

Name _____ Group Members (list other members of your group) _____

LAB #3: FOREST SUCCESSION: EXAMINING FOREST STRUCTURE AND COMPOSITION THROUGH TIME

Purpose:

To examine changes in community structure and composition over time so you will be better prepared to evaluate and project the past, present, and future development of an ecosystem.

Introduction:

Forests have *vertical structure* (layers of vegetation - overstory, mid-story, shrub, and herb strata), but there may be variability in how well the vertical structure is developed in different communities. In this lab, we'll use **basal area** to sample plant communities. Basal area is the horizontal area of stems (usually with the diameter recorded at dbh – diameter at breast height = 1.37 m above ground). We'll use **basal area** (although you can also use foliage cover or basal cover) to examine ecological succession.

Succession is the progressive, orderly, and somewhat predictable series of replacements of one community by another. Not only does species composition change, but structure becomes more complex, habitats for animals change, and abiotic factors alter. Often there is an increase in soil organic matter, reduction in fluctuations of temperature and humidity, and a reduction in wind and light penetration within the canopy.

A *sere* is a sequence of communities that develops by the process of ecological succession. Individual communities in a sere are called *seral stages*. We'll visit 3 seral stages in a sere and describe the community in each.

On-Site Activity:

We'll visit 3 sites in the Capitol State Forest: (1) **early seral stage** (less than 10 years old), (2) **early-mid-seral stage**, and (3) a **mid-seral stage**. None of these sites are totally "natural" - all have been manipulated by humans over time. Ideally we would visit a **late-seral** stage site as well, but these are hard to come by in close proximity to Olympia! At each site we'll break into groups and examine the plant community. We will spend approximately **45 minutes** at each site.

At each site:

1. Answer the Ecosystem Analysis Questions. Sketch a diagram of the vertical structure (basal area by vertical height layer) for Question 5.
2. Community Description: 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 overstory and midstory trees using a 500 m² circle plot** [12.6 m (41 ft) radius] and **sample shrubs (including saplings) and herbs using a 100 m² plot** [5.6 m (*ca.* 18 ft) radius]. Measure and mark your plots as in Lab 2, identify and estimate basal area for each species.

To estimate basal area of the stand you will record the dbh of all of the trees located within your plot (see more detailed instructions below):

Before leaving each site, we'll review what you've observed. (Flagging is biodegradable but it takes a while so you might want to remove your flagging.)

Assignment:

Write up a technical laboratory report summarizing the activities, sampling, and results of this laboratory exercise. Please write so that 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 (12 point font), and 2-3 pages in length. The report is due at the beginning of your lab on August 19.

Introduction:

Describe the purpose of this laboratory and the sites we visited (why were we there?).

Site Description:

Describe the sites 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 sites?

Methods:

Succinctly state the objectives of the lab. Describe what information you collected and how you collected it. Identify and briefly explain the indices used to compare the different sites. Attach your spreadsheet calculations to the back of the report to show how you calculated the indices.

Summary:

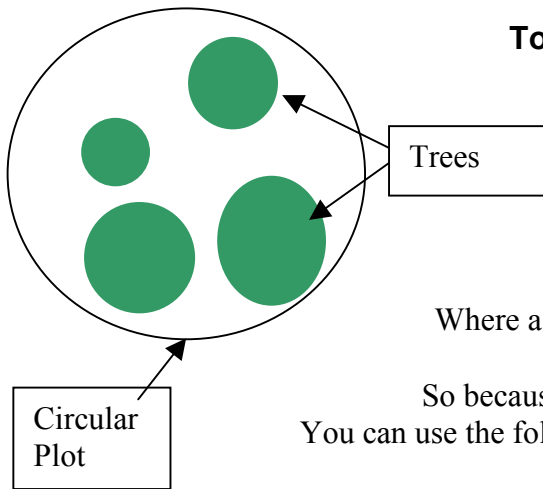
What were your results? Be sure and answer the following questions within the body of your summary:

1. Which site(s) has the greatest number of species (combine species from all layers)? For each site, which layer has the most species?
2. Which species were common to all seral stages? Which species were unique to 1 seral stage? (Answer this question for each site.) Based on these observations, which 2 sites do you think were most similar, and which 2 sites do you think were least similar? (Hint: think about percent similarity.)
3. Use the Shannon Diversity Index to calculate foliage height diversity (FHD) for each site (Use data from your group only). Each layer will be considered a "species". (Consider percent cover equivalent to number of individuals.) Compare vegetation profiles for each site (this is the diagram of vertical structure you create in question 5). Which site has the most structurally complex plant community? Why? (Hint: use data from Shannon Diversity Index and vegetation profile plots.)
4. What evidence of wildlife use did you observe at each site? Which site would you expect to have the most niches? Why?
5. Predict successional change after 50 years in each of the 3 sites (consider dominant plant species, horizontal patchiness, vertical structure, dead wood). How easy was this to do? Why or why not?

