

slope, and valley. The two valley plots had an average site index of 153 feet at 100 years for Douglas fir. Ten mid-slope plots averaged 144 feet and two ridge plots averaged 136 feet in site index.

QUALITY AND DEFECT

The photo-interpreter must rely on field data to assess quality and defect. Such information should be collected on any plots established under a double-sampling plan.

CONCLUSIONS

As in all uses of aerial photographs, the advantages of photo-mensurational techniques depend upon the extent to which field observations may be replaced by the study of air photographs. If the intensity of the ground survey is to be high, and details of species, quality, defect, and site are required, the principal uses of aerial photographs would be in typing, mapping, and the control of inventory. There also could be little advantage to intensive application of photomensurational techniques in

stands that are small in area and easily accessible. This would be especially true if high correlations between basal area and volume favored application of "quick-cruising" methods.

If the basic field sample is a cluster of plots that requires several man-days for establishment and subsequent analysis, important savings can be effected by a combination of field- and photo-sampling.

Photo-volume tables would have many possibilities of application both in reconnaissance and in inventories where stand maps are not required. Detailed photomensurational studies should be helpful wherever estimates must be secured quickly for a large area and in situations where ground-sampling intensities are to be light for management reasons or because of difficult access.

The success of attempts to supplement field measurements will depend on the accuracy of photo-volume tables used, the quality of photographs, and above all upon the training and experience of the photo interpreter.

*An Improved Technique of Forest Type Transfer**

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UNTIL recently, the two most widely used methods of Forest Type Transfer were:

- (a) Visual transfer from photo to map using the stereo-instrument.
- (b) Direct transfer from photo to map using the Kail plotter.

In both cases the photos would normally have been interpreted by an experienced forester and in method (a) he would likely have carried out the type transfer to map himself, using the stereo-instrument.

Since it is unlikely that a qualified forester is an experienced stereo-operator, much expense and time are lost in releasing a stereo-instrument to such forestry representative and, of course, periodic services of a photogrammetrist to orient and scale

the stereo model, etc. The repetitious glancing from photo to map/model is probably the most time-consuming factor of all.

The Kail plotter method (b) mentioned is doubtless more familiar in the industry and indeed, it will probably remain a permanent method of transfer in field locations. However, the time-consuming necessity of having to plot on the original base map about four picture points per 12-inch overlapping pair of photos, and the difficulty of plotting type lines by radial-line intersections, are doubtless well appreciated. The accuracy of placement and configuration of types can provide only a close approximation of timber volumes, etc.

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By obtaining simultaneous 6-inch and 12-inch cone photography there is a two-fold, essential achievement. A suitable and economic scale of photography is available to the forester and photogrammetrist alike. Only for very general and broad forest types is the 6-inch cone photography of value to the foresters, and visual transfer from the photographs to maps (at time of compilation) is usually adequate for such broad typing.

It is believed that most of these negotiations have been cancelled out by the following improved technique of type transfer. The method developed was, until recently, probably only a dormant method of stereo-instrument usage pending the wider use of aerial survey techniques by professional and industrial managements, and whereas accuracy has been greatly improved, costs of transfer have been reduced by almost 50%.

For detailed or semi-detailed types, interpretation is made on the large scale 12-inch cone photography and within a format area mutually convenient to both forester and photogrammetrist. These types are then carefully transferred to the base of the original air film. Glass diapositives for use on the stereo-instruments are prepared. The topographic maps are then prepared in the normal way with care being taken to ensure sufficient supplementary horizontal control data being plotted to ensure restitution of the 12-inch frames later.

For example, in the case of a map being prepared on the Kelsh plotter at scale 330 ft./in. (5 chains) from 1,500 ft./in. photography, then the transfer of forest types to map is achieved by setting the 12-inch frames in Multiplex equipment and plotting the types and photo centres directly on the map at original compilation scale. If desired, these may be superimposed on to the original mapping manuscript.

A similar procedure would be adopted where map-scale was desired at 500 ft./in. from 2,500 ft./in. photography and, in fact, for nearly all projects where the final

map-scale was some five times larger than the scale of photography.

Where the original topographic map had been compiled from larger scale photography and/or where Multiplex compilation had been involved, then several points of scaling would be selected, the 12-inch types plotted at twice that of compilation scale, and photographically reduced to final map scale for fairdrawing.

Many combinations of course, could be made along these general lines as available photography and desired mapping scales were demanded. The essential factor is, simply, that the skills and abilities of both forester and photogrammetrist are combined towards the achievement of the best end result in accuracy, time and cost. The forester remains confident that his studied interpretation and inking up of the pictures will be presented on the map unaltered; the photogrammetrist is satisfied that he has presented such data in precise scale and placement to the topographic features of the map.

Many square miles of this type of mapping have been prepared in recent months and at various scales; much testing of the method has also been performed over well-controlled areas to prove the final accuracy. Where feasible, clients are advised to have forest types prepared on transparent overlays to the mapping, so that amendments may be made as logging progress etc., is made, leaving the basic topographic map sheets intact.

In so far as the restitution of the stereo-instrument models is concerned, the operator should anticipate a small, residual want of correspondence which is discernible as "Y" parallax. However, by clearing the spatial model at the base line and base square setting points, this residual parallax may be eliminated from the actual plotting format causing no interference with vision.

If forest typing and transferral were carried out simultaneously with the topographic mapping, it is apparent that an over-all efficiency and economy would result from continuity and fullest use of original project mobilization.