Global Change Biology, BIOL 26

Professor: Caitlin Hicks Pries (LSC 349), Office hours Tuesday 2:30-3:30 pm & by appt.

Class: Spring 2021, MWF 1:10-2:15, The Internet
X-hours (Tuesdays 1:40-2:30, will be used to learn data analysis skills and as a time for group work).

Learning objectives

Mission Statement: Understand how humans are reshaping the processes of nature in the Anthropocene, articulate the repercussions of those changes for ecology, evolution, and human health; use global change datasets to answer biological questions; and be able to evaluate solutions that might mitigate the consequences of global change.

By the end of this course, you will be able to:

- Describe the myriad of ways humans are altering earth's atmosphere, land, and water.
- Understand how global change is fundamentally altering the way species interact with their environment and with other species (including humans).
- Apply the concepts and theory of ecology and evolution to case studies detailing the effects of global change on species, species interactions, human health, carbon balance, and nutrient cycling.
- Understand, summarize, and critically evaluate primary scientific literature on global change biology including how scientists use gradients, experiments, and models to investigate global change.
- Develop and answer scientific questions by using R to access, organize, and visualize actual data sets.
- Articulate the pros and cons of potential solutions to global change issues and to be able to defend your position on potential solutions.

I want you to come away from this course with the ability to evaluate new technologies and policies for their potential impact on ecosystems and sustainability.

Course description

We are currently living in the Anthropocene era where humans are having an outsize effect on the Earth's environment through the burning of fossil fuels, the large-scale conversion of land for agriculture, the modification of water courses for flood control and energy, and the use of fertilizers, to name a few. These changes have major consequences for both ecosystems, individual species, and species interactions. Through this course, you will apply fundamental ecological principles to the Anthropocene by reading and discussing the primary literature and working with long term ecological datasets. Through reading and data exploration you will investigate how humans have altered the environment and what the consequences have been for biogeochemical cycling, species' phenology, and species' distributions. You will also evaluate solutions for mitigating these consequences and restoring ecosystem functions.

Course structure

Each week will be dedicated to studying the effects of a global change factor such as climate

change, increased concentrations of carbon dioxide in the atmosphere, land use change, excessive fertilizer use, invasive species, and air, noise, and light pollution. Generally, the first class of each week will be a mix of lecture and class activities to orient the students to a different aspect of global change, its causes, and the biological concepts needed to understand its repercussions. The second class of each week will be a student-led discussion of two papers from the scientific literature describing biological consequences of a global change factor. The third class of each week will consist of a data exercise. Data exercises will include exploration of actual long-term observational and experimental datasets. The last week of class will be dedicated to student presentations evaluating solutions for mitigating the consequences of global change and how they would test their efficacy. Students will have to defend their ideas to the broader class community. This class will have quizzes every couple of weeks and a final project.

Course expectations

This is an active learning course. As such, you are expected to attend live classes and to participate in class activities and discussions. I firmly believe that you need to engage with this course and the material to master it. This means taking notes, answering questions, and, perhaps most importantly, asking questions. In order to have productive discussions and breakout groups during synchronous classes, you need to be present on zoom with your *video turned on*. Please have your microphone muted unless you are talking.

Given the remote nature of this course, more of the burden of learning this material is on your shoulders than is typical. It is highly recommended that you do the readings, watch recorded material, attend live classes, and complete all activities in the week they are assigned. Please let the professor know if circumstances will cause you to miss class or turn in an assignment late.

We will be recording all discussions and lectures on Zoom. By taking this course, you consent to being recorded (see RECORDING INFORMATION on last page of syllabus).

Technological expectations

We will make *extensive* use of the Canvas system in all aspects of this course. Please check Canvas regularly for announcements, lecture videos, assignments, readings, quizzes, and assignment information and due dates.

Given the online nature of this course, it is required that students have the ability to stream 1 hour or less of video content each day and participate in live Zoom lectures, X-hours, and lab sections with their video on.

You will need a laptop that has R and R Studio installed on it for this course.

We will do our very best to accommodate any limitations to your access to the required technology. It is impossible for us to plan for every possible technology constraint. Therefore, please let Prof. Caitlin know what barriers you have to completing the online course as soon as possible.

Readings

Readings for this course will be from the primary literature, select chapters from books, and reports from both governmental and non-governmental organizations. The readings will be available as links or to download as pdf files from the course's Canvas website.

Assessment

Your learning and understanding will be assessed throughout the course and through a final presentation in which you will evaluate solutions to a global change problem of your choice, and a final project in which you will use publicly available data and the scientific literature to answer a global change related question of your choice. There will be in class activities or discussions almost every day. Participation will be 10% of your grade. Each week, we will discuss a paper from the primary scientific literature and you and a partner will be responsible for leading one of these discussions during the course. Leading the discussion will be 10% of your grade. Several times during the term, we will use class time to learn R and explore actual datasets. Some of these activities may be completed in a class or two while others will need work outside of class before they are turned in. These data activities will be 15% of your grade. In lieu of midterms and a final, there will be 3 quizzes, roughly every three weeks throughout the term. These will be timed (30-45 minutes each) and taken via Canvas. They will involve short answer and reflection. They will be posted on Friday afternoon to be completed by Monday at 11:59 EST. The quizzes will not be cumulative and will only test the previous 2-3 weeks.

