Population and Community Ecology
BISC 7501, Fall 2014

⌛ **Meeting place and times:** Larkin Hall Rm 170, Mondays & Wednesdays, 6:00-8:00 pm

☛ Course Overview: This core course focuses on the evolution and ecology of populations, including both intra- and interspecific interactions. Particular emphasis is placed on evolution, species, speciation, gene flow, adaptation, behavioral ecology, life histories, population growth, community structure, species diversity, niche theory, and competition, predation, parasitism and mutualisms within and among species.

❝ **Instructor:** Drs. Jason Munshi-South & J.D. Lewis
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- Office Hours
  JMS: (Rose Hill office): Mondays / Wednesdays 2:30-4:00 PM and by appointment
  JDL: (Rose Hill office): Mondays / Wednesdays 2:30-4:00 PM and by appointment
- ☎ Rose Hill Office:
  JMS: Larkin Hall 400, x0534
  JDL: Larkin Hall 160, x3642

Course page: http://fordham.blackboard.com

📖 **Textbooks:**

Required texts:	Futuyma, DJ. 2013. Evolution, 3rd Ed. (2nd also OK!)
	Community Ecology, 2nd Ed. P.J. Morin (2011)
	A Primer of Ecology, 4th Ed. N.J. Gotelli (2008)
	Primary literature as assigned (on BlackBoard)
	Graham Coop's "Notes on Population Genetics" v.3 (on BlackBoard)

Readings will consist of selected pages from the required text and research papers. Texts serve predominantly to provide introductory information in a highly structured format. Research paper discussions and writings are to examine specific methods and topics in detail.

Participation is mandatory! In-class discussion is an integral part of the course, and class meetings will be a combination of lecture and discussion. Supplemental readings for a given meeting are available online from the course website, and will be a basis for the discussions. You are expected to read the designated text and supplemental readings in advance of the corresponding meeting and to participate in the discussions.

☛ **Grading:**

Writings / Problem Sets	10%
Exam 1:	20%
Pre-doc Research Proposal:	10%
Exam 2:	20%
Final presentation	10%
Exam 3:	20%
Participation:	10%

Exams will be essay-type exams with some application of the models we will cover during the course. The final will be cumulative, but will emphasize material covered during the latter part of the course. These exams will be designed to help you pass your first exam for Fordham's graduate program. Make-up exams are strongly discouraged; make-ups will be given only if

arranged before the absence or if you have a note from a medical doctor or a Dean's note. Make-ups will not duplicate regular exams and may be harder. To be fair to everyone in the class, there are no exceptions to this policy.

Course dynamics. Classes will include discussions of ca. 2-3 scientific papers per week, lectures, and lots of writing. **For the first several weeks, students will write a well-structured 1 page essay (12 point font, single spaced, 1 inch margin) about the topic to be discussed in class.** Essays should include one opening paragraph or sentence, 2-3 content-focus paragraphs, and a closing statement that either connects the discussed topics, proposes new areas for research, makes links with the research area of the student, or provides a concluding remark. Remember to begin every paragraph with an opening sentence and to connect paragraphs along the text. Essays are due in the following class period (points WILL be taken off for late students) and will be discussed in class. Both content and format of essays will be discussed with the group.

After the first exam, I will assign a small number of population genetic simulations / analyses that students will run as homework. These well-documented exercises will introduce students to working with population genetic data in the R statistical platform. The R software is freely available for all operating systems (http://www.r-project.org/), and can be installed on your personal computers or others at Fordham.

Mini pre-doc proposal write-up and review panel. As a mid-term project in Population Biology, you will present a pre-doctoral research proposal within the field of Evolution, Evolutionary Ecology, or Conservation. This assignment should be taken as an opportunity to use your newly gained knowledge, to articulate your thoughts on the research topic that you want to pursue, and to prepare eligible students for real NSF grant submission. Please contact your research advisor if you want to use this as an opportunity to prepare yourself for real grant submission this Fall. Guidelines for NSF Pre-doctoral grants are found online at:

http://www.nsf.gov/pubs/2014/nsf14590/nsf14590.htm

All proposals will be reviewed by 2-3 student colleagues and myself (the acting program manager!) as in a peer-reviewed system, and will be discussed and evaluated through a mock class-based panel. Class activities have been scheduled to give feedback to each student so that he/she can review it in time for NSF's real deadline (**November 4th**).

