School of Biological Sciences
Te Kura Pūtaiao Koiora

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Course outline | Ngā Whakamārama - 2022

BIOL336
Ecological and Evolutionary Models

0.125 EFTS 15 Points
Semester 1

Course description | Whakamahuki

The general aim of the course is to **introduce you to the major concepts in developing theoretical biological models. This is achieved by examining key ecological and evolutionary models**. The central focus is on understanding, creating, and analyzing basic biological models. We will highlight the importance of theoretical modelling to the fields of ecology and evolution and help you develop key computational and mathematical skills.

An understanding of basic ecological and evolutionary principles is assumed. If at any stage you feel that you do not understand the assumed basics, refer to the general reference materials listed below or seek help from the lecturer concerned as soon as possible.

Course Co-ordinator | Kairuruku Akoranga

Associate Professor Daniel Stouffer, Julius von Haast 518, 03 369 2880, ext 92880, email daniel.stouffer@canterbury.ac.nz

Lecturer | Pūkenga

Dr Sarah Flanagan, Julius von Haast 520, 03 369 0443, ext 90433, email sarah.flanagan@canterbury.ac.nz

Goals of the Course

To introduce the methodology required to create and analyze theoretical models, to develop an appreciation of the importance of theory in ecology and evolution, and to provide transferrable computational and quantitative skills.

Graduate Profile | Āhuatanga Taura

This course will provide students with an opportunity to develop these UC Graduate Attributes (GP) (www.canterbury.ac.nz/study/graduate- profile/students/what-are-the-graduate-attributes/):

- GP1 Critically competent in a core academic discipline.
- GP2 Employable, innovative and enterprising.
- GP3 Biculturally competent and confident: K1 A process of self-reflection on the nature of ‘knowledge’ and ‘norms’
- GP5 Globally aware.

Intended Learning Outcomes | Hua Akoranga and Associated Assessment | Aromatawai

As a student in this course, I will develop the ability to:

- Clearly understand the basic techniques in building theoretical models.
  Assessment tasks: Quizzes, mid-term, research project
  Related graduate attributes: GP1, GP2
- Understand mathematical models and their applications to ecology and evolution.
  Assessment tasks: Quizzes, mid-term, research project
  Related graduate attributes: GP1, GP2, GP3 (K1), GP5
- Demonstrate proficiency in analyzing mathematical models.
  Assessment tasks: Quizzes, mid-term, research project
  Related graduate attributes: GP1, GP2
- Develop new models that reduce complex biological realities to a manageable representation.
  Assessment tasks: Research project
  Related graduate attributes: GP1, GP2, GP3 (K1), GP5
- Synthesise outcomes of mathematical models to clearly communicate their meaning and their relevance in a biological context.
  Assessment tasks: Research project
  Related graduate attributes: GP1, GP2, GP3 (K1), GP5

Transferable Skills Register | Pūkenga Ngaio

As a student in this course, I will develop the following skills:

- Understand theoretical models presented in research papers. This skill is invaluable for students pursuing further academic study, but is also a form of problem solving that is applicable to daily live.
  Related graduate attributes: GP1, GP2, GP5
- Ability to build and analyze a mathematical model. This ability is a useful way of taking a complicated world (or problem) and turning it into a manageable representation that can be solved with the skills in your toolbox. This way of approaching problems will be broadly applicable to most professional careers.
  Related graduate attributes: GP1, GP2, GP3 (K1), GP5
- Basic modeling skills in R. The development of these computational skills will be useful to anyone pursuing a career in science and technology.
  Related graduate attributes: GP1, GP2
- Preparing an oral presentation on findings. Clear written communication of complex problems is essential for most professional careers.
  Related graduate attributes: GP1, GP2, GP3 (K1)

Timetable | Wātaka

Lectures

Lectures will be held during the first 8 weeks of the semester, during which we will have two 2-hour lectures per week. During this time we will have a mix of whiteboard lectures and computer work.

Tutorials

Project tutorials will be organised for weeks 8 to 11 of the semester and will last 1 hour each. These sessions have been included to provide students with an opportunity for structured time

to work on their Research Project. The latter three are optional, but we highly recommend that students make use of this time to take advantage of our help. During the last week of the semester, there will also be a Presentation session during which students will give oral presentations about their Research Project.

Students should note that they are responsible for 10 hours of study per credit point – this equates to approximately an average of 9-10 hours of *additional* study per week of the course at the 300-level. In this course, we expect students to require fewer out-of-class hours during the first 8 weeks but students will spend much more time working outside of class during final weeks of the semester while working on their project.

