Bi 496/596
Conservation Genetics
Course Syllabus


African Elephant, *Loxodonta africana*

Florida Manatee, *Trichechus manatus*



Cape Hyrax, *Procavia capensis*

Contact and Course Information

Instructor: Bill Cresko. 312 Pacific Hall. 346-4779. wcresko@uoregon.edu
Lectures: Tuesday/Thursday 6:00-7:20, 11 Pacific Hall
Office Hours: Thursday 2:30-3:30 PM or by appointment
Course Website: https://blackboard.uoregon.edu

Text and Additional Readings (books available in the Science Library):

A Primer of Ecological Genetics. **Conner, J. K. and D. L. Hartl.** Sinauer Associates.
Phylogenetic Trees Made Easy 3rd edition. **Hall, B. G.** Sinauer Associates.
Additional readings will be assigned and covered in discussions

Course Description:

Organismal populations and species can become endangered when their habitats are lost or altered, and these deleterious effects can be caused by changes in genetic diversity. Over ecological time scales the loss of diversity may reduce the viability of populations in fragmented habitats, and increase extinction probabilities for entire species. In addition, the loss of genetic diversity can have more long term, evolutionary consequences. The rate of evolutionary change in a population is proportional to available genetic diversity, the loss of which may retard the rate of evolution in response to habitat loss. Loss of genetic diversity is of practical concern for humans. All of life's library is encoded by DNA, and loss of genetic diversity may remove a vast repository of resources for future discoveries in drugs, materials and energy, to name just a few.

Conservation genetics as a field aims to understand the effects of habitat loss, exploitation, and/or environmental change on the genetic composition of natural populations, and how these changes affect the viability of these populations. In addition, defining evolutionarily significant units for management decisions is an important goal of conservation genetics. Lastly, conservation geneticists are often called on to make prescriptions for maintaining biological diversity, and to explain the importance to human well being for doing so. Conservation geneticists employ tools and techniques from population, quantitative and molecular genetics, as well as systematics and phylogenetics. This course will provide a foundation for the acquisition and interpretation of many of the most common types of genetic data that are important for conservation problems.

Course Format:

Lectures are from 6:00-7:20 PM, Tuesday and Thursday. The lectures will be interactive and involve discussions of textbook and primary literature readings assigned for the week. Please ask questions if you think they can be answered quickly and the answers would benefit the rest of the class. For more complicated questions, please plan to talk with me during office hours. Have the assigned readings done ahead of class as the lectures will draw from these readings. In addition, we will have some hands-on sessions that involve the analysis of molecular genetic data. These will be held in 33 Klamath Hall, and will involve homework problems outside of class.

Expectations and Grade Evaluations:

I expect all students to attend each class. Grades are based on a mid-term and final exam, weekly write-ups about your additional papers (see below), problem sets,and discussion participation. In addition, graduate students are required to perform a project on a topic of her or his choice. Letter grades will be assigned based upon the University of Oregon's standard percentage translation. More detailed descriptions of the assignments are as follows:

Evaluation	% of grade undergrad	% of grade grad	Description
Midterm	25%	20%	Both the midterm and final are cumulative, and will have the same format of short answer and longer discussion questions.
Final	40%	32%	
Two Problem Sets	15%	12%	Addressing many problems in conservation genetics requires one to calculate statistics from molecular genetic and phenotypic data. You will be assigned a set of problems that will give you practice calculating these statistics using software that you will learn about during our hands-on sessions. You may discuss the problem sets with your classmates, but I expect the work to be your own.
Two Write-ups	15%	12%	You will be assigned papers from the primary literature to read during the term, approximately eight in total. For four of them you will produce a short writeup. As you read the papers I want you to make note of additional ideas or problems concerning the topics covered in the assigned paper. For this exercise, use these thoughts to track down an additional paper in the primary literature that addresses your concerns. **I expect you to do more than simply choose a paper from the literature cited in the assigned paper.** In fact, you may often find a paper that presents an alternative point of view. On the dates marked in the syllabus, you will hand in a brief, typed, one page write-up of the idea you had while reading the assigned paper, the citation for both papers (assigned and yours), the main points of your new paper, how these points relate to the assigned paper, and whether you agree with the author's conclusions in each paper (see the course blackboard website for an example write-up). You will hand in two write-ups at a time.
Participation	5%	4%	During our discussions of papers and problem sets, I expect that you will contribute when you feel you have something appropriate to add to the discussion. In particular, the additional paper you find should provide a rich source of ideas to discuss.
Grad Project	0%	20%	see below

Graduate Student project:
The graduate student project can focus on any current issue in conservation genetics, and should draw strongly from the primary literature. In addition students are expected to obtain and analyze a data set relevant to a project related to conservation genetics, either from the primary literature or from their own work. Graduate students will present a brief presentation on their projects to me and each other, and produce a short write-up of their findings.

Academic Code of Ethics:
I will work hard to make this a course from which you can learn the fundamental concepts of conservation genetics. I welcome suggestions from you at any time for improvements. I ask you to respect your classmates and arrive on time. Also, please read the student conduct code at the back of the time schedule; academic dishonesty includes cheating, plagiarizing (taking credit for the work of others) or knowingly supplying false information. **Academic dishonesty is a serious offense for which I have ZERO tolerance**. Sanctions for academic dishonesty will be a lowering of the final grade or failure. If you find yourself in trouble, or if you are aware of academic dishonesty occurring, please talk to me. Personal crises do happen. I may be able to refer you to someone for help or to make special arrangements if the need is real and if you have done your best to deal with the situation in a timely manner. Finally, I promise to respect you as students and as individuals, and I ask that you return that respect to me and to your fellow classmates.

