Measuring Plant Cover

I. Definition = % of ground surface covered by vegetation or other coverages including rocks, litter, moss, or bareground

Types of cover measurements? - Need to define

A. Basal Cover = Measure only the proportion of the plant that extends into the soil.

1. Basal cover is generally more stable from year to year and less changes due to climatic fluctuation or utilization by grazing animals.

2. This measure is usually used from trend comparisons or for calculation of species composition.

3. Can be difficult to measure for forbs with a single, small stem.

B. Foliar Cover = Measure a vertical projection of exposed leaf area. The cover would equal the shadow cast if the sun was directly overhead.

1. Small openings in the canopy or overlap within the plant are excluded.

2. Highly susceptible to yearly fluctuations due to climatic or biotic factors.

3. Can be difficult to measure except for some growth forms. Easiest to measure for forbs, shrubs or succulents with large leaves (i.e., cactus).

4. See figure 6, pg 23 in Interagency Handbook

C. Canopy Cover = Estimate of the area of influence of the plant.

1. Including potential influence of the roots.

2. Ignores gaps in the canopy.

3. Vertical projection of the outermost perimeter of the natural spread of foliage of plants.

4. For any area, the total canopy cover can exceed 100% because plants can overlap.

5. See figure 7, pg 23 in Interagency Handbook

D. Ground Cover = Cover of the soil surface with plants, litter, rocks or gravel.

1. Most often used to determine the watershed stability of the site.

2. Commonly included in measures of sparsely vegetated communities (i.e., deserts).

II. When to measure cover?

A. Cover is thought to be more ecologically significant than density or frequency because it is an estimate of how much a plant dominates an ecosystem:

1. Cover is more highly related to biomass than density or frequency and therefore reflects the amount of CO_2 and light that the plant capture and turn into phytomass (above-ground plant biomass)

2. Cover also reflects the amount of soil water and nutrients that the plant can harvest and use (best estimated by canopy cover)

B. Cover is especially useful in the evaluation of hydrologic processes.

1. Foliar cover influence the amount of rain that is intercepted.

2. Ground cover (especially vegetation or litter) influences infiltration and potential erosion.

C. Cover is also good for characterizing ecosystems across life forms. Cover is expressed as % of area. Therefore, the meaning of cover is the same for grasses, forbs, shrubs etc. Relatively contribution of plants of different life-forms in the community can be more easily understood.

III. Advantages:

A. Can be used to measure a variety of life-forms (i.e., moss, annual forbs, shrubs, trees).

B. Strongly related to biomass and ecosystem processes.

C. Does not require determining number of individuals within a species (usually estimated by species).

D. Can easily be used to measure plants, mosses, or lichens at the ground surface.

IV. Disadvantages:

A. Most measures of cover (except basal cover) vary greatly depending on climatic conditions.

B. Most measures of cover (except basal cover) are affected by utilization of animals.

C. Not always easy to estimate.

D. Lots of variation between observers because cover is subjective and is difficult to determine the accuracy of the estimate.

V. Three basic ways to measure cover: Points, Lines or Plots

A. Point - a quadrat with the smallest possible dimensions.

1. Most objective measurement type

2. Geometrically, points have no area, however, in reality we treat them as samples with very small area.

3. Can be used to measure basal, foliar, or ground cover, Doesn't work very well for canopy cover.

B. Intercept Along Lines - a line (usually a tape measure) of known distance

1. Line intercept is fairly objective, but the observer must decide the edge of the canopy.

2. Usually used to measure canopy cover, but can be used for foliar cover with some species (those with large leaves and dense canopies).

C. Plots - area estimated or measured in quadrats

1. Usually just an estimate of cover in a plot, therefore very subjective

2. Can be done with objective measures but it is difficult (e.g., photographic techniques or pantographs)

3. Plots can be used to estimate canopy, foliar, or ground cover. Doesn't work very well for basal cover.

4. Plots can be any size, including belt transects that a 1 or 2 meter wide belts adjacent to a line transect

VI. Techniques for **Points** to measure cover.

A. Step-point - used to measure basal cover and ground cover (pgs 70-76 in Interagency Handbook).

1. Make observations along a walking transect at specified intervals (e.g., number of steps).

2. At each specified step, project a pin at mark on boot into the vegetation or soil.

3. Record the plant base or ground cover intersected by the point referred to as a "hit".

4. $$Cover\ of\ Spp\ A = \left(\frac{\#hits\ Spp\ A}{total\ \#points}\right) \times 100$$

5. Advantages of this technique:

    a. Requires little equipment

    b. Can cover a large area

    c. Quite objective and requires little training.

