WBIO540 Research Design with WBIO 595 R Lab **Fall 2015**

Students must be enrolled in both the lecture and the lab

Lecture: Lisa Eby
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Office Hours: Tuesday and Thursday 10-11:30am or by appointment
R-Lab: Paul Lukacs
Office: Forestry 307, phone 243-5675, email: paul.lukacs@umontana.edu
This class will meet three times weekly MWF 11:10-12:00 and the computer lab (WILD 595) will be in Stone Hall 107 Mondays 2-4 pm (Old Journalism).

Course Objectives:

The lecture will be reviewing scientific methods, critically thinking about questions posed in research, and the approach taken to collect data to answer them. Specifically we will explore issues of scientific inference, examine classic experimental and survey design, explore designs for common wildlife and fisheries questions, and investigate quasi-experiments (impact assessments). Within this class the students will be critically reviewing literature, discussing specific design issues, and practice designing experiments and surveys.

The lab will introduce wildlife biology students to the R statistical analysis environment to enhance learning objectives of lecture. Students will be expected to learn R programming skills, R data management and R graphing functions as well an introduction to statistical analysis in R. Labs will be designed to expose students to elements of research design, including basic probability theory, basic frequentist statistical approaches, sampling design, statistical power, maximum likelihood, generalized linear models and extensions, random effects models

Materials: We have a Moodle page to exchange readings, data sets, and assignments for this class. Let us know if you have any problems using Moodle.

Grading:

Participation (10%): This is a graduate class. Therefore it will be a mix of lectures and discussions. We expect you to come with the assigned readings completed and ready to discuss the topic.
Problem sets & assignments (70%): Throughout the semester, there will be assignments in lecture and lab that will ask you to demonstrate proficiency at R, general statistical concepts, and apply issues that we discuss in class, examine outcomes of different designs, evaluate design considerations, develop sampling or experimental designs for specific problems, and critique designs.
Class project (20%): The project for both lecture and lab will focus around your graduate student project. Through a series of assignments, you will be developing the design of your project, explicitly evaluating your designs strengths, weakness and power. Your work will be presented to the class for feedback at the end of the semester.

Module 1: Scientific method and experimental designs
Key components of experimental design, ethics of ecological field experimentation, & basic designs: factorial designs, blocking, nested designs, & split plots
Module 2: Introduction to design, population survey designs and estimators
Statistical basis for inference, generalized types of designs including different approaches and estimators for sample surveys: random, stratified, systematic, adaptive sampling.
Module 3: Designs and tools for evaluating populations
Monitoring populations: tradeoff in indices, estimators, and occupancy
Demographic information: Open versus closed models, Necessary requirements for different types of information (abundance, survival, migration) and probability of detection
What can genetics tell you about populations? What are major design decisions?

Module 5: Developing monitoring programs
Tradeoffs in resolution and extent, what to monitor, discussion of optimizing designs under economic and observational constraints, trend detection, debate over surveillance monitoring, and a look at genetic monitoring.

Module 6: Habitat Selection
Habitat use versus habitat selection and basic designs in habitat selection, matching your question to your design Issues and solutions in traditional approaches

Module 7: Impact Assessment
Examination of designs for impact assessment, improving your inference strength

Module 8: Introduction to Adaptive Management and Structured Decision-Making (Mitchell)
What is adaptive management and structured decision-making? Linking science and management: doing management relevant research and linking AM/SDM into the management process.

There will be no class Monday Sept. 7th (Labor Day), Wednesday November 11th (Veteran's Day) or Wednesday-Friday November 25th through 27th (Thanksgiving). Friday December 11th is the last day of regular classes and the exam period assigned to this class is 8-10am December 17th

Assignment 1: *Contact either the editor of a journal that you read (or plan to submit to), a statistician (USFS, MFWP, UM), or a funding program leader for grants. Ask these folks (1) what is the most common problem or issue associated with field research projects for funding or publication? What is the most common flaw in studies that you see? (2) And if journal editor or funding program leader, what is most common reason for a manuscript or grant rejection? Due Sept 9th in class.*

Class Schedule:

Week 1:
M (8/31): Class goals and introductions.
W (9/2): Scientific understanding & strengthening science
Belovsky et al. 2004. Ten suggestions to strengthen the science of ecology. Bioscience 54:345-351.
F (9/4): Distorting the Process of Scientific Inquiry
Hutto R.L. 2012. Distorting the Process of Scientific Inquiry. BioScience 62 707-708.

