Evolutionary Biology 30305 Fall 2017

Topics for the 2nd exam

This list is not meant to be totally inclusive. We have covered other topics and many examples not listed. You are responsible for all the material covered in the lectures. Bring a calculator to the exam.

Readings from Z&E

- Chapter 3 - *What the Rocks Say* - sections 3.8 – 3.10
- Chapter 13 – *The Origin of Species* - all sections
- Chapter 14 – *Macroevolution* – section 14.5
- Chapter 7 – *Beyond Alleles* - all sections
- Chapter 8 – *Natural Selection* - sections 8.2 & 8.4
- Chapter 11 – Sexual Selection- 11.2-11.6

Review Questions from the Book Chapters

- Chapter 3: Multiple Choice 4,9,11; Short Answer 3.
- Chapter 13: Multiple Choice 1-10; Short Answer 2-7.
- Chapter14: Multiple Choice 5.
- Chapter 7: Multiple Choice 1-4, 6; Short Answer 1 & 2.
- Chapter 8: Multiple Choice 1,2,4; Short Answer 2.
- Chapter 11: Multiple Choice 1-12; Short Answer 1-6.

Evolution of Complex Organisms†

Geologic Eras (Proterozoic and Paleozoic) – You do not need to know the finer geological eras EXCEPT the *Cambrian Era*
Earliest Multicellular Organisms
Ediacaran Fauna
Cambrian Explosion
Developmental Genes and the Origins of Complexity
Origin of Terrestrial Plants and Animals

Speciation

Anagenesis vs. cladogenesis
Species Concepts: Biological, Phylogenetic
Operational species Concepts: U.S. Endangered Species Act
Hybrid Zones – Hybridization vs. Introgression
Classic View of Speciation
Consequences of Secondary Contact
Ring Species
Pre- and Postzygotic Isolation and Barriers to Gene Flow
Haldane's Rule
Models of Speciation: Allopatric, Peripatric, Sympatric
Mayr's Genetic Revolution
Genetic Models of Speciation
Instantaneous/Infectious Speciation
Reinforcement
Names: Darwin, Mayr, Haldane, Feder, Coyne & Orr, Bateson, Muller, Dobzhansky

Adaptive Radiation (Lots of interesting examples in this section)

Ecological Opportunity
Key Innovations
Character Displacement – Competitive interactions

Parallel Evolution
Names: Simpson, Schluter

Multi Locus Genetics

Linkage Disequilibrium
Cuauses/Sources of Disequilibrium
Epistasis/Pleiotropy
Adaptive Landscapes
Wright's Shifting Balance Theory
Names: Wright

Quantitative Genetics

Source of the Normal Distribution of Phenotypes
Variance and Covariance
Components of Phenotypic Variation
Components of Genetic Variation
Additive vs. Dominance Genetic Variance
Resemblance Between Relatives
Genetic Covariance Between Relatives *(you need to know the components of phenotypic covariance between sets of relatives)*
Heritability
Slope of the regression of groups of related individuals
Univariate Breeder's Equation
Response to Selection
Modes of Selection
Price's Rule
Fisher's Fundamental Theorem
Red Queen Hypothesis – Antagonistic-Pleiotropy
Mutational Heritability
Rate of Polygenic Mutation
QTL Analysis (Few different examples of this type of analysis)
Names: Fisher, Hoekstra, Stockard, Price

Useful equations to know for this section – ***I will not ask you to calculate a variance or covariance by hand, but you may need to solve for one.***

Components of Phenotypic Variation:

$V_P = V_G + V_E$, where V_P is the total phenotypic variance, V_G is the total genetic variance and V_E is the environmental variance.

Components of Genetic Variation:

$V_G = V_A + V_D + V_I$, where V_G is the total genetic variance, V_A is the additive genetic variance, V_D is the dominance genetic variance, and V_I is the epistatic genetic variance.

Slope of a regression line:

$$b = \frac{COV_{xy}}{VAR_x}$$

Heritability:

$$h^2 = \frac{V_A}{V_P} = \frac{V_A}{(V_G + V_E)}$$

The Univariate Breeder's equation:

$R = h^2 S$, where *R* is the per generation response to selection, h^2 is the heritability, and S is the selection differential.

Price's rule: S = *Cov(relative fitness, phenotype)*

$$S = \frac{1}{N} \sum \left[(w_i - \overline{w})(P_i - \overline{P}) \right]$$

Evolutionary Consequences of Small Population Size

Genetic Consequences of Small Populations
Extinction Rates
Inbreeding Depression
Reducing the Impact of Small Captive Populations
Loss of Genetic Variation
Critical Rate of Evolution
Additive Genetic Variation under Drift/Mutation Balance
Genetic Diversity and Population Size
Extinction Vortex

Useful equations to know for this section:

V_A under drift-mutation equilibrium:

$V_A = 2NV_m$, where V_m is the genetic variance due to the input by mutation

Sexual Selection

Necessary Conditions for Sexual Selection
Forms of Sexual Selection
Investment in offspring production
Bateman's Principle
Sexual Dimorphism
Male-Male Competition
Sperm Competition
Evolution of Female Preference
Direct and Indirect Benefits
Good-Genes Model
Handicap Principle
Fisherian Runaway Sexual Selection
Sexual Conflict
Sensory Bias
Sex-role Reversal
Sexual Selection in Humans
Sexual Selection and Extinction
Names: Fisher, Bateman, Ryan, Zahavi

Evolution of Sex

The origin of recombination and the diversification of Eukaryotes
Genome size in prokaryotes and eukaryotes
Two-fold Cost of Sex
Role of beneficial and deleterious mutations

Muller's Ratchet and Mutational Meltdowns
The importance of variation
The Red Queen (again!)
Names: Muller, Lively