Part II: Ecological Study of An Ozark Forest

Introduction

The forest at Drey land has not been disturbed by man for over sixty years and may represent a climax community of the Ozarks. Within the forest, environmental variations have given rise to three distinct associations of plant and animal populations. For convenience, these will be designated <u>Flood Plain</u>, <u>Lower Slope</u>, and <u>Upper Slope</u> associations.

Objectives

During our four day stay here we will be comparing these three associations in detail, specifically looking at the degree of change in abiotic and biotic factors as you progress from the creek to the top of the hill.

Our investigations will include:

1. A survey and comparison of plant communities;
2. A survey and comparison of animal communities;
3. Identification of indicator plants;
4. Identification and measurement of limiting abiotic factors;
5. Observation of adaptations of plants and animals to their abiotic environment;
6. Construction of a transect line profile and a macrohabitat analysis.

Methods

Working in teams, you will visit the three associations in the Drey land area. Your teacher will assign tasks to you during your visit to each area. You will be responsible for carrying out the tasks assigned to you and recording data and observations which will be shared with your team during evening analysis periods.

Your final report will consist of portions of this field study guide along with assigned questions and an essay to be turned in before leaving camp on the last day of your session.

Succession

Forests will go through many predictable changes. One of these may follow deforestation of an area. Vacant or newly cleared areas, if left untouched, will not remain in this condition for long. An open area will soon become a grassy open area, and soon it becomes overgrown with weeds. This type of plant life, called a pioneer community, requires little topsoil or shade. Taller weeds begin to dominate the shorter ones and as they die and decay, they create more organic soil. Shrubs move in creating shaded areas which allow seedlings to establish themselves. These initial small trees grow tall and provide shade for larger tree species to take root. These final tree species become what is called the climax community of an area. In the Drey Land area of the Ozarks, this is called a deciduous oak/hickory forest

Forest Ecology

Forests, while many and varied in specific type, have predictable structure to them. There are five vertical levels that can be seen and easily identified. They include:

A. **The Overstory or upper canopy.** This is made up of the dominant trees. They are the tallest and receive the most sunlight. They are most often shade intolerant.

B. **The Understory or lower canopy.** These may be immature trees or other shade tolerant species. Either option results in trees that grow below the dominant or overstory trees.

C. **Shrub Layer.** This level is composed of woody shrubs and seedlings.

D. **Herbaceous plants.** This level consists of smaller plants such as weeds, flowers, ferns and small herbaceous plants. These usually bloom early and grow before the trees grow leaves in order to absorb the maximum sunlight before the tree leaves block the sun.

E. **Forest Floor.** This last level includes literally the dirt and the things living there. It includes fungi, small animals which decompose and recycle nutrients, and the debris which is being decomposed.

Climax Communities

Climax communities consists of the stable tree type or types that survive best in the ecosystem. In North America alone there are many types of climax forest communities. Many of these are deciduous forests. There are many different types, but all are named by the tree types that make up the climax community. For each of these forest types, the understory and herbaceous growth are as predictable as the dominant tree types. All of these deciduous forestsare influenced by (perhaps determined by) the abiotic conditions that make up the environment. These include;

1. Hemlock - White pine forest
2. Beech - Sugar Maple forest
3. Sugar Maple - Basswood forest
4. Yellow Poplar forest
5. Oak - Chestnut forest
6. Oak - Hickory forest
7. Emory Oak - Pine forest
8. Evergreen - Blue Oak forest

**Vertical Levels in a
Deciduous Forest**

Canopy

Understory

Shrubs

Herbs

Forest Floor
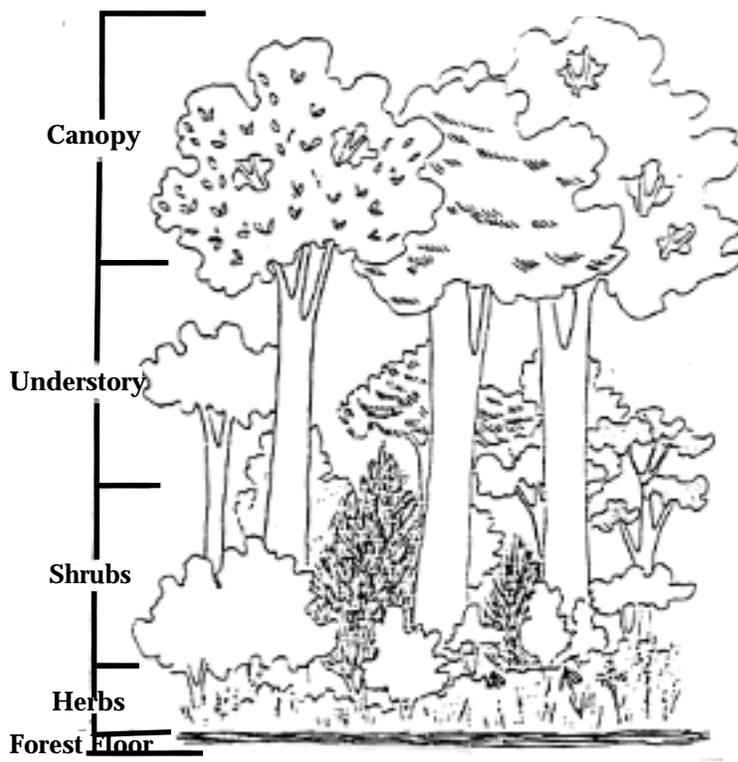
FIELD OBSERVATION AND JOURNALING AS A METHOD OF NATURE STUDY

Field study has existed since humans began to record what they saw around them. Cave paintings, sculpture, rock art and murals in and around ancient settlements depict the plants and animals that lived nearby. As civilization moved towards deeper inquiry about the natural world from a scientific view, nature study became more specialized. The explorers and mappers who journeyed from Europe beginning in the 13th century created detailed drawings, paintings and notes about the plants, animals and people they found. Today, scientists often use field notes and drawings to document endangered species, or newly discovered species. Many people also keep nature journals simply because they enjoy spending time observing the natural world and recording what they learn. Keeping a journal sharpens observation, drawing and writing skills, and allows the journaler to learn for themselves.

Drey land Field Study

You are now going to practice your own descriptive writing and drawing skills to learn about a Drey Land Ecosystem. Please use the Journaling Page provided as the last page of this forest manual.

1. Find a comfortable place to sit, where you can see well and where you will be inconspicuous to animals.

2. Spend about <u>twenty minutes</u> observing as much about your location as you can. The first part of this time should be purely <u>watching and listening</u> to what is around you. Use the questions below to help you look and learn in depth from your location.

3. Once you feel that you have spent enough time observing, you may begin to take notes and draw what you see. Use the questions below to help focus your thoughts.

