

ECOLOGY LAB PROJECT

PURPOSE: This is where you put your biology to work and you will use the **process of science**. You will identify the various biotic and abiotic factors in a particular habitat and examine their roles and relationships in the ecosystem, experience the collection and analysis of scientific data and the production of a formal report. Such relationships are increasingly more important to homeowners as well as government and industry. You should, therefore, take this project quite seriously and learn all you can from it. As part of your conclusion, ask the question "what if?" (What if we built a house here? What if we put a parking lot here? What if we built a highway through here? What if we took out 10% of the trees for firewood? What if we cleared the ground? What if we removed all the trees of one type like the gum trees?) Your report should help to answer questions such as these.

PROJECT: Each group will be assigned a particular area. A final report must be turned in by **each** student by the due date. The data gathering and analysis is expected to be a group effort but the narrative (the actual report) must be individual work. Deficiencies in the data will be charged against the person responsible for that set of data rather than the whole group--penalties will be severe considering the time allowed to gather the data. The final report must conform to the standard scientific and biology report format and in addition, the report must contain:

1. Abstract, Introduction, Methods, Results, Conclusions, Literature Cited, and an Appendix containing:
 - a plot map
 - completed graphs and tables - sample calculations
 - lists of organisms
 - A food web using all the organisms found
 - responsibility list
2. The Methods, Results, and Discussion must be a narrative using each of the tables, drawings, calculations, and maps etc. as supportive documentation. Each piece of data in the appendix must be addressed and used in the narrative.
3. The last page should contain names of the individuals in the group and the part of the project for which each person was responsible. Also write a personal critique of each person's work, including your own.

PROCEDURE FOR LAB PROJECT

Collect the basic data with the help of your group members. Share the load! Work together by assigning or volunteering for the various collection duties. Information which must be **collected and organized includes:**

- A. identity of all trees and grid location (see <http://www.vacadsci.org/JSR/BioLab/FieldLab.htm>)
- B. heights of all trees
- C. number and type of each plant species and grid location
 - 1. vines
 - 2. ground cover
 - 3. small shrubs
- D. soil description and land slope
- E. number and type animals and grid location
 - 1. animals in trees
 - 2. animals which visit
 - 3. animals on ground
 - 4. animals in soil and grid location
- F. any additional information you find useful
(see instructor for environmental impact grid)

- 2. Discuss and share your finding with group members.

On your own and using the format given, describe your assigned area and the ecological relations which occur there. **USE YOUR DATA TO SUPPORT YOUR RELATIONSHIPS.** You *cannot* say something without supplying evidence to support your statements.

Include a discussion of what would happen if the area was disturbed by man. Select several different types of disturbances (bad storm, fire, new building project, etc.) and give specific changes and results that would occur. Moralize whether the changes would be good or bad and explain why. What would be the role of the college and community? For example--what kind of example does the college set for the community in the way it handles the disturbance? As part of your conclusion, ask the question "what if?" (What if we built a house here? What if we put a parking lot here? What if we built a highway through here? What if we took out 10% of the trees for firewood? What if we cleared the ground? What if we removed all the trees of one type like the gum trees?) Your report should help to answer questions such as these.

ECOLOGIES PROJECT FORMAT AND CONTENT

1. One inch margin, printers produced, double-spaced text, stapled in the upper left hand corner.
2. Written in your own words. The object is for you to describe and translate technical information into everyday language. Do not introduce new terms without some definition or explanation.
3. Written in proper English with no grammatical errors or spelling errors.

The content must contain and be organized in the following manner:

1. Cover page--Student name, section number in upper right hand corner
2. Abstract--200 words or less indicating what you did and what you found out.
3. Introduction--brief description of what is generally known or believed about your type of area and what you hoped to learn or discover (may be different from what you actually did).
4. Methods--brief description of what you (or group members) did and how you did it.
5. Results--description of your area and its ecology using your groups findings and your individual work with appropriate supporting tables, figures, graphs and samples.
6. Discussion--thorough analysis of one aspect of the environment you worked in. This includes relationships, numbers of organisms, growth patterns, positions in food chain, future prediction if left alone and if disturbed (along the line of an environmental impact evaluation).
7. Literature Cited--complete references for all outside sources you used listed in alphabetical order by first author. Each of these sources should have been cited in the body of your report where you used the information. Generally, any descriptive or quantitative information you did not generate is cited. In text citation is in the form of "author, date". Example-- Virginia pines usually grow to a height of 20 m (Jones, 1977).
8. Appendix--this is where you put (in order) maps, tables, figures, etc.
9. Samples: identified and unidentified organisms which you found or used should have been described in the appendix and named by a system such as A1, A6, D4, Suzi's flower. Samples of these organisms should be supplied separately for examination by your instructor.

