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BIOE 371.00: General Ecology Lab

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ECOLOGY LABORATORY BIOLOGY 371

Fall Semester 2014



Bighorn Sheep Rams at Bison Range National Wildlife Refuge
(photo by Erick Greene)

INTRODUCTION

The purpose of this course is to give you practice in the four broad areas required to be an ecologist:

- 1) natural history and observational skills;
- 2) use of the scientific method to make and test hypotheses;
- 3) some quantitative and statistical methods used to evaluate ecological data; and
- 4) communicating with oral presentations and your writing.

Thus, these ecology labs will be an idiosyncratic mix of natural history observation, scientific method, hypothesis testing, experimental design, and statistical analyses appropriate for ecological data. A major goal of this class will be for you to gain experience communicating your results, both in written and in oral formats.

Writing Credit

Required text: *Writing Science in Plain English*, 2013, Anne Greene, University of Chicago Press.

This class constitutes 2/3 of an upper level writing (W) class, with a substantial part of your grade based on your written work. You will have the option to revise and resubmit some material to improve your writing. You will receive detailed instructions (including the evaluation criteria) for each lab write-up. One lab report and your independent research project will be written in the form of manuscripts for *Ecology*, a major scientific journal. In addition, your research group will present a 15-minute, conference-style talk to the class on your research project. You will be provided with lots of information on these later in the labs.

GRADING SCHEME

Your grade will be calculated from the following:

Individual lab write ups	50
<u>Group project</u>	
Project proposal	5
Literature search	5
Oral presentation	20
Written report	<u>20</u>
Total	100

2014 LAB SCHEDULE

Week of	Lab Activity
1 September	Introduction to labs. (Except Monday's section –go to 8 Sept lab)
8 September	Introduction to research and testing hypotheses – Lichens at Rattlesnake
15 September	Foodsheds – River Road Community Garden and Biga Pizza
22 September	Microclimate and distribution of plants on Mt Jumbo

	<u>Group Research Project Proposal due</u>
29 September	Literature searches and scientific writing
6 October	No formal lab - time for students to work on group projects
	<u>Group Research Project Literature search due</u>
13 October	Big Horn Sheep Lab
	Note: For this lab we will be hiking over hill and dale at the National Bison Range. Bring sturdy hiking boots, a backpack, suitable clothing, water, and snacks. We may not return until 7 PM, so please make arrangements for this ahead of time. I will come on all of these trips.
20 October	Matrix modeling of forest succession: Norway maples in Greenough Park
27 October	TBA
3 Nov	No labs – time for group projects
10 Nov	No labs - time for group projects
17 Nov	How to give a conference style oral presentation; help with projects
24 Nov	Thanksgiving week
1 Dec	Presentation of independent projects

Learning Outcomes for the writing part of the course

Here is how you will get experience with the following learning outcomes in this class.

1) Use writing to learn and synthesize new concepts

Throughout the semester we will work through chapters of the book ***Writing Science in Plain English***. We will focus sequentially on a small set of skills in each lab (e.g. passive versus active voice, abstract versus concrete subjects, noun strings). For each lab, you will be given feedback on that aspect of your writing. By the end of the class, we will have covered the main principles of clear science writing.

2) Formulate and express interpretations and ideas in writing

All of the labs that you write will involve synthesizing information, and conveying your ideas in writing. You will receive feedback on how you can more effectively convey your ideas.

3) Write documents that are appropriate for scientific audiences

You will learn to write manuscripts in the format for scientific journals. Your final paper will be in the format of an ***Ecology*** manuscript.

4) Revise your work based on feedback

For one of your major individual labs (big horn sheep) and the final paper, you will receive detailed feedback on your writing. You will be able to revise these papers and resubmit them.

5) Be able to find, evaluate and cite information effectively

You will have one lab devoted entirely to how to search for information. You will learn to evaluate the quality of that information, judge the impact factors of specific journals and specific publications.

6) *Use writing conventions appropriate for ecology*

The required book *Writing Science in Plain English* will help you write in the best way for a scientific audience.

7) *Use English language effectively in science writing*

The required book *Writing Science in Plain English* will help you write in the best way for a scientific audience.

Here are the main concepts and learning goals for this class. You should understand and be able to explain:

Experimental Design Lab

- what is meant by a population.
- what is meant by a sample.
- the relationship between a population and a sample.
- parameter.
- estimate.
- the relationship between a parameter and an estimate.
- sampling error.
- bias .
- random sample.
- independence of samples.
- nominal variable; ordinal variable; categorical variable.
- confounding factors.

Biostatistics lab

- the different types of variables.
- how to make bar graphs of the relative frequency for categorical variables
- how to make histograms (frequency distributions) for numerical variables.
- the basic construction rules for bar graphs and histograms.
- the difference between normal distributions and non-normal distributions.
- how to describe and calculate the following descriptive statistics for a distribution: mean, variance, and standard deviation.
- the difference between the standard deviation and the standard error.
- the meaning of α .
- Type I and Type II error.
- when it is appropriate to use parametric statistical tests
- when it is appropriate to use non-parametric statistical tests
- how and when to use a t-test.
- how and when to perform a Mann-Whitney U-test.