4. Create a cross-sectional view of the area you have been observing. Draw as well as you can the lay of the land, the vegetation, and any important features. If you have seen animals or plants, indicate their names. It will help to start with general lines and add detail as you proceed with the drawing.

Questions to consider:

1. What kinds of plant grow here? What patterns of plant growth? Draw a plant that appeals to you.

2. Do you see any birds? What kind and how many? Describe them by color, sound or name.

3. How does it smell here? Where do the smells come from?

4. What is the air like here? Humidity? Temperature? Why do you think it feels this way?

5. Do you see any animal signs? How do the animals react to you? What animals are here that you can's see?

6. How do you feel here? Write or draw about your reaction to this place.

SURVEY OF THE PLANT COMMUNITY

Field Equipment: Transect running from east to west across the three associations. Measuring tape, dbh tape, labeling tape, pruning shear, meter stick, permanent marker pen, plant presses, clipboard and data sheets.

Field Instructions: TREES
During this session you will determine and identify the dominant trees along the transect, measure and record the **diameter at breast height** (dbh at 1.5 m), and measure and record the **distance between pairs** of dominant trees. Pairs of trees will be selected at 7.6 meter (10 yard) intervals.

1. The reliability of your calculations increases with the number of trees sampled. Therefore, work quickly yet accurately.

2. Proceed with your team and equipment to the assigned intervals along your transect. You will move up slope as you collect data.

Data Procedures:
1. At the interval, select the nearest tree to the 1st interval marker that is 10 cm in diameter or greater. This is tree #1 for this interval.
2. Stand at the interval marker and face tree #1. Raise your arms out straight from your sides so that they form a line perpendicular to your line of sight (Refer to diagram).
3. Select the closest tree that is 10 cm or greater in diameter and is behind the line created by the raised arms. This is tree #2 for this interval.
4. Measure and record in the DOMINANT TREE data table (pages 6-8) the dbh of tree #1 and #2 for this interval. Use the dbh tape and take your measure of the tree diameter at a height of 1.5 m.
5. Using your guide to trees, identify the species of each tree and record. (NOTE: If you feel very uncertain about your identification, use the pruning shears to collect a small branch for later identification. Label the branch with its interval letter and its number, ex. B-#2. Place the branch in the plant press. In addition, place labeling tape around the diameter of the questionable tree and label with your initials.)
6. Measure the distance in meters between the centers of the pair of trees and record in the DOMINANT TREES data table.
7. Gather up your equipment and move up slope to the next interval marker and repeat steps "a" to "g" for each assigned interval.
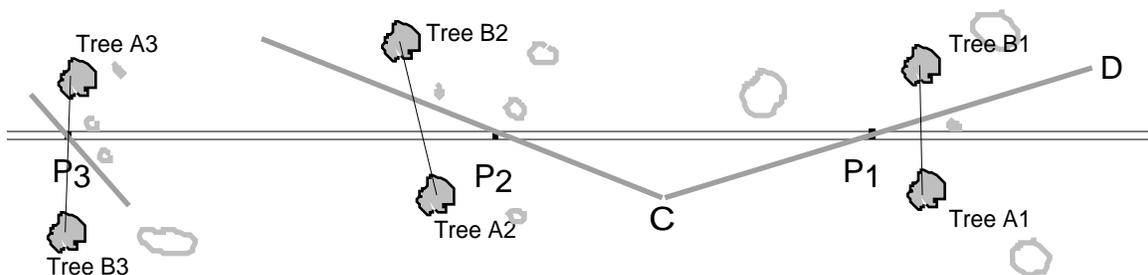
Data Table: Dominant Trees

Interval		Species (or Label)	dbh (m)	Distance between trees (m)	Basal Area (pi * r^2)
A	Tree 1 Tree 2				
B	Tree 1 Tree 2				
C	Tree 1 Tree 2				
D	Tree 1 Tree 2				
E	Tree 1 Tree 2				
F	Tree 1 Tree 2				
G	Tree 1 Tree 2				
H	Tree 1 Tree 2				
I	Tree 1 Tree 2				
J	Tree 1 Tree 2				
K	Tree 1 Tree 2				
L	Tree 1 Tree 2				
M	Tree 1 Tree 2				
N	Tree 1 Tree 2				
O	Tree 1 Tree 2				
P	Tree 1 Tree 2				

Data Table: Dominant Trees (Continued)

Interval		Species (or Label)	dbh (m)	Distance between trees (m)	Basal Area (pi * r²)
Q	Tree 1 Tree 2				
R	Tree 1 Tree 2				
S	Tree 1 Tree 2				
T	Tree 1 Tree 2				
U	Tree 1 Tree 2				
V	Tree 1 Tree 2				
W	Tree 1 Tree 2				
X	Tree 1 Tree 2				
Y	Tree 1 Tree 2				
Z	Tree 1 Tree 2				
AA	Tree 1 Tree 2				
BB	Tree 1 Tree 2				
CC	Tree 1 Tree 2				
DD	Tree 1 Tree 2				
EE	Tree 1 Tree 2				
FF	Tree 1 Tree 2				

Data Table: Dominant Trees (Continued)

Interval		Species (or Label)	dbh (m)	Distance between trees (m)	Basal Area (pi * r²)
GG	Tree 1 Tree 2				
HH	Tree 1 Tree 2				
II	Tree 1 Tree 2				
JJ	Tree 1 Tree 2				
KK	Tree 1 Tree 2				
LL	Tree 1 Tree 2				
MM	Tree 1 Tree 2				
NN	Tree 1 Tree 2				
OO	Tree 1 Tree 2				
PP	Tree 1 Tree 2				

**Techniques, diagrams and data tables have been used from two sources.

(1) Jackson, Jim *Ecology of Missouri Forests*, Missouri department of Conservation, 1984, pg. 16-21.
(2) Brower, James *Field and Laboratory Methods for General Ecology*, Wm. C. Brown Publishers, 1990, pg. 87-92.

Field Instructions: Seedlings and Saplings

Definitions:

1. Seedlings are trees that are <u>less than 1 meter</u> in height.

2. Saplings are trees that are <u>greater than 1 meter</u> in height AND have a <u>dbh less than 10 cm.</u>

      You have already determined the species and number of trees in the forest along the transect. You will now count the number of seedlings and saplings along the transect and determine their species.

      You have been assigned intervals along the transect within your assigned association. Move to the first interval. Record its letter in your data table entitled **Saplings and Seedlings: Individual Group**. Follow the data gathering procedures for each of your intervals.

1. Move along the interval's transect line counting how many of each seedling species touch or overhang the transect line. Determine the species type of each seedling. Record the species type and its number in the Seedlings and Saplings Data Table on the next page.

