## Pandemic Changes

Given the COVID-19 pandemic state, the University of British Columbia has directed all UBC programs to postpone or redesign courses to be delivered online (COVID-19 – Status of summer terms, UBC Broadcast March 25, 2020). As a result, this course has been redesigned to be delivered online.

## Course Information

| Course Title | Course Code, Section | Credit Value |
| --- | --- | --- |
| Finfish Genetics and Reproduction in Aquaculture | AQUA 504 | 3 |

| Class Time | Class Location | Session Term |
| --- | --- | --- |
| While there is some flexibility in this online course, you are expected to make yourself available to meet virtually on the following dates and times:   * September 9, 2:00pm-4:00pm * September 16, 2:00pm-4:00pm * September 23, 2:00pm-4:00pm * September 30, 2:00pm-4:00pm * October 7, 2:00pm-4:00pm * October 14, 2:00pm-4:00pm * October 21, 2:00pm-4:00pm * October 28, 2:00pm-4:00pm * November 2, 2:00pm-4:00pm * November 9, 2:00pm-4:00pm * November 18, 2:00pm-4:00pm * November 25, 2:00pm-4:00pm * December 2, 2:00pm-4:00pm | UBC Canvas Site | 2020W |

### Finfish Calendar Description

Genetics and Reproduction in Aquaculture is a graduate level course that will provide students with the initial knowledge and tools required to critically review and integrate a genetic approach to aquaculture management and development.

### Prerequisites

None

### Corequisites

None

### Course Structure

This course will be structured as thirteen (13) modules. Each module will have a 2-hour timeslot for lectures and class discussion. The lecture will be delivered by the instructor or a guest lecturer who is involved with research related to the module topic. After the lecture we will have class discussion, followed by student-led critical review of current research papers relevant to the module. The Canvas learning platform will be used for this course.

## Instructor Information

| Course Instructor | Email | Phone | Office Location | Office Hours |
| --- | --- | --- | --- | --- |
| Wendy Vandersteen, PhD | wvanders@mail.ubc.ca | 778-628-9179 | N/A | As needed |

### Welcome Message

Welcome to Finfish Genetics and Reproduction, part of the requirements for your Aquaculture Certificate. I’m excited to share my knowledge of broodstock development in aquaculture, and of course my enthusiasm for the industry as a whole. You are entering into an industry that can offer much potential, and my role is not only to provide you with the tools you need to navigate this industry successfully, but also to help you define the path that best meets your needs and interests.

### Contact Details

Email is the best way to contact me. I will reply as soon as I can. If you would like an online virtual meeting, I’m also happy to accommodate that as required.

## Course Description

### Course Overview

Production of fish and seafood by aquaculture is required to meet a global supply shortage that is expected to increase substantially in the next 20 years; in fact, it is predicted that global production will double by 2025. Within this context, aquaculture is a rapidly developing and dynamic industry and better integration of genomic approaches to strain development will facilitate economically and environmentally sustainable growth of the industry. Relative to other livestock industries, aquaculture diversification is highly skewed such that production of only 30 species provides about 90% of total aquaculture production; this illustrates the high need for application of genetic and reproductive knowledge to the aquaculture industry.

1. *Introduction and General Overview of Genetics*

Students will be introduced to the principles of genetics and provided with an historical overview of genetic applications in aquaculture development. We will discuss current status of finfish strains used in aquaculture and will critically review characteristics that would be desirable for aquaculture production systems.

1. *Tools of the Trade – Understanding Genetic Markers and Gene Expression*

Students will learn about techniques available for applying genetic concepts to strain development. This will include discussion on what genetic markers are, how they are detected, and what tools can be developed to enable applying this knowledge for strain development. We will also discussion gene expression, which is the measurement of the effect of genetic variation. Students will hear a guest lecture from a scientist involved with a large-scale salmonid genomics project.

1. *Sex Control and Reproduction of Fish*

The ability to manipulate sex and reproduction of finfish is a crucial component of a successful aquaculture operation. This module will present fundamental knowledge on the genetic basis of sex in finfish, development of the reproduction system, and general behavior and physiology of reproduction. The module will include discussion on the methods available to control sex and reproduction.

1. *Selection and Domestication*

The best strains for any agricultural industry, including aquaculture, are typically highly selected and domesticated. This module will present more in-depth review of finfish selection and will include a guest lecture who does extensive management of selective breeding programs for the aquaculture industry. Class discussion will focus on how to establish and maintain a selective breeding program and what traits should be the focus for the future of aquaculture.

1. *Genetic Engineering*

As more genomic sequencing information on fish is obtained, along with better understanding of how the genes interact to control physiological systems within the animal, we can develop methods to engineer strains with specific desired traits. This is a rapidly developing area of aquaculture and student will be guided to develop their ability to critically assess novel approaches and directions for strain development. Students will have a guest lecturer discuss the development of a transgenic salmon strain and the extensive risk assessment done to outline the uncertainty of threat posed by escape of these or similar strains into the wild. Class discussion will continue with a critical analysis of the costs and benefits of genetic engineering and social acceptance of the technology. The course will wrap up with student presentations on their version of the ideal aquaculture strain.

