

**Faculty of Science Course Syllabus (Section A)** (revised June 2021)**Department of Biology**

BIOL/MARI 3042

BIOL5042

Molecular Ecology

Winter 2025

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

**Instructor(s):**

- Dr. Paul Bentzen e-mail: [paul.bentzen@dal.ca](mailto:paul.bentzen@dal.ca) Office hours: by appointment; contact by email
- Dr. Daniel Ruzzante e-mail: [daniel.ruzzante@dal.ca](mailto:daniel.ruzzante@dal.ca) Office hours: by appointment; contact by email

**Lectures:** Monday, Wednesday, 10:05-11:25 ROOM LSC C208**Laboratories:** 0**Tutorials:** Monday: 08:35 – 09:55 ROOM LSC C208**Course delivery:** In-person

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**Course Description**

We survey techniques of molecular genetic analysis and consider how they can be used to identify species, populations, sexes, individuals and family relationships, and study population attributes such as historical dispersal, contemporary connectivity, mating behaviour and effective population size. Evaluation is based on assignments, and three tests.

**Course Prerequisites**

A grade of B- or better in each of [BIOL 2030.03](#) (or [GENE 2000.03](#)), [BIOL 2040.03](#), and [BIOL 2060.03](#).

**Learning Objectives**

Understanding theory of important laboratory methods used in molecular ecology, including the following:

- PCR and qPCR
- DNA sequencing methods including dideoxy, Ion Torrent, Nanopore and bisulphite.
- Methods of molecular marker analysis including allozyme, microsatellite, multilocus DNA fingerprinting, mitochondrial DNA, SNPs, RADseq, DNA barcoding and metabarcoding, metagenomics, environmental DNA analysis.
- Understanding theory of phylogeography, population genetics and conservation genetics, including the following concepts:
- Phylogenetic analysis to recover historical changes in distribution and abundance of populations.

- Understanding of principles in population genetics (Hardy-Weinberg Equilibrium, linkage disequilibrium, population structure and gene flow, Island model)
- Understanding of main concepts in conservation genetics (random genetic drift, effective population size, genetic diversity vs, genetic differentiation)
- Understanding of population subdivision (F-statistics & gene flow, model-based clustering)
- Basic understanding of the use of genomics in management and conservation and in the study of invasive species

Skills will include the following:

- Primer design for PCR
- Basic population genetic analyses
- Estimation of effective population size
- Bayesian clustering using STRUCTURE
- DNA sequence analysis

### **Course Materials**

- Provided on course Brightspace page
- The 3<sup>rd</sup> edition of *Conservation and the Genomics of Populations* by Allendorf, Funk, Aitken, Byrne and Luikart is an excellent reference book and is accessible online [https://dal.novanet.ca/permalink/01NOVA\\_DAL/17sp06p/alma9970852455007190](https://dal.novanet.ca/permalink/01NOVA_DAL/17sp06p/alma9970852455007190)
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- Some course material is derived from various chapters in this book and students are encouraged to read these chapters in advance of the corresponding lectures

### **Online/blended course delivery information:**

- Online lecture delivery will be synchronous via Microsoft Teams. Students require access to a computer with internet access, camera, and microphone.
- Instructors and TA should be contacted via email at any time; replies will be asap during normal working hours.
- Contingency plan for power/technology interruptions during synchronous sessions or exams will be cancellation or rescheduling, depending on circumstances; rescheduling will be arranged by online polling of students.
- Assignments will be due by 12:00AM (midnight), AST, on dates indicated in course schedule.

### **Course Assessment**

#### ***Assignments*<sup>1</sup>**

- 1) Microsatellite primer design, 5%;
- 2) Basic population genetics, 5%;
- 3) Effective Population Size, 10%;
- 4) STRUCTURE, 10%;
- 5) Sequence analysis, 10%;

#### ***Tests***

Midterm exam1: 20%, in class, 80 minutes; subject to revision or cancellation if instruction is online.

Midterm exam 2: 20%, in class, 80 minutes; subject to revision or cancellation if instruction is online.

Midterm exam 3: 20%, in class, 80 minutes; subject to revision or cancellation if instruction is online.

### **Other course requirements**

None

### **Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale**

A+ (90-100)	B+ (77-79)	C+ (65-69)	D	(50-54)
A (85-89)	B (73-76)	C (60-64)	F	(<50)
A- (80-84)	B- (70-72)	C- (55-59)		

### **Course Policies on Missed or Late Academic Requirements**

- No need to use student declaration of Absence
- Late assignments: 10% PER DAY
- Missed midterm exam: content of the missed exam and percentage points will be transferred to the next exam (exam duration will be extended)

### **Course Policies related to Academic Integrity**

- Assignments can be discussed among students, but reports are individual and are expected to be produced independently.

