

**Theoretical Ecology**  
BIOL 70X/80X  
Typically Fall semesters

**Professor:** Dr. Easton White  
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## Syllabus & Schedule

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### Time and Place (preferably):

In-person or hybrid course for a total of 3 credits

- In-person or asynchronous lecture (80 minutes)
- In-person problem solving and discussion (80 minutes)

### Office Hours: TBD

**Course Description:** Introduces students to the theoretical development of the field of ecology. Students will read historic and modern papers on topics ranging from the foundations of population and community ecology as well as applied examples. Students will also develop skills in building mathematical models and programming them into a computer language of their choice. The class culminates with a small group project analyzing a dataset, writing up findings in R markdown, and presenting to the course.

### Prerequisites:

- Students should have experience programming in R, python, Matlab, or a similar language. Students should understand how to define objects, write custom functions, and use for loops.
- Students should have taken an introductory calculus course (e.g., MATH 424b)

**Learning Outcomes (more specific):** By the end of the course, students should be able to:

- Understand and connect classical and modern papers in theoretical ecology
- Understand and apply mathematical tools, including equilibrium and stability analysis, matrix algebra, differential and difference equations, bifurcation analysis, and probability theory
- Use a programming language to build simple population models
- Construct a mathematical model of a system from scratch

### Textbooks and course materials:

I do not assign any textbooks for my courses. Therefore, I provide all the necessary readings (mostly peer-reviewed scientific publications) for the course and make them available online through Canvas. I will also post the lecture slides on Canvas.

All course materials (e.g., R, Git, etc.) are open-source and freely available.

### Assignments and Evaluation:

Assignment	Percent of Grade
Homework assignments (10 total)	40%
Online discussion posts (10 total)	20%
Final project	20%
Participation	20% (10% for grad students)
Teaching demo (grad students only)	10%

- *Homework assignments:* Each week, there will be a lab assignment corresponding with that week's lecture material. Each lab assignment will consist of a series of challenges involving data sets from across the

life sciences. Students will prepare their assignments using R markdown and submit them via Canvas. These will mostly be completed during class time in small groups.

- *Online discussion posts*: To help students prepare for the material each week, they will be required to post on that week's prompt and respond to other student's responses
- *Final project*: The lab assignments described above build on one another to provide all the computational skills needed to complete a stand-alone research project. The culmination of the class will result in a small group research paper using a data set of the groups choosing. Each group will also deliver a brief presentation of their paper.
- *Participation*: Points will be given out for both "in-class" discussion participation as well as discussion in online forums.
- *Teaching demo (graduate students only)*: Each graduate student will give one, 30-minute lecture on an R package of their choosing. Each student will be scheduled to give a presentation over the final portion of the semester (schedule TBD, but all students will have a minimum of 3 weeks between receiving feedback on their proposed topic and giving their presentation.

**BIOL 706 (undergraduate) vs. BIOL 806 (graduate)**: The lecture material and assignments are similar for graduate and undergraduate students. Graduate students will receive one additional question on the weekly quantitative assignments requiring deeper exploration of the material. **In addition, towards the end of the semester, each graduate student will be expected to teach a mini-lesson ("teaching demo") on a mathematical topic or lead a paper discussion.**

### **Grading:**

The grading scale for this course is:

100	- 94.00	A
93.99	- 90.00	A-
89.99	- 87.00	B+
86.99	- 83.00	B
82.99	- 80.00	B-
79.99	- 77.00	C+
76.99	- 73.00	C
72.99	- 70.00	C-
69.99	- 67.00	D+
66.99	- 63.00	D
62.99	- 60.00	D-
<59.99		F

The maximum possible grade on any assignment will drop by 10% for every day it is late. Weekends count. There are no makeups or extra-credit options. I have a policy of dropping the lowest score on the weekly lab assignments.

