BIOLOGY 1101
LAB 10: ECOLOGICAL SUCCESSION

READING: Please read pages 428-437 in your text book before coming to class. Pay special attention to discussions of species interactions and disturbance.

INTRODUCTION: In this lab you will explore how ecological communities change over time and how **disturbance**, such as fire or herbivory by animals, influences the composition of the plant community. Change in the composition of species within an ecological community over time in response to an environmental change is called **succession**. In this lab, you will play a board game to simulate the development of a fictitious plant community under varying environmental conditions. You will play the game several times to learn how the final community structure is influenced by frequency and types of environmental disturbances. You will then act as land managers and attempt to manage your community for one plant species picked at random from the available species.

LABORATORY OBJECTIVES:

Through playing The Floristic Relay Game, you will learn that:

1. different plants respond differently to changes in their physical environment
2. plants respond to each other
3. both physical environment and other plants are factors that can influence the way a plant community changes over time
4. random processes play an important role in plant community succession
5. all of these factors pose challenges to natural resource management of landscapes in different successional states

LEARNING OUTCOMES:

At the end of the laboratory exercise, you will be able to:

1. Diagram the changes in the imaginary plant community over time in the presence of environmental disturbances.
2. Predict the most likely outcome of plant succession in the imaginary plant community following environmental disturbances or periods of no disturbance.
3. Predict the outcome of land management strategies that increase or decrease the frequency of disturbances.

EXERCISES:

A. The Floristic Relay Game

An important and often misunderstood concept in ecology is **succession**. Succession refers to the series of changes observed in a plant community following a **disturbance** event. A disturbance event, such as a wildfire, flood, landslide or hurricane, is an event that changes **ecosystem** structure and resource availability. For an example of succession, think of a severe forest fire that kills many trees. What was once a closed canopy forest with very little light reaching the ground is now a very open and bright place. Plants and seeds that were in the shade can take advantage of the new available resources, including sunlight. The plant species that will thrive in the new, open environment may be different from those that grew under the closed forest canopy. These plants are called **early successional** plants because they thrive in recently disturbed environments. They are also called colonizers, ruderals or weeds.

Over time, as early successional plants grow, they change the environment again (by shading, or changing soil conditions), which creates opportunities for a different set of plant species. These plant species that establish after the early successional species are called **late successional** species. They are generally less tolerant of disturbance events, for example a late successional species might thrive in low light conditions. These species also often grow more slowly and live longer than early successional species and only become prevalent a while after the disturbance event. Plant communities can be thought of as going through cycles of disturbance followed by succession followed by disturbance and so on. This is not to say that these cycles, and the resulting communities, are ever identical or exactly repeatable.

In this lab, you will explore the **dynamics** of plant communities, that is, how plant communities change over time and space as a result of interactions between plants, their **biotic** (e.g., herbivores) and **abiotic** (e.g., precipitation) environment, and chance events (e.g., fire, landslides). The concepts of succession and disturbance dynamics are timely given the extent to which human-caused disturbances, such as logging and land development, are influencing global ecosystems and the extent to which natural disturbances, such as fires and floods, are actively managed by humans. Informed voters and citizens should know about disturbance and succession in plant communities. Knowledge of these processes will help them make decisions about land conservation, wildlife habitat restoration and natural resource management practices.

Materials:

- Game board
- Game pieces, 1 per plant species (total = 6)
- Disturbance event cards
- Non-disturbance event cards
- Character cards - each student takes 1 or 2 cards.
- Interaction cards.
- Handouts include the rules, worksheet and sample community diagram.

Procedure: Work in groups of 3-6. In the game, each of you will play the role of one (or two if there are less than 6 people per group) of six different imaginary plant species. The student with the most plants of his or her species in the community wins the game. As you play the game, you will learn that the six plants respond differently to the disturbances. The plants also interact with each other. Each round begins with an event card randomly drawn from a deck of cards. All the players then move across the playing board based upon that one event and the response of their given plant species. When two or more players land on the same spot, they must draw an interaction card for each pair of interacting players.