⌛ Schedule of Topics

Note: This is a rough schedule of events; some topics may take more or less time than indicated. The chapters in the Futuyma book are highly recommended if you do not have prior experience with these topics (e.g. you did not take an undergraduate evolution course). The papers that we will read each class follow after the schedule and will be available as PDFs on the course BlackBoard site.

Date	Day	Topic	Text Reading
		The rise of biodiversity on earth	
03 Sept.	W	Introduction to Evolutionary Biology	Ch. 1, Futuyma
08 Sept.	M	Systematics / phylogenetic analysis*	Ch. 2, Futuyma
10 Sept.	W	Character evolution / adaptations*	Ch. 3, Futuyma
15 Sept.	M	Adaptive divergence, radiations, diversification*	Ch. 6-7, 22 Futuyma
17 Sept.	W	Co-evolution, host-pathogen, geographic mosaics*	Ch. 19, Futuyma
22 Sept.	M	Niche evolution*	Ch. 19, Futuyma
24 Sept.	W	**EXAM 1**	
		Evolution and natural selection	
29 Sept.	M	Variation & mutation	Ch. 8-9, Futuyma
01 Oct.	W	Genetic drift, demography, coalescence	Ch. 10, Futuyma
06 Oct.	M	Natural selection & adaptation	Ch. 11-12
08 Oct.	W	Populations & Species*	Ch. 17
13 Oct.	M	**COLUMBUS DAY**	
15 Oct.	W	Speciation*	Ch. 18
20 Oct.	M	Genomic evolution*	Ch. 20
22 Oct.	W	Evolution and development **NSF GRFP PROPOSALS DUE**	Ch. 21
27 Oct.	M	**Pre-doctoral Review Panel**	
29 Oct.	W	**Pre-doctoral Review Panel**	
03 Nov.	M	Evolution and society	
05 Nov.	W	**EXAM 2**	
		Interactions between species	
10 Nov.	M	Species assemblages in space and time	Ch. 1 Morin
12 Nov.	W	Competition: Mechanisms and models	Ch. 2 Morin, Ch. 5 Gotelli
17 Nov.	M	Competition: Empirical evidence	Ch. 3 Morin
19 Nov.	W	Competition and community structure	Ch. 3 Morin

* One page essay due

24 Nov.	M	Predator prey interactions	Ch. 4 Morin
26 Nov.	W	**THANKGSIVING BREAK**	
01 Dec.	M	Predation models	Ch. 5 Morin, 6 Gotelli
03 Dec.	W	Predation and community structure	
08 Dec.	M	Parasites and parasitoids	(suggested Ch. 12 BHT)
10 Dec.	W	Mutualisms and commensalisms	Ch. 7 Morin
15 Dec.	M	Mutualisms and commensalisms	
17 Dec.	W	Presentations	
22 Dec.	M	**EXAM 3**	

Readings and Assignments: Sept. 3th

Futuyma: Chapter 1

pp. 375–379 in: Darwin, C. 1891. Journal of researches into the natural history and geology of the countries visited during the voyage of H.M.S. “Beagle” round the world. Ward, Lock, and Co., London.

Assignment (in class): On multiple occasions throughout this text, Darwin brings up the roles of contingency and determinism in shaping patterns of diversity in the Galapagos islands. Identify these quotes for discussion.

Readings and Assignments: Sept. 8th

Futuyma: Chapter 2

Rambaut, A. How to read a phylogenetic tree.
http://epidemic.bio.ed.ac.uk/how_to_read_a_phylogeny (PDF on Blackboard)

Scaduto DI, Brown JM, Haaland WC, Zwickl DJ, et al. (2010) Source identification in two criminal cases using phylogenetic analysis of HIV-1 DNA sequences. *Proceedings of the National Academy of Sciences*, **107**, 21242–21247.

Pyron RA, Burbrink FT (2014) Early origin of viviparity and multiple reversions to oviparity in squamate reptiles. *Ecology Letters*, **17**, 13–21.

