# BIOL 3295: Population and Evolutionary Ecology, Winter 2023

Amy Hurford

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# Contents

# Chapter 1

# Syllabus

## 1.1 Instructor Information

Instructor: Dr. Amy Hurford
Office: CSF 4338
Email: ahurford@mun.ca
I will try to reply to emails within 24 hours (excluding evenings, weekends and holidays). Office hours: Tuesday 1-2pm; Thursday 1-2pm

## 1.2 Course Information

TR 12.00-12.50pm
F 1-1.50pm
Classroom: SN3060

All Course Announcements will be made on BrightSpace. Should lectures be remote a WebEx link will be provided on BrightSpace.

Course description:
Population and Evolutionary Ecology is an introduction to the theory and principles of evolutionary ecology and population dynamics. Pre-requisites: BIOL 2600; at least one of BIOL 2010, 2122 or 2210.

Course format:
The course consists of lectures, 4 data analysis assignments, 2 exams and a final exam.

Course expectations:
Please attend lectures and respect the learning environment of other students.

If you have COVID-19 please follow university and provincial public health guidelines.

Learning goals:
The course content emphasizes a deeper understanding of fewer concepts. You have seen much of the course material in pre-requisite courses. In this course, I will revisit the models, clarify the assumptions and when they are appropriate, and we will fit the models to data to estimate parameters. By the end of the course, I hope that if you were given population data, that you would know the key quantities that you might estimate, and could complete the analysis.

Required Text and Resources:
The course materials are online at https://ahurford.github.io/biol-3295-winter-2023/index.html.

Most readings are assigned from two textbooks that are available electronically from the library:

- Vandermeer, J.H., Goldberg, D.E., 2013. Population Ecology: First Principles (Second Edition). Princeton University Press, Princeton, United States. Link
- Otto, Sarah P., and Troy Day. 2007. A Biologist's Guide to Mathematical Modeling in Ecology and Evolution, Princeton University Press. Link

If you wish to use your own computer for assignments you should install `R` and `RStudio` (see also here).

## 1.3 Method of Evaluation

- 4 Assignments - 20%
- 2 Exams - 40%
- Final Exam - 40%

Late assignments and missed exams, and final exams will be accommodated as described by University Regulation 6.7.3 and 6.7.5 (see https://www.mun.ca/regoff/calendar/sectionNo=REGS-0474 for Regulations). Please discuss missed assignments and exams with me. To accommodate the absence an assignment may be modified or exempted and re-weighted in the grading scheme.

## 1.4 Additional Policies

### 1.4.1 Accommodation of students with disabilities

Memorial University of Newfoundland is committed to supporting inclusive education based on the principles of equity, accessibility and collaboration. Accommodations are provided within the scope of the University Policies for the Accommodations for Students with Disabilities see www.mun.ca/policy/site/policy.php?id=239. Students who may need an academic accommodation are asked to initiate the request with the Glenn Roy Blundon Centre at the earliest opportunity (see www.mun.ca/blundon for more information).

### 1.4.2 Academic misconduct

Students are expected to adhere to those principles, which constitute proper academic conduct. A student has the responsibility to know which actions, as described under Academic Offences in the University Regulations, could be construed as dishonest or improper. Students found guilty of an academic offence may be subject to a number of penalties commensurate with the offence including reprimand, reduction of grade, probation, suspension or expulsion from the University. For more information regarding this policy, students should refer to University Regulation 6.12.

### 1.4.3 Equity and Diversity

A safe learning environment will be provided for all students regardless of race, colour, nationality, ethnic origin, social origin, religious creed, religion, age, disability, disfigurement, sex (including pregnancy), sexual orientation, gender identity, gender expression, marital status, family status, source of income or political opinion.

You should not photograph or record myself, teaching assistants, or other students in the class without first obtaining permission. Accommodation will be made for students with special needs.

The sound should be turned off on phones and computers during class.

## 1.5 Additional Supports

Resources for additional support can be found at:

- www.mun.ca/currentstudents/student/
- https://munsu.ca/resource-centres/

# Chapter 2

# Schedule

- Thurs Jan 5: Introduction
- Fri Jan 6: Population biology with discrete and continuous variables
- Tues Jan 10: Introduction to Rmarkdown and tidyverse **Assignment 1 is assigned**
- Thurs Jan 12: Geometric growth
- Fri Jan 13: Geometric growth
- Tues Jan 17: Numerical solutions and graphing population data **Assignment 1 is due & Assignment 2 is assigned**
- Thurs Jan 19: Exponential growth
- Fri Jan 20: Exponential growth
- Tues Jan 24: Density dependence and logistic growth **Assignement 2 is due**
- Thurs Jan 26: Density dependence and logistic growth
- Fri Jan 27: Density dependence and logistic growth
- Tues Jan 31: Discrete time density dependence
- Thurs Feb 2: **EXAM I** (all material covered to date)
- Fri Feb 3: Age-structured models
- Tues Feb 7: Stage-structured models
- Thurs Feb 9: Stage-structured models
- Fri Feb 10: Stage-structured models
- Tues Feb 14: Numerical analysis of stage-structured models **Assignment 3 is assigned**
- Thurs Feb 16: Density dependence in stage-structured models
- Fri Feb 17: Metapopulation models

