SIO 127: Marine Molecular Ecology
Spring Quarter 2022

Course Instructor:
> Dr. Ron Burton, Scripps Institution of Oceanography
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Office Hours: Tuesday 11am – 12:30pm and by appointment (set up by email)
> Don't be bashful - I'm happy to schedule time with each of you!

Course Description and Goals:

Molecular methods are now commonly used to address a broad range of questions in ecology and evolution. These tools have had an enormous impact on our understanding of marine organisms, revealing information about patterns of biodiversity, connectivity, and mating systems in natural populations. The role of genetic drift and natural selection in adaptation to the environment can now be inferred from population analyses of whole genomes using methods that have become available only in the past few years. This course will survey the application of molecular methods to address diverse questions concerning the ecology and evolutionary biology in marine organisms. Students will learn how different molecular approaches can be applied to understanding how marine organisms adapt to their physical and biotic environments.

Course structure: Lectures on T/Th, 9:30 am - 10:50 am, Eckart 227
> Thursday 11:00 am - Discussion (Eckart 227, right after lecture)

Lectures are important. This is an in-person course. It is critical that you attend the lectures since they will not be recorded, although the powerpoint presentations will be available on the Canvas website.

FREE Textbook (required): Molecular Ecology (3rd edition, 2020) Joanna Freeland
> **Available electronically from the UCSD Library**

The text provides a wealth of background information for many lecture topics and expands on some topics we only touch on in class. The text is not focused on marine organisms but applies the same concepts to many terrestrial systems that are equally relevant to your understanding of molecular ecology. To help coordinate between lectures and the textbook, I've arranged lectures into "modules" that roughly correspond to chapters in the textbook.

Additional course readings, consisting of primary literature, will occasionally be assigned in class then posted on the Canvas website.

Assignments:
1) There will be three short homework assignments designed to get you engaged in the material and allow me to make sure we are all on the same page. These will include a one-page paper and a population genetics problem set (or two).
2) You will also write a brief research proposal on a "course-appropriate" topic of your choice (approx. 3-5 pages) – more details to follow!

– **Homework assignments**		**30 pts**
– **Research Proposal**		**50 pts**
– **Two midterm exams**	**2 x 50 pts each**	**100 pts**
– **Final (really a third midterm)**		**50 pts**
	Total	**230 pts**

Module	Lecture Topic	Text reading
1	**Introduction and History of Molecular Ecology**	**Chapter 1**
	Mar 29 Lecture 1 Introduction to Molecular Ecology	
2	**Species Identification and Application**	**Chapter 3**
	Mar 31 Lecture 2 DNA Barcoding	
	Apr 5 Lecture 3 Metabarcoding, Metagenomics, eDNA	
	Apr 7 Lecture 4 Microbiomes, microbial ecology and metagenomics	
3	**Methods in Molecular Ecology**	**Chapter 2**
	Apr12 Lecture 5 Genetic markers: Allozymes to SNPs	
4	**Theoretical Background**	**Chapter 5**
	Apr 14 Lecture 6 Population genetics 1: drift and effective population size	
	Apr 19 Lecture 7 Population genetics 2: migration and natural selection	
	Apr 21 Midterm 1	
5	**Genes and Individual Fitness**	
	Apr 26 Lecture 8 Functional ecology: molecular adaptations at single loci	
	Apr 28 Lecture 9 Functional ecology: transcriptomics and regulatory variation	
	May 3 Lecture 10 Natural Selection	
6	**Population Differentiation and Speciation**	**Chapter 6**
	May 5 Lecture 11 Population structure	
	May 10 Lecture 12 Phylogeography	**Chapter 4**
	May 12 Midterm 2	
	May 17 Lecture 13 Hybrid breakdown	
	May 19 Lecture 14 Speciation	
7	**Molecular Ecology Applications**	**Chapter 8**
	May 24 Lecture 15 Fisheries genetics 1	
	May 26 Lecture 16 Fisheries genetics 2	
	May 31 Lecture 17 Conservation genetics	
8	**Behavioral Ecology**	**Chapter 7**
	June 2 Lecture 18 Mating systems	
	June 7 Final Exam 8:00am – 10:59 am	

UCSD Academic integrity policy:

Integrity of scholarship is essential for an academic community. For students, this means that all academic work will be done by the individual to whom it is assigned, without unauthorized aid of any kind. All suspicions of integrity violation will be reported to the Academic Integrity Office according to university policy. Integrity violation is not just blatant cheating (e.g., copying off another student during an exam), but include copying other students' papers or homework, copying or using old papers/report, working with others on individual assignments. Those students found to have committed academic misconduct will face administrative sanctions imposed by their college Dean of Student Affairs and will also face consequences for this course which may range in severity from an F on the exam or assignment to an F in the course. Students who assist in or are complicit with cheating could also be in violation of the Policy. Thus, students who become aware of their peers either facilitating academic misconduct or committing it should report their suspicions to us for investigation. For more information on academic integrity please refer to The Policy on Integrity of Scholarship (academicintegrity.ucsd.edu).

Brief biography of your enthusiastic instructor:

I grew up in suburban Chicago, so when I got the chance to escape shoveling snow and go to college in California, I jumped at it! I did a BS/MS program at Stanford University (it was easier to get into Stanford back then!), where I spent two summers at Hopkins Marine Station falling in love with marine biology. But I wanted warmer water, so I went to the University of Miami to start a Ph.D. Well, I learned that you shouldn't pick graduate schools based on water temperature (!!) so after one long year in Miami, I returned to Stanford to do my PhD working on the genetics of marine organisms (in cold water!).

I got my first faculty position at the University of Pennsylvania, which was a great job except that it was in Philadelphia… I left for the University of Houston - that might not sound great, but after six years of hard time in Philadelphia, Houston was quite nice!   Five years later, a job was advertised at Scripps Institution of Oceanography. I'd never visited Scripps but the pictures looked nice and I had collected marine animals in San Diego and thought it'd be a nice place for the family! Got the job and I've now been here for almost 30 years.
Quiz question: Burton has been a professor for how many years total?

At SIO/UCSD, I've played a role in developing both the Environmental Systems major and the Marine Biology major and I have taught in both, so I'm pretty dedicated to undergrad education. I've also been advisor to ~10 PhD, 20 MS and 15 postdoctoral students. Together, with many undergrad lab assistants, we've published ~125 research articles - almost all are "marine molecular ecology," so yeah, you'll hear about a number of studies from my own lab.