More detailed description of the scientific format can be found at

<http://www.vacadsci.org/vjasstyle.htm>

(The VJAS length restriction does not apply here)

USEFUL FORMULAS

Area = length X width

Area of circle = πr^2

Circumference = πD ($D = 2r$)

Density = number of individuals/area sampled

Basal area = total cross sectional area at breast height

Dominance = total basal area/area sampled

Relative Dominance =
(dominance for a species/total dominance for all species) x 100

$\sin(\theta) = a/h$

$\cos(\theta) = b/h$

$\tan(\theta) = a/b$

SAMPLE DATA TABLE

STUDENT _____

DATE _____

TIME _____

DATA COLLECTION SHEET

Location _____

Weather _____

Habitat _____

Vegetation Type _____

Litter Depth _____

Drainage _____

Type of Litter _____

Depth of A Horizon _____

Air Temp. _____ Litter Temp. _____ 5 cm Temp. _____ 10 cm temp. _____

Method of collection _____

Area _____ Volume _____

Organism	Quantity	Remarks (associations, color, size, condition, etc.)
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
18.		
19.		
20.		

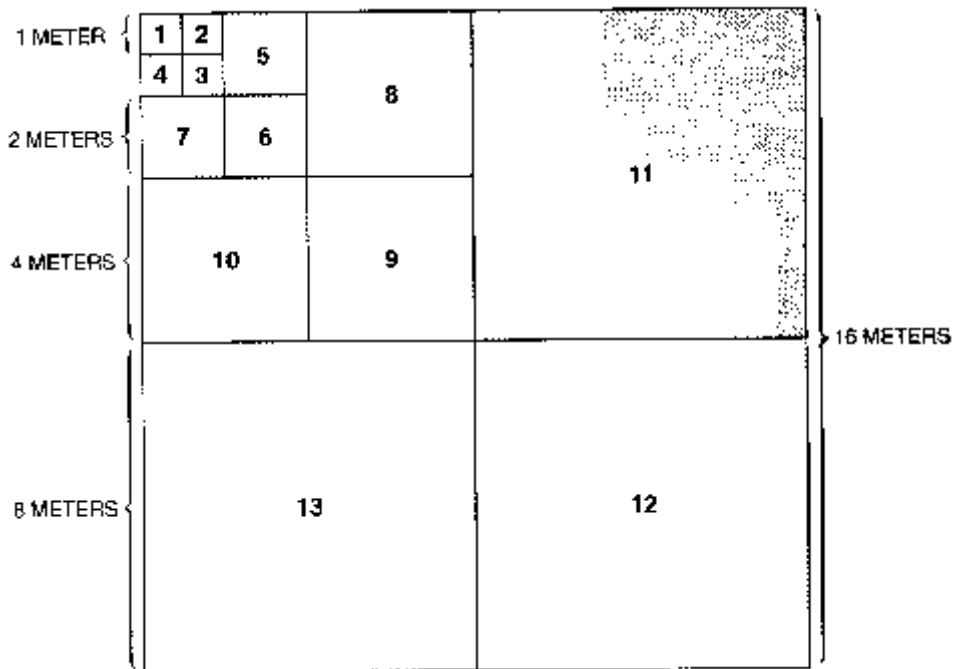
SMALL PLANT BIO DIVERSITY FIELD LAB

Systematic inventory of plots of woodlands and fields can be of practical use in planning how best to conserve wildlife in a given patch of land. These surveys show vividly how the number of species encountered in a plot varies with the amount of land inspected. They also help to provide a quantitative way to see how human activity affects local biological diversity. With such observations, conservationists, ecological planners and policymakers can estimate the smallest amount of land needed to preserve a percentage of the natural flora and fauna. Particularly useful in this regard is the relation between the diversity of woodland creatures and plants and the size of forest "islands" in an urban or suburban "sea." Such relations are technically referred to as species-area curves.

Counting plant species within a lawn or an assigned woodland plot is an instructive analogue of such quantitative methods. (Tabulating things that crawl or fly is difficult and tends to lie beyond the amateur level.) The project can be done at any level of complexity, from childlike exploration to professional analysis. Although each level poses its own important questions about conservation, the basic issue that remains is how much land is needed to sustain species diversity.

Students should work in teams of four people. Start by staking string boundaries on the plot in nested blocks. The blocks ranged

in size from a meter square up to 16 by 16 meters. We set the boundaries for the largest area first. Because the ground surface is irregular (it makes the sum of the four angles greater than 360 degrees), fudge the plot into a square by making the diagonals equal in length. Divide this large square into four equal areas and then further subdivided one corner



until the last blocks were one meter square. A tape measure and 3-4-5 right triangles come in handy.

