9.3 Habitat Quality Assessment w/ alternate Sample Units

Lower Canopy Vegetation

Important for forest health monitoring, biodiversity assessment, forest vegetation biomass & carbon content

Includes mosses, lichens, ferns, grasses, herbs, shrubs, natural tree regeneration

Most important attributes:

- Species composition,
- Cover, or relative cover by species or species group
- Frequency (proportion of samples in which species is present)
- Abundance (number of stems or plants per sample)
- Sizes (height, diameter, esp. for natural tree regeneration)
- Density (number of stems or plants per unit area)

Cover – the simplest definition of cover is the percentage of ground surface covered by vegetative material

Relative Cover – cover of a species or life-form expressed as percentage of total vegetation cover

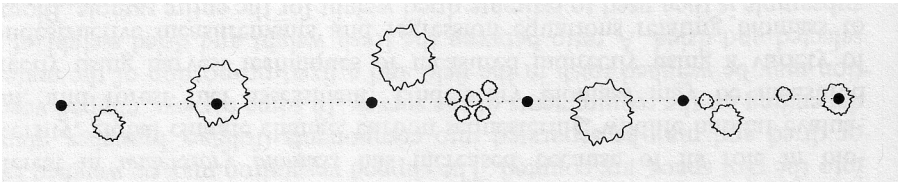
Cover is generally measured as the vertical projection of the vegetation onto the ground surface – does not require identification of individual plants

Cover can be estimated visually, with fixed-area plots, with line intercept technique (transects), point intercept technique, or the point transect method (a combination of the line intercept and the point intercept methods)

Point Transect Method for estimating cover

A transect of a given length is established and points are sampled at pre-determined, fixed intervals along the transect

Each point is assessed to determine if it is covered or not covered:



Percent cover is simply estimated as the number of covered points divided by the total number of points assessed – average cover would be calculated as the average of cover values determined from multiple transects

By recording all species (or species groups) covering the point – layering is possible, even probable – relative cover can also be computed

Line Intercept Method for estimating cover

Record species, D1 (starting distance), D2 (ending distance), and height or length of plant

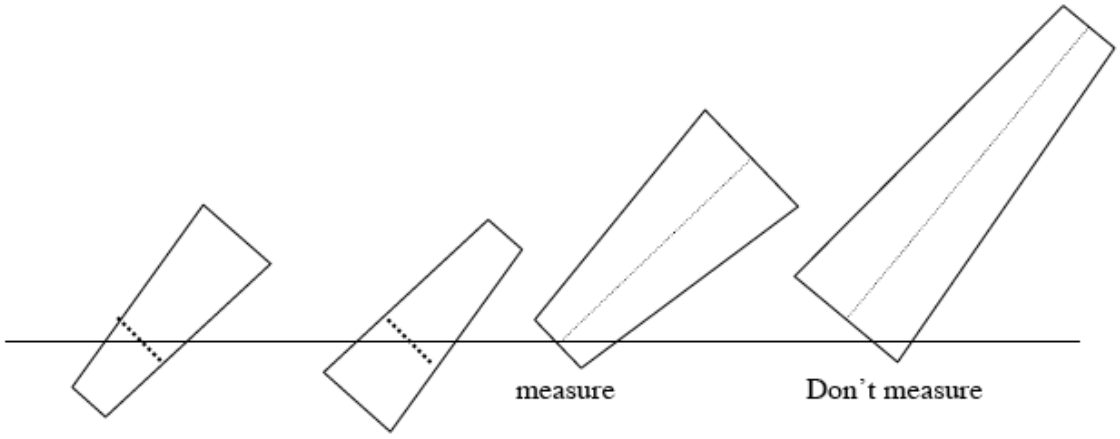
$$l_{1,spp} = \mathrm{D2}_{1,spp} - D1_{1,spp} \quad \Rightarrow \quad r_{spp} = \sum l_{i,spp} \quad \Rightarrow \quad \bar{r}_{spp} = \frac{1}{n}\sum r_{spp}$$

Woody Detritus

Important component of forest ecosystems of interest to wildlife scientists, mycologists, foresters, fire scientists

Sampling Units employed for assessing woody detritus include fixed-area plots, line intersect sampling (LIS), or Point Relaskop Sampling

Line Intersect Sampling



Measure and record the diameter at the point of crossing, perpendicular to central axis of piece. Measure and record the length of the piece, also.

