DALHOUSIE UNIVERSITY

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

Department of Biology

BIOL/MARI 3042
BIOL5042
Molecular Ecology
Winter 2024

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 **Office hours:** by appointment; contact by email
- Dr. Daniel Ruzzante **e-mail:** daniel.ruzzante@dal.ca **Office hours:** by appointment; contact by email

Lectures: Tuesday, Thursday, 10:05-11:25 *ROOM LSC C206*

Laboratories: 0

Tutorials: Monday: 17:05 – 18:55 *ROOM LSC C208*

Course delivery: In-person or Online (depending on current guidelines; synchronous)

The following information should be included, as a minimum, in every course syllabus.

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
- No required textbook, but the 3rd edition of ***Conservation and the Genomics of Populations*** by Allendorf, Funk, Aitken, Byrne and Luikart is an excellent reference book.

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[1] *(title, weight of final grade, due date as shown in schedule)*

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

Tests *(list)*

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.

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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: percentage points will be transferred to the next midterm

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
EW: Teaching Assistant Ellie Weise

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WEEK	DATE	LECT #	INST	TOPIC	Assignments
1	Tue Jan 9	Lect 1	PB	Course intro, what is Mol Ecol, reasons for studying genetic variation	
	Thu Jan 11	Lect 2	PB	Genetic markers : allozymes; begin lab methods - PCR	
2	Tue Jan 16	Lect 3	PB	Lab methods: quantitative & reverse transcription PCR, DNA sequencing	
	Th Jan 18	Lect 4	PB	Genetic markers: microsatellites & SNPs	Assign 1 Intro
3	Mon Jan 22	Tut 1	EW	Tutorial Assignment 1	tut 1
	Tue Jan 23	Lect 5	DR	Neutral Evolution: HWE, drift, *N*	
	Thu Jan 25	Lect 6	DR	Neutral Evolution: HWE, drift, N_e	Assign 2 intro
4	Mon Jan 29	Tut 2	EW	Tutorial Assignment 2	tut 2 & Assign 1 due
	Tue Jan 30	Lect 7	DR	Population subdivision, F-statistics & gene flow	
	Thu Feb 1	Lect 8	DR	Population subdivision, Model based clustering	
5	Mon Feb 5	free		free	
	Tue Feb 6	MDT	PB & DR	MIDTERM EXAM 1	
	Thu Feb 8	Lect 9	DR	Inbreeding, inb. depression, purging	
6	Mon Feb 12	free		free	
	Tue Feb 13	Lect 10	DR	Inbreeding, population fragmentation, demography	
	Thu Feb 15	Lect 11	DR	Close Kin Mark Recapture	Assign 2 due
7	Mon Feb 19			READING WEEK - NO CLASS	
	Tue Feb 20			READING WEEK - NO CLASS	
	Thu Feb 22			READING WEEK - NO CLASS	
8	Tue Feb 27	Lect 12	PB	genetic markers: mtDNA (1)	Assign 3 intro
	Thu Feb 29	Lect 13	PB	genetic markers: mtDNA (2); phylogenetic analysis	
9	Mon Mar 4	Tut 3	EW	Tutorial Assignment 3	
	Tue Mar 5	Lect 15	PB	Phylogenetic analysis (2), barcoding and study of biodiversity	
	Thu Mar 7	Lect 16	PB	Phylogeography: bridge between phylogenetics and population genetics	Assign 3 due
10	Tue Mar 12	MDT 2	PB & DR	MIDTERM 2	
	Thu Mar 14	Lect 17	PB	Phylogeography (2)	Assign 4 intro
11	Mon Mar 18	Tut 4	EW	Tutorial Assignment 4	
	Tue Mar 19	Lect 18	PB	Next Generation DNA sequencing, metagenomics	
	Thu Mar 21	Lect 19	PB	The evolution of molecular ecology methods: from allozymes to SNPs & RAD	Assign 5 intro
12	Mon Mar 25	Tut 5	EW	Tutorial Assignment 5	
	Tue Mar 26	Lect 20	DR	Hybridization, Climate change and epigenetics	Assign 4 due
	Thu Mar 28	Lect 21	DR	Invasive species	
13	Tue Apr 2	Lect 22	DR	Exploitation - Conservation Breeding and Restoration	Assign 5 due
14	Thu Apr 4	MDT 3	PB & DR	MIDTERM 3	
15	Mon Apr 8			NO LECTURE	