Using Aerial Photographs—
A Layman's Guide

Aerial photographs are one of the most useful tools for mapping and management planning available to the forest and land manager. Photos are invaluable for laying out a road, planning a timber harvest, or choosing a site for a home or building. Aerial photos provide a bird's-eye view of the total property—an accurate and inexpensive source of information that can save time spent in the field. They reveal present and past land uses, and the relationship of land to adjoining properties. Aerial photos can help you make efficient and non-conflicting land management decisions.

Most aerial photographs are taken with the camera pointed straight down. These "vertical" aerial photos can be used to locate property lines, roads and trails; determine bearings and distances; identify vegetation types; and measure land areas. Figure 1 shows a typical aerial photo.

Since flight paths overlap, two overlapping photos can be interpreted three-dimensionally with special equipment to make topography and timber stand out clearly. Land managers can estimate tree heights, stand volumes, slope, and other land form characteristics before undertaking field reconnaissance.

Aerial photos are best used in combination with field measurements, because accurate measures of tree diameter, form class, stem defect, and stand volume are difficult to obtain from aerial photographs alone.

Advantages And Disadvantages Of Aerial Photographs

Advantages:

- are an inexpensive data source
- locate lines and roads with ease
- are useful for map development
- document historical land use and land use changes
- are easy to interpret with minimal training
- reduce amount of field work
- are reliable and readily available
- identify major vegetative types with ease

Disadvantages:

- may not be current enough to reveal new disturbances
- may distort images somewhat
- may require special three-dimensional interpretation equipment
- can require field verification

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Figure 1. How forest and land features look from the air. The following features are depicted: A) hardwood stand, B) pond, C) right-of-way, D) pasture, E) mature pine stand, F) young pine plantation, G) harvest road system, H) seed tree harvest, I) buildings, J) interstate highway, K) upland hardwoods (winter), L) shelter wood harvest, M) lake, N) creek, O) residential roads.

Vegetative Delineation — Identifying Forest And Vegetative Types

Cropland, pasture, water, and major forest types are easily identified on aerial photographs. Each type has distinctive characteristics:

Cropland: Crop rows and ditching are often evident; fields appear as patchwork.

Pasture: Pasture appears as smooth and uniform with little variation in color or texture.

Water: Water appears dark gray to black. In shallower areas or where water is turbid, it may appear much lighter. Ponds and man-made lakes will often have a straight line indicating the dam location.

Forest Types: Timber stands appear as contiguous, rough-textured areas. Conifers appear darker than deciduous hardwood forests. Shadows are common in winter photos of hardwood stands because of an absence of foliage.

Once you can distinguish between land forms and vegetation, you can begin to group, or stratify, similar types into managements units called *stands.* Stands are blocks of timber of the same species and relative age that can be managed as a unit.

Grouping, or stratification of stands and other vegetative types makes management more efficient. For example, if managing for timber production, fully stocked stands can be mapped separately from young or intermediate-growth stands. Prescriptions for final harvest, thinning, controlled burning, or other treatments can then be made on a stand-by-stand basis. If increasing wildlife is an objective, water sources, edge (transitions between vegetative types), and field borders are important. By recognizing and locating these criti-

