

## OEB COURSE REQUIREMENTS

### Evolution and Ecology

OEB has few course requirements, allowing great flexibility in the training programs of individual students. However, as a broadly based program, we feel that all OEB students must have a solid foundation in both ecology and in evolution. Beginning in Fall 2009, we are initiating a 2-part team taught core sequence of a course in Ecology and a course in Evolution. These will be taught in alternate fall semesters (Ecology in odd years and Evolution in even years). These courses are required for students entering in Fall 2009 or later. Students that entered earlier are grandfathered in under the course requirements that were in place when they entered. However, all OEB students are invited to take the new Core Courses.

### Additional Course Requirements

**Additional Courses** Beyond the two core courses and other requirements listed here, many other courses may be useful to you. A list of relevant courses is below.

**Statistics** Information on OEB's statistics requirement is at the end of this document.

**OEB Graduate Seminar** (Org&EvBi 891C), our weekly seminar series, is held on most Fridays at 4:00 p.m. Students are required to register for this course twice and plan to complete this requirement in the first year in residence.

**OEB Ecology and Evolutionary Biology Discussion** (Org&EvBi 697B) 1-credit proseminar offered each fall for new students.

**OEB Graduate Student Symposium** (Org&EvBi 697 Y) 1-credit course offered each spring where students present their research in an informal setting. This may be taken at any time, but is best taken when you have data to present.

## ADDITIONAL COURSES TO CONSIDER

### ECOLOGY COURSES

Biology 514	Population Genetics	Caicedo
Biology 550	Animal Behavior	Novak, Podos
Biology 597A	Animal Communications	Houlihan
Entomol 511	Insect Behavior	Averill
Entomol 683	Insect Ecology	Elkinton
Entomol 597A	Insect-Plant Interactions	Adler
Entomol 697B	Field Research in Ecology	Adler
Forest 577	Ecosystem Modeling and Simulation	Finn
Forest 703	Advanced Forest Ecology	Patterson
Forest 777	Advanced Systems Ecology	Finn
Geo-sci 658	Paleoclimatology	Bradley
Geo-sci 541	Paleoecology	Staff
W&FConsv 563	Wetland Wildlife Ecology and Mgmt.	Griffin
W&FConsv 571	Marine Fisheries Science & Mgmt.	Juanes
W&FConsv 565	Pop. Dyn. & Mgmt. of Animal Pop.	Juanes
W&FConsv 697	Carnivore Ecology, Biology & Behav.	Fuller
W&FConsv 697C	Conservation Biology	Griffin
W&FConsv 697 U&V	Urban/Sub Wildlf Ecol & Mgmt	Warren
NRC 621	Landscape Ecology	McGarigal
Psych 891	Behavioral Ecology	Jakob
W&FConsv 720	Ecological Interactions of Fishes	Mather

## EVOLUTION COURSES

Biology 521	Comparative Vertebrate Anatomy	Coombs, Richmond
Biology 522	Vertebrate Fossils and Evolution	Coombs
Biology 528	Principles of Evolution	Byers
Biology 540	Herpetology	Richmond
Biology 542	Ichthyology	Cox Fernandes
Biology 544	Ornithology	Byers
Biology 548	Mammalogy	Dumont
Biology 597L	Molecular Evolution	Riley
Biology 722	Vertebrate Paleontology	Coombs
Entomol 697Q	Evolutionary Genetics	Porter
Entomol 526	Insect Biology	Stoffolano
Entomol 655	Insect Classification	Staff
Geo-sci 597L	Evolution, Symbiosis & Earth History	Margulis
Org&EvBi 797E	Environmental Evolution	Margulis
Microbio 560	Microbial Diversity	Staff

## STATISTICS (see Appendix B for information on the Statistics requirement)

Statisc 501	Intro Statistics	
BioEpi 540	Introductory Biostatistics (recipe-based tour)	
BioEpi 640	Intermediate Biostatistics (continues recipe-based tour)	
NRC 697 G & S	Design & Analysis of Ecological Data	McGarigal
NRC 697 S	Applied Biostatistics for Nat. Res	Sievert
NRC 797 S & T	Multivariate Statistics for Nat. Res.	McGarigal
PLNTSOIL 661	Intermediates Statistics	