Outline of the course

Week	**Format**	**Biological Topics**	**Mathematical Concepts**	**Lecturer**
1	Two 2-hour lectures	Building a model Logistic growth	Logarithms Algebra	Daniel
2	Two 2-hour lectures	Discrete/continuous single-species models	Derivatives and integrals	Daniel
3	Two 2-hour lectures	Density dependence and frequency dependence	Stability analysis Steady state	Daniel
4	Two 2-hour lectures	Island biogeography and Levin's metapopulations	Deterministic vs stochastic	Daniel
5	Two 2-hour lectures	Two-species models	Matrices Invasion	Daniel
6	Two 2-hour lectures	Allele frequencies Hardy-Weinberg Equilibrium	Probability	Sarah
7	Two 2-hour lectures	Selection	Limits	Sarah
8	Two 2-hour lectures One 1-hour tutorial	Inbreeding and mixed mating	Review of all topics	Sarah
MIDTERM				
9	One 1-hour tutorial	Dedicated Research Project work time		Both
10	One 1-hour tutorial			Both

11	One 1-hour tutorial		Both
12	One 3-hour tutorial		Both
		PROJECT DUE	

Research Project & Presentation

The research project is a key component of this course. We will provide a list of papers presenting evolutionary or ecological models as applied to a relevant biological example. For the project, you will choose one of the provided models, dedicate yourself to understanding the assumptions and mathematics of that model, and determine a reasonable biological component that could be added to it. You will then give a short presentation to the lecturers and rest of the class leveraging the mathematical and computational skills learned during the first 8 weeks of the course. This will likely include things such as plots of different model components, simulations of the model dynamics, reproduction of findings from the original study, etc. You will also submit R code developed during your analysis of the model for assessment.

Assessment | Aromatawai

Quizzes 30%

Weekly administered via Learn during first 8 weeks

Mid-course test - 2hrs (8 weeks of lectures) 40%

Online access via Learn during week 8 of semester (date/time pending Timetable)

Research Project & Presentation (Final Exam) 30%

To be given in during last week of semester (date/time pending Timetable)

Note that the course will be subject to the Biology policy on late submission of work (see below).

What is expected in assessments?

The expectations for assessment items relate to the learning outcomes above. A marking schedule will be given in advance for the proposal and field trip assignments, however, a general marking rubric is as follows:

A to A+ : Evidence that the student has developed an individual conception of the subject from wide reading and reflection. This individual understanding will likely be applied to a novel situation.

B+ to A- : Evidence of strategic reading from a few sources, and the ability to present lecture content in the student's own words.

C to B: Reproduction of lecture content following the structure used by the lecturer.

D to C- : Reproduction of some lecture content without clear structure.

E : Confusion of content or no meaningful content presented beyond knowledge that would be expected at the start of the course.

Textbooks

We do not expect you to purchase a textbook, but we recommend accessing the suggested book through the library. During the course you will be directed to additional books and to primary scientific papers. This allows us to include in this course the most current scientific knowledge available, and to provide greater breadth than would be found in a single textbook. **To do well on the mid-semester test, you must show evidence that you have read and understood this material.**

Suggested book: A Biologist's Guide to Mathematical Modeling in Ecology and Evolution by Sarah P. Otto and Troy Day. A hardcopy and e-book of this text are currently available in the library.

Class material on Learn & use of *Turnitin*

Resources used or referred to in lectures will be available on-line on the course link in Learn.

Quizzes will be on LEARN. Please also note that we will occasionally be requesting that you submit written work in both hard copy (for grading) and in electronic form (for assessment of originality using "*Turnitin*"). Instructions will be given on how you do this via Learn.

Prerequisites

BIOL209 or 15 Points of 200-level COSC or DATA or EMTH or ENCE or PHYS or MATH or STAT

Recommended Preparation

BIOL270 and BIOL271

RULES, REGULATIONS, AND WHAT TO DO WHEN THINGS GO WRONG

[updated 3 April 2020]

If in doubt: ASK! The course coordinator is happy to answer questions at any time. All staff involved in the course are available for advice on specific issues.

What do I do if I have to miss something or if my performance was impaired?

If you feel that **illness, injury, bereavement or other extenuating circumstances beyond your control** prevented you from completing an item of assessment worth 10% or more of the total course assessment or if these circumstances affected your performance in such assessments, you should apply for Special Consideration. Applications for Special Consideration should be submitted via the Special Consideration website http://www.canterbury.ac.nz/study/special-consideration/ *within five working days* of the assessment or its due date. You will also need to notify the course coordinator. If you apply for Special Consideration because of medical reasons, you should visit a doctor within a reasonable timeframe (application form available on the website above or from the Student Health Centre).

The Special Consideration provisions are intended to assist students who have covered the work of a course but have been prevented by illness or other critical circumstances from demonstrating their mastery of the material or skills at the time of assessment – they do not excuse you from doing the assessment within a reasonable time agreed with the course coordinator. You should expect to be required to submit additional work if you miss a major assignment (e.g. a field trip for which a major write-up is required).

You should also apply for Special Consideration if you are not be able to complete an assessment or attend a field trip because of **involvement in international or national representative sport or cultural groups**. Please review the Special Considerations policy, because very few kinds of activities will be eligible for such consideration (e.g. holiday trips, birthday parties etc. are not given special status in the University policy).

Students prevented by extenuating circumstances from completing the course after the final date for withdrawing, may apply for Special Consideration for late discontinuation of the course. Applications must be submitted via http://www.canterbury.ac.nz/study/special-consideration/ no later than five working days after the examination period has finished.