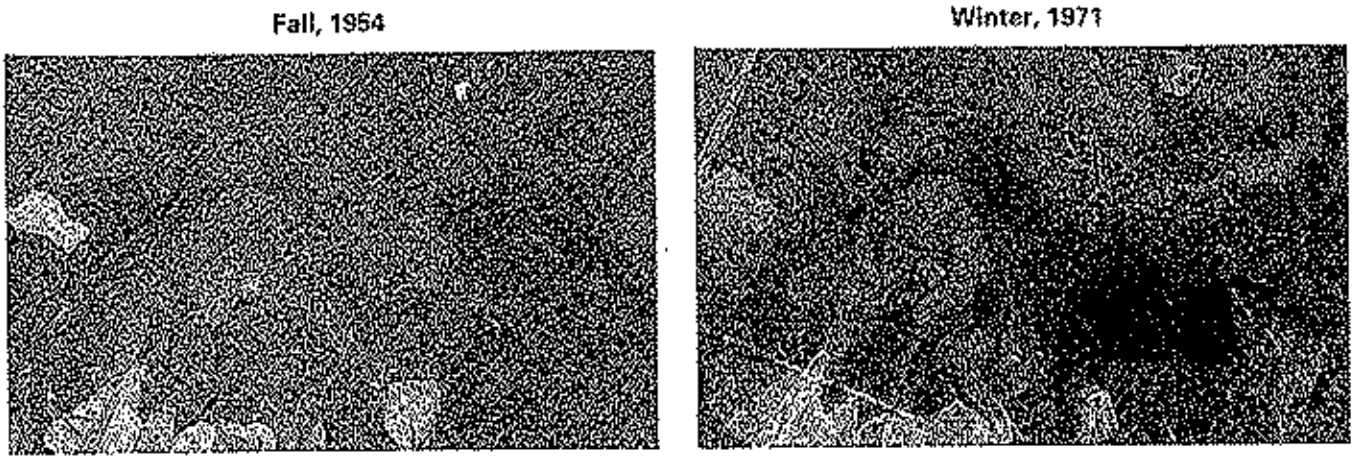


Figure 2. Changing land cover caused by beaver immigration. These photos show identical acreage. In the 1971 photo at right, beaver pond appears black. Changes in rights-of-way,vegetation types, and field borders also mark the 17 years between photos.

cal areas, wildlife management practices can be implemented to provide maximum benefit.

Stratification is also important when doing a forest inventory. Field work can be minimized and the number of inventory plots reduced by sampling within strata. Fewer sample plots are needed to sample uniform areas (within strata) than to sample a highly variable area (the total forest) to yield statistically accurate data.

Locating Roads, Property Lines, and Other Land Features

Linear features such as roads, streams, power lines, ponds, and lakes are clearly visible in aerial photos unless covered by vegetation. Aerial photographs taken in late fall or winter after leaf fall are preferred.

Permanent roads are usually easy to identify. Using an aerial photo, the manager can determine the location of existing roads and decide if access is adequate to accomplish forest management objectives. Well designed and placed, roads provide access for fire protection, timber management, and recreation. But roads are expensive to build and maintain. Where roads are needed, the rough location can be done by photo interpretation prior to on-the-ground layout and design.

Property lines are often apparent, particularly when adjacent land use is different. Many deed descriptions call for a property line which runs the course of a stream, main run of a swamp, road, or fence. Large trees are often left to mark lines or corners. Photo interpretation prior to field investigation can locate these features and facilitate on-the-ground boundary location.

State law requires land managers to protect water quality during forestry activities. Using aerial photos, a manager can identify streams, ponds, and ditches to help decide where Streamside Management Zones (SMZ) are necessary. SMZs are buffer areas along water courses which trap sediment and prevent contamination. Special care is also required in these zones to protect the integrity of the ground cover and mid-story vegetation. Log decks and roads should be located outside of the SMZ when possible and the number of roads crossing the SMZ should be kept to a minimum.

Changes in the Land

Comparing aerial photographs taken at different times is an easy way to detect changes in land use or condition. Forest growth, timber type changes, forest mortality, changes in waterways, and residential developments are examples that may affect management decisions. Another excellent example of change is the impact of beavers on bottomland hardwoods. Figure 2 shows an area before and after flooding by beaver. Management decisions related to this flooding may include the salvage or harvest of affected timber, followed by reforestation with tree species tolerant to flood conditions. Wildlife management opportunities for the same area could include the sowing of millet for waterfowl or erection of wood duck boxes.

Mapping And Area Determination

If the accuracy of area measurement is not critical, maps can be produced at the same scale of the photo by direct tracing. Such maps are useful for management plans.