Participation in class (activities, discussions on zoom and slack)	10%
Lead discussion	10%
Data analysis assignments	15%
Solutions Presentation	15%
Quizzes (3)	15%
Final data analysis project	35%

Learning Accommodations:

Students requesting disability-related accommodations and services for this course are encouraged to schedule a phone/video meeting with Prof. Caitlin as early in the term as possible. This conversation will help to establish what supports are built into my online course. In order for accommodations to be authorized, students are required to consult with Student Accessibility Services (SAS; student.accessibility.services@dartmouth.edu; SAS website; 603-646-9900) and to email me their SAS accommodation form. We will then work together with SAS if accommodations need to be modified based on the online learning environment. If students have questions about whether they are eligible for accommodations, they should contact the SAS office. All inquiries and discussions will remain confidential.

You may also wish to contact or visit the Academic Skills Center (http://www.dartmouth.edu/~acskills), the Research Center for Writing and Information Technology http://www.dartmouth.edu/~rwit, and/or Student Accessibility Services (http://www.dartmouth.edu/~accessibility).

Illness/Life/Religious Holidays:

If illness, religious holidays, or other life circumstances affect your ability to attend a Zoom Lecture/X-hour or complete your assignment or quiz for the week, please let Prof. Caitlin know so we can discuss accommodations.

Mental Health:

I recognize that the academic environment at Dartmouth is challenging, that our terms are intensive, and that classes are not the only demanding part of your life. There are a number of resources available to you on campus to support your wellness, including: your undergraduate dean (http://www.dartmouth.edu/~upperde/), Counseling and Human Development

(http://www.dartmouth.edu/~chd/), and the Student Wellness Center (http://www.dartmouth.edu/~healthed/). I encourage you to use these resources, to take care of yourself throughout the term, and to feel free to come talk with Prof. Caitlin when needed.

Collaboration and academic integrity:

This course involves several group projects. However, when specified, certain assignments, such as the quizzes and reading responses, are to be completed independently. For further information, please consult the Dartmouth College Academic Honor Principle http://www.dartmouth.edu/~reg/regulations/undergrad/acad- honor.html.

Course Schedule:

Week	Date	Topic	Class	Reading	Assignments Due
1	29-Mar	Global Change	Global Change Introduction		
	30-Mar		Introduction to data project		
	31-Mar		*"Anthropause" Discussion*	Papers TBA	Reading Responses
	2-Apr		Intro to Data Science in R I		Come with R and R Studio installed on your laptops
2	5-Apr	Climate Change Feedbacks	Lecture and C Cycle Activity	IPCC summary for policymakers	
	6-Apr		R Breakout Groups		R Practice Activity I
	7-Apr		*Ecosystem Carbon Feedbacks Discussion*	Papers TBA	Reading Responses
	9-Apr		Intro to Data Science in R II		
3	12-Apr	Species' Responses to Global Change	Phenology and Range shifts	Papers on Assisted Migration	**Project Proposals DUE**
	13-Apr		Proposal Peer Review in Class		R Practice Activity II
	14-Apr		*Bird Evolution Discussion*	Papers TBA	Reading Responses
	16-Apr		Graphing in R Activity		
4	19-Apr	Increased Atmospheric CO2	Lecture on Photosynthesis and Ocean Acidification		
	20-Apr		R Breakout Groups		R Graphing Activity
	21-Apr		*Nutritional Consequences Discussion*	Papers TBA	Reading Responses
	23-Apr		Mapping in R Activity		
5	26-Apr	Air pollution	Acid Rain and Hubbard Brook, Ozone	Original Acid Rain papers	
	27-Apr		R Breakout Groups		R Mapping Activity
	28-Apr		*Human Health Consequences and Equity Discussion*	Papers TBA	Reading Responses
	30-Apr		Data Activity: Long term data at Hubbard Brook		
6	3-May	Urbanization	Cities as Ecosystems	Urban evolution, ecology, and equity	**Project Introduction and Preliminary Graphs DUE**
	4-May		Project Meetings with Professor	papers	
	5-May		*Noise and light pollution discussion*	Papers TBA	Reading Responses
	7-May		Data Activity: Long term data at Hubbard Brook		Group mini presentations (in class)
7	10-May	Water Pollution	Eutrophication, Salt, PFAS, and Plastics	N Cycle Introduction	**Solutions Outline DUE**
	11-May		TBA		
	12-May		*Discussion TBA*		Reading Responses
	14-May		Data Activity: Ocean Plastics		
8	17-May	Land Use Change	Consequences of Land Use Change: Disease and ?		
	18-May		TBA		Ocean Plastics Activity
	19-May		*The "4 per mille" Initiative Discussion*	Sanderman et al 2017, Ryals et al. 2014	Reading Responses
	21-May		Data Activity: TBA		
9	24-May	Class Choice!!!	Lecture and readings this week will be determined by the class's interests.		
	25-May		TBA		TBA Activity
	26-May		*Discussion*	Papers TBA	Reading Responses
	28-May		NO CLASS: Prof's Brother is getting married!		
10	31-May		NO CLASS: Memorial Day		
	1-Jun	Solutions	Student Presentations		**8 minute Solutions presentation DUE**
	2-Jun	Solutions	Student Presentations		**8 minute Solutions presentation DUE**
Exam Week					**Final Project DUE**