Students with Disabilities: If you require an accommodation based on a disability, I would like to meet with you in the privacy of my office the first week of the semester to be sure you are appropriately accommodated.

Course Schedule

Texts, Additional Readings and Software:

CH=*A Primer of Ecological Genetics*. **Conner, J. K. and D. L. Hartl.** Sinauer Associates.
HA=*Phylogenetic Trees Made Easy* 3rd edition. **Hall, B. G.** Sinauer Associates.
AV=*Molecular Markers, Natural History, and Evolution* 2nd edition. **Avise, J. C.** Sinauer Associates.
MEGA - Molecular Evolutinary Genetic Analysis. (http://www.megasoftware.net/)

Week	Date	Topic	Assignments	Readings
One	04 Jan	Introduction, populations & sampling, and probability		**CH** 1-9; 22-35
	06 Jan	Mutations, genetic diversity and molecular markers		**CH** 12-22 **AV** 56-100
Two	11 Jan	Individuality, parentage and relatedness		**AV** 161-183
	13 Jan	Effective population size (Ne) & Inbreeding		**CH** 36-45; 62-66
Three	18 Jan	Foundational population genetic concepts		
	20 Jan	Genetic drift & random processes in small populations		**CH** 47-55
Four	25 Jan	Gene flow and the structuring of populations		**CH** 55-61
	27 Jan	**HANDS - ON GENETIC ANALYSES Mac BioLab - Klamath Hall**	**Problem Set Due**	**HA** 1-7 **AV** 401-432
Five	01 Feb	Phylogenetic concepts and processes	***Grad Topic Due***	**HA** 1-29; 189-203 **Download MEGA**
	03 Feb	**MIDTERM EXAM**		
Six	08 Feb	Molecular evolution and DNA barcoding		**HA** 31-107;
	10 Feb	Phylogeography ESUs and species concepts	**First two write-ups due**	**CH** 231-235 **HA** 110 -123; **AV** 283-316; 321-331
Seven	15 Feb	Quantitative genetics and complex traits		**CH** 97-112 **HA** 125-141
	17 Feb	Heritability and estimating quantitative genetic diversity		**CH** 112-133 **HA** 143-163
Eight	22 Feb	Response to environmental change	***Grad Outline Due***	**CH** 241-245
	24 Feb	**HANDS - ON GENETIC ANALYSES Mac BioLab - Klamath Hall**	**Problem Set Due**	
Nine	01 Mar	Mutational meltdown in small populations		**CH** 121-133; 235-241
	03 Mar	Artificial selection & QTL mapping		**CH** 163-180
Ten	08 Mar	Invasive species and transgene escape Pesticide and antibiotic resistance		**CH** 245-263
	10 Mar	Ancient DNA and resurrecting extinct organisms	**Second two write-ups due**	**HA** 166-176
Finals	17 Mar	**Final exam is on Tuesday Mar15th @ 7:00 PM**	**FINAL (2 hour)** ***Grad Project Due***	

Primary Literature Readings

Week	Citations for primary literature readings
1	
2	Bowen, B.W. 1999. Preserving genes, species or ecosystems? Healing the fractured foundations of conservation policy. *Molecular Ecology* **8**, S5-S10.
3	Vila et al. Rescue of a severely bottlenecked wolf (*Canis lupus*) population by a single immigrant. 2003. Proceedings of the Royal Society of London. 270; 91-97. Spielman, D., B. Brook, and R. Frankham. 2004. Most species are not driven to extinction before genetic factors impact them. Proceedings of the National Academy of Sciences (PNAS) 42, 15261-15264.
4	Segelbacher, G. et al. 2003. From connectivity to isolation: genetic consequences of population fragmentation in capercaillie across Europe. Molecular Ecology. 12; 1773-1780. Pearse, D. E. and K. A. Crandall. 2004. Beyond Fst: Analysis of population genetic data for conservation. Conservation Genetics 5; 585-602.
5	Pearman. 2001. Conservation value of independently evolving units: Sacred cow or testable hypothesis? Conservation Biology 15: 780-783 Fernando et al. 2003. DNA Analysis Indicates That Asian Elephants Are Native to Borneo and Are Therefore a High Priority for Conservation 1(1). PLoS Biology e110.
6	Hebert et al. 2004. Identification of birds through DNA Barcodes. PLoS Biology. 2(10): e312 Whitworth, Tl L. et al. 2007. DNA barcoding cannot reliably identify species of the blowfly genus Protocalliphora (Diptera: Calliphoridae). Proceedings of the Royal Society B: 274: 1731-1739
7	Lynch, M. 1996. A quantitative genetic perspective on conservation issues. Reed, D. H. and R. Frankham. 2001. How closely correlated are molecular and quantitative measures of genetic variation? Evolution 55(6); 1095-1103.
8	Bradshaw, W. E. and C. M. Holzapfel. 2001. Genetic shift in photoperiodic response correlated with global warming. PNAS 98(25); 14509-14511. Bradshaw, W. E. and C. M. Holzapfel. 2006. Evolutionary response to rapid climate change. Science 312; 1477-1478.
9	Losey, JE, Rayor, LS, Carter, ME. 1999. Transgenic pollen harms monarch larvae. Nature. 399 (6733) pp. 214-214. Hughes, AR, Stachowicz, JJ. 2004. Genetic diversity enhances the resistance of a seagrass ecosystem to disturbance. PNAS. 2004 vol. 101 (24) pp. 8998-9002
10	Dolan. Rewilding North America. Nature 2005 vol. 436 (7053) pp. 913-914 Wakayama et al. 2008. Production of healthy cloned mice from bodies frozen at -20 degrees C for 16 years. PNAS. 105 (45) pp. 17318-22 Green et al. 2010. A Draft Sequence of the Neandertal Genome. Science 328, 710-722