Your lab should be typed and is due at **the beginning of lab next week on August 19.**

Determining basal area:

Basal area is the horizontal area of all of the stems in a stand at dbh height (1.37 m/ 4.5 ft). Think of it as if all of the stems were sliced off 1.37 m above the ground and you could measure their radius to calculate their area. Recall that the area for a circle is: $\text{Area} = \pi r^2$ where π is pi=3.14159 and r is the radius of a circle (and the radius is ½ of the diameter).



To calculate basal area in m^2/ha of a stand (G) from a given sized circular plot you use this formula:

$$G = \frac{\pi}{40000} * \frac{\sum dbh^2}{a} = 0.0000785398 * \frac{\sum dbh^2}{a}$$

Where a is the area of the plot that you are measuring in (in hectares)

And dbh is the diameter in cm .

So because we are using a 0.05 hectare plot we would plug this in and You can use the following equation to calculate basal area in each of the layers:

$$\text{Basal Area (m}^2/\text{ha)} = G = \frac{0.0000785398 * \sum (\text{dbh} - \text{in cm})^2}{0.05 \text{ or } 0.01 \text{ (the size of our treesplots in ha)}}$$

$$\text{BA (m}^2/\text{ha} - \text{tree plot)} = G = 0.001570796 * \sum (\text{dbh})^2$$

$$\text{BA (m}^2/\text{ha} - \text{shrub plot)} = G = 0.00785398 * \sum (\text{dbh})^2$$

E.g.If in the above diagram the 4 trees were of dbh 30, 50, 60, and 70 cm dbh, and the circular plot was 0.05 ha, then you would get the following:

$$\text{BA} = 0.001570796 * [(30*30)+(50*50)+(60*60)+(70*70)] = 18.7 \text{ m}^2/\text{ha}$$

Shannon Diversity Index (H') used to calculate Foliage Height Diversity (FHD)

$$H' = - \sum p_i \ln p_i,$$

This procedure uses the same formula as for species diversity: where the proportion of basal area (p_i) for layer i is calculated by dividing the basal area for that layer (b_i) by the total basal area for all layers in the community. The proportions are then summed for the total number of layers in the community.

The units of H' are unimportant; the values of H' are used in a relative fashion, to determine which communities are more or less structurally diverse than others. ****Please Note, we are using the natural log (ln) instead of \log_{10} .**

EXAMPLE:

"Species"	<u>Community A</u>	
	<u>basal area</u>	<u>proportion (p_i)</u>
Overstory Tree	11	11/20 = 0.55
Midstory Tree	6	6/20 = 0.3
Shrub/Sapling	3	3/20 = 0.15
Total	20	

for Community A:

$$H' = -[(0.55 \ln 0.55) + (0.3 \ln 0.3) + (0.15 \ln 0.15)]$$

$$H' = -[0.55(-0.60) + 0.3(-1.20) + 0.15(-1.90)]$$

$$H' = -[-0.33-0.36-0.29] \dots \dots H' = 0.98 = \text{FHD}$$

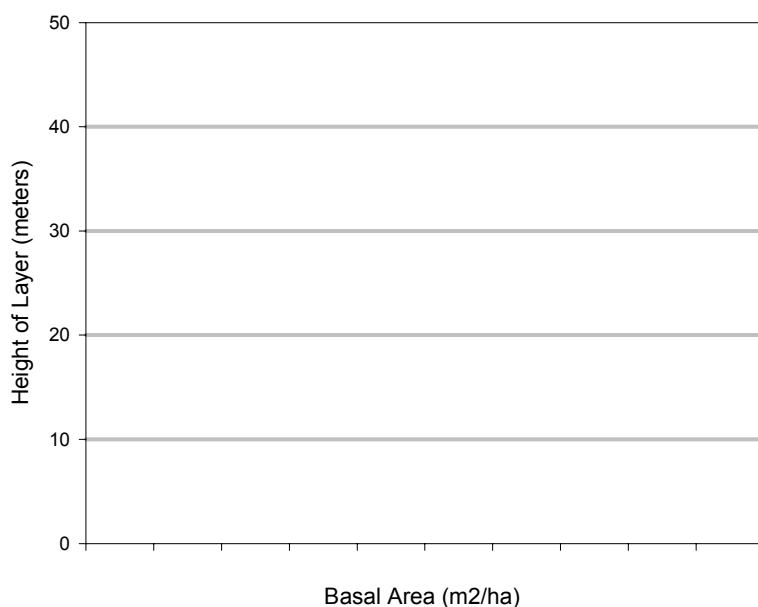
ECOSYSTEM ANALYSIS QUESTIONS

SITE: _____ NAME: _____

1.. List all (a) Symbiotic (even if you do not observe these, what relationships would you EXPECT to exist) and (b) Antagonistic Interactions

2. What is the successional stage of the site (stand initiation, stem exclusion, understory reinitiation, old-growth)? What evidence do you see that supports this successional stage?