Of course, the area may be increased, or the smallest squares subdivided, depending on the number of species that appear during the investigation. A rough criterion for the right-size area is that a middle-aged and mildly myopic biologist can walk across it and count about 12 obviously different species. Such an area will yield about 30 to 40 species on closer examination.

For familiar plant species, use the common name. A professional version of the activity would use a

technical key to the flora. For our quantitative pattern and just for fun, if you can't identify the plant, define your own "species" by differences in the leaves.

Set up a "museum" of paper on which a "curator" writes the name of each species found and tapes a specimen next to it. While two crew members set up the sampling boundaries, the other two explore the region for new species. Any specimen that shows novel features (new and not yet identified) is taken back to the museum. The investigators compared the specimen with named species and assessed its novelty in consultation with the curator. If the specimen was truly new, it was added to the collection. The discoverer has the honor of naming it. Without thinking about it, you will probably name species just as professional taxonomists do--as often for oneself or for a friend as for defining characteristics of the specimen, the habitat or related plants.

After completing the survey, add the totals in each block. Also accumulate a running count of the numbers, starting with those in the smallest square and then adding those in subsequent blocks until you

have included the entire plot. (A sample tally sheet appears in the Figure to the right) Even without technical analysis, the results provoke many interesting observations. Some species are common to nearly every

	GRID BLOCK NUMBER												
SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13
Turkeytrack grass	W	U	U	U	U	U	U	U	U	U	U	U	U
Scotts tooth grass	W	U	U	U	U	U	U	U	U	U	U		U
Little broad-leaved grass	W	U	U	U	U	U	U	U	U	U	U		U
Fat-leaved grass	W	U		U	U	U	U	U	U	U	U	U	U
White clover	W	U	U	U	U	U	U		U	U	U	U	U
Alsike clover	W	U	U	U	U		U		U	U	U	U	U
Hop clover				W			U			U			U
Yellow wood sorrel	W		U	U		U	U	U			U		U
Mouse-eared chickweed	W	U	U	U	U	U	U	U	U	U	U		U
James's 3-leaf							W			U			U
Smooth-leaved Barbara		W		U	U		U		U	U			U
Hairy Harry				W	U		U						U
Broad-leaved plantain	W	U	U	U	U	U	U	U	U	U	U	U	U
Fancy Mary	W	U			U				U		U	U	U
Dandelion	W	U	U		U	U	U	U	U	U	U	U	U
Itty-bitty					W		U						U
White ash tree								W		U			
Speedwell		W	U		U	U	U	U	U		U	U	U
Bert weed							W						U
Indian strawberry			W			U		U			U	U	U
Brown-top mushroom					W								
Petite Lisa	W				U								U
Boss moss	W	U		U	U		U			U			
Field speedwell	W												U
Fuzzy chickweed											W	U	
Scarlet pimpernel										W			U
Twin Betty												W	
Narrow-leaved plantain					W								
Mystery plant					W						U		U
Nova terra Sharon											W		
Princeton parsley											W		
Poison ivy											W		
Linda berry													W
Ernie weed											W		
TOTAL PER BLOCK	14	13	11	13	19	11	18	11	12	15	19	13	22
CUMULATIVE TOTAL	14	16	17	19	23	23	25	26	26	27	32	33	34
AREA OF BLOCK	1	1	1	1	4	4	4	16	16	16	64	64	64
CUMULATIVE AREA	1	2	3	4	8	12	16	32	48	64	128	192	256

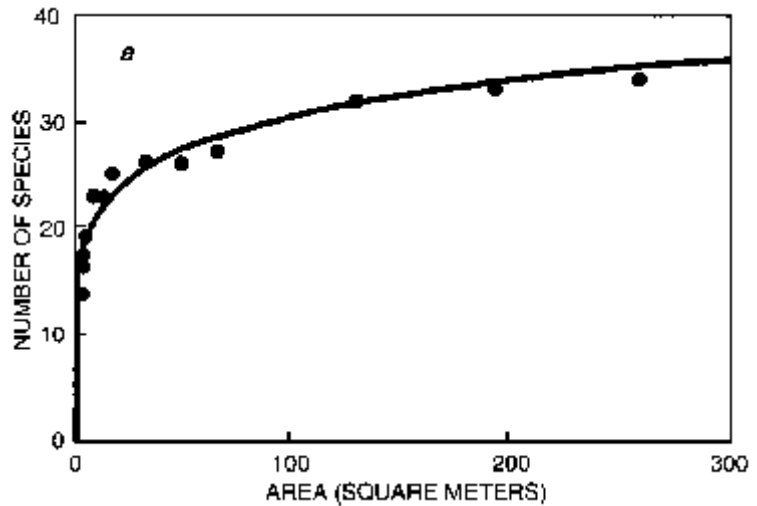
Tally sheet keeps track of the species found. Y marks denote the smallest block number in which the species was encountered. The cumulative total is the running count of the

block; others are rare. Some appear as lone or scattered individuals. Others are found in clumps of several individuals, although the clumps themselves are unique or scattered. **Is there any pattern to which species are common and widespread, which are clumped, and which are rare and scattered?**