6. Disadvantage of this technique:

    a. The transect is the sample unit therefore, it can be difficult to make statistical conclusions unless several transects are taken.

B. Point Frames or Point-Intercept Methods (pgs 78-85 in Interagency Handbook)

1. Groups or clusters of points.

2. A point can be a sharpened pin or cross-hairs (made with lines on a frame).

3. With pin-type point frames:

    a. Usually a group of 10 or more points.

    b. Frame is place along a line or at regular or random intervals in a large plot

    c. Each pin is lowered and the foliar or basal cover is recorded.

    d. $$Cover\ of\ Spp\ A = \left(\frac{\#hits\ Spp\ A}{total\ \#\ points}\right) \times 100$$

    e. Total number of "hits" = pins/frame * number of frames placed.

4. Point-type frames:

    a. Usually a group of many points (100 or more).

    b. Frame is placed along a line or ate regular or random intervals in a large plot.

    c. The foliar or ground cover at each point (intersection of two lines) is recorded.

    d. $$Cover\ of\ Spp\ A = \left(\frac{\#hits\ Spp\ A}{total\ \#\ points}\right) \times 100$$

    e. This frame technique is objective but, there can be substantial observer error deciding exactly where the point is projected to the vegetation. Several sighting devices have been developed to reduce this error including, laser points, plumbs, and periscopes.

VII. **Line**-Based Methods

A. Line-Intercept Methods (pgs 64-67 in Interagency Handbook)

1. Geometrically, a line is a single dimension distance measure. In reality, it is a long thin plot.

2. Measure the distance of first contact to the last contact of the species.

3. Ignore overlap of individuals of same species.

4. Count overlap of differing species.

5. $$\%\ cover\ Spp\ A = \left(\frac{total\ distance\ Spp\ A}{\sum\ distance\ of\ all\ spp\ along\ line} \right) \times 100$$

6. Determine % cover for each line then average lines together for estimate of cover.

7. Easily be used to measure canopy cover or foliar cover. Not well suited for ground or basal cover.

8. Potential observer error in data collection:

   a. May be difficult to tell where the canopy starts or ends.

   b. Decide what to do with broken canopy within a shrub or tree. Usually, if there is a gap less than 10 cm ignore it, count gaps greater than 10 cm.

VIII. **Plot** Estimate Techniques:

A. Direct Estimates of Cover:

1. Place a plot (usually 20*50cm) along a transect, or randomly or systematically in a plot.

2. Estimate foliar or canopy cover of plants in the plot

3. Record estimate as % of total area

4. Main difficulty is that estimates are very subjective.

5. There are a few methods to objectively measure cover (pento-graphs or photo methods). But, they are very time consuming. Could be used for training or in a double sampling technique.

6. This method is faster than point-based techniques.

7. $$\%\ cover\ Spp\ A = \left(\frac{Total\ \%\ cover\ Spp\ A\ in\ all\ plots}{number\ of\ plots\ estimated} \right) \times 100$$

B. Daubenmire Cover-Class (pgs 55-58 Interagency Handbook).

1. Place a plot along a transect, or randomly or systematically in a plot. A Daubenmire Frame is specified as 20x50 cm with painted sides (see pg 63 in interagency handbook).

2. Estimate foliar or canopy cover of plants in the plot.

   a. Record estimate by cover class

Cover Class	Range of Coverage	Midpoint of Range
1	0-5%	2.5%
2	5-25%	15.5%
3	25-50%	37.5%
4	50-75%	62.5%
5	75-95%	85.0%
6	95-100%	97.5%

   b. These cover classes were designed to make if faster to estimate cover (don't need to decide if it is a few percentages more or less just need to put coverage into classes).

   c. Estimates are still very subjective

3. As above, there are very few methods to test the accuracy of estimates. The few methods that exist are very expensive.

4. Cover calculation:

*% cover of spp A = (# of plots cover class 1 * 2.5%*
+ *# of plots cover class 2 * 15.5%*
+ *# of plots cover class 3 * 37.5%*
+ *# of plots cover class* 4 * 62.5%
+ *# of plots cover class* 5 * 85.0%
+ *# of plots cover class* 6 * 97.5%) ÷ total number of plots

Useful References about Cover Estimation

Canfield, R.H. 1941. Application of the line intercept method in sampling range vegetation. J. Forestry. 39:388-394.

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