DALHOUSIE UNIVERSITY

Faculty of Science and Faculty of Graduate Studies Course Syllabus
Department of Biology

Ecosystem Modelling for Aquaculture

MARI 4600.03
Cross list: BIOL 5660.03
(Fall 2022)

Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq. We are all Treaty people.

Instructor: Dr. Diego Ibarra | email: Diego.Ibarra@dal.ca | Office: LSC-5014 (Biology)
Questions MUST be posted in Brightspace's Discussion boards (see guidelines below). Only use email for private/personal matters.

Lectures: Fri 11:35 am - 2:25 pm | *Location:* SIR JAMES DUNN BUILDING 301A

Course delivery: In-person. However, due to the covid19 pandemic, we can switch to online teaching if needed.

TA: Nan Chen | email: nn255237@gmail.com

Time zone: All times (syllabus, Brightspace, calendar, etc.) are in **Halifax Time (ADT/UTC-3 or AST/UTC-4)**

Course Description

Learn a collection of tools for the sustainable utilization of aquatic resources. Emphasis is on bilateral interactions between aquaculture and the environment. Topics include water/sediment/biota variability, carrying capacity, invasive species, habitat destruction/creation, ecosystem functions/services, climate change, etc. Tools include data analysis/modelling/visualization/mapping using Python™ (prior programming experience is not required).

Course format

The course is intended to be delivered in-person. However, due to the covid19 pandemic, we can switch to online delivery if cases of covid19 in Halifax and/or Dalhousie increase to unsafe levels. If this is the case, a Brightspace announcement will be used to do the switch from in-person to online (or vice versa).

In-person

Lectures/Labs are on Fridays from 11:35 am to 2:25 pm, in SIR JAMES DUNN BUILDING 301A.
Please wear a MASK while in the classroom and hallways.
Quizzes, midterms and final will take place in the classroom during lecture time.
Online discussion will be the same as in the online format (see below).

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Online

If covid19 prevents us from doing in-person learning, we can switch to the following online format. The online version of this course is delivered mainly using Brightspace and zoom. You will need a laptop with a webcam and microphone (or equivalent hardware), and you will need to install (free) zoom software.

- **Asynchronous lectures, quizzes and labs (required)** are delivered online (via Brightspace) under an asynchronous format, so that students can access course elements at their convenience. Lectures and labs are released weekly. Quizzes are also released weekly but are only available for a 24-hour period. You will need to install Python in your Laptop to be able to do the labs (see below for instructions)
- **Synchronous midterms and final exams (required).** There are two required exams that must be done at specific date/times (see schedule for details).
- **Zoom synchronous conversations (not required).** There are weekly conversations (Fridays @ 11:35 am ADT) where the class can meet (via zoom, link in Brightspace) to ask questions, spark discussion and interact with each other. Students are encouraged, **but not required**, to attend to these sessions. **These synchronous events will NOT be recorded.** During these video-calls, please follow the etiquette below:
    - You are expected to have your **CAMERA AWAYS ON** when in the zoom room, therefore:
        - Be mindful of your clothing and appearance
        - Be mindful of your background (virtual backgrounds are ok)
        - Silence your cellphone and other electronic devices
        - Advise your roommates about your video-call so they are also mindful too
    - Keep you **MICROPHONE ALWAYS MUTED**, unless you need to speak

Differences between undergraduate (4600) and graduate (5660) levels

Graduate students taking this course are expected to do about 30% more work than the students taking the course at the undergraduate level. Detailed distinctions between undergraduate (4600) and graduate (5660) students are included throughout this document. Graduate students are marked following a grading scale that is stricter than the undergraduate scale, where a minimum of 70% (B-) is required to pass.

Course Prerequisites

Undergraduate	Graduate
MARI 3602.03 - Introduction to Aquaculture **OR** Instructor's approval	Instructor's approval

Key knowledge or skills expected of students coming into the course

- Students should be familiar with the basic concepts of aquaculture.
- Prior computer programming knowledge is NOT required.

