Lesson 7

Vegetation Analysis

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Description: In this lesson we examine the process of vegetation analysis. We will first consider the particular elements of image interpretation that are most useful to classification of vegetation. We then will work with PI tools for estimating the crown size and stocking density of forest vegetation in an effort to quantify the vegetation present in each given stand. We will conclude by attempting to group forest stands by species group so that an estimate of the dominant vegetation class can be made.

Vegetation Analysis

One of the more common uses of aerial photography in natural resource management is vegetation mapping. Vegetation is often of direct interest for a wide range of resource issues including timber, wildlife habitat, watershed or ecosystem management. With good quality photographs, an experienced interpreter can quickly and efficiently map a range of vegetation characteristics. In many cases it is the dominant vegetation type that is of primary interest, either for a direct use, such as its timber value, or indirectly as a proxy for the underlying soils, hydrology or habitat identification.

Mapping vegetation requires an interpreter with good familiarity with the area of interest. Having a firsthand knowledge of the species likely to be present, their characteristics and ecological niches leads to a more reliable result. Although it is possible to make a reasonable map based simply on the visual cues provided by aerial photographs, ground truth for several representative stands in the area of interest will typically lead to a better result. Many interpreters will create a key for the specific area of interest to facilitate consistent and reliable mapping, especially if there is likely to be more than one photo interpreter involved in the project.

The quality of the aerial photos is also crucial. Dependent on the goals of the project, photos collected at an appropriate time of the year may be important. For a project involving deciduous species it may be helpful to collect the images during the fall color change, whereas if conifers are the species of interest, perhaps winter photography would be advantageous. Photo scale may also be used to your advantage, for example to study the branching characteristics of deciduous trees, large-scale, winter photography may be useful. For mapping very large areas choosing a smaller scale to minimize the number of photos that need to be collected and interpreted may be the better option. Selection of an appropriate image date, scale, film type, and format can all be essential to obtaining the desired result with a minimum of time and expense.

As with any image interpretation, it is essential to use as many of the elements of image interpretation as are appropriate. Some particularly useful elements to consider as you analyze vegetation classes are listed below with examples of how they might be used.

Shape and size: the crown shape and size can often help you to identify the species. For example, narrow conical crowns of black spruce are quite different in appearance than the star shaped crowns of white pine or the large rounded crowns of oak. Crown size can be easily measured using a **crown diameter scale**.

Tone or color: the color of vegetation can often help to differentiate species. The deciduous trees tend to be lighter in tone than conifers. Within these groups, many species have particular colors that may be associated with them. Color can also be useful in identifying stressed or diseased trees, such as the yellow color often associated with oak-wilt when viewed with CIR films.

Texture: the general size and age class of a stand can often be, in part, determined by its texture. Small or young trees will often have a smooth, feathery appearance as opposed to a rough, bumpy appearance often associated with larger and older trees.

Site: natural vegetation typically can be associated with a preferred site in the terrain. By noting the topographic position, slope, aspect or other site characteristics, we can often narrow the likely range of possibilities.

Shadow: in some cases it is possible to determine the shape and characteristics of the crown or branching structure of a tree by examining the shadow it casts. This may be difficult in the middle of a dense stand, but in cases where trees are widely spaces, or fall along an edge of a recent cut or a road, shadows can provide useful insight.

Pattern: this is most often useful in differentiating natural stands from plantations. The regular rows often left by planting are obvious versus the irregular and sometimes patchy appearance of a natural stand.

Quantification of Vegetation

Beyond simply identifying the stand boundaries or species present in an area, we often need to quantify it. To accomplish this simple PI tools can be used. The crown diameter scale provides a rough measure of crown size, and the **crown density scale** provides a rough estimate of stocking density. Using the percentage estimate of stocking in conjunction with the total area of the stand, we can get an estimate of the overall amount of vegetation present.

For some species there are formulas available to estimate parameters such as height or bole size from the crown size. If the interpreter has such information available it is possible to get an estimate of the total basal area of the stand from the photo interpretation. As is always the case, however, any such calculations should be ground checked against a reasonable sample of the area being interpreted.

