BIOL 466 FRONTIERS IN MARINE BIOLOGY

OCEAN CLIMATE CHANGE: IMPACTS and SOLUTIONS

Instructor: Prof. Julia Baum. **TAs:** Dr. Sam Starko, Matt Csordas

Monday/Thursday | 1 – 2:20pm | Offered through Zoom (for now….)

No textbook required. Readings and other materials will be provided.

Our course within the COVID-19 context

We will meet on **Zoom** during our scheduled class time, at least for the first few weeks of the semester. As soon as we know more, we will post the info on Brightspace. Classes will include lectures, presentations, discussion and other activities. You are expected to attend and be an active participant in these classes. These sessions will be recorded & posted on our course **Brightspace** page. General course discussions and Q&A will take place on **Slack**: biol466climate2022.slack.com

Instructor:

Professor Julia K. Baum, Ph.D.
Please call me: Julia or Dr./Prof. Baum (pronouns: she/her)
Email: baum@uvic.ca | @BaumLab
Student Support Hours: Th. 3-5pm or by appointment

Trained as a marine ecologist & conservation biologist, I lead a large, research group here in UVic's Dept. of Biology. We focus on understanding how climate change and other stressors are altering coastal marine ecosystems, and climate change solutions (https://juliakbaum.com).

How are warming seas impacting marine populations and communities?

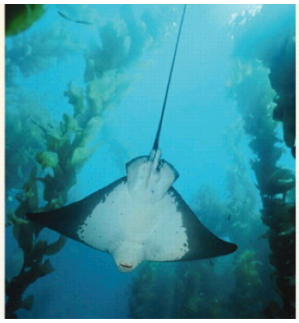
Are marine heatwaves going to wipe out coral reefs?

Will marine fisheries still be as productive under climate change?

What are the solutions to ensure healthy future oceans and how can we stay optimistic about climate change?

If these questions keep you up at night, this is the class for you! This course will focus on understanding how climate change is altering marine species and ecosystems. There is no text book, because we're focusing on the frontiers of this field (primarily discoveries made in the past 5-10 years), and it is an exciting and rapidly evolving one.

New discoveries about the ecological effects of climate change in the ocean are being made all the time. They appear regularly in the news, and help to inform (we hope) public discourse and policy about climate change mitigation and adaptation. Given science's central role in our society, learning ***1)*** critical-thinking skills to evaluate evidence, ***2)*** how to do science, and ***3)*** how to communicate science, should play a central role in any scientist's training. Yet, for many of you, your exposure to science so far has been restricted to learning the core ideas and facts that underpin your chosen fields. This course aims to change that by making you active participants in your learning, as we evaluate and discuss scientific discoveries, analyze data, synthesize the literature, and interact with real ocean climate change scientists. In the process of this scientific training, you'll become better readers, thinkers, analysts, communicators, and collaborative group members, skills that will set you apart on whatever path you choose.



Instructional Team

Matt Csordas (pronouns: he/him) will be leading the R components of our course. Matt is a 2nd year MSc student in the Baum Lab, exploring the changing distributions and abundance of foundational kelp species and what this means for the persistence of these productive coastal ecosystems and their blue carbon potential. Matt did his undergrad at McMaster University in Chemical and Bioengineering and is now applying the statistical and coding skills he gained in that degree to the field of marine ecology. He has experience in a wide variety of coding languages and is no stranger to debugging his own occasionally questionable code (so should be able to help you do the same!). Matt loves to spend his free time cycling and in or by the ocean. His favourite kelp is *Postelsia*, the sea palm, a charismatic and tough kelp found high in the intertidal.

Dr. Samuel Starko (pronouns: he/him) will be helping to facilitate class discussions and activities. Sam is a marine researcher interested in how environmental drivers influence the evolution and ecology of coastal habitat forming species, such as corals and seaweeds. Sam is a postdoctoral fellow in the Baum lab and studies how microalgal symbionts influence the resistance of corals to heat stress, while also conducting work locally exploring how fine-scale variation in the environment can influence persistence of kelp forests in the face of climate change. Sam loves to spend time in or around the ocean and is fascinated by the opportunity it provides for exploring ecological questions.