Week 2:
M (9/7): Labor Day (Holiday)
W (9/9): Discussion Assignment 1: common mistakes to avoid and developing strong inference in research
Read two classics: Platt 1964 and Chamberlain 1965
Review: Scientific Process in Animal Ecology (Chapter 2 Williams et al.)
F (9/11): Developing research questions and plans
Wolff 2000. Reassesssing Research Approaches in the Wildlife Sciences. Wildlife Society Bulletin 28:744-750.
Developing a Research Plan (Ford Chapter 2)

Week 3:
M (9/14): Types of field studies and relationships with inference strength
Eberhardt and Thomas 1991. Designing Environmental Field Studies. Ecological Monographs 61:53-73
Johnson, D. H. 2002. The importance of replication in wildlife research. The Journal of Wildlife Management. 66:919-932.
W (9/16): Minimal requirements for experiments & pseudoreplication class discussion
Hulbert, S.H. Pseudoreplication and the design of ecological field experiments. Ecological Monographs 54:187-211.
F (9/18): Designs & linking questions to designs
Mikola et al. 2002. Studying the effects of plant species richness on ecosystem functioning: does the choice of experimental design matter? Oecologia 133:594-598.
Krebs Chapter 10

Week 4:
M (9/21): Basic ANOVA Experimental designs

Krebs Chapter 10

W (9/23): Experimental designs: Random vs Fixed Effects, Factorial designs

Krebs Chapter 10

F (9/25): Experimental designs: Blocking, split-plot, nested, and repeated measures

Krebs Chapter 10

Week 5:

M (9/28) Likelihood – Paul Lukacs, prep for likelihood lab

Section 1.3 *of chapter one of this online book*

W (9/30) Finish Experimental Designs and alternatives to statistical testing

Cottingham et al. 2005. Knowing when to draw the line: designing more informative ecological experiments. Front. Ecol Environ 3:145-152

Stephens et al. 2006. Inference in ecology and evolution. Trends in Ecology and Evolution 22:192-197.

Optional: Hobbs and Hilborn. 2006. Alternatives to statistical hypothesis testing in ecology: a guide to self-teaching. Ecological Applications: 16:5-19.

F (10/2) Fundamentals and types of survey designs: random, systematic, stratified, two-stage, cluster..

Krebs, C.J. 1999. Chapter 8: Sampling designs: random, adaptive and systematic sampling. In Krebs (ed) Ecological Methodology 2nd Edition

Week 6:

M (10/5) Fundamentals and types of survey designs: random, systematic, stratified, two-stage, cluster.

Krebs, C.J. 1999. Chapter 8: Sampling designs: random, adaptive and systematic sampling. In Krebs (ed) Ecological Methodology 2nd Edition

W (10/7) Discussion of Projects – 3 students

F (10/9) Discussion of Projects – 3-4 students

Week 7:

M (10/12): Discussion of Projects – 3-4 students

W (10/14): Discussion of Projects – 3-4 students

F (10/16): Discussion of Projects – 3 students

Week 8:

M (10/19) Finish Fundamentals and types of survey designs: random, systematic, stratified, two-stage, cluster..

Krebs, C.J. 1999. Chapter 8: Sampling designs: random, adaptive and systematic sampling. In Krebs (ed) Ecological Methodology 2nd Edition

Morrison et al. 2008. Evaluating sampling designs by computer simulation: a case study with the Missouri bladderpod. Population Ecology 50:417-425.

W (10/21) Overview of sampling strategies – distance, fixed area plot, line intersect

F (10/23) Case study examples of above _ class discussion.

