Fall 2022

MW 10-11 MCZ 101

+ Friday discussion section 10-11 MCZ 101a Gilbert Room or field trip to Museums

COURSE DETAILS

Instructor: James Mallet
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Office Hours:

Course description

TIMETABLE

USEFUL BOOKS

Speciation is the part of evolutionary biology that deals with the emergence of distinct biological forms and biodiversity on our planet. Ever since Lamarck and Darwin wrote their important books on evolution, the topic of the origin of species has generated controversies, and in some countries (!) still does. These controversies are not only between religion and science, but also among evolutionary biologists; speciation is arguably the most contentious part of evolution. Because species tend to originate rather slowly (although not always, as we shall see), the study of speciation is inevitably partly a historical branch of evolutionary biology not so amenable to laboratory experiments. Since the 1980s, when molecular methods, and more recently genomic methods, have become widely available, I think it is true to say that our understanding of speciation has been revolutionized in very unexpected ways.

This new course will survey modern ideas on speciation, and will include the following topics:

- History of ideas in speciation; pre-Darwin, Darwin & Wallace, 1930-1940s, recent.
- What are species? Species concepts and species delimitation.
- What is needed to understand speciation? The population genetics of gene flow, and genetic divergence via mutation, drift, and selection
- The concept of reproductive isolation
- Brief introduction to coalescent theory and the multi-species coalescent
- The geography of speciation, including allopatric, parapatric, and sympatric speciation
- Ecological "races" and ecological speciation
- Behavioral divergence and mate choice, including "reinforcement"
- Hybrid inviability and hybrid sterility between species
- Idealized population genetic models of speciation
- Chromosomal evolution, genomic rearrangements, and speciation
- Speciation: caused by natural selection or by genetic drift?
- Beyond the species: macroevolution and diversification
- Applications in conservation and biodiversity

Course format:

The course meets twice weekly for one hour classes, 10-11, and also (hopefully) on Friday for discussion section or Museum visit at the same times. At each of the main meeting times, I will present a lecture, but also encourage interactions, questions and arguments! I'm not kidding when I say speciation is contentious -- I will present my own viewpoints that are I believe well-informed but also are sometimes divergent from the views of my fellow scientists. So I don't mind if you disagree with me and take a more traditional view. The readings will cover a diversity of views.

The great Ernst Mayr, who was at Harvard for around half a century, made Harvard and the Museum of

Comparative Zoology (MCZ) famous for speciation. He published very influential and magisterial books on speciation and lived for almost exactly a century, before dying in 2005. The Mayr Library in the MCZ is named after him.

Unfortunately, there are no really up-to-date books that cover the whole topic of the course. The last available one is Coyne & Orr (2004) which came out before genomics was widely available to evolutionary biologists (see Useful Books link above); it's also very expensive. I will have this and some copies of relevant books placed on reserve in the Mayr library. You may want to consult, especially for your term paper.

Instead of required books, I will assign reading of one or two published papers on the weeks' topics. To encourage students to do the reading, I expect a one paragraph summary on each paper which will be graded.

Learning objectives:

By the end of this course, students are expected to:

- Have a good understanding of the breadth of this field
- Understand major controversies in speciation
- Develop an ability to understand cutting-edge research in the field
- Develop an understanding of the importance of speciation in the generation of biodiversity, and in applications such as conservation.

Who should take this course:

(A) Undergraduates with an interest in developing a broad knowledge in a key topic of biological evolution. I do not limit this to Integrative Biology majors, because I am hoping that the course will appeal to scientists in general, and to those in other majors such as philosophy or history of science.

(B) Graduate students similarly.

Prerequisites: None. This new course will build on a general understanding of evolution to topics not found in other courses. Although not mandatory prerequisites, students will benefit from having taken a basic undergraduate course in biology (e.g. LS 1B) or evolution (e.g. OEB 53). If in doubt, consult
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Written work:

- A near weekly news-style paragraph on each reading in your own words, mentioning important points, and a critical overview (not just a summary).
- Term paper on a topic about speciation of your own preference (but you must consult with instructor and/or TF). Due in reading week Tue 6 Dec 2022. About 6-10 pages, correctly referenced with citations. 10/22/2022: I've made a few edits to the above in red.

Grading:

There is a letter grade for this course. However, it is mainly an upper-level course, and the goal is to have students learning to enjoy reading the material, forming opinions, and discussing them in class, rather than to rank the students. Thus the TF will keep a record of your contributions in class (33%), and we'll jointly check your weekly paragraphs (33%). We'll also grade the final paper (34%). No written exams, unless there's a clamor from you for one!

Academic Integrity:

Meetings with fellow students outside class to discuss these topics and the readings is encouraged, but you should always write and submit your own written work. If you lift a quotation from a publication, you should put it in quotation marks. You should always cite your sources fully for all quotations, information, or ideas other than your own.