Assessing Lower Canopy, LOD Attributes

OFFICE WORK

Using the data collected by the entire class, develop responses to the following questions.

1. What is the **mean cover for the *vegetation*** species named in class following fieldwork using each of the two lower canopy assessment methods? How do they compare? If different, why do you think they differ?

Point transect method

Percent Cover (PC) in percent of species “j” for a single transect is estimated by the formula:

$$PC_j(\%) = \frac{i_j}{p}(100)$$, where

i_j = the # points intersecting just species “j”,

p = total number of points sampled along transect

Fixed-Area plot method

Percent Cover (PC) in percent of species “j” for a single plot is estimated by eye in the field.

Mean Cover (either method)

$$\bar{P}\bar{C} = \frac{1}{n}\sum_{i=1}^{n} PC_i$$, where

n = the # transects or plots

2. Which **vegetation** method produces more variable observations? Why do you think that is? Which method would you recommend to your colleagues for use? Why? Would you change anything about that method? Why or why not?

Variance of Cover (either method)

$$s_{PC}^2 = \frac{\sum_{i=1}^{n} PC_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} PC_i\right)^2}{(n-1)}$$

Coefficient of Variation of Cover

$$C_{PC} = \frac{s_{PC}}{\overline{PC}}$$

3. What is the **mean volume per acre of LOD** using each of the two LOD assessment methods? How do they compare? If different, why do you think they differ?

Line intersect method

Analysis of LOD Data collected with Line Intersect Method

In general, for any attribute of interest we use an "attribute-to-length ratio" to estimate the total amount of the attribute per unit area.

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

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

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 "amount of attribute x per sq. ft." (Units of l and L must match to make any sense.)

When the attribute of interest, x, is VOLUME (cubic feet), we typically assume fallen logs are shaped like cylinders.

$$x = v_{cyl} = \pi r^2 l = \pi\left(\frac{d_i}{2}\right)^2 l$$

$$T_V = \frac{\pi}{2L}\sum_i \frac{\pi\left(d_i^2/2\right)l_i}{l_i} = \frac{\pi^2}{8L}\sum_i d_i^2 \Rightarrow \text{ ft}^3 \text{ / sq.ft}$$

The volume of woody debris per acre is obtained by multiplying T_V by 43,560 (1 acre = 43,560 ft^2):

$$\hat{V} = 43{,}560 \cdot T_V = 43{,}560\frac{\pi^2}{8L}\sum_i d_i^2 = \frac{5445\pi^2}{L}\sum_i d_i^2 \Rightarrow \text{ ft}^3 \text{ / acre}$$

Now, if d is measured in inches and L in feet, the volume of woody debris per acre (ft^3 / acre) becomes:

$$\hat{V} = \frac{5445\pi^2}{L}\sum_{i=1}^{k}\left(\frac{d_i}{12}\right)^2 = \frac{5445\pi^2}{144L}\sum_{i=1}^{k} d_i^2 = \frac{373.2}{L}\sum_{i=1}^{k} d_i^2$$

Fixed-Area plot method

First, calculate the volume of each individual piece on a plot:

$v = 0.005454 \cdot d_m^2 \cdot l$, where

- v is piece volume in cu.ft,
- d_m is diameter (in.) at the middle of the LOD,
- l is the piece length (ft).

Then, total volume of LOD, T_V on a single plot (sum up all the individual pieces):

$$T_V = \sum_i v_i$$

The volume of woody debris per acre is obtained by multiplying T_V by the plot expansion factor, which is the inverse of the plot size, a:

$$\hat{V} = \left(\frac{1}{a}\right)T_V$$

Mean LOD volume per acre (either method)

$$\bar{V} = \frac{1}{n}\sum_{i=1}^{n}\hat{V}_i$$

4. Which **LOD** assessment method produces more variable observations? Why do you think that is? Which method would you recommend to your colleagues for use? Why? Would you change anything about that method? Why or why not?

Variance of LOD volume per acre (either method)

$$s_{\hat{V}}^2 = \frac{\sum_{i=1}^{n}\hat{V}_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n}\hat{V}_i\right)^2}{(n-1)}$$

Coefficient of Variation of LOD vol. per ac.

$$C_V = \frac{s_V}{\bar{V}}$$

5. Calculate the number of *point-transect* sampling units needed to estimate mean *total* percent cover (*PC*) to within 5% of the mean with 90% confidence.

Use of statistical formulas preferred

- For SRS infinite populations (or sampling with replacement)

$$n = k + \frac{z^2 (CV)^2}{E^2}, \quad \text{where}$$

n = number of sample units required for desired precision E, with confidence level implied by z, k

k = correction term to avoid iterating between *t*-values

Confidence level	z-value	k
80%	1.282	1.31
90%	1.645	1.87
95%	1.960	2.44
99%	2.576	3.79

z = standard normal deviate

CV = coefficient of variation, standard deviation divided by mean (in percent), for forest to be sampled

E = allowable error or desired precision (in percent) for average volume (or basal area, etc.).

- For SRS finite populations (or sampling without replacement)

$$n = k + \frac{Nz^2 (CV)^2}{NE^2 + z^2 (CV)^2}, \quad \text{where}$$

N = Total number of sampling units in population,
and all other symbols are as before

– Rules of thumb:

For ~ 1/10 acre plots in highly variable (i.e., CV > 45% populations:

Area (in acres)	number of samples
Up to 10	10
11 – 40	1 per acre
41 – 80	20 + 0.5 (area in acres)
81 – 200	40 + 0.25(area in acres)
	200 + Use sample size formulas

Be sure to include an introductory paragraph stating the purpose of the field work, weather experienced, all equipment used, methods employed, etc. Conclude with a paragraph restating your findings and any other observations made. Submit individual reports to the *Collect It* space for the class by 11:45 PM, one week hence.

For more general understanding of how estimates are derived from sampling units, read Chpt. 11 in Husch, et al. 2003. Forest Mensuration, John Wiley & Sons, Inc., New York.