2. Move back along the same interval's transect line counting how many of each sapling species touch or overhang the transect line. Determine the species type of each sapling. Record the species type and its number in the Seedlings and Saplings Data Table on the next page.

3. If the species cannot be determined in the field, take a small sample that includes both the leaf and the branch and bring it back for later identification.

Data Table: Seedlings and Saplings
Individual Group

Association: _____

Transect Interval Letter _____		
Species or Label	**# of Saplings**	**# of Seedlings**

Transect Interval Letter _____		
Species or Label	**# of Saplings**	**# of Seedlings**

Transect Interval Letter _____		
Species or Label	**# of Saplings**	**# of Seedlings**

Data Table: Seedlings and Saplings
Session Totals

Association: **Flood Plain**	# of Intervals Sampled _____	
Species or Label	# of Saplings	# of Seedlings
TOTALS		

Association: **Lower Slope**	# of Intervals Sampled _____	
Species or Label	# of Saplings	# of Seedlings
TOTALS		

Association: **Upper Slope**	# of Intervals Sampled _____	
Species or Label	# of Saplings	# of Seedlings
TOTALS		

Field Instructions: Non-Woody Plants: Shrubs, Vines and Ground Cover.

Non-woody plants include all the soft stemmed grasses and broad leaf weeds. This includes the following subgroups.

1. **Shrubs** are those plants with woody stems but which usually are small and consist of many stems growing together from the ground.

2. **Vines** are plants with flexible stems which are supported by climbing, twining, or creeping along a surface.

3. **Grasses** are those plants that characteristically have a single narrow slender leaf and a hollow stem.

4. **Ferns** are plants having fronds with divided leaflets which reproduce with spores.

5. **Mosses and lichens** are two examples of small flat plants which do not act to shade any other layers of plants beneath them.

6. **Not** part of this group of living plants, but equally important for the forest ecosystem is **Litter** which consists of dead leaves, pine needles, branches, and other plant and animal remains covering the ground.

Use the diagram below as a guide to both terms and basic design.
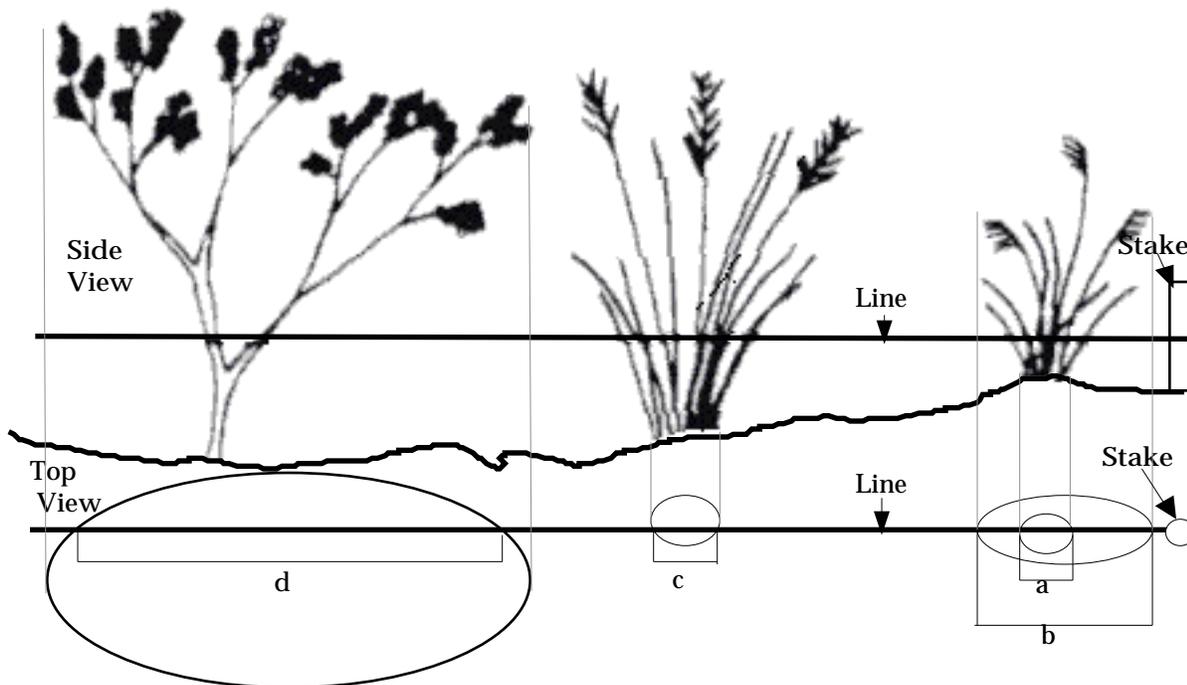
This diagram shows you two types of **intercept lengths**:

1. **Basal intercept** measures the distance across the base of the plant at the level of the ground. This is the distance that actually meets the ground (see above: examples a and c).

2. **Aerial intercept** measures the foliage of the plants. This is the distance across the fullest part of the plant where it intersects the transect (see above: examples b and d).

Field Instructions: Non-Woody Plants: Shrubs, Vines and Ground Cover Continued

You are going to identify the plants in this section only by groups. These are listed on your data collection table and include: shrubs, vines, grasses, ferns, mosses & lichens. You will measure the size of the two intercepts for each type of plant, and the heights for each of these. Make all measurements in __cm__. A perpendicular look yields the best data.

1. Go to your assigned transect marker. From that marker, walk in a line perpendicular to the transect and to the right for a distance of 5 meters. Use a tape measure or meter stick to measure this distance. At this point, lay the meter stick on the ground parallel to the transect line. Your study area includes the 10 cm on both sides of the meter stick.

2. Record the number of each plant type that is found in this area around your meter stick. (Clumps of grasses should be recorded and treated as one individual count.) Measure and record the average basal intercept, average aerial intercept and the average height for the plants and record this in the Non-Woody Plants and Soil Cover Data Table on the next page.

3. Measure and record the litter __depth__ at the 50 cm mark and record the length occupied by litter and by bare ground along the meter stick. Describe the composition of the litter.

4. A quick sketch can be done on sight to record the locations and sizes of the samples in this area. These will be expanded and augmented later tonight.

5. Move the meter stick upslope one meter and repeat the data collection procedure. Continue recording until you have gathered data and "mapped" five consecutive meters.

