ESSM/MEPS 689 Special Topics in Ecological Genomics
Spring 2015 - 3 credits

Course Description and Prerequisites

Course rationale: Ecological Genomics is the study of the structure and function of a genome as it pertains to the organism-environment relationship. While the close relationships between this discipline and fields such as ecological genetics, molecular ecology and physiological ecology are apparent, ecological genomics has developed its own theoretical ground and specific toolkits in the past decade. In addition, the emergence of ecological genomics has led to powerful ways to address core issues in ecology, the onset of novel questions in ecology, physiology and microbiology, and the development of genomic tools tailored to these disciplines.

Ecological genomic studies can be oriented towards a variety of objectives, including the following goals:

- Identifying the genetic basis of adaptation and the mechanisms of adaptive responses in the wild
- Identifying processes underlying patterns of genetic variation in the wild
- Determining mechanisms of adaptation, speciation and hybridization
- Finding the genetic basis of phenotypic traits variation among species and populations
- Finding the genetic basis of stress responses, and predict ecological and physiological response to projected climate changes at different scales
- Identifying the genomic basis of life history traits (longevity and aging, life cycles, phenotypic plasticity, etc.)
- Understanding the structure and function in microbial communities

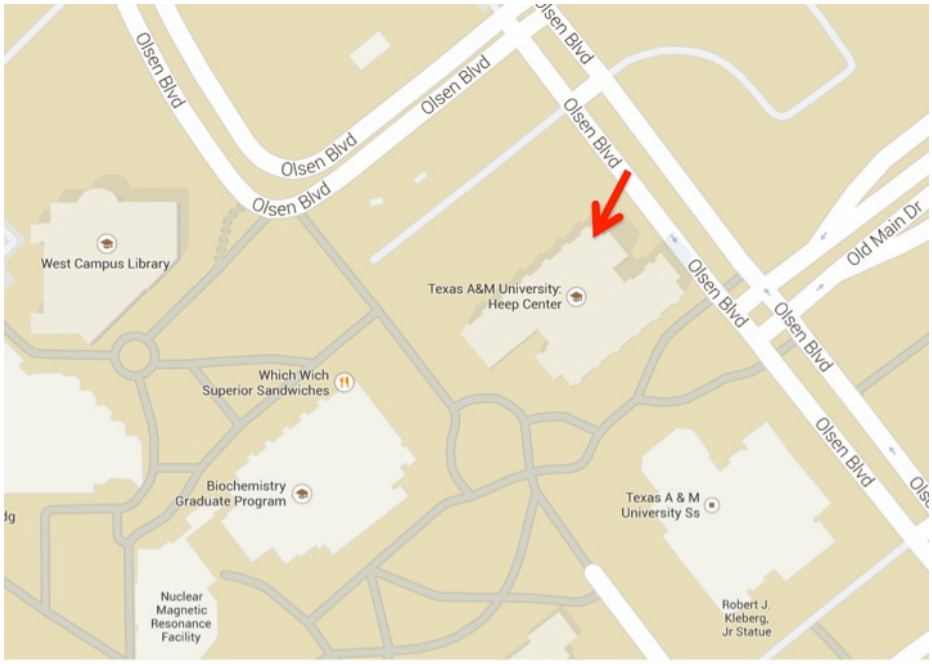
Prerequisites: GENE 603 and STAT 651 or an equivalent general introduction to general, population or ecological genetics (such as GENE 301, 302, 310 or 412) and an introductory course in probability and statistics are suggested, but not required, prerequisites. However, without the suggested courses, you will not understand much of the material, and you may have difficulty passing the course.

Computational resources: Students should bring their own laptop during the computer demonstrations. If this is not possible, they should contact the instructor. As an alternative, computer labs might be used for the demonstrations, if available.

Instructor Information

Name:	Dr. Claudio Casola, Assistant Professor in Forest Genomics, ESSM Department
Phone:	(979) 845-8803
email:	ccasola@tamu.edu
Office hours:	Monday 10-12 or by appointment
Office:	HFSB 317

Meeting times and location: Tuesday-Thursday 12:45-2pm Heep Center 123x (Northwest corner, see map)



Learning Outcomes

The primary learning outcomes for this course include:

- Define and describe theoretical and historical foundations of ecological genomics
- Understand the basics of current high-throughput DNA sequencing techniques, perform basic analysis of genomic variants and transcriptomic data sets, and interpret their results
- Describe association and linkage mapping approaches and the use of molecular markers for genetic mapping
- Use empirical methods and tools to describe levels and patterns of genetic diversity and differentiation in populations and to infer and assess population genetic structure
- Apply genomic principles and methods to the study of adaptation in natural populations, the molecular basis of stress response, the evolution of life-history traits, microbial community structure and evolution, genomic and epigenomic variation, and phylogeography

Resource Material

Reading assignments will mostly consist of primary literature and the following book: *Molecular Ecology*. Joanna R. Freeland, Heather Kirk and Stephen Petersen. Second edition. 2011. Wiley-Blackwell. (available online at TAMU University Libraries http://onlinelibrary.wiley.com/book/10.1002/9780470979365)

The specific reading assignments will be determined by the instructor at least 2 weeks in advance of the date they will be required.

