# Global Change Biology, BIOL 26

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

*Class*: Spring 2019, MWF 12:50-1:55, LSC 205
X-hours (Tuesdays 1:20-2:10, will be used occasionally 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 and evolution, use global change datasets to answer biological questions, and be able to evaluate solutions that might mitigate the consequences.

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 environments.
- Apply concepts and theory of ecology and evolution to case studies detailing the effects of global change on species, species interactions, and carbon 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 graph 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.

## 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, noise and light pollution, etc. 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. There will be one midterm and a final project.

## Course expectations

This is an active learning course. As such, you are expected to attend class each day and to participate in class activities and discussions. We firmly believe that you need to engage with this course and the material to master it. This means taking notes (by hand) and focusing on what's going on in the classroom. Multi-tasking with an electronic device (laptop, iPad, smartphone) that distracts you from participating fully during lectures– such as checking e-mail or Facebook, making online purchases, reading the newspaper, etc. – is strictly prohibited. If we notice you doing this, we will ask you to turn off your electronics and put them away. Repeated violations will result in a reduced course participation grade. We request that laptops are only out during the activities in which their use is specified. If you need to use a device for note-taking, please check in with Prof. Hicks Pries during the first week of the term.

You will be expected to regularly check Canvas for assigned readings. You will be expected to come to class with a laptop that has R and R Studio installed on it on Fridays. You will be expected to turn in assignments on time and late assignments will receive a 15% per day penalty. If circumstances, such as a medical emergency, will cause you to miss class or turn in an assignment late, please contact the professor.

## 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 be a midterm exam but no final exam. 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 15% 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.

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| Participation in class (activities and discussions) | 10% |
| Lead discussion | 15% |
| Data analysis projects | 15% |
| Solutions evaluation (presentation) | 15% |

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| Midterm Exam | 15% |
| Final Data Analysis Project | 30% |

## Academic accommodations:

Students with disabilities who may need disability-related academic adjustments and services are encouraged to see me privately as early as possible in the term. Students requiring disability-related academic adjustments and services must consult the Student Accessibility Services office (205 Collis Student Center, 646-9900, Student.Accessibility.Services@Dartmouth.edu). Once SAS has authorized services, students must show the originally signed SAS Services and Consent Form and/or a letter on SAS letterhead to their professor. As a first step, if students have questions about whether they qualify to receive academic adjustments and services, they should contact the SAS office. All inquiries and discussions will remain confidential.

Some students may wish to take part in religious observances that occur during this academic term. If you have a religious observance that conflicts with your participation in the course, please meet with me before the end of the second week of the term to discuss appropriate accommodations.

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).

## Mental Health:

We 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/). We encourage you to use these resources, to take care of yourself throughout the term, and to feel free to come talk with Prof. Hicks Pries when needed.

## Collaboration and academic integrity:

This course involves several group projects. However, when specified, certain assignments, such as the midterm exam 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 | Assignment Due |
|---|---|---|---|---|---|
| 1 | 25-Mar | Climate Change and Phenology | Global Change Introduction | | |
| | 27-Mar | | *Phenology Discussion* | Richardson et al 2018 and 2006 | Reading Responses |
| | 29-Mar | | Intro to Data Science in R I | | Come with R and R Studio installed on your laptops |
| 2 | 1-Apr | Climate Change Feedbacks | Lecture and C Cycle Activity | IPCC summary for policymakers | R Practice Activity |
| | 3-Apr | | *Permafrost Carbon Feedbacks Discussion* | Schuur et al. 2008, McGuire et al. 2018 | Reading Responses |
| | 5-Apr | | Intro to Data Science in R II | | |
| 3 | 8-Apr | Climate Change and Range Shifts | Assisted Migration and Evolutionary Rescue | Papers on Assisted Migration | |
| | 10-Apr | Climate Models | Guest Lecture (Prof. Mankin, Geography) | | R Extension Activity |
| | 12-Apr | | NO CLASS: Professor at Conference | | **Project Proposal DUE** |
| 4 | 15-Apr | Increased Atmospheric CO2 | Lecture on Photosynthesis and Ocean Acidification | | |
| | 17-Apr | | *Nutritional Consequences Discussion* | Papers TBA | Reading Responses |
| | 19-Apr | | Graphing in R Activity | | |
| 5 | 22-Apr | Urbanization and Pollution | Lecture: How Species are affected by pollution | Reading TBA | Graphing Extension Activity |
| | 24-Apr | | *Noise and light pollution on species discussion* | Papers TBA | Reading Responses |
| | 26-Apr | | Mini Lecture and Data Activity: Ocean Plastics | | Group mini presentations (in class) |
| 6 | 29-Apr | Nitrogen Deposition | Play the N Game! | Nutrient Chapter from "Principles of Terrestrial Ecosystem Ecology" | |
| | 1-May | | *Forest Change and Lake Eutrophication Discussion* | Papers TBA | Reading Responses |
| | 3-May | | **Midterm Exam** | | |
| 7 | 6-May | Precipitation Havoc! Acid Rain and Ice Storms | Lecture: The Hubbard Brook Ecosystem Story | Select Chapters from "Hubbard Brook: The Story of a Forest Ecosystem" | **Solutions Outline DUE** |
| | 8-May | | *Acid Rain Discussion* | Papers TBA | Reading Responses |
| | 10-May | | Potential Field Trip to Hubbard Brook | | **Project Introduction and Preliminary Graphs DUE** |
| 8 | 13-May | Land Use Change and Management | Lecture and Land Use History of New England Activity | | |
| | 15-May | | *The "4 per mille" Initiative Discussion* | Sanderman et al 2017, Ryals et al. 2014 | Reading Responses |
| | 17-May | | Data Activity: TBA | | Group mini presentations (in class) |
| 9 | 20-May | Class Choice!!! | Lecture and readings this week will be determined by the class's interests. | | |
| | 22-May | | *Discussion* | Papers TBA | Reading Responses |
| | 24-May | Solutions | Student Presentations | | **8 minute Solutions presentation DUE** |
| 10 | 27-May | | NO CLASS: Memorial Day | | |
| | 29-May | Solutions | Student Presentations | | **8 minute Solutions presentation DUE** |
| **Exam Week** | | | | | **Final Project DUE** |