EEB 2245/2245W Spring 2009

Study guide for exam #2

Questions for the exam will be drawn from topics covered in lecture. You will not be required to remember complicated formulas, but you will be expected to solve problems similar to those on the homework problems without referring to notes. The exam will consist of a combination of short answer questions and problems similar to those on the homework. You will not be required to remember complicated formulas, but you will be expected to solve these problems without referring to notes. You may be required to provide definitions of key concepts or to distinguish among them.

The genetics of natural selection

- Given fitnesses (viabilities) for each of three different genotypes and genotype counts before selection, be able to calculate
  - Genotype and allele frequencies before selection
  - Genotype and allele frequencies after selection
  - The population mean fitness
- Know how the allele frequency in adults after selection is related to the allele frequency in newly formed zygotes of the next generation.
- Know how the allele frequency in adults after selection is related to the genotype frequencies in newly formed zygotes of the next generation.
- Given fitnesses (viabilities) for each of three different genotypes be able to
  - Recognize the mode of selection
  - Predict the ultimate genetic composition of the population consistent with that mode of selection
  - Draw a diagram illustrating the relationship between mean fitness and allele frequency
- Be able to state Fisher's Fundamental Theorem of Natural Selection and to interpret it.

Evolution of quantitative traits

- Know the three consequences of polygenic inheritance (in the summary slides for 2/23).
- Know how phenotypic variance, V_P, is partitioned into genetic variance, V_G, and environmental variance, V_E.
- Know how heritability, h^2
  - Is defined
  - Is interpreted
  - Can be estimated from the relationship between parental and offspring phenotypes (be able to draw or interpret a simple graph)
- Given a phenotype mean before selection, a phenotype mean after selection, and the heritability, be able to calculate
  - The response to selection

- o The phenotype in the next generation
- Be able to define phenotypic plasticity and to provide an example.

Sexual selection
- Know the relationships among natural selection, viability selection, and sexual selection.
- Know how sexual selection is defined.
- Be able to state the two major ways in which sexual selection occurs
- Bateman's principle: Be able to explain what it says and to explain the reasons it holds.
- Know the difference between primary and secondary sexual characters and which set of characters sexual selection operates on.
- Be able to provide an example of a sexually selected trait in birds of paradise or Australian bower birds (refer to the YouTube videos if you need a reminder).
- Be able to describe Fisher's process of runaway sexual selection.

Evolution of altruism
- Be able to provide an evolutionary definition of altruism and to recognize it if an example is provided.
- Know the two different ways in which evolutionary biologists can explain the evolution of altruism.
- Know the requirements for altruism to evolve when it is reciprocal.
- Be able to state Hamilton's rule and to apply it if given the relatedness coefficient and the information necessary to calculate the costs and benefits of altruistic behavior.

Ecotypes and adaptive variation
- Be able to define "ecotype" and to explain the kinds of experiment that are needed to distinguish ecotypes from populations that are merely different.
- Be able to identify whether natural selection or genetic drift is more important in the evolution of ecotypes.
- Be able to explain how the experiments on yarrow (*Achillea millefolium*) described in lecture show that among population differences in this species are adaptive.
- Be able to explain the roles that geographic isolation plays in the evolution of ecotyptes.