Course Topics, Calendar of Activities, Major Assignment Dates

Course website: http://agrilife.org/casolalab/689-ecological-genomics/

Readings and discussions: Except for the computer demonstrations, each session will consist in the discussion of an assigned book chapter or papers. Papers discussion will be led by students, with exact dates to be determined at the beginning of the semester. When leading the discussion, students will prepare a PowerPoint presentation with information about the background, methodological approach and main findings of the article, including tables/figures in the main text and supplementary online material or other material if deemed interesting. The presenting student is encouraged to prompt the discussion with questions to the 'audience'. Meeting with the instructor a week or a few days before presenting the paper is recommended. Online resources to help put together an effective presentation and leading a discussion will also be provided.

Homework: Written homework will be assigned in class and/or on the course website, usually about once a month. The objective of the homework is to help students practice the nuts-and-bolts computations of population genetics, population genomics and transcriptomics, using available data sets. Answers to the homework will be available on the course website within 1-2 days after the class session at which the homework is due. Late assignment submissions will not be accepted, unless prearranged with the instructor or in an emergency situation.

Written Paper and final presentation: Students will write a literature review of a topic of choice in ecological genomics. The subject of the review will be discussed with the instructor no later then **March 12th.** This assignment will be graded on the basis of the quality of the points presented, the skill with which the arguments are made, as well as the quality of the writing. The review needs to be based on at least 5 papers. Length: 4-5 pages, excluding bibliography. Format: Times Roman 12 point font, double space, standard line and character spacing, 1" borders all around. No copying or pasting based on published or online material is allowed. The main points of the review will be presented by each student in a 15 minutes talk toward the end of the course.

Course tentative schedule:

Date	Activity
Jan 20 (Tue)	1. Introduction to ecology and evolutionary genomics

Jan 22 (Thu)	2. Review of genome structure and organization
Jan 27 (Tue)	3. Genome sequencing and annotation
Jan 29 (Thu)	4. Genetic analysis of single populations
Feb 3 (Tue)	5. Genetic analysis of multiple populations - I
Feb 5 (Thu)	6. Genetic analysis of multiple populations - II
Feb 10 (Tue)	7. *Computer demonstration #1*
Feb 12 (Thu)	8. Association mapping and QTL mapping - I
Feb 17 (Tue)	9. Association mapping and QTL mapping – II
Feb 19 (Thu)	10 Next-gen sequencing techniques.
Feb 24 (Tue)	11. Genomic polymorphisms, variation and adaptation
Feb 26 (Thu)	12. Homework #1 discussions - *Computer demonstration #2*
Mar 3 (Tue)	13. RNAseq experiments
Mar 5 (Thu)	14. Epigenetic variation and developmental change
Mar 10 (Tue)	15. Speciation and hybrids
Mar 12 (Thu)	16. Homework #2 discussions - *Computer demonstration #3*
Mar 17 (Tue) Mar 19 (Thu)	***Spring Break***
Mar 24 (Tue)	17. Determining functions from environmental genomes - I
Mar 26 (Thu)	18. Determining functions from environmental genomes - II
Mar 31 (Tue)	19. Homework #2 discussions - *Computer demonstration #3*
Apr 2 (Thu)	20. Longevity and aging
Apr 7 (Tue)	21. Life cycle and phenotypic plasticity
Apr 9 (Thu)	22. Homework #3 discussions - *Computer demonstration #4*
Apr 14 (Tue)	23. Abiotic stress
Apr 16 (Thu)	24. Biotic stress
Apr 21 (Tue)	25. Climate change, adaptation and genomics
Apr 23 (Thu)	26. Phylogenetics and phylogeography
Apr 28 (Tue)	27. Homework #4 discussions
Apr 30 (Thu)	Students presentations
May 5 (Tue)	Students presentations
May 7 (Thu)	*Reading day*
May 11 (Wed)	**Papers due (5:00 pm)**

Please note that lecture order may vary from the schedule above.

Grading

Overall course percentage grade will be determined from a weighted average of:

- Participation in discussions (20%)
- Leading discussions (20%)
- 4 homework (30% total)
- Written paper and final presentation (30%)

Course percentage grade will be converted to a letter grade as follows:

A = 90-100%
B = 80-89%
C = 70-79%
D = 60-69%
F = less than 60%

Attendance and Make-up Policies

The attendance policy will follow indications from the Section 7 of the Texas A&M University Student Rules (http://student-rules.tamu.edu/rule07). In order to earn all possible participation points, perfect attendance is expected; otherwise, the student must inform the instructor as soon as possible about the reason for the absence, and he/she should provide documentation substantiating the reason for his/her absence whenever possible.

Americans with Disabilities Act (ADA)

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, in Cain Hall, Room B118, or call 845-1637. For additional information visit http://disability.tamu.edu

Academic Integrity

For additional information please visit: http://aggiehonor.tamu.edu

"An Aggie does not lie, cheat, or steal, or tolerate those who do."