Data Tables: Non-Woody Plants and Soil Cover
Individual Group Data

Transect Interval Letter _____ Association _____

Type of Plant **Meter #1**	Plant Count	Basal Intercept	Aerial Intercept	Average Height
Shrubs				
Vines				
Grasses				
Ferns				
Moss/Lichen	XXXXXXXX			

Bare Earth: Meter Intercept Length = _____ cm

Litter Depth = _____ cm   Litter Intercept = _____ cm
Litter Composition:

Transect Interval Letter _____ Association _____

Type of Plant **Meter #2**	Plant Count	Basal Intercept	Aerial Intercept	Average Height
Shrubs				
Vines				
Grasses				
Ferns				
Moss/Lichen	XXXXXXXX			

Bare Earth: Meter Intercept Length = _____ cm

Litter Depth = _____ cm   Litter Intercept = _____ cm
Litter Composition:

Data Tables: Non-Woody Plants and Soil Cover
Individual Group Data

Transect Interval Letter _____ Association _____

Type of Plant **Meter #3**	Plant Count	Basal Intercept	Aerial Intercept	Average Height
Shrubs				
Vines				
Grasses				
Ferns				
Moss/Lichen	XXXXXXXX			

Bare Earth: Meter Intercept Length = _____ cm

Litter Depth = _____ cm   Litter Intercept = _____ cm
Litter Composition:

Transect Interval Letter _____ Association _____

Type of Plant **Meter #4**	Plant Count	Basal Intercept	Aerial Intercept	Average Height
Shrubs				
Vines				
Grasses				
Ferns				
Moss/Lichen	XXXXXXXX			

Bare Earth: Meter Intercept Length = _____ cm

Litter Depth = _____ cm   Litter Intercept = _____ cm
Litter Composition:

Data Tables: Non-Woody Plants and Soil Cover
Individual Group Data

Transect Interval Letter _____ Association _____

Type of Plant **Meter #5**	Plant Count	Basal Intercept	Aerial Intercept	Average Height
Shrubs				
Vines				
Grasses				
Ferns				
Moss/Lichen	XXXXXXXX			

Bare Earth: Meter Intercept Length = _____ cm

Litter Depth = _____ cm   Litter Intercept = _____ cm
Litter Composition:

Data Tables: Non-Woody Plants and Soil Cover
AVERAGE Group Data

Transect Interval Letter _____ Association _____

Type of Plant **AVERAGE**	Plant Count	Basal Intercept	Aerial Intercept	Average Height
Shrubs				
Vines				
Grasses				
Ferns				
Moss/Lichen	XXXXXXXX			
TOTALS**				XX

Bare Earth: Meter Intercept Length** = _____ cm

Litter Depth** = _____ cm   Litter Intercept** = _____ cm
Litter Composition:

** These data need to be posted on your large sketches prior to hanging.

Data Tables: Non-Woody Plants and Ground Cover
Session Totals

Association: Flood Plain				
Measurement Average Values	Group A	Group B	Group C	Average Values
Plant Count				
Basal Intercept				
Aerial Intercept				
Average Height				
Bare Earth				
Litter Depth				
Litter Intercept				

Association: Lower Slope				
Measurement Average Values	Group A	Group B	Group C	Average Values
Plant Count				
Basal Intercept				
Aerial Intercept				
Average Height				
Bare Earth				
Litter Depth				
Litter Intercept				

Association: Upper Slope				
Measurement Average Values	Group A	Group B	Group C	Average Values
Plant Count				
Basal Intercept				
Aerial Intercept				
Average Height				
Bare Earth				
Litter Depth				
Litter Intercept				

Field Instructions: Community Profile

   This segment will provide instructions on how to measure heights of tall trees and to determine the slope of the land in your association and your interval.

Equipment: Hypsometer, 10 meter rope, meter stick, 10 meter cord with level attached.

Instructions:

Part I: Heights of Overstory and Understory Trees

Within each transect interval assigned to you, find the closest overstory tree and the closest understory tree to the transect line.

1. To measure the heights of these two trees, stand 10 meters away from the tree trunk. You can measure this with your 10 meter rope.

2. Hold the hypsometer vertically, 1 meter from your eyes. To do this, you must create a right angle between the meter stick resting on the bridge of your nose and the upright meter stick used to measure the height of the tree. You may need help in holding this.

3. Line up the bottom of the hypsometer with the bottom of the tree. Without moving your head, sight to the top of the tree. Read the **centimeter** number on the hypsometer where your line of sight matches the top of the tree and <u>divide this cm reading by 10</u>. This number equals the height of the tree in **meters**.

4. For trees taller than 10 meters, double the distance from the tree (20 meters) and follow the same instructions but **double** your measured tree height.

5. Record the measurements in the Community Profile Data Table on page 20.

Part II: Slope Measurement

Determine the slope of the ground below the forest at each interval assigned to your group. To do this, measure the slope at three different areas within each interval of your assigned association and average the values to get an average slope for the area. The data can be recorded below and used later for the community profile sketch.

1. Lay out a 10 meter cord down the slope of the land from the interval **end** point. One person should stand on the upper end of the slope holding the cord tightly to the ground.

2. A second person raises the lower end of the cord until it is level. This can be carefully determined by reading the carpenter's level found on the cord until the bubble in the level is approximately centered.

3. Once the rope is level, measure the distance in **centimeters** from the downslope end of the cord to the ground.

10 m cord   Level

Ground

Measure this Distance
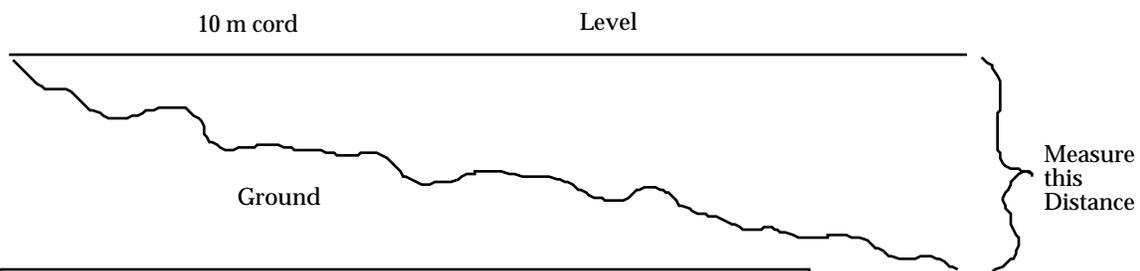
> Slope can then be calculated as:
>
> Slope = cm measured ∕ 10 meters (or "rise over run"); Units will be cm∕m .
>
> Record all data in the Community Profile Data Table (Next Page)

Information for creating your profile sketch as a group:

1. Your sketch should represent an <u>average meter</u> based on the data collected for five consecutive meters in an interval. The data for the five consecutive meters is found on pages 14-16. Your first step should be to average the data in these five tables and fill in the average data table at the bottom of page 16. Your sketch is based on <u>this</u> data table.

