Draft Syllabus: AQUACULTURE AND FISHERIES BIOTECHNOLOGY

Memorial University of Newfoundland
Department of Ocean Sciences
Winter Semester, 2021

Aquaculture and Fisheries Biotechnology, OCSC 3002

- This course will be delivered remotely this semester due to COVID-19.

Lectures: Asynchronous (Powerpoint files with recorded audio for each slide; lectures posted on Brightspace)

- ~ 3 lectures with recorded audio (~ 50 minutes each lecture) will be posted on Brightspace each week.

- Assigned readings will be posted on Brightspace to complement the lectures.

- It will be helpful if you can keep up with the material (i.e. assigned readings and lectures on Brightspace) and not fall behind.

Prerequisites for OCSC 3002: OCSC 1000 and Biology 2250 (or Biochemistry 2100)

Instructor: Matthew Rise, Ph.D., Professor, Department of Ocean Sciences, MUN
Office phone: 709-864-7478; Email: mrise@mun.ca

Office hours and class meetings: Fridays from 1 pm to 3 pm will be set aside for office hours and other “in-person” aspects of this course. If there are class meetings (e.g. discussions or tutorials), they will be scheduled for Fridays between 1 pm and 2 pm (i.e. a regular meeting time for OCSC 3002 in past years); notification of a class meeting will be sent out to all students by email in advance. Class meetings will be via WebEx (with links sent to students via email), and office hours will be by appointment (and using Zoom, WebEx, Skype or phone). My office hours can be extended if needed.

For a rapid response via email, please contact me at the following: mrise@mun.ca

The textbook is available for purchase in the MUN Bookstore or on-line.

A link to this textbook is: https://onlinelibrary.wiley.com/doi/book/10.1002/9781444318791

Some reading assignments may come from books such as:


Outside of the textbook (Beaumont et al. 2010), reading assignments will be posted on Brightspace. Course materials will also come from primary literature (e.g. open access journal articles) posted on Brightspace.
OCSC 3002 Course Outline, Schedule, and Method of Evaluation

Biotechnology has had, and continues to have, a profound influence on aquaculture and fisheries research. This course will build on the foundation of introductory biology and genetics, and provide students with information on the theory and application of biotechnology to the study of farmed and wild aquatic organisms. Aquaculture and Fisheries Biotechnology (OCSC 3002) is a lecture-based course. Topics covered include:

- defining genetic variation (including a brief review of the principles of genetics);
- measuring genetic variation (including aquaculture and fisheries relevant applications of various molecular techniques, e.g. PCR, cloning, sequencing);
- genetic structure of fish and shellfish populations;
- genetics of population size in conservation and aquaculture;
- genetic basis of aquaculture traits (including qualitative and quantitative traits);
- introduction to finfish and shellfish genomic research;
- applications of genomics in fisheries and aquaculture research;
- marker-assisted selection in aquaculture;
- manipulation of ploidy;
- genetic engineering in aquaculture;
- vaccine development in aquaculture (guest lectures by Dr. Javier Santander);
- techniques used to study the responses of aquatic animals to different diets, immune stimulation, or external stressors (e.g. temperature stress, handling stress, acidification, hypoxia, pollutants);
- ethical issues that may be associated with aquaculture biotechnology.

Background theory on techniques (e.g. microsatellite and SNP genotyping used to study the genetic structure of fish and shellfish populations; microarrays and other tools for studying the genetic basis of aquaculture traits or the impact of stressors on aquatic organisms; production of reproductively sterile triploids; generation of transgenic organisms) will be provided in lectures. The lectures will be based on the content of the text (Biotechnology and Genetics in Fisheries and Aquaculture, Second Edition; A. Beaumont et al. 2010) and other assigned reading. Open access papers in peer-reviewed journals that demonstrate the application of biotechnology in aquaculture or fisheries research will be placed in “Course Content” on the Brightspace web site as assigned reading, and students will be required to write a summary on one of these papers approximately every two weeks. This course has approximately 3 hours of lecture per week.
Course Schedule

- Note: Most research articles that are included as assigned reading are Open Access papers. You can access these papers by querying PubMed with key words (e.g. author surnames) or from the journal home pages.

During each week of the semester, we will cover topics from the text and/or assigned readings. (Note: Additional assigned readings, including the papers for written critiques, will be posted on Brightspace.) Topics to be covered include:

**Week 1 (Jan. 7, 8):** Genetic variation (including a brief review of the principles of genetics and molecular biology).
Assigned reading: Textbook chapter 1 (What is genetic variation?)