Course Goals and Outcomes

Goals and Outcomes for both undergraduate and graduate students

- Explain environmental impacts of aquaculture (i.e. "aquaculture → environment" interactions)
- Explain effects of the environment on aquaculture production (i.e. "environment → aquaculture" interactions)
- Describe the concept of Environmental Carrying Capacity (ECC)
- List the relevant environmental variables (water-column, sediments and biota) involved in aquaculture-environment interactions
- Characterize methods and tools to assess and monitor the relevant environmental variables
- Describe mechanisms causing variability in the relevant environmental variables

- Explain the effects of aquaculture on ecosystem functions and services
- Explain the effects of global warming and ocean acidification on aquaculture and vice versa
- Demonstrate the use of Aquaculture Ecosystem Models for the estimation of ECC on an idealized aquaculture farm

Additional Course Goals and Outcomes for graduate students only

- Demonstrate critical thinking and capacity to solve quantitative problems related to aquaculture-environment interactions
- Develop, code and parameterize an original Aquaculture Ecosystem Model
- Evaluate mass-conservation and parameter sensitivity of your original Aquaculture Ecosystem Model

Course Materials

Class notes: Class notes are posted on BrightSpace.
Announcements: Electronic announcements and additional material will be posted from on BrightSpace. Students should check the site frequently.
Text book: There is no textbook required for this course.
Other suggested resources:

IMO/FAO/UNESCO/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Pollution. 1991. Reducing environmental impacts of coastal aquaculture. Food and Agriculture Organization of the United Nations.	SH 171 R42 1991
Aquaculture. Farming Aquatic Animals and Plants. 2nd edition 2012. J. Lucas and P. Southgate (Editors), 629 pp.	SH 21 A68 2003
Encyclopedia of Aquaculture. (2000). R. Stickney (Editor)	SH 20.3 E53
Principles of Aquaculture. R Stickney	SH 135 S74 1994
Introduction to aquaculture. M. Landau	SH 135 L36 1992
Ecological Aquaculture. The evolution of the blue revolution B. Costa-Pierce	SH 135 E35 2002
Cold-water aquaculture in Atlantic Canada A. Boghen	SH 37 C64 1995

Course Assessment

Component	Weight (% of final grade)		Date
	Undergraduate	Graduate	
Weekly Quizzes	20	15	See table in Couse Content below for specific dates
Laboratories	30	25	
Physiology model (Short report)	-	7.5	
Physiology model (Python code)	-	7.5	
Midterm	10	10	
Student project (Long report)	20	15	
Final Exam	20	20	Determined by Registrars Office
Participation in Discussion Boards	2% bonus	2% bonus	Continuously
TOTAL	**/100**	**/100**	

All components are individual (i.e. not in teams)

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Weekly Quizzes

Quizzes are designed to test you on the material from lectures. Quizzes are based on the **.PDF lecture-notes** uploaded to Brightspace. Quizzes are online (approx. 10 minutes) and are applied via Brightspace. We will use Dalhousie's software to prevents other software to run in your laptop during the exam, and to use your laptop's webcam to record your quiz session and flags any suspicious behavior.

- **In person:** If in person teaching, quizzes will be done during lecture time as shown in the schedule.
- **On-line:** If we switch to online format, each quiz will be available for 24 hours, dates are the same as if "in person" (see specific due dates in the schedule below), however the closing time will be different… at 11:30 pm. Students can answer the quiz at anytime during those 24 hours; however, there is set amount of time to answer the quiz once it is started, and there is only one attempt.

Students are **required** to make and use a **hand-written "cheat-sheet"** for each Quiz. **A photo of the cheat-sheet must be uploaded to its corresponding Brightspace dropbox BEFORE you do the quiz.** Cheat-sheets not meeting specifications (see below) will result in a zero grade on the corresponding quiz.

Cheat-sheet specifications:

- Cheat-sheets are personal. **Copying somebody else's cheat-sheet is a serious plagiarism offence** requiring the Instructor to report all involved parties to the Academic Integrity Office.
- Cheat-sheets **MUST** be hand-written on paper. Digitization, electronic manipulation, photocopying, photographing and/or printing of cheat-sheets is not allowed.
- On your cheat-sheet, write your name, B00 number, date and Quiz number
- Size: each cheat-sheet is limited to one side of a letter-sized sheet of paper.
- Content: Anything you want, but **must** demonstrate an effort to synthetize lecture content.

