

Syllabus: AQUACULTURE AND FISHERIES BIOTECHNOLOGY

Memorial University of Newfoundland

Department of Ocean Sciences

Winter Semester, 2023

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

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

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

Instructor: Matthew Rise, Ph.D., Professor and Interim Head, Department of Ocean Sciences, MUN
Office phone: 709-864-3276; Email: mrise@mun.ca

Office hours: My office is at the Ocean Sciences Centre (OSC, 1 Marine Lab Road, St. John's) in the main office (room OS 3017). I can meet with you in my office as needed (by appointment). I will also set aside Fridays from 4 pm to 6 pm as office hours in CSF room 4220 (with the exception of January 13th). I can also meet with you at other times by appointment if needed.

Textbook: There is no textbook for this course. Assigned readings will be from several sources including the books below and the primary literature (e.g. open access articles). Less than 10% of each book will be used as assigned reading (placed on Brightspace).

- Watson JD et al. 2007. Recombinant DNA: Genes and Genomes – A Short Course. Cold Spring Harbor Laboratory Press, New York.
- Beaumont AR, Boudry P, and Hoare K. 2010. Biotechnology and Genetics in Fisheries and Aquaculture (Second Edition). Wiley-Blackwell.
- Lesk AM. 2017. Introduction to Genomics (3rd edition). Oxford University Press.
- Fletcher GL and Rise ML (editors). 2012. Aquaculture Biotechnology. Wiley-Blackwell.
- Overturf K (editor). 2009. Molecular Research in Aquaculture. Wiley-Blackwell.

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 molecular biology and 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 in aquaculture;
- genetic engineering in aquaculture (e.g. transgenic organisms);
- 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 single nucleotide polymorphism (SNP) genotyping used to study the genetic structure of fish and shellfish populations; microarrays, RNA sequencing (RNA-seq), 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 assigned readings from various texts and other sources (e.g. journal articles). 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.
- The web site for PubMed is: <http://www.ncbi.nlm.nih.gov/pubmed/>

During each week of the semester, we will cover topics from the assigned readings (posted on Brightspace). Topics to be covered include:

Week 1 (Jan. 5-6): Genetic variation (including a brief review of the principles of genetics and molecular biology).
Assigned reading: Will be placed on Brightspace.

Week 2 (Jan. 9-13): 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
Assigned reading: Will be placed on Brightspace.

- The first paper for 2-page written critique will be assigned on **January 10th**.

Week 3 (Jan. 16-20): Techniques used to measure genetic variation, continued (e.g. cloning, PCR, qPCR, electrophoresis, DNA and RNA sequencing); MSDS for reagents used in molecular biology (e.g. ethidium bromide; TRizol); mitochondrial genetics and genomics in fisheries and aquaculture research
Assigned reading: Will be placed on Brightspace.

- The first 2-page written critique is due on **January 20th**. Please bring your printed critique to class or email your critique to: mrise@mun.ca

Week 4 (Jan. 23-27): Techniques used to measure genetic variation, continued (e.g. SNPs, RFLPs, VNTR, RAPD).
Assigned reading: Will be placed on Brightspace.

- The second paper for 2-page written critique will be assigned on **January 24th**.

Week 5 (Jan. 30-Feb. 3): Techniques used to measure genetic variation, continued.
Assigned reading: Will be placed on Brightspace.

- The second 2-page written critique is due on **February 3rd**. Please bring your printed critique to class or email your critique to: mrise@mun.ca

Week 6 (Feb. 6-10): Genetic structure of fish and shellfish populations.
Assigned reading: Will be placed on Brightspace.

- The third paper for 2-page written critique will be assigned on **February 7th**.

Midterm Exam 1: February 10th (during lecture time in room SN 1019)

Week 7 (Feb. 13-17): Genetics of population size in conservation and aquaculture.
Assigned reading: Will be placed on Brightspace.

- The third 2-page written critique is due on **February 17th**. Please bring your printed critique to class or email your critique to: mrise@mun.ca
- The fourth paper for 2-page written critique will be assigned on **February 17th**.
- **Papers for student presentations will be assigned by February 17th**.

Week 8 (Feb. 20-24): **Winter Semester Break – no classes.**

Wk 9 (Feb 27-March 3): An introduction to finfish and shellfish genomic research.
Assigned reading: Will be placed on Brightspace.

