VEGETATION ANALYSIS, CENTRAL TENDENCIES AND LITERATURE REVIEW
BI 311
Laboratory 02 and Homework 02

Introduction:

Knowing how to identify common plants is a very useful skill for an ecologist. Because plants are **sessile**, we use them to name groups of spatially associated organisms. These groups may be large-scale associations such as major biomes (montane forests or temperate prairie grasslands) or the groups may be small-scale biotic communities (ponderosa pine forests or short grass prairies). By comparison, it would be very difficult to name communities after mobile animal species.

Another advantage to studying plants is that they increase our understanding of how **abiotic processes** (climate or fire disturbance) or **physical structure** (topography or soil characteristics) influence the distribution and abundance of organisms. Plants are often abundant and easily accessible for short-term studies such as the field study you are required to complete.

Skills:

1. Learn how to quantify patterns in vegetation cover using field measurements such as: quadrant, line intercept, point-quarter sampling, tree cores, tree circumference, and slope measurements.
2. Practice using EXCEL to calculate descriptive statistics.
3. Practice using ENDNOTE and WEB OF SCIENCE to collect and manage literature references.

Materials:

1. Compass with slope tool
2. Tree corers
3. Half meter and one meter quadrants
4. Measuring tape
5. Access to EXCEL
6. Introductory pdf files for ENDNOTE, WEB OF SCIENCE and CSE style

EXERCISE 1- SAMPLING METHODS FOR TREES

Background:

The most dominant plants in our Rocky Mountain landscape are forests. Forests provide a wide array of ecosystem services, from food and shelter for wildlife to fiber used to build homes and supply paper. You can use tree core samples to study factors that influence the distribution patterns of trees. As you all know, tree cores can be used to age trees. When the age is compared with the size of the tree, density of neighboring trees and other habitat characteristics, it is possible to deduce factors that influence tree distribution. For example, soil moisture can greatly influence the distribution of trees. In turn, soil moisture is influenced by precipitation, soil texture, and topography. In the northern hemisphere, south facing slopes receive more solar radiation than north facing slopes. Consequently, the soils on south facing slopes are usually drier than the soils on north facing slopes. Biotic factors such as interspecific and intraspecific competition can also influence the distribution and growth patterns of individual trees.

Field Procedure:

You can use the point-quarter method to collect field data on tree age, circumference (size), species and density.
1. Randomly locate sampling points using a random number generator or random number sheet.
2. From each of your sampling points, define 4 quadrants: NW, SW, SE, NE.
3. Start in the NE quadrant and record the distance (m) from your sampling point to the nearest tree, the species of tree, and the circumference of the tree trunk (cm) at about 1 m above the ground surface. The average distance from your sampling point to the closest tree should be an inverse measurement of density (number of trees per m^2). If density is high, the distance between sampling points and the closest tree should be small and vice versa. Enter the data in the table provided below.
4. Age the tree by taking a core sample as demonstrated at the beginning of the lab. Once back in lab, enter the age in the table below.
5. Repeat steps 3 and 4 for the next 3 quadrants and then move on to your next sampling point.
6. You should repeat steps 1-5 for as many replicate samples as time allows.
7. Once back on campus, create an EXCEL data sheet that duplicates the data (and table) recorded in the field.

Sampling Point	Quadrant	Tree Species	Point-to-Plant (m)	Circumference (cm)	Tree Age (yrs)
1	NW				
1	SW				
1	SE				
1	NE				
2	NW				
2	SW				
2	SE				
2	NW				
3	NW				
3	SW				
3	SE				
3	NE				
4	NW				
4	SW				
4	SE				
4	NE				

Follow up: Using other Vegetation Analysis Tools

You can use the point-quarter method to compare different study sites to test for patterns in distribution and abundance. For example, you can compare two or more sites for differences in tree species, age, size, and density. The sites you select will depend on what factor you are interested in testing: e.g. low versus high elevation, north-slope versus south-slope, beetle kill areas versus non-beetle kill areas, etc. However, there are many plants other than trees. The following demonstrations will provide you with other tools that you may use in your field studies.
1. Demonstration of the use of 1 m quadrants (or other sized quadrants) for sampling shrubs, forbs and grasses.
2. Demonstration of the use of 0.5 m quadrants for sampling dense forbs and grasses.
3. Demonstration of the use of line-transect method.
4. Demonstration of the use of the slope scale on the compass.

EXERCISE 2- ESTIMATING CENTRAL TENDENCIES

Background:

Measures of **central tendency**, or averages, are useful measures of the middle value in a sample population. Chapter 4 of Ambrose et al. (2007) reviews the use of three common types of central tendencies, the mean, median and mode. The **arithmetic mean** (the sum of the data set divided by the number of samples) is the most commonly used average measurement because of its relationship with other descriptive and inferential statistics.