In general, for any attribute of interest we use an "attribute-to-length ratio" that is analogous to the VBAR (Variable-to-Basal Area Ratio), however, the denominator is length of piece rather than basal area,

Total amount, T, of attribute *x* per unit area, is estimated using this fundamental equation:

$$T = \frac{\pi}{2L} \sum_i \frac{x_i}{l_i},$$

where L = length of transect,
x_i = attribute of interest, and
l_i = length of intersecting piece.

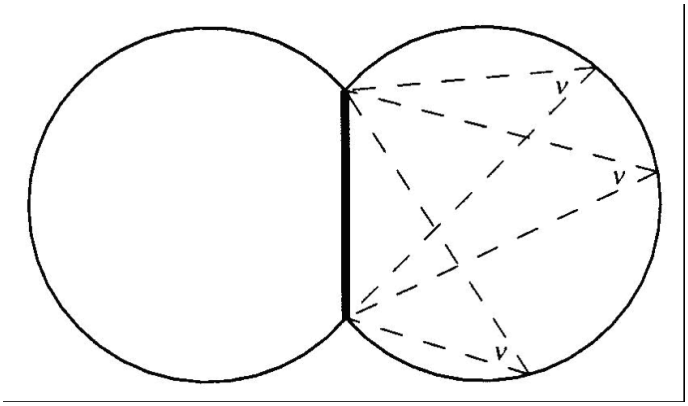
If l, L are measured in feet, then units of T are "x attribute per sq. ft." (Units of l and L must match to make any sense.)

Point Relaskop Sampling (PRS) Units

PRS is a form of pps sampling used for sampling CWD or fuelwood loading like LIS

Method is very similar to horizontal point sampling using an angle gauge

A horizontally projected angle is used to sight each piece of downed woody detritus – if the length of the piece meets or exceeds the width of the projected angle at its location, it is "IN" or a TALLY piece



The angle of the gauge determines a "squared-length" factor, $\mathcal{L}$, such that each "IN" log represents $\mathcal{L}$ units of squared length per unit area ($\mathcal{L}$ is analogous to BAF)

Any quantity that can be associated with a log (such as mass of fungi, number of beetle colonies, etc.) can be expanded to a unit area estimate

For PRS, the fundamental equation for quantity per unit area of any attribute, y, is:

$$\hat{Y} = \mathcal{L} \sum_i \frac{y_i}{l_i^2}$$

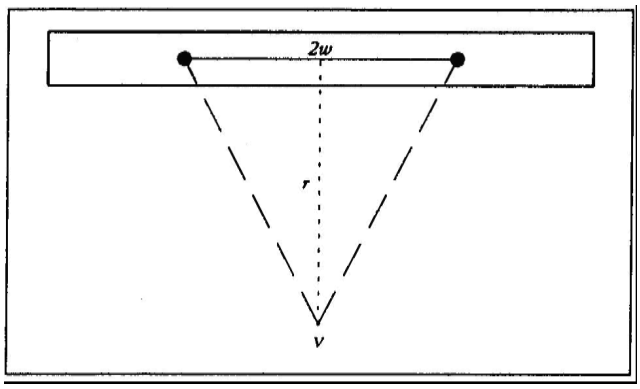
where, $\hat{Y}$ = quantity of y per unit area at the sample point,

$\mathcal{L}$ = squared length factor for a particular angle gauge,

y_i = quantity of interest (volume, biomass, bugs, etc.) of, in, or on i^{th} log

l_i = length of i^{th} "IN" log

A simple relaskop can be constructed out of many different materials



The relaskop angle, v, is formed from the ratio of reach length, r, and width, w, which is ½ the distance between two endpoints of the device (endpoints form the rays of the angle) – ends are $2w$ apart

