Syllabus: AQUACULTURE AND FISHERIES BIOTECHNOLOGY

Memorial University of Newfoundland
Department of Ocean Sciences
Winter Semester, 2020

Aquaculture and Fisheries Biotechnology, OCSC 3002
Lecture Room SN 1019
Lecture: Tuesday and Thursday, 12:00 – 12:50 pm; Friday 1:00 – 1:50 pm
Prerequisites for OCSC 3002: 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: My office is at the Ocean Sciences Centre (1 Marine Lab Road, St. John's) in the Annex Building (room AX3001 in the back of my lab). I will be available to meet with you in person in my office, or by phone or Skype, every Friday from 9 am to 11 am. I can also meet with you at other times by appointment if needed.


The textbook is available for purchase in the MUN Bookstore or on-line. I will put my own copy of the textbook on 2-hour reserve in the library for this course.

Examples of relevant books in the QEII library (Note: Some reading assignments may come from these books):


Course materials will also come from other books and primary literature posted on Brightspace. Some handouts will be provided.
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 lecture 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 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, 9, 10):** 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. 14, 16, 17):** 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.

**Note:** There will be a “mitochondrial DNA” guest lecture on January 17th.
- The first paper for 2-page written critique will be assigned on January 14th.

**Week 3 (Jan. 21, 23, 24):** Techniques used to measure genetic variation, continued (e.g. SNPs, RFLPs, VNTR, RAPD).
Assigned reading: Textbook chapter 2 (How can genetic variation be measured?)

- The first 2-page written critique is due on January 24th.

**Week 4 (Jan. 28, 30, 31):** 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.

**Note:** There will be a “fish immune relevant gene characterization” guest lecture on January 31st.
- The second paper for 2-page written critique will be assigned on January 28th.
Week 5 (Feb. 4, 6, 7): **Midterm Exam 1 (February 7th)**

Before midterm exam: 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 7th**.

Wk 6 (Feb. 11, 13, 14): Genetics of population size in conservation and aquaculture.
**Note:** There will be a “Genetic tools for population analyses of marine species” guest lecture on February 14th.
- The third paper for 2-page written critique will be assigned on February 14th.

Week 7 (Feb. 18-21): Winter Break – no classes.

Week 8 (Feb. 25, 27, 28): 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 a “vaccinology in aquaculture” guest lecture on Feb. 28th.
- The third 2-page written critique is due on **February 25th**.

The fourth paper for 2-page written critique will be assigned on February 25th.
- **Papers for student oral presentations will be assigned by February 27th.**

Week 9 (March 3, 5, 6): Genomics applications in aquaculture and fisheries, continued; marker-assisted selection in aquaculture.
Assigned reading: Open access papers will be posted on Brightspace.
**Note:** There will be an “aquaculture transcriptomics” guest lecture on March 5th.

**Midterm Exam 2 (March 6th)**
- The fourth 2-page written critique is due on **March 6th**.
**Wk 10 (March 10, 12, 13):** 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 10th.

**Wk 11 (Mar. 17, 19, 20):** 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.

**Note:** There will be a “manipulation of ploidy in aquaculture” guest lecture on March 19th.

**Note:** There will be a “transgenics in aquaculture” guest lecture on March 20th.
- The fifth 2-page written critique is due on March 20th.

**Wk 12 (Mar. 24, 26, 27):** Student presentations will occur during the lecture times this week.

**Wk 13 (Mar 31, Apr 2, 3):** 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.

**Note:** There will be a guest lecture on the use of biotechnology in aquaculture immunology research on April 2nd.

**Note:** There will be a guest lecture on the field of transgenics in aquaculture on April 3rd.

**Final Exam:** Date and location to be announced.
Method of Evaluation

Each student will be required to write a 2-page (double-spaced) critique of one open-access paper approximately every two weeks (see "5 assignments" below). The rubric for marking these critiques is on page 8 of this document. Each student must work independently on these written critiques. They are not group assignments.

The 5 assignments (i.e. written critiques of 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);
- 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;
- The quality of your writing (e.g. grammar, spelling, sentence structure, organization, etc) will also be evaluated.

Critiques must be turned in by the due dates provided in this syllabus. Critiques may be brought to class (as hard copies) or emailed to the instructor at: mriseng@mun.ca

Finally, students will work in groups of 2 on Powerpoint presentations on open access papers in the field of Aquaculture and Fisheries Biotechnology (see “Student oral presentation” below). Guidelines for the student presentations will be provided in class. The articles for these presentations will be assigned by February 27th, and student presentations will occur during the lecture times on March 24th, March 26th and March 27th.

OCSC 3002 Evaluation

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<tr>
<th>Component</th>
<th>Percentage</th>
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<tr>
<td>Midterm Exam 1 (in Week 5)</td>
<td>20%</td>
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<tr>
<td>Midterm Exam 2 (in Week 9)</td>
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<td>Comprehensive Final Exam</td>
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<td>5 assignments (5% each)</td>
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<td>Student oral presentation</td>
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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