**BIOL 3295 – Population and Evolutionary Ecology**

**Instructor Information**

Instructor: Dr. Amy Hurford
Office: SN-1093 (x8301)
Email: Please email me via `Brightspace`
Office hours: M 9-11am

**Course Information**

Lecture
TR 12.00-12.50pm
F 1-1.50pm
SN-2067

Lab
W 2-5pm
SN-4110, 4116F and 3000

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:
*Prior to lecture.* Readings are to be completed before some lectures (see *1.1 Lecture Schedule* and *1.3 Readings* for more details).

*Lecture*. There are 3 x 50 minute lectures each week. Lectures will be a combination of *me* lecturing and *you* problem solving, running simulations, and analyzing data to understand how to answer research questions in population and evolutionary ecology.

- Plan to bring a laptop computer with the recommended software installed (see *1.5 Software* for installation instructions).

*Labs.* There are 8 x 3 hour labs. See *1.2 Lab Schedule*.

Course expectations: Any students that are disruptive, violating university policies, or acting in a potentially unsafe way will be warned and asked to leave.

**Learning goals**

- Understand key concepts
- Perform calculations
- Know how to gain knowledge and assess information sources
- Gain some experience running simulations and coding

**Required Text and Readings**

- I will conduct a computing resources survey on the first day of class. Please notify me if you have limited access to computing resources.
- All readings are available online via the links in *1.3 Readings*, or can be accessed via the library website.

- `Brightspace` – will be used: a) to make announcements (in addition to in class); b) for class-related emails; c) to disseminate grades; d) for students to post questions on the readings.
- `Github` – Lecture slides, Labs, and other resources will be available to download at https://github.com/ahurford/BIOL-3295

**Method of Evaluation**

- Assignments 20%
- Midterm (take home) 20%
- Labs 20%
- Final exam 40%

Late assignments, labs, and missed midterms, 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). The Final exam will cover all Lecture material and readings, but not Labs. Specific regulations governing final examinations are described by University Regulation 6.8. Lecture participation is highly recommended and practice problems completed during lectures may appear on Assignments.

**1.1 Lecture schedule**

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| Week 1<br>Fri Sept 6 | **What is a population and why does is matter?** |
| Week 2<br>Tues Sept 10 | **What is evolutionary ecology?**<br>• Björklund, 2019.<br>**Estimating population size**<br>• Sacchi et al., 2002.<br>(Skalski et al., 2005. 8.1.2 Basic Sampling Methods and 8.2 Description of Common Indices. p363-394 – Read only if you are interested in additional details) |
| Week 3<br>Tues Sept 17 | **Discrete and continuous time population dynamics** **Assignment 1 set**<br>**Exponential/geometric growth**<br>• Vandermeer and Goldberg, 2013. p1-8 (beginning after the Exercises on p4) |
| Week 4<br>Tues Sept 24 | **Density dependence**<br>• Vandermeer and Goldberg, 2013. The Logistic Equation. p13-17<br>• Vandermeer and Goldberg, 2013. Density dependence in discrete time models. p28-29 **Assignment 1 due** |
| Week 5<br>Tues Oct 1 | **Evolution in low- and high-density populations** **Assignment 2 set**<br>• "Zombie ideas in ecology," 2011<br>• Pianka, 1970<br>• Travis et al., 2013 |
| Week 6<br>Tues Oct 8 | **Age structure**<br>• Vandermeer and Goldberg, 2013. Elementary Age Structured Projection Matrices. p30-39 |

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| | **Stage structure**<br>• Vandermeer and Goldberg, 2013. Non-Age Structure: Stage projection models. p39-47<br>• Kendall et al., 2019<br>**Assignment 2 due**<br>**MIDTERM AVAILABLE** |
| **Midterm break**<br>Week 7<br>Thurs Oct 17 | **Evolution of life history strategies**<br>• Vandermeer and Goldberg, 2013. Life History Analysis. p63-72 |
| Week 8<br>Tues Oct 22 | **Evolution of life history strategies**<br>**Structured populations - space**<br>• Vandermeer and Goldberg, 2013. Metapopulations. p142-151 |
| Week 9<br>Tues Oct 29* | **Structured populations – space** **MIDTERM DUE**<br>• Andow et al., 1990<br>**Evolution in spatially structured populations**<br>• Lion and Baalen, 2008 |
| Week 10<br>Tues Nov 5 | **Population dynamics in seasonal environments** **Assignment 3 set**<br>• Saunders et al., 2019<br>**Population dynamics in a warming world**<br>• Walsh et al., 2019<br>• Baltar et al., 2019 |
| Week 11<br>Tues Nov 12 | **Evolution in a warming world**<br>• Edelaar and Bolnick, 2019<br>**Assignment 3 due** |
| Week 12<br>Tues Nov 19 | **Stochastic population dynamics**<br>• Chapter 13: Probabilistic Models https://www.zoology.ubc.ca/biomath/<br>**Evolution in fluctuating environments**<br>• Sæther and Engen, 2015 |
| Week 13<br>Tues Nov 26 | **Big questions in evolutionary ecology**<br>Reading TBD |

*Oct 30 is the last day to drop fall semester courses without academic prejudice.