The inclusion area, A, for an individual log (analogous to an individual tree zone in Bitterlich sampling), is obtained from

$$A_i = \phi l_i^2$$

Where, the gauge constant, ϕ, is given by

$$\phi = \frac{\pi\left(1 - v/180\right) + \sin v \cos v}{2\sin^2 v}$$

Derivation of Squared Length factor

The squared length per unit area factor $\mathcal{L}$ is derived by expanding the squared length per inclusion area A to a per unit area basis

The squared Length Factor for the i^{th} log is:

$$LF_i = l_i^2 \bullet XF_i$$

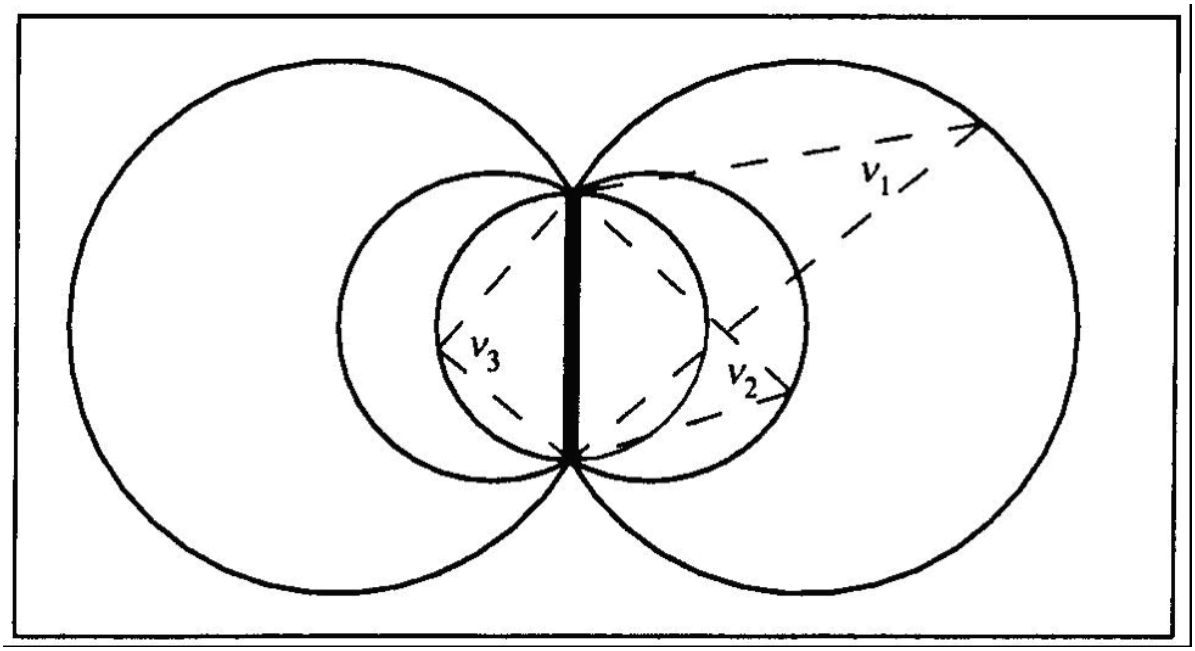
Since the expansion factor for any attribute X and any plot size is

$$XF_i = \frac{unit\ area}{plot\ area_i} = \frac{unit\ area}{\phi l_i^2}$$

then substituting the last expression for XF_i into the equation above for LF_i, gives

$$LF_i = l_i^2 \bullet \frac{unit\ area}{\phi l_i^2} = \frac{unit\ area}{\phi} = \mathcal{L}$$

Note that the squared length factor for an individual log does not depend on individual log length, just the size of the angle used (note that in figure below angle $v_1 < v_2 < v_3$)