Missed quizzes. There are no makeup quizzes. However, the quiz with the lowest mark will be automatically dropped so that it does not count towards the final grade. Therefore, students can miss **one** quiz during the course (for any reason) without any penalty. Students that enrol late can get exemptions for the quizzes missed before they enrolled to the class (up to two weeks from the start of class). Students with prolonged illness and other extenuating circumstances can contact the instructor to arrange for further quiz exemptions. Please read the instructions below (Course Policies > Missing course requirements) on how to submit an SDA form and ask for quiz exemptions.

Laboratories

Most classes have a lab requiring students to run Python code in their computers (see instruction below on how to install Python). Interspersed within the lab instructions are several questions, which must be answered in the corresponding **Brightspace Lab quiz** (titled "LAB# - Lab Title"). Each Brightspace lab quiz can be accessed for one week (due dates shown in schedule below).

How to install Python

- Go to: https://www.anaconda.com/products/distribution#Downloads
- Download the "Graphical Installer" for your operating system (i.e. Windows or MacOS)
- Open the download file and follow instructions
- Note that you will be downloading the free "Individual Edition" of Anaconda
- Feel free to search YouTube for tutorials (hint: sort results by upload date. Choose a recent video)

Missed laboratories: Since there is one week to finish each lab, it is not usual to grant extensions. The exception are students that enrol late, in which case a due date extension can be granted for the labs missed before they enrolled to the class (up to two weeks from start of class). There may be other, very extenuating circumstances, in which an extension may be granted. Students are strongly encouraged to notify the instructor of any conflict well in advance of the lab due date. If you are late to register, or have extenuating circumstances, please read the instructions below (Course Policies > Missing course requirements) on how to submit an SDA form and ask for an extension.

Physiology model (Grad students only)

Each graduate student will choose a peer-reviewed publication describing a physiological model for an aquatic species that is either suitable for cultivation, or that is known to interact with aquaculture species. Articles (i.e. full reference) need to be posted in a Brightspace discussion board to avoid duplication. In case of duplication, the first post stays, the others must find another article.

Students must use the model equations in their chosen article to write the model in Python, and prove the model works (i.e. conserves mass, etc.). Students must (1) hand in a short report, and (2) hand in the python code running the model. All the models will be uploaded to a repository and be made available to entire class so that the can all be used, if needed, in the student projects.

Rubric: Physiology model (Python code)

Component	Comments	Weights (%)	
		Undergraduate	Graduate
Model functioning	Does the model run?	-	50%
Commenting	Is the model adequately commented? In the comments, include the full reference of the peer-reviewed article where the model was published Also include a list of names of people that worked on the code (credits)	-	50%
		-	100%

Rubric: Physiology model (Short report)

Component	Comments	Weights (%)	
		Undergraduate	Graduate
Summary	Brief description of the work and findings. Maximum length: 1 page	-	10%
Model Diagram	Visual representation of all variables and processes of the model	-	10%
Table of symbols and units	List of symbols and units used in the model	-	10%
Table of parameters	List of all parameters (name and value used) as well as references justifying used values	-	10%
Test mass conservation	Prove that model conserves mass (include graphs with captions and correct units)	-	10%
Model run examples	Show 2 or 3 model simulations (include graphs with captions and correct units)	-	10%
Discussion	Did the article had all the information needed for you to write the model? Did you find any errors in the article? If you ran into road blocks, how did you dealt with them? Any other comments about the model?		35%
References	Format: Ecological Modelling Journal	-	5%
	TOTAL:	-	100%

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Midterms and Final exam

These exams are online via Brightspace with Dalhousie's software to prevents other software to run in your laptop during the exam, and to use your laptop's webcam to record your quiz session and flags any suspicious behavior. The format is multiple choice and/or short answers. You **are allowed** to use your cheat-sheets during these exams. These exams will be synchronous. Date/time of the midterm is shown in the schedule below. For Final exam, date/time will be determined later by the Registrars Office.