Plagiarism

It is essential that you are aware that plagiarism is considered a very serious offence by the academic community, the University and the School of Biological Sciences. Plagiarism is defined as taking content from another work or author and presenting it, without attribution, as if it is your own work. Content here includes text (sentences or major parts of sentences), display items (graphs and tables), and overall structure (the detailed sequence of ideas). Plagiarism includes:

- re-use of previous assignments (even if each individual sentence has been rephrased to say the same thing in different words, if the overall structure is re-used).
- copying of another student's work (with or without their consent).
- the unreferenced use of published material or material from the internet, e.g. cutting and pasting of paragraphs or pages into an essay.

For most pieces of in-term assessment you will be given information concerning the use of direct and indirect quotes from previously published work. If you have any doubt about the appropriate use of published material, please speak with an academic staff member. If you are unsure what plagiarism is, seek advice.

It is a School policy that courses may request that you submit work electronically for subsequent analysis of originality using *Turnitin*. Students agree that by taking courses in BIOL, assessments may be submitted to Turnitin.com for textual similarity review. All submitted papers will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. Use of the Turnitin.com service is subject to the Terms and Conditions of Use as posted on the Turnitin.com site.

Where do I hand in assignments and then collect them once marked?

All assignments should be placed in the designated collection boxes in the foyer of the 2nd floor of the School of Biological Sciences (Julius von Haast building, at the top of the stairs), unless directed otherwise by the course coordinator. All assignments must be accompanied by a cover sheet signed by you stating that the submitted work is not plagiarised. Cover sheets are available on top of the collection boxes, or you can download one from the Biology website (http://www.canterbury.ac.nz/media/documents/science-documents/assignment-coversheet.pdf). In addition, you may also be asked to submit your work electronically (via Learn) for analysis in *Turnitin*.

Marked assignments can be collected from the School of Biological Sciences reception, unless directed otherwise by the course coordinator. Teaching staff will endeavour to return work as soon as possible, and should contact you if there are likely to be any delays that will prevent return within the maximum 4-week timeframe.

What if I can't get it finished in time?

Reports and assignments should be handed in on time. Extensions may be granted if you have a valid reason. **If you require an extension, you should request one from the course coordinator** (or the lecturer responsible for marking the work), with as much notice as possible. Please do this BEFORE the deadline for the assignment. **If you have been given an extension you should hand the work DIRECTLY to the course coordinator** (do not put it in the drop box as it may not be cleared after the due date).
If an extension has not been granted:

- work handed in within 1 hour of the deadline: penalty of up to 5 percentage points of the mark for the assignment (e.g., a mark of 75% might be reduced to 70%).
- work handed in 1 – 24 hours after the deadline: penalty of 10 percentage points of the mark for the assignment (e.g., a mark of 75% is reduced to 65%).
- work handed in 1 – 7 days after the deadline: penalty of 15 percentage points of the mark for the assignment (e.g., a mark of 75% is reduced to 60%).
- work handed in more than 7 days after the deadline will not be marked or earn credit.

What if I have written more than the word or page limit?

If there is a word limit on an assignment, it is usually there to stop you doing too much work and to encourage you to write succinctly. You can be up to 10% over without too much worry, but if the length increases beyond that your mark may suffer due to failure to follow the requirements. If you find yourself way over the word limit talk to the lecturer concerned about how to get your assignment to an acceptable length.

What if I fail part of the course?

In Biological Sciences, we require a satisfactory level of achievement in both the theoretical aspects of the discipline and in practical activities. This means you must attend all class activities and submit all items of assessment unless you have a very good reason not to (e.g. medical reasons). **A student must attain an average score of at least 40% for in-course assessments (e.g. assignments, reports) and an average score of at least 40% in the exam and/or tests, AND score at least 50% overall for the course, to be awarded a passing grade. See the course outlines for clarification of the assessment items included in each category and ask the coordinator if you are still unsure.**

What's the best way to give feedback?

We welcome constructive feedback at all times – help us to make this a valuable course for you. We endeavour to remain approachable at all times. If you would rather give feedback anonymously, please use the online course survey or talk to lab demonstrators, or your class rep (who will all report back to the staff-student liaison committee that includes a representative from each of the undergraduate classes). Class representatives will be selected from each class at the start of course.

What's the best way to complain?

If you feel you have not been fairly treated during this course, please raise the issue with the lecturer or course coordinator in the first instance. Other avenues include your class rep., who can raise issues anonymously, or the UCSA education coordinator.

Grading

A+	90% or above
A	85 – 90
A-	80 – 84
B+	75 – 79
B	70 – 74
B-	65 – 69
C+	60 – 64
C	55 – 59
C-	50 – 54

A restricted pass (R) **may** be awarded to those who are close to a pass (i.e. an overall score of 48-49.9%) AND who have achieved at least a 40% overall score in both in-course assessment and tests/exams. If an R grade is

awarded you gain credit for the course but **cannot continue into papers that require this course as a pre-requisite**. NB. The R grade is only available at 100 and 200 level - it cannot be awarded for third year papers.

Failing grades: D 40-49 E 0–39