Assignment (bring to class): The papers above include descriptions of several phylogenetic trees. What is a phylogenetic tree? What types of assumptions are inherent to phylogenetic analysis? What are some of the uses of phylogenies for evolutionary biology?

Readings and Assignments: Sept. 10th

Futuyma: Chapter 3

Boag, P. and Grant, P. 1981. Intense Natural Selection in a Population of Darwin's Finches (Geospizinae) in the Galapagos. Science 214: 82-85.

Bearhop, S et al. 2005. Assortative Mating as a Mechanism for Rapid Evolution of a Migratory Divide. Science 310: 502-504.

Rosenblum, E.B., Römpler, H., Schöneberg, T., and Hoekstra, H. 2010. Molecular and functional basis of phenotypic convergence in white lizards at White Sands. PNAS 107(5): 2113-2117.

Assignment (bring to class): You have read about several great examples of natural selection in action. Briefly describe three of them: what outcomes were observed, what processes led to them, and how were selection and adaptation inferred in each case?

Readings and Assignments: Sept. 15th

Futuyma: Chapter 6-7, Chapter 22

Hughes, C. and Eastwood, R. 2006. Island radiation on a continental scale: exceptional rates of plant diversification after uplift of the Andes. PNAS 103: 10334-10339.

Harmon, L. J., J. B. Losos, J. Davies, R. G. Gillespie, J. L. Gittleman, W. B. Jennings, K. Kozak, M. A. McPeek, F. Moreno-Roark†, T. J. Near, A. Purvis, R. E. Ricklefs, D. Schluter, J. A. Schulte II, O. Seehausen, B. Sidlauskas, O. Torres-Carvajal†, J. T. Weir†, & A. Ø. Mooers. 2010. Early bursts of body size and shape evolution are rare in comparative data. Evolution 64: 2385-2396.

Assignment (bring to class): What is an adaptive radiation – what processes lead to it, what is its end result, how does one study them, and what are the challenges involved?

Readings and Assignments: Sept. 17th

Futuyma: Chapter 19

Thompson, J., Cunningham, B.M. 2002. Geographic structure and dynamics of coevolutionary selection. Nature 417: 735-738.

Pigot AL, Tobias JA (2013) Species interactions constrain geographic range expansion over evolutionary time. *Ecology Letters*, **16**, 330–338.

Meyer JR, Dobias DT, Weitz JS, Barrick JE, et al. (2012) Repeatability and Contingency in the Evolution of a Key Innovation in Phage Lambda. *Science*, **335**, 428–432.

Assignment (bring to class): How can interactions among and within species drive diversity patterns?

Readings and Assignments: Sept. 22nd

Futuyma: Chapter 19

Peterson, A. et al. 1999. Conservatism of Ecological Niches in Evolutionary Time. Science 285, 1265-7

Smith, S and Beaulieu, J. 2009. Life history influences rates of climatic niche evolution in flowering plants. Proc. R. Soc. B 276, 4345-4352.

Carnaval AC, Waltari E, Rodrigues MT, Rosauer D, et al. (2014) Prediction of phylogeographic endemism in an environmentally complex biome. *Proceedings of the Royal Society B: Biological Sciences*, **281**, 20141461.

Assignment (bring to class): When and how do niches evolve (and how do we know it)?

Readings and Assignments: Sept. 29th

Futuyma: Chapter 8-9

Coop, G. Notes on Population Genetics. **Section 1.** (PDF on BlackBoard)

Kimura, M. 1968 Evolutionary Rate at the Molecular Level. Nature 217: 624-6.

Ohta, T. 2002. Near-neutrality in evolution of genes and gene regulation. PNAS 99: 16134–16137

Assignment: Problem set or simulation to be determined.

Readings and Assignments: Oct. 1st

Futuyma: Chapter 10

Coop, G. Notes on Population Genetics. **Section 6.** (PDF on BlackBoard)

Freedman AH, Gronau I, Schweizer RM, Ortega-Del Vecchyo D, et al. (2014) Genome Sequencing Highlights the Dynamic Early History of Dogs. *PLOS Genetics*, **10**, e1004016.