The exams will include material from the lectures, quizzes, and discussion boards. The midterm will include content from the beginning of the course and up to the material covered on the week of the midterm. The Final Exam will include all the material included in the course.

Missed exams: In extenuating circumstances, a make up exam may be scheduled for students that cannot take the exam at the normal date/time (note: heavy course load and travel are not normally considered extenuating circumstances). Students are strongly encouraged to notify the instructor of any conflict well in advance of the start of the normal exam. Make up exams are commonly scheduled before the date/time of the regularly scheduled exam. There is usually only one make up exam. For the midterm exam, students that cannot attend neither the regularly scheduled exam nor the makeup exam, the weight of the missed midterm will be added to the weight of the final exam. If you have extenuating circumstances, please read the instructions below (Course Policies > Missing course requirements) on how to submit an SDA form and ask for make up exam.

Participation in Discussion Boards

You are expected to contribute to the discussion boards (questions **AND ANSWERS**). Please follow the posting guidelines below:

- Before you post your question, **CHECK** if the question has already been asked/answered
- Post only ONE question per post. If you have multiple questions, post them in separate posts
- The post's TITLE should be your question
- If you know the answer to a question, please help by answering the post
- Be respectful and polite

Participation grades will be computed at the end of the course. First, *engagement points* (see below) will be tallied for each student. Then, a curve will be calculated (after removing outliers) to compute the participation bonus points for each student.

Item	Score (units: engagement points)
New question	1
Already posted question	0 for the first 3 events, -1 for additional events
Correct answer	1
Partially correct answer	0.5
Incorrect answer	0 for the first 3 events, -1 for additional events
Useful comment or sharing a link to a useful resource	1
Using offensive tone or language	-1

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Student project (Long report)

Each student will work on a student project requiring to do a substantial written report. The project requires the use of an aquaculture-environment model to estimate the effect of aquaculture operations on the environment and to estimate the Environmental Carrying Capacity of the farm. Students can use the ecosystems models provided in class, or the ones contributed by the graduate students. For their projects, each student will need to apply their aquaculture-environment model to an "idealized" aquaculture farm, defined by an environment (shape of bay, depth, currents, tides, temperature, etc.) as well as the cultured species (one or more) and culture system(s). The final written report is due at the end of the term.

Rubric: Student project (Long report)

Undergraduates and graduate students are marked the same. However, the total mark of the report is weighed differently in the final grade calculation (see "Course Assessment section).

Section		Description	Points
Summary		• Include a concise overview of your project (including introduction, methods, results, discussion and conclusions) • One paragraph, maximum 350 words • Similar to an abstract	**3**
Introduction		• Give a very brief background and introduction to aquaculture and aquaculture modeling (why it is used, why it is important etc. Draw from the literature). 1-2 paragraphs. **1 point** • Include the culture area, type of organism(s) and culture method you are modeling. **2 points** • Include some details about the model you are using. **1 point** • Discuss the objectives of your project (i.e., what are the goals of this paper?) 1 paragraph. **1 point** • State what you think will happen (hypothesis) and what you hope to gain from this project. **1 point** • Do not go into depth – you will do this in your methods	**5**
Methods	**Description of Environment**	• Describe the location of your site and the type of site you are using (lake, bay, open ocean, recirculation system) as well as the physical dimensions (average length, width, depth) and any relevant geological features (bathymetry etc.). **1.5 points** • Discuss the relevant physical (salinity, temperature, density etc.), chemical (i.e. pH) and biological variables (i.e. impacted by spring algal blooms) of your site and report any other relevant water quality parameters (i.e. organic or inorganic constituents). **2 points** • Produce an original figure of your site, outlining any important characteristics within the figure. If adapted, reference properly. **1.5 points**	**5**
	Description of Model	• Discuss and describe the model being used for this project • Describe and reference any supplementary data or data files being used to run your model • Reference appropriately	**5**