### Learning Outcomes

After completing this course, students should be able to:

* Differentiate the genetic basis of traits in finfish, including control of sex and reproduction;
* Evaluate traditional and current genetic and genomic approaches to aquaculture development;
* Identify traits that would improve production within a defined system from both an economically and environmentally sustainable perspective;
* Evaluate and apply the basic requirements for developing and managing a selective breeding program for the aquaculture industry;
* Develop the ability to critically assess this rapidly evolving science and its application to aquaculture.

### Learning Activities

This material will be delivered through live virtual sessions, with opportunity for in-class and online discussion. Students will be expected to participate in discussions as required. There will also be a quiz, individual assignments and an in-class presentation.

### Learning Materials

**Required Readings**

All required readings will be available and accessible online.

1. **Abernathy JW, Peatman E, Liu Z. 2010. Basic aquaculture genetics. SRAC Publication No. 5001.**
2. **Georges M, Charlier C, Hayes B. 2019. Harnessing genomic information for livestock improvement. Nature Reviews Genetics 20: 135-156.**
3. **Piferrer F, Martinez P, Ribas L, Vinas A, Diaz N. 2012. Functional genomic analysis of sex determination and differentiation in teleost fish. In: Functional Genomics in Aquaculture, Edited by Saroglia M and Zhanjiang L. Wiley & Sons, Inc.**
4. **Teletchea F, Fontaine P. 2012. Levels of domestication in fish: implications for the sustainable future of aquaculture. Fish and Fisheries 15: 181-195.**
5. **Sonesson AK, Odegard J. Mating structures for genomic selection breeding programs in aquaculture. In: Genetics, Selection, Evolution. Vol 48. London.**
6. **Gjedrem T. 2005. Selection and Breeding Programs in Aquaculture. Springer.**
7. **Clauesen R, Longo SF, Clark B. 2016. Fishy business: genetic engineering and salmon aquaculture. In: Genetically Modified Organisms in Food. II Social and Economic Context of GMO Foods.**

**Optional Readings**

Additional optional readings will be provided during the course of the class, and will be derived based on current research, current issues in aquaculture development, and student interests.

## Assessments for Learning

### Summary

(Subject to change with class consultation)

| # | Component | Weight |
| --- | --- | --- |
| 1 | Quiz | 5% |
| 2 | Bibliography | 5% |
| 3 | Research paper summary | 20% |
| 4 | Critical review and discussion | 20% |
| 5 | Final project – Breeding program design | 40% |
| 6 | Presentation | 10% |
|  | Total | 100% |

### Details of Assessments

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **GOAL** | **Assessment** | **Grading Criteria** | **Percent Weight** | **Due Dates** |
| General Knowledge | Quiz based on an introductory lecture that provides an introduction to genetics in aquaculture. | 1. Correct responses on the quiz. | 5% | Week 2 |
| Information Acquisition | Preparation of a bibliography and list of resources related to an assigned production problem. | 1. In-depth coverage of topic.  2. Use of a wide range of resources.  3. Compilation of resources.  4. Indication of the reliability of the source.  5. Indication of the search criteria or method used. | 5% | Week 4 |
| Information Synthesis | Presenting a summary of a research paper related to the module topic | 1. Ability to read a research paper and comprehend the conclusion(s) presented.  2. Ability to concisely, clearly, and accurately present the idea(s) of a research paper to the class. | 20% | Week 8 |
| Critical Analysis and Review | Critical review of research papers related to module topics | 1. Ability to present a critical assessment your own selected research paper; outline strengths and weaknesses of the paper, relevance to industry, generality of results, and implications.  2. Contribute to discussion on critical analysis and review of other student paper summaries. | 20% | Week 11 |
| Application of Concepts | Preparation of a selective breeding program outlining specifics about the technology, species, and infrastructure. | 1. A breeding program that specifies the species, the technology applied, and the structure of the program.  2. Justification for the choices made in the plan.  3. Consideration of the environmental and socio-economic implications of the program.  4. Evidence of long-term contingency planning and identification of any limitations on achieving the outlined goal. | 40% | At end of the course |
| Innovation and Creation | Design of the “ideal” aquaculture finfish strain (individual presentations during last class) | 1. Identification of a challenge or opportunity that can be solved with a genetic approach.  2. Identification of an innovation solution to the challenge or opportunity using a genetic approach.  3. Contribution to discussion on development of an ideal strain. | 10% | Week 13 |

### Grading Scheme

| Grade | Percent | Level of Achievement |
| --- | --- | --- |
| A+ | 90-100 | Exceptional |
| A | 85-89 | Exceptional |
| A- | 80-84 | Exceptional |
| B+ | 76-79 | Competent |
| B | 72-75 | Competent |
| B- | 68-71 | Competent |
| C+ | 64-67 | Adequate |
| C | 60-63 | Adequate |
| C- | 55-59 | Adequate |
| D | 50-54 | Adequate |
| F | 00-49 | Inadequate |

### Missed or Late Assignments, and Regrading of Assessments

Late assignments will be deducted 10% per day. Missed assignments will receive a score of 0.