**Week 2 (Jan. 11 - 15):** Techniques used to measure genetic variation (e.g. cloning, PCR, qPCR, electrophoresis, DNA sequencing); MSDS for reagents used in molecular biology (e.g. ethidium bromide; TRIzol); mitochondrial genetics and genomics in fisheries and aquaculture research; aquaculture vaccine development
Jan. 14 assigned reading: Textbook chapter 2 (How can genetic variation be measured?)
Jan. 14 assigned reading: To be posted on Brightspace.
- The first paper for 2-page written critique will be assigned on January 12th.

**Week 3 (Jan. 18 - 22):** Techniques used to measure genetic variation, continued (e.g. SNPs, RFLPs, VNTR, RAPD).
Assigned reading: Textbook chapter 2 (How can genetic variation be measured?)
Additional assigned reading to be posted on Brightspace.
- The first 2-page written critique is due on January 22nd.

**Week 4 (Jan. 25 - 29):** Techniques used to measure genetic variation, continued.
Assigned reading: Articles related to the biotechniques discussed in class will be placed on Brightspace as assigned reading.
- The second paper for 2-page written critique will be assigned on January 26th.
**Week 5 (Feb. 1 - 5):** Genetic structure of fish and shellfish populations.
Assigned reading: Textbook chapter 3 (Genetic structure in natural populations).
- The second 2-page written critique is due on **February 5th**.

**Take-home Midterm Exam 1:**
- Posted on Brightspace **February 9th**
- Due by 3 pm **February 12th** (Send to Dr. Rise via email.)

**Week 6 (Feb. 8 - 12):** Genetics of population size in conservation and aquaculture.
- The third paper for 2-page written critique will be assigned on **February 9th**.

**Week 7 (Feb. 15 - 19):** An introduction to finfish and shellfish genomic research.
Assigned reading: Textbook chapter 6 (From genetics to genomics). Open access papers will be posted on Brightspace.

**Note:** There will be “vaccinology in aquaculture” guest lectures.
- The third 2-page written critique is due on **February 19th**.

The fourth paper for 2-page written critique will be assigned on **February 19th**.
- **Papers for student presentations will be assigned by February 19th.**

**Week 8 (Feb. 22 - 26):** Winter Semester Break – no classes.

**Week 9 (March 1 - 5):** Genomics applications in aquaculture and fisheries, continued; marker-assisted selection in aquaculture.
Assigned reading: Open access papers will be posted on Brightspace.
- The fourth 2-page written critique is due on **March 5th**.

**Wk 10 (March 8 - 12):** Next-generation sequencing applications in fisheries and aquaculture research.
Assigned reading: Will be posted on Brightspace.
The fifth paper for 2-page written critique will be assigned on March 9th.

**Take-home Midterm Exam 2:**
- Posted on Brightspace March 16th.
- Due 3 pm March 19th (Send to Dr. Rise by email.)

**Wk 11 (Mar. 15 - 19):** Biotechnology used to study the responses of aquatic animals to different diets or external stressors (e.g. temperature stress, hypoxia, pollutants, and pathogens). Manipulation of ploidy in aquaculture (e.g. production of reproductively sterile triploid fish).

Assigned reading: Textbook chapter 7 (Triploids and beyond: why manipulate ploidy?). Additional assigned reading will be posted on Brightspace.

**Wk 12 (Mar. 22 - 26):** Student presentations due (emailed to Dr. Rise) by March 23rd. These will be placed on Brightspace for all students to review, and will be included on the take-home Final Exam.
- The fifth 2-page written critique is due on March 26th.

**Wk 13 (Mar 29, Apr 1, 2):** Genetic engineering in aquaculture (e.g. generation of transgenic organisms); Other topics in aquaculture and fisheries biotechnology.

Assigned reading: Textbook chapter 8 (Genetic engineering in aquaculture). Additional assigned reading will be posted on Brightspace.

**Week 14 (April 5 - 9):** Genetic engineering in aquaculture (e.g. CRISPR-Cas9); Other topics in aquaculture and fisheries biotechnology

Assigned reading: To be announced.

**Take-home Final Exam:** Posting and due dates to be announced.
Assignments: Written Critiques

Each student is required to write a 2-page (double-spaced) critique of one open-access marine omics-related article approximately every two weeks (see “5 assignments” below, and page 10 of this document). Students may choose between two or three options (placed on Brightspace) for each article critique. Each student must work independently on these written critiques. They are not group assignments.

