Course Information

Course Number: ESSM 689
Course Title: Special Topics in Modeling Ecological Niches and Species' Distributions
Time: 9:20 – 10:35 am MW
Location: Online
Credit Hours: 3

Instructor Details

Instructor: Dr. Michelle Lawing
Office: 322 WFES
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Office Hours: by appointment

Course Description

This course takes a deep dive into ecological niche theory and species' geographic distributions – two extremely rapidly growing areas of research in ecology and biogeography. These areas are particularly important to link individual and population processes to species' distributions in geographic space, which in turn influence patterns of the multiple dimensions of biodiversity. This course will highlight problems in the fields of evolutionary ecology, macroecology and biogeography and will be particularly focused on understanding how to assess inferences from the correlative approach of modeling ecological niches and species' distributions, known as ecological niche modeling, species distribution modeling, and habitat suitability modeling. These models represent a suite of analytical techniques that associate an occurrence or incidence record from many individuals within a species with a set of environmental variables to identify ecological requirements and potential geographic distributions. They have become widely used to address issues in ecology, evolution, biogeography, conservation science, epidemiology, and the biological implications of climate change. It is important that students within these fields have a firm grasp on underlying theory, modern modeling practice, and limitations.

This course will have lecture sections and lab classes that include modeling assignments in the R statistical programing language. Students should be somewhat familiar with R (reading in data, assigning variables, basic functions, plotting), but I will provide tutorials if students need a refresher or to catch up.

Course Prerequisites

Students in this class will have graduate student status or permission from the instructor to enroll.

Course Learning Outcomes

1. Define concepts of ecological niches, species' geographic distributions, and the relationship between environmental and geographic space.
2. Articulate the theory behind estimating geographic areas and ecological niches.

3. Articulate the steps to building niche models and the considerations associated with each step.
4. Practice collecting species occurrence data and environmental data. Demonstrate competence in reading in data and data manipulation in R.
5. Practice modeling ecological niches, learn a variety of algorithms and other modeling choices, discuss modeling extrapolation and transferability, select best modeling strategies and best models, and evaluate model performance.
6. Apply models to discover biodiversity (populations, species limits, and unknown species), conservation planning and climate change effects, species' invasions, the geography of disease transmission, and linking niches with evolutionary process.
7. Demonstrate an ability to acquire, interpret, and present conclusions orally and in writing.

Mode of Instruction and Course Access

This course is a 100% online course and uses Zoom to meet virtually.

Course Zoom: https://tamu.zoom.us/j/92704604491

Textbook and/or Resource Materials

Required
Peterson, A.T., Soberón, J., Pearson, R.G., Anderson, R.P., Martínez-Meyer, E., Nakamura, M. and Araújo, M.B., 2011. *Ecological niches and geographic distributions (MPB-49)* (Vol. 49). Princeton University Press. Full text available here: https://www.researchgate.net/publication/230709994_Ecological_Niches_and_Geographic_Distributions

Suggested
Franklin, J., 2010. *Mapping species distributions: spatial inference and prediction*. Cambridge University Press.

Papers and book chapters will be assigned throughout the course to supplement readings.

Grading Policy - Grading (A: 90-100, B: 80-89, C: 70-79, D: 60-69, F: <60)

Section	Grading
Lecture (general attendance, assigned work during class, participation in lecture, demonstration of topic competence through discussion, discussion leadership)	**40 %**
Lab (practice and application of modeling)	**20 %**
Term project (proposal, presentation)	**20 %**
Exam	**20 %**
Total	**100 %**

Lecture: Classes will be structured around discussion of the assigned material consisting of some reading from the required book and a reading of a student-selected, instructor-approved paper. Students are expected to attend each lecture section having read, developed questions, and identified important findings/highlights/ideas of the assigned material. Students will sign up on the first day of class to choose a topic for which they want to select a paper and lead a discussion.

Lab: Students will generally have one week to complete lab assignments. Please have the latest version of R and RStudio downloaded on your computer.

Term Project: The proposal will give an overview of a problem the student plans to tackle with the term project and explain how they will address it with the methods learned in this class. There will be a clear hypothesis statement to test. _The proposal will be due mid-March._ Students should gain approval of the proposal from the instructor before completing their term project. Students will pull their term project together in the form of a presentation. Presentations will be ten to fifteen minutes in length followed by a few minutes of questions (depending on class size). _Presentations of term projects will take place the last week of class and during our assigned final examination period._

Exam: There will be three take home written exams during this course. Those are indicated on the schedule below.