When working with any of the PI tools it is crucial to be aware of the scale the tool was designed for, and when necessary, to calculate a conversion factor for use with photos of a different scale. A good rule of thumb is to correct any time the actual photo scale varies more than 3% from the scale of the tool. When the scale is within 3% corrections are not worthwhile since your own measurement error will typically fall outside of a ±3% range. Remember that when converting for a linear measurement, the conversion factor is a direct relation, but when converting for an area measure (such as crown size) the conversion factor must be squared.

Thus for an interpreter's scale designed for 1:20000 being used on a photo at a scale of 1:18000, the conversion factor is:

$$\frac{\text{(Photo scale)}}{\text{(Crown scale)}} \qquad \frac{18{,}000}{20{,}000} \qquad (1)$$

So, for example, a linear measurement of 10 chains using the interpreter's scale would actually be:

$$10 \text{ chains} \times 0.9 = 9 \text{ chains} \quad \text{(on the photo)} \qquad (2)$$

But a measure of one acre would be:

$$1 \text{ acre} \times (0.9)^2 = 0.81 \text{ acres} \qquad (3)$$

Some photo characteristics that will affect the accuracy of density estimates include:

- skill of the interpreter.
- quality of the photos.
- sun angle (time of the day or year, affecting the shadow length).
- radial displacement (shorter focal lengths will cause a greater likelihood of overestimation as measurements are made further from the PP of the photograph).

A formula for determining the error of your measurements is shown below.

$$\text{Error} = \frac{\text{type area} - \text{unit area}}{\text{unit area}} \times 100$$

Lesson 7 Exercises

Objective: These exercises focus on the interpretation of vegetation types to create a cover map and to make quantitative estimates of size and density using the appropriate PI tools.

Materials: Photos CBM-21-52 and CBM-21-53, mirror stereoscope, crown diameter scale, crown density scale, dot grid, overlay for the photos, and calculator.

Vegetation Classification Exercise:

For this exercise we wish to create a type map for a forested area in northwest Minnesota. In an actual work situation, we would outline the effective area for measurements. For purposes of this lab, (time constraints and fairly level terrain) we will skip this step. We will measure and record data for 18 separate stands based on the following criteria:

- Crown Size
- Stocking Density
- Stand Area
- Stand Origin (natural or planted)
- Species (hardwood or conifer)
- Size Class (sapling, pole or sawtimber)

Keep in mind that this is a sample exercise. To create a reliable vegetation map of this area we would need to have additional information obtained on the ground to guide our interpretation work, particularly for the size class. Instead, we will use photos CBM-21-52 and -53 and the provided overlay as an illustration of different stands. You can assume the sections visible in these photos are exactly one square mile for the purpose of making a scale calculation and determining any needed correction factors.

1) You need to acquire the photo scale (you already calculated this in Lesson 6, Exercise 3) and the scale of your PI tools. Make any necessary calculations to determine a correction factor for distance (Lesson 4) and area (Lesson 6). Place the stand overlay on photo CBM-21-53.
2) Arrange your photos for stereo viewing.
3) Use your knowledge of vegetation and the elements of image interpretation to identify the individual forest stands using a minimum mapping unit of 0.5 acres.
4) For the numbered forest stands make any necessary measurements and calculations to complete the table.
5) Compare your results with your partner's and with the results provided by the instructor.

Note: the crown diameter scale is measured in thousandths of an inch. You will need to convert this measure to fit the scale of your photo. For example, on a photo with a scale of 1:18,000 and using a grid scale of 1:20,000, a tree matching the ".02225 inch" dot would have a crown width of 38 feet.

Converting inches to feet PD PSR = GD

0.0225 in | 1 ft / 12 in = 0.001875 ft 0.001875 ft x 18,000 = 33.75 ft, rounded to 34 ft

Stand Number	Crown Size	Size Class	Stocking Density	Stand Area *Use dot grid GAE*	Stand Origin *Planted or Natural*	Species *Deciduous or Conifer*
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						

6) Based on the above information do deciduous or coniferous species dominate this area?

7) What is the overall percentage covered by your above choice?

Lesson 7 Outcomes

At this point you should:

1. Understand the necessary calculations for any needed correction factors when using PI tools for linear and area measurements.

2. Understand the use of the crown diameter and crown closure scales in making measurement of forest stands.

3. Be able to delineate stand boundaries using a stereo photo pair.

4. Feel comfortable making informed interpretations of stand size, origin and species.

5. Be able to determine the dominant species and estimate its percent of the overall cover in a selected mapping unit.