Core Principles

We have structured your learning in this course around three core principles:

1. **We're all on the same team:** This statement has two key implications. First, science in the 21st century is a team sport, and the best scientists are those that can work well together, even as they encounter inevitable challenges along the way. This course is designed to give you opportunities to practice the skills necessary to work productively and enjoyably in teams, and you'll regularly do so. It is not a competition. Second, even the best teams have coaches. This is how we see our role: to help all of you achieve your learning goals by 'steering the ship', and providing you with a framework, direction and feedback.
2. **Keep it real:** We have designed activities, assignments, and assessments to align as closely as possible with what you'll do, and how your work will be evaluated, in the "real world". For each assignment – be it crafting a short presentation, producing clearly annotated R code, or writing a paper – we will provide you with a set of criteria for what success looks like based on the external standards on which "real" science is judged. We're always impressed by how much students can accomplish when given the chance to join the ranks of a real scientific community, this one focused on confronting the ongoing climate change challenges facing our oceans. We're excited to welcome you to this community.
3. **Equity, inclusion, and empathy:** We endeavor to provide an equitable, inclusive, and accessible learning environment. In turn, we expect everyone in the class to help us to foster these principles, to contribute to a collegial environment in which all individuals and their rights to learn are respected, and everyone (us included!) is treated with respect, as described

in the UVic Student Code of Conduct https://www.uvic.ca/services/advising/advice-support/academic-units/student-code-of-conduct/index.php If you are registered with the Centre for Accessible Learning (CAL) and anticipate or experience any barriers to learning in this course, please feel welcome to discuss your concerns with me. If you are a student with a disability or chronic health condition you can meet with an advisor at CAL to discuss access and accommodations https://www.uvic.ca/services/cal/

We are also notably still in the midst of a global pandemic. We didn't expect that we would still be teaching under these circumstances by 2022, and you probably didn't expect to be doing most of your degree under such circumstances either. But here we are. We are all going to do our best, while recognizing that class members may be facing challenges beyond ones they normally would. We will all strive to be empathetic and kind to each other.

Goals and Learning Outcomes

This course is designed around four interrelated learning goals, each of which is fundamental for modern scientists. These, along with their specific **learning outcomes that describe what you will know and be able to do** at the end of the course are detailed below. We have designed the class activities and assignments around these goals, with the aim of helping you to achieve these outcomes.

Goal	**Learning Outcomes:**
G1. Learn foundational knowledge & improve critical thinking skills	▪ Effective and efficient critical readers of the scientific literature; ▪ Distinguish scientific evidence from interpretation; develop and critique scientific arguments; ▪ Understand how climate change is affecting marine species and ecosystems. Apply relevant knowledge and critical assessment to future work (e.g. discussions, presentations, and papers in the course).
G2. Effective scientific communication and collaboration	*Oral (O):* ▪ Presentations: Use clear communication and modern visual tools to communicate scientific information and assessment effectively to peers; ▪ Discussions: Discuss content and critical evaluations of the scientific literature with peers, including active and respectful listening to peers, and being open to diverse perspectives; *Written (W):* ▪ Demonstrate understanding of scientific literature; clearly communicate scientific information, synthesis and assessment; *Collaboration (C):* ▪ Work effectively as a team, including identifying roles and responsibilities, setting priorities, giving and receiving feedback that leads to positive change, identifying and resolving interpersonal conflict.
G3. Ecological data analysis and interpretation	*Data Science:* ▪ Write code in R in order to conduct data exploration, apply common statistical tools to analyze data, and produce figures; ▪ Annotate code and produce documents using R Markdown; *Evidence and Inference:* ▪ Interpret the evidence in data sets and make reasonable scientific inference
G4. Engage with a real scientific community	▪ Pose insightful questions to researchers ▪ Participate meaningfully in conversations about the primary literature

Course Components and Evaluation

There will be no midterms or final exam in this course. Instead, you will demonstrate your success by learning and communicating the course material through in-class discussions with peers and scientists, presentations, quantitative assignments, and a literature review. Evaluation of this type is designed to emphasize **new knowledge *and* the skills that scientists require** – the specific course learning goals (G) that each course component will strengthen are denoted below in blue. Our course structure requires that you commit to being an active participant in your learning, and to doing a steady amount of work each week. Evaluation will be as follows:

I. Class Interaction: 45%

Our course will involve active participation and learning collectively in class on Zoom or together in person. You will prepare for these sessions in advance and come to class ready to contribute.

