


**ADVANCED ECOLOGY:
FUNDAMENTALS OF
ECOLOGICAL MODELING**



BIO534 & BIOL534
Professor: Stuart Borrett
M-W 12:30-1:45 am & W 2-4:50 pm

Plan for Today's Meeting

- Introductions & Create Cards (~10 min.)
- Course Introduction (~30 min.)
- Consensogram Activity: Preparing the way (~20 min.)

Information Card

Front hometown _____ Major/degree _____

FIRST NAME LAST NAME

Back Hobby _____ Adjective _____

Fav. Bio. Course(s)	Math/Stat. Course(s) completed
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Leave Blank for now

Introductions

Front El Paso, TX _____ Ph.D. Ecology
B.A. Biology. minor EVS

STUART BORRETT

Back cycling _____ creative _____

Ecology Systems Ecology Population Ecology Limnology	Diff. Calculus (3 x) Integral Calculus Differential Equations Linear Algebra Intro to Stats Linear statistical models
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Introduce yourself to at least 1 new person in the room

Course Objectives

Through Bio534 and Biol534 you will have the opportunity to:

- Understand **modeling concepts**, their application, and use in the science of ecology;
- Interpret and analyze **primary literature** that uses models;
- **Construct and use simulation** models to evaluate biological/ecological hypotheses;
- **Communicate** modeling results to a scientific audience; and
- (Lab) Use R programming language to implement simulation models as well as manage, analyze, and visualize data.

Course Sechedule

Please see course materials on website,
Including course schedule

<http://people.uncw.edu/borretts/teaching.html>

PDF password = bio534

Lecture Assessment

Activity	Course Weight (%)
Participation	25
Homework Assignments (5 × 5% each)	25
Exam I	25
Exam II	25
total	100

Participation Expectations
 Attend class (on time)
 Prepare for class (read/homework)
 Participate in activities and discussions
 Be respectful

Homework Assignments
 1. Math Warm Up
 2. Model Characterization
 3. Conceptualization
 4. Problem Set 1
 5. Problem Set 2

Exams
 Each is comprehensive
 Mixture of short answer and essay

Laboratory Assessment

Laboratory	Weight (%)
1 Introduction to R	5
3 Exponential Growth	5
4 Density Dependent Growth: Logistic	5
5 Chaotic Dynamics	5
6 Resource-Consumer Dynamics	15
7 Three State Variable Models: Chains and Webs	15
8 Connecting Models and Data	5
<i>Final Project</i>	
Task I: Topic Selection	5
Task II: Report	30
Task III: Presentation	10
total	100

Laboratories
 Series of exercises that build in complexity.
 Work reported in concise lab reports.

Project Assignment
[website](#)

Lecture and Lab Integration

Modeling is something best learned by doing it.

Lecture and Lab will work together
 – I strongly recommend you take both

Starting Assumptions

All students ...

1. Have had a general introduction to ecology (this is “advanced ecology”)
2. Have completed a college level mathematics course, probably diff. calculus

AND

have forgotten nearly all of it!

What is Ecology?

Definitions: Ecology is ...

the scientific study of the **relationship** between **organisms** and their **environment**
Smith & Smith

the study of the **distribution** and **abundance** of **organisms**
Andrewartha & Birch

scientific **natural history**
C. Elton

that branch of **physiology** which deals with the **organisms** as a whole, with its general life processes
V. Shelford

the science of **environment**
K. Frederick

Definitions (2)

By ecology, we mean the body of knowledge concerning the **economy of nature** --

the investigation of the **total relations** of the animal both to its inorganic and its organic; including above all, its friendly and inimical relations with those animals and plants with which it comes **directly or indirectly into contact** --

in a word, ecology is the study of all those **complex relationships** referred to by Darwin as the conditions of the struggle for existence.

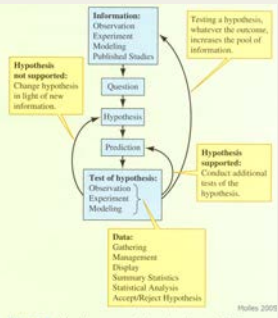
E. Haeckel, 1866

Ecological Levels of Organization

	Biosphere What role does concentration of atmospheric CO ₂ play in the regulation of global temperature?		Community How does disturbance influence the number of species in communities?
	Region How has geologic history influenced regional diversity within certain groups of organisms?		Interactions How does root nutrient availability affect the exchange of materials between plants and mycorrhizal fungi (fungi associated with plant roots)?
	Landscape How do habitats and other vegetated corridors affect the rate of movement by mammals among isolated forest fragments?		Population What factors control population growth rates?
	Ecosystem What factors control rate of energy fixation by ecosystems?		Individuals How do plants or animals regulate their internal water balance?

Figure 1.1 Levels of ecological organization and examples of the kinds of questions asked by ecologists working at each level. These ecological levels correspond broadly to sections III to VI of this book.
Moles 2005

Ecology is a Science - Scientific Method



Hypothesis not supported: Change hypothesis in light of new information.

Hypothesis supported: Conduct additional tests of the hypothesis.