	Model Diagram	• Include an original visual diagram (i.e. figure) of all model processes (i.e. Ibarra et al. 2014) **5 points**
		  o Represent all relevant model processes
		  o Do not copy and paste from another paper; adapt your own
		  o If your model is adapted from another paper, reference appropriately
		• Include an adequate figure title. **1 point**
			6

	Table of Symbols and Units	• List all symbols and their units in the model. **2.5 points** • Define all symbols used. **1.5 points** • **Do not** include parameters – these will be defined in your "Table of Parameters" • May be put in your appendix, but must be referenced somewhere in your methods section	**4**
	Table of Parameters	• List and define all parameters used in the model. **3.5 points** • Define values and units of parameters used in the model. **1.5 point** • Reference all parameters appropriately. **1 point** • May be put into your appendix, but must be referenced somewhere in your methods section	**6**

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	Sensitivity Analysis	• Describe what a sensitivity analysis is and why you are conducting one for your model. Reference if appropriate. **1 point** • Describe how the sensitivity analysis will be carried out by the model. **2 points** • Describe at what threshold you consider a variable **unreasonably sensitive.** Justify this**.** Reference if appropriate. **1 point**	**4**
	Mass Conservation	• Describe what it means to test mass conservation and why you are testing it for your model. Reference if appropriate. **1.5 point** • Describe how your model tests mass conservation. **1.5 points**	**3**
	Production Carrying Capacity	• Define production carrying capacity. Reference if appropriate. **1.5 point** • Describe how your model will be used to calculate production carrying capacity (i.e. how does your model produce its outputs?) and how you will estimate carrying capacity. **2.5 points**	**4**
	Environmental Impacts and Carrying Capacity	• Describe the parameters used to determine the environmental impacts of your farm (i.e. oxygen and ammonia) and why you are using them. Reference if appropriate. **2 points** • Describe how the model will calculate the environmental impacts of your farm. **2 points** • Describe how you will calculate environmental carrying capacity using your model. **1 point**	**5**
You may arrange the order of your methods section as you see fit			
Results	**Sensitivity Analysis**	• Produce graph of your sensitivity analysis with proper units, axis labels, axis titles (**2 points**) and an adequate figure caption (**1 point**) • Text should describe (not discuss) the results of the sensitivity analysis. Text should refer to figure. Figure should come after the paragraph where it is first referenced. **1 point**	**4**
	Mass Conservation	• Produce graph of your mass conservation analysis with proper units, axis labels, axis titles (**2 points**) and an adequate figure caption (**1 point**) • Text should describe (not discuss) the results of the mass conservation test. **1 point** • Text should describe (not discuss) the results of the sensitivity analysis. • Text should refer to figure. Figure should come after the paragraph where it is first referenced.	**4**
	Production Carrying Capacity	• Produce a graph of your production carrying capacity analysis with proper units, axis labels, axis titles (**2 points**) and an adequate figure caption (**1 point**). Your production carrying capacity value should be outlined on your graph (i.e. with a vertical line or equivalent). • Text should describe (not discuss) the results of this section and your estimated production carrying capacity. **1.5 point** • Text should refer to figure. Figure should come after the paragraph where it is first referenced.	**4.5**
	Environmental Impacts and Carrying Capacity	• Produce graphs of your environmental impact analyses. Include proper units, axis labels, axis titles (**2 points each**) and an adequate figure caption (**1 point each**) for each graph. Your carrying capacity values should be outlined on your graph (i.e. with a vertical line or equivalent) **6 points** • Text should describe (**not discuss**) the results of this section and your estimated carrying capacities for oxygen, ammonia and overall (i.e. ecological) carrying capacity. **3 points** • Text should refer to figure. Figure should come after the paragraph where it is first referenced.	**9**
You may arrange the order of your results section as you see fit			
	Discussion	• Discuss the meaning and implications behind your results. Back up (or contrast) your findings with peer-reviewed literature. Do not just repeat your results. • Discuss your overall carrying capacity • Should include caveats and ideas for future research • Your discussion should be **~ 3-5 paragraphs**	**6**
	Conclusions	• A concise recap of your report and major findings. 3-5 sentences.	**3**
	References	• All references included • All material referenced appropriately • In-text citations are consistent and correct • Formatting is consistent. Follow format from "Ecological Modelling Journal"	**2.5**