5. Vertical Structure



Use Data p5

Community Description

6. Community structure and composition

Tree Species	DBH (cm)	Approximate Height (m)	Shrub Species	Mean DBH (cm)	Number of stems

Wildlife

Habitat Components (snags, tree crowns, grasses, etc.)

Habitat Function (cover, food, etc.)

7. Total number of tree species = _____ (tally number of species for all layers).

8. What is the percent cover of the thallophyte layer (lichens, mosses) in your plot?

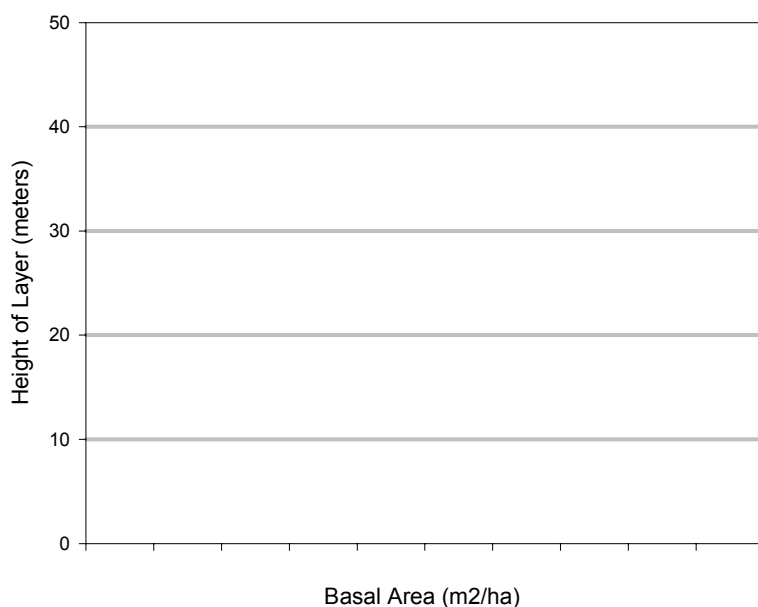
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5. Vertical Structure



Use Data p7

Community Description

6. Community structure and composition

Tree Species	DBH (cm)	Approximate Height (m)	Shrub Species	Mean DBH (cm)	Number of stems

Wildlife

Habitat Components (snags, tree crowns, grasses, etc.)

Habitat Function (cover, food, etc.)

7. Total number of tree species = _____ (tally number of species for all layers).

8. What is the percent cover of the thallophyte layer (lichens, mosses) in your plot?

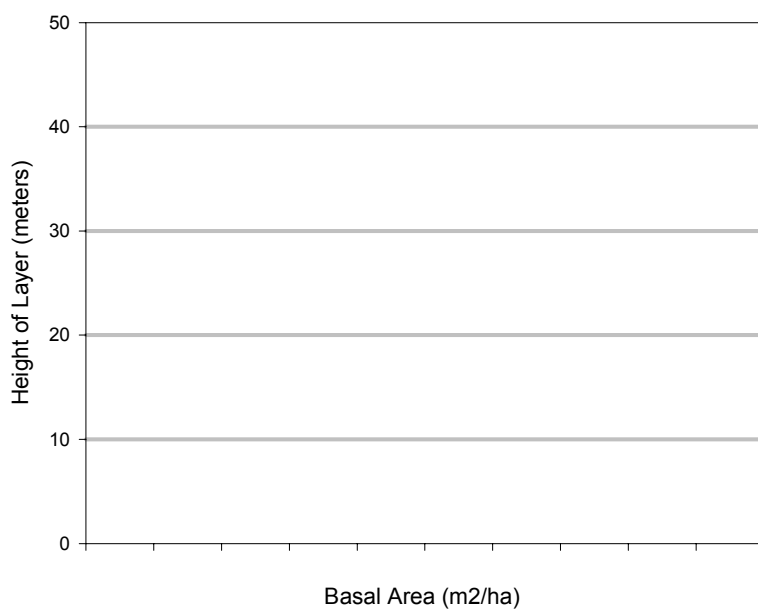
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SITE: _____ NAME: _____

1.. List all (a) Symbiotic (even if you do not observe these, what relationships would you EXPECT to exist) and (b) Antagonistic Interactions

2. What is the successional stage of the site (stand initiation, stem exclusion, understory reinitiation, old-growth)? What evidence do you see that supports this successional stage?

5. Vertical Structure



Use Data p9

Community Description

6. Community structure and composition

Tree Species	DBH (cm)	Approximate Height (m)	Shrub Species	Mean DBH (cm)	Number of stems

Wildlife

Habitat Components (snags, tree crowns, grasses, etc.)

Habitat Function (cover, food, etc.)

7. Total number of tree species = _____ (tally number of species for all layers).

8. What is the percent cover of the thallophyte layer (lichens, mosses) in your plot?