Testing a hypothesis, whatever the outcome, increases the pool of information.

Epistemic Enhancers
Humphries 2004



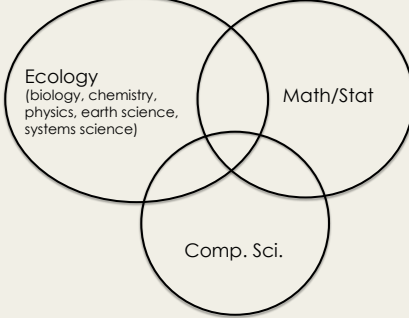



Figure 1 Graphic summary of the scientific method. The scientific method centers on the use of information to propose and test hypotheses through observation, experiment, and modeling.
Holes 2005

Ecological Modelling


A first consideration...

Ecological Modelling




Example: Predicting Hurricane IRENE

Aug. 23 4 pm
www.weatherunderground.com



Aug. 24 8 am

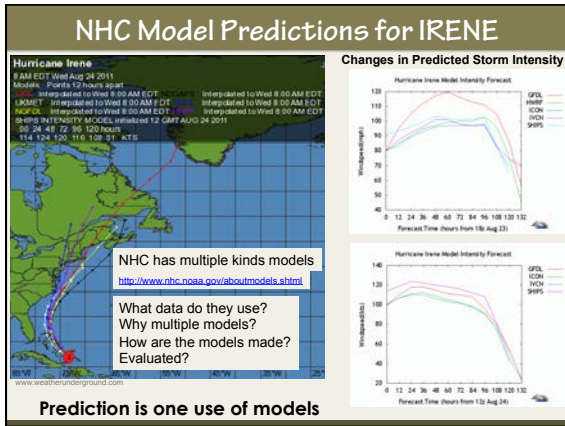


Storm Category

1	15-30 mph
2	31-50 mph
3	51-65 mph
4	66-80 mph
5	81-100 mph
6	101-120 mph
7	121-150 mph
8	151-200 mph
9	201-300 mph

Predict where the storm might go in 5 days Predicted storm tracks are different
Predict strength
Changing uncertainty shown

How does NHC make these predictions?



Consensogram

What is our starting point?

Everyone needs 7 post-it notes.
 Please number them 1-7 in top left corner

Question 1

How confident are you that...
 you could explain to your family how
 models are used in science?

Scale
 1—5
 1 is totally confident
 5 is not confident

Question 2

How confident are you that...
 you could critique a reading that
 draws conclusions from a model?

Scale
 1—5
 1 is totally confident
 5 is not confident

Question 3

How much do you agree with the
 following statement?

I plan to use a model in my research.

Scale
 1—5
 1 is totally confident
 5 is not confident

Question 4

How much experience have you had
 with *quantitative* models?

Scale

1. I have built, analyzed, and evaluated quantitative models.
2. I have built a quantitative model.
3. I have used or played with simulation models.
4. I have read or seen quantitative models in the literature.
5. None.

Question 5

How much do you agree with the following statement?

When I am reading, I skip over equations presented.

Scale

1–5
1 always
5 never

Question 6

How would you describe your skill and comfort with computers?

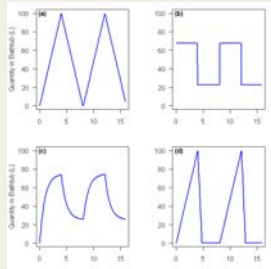
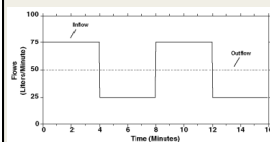
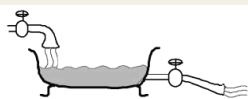
Scale

1. I enjoy finding ways to automate computer tasks and have programming experience.
2. I am a power user of the OS and applications like MS Office.
3. I use a computer on a daily basis for multiple life and work tasks.
4. I am comfortable with word processing, email, and surfing the internet.
5. I only use the dang things when forced!

Question 7

Consider the bathtub shown below, which is initially empty. Water flows into the tub at a variable rate of 25 and 75 L min⁻¹ and drains at the constant rate of 50 L min⁻¹ (shown in the graph below the tub).

Which of the following graphs most accurately represents the **amount of water stored** in the bathtub?



Last Question

Think about 3 personal goals you wish to accomplish in this course.

By the end of the semester, what do you want to know and be able to do regarding ecological modeling?

Write your goals on your note card

Assignments

1. Reading

Otto&Day Ch1(download from website)

2. Homework 1: Math Warm Up

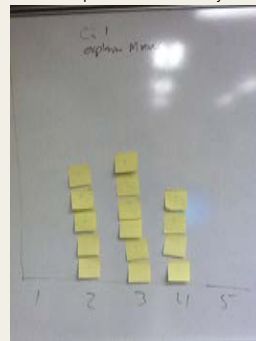
Read Mangel, Ch 1 (download from website)

Solve Problems 1.1, 1.2, 1.3, 1.4 (due Monday Aug 29)

- Show your work
- Will be graded on effort, not correct answers.

Consensogram Results 2011

Q1 Explain Models to Family



Q2 Critique Models in Literature