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Appendix	**Model Equations**	• Include and define all differential and ancillary equations used in your model • Do not screen-shot equations. Ideally, use Microsoft Word equation tool	**7**
	Code	• Include code for entire model • Code must be appropriately commented • Code must run properly and be error-free	**5**
Style and Structure		• 12 pt. font • Double spaced • All report sections included • Writing is logical and easy to read • Writing is free of spelling and grammatical errors • Figures referenced appropriately in text • Figures placed immediately after paragraph where they are referenced	**5**

Conversion of numerical grades to Final Letter Grades

Undergraduate students follows the Dalhousie Common Grade Scale. Graduate students follow a stricter scale, where a minimum of 70% (B-) is required to pass.

	Undergraduate			Graduate		
%	**Letter Grade**	**Grade Point Value**	**Definition**	**Letter Grade**	**Grade Point Value**	**Definition**
90 - 100	**A+**	4.30	Exceptional	**A+**	4.30	Exceptional
85-89	**A**	4.00	Excellent	**A**	4.00	Excellent
80-84	**A-**	3.70	Very Good	**A-**	3.70	Very Good
77-79	**B+**	3.30		**B+**	3.30	
73-76	**B**	3.00	Good	**B**	3.00	Good
70-72	**B-**	2.70		**B-**	2.70	
65-69	**C+**	2.30	Satisfactory	**F**	0.00	Failure
60-64	**C**	2.00		**F**		
55-59	**C-**	1.70		**F**		
50-54	**D**	1.00	Marginal Pass	**F**		
<50	**F**	0.00	Failure	**F**		

Course Policies

Questions. All questions MUST be posted in Brightspace's Discussion boards (see posting guidelines above). Only use email for private/personal matters.

Missing or late academic requirements. If you qualify for a quiz exemption or a make up exam (see policies in Course Assessment section above), please:

- Email **both**, the TA and the Instructor, briefly explaining your circumstance and dates.
- Fill in a Student Declaration of Absence (SDA) form and upload it to the Brightspace Dropbox designated for SDAs.
- Students with an Accessibility or Accommodation Plan in place **do not** need to submit SDA form.
- For extenuating circumstances (e.g. prolonged illness, family matters, etc.) contact the instructor.

Brightspace will be used to post lectures, updates and announcements.

Late assignments: A 10% reduction in grade will be applied for every day an assignment is late.

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Assignment submission: Assignments should be submitted via Brightspace as .pdf file by 11:30 pm on the due date.

Course Content

All dates and times are in **Halifax Time** (ADT/UTC-3 or AST/UTC-4). Note that quizzes, exams and other due dates are shown in red.