However, sometimes the mean is not the best measure of central tendency. Sometimes a few samples with extreme values (**outliers**) can bias the estimate of the mean. In such cases, the **median** (the middle value in a list of data) may be a more accurate measure of central tendency.

Sometimes neither the mean nor the median are an appropriate measure of central tendency. For example, when we have nominal data (data that describe categories rather than numbers), the mean and median are not useful. Consider if we have nominal age categories for lizards (hatchlings, juveniles and adults). Calculating the mean would not make much sense. We might still want to know which age category is most common. The **mode** is the data value (nominal or numeric) that is most common in the dataset.

We will use EXCEL to calculate the mean, median and mode.

Laboratory Procedure:

1. Mean: There are two ways to calculate a mean in EXCEL. Open your newly created EXCEL file with the tree data. At the bottom of the column "point-to-plant', select the next open data cell. From the *Formula* menu select *Insert Function* and then *Average* from the list of options followed by *OK*. In the *Function Argument* table that pops up, make sure that *Number1* has the correct data cells highlighted. It should say D2:D##, where ## depends on how many tree samples you have. If not, select the red arrow and highlight cells D2 through D##. Select *Ok* and the average will appear in the formerly blank cell. A shortcut method for calculating the same average would be: select the next open cell at the bottom of the data column and type "*=average(*". As soon as you type the open parentheses, a highlight pops up asking you which cells you want to use for your estimate. Using the cursor,

2. Median: You can calculate the median in the same way you calculated the mean except, instead of typing "*=average(*", you should type "*=median(*". Calculate the median for the data in the row below the calculations for the mean. As a rule of thumb, if the median and the mean differ by more than 3 units (m, cm and years for the 3 columns in this case), the sampling distribution of the data may not exhibit a "normal" distribution. This usually means the median is a better measure of central tendency than the mean. We will return to this issue when we calculate inferential statistics. Do the means and medians for the data differ by more than 3 units? Use yellow to highlight the cells that have means and medians that differ by more than 3 units.
3. To estimate the mode, type "*=mode(*", and then highlight the column of data you wish to use. In your EXCEL file is a species column that has names for the tree species you encountered. If we wish to know the most common tree species, we can use the mode function. What is the mode for species in your data? Type the answer at the bottom of the data.

EXERCISE 3- HOW TO SEARCH AND MANAGE SCIENTIFIC LITERATURE

Background:

  For some time, ecologists have been interested in standardizing definitions for biotic communities. This would make comparisons between studies much more feasible. There are several vegetation classification schemes that have been proposed to help classify biotic communities. Currently, there is no agreement on which scheme (or combination of schemes) should become the standard. However, in the near future (within 5 years) standard vegetation classification will be a reality.

  One popular proposal is the **U.S. National Vegetation Classification** scheme. This scheme is organized in a hierarchy similar to the taxonomic scheme we use for species groupings. Instead of kingdom, phylum, class, etc., we have system, physiognomic class, physiognomic subclass, etc. The hierarchy is split into 3 main regions: system level, physiognomic level, and floristic level. The system level simply refers to major divisions such as terrestrial, freshwater aquatic, and marine aquatic. The physiognomic level refers to physical plant features such as deciduous, coniferous, forest, shrubland, grassland, etc. The floristic level refers to specific species information such as ponderosa versus Douglas fir trees. An example of such a hierarchy follows:

Region	Level	Primary Basis for Classification	Example
System	System	Terrestrial, aquatic, or subterranean	Terrestrial
Physiognomic	Class	Growth form structure (woody, grass, herb)	Woodland
	Subclass	Growth from characters (e.g. leaf phenology)	Deciduous
	Group	General climate patterns (temperate, tropical)	Cold Temperate
	Subgroup	Relative human impact (natural, semi-natural, cultivated)	Natural
	Formation	Hydrology (flood plain, upland, etc)	Temporarily Flooded
Floristic	Alliance	Dominant species of the uppermost strata (strata = canopy, underbrush, groundcover)	*Populus deltoides* (narrow leafed cottonwood)
	Association	Additional dominant species from any strata	*Salix amygdaloides* and *Salix exigua* (two willow species)

So the complete taxonomic description for this plant association would be:

  System- Terrestrial
    Class- Woodland
      Subclass- Deciduous
        Group- Cold Temperate
          Subgroup- Natural
            Formation- Temporarily Flooded
              Alliance- *Populus deltoids*
                Association- *Salix spp*