Thinking about food sheds

- the various food production systems and how they deliver food to us.
- the ecological implications of different food production systems.
- your own behavioral decisions as a forager.
- Pollan's arguments about the ecological consequences of our current our food production systems and why he thinks they should change.
- summarize Katherine Mangu-Ward's and the National Chicken Council's rebuttals to Pollan's position.

Microclimate and distribution of plants on Mt Jumbo

- the diversity of microenvironmental gradients on Mount Jumbo.
- the distribution of representative plants of six of the major biomes on Mount Jumbo.
- how the biomes relate to the environmental gradients.
- how climate change might influence the distribution of plant communities on Mount Jumbo.

Big Horn Sheep

- how to construct a dominance hierarchy with behavioral data.
- the mating systems of big horn sheep.
- how the polygynous mating system influences N_e .
- how the occurrence of alternative mating tactics influences N_e .
- the recommendations you would make to ensure the long-term persistence of this population of big horn sheep.

Group projects

- the skills that are required to work effectively in groups.
- the strategies that ensure good communication and participation by group members.
- the ways to give effective conference-style oral presentations.

Late Policy

Without an authorized extension, labs will lose 10% per day that they are late.

Switching Lab Sections

If you need to attend a different lab section for any reason during the semester, you need to get prior permission for this with your regular TA and the TA of the section you wish to attend.

Group Projects

Half of your grade will be based on an independent research project that you do with a team of several other students. Think of the group project as an ecology lab that you invent. The purpose of this independent project is to give you a chance to be involved in all stages of a small scientific investigation, from the identification of an interesting ecological pattern or question, formulation of hypotheses that might account for the observed patterns, appropriate experimental design, collection, analysis and interpretation of the data. We will provide you with plenty of feedback throughout the semester as you develop your projects.

Working together

Working well in groups is an essential and important skill that will be important to you after you graduate. If your group works well together, this can be an incredibly rewarding experience. If your group is dysfunctional, this is incredibly frustrating. The major source of friction usually occurs when a member of a group does not pull his or her weight. Don't be that person!! As a group you will need to negotiate how to make sure that everyone is participating fully in the project. If you have problems with this that you are having difficulty resolving, please communicate with your TA.

We will work with you to help you develop methods to ensure that your groups work together effectively. If you do not pull your weight in a group project you will lose points.

Possible Research Questions

You will initially be tempted to carve out too big a project. A good project will consist of ONE carefully defined and delimited question, a set of hypotheses that might explain this pattern, and appropriate data collected to evaluate your hypotheses. One way of coming up with a project is to think of questions that you might have had while we were doing other labs. You should pick something fairly near Missoula. Also, stick with a project for which your group has appropriate natural history expertise. For example, do not look at the effects of spotted knapweed on native plant diversity if no one in your group can identify plants. Let your TA know if you need equipment for your project. To help you get started, I have listed below some ideas that would be appropriate:

- 1) Associations between some plants and rock slides on Mount Sentinel. Some plants on Mount Sentinel seem to be found almost exclusively near rock slides. Is this association real? If it is, what may cause the association?
- 2) Species distribution and abundance in clear cuts versus burns. Are clear cuts ecologically similar to burned forests? Pick a group of organisms (e.g. lichens, beetles under rocks, ground cover, etc.) and compare the patterns of diversity in clear cuts versus burned areas. Note: If you choose this topic, it is especially important that you talk to me about experimental design. For example, you will have to pair sampling areas so that they are similar in elevation, exposure, and time since the disturbance, etc.
- 3) Biocontrol of knapweed. Several different species of Tephritid flies have been released to control spotted knapweed. It is easy to find the maggots of these flies in the seed heads of the knapweed. Does the presence of a maggot influence the number of seeds produced? Can you detect density dependence in the rates of parasitism (i.e. are there more maggots in dense clumps of Knapweed than in sparse areas)? Based on your data, do you think these species might realistically afford a viable method of biocontrol?
- 4) Ant foraging and ecology. One local species of ant (*Formica rufa*) builds a very prominent mound nest. How far from the nest do these ants forage? What do they forage on? What quantity of food does a nest harvest a day? What might be the ecological impact of these ants on the surrounding vegetation? How does weather influence the activity patterns of the ants? What is the function of the mound? **THERE ARE MANY PROJECTS IN HERE! DON'T ATTEMPT ALL OF THIS.**

These are just a few ideas to give you some ideas about the sorts of questions that would be reasonable. However, we ENCOURAGE you to come up with your own research ideas. This is a chance to use your imagination and investigate something that excites you.

Miscellaneous

- ❖ NO projects involving handling of vertebrates are allowed. This is because the permits required through the university are too difficult to get for this activity.
- ❖ Projects that involve observations or handling of any animals require that you fill out a research application through IACUC (Institutional Animal Care and Use Committee).