Entomology/Zoology 540: Theoretical Ecology

Syllabus 2007

Tony Ives

This course will introduce you to a range of ecological problems through the use of simple mathematical models. Mathematical models are useful in ecology for two reasons. First, they provide an avenue to investigate ideas in their simplest form. Hypotheses in ecology are often first generated by verbal arguments -- speculations about how things work in nature. Mathematical models allow hypotheses to be formulated with more precision and detail. There are numerous examples in which theoretical models have lead to hypotheses that are later confirmed through experimentation. Second, mathematical models can be used to simulate experiments that are impossible in nature. Nature is sufficiently complex that many important experiments cannot be done. Examples include experiments on the effect of introducing exotic species into new habits, and the effect of global climate change on the world's biota. Mathematical models can be used as surrogate ecosystems to mimic impossible experiments.

This course is centered around problem sets. I will introduce a problem in class, giving some biological background and a short theoretical discussion. The problem set will then lead you through a more detailed investigation of the problem. The problem sets should be done in groups of 2-3 students. I will assign groups and mix you up for each of the 5 problem sets.

In advance, I will tell you which questions in the problem set you should have for each class. I will then pick groups at random to do problems in front of the class. I will provide help when needed, and also additional questions to keep you on your toes. I will ask the entire class to grade your performances. Course grades will be based solely on your class participation; there is no final exam.

For each problem set, I will also have a few papers that I expect you to read. I will ask a group to answer questions about them, but then we will also discuss them in a journal-club-like format. The goal of reading papers is to see how some of the ideas that we discuss in class appear in the primary research literature. Some of these papers might be hard, but you should be able to get at least the general message from them.

In addition to the problem sets, I would like to try to tackle some modeling problems as a class. I don't think it is really possible to teach how to model; it is only possible to teach the tools that are needed. Learning how to model must be done through experience. A few times throughout the semester, I will solicit questions that might be good grist to model, and then as a class we will try to explore the questions with theory. I don't know how this will work, so we will just have to try it.

This course is interactive, and I expect you to participate in helping to design it. I suspect that there will be some students with extensive mathematical experience, and some with very little. I want this course to accommodate both. My ability to do this depends on you; I need as much feedback as possible. Therefore, I will ask you to evaluate each problem set so I can better tailor the course for you. You should also feel free to make suggestions at any time.

Course Credits: This course is 3 credits.

Readings: Most of the readings for the course are from the primary literature. I will send these out via email. Two recommended readings are:

Gotelli, N. J. 1995. A primer of ecology. Sinauer Associates, Sunderland, MA.

Ives, A. R. 1998. Population ecology. Pages 235-314 in S. I. Dodson, T. Allen, S. R. Carpenter, A. R. Ives, R. Jeanne, J. K. Kitchell, N. Langston and M. G. Turner, editors. Ecology. Oxford University Press, New York, New York.

Office Hours: Contact me whenever you like at arives@wisc.edu.

Problem Sets: Problem sets should be done in groups of 2-3. I will ask you to change groups for each problem set. Your entire grade will be based on class participation involving the problem sets.

Access to computers and Matlab: I assume that you will have access to computers and Matlab. If not, you can buy Matlab at the University Bookstore.

What computers to use: I will write code in Matlab 7.4 on a mac. You can use the Matlab code on Windows machines. I will send out the code via email to everybody in the class.

Schedule: In order to give flexibility, I will not try to give dates for problem sets for the entire semester now, but instead play it by ear.