

gave to this matter and wonder why the method wasn't used earlier. It is certainly something that we must keep in mind and develop as time goes on.

The Forest Service, as you probably know, has done some experimental color photography in California. Mr. Massie, who is in charge of aerial photographic work for the Forest Service, is here. Mr. Massie, will you make a few comments on the experimental color work that was done by two commercial operations.

Mr. E. S. Massie, Jr. (Forest Service, U. S. Department of Agriculture): I should like to go beyond the Forest Service work. One or two of us had an opportunity to see some color negatives exposed and processed by one of the aerial concerns. They covered an area in the Southwest. Exposures and colors appeared perfect, with gradation of color between soils. We, with the cooperation of Eastman and Agfa, obtained color film and had it exposed in California. We also obtained color film and had it exposed in Montana. Our results were very similar to some that the Soil Conservation Service, I believe, had: we were not getting ample exposure control and this resulted in unsatisfactory photography. Again, we were working with negatives instead of positives which, for the varied uses in the Forest Service, introduces another problem.

On the other hand, in Montana we took some oblique color photography above bug infested timber. These covered out to a distance of some twenty to thirty miles, and we could pick out individual bug-infested trees to a distance of about 15 miles.

Personally, I think there is a big future in color photography, if it can be developed so that we can differentiate between species, on positive prints—not negatives, but up to the present time, I am very discouraged about it.

The Moderator, Mr. Wright: Are there any more comments or questions? If not, we will stand adjourned. Thank you for your attention.

USE OF PHOTOS BY THE FOREST SURVEY IN CALIFORNIA*

*K. E. Bradshaw, California Forest and Range Experiment Station,
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THE preceding speakers have described the use of aerial photographs in both small and large private forestry operations, and in region-wide Federal Management operations. I should like to tell you something of their use by the Forest Survey in California, where they are applied to all sizes of private holdings, and to Federal National Forests as well.

As probably most of you already know, the Forest Survey is a nation-wide project which was initiated in order to gain information on the location, extent, and condition of the forest resources of the United States. Responsibility for conducting the Survey was assigned to the eleven Forest Service Experiment Stations scattered throughout the States. Washington, D. C. set up certain requirements for data which were to be obtained and published by each Station in the form of statistical and analytical reports, but each Station was allowed flexibility in the actual conduct of its survey.

In the California Region, the Forest Survey is based primarily on the fullest use of aerial photographs. In addition to providing the data required by Wash-

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ington, it was decided to provide maps and timber stand data for the forest land areas, so that the data as a whole would provide maximum usefulness to the Regional Office and to our National Forests in their administration and management activities, and also to private operators in the areas outside the National Forests.

Aerial photos for all forest lands are classified by stereoscopic study to minimum-sized areas of 40 acres. On commercial forest lands, the timber stands are broken down into age groups and density groups. In addition, the vegetation elements in each area are identified as hardwoods, conifers, chaparral, etc.

Within the National Forest areas, these data are transferred to the best available base maps by means of Kail plotters. The base maps are $7\frac{1}{2}$ -minute quadrangles, at a scale of 2 inches to the mile. Funds are not available for publication of these "work maps," but the originals are made available for reproduction by anyone desiring copies.

Field sampling consists of taking groups of three $\frac{1}{5}$ -acre sample plots at statistically located points throughout the commercial forest area. Because the photo classification of the timber stands into age and density classes results in a stratification, the number of plots required to give the desired degree of accuracy for the State, and subregions and counties within the State, is very small. Each group of plots represents a sample of about 14,000 acres. It can be seen that the samples would only be useful for relatively large areas, and would not provide accurate enough data for a small ownership, or even a working circle.

Data gathered on the plots consist of measurements of tree heights and diameters and form classes, increment borings to determine growth, notes on defects, etc. These data are recorded on plot forms which are sent to the office, and the data are transferred to I.B.M. machine punch cards, along with other data on areas, ownerships, and other matters.