Examples of Montana **plant alliances** can be found at the following link: http://fieldguide.mt.gov/displayES_LCLU.aspx. This site, provided by the Montana Natural Heritage Program, will provide a comprehensive review of major plant alliances in Montana and can be a useful reference for your research projects. By selecting one of the major systems (e.g. forest, alpine, grassland, etc.), you will be taken to the next level in the hierarchy that provides a list at the physiognomic level. Then select one of the floristic level options to take you a description of the plant alliance. For example, by selecting Alpine Systems and then Alpine Grassland and Shrublands, you find the Alpine Dwarf Shrubland alliance. Included are photos, general descriptions, distribution maps, management plans, and plant species lists down to the association level.

Finally, knowing how to conduct a literature search is one of the most useful skills you will need as a research scientist or as a professional in the health field. Today's electronic tools make it relatively easy to collect and manage a library of references, abstracts, annotations and an archive of important articles. ENDNOTEWEB is a free, cloud-based application that allows you to store your citations and create properly formatted bibliographies. All of you have likely completed a literature search using tools such as JSTOR, PUBMED, or ACADEMIC ONE. We have these search tools at Carroll but also have ISI-WEB OF SCIENCE. The WEB OF SCIENCE tool allows you to search all of the above search engines simultaneously, link to full-text articles, and download citations directly into your citation manager ENDNOTEWEB. You will be introduced to these tools in this assignment and will use them to create a reference bibliography to complete your homework for this week.

Laboratory Procedure:

1. Select a plant alliance that is of interest to you and that you will explore further by completing a literature review.
2. Read the instructions in the ENDNOTEWEB Quick Reference Guide (I've placed the guide on MOODLE) for creating your own ENDNOTEWEB account. It is free of expense. Feel free to read the rest of the guide about the many features found in ENDNOTEWEB. You can also connect directly to the ENDNOTE page through the following link: https://www.myendnoteweb.com/EndNoteWeb.html?func=slogout&locale=en_us&
3. Read the WEB OF SCIENCE Quick Reference Guide (also on MOODLE) for a brief introduction to conducting a literature search.
4. Select "Library" from the Carroll student website and then "Search for Databases" to arrive at a menu of database search engines. Select "Web of Science" to begin your search.
5. Conduct your search. There are many ways this can be done, such as: a) You can begin with a topic search using your selected plant alliance as a keyword, b) you can search alternative keywords that are associated with your selected alliance, or c) you can search for an author cited in the online Montana field guide. One tip: as you start finding relevant articles, search through their titles and abstracts for additional keywords/authors to use to help refine your search. Depending on your plant alliance, you may have to greatly refine your search when overwhelmed with too many citations. Note the "Refine Search" block located in the left margin of WEB OF SCIENCE. This will help you narrow your search to more relevant citations. Be sure to read the abstracts to determine whether the reference is relevant to the plant alliance of interest.
6. Once you have cataloged a list of references, use the ENDNOTEWEB tool located at the top of the WEB OF SCIENCE search page to select and send your list of references to your own library account on ENDNOTEWEB (that you created in step 2). Simply check the "select" box for the references you want to send and submit them to ENDNOTEWEB by selecting the tool button.
7. Now this is the really cool part in using ENDNOTEWEB…Visit your ENDNOTEWEB account and create a bibliography of at least 5 references by selecting the "Bibliography" option inside the "Format" tab. Complete the required information from the drop down menus by selecting the "group" of references you wish to make into a bibliography (it helps to first organize your references into a group with a unique name... such as the name of the plant alliance you are studying), then select the preferred format (we will use the CSE Style Manual N-Y), select RTF format, and then select the "Save" option to open in WORD or any other word processor/text editor. ENDNOTEWEB will create a bibliography of the selected references that will be in the CSE (Council of Science Editors) N-Y (name-year) style. To be certain, check that each citation is in the proper format by comparing it with the CSE Style Reference, I've placed on MOODLE.
8. Save your WORD file to help complete the homework for this week.
   Note: the exercise you just completed can be used to search for literature and to organize sources for any class, any thesis project, or any paper you are trying to write. Your group can use these tools to search for a paper to present to the rest of the class… starting next week for groups A and B.

HOMEWORK SUBMISSION

Each person should create a WORD file named *Homework 2*, answer the following questions, and submit their file to me via email.

1. Copy your EXCEL spreadsheet created in exercise 2 into the WORD file. Be sure you have answered the questions in exercise 2.
2. Regarding exercise 3, copy and paste your bibliography for the plant alliance you selected. Be sure you have checked the formatting.