

# BIG DATA IN ECOLOGY

BIO 394 - Fall 2019 - Macalester College

## COURSE INFORMATION

- **Instructor:** Prof. Mary Heskell (she/hers); [mheskel@macalester.edu](mailto:mheskel@macalester.edu)
- **Class:** MWF 1:10-2:10 PM; Theater 204
- **\*Student\* Hours:** M 1-2PM; W 3:30-4:30 PM; OIRi 220 (or by appt)
- **Texts:** All readings will be available through moodle.

**Email Policy:** I aim to respond to emails between 9AM-5PM on weekdays; emails received after 5PM will be answered the following morning. I often cannot answer emails over the weekend, so plan accordingly. Many topics may be answered more easily in person, and we will devote time in class each day to answering questions.

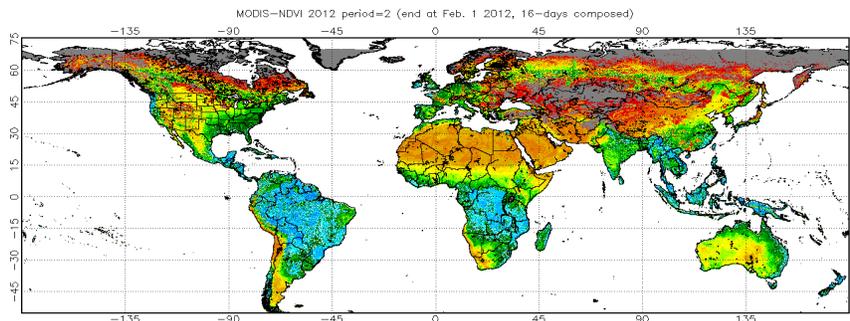
## Class Meetings & Attendance:

- You are expected to attend every class. If you are unable to attend class for an academic (ie - a field trip for another class) or personal (your discretion) reason, please email Mary *\*before\** that class meeting.
- You are responsible for emailing class groups/partners if we are working in groups that day, and making up materials via moodle, office hours, or classmate meetings.

## Late work policy/NQA:

- Assignments are expected to be turned in on the assigned date.
- Everyone is granted **one** "no questions asked" (NQA) 4-day extension on an assignment. To use this, email Mary within 24 before the deadline that you are applying your NQA extension for 4 extra days. This does not apply to the final report or presentations.

**Developing your voice and being a team member:** Science requires a balance of confidence and humility – this is as true for undergraduates as it is for researchers at leading institutions. We will need confidence to pursue and develop new ideas and approaches, to thoughtfully critique ideas, and to follow your curiosity. Science also requires humility and patience - with yourself, others, and the material. Individually, in groups, and as a class, we will identify our limitations, ask for help and guidance, listen to thoughtful, appropriate criticism from others, and reflect on our improvement and setbacks. As you develop your thoughts and opinions in this class, be mindful that we are also collectively creating an open, accepting community of learning and growth.



Big Data in Ecology is a new class and I envision it as a place to grow and experiment with new approaches and ideas. For everyone to do that successfully, the class needs to be a welcoming, supportive, and inclusive environment grounded in mutual respect of the individuals that comprise the class and their ideas.

If you at any point feel there is something about the class that is keeping you from success, I encourage you to reach me by email, in person, or through a designated student 'ombudsman'.

I also encourage you to take care of yourselves through the semester - eat well, sleep well, and take breaks as needed. If you are feeling overwhelmed, need academic or mental health support, prioritize those needs.

Academic support for writing: Works in Progress peer-support or MAX Center

Disability Services: 651-696-6275 or [disabilityservices@macalester.edu](mailto:disabilityservices@macalester.edu)

Student Support: Office of Student Affairs at 651-696-6220 [studentaffairs@macalester.edu](mailto:studentaffairs@macalester.edu)

## LEARNING GOALS

The practice of Ecology in the 21st century relies heavily on the analysis, modeling, and synthesis of diverse and broad datasets. In this course, we will learn how data is collected, organized, and handled in these fields, with the goal of becoming 'data stewards'. \*This *NOT A STATISTICS* class - Macalester offers many wonderful upper-level statistics classes that deal with how to quantitatively analyze datasets of all kinds. I encourage you to take them!\* We will focus more on how ecological data emerges from experiments and observational measurements, and how we can use it to learn more about the natural world.

Our learning goals for the semester are to:

- Learn how data is collected, stored, and shared in current ecological research
- Become comfortable and confident using R/RStudio to analyze ecological datasets
- Develop effective practices for data organization
- Practice data manipulation using dplyr using packaged and novel datasets
- Develop & practice data visualization using ggplot2
- Apply basic analysis to ecological topics that span biomes and taxa
- Communicate findings effectively via writing, RMarkdown code, and visual displays
- Work productively in groups and create supportive, effective communities based on open communication, engagement, and sharing of responsibilities.
- Discuss and critique primary literature
- Identify limitations, potential drawbacks of data and where to focus additional measurements
- Consider and integrate Environmental Justice issues into environmental and ecological data analysis
- Build a community of learning where challenges are met with thoughtful, open discussion and collaboration
- Engage in and develop a collaborative, supportive learning environment

## ASSESSMENTS

Our class aims to model data-heavy work that you might experience in graduate school or a post-college job. These often entail mid-length reports, group and individual work, analyses of the literature, and presenting your findings.