## Tentative Schedule

Date	Type	General topic	Assignment Due	Reading Due
Week 1	Lecture	What are models	Pre-assessment	Download R and Rstudio. Read Levins 1976 and White 2018
	Lab	Try to model system together		
Week 2	Lecture	Simple models: exponential and logistic		Read Malthus excerpt, Gause 1934
	Lab	Problem solving - qualitative solutions and coding	Hwk 1: What is a model	
Week 3	Lecture	Chaos and complex dynamics		Read May 1974, Munch et al. 2022
	Lab	Coding lab	Hwk 2: Simple models	
Week 4	Lecture	Matrix models		Read Caswell 1976
	Lab	Matrix models	Hwk 3: Complex dynamics	
Week 5	Lecture	Matrix models		Read background on COMPADRE website
	Lab	Matrix models	Hwk 4: Matrix models	
Week 6	Lecture	SIR models		Read Kermack-Mckendrick 1927, Rahimi et al. 2021
	Lab	SIR models	Hwk 5: Matrix models - part 2	
Week 7	Lecture	Bifurcation theory		Read Hastings 2018
	Lab	Bifurcation theory	Hwk 6: SIR models	
Week 8	Lecture	Spatial ecology		Read Levins 1969, Hanski 1998, White and Smith 2018
	Lab	Spatial ecology	Hwk 7: Bifurcation theory	
Week 9	Lecture	Stochasticity		Read probability primer chapter
	Lab	Stochasticity	Hwk 8: Spatial ecology	
Week 10	Lecture	Multi species		Read Chesson 1991, Schreiber 2020
	Lab	Multi species	Hwk 9: Stochasticity	
Week 11	Lecture	Applied topics - MPAs, decision science		Read MPA special issue 2004
	Lab	Applied topics - MPAs, decision science	Hwk 10: Multi species models	
Week 12	Lecture	Applied topics - MPAs, decision science		
	Lab	Applied topics - MPAs, decision science		
Week 13	Lecture	No class		
	Thanksgiving	No class		
Week 14	Lecture	Final project work		
	Lab	Final project work		
Week 15	Lecture	Presentations	Presentations and final report due	
	Lab	Presentations		
#####	Finals	Final Exam Period		

All information on this syllabus and schedule is subject to change as the course evolves during the semester.

## Course policies and expectations

**Classroom Behavior Expectations:** To ensure a climate of learning for all, disruptive or inappropriate behavior may result in exclusion (removal) from this class. As a reminder, cell phone/pda, etc. use, including text messaging, and videotaping and recording is not permitted in this class by Faculty Senate rule unless by instructor permission.

**Communication Policy:** If you have questions about anything related to the course, please email: [Easton.White@unh.edu](mailto:Easton.White@unh.edu). If you need to contact me about a personal or confidential matter (e.g., disability accommodations), please e-mail me directly. I will make every effort to answer your emails promptly, but email replies may take up to 24 hours during the week and 48 hours over the weekend.

**Attendance:** Class attendance is required. However, if an emergency arises or if the weather is bad, please don't come to class and instead let me know so we can make alternative arrangements.

**Cooperation/cheating:** In general, I encourage you to work and study together. There are a lots of small group assignments. I enforce a zero-tolerance policy with regard to plagiarism. There are no exceptions or excuses. If you plagiarize in this class, you will fail the course and there will be a letter placed in your file in the Dean's Office documenting the reason. UNH's policy on Academic Honesty is included in the latest edition of "Student Rights, Rules, & Responsibilities" (<http://www.unh.edu/student-life/academic-honesty-policy> ).

**Disability Accommodations:** According to the Americans with Disabilities Act (as amended, 2008), each student with a disability has the right to request services from UNH to accommodate his/her disability. If you are a student with a documented disability or believe you may have a disability that requires accommodations, please contact Student Accessibility Services (SAS) at **201 Smith Hall**. Accommodation letters are created by SAS with the student. Please follow-up with your instructor as soon as possible to ensure timely implementation of the identified accommodations in the letter. Faculty have an obligation to respond once they receive official notice of accommodations from SAS, but are under no obligation to provide retroactive accommodations. For more information refer to [www.unh.edu/studentaccessibility](http://www.unh.edu/studentaccessibility) or contact SAS at 603.862.2607, 711 (Relay NH) or [sas.office@unh.edu](mailto:sas.office@unh.edu).

If you are having academic difficulty, you should visit the **Center for Academic Resources (CFAR)** in Smith Hall (on Main Street by Stoke Hall, phone 862-3698; or <https://www.unh.edu/cfar>). They have a variety of written materials that will help you develop effective study skills, including note-taking, planning your study time, exam skills, how to take different kinds of exams, and how to study for different exam types. This is an **extremely valuable source of information for students**. The Center also has counseling and training sessions tailored for individuals and groups.

Your academic success in this course is very important to me. If, during the semester, you find emotional or mental health issues are affecting that success, please contact [Psychological and Counseling Services](#) (PACS) (**3<sup>rd</sup> fl, Smith Hall; 603 862-2090/TTY: 7-1-1**) which provides counseling appointments and other mental health services.

The University of New Hampshire and its faculty are committed to assuring a safe and productive educational environment for all students and for the university as a whole. To this end, the university requires faculty members to report to the university's Title IX Coordinator (Donna Marie Sorrentino, [dms@unh.edu](mailto:dms@unh.edu), 603-862-2930/1527 TTY) any incidents of sexual violence and harassment shared by students. If you wish to speak to a confidential support service provider who does not have this reporting responsibility because their discussions with clients are subject to legal privilege, you can find a list of resources here ([privileged confidential service providers/resources](#)). For more information about what happens when you report, how the university considers your requests for confidentiality once a report is made to the Title IX Coordinator, your rights and report options at UNH (including anonymous report options) please visit ([student reporting options](#)).