Measuring Plant Structure

I. Definition = The way in which vegetation is arranged in 3-dimensional space.

A. "Structure" usually refers to *vertical structure*. However, *horizontal structure* could also be measured with techniques based on cover, density, or distribution.

B. Structure is measured as vegetation layers on vertical plains.

C. Methods of measurement are usually based on either:

1. Height of vegetation

2. Cover of vertical plots

D. Layers in the canopy of rangelands can be described following Short 1986

1. Tree canopy - vegetation structure is 8 m or more above the terrestrial or aquatic surface and provides at least 5% cover when projected to the surface.

2. Tree bole - Tree trunks have a dbh 20 cm and occur at a density of 12/ha.

3. Shrub midstory - vegetation height from 50 cm up to 8 m, which provides at least 5% cover when projected to the surface.

4. Understory - layer extends from 10 cm below the apparent surface up to, but not including, 50cm above the apparent surface and provides at least 5% cover when projected to the surface.

5. Terrestrial subsurface - extends from more than 10 cm below the apparent surface down.

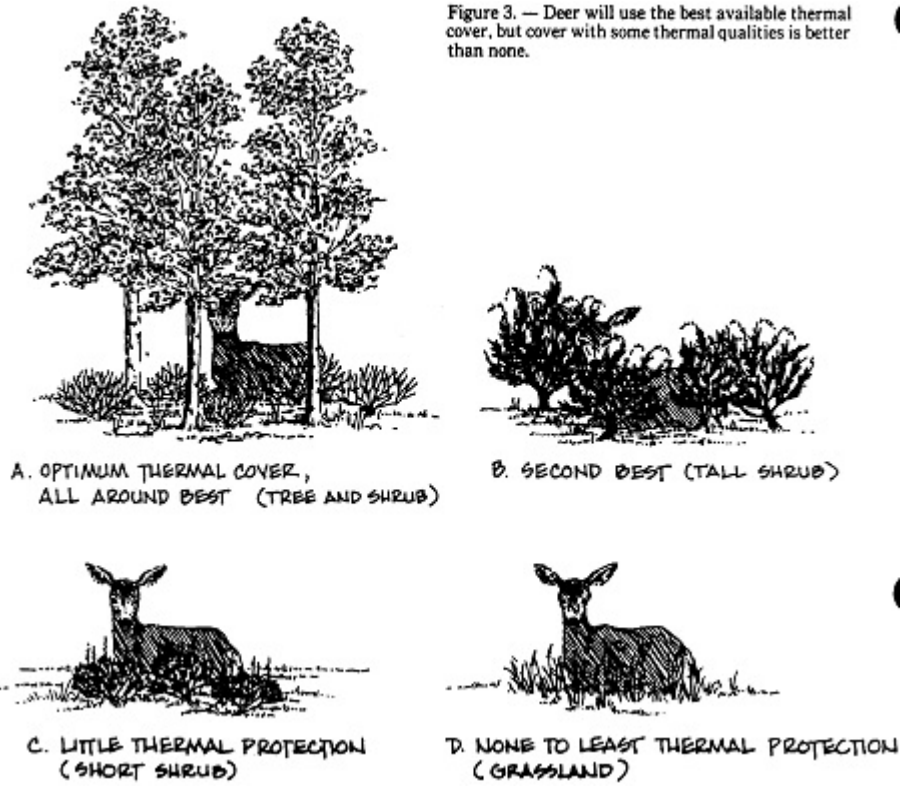
6. Surface water layer - land surface-water interface and shallow water up to 25 cm deep.