For borderline cases, i.e., in situations where log length seems to coincide exactly with endpoints of angle gauge, we calculate the limiting log length as:

$$l_i^* = \sqrt{a^2 + b^2 - 2ab\cos(v)}$$

where a = distance from the sample point ("plot" center) to large end of log,

b = distance from sample point to small end

Some useful reach/width ratios with their associated angles and $\mathcal{L}$ factors

Angle gauge $(r : w)$	v (deg)	$\mathcal{L}$
1:1	90.00	55,462
2:1	53.13	20,694
3:1	36.87	10,531
4:1	28.07	6,291
5:1	22.62	4,155
6:1	18.92	2,939
7:1	16.26	2,185
8:1	14.25	1,686

To calculate the *number* of logs per unit area at a particular point, we represent each log with its count, typically 1, and plug into the fundamental equation:

$$\hat{N} = \mathcal{L} \sum_i \frac{1}{l_i^2}$$

Per unit area values for any other attribute are calculated in like manner, by letting y_i be the quantity of interest.

For example, let m_i = quantity (say, mass) of mushrooms on the i^{th} log. The total quantity of mushrooms per unit area at the sample point is estimated from:

$$\hat{M} = \mathcal{L} \sum_i \frac{m_i}{l_i^2}$$

Example. Field tally for a single sample point using PRS and an $r:w$ ratio of 4:1.

Log No.	Diam. (in.)	length (l_i)	Distance		l*	Vol (ft^3)
			a (ft.)	b (ft.)		
1	3.4	7.0	7.5	3.1	5.0	0.4
2	3.2	13.4	-	-	-	0.7
3	4.5	11.1	-	-	-	1.2
4	5.1	35.8	-	-	-	5.1

An estimate of total volume using the fundamental equation, plugging in volume for the attribute of interest, first noting that a reach:width ratio of 4:1 gives $\mathcal{L}$ = 6291 yields:

$$\hat{V} = \mathcal{L} \sum_i \frac{v_i}{l_i^2} = 6291 \left(\frac{0.4}{7^2} + \frac{0.7}{13.4^2} + \frac{1.2}{11.1^2} + \frac{5.1}{35.8^2} \right) = 162.2 \ ft^3 / ac$$

Mean, variance, standard deviation, standard error, and confidence intervals are calculated with the usual statistical formulas using the number of sampling points as the sample size, n.

Forest Floor Depth

Depth of forest floor litter, or duff, is a key habitat characteristic for small mammals, such as voles, shrews, mice, rats, etc.

This habitat attribute is easily measured by pushing a small diameter stake (iron, in the picture) or trowel into the ground until mineral soil resistance is felt, gauging then “marking” that depth (perhaps with a finger), then extracting and measuring the portion that had been buried

Vertical Foliage Structure Diversity (a.k.a. Horizontal Porosity)

Foliage Structural Diversity (FSD) is proportional to Bird Species Diversity (BSD), among other things

Coverboard Sample Units

A coverboard is a simple device (a board, a screen, a shade) on which a checkerboard pattern of known dimensions is displayed

The basic technique is to stand at a distance and while looking at the coverboard, count the number of squares in the checkerboard pattern that are covered by vegetation at various heights

One person sets the board up at the sample point and the other paces or measures off a pre-determined distance (say, 7.2 m) to the north. The observer, using a reference staff, crouches down to an eye level of 0.5 m and counts the visible 10 by 10 cm squares on the bottom 1 m grid.

The observer then stands, using the reference staff to position his eye height at 1.5 m, counts the number of visible squares between the 1 and 2 m height markers on the board. Finally, the observer counts the visible squares between the 2 and 3 m markers. This process is repeated, counting visible squares from the east, south and west as well.

The biggest source of variability is observer bias in not consistently observing from the same assigned eye height, which is easily overcome by using a reference staff at each measurement.

Another large source of variability (non-sampling error) is due to observer inconsistently deciding whether or not a square is clear. For example in the photo above there is no square on the top tier that is completely clear.