Paper Discussions: We will read and discuss carefully selected scientific reports on the current state of knowledge and papers describing discoveries at the frontiers of understanding the ecological effects of ocean climate change. I'll explain how our discussions for Theme I will work in week one. After that, we will have 7 discussion classes (D1-D7) in which you and your peers will be the leaders.

Here's how D1-D7 will work: Each of you will belong to two different teams: a 'Breakout room discussion (BRD) team' and a 'Presentation team'. The class will be divided into 3 'BRD teams' with ~7 people per team. There will be 7 presentation teams (which will also serve as your 'Lab bench'), with one person from each BRD team in each presentation team:

1. **Paper presentation & discussion lead (10%; G1; G2-O,C):** For one of the discussion classes, you will work with your presentation team to prepare a short presentation that introduces the week's discussion paper(s), along with a set of guiding questions that you will use to lead the discussion. After the group presentation, we will split into our breakout room discussion teams, with each team led through the discussion by one of the presentation team members. These sessions are indicated by D1 – D7 on the course calendar. See full assignment for more details.
2. **Discussion preparation and participation (6 X 4% = 24%; G1; G2-W,O,C):** For the six discussions in which your presentation team is not leading, you will prepare by reading the assigned paper(s) and answering a short question set (2% each). Participation in the discussion (2% each) will be assessed by self-evaluation and peer-evaluation. See full assignment for more details.

Interacting with Scientists (5%; G4): We are fortunate to have 5 world-class ocean climate change scientists joining us for classes interspersed throughout our course themes. These classes will typically involve a guest lecture followed by a discussion on a topic in the realm of their expertise. You may be assigned one of their papers to read. You will prepare questions in advance, vote on the best questions, and take turns asking them during the session. Questions may focus on our guest's research or their career. A substantive question is relevant, open-ended, clearly articulated, and describes the intent behind it. This course component will be assessed via your active participation, and your professional and courteous presence in these sessions with our guests.

Overall participation and class contributions (6%; G1, G2, G4): Finally, I will assess your overall course participation, including the quality of your contributions. As one component of this, aimed at helping us to engage with new discoveries in this rapidly evolving field, you will find and post one relevant new discovery in our Slack #climatechange-inthe-news channel, and tell us about it briefly (i.e. a simple one-minute max. verbal description, with no visuals) in class.

II. Analyzing Climate Change Impacts: 20%

You will conduct two assignments (R1 8%, R2 12%; G3), in which you analyze data sets on climate change impacts in the ocean using the open-source programming language R. See full assignment for more details, and the set of mandatory R tutorials to help you prepare for these assignments.

III. Literature Synthesis: 35%

You will choose a topic relevant to our course and review a small subset of the literature on it. This is not meant to be an exhaustive literature review. Instead, this is your opportunity to read (~10-12 papers) and think more deeply on an aspect of 'ecological effects of ocean climate change' that you are especially interested in, to synthesize the information and your critical assessment of it, and to practice your scientific writing and presentation skills.

Review Paper (25%; G1, G2-W): You will write a review paper (10 pages double spaced max.) on your approved topic. Topics must be approved by me by Th. Jan. 27th. A paper outline is due Th. March 21st, optional paper draft by Fr. April 1, and final paper due Th. April 14th.

3-Minute Presentation (10%; G2-O): You will record yourself giving a short talk (max. 3 min.) using Powerpoint, in which you present your literature synthesis; due Mon. March 28th. We may watch some of the videos together in class.

****Assignments, projects and assessments will be posted in and submitted through BrightSpace with each due by noon on the specified date on the course schedule****

Academic Integrity: It is expected that all of us, as members of an intellectual community, will adhere to the values of honesty, trust, fairness, respect, and responsibility. Any action that contravenes this standard, including misrepresentation, falsification or deception, undermines the intention and worth of scholarly work and violated the fundamental academic rights of members of our community. **You are responsible for the entire content and form of your work.** Plagiarism and other acts against academic integrity are serious academic offences, and it your responsibility to understand the University's policy on academic integrity. Nothing in this policy is intended to prohibit students from developing their academic skills through the exchange of ideas and the utilization of resources available to support learning. Please consult https://www.uvic.ca/students/academics/academic-integrity/index.php for more information.

