Preliminary Syllabus (subject to change):

Advanced Ecology: Theory and Computational Methods
ZOO 4926 and PCB 5046C

This class is cross listed as both an upper-level undergraduate course (where it is listed as ZOO 4926 “Special Topics in Zoology") and as PCB 5046C (where it is listed as “Advanced Ecology” but associated with an antiquated course description that is no longer relevant).
Instructors: Mathew Leibold and Francisca Javiera Rudolph

Credit hours: 3, graded.
Time and location: 521 Carr Hall, Tuesday 10:40-11:30, Thursday 10:40-12:35
Zoom participation link (if needed by prearrangement): TBA

Prerequisites:

This class is aimed at students who are currently in, or plan to attend, graduate school in the general area of ecology, evolution and behavior. It assumes that students have had previous exposure to the basic principles of ecology, such as is commonly taught in a general or introductory class in ecology (Intro Biology is not enough). If you have any questions about the suitability of the course, given your background and interests, please contact either one of the instructors.

We also assume you have a basic working knowledge of R. You should be comfortable with data manipulation, visualization, and basic statistical modeling. We will build from there and will not teach R basics. There are numerous resources you can use to prepare, an example is Data Analysis and Visualization in R for Ecologists: Summary and Setup.

This class will be fairly demanding. It will require attention to the readings as preparation for the lecture materials and it will require substantial commitment in the lab part of the class. We will assume that you are aware of this. But we hope the rewards will justify the efforts!

Description:

Want to work with cutting-edge community ecology methods while deepening your theoretical foundation? This course combines classic and contemporary ecological theory with hands-on training in Joint Species Distribution Models (JSDMs), one of the most powerful and increasingly essential tools in modern ecology and other advanced computational tools to study ecology.

This class aims to do two things. First, it aims to cover material that is not normally covered in a basic upper-level general ecology course that might be critical in helping students who are or who plan to go into graduate school in ecology. It will emphasize novel critical approaches but will also review how to synthesize it with “the classics”. Second, it will involve hands-on analysis of large-scale data using cutting edge computational methods to address synthetic approaches

to community ecology. This will involve both developing computational literacy and open science methods that represent the future of work in this area.

Theoretical depth: From behavioral ecology to metacommunities, we'll cover advanced topics often missing from general ecology courses. These are the concepts that matter when you're designing research or heading to grad school.

Computational skills: You'll gain practical experience with JSDMs and other methods, learning to analyze large-scale community data, interpret species associations, and explore ecological patterns at multiple scales.

Our approach to computational training is built on the framework of computational literacy. This includes the following:

- *Working with real, messy data at scale:* You'll learn to wrangle, explore, and visualize large-scale community datasets, like the kind you'll encounter in your own research. No toy datasets or pre-cleaned examples.
- *Understanding modern statistical approaches:* JSDMs represent a paradigm shift from species-by-species modeling to joint modeling that accounts for species associations and environmental gradients simultaneously. You'll learn not just *how* to fit these models, but *when* to use them and *how* to interpret what they're telling you about ecological processes.
- *Reproducible workflows:* Every analysis will emphasize reproducible practices such as organized code, clear documentation, and version control concepts. These skills transfer directly to your thesis work and future publications.
- *Troubleshooting and iteration:* Real ecological analysis is rarely plug-and-play. You'll develop problem-solving skills: diagnosing convergence issues, interpreting warnings, adapting methods to your data's quirks.
- *From methods to ecological insight:* The goal isn't just technical proficiency, it's learning to extract meaningful ecological understanding from complex models. You'll practice translating statistical output into ecological inference.

Structure: The class meets twice a week. The one-hour lecture-style Tuesday class will be focused on the conceptual part of the class, whereas the two-hour Thursday is a hands-on analysis component focused on building computational literacy, which will involve novel datasets and methods that should result in publishable findings.

Assignments: Grades will involve the following types of assignments (subject to change).

1) Occasional homework or quizzes in the lecture part of the course (15% overall)
2) Two exams (midterm and final) in the lecture part of the course (15% each)
3) Research style paper resulting from the workshop project by students (15%)
4) Final ‘symposium’ presentations from the workshop projects (15%)
5) Synthetic statement about the symposium activity (15%)
6) Participation points for the class in general (10%)

Grading Scale: A ≥ 93%; A− ≥ 90%; B+ ≥ 87%; B ≥ 83%; B− ≥ 80%; C+ ≥ 77%; C ≥ 73%; C− ≥ 70%; D+ ≥ 67%; D ≥ 60%; D− ≥ 57%; E < 57%

Tentative Schedule

Week	Lecture topic	Lab topic	Assignments
1	Intro: Competition and coexistence	Intro to the data (National Lakes or similar), exploratory data analysis	TBA
2	Contemporary niche approaches	Community data visualization, understanding multivariate ecological data	“
3	Metacommunities part a	Review of GLMs for single-species distribution models	“
4	Metacommunities part b including JSDMs	Why JSDMs? The problem with species-by-species models, conceptual intro to joint modeling	“
5	Macroecology	Fitting your first JSDM (simple example, focus on interpretation)	“
6	Biodiversity, complexity and stability	Understanding JSDM outputs (residual correlations, environmental responses, predictions)	“
7	Food webs and ecosystems	Spatial JSDMs and when/why spatial structure matters	“
8	Midterm – visual conceptual map	Scaling laws demo	“
9	Complexity and ecosystem attributes	Break into groups – discuss approaches	“
10	Behavioral Ecology 1: Foraging	In-class assisted group work	“

11	Foraging and habitat use	In-class assisted group work	“
12	Territoriality and allelopathy	Problem sharing and troubleshooting	“
13	Dispersal and spatial effects	In-class assisted group work	“
14	Population growth, regulation, oscillations and chaos (oh my!)	In-class assisted group work	“
15	Symposium	Final - Synthesis discussion and updating conceptual map	

Required Policies

1. Students Requiring Accommodation

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

2. UF Evaluations Process

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

3. University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/) specifies a number of

behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

4. Counseling and Wellness Center

Contact information for the Counseling and Wellness Center: https://counseling.ufl.edu/, 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

5. The Writing Studio

The writing studio is committed to helping University of Florida students meet their academic and professional goals by becoming better writers. Visit the writing studio online at http://writing.ufl.edu/writing-studio/ or in 2215 Turlington Hall for one-on-one consultations and workshops.

6. Policy on Recordings

Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.