II. When to measure structure?

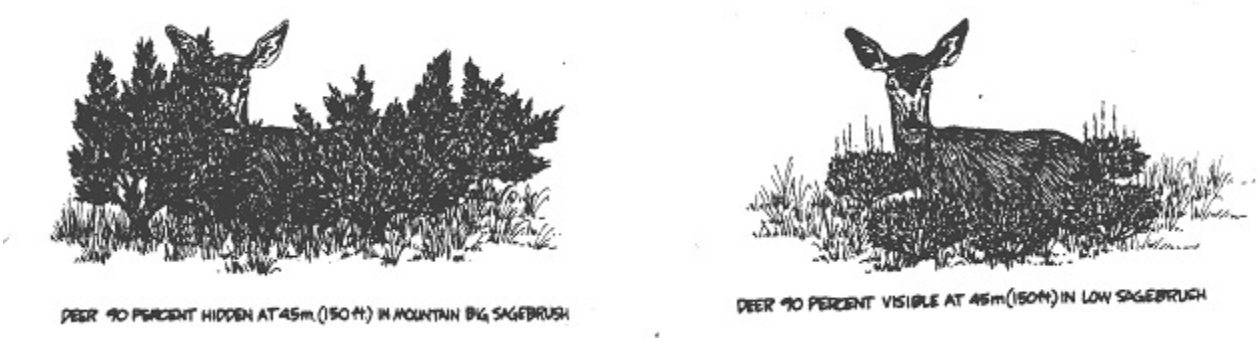
A. To estimate value of habitat for wildlife

1. Thermal cover

Figure 3. — Deer will use the best available thermal cover, but cover with some thermal qualities is better than none.



2. Hiding cover



3. Nesting cover

B. To more carefully characterized ecosystems to assess community change.

C. Could have some value in watershed assessment.

III. Advantages

A. Most techniques are quick and easy to estimate.

B. Can be used to estimate distribution of biomass in the environment.

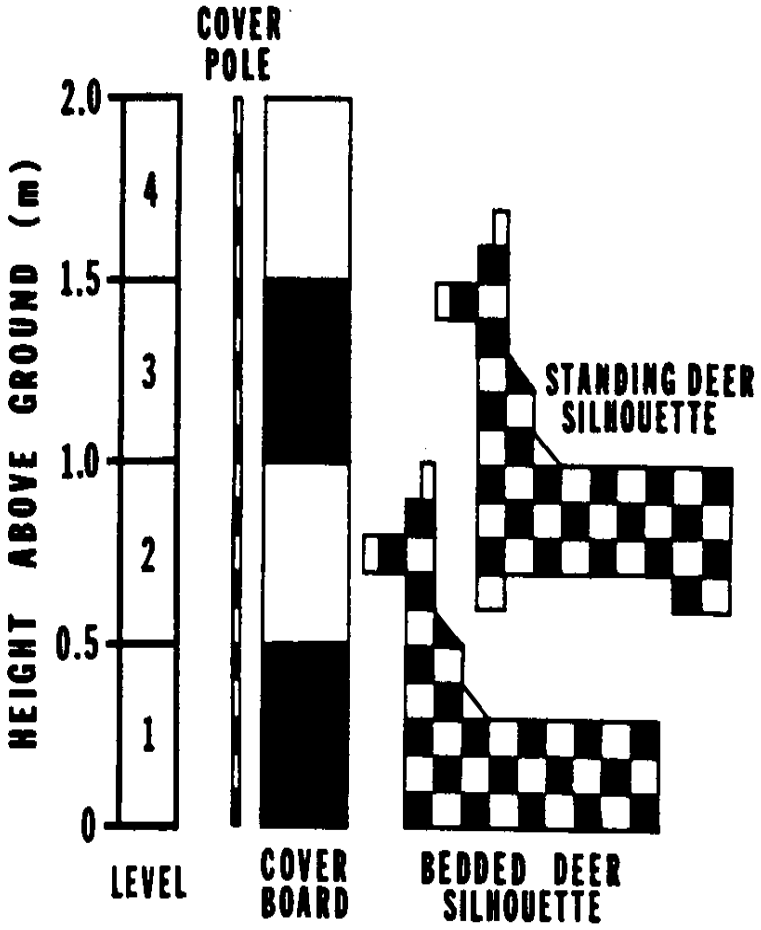
IV. Disadvantages:

A. Usually takes 2 people to efficiently measure cover (one to hold the board or pole and one to estimate height or cover).

