

Ecological Genetics (Biology 324)

Credits: 3

Professor: Dan Schoen (Daniel.Schoen@mcgill.ca)

Office Hours: By appointment

Description: Ecology, evolution, and genetics are typically taught as separate courses. Ecology and genetics combined, however, are fundamental to the mechanisms of evolutionary change. In particular, the interactions of organisms with their biotic and abiotic environments are what set the stage for natural selection. Moreover, the structure and history of populations (e.g., population size, degree of population fragmentation) may strongly influence the potential for evolutionary change. This course will explore the interface of population biology, ecology, genetics and evolution.

Students enrolling in this course will have taken *Introductory Genetics* (Biology 202) and *Introduction to Ecology and Evolution* (Biology 215), and so it is assumed that they will have had some prior exposure to elementary population and quantitative genetics as well as to basic ecology and evolutionary principles.

Lecture and Discussion Topics (not necessarily presented in this order):

1. Overview of Ecological Genetics.
2. Review and simple population genetics principles: types of population genetic variation, some tools and approaches used to reveal genetic variation within and among populations, measuring genetic variation.
3. The organization of genetic variation in single populations: random mating and non-random-mating populations in the absence of forces that change allele frequencies.
4. How individual populations evolve—how allele frequencies change: (mutation, migration, genetic drift, and selection)
5. Interaction among forces altering allele frequencies within single populations (mutation-selection balance, selection-drift balance).
6. Groups of populations evolving: gene flow and migration, F-statistics, evolution in metapopulations.
7. Quantitative genetic variation in populations: Genetic basis of continuous genetic variation, heritability, estimation of variance components, QTL analysis.
8. Natural selection at the phenotypic level: “Chicago School” approach, identifying selective agents, predicting short-term phenotypic evolution.
9. Applied ecological genetics (conservation genetics, transgene escape, evolution of resistance to antibiotics and pesticides).
10. Molecular evolution and population genomics (the neutral theory)
11. Tools in ecological genetics: molecular markers, estimation of gene flow and mating systems, phylogeographic studies.
12. Human population genetics

Reading (required):

1. Assignments from Hamilton, M.B. 2009. *Population Genetics*. Wiley-Blackwell (available as an on-line .pdf file on this *MyCourses* site)
2. Articles assigned for Discussion section of course (available on-line on this *MyCourses* site).
3. Occasional extra reading provided posted on-line.

Evaluation for Biology 324:

Exercise sets (6 @ 5% each = 30%) Dates through the semester due to be announced.

Participation in Discussion Group (20% from the journal paper presentation)

Midterm (25%) Covers first half of course

Final exam (25%) Scheduled during the final exam period. *Comprehensive and includes conference papers.*

The midterm and final exam are open book.

Learning Outcomes: By the end of this course, students should have a broad overview of the field of ecological and evolutionary genetics, including recent developments. They should also be more comfortable and able to read the primary scientific literature in this field.

Required Statements:

McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see www.mcgill.ca/students/srr/honest/ for more information). (approved by Senate on 29 January 2003)

L'université McGill attache une haute importance à l'honnêteté académique. Il incombe par conséquent à tous les étudiants de comprendre ce que l'on entend par tricherie, plagiat et autres infractions académiques, ainsi que les conséquences que peuvent avoir de telles actions, selon le Code de conduite de l'étudiant et des procédures disciplinaires (pour de plus amples renseignements, veuillez consulter le site www.mcgill.ca/students/srr/honest/).

“In accord with McGill University’s Charter of Students’ Rights, students in this course have the right to submit in English or in French any written work that is to be graded.” (approved by Senate on 21 January 2009 - see also the section in this document on Assignments and evaluation.)

Conformément à la Charte des droits de l'étudiant de l'Université McGill, chaque étudiant a le droit de soumettre en français ou en anglais tout travail écrit devant être noté (sauf dans le cas des cours dont l'un des objets est la maîtrise d'une langue).