2. Your profile sketch should portray, **to scale**, the following features:
   • the average slope for the entire association
   • the average height, basal and aerial intercepts for each type of plant
   • the litter depth, litter intercept and bare earth intercept

3. Your profile sketch should also include:
   • the average numbers of each type of plant
   • a legend or key to the symbols you have used for each plant type
   • a title consisting of the association portrayed in your sketch
   • the names of the group members

Data Table: Community Profile Tree Heights and Slopes

Raw Data for Assigned Intervals			
Interval	**Overstory Height (m)**	**Understory Height (m)**	**Slope (cm/m)**

Data Tables: Community Profile Data Table Tree Heights and Slopes

Session Averages

Association: Flood Plain			
Interval	**Overstory Height (m)**	**Understory Height (m)**	**Slope (cm/m)**

Data Tables: Community Profile Data Table Tree Heights and Slopes
Session Averages

Association: Lower Slope			
Interval	Overstory Height (m)	Understory Height (m)	Slope (cm/m)

Association: Upper Slope			
Interval	Overstory Height (m)	Understory Height (m)	Slope (cm/m)

Field Instructions: Abiotic Environment

<u>Field Equipment</u>: Thermometer, soil thermometer, sling psychrometer, photometer, compass, distilled water, trowel, zip lock collection bags
<u>Laboratory Equipment</u>: balance, standard masses, drying pan, oven, soil test kits
<u>Instructions</u>: Make the following measurements in intervals assigned to your team.

1. **Temperature**: Allow all thermometers to equilibrate for 3 minutes. Measure air temperature at waist height in the shade and in the sunlight. Loosen the soil with a trowel and measure the soil temperature in the sun and shade by inserting the special thermometer into the soil to the depth of 5 cm. Measure the temperature of the litter in the sun and shade by placing the regular thermometer under the upper layers of the litter. Record all temperatures in Celsius.
2. **Humidity**: Using distilled water wet the wick covering the wet bulb thermometer of a sling psychrometer. Swing the instrument rapidly through the air for 3 minutes. <u>Do not break the instrument by twirling it carelessly</u>. Immediately read both thermometers; the wet bulb thermometer should read a lower temperature than the dry bulb thermometer. Convert these temperature readings to relative humidity by using the scale on the psychrometer.
3. **Light Intensity**: Stand two meters away from each flag of your assigned intervals. Hold the photometer level. Take one reading for each of the four compass headings (N,E,S,W) at each flag. Average all the numbers. Record.
4. **Soil Moisture**: Remove the litter from a 25 cm x 25 cm area of soil. Fill the zip lock collection bag with soil from the area cleared of litter. <u>Do not</u> include roots or other organic matter in the sample. Label the bag with your name and association. Return to the pavilion weigh the soil using this procedure:
    a. label an aluminum pie pan with your name and association
    b. weigh the pan. Record below.
    c. add the soil to the pan and weigh again. Record below.
    d. place the pan and soil in the oven at 250 oF. Leave it there until the evening lab.
    e. weigh the pan the dry soil together. Record below
    f. calculate the soil moisture and record on the Abiotic Data Table.

---

pan weight   = _____ g
wet wt. (wet soil + pan)   = _____ g
dry wt. (dry soil + pan)   = _____ g

Soil Moisture (%) = (wet wt. - pan wt.) - (dry wt. - pan wt.)

$$\text{Soil Moisture (\%)} = \frac{(\text{wet wt.} - \text{pan wt.}) - (\text{dry wt.} - \text{pan wt.})}{(\text{wet wt.} - \text{pan wt.})} \times 100$$

**** <u>SAVE THE DRY SOIL FOR THE NEXT TESTS</u> ****

5. **Soil Tests**: Use the soil collected and dried for the moisture computations. The soil from each of the 3 associations will be tested for sand, silt and clay content, pH, phosphorus, nitrogen, and potassium.   You will be assigned a particular test to perform. Instructions for these test are contained in the soil test kit to be used during the evening labs. Record each measurement as it is made.

Data Table: Abiotic Factors

Association	Upper Slope				Lower Slope				Flood Plain			
Group	A	B	C	Ave	A	B	C	AVE	A	B	C	Ave
Date												
Air Temp Sun oC												
Air Temp Shade oC												
Soil Temp Sun oC												
Soil Temp Shade oC												
Litter Temp Sun oC												
Litter Temp Shade oC												
Humidity (%)												
Light Intensity												
% Sand in Soil												
% Silt in Soil												
% Clay in Soil												
pH of Soil 6.0 - 6.5 optimum												
Nitrogen 20 lb./ acre minimum												
Phosphorus 40 lb./ acre minimum												
Potassium 70 lb. acre min.												
% Soil Moisture												

SURVEY OF THE ANIMAL COMMUNITY

Before one can begin to understand the dynamics of the forest ecosystem, one must know what animals live in that area. The animal life found in the forest is dependent on many factors including the types and numbers of plants available for their food and protection. It is the objective of this section of the forest study to sample the species of animals that are found in the Drey Land forest, to compare the relative sizes of the populations, and determine the habitat locations of the species that make up this interactive community of the forest.

Another of the normal tasks of the field biologist is to provide habitats for some of the indigenous species and then to care for these habitats. Some of the study groups of this session of Bio. Drey land will be responsible for building, or repairing, some of these habitats. While each group may be involved in different activities, all groups will in some way contribute to the overall data for this section and will be responsible for sharing and gathering the total set of data.

EQUIPMENT (per group): 5 capped vials, 1 beating sheet, insect keys

Field Instructions

Because animals can flee at the sounds of approaching humans, the data gathered is less exact than the data gathered for plants. However, an animal presence can be <u>assumed</u> by looking for nests, footprints, droppings, remains of food, etc. Many different methods will by used in this study to determine what animals live in the area. You may not be involved in each one of them but you will contribute to the total picture being pieced together. Following are the individual tasks to be done by the group during the Drey Land study.

Each division of the class group will be assigned to an association. Within that association you will spend **<u>10 minutes</u>** in <u>each</u> of the following activities. Use a watch to time yourself.

1. Sit silently and listen to the sounds of your association. Record in the Animal Tally Sheet on page 27 all evidence of animal life that you hear.

2. Using your beating sheet to collect insects, place the sheet under a typical tree and **shake the tree vigorously** to loosen any insects from the branches. These will fall onto the sheet and from there you can *identify and count* them. If any cannot be identified on the spot, use the insect key. You may need to capture one or two in the plastic vial to hold them while you identify them. When finished, release them into the same area. Record this data on the Animal Tally Sheet.

3. Using your beating sheet, walk through your area and sample the brushy vegetation in the same manner as you did with the trees, collecting any organisms that fall off of the plants into your beating sheet. Again, count and key, and record data on the Animal Tally Sheet.

4. Look in, on, and under the litter which is on the forest floor in your area. Identify and count any organisms that you find in this area. Record this in the data table.