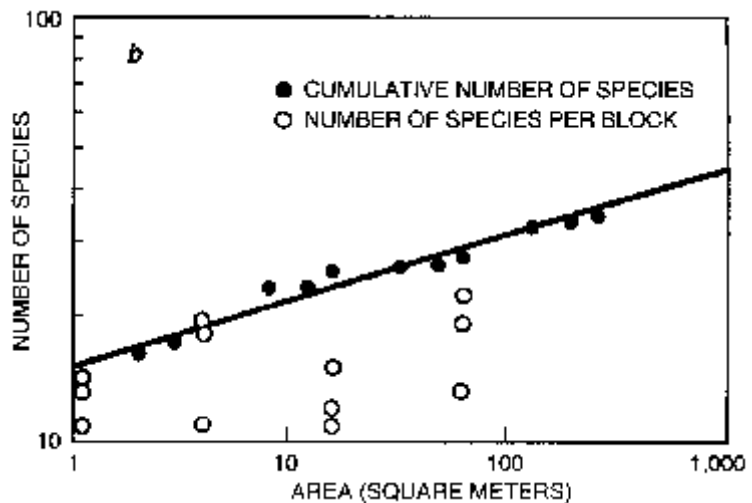
To explore for patterns, plot the number of species against the area surveyed in several ways. First, we graphed the cumulative numbers of species for each surveyed square, starting with the most subdivided corner. This cumulative curve shows that 75 percent of our species are found in areas as small as 20 square meters.

To test the quantitative pattern we found against the traditional species-area equation (*Figure b to the right*), we plotted the same data on logarithmic axes. Some of you may be wary of logarithms, but the sampling squares are already scaled by a factor of two in length, or a factor of four in area. A logarithmic scale is easy to construct for the number of species by marking fixed intervals on linear graph paper with 1, 2, 4, 8, 16 and so on. The bilogarithmic plot of our data is a straight line, which conforms to the theoretical generalization given by the species-area equation.

On the same graph, plot the surveys for each individual block. We expect the plots to show the same pattern as the cumulative data does, perhaps with a bit of variation and a slightly lower slope and species-intercept point. That is because the cumulative curve must rise continuously with increasing area. Sometimes, to our dismay, the pattern of the individual blocks is somewhat inconsistent.



Species-Area curve shows that the cumulative number of plant species encountered increases with the area surveyed.



A logarithmic graph of the data reveals a straight line which provides constants c and z . The plots of the number of species per block, in this example are inconsistent. Experimenter fatigue or lack of care in getting samples are possible reasons.

Suggest possible causes (i.e., being less than thorough in their surveys). It is possible that lapses by one group or by a few individuals are compensated by others in the cumulative data, hence explaining the consistency of those data. It is also possible, however, that we underestimated the slope of the species-area curve for our plot.

Further questions: Can our results be safely extrapolated to areas larger than those sampled? How much area would be needed to preserve 50 percent, or even 90 percent, of the regional plot species? **How would the diversity of plants in real "islands" such as lawns or a paved parking lot differ from marked-off samples of the same size in a continuous lawn or forest plot? What insights does this analysis give into the planning of urban parks, i.e., practical uses of species-area curves?**

Deriving the Species-Area Curve

For many groups of organisms, the number of species encountered increases as the area increases. A suitable relation can be expressed as

$$S = cA^z$$

where S is the total number of species observed in a surveyed area, A is the area surveyed and c and z are constants fitted to the data.

$$\log S = \log c + z \log A.$$

This equation is an empirical generalization. Many researchers are currently trying to pose theories that "predict" it. The reality of this equation can be tested, for a given region and group of organisms, by plotting surveys on logarithmic scales of both species and area to see if they conform to the generalization of a straight line. If they do, then the relation can be characterized by only two fitted parameters, c and z.

As appropriate as this equation may be, the species-area curve is often more rhetorically convincing as an argument for conservation if the number of species and area are plotted linearly. Then it is clear that efforts to find as many species as possible have diminishing returns.