Caveat on schedule and assignments: This is the first time I'm offering this course, so as the semester progresses there may be changes to lecture and lab assignments or to the exam schedule. I will be sure to give you plenty of advanced notice if these changes occur. I will welcome suggestions on coverage of content from the class, so that we are learning and discussing topics of interest.

Graded Attendance – We will meet virtually via Zoom with video. Students are expected to attend and participate in all class meetings.

Late Work Policy

Late work will be accepted for one week after the due date and will receive a deduction of ten percent of available points. Makeup work for an excused absence is not considered late work and is exempted from the late work policy. (See Student Rule 7.)

Course Schedule

Week	Lecture	Lab
1	Introduction and niche concepts Reading: Peterson et al. Ch. 1, Peterson et al. Ch. 2	No lab 1st week
2	Niches and distributions Reading: Peterson et al. Ch. 3, paper (TBD)	Introduction (reintroduction) to R and introduction to GIS in R

Week	Lecture	Lab
3	Niches and distributions in practice and species' occurrence data Reading: Peterson et al. Ch. 4, Peterson et al. Ch. 5, paper (TBD)	Finding species occurrence data; mapping species' distributions in R
4	Environmental data and modeling ecological niches (part 1) Reading: Peterson et al. Ch. 6, Peterson et al. Ch. 7 (pgs. 97 – 112), paper (TBD)	Finding environmental data; raster manipulation in R
5	Modeling ecological niches (part 2) Reading: Peterson et al. Ch. 7 (pgs. 112 - 138), Peterson et al. Ch. 8, paper (TBD)	**Exam**
6	Algorithms: modern regression Reading: Franklin and Miller Ch. 6, paper (TBD)	Modern regression algorithms in R
7	Algorithms: machine learning methods Reading: Franklin and Miller Ch. 7, paper (TBD)	Machine learning methods in R
8	Algorithms: classification, similarity, and other methods Reading: Franklin and Miller Ch. 8, paper (TBD)	Classification, similarity and other algorithms in R
9	Evaluating performance and significance Reading: Peterson et al. Ch. 9, paper (TBD)	**Proposals Due, Exam**
10	Applications: discovering biodiversity Reading: Peterson et al. Ch. 10, Peterson et al. Ch. 11, paper (TBD)	Gathering, cleaning, manipulating, and plotting environmental data for term project
11	Applications: conservation planning and climate change effects Reading: Peterson et al. Ch. 12, paper (TBD)	Implementing and calibrating models for term project

Week	Lecture	Lab
12	Applications: species invasions Reading: Peterson et al. Ch. 13, paper (TBD)	Evaluating models for term project
13	Applications: geography of disease transmission Reading: Peterson et al. Ch. 14, paper (TBD)	Projecting models for term project
14	Applications: linking niches with evolutionary processes Reading: Peterson et al. Ch. 15, paper (TBD)	Completing figures and overall term project narrative
15	**Exam**	**Term Project Presentations**
16	**Term Project Presentations**	**Term Project Presentations**

University Policies

Attendance Policy

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to Student Rule 7 in its entirety for information about excused absences, including definitions, and related documentation and timelines.

Makeup Work Policy

Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in Student Rule 7, or other reason deemed appropriate by the instructor.

Please refer to Student Rule 7 in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor" (Student Rule 7, Section 7.4.1).

"The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence" (Student Rule 7, Section 7.4.2).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See Student Rule 24.)

Academic Integrity Statement and Policy

"An Aggie does not lie, cheat or steal, or tolerate those who do."

"Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must keep appropriate records at all times. The inability to authenticate one's work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case" (Section 20.1.2.3, Student Rule 20).

You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at aggiehonor.tamu.edu.

Americans with Disabilities Act (ADA) Policy

Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact Disability Resources in the Student Services Building or at (979) 845-1637 or visit disability.tamu.edu. Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

Title IX and Statement on Limits to Confidentiality

Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit gender-based discrimination and sexual harassment, including sexual assault, sexual exploitation, domestic violence, dating violence, and stalking.

With the exception of some medical and mental health providers, all university employees (including full and part-time faculty, staff, paid graduate assistants, student workers, etc.) are Mandatory Reporters and must report to the Title IX Office if the employee experiences, observes, or becomes aware of an incident that meets the following conditions (see University Rule 08.01.01.M1):

- The incident is reasonably believed to be discrimination or harassment.
- The incident is alleged to have been committed by or against a person who, at the time of the incident, was (1) a student enrolled at the University or (2) an employee of the University.

Mandatory Reporters must file a report regardless of how the information comes to their attention – including but not limited to face-to-face conversations, a written class assignment or paper, class discussion, email, text, or social media post. Although Mandatory Reporters must file a report, in most instances, you will be able to control how the report is handled, including whether or not to pursue a

formal investigation. The University's goal is to make sure you are aware of the range of options available to you and to ensure access to the resources you need.