## OTHER

Entomol 697C	Grant Writing	Adler/Normark
Org&EvBi 797T	Skills for College Teachers	Jakob
Org&EvBi 699	Thesis Credits	
Org&EvBi 899	Dissertation Credits	
GradSch 999	Continuous Enrollment	

## OEB STATISTICS GUIDELINES

- I. It is vital that all OEB doctoral students obtain familiarity with the introductory and intermediate statistics topics listed below in sections II. and III. All students should have a clear understanding of what procedures should be applied to particular data sets and to particular research questions. They should know the underlying assumptions and limitations of each procedure. They should have familiarity with the major statistical packages available for applying these procedures and they should have some hands-on experience with using them to analyze data. Masters students are expected to take an introductory level statistics course at a minimum.
- II. Introductory Statistics  
Possible courses: PUBHLTH 540, STATISTC 501, NRC 697G&S
  - Probability theory and distributions
  - Central Limit Theorem
  - Hypothesis testing, confidence intervals
  - Basic one-way ANOVA, t-tests and linear regression
  - Chi-square
- III. Intermediate Statistics  
Possible courses: W&FCONSV 697S&T, PUBHLTH 640, PLNTSOIL 661
  - Analysis of contingency tables, goodness of fit tests
  - Correlation

## Regression

- Simple vs. Multiple regression
- Nonlinear regression
- Logistic regression
- Correlation

## ANOVA

- One-way
- N-way
- Multiple comparisons
- Factorial vs. nested design
- Fixed vs. random effects
- Repeated measures
- Experimental design (Latin squares, etc.)
- Mixed models, ANCOVA

## Non-parametric statistics

Data re-sampling procedures: Bootstrap etc.

## Bayesian stats

### IV. Comments:

1. The topics above constitute 'basic training' in statistics. Every scientist will need some familiarity with each of them in order to conduct research and to read the scientific literature intelligently. OEB students should know, however, that cutting-edge research in all fields of ecology and evolutionary biology often involves application of advanced statistical techniques beyond those listed above. We thus urge all students to take additional courses in statistics to match their particular career objectives. One such course is offered by OEB faculty:

Multivariate Statistics for Natural Resources NRC 797S (Lec) & 797T (Lab)  
Instructor: Kevin McGarigal

2. If students come to OEB with some prior training in statistics, they might consider opting out of introductory statistics and going directly to intermediate statistics. OEB will maintain a file of syllabi of these courses to help students decide if this is a wise course of action.
3. The three intermediate statistics courses (W&FCONSV 697S&T, PUBHLTH 640, PLNTSOIL 661) cover most, but not all, of the topics listed above. It is not possible to cover them all in a single semester. W&FCONSV 697S&T cover the greatest number of these topics. PUBHLTH 640 and PLNTSOIL 661 do not present data resampling or bootstrapping. PLNTSOIL 661 is the most thorough regarding ANOVA and regression but leaves out contingency tables, logistic regression and non-parametric stats. If OEB students select statistics courses that do not cover all of the topics in sections II. and III., they should plan to cover these topics through other means.
4. The instructors of each of these courses are committed to providing modern and comprehensive training in basic statistics. The courses are frequently updated and, in some cases different instructors, will teach them. New courses along these lines may be offered in the future. OEB students will need to keep abreast of these changes.

### V. Other advanced courses in Mathematics and Statistics (accessible to those without a major math background) include:

Regression Analysis STATISTC 505

Design of Experiments STATISTC 506  
Multivariate Statistical Methods STATISTC 511

VI Advanced courses offered in the Department of Public Health include:

Data Management and Statistical Computing PUBHLTH 691F  
Analysis of Mixed Models and Longitudinal Data PUBHLTH 740  
Advanced Methods in Biometric Research PUBHLTH 742  
Analysis of Categorical Data in the Health Sciences PUBHLTH 743  
Nonparametric Methods PUBHLTH 746

There are other quantitative courses offered in Resource Economics, Natural Resources Conservation, etc., but because they are more specialized, we have not listed them here.