These are challenging times. I understand you all are under a lot of stress and anxiety, and that sometimes you are unable to be as productive as you had hoped for. Thus, if you need an extension for any class assignment you can simply ask (in writing, via email to me), and it will be granted. No questions asked, and no documentation needed (apart from the request in writing).

Course Resources and Technology

We will use several different software tools and online platforms used by practicing scientists, with course materials and communication spread across the platforms as follows:

Brightspace: Brightspace (**bright.uvic.ca**) will be the learning hub for the course. This is the main way that you will 1) access course materials, 2) submit assignments, 3) view course announcements, and 4) track your grades.

Zoom: At least for the first two weekss, we will use Zoom for our class time (Meeting ID: 811 5845 0740, Passcode: 221698; https://uvic.zoom.us/j/81158450740?pwd=bU1zTk9qL0Y0TlQ4aWZUQlRaTFI0QT09) and Student Support Hours (Meeting ID: 853 5043 1667, Passcode: 655085; https://uvic.zoom.us/j/85350431667?pwd=MHNoMXNvWkJpLocrYTcyV3FZbDVTdz09, at least for the first two weeks. UVic instructions for using Zoom are here: https://onlineacademiccommunity.uvic.ca/TeachAnywhere/2020/09/10/essential-zoom-tips-for-students/ We will discuss best practices and etiquette for our virtual classroom during our first class to help ensure it is a comfortable, engaging, and positive place for learning for all of us. Note: To join Zoom, you will need to sign in through the UVic system each time. Our Zoom classes will be recorded, and

I will post the most relevant components (e.g. lecture portions) on Brightspace.

Slack: We will use the online collaboration tool Slack for general discussions about the course, with discussion topics organized into 'channels'. Think you need to send an email? Think again! Please use our #general-q-and-a channel if you have a general question, and the answer is not in the syllabus (or already answered in the channel!). Many people likely have the same question, and that way the answer can be seen by all. **Note:** Please email me (baum@uvic.ca) if you have an urgent or private question or concerns. Please download Slack (https://slack.com/intl/en-ca/) and create an account. We'll then invite you to the course workspace: **biol466climate2022.slack.com**

R: The open source software R has become the software of choice for most practicing ecologists. We will conduct two data analyses using it. Please install R: https://www.r-project.org/ and RStudio: https://rstudio.com (a GUI (graphical user interface) that makes using R friendlier).

If you any questions or concerns about accessing or using any of these programs, please let us know (ideally through the Q & A channel on Slack).

Course Schedule

Focal Theme	Wk	Date	Topic	Assessment due
	1	M 1/10	Course Introduction/Overview	
1 Climate change in the ocean		Th 1/13	IPCC 2019 Oceans report	
	2	M 1/17	IPCC 2019 Oceans report	
2 Why temperature matters		Th 1/20	GL: Prof. Mary O'Connor (UBC)	
	3	M 1/ 24	D1	D1 prep due
3 Gradual climate change		Th 1/27	Species responses to gradual warming	Review proposals due
	4	M 1/31	D2	D2 prep due
		Th 2/2	Ecosystem tropicalization	
	5	M 2/7	D3	D3 prep due
		Th 2/10	GL: Prof. Amanda Bates (UVic)	R Asst. #1 due 2/11
4 Extreme climatic events	6	M 2/14	Marine heatwave intro / Temperate HW	
		Th 2/17	GL: Dr. Sam Starko (UVic)	
Reading Break (February 21 - 25)				
4 Extreme climatic events (cont'd):	7	M 2/28	D4	D4 prep due
		Th 3/3	MHWs and coral reefs	R Asst #2 due 3/4
	8	M 3/7	MHWs and coral reefs	
		Th 3/10	D5	D5 prep due
5 Changing fisheries	9	M 3/14	GL: Prof. William Cheung (UBC)	
		Th 3/17	D6	D6 prep due
6 Social inequity	10	M 3/21	Social inequity & Pacific Islands case study	Review outline due
7 Climate change solutions		Th 3/24	Ocean climate change solutions	
	11	M 3/28	Solutions	3-Min. talk due
		Th 3/31	GL: Dr. Susanna Fuller (Oceans North)	Paper draft due 4/1
	12	M 4/4	D7	D7 prep due
		Th 4/7	Solutions	
				Paper due Th 4/14

D = Discussion | GL = Guest Lecture. *Draft: 6 January 2022