Students wishing to discuss concerns in a confidential setting are encouraged to make an appointment with Counseling and Psychological Services (CAPS).

Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the University's Title IX webpage.

Statement on Mental Health and Wellness

Texas A&M University recognizes that mental health and wellness are critical factors that influence a student's academic success and overall wellbeing. Students are encouraged to engage in proper self-care by utilizing the resources and services available from Counseling & Psychological Services (CAPS). Students who need someone to talk to can call the TAMU Helpline (979-845-2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends. 24-hour emergency help is also available through the National Suicide Prevention Hotline (800-273-8255) or at suicidepreventionlifeline.org.

COVID-19 Temporary Amendment to Minimum Syllabus Requirements

The Faculty Senate temporarily added the following statements to the minimum syllabus requirements in Spring 2021 as part of the university's COVID-19 response.

Campus Safety Measures

To promote public safety and protect students, faculty, and staff during the coronavirus pandemic, Texas A&M University has adopted policies and practices for the Spring 2021 academic term to limit virus transmission. Students must observe the following practices while participating in face-to-face courses and course-related activities (office hours, help sessions, transitioning to and between classes, study spaces, academic services, etc.):

- Self-monitoring—Students should follow CDC recommendations for self-monitoring. **Students who have a fever or exhibit symptoms of COVID-19 should participate in class remotely and should not participate in face-to-face instruction.**
- Face Coverings—Face coverings (cloth face covering, surgical mask, etc.) must be properly worn in all non-private spaces including classrooms, teaching laboratories, common spaces such as lobbies and hallways, public study spaces, libraries, academic resource and support offices, and outdoor spaces where 6 feet of physical distancing is difficult to reliably maintain. Description of face coverings and additional guidance are provided in the Face Covering policy and Frequently Asked Questions (FAQ) available on the Provost website.
- Physical Distancing—Physical distancing must be maintained between students, instructors, and others in course and course-related activities.
- Classroom Ingress/Egress—Students must follow marked pathways for entering and exiting classrooms and other teaching spaces. Leave classrooms promptly after course activities have concluded. Do not congregate in hallways and maintain 6-foot physical distancing when waiting to enter classrooms and other instructional spaces.

- To attend a face-to-face class, students must wear a face covering (or a face shield if they have an exemption letter). If a student refuses to wear a face covering, the instructor should ask the student to leave and join the class remotely. If the student does not leave the class, the faculty member should report that student to the Student Conduct office for sanctions. Additionally, the faculty member may choose to teach that day's class remotely for all students.

Personal Illness and Quarantine

Students required to quarantine must participate in courses and course-related activities remotely and **must not attend face-to-face course activities**. Students should notify their instructors of the quarantine requirement. Students under quarantine are expected to participate in courses and complete graded work unless they have symptoms that are too severe to participate in course activities.

Students experiencing personal injury or Illness that is too severe for the student to attend class qualify for an excused absence (See Student Rule 7, Section 7.2.2.) To receive an excused absence, students must comply with the documentation and notification guidelines outlined in Student Rule 7.

Operational Details for Spring 2021 Courses

For additional information, please review the FAQ on Spring 2021 courses at Texas A&M University.

College and Department Policies

Non-discrimination Policy

A major goal of the Department of Ecology and Conservation Biology is to foster a learning environment that nurtures diversity and promotes inclusion. Texas A&M University and the Department of Ecology and Conservation Biology are committed to the fundamental principles of academic freedom, equality of opportunity, and human dignity. We expect a climate that values and nurtures collegiality, diversity, pluralism, and the uniqueness of the individual within our state, nation, and world. Texas A&M University, in accordance with applicable federal and state law, prohibits discrimination, including harassment, on the basis of race, color, national or ethnic origin, religion, gender identity, disability, age, sex, sexual orientation, marital or parental status, national or ethnic origin, or veteran status in employment, educational programs, and admissions. Discrimination of a student in class, i.e., behavior directed against a particular student that harms, humiliates, or intimidates that student, will not be tolerated. The mere expression of one's ideas is not discrimination and is fully protected by academic freedom; however, personal attacks of individual students are not permitted. We do not tolerate racial and ethnic harassment (defined in Student Rule 31; https://student-rules.tamu.edu/rule31) or sexual harassment (defined in Student Rule 47; https://student-rules.tamu.edu/rule47) and we will report any incidents to the proper authorities, https://stophate.tamu.edu/, or https://tellsomebody.tamu.edu.