5. Find a decaying log. Observe the log on its surface, underneath its surface, and below the log itself looking for and counting the organisms present. Record your results.

UPPER SLOPE DEN BOX INSTRUCTIONS

Each year, the den boxes are checked for evidence that they were occupied during the past season. The evidence that we check for is nesting materials within the box. We identify this by knocking on the boxes and listening for the sound of empty or not empty. Often these boxes need maintenance and part of your task may include fixing them or constructing new den boxes. If not, proceed with the following directions.

1. Identify the squirrel den boxes which are located in the trees throughout the study area.

2. With a ladder, climb to the den box. Tap on the box to chase out any inhabitants. This may include black snakes so be ready for anything! Carefully open the box to determine whether the box is or was lived in. Record this information in the DEN BOX DATA TABLE.

SNAKE BOARDS

Snake boards provide a protected environment for snakes and other animals. While we may not actually see these animals (they heard us coming long ago) they may have left trails, food or other indications that they have been here.

Locate the fifteen snake boards. Lift each board cautiously and be ready to observe any animal that may be present. Note the signs of habitation such as tunnels, burrows, tracks, droppings, food remains, etc. Record this data in the SNAKE BOARD DATA TABLE. When you are finished replace the boards in their original position.

WORM SAMPLING

Worms are important to the ecosystem. They not only serve as a food source for other organism, but they aerate the soil which improves living conditions for both the plants in the area and the bacteria in the soil. Worm populations can be used as an indicator for ecosystem health. In this activity we will attempt to sample a worm population and compare the numbers found on each association. The process irritates the worms causing them to come to the surface. While this may be a minor irritant, the worms are not harmed during this process. The way in which you handle them is much more important to their survival.

1. Mark off an area 1 meter by 1 meter. Record a description of the area (shape, sun: debris, environmental conditions, etc.)

2. **SLOWLY** pour one gallon of mustard solution over the area. This solution is made by adding 2 TBSP of mustard powder to 1 gallon of water.

3. Watch for 10-15 minutes for the worms to come out of the ground. You may remove any worms as they break free of the soil. Gently place them into the metal trays. These trays must be lined with wet paper towels. Measure the lengths of each. After 15 minute of collecting, total the number in your sample. Average the lengths and record.

4. Replace the worms just <u>outside</u> of your sample area. (Remember the mustard is still there!)

5. Move to another location in your association, and repeat the procedure.

Data Table: Individual Group Worm Data

Association: _____

Description: _____

Worm Length (cm)	# of Worms	Worm Length (cm)	# of Worms
1 cm		16 cm	
2 mc		17 cm	
3 cm		18 cm	
4 cm		19 cm	
5 cm		20 cm	
6 cm		21 cm	
7 cm		22 cm	
8 cm		23 cm	
9 cm		24 cm	
10 cm		25 cm	
11 cm		26 cm	
12 cm		27 cm	
13 cm		28 cm	
14 cm		29 cm	
15 cm		30 cm	

Average Number of Worms per Square Meter: _____

Data Table: Total Number of Worms by Length Category Session Results

Worm Lengths	Flood Plain	Lower Slope	Upper Slope
1 - 5 cm			
6 - 10 cm			
11 - 15 cm			
16 - 20 cm			
21 - 25 cm			
26 - 30 cm			
Total of all Length Categories			

Data Table: Animal Tally Sheet

Animal	Trophic Level	Flood Plain	Lower Slope	Upper Slope
Ants	1			
Aphids	1			
Bees	1			
Beetles	1			
Butterflies	1			
Caterpillars	1			
Crickets	1			
Gnats	1			
Inchworms	1			
Leafhoppers	1			
Moths	1			
Flies	2			
Wasps	2			
Termites	decomposers			
Mosquitoes	parasites			
Millipedes	1			
Centipedes	2			
Slugs	1			
Snails	1			

Data Table: Animal Tally Sheet

Animal	Trophic Level	Flood Plain	Lower Slope	Upper Slope
Harvestman	1			
Isopods	1			
Spiders	2			
Tick	parasite			
Squirrels	1			
Tadpoles	1			
Frogs	2			
Snakes	3			
Birds	3			
Earthworms	1			
Soil Mold/ Bacteria	decomposers			

Data Table: Squirrel Den Boxes

Den Box Number	Occupied?	Nested?	Not Nested?
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Data Table: Snake Boards

Board Number	Tunnels	Scat	Food Waste	Skins	Animals	Other
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						

CALCULATIONS FOR DOMINANT TREES
(Round all numbers to two decimal places; include units when appropriate)

1. For each association, determine the total number of trees of each species. This information was recorded in the dominant trees data table on pages 6-8. List in alphabetical order the species name and the total number of individuals observed for each species within each association in Data Table A on the next page.

2. In the data table below, calculate the **average distance** between all trees for each association. Use the Data Table: Dominant Trees on pages 6-8. For each association, sum all of the distances between trees that were recorded and divide this number by the total number of transect points samples for that association. In the second space provided, list the square of the average distance value. This is the **average area** occupied by a tree in this association.

$$\text{Average Distance} = \frac{\text{Sum all of the distances between trees}}{\text{Total number of transect points sampled for that association}}$$

$$\text{Average Area} = (\text{Average Distance})^2 \qquad \text{Density} = \frac{10{,}000}{\text{Average Area}}$$

Association	Average Distance	Average Area Occupied	Density
Flood Plain			
Lower Slope			
Upper Slope			

3. Determine the **density** of all tree species for each association by dividing the average area occupied into the size of the area sampled. In this case use a sample area of 10,000 m^2, which is one hectare. Thus, you can say that for a particular association the density of trees would be 'x' trees per hectare. (10,000 / Avg. area) Record your numbers in the table above. List below, **in order from highest to lowest**, the associations and their densities.

Order	Association	Density
Highest		
Middle		
Lowest		

Data Table A: Total Number of Trees and Average Cover

Association	Species	# of Individuals	Average Cover
Flood Plain			
	Overall Average Cover ------------>		
Lower Slope			
	Overall Average Cover ------------>		
Upper Slope			
	Overall Average Cover ------------>		

4. In the dominant trees data table (pages 6-8), calculate the the **basal area** of each recorded tree (the area of a cross section at dbh) in each association. Basal area is calculated by the taking 1/2 the diameter (the radius) of each tree, squaring this number and multiplying by π. Basal area = (dbh x .5)^2 x π. Record the basal area values in the last column of the dominant trees data table on pages 6 - 8.

> **Basal area of a tree = (dbh x .5)^2 x π.**

5. Compute the total basal area for each species in each association by totaling the basal area values for a given species within each association. Divide this number by the number of individual trees of that species in each association to calculate the **average cover** for each species. Record these values in Table A on page 32.

