BIOL 823 DEMOGRAPHIC METHODS - FALL 2006

BIOL 823	Hours	Room	Contact
Lectures and Labs	Tuesday/Thursday 2:30 to 4:00 pm	Ackert 324A	K-State Online
Instructor Brett K. Sandercock	By appointment	Ackert 425	PH: 532-0120 EM: *bsanderc@ksu.edu*

Schedule: Biol 823 is scheduled for Tuesday and Thursday afternoons 2:30 to 4:00 pm. Tuesdays will usually be a lecture on topics in demographic methods and Thursdays will be computer exercises. Biol 823 has no required prerequisite courses but students should have some background in population biology, having taken upper level courses in wildlife management or conservation biology.

Course description: In this course, we will explore applications of demographic methods for the conservation and management of plant and animal populations. Quantitative methods for demographic analyses are currently used in two arenas of modern ecology. Evolutionary ecologists use these methods to investigate explanations for the variation in life-history traits of organisms, whereas conservation and wildlife biologists use these tools to address management issues for populations of threatened or exploited species. Demographic methods have a steep learning curve and this course will give you training in the both the theory underlying these methods and the software tools that are used in this area of ecology.

The first half of the course will be devoted to estimation of demographic rates and their variance. I will start by introducing mark-recapture statistics, and the new models that are available in Program MARK to estimate vital rates, particularly survivorship. Starting topics will be include use of parameter index matrices and link functions to construct maximum likelihood models. Model selection will cover initial goodness-of-fit testing (GOF), likelihood ratio tests (LRT) and Akaike's Information Criterion (AIC). Mark-recapture modeling will start with classic Cormack-Jolly-Seber models and will progress to more advanced topics such as direct estimation of rates of population change and multistrata models. Methods of variance decomposition will be used to illustrate approaches for obtaining robust estimates of parameter estimates and their process variance. The second half of the course will introduce matrix models and their uses for modeling age and stage-structured populations. This part of the course will start with a refresher on conventional life-table analyses, and will then review the main tools of matrix methods including life cycle diagrams, projection matrices, pre- and postbreeding models, and age- and stage-based approaches. Algorithms of Program MATLAB will be used to estimate asymptotic properties such as the rate of population change (λ), and evaluate the elasticity and sensitivity of demographic parameters to perturbation. Advanced topics will include life-table response experiments (LTRE) and stochastic simulation modeling.

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Course objectives: Students will gain skills in the following areas:

1. Use of mark-recapture statistics to estimate mean and variance of survival and other demographic parameters.
2. Construction of mark-recapture models and the information-theory approaches to model selection.
3. Construction, parameterization and use of life tables, life cycle diagrams and Leslie-Lefkovitch matrices to calculate rates of population change (λ).
4. Use of sensitivity and elasticity analyses for conservation and management.
5. An understanding of demographic analyses and an ability to read and comprehend technical articles in ecological and conservation journals.
6. Prepare research results for dissemination as an oral presentation and as a written manuscript in the format of a scientific paper.

Expectations of Students

1. Regular attendance at classes and participation in discussions and computer exercises.
2. There is no textbook for the course. Students are expected to read the weekly readings that are posted on K-State Online. The material is likely to be challenging so do not be dismayed if the papers are difficult to absorb in your first reading. Some papers will be best digested if read in sections over the course of the term. The papers are primarily review articles but also include a few empirical papers that will be used as model datasets for class exercises.
3. Complete and submit answers to weekly problem sets. Demographic methods often involve use of unfamiliar computer software and there is no substitute for learning by trying to run the analyses yourself. The problems sets will not be graded, they are aimed at giving you an actual example to try and work through. Work in groups to solve the problems if you like but write up the problem sets independently.
4. Complete two exams on mark-recapture models and matrix population models. A majority of the questions will be multiple-choice, and formulae will be provided if necessary.
5. Complete a term research paper. Each student will prepare a 2-3 page proposal for their term research project. Proposals should include an outline of the problem, a statement of the demographic methods that will be used and the sources of data that will be obtained. The results of term research projects will be presented in two formats: as an oral presentation to the class (Dec. 7, 30 points) and as a research paper prepared in the format of a scientific paper (Dec. 12, 40 points). In their research projects, students will apply the demographic methods learned in this course to a selected topic in evolutionary ecology or conservation biology.

Breakdown of marks for the course	**Points (100 total)**
Midterm exam	20
Final exam	20
Oral presentation	30
Research paper	30

Grades will be based on the standard scale assessed as a percentage of total points possible (e.g., A = $\geq$90%, B = 80-89%, C = 70-79%, D = 60-69%, F = <60%).

