Name _____ Group Number _____

COMMUNITY DIVERSITY ON TREES+SHRUBS, NOT TREE COMMUNITY AND SHRUB COMMUNITY SEPARATELY.

LAB #1
FOREST COMPOSITION

Purpose:
To study some features of community organization by sampling and comparing biotic features (species composition and diversity) of forest communities. To consider some of the abiotic factors influencing development of forest communities.

Introduction:
Communities are naturally occurring, interacting assemblages of plant and animal populations. Adaptations of these populations to the physical environment (soil, temperature, moisture, light, nutrients) and interactions between populations (predation, competition, symbiosis) determine the structure, dominance, species diversity, and niches in a community.

Communities are often too large or complex to be completely studied in 1 visit, but some features of community structure and function can be examined relatively quickly. For example, we can look at just plants and animals inhabiting a rotting log rather than the entire forest community.

In forests, trees are the dominant vegetation. They influence microclimate, light reaching the forest floor, and soil conditions. They also provide protection, feeding, and nesting sites for animals. We will examine forest plant communities and make observations about their composition and structure, and discuss site potential as wildlife habitat. We will use measures of community structure (species diversity and richness) to examine 3 sites and a measure of community similarity to compare the sites.

Calculating species diversity requires knowledge of species richness (**number of species in a community**) and **number of individuals within each species**. A community with many equally abundant species is considered to have high species diversity. For example, in a community of 10 species with 100 individuals, maximum possible diversity would occur if there were 10 individuals in each of the 10 species. Least possible diversity would occur if there were 91 individuals of 1 species and 1 individual in each of the other 9 species. Equitability in the second example is lower because individuals are not evenly distributed among the 10 species.

High species diversity usually indicates a complex community because the greater variety of species allows more interactions among species. Population interactions involving predation, competition, and energy transfer are more complex and varied. There is not always a simple relationship between diversity and stability however.

After determining the species composition in multiple communities, you may want to see how similar or dissimilar they are. You can do this by using a community similarity index. (These indices can also be used to compare the same community at 2 different times.) Although there are several indices, we'll use the percent similarity index.

On-Site Activity:
We'll visit 3 sites within TESC campus forest: 1) a riparian zone 2) a western redcedar stand and 3) a mixed conifer – primarily Douglas-fir stand. At each site we'll break into groups 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 (biome, moisture classification, historical events that have influenced community type), biotic and abiotic 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^2 radius circular plot** (0.001 ha = 10 m^2).

Tree = any woody plant with a single main stem that is > 4 m (about 15 ft) tall
Shrub or sapling = 1 or multiple stemmed but $\leq$ 4 m tall.

Measure out and mark your plots (shrub plot can be within the tree plot), identify each species, and count number of individuals of each 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**!

b. Combine data from all groups keeping tree and shrub plot data separate. Sum the number of individuals in each plant species for the first plot (for example, the upland tree plot). Calculate density (number of individuals in each species per unit area) - use #/ha. Repeat for the other tree plot and the 2 shrub plots. You'll use these data to calculate species diversity and community similarity. Keep in mind that when you sum tree data, you're also summing the area sampled. If you sum tree data from 10 groups, for example, the total area sampled is 10 x 100 m^2 or 1000 m^2 (= 0.1 ha). Summing data from 10 shrub groups gives you a sampling size of 10 x 10 m^2 or 100 m^2. *Show your calculations.*

Before leaving each site, we'll review what you've observed.

Calculating Species Diversity and Community Similarity

1. Shannon Diversity Index (H')

$H' = - \Sigma\, p_i \log_{10} p_i$ where $p_i = n_i/N$.

P_i is the proportion of individuals for species *i*. It is calculated by dividing the total number of individuals for a species by the total number of individuals in the community.

The units of H' are unimportant; the values of H' are used in a relative fashion, to determine which species assemblages are more or less diverse than others.

EXAMPLE:

	Community A	
Species	abundance	proportion (p_i)
Douglas-fir	3	3/4 = 0.75
Western redcedar	1	1/4 = 0.25

for Community A:

H' = -[(0.75 log0.75) + (0.25 log 0.25)]
H' = -[0.75(–0.29) + 0.25(–1.39)]
H' = 0.56

	Community B	
Species	abundance	proportion (p_i)
Douglas-fir	2	2/4 = 0.50
Western redcedar	2	2/4 = 0.50

for Community B:

H' = -[(0.50 $\log_{10}$ 0.50) + (0.50 $\log_{10}$ 0.50)]
H' = -[0.50(–0.69) + 0.50(-0.69)]
H' = 0.70

In this comparison, Community B is more diverse (because it's value of H' is higher).