The 5 assignments (i.e. written critiques of marine omics related articles) will be evaluated based on the following criteria:

- **Summary** (i.e. overview) of the paper (including hypotheses/objectives, methods, experimental design, primary results, and conceptual advancement);
- **Analysis/evaluation**: Outline and justify strengths and weaknesses of different parts of the paper (e.g. abstract, introduction, methods, results, discussion, conclusions), including comments on the organization and writing quality/style;
- **Organization/quality of writing** (e.g. grammar, spelling, sentence structure, organization, etc).
- For additional details on critique guidelines, please see page 10 of this document.

Finally, each student will create a Powerpoint presentation on an open access paper in the field of Aquaculture or Fisheries Biotechnology (see “Student presentation” below); this will be accompanied by a Doc file that provides a script (i.e. text of what you would say about each slide if you were giving an oral presentation). Guidelines for the student presentations will be provided on Brightspace. The articles for these presentations will be assigned by **February 19th**, and student presentations should be submitted to Dr. Rise via email by **March 23rd**. Student presentations will be posted on Brightspace, and content from these presentations will be included on the Final Exam.

**OCSC 3002 Evaluation**

- Take-home Midterm Exam 1: 20%
- Take-home Midterm Exam 2: 20%
- Take-home Final Exam (Date TBA): 25%
- 5 assignments (5% each): 25%
- Student presentation: 10%

**Total: 100%**
The following statement is in regard to Memorial University’s commitment to accommodation of students with disabilities:
“Memorial University of Newfoundland is committed to supporting inclusive education based on the principles of equity, accessibility and collaboration. Accommodations are provided within the scope of the University Policies for the Accommodations for Students with Disabilities (www.mun.ca/policy/site/policy.php?id=239). Students who may need an academic accommodation are asked to initiate the request with the Glenn Roy Blundon Centre at the earliest opportunity (www.mun.ca/blundon)."

The following statement is in regard to Memorial University’s policy on academic integrity:
“Students are expected to adhere to those principles which constitute proper academic conduct. A student has the responsibility to know which actions, as described under Academic Offences in the University Regulations, could be construed as dishonest or improper. Students found guilty of an academic offence may be subject to a number of penalties commensurate with the offence including reprimand, reduction of grade, probation, suspension or expulsion from the University. For more information regarding this policy, students should refer to the University Regulations for Academic Misconduct (Section 6.12) in the University Calendar.”
How written critiques of articles are evaluated (10 points total per critique)
OCSC 3002

**Length of critique:** 2 pages double-spaced

**Summary/Presentation (4 points out of 10)**

Expected: a brief, accurate outline of the general subject/problem/research and its central idea, including a summary of the major findings and conclusions. Key omics methods utilized in the research should be mentioned. This section should be approximately one page double-spaced.

**Analysis/Evaluation (4 points out of 10)**

This component of the grade is based on how you analyzed the various parts of the paper to assess its *strengths* and *weaknesses* (accounting for your level of knowledge). Considering both strengths and weaknesses generally allows a more thorough and more persuasive critique by presenting a balanced view. The grade is based on the following criteria: the variety of aspects you analyzed and critiqued (coverage, 1 point), your ability to find and present both strengths and weaknesses (balance, 1 point), and how well you supported your arguments (2 points). This section should be approximately one page double-spaced.

Some questions you might consider (of course, not all are appropriate for every paper):

- Did the title adequately convey the main subject or message of the paper?
- What was the main objective/purpose of the research, study or work? Did the author(s) meet this objective?
- As far as you know, did the paper describe new work, new results, or a new theory or interpretation? Or did the paper provide valuable confirmation of previously published information?
- Were the different sections of the article well balanced? Did the paper read well?
- Were the methods sufficiently detailed to understand or replicate the study? How adequate were the methods and the controls used?
- Who was the intended audience? Was the writing style appropriate for this audience?
- Did the author(s) properly define any jargon they used?
- Were illustrations, tables or figures used to good effect? Did they complement the text? Were they the best method to present data or were they unnecessary or overly complex?
- Were the conclusions justified? Was interpretation adequate, or perhaps not fully warranted by the data (e.g. important omissions or loose generalisation).
- Did the author(s) suggest areas for further research or discussion?
- What was the size of the reference section? Were recent references included? Were references used for both support and rebuttal? Was proper respect given to pioneer work on the topic?
- What did you take out of this paper? Any suggestions for future work in this field?

**Organization (2 points out of 10)**

Critical reviews should be coherent and allow the reader to go smoothly from one part to another and follow your arguments. You do not necessarily need to use formal sections or subheadings; more importantly, transitions between sentences and paragraphs must provide logical flow.

**Typos/grammatical errors**

2-5: -0.25 of a point  
5-10: -0.5 of a point  
>10: -0.75 of a point