Where the terrain is relatively flat, the map or the photo may be measured directly with an acceptable degree of accuracy for most forest management decisions.

In steep terrain, the photo scale must be corrected for slope to achieve a more accurate acreage determination. Contact a surveying professional for assistance.

If linear or area measurement is critical, the scale of the aerial photo must be determined. The scale is usually marked directly on the photograph, or the photographer may provide the scale with accompanying literature. The most accurate measure of scale is the proportion of distance on the photograph to actual distance on the ground. For example, on a 1:12,000 scale photo, 1 inch measured on the photo would equal 12,000 inches, or 1,000 feet, on the ground. (See Table 1 for other commonly used photo scales.)

If scale is not known, determine the average scale of an aerial photo by selecting a linear feature in the picture. Roads, fence lines or power lines make good ground references. Measure the linear distance on the ground (in feet) and do the same on the photograph (in inches).

The scale is then calculated by dividing the inches on the photo by the ground distance in feet.

Example:

Ground distance = 2,000 feet

Photo Distance = 2 inches

Photo Scale = ground distance ÷ photo distance

= 2,000 ÷ 2 = 1,000

1 inch = 1,000 feet

Therefore the photo scale = 1:12,000

Once the scale is known, an area measurement can be done. For more regularly shaped features like squares and rectangles, calculate the area by multiplying the object's length times its width.

For odd-shaped features, the easiest method of calculating area uses a dot grid. A dot grid is a clear sheet of acetate with dots arranged systematically on a grid pattern (see example, Figure 3). The grid is aligned with a straight line feature on the photo and the number of dots counted within the area to be measured. The number of dots multiplied by the area represented per dot gives the area measurement.

Three-Dimensional Viewing

Three-dimensional viewing is another aspect of aerial photography's usefulness. Overlapping photographs of the same area can be viewed simultaneously with a device called a stereoscope, making hills and trees "stand out." Trained viewers can estimate such three-dimensional characteristics as tree height, stand volume, and slope characteristics of the property. For the average landowner, stereoscopes may be too expensive to consider purchasing, but local offices of the Natural Resources Conservation Service, North Carolina Division of Forest Resources, or Consolidated Farm Services Agency can provide assistance in supplying and interpreting aerial photos.

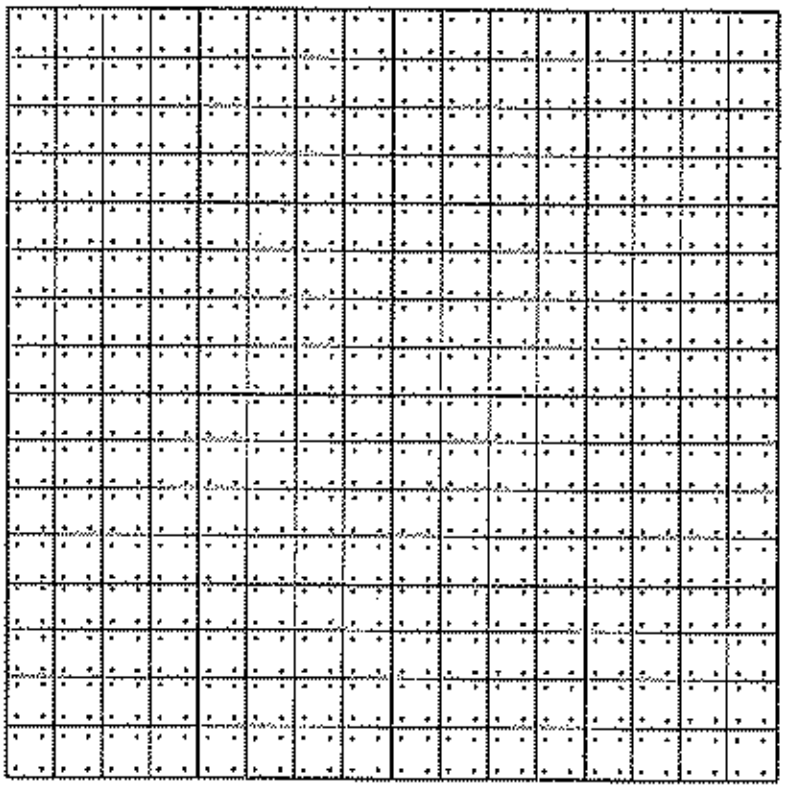
Table 1. Commonly Used Scale Conversions for Vertical Aerial Photographs