The statistical and analytical reports, based on the compiled data, are now being prepared, and the first one should be available early next year.

The State of California wanted more information than the Survey provided on the lands which lie generally outside the National Forests and Parks, in the Sierra foothills and in the north coast counties. In order to get that information, they contributed funds to our project under a cooperative arrangement. These funds provided for procuring new aerial photography over a considerable area where logging and fires had caused many changes in recent years, and the preparation of new base maps from photos where the existing bases were not satisfactory. Also, the money was used for intensification of photo classification in the areas of State interest down to a minimum-sized area of 10 acres, rather than 40 acres.

The maps prepared from the photo classification in the State area are published as finished maps, called "Timber Stand" maps, and these are available to anyone at the cost of reproduction. Just as with the work maps prepared for the National Forest areas, these maps are $7\frac{1}{2}$ -minute quadrangles, 2 inches to the mile, and they show the age and density classifications of timber stands, and the broad vegetation elements present in each area, all of these data being from the photos.

In addition to the Timber Stand maps, another series of maps is being prepared for the State, based on field mapping of the dominant species of vegetation, the site quality of commercial forest lands, and the kind and depth of soil. These maps are called "Vegetation-Soil" maps, and are printed on the same bases as the Timber Stand maps. The field mapping is slow, detailed work, but to date about $\frac{1}{5}$ of the area to be mapped has been completed, and about $\frac{1}{10}$

of the maps have been published. It is felt that the data being obtained will be extremely valuable in timber, range and watershed management, assessment, and other uses.

So far there has been considerable demand for the maps produced by the Survey. Within the National Forest areas, the Regional Office and the individual forests have put the work maps to use in preparing working circle management plans, land exchanges, etc. Several private individuals and companies have put the Timber Stand maps to work in connection with sampling for volume estimates, preparing management plans, locating logging roads, and many other uses.

In concluding this discussion of the Forest Survey activities in California, I might re-emphasize the fact that the whole sampling system and production of maps is based on the use of aerial photos. In addition, the photos are used extensively in the field by both the plot sampling crews and the field mappers, as a means of orientation and to facilitate all phases of the field work.

THE USE OF AERIAL PHOTOGRAPHS IN TIMBER CRUISING ON THE NATIONAL FORESTS*

Homer J. Hixon, Forester, U. S. Forest Service, Portland, Oregon

AERIAL photographs are being used more and more in timber cruising work on the National Forests. Before going into further detail, however, I should like to present some of the background which, from technical and administrative standpoints, affects and sometimes limits the use which we make of aerial photos in cruising work.

From 75 to 80% of National Forest lands in the Pacific Northwest are covered with vertical, single-lens aerial photographs, and this photography is available for our use. This coverage has been accomplished by a number of agencies. It varies considerably in age, quality, and scale. Scales range from 1:40,000 to 1:10,000 with the bulk being 1:20,000.

As necessary and as funds permit, this existing photography is being supplemented by rephotographing the older inferior coverage and by undertaking new coverage. We customarily contract our aerial photography to private bidders.

The Pacific Northwest Region of the U. S. Forest Service, with headquarters in Portland, embraces 19 National Forests located in Oregon and Washington. For timber management purposes, for planning and for making and administering timber sales, the 19 forests are divided into 92 management units called working circles. Twenty-nine of these working circles are located in the ponderosa pine subregion east of the Cascade Summit, and 63 are located in the Douglas-fir subregion on the western slope. Within the 92 working circles, there are nearly 14 million acres of forest land on which the available annual allowable cut is nearly 2.5 billion board feet. Our actual cut, which has been generally increasing as transportation systems are extended, is now around 1.5 billion board feet. After advertising, an individual timber sale is awarded to the highest bidder. Each year we are now making approximately 2,500 individual timber sales.

Obviously the amount of timber resource involved and its importance to the economy of the Northwest calls for considerable planning which in turn

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