Week 9:

M (10/26) Probability of detection: Indices versus estimators and approaches for solutions

Fletcher, R.J. and R.L. Hutto. 2006. Estimating detection probabilities of river birds using double surveys. The Auk 123: 695-707.

W(10/28) Solutions for detection probability: mark-recapture general designs

Lindberg and Rexstad. 2002. Capture recapture sampling designs. Encyclopedia of Envrionmetrics 1:251-262.

Mills et al. 2005. Pellet count indices compared to mark-recapture estimates for evaluating snowshoe hare density. Journal of Wildlife Management 69:1053-1062

F (10/30) Occupancy Frameworks

Rhodes et al. Optimizing presence-absence surveys for detecting population trends. The Journal of Wildlife Management 70:8-18

Bailey, L.L., J.E Hines, J.D. Nichols, and D.I. MacKenzie. 2007. Sampling design trade-offs in occupancy studies with imperfect detection: examples and software

Week 10:

M (11/2) Population Monitoring

Morrison 2007. Assessing the reliability of ecology monitoring data: power analysis and alternative approaches. Natural Areas Journal. 27:83-91.

W (11/4) Population Monitoring

Seavy and Reynolds. 2007. Is statistical power to detect trends a good assessment of population monitoring? Biological Conservation 140:187-191.

Pollock, J.F. Detecting population declines over large area with presence-absence, time-to-encounter, and count survey methods. Conservation Biology 20:882-892.

F (11/6) Population Monitoring

Case study

Week 11:

M (11/9) Do we have the correct approach towards population monitoring? Class Discussion

Nichols J.D. and B.K. Williams. 2006. Monitoring for conservation. TREE 21:668-673.

Campbell et al. 2002. An assessment of monitoring efforts in endangered species recovery plans. Ecological Applications 12:674-681.

F (11/13) The genetics toolbox: populations and population structure

Palsboll et al. 2007. Identification of management units using population genetic data. TREE: 22:11-16.

Schwartz and McKelvy. 2008. Why sampling scheme matters: the effect of sampling scheme on landscape genetic results. Conservation Genetics

Week 12

M (11/16) Impact Assessment

Skalski, J.R. 1995. Statistical considerations in the design and analysis of environmental damage assessment studies. Journal of Environmental Management 43: 67 ;

Wiens and Parker. 1995. Analyzing the effects of accidental environmental impacts: approaches and assumptions. Ecological Applications 5:1069

W (11/18) Impact Assessment complete

F (11/20) Habitat Selection Overview

Manly 2002. Chapter 1 Introduction to resource selection studies in Resource Selection by Animals.

*Boyce, M. S. 2006. Scale for Resource Selection Functions. Diversity and Distributions **12**:269-276.*

Week 13

M (11/23) Habitat Selection wrap-up

W (11/25) Thanksgiving

M (11/27): Thanksgiving

Week 14

M (11/30): Ethics in field research (Class discussion)

Farnsworth 1993. Ethics of Field Experimentation. 1993. Conservation Biology 7:463-472.

Minteer, B.A. and J.P. Collins. 2005. Why we need an "ecological ethics". Frontiers in Ecology and the Environment 3:332-337.

Vucetich, J.A. & M.P. Nelson. 2007. What are 60 warblers worth? Killing in the name of conservation. Oikos 116:1267-1278.

W (12/2) Adaptive Management and Structured Decision Making (Mike Mitchell)

Re-read Nicholas and Williams Monitoring for Conservation

Lancia et al. 1996. ARM! For the future: adaptive resource management in the Wildlife Profession. Wildlife Society Bulletin 24:436-442.

Nichols, JD, Runge, MC, Johnson FA, Williams, BK. 2007. Adaptive harvest management of North American waterfowl populations: a brief history and future propects. J. Ornithol. 148 (Suppl 2):343-349.

F (12/4) Adaptive Management and Structured Decision Making (Mike Mitchell)

Week 15

M-F (12/7, 12/9, 12/11) Wrap–up, and Student Presentations