- The fourth 2-page written critique is due on **March 3rd**. Please bring your printed critique to class or email your critique to: mrise@mun.ca

Week 10 (March 6-10): Genomics applications in aquaculture and fisheries, continued; marker-assisted selection in aquaculture.
Assigned reading: Open access papers will be posted on Brightspace.

- The fifth paper for 2-page written critique will be assigned on **March 7th**.

Week 11 (March 13-17): Next-generation sequencing applications in fisheries and aquaculture research.

Assigned reading: Will be posted on Brightspace.

Midterm Exam 2: March 17th (during lecture time in room SN 1019)

Week 12 (March 20-24): 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: Will be posted on Brightspace.

- The fifth 2-page written critique is due on **March 24th**. Please bring your printed critique to class or email your critique to: mrise@mun.ca

NOTE: Student Powerpoint presentations due (emailed to Dr. Rise in Brightspace) by March 27th. These will be placed on Brightspace for all students to review, and some content from these presentations will be included on the Final Exam.

Week 13 (March 27-31): Genetic engineering in aquaculture (e.g. generation of transgenic organisms) and **Student Presentations**.

Assigned reading: Will be posted on Brightspace.

Week 14 (April 3 - 6): **Student Presentations**

Assigned reading: Will be posted on Brightspace.

Final Exam: Date, time and location to be announced.

Assignments: Written Critiques

Each student is required to write a 2-page (double-spaced) critique of one open-access aquaculture/fisheries biotechnology-related article approximately every two weeks (see “5 Assignments” below, and page 8 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 aquaculture/fisheries biotechnology-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).
- **For additional details on critique guidelines, please see page 8 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). Guidelines for the student presentation (10 minute talk followed by 3-5 minutes of discussion) will be provided in class. The articles for these presentations will be assigned by **February 17th**, and student presentations should be submitted to Dr. Rise via email (within Brightspace) by **March 27th**. Student presentations will be posted on Brightspace, and content from these presentations will be included on the Final Exam.

OCSC 3002 Evaluation	Midterm Exam 1:	20%
	Midterm Exam 2:	20%
	Final Exam (Date TBA):	25%
	5 Assignments (5% each):	25%
	Student Presentation:	<u>10%</u>
	Total:	100%

- Should courses be disrupted due to COVID-19 or other causes, we will aim to transition to remote delivery.

- In the case of a class disruption or cancellation, and in the case of revisions to evaluation methods, the Instructor will notify all students registered in the course via the course shell in Brightspace. Any necessary revisions to the evaluation methods will be made in consultation with the students registered in this course.

- This course does not have a required textbook. We will use the primary literature and other sources (e.g. less than 10% of a given textbook) for course content. Resources will be accessible via Brightspace.

- Memorial University of Newfoundland is committed to fostering equitable and accessible learning environments for all students. Accommodations for students with disabilities are provided in accordance with Accommodations for Students with Disabilities Policy (www.mun.ca/policy/site/policy.php?id=239) and its related procedures. Students who feel that they may require formal academic accommodations to address barriers or challenges they are experiencing related to their learning are encouraged to contact Accessibility Services (the Blundon Centre) at the earliest opportunity to ensure any required academic accommodations are provided in a timely manner. You can contact Accessibility Services (Blundon Centre) by emailing blundon@mun.ca

- 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.

- Academic supports at MUN include, but are not limited to: Memorial University Libraries, The Commons (QEII Library), The Glenn Roy Blundon Centre, The Writing Centre, Center for Innovation in Teaching and Learning Support Centre, Information Technology Services, Academic Advising, and specific departmental help centres.

- Student life supports at MUN include, but are not limited to: Student Wellness and Counselling Centre, Student Support and Crisis Management, MUN Chaplaincy, Sexual Harassment Office, The Circle: First Nations, Inuit & Métis Students Resource Centre, Disability Information Support Centre, International Students Resource Centre, Sexuality and Gender Advocacy, Student Parent Assistance & Resource Centre, Students Older Than Average, Intersections – A Resource Centre for Marginalized Genders, and specific departmental societies.

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 ideas, including a summary of the major findings and conclusions. Key biotechnology methods used 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? Alternatively, 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 that 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 the interpretation adequate, or perhaps not fully warranted by the data (e.g. important omissions or loose generalization)?
- 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)

Critiques of articles should be coherent and allow the reader to go smoothly from one part to another and follow your arguments. You do not 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