The rules handout explains how to play, step by step. The game ends when a player reaches the "Finish" square. At the end of the game, count the event cards that were played, and record the number of each event type on their worksheet. The position of the players on the playing board should also be recorded. Using the sample diagram (at end of this lab) as a guide, diagram your final plant community at the end of the game. The further a player travels on the board, the greater the number of individuals of their species that are represented in the final plant community. If any players are at the "Start Box" at the end of the game, their species has zero plants in the diagram.

1. Play the Floristic Relay Game. The first player to reach the "Finish" square wins! Play until at least 5 plants have finished.
    a. Step 1: Choose a dealer.
    b. Step 2: All players, including the dealer, choose a game piece. Place game pieces in the "Start" square.
    c. Step 3: Dealer shuffles Event Cards and places them face down in Future Events spot on the playing board. Shuffle and place the Interaction Cards face down in their spot, and deal one Character Card to each player.
    d. Step 4: The dealer draws the first Event Card and places it face up in the Current Event spot.
    e. Step 5: Each player then plays according to the Event and Character Card directions, starting with the dealer and going clockwise. You cannot leave the "Start" square until your plant responds positively to the event (moves forward).
    f. Step 6: After all players have their turn, check the board for players who landed on the same square. These players are interacting.
        i. Interactions are played in the same order as Events (clockwise starting at the dealer)
        ii. Two at a time, the interacting players draw one Interaction Card. Proceed according to the instructions on the interaction card.
        iii. Play according to the interaction card. If the same two players are still interacting, move on to a new event card. If two new players are interacting, choose another interaction card.

g. Step 7: Repeat Steps 4-6 until a player wins. Record the order of the players and the number of each type of event that occurred during the game on your worksheets. Be sure that each student completes a worksheet because this can be used to study for the lab exam.

Questions: Discuss with your group, write out answers, and prepare to discuss with whole class.

1. How would you describe the diagram produced, is it more like a forest, a grassland or a shrubland?

2. How do you think your community was influenced by fire? A landslide? Grazing? What about during no disturbance periods?

3. Which species tend to increase in abundance during times of no disturbance? What traits do they have in common?

4. How do early and late successional species differ from each other?

5. Think about your local plant communities. Which species could you identify as early and late successional species? How would the community be affected by increased fire frequency?

2. Simulating effect of managing disturbance. Next, predict the results of a game played without the Disturbance Event cards and write out a prediction (see below). Play the game again, following the directions above, but without the Disturbance events to test your prediction.
   a. What did you predict the community would look like without disturbance? Were your predictions supported by the data? Why or why not?

3. Design an experiment to solve a management dispute. Environmentalists of the group *Earth Brigade* are asking the government to ban all grazing in a National Forest. They believe that if the park manager continues to allow cattle to graze in the forest, that soon there will be no big blue stem grass in the forest. The rancher who owns the cattle that are in the forest has told the government that grazing is good for the forest. Grazing encourages the rough bentgrass to grow, and the bentgrass grass helps the big blue stem. The park manager at the National Forest has been telling his boss and others in the government, that grazing makes no difference. Who is right? What happens if we remove grazing? If the decision is made to allow grazing, how often should it happen?
   a. Design a management plan to test these ideas by adding or removing disturbance cards from the deck. Play the game to simulate the plan and diagram the resulting community.

   b. Did your management plan have the expected outcome? If it did, do you think it will always work out this way? If not why do you think it did not work? What could you change?

4. Managing for a specific species. Now pretend that you are land managers trying to promote the growth of one species. Pick a species at random from among the character cards. Now make a plan to manage for that species. Answer questions (a) and (b) and then play the game according to your plan before answering the rest of the questions.
   a. Which species are you managing for and what are its characteristics?

   b. What is your management plan (recall that some types of disturbances can be manipulated and others can't).

   c. After playing the game and diagramming your final plant community…Did your management plan work? If so, do you think it will always work this well? If not, why? What could you change?