Lab Two – Forest Management: Effects of Thinning on Stand Structure

PURPOSE: The purpose of this lab is to investigate how forest management practices, such as thinning, can change the structure of a forest. We will also investigate how measurements differ when using point sampling in place of fixed-radius sampling.

INTRODUCTION:
In the early 1900's much of Capitol Forest (along with many other forests in western Washington!) had been logged and burned without efforts at reforestation. Much of this deforested land was acquired by the state. Today these forests are managed by the WA State Department of Natural Resources (DNR) as a "permanent endowment" for all generations of Washingtonians. Money generated from the timber on these lands is used to provide for the construction of public services such as schools, roads, hospitals, libraries, fire districts, and income for the state general fund. As steward of these forest resources, DNR attempts to ensure that, in addition to generation of revenue, that these resources are harvested sustainably and that the present generation does not benefit at the expense of future generations. DNR also functions to protect public resources such as fish and wildlife and their associated habitat, water quality and quantity, and slope stability. The forests found in Capitol Forest provide examples of the types of forests currently found in the landscape of western Oregon.

More complex forest structures help make ecological conditions more suitable to a broad array of plant and animal species. The more complex the forest structure, the more functional that it is considered as an ecological system and it can, potentially, support more species. Forests can be managed either passively or actively to achieve a complex forest. Passive management occurs when there is minimal forestry activity employed during the growth of the forest. Development of the forest occurs based solely on the stand attributes and any natural disturbances that occur on them. In contrast, active management occurs when forestry activities are employed at various stages during the development of a forest in order to accelerate growth and structural development. For example, thinning could be used to accelerate the growth of the remaining trees by freeing up space, light, and nutrients that were previously being used by neighboring trees. Forest stewards such as DNR can use active management that is based on sound forest ecology principles to develop stands that possess later-seral characteristics in younger-aged stands. For example, thinning of carefully selected areas of the forest could be used to create gaps, thus allowing for increased light penetration to the understory, and in turn allowing for increased growth of understory trees, which could then lead to a multi-layered forest at a younger age than would occur in the absence of management.

To evaluate the structure of a forest, one can measure forest attributes such as stem density, diameter distribution of stems, basal area[11], understory composition, and canopy cover. Tree measures can be calculated within fixed areas, or alternatively using point sampling. Whereas in fixed area sampling, trees are counted based on their frequency of occurrence in the landscape, with point sampling, trees are counted based on their size.

In this lab we will evaluate and compare the structure of three forests that have had different levels of management at different times in the past using both fixed area and point sampling.

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[1] If you sliced a tree off at breast height and measure the surface area of the stump, you would have the basal area of the tree. * Used to describe the amount of space in a given area that is being occupied by tree stems.

ON-SITE ACTIVITY:

We'll visit 3 Douglas-fir dominated stands within the McClane Creek Demonstration Forest: 1) a stand that was cut in 1968 and then re-planted at a density of 600 tpa, 2) a stand that naturally reseeded around 1933, was pre-commercially thinned in 1960, and was commercially thinned in 1986 (3500 bf/acre), and 3) a stand that naturally reseeded after burn/harvest around 1930 and has some evidence of recent harvest activity. At each site we'll break into groups (4-5 students per group) and examine the plant community. We will spend approximately 1 hour at each site.

At each site we will collect:

1. Qualitative information: Collect spatial information (topography), describe the community type, moisture classification, historical events that have influenced community type, and biotic features information.

2. Quantitative information:

a. Select a plot that is **representative** of the forest around you (do not use exceptionally dense or sparsely vegetated sites unless this truly represents your forest site). **Sample trees using a 8-m radius circular plot** (0.02 ha = 201 m^2) and **sample shrubs and saplings using a 1.8-m radius circular plot** (0.001 ha = 10 m^2).