Week	Date	Content
1	Fri, Sep 9 @ 11:35 am	Lecture: Introduction to Aquaculture Modelling
	Fri, Sep 9 @ 11:30 pm	Lab: Python basics and course teaser
2	Fri, Sep 16 @ 11:35 am	Lecture: Introduction to ecosystem (NPZ) modelling
	Fri, Sep 16 @ 11:30 pm	Quiz: Introduction to Aquaculture Modelling
	Fri, Sep 16 @ 11:30 pm	Lab: Building a simple plankton-mussel model (NPZM) from scratch
3	Fri, Sep 23 @ 11:35 am	Lecture: Modelling physiology (energy budgets)
	Fri, Sep 23 @ 11:30 pm	Quiz: Introduction to ecosystem (NPZ) modelling
	Fri, Sep 23 @ 11:30 pm	Lab: Coding a mussel physiology model (SHELL-E) from the equations in a peer-reviewed paper
	Fri, Sep 23	Grad students should start working on their "Physiology Model" code
4	Fri, Sep 30	No class (National Day for Truth and Reconciliation)
5	Fri, Oct 7 @ 11:35 am	Lecture: Water-column physical variables 1
	Fri, Oct 7 @ 11:30 pm	Quiz: Modelling physiology (energy budgets)
	Fri, Oct 7 @ 11:30 pm	Lab: Forcing SHELL-E model with temperature from satellites (POES, AVHRR and GAC)
6	Fri, Oct 14 @ 11:35 am	Midterm: Included content from weeks 1 to 4
	Fri, Oct 14 @ 11:30 pm	Lab: Coupling SHELL-E to a NPZD2 plankton model
7	Fri, Oct 21 @ 11:35 am	Lecture: Water-column physical variables 2
	Fri, Oct 21 @ 11:30 pm	Lab: SHELL-E / NPZD2 Pond with Oxygen
8	Fri, Oct 28 @ 11:35 am	Lecture: Water-column biogeochemical variables
	Fri, Oct 28 @ 11:30 pm	Quiz: Water-column physical variables 2
	Fri, Oct 28 @ 11:30 pm	Due date (Grad students only): Physiology model short report AND code
	Fri, Oct 28 @ 11:30 pm	Lab: Applying SHELLE-NPZD2 to an embayment with an Open Boundary and Climatology forcing (eutrophication and oxygen depletion)
9	Fri, Nov 4 @ 11:35 am	Lecture: Carrying Capacity and Sensitivity Analysis
	Fri, Nov 4 @ 11:30 pm	Quiz: Sediments: Water-column biogeochemical variables
	Fri, Nov 4@ 11:30 pm	Lab: Carrying Capacity and Sensitivity Analysis
	Fri, Nov 4	All students should start working on their Student projects (Long report)
10	Mon, Nov 7… …Fri, Nov 11	Reading week
11	Fri, Nov 18 @ 11:35 am	Lecture: Sediment biogeochemical variables
	Fri, Nov 18 @ 11:30 pm	Quiz: Carrying Capacity and Sensitivity Analysis
	Fri, Nov 18 @ 11:30 pm	Lab: Adding fish and macroalgae to SHELL-E/NPZD2
12	Fri, Nov 25 @ 11:35 am	Lecture: Multi-Trophic Aquaculture and interactions with wild fauna and flora
	Fri, Nov 25 @ 11:30 pm	Quiz: Sediment biogeochemical variables
	Fri, Nov 25 @ 11:30 pm	Due date: Student projects (Long report)
13	Fri, Dec 2 @ 11:35 am	Final exam: Includes all content from lectures (no labs)

Note that the schedule may chance in short notice depending on university closures (e.g. weather) and pace of class delivery. Any changes will be posted in Brightspace.

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University Policies and Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity.

Information: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).

Information: https://www.dal.ca/campus_life/academic-support/accessibility.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.

Code: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness

Statement: http://www.dal.ca/cultureofrespect.html

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit or e-mail the Indigenous Student Centre (1321 Edward St) (elders@dal.ca).

Information: https://www.dal.ca/campus_life/communities/indigenous.html

Important Dates in the Academic Year (including add/drop dates) https://academiccalendar.dal.ca/Catalog/ViewCatalog.aspx?pageid=viewcatalog&catalogid=117&chapterid=-1&topicgroupid=31821&loaduseredits=False

University Grading Practices

https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

DALHOUSIE UNIVERSITY

Student Resources and Support

Advising

General Advising https://www.dal.ca/campus_life/academic-support/advising.html

Science Program Advisors: https://www.dal.ca/faculty/science/current-students/undergrad-students/degree-planning.html

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Black Students Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre/current-students.html

Academic supports

Library: https://libraries.dal.ca/

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Studying for Success: https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Copyright Office: https://libraries.dal.ca/services/copyright-office.html

Fair Dealing Guidelines https://libraries.dal.ca/services/copyright-office/fair-dealing.html

Other supports and services

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness.html

Student Advocacy: https://dsu.ca/dsas

Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Safety

Biosafety: https://www.dal.ca/dept/safety/programs-services/biosafety.html

Chemical Safety: https://www.dal.ca/dept/safety/programs-services/chemical-safety.html

Radiation Safety: https://www.dal.ca/dept/safety/programs-services/radiation-safety.html

Scent-Free Program: https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html

Dalhousie COVID-19 information and updates: https://www.dal.ca/covid-19-information-and-updates.html