Photo Scale	Feet per inch	Inches per mile	Acres per square inch	Square mile per square inch
1:7,920	660.00	8.00	10.00	0.0156
1:12,000	1,000.00	5.28	22.96	0.0359
1:15,840	1,320.00	4.00	40.00	0.0625
1:24,000	2,000.00	2.64	91.83	0.1435

DOT GRID

Figure 3. Dot grid with map scales and equivalents for a 64 dot per-square-inch acreage grid.

To use this grid, photocopy the figure on a transparent overlay sheet available from any copy center.



(64 dots per square inch)

How to Use the Dot Grid

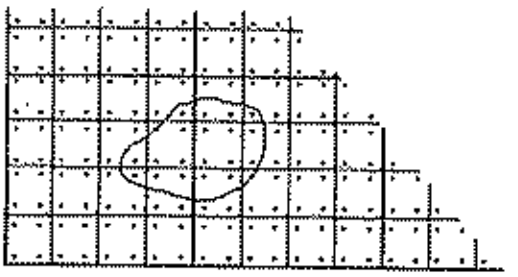
Place grid over area to be measured. Count all dots that fall within the measurement area. Dots which fall on lines are counted as one-half dots. To compute total acreage, multiply dot total by conversion factor for your photo's scale.

MAP SCALES AND EQUIVALENTS

Equivalent Scale	Inches Per Mile	Acres Per Square Inch	Converting Factor Each dot equals:
1" = 660'	8.00	10.00	0.156 acres (about 1/6 acre)
1" = 1,000'	5.28	22.96	0.359 acres (about 1/2 acre)
1" = 1,320'	4.00	40.00	0.625 acres (about 2/3 acre)
1" = 2,000'	2.64	91.83	1.435 acres (about 1 1/2 acre)

EXAMPLE:

A section of a dot grid is placed over an irregular shape. Nineteen dots fall within the object's boundaries. Two fall on the line and are counted as one-half each. The total number of dots is 19 + (2 x ½) = 19 + 1 = 20. Multiply this total by the acreage conversion factor.



Obtaining Aerial Photographs

Contracting with an aerial photographer is expensive, but gives the landowner control over the type, scale, and timing of photography. Cost is usually prohibitive for small woodlot owners.

Landowners may purchase existing photos from the Consolidated Farm Services Agency or the North Carolina Department of Transportation. Local offices can provide order forms for the photos, which include complete ordering instructions and pricing information. One major timber company, the Weyerhaeuser Company, also has aerial photographs of counties in eastern North Carolina. Photos can be viewed at the Aerial Photo Sales Department in the N.C. Timberlands Building of Weyerhaeuser in New Bern, N.C. Call the Aerial Photo Department at (919) 633-7646 for more information.

Summary

Aerial photographs are a management planning tool which reduces the time spent in the field. Preplanning using aerial photographs allows a land manager to inventory vegetative types, locate environmentally sensitive areas, plan wildlife habitat improvement, identify changing land uses, and strategically plan timber management activities. They can be easily obtained at a reasonable cost.

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5,000 copies of this public document were printed at a cost of $1,244, or $.25 per copy.

Published by
NORTH CAROLINA COOPERATIVE EXTENSION SERVICE

05/95—5M—DLZ—250265

AG-531