Liti G, Carter DM, Moses AM, Warringer J, et al. (2009) Population genomics of domestic and wild yeasts. *Nature*, **458**, 337–341.

Assignment: Problem set or simulation to be determined.

Readings and Assignments: Oct. 6th

Futuyma: Chapter 11-12, 15

Coop, G. Notes on Population Genetics. **Section 2.** (PDF on BlackBoard)

Patricelli GL, Uy JAC, Walsh G, Borgia G (2002) Sexual selection: Male displays adjusted to female's response. *Nature*, **415**, 279–280.

Phillips, B. and Shine, R. 2004. Adapting to an invasive species: toxic cane toads induce morphological change in Australian snakes. PNAS 101: 17150-17155.

Weber JN, Peterson BK, Hoekstra HE (2013) Discrete genetic modules are responsible for complex burrow evolution in Peromyscus mice. *Nature*, **493**, 402–405.

Assignment: Problem set or simulation to be determined.

Readings and Assignments: Oct. 8th

Futuyma: Chapter 17

De Queiroz, K. 2007. Species concepts and species delineation. Systematic Biology 56: 879-886.

Mallet, J. 2008. Hybrid Speciation. Nature 446: 279-283

Waples RS, Gaggiotti O (2006) What is a population? An empirical evaluation of some genetic methods for identifying the number of gene pools and their degree of connectivity. *Molecular Ecology*, **15**, 1419–1440. (**NOTE**: **You can skim the simulations part of this paper and focus on the review**)

Assignment (bring to class): What are populations? What are species and how have people been delimiting them? Are these real quantities?

Readings and Assignments: Oct. 15th

Futuyma: Chapter 18

Hoskin, C. et al. 2005. Reinforcement drives rapid allopatric speciation. Nature 437: 1353-1356.

Nadeau, N et al. 2012. Genomic islands of divergence in hybridizing *Heliconius* butterflies identified by large-scale targeted sequencing. Proc Roy Soc 367: 343-353.

Schluter D et al. 2009. Evidence for Ecological Speciation and Its Alternative. Science 323, 737-741

Assignment (bring to class): How do species arise?

Readings and Assignments: Oct. 20th

Futuyma: Chapter 20

Jones FC, Grabherr MG, Chan YF, Russell P, et al. (2012) The genomic basis of adaptive evolution in threespine sticklebacks. *Nature*, **484**, 55–61.

Messer PW, Petrov DA (2013) Population genomics of rapid adaptation by soft selective sweeps. *Trends in Ecology & Evolution*, **28**, 659–669.

Shapiro MD, Kronenberg Z, Li C, Domyan ET, et al. (2013) Genomic Diversity and Evolution of the Head Crest in the Rock Pigeon. *Science*, **339**, 1063–1067.

Assignment (bring to class): How has genome-scale data changed our understanding of evolution?

Readings and Assignments: Oct. 22nd

Futuyma: Chapter 21

Pennisi, E. 2008. Deciphering the Genetics of Evolution - Powerful personalities lock horns over how the genome changes to set the stage for evolution. Science (NewsFocus) 321

Brykczynska U, Tzika AC, Rodriguez I, Milinkovitch MC (2013) Contrasted evolution of the vomeronasal receptor repertoires in Mammals and Squamate reptiles. *Genome Biology and Evolution*, evt013.

Ichihashi Y, Aguilar-Martínez JA, Farhi M, Chitwood DH, et al. (2014) Evolutionary developmental transcriptomics reveals a gene network module regulating interspecific diversity in plant leaf shape. *Proceedings of the National Academy of Sciences*, **111**, E2616–E2621.

Readings and Assignments: Nov. 3rd

Coyne JA (2012) Science, Religion, and Society: The Problem of Evolution in America. *Evolution*, **66**, 2654–2663.

Donihue CM, Lambert MR (2014) Adaptive evolution in urban ecosystems. *AMBIO*, 1–10.

Palmer AC, Kishony R (2013) Understanding, predicting and manipulating the genotypic evolution of antibiotic resistance. *Nature Reviews Genetics*, **14**, 243–248.