B. Most techniques are just estimates with little opportunity to determine accuracy.

V. Techniques for Measuring Vertical Structure

A. Density Boards/Cover Boards - Many different types of boards have been proposed. They vary in dimensions but are generally narrow boards with bands of alternating colors that define vertical bands.



1. Density Board - Described by DeVos and Mosby (1971).

a. Board 6 ft tall.

b. Painted Black/White every foot and a large number 1-6 painted over each section (1 at the bottom, 6 at the top).

c. Board (or rod) is held by the “rodman” at a sample location.

d. The observer paces away from the board 66 ft. in a randomly chosen direction.

e. Facing the board, the observer records all the numbers that are unobscured by vegetation. The numbers are simply added up to get a density reading. For example, if there was no cover the reading would be 21 (1+2+3+4+5+6). If cover completely obscured the board the reading would be 0.

f. Problem - The main problem with this technique is that 2 very different habitats could yield the same density score. For example, a shrubland where the bottom 3 segments are covered (1+2+3) would have the same score (6) as a forest with cover at the top of the board (segment 6), but no understory.

2. Vegetation Profile Board as described by Nudds 1977

a. The board is 2.5 tall, 30.48 cm wide, and is made of .95-cm plywood.

b. The board is marked in alternate colors (black/white) at 50-cm intervals.

c. The board is set in the ground and read at 15 m (though this could vary with ecosystem) in a randomly chosen direction.

d. The proportion of each ½ m interval covered by vegetation is recorded as single digit between 1 and 5:

(1) 1 = 0-20% cover

(2) 2 = 21-40% cover

(3) 3 = 41-60% cover

(4) 4 = 61-80% cover

(5) 5 = 81-100% cover

e. An average density can therefore be obtained for each vertical layer of vegetation

3. Robel Pole for Visual Obstruction (as described by Robel et al. 1970)

a. The Roble pole was designed to assess bird nesting habitat. It is essentially a density board that is reduced and modified for grassland communities.

b. The Robel pole is 150-cm (or 48") tall and 3 cm (or 1 ⅛") in diameter.

c. The pole is marked with alternating colors every 10-cm (or 1").

d. The Roble pole is secured or held at a sample location. The observer moves away from the pole 4-m (or 157") in a random direction or parallel to a transect. This distance (4-m) is usually determined with a string or cord that is attached to the pole at a height of 1-m (39").

e. A second pole, 1-m (or 39") tall, is used a sighting tool to ensure that each visual obstruction measurement is taken from the same height.

f. The observer lowers her (or his) eye to the sighting pole and records the highest band on the Robel Pole that is completely obscured by vegetation.

g. A second measurement is usually made from the opposite direction as the first reading.

h. In some ecosystems, it is possible to record the specific species with obscures the Robel Pole. This can be recorded as a measure of composition as it relates to cover.

i. Visual obstruction (as measured by a Roble Pole) can also be used to estimate herbaceous biomass in a double-sampling technique.

4. Vegetation Profile Board modified for grasslands by Hays et al. 1981.

   a. Board is 2.25-m tall.

   b. The board is marked in alternate colors (black/white) at 25-cm intervals.

   c. The board is set in the ground and read can be read in 2 ways:

      (1) At a set interval (e.g., 15 m) where the proportion of each vertical interval that is covered by vegetation is recorded in the same classes (1-5) as outlined by Nudds 1977.

      (2) At variable distances where the distance required to obscure 50% of the board is recorded.

5. Cover Board Methods as outlined in the Interagency Handbook 1996.

   a. The board can be of any height deemed appropriate by the researcher. Recommended heights are 2 meters or 5 feet. Segments of 50-cm or 1-foot are marked with alternating colors

   b. The board is read at 15 feet.

   c. The percent of cover by vegetation at each vertical segment is recorded with Daubenmire cover classes or as simple estimates of cover to the nearest 10%

   d. Daubenmire cover classes:

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%

e. The midpoint of each cover class is used to calculate the average cover for each layer.