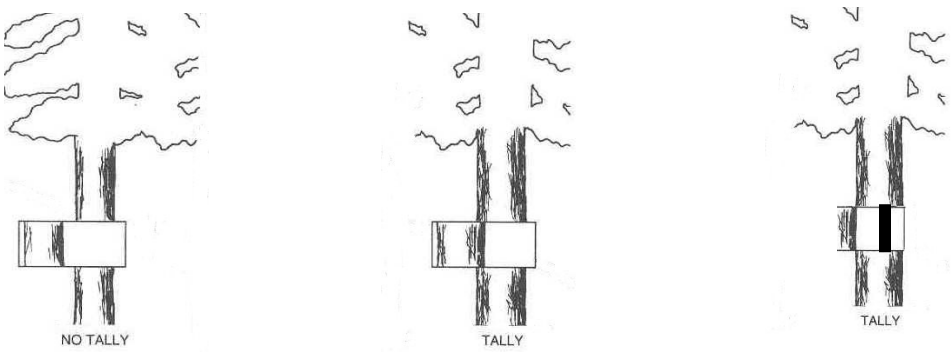
Recall that a tree = any woody plant with a single main stem that is > 4 m (about 15 ft) tall

Shrub or sapling = 1 or multiple woody stems, but $\leq$ 4 m tall.

b.

- Measure out and mark your plots (shrub plot can be within the tree plot), and identify each tree by species. If you are uncertain of species identification, collect a sample and label as Species 1, 2, etc but **be sure and identify the species before leaving your plot**! You can use the Tree and Shrub ID book to help you identify the species.
- Measure the dbh of each individual. Dbh is diameter at breast height (1.37 m above ground). Use the dbh tape to get a value for the diameter – note that it makes the conversion to diameter for you, as the numbers on it are diameter equivalents! This information will be used to calculate an estimate of basal area, and to plot a diameter distribution curve.
- Use the basal area factor (BAF) prisms to get estimates of basal area. You have two prisms – a 20 BAF and 40 BAF prism. A BAF of 20 means that you can calculate the basal area of the stand by taking the number of the trees that are counted as "in" by the prism and multiply this by the BAF to get an estimate of basal area for that stand. The prisms that we are using are 20 and 40, and these correspond to square feet per acre[2]. To calculate metric values of square meters per hectare you can substitute the multiplying by 20 and 40, with 4.592 and 9.184 respectively. There are also metric prisms, but TESC does not have any!

[2] Note also that to convert from acres to hectares: 1 ha = 2.47 acres, and thus 1 acre = 0.40 ha.



To determine whether a tree is counted by a prism, check whether it is "in" as are the middle and right trees above The tree on the left is "out" and is too small to count, so do not count it as part of your tally. *Make sure that you are holding the prism at arm's length from you. (FYI - Ideally you would select a prism that would tally 8-12 trees per stand – rather than using multiple prisms that we are doing today to examine sampling alternatives).

- Calculate an estimate of canopy cover for the plot, using the convex spherical densiometer. With the densiometer level, calculate how many of the cross-hairs are intersected by cover. Dividing this number by the total number of cross-hairs will provide an estimate of the percent canopy cover.
- Core one or two trees in each stand to try and determine the age of the dominant overstory trees, and also to see whether there is evidence of increased growth rates following release by thinning.
- For the shrub plot (1.8-m radius plots) calculate the percent cover by species for shrubs.

Post-Lab Calculations:

1.Calculate the density of trees for each of the three sites (number of individuals in each species per unit area) - use #/ha.

- Recall that if you sample an area that is 0.02 ha, then to convert that area to a full hectare you have to multiply it by 50 to get a value per hectare.

2. Plot the density of trees (per ha) as a function of their dbh
3. Calculate the basal area of the stand using the data collected in the fixed radius plot. Remember that we assume that the stem is a circle, and therefore use the area of a circle equation:

$$\text{Basal area of a single stem} = \pi * (\text{radius at breast height})^2$$

* don't forget to divide the diameter in half to get radius

To calculate the basal area of a stand, sum up the basal area for all of the trees within the fixed radius plot, and then multiply them by the conversion factor (i.e. multiply by 50 if you sampled a .02 hectare stand).

