THE USE OF AERIAL PHOTOGRAPHS IN RANGE INVENTORY WORK ON THE NATIONAL FORESTS*

By John G. Clouston, Range Conservationist, Umatilla National Forest, Pendleton, Oregon

THIS contribution to the symposium consists of a description of how aerial photographs and the planimetric maps made from them are used in making grazing surveys, or as now called, a range inventory.

As a start, I will describe what a range inventory is and what it does. Briefly, it is designed to do the same thing for the grazing resource as a timber management survey does for the timber resource. It is gathering together data on the amount and kind of useable forage; the accessibility of that forage; the condition and the trend in condition of both vegetation and soil as weighed against an ideal standard; the degree of erosion; and management data which includes the location of water and potential water developments, for example, and recommendations for the location of other improvements necessary in the management of livestock. The end objective is a management plan which will provide for use of the resource in perpetuity, by maintaining or building up its present productivity.

Before the advent of aerial photographs range surveys were made by the strip method. This was quite similar to the old strip method of cruising timber. Only two strips were run through each section with offsets where necessary to determine type boundaries. Mapping was done on reconnaissance map sheets at 2″ per mile scale. The mapping consisted only of type boundaries and such cultural features as were pertinent to range management. Needless to say the use of these wide strips resulted in considerable inaccuracy in the delineation of type lines; often small areas of high productivity were missed entirely. Also the pressure on examiners to complete two full sections each field day induced the less conscientious men to skip or guess.

Shortly after the advent of aerial photographs—1940 in this region of the Forest Service and earlier in some other regions—photographs were used for range inventory work. They were found to be so valuable that they now have been adopted as the standard procedure throughout the Forest Service.

The first step in this work is the preparation of the photographs. These are on a scale of 1:20,000. Duplicate prints for the area to be covered in a season's work are secured. Every other photo in each line is then "jibed" by delineating lines which correspond on all four sides with similar overlapping prints. Only every other print in a flight line is used because with the accurate planimetric maps now available and made from these same photos, type lines can be transferred to the maps without distortion. If sectionized prints are used, there are never more than two sections shown on any print. The jibe lines from these prints are then drawn on a $\frac{1}{2}$-inch to the mile scale map, and this is used throughout the season as a progress map. That's all that is necessary in the preparation of the photos and maps for field work. The quality of the prints however is very important; sharp clear prints on semi-matte paper are necessary to good work. This semi-matte will take the crayon and ink without smearing or indentation. Glossy prints are never used.

Field examiners are given a short training course when the field work is

* Paper read at Annual Meeting of Columbia River Section of American Society of Photogrammetry, Multnomah Hotel, Portland, Oregon, December 7, 1949.

started. This training includes a review of plant identification; the estimation of vegetative density and percentage composition; the use of aerial photographs both with and without a stereoscope; the recognition of type changes in the field and on the prints; and practice in use of the prescribed data forms. This training period takes about ten days. Each examiner is then supplied with one jibed photograph and the two adjacent unjibed prints. This is to make possible getting complete stereoscopic coverage. In addition to the photographs, the examiners carry with them a field stereoscope, type write-up sheets, tables of plant proper-use factors, lists of classified range types, condition and trend write-up sheets, and an acetate overlay for each photograph.

I digress here to explain that 18 major grazing types in the United States are recognized. However, in the Blue Mountains of Oregon, only 8 are commonly found. These are known by number as follows: 1. Grasslands—open and without shrubs or trees; 2. Meadows both wet and dry, 3. Perennial weeds, 4. Sage, 5. Browse or shrubs, 6. Coniferous timber, 7. Waste range, which may be any of the other types but which for some reason is not useable for domestic livestock, 8. Barren. We occasionally find also type 10. Broadleaf trees, and 18. Annual weeds and grasses.

The examiner proceeds into the types on his assigned photograph and makes the following observations: (1) Designation and delineation of the type; (2) estimation of density and composition; (3) determination of utilization adjustments, soil characteristics, per cent of slope, degree of erosion; and (4) judgment of condition and trend. Meadows are typed to a minimum area of two acres; all other types are mapped to a twenty-acre minimum.

Field work is assigned daily. Photographs are assigned the evening before to enable examiners to study the terrain and to plan a route of travel which minimizes crossing deep canyons while expediting delivery to work and subsequent pickup for return to camp. This delivery and pickup is made by jeep. Assignment of photographs is alternated to avoid the working of adjacent photographs by the same man, thus preventing accumulation of errors in judgment. This practice focuses the judgment of two or more men upon the larger types.

In addition to type lines which are placed on the photos in ordinary pencil, the sub-types are entered by symbol inside the type. The examiner's type number is also entered in the type. Also directly on the photographs, the drainage pattern and any live water is shown in blue color, while cultural features, roads, trails, buildings, fences, corrals, salt grounds, are shown by symbol in red color.

On the acetate overlay are entered the photo number, the condition and trend data, information on needed range improvements, the erosion class, poisonous plant areas and possible reseeding chances.

All these data are permanently inked on the photos and overlays. This work takes about one day out of ten during the field season. Type lines are jibed between photos, and any differences are reconciled while there is still field time to make a re-examination if necessary. The photograph and its companion data are then filed in folders bearing the examiner's name.

When the season's field work is completed, photos are examined to make sure that all data are complete and in agreement with the write-up sheet. The prints are then sent to the Office of Surveys and Maps where these data are transferred from the photographs in pencil to a brown-line print which is used as a correction map. After careful correction, blue-line prints are made; these are used to planimeter acreages by types which in turn are converted into

carrying capacity. Finally black and white 1″ to the mile type maps are made. These are colored by types for final use in management planning. The overlay material gathered in the field is transferred to overlays for the 1″ type base map. Further detail concerning the preparation of the management plans will not be described in this paper.

We are certain that by using aerial photographs we have gained immeasurably in the accuracy of making range inventories. The photographs reveal, prior to field examination, the major type changes. These are quite clearly defined and this is an important feature since carrying capacity varies widely between various types and even sub-types. Also small types—meadows down to 3 acres—are found in dense timber which could easily be missed without photos. The ability to plan travel from type to type and within types saves many hours of time and many weary footsteps. By using a planimetric base map, there is no distortion of the actual type boundaries when type lines are carefully transferred from photos to the map.

There are some inherent faults in the photographs themselves that may be stated. The time of day when the photos are taken, with the resultant shadows, may affect the delineation of type boundaries. Long shadows often make it difficult to determine exact locations. Shadows of hills and peaks often completely obscure some types. This is especially true of early morning and late evening photographs of country with steep topography. An over-extended gap between flight lines may result in inadequate coverage of the terrain, thus necessitating the use of the outer edges of the photographs where distortion is great. The closer to the center of the individual print, the greater the degree of accuracy. The presence of clouds and cloud shadows on photographs also obscures detail. Clear definition in the film, carefully printed on top quality paper, is needed.

There are some inherent human aspects which also enter into the work. The chief weakness is the tendency of lazy examiners to dry-lab a type rather than do the canyon crawling necessary to get into it for the detailed examination necessary. On the other hand, the over-conscientious examiner can waste valuable time examining a type which a close study of the photo should tell him is waste range. Training and close supervision and the system of using different examiners on adjacent prints overcome these tendencies.

From the standpoint of cost of field work we know that the use of aerial photos has paid off. While the cost per man day including salaries, transportation, subsistence and equipment is more than double, the cost per acre has been increased only from 2.49 cents to 2.5 cents. These cost figures are for field work only and do not include the work of compilation and management planning.

I believe it safe to say that anyone who has used a range inventory based on aerial photographs would not be satisfied with an inventory made in any other way.