Conservation Genetics 1-2-3045 3 CREDITS

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Course Description:
Conservation Genetics is an emerging discipline that integrates principles of population genetics, molecular genetics, ecology and evolution applied to the conservation of natural populations.
This course aims to provide:
1. An introduction to the theories and practices of population and conservation genetics.
2. Examples of case studies, including projects carried out in Israel.
3. An introduction to concepts and tools for analyzing genetic databases for conservation genetics purposes.

The course consists of lectures, students' seminars and tutorials.

Course structure:
Lectures and Tutorials are held weekly.
Students are asked to present a seminar and to analyze a genetic dataset (at the end of the semester) based on concepts and using the tools studied during the course.
Grading will be based on the seminar (45%) the analysis work (45%) and the student's participation in class (10%).

Topics of Lectures and Seminars:
Introduction to Conservation Genetics:
Recognition of genetic factors in conservation biology. Genetic vs. demographic and environmental factors in conservation biology. How can conservation genetics minimize extinctions?
Genetic Diversity and Extinction:
What is genetic diversity, how do we measure it, and how important is it for evolutionary potential? What role do inbreeding and loss of genetic diversity play in an 'extinction vortex'?
Genetic Diversity at a single locus:
Review of Hardy-Weinberg principles, and their importance to conservation genetics. Calculating expected heterozygosity and allelic diversity, and how these parameters operate in inbred and in fragmented populations. Case studies are used to illustrate these points.
Large *vs*. small populations: Effects of drift, mutations and migration
The effects of mutations and migration in large *vs*. small populations and their interactions with natural selection. Mutations – generating genetic diversity over time. Random genetic drift and fixation of alleles. Population bottlenecks and loss of heterozygosity over time.
Inbreeding & inbreeding depression

Inbreeding as a process. Inbreeding coefficient. Genetic consequences of inbreeding. Mutation-selection balance in inbred populations, and the effects of purging. Genetic basis of inbreeding depression. Relationship between population size and genetic diversity in wild populations.

Gene flow and dispersal

Identifying patterns of dispersal using genetic data. Identifying sex-specific differences in gene flow (e.g. sex-biased dispersal in bats). Metapopulation concept in conservation genetics (e.g. importance of migration). Effect of fragmentation on gene flow and genetic variation.

Genetic management of captive and wild populations

Critical goals of genetic management of captive populations. Genetic management for reintroduction . The importance of increasing population size in the wild. Dealing with fragmented and single, isolated populations. The complexity of managing gene flow, and the utility of translocation.

From conservation genetics to conservation genomics:

Recent developments in genomic techniques, including next generation sequencing and gene-expression pattern analysis, have made it possible to step up from a limited number of neutral markers to genome-wide estimates of functional genetic variation. Will it lead to entire new insights?

---**Additional topics if time allows (or through students' seminars):** Genetically modified organisms and species conservation; Wildlife diseases and conservation; Molecular-genetic tools as a way to infer species behavior; Environmental DNA: Tool for genetic/genomic monitoring of wild populations; Genetic rescue; Ancient DNA in conservation biology.

<u>Tutorials:</u>

1. Introduction to population genetic variation and frequency-based analyses: Genetic marker analysis, calculating allele frequency, number of alleles, heterosigozity, fixation index, and F statistics. Testing for Hardy-Weinberg equilibrium.
2. Introduction to probability of identity and population assignment tests.
3. Introduction to genetic distance-based analyses: Calculating individual*individual genetic distance (haploid genetic distance, codominant genotypic distance) and Analysis of Molecular Variance (AMOVA)
4. Introduction to spatial genetic analysis: Principal Coordinate Analysis (PCA), and Mantel Tests for Isolation-by-Distance.

Examples are taken from data sets of variety of species.

We will use the software package GenAlEx (Genetic Analysis in Excel, Peakall and Smouse 2006).

<u>Relevant books:</u>

Frankham R, J.D. Ballou and D.A. Briscoue (2002 or the newer edition). Introduction to Conservation Genetics. Cambridge University Press

Allendorf F.W. and G. Luikart (2007). Conservation and the Genetics of Populations. Blackwell Publishing

Templeton, A. R. (2006). Population Genetics and Microevolutionary Theory. John Wiley & Sons, Inc., Hoboken, New-Jersy.