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Week	Date	Topic
1	**Aug 22**	Lec. Introduction to mark-recapture statistics
	Aug 24	Lab. Managing data with Program Access, Introduction to Program Mark
2	**Aug 29**	Lec. Model selection and introduction to group, time and age-structured models
	Aug 31	Lab. Parameter index matrices in Program Mark.
3	**Sep 5**	Lec. Building models with design matrices
	Sep 7	Lab. Design matrices in Program Mark
4	**Sep 12**	Lec. Advanced models: multistate, robust design and temporal symmetry
	Sep 14	Lec. Closed population models for estimation of population size
5	**Sep 19**	Lec. Coping with overdispersion, goodness-of-fit procedures
	Sep 21	Lab. Estimating c-hat in Program Mark
6	**Sep 26**	*No class*
	Sep 28	*No class*
7	**Oct 3**	Lec. Parameter estimation: model averaging and variance components **Research proposals due**
	Oct 5	Lab. Variance components in Program Excel
8	**Oct 10**	*No class*
	Oct 12	*No class*
9	**Oct 17**	*No class*
	Oct 19	**Midterm exam**
10	**Oct 24**	Lec. Introduction to demographic models and review of life tables
	Oct 26	Lab. Life tables in Program Excel
11	**Oct 31**	Lec. Life-cycle diagrams and projection matrices
	Nov 2	Lab. Projection matrices in Program Excel
12	**Nov 7**	Lec. Sensitivity and elasticity values

	Nov 9	Lab. Sensitivity and elasticity values in Program Excel
13	**Nov 14**	*No class*
	Nov 16	Lec. Loop analysis and lower-level elasticities
14	**Nov 21**	Lab. Sensitivity and elasticity values in Program Matlab
	Nov 23	*Thanksgiving Holiday*
15	**Nov 28**	Lec. Life-stage simulation analyses (LSA) and life-table response experiments (LTRE)
	Nov 30	Lec. Stochastic population models and estimating variance of population growth (λ)
16	**Dec 5**	Lab. Variance of population growth (λ) with fixed and random models in Program Matlab
	Dec 7	**Oral presentations of research projects**
17	**Dec 11**	**Research paper due**
	Dec 15	**Final exam, 9:40 am**

BIOL 823 DEMOGRAPHIC METHODS - RESEARCH PROJECT

The purpose of the research project is to allow students to develop a project application of demography to a selected topic in evolutionary ecology or conservation biology. The paper should not merely summarize previous publications on that topic but should consist of original analyses and thought.

The project does not require independent data collection and can be based on information that the student has collected for their thesis or dissertation. The project can also be based upon data collected by colleagues or obtained from the literature. Research papers can be included in a thesis by permission of the student's supervisory committee. I will consider requests to work in groups, but the project must be ambitious enough to warrant collaboration. Students must analyze their data using the demographic methods that have been learned in Biol 823. Students must present their paper in the format used at a scientific meeting and will be expected to prepare the paper in the format of a scientific paper that could be submitted for publication.

Past projects that have been published or are manuscripts out for review have included:
1. Use of mark-recapture models to examine dormancy rates in orchids (Shefferson), 2. Effects of radios on survival of Lesser Prairie-chickens in eastern Kansas (Hagen), 3. Survival of tropical birds in Ecuador (Parker), 4. Effects of landscape features on disease dynamics of prairie dogs (Johnson), 5. Community dynamics of amphibians and reptiles (Wilgers), 6. Community dynamics of birds in restored riparian habitats (Johnson), 7. Population models for bunchgrasses exposed to experimental levels of nitrogen (Dalgleish), 8. Modeling the effects of climatic change on small mammals with stochastic population models (Reed), and 9. Determining the minimum demographic rates for sustainable populations of Bobwhite Quail (Jensen). You are limited only by the availability of data and your ability to process it on computers or in the lab. Use your imagination but try to find a feasible topic that can be realistically answered. In preparing your paper, take the long view and consider it as something that might be worthy of publication.

Deadlines: Consider research topics that interest you over the month of September and discuss your topic with the instructor before *Sep 8*. All topics are subject to approval. Research proposals will be due on *Oct 3*. This will give you a chance to receive some feedback and some suggestions as you begin to structure your project. In your proposal you should state what the nature of the problem is, where and what kind of data you will obtain, and how you will try to analyze the problem. To do this, you should have a fairly good knowledge of the study system and what will be feasible.

In the week of *Dec 4*, you should be nearly finished with a first draft of your project because you will present your major findings to the class in a 12 minute presentation. This class will be run like a paper session at a national scientific meeting. Present your findings using tables and figures and discuss how they relate to other work. Each presentation will be followed by 3-5 minutes of questions. Again, this will be a time to receive feedback and suggestions for improvements that could be included in the final version of your research paper. The paper based on the research project is due on *Dec 11*, but may be handed in before then. Papers should be prepared following the guidelines described in the Research Paper Format handout.