Measures of Evenness

The maximum Shannon-Wiener index for a given number of species can be calculated as:

$$H'_{max} = \log S$$

The minimum Shannon-Wiener index for a given data set can be calculated as:

$$H'_{min} = \log N \left(\frac{N - S + 1}{N} \right) [\log (N - S + 1)]$$

Where:

S is the number of categories or species
N is the total number of observations.

The evenness of the sample can be calculated by the following two equations:

$$J' = \frac{H'}{H'_{max}}$$

or

$$\text{Evenness} = \frac{N_1}{S}$$

2. Community Percent Similarity (PS)

Percent similarity is calculated by summing the lowest proportion of each species in 2 communities. Communities that are exactly the same will have 100% similarity. Dissimilar communities will have low percent similarity values.

EXAMPLE:

	Community A		*Community B*	
Species	abundance	proportion	abundance	proportion
Douglas-fir	5	5/7 = 0.71 = 71%	2	2/5 = 0.40 = 40%*
grand fir	1	1/7 = 0.14 = 14%*	3	3/5 = 0.60 = 60%
big-leaf maple	1	1/7 = 0.14 = 14%	0	0/5 = 0 = 0%*

* The lower of the two percentages for each species.

PS = Σ [lowest proportion or percentage for the species]
PS = 0.40 + 0.14 + 0
PS = 0.54 = 54%

Assignment:

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 (12 point font), and 2-3 pages in length. The report is due at the beginning of your next lab period (August 5).

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. Identify and briefly explain the indices used to compare the two communities. Attach your spreadsheet calculations to the back of the report to show how you calculated the indices.

Site Comparisons (Quantitative):
Discuss the results of the site comparisons, using the relative H' and PS values of each site. Include your spreadsheet or show your work on additional sheets added to the end of your report.

Address how your individual group data compared with the data from the entire class. Why might it be different? What are your thoughts on sampling techniques based on this experience?

Conclusion:
How did the diversity and similarity indices help to compare the 3 sites? What different conclusions might you have reached without the quantitative comparisons? How has disturbance shaped these forests and how will future disturbance affect the diversity of the sites, provide a brief example. Are these "healthy" forest communities?

Qualitative Information

1. Spatial Information

	Western redcedar Site	Hardwood Site	Mixed Conifer Site
Elevation (m)			
Slope (%)			
Aspect			
Position (ridge, upper-slope, mid-slope, lower slope, bench, stream bottom)			

2. Community Type

	Western redcedar Site	Hardwood Site	Mixed Conifer Site
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, timber harvest, grazing)

3. Biotic Features

	Western redcedar Site	Hardwood Site	Mixed Conifer Site
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?			

4. Abiotic Features

	Western redcedar Site	Hardwood Site	Mixed Conifer Site
Soil characteristics depth and composition of litter layer evidence of mass soil movement or surface erosion Fire Evidence of past fires? Potential for fire?			

Record any additional observations:

Quantitative Information

5. Tree Species > 4 m tall (200 m^2 plot)

Tree Plot (8m radius)	Western redcedar Site # individuals #/ha*	Hardwood Site Site # individuals #/ha	Mixed Conifer Site # individuals #/ha*
Douglas-fir			
Western redcedar			
Western hemlock			
Bigleaf maple			
Pacific yew			
Red alder			
other species:			

*A hectare (ha) is a unit of area that is 10,000 m^2

6. Shrub and Sapling Species ≤ 4 m tall (1.8m radius plot)

Shrub Plot (7.3 x 14.5 ft)	Western redcedar Site # individuals	#/ha*	Hardwood Site Site # individuals	#/ha	Mixed Conifer Site # individuals	#/ha*
Douglas-fir						
Bigleaf maple						
Oregon grape						
Salal						
Hazel						
Ocean spray						
Blackberry						
Thimbleberry						
Holly						
other species:						

GROUP DATA

Western redcedar Site	Hardwood Site Site	Mixed Conifer Site
# individuals #/ha*	# individuals #/ha	# individuals #/ha*

	Western redcedar			Hardwood			Mixed conifer		
Tree Species	1	2	3	1	2	3	1	2	3
Douglas-fir									
Western redcedar									
Western hemlock									
Bigleaf maple									
Pacific yew									
Red alder									
other species:									

GROUP DATA

	Western redcedar			Hardwood			Mixed conifer		
Shrub Species	1	2	3	1	2	3	1	2	3
Douglas-fir									
grand fir									
big-leaf maple									
hazel									
ocean spray									
cascara									
snowberry									
blackberry									
Thimbleberry holly									