> **Average Cover** **=** $\dfrac{\text{Total basal area for a species}}{\text{Total number of individuals of the species}}$
> **For a Species**

6. Define the term **Average Cover**. _____

_____

7. Compute the overall averages of the **average covers** for each of the three associations. This average should be calculated by totaling <u>all</u> of the covers for an association and dividing by the <u>total</u> number of trees measured for that association.

> **Average Cover** **=** $\dfrac{\text{Total of all covers for the association}}{\text{Total number of trees for the association}}$
> **For an Association**

Association	Average Cover for the Association
Flood Plain	
Lower Slope	
Upper Slope	

8. Compare the overall averages of the average covers for the three associations. What might you infer about the maturity of the trees from these values?

9. To determine the importance of each tree species in each association we will calculate a value called the **Importance Value**. Your teacher will work through the following calculations on the computer for each species of tree and post the data in Data Table B: Tree Species and Importance Values on the following page. The final calculation will give you the importance value for each tree type.

(**NOTE**: This will be done for you on the computer, but you need to understand how the values were generated to understand the idea of Importance Value.)

Calculations for a Tree Species Importance Value

A) **Frequency** $= \dfrac{\text{\# Of transect points within the association in which a species occurs}}{\text{Total number of transect points in the association}}$

B) **Relative Frequency** $= \dfrac{\text{Frequency of a species (from A)}}{\text{Sum of frequencies of all species in the association}} \times 100$

C) **Relative Density** $= \dfrac{\text{\# Of individuals of a species in the association}}{\text{Total \# of individuals in an association}} \times 100$

D) **Density** $= \dfrac{\text{Relative density of a species (from C)}}{100} \times \text{Density of all species for this association (from question 2)}$

E) **Cover** $=$ Density of a species (from D) $\times$ Average cover for the species (from Table A)

F) **Relative cover** $= \dfrac{\text{Cover for a species (from E)}}{\text{Sum of the covers for all species within the association}} \times 100$

G) **Importance Value** $=$ Relative Frequency (**B**) + relative Density (**C**) + Relative Cover (**F**)

Data Table B: Tree Species and Importance Values

Association	Tree Species Names	Importance Values
Flood Plain		
Lower Slope		
Upper Slope		

Summary Plant Data Tables

(Referring to Data Table B Tree Species and Importance Values on the previous page, list the top three tree species for each association in <u>decreasing</u> order. If ties exist, list <u>both</u> species.)

Association	Species	Importance
Flood Plain	1. 2. 3.	1. 2. 3.
Lower Slope	1. 2. 3.	1. 2. 3.
Upper Slope	1. 2. 3.	1. 2. 3.

(Referring to the Data Table on Seedling and Saplings on page 11, list the top three tree species for each association in **decreasing** order. If ties exist, list **both** species.)

Association	Sapling Species	Total	Seedling Species	Total
Flood Plain	1. 2. 3.	1. 2. 3.	1. 2. 3.	1. 2. 3.
Lower Slope	1. 2. 3.	1. 2. 3.	1. 2. 3.	1. 2. 3.
Upper Slope	1. 2. 3.	1. 2. 3.	1. 2. 3.	1. 2. 3.

Data Analysis of the Forest Ecosystem

10. Refer to your journal entry and describe your feelings when you journaled. How have your feelings changed since completing the forest study?

11. What tree species was most numerous in the associations listed below and give the average dbh for each answer.

| | **TREE SPECIES** | **DBH** |

        A. flood plain   _____   _____

        B. lower slope   _____   _____

        C. upper slope   _____   _____

12. List the 2 most numerous species of seedlings found in each association. List the total counts for each.

Association	Most Numerous Seedling	Second Most Numerous Seedling	Total Count of Seedlings
Flood Plain			
Lower Slope			
Upper Slope			

13. List the 2 most numerous species of saplings found in each association. List the total counts for each.

Association	Most Numerous Sapling	Second Most Numerous Sapling	Total Count of Saplings
Flood Plain			
Lower Slope			
Upper Slope			

14. How many intervals were sampled in each association with respect to seedlings and saplings?
     A. upper slope _____   B. lower slope _____   C. flood plain   _____

15. Using the numbers from Q. 12 - 14, calculate the average number of seedlings and saplings per interval for each association.

	Ave. Seedlings / interval	**Ave. Saplings / interval**
A. flood plain	_____	_____
B. lower slope	_____	_____
C. upper slope	_____	_____

16. Which association showed the greatest diversity in:

mature tree species? _____

sapling species? _____

seedling species? _____

17. List the three associations in order of greatest herbaceous plant density.

_____   _____   _____

18. Which association produces the greatest depth of litter?_____

19. Which association produces the greatest litter intercept? _____

20. **Looking at the sketches** of the associations and their ground cover, which association has the greatest intercept of lichens and mosses? ... of ferns?

_____ Lichens and mosses

_____ Ferns

21. What 2 abiotic factors (check the data tables) might account for the answer to Q. 20?

_____   &   _____

22. **Looking at the sketches** of the associations and their ground cover, which one had the greatest:

Overall height? _____

Overall diversity? _____

Litter depth? _____

Litter diversity?_____

23. List the average slope values for each association:

flood plain   _____

lower slope   _____

upper slope   _____

24. Looking at the data from Q. 23, list 2 effects that this could have on the biotic conditions found in this association?

1._____

2._____

25. List the average tree heights found in each of the associations :

	Overstory	**Understory**
flood plain	_____	_____
lower slope	_____	_____
upper slope	_____	_____

26. Looking at the information in Q. 25, and the data on tree density (p.31) summarize the relationship observed.

27. Which association had the highest average air temp?_____

Give the value.   _____

28. Which association had the highest average soil temp?_____

Give the value.   _____

29. Which association had the highest average humidity?_____

Give the value.   _____

30. Which association had the highest average light intensity?_____

Give the value.   _____

31. Which association had the highest average soil moisture?_____

<div align="right">Give the value. _____</div>

32. Which association had the highest average soil pH?_____

<div align="right">Give the value. _____</div>

33. Compare the soil compositions found in each association by giving the percents:.

	Sand	**Silt**	**Clay**
flood plain	_____	_____	_____
lower slope	_____	_____	_____
upper slope	_____	_____	_____

34. Looking at the data from Q. 33, list 3 effects that this could have on the abiotic or biotic components of these associations?

1._____

2._____

3._____

35. For the following soil nutrients, list the minimum amount required, followed by the amount found for each association.   **Circle** the one value that is most likely the limiting factor for **each** association.