4. Calculate basal area using each of the basal area factor prism values. Recall that you just multiply your stem tally by the basal area factor to get an estimate of basal area from this point sampling method.
5. Calculate overstory cover by dividing the number of cross-hairs intersected by cover by the total number of cross-hairs possible (37), to get an estimate of cover. Then take the average of your five measurements for each stand to get an overall estimate of canopy cover for that stand.

ASSIGNMENT TO BE HANDED IN:

Write up a technical lab report summarizing the activities, sampling, and results of this exercise. Please write so someone who was not along on the laboratory would understand where you went, what you did, why you were there, and what you learned or found. Your report should be typed, double-spaced, double-sided and 3-4 pages in length. **The report is due at the beginning of your next lab period (August 10).**

Included in your report should be:

Introduction:
Describe the purpose of this lab and the sites we visited (why were we there?)

Site Description:
Describe each site that we visited and sampled. Address the following questions adding additional information as appropriate: Where is the study site? What is the dominant vegetation form? What types of over and understory vegetation did you observe? What are the major topographic characteristics of the sample site?

Methods:
Succinctly state the objectives of the lab. Describe what information you collected and how you collected it.

Results:
See required post-lab calculations described earlier in the lab. Provide estimates of stem density for each stand. Plot a graph of the stem density as a function of the stem diameter for each of the stands. How do the diameter distributions differ among the stands? Based on tree cores, did you see evidence of increased diameter growth after thinning? How did the forest structure (both overstory and understory) differ among the stands? How did basal area estimates using fixed-area sampling differ with those that were estimated using the basal area factor prisms?

Discussion & Conclusion: Do you think differences in forest structure among the stands were related to the management activities that were applied to each of them? Why or why not? Did you see any evidence of later-successional characteristics in this forest (such as gaps, multi-layered canopy, decadence)? What are your thoughts on sampling techniques based on this experience? What are some reasons you might prefer to use fixed area sampling, or instead use point sampling?

Qualitative Information

1. Spatial Information

	Site 1	Site 2	Site 3
Slope (%)			
Aspect			
Position (ridge, upper-slope, mid-slope, lower slope, bench, stream bottom)			

2. Community Type

	Site 1	Site 2	Site 3
community type*			
dominant plant species			
moisture classification**			
Known historical events***			

* tundra, grassland, field, meadow, marsh, swamp, bog, deciduous forest, coniferous forest, broad-leaf forest, scrub, shrub, woodland, savanna, desert

**moisture classification: rainy, humid, dry

***any known historical events that have influenced community type (e.g., recent burning, flooding, evidence of previous timber harvest, grazing)

3. Biotic Features

	Site 1	Site 2	Site 3
Overstory Species present in the overstory			
Mid-Canopy Species present in the mid-canopy How vigorous are they and what are causes of mortality?			
Understory What type of vegetation dominates (shrubs, grasses, herbs)? Are there areas of exposed soil? What are principle causes?			
Wildlife List any signs of wildlife activity in the area. What parts of the forest are being used by wildlife?			
Human Influences Are there signs of human activity in the area? What is the evidence?			

Overstory/Tree Data Quantitative Information SITE: _____

1. Fixed Area Sampling (8-m radius plot)

Tree #	Species	DBH (cm)	Age/Comments - measure the age of a couple of trees (core)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			

Did you see evidence of growth rate increase associated with release by thinning? Describe.

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2. Point Sampling Estimates

a. Basal Area Factor (BAF) Estimates

Prism	Number of "in" trees
20 BAF	
40 BAF	

b. Canopy Cover (using convex spherical densiometer)

Location	# cross-hairs intersecting cover
Center	
North edge	
East edge	
South edge	
West edge	

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Shrub Plot (1.8-m radius plot)

Site 1

Species	Cover (%)

Site 2

Species	Cover (%)

Site 3

Species	Cover (%)