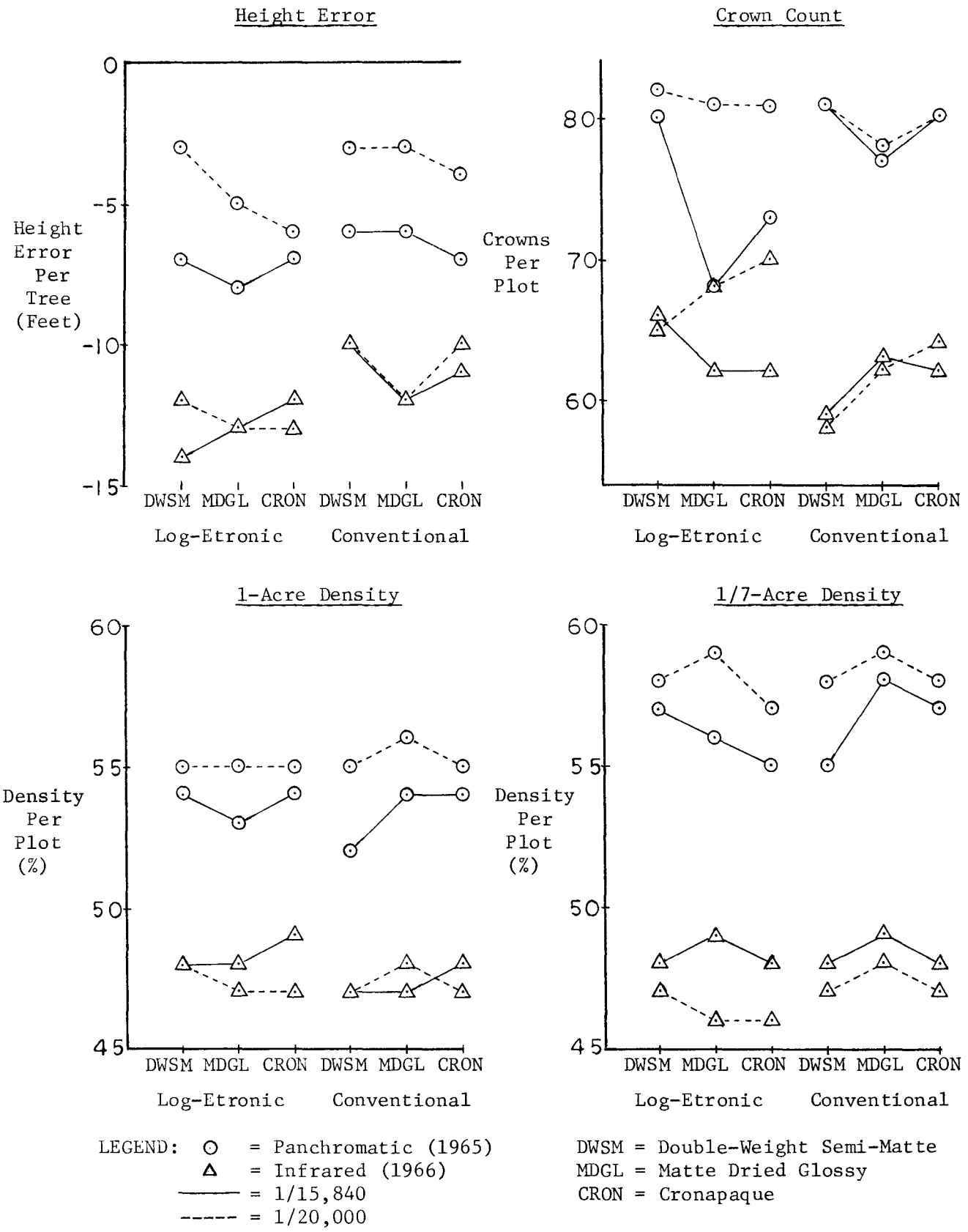

Figure 1. Mean values for height error, crown counts, and 1-acre and 1/7-acre density estimates by scale, printing method, and print surface.

PHOTO SCALE

1965 Panchromatic Photography

Height measurement errors -- significantly lower for 1/20,000 scale

Crown counts -- significantly higher for 1/20,000 scale[3/]

Density estimates -- significantly lower for 1/15,840 scale[4/]

1966 Infrared Photography

Height measurement errors -- no significant difference

Crown counts -- no significant difference

Density estimates -- significantly lower for 1/20,000 scale

PRINTING METHOD

1965 Panchromatic Photography

Height measurement errors -- significantly lower for conventional printing

Crown counts -- not clearcut since it varies with scale

Density estimates -- no significant difference

1966 Infrared Photography

Height measurement errors -- significantly lower for conventional printing

Crown counts -- not clearcut since it varies with scale

Density estimates -- no significant difference

PRINT SURFACE AND MATERIAL

1965 Panchromatic Photography

Height measurement errors -- varies with scale

Crown counts -- varies with scale

Density estimates -- varies with scale, printing method and size of plot

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3/Since photo crown counts usually underestimate the ground truth considerably, higher counts tend, on the average, to be more accurate.

4/Density overestimation is a normal tendency.

1966 Infrared Photography

Height measurement errors -- varies with scale and printing method

Crown counts -- varies with scale and printing method

Density estimates -- no significant difference

Variability among interpreters and plots was found to offset any variability of significance in the three factors tested (i.e., scale, printing method, print surface-material), indicating that more emphasis needs to be placed upon means for controlling interpreters and plots. In addition, tonal differences between plots were not accounted for in the analysis and this factor might have a significant influence upon interpretation results.

In summary, while it might be possible to determine the best scale-printing-surface combination for a limited purpose or single measurement (e.g., height measurement), no particular scale-printing-surface combination can be selected which is significantly better than any other for general purpose forestry applications. Such limited-purpose aerial photography is, of course, usually neither desired nor financially practical; therefore, the following conclusion is drawn:

> In terms of the variables and conditions tested, nothing in the results of this study suggests the desirability for a change from conventionally-printed double weight semi-matte contact prints when scales of 1/15,840 - 1/20,000 are employed for general forestry purposes.

Published as Sci. Jour. Ser. Paper No. 6992 of the Univ. of Minn. Agr. Expt. Sta.