	Requirement	**FP**	**LS**	**US**
Nitrogen	_____	_____	_____	_____
Phosphorus	_____	_____	_____	_____
Potassium	_____	_____	_____	_____

36. Complete the food pyramid found on the next page. Be sure to read the directions carefully.

Food Pyramid

Directions: Enter the names of five producers and fifteen consumers observed in the forest at Drey land in the appropriate trophic level of the pyramid drawn below. Refer to the cumulative vertebrate and invertebrate charts posted in the pavilion. For simplicity, restrict your animals to the trophic level where they receive the **most** food. Do not list parasites or decomposers. After listing the names, give the **total** of all of the animals seen for that trophic level.

Total Number Observed

3rd Order

_____

2nd Order

_____

1st Order

_____

Producers
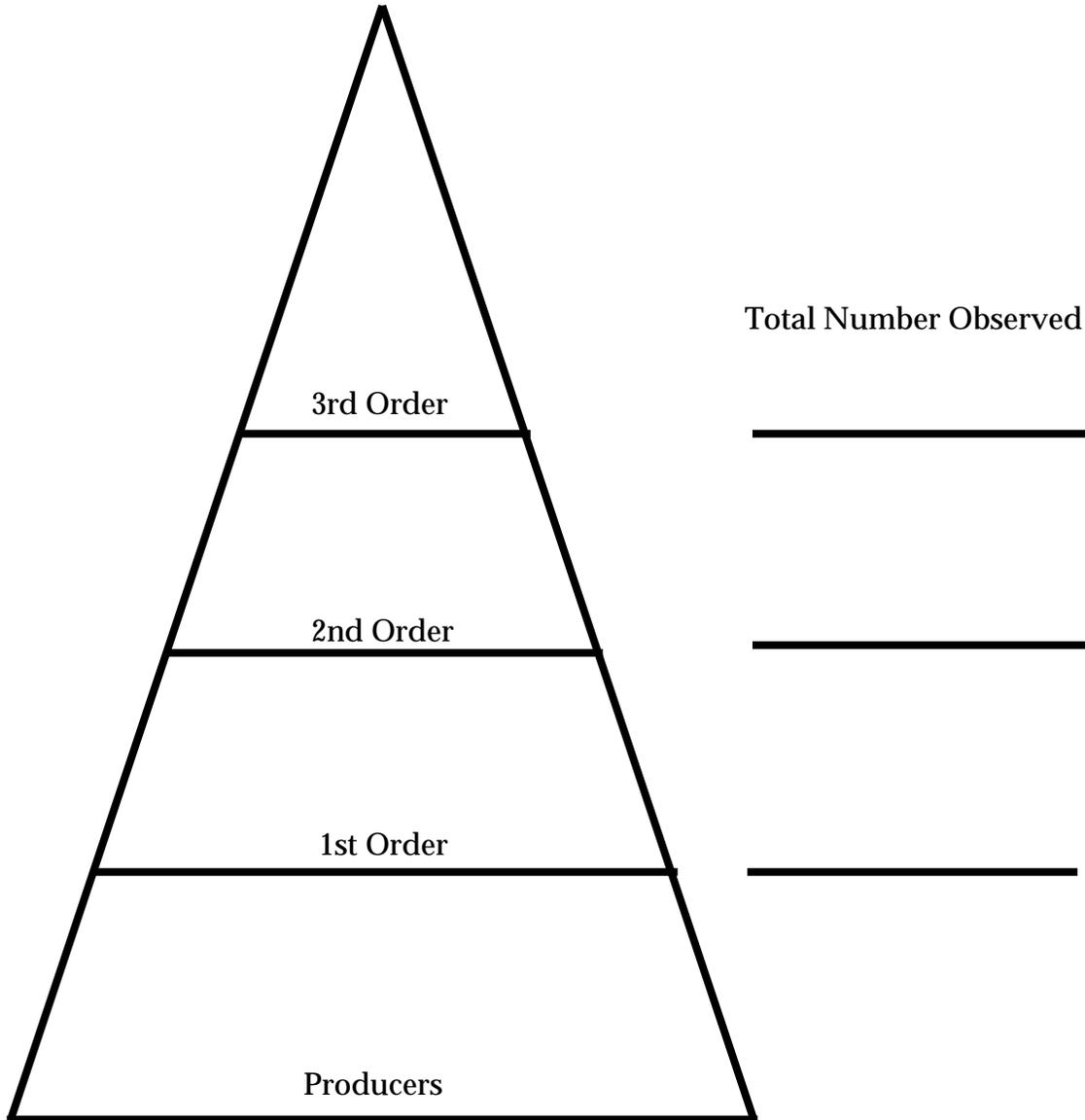
37. List the total number of animals found in each association. (Use <u>all</u> of the animal data tables.) Circle the association in which the greatest number of animals were counted.

    A. flood plain   _____

    B. lower slope   _____

    C. upper slope   _____

38. List the phyla names and numbers of individuals found for the animals observed in the forest study from most plentiful to least plentiful. (The Phyla include: Platyhelminthes, Nematoda, Annelida, Mollusca, Arthropoda, and Chordata.)

Phyla (Most to Least Plentiful)	Number Found

39. Compare your answer to Q. 38 to the animal phyla observed in the stream study. Which ecosystem shows the greatest phyla diversity?_____

40. Why can we assume that our animal samples are only random indications of types and numbers and not absolute counts of individuals living there?

41. List two biotic factors that might influence what animals live in an area and tell why they might be important.

    A._____

    _____

    B. _____

    _____

42. What was the most common indicator found to show the evidence of a snake population?_____

43. What was the most common indicator found to show the evidence of a squirrel population?_____

44. Explain in words what is meant by "Importance Value". _____

_____

_____

45. Why is importance value the best way to discuss the mature trees in a forest?

_____

_____

46. Define the term Succession. _____

_____

_____

47. Is succession evident in the Drey Land Forest? Support your answer with data.

_____

_____

_____

48. What type of mature forest is typical in Missouri?_____

49. Looking at the Summary Plant Data Table (p. 36), how is the Drey Land Forest a typical Missouri forest? How is the Drey Land Forest not a typical Missouri forest?

Concluding Forest Essay

Directions: The final requirement for the forest study is a one page essay chosen from the list below. A good scientific essay draws upon the facts and observations of the experience (the raw **data**) and uses this data to support its conclusions. Your essay should be such an essay.

1. Compare the three associations of the Drey land forest with respect to plant life. Be sure to include factors (biotic and abiotic) that influence the diversity and distributions of plants found.

2. Compare the three associations of the Drey land forest with respect to animal life. Be sure to include factors (biotic and abiotic) that influence the diversity of animal life found.

3. Compare the three associations with respect to successional development. Is there evidence of succession? Do all three associations show evidence of being at different stages in the successional sequence? What evidence from your data supports this?

4. Create a topic of your own and discuss it thoroughly. **Note:** your topic <u>must</u> be approved by your Drey land teacher before you begin!

Page for Journaling