### **Course Content (Lecture content and topics subject to potential change)**

**PB: Paul Bentzen**

**DR: Daniel Ruzzante**

JK: Teaching Assistant James Kho



WEEK	DATE	LECT #	INST	TOPIC	Assignments
1	Mon Jan 6	Lect 1	PB	Course intro, what is Mol Ecol, reasons for studying genetic variation	
	Wed Jan 8	Lect 2	PB	Genetic markers : allozymes; begin lab methods - PCR	
2	Mon Jan 13	Lect 3	PB	Lab methods: quantitative & reverse transcription PCR, DNA sequencing	
	Wed Jan 15	Lect 4	PB	Genetic markers: microsatellites & SNPs	Assign 1 Intro
3	Mon Jan 20	Lect 5	DR	Neutral Evolution: HWE, drift, effective pop size	
	Mon Jan 20	Tut 1	JK	Tutorial Assignment 1	tut 1
	Wed Jan 22	Lect 6	DR	Neutral Evolution: HWE, drift, effective pop size	Assign 2 intro
4	Mon Jan 27	Lect 7	DR	Population subdivision, F-statistics & gene flow	
	Mon Jan 27	Tut 2	JK	Tutorial Assignment 2	tut 2 & Assign 1 due
	Wed Jan 29	Lect 8	DR	Population subdivision, Model based clustering	
5	Mon Feb 3	MDT	PB & DR	MIDTERM EXAM 1	
	Mon Feb 3	free		free	
	Wed Feb 5	Lect 9	DR	Inbreeding, inbreeding depression, purging	
6	Mon Feb 10	Lect 10	DR	Inbreeding, population fragmentation, demography	
	Mon Feb 10	free		free	
	Wed Feb 12	Lect 11	DR	Close Kin Mark Recapture	Assign 2 due
7	Mon Feb 17			READING WEEK - NO CLASS	
	Mon Feb 17			READING WEEK - NO CLASS	SCAS
	Wed Feb 19			READING WEEK - NO CLASS	SCAS
8	Mon Feb 24	Lect 12	PB	genetic markers: mtDNA (1)	Assign 3 intro
	Wed Feb 26	Lect 13	PB	genetic markers: mtDNA (2); phylogenetic analysis	
9	Mon Mar 3	Lect 15	PB	Phylogenetic analysis (2), barcoding and study of biodiversity	
	Mon Mar 3	Tut 3	JK	Tutorial Assignment 3	
	Wed Mar 5	Lect 16	PB	Phylogeography: bridge between phylogenetics and population genetics	Assign 3 due
10	Mon Mar 10	MDT 2	PB & DR	MIDTERM 2	
	Mon Mar 10	free		free	
	Wed Mar 12	Lect 17	PB	Phylogeography (2)	Assign 4 intro
11	Mon Mar 17	Lect 18	PB	Next Generation DNA sequencing, metagenomics	
	Mon Mar 17	Tut 4	JK	Tutorial Assignment 4	



	Wed Ma4 19	Lect 19	<b>PB</b>	The evolution of molecular ecology methods: from allozymes to SNPs & RAD	<b>Assign 5 intro</b>
<b>12</b>	Mon Mar 24	Lect 20	<b>DR</b>	Hybridization, Climate change and epigenetics	<b>Assign 4 due</b>
	<b>Mon Mar 24</b>	<b>Tut 5</b>	<b>JK</b>	<b>Tutorial Assignment 5</b>	
	Wed Mar 26	Lect 21	<b>DR</b>	Invasive species	
<b>13</b>	Mon Mar 31	Lect 22	<b>DR</b>	Exploitation - Conservation Breeding and Restoration	<b>Assign 5 due</b>
	<b>Mon Mar 31</b>	<b>free</b>		<b>free</b>	
<b>14</b>	<b>Wed Apr 2</b>	<b>MDT 3</b>	<b>PB &amp; DR</b>	<b>MIDTERM 3</b>	
<b>15</b>	Mon Apr 7			NO LECTURE	

## **University Policies and Statements**

### **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 at 1321 Edward St or [elders@dal.ca](mailto:elders@dal.ca). Additional information regarding the Indigenous Student Centre can be found at: [https://www.dal.ca/campus\\_life/communities/indigenous.html](https://www.dal.ca/campus_life/communities/indigenous.html)

### **Internationalization**

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: <https://www.dal.ca/about-dal/internationalization.html>

### **Academic Integrity**

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all 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. Additional academic integrity information can be found at: [https://www.dal.ca/dept/university\\_secretariat/academic-integrity.html](https://www.dal.ca/dept/university_secretariat/academic-integrity.html)

### **Accessibility**

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre ([https://www.dal.ca/campus\\_life/academic-support/accessibility.html](https://www.dal.ca/campus_life/academic-support/accessibility.html)) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (<https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html>)

### **Conduct in the Classroom – Culture of Respect**

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

## **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 (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: <http://www.dal.ca/cultureofrespect.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. The full Code of Student Conduct can be found at:

[https://www.dal.ca/dept/university\\_secretariat/policies/student-life/code-of-student-conduct.html](https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html)

## **Fair Dealing Policy**

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at:

[https://www.dal.ca/dept/university\\_secretariat/policies/academic/fair-dealing-policy-.html](https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html)

## **Originality Checking Software**

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at: <https://www.dal.ca/about/leadership-governance/academic-integrity/faculty-resources/ouriginal-plagiarism-detection.html>

## **Student Use of Course Materials**

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for



distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.