WINTER BREAK

- Tues Feb 28: Continuous space models **Assignment 3 is due**
- Thurs Mar 2: Spatially explicit models in population biology
- Fri Mar 3: Population dynamics in a warming world

- Tues Mar 7: Spatially explicit population dynamics in a warming world
- Thurs Mar 9: Disease dynamics
- Fri Mar 10: The net reproduction number
- Tues Mar 14: Overview of models in population biology
- Thurs Mar 16: **EXAM II** (All material since Exam I)
- Fri Mar 17: What is evolutionary ecology?
- Tues Mar 21: Haploid selection model
- Thur Mar 23: Selection coefficients for COVID-19 variants
- Fri Mar 24: Estimating selection coefficients **Assignment 4 is assigned**
- Tues Mar 28: The evolutionary ecology of pathogens
- Thurs Mar 30: The evolutionary ecology of COVID-19
- Fri Mar 31: The evolutionary ecology of hosts **Assignment 4 is due**
- Tues Apr 3: The evolution of reproductive effort in plants
- Thurs Apr 5: Evolutionarily stable and convergent stable strategies
- Fri Apr 6: Review

TBD **FINAL EXAM** (all course material)

# Chapter 3

# Jan 5: Introduction

- Survey of student computer preferences

## 3.1 Some questions

- What is a population?
- What are some definitions of a population that are given in textbooks?
- In research studies, how are populations discussed in the *Discussion*?
- How are individuals that comprise the sample selected in the *Methods* of a research study?
- List some potential differences between how populations are defined and discussed and the research methods?
- Why does the definition of a population matter?

## 3.2 References

Vandermeer, J.H., Goldberg, D.E., 2013. Population Ecology: First Principles (Second Edition). Princeton University Press, Princeton, United States. Link

The Princeton Guide to Ecology, edited by Simon A. Levin, et al., Princeton University Press, 2009. ProQuest Ebook Central, Link

Sacchi, R., Gentilli, A., Razzetti, E., Barbieri, F., 2002. Effects of building features on density and flock distribution of feral pigeons Columba livia var. domestica in an urban environment. Can. J. Zool. 80, 48-54. Link

# Chapter 4

# Jan 6: Discrete and continous variables

Reading: Otto, Sarah P., and Troy Day. 2007. A Biologist's Guide to Mathematical Modeling in Ecology and Evolution, Princeton University Press. Link **pages 33-38 in Section 2.3**

- Parameters versus variables
- Fitted versus independently estimated parameters

# Chapter 5

# Jan 10: ASSIGNMENT Rmarkdown and tidyverse

The assignment will appear here

# Chapter 6

# Jan 12: Geometric growth

## 6.1 Reading

Vandermeer, J.H., Goldberg, D.E., 2013. Population Ecology: First Principles (Second Edition). Princeton University Press, Princeton, United States. **p1-3.** Link

# Chapter 7

# Jan 13: Geometric growth

## 7.1 Reading

Download the .pdf of the MSc thesis below and read the Abstract (the first two pages prior to the title page). Pay specific attention to the number of pheasants at different points in time, these might be $N_{t+1}$ and $N_t$ in the geometric growth model formula; and the number of births and deaths that occur, these may help you estimate $\lambda$ in the geoemtric growth formula. Pay attention to the length of time that births and deaths are reported over, and what time of the year the population size is reported.

Newcomb, HR. 1940. Ring-necked pheasant studies on Protection Island in the Strait of Juan de Fuca, Washington. MS thesis. Oregon State University. [two pages prior to the title page]

Noteably,

a. Pheasant chicks are born during the summer.
b. In May 1937, 10 pheasants were introduced to the island. Before the next breeding season there were 35.
c. November 10, 1938 a census estimated 110 pheasants.
d. October 13, 1939 a census estimated 400 pheasants.
e. Between the 1938 and 1939 censuses, Newcomb observed that 17 adult birds died.
f. During the 1938 nesting season there were 5.86 eggs/nest. 83.57% of eggs hatched.
g. During the 1939 nesting season there were 8.73 eggs/nest. 64.58% hatched.
h. During the 1939 nesting season: Average number of chicks per clutch was 6.93.[1]
i. You can assume the sex ratio is 50:50 male to female. Pheasants are a sexually reproducing species.

[1] Note that g. and h. appear to be contradictory.