6. Densiometers -

a. Used to measure canopy overhead. (Don't really measure vertical structure but do relate to one aspect of 3-dimensional structure)

b. Concave or convex mirrors (usually 2-3" in diameter) that have a grid on them.

c. Hold the densiometer 12" to 18" in front of body at elbow height and count the number of points on the grid which are reflecting vegetation.

d. Number of points intersected divided by total number of points on the grid can yield estimate of % overhead cover.

B. Photometric Techniques (Devos and Mosby 1971).

1. Several techniques have been developed to measure the amount of light available at (or near) the ground surface as a measure of overhead vertical cover.

2. One such technique uses an illuminator meter.

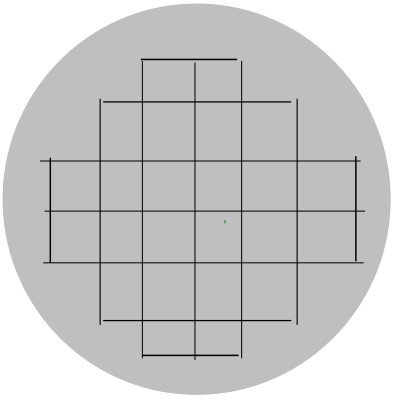
a. The device measures foot candles of light to which it is exposed

b. The illuminator meter is mounted an a board 8 inches from the ground and the light received is measured

3. Photo-voltaic cells have also been employed to measure light.

4. The value of these techniques is that they are objective and not biased by the observer. The problem is that the light conditions of the day or time of day affect the observations and corrections must be made.

VI. Diversity of Vertical Structure. In assessing wildlife habitat diversity (or variation) in vertical cover may be as important as adequate cover in specific places. This is because animals require a variety of cover types to meet their daily needs of nesting, feeding, resting, etc. Several authors have suggested indexes to assess diversity of vertical structure.



A. Foliage Height Diversity (Hays et al. 1981)

1. The FHD is simply a Shanon-Weiner index calculated as % cover at different heights (instead of % cover of different species)

2. To calculate the FHD, a cover board of vegetation profile board is used to

estimate cover at vertical layers in the vegetation.

B. Habitat Layer Index - HLI (Short 1986). First, the dominant cover type (tree canopy, shrub canopy, understory herbaceous canopy or bare ground) of each area is mapped.

1. Then, an index can be calculated as: $$\mathrm{HIL} = \frac{x \sum A_i}{5 \times 6\left(\sum A_j\right)}$$

x = the number of layers of habitat present within some bounded area

A_i = The area of layer of habitat *i* within the bounded area

A_j = the surface area cover type *j* within the bounded area

n = the number of different cover types present within the bounded area,

6 = the maximum number of units of area of habitat layers that could occur within a unit of structurally complex terrestrial habitat.

5 = the maximum number of units of area of habitat layers that could occur within a number of units of structurally complex terrestrial habitats.

Literature Cited

DeVos, A. and H.S. Mosby. 1971. Habitat analysis and evaluation. *pp142-143. In*: Giles, R.H. (ed). Wildlife Management Techniques. The Wildlife Society, Washington D.C.

Hays, R.L., C.Summers and W.Seitz. 1981. Estimating wildlife habitat variables. Fish & Wild. Serv./Office of Biol. Serv. Publ. # FWS/OBS-81/47.

Nudds, T.D. 1977. Quantifying the vegetation structure of wildlife cover. Wildl. Soc. Bull. 5:113-117.

Robel, R.J., J.N. Briggs, A.D. Dayton, and L.C. Hulbert. 1970. Relationship between visual obstruction measurements and weight of grassland. J. Range. Manage. 23:295-297.

Short, H.L. 1986. Rangeland. *pp. 122 In*: Cooperrider, A.Y., R.J. Boyd and H.R. Stuart (eds.) Inventory and Monitoring of Wildlife Habitat. Bureau of Land Management Pub. # BLM/YA/PT-87/001 + 6600.