**1.2 Lab schedule**

- For labs you should, bring your own laptop computer with software installed to work on (recommended; see *1.4 Software*).
- On Sept 16, Lab 2a will require, walking to and through bush in Pippy Park. Please dress appropriately.
- You will need a Github account to contribute data and code for Labs 5 and 7. (see *1.4 Software*)

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| Sept 11 | Lab 1: Getting started in R/Duck data collection | `R/RStudio` |
| Sept 18 | Lab 2a: Pippy park – data collection* | – |

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| Sept 25 | Lab 2b: Pippy park – data analysis | `R/RStudio` |
| Oct 2 | Lab 3: Testing for density dependence | `R/RStudio` |
| Oct 9 | Lab 4: Stage structure | `R/RStudio` |
| Oct 23 | Lab 5: Life history evolution | `R/RStudio; Github` |
| Oct 30 | Lab 6: Spatial and stochastic population dynamics | `R/RStudio; Netlogo` |
| Nov 13 | Lab 7: Ducks on Burton's pond | `R/RStudio; ImageJ` |

**1.3 Readings**

- All of the readings are available as online resources available from the MUN library website. The journal articles should be accessible via the links, but you might also be able to access them via *Web of Science* from the library website.
- See *1.1 Lecture Schedule* for the timing of the readings and see *1.4 References* for full bibliographic information.
- Prior to the day that a reading is due, you should post any questions or comments you have on the reading to the *Discussion* on `BrightSpace`. If you are having trouble viewing any of the required readings, please contact myself, or a teaching assistant.
- Please consult *"How to Read a Scientific Paper"* (2014) for the recommended approach to 'reading' journal articles. Steps 1,2, and 4 are good advice, but step 3 may not be relevant for some readings.
- Readings from textbooks (i.e., Vandermeer and Goldberg, 2013) can be read linearly (from beginning to end).

**1.4 References (It is recommended to cut and paste links into a web browser to access journal articles; alternatively follow the instructions from 'Guide for accessing readings.docx')**

Andow, D.A., Kareiva, P.M., Levin, S.A., Okubo, A., 1990. Spread of invading organisms. Landsc. Ecol. 4, 177–188. https://doi.org/10.1007/BF00132860

Baltar, F., Bayer, B., Bednarsek, N., Deppeler, S., Escribano, R., Gonzalez, C.E., Hansman, R.L., Mishra, R.K., Moran, M.A., Repeta, D.J., Robinson, C., Sintes, E., Tamburini, C., Valentin, L.E., Herndl, G.J., 2019. Towards Integrating Evolution, Metabolism, and Climate Change Studies of Marine Ecosystems. Trends Ecol. Evol. 0. https://doi.org/10.1016/j.tree.2019.07.003

Björklund, M., 2019. Lamarck, the Father of Evolutionary Ecology? Trends Ecol. Evol. S0169534719301909. https://doi.org/10.1016/j.tree.2019.06.010

Edelaar, P., Bolnick, D.I., 2019. Appreciating the Multiple Processes Increasing Individual or Population Fitness. Trends Ecol. Evol. 34, 435–446. https://doi.org/10.1016/j.tree.2019.02.001

How to Read a Scientific Paper [WWW Document], 2014. . Research4Life. URL https://www.research4life.org/blog/how-to-read-a-scientific-paper/ (accessed 9.3.19).

Kendall, B.E., Fujiwara, M., Diaz-Lopez, J., Schneider, S., Voigt, J., Wiesner, S., 2019. Persistent problems in the construction of matrix population models. Ecol. Model. 406, 33–43. https://doi.org/10.1016/j.ecolmodel.2019.03.011

Lion, S., Baalen, M. van, 2008. Self-structuring in spatial evolutionary ecology. Ecol. Lett. 11, 277–295. https://doi.org/10.1111/j.1461-0248.2007.01132.x

Pianka, E.R., 1970. On r- and K-Selection. Am. Nat. 104, 592–597.

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. https://doi.org/10.1139/z01-202

Sæther, B.-E., Engen, S., 2015. The concept of fitness in fluctuating environments. Trends Ecol. Evol. 30, 273–281. https://doi.org/10.1016/j.tree.2015.03.007

Saunders, S.P., Ries, L., Neupane, N., Ramírez, M.I., García-Serrano, E., Rendón-Salinas, E., Zipkin, E.F., 2019. Multiscale seasonal factors drive the size of winter monarch colonies. Proc. Natl. Acad. Sci. 116, 8609–8614. https://doi.org/10.1073/pnas.1805114116

Skalski, J.R., Ryding, K.E., Millspaugh, J.J., Millspaugh, J., 2005. Wildlife Demography: Analysis of Sex, Age, and Count Data. Elsevier Science & Technology, Burlington, UNITED STATES. https://ebookcentral-proquest-com.qe2a-proxy.mun.ca/lib/mun/detail.action?docID=269552

Travis, J., Leips, J., Rodd, F.H., Reznick, S.E.D.N., 2013. Evolution in Population Parameters: Density-Dependent Selection or Density-Dependent Fitness? Am. Nat. 181, S9–S20. https://doi.org/10.1086/669970

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

Walsh, B.S., Parratt, S.R., Hoffmann, A.A., Atkinson, D., Snook, R.R., Bretman, A., Price, T.A.R., 2019. The Impact of Climate Change on Fertility. Trends Ecol. Evol. 34, 249–259. https://doi.org/10.1016/j.tree.2018.12.002

Zombie ideas in ecology: r and K selection, 2011. Oikos Blog. URL https://oikosjournal.wordpress.com/2011/06/29/zombie-ideas-in-ecology-r-and-k-selection/ (accessed 8.28.19).

**1.5 Software**

The following computing resources will be used during the course. Below are the links to download these software.

R: https://www.r-project.org/

RStudio: https://www.rstudio.com/products/rstudio/#Desktop

Github: https://github.com/join

Github Desktop: https://help.github.com/en/desktop/getting-started-with-github-desktop/installing-github-desktop

Netlogo: https://ccl.northwestern.edu/netlogo/

ImageJ: https://imagej.nih.gov/ij/download.html

**Additional Policies**

*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 (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 (www.mun.ca/blundon).

*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.

*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.

**Additional Supports**
Resources for additional support can be found at:

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