## Course Schedule

(Subject to change with class consultation)

| Week | Date | Topics / Readings / Activities | Assessments Due |
| --- | --- | --- | --- |
| 1 | Sept 9 | Introduction to Course and Principles of Genetics   * Read Ref (1) and (6) Ch 2 | Quiz: Due Sept 16 by 2:00pm |
| 2 | Sept 16 | History of Genetic Applications in Aquaculture   * Read Ref (1) and (6) Ch 1 |  |
| 3 | Sept 23 | Tools of the Trade – What are Genetic Markers?   * Read Ref (2) |  |
| 4 | Sept 30 | Tools of the Trade – Understanding Genomics   * Continue reading Ref (2) | Assignment #1: Due Sept 30 by 11:59pm |
| 5 | Oct 7 | Tools of the Trade – What About Gene Expression? |  |
| 6 | Oct 14 | Sex Control and Reproduction of Fish – Overview   * Read Ref (3) and (6) Ch 8 | Assignment #2: Due Oct 14 in class |
| 7 | Oct 21 | Sex Control and Reproduction of Fish – Manipulation Strategies   * Continue reading Ref (3) and (6) Ch 8 |  |
| 8 | Oct 28 | Selection and Domestication – Introduction   * Read Ref (6) Ch 5 | Assignment #3: Due Oct 28 in class |
| 9 | Nov 2 | Selection and Domestication – Methods   * Read Ref (6) Ch 7, 10, 11 |  |
| 10 | Nov 9 | Selection and Domestication – Implementation   * Read Ref (5) and (6) Ch 12, 16, 17 |  |
| 11 | Nov 18 | Genetic Engineering in Aquaculture – Where Are We?   * Read Ref (7) |  |
| 12 | Nov 25 | Genetic Engineering in Aquaculture – Looking Ahead | Assignment #4: Due Nov 25 in class |
| 13 | Dec 2 | Conclusion and Review |  |
| 14 | Dec 9 |  | Final project: Due Dec 9 by 11:59pm |

## University Policies

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions.

Details of the policies and how to access support are availableon[the UBC Senate website](https://senate.ubc.ca/policies-resources-support-student-success)**.**

### Academic Integrity

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply when the matter is referred to the Office of the Dean. Careful records are kept in order to monitor and prevent recurrences. A more detailed description of academic integrity, including the University’s policies and procedures, may be found in the [UBC Calendar: Student Conduct and Discipline](http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,54,0,0).

### Academic Accommodation for Student with Disabilities

Academic accommodations help students with a disability or ongoing medical condition overcome challenges that may affect their academic success. Students requiring academic accommodations must register with the [Centre for Accessibility](https://students.ubc.ca/about-student-services/centre-for-accessibility). They will determine the student's eligibility for accommodations in accordance with [Policy 73: Academic Accommodation for Students with Disabilities](https://universitycounsel-2015.sites.olt.ubc.ca/files/2019/08/Disability-Accommodation-Policy_LR7.pdf?file=2010/08/policy73.pdf). Academic accommodations are not determined by your instructors, and instructors should not ask you about the nature of your disability or ongoing medical condition, or request copies of your disability documentation. However, your instructor may consult with the Centre for Accessibility should the accommodations affect the essential learning outcomes of a course.

## Other Course Policies

### Learning Analytics

Learning analytics includes the collection and analysis of data about learners to improve teaching and learning. This course will be using the following learning technologies: Canvas. Many of these tools capture data about your activity and provide information that can be used to improve the quality of teaching and learning. In this course, I plan to use analytics data to:

* View overall class progress
* Track your progress in order to provide you with personalized feedback
* Review statistics on course content being accessed to support improvements in the course
* Track participation in discussion forums
* Assess your participation in the course

### Copyright

All materials of this course (course handouts, lecture slides, assessments, course readings, etc.) are the intellectual property of the Course Instructor or licensed to be used in this course by the copyright owner. Redistribution of these materials by any means without permission of the copyright holder(s) constitutes a breach of copyright and may lead to academic discipline.

## Acknowledgement

UBC’s Point Grey Campus is located on the traditional, ancestral, and unceded territory of the xwməθkwəy̓əm (Musqueam) people. The land it is situated on has always been a place of learning for the Musqueam people, who for millennia have passed on their culture, history, and traditions from one generation to the next on this site.