**MiniQuizzes (MQ):** MQs will occur roughly every week and test knowledge from the previous few class meetings. After completing each quiz, students will confer with their neighbor and resolve answers together. We will go over answers as a class after the paired discussions. MQs are graded Credit/No Credit.

**Reading Responses and Discussion Responses:** Prior to each reading discussion, students will write a 2 paragraph reading response. The first paragraph will summarize the motivation, questions, methods, and findings. The second paragraph will focus on how the paper could be improved (2-3 reasons), identify 'sticky' areas, and propose 1-2 future directions for the research. Discussion Responses will be in-class writing to summarize small group discussions and will be collected.

**Attendance, Preparation, Participation, and Group Work** - A large portion of this class relies on students participating in large and small groups, which requires people to be prepared and focused for class time, supportive and helpful, good listeners, note-takers, and volunteers. You will be evaluated and self-evaluate on these aspects of the class regularly.

**Eco-Topic Presentations (group):** For each two-week eco-topic section, groups will present their findings to the class in 5-10 minute (depending on group size) presentations. These will highlight challenges, methods, findings, similar studies, and future directions.

**Eco-Topic Reports (ETR; individual):** For each of the two week eco-topics, students will create an original RMarkdown file describing their findings on the eco-topic. These are comprised of 250 word introductions to the topic that includes a social/environmental justice tie-in, at least 4 peer-reviewed references, hypotheses and research questions addressed by the data analysis. The report will also include a description of the dataset and how it was collected. The Markdown file will also include your code and at least 4 figures with annotations and explanations. Finally, the report will include a 250 word summary of your findings and suggestions on next directions in terms of analysis and new research questions.

**Final Report & Presentation (individual):** Your final report will follow similar guidelines as the Eco-Topic Reports, but be on a novel topic using a dataset of your choosing. Refer to documents on moodle for guidelines

Assessment	Due	Points	%
MiniQuizzes (MQ)	Weekly	5 each = 50 total	5%
Reading Responses	10 AM day of discussion; 6 total	10 each = 50 total	5%
Discussion Responses	Day of discussion	10 each = 50 total	5%
APPGW	Every class	75	7.5%
Eco-Topic Presentations	4 Total	25 each = 100 total	10%
Eco-Topic Reports	4 Total	100 each = 400 total	40%
Final Presentation	12/9-12/11	75	7.5%
Final Research Report	12/15	200	20%

Total Points Possible: 1000

All readings, assignment descriptions, and other information about the course will be on Moodle.

Week: Topic	Monday	Wednesday	Friday
1:		9/4 FIRST CLASS	9/6 Ethics & Discussion & Jobs!
2: Data Organization	9/9 Forms of data; Pretty & Ugly datasets	9/11 Metadata & Dataset critique	9/13 Naming & organization <a href="#">Quiz #1</a>
3: Working with Datasets - dplyr	9/16 Intro to R/RStudio & RMarkdown	9/18 dplyr 1 & Forest Diversity	9/20 dplyr 2 & Forest Diversity
4: Working with Datasets - ggplot	9/23 DataViz Rules & Goals	9/25 ggplot 1	9/27 ggplot 2; <a href="#">Quiz #2</a>
5: Agricultural Nutrient Loading	9/30 N and P in Aquatic Ecosystems	10/2 Discuss Peterson et al (2001)	10/4 Exploring Midwestern streams and rivers
6: Agricultural Nutrient Loading	10/7 Water Quality Data	10/9 Rural/Urban land use effects & Biotic Controls	10/11 Group Presentations
7: Forest Primary Productivity	10/14 Carbon fluxes in a forest ecosystem	10/16 Discuss HF EC Paper TBA	10/18 Eddy Covariance data; Group idea development <a href="#">(ETR1 due)</a>
8: Forest Primary Productivity	10/21 Examining fluxes @ HF	<b>10/23 Group Presentations</b>	10/25 FALL BREAK - NO CLASS
9: Observing & Tracking Phenology	10/28 Phenology & Community Science data	10/30 Discuss Monarch Phenology paper	11/1 iNaturalist data exploration <a href="#">(ETR2 due)</a>
10: Observing & Tracking Phenology	11/4 Climate anomalies / Group Work	11/6 Group work	11/8 <b>No Class meeting</b>
11: CHANS: Climate Change & Migration	<b>11/11 ETR3 Group Presentations</b>	11/13 CC & Migration Discuss Blitzer (NYer)	11/15 Discuss Abel et al (2019); Idea Development for Group Work
12: CHANS: Climate Change & Migration	11/18 Geospatial data & CHANS in Google Earth Engine <a href="#">(ETR3 due)</a>	11/20 Group Workshop time	<b>11/22 Group Presentations on CHANS, Climate change and migration</b>
13: Pitch Session & Feedback	11/25 Independent Project Pitch Session & Peer Feedback	11/27 & 11/29 - THANKSGIVING - NO CLASS	
14: Summarizing Ideas	<b>12/2</b> Looking to the future: jobs and skills	<b>12/4 In class workshop</b> <a href="#">(ETR4 due)</a>	12/6 In class workshop & Peer Review
15: Last Week	12/9 Presentations I	12/11 Presentations II & Final Discussion	<b>Final Independent Projects due 12/15</b>